

## Eco-Schools USA Pathways 5-8 Connection to the National Science Education Standards



*A well-educated student is exposed to a well-rounded curriculum. It is the making of connections, conveyed by a rich core curriculum, which ultimately empowers students to develop convictions and reach their full academic and social potential.*

U.S. Secretary of Education Arne Duncan

With a number of research studies to support the viability and success of environmental education in schools as well as the tremendous academic benefits and social impacts environmental education provides for students, National Wildlife Federation recognized the need and took charge by becoming the sole host organization for the International Eco-Schools program. Eco-Schools USA is a holistic program. It strives to make environmental awareness and action, **not additional curricula, but an intrinsic part of the life and culture of a school**, including students, teachers, administrative staff, non-teaching staff and parents, as well as the local community. Eco-Schools USA works to extend learning beyond the classroom and develop responsible environmental attitudes and commitments, both at home and in the wider community. Whether you are a teacher, student, administrator or facilities manager, the Eco-Schools USA program can benefit your school and local communities.

National Wildlife Federation has identified eight areas of primary focus or “pathways” to help schools become an Eco-School, Climate Change, Consumption and Waste, Energy, Global Dimensions, Green Hour, School Grounds, Transportation, and Water. The icons that represent each pathway can be seen above. In an effort to demonstrate that Eco-Schools USA can be interwoven through any teacher’s curriculum the pathways have been aligned to the National Science Education Standards from which all states base their state standards. On the following pages each content standard is shown with one or more of Eco-Schools USA’s pathways. These icons denote the pathways that can be targeted when teaching this content standard.

### The eight categories of content standards are

- Unifying concepts and processes in science.
- Science as inquiry.
- Physical science.
- Life science.
- Earth and space science.
- Science and technology.
- Science in personal and social perspectives.
- History and nature of science.

The standard for unifying concepts and processes is presented for grades K-12, because the understanding and abilities associated with major conceptual and procedural schemes need to be developed over an entire education, and the unifying concepts and processes transcend disciplinary boundaries. The next seven categories are clustered for grades K-4, 5-8, and 9-12. Those clusters were selected based on a combination of factors, including cognitive development theory, the classroom experience of teachers, organization of schools, and the frameworks of other disciplinary-based standards.



Conceptual and procedural schemes unify science disciplines and provide students with powerful ideas to help them understand the natural world. Because of the underlying principles embodied in this standard, the understandings and abilities described here are repeated in the other content standards.

**Unifying concepts and processes include**

- Systems, order, and organization.
- Evidence, models, and explanation.
- Change, constancy, and measurement.
- Evolution and equilibrium.
- Form and function.

This standard describes some of the integrative schemes that can bring together students' many experiences in science education across grades K-12. The unifying concepts and processes standard can be the focus of instruction at any grade level but should always be closely linked to outcomes aligned with other content standards. In the early grades, instruction should establish the meaning and use of unifying concepts and processes—for example, what it means to measure and how to use measurement tools. At the upper grades, the standard should facilitate and enhance the learning of scientific concepts and principles by providing students with a big picture of scientific ideas—for example, how measurement is important in all scientific endeavors.

*All users and reviewers are reminded that the content described is not a science curriculum. Content is what students should learn. Curriculum is the way content is organized and emphasized; it includes structure, organization, balance, and presentation of the content in the classroom.*

National Science Education Standards, (1996)  
National Committee on Science Education Standards and Assessment, National Research Council



**Content Standard A**  
**Science as Inquiry**



As a result of activities in grades 5-8, all students should develop

- **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 relationship between evidence and explanations.
  - Recognize and analyze alternative explanations and predictions.
  - Communicate scientific procedures and explanations.
  - Use mathematics in all aspects of scientific inquiry.
- **Understanding about scientific inquiry**
  - Different kinds of questions suggest different kinds of scientific investigations.
  - Current scientific knowledge and understanding guide scientific investigations.
  - Mathematics is important to all aspects of scientific inquiry.
  - Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.
  - Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.
  - Science advances through legitimate skepticism. Asking questions and querying other scientists' explanations is part of scientific inquiry.
  - Scientific investigations sometimes result in new ideas and phenomena for study generate new methods of procedures for an investigation, or develop new technologies to improve the collection of data. All of these results can lead to new investigations.

