

# **Environmental Education Report**

**Empirical Evidence, Exemplary  
Models, and Recommendations on  
the Impact of Environmental  
Education on K-12 Students**



Office of Superintendent of Public Instruction  
Old Capitol Building  
P.O. Box 47200  
Olympia, WA 98504-7200

For more information about the contents  
of this document, please contact:  
Gilda Wheeler, OSPI  
E-mail: [Gilda.Wheeler@k12.wa.us](mailto:Gilda.Wheeler@k12.wa.us)  
Phone: 360.725.4976

Please refer to the document number below for quicker service:  
07-0036

This document is available online at:  
[www.k12.wa.us/research](http://www.k12.wa.us/research)

# **Environmental Education Report**

## **Empirical Evidence, Exemplary Models, and Recommendations on the Impact of Environmental Education on K-12 Students**

Prepared by

Gilda Wheeler, Environmental and Sustainability Program Coordinator, OSPI

Colleen Thumlert, Cascadia Consulting Group

Lise Glaser, Cascadia Consulting Group

Matt Schoellhamer, Cascadia Consulting Group

Oksana Bartosh, University of British Columbia

**Teaching and Learning**  
**Office of Superintendent of Public Instruction**

---

Dr. Terry Bergeson  
Superintendent of Public Instruction

Cathy Davidson  
Chief of Staff

Dr. Corrine McGuigan  
Assistant Superintendent, Teaching and Learning

---

**December 2007**

## **OSPI Mission**

### **Preparing Washington Students to Live, Learn, and Work As Productive Citizens in the 21st Century**

In collaboration with educators, students, families, local communities, business, labor, and government, the Office of Superintendent of Public Instruction leads, supports, and oversees K-12 education, ensuring the success of all learners.

## **Acknowledgements**

The authors would like to acknowledge the assistance provided by the following people in reviewing earlier drafts of this document and/or providing pertinent information and sources:

Marty Fortin, Association of Washington School Principals  
Frank Hein, Woodland Park Zoo  
Rhonda Hunter, Washington State Department of Ecology  
Martin LeBlanc, Sierra Club  
Jean McGregor, Evergreen State College  
Abby Ruskey, Environmental Education Association of Washington  
Shelley Stromholt, IslandWood  
Margaret Tudor, Pacific Education Institute  
Eric Wuersten, Office of the Superintendent of Public Instruction

Jessica Branom-Zwick, Cascadia Consulting Group  
Dominique Gomez, Cascadia Consulting Group  
Rob Oswald, Cascadia Consulting Group  
Sara Rutherford, Cascadia Consulting Group  
Christy Shelton, Cascadia Consulting Group  
Lauren Sloane, Cascadia Consulting Group

This report was funded in part by a generous contribution from the Sierra Club.

## **Suggested Citation**

Wheeler, G. and Thumlert, C. (2007). *Environmental Education Report*. Olympia, WA: OSPI.



# Table of Contents

---

<b>Executive Summary</b> .....	<b>i</b>
Introduction .....	i
Methodology.....	i
Summary of Key Findings .....	i
Recommendations .....	iii
<b>A. Introduction</b> .....	<b>1</b>
Purpose and Goals.....	2
<b>B. Project Background</b> .....	<b>4</b>
A Brief History of Environmental Education in North America .....	4
Environmental Education Today.....	5
The Evolution of Research in Environmental Education.....	7
OSPI's Role in Environmental Education in Washington.....	8
<b>C. Approach and Methodology</b> .....	<b>9</b>
Criteria for Initial Selection of Studies.....	9
Criteria for Evaluation of Studies .....	10
Database for Collecting Research.....	12
<b>D. Research Findings for Outcome Areas</b> .....	<b>14</b>
1. Academic Achievement.....	16
2. Career Development .....	27
3. Graduation Requirements: Culminating Projects.....	30
4. Student Self-Esteem, Engagement, and Motivation .....	31
5. Civic Responsibility and Service-Learning.....	34
<b>E. Characteristics of Successful Programs</b> .....	<b>36</b>
<b>F. Research Conclusions</b> .....	<b>40</b>
<b>G. Recommendations</b> .....	<b>42</b>
Recommendations for the Washington State Legislature.....	42
Recommendations for OSPI and the Environmental and Outdoor Education Community .....	43
Recommendations for Environmental Education Researchers .....	44
<b>Appendix A: Engrossed House Bill 2910</b> .....	<b>47</b>
<b>Appendix B: Definitions</b> .....	<b>48</b>
<b>Appendix C: Historical Highlights of Environmental Education in Washington State</b> .....	<b>51</b>
<b>Appendix E: Additional Literature Reviews of EE Studies</b> .....	<b>62</b>
<b>Appendix F: Sources for Research</b> .....	<b>63</b>

<b>Appendix G: Database Snapshots .....</b>	<b>65</b>
<b>Appendix H: Outcome Area Tables .....</b>	<b>67</b>
Academic Achievement .....	67
Career Development .....	86
Graduation Requirements .....	88
Self-Esteem, Engagement, and Motivation .....	89
Civic Responsibility and Service-Learning .....	95
<b>Appendix I: Model Programs .....</b>	<b>99</b>
<b>Appendix J: Bibliography of Studies Collected and Reviewed .....</b>	<b>108</b>
<b>Appendix K: Additional References.....</b>	<b>113</b>

# Executive Summary

---



## Introduction

In 2006, the Washington State Legislature passed Engrossed House Bill 2910, directing the Office of the Superintendent of Public Instruction (OSPI) to provide a report with “empirical evidence, exemplary models, and recommendations” on the impacts of environmental education on K-12 students. In order to meet the needs of EHB 2910, this report summarizes the results of academic research that measures these impacts in one or more of five outcome areas:

- 1) Academic achievement
- 2) Career development
- 3) Graduation requirements
- 4) Self-esteem, engagement and motivation
- 5) Civic responsibility and service-learning

The outcomes from this study will contribute to Washington State’s ongoing efforts to strengthen its educational programs and ensure that environmental education is incorporated into those efforts in the most effective way possible.

## Methodology

This study examined reports and programs from across the state, the nation and from international sources to gather a broad selection of published and unpublished environmental education research. A variety of sources were used, such as the internet, interviews with key informants and experts in the field of environmental and sustainability education, and bibliographies of other published studies. In all, 76 studies were located. Each study was then reviewed and specific pieces of information gleaned from the studies were entered into an Access database. To compare content among the studies, a set of criteria was developed to “grade” each study based on its methodology and outcomes. These criteria helped the team identify “gold”<sup>1</sup>, or most rigorous, and “supporting” standard studies. Subsequently, gold-rated studies received further in-depth review and are discussed in the Key Findings section of this report.

## Summary of Key Findings

This study uncovered a number of overall findings, as well as findings specific to each outcome area.

---

<sup>1</sup> The term “gold standard study” is used by the US Department of Education to describe a study that is experimental with randomly assigned samples. The term is defined differently for this report, and studies identified as gold herein do not necessarily meet the Department of Education definition.



## Overall Findings

The studies identified a number of general conclusions on the effectiveness of environmental education programs, the state of environmental education in Washington and indicated opportunities for additional research. These include:

### Effectiveness of Environmental Education

- Environmental Education is an effective means of achieving a number of desirable student outcomes.
- Environmental Education allows for the ready integration of many techniques that are thought to define good education.
- The multi-faceted nature of Environmental Education is a key component of its effectiveness.

### Environmental Education in Washington State

- Washington State has consistently played a leadership role in both the quality of its environmental education programs and in supporting research.
- There are numerous opportunities for WA to continue that leadership.

### Additional Research on Environmental Education

- There are abundant opportunities for valuable research.

## Findings by Outcome Area

In addition to general findings, the study produced a number of findings specific to the five outcome areas. These are detailed below.

### Academic Achievement

- Of the 20 reviewed studies that address student achievement, 18 indicate a correlation between participation in environmental education and improved academic achievement.
- Some research suggests that environmental education may increase achievement for both high-ranking and low-ranking students.
- There is strong evidence that environmental education increases math and science achievement; some evidence that it increases social studies achievement; and mixed evidence that it increases language arts achievement.
- Many studies did not test for statistical significance, or they relied on small sample sizes. Very few studies controlled for other factors such as gender, socioeconomic status, age, and level of achievement prior to participation in environmental education.

### Career Development

- No studies were found that examined the impact of K-12 environmental or sustainability education on career choice. Additional research is needed to follow K-12 environmental and sustainability education participants through college/university and career choices.
- Several studies that analyze adult populations suggest that environmental education programs increase awareness and interest in environmental careers and that participation in service-learning programs, which are frequently a part of environmental education programs, can enhance career development.

- Individuals working in the environmental field frequently cite outdoor opportunities and participation in environmental educational programs as an influence in their career choice.

### Graduation Requirements – Culminating Projects

- Limited evidence is available on the impact of environmental education on graduation rates.
- One study suggests that environmental education participation reduces dropout rates and increases university enrollment.
- No studies focused on culminating projects.

### Self-Esteem, Engagement and Motivation

- The sixteen studies reviewed provide some evidence that environmental education has a positive impact on students' self-esteem, motivation and engagement.
- However, much of the impact may be due to the often experiential nature of environmental education programs examined, which frequently involved outdoor/adventure activities as opposed to traditional classroom learning.
- Only one study used well-developed and reliable instruments for measuring changes.

### Civic Responsibility and Service-Learning

- The eight studies reviewed found mixed evidence that participation in environmental education increases civic engagement. These studies focused on self-reported data rather than measured behavior changes.

## Recommendations

Based on the conclusions contained in this report, OSPI and the statewide partners have developed recommendations to guide Washington State in maintaining its leadership role in environmental and sustainability education, and to help ensure the success of each and every Washington State student. The following recommendations are directed to the Legislature, OSPI and the environmental and outdoor education community, and environmental education researchers.

### Recommendations for the Washington State Legislature

- 1) **Fund integrated project-based learning opportunities for all students.** Support from the Legislature for project-based learning could include funding the Sustainable Design Project, a public-private partnership launched in 2007 by OSPI, EEAW, Puget Sound Energy, and numerous other partners, specifically for an online database allowing students to find project-based learning opportunities and post their own projects.
- 2) **Continue to fund and expand the intent of House Bill 1677 to provide financial support to school districts for outdoor/experiential education for all students.** The Legislature is encouraged to fund HB 1677 in the 2009 legislation and expand the intent of the program to provide an equal per-student allocation (e.g. \$20 per student) to districts to ensure that all public school students have the opportunity to participate in at least one full-day outdoor, experiential program during their K-12 years.

- 3) **Continue to fund the OSPI environmental education partnership grant program established by HB 1466.** The Legislature earmarked funds for the EE Partnership grant program in the 2005 and 2006 budgets, but not in the 2007 budget. Reinstatement and an increase of budget allocations to the EE partnership grant program will ensure that more students have access to high quality standards-based environmental learning opportunities.
- 4) **Provide funding for collaborative partnerships between colleges of education and school districts to develop and implement environmental and sustainability teaching and learning programs.** Specific funding should be directed to assist colleges of education in implementing the Professional Education Standards Board's new Standard V pertaining to integrated teaching and teaching environmental sustainability.

### Recommendations for OSPI and the Environmental and Outdoor Education Community

- 1) **OSPI should update the 2000 Washington State Environmental Education Guidelines.** OSPI should develop a process and convene a working group to review and update these standards and ensure that they are aligned with national standards, and Washington State core subject area Essential Academic Learning Requirements.
- 2) **Ensure that outdoor and experiential education programs in Washington State are entered into the new EE Resources Center developed through E3 Washington.** Although the study includes a listing of these resources as directed by the bill, this listing is static. An online database provides the flexibility necessary to keep such a list up-to-date, relevant, and accessible.
- 3) **Compile and disseminate the results of environmental and sustainability education research to educators.** Environmental education research is continually being conducted by universities, non-profit organizations, and private research institutions. An organization or institution should be identified to be the repository of this research to ensure that new data is synthesized and provided to educators and the public as it becomes available.
- 4) **Finalize and provide professional development for the Environmental and Sustainability Education Educator Guidelines.** Once OSPI and EEAW draft educator guidelines and align them with the revised learner guidelines referenced above, a professional development workshop module and a series of workshops detailing the use of the guidelines will need to be developed and delivered across the state.
- 5) **Create a recognition program to honor exemplary environmental and sustainability programs and educators.** This program would incentivize the creation and continuation of effective environmental education in Washington, and should include recognition for high quality environmental sustainability education by college of education faculty, district or school-wide programs, teachers, and students.

## Recommendations for Environmental Education Researchers

- 1) **Conduct education studies with a more robust methodology.** In particular, the body of research on environmental education would benefit from more studies that control for different populations, employ statistical methods and large sample sizes, and use more established evaluation methods.
- 2) **Conduct longitudinal studies.** There is a need for longitudinal studies that explore the changes in student outcomes over a period of time greater than one year.
- 3) **Conduct additional studies in under-researched areas, such as the teaching strategies used in environmental education programs.** Many studies have analyzed whether certain outcomes have been achieved. Now educators and students would benefit greatly from studies that analyze and isolate which specific teaching strategies affect student outcomes such as student achievement and graduation rates.



## A. Introduction



Washington State has a long history of leadership in environmental education. The state is home to one of the nation's first outdoor schools (founded in the 1920s), a nationally recognized Environmental Education Assessment Project (created in the 1990s), and continues to be a leader in environmental and sustainability education.

Recognizing the benefits that environmental education offers, Washington State law mandates that environmental education be included as part of the common school curriculum. Under **RCW 28A.230.020** and **WAC 392-410-115** (formerly WAC 180-50-115), the state requires instruction about conservation, natural resources, and the environment be provided at all grade levels in an interdisciplinary manner through science, the social studies, the humanities, and other appropriate areas with an emphasis on solving the problems of human adaptation to the environment. See Table 1 for more information on Washington State legislation related to environmental education.

**Table 1.** Key Washington State Environmental Education Legislation and Regulations

Legislation/Regulation	Description
<b>RCW 28A.230.020</b> Common school curriculum (1988)	Requires that "All common schools shall give instruction in ... science with special reference to the environment. ... All teachers shall stress ... the worth of kindness to all living creatures and the land. ..."
<b>WAC 392-410-115</b> (formerly WAC 180-50-115) Mandatory areas of study in the common school (1990)	Requires "instruction about conservation, natural resources, and the environment be provided at all grade levels in an interdisciplinary manner through science, the social studies, the humanities, and other appropriate areas with an emphasis on solving the problems of human adaptation to the environment."
<b>HB 1466</b> Washington Natural Science, Wildlife, and Environmental Education Partnership Account and Grant Program (2003)	Creates a grant program to "promote proven and innovative natural science, wildlife, and environmental education programs that are fully aligned with the state's essential academic learning requirements, and includes but is not limited to instruction about renewable resources, responsible use of resources, and conservation." The program is administered by the Office of Superintendent of Public Instruction.
<b>HB 2910</b> Environmental Education Study (2006)	Requires OSPI to "conduct an environmental education study in partnership with public and private entities invested in strategies to reach every student, family, and community with quality environmental education experiences."

<b>HB 1677</b> No Child Left Inside (2007)	Establishes an outdoor education and recreation program to “provide a large number of underserved students with quality opportunities to directly experience the natural world.” The program is administered by the Washington State Parks and Recreation Commission.
<b>PESB Standard V</b> Teacher Education Program Approval Standards (2007)	Established by the Professional Educator Standards Board (PESB) Standard 5.3.D (Knowledge of Learners and their Development in Social Contexts) requires that “teacher candidate practice reflects planning, instruction, and communication in which... all students are prepared to be responsible citizens for an environmentally sustainable, globally interconnected, and diverse society.”

## Purpose and Goals

In 2006, the Washington State Legislature passed Engrossed House Bill 2910, directing the Office of the Superintendent of Public Instruction (OSPI) to provide a report with “empirical evidence, exemplary models, and recommendations” on the impacts of environmental education on students. This report has three primary purposes:

- 1) To identify the effects that environmental education programs and public-private environmental education partnerships have on academic achievement, student self-esteem, and personal responsibility;
- 2) To provide findings and recommendations useful to the Washington State comprehensive environmental education plan; and
- 3) To help identify outdoor environmental education opportunities for students, families, and communities in Washington.

See Appendix A for the complete text of Engrossed House Bill 2910.

As the lead agency for this project, OSPI contracted with Cascadia Consulting Group to conduct a comprehensive assessment and review of existing studies on environmental education. The goal was to gather available data on the impacts of environmental education on several outcome areas specifically requested by the Legislature:

- 1) **Career development;**
- 2) Good citizenship as proven through **service-learning;**
- 3) **Graduation requirements**, specifically addressing senior culminating projects;
- 4) **Underserved youth and demographic groups;** and
- 5) Models of **professional development** for community-based service organizations, including state and local agencies.

In addition to hiring a consultant, OSPI established a team of partners from various fields of environmental and sustainability education. This team provided input on the literature review methodology, acted as a resource for the literature review process, and provided feedback on the report and recommendations. In particular, the project partners, together with OSPI, recommended adding the impact of environmental education on **student academic achievement** and **student engagement** as additional outcome areas to evaluate in the report.

Key components of this report include:

- The methodology of the literature review;
- A summary of findings for each of the outcome areas named in the bill;
- A summary of characteristics of successful environmental and sustainability education programs;
- Recommendations for the Legislature; and
- A table of outdoor and experiential education providers throughout the state.

The outcomes from this study will contribute to Washington State's ongoing efforts to strengthen its educational programs and ensure that environmental education is incorporated into those efforts in the most effective way possible. Other initiatives, such as the E3 statewide comprehensive environmental education plan, led by the Environmental Education Association of Washington, are also under way to ensure that environmental education in Washington State continues both to set and raise the standards for excellence in education.



## B. Project Background

---

This report contains an analysis of research conducted from 1990 to 2007 on the impacts and effectiveness of environmental education. However, to most effectively interpret the results, it is first necessary to understand the history of both environmental education and of environmental education research that occurred prior to this study.

### A Brief History of Environmental Education in North America<sup>2</sup>

The present-day field of environmental education has been compared to an arbor, having been formed by the intertwining of many different fields of education, each remaining somewhat distinct and having its roots in a different historical moment, but all coming together to form the larger field of environmental education. The four primary roots of the current field are:



- **Nature Study:** Nature study took root in the rapid industrialization of the late 19th century as a movement to rekindle an interest in and connection to the natural world. It emphasized direct observation of the natural world. In addition to its content, it differed greatly from standard forms of education of the day in that it encouraged direct, first-hand observation and active, inquiry-based learning.
- **Conservation Education:** At the turn of the 20th century, extensive over-harvesting of the nation's natural resources led some to believe that these resources needed to be managed and protected by the government in order to ensure their continued presence for future generations. Conservation education grew out of this movement, and as a result was driven largely by government resource managers educating the public about the conservation of natural resources.
- **Outdoor Education:** While outdoor education also traces its roots to the early 20th century, it differed from both conservation education and nature study in that it was distinguished primarily by its teaching method, rather than by its content. The goal was to better educate children by more explicitly connecting education to the real world outside the school. Since the 1920s, this category has generally evolved along two separate but similar lines: 1) centering the curriculum in the student's home community and environment outside of the classroom, and 2) the school camping movement, where students live together away from home and learn new outdoor-oriented skills as a way to build self-esteem and socialize the group.

---

<sup>2</sup> Material for this section was adapted from work by Jean MacGregor, Evergreen State College

- **Experiential Education:** Experiential education is a branch of education that developed as a result of lessons learned from soldiers' behaviors in WWII and the perceived benefit of training children through activities that would both require teamwork and induce stress. The original prototype for this model is Outward Bound, the success of which has spawned a legion of similar programs over the years.

Within this greater national context, Washington State has a rich history of environmental education that encompasses all of these threads. For more information on this history, see Appendix C.

## Environmental Education Today

### Definition of Key Terms

**Formal Education:** the curriculum, instruction, and assessment that occur within the K-12 school setting.

**Non-formal Education:** the community-based instruction that occurs outside the school setting, such as at outdoor learning centers, museums, zoos, forests, gardens, and parks.

For more definitions, see Appendix B.

In 1977, the United Nations defined environmental education as a learning process that increases knowledge and awareness about the environment and associated challenges; develops the necessary skills and expertise to address these challenges; and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.<sup>3</sup> Environmental education serves to prepare students to tackle the broad range of environmental concerns that face our planet in the 21<sup>st</sup> century, both in their backyards and around the world.

On the ground, environmental education encompasses a broad range of educational programs at a variety of institutions, a diversity that reflects the field's historical development. These programs can be **formal** or **non-formal**, and vary tremendously in their duration, educational content, and teaching methods. The following

categories all fall under the umbrella of environmental education:

### School-Based Programs

A substantial amount of environmental education takes place in the state's K-12 schools. These programs take numerous forms as schools meet the requirements set out in RCW 28A.230.020 and WAC 180-50-115. They range from single-day programs taught by members of an outside institution to multiple-year programs integrated into the basic curriculum and featuring both classroom and outdoor components. These integrated programs can even extend across school years. For instance, the Tahoma School District implements a program wherein 5<sup>th</sup> grade students construct boats, release them into Puget Sound with email addresses on them, track where the boats returned to shore based on the incoming emails, and begin to ask questions about how weather and tidal patterns affected the movement of the boats. This dovetails nicely with a component of the 6<sup>th</sup> grade curriculum where students study the tides, currents, and weather of Puget Sound.

### Education Materials and Curriculum

Effective environmental education, especially in formal programs, requires the development of curriculum standards and guidelines for teachers and administrators. This work covers

<sup>3</sup> UNESCO, 1977

development of classroom texts and other materials and the design of lesson plans for teachers, all the way up to identifying educational goals for students and developing curricula to help them achieve these goals and evaluation tools to measure their progress along the way.

Institutions such as the Pacific Education Institute (PEI) provide curriculum integration models, measurement tools and benchmarks to assist schools in integrating environmental education subjects and methods across a wide range of classes. Other programs, such as Project WET and Project WILD, focus on developing curriculum in specific subject areas, such as ecology and wildlife conservation.

## Professional Development

Effective environmental education first and foremost requires a highly trained and competent instructor. These educators work in a variety of settings, at a variety of jobs. They teach in public and private classrooms, and lead activities for children and adults at non-formal educational institutions such as nature centers, zoos, museums, outdoor learning centers, and parks. They develop curriculum materials, put on public awareness events, and administer national, state, and local programs. Their training involves both initial educator training, as well as ongoing professional development.

Professional development itself takes a number of different forms. Programs such as the Seattle Woodland Park Zoo's teacher training program offer training workshops to area teachers that help them develop knowledge, skills, and resources to effectively incorporate environmental education in their classrooms. At the state level, OSPI has worked with EEAW to develop a set of draft guidelines for formal and non-formal environmental and sustainability instructors in Washington that integrate the NAAEE's *Guidelines for Professional Development of Environmental Educators* with OSPI's *Washington State Professional Development IN ACTION Guidelines*. Released in 2007, this synthesis ensures that the guidelines for environmental education in Washington meet both state and federal professional development standards.

## Outdoor Education

Outdoor education providers are a vital component of environmental education. At their heart, all of these programs aim to get students into nature and actively engage them in their lesson material. In practice, however, outdoor education programs can vary greatly in content and duration, ranging from taking a group of students out for a short hike in an urban park and learning to identify native plants, to several-week camping trips during which students learn survival skills and tackle such activities as ropes courses and rock climbing. In addition to differences in content, these programs take place in many different educational settings, from summer camps to research facilities and Outward Bound-style courses. One common form of outdoor program is the outdoor learning center, which provides many of these outdoor environmental education programs at one facility.

A catalogue of these providers and their programs offered throughout Washington State has been included in this report, as directed by the Legislature. The catalogue of providers can be found in Appendix D and includes the following information, organized by region:

- Name of the provider/organization;
- Short description of the program offerings;

- Age group of the students;
- Number of participants per year (if available);
- Presence of a program evaluation; and
- Special notes about the program.

As with any printed directory or catalogue, the information provided may have changed by the time of printing. A web-based database housed through an environmental education organization may provide a solution to this problem by allowing providers the opportunity to keep their information current.

