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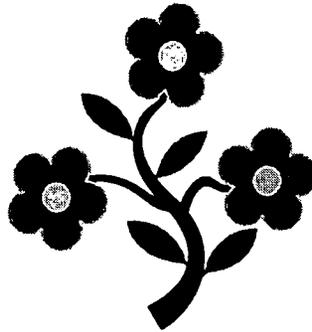
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ABSTRACT

These American Indian standards for science education were developed in close alignment with the 1995 "National Science Education Standards," but tailored specifically for use in schools serving American Indian students. This document applies most of the science concepts of the U.S. national standards to American Indian life and issues, but there are significant differences between traditional American Indian beliefs and the empirical basis of Western science. Thus, making blanket alignments--"Indianizing" all of the national standards--to reflect Indian knowledge and ways of knowing, was not possible. These content standards are organized into three grade level groupings: K-4, 5-8, and 9-12. Within each grade level grouping, the standards indicate areas of knowledge that all Indian students should understand for seven broad topics: science as inquiry, physical science, life science, earth and space science, science and technology, science in personal and social perspectives, and history and nature of science. This document may also be used by American Indian nations to develop their own tribally specific local standards and as a tool to adapt state standards to be more culturally relevant to Indian communities. (SV)

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AMERICAN INDIAN STANDARDS FOR SCIENCE EDUCATION



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published by the National Academy of Sciences*

American Indian Standards for SCIENCE EDUCATION

Introduction

These American Indian Standards for Science Education have been developed in close alignment with the 1995 *National Science Education Standards*. However, the student learning material, bulleted underneath each standard, has been tailored specifically for use in schools serving American Indian students. Like the national standards, this material is broken into three grade level groupings: K-4; 5-8; and 9-12.

Although the authors were, in general, able to apply most of the science concepts of the National Science Education Standards to American Indian life and issues, we do caution the users of these Indian Standards that there is a significant difference -- e.g., in terms of etiology and cosmology -- between traditional American Indian beliefs and the empirical basis of Western science related to the sciences. Thus, making across-the-board alignments -- i.e., to "Indianize" all the national standards -- in order to reflect Indian knowledge and ways of knowing, was not possible.

The authors of this document also note that the National Science Education Standards provide guidance regarding the fundamental concepts and principles underlying each of the Standards. We have not attempted to duplicate any of that information. Rather, we refer the reader to the *Guide to the Content Standard* sections of the national publication. All italicized text in these American Indian Standards has been taken directly from the national standards document. Text that appears in unitalicized typeface has been developed specifically for use in classrooms with American Indian students.

It is hoped that teachers will find these Standards helpful for providing science instruction to Indian students. However, the authors of this material also encourage each Indian nation to consider development of its own standards for science education of its tribal citizens. For tribes which choose to undertake that process, these American Indian Standards might provide useful ideas for possible adaptation. These American Indian Standards might also serve as a useful tool for adapting State Standards to be more culturally relevant to Indian communities.

We note that these Standards should be considered "a work in progress." As such, they will periodically be improved and revised by the BIA, based on input from American Indian educators and leaders. Please send any comments you might have to:

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Grades K-4

AMERICAN INDIAN STANDARDS FOR SCIENCE EDUCATION

SCIENCE AS INQUIRY: CONTENT STANDARD A

As a result of activities in grades K-4, all Indian students should develop:

- an awareness that observations and understandings of nature and ecological relationships traditionally formed an essential base of knowledge among American Indian cultures. [*understanding about scientific inquiry*]

PHYSICAL SCIENCE: CONTENT STANDARD B

As a result of activities in grades K-4, all Indian students should develop an understanding of:

- the innate properties of objects and materials were (and are) recognized by traditional American Indian cultures in the manufacture and use of specific tools and material objects that capitalize upon those properties. [*properties of objects and materials*]
- the fact that special properties of building materials in relation to heat and heat conduction were recognized and used in traditional housing of various American Indian cultures [*light, heat,*]

LIFE SCIENCE: CONTENT STANDARD C

As a result of activities in grades K-4, all Indian students should develop an understanding of:

- plant and animal life cycles as exemplified in traditional American Indian concepts such as the Medicine Wheel. [*life cycles of organisms*]
- characteristics of various animals as exemplified in traditional American Indian stories, legends, songs, and dances. [*the characteristics of organisms*]

EARTH AND SPACE SCIENCE: CONTENT STANDARD D

As a result of activities in grades K-4, all Indian students should develop an understanding of:

- properties of earth, air, fire and water and how they served as a basis for traditional American Indian production of clothing, housing, tools, and food. [*properties of earth materials*]

- objects in the sky as exemplified by historical American Indian lunar calendars, traditional stories, and knowledge of weather patterns, constellations and the habits of birds. [*objects in the sky*]
- changes in the earth's surface, weather fluctuations and the movements of celestial objects and how they affected historical American Indian community locations, annual migrations, and agricultural and ceremonial cycles. [*changes in the earth and sky*]

