Project WILD

Correlations of the Project WILD and the Project WILD Aquatic K-12 Curriculum and Activity Guides to the National Science Education Standards

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K-12 Curriculum and Activity Guides

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Project WILD is an interdisciplinary conservation and environmental education program emphasizing wildlife. The goal of Project WILD is to assist students of any age in developing awareness, knowledge, skills, and commitment to result in informed decisions, responsible behavior, and constructive actions concerning wildlife and the environment.

Project WILD is sponsored by the Council for Environmental Education with the Western Association of Fish and Wildlife Agencies. The program is based on the premise that young people and their educators have a vital interest in learning about the Earth as home for people and wildlife. For instructional purposes Project WILD defines wildlife as any nondomesticated animal. Wildlife may be as small as a microscopic organism or as large as a great blue whale. Wildlife includes but is not limited to insects, spiders, birds, reptiles, fish, amphibians, and mammals.

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INTRODUCTION

In order to meet the needs of educators nationwide, correlations of Project WILD K–12 materials have been developed for the National Academy of Science's *National Science Education Standards* (the *Standards*).

The *Standards* provide a set of criteria that can measure the quality of science education. The correlations document allows educators to identify which of the *Standards* are addressed by each Project WILD activity, in either the *Project WILD* or the *Project WILD Aquatic K–12 Curriculum and Activity Guide*.

TABLE OF CONTENTS

HOW TO USE THIS DOCUMENT

- This document is separated into three sections based on grade level: K–4, 5–8 and 9–12.
- The complete *Standards* are provided in each grade level section, and are followed by charts correlating Project WILD activities to each *Standard*.
- Correlation charts include *Standard* fundamental concepts in the left column and Project WILD activities (including grade level and page numbers) along the top row.
- Key to symbols
  - ● The science concept is the main focus of the Project WILD activity.
  - ⦿ The science concept is one of the main focuses of the Project WILD activity; is reinforced.
  - ○ The science concept is not the main focus of the Project WILD activity, but it is supported or reinforced.

NATIONAL SCIENCE EDUCATION STANDARDS GRADES K–4

UNIFYING CONCEPTS AND PROCESSES

Systems, Order, and Organization

- A system is an organized group of related objects or components (organisms, machines, fundamental particles, galaxies, ideas, numbers, transportation, and education).
- Students should analyze in terms of systems (mass, energy, objects, organisms, and events).
- Systems have structure and function.
- Feedback and equilibrium are associated with systems.
- Systems can be open or closed.
- The assumption of order establishes the basis for cause-effect relationships and predictability.
- Prediction can be used to explain change. Math can be used to do this through probability.
- Systems have levels of organization (periodic table & classification of organisms).
- Living systems have levels of organization (cells, tissues, organs, organisms, populations and communities).
- Interactions occur in systems.

Evidence, Models, and Explanation

- Evidence should be used in explanations.
- Models can be used in explanations.
- Terms such as hypothesis, model, law, principle, theory, and paradigm are used to explain scientific explanations.

Constancy, Change, and Measurement

- Interactions result in change.
- Changes vary in rate, scale, and pattern, including trends and cycles.
- Math measures change.
- Scientists use the metric system.
- Scale includes understanding that parts of a system might change as its size changes.
- Rate compares one measured quantity with another.

Evolution and Equilibrium

- Evolution is a series of changes. This includes changes in the universe.
- The present is a result of the past.
- Equilibrium is a physical state in which forces and changes occur in opposite and offsetting directions.
- Steady state, balance, and homeostasis describe equilibrium states.

Form and Function

- Form follows function.
- Students should explain function in terms of form and form in terms of function.

A. SCIENCE AS INQUIRY

Abilities Necessary to do Scientific Inquiry

- Students answering questions using scientific resources combined with observations.
- Plan and conduct a simple systematic observation or investigation.
- Use simple instruments such as ruler, thermometer, watch, balance, magnifier, microscope, computer, or calculator to gather data and extend the senses.
- Use knowledge and evidence (data) to formulate explanation.
- Communicate or analyze investigations and explanations that might be drawn or spoken as well as written.

Understanding about Scientific Inquiry

- Recognizing that all of the above are things scientists do.

B. PHYSICAL SCIENCE

Properties of Objects and Materials

- Objects have measurable and observable properties, which use tools.
- Objects can be described by their properties and classified accordingly.
- Materials can exist in different states (solid, liquid, gas).

Position and Motion of Objects

- Position of an object can be described relative to other objects.
- Object's motion can be described by observing its position over time.
- Position or motion of object can be changed by pushing or pulling.
- Sound is produced by vibration of objects and pitch can be varied.

Light, Heat, Electricity, and Magnetism

- Light travels in a straight line and can be reflected, refracted, and absorbed by objects.
- Heat can be produced and conducted.
- Electricity in circuits can produce light, heat, sound, and magnetic effects.
- Magnets attract and repel.

C. LIFE SCIENCE

Characteristics of Organisms

- All organisms have different needs.
- The environment must supply the needs of organisms.
- Each organism has different structures for different functions.
- Behavior is influenced by internal cues (hunger) and external cues (change in environment).

Life Cycles of Organisms

- Plants and animals have life cycles.
- A life cycle includes: birth, development, adulthood, reproduction, and death.
- Offspring resemble parents.
- Some characteristics of organisms are inherited while others result from interactions.

Organisms and Their Environments

- Plants are the base of an ecosystem.
- All animals depend on plants.
- Organisms' patterns of behavior relate directly to the environment (kinds and numbers of other organisms, the availability of food and resources, and physical characteristics of the environment).
- Organisms can cause changes.
- Humans depend on environments.

D. EARTH AND SPACE SCIENCE

Properties of Earth Materials

- Earth materials have different physical and chemical properties.
- Soils have different properties and abilities to support plants.
- Fossils provide evidence about the environment, plants, and animals of the past.

Objects in the Sky

- The sun, moon, stars, birds, clouds, airplanes, all have characteristics that can be observed and described.
- The sun provides light and heat necessary to maintain Earth's temperature.

Changes in the Earth and Sky

- The surface of the Earth changes.
- Weather changes from day to day and over the seasons.
- Objects in the sky have patterns of movement.

E. SCIENCE & TECHNOLOGY

Abilities of Technological Design

- Identify a simple problem.
- Propose a solution.
- Implement a proposed solution.
- Evaluate a product of design.
- Communicate a problem, design, and solution.

Understanding About Science and Technology

- Science is one way of answering and explaining the natural world.
- Trying to determine the effects of solutions helps people avoid some new problems.
- Scientists and engineers work in teams.
- 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.

Abilities to Distinguish Between Natural Objects and Objects Made by Humans

- Some objects occur in nature; others have been designed and made by people to solve human problems and enhance the quality of life.
- Objects can be categorized into two groups, natural and designed.

F. SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

Personal Health

- Safety and security are basic needs of humans.
- Individuals have some responsibility for their own health.
- Nutrition is essential to health.
- Different substances can damage the body and how it functions.

Characteristics and Changes in Populations

- Human populations include groups of individuals living in a particular location. Population density refers to the number of people of a particular population that live in a given amount of space.
- The size of human populations can increase or decrease.

Types of Resources

- Resources are things we get from the living and nonliving environment to meet the needs and wants of a population.
- Some resources are basic materials (air, water, soil).
- Some resources are produced (food, fuel, building materials).
- Some resources are nonmaterial (quiet places, beauty, security, safety).

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 environmental changes occur slowly, and others occur rapidly.

Science and Technology in Local Challenges

- People continue inventing new ways of doing things. It is helpful to try to determine in advance how ideas and inventions will affect other people.
- Science and technology have greatly improved food quality and quantity, transportation, health, sanitation, and communication. These benefits are not available worldwide.

G. HISTORY AND NATURE OF SCIENCE

Science as a Human Endeavor

- Science has a rich history.
- Many contributions have been made to science and technology.
- Science will never be finished.
- Science can be a life-long career.
- Many people derive great pleasure from doing science.