## Museums, Aquariums, and Zoos

Museums and other similar institutions such as aquariums and zoos offer a wealth of environmental education opportunities for K-12 students. Again, these vary greatly in content, size, and duration, and often include educational tours of exhibits and field days in which students go outside the institution to conduct experiments assisted by local scientists. These institutions also often offer a wide range of educational summer camps in a variety of program lengths and for many different age groups. One such program is the Seattle Aquarium's Citizen Science Program, which trains students to go into the field and collect data that can be used to gauge the health of Puget Sound.

## The Evolution of Research in Environmental Education

While this report focuses on research conducted on the five outcome areas since 1990, ample research on the effectiveness of environmental education predates this timeframe or lies outside the scope of this study. Literature reviews conducted on this research allow us to draw the following conclusions:

- In general, studies prior to 1990 focused on measuring students' environmental knowledge, behaviors, and attitudes, rather than on evaluating the educational methods and how they produced results.
- Most of these studies report a relatively poor understanding of environmental issues by students.<sup>4</sup>
- Environmental education programs (both formal and non-formal) were able to affect how students related to the environment, what they thought about environmental issues, and what actions they were willing to take to solve growing environmental problems.
- There is evidence that environmental education leads not only to increased awareness of environmental issues, but also to improved environmental behavior.<sup>5</sup> However there is disagreement as to whether formal or non-formal programs are more effective at achieving these improvements, and over the effects of program length on student outcomes.

In recent years several new focal points have emerged in the field of environmental education research. These studies explore how environmental education affects more general outcomes such as academic achievement, motivation and engagement, career development, self-esteem and civic responsibility of students. In this report, we set out to review the research studies

---

<sup>4</sup> Gigliotti, 1990; Hausbeck *et al.*, 1992; Kuhlemeier *et al.*, 1999; Wright and Floyd, 1992

<sup>5</sup> Disinger, 1982; Marcinkowski, 1987; Sia, 1984; Zelezny, 1999

conducted and reported between 1990 and 2007 in order to explore what specific outcomes of environmental learning have been identified and studied, assess the quality of studies and research evidence obtained, and identify those areas for which additional research is needed.

For a summary table of the five literature reviews<sup>6</sup> that analyzed studies which predated or fell outside the scope of this report, see Appendix E.

## OSPI's Role in Environmental Education in Washington

OSPI's role in developing and supporting effective environmental education in Washington make it well suited to analyze this research. Its environmental education programs have played an important role in elevating public understanding of and responsibility for the quality of our Northwest environment and the stewardship of our important natural resources. OSPI's work has shown that using the environment as a curriculum integrator can be a successful strategy to improve both teaching and learning. Washington State has been praised nationally for its excellent environmental education programs and the leadership shown by the Superintendent of Public Instruction and statewide partners.

In 2006, OPSI redefined environmental education as education for environment and sustainability. This reflects a more comprehensive view of the world that includes the natural, physical environment as well as the social constructs of culture, society, governance, and economics. Sustainability education requires that students consider the interdependency of environmental, economic, and social systems, and of how individuals understand their role in an interdependent world. The goal of sustainability education is to develop the capacity for society to meet the needs of today while instilling a sense of intergenerational responsibility.

See Appendix C for more information on OSPI's role in the history of Washington environmental education.

---

<sup>6</sup> Carson and Gillis, 1994; Hattie, March, Neil, and Richards, 1997; Volk and McBeth, 1998; Rickinson, 2001; Bartosh, 2003

## C. Approach and Methodology

---



EHB 2910 requires OSPI to provide “empirical evidence, exemplary models, and recommendations” on the efficacy of environmental education.

In order to determine the extent and findings of research devoted to the relationship between environmental education and student development, we conducted a comprehensive search of published and unpublished studies of environmental education

programs.

First, a systematic methodology was developed to gather information for this report. Meetings were held with OSPI and the educational partners to gather information about the assortment of reports and programs that were readily available. From there, we conducted extensive literature reviews using the Internet and academic libraries to identify published and unpublished information. A complete list of the sources used is included in Appendix F.

In addition to catalogue and database research, we contacted environmental, science, and education departments within colleges and universities throughout Washington State to find out if students’ theses or dissertations addressed the impact of environmental and sustainability education on learning.

A variety of filters were applied during the research process to assess the following aspects of environmental education per the intent of HB 2910:

- Academic achievement – how environmental education impacts and affects student learning and academic performance;
- Career development – how students incorporate environmental education into their careers;
- Good citizenship – how this is manifested through service-learning;
- Graduation requirements – how students incorporate environmental education in culminating projects during their senior year of high school; and
- Demographics – how environmental education serves underserved youth and other demographic groups

Finally, the selected studies were evaluated based on the quality of their methodology. Using a pre-determined list of criteria, gold and supporting studies were selected for further evaluation.

### Criteria for Initial Selection of Studies

The following criteria were used for selecting the studies for review.

#### Program Type

This review focused on studies that evaluated formal K-12 classroom learning. Studies of outdoor and experiential education programs were also analyzed, including non-traditional

programs such as hunting and fishing. Studies of programs in life-long learning, home schooling, and pre-K were not included.

### Geographic Area of Study/Research

Special attention was paid to those studies and evaluations that looked at programs located in Washington State. National and international studies, as well as those from other states were also included if they met particular criteria, including importance in the field and quality of the study design and methodology.

### Demographic and Geographic Reach

As mentioned above, the review focused on formal K-12 classroom learning audiences. Studies of underserved populations were sought out as well as those that took place within various regions of the state.

### Criteria for Evaluation of Studies

A set of criteria (see Table 2) was developed in order to narrow the total pool of studies down to a smaller list of gold standard studies. All studies with a quantitative component to their methodology were evaluated in each of the following categories:<sup>7</sup>

- Type of study;
- Level of statistical analysis;
- Use of valid outcome measures;
- Use of techniques to avoid group bias;
- Description of the program characteristics and participants; and
- Sample size

---

<sup>7</sup> The literature review only located one study that had no quantitative component to its methodology.



**Table 2.** Evaluation Criteria for Identifying Gold and Supporting Studies

<b>Evaluation Category</b>	<b>Gold Study Criteria</b>	<b>Supportive Study Criteria</b>
Type of study	<ul style="list-style-type: none"> <li>▪ Experimental study</li> <li>▪ Quasi experimental design with a control group, or results are compared to state level or district level data</li> </ul>	<ul style="list-style-type: none"> <li>▪ Non-experimental study (no control group/ no pre-post tests, etc)</li> </ul>
Statistical analysis	<ul style="list-style-type: none"> <li>▪ Uses inferential statistics</li> <li>▪ Controls for pre-existing differences</li> <li>▪ Uses a combination of descriptive statistics for a large sample and control and treatment groups</li> </ul>	<ul style="list-style-type: none"> <li>▪ Uses basic descriptive statistics only</li> </ul>
Valid outcome measures	<ul style="list-style-type: none"> <li>▪ Uses state tests, or other instruments that have been published and piloted</li> <li>▪ Provides information on the reliability of the instrument, especially if the test has been developed by the author</li> <li>▪ The measures used and the correlation between different measures are examined</li> <li>▪ If tests or student works are scored by several people, there is information on the level of rater agreement</li> </ul>	<ul style="list-style-type: none"> <li>▪ Uses questionable instruments. For instance, the instrument was developed by the researcher(s) and has not been piloted yet, or was piloted using a small number of participants</li> <li>▪ No reliability or internal consistency information is provided</li> </ul>
Randomization/matching or other technique to avoid group bias	<ul style="list-style-type: none"> <li>▪ Uses a technique such as random selection or matched pairs to ensure the comparability of the groups (pairs)</li> </ul>	<ul style="list-style-type: none"> <li>▪ No methods were used to ensure the comparability of the groups</li> </ul>
Description of intervention and participants	<ul style="list-style-type: none"> <li>▪ Description is provided and thorough</li> </ul>	<ul style="list-style-type: none"> <li>▪ Description is absent or insufficient</li> </ul>
Sample size	<ul style="list-style-type: none"> <li>▪ ~200-300 students or multiple groups/classrooms</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fewer than 200 students</li> </ul>



A quantitative study had to meet the gold criteria in each of these six categories to be considered a gold study. However, the evaluation also applied what Rickinson (2001) called “sensitivity to the context”, which involves accounting for the situation in which the research took place while evaluating it. As a result, small studies with few researchers are granted more leeway for having small sample sizes than are studies by large research organizations or government agencies. For example, in this study a sample size of 150-180 participants was “gold” for a master’s or PhD study but not sufficient for a national or international study by a large research agency. Characteristics that affected the gold evaluation criteria were:

Characteristic	Criteria to measure the study by more lenient criteria	Criteria to measure the study by the gold criteria
Who conducted the study?	One person	An organization, agency or institution
How well funded was the study?	PhD research	Well funded research (i.e. through a grant)
What audience was the study for? Where was it published?	Published in a report for a school district, government agency, or the general public	Published in a peer-reviewed journal

While not factored into the gold or supporting criteria, the following characteristics were also taken into account when evaluating the studies:

- **Length of studies:** Most of the studies located for this report analyzed data collected over a period of one year or less. While these studies were not penalized, longer term projects were rewarded.
- **Variety in data collection methods:** Studies that use several different methods of data collection that produce the same result were rewarded. For example, if a study has a smaller sample size, but uses several different methods of data collection, strong analysis methods and valid instruments, it can still be considered gold.

## Database for Collecting Research

In order to assist with the collection and analysis of the studies, an Access database was developed. Information was recorded for all studies in the following areas:

- Name of reviewer
- Date of review
- Description of program
  - State or country of origin for the program
  - Education type: formal or non-formal
    - Formal type descriptions: one unit, year-long, ongoing
    - Non-formal type descriptions: camp, after school, hunting, fishing, agriculture
  - Age group of students in the study

- Grade level of students in the study
- Rank of the study's treatment of each outcome area
  - 5 = Study is primarily focused on this central outcome
  - 4 = Study focuses closely on this outcome, but it is not the primary focus
  - 3 = Study examines this outcome to a small extent
  - 2 = Study mentions this outcome briefly
  - 1 = Study does not mention this outcome at all
- Analysis of research study
  - Study sample size and characteristics, any demographic information provided for the population, and sample selection procedures and rationale
  - Methods for data collection and analysis
- Findings
  - Main findings: summary of the research as reported by the authors
  - Key conclusions: summary of the author's main conclusions
- Characteristics or program elements that made it successful: How well did the study address or describe the successful characteristics?

Additional information was also recorded for the gold standard studies. For screen shots of the final database, which include these additional fields, see Appendix G.

## D. Research Findings for Outcome Areas

---

This chapter presents the results from the research on environmental education programs and their impact on the targeted outcomes. In total, the research team collected and reviewed 76 articles that examined the impacts of environmental education programs on the five outcome areas:

- 1) Academic Achievement
- 2) Career Development
- 3) Graduation Requirements – Culminating Projects
- 4) Self-Esteem, Engagement and Motivation
- 5) Civic Responsibility and Service-Learning

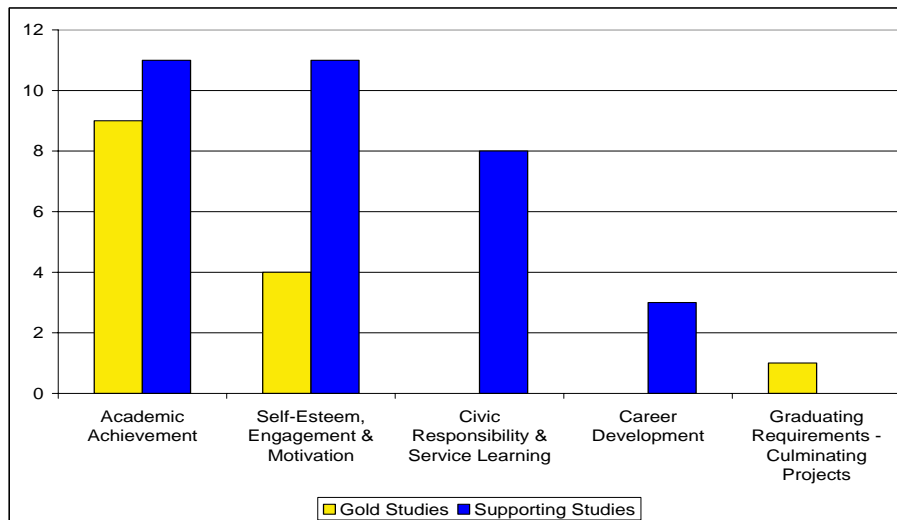
The questions of how and to what extent environmental programs affect students have been discussed for several decades, but only recently have researchers started to go beyond investigations of environmental education-specific outcomes such as environmental knowledge, attitudes, and skills to look at more general educational outcomes. Since 2000 several reports have been published by the North American Association for Environmental Education (NAAEE) and the National Environmental Education and Training Foundation (NEETF) which suggest that environmental education programs benefit students. This study builds on this suggestion by providing additional in depth analysis of the research so that teachers, administrators, and policy makers can make decisions based on empirical data regarding the role environmental education plays in the lives of our children.

However, when making these decisions it is important to remember that environmental education programs vary greatly in such characteristics as length, subject, and rigor. Administrators and policymakers should take great care to keep these findings in context, and to avoid expecting one program's benefits to be achieved by another whose characteristics differ significantly, even if both programs fall under the umbrella of environmental education.

This study identifies those specific outcomes of environmental learning that have been studied by researchers and examines the quality of the evidence obtained. Areas where more research is needed were identified. The following sections of this report present the analysis and research evidence for each of the five outcome areas. For a summary of each study used for this report, please see Appendix H.



**Figure 1.** Number of Gold and Supporting Studies by Outcome Area<sup>8</sup>



<sup>8</sup> Many of the studies address more than one outcome area.

# 1. Academic Achievement

## Summary of Key Findings

A total of 20 studies, nine gold and eleven supporting, analyze the effects of environmental education on academic achievement, making it by far the most studied outcome area. Academic achievement is defined as a student's demonstration of high levels of achievement in the four Washington State Learning Goals (see sidebar at right) and graduation from high school ready to implement a positive plan for his or her future. The analysis of these studies produced the following findings:

### Positive Findings

- 18 out of 20 studies indicate a positive correlation between participation in certain environmental education programs and improved academic achievement.
- Some evidence suggests that environmental education may increase achievement for both high-ranking and low-ranking students.
- There is strong evidence that environmental education increases math and science achievement, limited evidence that it increases social studies achievement; and mixed evidence that it increases language arts achievement.
- There has been a proportionally large amount of research in this outcome area, as opposed to the other four analyzed by this report.

### Limitations

- Many studies did not test for statistical significance or had small sample sizes.
- Only two studies controlled for other factors such as gender, socioeconomic status, age, and level of achievement prior to participation in environmental education.

## In-depth Review of Findings

Twenty achievement studies were selected for review. Nine of these studies were rated as gold studies because of the quality of the research and evidence. Eleven studies were included in the "supporting" list – these are the studies that did not meet the quality criteria in full, either because of the small sample size or limited data analysis.

### Academic Achievement – Statewide Goals

1. Read with comprehension, write effectively, and communicate successfully in a variety of ways and settings and with a variety of audiences;
2. Know and apply the core concepts and principles of mathematics; social, physical, and life sciences; civics and history, including different cultures and participation in representative government; geography; arts; and health and fitness;
3. Think analytically, logically, and creatively, and integrate different experiences and knowledge to form reasoned judgments and solve problems; and
4. Understand the importance of work and finance and how performance, effort, and decisions directly affect future career and educational opportunities.

**Table 3.** Number of references to academic achievement in specific subject areas in gold and supportive studies.

	<b>Gold studies</b> (# of references)	<b>Supportive</b> studies (# of references)
Math	8	5
Reading	6	7
Writing	6	6
Listening	2	1
Science	3	5
Social Studies	1	3
Other	5	1
<b>Total<sup>9</sup></b>	<b>9</b>	<b>11</b>

Most of the studies selected for this review indicate that there is a link between participation in environmental education and improved academic achievement and suggest that environmental programs might be one of the factors that improves student performance in mathematics, reading, writing, science, and social studies and help develop better critical thinking skills.

### Changes in Math Achievement

#### **Positive Findings**

- All 13 studies that analyzed students' math achievement found that certain environmental education programs increase math achievement.
- Three of the thirteen studies found that students exposed to environmental education perform significantly better on state math achievement tests, including in Washington State.

#### **Limitations**

- Only four of the thirteen studies used tests of significance.

Thirteen studies, eight gold and five supporting, examined the relationship between participation in environmental education programs and achievement in math measured through changes in scores on state, district, and school tests. All 13 studies varied in their sample sizes, research design, and instruments used for assessing student achievement. Four of the studies used a mixed method research method of data collection and analysis; one was primarily qualitative, and the remaining eight employed quantitative methods.

Four of the thirteen studies gathered enough data to examine statistical significance, and three of the four examine math performance in schools within Washington State. These studies indicate the following:

---

<sup>9</sup> Studies often addressed more than one subject area, thus the columns in this table do not add up to the total number of gold and supporting studies analyzed.

- 1) Bartosh (2003) compared state standardized scores from 77 pairs of schools (with and without environmental programs) that had been matched using US census and other economic, demographic, and geographic criteria. Bartosh found that schools with environmental education programs consistently outperformed “traditional” schools on state standardized tests in math, reading, writing, and listening. Specifically, 65 percent of the schools with environmental education programs performed significantly better in math on the Washington Assessment of Student Learning (WASL) and 58 percent of the schools with environmental education programs did better in math on the Iowa Test of Basic skills.
- 2) Similarly, a study of 400 Washington middle school students, half of whom were participating in environmental education programs, found that these students consistently and significantly outperformed students not involved in an environmental education program in the math WASL.<sup>10</sup>
- 3) A smaller study of 181 Grade 10 students in Washington State found that students in an environmental education program were significantly more likely to meet or exceed the state and school district average score on the math WASL.<sup>11</sup> Because this study controlled for differences in pre-program achievement level, gender and education goals, the findings can be considered strong evidence of the positive influence of environmental education on academic achievement.
- 4) Two studies in California found that students involved in environmental education programs and programs that use the Environment as the Integrating Context (EIC) significantly outperformed students in traditional math programs on assessments. These studies compared twelve pairs of schools that had been matched using demographic and socioeconomic criteria and information about their environmental programs.<sup>12</sup>

The remaining four of the eight gold studies provide strong evidence that environmental education has a positive impact on student math achievement. Although these studies did not use extensive statistical analysis and mostly compared changes in the percentages of students who performed at satisfactory/unsatisfactory levels on the state tests and/or changes in the test scores, the fact that all of these studies undertook a longitudinal analysis and had large sample sizes suggests that these findings are significant. Three of these studies found the following:

- 1) Duffin, Phillips, and Tremblay and PEER Associates (2006a, b) explored the impact of Antioch New England Institute’s Community-based School Environmental Education (CO-SEED) on 3,395 students in New Hampshire and Massachusetts from 1993 to 2005. In New Hampshire scaled math scores for environmental education students increased by an average of twelve points from Grade 3 to Grade 6, while state scores decreased by four points. Similarly in Massachusetts, the study showed increased student achievement in math, mostly for upper-level grades but also for Grade 4, which outperformed both the district and the state in 2004.

---

<sup>10</sup> Bartosh, Tudor and Ferguson, 2005

<sup>11</sup> Bartosh, 2006

<sup>12</sup> Lieberman, Hoody and Lieberman, 2000 and Lieberman, Hoody and Lieberman, 2005

- 2) In a study of 18,982 students in 176 schools from Alaskan school districts that used the Alaska Rural Systemic Initiative (AKRSI), a place-based, systemic approach, Emekauwa (2004a) compared performance on the state math tests to results from 28 non-AKRSI schools and data for the Native Alaskan student population as a whole. Grade 8, 10, and 11 students performed better on the state math tests compared to students from traditional programs. AKRSI students in 2001 also showed improvement over Alaskan Native students as a whole. Improvements were seen in the percentages of AKRSI students moving into the highest quartile and out of the lowest quartile.
- 3) A study of over 2,000 middle- and elementary-school students conducted in a Louisiana school district investigated the district's place-based program.<sup>13</sup> The study found that the percentage of students performing at unsatisfactory levels on the Louisiana Educational Assessment Program for the 21st Century (LEAP 21) decreased more in participating schools than in the state as a whole in four areas. In particular, the percentage of students receiving a score of unsatisfactory in math declined by 14.1 percentage points among participating students, compared to a 3.6-point decline in the state as a whole.

Of the five supporting studies that relate to math achievement, three provide additional evidence of the positive impact of environmental education on student math achievement.

- 1) Danforth (2005) compared students' achievement in math and reading in three pairs of schools (306 students in the Schoolyard Habitat Program group and 186 students in traditional classes). The study found that the math scores on the Texas Assessment of Knowledge and Skills (TAKS) tests increased more on average for participating students than for students in traditional classes.
- 2) Lieberman and Hoody (1998) conducted four surveys and 665 interviews regarding student achievement at 40 elementary, middle, and high schools with environment-based programs across the United States. They suggest that students involved in an EIC program tend to have higher scores on standardized tests in math, among other subjects. However, this study was primarily qualitative, and no control group of schools or students were used. While the study indicates that 14 schools undertook comparative studies of their students, analyzing the differences in grade point averages, standardized test scores, attendance rates, and attitude to school measures, there is no clear description of these studies in the report.
- 3) Workman (2005) analyzed the performance of 941 students, including some students who attended environmental education classes and others who did not, on the Minnesota Comprehensive Assessment. The study found that the students involved in environmental education classes significantly outperformed the other students in math 33 percent to 66 percent of the time.

---

<sup>13</sup> Emekauwa, 2004b



## Changes in Science Achievement

Seven studies, three gold and four supporting, examined the effects of environmental education on students' science achievement. These studies conclude the following:

### Positive Findings

- There is strong evidence that certain environmental education programs increase science achievement.
- All seven studies reviewed found that environmental education increases student performance in science.
- One study, located in Washington, found that students exposed to environmental education had higher WASL science scores and that the difference was statistically significant.

The seven studies looked specifically at student achievement in science as measured by student performance on state, district, and school tests and assessments. The results indicate that participation in environmental education and/outdoor programs may improve student achievement in science.

The three gold studies provide strong supporting evidence of the impact of environmental education on student science performance:

- 1) Bartosh (2006) analyzed the experiences of 181 students in one Washington State public high school and found statistically significant differences in the WASL science scores of students in environmental education classes compared to those in non-environmental education classes.
- 2) Duffin, Phillips, Tremblay, and PEER Associates (2006a, b) also report increased student achievement, mostly for upper-level grades in two New Hampshire and Massachusetts school districts that participated in Antioch New England Institute's CO-SEED place-based education program.
- 3) In one Louisiana school district with a place-based program, the number of Grade 4 students from environmental education programs scoring unsatisfactory decreased by 8.1 points between 1999-2000 and 2001-2002, while in the state overall, there was a 3.7-point decrease.<sup>14</sup>

The remaining four studies provided supporting evidence of a *possible* connection between participation in environmental education and better grades and scores in science.

- 1) A study of four outdoor schools in California (often referred to as outdoor science schools) conducted by the American Institutes for Research (2005) found that students who attended outdoor programs improved their science scores significantly between the beginning and end of the program.

---

<sup>14</sup> Emekauwa, 2004b

- 2) Lewicki (2000) examined experiences of 14 high school students who participated in a long-term place-based program in Wisconsin, and found that science scores on the Iowa Test of Basics Skills increased by three grade points between the beginning and the end of the program. However, the small sample size of this study as well as limited statistical analysis do not allow for conclusions regarding the significance of these findings.
- 3) Lieberman and Hoody (1998) conducted four surveys and 665 interviews regarding student achievement at 40 elementary, middle, and high schools with environment-based programs across the United States. They found that EIC students performed better in three out of four science assessments. Anecdotally, 99 percent of teachers who completed the survey instrument reported increased knowledge and understanding of science content, concepts, processes, and principles of their students as well as better ability of their students to apply science to real-world situations.
- 4) Results of the California Student Assessment project that compared results for eight pairs of schools (matched using demographic and socioeconomic criteria, and information about their environmental programs) suggest that EIC students performed better than non-EIC students in science assessments; however, it was not clear that this difference was statistically significant.<sup>15</sup>

## Changes in Language Arts Achievement

Fourteen studies analyzed the effects of environmental education on language arts achievement.

### **Positive Findings**

- There is some evidence that certain environmental education programs improve language arts achievement.
- Of the 14 studies reviewed, seven studies found a strong positive impact and four studies found some positive impact.
- Two studies conducted in Washington State found that students in environmental education programs performed significantly better on the language arts and writing section of the WASL.

