

Finding Environmental Education in the National Science Education Standards

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Most disciplines in our K-16 educational system now have national standards that are used as a guide for state and regional curriculum development. While most teachers are familiar with their own national and regional standards few have the time to familiarize themselves with how other standards overlap and integrate with their own discipline. This review summarizes the congruence and divergence of the *National Science Education Standards* (NSES) and the national goals set for environmental education (EE). Upon review of the science standards it was found that many of the components of EE could be found in the NSES. Of the five major themes of EE the component involving issue analysis and problem solving was found to be most lacking. It is recommended that the components of EE be more clearly identified in the science standards as well as EE's primary goal of promoting environmentally responsible behavior.

In 1996, the National Research Council published a document entitled the *National Science Education Standards* (National Research Council, 1996). This document was the end product of years of work by representatives from all major disciplines in the teaching and learning of science. The *Standards'* primary goal is for all students to achieve scientific literacy. While use of this document is not mandated for high school teachers or school curriculum coordinators, it is arguably the most comprehensive and integrative document about how and what we teach in science. The extent to which the standards are used is yet to be seen. It has the potential to become the central unifying document that all individuals and groups refer in teaching and learning science. At a minimum, future funding from the major government organizations in science education will expect applicants to refer to and implement its principles.

Over the last three decades environmental education (EE) has shown an increased prominence in K-12 school curriculum across the country. EE, while not solely science based, is dominated by concepts commonly found under the rubric of science. One look at a sampling of environmental education focused curriculum will show students engaged in all major science disciplines including biology, chemistry, earth science, and physics. While the science standards have a significant degree of acceptance in the K-12 schools, EE has had significant opposition to its inclusion in traditional education. A number of anti-environmental education initiatives have been launched in the recent years asserting the EE is biased and full of "soft

science." Michael Sanera recently published a book entitled *Facts not Fears* (Sanera & Shaw, 1999) that outlines how EE is making our children fearful of regarding human interaction with the environment. Sanera claims educators should be teaching students scientific facts about human impact on resources rather than generalizations based on incomplete research and evidence. Corporate America has responded as well to the influx of EE in the K-12 schools (Williams, 2000). Some energy-based companies claim that EE is showing just one side of the story regarding environmental problems and have started to create and implement their own EE school curriculum. In addition, companies have begun aggressive advertising campaigns aimed at educating the populace about how environmentally friendly they are in contrast to the messages they see being sent by the EE field.

As a teacher or curriculum coordinator where environmental education is a part of the existing curricula, it will be important to understand not only what EE is but also where the components of environmental education can be found in the national science standards. It is hoped that this information will help support and justify EE's presence in K-12 education as pressure from the anti-environmental movement mounts on schools and educators. Below is a review of the *National Science Education Standards* aimed at identifying and analyzing the science standards within the context of EE. A series of questions will be used to help guide the review of the standards with regards to EE including: Is EE found in the standards? What teaching processes are consistent between both standards? What content is common between both standards? What are the strengths and weaknesses of the standards with regard to EE?

Is environmental education found in the standards?

Before identifying what components of EE are found in the science education standards, first let's define what EE is and what the fundamental components are. EE is different from other environmental subjects such as ecology, environmental science, and environmental studies in that its primary aim is to promote environmentally responsible awareness (North American Association for Environmental Education, 1998). Within the context of the educational system four central themes or levels have been identified which are characteristic of EE programs and curriculum. "Ecological foundations" refers to students having some degree of understanding in basic ecology as a basis for understanding the world around us. "Conceptual awareness -issues and values" refers to the development of an understanding of how humans have impacted the environment, the associated issues that have come from these interactions, and the development of an understanding of the underlying value systems that people are basing their decisions on regarding these issues. "Investigation

and evaluation" outlines experiences, understanding and skills students develop involving the investigation and proposed solutions to environmental issues and problems. "Environmental Action Skills - training and application" is the final level of study that is aimed at providing students with specific skills to participate in community problem-solving and service projects. These levels may be found in one program but more broadly are viewed as a framework that should be applied to an educational system K-12.

Given this background the quick answer to the question of whether EE is found in the science standards is yes. It will take digging to find it, however. The science standards are organized into six major sections: Science teaching standards, Professional development, Assessment, Science content, Program standards, and System standards. The greatest concentration of discussion involving EE is found in the "Science content" standards, which has the following eight sections: Unifying concepts, Science as inquiry, Physical science, Life science, Earth and space, Science in personal and social perspectives, History and nature of science. Within the seven sections the bulk of the description of EE is found in the "Science in personal and social perspectives" section. EE is not referred to specifically, rather the term environment or environmental studies is used.

What teaching processes are consistent between both standards?

In general the science standards state they want students to be given a variety of experiences which lead to understanding and eventual engagement in personal and social action with regards to health, population, resources, and the environment. The teaching emphases in the early grades focus on building conceptual understanding and awareness with less emphasis on action and problem solving. In the middle grades understanding concepts continues with more emphasis placed on establishing linkages, decision making, and misconceptions. In the high school grades the focus changes to application of concepts, critical thinking, and action. The standards stop short of suggesting specific action. They do however specifically imply action. There is also explicit identification of applying student understanding to both local and global issues. Below is an overview of the major pedagogical emphases by grade level.