Key to Symbols:
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NATIONAL SCIENCE EDUCATION STANDARDS (Content, K–4)	**Color Crazy** (gr. K–4, p. 2)	**Grasshopper Gravity** (gr. K–4, p. 4)	**What's Wild?** (gr. K–4, p. 7)	**Classroom Carrying Capacity** (gr. K–4, p. 9)	**Graphananimal** (gr. Pre-K–4, p. 49)	**Wildlife Is Everywhere!** (gr. K–4, p. 51)	**Habitracks** (gr. K–4, p. 53)	**What's That, Habitat?** (gr. K–4, p. 56)	**Beautiful Basics** (gr. K–4, p. 58)	**Everybody Needs a Home** (gr. K–4, p. 59)	**Environmental Barometer** (gr. Pre-K–4, p. 77)	**Habitrekking** (gr. 3–4, p. 79)
UNIFYING CONCEPTS AND PROCESSES												
Systems, order, and organization	○	○	○	○	○	○	○	○	○	○	○	○
Evidence, models, and explanation	⦿	⦿		○	○	○	○	○		○	⦿	
Constancy, change, and measurement			○	○								
Evolution and equilibrium	○			○								
Form and function	●	●	○									
A: SCIENCE AS INQUIRY												
Abilities necessary to do scientific inquiry		●			○	⦿	⦿	○	⦿	○	○	○
Understanding about scientific inquiry		⦿										
B: PHYSICAL SCIENCE												
Properties of objects and materials		○										
Position and motion of objects												
Light, heat, electricity, and magnetism												
C: LIFE SCIENCE												
The characteristics of organisms	○	●	⦿	●	○	○	⦿	⦿	⦿	⦿	○	○
Life cycles of organisms		○	○	○								
Organisms and environments	○	⦿	○	⦿	○	○	⦿	⦿	⦿	○	⦿	⦿
D: EARTH AND SPACE SCIENCE												
Properties of Earth materials												
Objects in the sky												
Changes in Earth and sky												
E: SCIENCE & TECHNOLOGY												
Abilities of technological design				○						○		
Understanding about science and technology			○	○	○	○					○	
Abilities to distinguish between natural objects and objects made by humans			○									
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES												
Personal health												
Characteristics and changes in populations				○								
Types of resources		○	○	●			⦿	⦿	●	⦿		
Changes in environments	○	○		○	○		○	○	○	⦿	○	○
Science and technology in local challenges				○								
G: HISTORY AND NATURE OF SCIENCE												
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NATIONAL SCIENCE EDUCATION STANDARDS (Content, K–4)	**Thicket Game** (gr. Pre-K–4, p. 114)	**Seeing Is Believing!** (gr. K–4, p. 116)	**What Bear Goes Where?** (gr. K–4, p. 118)	**Surprise Terrarium** (gr. K–4, p. 120)	**First Impressions** (gr. K–4, p. 178)	**And the Wolf Wore Shoes** (gr. K–4, p. 180)	**Make a Coat!** (gr. K–4, p. 243)	**Learning to Look, Looking to See** (gr. Pre-K–4, p. 278)	**Animal Charades** (gr. K–4, p. 280)	**Too Close for Comfort** (gr. K–4, p. 300)	**Ethi-Thinking** (gr. K–4, p. 303)	**Playing Lightly on the Earth** (gr. Pre-K–4, p. 432)
UNIFYING CONCEPTS AND PROCESSES												
Systems, order, and organization	○		○	○		○	○	○	○	⦿	○	○
Evidence, models, and explanation		○	○			○	○		○	○	○	○
Constancy, change, and measurement				○						⦿	○	○
Evolution and equilibrium				○								
Form and function	○	⦿		⦿	○				○			
A: SCIENCE AS INQUIRY												
Abilities necessary to do scientific inquiry	○	⦿	⦿	○	○	○		○	○	●	⦿	○
Understanding about scientific inquiry											○	○
B: PHYSICAL SCIENCE												
Properties of objects and materials		○	○			○			○	○		
Position and motion of objects	○									○		
Light, heat, electricity, and magnetism												
C: LIFE SCIENCE												
The characteristics of organisms	⦿	⦿	⦿	⦿	○	○	○		⦿	⦿	⦿	⦿
Life cycles of organisms						○				○	○	
Organisms and environments	○	○	○	○	○	○			○	⦿	⦿	●
D: EARTH AND SPACE SCIENCE												
Properties of Earth materials												○
Objects in the sky												
Changes in Earth and sky												
E: SCIENCE & TECHNOLOGY												
Abilities of technological design		⦿	○		○	○	○				⦿	⦿
Understanding about science and technology		⦿			○		○	○	○	○	○	○
Abilities to distinguish between natural objects and objects made by humans						○	○		○			
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES												
Personal health												
Characteristics and changes in populations												
Types of resources			○		○		○	○	○		⦿	○
Changes in environments	○	○		○						●	●	⦿
Science and technology in local challenges							○					
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NATIONAL SCIENCE EDUCATION STANDARDS (Content, K–4)	**Are You Me?** (gr. K–4, p. 2)	**Aqua Words** (gr. K–4, p. 29)	**Water Plant Art** (gr. K–4, p. 31)	**Marsh Munchers** (gr. K–4, p. 34)	**Fashion a Fish** (gr. K–4, p. 56)	**Sockeye Scents** (gr. 3–4, p. 61)	**Water We Eating?** (gr. K–4, p. 83)	**Plastic Jellyfish** (gr. K–4, p. 128)	**Silt: A Dirty Word** (gr. 3–4, p. 176)
UNIFYING CONCEPTS AND PROCESSES									
Systems, order, and organization		⦿	○	●	○		○	⦿	○
Evidence, models, and explanation	○		○	○	⦿	○	○	○	○
Constancy, change, and measurement				⦿	○		○	○	○
Evolution and equilibrium				⦿	○				○
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A: SCIENCE AS INQUIRY									
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Life cycles of organisms	⦿	○	○	⦿		⦿		⦿	
Organisms and environments		⦿	○	●	○		⦿	⦿	○
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Objects in the sky		⦿							
Changes in Earth and sky		●							
E: SCIENCE & TECHNOLOGY									
Abilities of technological design				○	⦿		⦿	●	
Understanding about science and technology					○			○	
Abilities to distinguish between natural objects and objects made by humans								●	
STANDARD F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES									
Personal health		○					○		
Characteristics and changes in populations				○					
Types of resources		⦿		⦿			○	⦿	
Changes in environments		⦿		○			⦿	●	
Science and technology in local challenges		○					⦿	○	
G: HISTORY AND NATURE OF SCIENCE									
Science as human endeavor									

NATIONAL SCIENCE EDUCATION STANDARDS GRADES 5–8

UNIFYING CONCEPTS AND PROCESSES

Systems, Order, and Organization

- A system is an organized group of related objects or components (organisms, machines, fundamental particles, galaxies, ideas, numbers, transportation, and education).
- Students should analyze in terms of systems (mass, energy, objects, organisms, and events).
- Systems have structure and function.
- Feedback and equilibrium are associated with systems.
- Systems can be open or closed.
- The assumption of order establishes the basis for cause-effect relationships and predictability.
- Prediction can be used to explain change. Math can be used to do this through probability.
- Systems have levels of organization (periodic table & classification of organisms).
- Living systems have levels of organization (cells, tissues, organs, organisms, populations and communities).
- Interactions occur in systems.

Evidence, Models, and Explanation

- Evidence should be used in explanations.
- Models can be used in explanations.
- Terms such as hypothesis, model, law, principle, theory, and paradigm are used to explain scientific explanations.

Constancy, Change, and Measurement

- Interactions result in change.
- Changes vary in rate, scale, and pattern, including trends and cycles.
- Math measures change.
- Scientists use the metric system.
- Scale includes understanding that parts of a system might change as its size changes.
- Rate compares one measured quantity with another.

Evolution and Equilibrium

- Evolution is a series of changes. This includes changes in the universe.
- The present is a result of the past.
- Equilibrium is a physical state in which forces and changes occur in opposite and offsetting directions.
- Steady state, balance, and homeostasis describe equilibrium states.

Form and Function

- Form follows function.
- Students should explain function in terms of form and form in terms of function.

A. SCIENCE AS INQUIRY

Abilities Necessary to do Scientific Inquiry

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

Understandings About Scientific Inquiry

- Different kinds of questions suggest different kinds of scientific investigations, such as collecting specimens, doing experiments, seeking more information, making models, and discovering new objects.
- Current knowledge and understanding guide scientific investigations.
- Mathematics is important in all aspects of scientific inquiry.
- The use of technology to gather data enhances accuracy.
- Scientific explanations emphasize evidence, have logically consistent arguments and use scientific principles, models, and theories.
- Asking questions is part of scientific inquiry.
- Scientific investigations sometimes result in new ideas for study, generate new methods or procedures for an investigation, or develop new technologies for data collection.