SCIENCE AND TECHNOLOGY: CONTENT STANDARD E

As a result of activities K-4, all Indian students should develop:

- an awareness of the problem solving skills demonstrated by historical American Indians in the development and improvement of tools and technologies, such as in pottery technology -- e.g., types of clay, tempering, firing techniques, decorative techniques. [*understanding about science and technology*]
- various forms of scientific and technological work currently engaged in by American Indian men and women (e.g., fisheries biology, forestry, geology) and in what ways their fields require the process of problem identification, design and solution. [*abilities of technological design, understanding about science and technology*]

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES: CONTENT STANDARD F

As a result of activities in grade K-4, all Indian students should develop an understanding of:

- elements of nutrition and how they were understood and applied in the diets of American Indians prior to the arrival of the Europeans [*personal health*]
- technologies, diseases, warfare, and other factors and how they affected pre- and post-Columbian American Indian population densities, [*characteristics and changes in populations*]
- elements of the pre-contact North American environment and how changes to them were brought on by the arrival of Europeans in North American, such as the effects of the fur trade on animal populations and its subsequent effect on Indian life. [*changes in environments*]
- local challenges in medicine and environmental protection and how traditional Indian knowledge, practices and philosophies have been and continue to be called upon for solutions. [*science and technology in local challenges*]

HISTORY AND NATURE OF SCIENCE: CONTENT STANDARD G

As a result of activities in grades K-4, all Indian students should develop an understanding of:

- elements of science and technology in the fields of medicine, botany, psychology and ecology which have benefitted from the contributions of American Indians (e.g., the development of aspirin, pro-environment philosophies). [*science as a human endeavor*]
-

Grades 5-8

AMERICAN INDIAN STANDARDS FOR SCIENCE EDUCATION

SCIENCE AS INQUIRY: CONTENT STANDARD A

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

- the ability to articulate examples of the scientific inquiry necessary to develop and improve technologies employed by early American Indians, such as tempered pottery, corn agriculture, and arched roof structures. [*understandings about scientific inquiry*]

PHYSICAL SCIENCE: CONTENT STANDARD B

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

- the principle of changes of properties in materials applied in the daily activities of early Indians, such as evidenced in the preparation of wood splints for basketry, the production of glue from the hooves of a deer, and the preparation of natural dyes. [*properties and changes of properties in matter*]
- how energy was transferred through the use of early Indian hunting tools, such as the act of throwing a spear with an atlatl. [*transfer of energy*]

LIFE SCIENCE: CONTENT STANDARD C

As a result of activities in grade 5-8, all Indian students should develop an understanding of:

- immune system factors which led to the devastating effects of European-based diseases on American Indians [*structure and function in living systems*]
- the ecosystems knowledge evident in the American Indian agricultural practices of companion planting and fertilization. [*populations and ecosystems*]
- concepts of nature's diversity, codependency and the intricate balance between natural forces and how they are reflected in traditional Indian philosophies and symbols, such as the Medicine Wheel. [*populations and ecosystems, diversity and adaptations of organisms*]

EARTH AND SPACE SCIENCE: CONTENT STANDARD D

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

- the regular and predictable motion of the sun and moon and the places and ways in which American Indian observed them and how they employed their observations, e.g., in agricultural and ceremonial cycles. [*earth in the solar system*]

SCIENCE AND TECHNOLOGY: CONTENT STANDARD E

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

- an understanding of the technological design process and how it was applied in the development of various tools and technologies employed by early American Indians, such as fish weirs, salmon spearing platforms, and road and building construction technologies. [*abilities of technological design, communicate the process of technological design*]
- the ability to speculate about and describe the intended benefits and unintended consequences of early American Indian technologies, such as a fish weir or corn agriculture. [*understanding about science and technology*]
- an understanding of the benefits and constraints of technological design through an examination of the building materials used in traditional American Indian housing (e.g., Pueblo *adobe*, Northwest Coast *planks*, *hide tipi coverings*). [*understanding about science and technology*]

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES: CONTENT STANDARD F

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

- how environmental degradation may be occurring in their communities and/or on reservation lands [*populations, resources and environments*]
- American Indian past and contemporary contributions to science and technology (agriculture, pharmacology). [*science and technology in society*]

HISTORY AND NATURE OF SCIENCE: CONTENT STANDARD G

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

- ways in which reasoning, insight, energy, skill and creativity were demonstrated in the scientific achievements of early American Indians -- architecture, tools, health and medicine [*science as a human endeavor and history of science*]

- examples of Indian men and women with diverse interests, talents, qualities, and motivations who currently engage in the activities of science, engineering and related fields. [*science as a human endeavor*]
-