Table 1
NSES/EE Common Teaching Emphases

Grade Level	Focus	Pedagogical Emphasis
K-4	Experiential Understanding	<ul style="list-style-type: none"> ▪ Experiential Understanding ▪ Building Foundations ▪ Engagement ▪ Awareness ▪ Recognition
5-8		<ul style="list-style-type: none"> ▪ Establish Linkages ▪ Understanding ▪ Roles Play ▪ Personal Decisions ▪ Environmental Issues ▪ Challenges ▪ Misconceptions ▪ Awareness of Environmental problems
9-12	Action	<ul style="list-style-type: none"> ▪ Understanding ▪ Application to local and global problems ▪ Reasoning ▪ Critical thinking

What content is common between both standards?

The science content requirements for EE are found mostly in section four in the "Science in personal and social perspectives" content standard. These include Population, Resources, Environment, and Hazards. In the early grades the content areas of population, resources, and environment are the focus. All have students developing a definition of the central term and the unifying principals of variation and change. In the middle grades students begin to study more complex concepts and their interrelationships. Cycles, structure and function of the ecosystem, and human impact on the environment are examples of these content focus areas. Natural and made-made hazards are introduced as well. Tying together the content areas is a theme of human impact through degradation of the environment and depletion of natural resources. In the high school grades more formal concepts are introduced such as systems, rates, and carrying capacity. Linking the content areas is a focus on human effects, analysis, and assessment. Below is an overview of the EE focused content requirements by

grade level.

Table 2
EE Content Requirement of the National Science Education Standards

Grade	Science in Personal and Social Perspectives Content Standard Area			
	Population	Resources	Environment	Hazards
K-4	<ul style="list-style-type: none"> ▪ Definition ▪ Density ▪ Population change 	<ul style="list-style-type: none"> ▪ Definition ▪ Resource types ▪ Supply ▪ Earth materials: <ul style="list-style-type: none"> - What they are? - How are they used? ▪ Soils ▪ Fossils 	<ul style="list-style-type: none"> ▪ Definition ▪ Changes in environments ▪ Speed of changes in environments ▪ Characteristics of organisms ▪ Life cycles ▪ Organisms & the environment 	
6-8	<ul style="list-style-type: none"> ▪ Over population ▪ Environmental degradation ▪ Causes of environmental degradation 	<ul style="list-style-type: none"> ▪ Resource depletion ▪ Rock/Mineral cycles ▪ Structure of earth systems 	<ul style="list-style-type: none"> ▪ Degradation ▪ Ecological Structure and function ▪ Levels of ecosystem study ▪ Diversity ▪ Adaptation 	<ul style="list-style-type: none"> ▪ Natural hazards ▪ Structure of earth system ▪ Intro. to human hazards ▪ Risks analysis
9-12	<ul style="list-style-type: none"> ▪ Factors effecting growth ▪ Carrying capacity ▪ Rates Technology impact 	<ul style="list-style-type: none"> ▪ Geo-chem cycles ▪ Resource use ▪ Limited resources ▪ Human stress on resources 	<ul style="list-style-type: none"> ▪ Human changes and effect ▪ Systems ▪ Factors affecting environment 	<ul style="list-style-type: none"> ▪ Human induced hazards ▪ Benefits

What are the strengths and weaknesses of the standards with regard to EE?

The good news is many of the central components of EE are met in the standards. Clearly stated at the beginning of the "Science in personal and social perspectives" section is the following:

Central ideas related to health, populations, resources, and environments provide the foundations for students' eventual understandings and actions as citizens.

The standards want students to become active participants in making local and global change. They propose to get students to do this through a steady

diet of experiential learning of fewer concepts more in-depth, and appropriately progressing from concrete to formal concepts. Issues become more of a focus as students enter the middle grades, and application and action is suggested in the high school. While not specifically identified in the content standards, cooperative group learning is highly recommended, as is alternative forms of assessment. In addition, interdisciplinary and theme-based learning is recommended. All of these approaches are characteristic of many EE learning environments.

While the conceptual understanding and suggestion for action is a strength in the standards, they fall short in a number of areas. In the middle grades it is suggested that students begin to identify and make personal decisions about environmental problems. Central to this experience is students identifying human values and attitudes with regards to the issue being studied. This process, commonly referred to as values clarification in the EE literature, is left out of the standards. Sense of place, another common component to EE, is not identified as an important part of students' learning experience about the environment. And while the standards state that personal action is their goal, they stop short of requiring it or giving examples of appropriate action.

In many ways the standards overlap very well with EE. The pieces that are missing however are central to the EE learning experience. EE's primary goal is to promote environmentally responsible behavior. This goal is also articulated in the *National Science Education Standards*. To produce this outcome environmental educators have identified four major areas that should be part of students' learning experience. These include: Ecological foundations, Conceptual awareness -issues and values, Investigation and evaluation, and Environmental action skills-training and application. Without all four of these areas clearly identified and integrated into student learning, the goal of students developing environmentally responsible behavior will not be met. The *National Science Education Standards* need to state more clearly what EE is and how it is infused in the science standards. By doing this, teachers will be able to more effectively develop courses and curriculum that incorporate all levels of environmental education. This in turn will provide students with a greater opportunity to develop the knowledge and skills that will lead to solving one of the greatest threats to our natural world, human destruction of our biosphere.

References

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