B. PHYSICAL SCIENCE

Properties and Changes of Properties in Matter

- Substances have characteristic properties that are independent of the amount of the sample and mixtures can be separated.
- Substances react chemically to form new substances whereas the total mass is conserved and they can be grouped if they react in similar ways (i.e. metals).
- Chemical elements do not break down during normal laboratory reactions. One hundred known elements combine to produce compounds and make up all living and nonliving things.

Motion and Forces

- The motion of an object can be described by its position, direction, and speed, and can be measured and shown on a graph.
- An object will move at a constant speed and in a straight line if no force is on the object.
- If there is more than one force on an object along a straight line, the forces will reinforce each other or cancel each other.

Transfer of Energy

- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, and the nature of a chemical. It is transferred in many ways.
- Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.
- Light interacts with matter by transmission, absorption, or scattering.
- Electrical circuits provide a means of transferring electrical energy.
- In most chemical and nuclear reactions, energy is transferred into or out of a system.
- The sun is a major source of energy for changes on the Earth's surface. The sun loses energy by emitting light. Energy arrives as light on Earth in a range of wavelengths.

C. LIFE SCIENCE

Structure and function in living systems

- Form follows function.
- All organisms are composed by cells.
- Cells carry on the functions of life.
- Cells have specialized functions in organisms.
- Humans have specialized systems for carrying out functions.
- Disease is a breakdown in the system caused by internal failures or infection.

Reproduction and Heredity

- All living systems reproduce because it is essential for the continuation of a species.

- Organisms that reproduce sexually are created as a result of the mother's egg and a father's sperm, each carrying half of an offspring's genes.
- Heredity is the passage of the required set of instructions for specifying traits.
- Hereditary information is contained in genes that are located on chromosomes.
- Some traits are inherited others result from environmental influences.

Regulation and Behavior

- All organisms must be able to obtain resources to grow, reproduce, and maintain stable internal conditions.
- Organisms must regulate their internal environment by sensing it and changing physiological activities to survive.
- Behavior is a response to an internal or environmental stimulus.
- An organism's behavior evolves through adaptation to its environment.

Populations and Ecosystems

- A population consists of all of the organisms of a species living together in a given place at a given time.
- Populations can be categorized by their function in the ecosystem (consumer, producer....).
- Sunlight, the major energy source in an ecosystem, is passed through organisms in a food web.
- Numbers of organisms in an ecosystem depend on available resources and abiotic factors (space, temperature, etc.).

Diversity and Adaptations of Organisms

- Organisms are similar in internal structures, chemical processes and common ancestry although they may have different outward appearances.
- Diversity in species is a result of biological evolution.
- Fossils show us that many organisms that lived long ago are extinct.
- Extinction occurs due to a lack of the ability to adapt.

D. EARTH AND SPACE SCIENCE

Structure of the Earth

- Earth is layered and has a solid crust, hot, convecting mantle, and a dense metallic core.
- Crustal plates constantly move in response to the movements of the mantle.
- Landforms are the result of a combination of constructive (sedimentation, volcanoes) and destructive forces (weathering and erosion).
- Some changes in the solid earth can be described as the "rock cycle."
- Soil consists of weathered rocks and decomposed organic material from dead animals, plants, and bacteria, that have a different chemical compositions and textures.
- Water circulates through the crust, atmosphere, and oceans (water cycle).
- Water is a solvent-it dissolves minerals and gases during the water cycle and carries them to the oceans.
- The atmosphere is a mixture of nitrogen, oxygen, and trace gases and water vapor and has different properties at different elevations.
- Clouds, formed by the condensation of water vapor, affect weather and climate.
- Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate because they hold heat.
- Living organisms have played many roles in the Earth system, including the composition of the atmosphere, producing some kinds of rocks, and contributing to weathering of rocks.

Earth's History

- The Earth processes we observe today are similar to those that occurred in the past.
- Fossils provide important evidence of how life and environmental conditions have changed.

Earth in the Solar System

- Earth is third planet from the sun in a system that includes the moon, sun, eight other planets, etc.
- The sun, an average star, is central and the largest body in our solar system.
- Most objects in the solar system are in regular and predictable motion and explain day, year, moon phases, and eclipses.
- Gravity is the force that keeps planets in orbit and governs the motion of the solar system. Gravity alone holds us to the Earth's surface and explains the phenomena of the tides.
- 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 rotation on its axis and the length of the day.

E. SCIENCE AND TECHNOLOGY

Abilities of Technological Design

- Identify a simple problem.
- Design or propose a solution.
- Implement a proposed solution.
- Evaluate a product of design.
- Communicate a problem, design, and solution.

Understanding About Science and Technology

- Scientific inquiry and technological design have similarities and differences.
- Many different people in different cultures have made and continue to make contributions to science and technology.
- Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique.
- Perfectly designed solutions do not exist. All technology solutions have tradeoffs, such as safety, cost, efficiency, and appearance.
- Technological designs have constraints.
- Technological solutions have intended benefits and unintended consequences.

F. SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

Personal Health

- Regular exercise is important to the maintenance and improvement of health.
- The potential for accidents and the existence of hazards imposes the need for injury prevention.
- The use of tobacco increases the risk of illness.
- Alcohol and other drugs are often abused substances.
- Food provides energy and nutrients for growth and development.
- Sex drive is a natural human function that requires understanding.
- Natural environments may contain substances (for example, radon and lead) that are harmful to human beings.
- Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

Populations, Resources, and Environments

- When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.

- Causes of environmental degradation and resource depletion vary from region to region and from country to country.

Natural Hazards

- Internal and external processes of the Earth system cause natural hazards, events that change or destroy human and wildlife habitats.

Risks and Benefits

- Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences.
- Understand the risks associated with natural hazards (fires, earthquakes, volcanic eruptions), biological hazards (pollen, viruses, bacteria, and parasites), social hazards (occupational safety and transportation), and personal hazards (smoking, dieting, and drinking).
- Think critically about risks and benefits.
- Important decisions are based on perceptions of benefits and risks.

Science and Technology in Society

- Science influences society through its knowledge and world view.
- Societal challenges often inspire questions for scientific research, and social priorities often influence research priorities through funding or research.
- Technology influences society through its products and processes.
- Science and technology have advanced through contributions of others at different times in history.
- Scientists and engineers work in many different settings.
- Scientists and engineers have ethical codes regarding human subjects.
- Science cannot answer all questions and technology cannot solve all human problems or meet all human needs.

G. HISTORY AND NATURE OF SCIENCE

Science as a Human Endeavor

- People of various ethnic backgrounds engage in science.
- 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.
- Recognize that scientific theories emerge over time, depending on the contributions of many and reflect the social and political climate of their time.

Nature of Science

- Scientists formulate and test ideas.
- Different scientists may publish differing results based on the same data.
- Part of scientific inquiry is to evaluate the results of scientific investigations.

History of Science

- Many individuals have contributed to science.
- Some scientists are considered to be among the most valued contributors to their culture.
- The history of science can show how difficult it has been for scientific innovators to break through the accepted ideas of their time to reach conclusions that are now taken for granted.

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Interview a Spider** (gr. 5–8, p. 12)	**Habitat Rummy** (gr. 5–8, p. 14)	**Bearly Growing** (gr. 5–8, p. 19)	**How Many Bears Can Live in This…** (gr. 5–8, p. 23)	**My Kingdom for a Shelter** (gr. 5–8, p. 28)	**Tracks!** (gr. 5–8, p. 30)	**Spider Web Geometry** (gr. 5–8, p. 34)	**Oh Deer!** (gr. 5–8, p. 36)	**Wild Worls** (gr. 5–8, p. 41)	**Habitat Lap Sit** (gr. 5–8, p. 61)	**Who Fits Here?** (gr. 5–8, p. 64)	**Which Niche?** (gr. 5–8, p. 66)	**What Did Your Lunch Cost…** (gr. 5–8, p. 68)
UNIFYING CONCEPTS AND PROCESSES													
Systems, order, and organization	○	○	○	○				●		⦿	⦿	○	○
Evidence, models, and explanation	⦿	○	⦿	⦿	○	○	○	⦿		⦿	○		○
Constancy, change, and measurement			⦿	○	○		○	⦿			○		○
Evolution and equilibrium				○				⦿			○		
Form and function	⦿				⦿	⦿	○				○	○	
A: SCIENCE AS INQUIRY													
Abilities necessary to do scientific inquiry	⦿	○	⦿		○	○	○	○			⦿		○
Understanding about scientific inquiry	⦿		○		○						○	○	○
B: PHYSICAL SCIENCE													
Properties and changes of properties in matter													
Motion and forces													
Transfer of energy													
C: LIFE SCIENCE													
Structure and function in living systems	○		○			○	○						
Reproduction and heredity	○		○										
Regulation and behavior	○	○	○	⦿				○		○	●	○	○
Populations and ecosystems	○	○	○	⦿				⦿			○	⦿	○
Diversity and adaptations of organisms			○										
D: EARTH AND SPACE SCIENCE													
Structure of the Earth system													
Earth's history													
Earth in the solar system													
E: SCIENCE & TECHNOLOGY													
Abilities of technological design					○								⦿
Understandings about science and technology					○								○
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES													
Personal health													○
Populations, resources, and environments								⦿		○			
Natural hazards										○			
Risks and benefits													○
Science and technology in society													○
G: HISTORY AND NATURE OF SCIENCE													
Science as human endeavor	○								○				○
Nature of Science			○					○					
History of Science									○				