### **Negative Findings**

- One study found that language arts achievement declined for students who participated in an environment education program, relative to students at the same school who did not. However, these results are not statistically significant.

### **Limitations**

- Results indicate the need for additional research in this area. Very few of the 14 studies applied a comprehensive statistical analysis and only one study controlled for pre-existing differences in the student population.

---

<sup>15</sup> Lieberman, Hoody, and Lieberman, 2000

Although some of the reports claim that there is a correlation between participation in environmental education programs and improved achievement in language arts<sup>16</sup>, the evidence collected is somewhat contradictory. While some studies report significant improvement of student performance in reading and writing, others show no or negative change.

Seven studies were located that present strong evidence on the positive impact of environmental education on language arts (reading, writing, and spelling) performance.

- 1) Bartosh's (2005) study of 77 pairs of schools in Washington State found a significant difference between schools with environmental education programs and schools without environmental education on language arts performance on the Washington Assessment of Student Learning (WASL) and the Iowa Test of Basic Skills (ITBS). On the WASL test, 56 schools with environmental education did better in writing, and 51 schools with environmental education outperformed their counterparts in reading. On the ITBS test, 45 schools with environmental education performed better in reading.
- 2) A study conducted in Washington State by the Pacific Education Institute found that middle school students from five schools with environmental education significantly outperformed "non-environmental education program" schools on the writing WASL.<sup>17</sup> Students from environmental education schools also tended to outperform students from non-environmental education schools on the WASL reading tests. However, the difference on the reading tests was not significant.
- 3) Lieberman, Hoody, and Lieberman (2005) compared four pairs of schools in California that had been matched using demographic, socioeconomic criteria and information about their environmental programs, finding that EIC students scored as well or significantly higher than non-EIC students in language, spelling, and reading assessments.
- 4) Gorham elementary students in New Hampshire who participate in CO-SEED demonstrated improved scaled language arts scores by an average of 16 percentage points from Grade 3 to Grade 6, compared to a 2-point decrease in state scores during the same time period for students who did not participate in CO-SEED. However, the study does not indicate if the increase was statistically significant.<sup>18</sup>
- 5) In one Louisiana school district, the percentage of Grade 4 students who performed at the unsatisfactory level in English Language Arts decreased 13.2 percentage points (from 32.6 percent in 1999 to 18.4 percent in 2002) for students participating in an environmental education program, compared to only a 6.5-point decrease for the state as a whole. While the testing of the significance of the increase was not conducted (or at least not presented), the large sample size of the study allows us to suggest that this finding is important.<sup>19</sup>

---

<sup>16</sup> Lieberman and Hoody, 1998; NEETF and NAAEE, 2001

<sup>17</sup> Bartosh, Tudor, and Ferguson, 2005

<sup>18</sup> Duffin, Phillips, Tremblay, and PEER Associates, 2006

<sup>19</sup> Emekauwa, 2004b

- 6) Bartosh *et al*'s (2005) study of 181 students in Washington State found that students from schools with environmental education programs performed better on the reading and writing WASL.
- 7) Workman's (2005) study of elementary schools in Minnesota found a significant difference in reading scores on the MCA test between students who participated in an integrated environmental education program and students from traditional classrooms, with "environmental education" students outperforming "non-environmental education" students 33 percent of the time.

Four other studies also provide some supportive evidence on improved reading and writing achievements.<sup>20</sup> More information on these studies and their findings can be found in Tables 12 and 14 in Appendix H. All of these studies used small sample sizes and basic descriptive statistical analysis, and thus have produced slightly less reliable results.

Three studies in the sample do not find any significant difference in language arts test scores between students at schools with environmental education programs and those enrolled in more traditional programs.

- 1) When Bartosh (2006) controlled for pre-program differences in academic achievement, gender, and educational goals, the average scores on the WASL reading and writing tests were higher for the students from schools with environmental education programs. However, these differences were not large enough to be considered statistically significant.
- 2) A summary evaluation of Middle Links schools conducted by Yap (1998), who compared scores on Comprehensive Tests of Basic Skills for seven pairs of environmental education and traditional schools, found no consistent difference in student achievement between the two groups of schools.
- 3) Danforth's (2005) examination of student performances on the TAKS test for students in three schools attending Schoolyard Habitat Program and students from three schools without environmental education classes found that reading scores decreased for both groups over the study period, and that the environmental education group's scores decreased slightly more. However, the change was not statistically significant.

Thus, the research evidence on the possible impact of environmental education on student performance in language arts is not conclusive. Few researchers undertook comprehensive statistical analysis. Only one study attempted to control the results for pre-existing differences between the treatment and control groups. To fully understand how and to what extent environmental education affects student performance in language arts, more controlled and evaluative studies are needed.

---

<sup>20</sup> Leweck, 2000; Lieberman and Hoody, 1998; and Lieberman and Hoody, 2000; Randall, 2001

## Changes in Social Studies Achievement

Four of the 20 studies examined the effects of environmental education programs on social studies achievement. The findings from these studies were:

### **Positive Findings**

- All four studies suggested that some environmental education programs may have a positive impact on student achievement in social studies.

### **Limitations**

- Very little research has examined the effect of environmental education on social studies achievement, with only one of the four studies qualifying as a gold study.

Analysis of the research indicates that very little has been done to examine the impact of environmental education on student achievement in social studies. This may be partially explained by the fact that some states, including Washington State (where several gold studies included in this review were conducted), do not have a standardized test in this area.

The four studies that addressed this area (one gold and three supportive) all report a positive increase in students' performance in social studies after participating in environmental programs. This is not surprising as social studies is one of the areas where environmental education is officially placed by administrators and curriculum developers and more readily taught by teachers. Because many environmental problems have social and historical dimensions, programs often find it relatively easy to link environmental education programs to social studies, in addition to science.

The one gold study identified in the research concluded the following:

- In one Louisiana school district, analysis of student achievement on the LEAP 21 assessments indicates that between 1998 and 2000 there was an 11.3-point decrease in the number of students scoring unsatisfactory in social studies among students participating in a place-based program compared to 3.2-point decrease at the state level.<sup>21</sup>

The other three studies corroborate Emekauwa's findings:

- 1) After participation in a long-term place-based program, fourteen freshman students in Wisconsin demonstrated improved scores on ITBS test. However, a small sample size and limited statistical analysis lessen the reliability of this evidence.<sup>22</sup>
- 2) Lieberman and Hoody's (1998) study of 40 schools across the United States found that in the two schools compared using social studies assessments EIC students performed better than traditional students. Also, teachers reported greater comprehension of social studies content by their students.

---

<sup>21</sup> Emekauwa, 2004b

<sup>22</sup> Lewicki, 2000

- 3) A study of eight pairs of schools in California reports that EIC students performed better than traditional students in eight out of eleven social science assessments.<sup>23</sup>

While these results indicate that environmental education may have a positive effect on student performance in Social Studies, they also indicate a need for more studies with in-depth qualitative and quantitative descriptions and analysis in order to reach more conclusive and applicable results.

### Improvements in Other Academic Areas

While the majority of the studies selected for this review in the area of achievement focused on achievement in math, science, and language arts, three studies addressed other more general outcome areas. Findings from these studies indicate:

#### **Positive Findings**

- Two studies suggest that certain environmental education programs positively impact students' critical thinking.
- One study found that environmental education may have a positive impact on grade point averages.

#### **Limitations**

- A limited number of studies addressed this area, making it difficult to draw firm conclusions from them.

Out of 20 research studies that address academic achievement, two looked directly at the impact of environmental education on *critical thinking*. Both found that environmental education students scored higher on tests of critical thinking.

- 1) In their study of the impact of environmental education on students' critical thinking, Athman and Monroe (2004a, 2004b) found a strong positive correlation between participation in environmental education program and improved thinking skills. The researchers compared students who participated in environment-based programs with students who attended traditional programs in the same school (404 students from eleven Florida high schools). The study found that students in programs designed around an environmental context tended to score higher on the Cornell Critical Thinking Test than students in the traditional classes. The results of this study are also controlled for pre-existing differences in academic achievement at the start of the program and for gender which distinguishes this work from most other studies in this area. While these results are not completely conclusive, they support previous qualitative and anecdotal reports about the development of critical thinking skills.
- 2) Cheak, Hungerford, and Volk (2002) investigated an inquiry-based environmental education program, called Investigating and Evaluating Environmental Issues and Actions (IEEIA), in a public elementary school in Hawaii using qualitative and

---

<sup>23</sup> Lieberman, Hoody and Lieberman, 2000

quantitative methods. Thirty-eight IEEIA students and 28 non-IEEIA students completed two assessments: the critical thinking test in environmental education and the middle school environmental literacy instrument. Students in the IEEIA program scored higher both on the critical thinking test and five out of eight components of environmental literacy instrument; however, the study size was small and the statistical analysis was limited.

### Grade Point Average

Environmental education may also affect students' Grade Point Averages as found by Bartosh (2006).

- The GPAs of 79 Grade 10 students in Washington State who participated in a yearlong outdoor environment program became significantly higher by the end of the year compared to GPAs of 102 students from traditional classes.

### Conclusions for Academic Achievement

When it comes to research on the impact of environmental education on academic achievement, most of the studies focus on student performance in math, science, and language arts; likely because these are the most “tested” areas in the curriculum across the country. Social studies and development of other skills such as critical thinking are traditionally given less attention. Also, a majority of the studies employ basic statistical analysis and do not go beyond testing of statistical significance. Only two studies attempted to control the results for pre-existing differences, although such factors as gender, socioeconomic status, age, and level of achievement at the beginning of the program may affect how students would perform on the tests during and/or after participation in environmental education courses. Overall, there is a need for more comprehensive studies that would employ both qualitative and quantitative methods, diverse research designs, and large sample sizes. In addition, there is a need for more longitudinal studies that would evaluate student performance over time and assess how their participation in environmental education programs affects their achievement.

## 2. Career Development

### Summary of Key Findings

Three studies were found that addressed the relationship between environmental education and service-learning, and their impact on career development. Key findings for the career development outcome area include:

#### **Positive Findings**

- Some research has found that individuals working in the environmental field often cite outdoor opportunities and participation in environmental educational programs as an influence in their career choice.
- The studies suggest that environmental education programs increase awareness and interest in environmental careers and that participation in service-learning programs, which are frequently a part of environmental education programs, can enhance career development.

#### **Limitations**

- None of the studies examined the impact of K-12 environmental or sustainability education on career choice. Additional research is needed to develop long-term studies that would follow K-12 environmental and sustainability education participants through college/university and into their professional careers.

### In-depth Review of Findings

Through this literature review and interviews with experts in the field, the research team attempted to obtain information on how environmental programs influence students' decisions to pursue environmental careers, and evidence of the types of careers that environmental education students ultimately work in. However, this research did not uncover any studies of K-12 students that provided insight on the impacts of their environmental education experiences on subsequent career choices. This is likely due primarily to the fact that the literature search was limited to research conducted on grades K-12.

While no research was found that specifically tracked career development, several studies and reports have addressed some aspect of the connection between environmental education and the job market. For instance, the NEETF and NAAEE (2001) report notes that environmental education programs allow students to gain skills and abilities needed to be successful on the job market. While undertaking different projects in their communities, students learn problem-solving, communication, and decision-making skills, and also develop the ability to work in groups. Furthermore, one supporting study relates environmental education to career opportunities.

- 1) Seever (1991), who evaluated the Nowlin Environmental Science Magnet Middle School in Missouri, reports that about 45 percent of students reported that they learned about career opportunities in the field of environmental science through participation in the



program. Furthermore, 23 percent to 30 percent of students from grades 6-8 said that they might be thinking about a career in an environmental field.

Two other supporting studies were found that reported data on the development of career skills and knowledge of students in service-learning programs. While not all of the service-learning programs surveyed by these studies were environmental in nature, service-learning is a large part of many environmental programs. Thus, the findings of these two studies are included in this report.

- 1) Grassi, Hanley, and Liston (2004), who examined 29 service-learning programs in Colorado, found that students reported having gained work experience, job skills, and career awareness through participation in service-learning. Parents and teachers also reported that students gained communication skills.
- 2) Billig, Root, and Jesse (2005), who surveyed 1,000 students, including a group from schools with service-learning programs and a group from schools with a traditional curriculum, found that service-learning students significantly outperformed comparison students in the development of career and work skills.

There were two studies that queried adults, rather than K-12 students, that shed some light on the factors that affect career choices.

- 1) Tanner (1980) surveyed the autobiographies and biographies of eleven individuals working in the field of conservation to identify several types of formative experiences that led them to conservation jobs. The top seven experiences were:
  - a. Experiences in the outdoors with a youth-oriented program;
  - b. Frequent contact with nature;
  - c. Parental influence;
  - d. The influence of teachers and books;
  - e. Experience with adults other than parents or teachers;
  - f. Experience with the loss of beloved open space; and
  - g. Love of solitude in nature and other miscellaneous experiences.
- 2) Palmer (1993) studied autobiographical statements from 232 environmental educators in the United Kingdom to explore what formative experiences led to a “practical concern for the environment” and choosing to become an environmental educator. Again, time spent outdoors during education and coursework were among the most common responses given.

In conclusion, although studies are limited, the anecdotal evidence indicates that educational programs and courses, quality teachers, and an opportunity to be outside the classroom can influence students’ career choices. However, to collect information on the impact of environmental programs on career development and career choices of students, it is necessary to expand the literature search to include studies of college and university students. Ultimately, future collaboration with schools, school districts, colleges and universities, and funding longitudinal studies that track environmental education students through their college years and even into the job market would be beneficial to understanding the effect of environmental

education on this outcome area. Please see Tables 16 through 19, Appendix H for more information on the studies mentioned in this section.

### 3. Graduation Requirements: Culminating Projects

#### Summary of Key Findings

Only one study out of 76 investigated the link between environmental education programs and fulfilling students' graduation requirements or their successful completion of culminating projects. Findings suggest:

#### **Positive Findings**

- Participating in some types of environmental education programs reduces drop-out rates and increases university enrollment.

#### **Limitations**

- The single study found addressed the effects of environmental education on graduation rates only. It did not evaluate the cause of these effects, or address the program's effect on culminating projects.

#### In-depth Review of Findings

Few studies have examined how participation in environmental education programs affects graduation rates. In fact, only one study on this topic was found. In her study of 18,982 high school students in 176 schools from Alaskan school districts that used the Alaska Rural Systemic Initiative (AKRSI), a place-based, systemic approach, Emekauwa (2004) observed that reductions in the dropout rate are larger for AKRSI students than for students from 28 non-AKRSI schools. Dropout rates for Grades 7-12 in AKRSI schools declined from an average of 4.4 in 1995 to 3.6 in 2000 compared to a decrease from 2.7 to 2.4 for non-AKRSI schools over the same period. Furthermore, the first-time, freshmen enrolment at the University of Alaska from AKRSI districts increased by 49 percent in 2001 over the numbers enrolled in 1995. While there is no indication as to whether these changes were statistically significant, the large sample size and collection of data over time suggest that the study provides strong evidence that such a program can positively influence student graduation rates.

Please see Tables 20 and 21, Appendix H for more information on this study.

#### **Culminating Projects**

##### **Definition:**

An integrated learning project that helps students understand the connection between school and the real world.

##### **Statewide Goals:**

- Encouraging students to think analytically, logically, and creatively and to integrate experience and knowledge to solve problems;
- Giving students a chance to explore a topic in which they have a great interest; and
- Offering students an opportunity to apply their learning in a "real world" way.

##### **Requirements:**

Completion of a culmination will be a Washington State graduation requirement starting with the class of 2008

## 4. Student Self-Esteem, Engagement, and Motivation

### Summary of Key Findings

Fifteen studies, four gold and 11 supporting, analyzed the effects of environmental education on students' self-esteem, engagement, and motivation. For the purposes of this study, these attributes encompass self-concept, self-efficacy, self-understanding, and school attendance and are often measured by observation of students in class, student self-assessment, and teacher perspective. The findings are as follows:

#### **Positive Findings**

- All 15 studies provide some evidence that certain environmental education programs have a positive impact on students' self-esteem and increase their level of engagement and motivation.

#### **Self-Esteem**

Self-esteem is a student's experience of his or herself as being competent to cope with the basic challenges of life and of being worthy of happiness. It is confidence in the efficacy of their ability to think. By extension, it is confidence in the ability to learn, make appropriate choices and decisions, and respond effectively to change.

#### **Limitations**

- Many of these studies base their conclusions on information self-reported by the students, teachers or parents and/or do not use statistical methods to analyze the data.
- Much of the positive impact may be due to the nature of the environmental education programs examined, which frequently involved outdoor/adventure activities as opposed to traditional classroom learning.
- Of the nine studies that specifically examined self-esteem, only two (neither of them a gold study) were conducted on formal programs.

### In-depth Review of Findings

Learning outdoors is often considered more fun than traditional classroom learning, so it comes as no surprise that students enjoy classes that take them beyond the school walls and find themselves more engaged and motivated as a result. In environmental, outdoor, place-based, and service-learning programs, students can investigate real-life issues that are connected to their own lives and explore and engage in projects in their communities. Students also enjoy hands-on learning, which often comes easier, is more interesting and fun, and provides an opportunity for them to direct their own learning. As a result, students become more engaged and interested in learning in general and are motivated to achieve in school.

These behaviors also often lead to increased feelings of self-control and self-esteem. Earlier meta-analyses of the research on the effectiveness of outdoor education efficacy reported significant changes in self-concept (such as self-efficacy, self-understanding) by students in environmental education programs.<sup>24</sup> Other earlier meta-analyses that combined results from

---

<sup>24</sup> Cason and Gillis, 1994; Hattie, March, Neil and Richards, 1997

multiple studies report that outdoor education significantly increases self-esteem.<sup>25</sup> Additional reports (SEER, NEETF, and NAAEE) claim that participation in environmental education programs increases self-esteem and confidence in children. Thus, it was expected that there would be more recent evidence that would support these claims.

Fifteen studies, four gold and 11 supportive, examined self-esteem, engagement, and motivation. For more information about these studies, please see Tables 22 through 25, Appendix H.

While self-esteem, engagement and motivation are inextricably linked as student behaviors, all but one of these fifteen studies analyzed them independently, either as self-esteem or as engagement and motivation. Therefore, findings are presented below for each category:

### **Self-Esteem**

Findings on the impact of environmental education on students' self-esteem include<sup>26</sup>:

- 1) In the American Institutes for Research (2005) study of outdoor programs in four California elementary schools, students who participated in the course showed positive gains in self-esteem, leadership, cooperation, conflict-resolution, and students' relationships with their teacher immediately after the program. Significant differences in cooperation and conflict-resolution skills were found between the participating and control groups six to 10 weeks later.
- 2) Garst and Baker (2001) analyzed young people who participated in a three-day outdoor adventure program. Their study found that several areas of self-perception profiles, such as social acceptance and behavior conduct, increased immediately after the program and that some behavior impacts may have remained four months after the trip. After conducting interviews with the participants, the researchers concluded that changes in self-perception occurred due to the novelty of the program experience and its duration.
- 3) Cross (2002) analyzed seventeen pairs of high school students (half of whom participated in a rock climbing camp), reporting that although the two groups exhibited similar behavior before the treatment, the rock climbing group appeared to be less alienated and demonstrated a stronger sense of personal control after the program than did the control group.
- 4) Kaly and Heesacker (2003) compared the experiences of 265 males and females between 12 and 22 years old in a summer ship-based adventure program "Actionquest." They found no significant difference in self-esteem between the treatment and control groups, either before or after the program.

### **Engagement and Motivation**

Findings on the impact of environmental education on students' self-esteem include<sup>27</sup>:

---

<sup>25</sup> Cason and Gillis, 1994; Hattie, March, Neil, and Richards, 1997

<sup>26</sup> Findings are from selected studies. For information on the remaining studies, refer to Appendix E, Tables 12-15

<sup>27</sup> Findings are from selected studies. For information on the remaining studies, refer to Appendix E, Tables 12-15

- 1) Athman and Monroe (2004b) compared Florida high school students who participated in environment-based programs with students who attended traditional programs in the same 11 schools, finding that students participating in an EIC program scored significantly higher on the California Measure of Mental Motivation and the Achievement Motivation Inventory.
- 2) Lieberman and Hoody (1998) conducted surveys and interviews regarding student achievement at 40 elementary, middle, and high schools with environment-based programs across the United States. They found that most EIC teachers reported growing enthusiasm and motivation to learn in social studies, science, math, and language arts.
- 3) In three elementary and two middle schools in Maryland, student engagement within each school was statistically significantly higher for students who had more intense EIC experiences.<sup>28</sup>
- 4) Teachers who taught in the Model Links Program in Washington State schools identified a range of benefits of environmental programs for students: improved student motivation, self-confidence, critical thinking, technical reading and writing skills, and decrease in behavior and discipline problems. According to the teachers, students were more engaged in hands-on learning and the program has also had a positive impact on the learning of at-risk populations.<sup>29</sup>

While many other research publications also mention increased self-esteem<sup>30</sup>, engagement, and motivation, these claims are often based on comments from teachers and/or students, and in most cases the changes are not measured and analyzed statistically. Furthermore, much of the research, especially on self-esteem specifically, has focused on informal, rather than formal education. While the existing evidence lends support to the positive effects of environmental education on this outcome area, additional research that analyzes formal environmental education programs, incorporates the use of pre-post tests and statistical analyses, and controls for additional variables would help provide a more concrete basis for policy decisions.

---

<sup>28</sup> Secker, 2004

<sup>29</sup> Yap, 1998

<sup>30</sup> Battersby, 1999; Lieberman and Hoody, 1998; Yap, 1998

## 5. Civic Responsibility and Service-Learning

### Summary of Key Findings

Eight of the reviewed studies analyzed the effects of environmental education programs on civic responsibility (the actions a citizen is required to do for the good of society), and service-learning (a teaching method that incorporates classroom learning objectives with meaningful community-focused action) for students in grades K-12. Findings include:

#### **Positive Findings**

- All eight studies reported some evidence that participation in certain environmental education programs increases civic engagement.

#### **Limitations**

- The majority of studies focused on self-reported data rather than on measured behavior changes.
- None of the studies in this outcome area used a methodology robust enough to qualify it as a gold study.

#### **A responsible citizen:**

- Uses knowledge of government, law, and politics to make decisions about and take action on local, national, and international issues to further the public good.
- Uses a wide range of social studies skills, including critical thinking, to investigate and analyze a variety of resources and issues and seek answers.
- Effectively uses both group process and communication skills to participate in democratic decision making.

### In-depth Review of Findings

Few researchers have tried to examine environmentally-responsible behavior in young people and ways to develop civic responsibility and stewardship. This review uncovered eight studies that examine changes in students' environmental behaviors and civic engagement. However, most of these studies focused not on actual behavior, but rather presented self-reported data obtained through surveys and interviews.

- 1) In a study of 255 Grade 6 students from four elementary schools conducted by the American Institutes for Research (2005), students who attended the program showed increased concern about conservation; however, this gain was not significantly different than that shown by the control group. On the other hand, parents whose students attended the outdoor science program reported observing children engaging in significantly more positive environmental behaviors at home than parents of children who did not attend.
- 2) Siemer and Knuth (2001) who examined experiences of 619 Grade 6-8 students in the "Hooked on Fishing - Not on Drugs" program found that youth in fully implemented fishing programs demonstrated better fishing skills, better knowledge and awareness of aquatic environments, and issues related to fishing as well as a stronger commitment to limit their personal impact on the environment while fishing.
- 3) Duffin, Powers, Tremblay, and PEER Associates (2004) claimed that participation in Place-based Education Evaluation Collaborative PEEC programs makes significant and

positive contributions to student engagement in learning, student civic engagement, student time spent outdoors, and student stewardship behavior.

- 4) Cheak, Hungerford, and Volk (2002) investigated an inquiry-based environmental education program in a public elementary school in Hawaii, finding that participating students demonstrated improved personal characteristics and participatory citizenship in the community, based on data obtained from student and teacher interviews.

These studies indicate that there may be a relationship between participating in environmental education programs and increased levels civic responsibility shown by students. However, much of these data are self-reported, and further research is needed both to establish the extent of this connection and to determine what characteristics of environmental education programs are responsible for changes in student behavior. For more information on the studies in this section please see Tables 26 and 27 in Appendix H.