Grades 9-12

AMERICAN INDIAN STANDARDS FOR SCIENCE EDUCATION

SCIENCE AS INQUIRY: CONTENT STANDARD A

As a result of activities in grades 9-12, all Indian students should develop:

- an understanding about science inquiry as a specific process/framework for investigating natural phenomena in order to infer how similar, but not necessarily identical, processes -- involving skills such as acute observation, formulation of hypotheses, classification, measurement, and communication -- were used by different American Indian peoples in the past to investigate and explain natural phenomena. [*understandings about science inquiry and abilities necessary to do scientific inquiry*]

PHYSICAL SCIENCE: CONTENT STANDARD B

As a result of activities in grades 9-12, all Indian students should develop an understanding of:

- structure and properties of matter and be able to discuss analogies/differences between empirical and traditional American Indian concepts about matter; for example, discussing the electrical force in atoms in relation to the Algonquian concept of manitou, or the interactions of energy and matter in relation to the traditional representation of earth, air, fire and water as parts of the Medicine Wheel. [*structure and properties of matter, and interactions of matter and energy*]
- chemical reactions and be able to apply this knowledge to traditional American Indian technologies such as processing of natural materials to make dyes, the detoxification of acorn meal through leaching, the firing of clay to make traditional Indian ceramics. [*chemical reactions*]
- kinetic and potential energy, heat and energy transference, etc., in order to apply these concepts to traditional American Indian technologies, such as the bow and arrow, the use of heating stones, the thermodynamics of a sweat lodge. [*conservation of energy and increase in disorder*]

LIFE SCIENCE: CONTENT STANDARD C

As a result of activities in grades 9-12, all Indian students should develop an understanding of:

- how atoms and molecules cycle among the living and nonliving components of the biosphere and be able to relate these to traditional tribal paradigms such as the Circle of Life, the Beauty Way, the Red Road, etc. [*the interdependence of organisms*]
- the fundamental tension between living organisms' capacity for infinite growth and the finite nature of environments and resources and to relate knowledge of this tension to traditional American Indian values about ecology. [*the interdependence of organisms*]
- photosynthesis as the basis for all food sources within the chain of plant and animal life in order to relate this knowledge to traditional American Indian beliefs about the interdependence of living things. [*matter, energy, and organisms in living systems*]

EARTH AND SPACE SCIENCE: CONTENT STANDARD D

As a result of activities in grades 9-12, all Indian students should develop an understanding of:

- the central interaction of sunlight (external energy) and the earth's heat (internal energy) which drive a variety of natural earth system cycles and relate this knowledge to traditional American Indian values/beliefs such as the Mother Earth concept, reverence for water and wind, the power of the Circle. [*energy in the earth system*]

SCIENCE AND TECHNOLOGY: CONTENT STANDARD E

As a result of activities in grades 9-12, all Indian students should develop:

- abilities of technological design and apply these to various traditional American Indian tools such as the pump drill and atlatl. [*abilities of technological design*]
- an ability to propose hypothetical science and technology problems/solutions inherent in the development of traditional American Indian technologies such as used in agriculture, arts (e.g., weaving and pottery), architecture and astronomy. [*abilities of technological design*]
- the ability to explain the interaction of science and technology -- how new technologies advance scientific knowledge, and how new scientific knowledge advances new technologies -- and the roles of creativity, scientific inquiry skills and knowledge base in order to discuss how these are manifested in the development of American Indian cultures, especially within their own tribes. [*understandings about science and technology*]

- an understanding of the importance of knowledge about science and technology as it applies to contemporary Indian communities in such areas as natural resources development, management and conservation. [*understandings about science and technology*]

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES: CONTENT STANDARD F

As a result of activities in grades 9-12, all Indian students should develop an understanding of:

- factors -- including cultural beliefs and values, historic/contemporary practices -- that contribute to their tribe or community's overall health. [*personal and community health*]
- factors -- birth rates, employment rates, educational achievement, availability of jobs -- that affect their tribe or community's abilities to meet the needs of their constituent members. [*population growth*]
- historic and contemporary contributions of American Indians to current knowledge about conservation and healthy ecological practices and how these relate to applications of modern science and technology in local, regional, national and global circumstances/problems. [*natural resources, environmental quality, human-induced hazards*]

HISTORY AND NATURE OF SCIENCE: CONTENT STANDARD G

As a result of activities in grades 9-12, all Indian students should develop an understanding:

- that traditional American Indian life involved skills and practices common to the process of scientific inquiry. [*science as a human endeavor, historical perspectives*]
- of science as it is practiced by American Indian scientists and science/technology related professionals in their communities. [*science as a human endeavor*]
- of various opportunities for science careers. [*science as a human endeavor*]
- of American Indian contributions to science in such areas as medicine, botany, psychology and ecology. [*science as a human endeavor, historical perspectives*]



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