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Urban Nature Search** (gr. 5–8, p. 70)	**Rainfall and the Forest** (gr. 5–8, p. 73)	**Microtrek Treasure Hunt** (gr. 5–8, p. 82)	**Stormy Weather** (gr. 5–8, p. 85)	**Ants on a Twig** (gr. 5–8, p. 88)	**Good Buddies** (gr. 5–8, p. 91)	**What's for Dinner?** (gr. 5–8, p. 96)	**Seed Need** (gr. 5–8, p. 98)	**Owl Pellets** (gr. 5–8, p. 100)	**Eco-Enrichers** (gr. 5–8, p. 102)	**Energy Pipeline** gr. 7–8, p. 105)	**Quick-Frozen Critters** (gr. 5–8, p. 122)	**Polar Bears in Phoenix?** (gr. 5–8, p. 125)
UNIFYING CONCEPTS AND PROCESSES													
Systems, order, and organization	⦿	●	○	○	○	⦿	○	○	○	⦿	○	⦿	⦿
Evidence, models, and explanation	○	⦿	⦿		⦿		○	⦿		⦿	●	○	○
Constancy, change, and measurement	○	⦿	○		○			○		⦿	○		○
Evolution and equilibrium												○	○
Form and function					○			⦿				○	
A: SCIENCE AS INQUIRY													
Abilities necessary to do scientific inquiry	⦿	⦿	⦿		⦿		○	⦿	⦿	●	○		○
Understanding about scientific inquiry	○	⦿	⦿		⦿		○	⦿	⦿	●	○		
B: PHYSICAL SCIENCE													
Properties and changes of properties in matter													
Motion and forces													
Transfer of energy							○				○		
C: LIFE SCIENCE													
Structure and function in living systems					○			○					
Reproduction and heredity								○					
Regulation and behavior	○	○		○	⦿	○		○			○	⦿	⦿
Populations and ecosystems	⦿	⦿	○	○	●	⦿	○	○	⦿	⦿	●	⦿	⦿
Diversity and adaptations of organisms								○		○		○	
D: EARTH AND SPACE SCIENCE													
Structure of the Earth system													
Earth's history													
Earth in the solar system													
E: SCIENCE & TECHNOLOGY													
Abilities of technological design								○		○			⦿
Understandings about science and technology								○		○			⦿
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES													
Personal health											○		
Populations, resources, and environments		○	○								○	○	
Natural hazards		○		⦿									
Risks and benefits													
Science and technology in society		○									○		
G: HISTORY AND NATURE OF SCIENCE													
Science as human endeavor					○								
Nature of Science		○			○			○		○			
History of Science													

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Adaptation Artistry** (gr. 5–8, p. 128)	**Muskox Maneuvers** (gr. 5–8, p. 130)	**I'm Thirsty** (gr. 6–8, p. 134)	**Move Over Rover** (gr. 5–6, p. 144)	**Planting Animals** (gr. 5–8, p. 152)	**Here Today, Gone Tomorrow** (gr. 5–8, p. 154)	**Time Lapse** (gr. 5–8, p. 158)	**Ecosystem Facelift** (gr. 7–8, p. 166)	**Museum Search for Wildlife** (gr. 5–8, p. 182)	**Saturday Morning Wildlife Watching** (gr. 5–8, p. 184)	**Wildlife in National Symbols** (gr. 5–8, p. 186)	**Prairie Memoirs** (gr. 5–8, p. 188)	**Cartoons and Bumper Stickers** (gr. 5–8, p. 192)
UNIFYING CONCEPTS AND PROCESSES													
Systems, order, and organization		⦿		⦿	○	○	○	⦿					
Evidence, models, and explanation	⦿	○		●	○	○	○	⦿		○	○		○
Constancy, change, and measurement		○		○	○	○	○	○					
Evolution and equilibrium		○		○		⦿	○	○					
Form and function	●							○		○			
A: SCIENCE AS INQUIRY													
Abilities necessary to do scientific inquiry	○		○		⦿	○	○	○		○			
Understanding about scientific inquiry			○		⦿	○	○			○	○		○
B: PHYSICAL SCIENCE													
Properties and changes of properties in matter													
Motion and forces													
Transfer of energy													
C: LIFE SCIENCE													
Structure and function in living systems	○					○				○			
Reproduction and heredity	○	○		○	○	○							
Regulation and behavior	⦿	●	⦿	●	⦿	○		○		○			
Populations and ecosystems	○	●		⦿	⦿	○		⦿					
Diversity and adaptations of organisms	○	○			○	○							
D: EARTH AND SPACE SCIENCE													
Structure of the Earth system													
Earth's history							○						
Earth in the solar system													
E: SCIENCE & TECHNOLOGY													
Abilities of technological design	○				○								○
Understandings about science and technology	○				○								
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES													
Personal health													
Populations, resources, and environments				○	⦿	⦿	○						
Natural hazards					○	⦿	○						○
Risks and benefits													○
Science and technology in society													
G: HISTORY AND NATURE OF SCIENCE													
Science as human endeavor					○		○	○			○		⦿
Nature of Science			○		○			○					
History of Science													

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Power of a Song** (gr. 5–8, p. 194)	**For Your Eyes Only** (gr. 5–8, p. 197)	**Ethi-Reasoning** (gr. 5–8, p. 203)	**What You Wear is What They Were** (gr. 5–8, p. 210)	**Does Wildlife Sell?** (gr. 5–8, p. 213)	**Pay to Play** (gr. 5–8, p. 216)	**Lobster in Your Lunch Box** (gr. 5–8, p. 245)	**Let's Talk Turkey** (gr. 5–8, p. 248)	**Wildlife Bibliography** (gr. 5–8, p. 253)	**Changing Attitudes** (gr. 5–8, p. 255)	**Changing Societies** (gr. 7–8, p. 258)	**History of Wildlife Management** (gr. 5–8, p. 267)	**Animal Poetry** (gr. 5–8, p. 282)
UNIFYING CONCEPTS AND PROCESSES													
Systems, order, and organization			○	⦿			○		○				
Evidence, models, and explanation	○		○	○	○	⦿	○			○	○	○	
Constancy, change, and measurement				○			○	○		⦿	○		
Evolution and equilibrium							○			○		○	
Form and function													
A: SCIENCE AS INQUIRY													
Abilities necessary to do scientific inquiry			○	○	○		○	○	○	⦿		○	
Understanding about scientific inquiry			○	○	○		○		○	⦿		○	
B: PHYSICAL SCIENCE													
Properties and changes of properties in matter													
Motion and forces													
Transfer of energy													
C: LIFE SCIENCE													
Structure and function in living systems													
Reproduction and heredity				○						○			
Regulation and behavior			⦿	○	○			⦿		○		○	
Populations and ecosystems			⦿	○			○	⦿				○	
Diversity and adaptations of organisms								○					
D: EARTH AND SPACE SCIENCE													
Structure of the Earth system													
Earth's history													
Earth in the solar system													
E: SCIENCE & TECHNOLOGY													
Abilities of technological design			○	⦿					○	⦿			
Understandings about science and technology			○	⦿									
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES													
Personal health	○						○					○	
Populations, resources, and environments										○		⦿	
Natural hazards										○		○	
Risks and benefits				○						○			
Science and technology in society		○	○	⦿	○	○				○	○		
G: HISTORY AND NATURE OF SCIENCE													
Science as human endeavor	○		○	○		○				○	○	○	
Nature of Science												●	
History of Science												○	