## E. Characteristics of Successful Programs

---

In addition to analyzing programs' effects on student outcomes, environmental education research has helped to identify the characteristics that define successful environmental and sustainability education. This research indicates that successful programs are tied either to 1) teaching practices, where there tend to be elements of active experiential learning, or 2) program characteristics that promote community involvement, an integrated curriculum with an evaluation component, and well trained staff.

However, while research has identified many characteristics of successful environmental education programs, most of the reviewed studies focus on identifying measured changes in students' performance and behavior, and do not identify the specific factors that caused these observed effects. As such, while these studies allow some conclusions to be drawn about the characteristics of successful environmental education programs, further research in this area would be beneficial to educators and policymakers.



Characteristics identified by the studies reviewed for this report include:

### Teaching and Learning Practices

#### **Inquiry-based projects (critical thinking)**

Inquiry is at the core of best practices in environmental and sustainability education. In a classroom with fully implemented environmental and sustainability education, inquiry is an essential part of the teaching and learning practices. Effective teachers use a variety of methods and types of experiences to integrate inquiry into their everyday classroom activities. Students are involved in gathering and interpreting information through observation from a variety of sources and collaborate to investigate new ideas, issues, and concepts and in finding solutions to real-world problems using scientific research models and methods.

#### **Real-life projects and service-learning**

Programs appear to be most successful when they tie academic concepts to real-world, locally relevant examples and allow students to apply their knowledge to projects in their communities. Such service-learning activities increase student motivation and interest and help them develop a sense of pride, ownership, and respect for themselves and others.

#### **Student-led projects and activities (including leadership, cooperative learning, and group work)**

Student-centered and constructivist approaches to learning and teaching are often viewed as techniques to improve student performance, motivation, and engagement. Lessons and facts

become more interesting when students have an opportunity to construct their knowledge themselves and to apply it to real, important and relevant situations.

### **Hands-on learning**

When it comes to describing characteristics of the program, almost every publication mentions hands-on learning. Learning by “doing” helps students master real-life skills and provide an opportunity to integrate skills and knowledge from different areas. As a result, students are more motivated and engaged and are more likely to remember the learning and apply the information and skills to new situations.

## **Program Characteristics**

### **Integrated approach**

Being able to work on multiple tasks at the same time is a necessary skill in many current work environments. Integration of several disciplines allows students to draw connection between different subjects and to move from isolated concepts to a network of interrelated ideas.

Environmental programs that use integration help students develop greater motivation and interest in learning and, as a result, lead to higher academic performance.

### **Effective communication and documentation**

An effective communication system between team members, teachers, schools, and the community is one of the key elements of a successful environmental and sustainability program. Some studies also suggest that documenting the program activities would help with program assessment and evaluation. Finally, regular meetings and planning time for teachers involved in the development and delivery of the program improves the quality of the program.

### **Involvement of community partners**

Involvement of the community in the educational programs can improve their quality and impact on students. Community members and organizations can provide formal and non-formal programs with environmental learning opportunities, professional expertise, and financial support.

### **Professional development of environmental education teachers**

High-quality, well-educated staff is crucial to the success of the program. Ongoing professional development was suggested by several reports as a means to improve both formal and non-formal programs. For example, professional development can be in the form of summer institutes and workshops, weekly or biweekly learning sessions, and common planning time to collaboratively develop and refine ideas.

### **Authentic assessment**

Authentic assessment, specifically that which informs student learning, is one of the strategies to create and maintain a successful program. It allows students to assume an active role in the assessment processes and increase their self-esteem and motivation. Through tasks that are relevant to students' lives, what students gained from the program can be assessed. These assessments can help them develop ownership of their learning and improve their attitude to school specifically and to learning in general.

### **Long-term rather than short-term programs**

While there are many successful short-term programs that provide students with interesting and exciting experiences, long-term programs seem to have a stronger impact on students, especially in the area of academic performance. Long-term projects help students not only to create awareness of certain concepts or areas, but also to master skills and knowledge.

### **Other Measures of Quality Environmental Education Programs**

Above are the characteristics of successful programs identified by the research, but a great deal of work has also been done locally to develop quality standards for environmental education programs. For instance, in 2000 OSPI released a set of guidelines that set standards for student achievement and described effective environmental education practices that help reach them. In addition, the Pacific Education Institute developed a rubric for evaluating formal environmental education programs based on the extent of the program's integration into the curriculum, the level of community involvement, and the use of inquiry based instruction.

### **Model Programs**

EHB 2910 specifically requests examples of exemplary models of environmental education programs. However, while the body of academic research on environmental education indicates many of the characteristics that lead to quality programs, there is a shortage of research on what characteristics are responsible for achieving student outcomes. In fact, no studies identified by this report provided examples of exemplary models.

Despite this gap in the research, many environmental education programs have conducted evaluations that have not been published in academic journals. Examples identified for this report include programs with self evaluations, as well as recipients of an OSPI Natural Science, Wildlife and Environmental Education Partnership Grant. While self evaluations are often conducted with limited resources and can rely heavily on self-reported data, they can still provide useful information on the effects of environmental education and on which program characteristics are most responsible for those outcomes. Programs that have received an OSPI Natural Science, Wildlife and Environmental Education Partnership Grant do not necessarily have self evaluation measures in place, but have had to go through a very competitive and rigorous application process to receive funding. Therefore, programs that either have an evaluation in place or have been awarded an OSPI Grant are included in this report as model programs.<sup>31</sup> These programs are:

- Facing the Future
- The Integrated Environmental Health Middle School Project
- IslandWood
- North Cascades Institute
- Outdoor Academy Program
- Salish Sea Expedition
- Seattle Aquarium – Citizen Science

---

<sup>31</sup> There are hundreds of environmental education programs in Washington State. The ones listed here neither represent a comprehensive list of model programs nor do they indicate superior program quality. Rather they serve as examples of programs that have an evaluation component, which indicates some level of success in meeting their stated goals.

- Woodland Park Zoo Teacher Training Program
- OSPI Natural Science, Wildlife and Environmental Education Partnership Grant Program Recipients
- School District level models for integrated programs, including:
  - Cle Elum/Roslyn School District
  - Issaquah School District
  - Tahoma School District
  - West Valley School District

These programs' evaluations indicate that environmental education has a positive impact on students' attitude and level of engagement, academic achievement, and critical thinking. For a description of each program and evaluation, see Appendix I

## F. Research Conclusions

---

The review of the literature conducted for this report supports a number of conclusions about the present state of environmental education and of environmental education research. These include:



### Effectiveness of Environmental Education

- **Environmental Education is an effective means of achieving a number of desirable student outcomes.** The research substantiates that environmental education programs can increase academic achievement across a wide range of classes, increase students' self-esteem, engagement and motivation, and may increase their level of civic responsibility and improve their odds of graduating. Furthermore, none of the studies found any detrimental effects of environmental education programs.
- **Environmental Education allows for the ready integration of many techniques that are thought to define good education.** The characteristics of successful programs identified by this report are in line with much of what is known about what makes quality education.<sup>32</sup>
- **The multi-faceted nature of Environmental Education is a key component of its effectiveness.** This multi-faceted nature is part of what allows environmental education programs to encompass such a wide range of successful characteristics. Furthermore, while the breadth of programs encompassed by environmental education can make the subject difficult to study, it also affords these programs the ability to appeal to students who possess very different learning styles and backgrounds.

### Environmental Education in Washington State

- **Washington State has consistently played a leadership role in both the quality of its environmental education programs and in supporting research.** Innovative and effective programs and partnerships currently exist across the state.
- **There are numerous opportunities for Washington to continue that leadership.** While there have been many successes, opportunities still exist both to extend the benefits of environmental education to more students and to support additional research. See the Recommendations section below for more information.

### Additional Research on Environmental Education

- Despite the largely positive results of the studies reviewed in this report, **there is still much to be gained from supporting additional research on environmental education.** In particular, environmental education research would benefit greatly from:
  - Additional funding for: longitudinal studies that track students over time;

---

<sup>32</sup> For further reading on the characteristics of quality education programs see Bransford J. D., Brown, A. L., and Cocking, R. R., ed., 2000.

- Additional studies of these outcome areas that control for other variables (length of program, student background, etc.); and
- Studies of the impact of K-12 education programs on career choices.

Please see the Recommendations section for additional environmental education research needs.

## G. Recommendations

---

Based on the conclusions contained in this report, OSPI and the statewide partners have developed recommendations to guide Washington State in maintaining its leadership role in environmental and sustainability education, and to help ensure the success of each and every Washington State student. The following recommendations are directed to the Legislature, OSPI and the environmental and outdoor education community, and environmental education researchers.



### Recommendations for the Washington State Legislature

- 1) **Fund integrated, project-based learning opportunities for all students.** Project-based learning focused on environmental and sustainability concepts provides all students – including those at risk, not yet at standard, and underrepresented – with meaningful, relevant, and rigorous learning and gives students options for completing the culminating project required for graduation. Support from the Legislature for project-based learning could include funding the Sustainable Design Project, a public-private partnership launched in 2007 by OSPI, EEAW, Puget Sound Energy, and numerous other partners. Funding is specifically needed for an online database allowing students to find project-based learning opportunities and post their own projects. Other aspects of the Sustainable Design Project – such as professional development (workshops and seminars) for teachers and administrators and program evaluation – are expected to be funded through other private sources.
- 2) **Continue to fund and expand the intent of House Bill 1677 to provide financial support to school districts for outdoor/experiential education for all students.** As found in this report, there is increasing evidence of the benefit of outdoor education for all students. HB 1677, passed in 2007 created a grant program supporting outdoor and recreation programs administered by the State Parks and Recreation Commission. The Legislature is encouraged to fund HB 1677 in 2009 and expand the intent of the program to provide an equal per-student allocation (e.g. \$20 per student) to districts to ensure that all public school students have the opportunity to participate in at least one full-day outdoor, experiential program during their K-12 years. These funds could be used for either a residential (overnight) outdoor education experience or at a minimum one full-day experience.
- 3) **Continue to fund the OSPI environmental education partnership grant program established by HB 1466.** As of 2007, this program, established by the Legislature in 2003, has successfully funded eight high quality, innovative environmental education projects linking classrooms and community environmental resources across the state.

Demand for these grants continues to outstrip funding resources. The Legislature earmarked funds for the EE Partnership grant program in the 2005 and 2006 budgets, but not in the 2007 budget. Reinstatement and an increase of budget allocations to the EE partnership grant program will ensure that more students have access to high-quality standards-based environmental learning opportunities.

- 4) **Provide funding for collaborative partnerships between colleges of education and school districts to develop and implement environmental and sustainability teaching and learning programs.** Preparing new teachers with the knowledge and skills necessary to teach integrated project-based learning is critical to K-12 students' success. Collaborations between schools of education and school districts will provide pre-service teachers with direct field experience in integrated environmental and sustainability teaching experiences. Specific funding should be directed to assist colleges of education in implementing the Professional Education Standards Board's new Standard V pertaining to integrated teaching and teaching environmental sustainability. Supporting pre-service educational programs results in a multiplicity effect, ensuring that future generations of students receive comprehensive, state-supported environmental education.

## **Recommendations for OSPI and the Environmental and Outdoor Education Community**

As directed in HB 2910, the study and recommendations that have been developed in coordination with many environmental education partners are intended to inform the E3 Washington strategies due in May 2008. The following recommendations are directed to OSPI and the environmental and outdoor education community.

- 1) **OSPI should update the 2000 Washington State Environmental Education Guidelines.** To ensure that schools are providing high-quality environmental education programs the State Environmental Education Guidelines (2000) for learners will need to be updated. OSPI should develop a process and convene a working group to review and update these standards and ensure that they are aligned with national standards and Washington State core subject area Essential Academic Learning Requirements. The Washington environmental and sustainability standards will provide clear guidance to districts and community-based organizations to ensure alignment of programs with these newly-revised Washington State standards.
- 2) **Ensure that outdoor and experiential education programs in Washington State are entered into the new EE Resources Center developed through E3 Washington.** A considerable number of outdoor experiential education programs exist in Washington State, and there are tremendous benefits to making educators and the public more aware of these opportunities. Although the study includes a listing of these resources, as directed by the bill, this listing is static. An online database provides the flexibility necessary to keep such a list up-to-date, relevant, and accessible.
- 3) **Compile and disseminate the results of environmental and sustainability education research to educators.** Environmental education research is continually being



conducted by universities, non-profit organizations, and private research institutions. An organization or institution should be identified to be the repository of this research to ensure that new data is synthesized and provided to educators and the public as it becomes available. Additionally, this institution should provide a report of research on a regular basis and identify research needed.

- 4) **Finalize and provide professional development for the Environmental and Sustainability Education Educator Guidelines.** OSPI and EEA have begun the process of drafting educator guidelines and vetting these among the environmental education community. Once these are completed and align with the revised learner guidelines referenced above, a professional development workshop module and a series of statewide workshops will be needed to train educators in the use of the guidelines.
- 5) **Create a recognition program to honor exemplary environmental and sustainability programs and educators.** High-quality programs would benefit from public recognition of their work and contribution to the field. This program should include recognition for high quality environmental sustainability education by college of education faculty, district or school-wide programs, teachers, and students.

## **Recommendations for Environmental Education Researchers**

This report highlights the need for more research on the outcomes related to environmental and sustainability education programs. More research is needed in all five of the outcome areas covered in this report (academic achievement; self-esteem; engagement and motivation; civic responsibility and service-learning; and career development).

Numerous studies provide preliminary evidence of the impacts of environmental and sustainability education on students. However, relatively few studies use reliable statistical methods, especially among those that analyze the areas of career development and meeting graduation requirements. It is important to note that this is true of educational research in general and is not unique to studies focused on the impact of environmental education.

- 1) **Conduct education studies with a more robust methodology.** In particular, the body of research on environmental education would benefit from more studies that control for different populations, employ statistical methods and large sample sizes, and use more established evaluation methods.
- 2) **Conduct longitudinal studies.** There is a need for longitudinal studies that explore the changes in student outcomes over an extended period of time. In particular, relatively few studies have measured student performance over a period greater than one year for students who have been engaged in environmental and sustainability education for successive years.
- 3) **Conduct additional studies in under-researched areas, such as the teaching strategies used in environmental education programs.** Many studies have analyzed whether certain outcomes have been achieved. Now educators and students would

benefit greatly from studies that analyze and isolate which specific teaching strategies affect student outcomes such as student achievement and graduation rates.



## Appendix A: Engrossed House Bill 2910

---

Signed by Governor Gregoire on March 15<sup>th</sup>, 2006, EHB 2910 provides the legislative impetus for this report. The full text of the bill appears below.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF WASHINGTON:

**NEW SECTION. Sec. 1.**

- 1) The office of superintendent of public instruction shall conduct an environmental education study in partnership with public and private entities invested in strategies to reach every student, family, and community with quality environmental education experiences. The study shall provide empirical evidence, exemplary models, and recommendations focused on:
  - Career development
  - Good citizenship as proven through service-learning
  - Graduation requirements, specifically addressing senior culminating projects
  - Underserved youth and demographic groups
  - Models of professional development for community-based service organizations including state and local agencies.
- 2) The study in this section shall provide findings and recommendations useful to the Washington State comprehensive environmental education plan, a comprehensive public-private endeavor to develop local and statewide strategies to ensure quality outdoor environmental education opportunities for every student, family, and community in Washington.
- 3) By studying the concepts in this section, the study shall evaluate how environmental, natural science, wildlife, forestry, and agriculture education benefits Washington's students, families, and communities. Outdoor environmental education provides relevant quality education set in real world contexts of the built, natural, cultural, social, and economic environments. It provides opportunities for direct natural experiences to help Washington's youth develop self-esteem and personal responsibility. Washington benefits from exemplary environmental education programs and public-private environmental education partnerships across the state including outdoor, agriculture, forestry, angling and hunting, cultural competency, natural resource, natural science, and wildlife education programs. The study will be useful in identifying outdoor environmental education opportunities for Washington's students, families, and communities.
- 4) The office of superintendent of public instruction shall provide an interim update to the Legislature by December 1, 2006, and shall complete the study no later than October 1, 2007.

## Appendix B: Definitions

---

This section includes definitions of key terms that helped inform the study.

**Academic Achievement** – A student’s demonstration of high levels of achievement in the four state learning goals and graduating from high school ready to implement a positive plan for his or her future. The four state learning goals are to:

- Read with comprehension, write effectively, and communicate successfully in a variety of ways and settings and with a variety of audiences;
- Know and apply the core concepts and principles of mathematics; social, physical, and life sciences; civics and history, including different cultures and participation in representative government; geography; arts; and health and fitness;
- Think analytically, logically, and creatively, and integrate different experiences and knowledge in order to form reasoned judgments and solve problems; and
- Understand the importance of work and finance and how performance, effort, and decisions directly affect future career and educational opportunities.

**Career Development Education** – Instruction that focuses on the linkage between individual capabilities and needs, and the job market. It includes instruction in the variety and scope of available employment, how to access job information, and techniques of self-analysis with regards to career exploration. It may include work-based learning opportunities.

**Civic Responsibility** – The actions a citizen takes that contribute to the good of society. A responsible citizen:

- Uses knowledge of government, law, and politics to make decisions about and take action on local, national, and international issues to further the public good;
- Uses a wide range of social studies skills, including critical thinking, to investigate and analyze a variety of resources and issues and seek answers; and
- Effectively uses both group process and communication skills to participate in democratic decision making.

**Culminating Project** – An integrated learning project that helps students understand the connection between school and the real world. Completion of a Culminating Project is a graduation requirement beginning with the class of 2008. While each school district determines the guidelines for the Culminating Project, the goals for the project are statewide. These goals include:

- Encouraging students to think analytically, logically and creatively and to integrate experience and knowledge to solve problems;
- Giving students a chance to explore a topic in which they have a great interest; and
- Offering students an opportunity to apply their learning in a “real world” way.

As part of the Culminating Project, students must demonstrate essential skills through reading, writing, speaking, production and/or performance. To complete the project, students may be asked to write a research paper, work with a mentor either in school or in the community, present

the project to a community or peer panel, pull together a portfolio of work, and/or develop a multi-media presentation.

**Environmental Education** – A learning process that increases people’s knowledge and awareness about the environment and associated challenges; develops the necessary skills and expertise to address these challenges; and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action. Environmental education includes the three dimensions of education: *about* the environment, *for* the environment, and *in or from* the environment.<sup>33</sup>

**Experiential Education** – A philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values.

**Formal Education** – The curriculum, instruction, and assessment that occur within the K-12 school setting.

**Non-Formal Education** – The community-based instruction that occurs outside the school setting such as at outdoor learning centers, museums, zoos, forests, gardens, and parks.

**Outdoor Education** – Learning experiences that occur outside the classroom, usually in the natural environment and that encourage lifelong enjoyment of and an appreciation for the outdoors, wildlife, and nature.

**Self-Esteem** – A student’s experience of his or herself as being competent to cope with the basic challenges of life and of being worthy of happiness. It is confidence in the efficacy of their ability to think. By extension, it is confidence in the ability to learn, make appropriate choices and decisions, and respond effectively to change.

**Service-Learning** – A teaching method that incorporates classroom learning objectives with meaningful community-focused action for students in grades kindergarten through twelve.

**Student Engagement** – The state in which students are actively involved in the planning, implementation, and assessment of their own learning. Engaged students possess a sense of agency and ownership of their learning by knowing what is being expected of them, why it matters, and how they can use the skills. In addition, they see the efficacy of their work, and are advocates for their and their peers’ learning needs. Engaged students are able to:

- Answer questions such as: “What is my story as a learner?”, “How do I learn best?”, and “When I have something difficult to learn, what are my most effective strategies?”
- Explain the relationship between a particular learning goal, the standard to which that goal is measured on assessments, the skill represented by the standard, and the relevance of that skill to the students’ life outside the classroom and beyond graduation
- Understand how their classroom writing has application for a project or for an authentic audience; how their behavior affects the learning of another student; how their

---

<sup>33</sup> Palmer, 1993

participation builds a skill set they know to be useful and they know this because they have used the skills to achieve a “real-world” result

- Ask for help when they need it, find it when they need to, and advocate for the needs of others

**Sustainability Education** – A learning process that supports academic success and life-long learning, and develops a responsible citizenry capable of applying knowledge of ecological, economic, and socio-cultural systems to meet current and future needs. Through sustainability education students acquire and apply knowledge of:

- Sustainability, defined as “meeting the needs of the present generations without compromising the ability of future generations to meet their own needs”.<sup>34</sup> This is also referred to as “intergenerational responsibility”
- Sustainability further defined as the interconnectedness of environmental, economic, and social systems. This is also referred to as “the triple bottom line of environmental health, economic prosperity, and social wellbeing”<sup>35</sup>
- How personal and collective actions affect the sustainability of local and global systems

---

<sup>34</sup> World Commission on Environment and Development, 1987

<sup>35</sup> United Nations Department of Economic and Social Affairs, 1993

## Appendix C: Historical Highlights of Environmental Education in Washington State

---

### 1920s

- First recorded Outdoor School in the United States

### 1930s

- Northwest Regional Council creates conservation education curricula and teacher workshops for Washington public schools

### 1940s

- Camp Silverton-Waldheim established as a permanent outdoor education camp
- The nationally distributed film *Classroom in the Cascades* is filmed at a student workshop held at Camp Wascowitz

### 1950s

- The Northwest Environmental Education Center (NEEC) is created as the salt-water extension of Camp Silverton-Waldheim
- Teacher training workshops held to support conservation and outdoor education programs

### 1960s

- Governor's Conference on Environmental Education results in creation of advisory group, "The Forum", to advise OSPI and seek funding for environmental education
- OSPI acquires Cispus Learning Center near Randle as its first regional environmental education center

### 1970s

- OSPI produces numerous environmental education reports and plans that provide a comprehensive definition of environmental education, identify the goals and funding needs of the OSPI environmental education program, and develop guidelines for K-12 schools on conducting environmental education
- Senate Concurrent Resolution 12 passes, requiring OSPI to develop comprehensive K-12 interdisciplinary environmental education programs
- State Board of Education rule requires that environmental education be offered as a high school elective

### 1980s

- Two of OSPI's environmental education curriculums become distributed nationally: Energy, Food and You and Clean Water, Streams and Fish
- Legislature requires OSPI to create an Environmental Education Task Force to define an environmentally literate citizen, survey state public schools, review the state's environmental education program, and provide recommendations
- OSPI updates Environmental Education Guidelines for Washington Schools (reprinted in 1992, 1993 and 1995)
- OSPI publishes *Turning the Tide*, a teacher's guide and video

### 1990s

- OSPI publishes *Puget Sound Habitats*, teacher's guide
- The Governor's Council for Environmental Education is created as part of Executive Order 90-06, which implements recommendations generated from the Governor's advisory group as documented in *Toward 2010: An Environmental Action Agenda*
- OSPI and partners create Model Schools Program funded by an EPA Education Grant



- OSPI publishes *The Overwhelmed Educator's Guide to Environmental Education* and *The Nature of Learning – EE in Washington State*
- PEI develops integrated environmental benchmarks to measure 5<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> grade student performance in: understanding natural and social systems, undertaking research-based science and social science inquiry, Civic Participation and Policy Analysis, and communication through the Language, Visual and Performing Arts. These benchmarks are aligned to state and national standards
- Washington State School Directors Association (WSSDA) publishes a briefing paper for school board members on EE
- OSPI and partners build on Model Schools Program and link to education reform by creating the Model Links: Environmental Education and School Improvement Program to assist schools in implementing the new Essential Academic Learning Requirements (EALRs)
- State Education and Environment Roundtable (SEER) publishes *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*. Washington becomes a host state for the project
- The Environmental Education Assessment Project (EEAP) is created to research the assumption that using the environment as an integrating context for learning achieves measurable results in student learning