Scientific inquiry is the backbone of a strong science classroom. Beginning from its foundations in kindergarten students are cognitively molded into scientists, becoming science literate young men and women. The pathways provide a haven of opportunities to invite students into inquiry as you, the educator, facilitate student learning utilizing sound inquiry methods and strategies.

Check out NSTA's position statement on [scientific inquiry](#).



## Content Standard B Physical Science



As a result of activities in grades 5-8, all students should develop

- **Properties and Changes of Properties in Matter**

- A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.
- Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties.

- **Motions and Forces**

- The motion of an object can be described by its position, direction of motion, and speed.
- An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
- If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.

- **Transfer of Energy**

- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sounds, nuclear, and the nature of a chemical. Energy 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 (including refraction, absorption, or scattering (including reflection)).
- Electrical circuits provide a means of transferring electrical energy when heat, light, mechanical motion, or electricity might all be involved in such transfers.
- The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the Earth, transferring energy from the sun to the Earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

Matter is everywhere. Many of the eight pathways can be addressed when teaching physical science concepts. Fresh water pollution, chemical properties and reactions of what we consume and waste, as well as chemical properties of soils and contaminants in soils can be addressed in *Properties and Changes of Properties in Matter*. The sun, one form of alternative energy, can be studied in both *Motions and Forces* and *Transfer of Energy* and address the energy, green hour, school grounds and water pathways. All pathways above can be addressed as students gain conceptual knowledge in the standard, *Transfer of Energy*.



## Content Standard C Life Science



As a result of activities in grades 5-8, all students should develop

- **Structures and Function in Living Systems**
  - Disease is a breakdown in structures or functions of an organism. Some diseases are the results of intrinsic failures of the system. Others are the result of damage by infection by other organisms.
- **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 external environment.
  - An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger is based in the species' evolutionary history.
- **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 an ecosystem.
  - Populations of organisms can be categorized by the function they serve in an ecosystem, specifically producers, consumers, decomposers, and their interactions with food webs.
  - For ecosystems, the major source of energy is sunlight. Numerous energy transfers pass 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. 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 process 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 that have lived on the earth no longer exist.

Probably one of the most obvious signs of climate change is seen through the lives of wildlife and the delicate web that ties all organisms together. Through inquiry students can learn each of the life science standards. What is the potential relationship between climate change and lack of outdoor time and an increase in childhood asthma and obesity? How are organisms, both plant and animal adapting to changes in the environment? In a world with limited resources, the need to consume, limitless amounts of waste, and an increasing world population, what predictions can be made about viable space and resources in the future? How are and how will the diversity of plant and animal species be affected by various aspects of a changing climate? Who will be the most vulnerable to environmental changes, who will be able to adapt and who will suffer extinction? Through the power of inquiry the above pathways can be addressed.



## Content Standard D Earth and Space Science



As a result of activities in grades 5-8, all students should develop

- **Structure of the Earth System**

- Landforms are the results of a combination of constructive and destructive forces.
- Soils consist of weather rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.
- 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 is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.
- The atmosphere is a mixture of nitrogen, and trace gases that include water vapor. The atmosphere 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 affect on climate, because water in the oceans holds a large amount of heat.
- Living organisms have played many roles in the earth system, Including affecting the composition of the atmosphere and contributing to the weathering of rocks.

- **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 rotation on its axis and the length of the day.

Earth and space science are the foundations to understanding earth as a part of a larger system and as a system itself, containing many intricate systems of its own. Climate change affects the lithosphere, hydrosphere, and the atmosphere—all studied in the **Earth and Space Science** standard. Through this standard the Eco-Schools pathways above can be addressed.

An online earth system's learning experience for teachers can be found at [Teacher's Domain](#).

For classroom resources related to earth and space science and the environment check out this link at [Teacher's Domain](#).

Linking you to the teachers guide on the [GLOBE](#) website will allow you to further explore earth systems learning opportunities for your students.