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Drawing on Nature** (gr. 5–8, p. 285)	**The Hunter** (gr. 5–8, p. 287)	**No Water Off a Duck's Back** (gr. 5–8, p. 305)	**Migration Barriers** (gr. 5–8, p. 308)	**Shrinking Habitat** (gr. 5–8, p. 310)	**Smokey Bear Said What?** (gr. 5–8, p. 314)	**Noisy Neighbors** (gr. 5–8, p. 317)	**Flip the Switch for Wildlife** (gr. 5–8, p. 319)	**To Zone or Not to Zone** (gr. 5–8, p. 321)	**Hazardous Links, Possible Solutions** (gr. 7–8, p. 326)	**World Travelers** (gr. 5–8, p. 330)	**Rare Bird Eggs for Sale** (gr. 5–8, p. 335)	**Pro and Con:…** (gr. 5–8,p. 338)
UNIFYING CONCEPTS AND PROCESSES													
Systems, order, and organization		○	⦿	○	⦿	○	○	⦿	○	●		○	○
Evidence, models, and explanation			○	○	○	○	⦿	○	○	○		○	⦿
Constancy, change, and measurement		○	○	○	○	○	⦿	○	○	○	⦿	○	
Evolution and equilibrium					○	⦿					○		○
Form and function													
A: SCIENCE AS INQUIRY													
Abilities necessary to do scientific inquiry			○	⦿	○	⦿	⦿	⦿	⦿	○		⦿	○
Understanding about scientific inquiry			○	○	○	⦿	⦿	⦿	○	○		○	○
B: PHYSICAL SCIENCE													
Properties and changes of properties in matter													
Motion and forces													
Transfer of energy								○					
C: LIFE SCIENCE													
Structure and function in living systems													○
Reproduction and heredity		○										⦿	
Regulation and behavior		○	○	⦿	●	⦿	⦿		⦿	○		⦿	○
Populations and ecosystems		○	○	⦿	⦿	○	○	○	⦿	○	○	⦿	
Diversity and adaptations of organisms				○	○		○				○	○	
D: EARTH AND SPACE SCIENCE													
Structure of the Earth system													
Earth's history													
Earth in the solar system													
E: SCIENCE & TECHNOLOGY													
Abilities of technological design			○	⦿	⦿	○	⦿	⦿	⦿	○		⦿	●
Understandings about science and technology			○	⦿	●	○	○	●	○	○		○	○
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES													
Personal health									○	○			
Populations, resources, and environments		⦿	○	⦿	●	○	⦿		⦿	⦿	○	⦿	
Natural hazards		○	○	○	●	⦿							
Risks and benefits		○	⦿	⦿	●	⦿	⦿	⦿	○	⦿		⦿	○
Science and technology in society			○	⦿	○	○	⦿	⦿	○	⦿			
G: HISTORY AND NATURE OF SCIENCE													
Science as human endeavor	○		○	○	⦿	○	○	○	○	○		○	⦿
Nature of Science												○	○
History of Science									○				

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Riparian Zone** (gr. 5–8, p. 341)	**Changing the Land** (gr. 6–8, p. 345)	**Career Critters** (gr. 5–6, p. 371)	**Wildwork** (gr. 5–8, p. 385)	**Checks and Balances** (gr. 5–8, p. 387)	**Litter We Know** (gr. 5–8, p. 434)	**Planning for People and Wildlife** (gr. 5–8, p. 436)	**Improving Wildlife Habitat …** (gr. 5–8, p. 440)	**Enviro-Ethics** (gr. 5–8, p. 443)				
UNIFYING CONCEPTS AND PROCESSES													
Systems, order, and organization	⦿		○		⦿	○	●	⦿	○				
Evidence, models, and explanation	○	○	○		○	○	●	⦿					
Constancy, change, and measurement	○	○			○	○	⦿	○	○				
Evolution and equilibrium	○	○											
Form and function													
A: SCIENCE AS INQUIRY													
Abilities necessary to do scientific inquiry	⦿	○			○	⦿	●	⦿					
Understanding about scientific inquiry	⦿	○			○	○	⦿	○	○				
B: PHYSICAL SCIENCE													
Properties and changes of properties in matter													
Motion and forces													
Transfer of energy													
C: LIFE SCIENCE													
Structure and function in living systems													
Reproduction and heredity					○								
Regulation and behavior	⦿	⦿	○		⦿		⦿	○					
Populations and ecosystems	●	⦿	⦿		⦿		●	⦿					
Diversity and adaptations of organisms					○		○						
D: EARTH AND SPACE SCIENCE													
Structure of the Earth system							○						
Earth's history													
Earth in the solar system													
E: SCIENCE & TECHNOLOGY													
Abilities of technological design	●				⦿	⦿	⦿	●	○				
Understandings about science and technology	●				⦿	⦿	○	○	○				
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES													
Personal health													
Populations, resources, and environments	⦿				●	○	●	○					
Natural hazards	⦿				⦿								
Risks and benefits	⦿				○	○	●	○					
Science and technology in society	⦿			○		○	○						
G: HISTORY AND NATURE OF SCIENCE													
Science as human endeavor	⦿			○	○	○							
Nature of Science	⦿			○			○						
History of Science				○									

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Fishy Who's Who** (gr. 5–8, p. 8)	**Whale of a Tail** (gr. 5–8, p. 10)	**Migration Headache** (gr. 5–8, p. 15)	**Designing a Habitat** (gr. 5–8, p. 19)	**Where Does Water Run?** (gr. 5–8, p. 21)	**Water Canaries** (gr. 5–8, p. 24)	**Wetland Metaphors** (gr. 5–8, p. 39)	**Hooks and Ladders** (gr. 5–8, p. 43)	**Micro Odyssey** (gr. 5–8, p. 49)	**Blue-Ribbon Niche** (gr. 5–8, p. 52)	**Pond Succession** (gr. 5–8, p. 66)
UNIFYING CONCEPTS AND PROCESSES											
Systems, order, and organization	⦿		⦿	⦿	⦿	⦿	⦿	⦿	⦿	○	○
Evidence, models, and explanation	⦿	⦿	⦿	⦿	⦿	⦿	○	○	○	⦿	○
Constancy, change, and measurement		○	⦿	○	●	⦿		○		○	⦿
Evolution and equilibrium			⦿	○	⦿	○		⦿		○	○
Form and function	○		○	⦿	○		●	○	⦿	⦿	
A: SCIENCE AS INQUIRY											
Abilities necessary to do scientific inquiry	○	⦿		○	●	●	○		⦿	⦿	
Understanding about scientific inquiry	○	○		○	●	●			⦿	⦿	
B: PHYSICAL SCIENCE											
Properties and changes of properties in matter				○							
Motion and forces											
Transfer of energy											
C: LIFE SCIENCE											
Structure and function in living systems	⦿		○			○		○	⦿	○	
Reproduction and heredity	○	○	○					●	○	○	
Regulation and behavior	○	○	●	⦿	○	⦿		●	⦿	⦿	
Populations and ecosystems	●	○	●	⦿	○	●	○	●	●	●	○
Diversity and adaptations of organisms	⦿	○	⦿					○		○	○
D: EARTH AND SPACE SCIENCE											
Structure of the Earth system	○			○	○	○				○	○
Earth's history	○									○	
Earth in the solar system										○	
E: SCIENCE & TECHNOLOGY											
Abilities of technological design				⦿		○			○		
Understandings about science and technology				○		○		○	○		
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES											
Personal health										○	
Populations, resources, and environments		⦿	●	⦿		●	⦿			⦿	
Natural hazards			⦿			●				⦿	
Risks and benefits			○	○		⦿				⦿	
Science and technology in society		○		⦿		○					
G: HISTORY AND NATURE OF SCIENCE											
Science as human endeavor											
Nature of Science		○									
History of Science											