## 2000s

- OSPI revises *Environmental Education Guidelines for Washington Schools*, aligned with the state's EALRs
- Grant to the Environmental Education Assessment Project consortium supports initial work with Colleges of Education in Washington to foster curriculum integration using the environment in teacher preparation programs
- PEI develops multiple assessment tools to evaluate student performance in environmental literacy and more traditional subjects such as science, math, language arts and social studies. These assessments are modeled on the Washington Assessment of Student Learning (WASL), and their utility as assessment tools was tested using validity and reliability testing
- OSPI and Northwest Environmental Education Council (NWEEC) conduct state-wide public school survey, *Washington State Environmental Education Needs Assessment*
- State Legislature provides capital funds to begin construction of Chewelah Peak Learning Center located north of Spokane
- PEI creates an environmental education rubric, which defines and articulates best practices for school based EE programs
- Opening of IslandWood, a state-of-the-art sustainable environmental learning center on Bainbridge Island
- OSPI Office of Environmental Education loses federal funding and closes Seattle office
- The Legislature passes HB 1466 the Washington Natural Science, Wildlife, and Environmental Education Partnership Grant Program to provide funding for proven and innovative environmental education programs
- Integrated Environmental Health Middle School Project (IEHMS) begins at the University of Washington to provide professional development for middle school teachers in environmental health subject matters

- The Columbia Basin Environmental Education Capacity Building Initiative is established to increase communication among environmental educators throughout the Columbia River Basin and build the capacity of environmental education providers by enhancing their knowledge, skills, and resources
- The Environmental Education Association of Washington launches E3, a comprehensive planning process to develop a statewide vision and plan for environmental education
- The Legislature passes HB 2910 requiring OSPI to conduct a study of the efficacy of environmental education
- OSPI redefines environmental education as education for environment and sustainability
- The Legislature passes SSB 1677, the Outdoor Education Grant Program, to provide funding for outdoor education opportunities, primarily for underserved youth across the state
- OSPI launches the Washington State Sustainable Design for Students project in partnership with a variety of K-12 education, business, community, higher education, and industry partners

## Appendix D: Catalogue of Outdoor and Experiential Environmental Education Programs in Washington State<sup>36</sup>

Table 4. Olympic Peninsula and West Coast Programs

Outdoor/Experiential EE Provider	Description of EE Programs	Annual Participants	Program Length	Special Features	Program Website
<b>Olympic Park Institute</b>	Field science School; day and residential; summer programs	3,000 students + teachers	1- to 19- days	Rainforest location and focus, plus coastal proximity	<a href="http://www.yni.org/opi/">http://www.yni.org/opi/</a>
<b>Port Townsend Marine Science Center</b>	Beach, marine science and monitoring; citizen science; summer camp; lab and field work	30,000 incl. visitors; 75-85 classes; 24 teachers in workshop	90 minutes to week-long; day and over-night camps	Menzies Project teaches marine research; 200 volunteers	<a href="http://www.ptmsc.org/">www.ptmsc.org/</a>
<b>Washington Virtual Classroom Consortium</b>	Water quality project; electronic 12-school district collaboration; other subjects also taught	1,000 students annually; 60 teachers	2 – 3 hours per week	Statewide; based at Quillayute S.D. Innovative technology-field study link; spurs student science interest	<a href="http://www.forks.wednet.edu/wvc/cadre/WaterQuality/contact%20page.htm">http://www.forks.wednet.edu/wvc/cadre/WaterQuality/contact%20page.htm</a>
<b>Pacific Ecological Institute</b>	Leland Watershed Water Quality Monitoring	10 high school students, 10 teachers and volunteers	Ten hours per month	Students, adults members monitor 6 stations monthly	<a href="http://www.peiseattle.org/">http://www.peiseattle.org/</a>
<b>Grays Harbor College</b>	Model Watershed Project; Project SWISH (Students, Watersheds, Invertebrates, Streams and Habitats) Clean water theme	K-8 and general public. 1,000, mainly youth	Day-long visits to 2 <sup>nd</sup> growth forest site, trails, aquaculture center, pond	Business and aquaculture students initiated the program. Student-run	<a href="http://ghc.ctc.edu/catalog/index.htm">http://ghc.ctc.edu/catalog/index.htm</a>
<b>Streamkeepers of Clallam County</b>	Youth and adults study, monitor water quality on 12 streams; do restoration work	95 trained volunteers, 10 teachers and their students; general public	Year-round Quarterly monitoring Annual stream work Field training	Water quality data used by agencies. Monitoring protocols approved by Dept of Ecology	<a href="http://www.clallam.net/streamkeepers/">http://www.clallam.net/streamkeepers/</a>

<sup>36</sup> Some of this information was provided by the Environmental Education Association of Washington, [www.eeaw.org](http://www.eeaw.org)

<b>Olympic Natural Resources Center</b>	Environmental Learning Center; offers professional development programs; located in Forks, WA	-	-	-	<a href="http://www.onrc.washington.edu/EducationOutreach/educationoutreach.html">http://www.onrc.washington.edu/EducationOutreach/educationoutreach.html</a>
<b>Salish Sea Expeditions</b>	5 <sup>th</sup> to 12 <sup>th</sup> grade students design and conduct research while sailing aboard a 61' sailboat; located in Kingston, WA	-	-	-	<a href="http://www.salish.org/">http://www.salish.org/</a>
<b>Dungeness River Audubon Center</b>	Pre-K to college. Teach birding, natural science, water quality; Kids Day, grades 3-5 Summer science camp; located in Sequim, WA	Students 4,000 incl. homeschool students 12,000 people total	One hour to all day; also weekly series; with classroom work, several weeks Exhibits	Park owned by Jamestown S'Klallam. Center partners Audubon, tribe, Rainshadow Foundation	<a href="http://www.dungenessrivercenter.org/programs.html">http://www.dungenessrivercenter.org/programs.html</a>
<b>YMCA Camp Orkila</b>	Camps for students grade 1-12; leadership camp for high school students; located in Eastsound, WA	-	1 week	Offers specialty camps, including science camp	<a href="http://www.seattlemca.org/page.cfm?ID=coPrograms">http://www.seattlemca.org/page.cfm?ID=coPrograms</a>

**Table 5. Southwestern Washington Programs**

<b>Outdoor/Experiential EE Provider</b>	<b>Description of EE Programs</b>	<b>Annual Participants</b>	<b>Program Length</b>	<b>Special Features</b>	<b>Program Website</b>
<b>Center for Agriculture, Science and Environmental Education</b>	High school program on 80-acres site: forested, stream, pond, greenhouses	50 students	3 hours per day, school year	Strong research emphasis, including solar	<a href="http://casee.phenominet.com/main_pages/index.php">http://casee.phenominet.com/main_pages/index.php</a>
<b>Columbia Springs Environmental Education Center</b>	Field trip and field work site: hatchery, monitoring, restoration. Use FOSS science kits	6,000 students, 250 teachers. Also open to general public	One to 5 hours, depending on teacher/class needs	Programs meet State learning requirements and service-learning. 100-acre site	<a href="http://www.columbiasprings.org/">http://www.columbiasprings.org/</a>
<b>Vancouver Water Research Center</b>	River Rangers; Projects WILD, WET, Learning Tree; watershed congress, Columbia River Watershed Festival	4,500+ students 300+ teachers	40 minutes to 8 hours, to entire weeks.	Valued resource for SW teachers, students	<a href="http://www.cityofvancouver.us/watercenter.asp">http://www.cityofvancouver.us/watercenter.asp</a>

<b>Cispus Learning Center</b>	Outdoor school, 5 <sup>th</sup> -6 <sup>th</sup> grades. Leadership for secondary students. Teacher training	17,000 people (includes adult education groups). 53,000 days of use per year. Overnight capacity 400	Users provide programs: natural science, leadership, team building	-	<a href="http://www.awsp.org/AM/Template.cfm?section=Cispus">http://www.awsp.org/AM/Template.cfm?section=Cispus</a>
<b>Envirothon</b>	High school teams compete at regional, state. Winner to national.	Varies by number of participating schools. Up to 3 teams per high school. Typically 20-50 in each region; 80+ statewide	Regional, statewide each 1 day, capping semester of class work	Students understand agricultural science, resource policies and economics	<a href="http://www.envirothon.org/">http://www.envirothon.org/</a>

**Table 6. South Puget Sound, Lower Hood Canal, Kitsap and Pierce Counties**

<b>Outdoor/Experiential EE Provider</b>	<b>Description of EE Programs</b>	<b>Annual Participants</b>	<b>Program Length</b>	<b>Special Features</b>	<b>Program Website</b>
<b>South Sound GREEN</b>	Study water quality, local watersheds	4 school districts, 1 private school, 1 college, Over 1,000 students, 4 <sup>th</sup> grade up; 25-30 teachers. Community members	School year. Spring and fall water monitoring, classroom work, restoration	-	<a href="http://www.thurstoncd.com/?id=28">http://www.thurstoncd.com/?id=28</a>
<b>Northwest Trek</b>	Visiting classrooms, teacher training; located in Eatonville, WA	33,000 students	Varies	Partners with Bronx Zoo, Leopold Education Project, Project WILD	<a href="http://www.nwtrek.org/">http://www.nwtrek.org/</a>
<b>Nature Center at Snake Lake</b>	Guided tours; youth classes; located in Tacoma, WA	3,000 students	Tours 2 hours; classes vary	-	<a href="http://www.metroparkstacoma.org/page.php?id=20">http://www.metroparkstacoma.org/page.php?id=20</a>
<b>Point Defiance Zoo, Aquarium</b>	School visits, classroom programs, special programs	23,400 students	Varies	-	<a href="http://www.pdza.org/">http://www.pdza.org/</a>
<b>Wolf Haven International</b>	Guided site visits. Summer day, overnight camps. "Living with Carnivores" workshops	1,500-4,000; 100-300 educators	Site visits 45 min-1.5 hrs;	Internationally recognized wolf sanctuary	<a href="http://www.wolfhaven.org/adopt.html">http://www.wolfhaven.org/adopt.html</a>

<b>Camp Arnold</b>	Environmental Learning Center offering outdoor education programs and facility rental; located in Eatonville, WA	-	-	-	<a href="http://www.tsacamparnold.org/">http://www.tsacamparnold.org/</a>
<b>Camp Thunderbird</b>	Environmental Learning Center providing programs in natural science and environmental education; located in Summit Lake, WA	-	-	-	<a href="http://www.camptbird.org/index.html">http://www.camptbird.org/index.html</a>
<b>University of Washington Pack Forest</b>	Naturalist-led programs for students in grades K-12; located in Eatonville, WA	-	45 min-4hrs	-	<a href="http://www.packforest.org/education/k12.htm">http://www.packforest.org/education/k12.htm</a>
<b>YMCA Camp Colman</b>	Camps for students grade 1-12; leadership camp for high school students; located in Longbranch, WA	-	1 week	Offers specialty camps, including science camp	<a href="http://www.seattlemca.org/page.cfm?ID=cc">http://www.seattlemca.org/page.cfm?ID=cc</a>
<b>Tahoma Audubon</b>	Summer camps, nature education programs, and in-class outreach for schools in Pierce County, centered around habitat education; located in University Place, WA	5,538 total participants in 2006	-	-	<a href="http://www.tahomaaudubon.org/">http://www.tahomaaudubon.org/</a>
<b>YMCA Camp Seymour</b>	Camps for students grade 1-12; leadership camp for high school students; located in Gig Harbor, WA	-	1 week	Offers specialty camps, including science camp	<a href="http://campseymour.org/">http://campseymour.org/</a>

**Table 7. King and Snohomish Counties, and Bainbridge Island Programs**

<b>Outdoor/Experiential EE Provider</b>	<b>Description of EE Programs</b>	<b>Annual Participants</b>	<b>Program Length</b>	<b>Special Features</b>	<b>Program Website</b>
<b>King County</b>	Wheels to Water –Metro bus trips for water quality education	25-60 per trip One bus per school per year	Day-long trip	O and M; costs of buses, drivers	<a href="http://dnr.metrokc.gov/WTD/wheelstowater/">http://dnr.metrokc.gov/WTD/wheelstowater/</a>

<b>Woodland Park Zoo</b>	Wild Wise, Save Our Amazing Raptors, Zoo Corps Service-learning, Forest Explorers; teacher training, more	500,000 learners; 2,961 teachers	From 1 hour to semester	Wild Wise is statewide middle school program. Zoo Corps teens restoring Licton Springs Over 450 additional volunteers	<a href="http://www.zoo.org/wildwise/index.html">http://www.zoo.org/wildwise/index.html</a>
<b>City of Seattle</b>	Parks environmental stewardship and education	7,000-10,000 students; 40-50 teachers	2 hours+	Community advisory council supports these programs	<a href="http://www.seattle.gov/parks/environment/learning.htm">http://www.seattle.gov/parks/environment/learning.htm</a>
<b>Pacific Science Center</b>	Mercer Slough Environmental Education Center	8,000 students 300 teachers 1,800 members of the public	1.5 hours	School trans. Help teachers more. Seasonal interest	<a href="http://www.cmiregistration.com/user/org/category.jsp?id=2368andorg=135">http://www.cmiregistration.com/user/org/category.jsp?id=2368andorg=135</a>
<b>Seattle Aquarium/King County Beach Naturalist Program</b>	K-12, local communities	-	-	-	<a href="http://dnr.metrokc.gov/wlr/pi/beach-naturalists.htm">http://dnr.metrokc.gov/wlr/pi/beach-naturalists.htm</a>
<b>IslandWood Learning Center</b>	Elementary age residential program (Graduate and community programs also provided); located on Bainbridge Island, WA	4,000-5,000 students, 100-200 teachers	Four days for student programs	High standards. Showcase of environmental building principles	<a href="http://www.islandwood.org/default.php">http://www.islandwood.org/default.php</a>
<b>City of Edmonds</b>	Edmonds Discovery Programs: marine, beach, forest learning, Sound Salmon curriculum	6,000 students 200 teachers	1- 1.5 hours in classroom + guided walks	Popular programs	<a href="http://www.ci.edmonds.wa.us/Discovery_programs_website/Chitons.html">http://www.ci.edmonds.wa.us/Discovery_programs_website/Chitons.html</a>
<b>Camp Waskowitz</b>	Environmental Leadership Semester; part of Highline School District	36 high school students	Semester Also week-long outdoor education for upper elementary students	Established in 1946	<a href="http://www.hsd401.org/hr/School_Information/camp_waskowitz.html">http://www.hsd401.org/hr/School_Information/camp_waskowitz.html</a>
<b>Washington Trout Environmental Discovery Program</b>	EE in the classroom and field trips to Oxbow Farm for 4-5 grade	-	-	-	<a href="http://www.washingtontrout.org/EDP.shtml">http://www.washingtontrout.org/EDP.shtml</a>
<b>Camp Long</b>	Naturalists lead EE classes; overnight rental facilities	-	-	Rock climbing classes; O <sub>2</sub> program offers overnight excursions	<a href="http://www.seattle.gov/parks/environment/camplong.htm">http://www.seattle.gov/parks/environment/camplong.htm</a>

<b>Camp Killoqua</b>	Day and resident outdoor education programs for students grades 1-12, and facility use for schools and other groups.	-	1 Day to 1 Week	-	<a href="http://www.campfireusasnohomish.org/killoqua.htm">http://www.campfireusasnohomish.org/killoqua.htm</a>
<b>Camp Hamilton</b>	The Catholic Youth Organization provides a residential outdoor environmental education experience for elementary students through the use of hands-on, exploratory, investigative, and interdisciplinary teaching methods; located in Monroe, WA	-	-	-	<a href="http://www.seattlearch.org/BuildingCommunity/CatholicYouthOrganization/EarthEducation/">http://www.seattlearch.org/BuildingCommunity/CatholicYouthOrganization/EarthEducation/</a>
<b>Camp Sealath</b>	Outdoor and EE day and resident programs for students; located on Vashon Island	-	-	-	<a href="http://www.campfire-usa.org/">http://www.campfire-usa.org/</a>
<b>Cedar Springs Camp</b>	Environmental Learning Center offering day and resident programs; challenge course; located in Lake Stevens, WA	-	-	-	<a href="http://www.cedarspringscamp.net/">http://www.cedarspringscamp.net/</a>
<b>Warm Beach Christian Camp and Conference Center</b>	Environmental Learning Center; facilities rental for groups, day and overnight outdoor programs for students; summer camp	-	-	Horsemanship program	<a href="http://warmbeach.com/index.php">http://warmbeach.com/index.php</a>
<b>Wilderness Awareness School</b>	Intensive, experiential outdoor education programs for students ages 4-18; also offer adult and family programs; located in Duvall, WA	-	1 day-1 week	Week long wolf tracking program in Idaho	<a href="http://www.wildernessawareness.org/index.html">http://www.wildernessawareness.org/index.html</a>
<b>Seward Park Nature Center</b>	Offers educational programs about local ecosystems for Pre-K and K-6 students	-	1-1.5 hrs	-	<a href="http://www.seattle.gov/Parks/environment/seward.htm">http://www.seattle.gov/Parks/environment/seward.htm</a>



<b>Streamkeeper Academy, Adopt-A-Stream</b>	Experiential programs for K-9 students centered around aquatic ecosystems; professional development for teachers	-	-	-	<a href="http://www.streamkeeper.org/education/index.htm">http://www.streamkeeper.org/education/index.htm</a>
---	--	---	---	---	---

**Table 8. Northern Puget Sound Programs**

<b>Outdoor/Experiential EE Provider</b>	<b>Description of EE Programs</b>	<b>Annual Participants</b>	<b>Program Length</b>	<b>Special Features</b>	<b>Program Website</b>
<b>Lynden Christian School</b>	Senior biology class: 23-year old hatchery, marine biology	~24	Term	Strong support for 'real-life' experiences, FFA and other activities	<a href="http://www.lyncs.org/">http://www.lyncs.org/</a>
<b>North Cascades Institute</b>	Field and school programs	10,000 Teachers workshops 200	Skagit Watershed Educ. – 1 day (All Skagit students)	Ability to reduce tuition, reach more schools	<a href="http://www.ncascades.org/">http://www.ncascades.org/</a>
<b>Camp Casey</b>	Interactive classes on local ecosystems available for students; located on Whidbey Island	-	1-2 hours	-	<a href="http://www.spu.edu/casey/InfoFor/outdoored.asp">http://www.spu.edu/casey/InfoFor/outdoored.asp</a>
<b>Camp Moran</b>	Located on Orcas Island; Learning Center provides overnight rentals for groups up to 156; Outdoor School offers day and overnight classes for students	-	-	-	<a href="http://www.orcasisle.com/~elc/outdoorschool/program.htm">http://www.orcasisle.com/~elc/outdoorschool/program.htm</a>
<b>Padilla Bay National Estuarine Research Reserve</b>	Youth programs. Teacher training. Community education	Youth 14,000 (Programs based on estuarine research)	One to 6 hours	Dept. of Ecology –run. Unique estuary study facilities	<a href="http://www.padillabay.gov/">http://www.padillabay.gov/</a>

**Table 9. Central and Eastern Washington Programs**

<b>Outdoor/Experiential EE Provider</b>	<b>Description of EE Programs</b>	<b>Annual Participants</b>	<b>Program Length</b>	<b>Special Features</b>	<b>Program Website</b>
---	-----------------------------------	----------------------------	-----------------------	-------------------------	------------------------

<b>Chewelah Peak Learning Center</b>	Outdoor school, leadership for secondary students, teacher training, challenge course	-	-	-	<a href="http://www.awsp.org/Content/awsp/LearningCenters/ChewelahPeak/default.htm">http://www.awsp.org/Content/awsp/LearningCenters/ChewelahPeak/default.htm</a>
<b>West Valley Outdoor Learning Center</b>	Scientific research for students with field experience, onsite presentations, volunteer opportunities and teacher training. Also offers summer programs	-	-	Field program involving 6 <sup>th</sup> – 12 <sup>th</sup> graders data collection on disappearing mule deer	<a href="http://www.wvolc.org/">http://www.wvolc.org/</a>
<b>Yakima Basin EE Program</b>	Ecosystem/salmon education for K-12 students and teachers; provide field trips, teacher training and curriculum materials	50 teachers	-	All aspects of the program available at no cost to participants	<a href="http://www.ybeep.org/">http://www.ybeep.org/</a>
<b>Project CAT</b>	Integrated EE, scientific research for K-12 with field experience	-	-	-	<a href="http://depts.washington.edu/natmap/projects/cat/">http://depts.washington.edu/natmap/projects/cat/</a>
<b>Chehalis Basin Education Consortium</b>	Professional Development for 4 <sup>th</sup> -12 <sup>th</sup> grade teachers; project WET	-	-	-	<a href="http://www.crcwater.org/2006/200602cbecinfo.html">http://www.crcwater.org/2006/200602cbecinfo.html</a>

**Table 10. Statewide Programs**

<b>Outdoor/Experiential EE Provider</b>	<b>Description of EE Programs</b>	<b>Annual Participants</b>	<b>Program Length</b>	<b>Special Features</b>	<b>Program Website</b>
<b>WSU 4H Forestry Education Program</b>	Comprehensive forestry education in outdoor setting for K-12	-	-	-	<a href="http://www.ncw.wsu.edu/4h/4edintro2.html">http://www.ncw.wsu.edu/4h/4edintro2.html</a>
<b>NatureMapping</b>	K-12, adults and community study biodiversity map using math, science, technology and art	-	-	-	<a href="http://depts.washington.edu/natmap/">http://depts.washington.edu/natmap/</a>
<b>Student Conservation Association</b>	National program provides high school students with trail work and outdoor education programs	-	-	-	<a href="http://www.thesca.org/">http://www.thesca.org/</a>

## Appendix E: Additional Literature Reviews of EE Studies

The following studies include literature reviews that are relevant to this report, but which extend outside of its scope:

**Table 11. Additional Environmental Education Literature Reviews**

Study	# of Studies Reviewed	Timeframe Covered by Studies	Key Findings
Carson and Gillis (1994)	43	-	<ul style="list-style-type: none"> <li>Using meta-analysis, found that outdoor programs tend to have a positive impact on adolescents' behavior, self-concept, and academic performance.</li> </ul>
Hattie, March, Neil, and Richards (1997)	96	1968-1994	<ul style="list-style-type: none"> <li>Using meta-analysis, found that outdoor programs tend to have a positive impact on adolescents' behavior, self-concept, and academic performance.</li> </ul>
Volk and McBeth (1998)	32	1977-1995	<ul style="list-style-type: none"> <li>Found that research has been heavily slanted towards certain topics. Reviewed studies analyzed variables that affected students' environmental attitudes and factual knowledge. Relatively few reviewed studies investigated environmentally responsible behavior, and none focused on cognitive skill development.</li> </ul>
Rickinson (2001)	100	1993-1999	<p>Found that:</p> <ul style="list-style-type: none"> <li>In general, research has been done on the level of students' factual environmental knowledge, skills and behavior, NOT on the outcomes of EE programs or determining what factors determine these outcomes.</li> <li>Most studies found low levels of environmental knowledge.</li> <li>Students' attitudes tend to be pro environmental, but are less so when the issue has a more direct impact on their lifestyle choices (i.e. vehicle use).</li> <li>What research has been done on behavior tends to rely on self reported data.</li> </ul>
Bartosh (2003)	50	1990-2003	<p>Found that:</p> <ul style="list-style-type: none"> <li>In general, research has been done on the level of students' factual environmental knowledge, skills and behavior, NOT on the outcomes of EE programs or determining what factors determine these outcomes.</li> <li>Most studies found low levels of environmental knowledge.</li> </ul>

## Appendix F: Sources for Research

---

The following sources were searched while researching this report:

### Academic Search Engines:

- ERIC (FirstSearch) – a national education database containing citations to research documents, journal articles, technical reports, program descriptions and evaluations, and curricular materials dated post-1966.

Literature produced by local and national environmental education organizations, universities, and governmental offices, including:

- Association for Outdoor and Environmental Education
- Educational Perspectives
- Environmental Education Association of Washington
- Environmental Protection Agency - Office of Environmental Education
- Governor's Council on Environmental Education
- National Environmental Education and Training Foundation
- North American Association for Environmental Education
- Northwest Environmental Education Council
- Pacific Education Institute
- State Education and Environment Roundtable
- The Institute For Environmental Research and Education
- Washington State Office of Environmental Education

Articles from journal and periodical publications including:

- Applied Environmental Education and Communication
- Clearing Magazine
- Critical Studies in Education, Environmental Communicator
- EE Advocate
- Environmental Education Research
- Enviroteach
- The Branch
- The Journal of Environmental Education

GoogleScholar and Ask.com searches for combinations of key words and phrases such as:

- Career Development
- Citizenship
- Demographic
- Environmental Education
- Graduation
- Impact
- K-12
- Northwest
- Service-learning
- Washington



## Appendix G: Database Snapshots

The following screenshots show the database used to record information on the studies gathered for this report:

**OSPI v.1**

File Edit View Insert Format Records Tools Window Help Adobe PDF

Tahoma 7 B I

**Review of Existing Research**

Date of Review: 4/30/2007 Author: Governor's Council on Environmental Education  
Name of Reviewer: Lauren Sloane PublicationType:   
Title: Environmental Education In Washington: Status Report 2004.  
Citation: Governor's Council on Environmental Education. (2004) Environmental Education in Washington: Status Report 2004.