## Content Standard E Science and Technology



As a result of activities in grades 5-8, all students should develop

- **Abilities of Technological Design**
  - Identify appropriate problems for technological design.
  - Design a solution or product.
  - Implement a proposed design.
  - Evaluate completed technological designs or products.
  - Communicate the process of technological design.
- **Understandings 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 and technology are reciprocal. Science helps drive technology and technology is essential to science.
  - Perfectly designed solutions do not exist.
  - Technological designs have constraints. Some constraints are unavoidable and other constraints limit choices in design.
  - Technological solutions have intended benefits and unintended consequences.

This standard ties in well with the inquiry method of teaching and is a true science teaching best practice. Eco-Action teams will find they go through this process often as they look for ideas and ways to green their school. Investigating STEM careers and engaging with local community members will demonstrate to students the need for competencies in science and technology. Moving beyond basic computer skills are a must as we move toward the future in a green economy-build your student's confidence for using computers by allowing them to engage in technological inquiry, creating and solving, and evaluating green ideas and opportunities.



## Content Standard F Science in Personal and Social Perspectives



As a result of activities in grades 5-8, all students should develop

- **Personal Health**

- Food provides energy and nutrition for growth and development. Nutrition requirements vary with body weight, age, sex, activity, and body functioning.
- 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, damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, and storms.
- Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.
- Natural hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.

- **Risks and Benefits**

- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacteria, and parasites), social hazards (occupational safety and transportation, and with personal hazards (smoking, dieting, and drinking)
- Individuals can use a systemic approach to thinking critically about risks and benefits important personal and social decisions are made based on perceptions of benefits and risks.

This is an opportunity to take the science and technology you have taught and make it personal. Allow students to make personal connections by diving into the following questions.

1. How do humans affect the earth globally?
2. How do humans affect the earth nationally?
3. How does my community affect the earth?
4. How do I affect the earth?

Explore environmental social justice issues to help your students make connections; reach out to community members.

For ideas go to Facing the Future's, [Engaging Students Through Global Issues](#). (free download)



**Content Standard F**  
**Science in Personal**  
**and Social Perspectives Continued**



As a result of activities in grades 5-8, all students should develop

- **Science and Technology in Society**

- Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental.
- Societal questions often inspire questions for scientific research, and social priorities often influence research priorities through the availability of funding research.
- Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.
- Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Science and technology have contributed enormously to economic growth and productivity among societies and groups with societies.
- Scientists and engineers work in many different settings, including colleges and universities, businesses and industries, specific research institutes, and government agencies.
- Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot do.



## Content Standard G

### History and Nature of Science



As a result of activities in grades 5-8, all students should develop understanding of

- **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, engineering, and related fields such as the health professions. Some scientists 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 observation, 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.
- In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from the same data. Ideally, scientists acknowledge such conflict and work towards finding evidence that will resolve their disagreement.

If students in grades 5-8 are not engaged in science by the time they leave 8<sup>th</sup> grade they are typically lost before they ever enter the STEM pipeline. While text books are a good supplement to a strong inquiry based classroom they often portray science as static-unchanging. The introduction of women and men in STEM fields is a crucial component of science instruction, including exploring careers traditionally not investigated, what it means to be a scientist, what does a day in the life of a scientist look like (there are many forms and many student misconceptions), and how do scientists interact?



## Content Standard G History and Nature of Science Continued



As a result of activities in grades 5-8, all students should develop understanding of

- **Nature of Science Continued**

- It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretations of data, or about the value of rival theories, they do agree that questions, response to criticism, and open communication are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

- **History of Science**

- Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationship between science and society.
- In historical perspectives, science has been practiced by different individuals in different cultures. In looking at the history of many people, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.
- Tracing the history of science can show how difficult it was for scientific innovations to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.

Finally what does it take to be a scientist, how much money can I make, how much college do I need, and what classes should I focus on in high school? Throughout instruction take opportunities to share, research, and learn about scientist past and present who have contributed to our science understanding. How have theories changed over time and what were the events that led to change in scientific theory? What role did society play?

Check out [Kids.gov](http://kids.gov), [STEM Careers](#), [Learning about Scientists](#), and [How Much Can I Make?](#) .