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**Eat and Glow** (gr. 7–10, p. 69)	**Edge of Home** (gr. 5–8, p. 75)	**Mermaids and Manatees** (gr. 5–8, p. 80)	**Net Gain, Net Effect** (gr. 5–8, p. 85)	**Watered-Down History** (gr. 5–8, p. 91)	**Water Wings** (gr. 5–8, p. 110)	**Puddle Wonders!** (gr. 5–8, p. 114)	**Riparian Retreat** (gr. 5–8, p. 118)	**How Wet Is Our Planet?** (gr. 5–8, p. 121)	**Watershed** (gr. 5–8, p. 132)	**What's in the Air?** (gr. 5–8, p. 136)
UNIFYING CONCEPTS AND PROCESSES											
Systems, order, and organization	○	⦿		⦿	○	○	○	⦿	⦿	⦿	
Evidence, models, and explanation		⦿	⦿	⦿	⦿	○	⦿	○	⦿	●	
Constancy, change, and measurement		○		⦿	○	○	⦿		●	●	
Evolution and equilibrium	○			⦿	⦿				○	⦿	
Form and function		○	⦿								
A: SCIENCE AS INQUIRY											
Abilities necessary to do scientific inquiry	○	⦿	○	⦿	⦿	○	⦿	○	⦿	●	
Understanding about scientific inquiry	○	⦿	○	●	○	○	○	○	⦿	●	
B: PHYSICAL SCIENCE											
Properties and changes of properties in matter									○		
Motion and forces										○	
Transfer of energy											
C: LIFE SCIENCE											
Structure and function in living systems			○								
Reproduction and heredity	○			○			⦿				
Regulation and behavior		⦿		○			⦿			○	
Populations and ecosystems		●	○	○	⦿	○	○			⦿	
Diversity and adaptations of organisms	○			○	⦿						
D: EARTH AND SPACE SCIENCE											
Structure of the Earth system		○		○	○	○		○	⦿	○	
Earth's history		○			●	○				○	
Earth in the solar system		○		○							
E: SCIENCE & TECHNOLOGY											
Abilities of technological design		○	○	●	○	○			○	⦿	
Understandings about science and technology		○		●						⦿	
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES											
Personal health		○		○					○		
Populations, resources, and environments		○		⦿	○		○			⦿	
Natural hazards		○		⦿	○		○			○	
Risks and benefits				⦿	⦿			○	○	●	
Science and technology in society			○	⦿						○	
G: HISTORY AND NATURE OF SCIENCE											
Science as human endeavor				○					⦿		
Nature of Science				○						○	
History of Science				○							

Key to Symbols:
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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 5–8)	**What's in the Water?** (gr. 5–8, p. 140)	**Something's Fishy Here!** (gr. 5–8, p. 145)	**Water's Going On?** (gr. 5–8, p. 149)	**Alice in Waterland** (gr. 5–8, p. 151)	**Turtle Hurdles** (gr. 5–8, p. 158)	**Aquatic Roots** (gr. 5–8, p. 163)	**Where Have All the Salmon…** (gr. 5–8, p. 166)	**To Dam or Not to Dam** (gr. 5–8, p. 170)	**Aquatic Times** (gr. 5–8, p. 174)	**Kelp Help** (gr. 5–8, p. 181)	**Dragonfly Pond** (gr. 5–8, p. 184)
UNIFYING CONCEPTS AND PROCESSES											
Systems, order, and organization		⦿		⦿	⦿	○	●	⦿	○	○	⦿
Evidence, models, and explanation		○		●	⦿	⦿	●	○	○	⦿	⦿
Constancy, change, and measurement		○		●	○	○	●	○	○	○	○
Evolution and equilibrium	○	○		○	⦿	○	●	⦿			
Form and function				○		○		○		⦿	
A: SCIENCE AS INQUIRY											
Abilities necessary to do scientific inquiry		⦿		●	⦿	⦿	⦿	⦿	○	○	⦿
Understanding about scientific inquiry		○		●	○	⦿	●	○	○	○	⦿
B: PHYSICAL SCIENCE											
Properties and changes of properties in matter		○		○						○	
Motion and forces		○						○			
Transfer of energy		○						○			
C: LIFE SCIENCE											
Structure and function in living systems		⦿			○	○		○		○	
Reproduction and heredity		○			⦿	○	○	○			
Regulation and behavior		⦿		○	⦿	○	⦿	○	○	○	⦿
Populations and ecosystems		⦿		⦿	●	⦿	●	⦿		⦿	⦿
Diversity and adaptations of organisms		⦿		○	⦿	○	○	○			
D: EARTH AND SPACE SCIENCE											
Structure of the Earth system		○		○	○			○			○
Earth's history		○		○	○						
Earth in the solar system											
E: SCIENCE & TECHNOLOGY											
Abilities of technological design		●		●	⦿		○	●	○		●
Understandings about science and technology		●		●	⦿			●			⦿
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES											
Personal health	○	⦿		○	○	○		○			○
Populations, resources, and environments		●		⦿	○	⦿	○	⦿		○	
Natural hazards		○		⦿		○					
Risks and benefits		●		●	⦿	○		●			⦿
Science and technology in society		●	○	●	○	○	○	⦿			
G: HISTORY AND NATURE OF SCIENCE											
Science as human endeavor		●						⦿			
Nature of Science		●			○			○			○
History of Science		○									

NATIONAL SCIENCE EDUCATION STANDARDS GRADES 9–12

UNIFYING CONCEPTS AND PROCESSES

Systems, Order, and Organization

- A system is an organized group of related objects or components (organisms, machines, fundamental particles, galaxies, ideas, numbers, transportation, and education).
- Students should analyze in terms of systems (mass, energy, objects, organisms, and events).
- Systems have structure and function.
- Feedback and equilibrium are associated with systems.
- Systems can be open or closed.
- The assumption of order establishes the basis for cause-effect relationships and predictability.
- Prediction can be used to explain change. Math can be used to do this through probability.
- Systems have levels of organization (periodic table & classification of organisms).
- Living systems have levels of organization (cells, tissues, organs, organisms, populations and communities).
- Interactions occur in systems.

Evidence, Models, and Explanation

- Evidence should be used in explanations.
- Models can be used in explanations.
- Terms such as hypothesis, model, law, principle, theory, and paradigm are used to explain scientific explanations.

Constancy, Change, and Measurement

- Interactions result in change.
- Changes vary in rate, scale, and pattern, including trends and cycles.
- Math measures change.
- Scientists use the metric system.
- Scale includes understanding that parts of a system might change as its size changes.
- Rate compares one measured quantity with another.

Evolution and Equilibrium

- Evolution is a series of changes. This includes changes in the universe.
- The present is a result of the past.
- Equilibrium is a physical state in which forces and changes occur in opposite and offsetting directions.
- Steady state, balance, and homeostasis describe equilibrium states.

Form and Function

- Form follows function.
- Students should explain function in terms of form and form in terms of function.

A. SCIENCE AS INQUIRY

Abilities Necessary to do Scientific Inquiry

- Identify questions and concepts that guide scientific investigations (form a hypothesis).
- Design and conduct scientific investigations based on knowledge of major concepts, equipment, and safety precautions. Students may need to clarify parts of the experiment using evidence and logic.
- Use technology and math to improve investigations and communications (measurement instruments, calculators, computers, formulas) to present the design and results of the investigation.
- Formulate and revise scientific explanations and models using logic and evidence (models should be physical, conceptual and mathematical).
- Recognize and analyze alternative explanations and models by reviewing current scientific understanding, weighing evidence, and examining the logic.
- Communicate and defend a scientific argument through writing, following procedures, reviewing information, summarizing data, developing diagrams and charts, and speaking clearly.

Understandings about Scientific Inquiry

- Scientists usually inquire about how physical, living, or designed systems function and are guided by conceptual principles and knowledge.
- Scientists conduct investigations for a wide variety of reasons. For example, they may wish to discover new aspects about the natural world, explain recently observed phenomena, or the testing of prior conclusions.
- Scientists rely on technology to enhance the gathering of data.
- Mathematics is essential to scientific inquiry.
- Scientific explanations should be logical, based on evidence, open to questions and possible modification, and be based on historical and current scientific knowledge.
- Results of scientific inquiry emerge from different types of investigations and communication among scientists.

B. PHYSICAL SCIENCE

Structure of Atoms

- Matter is made of atoms that are composed of smaller components that have mass and electrical charge.
- An atom's nucleus has protons and neutrons which are more massive that its electrons. Atoms that differ in the number of neutrons are called isotopes.
- The nuclear forces that hold the nucleus of an atom together are usually stronger than the electrical forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy (fusion and fission). Fusion is the process responsible for the energy of the sun.
- Radioactive isotopes are unstable and undergo spontaneous nuclear reactions that emit particles or radiation. Large groups of nuclei decay at a predictable rate and can be used to estimate the age of materials containing radioactive isotopes.

Structure and Properties of Matter

- Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus. These outer electrons govern the chemical properties of the element.
- Elements are composed of a single type of atom and are listed in order according to the number of protons. The repeating patterns of physical and chemical properties identify families of elements.
- Bonds between atoms are created when electrons are paired up by being transferred or shared. Atoms may be bonded into molecules or crystalline solids. Compounds are formed when 2 or more atoms bond chemically.
- The physical properties of compounds reflect the nature of the interactions among its molecules.
- Solids, liquids, and gases differ in the distances and angles between molecules or atoms and, therefore, the energy that binds them together.
- Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.