Description Of Program Analysis Of Research Study Findings

Research aim--a summary of aims of the research study as reported in the publication:

Research project details--name, funding details (if mentioned), if this study is part of a larger study, etc.

Conceptual/theoretical approach--summary of the key conceptual and/or theoretical assumptions that underpin the work reported (only if mentioned by the author(s))

Sample size, sample characteristics, demographic information (underserved population, communities, etc.), selection procedures and rationale  
All students within WA state

Methodology--the broader epistemological and theoretical framework that underpins the methods of study (only if acknowledged by the author(s))

Methods (data collection and analysis)--type of study design--quantitative, qualitative, mixed research...triangulation of data Governmental Research Review; G Validity measure--any measure aimed at ensuring validity and/or reliability as reported by the author(s)

Record: 1 of 68

a summary of aims of the research study as reported in the publication

OSPI v.1

File Edit View Insert Format Records Tools Window Help Adobe PDF

Tahoma 7 B I

### Review of Existing Research

Date of Review: 4/30/2007 Author: Governor's Council on Environmental Education

Name of Reviewer: Lauren Sloane PublicationType:

Title: Environmental Education In Washington: Status Report 2004.

Citation: Governor's Council on Environmental Education. (2004) Environmental Education in Washington: Status Report 2004.

Description Of Program Analysis Of Research Study Findings

Research aim--a summary of aims of the research study as reported in the publication:

Research project details--name, funding details (if mentioned), if this study is part of a larger study, etc.

Conceptual/theoretical approach--summary of the key conceptual and/or theoretical assumptions that underpin the work reported (only if mentioned by the author(s))

Sample size, sample characteristics, demographic information (underserved population, communities, etc.), selection procedures and rationale

All students within WA state

Methodology--the broader epistemological and theoretical framework that underpins the methods of study (only if acknowledged by the author(s))

Methods (data collection and analysis)--type of study design--quantitative, qualitative, mixed research...triangulation of data

Governmental Research Review; G

Validity measure--any measure aimed at ensuring validity and/or reliability as reported by the author(s)

Record: 1 of 68

a summary of aims of the research study as reported in the publication

## Appendix H: Outcome Area Tables

Studies that were reviewed and analyzed are included in the following tables by outcome area. Descriptive information and a summary of findings are included for each study.

### Academic Achievement

**Table 12. Academic Achievement - GOLD Studies- Descriptive Information**

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Bartosh et al (2006) /Bartosh (2003)	WA	Formal	K-12	EE schools - schools that have at least 3 years of practicing EE strategies; have 20% of teachers/ classrooms and at least 20% of students involved	77 pairs of schools	Quantitative; comparison of scores on two state standardized tests; 77 pairs matched by demographic, economic and geographic criteria	Environmental education
Bartosh, Tudor and Ferguson (2005)	WA	Formal	Middle	EE schools - schools that have at least 3 years of practicing EE strategies - have 20% of teachers/classrooms and at least 20% of students involved have been selected as "environmental" schools	5 pairs of schools, ~ 200 EE and 200 non EE students	Quantitative, Quasi experimental, matched pairs; compared individual students' scores of the Washington Assessment of Student Learning test and EE-based integrated assessments for two groups of students – students who participated in EE programs and students in traditional classrooms	Environmental education



Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Emekauwa (2004)	Alaska	Formal and non-formal	High school	The Alaska Rural Systemic Initiative (AKRSI) is place-based, systemic Phase 1 consisted of 5 major initiatives: Native Ways of Knowing and Teaching - pre-service and in-service training for teachers; Culturally aligned Curriculum Adaptations - development of a comprehensive culturally aligned curriculum; Indigenous Science Knowledge Base-database of resources documenting indigenous knowledge; Elders and Cultural Camps; Village Science Applications.	176 schools, 18,982 students	Quantitative; comparison of relative changes in state math test scores for grades 8, 10, and 11 in AKRSI schools, non AKRSI schools, Native Indian population and state data	Place-based education
Lieberman, Hoody and Lieberman (2005)	California	Formal	K-5	EIC programs - interdisciplinary, collaborative, student- centered, hands-on, and engaged learning At least 3 years implementing EIC mode; collaborative teaching and learning	3500+ in 4 paired schools	Mixed methods (quantitative - analysis of standardized scores, grade point averages and attendance rates; qualitative – narratives and rubric surveys).; treatment/control group/quasi experimental design; schools were paired using demographic, economic and geographic criteria	Environment-based education
Lieberman and Hoody (1998)	US	Formal	K-12	EIC programs - interdisciplinary, collaborative, student- centered, hands-on, and engaged learning At least 3 years implementing EIC mode; collaborative teaching and learning	400 students, 250 teachers, 40 EIC schools	Qualitative primarily (although some quantitative data was collected about research done by schools. However, no detailed descriptions of these studies are provided)	Environment-based education

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Duffin, Phillips, Tremblay, and PEER Associates (2006)	New Hampshire	Formal	K-10	Antioch New England Institute's Community-based School Environmental Education (CO-SEED) Project exposes students to hands-on, real world learning experiences and strives to simultaneously enhance academic achievement, strengthen community vitality, promote appreciation for the natural world, and increase citizenship among students.	~600 students	Quantitative, compares longitudinal trends in standardized test performance for the District versus the state. students were grouped into eight sequential cohorts spanning academic years 1993-1994 through 2003-2004. Test scores from the New Hampshire Educational Improvement and Assessment Program (NHEIAP) were obtained and used for the analysis, including the proportion of students scoring at each of four proficiency levels, as well as Gorham's test score rank in the State.	Place-based education

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Duffin, Phillips, Tremblay, and PEER Associates (2006)	Massachusetts	Formal	K-10	Antioch New England Institute's Community-based School Environmental Education (CO-SEED) Project exposes students to hands-on, real world learning experiences and strives to simultaneously enhance academic achievement, strengthen community vitality, promote appreciation for the natural world, and increase citizenship among students. The Beebe School uses a school wide theme to connect health and environmental curriculum to real life issues in the surrounding community. The school's theme involves students in hands-on, integrated learning and utilizes local agencies, business, and local natural settings for learning. CO-SEED worked with the Beebe School to enhance the effectiveness of its existing curricular theme from 2000 through 2005.	Between 300 and 600 students each year between 2000 and 2005 (2795 students total)		Place-based education
Emekauwa (2004)	Louisiana	Formal	K-8	Place-based integrated program; hands-on learning, local projects	3 elementary and 2 middle schools, approximate 2000 students.	Quantitative; no control; analyzed changes in the percentage of students performing at unsatisfactory level on the LEAP 21 assessments and compared these data to the state level. 1998-2002	Place-based education

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Atman and Monroe (2004)	Florida	Formal	High	EIC programs, long term, environmental themes, community and service-learning, learner centered	404 students from 11 high schools	Mixed methods; Qualitative – 3 tests, Qualitative interviews; Controlled (pretest-posttest non-equivalent comparison group design)	Environment-based education
Bartosh (2006)	WA	Formal	High	Outdoor service-learning – based environmental program for Grade 10 students; integrated Language Arts, Science and Physical Education; has large service-learning component, year long	79 EE and 102 non-EE students	Mixed methods; quasi experimental design, no random selection, pre and post tests, surveys and interviews. Analysis of WASL scores in science math, reading and writing	Environmental education

**Table 13. Academic Achievement - SUPPORTING Studies- Descriptive Information**

Author and Year	Location	Program Type	Grade level/Age	Program Description	Sample Size	Methodology	Definition
Danforth, P. (2005)	Houston, TX	Formal	Elementary (Grade 3-4)	Schoolyard Habitat Program	3 pairs of schools - 492 students (306 in treatment group and 186 in control group)	Quantitative; nonrandomized control group –treatment group pretest-posttest design. Data on student academic scores (TAKS), attendance records, and demographic records from the beginning of the fall 2002 semester to the end of the spring 2004 semester were collected.	Environmental education
Lewicki (2000)	Wisconsin	Formal	High	Place-based 100 day program in charter school	14 freshmen	Mixed methods - comparison of change in the ITBS scores (pre and post) and reflections of students	Place-based education

Author and Year	Location	Program Type	Grade level/Age	Program Description	Sample Size	Methodology	Definition
American Institutes for Research (2005)	California	Formal	Elementary	Outdoor programs in California (often referred to as outdoor science schools)	255 grade 6 students from 4 elementary schools	Mixed - quantitative and qualitative. Delayed treatment design. Half of each school's grade 6 students (one or more classes) attended outdoor school during Sept-Nov, the remaining grade 6 classrooms attended outdoor school, after December, serving as a control group. Before, immediately after, and 6-10 weeks after the treatment students, parents and teachers were surveyed	Outdoor education
Cheak et al (2002)	Hawaii	Formal	Elementary	IEEIA program - team taught by 2 teachers in a large class, incorporates a public symposium. Curriculum is problem based, involves investigations, is student centered	100 students (50 IEEIA students and 50 from traditional classes)	Mixed methods, quantitative. Administered critical thinking test and the middle school environmental literacy instrument; control group; no control for pre-existing differences	Environmental education
Yap (1998)	WA	Formal	K-8	Model Links program	7 pairs of schools in Washington State	Quantitative; schools were matched by economic and demographic parameters	Environmental education
Lieberman, Hoody and Lieberman (2000)	California	Formal	K-5	EIC programs - interdisciplinary, collaborative, student- centered, hands-on, and engaged learning At least 3 years implementing EIC; collaborative teaching and learning	8 paired schools	Mixed methods (quantitative - analysis of standardized scores, grade point averages and attendance rates, qualitative – narratives and rubric surveys). Treatment/control group/quasi experimental design. Schools were paired using demographic, economic, and geographic criteria	Environment-based education

Author and Year	Location	Program Type	Grade level/Age	Program Description	Sample Size	Methodology	Definition
Randall (2001)	Florida	Formal	High	Biodiversity unit designed around an Internet database that utilizes collection records from the Florida Museum of Natural History and documents from other Florida environmental agencies. The curriculum contains five lessons: four refer to museum-related content, and one focuses on writing skills.	132 Grade 9 and 10 students,	Quantitative, pre and post test and writing samples assessed using state rubric for writing test	Environmental education
Workman (2005)	Minnesota	Formal	Elementary	Integrated environmental education curriculum	941 students(532 Grade 3 students and 409 Grade 5 students	Quantitative, ex post facto causal comparative design; achievement measured as MCA assessment scores; significance testing and regression analysis to control for covariate; 4 years of data	Environmental education
Connors and Elliot (1993)	Michigan	Formal	High	Agriscience and natural resource curriculum compared to traditional science classes	156 students in 4 high schools	Quantitative, compares achievement on the High school Biology test (standardized science test), administrative data and GPAs.	Environmental education/environmental science
Klemmer, Waliczek and Zajicek (2005)	Texas	Formal	Elementary	Hands on gardening program for elementary students	647 students from seven elementary schools	Quantitative; treatment and control groups; comparison of performance on the state test	

**Table 14. Academic Achievement – GOLD Studies- Summary of the Findings**

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Bartosh et al (2006)/Bartosh (2003)	<p>Significant difference – positive impact</p> <p>WASL: 50 EE schools did better in math (p=.000) ITBS: 45 EE schools did better in math (p=.010)</p>	<p>Significant difference – positive impact</p> <p>WASL: 51 EE schools did better (p=.000). ITBS: 45 EE schools did better in reading (p=.001)</p>	<p>Significant difference – positive impact</p> <p>WASL: 56 EE schools did better in writing (p=.000)</p>	<p>Significant difference – positive impact</p> <p>WASL: 46 EE schools did better in listening (p=.003)</p>				<p>In 73 pairs out of 77 environmental schools had higher scores in at least one subject.</p> <p>There is a significant difference in math, reading, writing, and listening on the WASL tests, with EE schools performing better than non-EE comparison schools in all tests. Longitudinal analysis showed that EE schools had higher mean percentages of students who met standards on the WASL for the period of 1997-2002.</p>

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Emekauwa (2004)	<p>Positive - significant?</p> <p>CAT-5: A 6.9-point increase in the percentage of 8th graders scoring in the upper quartile (compared to only 1-point increase for non-AKRSI schools)</p> <p>High School Qualifying examination: an 8.36 percent increase in the number of 10th graders scoring proficient or advanced on the state's math exam</p> <p>At the 11th grade level, AKRSI students are moving out of the lowest quartile in math performance at a significantly higher rate than non-AKRSI students</p>							<p>Grade 8, 10 and 11 students perform better on the state math tests compared to students from traditional programs.</p> <p>AKRSI schools in 2001 also showed a 5.61-point differential over Alaska Native students as a whole.</p>



Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Lieberman, Hoody and Lieberman (2005)	Significant difference – positive impact  in 92.5% of the math assessments EIC students scored as well or significantly higher than control students	Significant difference – positive impact  in 100% of assessments EIC students scored as well or significantly higher than control students	Significant difference – positive impact  in 95% of the language assessments EIC students scored as well or significantly higher than control students				Significant difference – positive impact  spelling - in 97.5% of the spelling assessments, EIC students scored as well or significantly higher than control students	EIC students outperformed students in control group in over 96% of assessments (136 out of 146) in four core areas: reading, math, language and spelling

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Bartosh, Tudor and Ferguson (2005)	<p>Positive change – significant</p> <p>Students from EE schools have higher scores on the WASL math - significant difference</p>	<p>Positive change</p> <p>Although students from EE schools tend to outperform students from non-EE schools on reading tests on the WASL, there is no significant difference in this area (p=.24).</p>	<p>Positive change – significant</p> <p>Students from EE schools have higher scores on the WASL writing - significant difference</p>	<p>Positive change</p> <p>Although students from EE schools tend to outperform students from non-EE schools on listening tests on the WASL, there is no significant difference in this area (p=.11).</p>			<p>Positive change – significant</p> <p>Students in EE schools tend to have higher scores on the Inquiry, System, and Civics WASL-like tests, and this difference was statically significant (p (inquiry)=0.036; p(systems)=0.001; and p(civics)=0.000). This demonstrates that students in EE programs develop stronger environmental literacy skills and deeper understanding of environmental systems.</p>	<p>EE students outperformed their counterparts from traditional program in Math and writing (significant), and in listening and reading (not significant). EE students also significantly outperformed non-EE students in environmental literacy tests.</p>

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Duffin, Phillips, Tremblay, and PEER Associates (2006)	Positive change  Gorham Math scaled scores for Cohorts 5-8 improved an average of 12 points from Grade 3 to Grade 6, or 63% of the increment required to advance from the basic to the proficient proficiency level (state scores decreased by 4 points).	Positive change  Gorham Language Arts scaled scores for Cohorts 5-8 improved an average of 16 points from Grade 3 to Grade 6, or 84% of the increment required to advance from the basic to the proficient proficiency level. (state scores decreased by 2 points).	See reading					The percentage of students at passing or higher proficiency levels for all subject areas tested in Grade 6 was higher for CO- SEED students than the state average.

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Duffin, Phillips, Tremblay, and PEER Associates (2006)	<p>Positive change</p> <p>Increased student achievement due to focused work in math, life science, physical science, and technology/engineering, mostly for upper level grades.</p> <p>Grade 4 Beebe starts out outperforming the District in 2000, though in years 2002 and later, District performance begins to reach Beebe performance. In 2004, Beebe outperforms both the District and the state.</p>				See math		See math	<p>Found increased student achievement due to focused theme work in math, life science, physical science, and technology/engineering, mostly for upper level grades. An examination of percent correct scores across subject areas from 2000-2005 shows that Beebe outperformed the District by about 2-5 percentage points.</p> <p>"Dose-response" analyses revealed that there is a reliable relationship between time in the Beebe school and performance on the MCAS, implying that students with more exposure to the CO-SEED curriculum do appear to perform better on standardized tests. However, of the 22 test administrations, the four that showed statistical significance for the dose-response correlation were all administered in 2004.</p>

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Emekauwa (2004)	<p>Positive change</p> <p>In mathematics, there was a 14.1-point decline for East Feliciana students who performed at the unsatisfactory level, from 39% in 1999-00 to 24.9% in 2001-02 (compared to a 3.6-point decline in the state as a whole)</p>	<p>Positive change</p> <p>The percentage of 4th grade students performing at the unsatisfactory level in english and language arts. decreased from 32.6% in 1999 to 18.4, a full 13.2 points (decrease for the state level is 6.5 points)</p>	See reading		<p>Positive change</p> <p>In science, East Feliciana's 4th graders posted an 8.1-point decrease in the number of students scoring unsatisfactory between 1999-00 and 2001-02 while in the state overall, there was a 3.7-point decrease. In 2000-01; East Feliciana's 4th graders tied the overall state performance in science.</p>	<p>Positive change</p> <p>In social studies, there was an 11.3-point decrease in the number of students scoring unsatisfactory</p>		<p>The percentage of low performing students decreased in all four areas both at the district and school levels</p>

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ subject areas	Summary of the results
Atman and Monroe (2004a)							<p>Positive change</p> <p>Critical thinking - Grade 9 students scored 4.33 points higher on the Cornell Critical Thinking Tests than the students in the control group. Grade 9 and Grade 12 students scored 3 and 9 points higher respectively than students in traditional programs</p>	Students in programs designed around an environmental context tended to score higher on the Cornell Critical Thinking Tests than students in the traditional classes.
Bartosh (2006)	<p>Positive-significant</p> <p>A statistically significant difference between EE and non-EE classes was found in math (<math>F=7.123</math>, <math>p=.009</math>).</p>	<p>Positive change</p> <p>While on average scores on the WASL reading and writing tests were higher for EE group, this difference was not large enough to be considered statistically significant (reading: <math>F=2.327</math>, <math>p=.130</math>; writing: <math>F=.001</math>, <math>p=.975</math>).</p>	See Reading		<p>Positive-significant</p> <p>A statistically significant difference between EE and non-EE class was found in science (<math>F=5.074</math>, <math>p=.026</math>).</p>		<p>Positive-significant</p> <p>EE group had significantly higher GPAs by the end of the year.</p>	<p>The percentages of students who meet/are above standards on the WASL for EE groups were higher than school, district and state averages in math, reading, writing and science. EE groups had significantly higher GPAs by the end of the year.</p> <p>The results are controlled for differences in pre program achievement level, gender, and education goals</p>

**Table 15. Academic Achievement – SUPPORTING Studies- Summary of the Findings**

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ Subject Areas	Summary of the Results
Danforth, P. (2005).	Positive  TAKS: The average change in math scores was 6.52 for treatment group (ranging from 0.46 to 3.79) and 0.56 for control group (ranging from -1.34 to 3.40).	Negative  TAKS : The average change in reading scores was -2.78 for treatment group (ranging from -1.55 to -3.58) and -2.16 for control group (ranging from -1.60 to -3.01)						Results showed a higher increase in average math scores for EE classes than for classes with a traditional curriculum. Reading scores were slightly negatively correlated for both groups, however, the average reading score was lower for EE group. The author argued that the curriculum was more directly connected to math than reading.
Lewicki (2000)		Positive change – significant?  Reading score increased from 10.4 to 12.7	Positive change – significant?  Writing score increased from 8.5 to 12.4		Positive change – significant?  Science score increased by grade 3 points	Positive change – significant?  Social studies score increased from 9.3 to 12.2		Composite score of students increased three grades by the end of the year
American Institutes for Research (2005)					Positive change – significant  Students who attended the program improved their science scores significantly from pre test to the first post survey. (gain 3.1 - significant at p= .001)			Students performance in science increased significantly by the end of the year.

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ Subject Areas	Summary of the Results
Cheak et al (2002)		Positive change  Students commented on improved reading skills (but it was not formally measured)	Positive change  Students commented on improved writing skills (but it was not formally measured)				Positive change - significant  Students in IEEIA program scored higher both on the critical thinking test (14.18 vs. 10.86, sig= .000) and five out of eight components of an environmental literacy instrument.	Students also commented on improved reading and writing skills, improved oral communication skills, effective use of technology, improved personal characteristics, and participatory citizenship in the community.
Yap (1998)	No significant difference  % of students who meet standards in math was higher for non-EE schools. No consistent difference in student achievement was found.	No significant difference  % of students who meet standards reading was higher for non-EE schools. No consistent difference in student achievement was found.	No significant difference  EE schools outperformed non-EE schools in writing. No consistent difference in student achievement was found.	No significant difference  EE schools outperformed non-EE schools listening. No consistent difference in student achievement was found.				Schools with higher levels of implementation of their environment-based programs had higher results on the standardized tests. On the standard based assessment, EE projects outperformed non-EE schools in writing and listening. However, % of students who met standards in math and reading was higher for non-EE schools. No consistent difference in student achievement was found, but there was a link between the level of EE implementation and achievement of the tests with schools with better EE programs performing better than schools with little or no EE.



Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ Subject Areas	Summary of the Results
Lieberman and Hoody (1998)	Positive  EIC students performed better in 71% of assessments (5). 73% of teachers reported improved understanding of mathematical concepts. 92% of teachers reported better mastery of math skills	Positive  EIC students performed better in 100% of assessments (17). 93% of educators reported improved development of language arts skills. 94% of teachers reported greater enthusiasm for language arts	See Reading		Positive  EIC students performed better in 75% of Science assessments (3). 99% of teachers reported increased knowledge and understanding of science content, concepts, processes and principles. 99% of teachers reported improved student ability to apply science to real-world situations	Positive  EIC students performed better in 100% of SS assessments (2). 95% of teachers reported greater comprehension of social studies content by their students. 97% of teachers reported more advanced skills in applying civic processes to real life situations		Students in classrooms with environment-based programs tend to have higher scores on standardized tests in math, reading, writing, science, and social sciences. 14 EIC schools conducted comparative analysis of data from both EIC and traditional students - looked at standardized tests, GPAs, attendance, student attitude measures (39 comparative analyses in total). 36(92%) indicate that students in EIC academically outperform their peers in traditional programs
Lieberman, Hoody and Lieberman (2000)	Positive - significant?  In 63% of math assessments (17 out of 27) EIC students outperformed non-EIC students	Positive - significant?  In 76% of language arts assessments (69 out of 91) EIC students outperformed non-EIC students	See Reading		Positive - significant?  In 64% of science assessments (7 out of 11) EIC students outperformed non-EIC students	Positive - significant?  In 73% of social science assessments (8 out of 11) EIC students outperformed non-EIC students		EIC students outperformed non-EIC students in 72% (101 out of 140) academic assessments in language arts, math, science, and social science

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ Subject Areas	Summary of the Results
Randal (2001)			<p>Positive - significant</p> <p>The students averaged an increase of .61 on a six point scale that measures presence and quality of writing attributes such as grammar, sentence structure, word choice, focus, transitional devices, and organization.</p>					Students who participated in a biodiversity program that focused on developmental biology and writing skills showed a significant increase in writing test scores
Workman (2005)	<p>Positive/no difference</p> <p>EE students significantly outperformed non-EE students in math in 1998 and 2000 (grade 3) and 1998 and 2001 – grade 5 (<math>p &lt; .05</math>) (66%).</p>	<p>Positive/no difference</p> <p>EE students outperformed non-EE classes in 1999 (grade 3) and 2001 (grade 5) (33%) (<math>p &lt; .05</math>)</p>						The difference in mean reading and math scores between the two groups was significant 33% of the time in reading and 66% of the time in math. However, the study did not take outside factors into account other than the percentage of free/reduced lunch students.

Author and Year	Math	Reading	Writing	Listening	Science	Social Studies	Other Skills/ Subject Areas	Summary of the Results
Connors and Elliot (1993)					No difference  no significant difference between students participating in agriscience classes and those who did not			While there was no difference in science scores, Agriscience students on average had less science credits compared to the control group (1.47 vs 2.79). The study also show correlation between student' scores and the number of science credits.