Chemical Reactions

- Chemical reactions occur all around us. Complex chemical reactions involving carbon-based molecules take place constantly in every cell of our bodies.
- Chemical reactions may release or consume energy. Burning of fossil fuels release large amounts of energy by losing heat and emitting light. Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog.
- Important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. Chemical bonds can be broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere burning and processing fossil fuels, and formations of polymers, and explosions.
- Chemical reactions can take place in an instant or billions of years.

- Catalysts accelerate chemical reactions. Chemical reactions in living systems are catalyzed by protein molecules called enzymes.

Motions and Forces

- Objects change their motion only when a net force is applied. Whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted on the first object.
- Gravitation is a universal force that each mass exerts on any other mass.
- The electric force is a universal force that exists between any two charged objects. Opposite charges attract while like charges repel.
- Between any two charged particles, electric force is vastly greater than gravity. Most observable forces can be traced to electric forces acting between atoms and molecules.
- Moving electric charges produce magnetic forces, and moving magnets produce electric forces.

Conservation of Energy and Increase in Disorder

- The total energy in the universe is constant. It can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in other ways. It can never be destroyed. As energy is transferred, the matter involved becomes steadily less ordered.
- All energy is either kinetic (motion), potential (depends on relative position), or is contained by a field.
- Heat consists of random motion and the vibrations of atoms, molecules, or ions.
- Everything tends to become less organized and less orderly over time, thus, in all energy transfers, the overall effect is that the energy is spread out uniformly (i.e. the warming of our surroundings as we burn fossil fuels).

Interactions of Energy and Matter

- Waves have energy and can transfer energy when they interact with matter.
- Electromagnetic waves (radio, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays, gamma rays) result when a charged object is accelerated or decelerated.
- Each kind of atom or molecule can gain or lose energy only in particular discrete amounts and thus can absorb and emit light only at wavelengths corresponding to these amounts. The wavelengths can be used to identify the substance.
- In some material, electrons flow easily while in others they cannot flow at all. Some have intermediate behavior (semiconductors).

C. LIFE SCIENCE

The Cell

- Cells have structures for carrying out various functions.
- Most cell functions involve chemical reactions (example: breakdown of food).
- Cells store and use information to guide their functions.
- Cell functions are regulated allowing them to respond to the environment coordinating growth and division.
- Plant cells, which contain chloroplasts, conduct photosynthesis using solar energy.
- Complex organisms are made of differentiated cells. Differentiation is regulated by genes.

Molecular Basis of Heredity

- DNA carries a set of instructions for specifying characteristics in organisms. (DNA is a polymer formed from 4 subunits—A, G, C, and T. Each DNA molecule in a cell forms a single chromosome).
- Humans contain 23 pairs of chromosomes one of which is responsible for sex determination (XX—female, XY—male).
- Changes in DNA (mutations) occur spontaneously at low rates.

Biological Evolution

- Species evolve over time.
- Biodiversity is due to over 3.5 billion years of evolution that has filled all available niches with organisms.
- Natural selection can be used to explain the fossil record as well as for molecular similarities among diverse living species.
- The millions of different species are related by descent from common ancestors.

- Biological classifications are based on how organisms are related.

Interdependence of Organisms

- Atoms and molecules cycle throughout the living and non-living parts of the biosphere.
- Energy flows through ecosystems (plants > herbivores > carnivores > decomposers).
- The cooperation and competition of organisms in ecosystems helps to maintain the ecosystem.
- Organisms can reproduce indefinitely but the population size is limited by the ecosystem's resource.
- Humans modify ecosystems (population growth, agriculture, pollution, destruction of habitat), sometimes irreversibly.

Matter, Energy and Organization in Living Systems

- Living systems require a continuous input of energy to maintain homeostasis.
- The energy for life comes primarily from the sun. Plants use the energy to form chemical bonds that can later by used as energy sources.
- The chemical bonds of food molecules contain energy that can be released or stored in cells temporarily in the compound ATP.
- The structure of organisms enables them to carry out the functions of matter and energy necessary to sustain the organism.
- Carrying capacity is due to the availability of matter and energy in an ecosystem.
- As matter and energy flow through different levels of organization in systems, elements are recombined in different ways.

Behavior of Organisms

- Multicellular organisms have complex nervous systems that generate behavior from specialized cells rapidly conducting signals.
- Organisms respond to internal changes and external stimuli. This behavior can be innate or learned, but it must be flexible so as to insure future reproductive success.
- Behaviors have evolved through natural selection.
- Behavioral biology has implications for humans by providing links to psychology, sociology, and anthropology.

D. EARTH AND SPACE SCIENCE

Energy in the Earth System

- Earth systems have internal (radioactive isotopes and gravitational energy) and external sources (sun) of energy that create heat.
- The outward transfer of Earth's internal heat drives convection circulation in the mantle that propels the crustal plates to move.
- Heating of the Earth's surface and atmosphere by the sun drives convection within the atmosphere and the oceans producing winds and ocean currents.
- Global climate is determined by energy transfer from the sun at and near the Earth's surface. It is influenced by cloud cover, Earth's rotation, and the position of mountains and oceans.

Geochemical Cycles

- The Earth is a system containing essentially a fixed amount of each stable chemical, atom, or element. Each element can exist in several different reservoirs and moves among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of geochemical cycles.
- Movement of matter between reservoirs is driven by the Earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter (i.e. carbon occurs in carbonate rocks, as a carbon monoxide gas in the atmosphere and dissolved in water, and in all organisms as complex molecules that control the chemistry of life).

Origin and Evolution of the Earth System

- The entire solar system formed from nebular dust and gas 4.6 billion years ago and the Earth was very different in the beginning.
- Geologic time can be estimated and observed in rock and fossil sequences using known decay rates of radioactive isotopes.
- Interactions in the Earth's systems (including living) have resulted in its ongoing evolution.

- Evidence for one-celled forms of life extends back more than 3.5 billion years. The evolution of life caused dramatic changes in our atmosphere, which originally did not contain oxygen.

Origin and Evolution of the Universe

- The Big Bang Theory places the origin of the universe between 10 and 20 billion years ago when it began as a hot dense state and has been expanding ever since.
- Early in the history of the universe, matter clumped together by gravitational attraction to form stars and galaxies, which now form most of the visible mass of the universe.
- Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all other elements.

E. SCIENCE AND TECHNOLOGY

Abilities of Technological Design

- Identify a problem or design an opportunity.
- Propose designs and choose between alternative solutions.
- Implement a proposed solution.
- Evaluate the solution and its consequences.
- Communicate the problem, process, and solution.

Understandings about Science and Technology

- Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanation.
- Science often advances with the introduction of new technologies.
- Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.
- Science and technology are pursued for different purposes. Scientific inquiry is driven by the desire to understand the natural world. Technological design is driven by the need to meet human needs and solve human problems.
- Technological knowledge is often not made public because of patents. Scientific knowledge is made public through presentations at professional meetings and in scientific journals.

F. SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

Personal and Community Health

- Hazards and the potential for accidents exist. Humans can reduce and modify hazards.
- The severity of disease symptoms is dependent on human resistance and the virulence of the disease-producing organism.
- Personal choice concerning fitness and health involves multiple factors.
- An individual's mood and behavior may be modified by substances. The abuse of illegal drugs can result in physical dependence and can increase the risk of injury, accidents, and death.
- Selection of foods and eating patterns determine nutritional balance.
- Families serve basic health needs, especially for young children.
- Sexuality is basic to the physical, mental, and social development of humans.

Population Growth

- Populations grow or decline through the effects of births, deaths, emigration, and immigration.
- Population growth affects the resources used and environmental pollution.
- Sociological factors (cultural norms, percentage of women who are employed, birth control methods) influence birth rates and fertility rates.
- Populations can limit growth.
- Carrying capacity is the maximum number of people in relation to resources and the capacity of Earth systems to support human beings.

Natural Resources

- Human populations use resources in the environment in order to maintain and improve their existence.
- The Earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed.

- Humans use many natural systems as resources. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically.

Environmental Quality

- Natural ecosystems provide an array of basic processes that affect humans. Quality of the atmosphere, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients are being changed in ways that are detrimental to humans.
- Materials from human societies affect both physical and chemical cycles of the Earth.
- Many factors influence environmental quality, such as population growth, resource use, population distribution, overconsumption, etc.

Natural and Human-Induced Hazards

- Normal adjustments of Earth may be hazardous for humans. Humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in the Earth's solid crust.
- Human activities can enhance potential hazards. Urban growth and waste disposal can accelerate rates of natural change.
- Some hazards happen quickly (earthquakes, volcanic eruptions), and others happen slowly (changes of stream channels, erosion of bridge foundations, sedimentation of lakes and rivers).
- Natural and human-induced hazards present the need for humans to assess potential danger and risk.

Science and Technology in Local, National, and Global Challenges

- Science and technology can indicate what can happen, not what should happen. Humans decide about the use of knowledge.
- Understanding basic concepts and principles of science and technology should come before active debate about the economics, policies, and ethics of various science and technology challenges.
- Progress in science and technology can be affected by social issues and challenges.
- Students should understand the appropriateness and value of basic questions "What can happen?" "What are the odds?"
- Humans have a major effect on other species. For example, the influence of humans on other organisms occurs through land use, which decreases space available to other species, and pollution, which changes the chemical composition of air, soil, and water.

G. HISTORY AND NATURE OF SCIENCE

Science as a Human Endeavor

- Individuals and teams continue to contribute to the scientific enterprise (in the form of a field study or a major scientific problem) as both a hobby and a career.
- Scientists value peer review, truthful reporting, and making public work results.
- Science is part of society and is influenced by societal, cultural, and personal beliefs and ways of viewing the world.

Nature of Scientific Knowledge

- Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism.
- Scientific explanations must meet these criteria: be consistent with evidence, make accurate predictions, be logical, be open to criticism, report methods and procedures, and make knowledge public.
- All scientific knowledge is subject to change as new evidence becomes available.

Historical Perspectives

- Throughout history, diverse cultures have contributed scientific knowledge and technological inventions that have had an impact on those societies in different parts of the world.
- Changes in science occur as small modifications in knowledge.

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 9–12)	**We're in This Together** (gr. 9–12, p. 44)	**Carrying Capacity** (gr. 9–12, p. 46)	**Birds of Prey** (gr. 9–12, p. 111)	**Forest in a Jar** (gr. 9–12, p. 137)	**Fire Ecologies** (gr. 9–12, p. 140)	**Bottleneck Genes** (gr. 9–12, p. 172)	**Wildlife on Coins and…** (gr. 9–12, p. 208)	**Artic Survival** (gr. 9–12, p. 234)	**Wild Bill's Fate** (gr. 9–12,p. 270)	**Know Your Legislation:…** (gr. 9–12, p. 272)	**Wildlife Issues: …** (gr. 9–12, p. 297)	**Cabin Conflict** (gr. 9–12, p. 353)
UNIFYING CONCEPTS AND PROCESSES												
Systems, order, and organization	○	⦿	●	⦿	⦿	⦿			○	○	○	○
Evidence, models, and explanation	○	⦿	●	●	⦿	⦿		⦿		○	○	○
Constancy, change, and measurement	○	⦿	⦿	⦿	⦿		○		○	○	⦿	○
Evolution and equilibrium		○	○	●	⦿	○						
Form and function					○							
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Abilities necessary to do scientific inquiry	⦿	⦿	⦿	⦿	⦿	○	○	○	○	○	⦿	⦿
Understanding about scientific inquiry	⦿	⦿	●	○	⦿	○		○			○	○
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Conservation of energy and increase in disorder												
Interactions of energy and matter												
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The cell												
Molecular basis of heredity						○						
Biological evolution			○	○		○						
Interdependence of organisms	⦿	⦿	○	○	○			○				○
Matter, energy, and organization in living systems		○	○	○	○	○		○				
Behavior of organisms			⦿									
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Energy in the Earth system					○							
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Population growth	○	○		○								
Natural resources	○		○					●			○	○
Environmental quality	⦿	○			○							⦿
Natural and human-induced hazards	⦿				○							
Science and technology in local, national, and global challenges	⦿	○							⦿	⦿	●	○
G: HISTORY AND NATURE OF SCIENCE												
Science as human endeavor					○				○	○	○	○
Nature of scientific knowledge		○	○						○	○		○
Historical perspectives							○				○	

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NATIONAL SCIENCE EDUCATION STANDARDS (Content, 9–12)	**Back from the Brink** (gr. 9–12, p. 355)	**Philosophical Differences** (gr. 9–12, p. 364)	**Turkey Trouble** (gr. 9–12, p. 367)	**Deer Crossing** (gr. 9–12, p. 392)	**From Bison to Bread: …** (gr. 9–12, p. 395)	**Bird Song Survey** (gr. 9–12, p. 406)	**A Picture is Worth a …** (gr. 9–12, p. 409)	**Wildlife Research** (gr. 9–12, p. 418)	**Dropping in on Deer** (gr. 9–12, p. 420)	**Deer Dilemma** (gr. 9–12, p. 426)	**Can Do!** (gr. 9–12, p. 446)	**Sustainability: Then, Now…** (gr. 9–12, p. 449)
UNIFYING CONCEPTS AND PROCESSES												
Systems, order, and organization			⦿	⦿	○	○		○			○	
Evidence, models, and explanation		○	○	○		○		⦿			○	
Constancy, change, and measurement			●		○	⦿		⦿			○	
Evolution and equilibrium			⦿									
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The cell												
Molecular basis of heredity												
Biological evolution												○
Interdependence of organisms	○		○	⦿	⦿						○	⦿
Matter, energy, and organization in living systems					○							
Behavior of organisms			○	○		○		○				
D: EARTH AND SPACE SCIENCE												
Energy in the Earth system												
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Abilities of technological design		○	⦿	○				●			●	
Understandings about science and technology			○					○			○	
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Natural resources	○			○	○			○		○	○	
Environmental quality			○								○	
Natural and human-induced hazards				○								
Science and technology in local, national, and global challenges		⦿			○		○			○	⦿	○
G: HISTORY AND NATURE OF SCIENCE												
Science as human endeavor			○	○		○		○		○	○	
Nature of scientific knowledge				○							○	
Historical perspectives												

Key to Symbols:
- ● The science concept is the main focus of the Project WILD activity.
- ⦿ The concept is one of the main focuses of the activity; is reinforced.
- ○ The concept is not the main focus of the activity, but it is supported or reinforced.

NATIONAL SCIENCE EDUCATION STANDARDS (Content, 9–12)	**Eat and Glow** (gr. 7–10, p. 69)	**When a Whale Is Right** (gr. 9–12, p. 94)	**Sea Turtles International** (gr. 9–12, p. 98)	**Facts and Falsehoods** (gr. 9–12, p. 124)	**The Glass Menagerie** (gr. 9–12, p. 155)	**Dam Design** (gr. 9–12, p. 179)	**Living Research: …** (gr. 9–12, p. 190)
UNIFYING CONCEPTS AND PROCESSES							
Systems, order, and organization	○				●		
Evidence, models, and explanation	⦿			⦿	●	○	
Constancy, change, and measurement					⦿		
Evolution and equilibrium					●		
Form and function	○				○		
A: SCIENCE AS INQUIRY							
Abilities necessary to do scientific inquiry	○			⦿	●	○	
Understanding about scientific inquiry	○			○	●	○	
B: PHYSICAL SCIENCE							
Structure of atoms							
Structure and properties of matter							
Chemical reactions					○		
Motions and forces							
Conservation of energy and increase in disorder							
Interactions of energy and matter							
C: LIFE SCIENCE							
The cell							
Molecular basis of heredity	○						
Biological evolution					○		
Interdependence of organisms		○	○		⦿		⦿
Matter, energy, and organization in living systems		○	○				
Behavior of organisms	○				○		
D: EARTH AND SPACE SCIENCE							
Energy in the Earth system							
Geochemical cycles							
Origin and evolution of the Earth system							
Origin and evolution of the universe							
E: SCIENCE & TECHNOLOGY							
Abilities of technological design				○	○	○	
Understandings about science and technology				○	○	○	○
F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES							
Personal and community health							
Population growth							
Natural resources		⦿	⦿		○		
Environmental quality					⦿	○	
Natural and human-induced hazards	○				○	○	
Science and technology in local, national, and global challenges		○	○		⦿	○	
G: HISTORY AND NATURE OF SCIENCE							
Science as human endeavor		○	○		○		⦿
Nature of scientific knowledge				⦿			⦿
Historical perspectives				○			⦿