## Career Development

**Table 16. Career Development - GOLD Studies – Descriptive Information**

Author and Year	Location	Program Type	Grade level/Age	Program Description	Sample Size	Methodology	Definition
None							

**Table 17. Career Development - SUPPORTING Studies - Descriptive Information**

Author and Year	Location	Program Type	Grade level/Age	Program description	Sample Size	Methodology	Definition
Seever and Nowlin (1991)	Missouri	Formal	Grade 6-8	Nowlin Middle School for Environmental Science; a team of five teachers (english, social studies, science, math and reading). Each student participated in these classes plus two exploratory classes (i.e. art). Career information is infused across the curriculum and field experiences	Not reported	Mixed - surveys, interviews, observations	Environmental education

Author and Year	Location	Program Type	Grade level/Age	Program description	Sample Size	Methodology	Definition
Grassi, Hanley and Liston (2004)	Colorado	Formal and non-formal	Youth	29 service-learning programs organized by school or school district.	672 students, 51 adults and 69 parents	Mixed - quantitative surveys, and qualitative interviews	Service-learning
Billig, Root and Jesse (2005)	USA (several states)	Formal	High school	8 pairs of schools , two classes in each. One school with service-learning program and the other with a traditional curriculum	1000 students	Mixed methods – surveys, interviews and focus groups. Matched schools, by location, subjects, demographics and achievement level, treatment and control groups, pre and post tests; included possible moderators of the outcomes.	Service-learning

**Table 18. Career Development- GOLD Studies – Summary of the Findings**

Author and Year	Sample size	Grade/Age	Results
None			

**Table 19. Career Development- SUPPORTING Studies – Summary of the Findings**

Author and Year	Sample size	Grade/Age	Results
Seever (1991) - Nowlin	Not reported	Grade 6-7	38%, 43% and 53% of students said that they have learned about career opportunities in the field of environmental science. 23%-30% of students from grades 6-8 said that they might be thinking about a career in environmental field.
Grassi, Hanley and Liston (2004)	672 students, 51 adults and 69 parents	Youth	Participation in the service-learning programs had a significant impact on the work experience gained by youth. 52 % (n=346) reported having gained work experience, 43% reported having gained job skills, and 26% reported having gained career awareness through participation in service-learning. Parents (58%) and teachers (50%) reported that students gained communication skills.
Billig, Root and Jesse (2005)	1000 students	High school	Service-learning groups outperformed comparison groups (significant difference) in the development of career, job, and work skills.

## Graduation Requirements

Table 20. Graduation Requirements - GOLD Studies – Descriptive Information

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Emekauwa (2004)	Alaska	Formal and non-formal	High school	The Alaska Rural Systemic Initiative (AKRSI) is place-based, systemic. Phase 1 consisted of 5 mayor initiatives: Native Ways of Knowing and Teaching - pre-service and in-service training for teachers; culturally aligned Curriculum Adaptations - development of a comprehensive culturally aligned curriculum; indigenous science knowledge base - database of resources documenting indigenous knowledge; Elders and Cultural Camps; Village Science Applications.	176 schools, 18,982 students	Quantitative; comparison of relative changes in state math test scores for grades 8, 10, and 11 in AKRSI schools and non AKRSI schools; Native Indian population and state data	Place-based education

Table 21. Graduation- GOLD Studies – Summary of the Findings

Author and Year	Sample size	Grade/Age	Results
Emekauwa (2004)	176 schools, 18,982 students	High school	Changes in the dropout rates are larger for AKRSI students; dropout rates for grade 7-12 in AKRSI schools declined from a mean of 4.4 in 1995 to 3.6 in 200, compared to a decrease from 2.7 to 2.4 for non-AKRSI schools. The first-time freshman enrollment from AKRSI districts increased by 49% in 2001 over the numbers enrolled in 1995.

## Self-Esteem, Engagement, and Motivation

Table 22. Self-Esteem - GOLD Studies – Descriptive Information

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Kaly and Heesacker (2003)	British Virgin Islands	Non-formal	12-22	A summer ship-based adventure program, Actionquest. The program is divided into three different sessions, each three weeks in duration, from June to August 1997	265 students	Quasi experimental design; treatment and control group, pre-post surveys, controlling for possible testing effects.	Outdoor adventure program
American Institutes for Research (2005)	California	Formal	Elementary (Grade 6)	Outdoor programs in California (often referred to as outdoor science schools)	255 grade 6 students from 4 elementary schools	Mixed - quantitative and qualitative. Delayed treatment design. Half of each school's grade 6 students (one or more classes) attended outdoor school during Sept-Nov, the remaining grade 6 classrooms attended outdoor school after December, serving as a control group. Students, parents and teachers were surveyed before, immediately after, and 6-10 weeks after the treatment	Outdoor education
Atman and Monroe (2004b)	Florida	Formal	High school	EIC programs, long term, environmental themes, community and service-learning, learner centered	404 students from 11 high schools	Mixed methods; quantitative – 3 tests, qualitative interviews; Controlled (pretest-posttest non-equivalent comparison group design)	Environment-based education

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Lieberman and Hoody (1998)	US	Formal	K-12	EIC programs - interdisciplinary, collaborative, student- centered, hands-on, and engaged learning. At least 3 years implementing EIC mode; collaborative teaching and learning	400 students, 250 teachers, 40 EIC schools	Qualitative primarily, although some quantitative data was collected about research done by schools. However, no detailed descriptions of these studies is provided	Environment-based education

**Table 23. Self-Esteem, Engagement and Motivation - GOLD Studies – Summary of the Findings**

Author and Year	Sample size	Grade Level/Age	Results
Kaly, P. and Heesacker, M. (2003)	265 students	12-22	no significant difference between pre and post test of self-esteem for both treatment and control groups
American Institutes for Research (2005)	255 grade 6 students from 4 elementary schools	Elementary (Grade 6)	To determine the impact of OE programs on students' personal and social skills, students and parents were surveyed on 5 constructs: self-esteem, leadership, cooperation, conflict resolution and students' relationships with their teacher. Students who participated in the program showed positive gains in all 5 constructs immediately after the program. Significant differences were found between groups 6-10 weeks later - in cooperation and conflict resolution skills. Teachers reported significant changes in their students in self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class.
Atman and Monroe (2004b) - motivation	404 students from 11 high schools	High school	EIC students scored significantly higher on the California Measure of Mental Motivation and the Achievement Motivation Inventory measuring achievement motivation, with Grade 9 and Grade 12 students having scored 3 and 9 points higher respectively than students in traditional programs.
Lieberman and Hoody (2002)	400 students, 250 teachers, 40 EIC schools	K-12	Teachers reported growing enthusiasm (and motivation to learn) in social studies- 95% of teachers; science - 98% of teachers; math - 89% of teachers; and language arts- 94% of teachers

**Table 24. Self-Esteem, Engagement and Motivation - SUPPORTING Studies – Descriptive Information**

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Larson, B (2007)	Kentucky	Non-formal	18-22	Life adventure program - summer program that provides a 5 day adventure camping experience for children with behavioral problems		Treatment and control group, randomly selected; quantitative study; pre-post program tests using self concept scales.	Adventure education, outdoor education
Garst and Baker (2001)	Southwest of USA	Non-formal	Youth	3 day outdoor adventure program . Activities- hiking, caving, environmental education programs. Participants organized in groups of 4 or 5 were responsible to setting up the campsite, cooking, cleaning, etc. they were also provided with unstructured time for reading, rest, exploring surrounding area.	58	Mixed methods: quantitative and qualitative. Quantitative -pretest, immediate post test and 4 months posttest questionnaires; qualitative - observations, journaling, immediate and 4 month interviews	Outdoor adventure program
Yap (1998)	WA	Formal	K-8	Model Links program	Seven pairs of schools in Washington State	Quantitative; schools were matched by economic and demographic parameters	Environmental education
Cross (2002)	Colorado	Formal and non-formal	High school	Rock climbing camp - 5 days, at a alternative high school for at-risk students	17 pairs of students	Quantitative, quasi experimental, pre-post test, treatment/control groups, matched pairs of students by gender, age, ethnicity, SES, family living situation and academic standing. Two instruments - Dean Alienation Scale and the Cornell instrument (perception of control)	Adventure outdoor education



Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Battersby (1999)	England	Formal	Year 11 and 13	England; geography classes. Students learn about the environment, conservation, etc (these are mandated topics of the geography curriculum)	not reported	Mixed (questionnaire and interviews)	Ennvironmental education
Duffin, Powers, Tremblay and PEER Associates (2004)	USA	Formal	K-12	Place-based Education Evaluation Collaboration - evaluated 5 place-based programs across USA	721 students and 338 teachers	Mixed - surveys and interviews; dose-response strategy - level of program implementation and its impact	Place-based education
Lieberman, Hoody and Lieberman (2000)	California	Formal	K-5	EIC programs - interdisciplinary, collaborative, student- centered, hands-on, and engaged learning. At least 3 years implementing EIC mode; collaborative teaching and learning	8 pairs of schools	Mixed methods (quantitative - analysis of standardized scores, grade point averages and attendance rates; qualitative – narratives and rubric surveys). Treatment/control group/quasi experimental design. Schools were paired using demographic, economic and geographic criteria	Environment-based education
Secker (2004)	Maryland	Formal	Elementary and middle schools	The Bay Schools Project uses EIC model. The goals of the project were to encourage students to act responsibly toward the environment and the Bay; foster greater engagement in learning; demonstrate successful integration of environmental education themes into the curricula of a range of school levels, types and populations	3 elementary and 2 middle schools	quantitative - student and teacher surveys	Environment-based education
Grassi, Hanley and Liston (2004)	Colorado	Formal and non-formal	Youth	29 service-learning programs organized by schools or school districts.	672 students, 51 adult and 69 parents	Mixed - quantitative - surveys, and qualitative - interviews	Service-learning

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Billig, Root and Jesse (2005)	USA (several states)	Formal	High school	8 pairs of schools, two classes in each. Each pair includes one school with a service-learning program and one with traditional a curriculum	1000 students	Mixed methods – surveys, interviews, and focus groups. Matched schools by location, subjects, demographics and achievement level; treatment and control groups, pre and post tests; included possible moderators of the outcomes.	Service-learning
Battersby (1999)	England	Formal	Year 11 and 13	England geography classes. Students learn about the environment, conservation, etc (theses are mandated topics of the geography curriculum)	Not reported	Mixed (questionnaire and interviews)	Environmental education

**Table 25. Self-Esteem, Engagement and Motivation - SUPPORTING Studies – Summary of the Findings**

Author and Year	Sample Size	Grade Level/Age	Results
Larson (2007)		18-22	While there was no difference between treatment and control groups, there were differences between the age groups within the treatment group
Garst and Baker (2001)	58 participants	Youth	Quantitative results suggest that several areas of self-perception profiles, such as social acceptance and behavior conduct, increased immediately after the program and that some behavior conduct impacts may have remained four months after the trip. Qualitative data supported the quantitative results and provided additional evidence that self-perception impacts occurred due to the interrelatedness of several outdoor adventure trip characteristics (novelty of the program, duration, etc.)
Yap (1998)	7 pairs of schools in Washington State	K-8	School staff identified a range of benefits for students: improved student motivation, self-confidence, critical thinking, technical reading and writing skills and decrease in behavior and discipline problems

Author and Year	Sample Size	Grade Level/Age	Results
Cross (2002)	17 pairs of students	High school	Though the two groups were no different before the treatment, the treatment group appeared to be less alienated after the program. Following the treatment, the experimental group demonstrated a stronger sense of personal control than did its control counterparts. No significant difference was detected for gender, ethnicity, and family. Thus, the intensive outdoor adventure experience has a significant effect on at-risk adolescents' feelings of alienation and perception of control.
Duffin, Powers, Tremblay, and PEER Associates (2004)	721 students and 338 teachers	K-12	Participation in PEEC programs makes significant and positive contributions to student engagement in learning, student civic engagement, student time spent outdoors, and student stewardship behavior
Lieberman, Hoody, and Lieberman (2000)	8 pairs of schools	K-5	In 77% cases attendance was better in EIC schools
Secker (2004)	3 elementary and 2 middle schools	Elementary and middle schools	Within each school, student engagement was statistically significantly higher for students whose EIC experiences were more intense. Standardized mean difference in the engagement of students whose EIC experience was high (10.6) compared to that of students with little EIC experience.
Grassi, Hanley, and Liston (2004)	672 students, 51 adult and 69 parents	Youth	Students also reported that service-learning improved their attitude to school and learning.
Billig, Root, and Jesse (2005)	1000 students	High school	There was a small, significant difference between the service-learning group and the comparison group in school enjoyment, favoring the service-learning group.
Battersby (1999)	Not reported	Year 11 and 13	Students adopted a more positive attitude to learning. Improved confidence. Some students expressed higher interest in school in general

## Civic Responsibility and Service-Learning

Table 26. Civic Responsibility - SUPPORTING Studies – Descriptive Information

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Siemer and Knuth (2001)	Nine states	Formal and non-formal	Grade 6-8	Hooked on Fishing - Not on Drugs - national program coordinated by Future Fisherman Foundation. Full implementation - actual finishing experience, teaching materials; involve partner organizations; involve parents and/or family members in actual fishing experiences. Long term programs, take place in three or more seasons of the year; opportunities for fishing apprenticeship and mentorship relationships; involve actually meetings, fieldtrips; organized as an after school program. If any of these characteristics are absent, the implementation is regarded as partial	619 students	Mixed methods - survey and interviews with subset of students. Control (no fishing experience/participation); treatment - one group from programs with partial implementation and one group from programs with full implementation	Environmental education
Duffin, Powers, Tremblay, and PEER Associates (2004)	USA	Formal	K-12	Place-based Education Evaluation Collaboration - evaluated 5 place-based programs across USA	721 students and 338 teachers	Mixed - surveys and interviews; dose-response strategy - level of program implementation and its impact	Place-based education

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Cheak et al (2002)	Hawaii	Formal	Elementary	IEEIA program - team taught by 2 two teachers in a large class, incorporates a public symposium. Curriculum is problem based, involves investigations, is student centered	100 students (50 IEEIA students and 50 from traditional classes)	Mixed methods, quantitative; critical thinking test of environmental education and the middle school environmental literacy instrument, control group; no control for pre-existing differences	Environmental education
American Institutes for Research (2005)	California	Formal	Elementary (Grade 6)	Outdoor programs in California (often referred to as outdoor science schools)	255 grade 6 students from 4 elementary schools	Mixed - quantitative and qualitative. Delayed treatment design. Half of each school's grade 6 students (one or more classes) attended outdoor school during Sept-Nov, the remaining grade 6 classrooms attended outdoor school after December - serving as a control group. Students, parents and teachers were surveyed before, immediately after and 6-10 weeks after the treatment	Outdoor education
Grassi, Hanley and Liston (2004)	Colorado	Formal and non-formal	Youth	29 service-learning programs organized by schools or school districts.	672 students, 51 adult and 69 parents	Mixed - quantitative - surveys, and qualitative - interviews	Service-learning
Billig, Root and Jesse (2005)	USA (several states)	Formal	High school	8 pairs of schools , two classes in each. One school in each pair has a service-learning program and the other has a traditional curriculum	1000 students	Mixed methods – surveys, interviews, and focus groups. Matched schools, by location, subjects, demographics and achievement level; treatment and control groups, pre and post tests; included possible moderators of the outcomes.	Service-learning

Author and Year	Location	Program Type	Grade Level/Age	Program Description	Sample Size	Methodology	Definition
Battersby (1999)	England	Formal	Year 11 and 13	England, Geography classes. Students learn about the environment, conservation, etc (theses are mandated topics of the Geography curriculum)	not reported	Mixed (questionnaire and interviews)	Ennvironmental education
Smith, T . (1995)	Wisconsin	Formal	Youth	Fresh Start School - educational and therapeutic program for sexually abused and exploited adolescents. 16 students lived and learned in north woods of Wisconsin. 185 days long. 45 days were spent in outdoor trips,	16 students	Not stated; academic achievement- two tests; behavior change - check list; self concept - the Tennessee Self concept inventory	experiential, adventure, outdoor education

**Table 27. Civic Responsibility - SUPPORTING Studies – Summary of the Findings**

Author and Year	Sample Size	Grade Level/Age	Results
Siemer and Knuth (2001)	619 students	Grade 6-8	Youth in fully implemented fishing programs demonstrated better fishing skills, better knowledge and awareness of aquatic environments and issues related to fishing as well as stronger commitment to limit the impact on the environment while fishing.
Duffin, Powers, Tremblay, and PEER Associates (2004)	721 students and 338 teachers	k-12	Participation in PEEC programs makes significant and positive contributions to student engagement in learning, student civic engagement, student time spent outdoors, and student stewardship behavior
Cheak et al (2002)	100 students (50 IEEIA students and 50 from traditional classes)	Elementary	IEEIA students demonstrated improved personal characteristics and participatory citizenship in the community (data obtained from student and teacher interviews)

Author and Year	Sample Size	Grade Level/Age	Results
American Institutes for Research (2005)	255 grade 6 students from 4 elementary schools	Elementary (Grade 6)	Stewardship - students who attended the program showed a significant increase in concern about conservation. However, this gain was not significantly different than the control group. Parents whose students attended the OE program observed children engaging in positive environmental behaviors at home, whereas a statistically significant finding was not observed for parents of the control group.
Grassi, Hanley and Liston (2004)	672 students, 51 adult and 69 parents	Youth	Students and parents reported increased engagement in the community
Billig, Root and Jesse (2005)	1000 students	High school	Study explored impact of different service-learning projects on students - Students who select service-learning projects that focus on a civic issue develop better civic knowledge than students who work on environmental projects. Students participating in environmental projects develop better attachment to community than those who work on civic issues.
Battersby (1999)	Not reported	Year 11 and 13	Students developed a sense of ownership of the world and of responsibility. EE allowed students to express their own opinions, feelings and concerns and demonstrate their values.
Smith, T. (1995)	16 students	Youth	Pre-post Behavior Checklist analysis indicated that students became more responsible, more considerate and trusting of others, more independent, better able to establish rapport with adults, better able to control anger, more enthusiastic about life, more relaxed and calm, and capable of some insight into their problems.

## Appendix I: Model Programs

---

The following Washington State environmental education programs were identified as having an evaluation component, or have received an OSPI Natural Science, Wildlife and Environmental Education Partnership Grant. This list should not be considered complete, but rather provides a few examples of effective programs.

### Salish Sea Expedition

The goal of this program is to “inspire a passion for exploring, understanding, and respecting the marine environment through hands on scientific inquiry on Puget Sound.” The program targets grade 5-12 students and has served hundreds of children since its inception in 1997. Students are involved in pre-trip program sessions, a 2-5 day expedition on board a ship, and post-trip sessions in the classrooms. Students are fully involved at all stages of the program. During the preparatory stage, they are involved in designing and preparing for the expedition, as well as participate in lectures and workshops and learn about the scientific method of research. On the expedition, students conduct their own research projects and learn how to navigate the ship. At the end of the program students present their findings to their peers, parents, and community using posters, newspapers, and science fair presentations.

The evaluation of the Salish Sea Expedition program indicates that students gain science knowledge and skills; acquire the ability to navigate the ship and use scientific equipment; develop teamwork skills and confidence in their own abilities; and feel more able to direct their own learning experiences. Teachers believe that the program supports classroom learning because it addresses the Essential Academic Learning Requirements.

### Woodland Park Zoo Teacher Training Program

Woodland Park Zoo provides education opportunities for teachers to develop knowledge, skills, and resources to effectively incorporate environmental education in their classrooms. From 1997 to 2001, over 1000 teachers participated in the workshops. The evaluation of the program shows that teachers gained environmental and science knowledge and skills and learn how to integrate environmental education with their curriculum.

### North Cascades Institute Youth Programs

North Cascades Institute’s school programs serve 85 classes in 9 school districts (2,500 students every year). The goal of the program is to integrate local places and local environmental concerns into the school curriculum. Teachers reported that the program improved students’ attitudes toward the environment and increased their interest and appreciation of local places. Students developed better skills and attitudes for studying outdoors. 74% of teachers saw new career aspirations from their students.

### Seattle Aquarium – Citizen Science

The Seattle Aquarium works with area high schools to collect baseline data about local beaches and key flora and fauna. The program, Citizen Science, is designed to provide students with an opportunity to experience relevant, hands-on fieldwork by building a database of information that scientists can use to understand local habitat and biodiversity changes over time. Through



Citizen Science, students from diverse backgrounds and from “low-to-middle achieving high schools” work with Aquarium staff to build investigative skills, collect data, and conduct independent research.

An evaluation conducted by Sound View in 2006 indicates that students enjoyed their experience and appreciated the hands-on experience they gained. Students liked seeing the animals and knowing that their contributions will be used by scientists to monitor beach habitat. According to the report, “high school students have benefited from the project and some have confirmed plans to go into marine science in college.” The report, however, does not include data on the number of students and teachers surveyed in the evaluation process. Five area high schools participated in the program and collected data from seven local Puget Sound beaches.

## Facing the Future

Facing the Future provides education curricula and professional development for classroom teachers on the topic of global sustainability. Facing the Future has conducted evaluations of its programs for over five years, which consist of pre and post surveys. In its January 2007 survey of 2,598 recipients who had purchased, downloaded, or attended a FTF workshop during the previous six months, respondents were asked to evaluate how FTF resources improve environmental education in a variety of areas.

Of the 2,598 people surveyed, 542 (or 21%) responded. Of these respondents more than half (63%) had used the FTF materials during the last 6-months. Of the 341 respondents who had used the materials, an overwhelming majority agreed that the FTF resources helped increase their students’ critical thinking skills, and 90% of these same respondents “observe[d] an increase in student engagement when using FTF materials.”

## The Integrated Environmental Health Middle School Project

IEHSMP is a collaboration between K-12 educators in Washington State and researchers at the University of Washington NIEHS Center for Ecogenetics and Environmental Health. The program’s goals are to 1) develop integrated environmental health (EH) curricula and materials; 2) train teachers to incorporate and use these curricula materials in the classroom; and 3) evaluate both curriculum implementation in classrooms and student learning outcomes. To date, over 6,500 students in Washington State have participated in the program.

In a program evaluation comparing 8th graders at two schools, one with elective EH classes and one with a project-based learning approach, the two groups displayed significant differences in their problem-solving skills and understanding of environmental health issues. Students in the project-based learning group scored higher than students in the elective course.

## IslandWood

IslandWood is a 255-acre outdoor learning center that provides a wide range of programs for schools, as well as for adults, children and families. In addition, they provide volunteer opportunities, a speaker’s series, and other community events open to the public. The program’s goal is to use hands-on outdoor learning experiences to inspire lifelong environmental and community stewardship in students. IslandWood is currently in the process of conducting a self-evaluation of its programs.

## OSPI Natural Science, Wildlife and Environmental Education Partnership Grant Program Recipients

In 2003, the Washington State Legislature passed ESHB 1466 establishing the Natural Science, Wildlife, and Environmental Education Partnership Grant program. The program was created to promote: “proven and innovative natural science, wildlife and environmental education programs aligned with the state’s Essential Academic Learning Requirements (EALRs), and includes but is not limited to instruction about renewable resources, responsible use of resources and conservation.” Grants were awarded to three programs in 2005 and five programs in 2007. Each of these programs went through a competitive and rigorous application and review process. These programs are:

### 2005-06 Grantees

**Citizens for a Healthy Bay** in Tacoma for “Junior Bay Ranger Program,” which included classroom presentations and field trips combined with a service-learning component to engage children in hands-on “cleanup, protection, and restoration” of Commencement Bay.

**Olympic Park Institute** in Port Angeles for “Elwha Restoration Project,” which included pilot testing, evaluation, and introduction of inquiry-based, interdisciplinary Elwha Restoration Project Curriculum to middle and high school teachers around the state; curriculum created in partnership with teams of teachers with support from Olympic National Park and Olympic Educational Service District; and formal teacher trainings.

**Stilly-Snohomish Fisheries Enhancement Task Force** in Everett for “Restoration Education for Young Stewards” which included student education about salmon biology, ecology, and conservation; participation in hands-on authentic salmon habitat restoration projects in their community; and teacher training in inquiry-based science teaching methods.

### 2007-08 Grantees

**Barn Beach Reserve** in Leavenworth for “Field Experiences for Elementary Students at Barn Beach Reserve” which includes outdoor learning opportunities on Wenatchee River for 4<sup>th</sup> and 5<sup>th</sup> grade students; the study of riparian plants, arthropods, water quality, fish biology and stream ecology; animal tracking, orienteering, winter ecology and environmental tolerance; and snowshoeing and cross country skiing.

**North Cascades Institute** in Sedro Wooley for “Mountain School Diversity Initiative” which includes a residential field-based educational experience for underserved, disadvantaged, and multicultural populations; understanding the interdependence of the North Cascades ecosystem through interdisciplinary study; a teacher’s guide; classroom visits by Institute staff; connections of the North Cascades to students’ home landscapes linking students and teachers to stewardship projects in their own communities; and education about sustainability.

**Northwest Environmental Education Council** in Seattle for “Cooper Elementary Environmental Education Collaboration” which includes bringing outdoor, place-based, experiential education to Cooper Elementary school’s curricula; kindergarten students will experience environmental education in diverse subject areas; and a culminating 5th grade environmental service-learning project.

**River Center Foundation** in Sequim for “Watershed Studies on the North Olympic Peninsula” which includes field study programs for 4th through 8th grade students; knowledge and awareness of the importance of healthy watersheds for the North Olympic Peninsula; resource issues relating to watersheds to help teach EALRs in science, social studies, reading, writing, and math; and critical thinking skills that help students demonstrate their knowledge of natural resource issues relating to their own community.

**Woodland Park Zoo** in North Eastern Washington for “Student Achievement from the Ground Up” which includes creating a model for engaging students high school students in hands-on, scientifically relevant research in the field; ecological monitoring in their community; and building a network of teachers in North Eastern Washington with the skills and resources they need to engage students in effective outdoor learning in partnership with local natural area landowners.

### **District-Level Models for Integrated Learning**

Below are five school district initiatives that model environment-based integrated learning and have student learning outcomes as the central core of their curriculum design. The school districts representing each of these models range from small rural districts to large suburban districts and serve students of differing socio-economic status across the state of Washington.

#### **Authentic Research Model: Cle Elum/Roslyn School District; Cle Elum, Washington**

Cle Elum/Roslyn School District consists of three schools in two buildings on adjoining properties and serves several small rural communities with forestry and mining at their roots. District administration aims to promote and model interdisciplinary education with a theme that is important to the community and students. As tourism expands with the construction of tourist facilities in the community, the district decided to integrate its curriculum units around the question of how development of tourist attractions and resort facilities affect culture, health and environment of the community. As a result, the district formed a partnership with the Department of the Fish and Wildlife (WDFW) that gives students the opportunity to do authentic scientific research through Project CAT under the direction of the WDFW and graduate students from Central Washington University and University of Washington.

Incorporating Project CAT into the curriculum has been the responsibility of the teachers. They received professional development training from the Pacific Education Institute in interdisciplinary environmental education. Teachers developed a scope and sequence for all subjects across all grade levels and designed essential questions around aspects of Project CAT. The combination of authentic research projects and standards-based

integrated lessons and units provides the basis for Cle Elum/Roslyn School District curriculum.

In elementary grades students learn how to identify plants and animals around their school and home in order to identify and document the habitat of the cougar. In grade four students participate in a unit on *NatureMapping* which integrates science, reading, art, communication, and writing. In grade eight students participate in an orienteering unit in which they learn to use a compass and a clinometer. Also, middle school students participate in a simple but effective physical analysis to determine the health of individual prey animals (Prey Health Study). These students also assess the implications of their study as a social studies activity.

Students at Cle Elum/Roslyn High School participate in the Cougar Movement Study and investigate the movement of cougars by collaring them with radio collars provided by the Washington Department of Fish and Wildlife. In their biology course students learn mapping techniques that add to techniques learned in earlier grades. In their math classes they learn basic probability and statistics that will help them analyze the cougar data. In their advanced biology class students learn to identify animal tracks, to track using telemetry, and the winter survival skills necessary to successfully track a cougar. Students practice snow shoeing in their physical education classes. Once students have all this background information, they participate in collaring the cougars. The data is used by students and researchers to determine the home range of individual cougars and to compare pre-resort to post-resort cougar movements.

Overall, the success of Project CAT of Cle Elum/Roslyn School District comes from multiple partnerships, buy-in by the community whose population generally understands the importance of the answers to the questions the students are researching, an enthusiastic faculty with key leaders at each grade level, and a supportive administration that actively pursues funding to support Project CAT activities and professional development.

#### **Extended Classroom Model - Issaquah School District; Issaquah, Washington**

The Issaquah School District, located just east of Seattle, consists of thirteen elementary schools, four middle schools, three high schools, and an alternative school. Using traditional environmental curricula such as Forests of Washington, Project Learning Tree, Project WET, and Project WILD, teachers created a scope and sequence of units for the District and developed model environmental study sites for their schools. The Pacific Education Institute assisted schools with site mapping, lesson alignment, and recommendations for specific site features.

With a grant from the Washington Department of Fish and Wildlife, teachers at Apollo Elementary created a butterfly garden in a courtyard. Fifth grade students planted the garden and maintain it from year to year. In grade four, teachers use the area as a part of the unit on Washington State forests when students learn about the functions of various plants in a forest ecosystem by observing, identifying, and sketching plants growing in their schoolyard. The third grade native plant unit is also well supported by the garden.

Discovery Elementary students observe bird species on the 37 acres of a Class 1 wetland adjacent to the school. In 2000 Discovery Elementary teachers received a grant from Project Learning Tree Greenworks to restore wetland habitat. Students researched their wetland and wetland restoration, and learned about invasive species. Now, the students actively work to physically control invasive species in this habitat. Discovery Elementary is also home to a raised bed garden planted to attract wildlife. As at other Issaquah School District Environmental Study Site schools, Discovery supports much of its integrated curricula with these school yard features.

At Endeavor Elementary, after mapping their school site, teachers decided to create garden features to compliment student learning. Six raised-bed gardens designed, built, planted, and maintained by students comprise the bulk of the curricular support. Students observe plant life cycles while raising vegetable and companion plants, monitor soil and maintain a worm bin for composting school waste products. Fourth graders have designated one of the gardens as the native plant garden. A butterfly garden provides a location for students to study habitats. Second graders are in the process of expanding the butterfly garden to include habitat for a greater variety of species.

The Issaquah Valley Elementary schoolyard includes theme gardens for each grade level specifically designed to support social studies and science. These include a garden for the senses (various smells and textures), a salad garden, and a pioneer garden. A native plant garden is used in habitat and forestry units. This garden, along with its central feature, a large rock surrounded by smaller rocks placed by students, transformed the view from a brick wall to a mini-forest. Many volunteers helped to construct the gardens including a Girl Scout troop who planted a “Mother’s Day” garden full of pink and blue flowers. The school’s PTA agreed to pay for the maintenance of the gardens for five years and parent volunteers agreed to maintain the beds over the summer.

Overall, Issaquah School District represents a successful model of using environmental study sites to enhance student learning. Their success depends on continued administrative support for teacher professional development and curriculum and assessment design.

### **The Curriculum Integration Model - Tahoma School District; Maple Valley, Washington**

Tahoma School District, located in Maple Valley, is home to four elementary schools, three middle schools, one high school, one alternative high school, and one parent-partnered school. The District’s goal is to create a community of learners using diverse teaching and learning strategies such as student-centered decision-making, developmentally appropriate integrated curriculum, multiple instructional strategies, diverse delivery systems, and integration of the learning activities around environment-based themes.

To design environment-based integrated curriculum, Tahoma School District has been working with representatives of the Pacific Education Institute for over ten years.

Teachers participate in professional development opportunities which help them create integrated unit plans that address critical thinking and the content that supports melding thinking skills with environmental topics.

Every year students participate in the environment-based learning activities that help to develop their problem solving abilities. As 5<sup>th</sup> graders, all students in the Tahoma School District participate in a three day adventure at Camp Casey on Whidbey Island, an island in north Puget Sound. As part of their experience, students construct boats and attach their school's email address with a note that they would like the finder to contact them. They then set the boats loose in Puget Sound. Back at school, students compile the incoming emails and begin to ask questions about the data such as how the weather affects the movement of the boats. As 6<sup>th</sup> graders, the students study Puget Sound, tides and currents, and weather and use the data collected in 5<sup>th</sup> grade to discover important currents in Puget Sound. In 8<sup>th</sup> grade students participate in the biosphere project, which integrates all sciences, art, math, language arts and social sciences. As they learn and plan for a sustained ecosystem within their biosphere, students discover factors important in sustaining earth's environment. One subgroup of high school students applies their knowledge and skills in an environment-based learning program called Outdoor Academy, an integrated hands-on program for average achievers and at-risk students.

The Tahoma School District has built a successful environment-based integrated learning program by selecting specific thinking skills and behaviors (Habits of Mind) around which to integrate students learning experiences. Furthermore, the district administration sees partnerships with such organizations as Pacific Education Institute (PEI), Washington Forest Protection Association, Washington Department of Fish and Wildlife, National Project Learning Tree, Project WILD, and Project WET as key to the ongoing success of the district's programs.

### **Outdoor Learning Center Model - West Valley School District; Spokane, Washington**

West Valley School District, located on the eastern edge of the city of Spokane, serves 3,795 students at ten schools including two high schools, two middle schools, three elementary schools, one alternative high school, one preschool, and one 5<sup>th</sup> grade only school. All students have access to the West Valley Outdoor Learning Center (WVOLC), constructed on District property with grant funding and used as a teaching and learning facility for grades K-12. The WVOLC site includes a recirculating pond and stream system, a hawk and owl sanctuary, an office building, and a classroom. A self-guided interpretive trail leads visitors through changing local ecosystems to learn about the plants and animals that live there.

In Grade 4 West Valley students take part in the Barn Owl Study. As part of this unit, students work with a local owl expert to study barn owl populations in Spokane County. Students make and hang boxes in various locations around the county, and use *NatureMapping* techniques to track barn owl productivity. They then record GPS locations for active nests and map the locations in a database back at school. As this

database grows, so will the understanding of the factors affecting barn owl populations in Eastern Washington.

West Valley School District has partnered with the Washington Department of Fish and Wildlife to carry out a study of mule deer in Eastern Washington. West Valley high school students taking Advanced Placement Biology participate in the capture and collaring of the animals. The collared animals will allow students and scientists to assess the health, productivity, range, and mortality of mule deer. Students analyze data to help the biologists determine if current management practices are effective for mule deer. Project Mule Deer offers classroom teachers and students the opportunity to connect subjects around a real world problem – declining mule deer populations. Students develop math skills, practice scientific inquiry skills, study human influences, read about the issues, and write about their conclusions.

While the WVOLC works like an environmental study site, similar to the backyard school sites in the Issaquah School District, it provides a focus point for the West Valley School District in terms of administration and maintenance and serves as the conduit for developing partnerships for environment-based integrated learning.

**Interdisciplinary Team Model - Tumwater School District; Tumwater, Washington**  
Tumwater School District, located at the Southern end of Puget Sound in Thurston County, operates ten schools serving 6,200 students. In order to make connections between the district's science and social studies benchmarks and the curriculum resources such as Project Learning Tree and Forests of Washington, the district created the Environmental Education Team. This team consists of 10-20 teachers representing all grade levels and differing areas of expertise, and it initiated a number of environment-based projects in the Tumwater schools.

Students in the Tumwater School District participate in the Project Bluebird. They are working with the Black Hills Audubon Society and the Nature Conservancy to create a bluebird "trail" (series of boxes) in the South Puget Sound area which will provide nesting habitat for the Western Bluebird. Students are learning about bird conservation and habitat protection and are educating community members about the issues involved. Project Bluebird is divided into two theme-based units, one in the spring focused on observation and one in the fall emphasizing maintenance.

The Tumwater District EE Team also developed Earth Day kit curricula containing activities for each grade level K-6. The activities are tied in with existing curricula, integrate multiple subjects, and focus on the environment. The K-2 curriculum kit helps students understand that many insects are beneficial and includes the video *Bugs Don't Bug Us*, a ladybug craft, stories, and a sing-a-long tape. Student learn to write different types of poems including haikus and acrostics, learn about biodiversity by sorting insects according to attributes such as color, shape, size, or whether or not they have wings.

Tumwater School District was one of the first districts to consider environment-based integrated learning in a concerted way that involves many teachers, and it continues to

assess the curricula and compares learning outcomes with state and national standards and aligns them with Washington State's Grade Level Expectations.



## Appendix J: Bibliography of Studies Collected and Reviewed

---

- Athman, A., and Monroe, M. (2001). *Elements of effective environmental education programs*. Unpublished. (Eric Document Reproduction Service No. ED 463936)
- Bartosh, O. (2006). *What do students learn in a high school environmental program?* Washington, D.C.: North American Association for Environmental Education.
- Bartosh, O., Tudor, M., and Ferguson, L. (2005). *Environmental education and its impact on students' test scores: A study of Washington State middle schools*. San Francisco, CA: Annual Meeting of the American Educational Research Association, April 7-11, 2006.
- Bartosh, O., Tudor, M., Ferguson, L., and Taylor, C. (2005). Improving test scores through environmental education: is it possible? *Applied Environmental Education and Communication*, 5(3), 161-169.
- Battersby, J. (1999). Does environmental education have 'street credibility' and the potential to reduce pupil disaffection within and beyond their school curriculum? *Cambridge Journal of Education*, 29(3), 447-460.
- Billig, S., Root, S., and Jesse, D. (2005). *The impact of participation in service-learning on high school students' civic engagement*. Retrieved August 20, 2007, from National Service-Learning Clearinghouse Web site:  
[http://www.servicelearning.org/lib\\_svcs/lib\\_cat/index.php?library\\_id=6411](http://www.servicelearning.org/lib_svcs/lib_cat/index.php?library_id=6411)
- Billings, J. A., Plato, K., Anderson, J., and Wiley, M. S. (1996). *Washington Environmental Education Model Schools Program "Environmental education in the school culture: a systemic approach."* What did we do? What did we learn? A final report submitted to the U.S. Environmental Protection Agency by the Washington State Office of Superintendent of Public Instruction. Olympia, WA: OSPI.
- Bobilya, A. J., and Akey, L. D. (2002). An evaluation of adventure education in a residential learning community. *Journal of Experiential Education*, 25(2), 296-304.
- Cheak, M., Volk, T., and Hungerford, H. (2002). *Molokai: an investment in children, the community, and the environment*. Carbondale, IL: The Center for Instruction, Staff Development, and Evaluation.
- Connors, J.J., and Elliot, J.F. (1995). The influence of agriscience and natural resources curriculum on students' science achievement scores. *Journal of Agricultural Education*, 36(3), 57-63.
- Coyle, K. (2004). *Understanding environmental literacy in America: and making it a reality*. Draft. Retrieved August 20, 2007, from National Environmental Education and Training Foundation Web site: <http://www.neefusa.org/roper/ELR.pdf>
- Coyle, K. (2005). *Environmental literacy in America*. Retrieved August 20, 2007, from National Environmental Education and Training Foundation Web site:  
<http://www.neefusa.org/pubs/ELR2005.pdf>
- Cross, R. (2002). The effects of an adventure education program on perceptions of alienation and personal control among at-risk adolescents. *Journal of Experiential Education*, 25(1), 247-254.
- Danforth, P. (2005). *An evaluation of National Wildlife Federation's Schoolyard Habitat Program in the Houston Independent School District*. Unpublished Master's Thesis. San Marcos, TX: Texas State University.

- Davies, K., and Cohen, M. J. (1995). Reconnecting with nature: educational self-esteem sensory activities for reducing drug use and irresponsible relationships in students at risk. In M. J. Cohen, *Reconnecting with Nature: A restoration of the missing link in Western thinking*, Chapter 11. Friday Harbor, WA: University of Global Education.
- Davila, A., and Mora, M. (2007). *Civic engagement and high school academic progress: an analysis using NELS data*. Retrieved August 20, 2007, from The Center for Information and Research on Civic Learning and Engagement (CIRCLE) Web site: <http://www.civicyouth.org/PopUps/WorkingPapers/WP52Mora.pdf>
- Dori, Y. J., and Herscovitz, O. (1999). Question-posing capability as an alternative evaluation method: analysis of an environmental case study. *Journal of Research in Science Teaching*, 36(4), 411-430.
- Duffin, M., Phillips, M., Tremblay, G., et al. (2006). *Project CO-SEED supplemental evaluation report: 2005-2006 Quantitative results, Beebe Environmental and Health Science Magnet School*. Retrieved August 20, 2007, from Place-Based Education Evaluation Collaborative (PEEC) Web site: [http://www.peecworks.org/PEEC/PEEC\\_Reports/S01469109-01469165](http://www.peecworks.org/PEEC/PEEC_Reports/S01469109-01469165)
- Duffin, M., Phillips, M., Tremblay, G., et al. (2006). *Project CO-SEED supplemental evaluation report: 2005-2006 Quantitative results, Gorham School District*. Retrieved August 20, 2007, from Place-Based Education Evaluation Collaborative (PEEC) Web site: [http://www.peecworks.org/PEEC/PEEC\\_Reports/S010DFF34-014690A4](http://www.peecworks.org/PEEC/PEEC_Reports/S010DFF34-014690A4)
- Duffin, M., Powers, A., Tremblay, G., et al. (2004). *Place-based education evaluation collaborative (PEEC) report on cross-program research and other program evaluation activities, 2003-2004*. Retrieved August 17, 2007, from Place-Based Education Evaluation Collaborative (PEEC) Web site: [http://www.peecworks.org/PEEC/PEEC\\_Reports/S0019440A](http://www.peecworks.org/PEEC/PEEC_Reports/S0019440A)
- Effects of outdoor education programs for children in California*. (2005). Retrieved August 17, 2007, from American Institutes of Research Web site: <http://www.air.org/news/documents/Outdoorschoolreport.pdf>
- Emekauwa, E. (2004). *The star with my name: The Alaska Rural Systemic Initiative and the impact of place-based education on native student achievement*. Washington, D.C.: Rural School and Community Trust. (ERIC Document Reproduction Service No. ED 484828)
- Emekauwa, E. (2004). *They remember what they touch: The impact of place-based learning in East Feliciana parish*. Retrieved August 20, 2007, from Rural School and Community Trust Web site: <http://www.promiseofplace.org/pdf/EastFelicianaParish2004.pdf>
- Ernst, J., and Monroe, M. (2004). The effects of environment-based education on students' critical thinking skills and disposition toward critical thinking. *Environmental Education Research*, 10(4), 507-522.
- Ernst, J., and Monroe, M. (2004). The effects of environment-based education on students' critical thinking skills and disposition toward critical thinking. *Environmental Education Research*, 14(4), 507-522.
- Evans, et al. (2005). The neighborhood nestwatch program: participant outcomes of a citizen-science ecological research project. *Conservation Biology*, 19(3), 589-594.
- Ferguson, L., Angell T., and Tudor, M. (2001). Better test scores through environmental education? *Clearing Magazine*, 110 (Fall), 20-22.
- Fischer, T. L., and Attah, E. B. (2001). City kids in the wilderness: a pilot test of outward bound for foster care group home youth. *Journal of Experiential Education*, 24(2), 109-117.

- Ford, P., and Payne, P. (1986). The effects of two outdoor education programs on knowledges and attitudes of selected six graders. *Bradford Papers Annual*, 1, 11-18.
- Garcia-Obregon, Z., Trevino, J., Uribe-Moreno, S., and Zuniga, S. (2000). *The effectiveness of a school based service-learning program "community connection" at a South Texas middle school*. Unpublished. (ERIC Document Reproduction Service No. ED 449338)
- Garst, B., Scheider, I., and Baker, D. (2001). Outdoor adventure program participation impacts on adolescent self-perception. *Journal of Experiential Education*, 24(1), 41-49.
- Glenn, J. L. (2000). *Environment-based education: creating high performance schools and students*. Washington, D.C.: National Environmental Education and Training Foundation. (ERIC Document Reproduction Service No. ED 451033)
- Glenn, J.L. (2000). *Environment-based education: creating high performance schools and students*. Washington, D.C.: National Environmental Education and Training Foundation. (ERIC Document Reproduction Service No. ED 451033)
- Governor's Council on Environmental Education. (2004). *Environmental education in Washington: status report 2004*. Unpublished.
- Grassi, E., Hanley, D., and Liston, D. (2004). Service-learning: an innovative approach for second language learners. *Journal of Experiential Education*, 27(1), 87-110.
- Gucker, P. (2001). Camp teaches life lessons: a director's commentary on camp's lasting educational value. *Camping Magazine*, 74(5), 25-28.
- Hattie, J., Marsh H. W., Neill, J. T., and Richards, G. E. (1997). Adventure education and outward bound: Out of class experiences that make a lasting difference. *Review of Educational Research*, 67(1), 43-87.
- Henderson, D. G., Fisher, D. L., and Fraser, B.J. (1998). *Learning environment, student attitudes and effects of students' sex and other science study in environmental science classes*. San Diego, CA: Annual Meeting of the American Educational Research Association. (ERIC Document Reproduction Service No. ED 420509)
- Isenson, B., and Moore, F. (2003). Washington Environmental Education Model Schools and Creating Model Links: environmental education and school improvement: a look at enduring changes. In *Governor's Council on Environmental Education, Environmental education in Washington: status report 2004* (Appendix E). Unpublished.
- Kaly, P., and Heesacker, M. (2003). Effects of a ship-based adventure program on adolescent self-esteem and ego-identity development. *Journal of Experiential Education*, 26(2), 97-104.
- Koliba, C. J., Campbell, E. K., and Shapiro C. (2006). The practice of service-learning in local school-community contexts. *Educational Policy*, 20(5), 683-717.
- Larson, B. A. (2007). Adventure camp programs, self-consent, and their effects on behavioral problem adolescents. *Journal of Experiential Education*, 29(3), 313-330.
- Lewicki, J. (2000). *100 days of learning in place: How a small school utilized "place based" learning to master state academic standards*. Washington, D.C.: Rural School and Community Trust. (ERIC Document Reproduction Service No. ED 459023)
- Lieberman, G. A., and Hoody, L. L. (1998). *Closing the achievement gap: using the environment as an integrating context for learning, executive summary*. San Diego, CA: State Education and Environment Roundtable (SEER). (ERIC Document Reproduction Service No. ED 428942)
- Lieberman, G., Hoody, L., and Lieberman, G. M. (2000). *California student assessment project: the effect of environment-based education on student achievement*. Retrieved August 20,

- 2007, from State Education and Environment Roundtable (SEER) Web site:  
<http://www.seer.org/pages/csap.pdf>
- Lieberman, G., Hoody, L., and Lieberman, G. M. (2005). *California student assessment project, phase two: the effects of environment-based education on student achievement*. Retrieved August 20, 2007, from State Education and Environment Roundtable (SEER) Web site:  
<http://www.seer.org/pages/research/CSAPII2005.pdf>
- Lindemann-Matthies, P. (2002). The influence of an educational program on children's perception of biodiversity. *Journal of Environmental Education*, 33, 22-31.
- Loveland, E. (2003). Achieving academic goals through place-based learning: students in five states show how to do it. *Rural Roots*, 4(1), 1, 6-11.
- McDavitt, D. S. (1994). *Teaching for understanding: Attaining higher order and increased achievement through experiential instruction*. Unpublished. (ERIC Document Reproduction Service No. ED 374093)
- McNamara, K. (2000). Outcomes associated with service involvement among disengaged youth. *Journal of Drug Education*, 30(2), 229-245.
- Model Links: Environmental Education and School Improvement. (1999). *What's Changing In Model Links Schools? 1995-1998 Progress Report*. Olympia, WA: Washington Department of Fish and Wildlife.
- Mogensen, F., and Nielsen, K. (2001). Students' knowledge about environmental matters and their belief in their own action possibilities - A Danish study. *Journal of Environmental Education*, 33(1), 33-35.
- Moote, G. T. Jr., and Wodarski, J. S. (1997). The acquisition of life skills through adventure-based activities and programs: a review of the literature. *Adolescence*, 32(125), 143-167.
- Palmberg, I. E., and Kuru, J. (2000). Outdoor activities as a basis for environmental responsibility. *Journal of Environmental Education*, 31(4), 32-36.
- Parrish, D. M., Phillips, G., Levine, R., Hikawa, H., Gaertner, M., Agosta, N., and Doyal, D. (2005). *Effects of outdoor education programs for children in California*. Retrieved August 20, 2007, from American Institutes for Research Web site:  
<http://www.air.org/news/documents/Outdoorschoolreport.pdf>
- Patterson, D. (1995). *The effects of outward bound on a group of middle school students*. Unpublished. (ERIC Document Reproduction Service No. ED 391822)
- Poudel, D. D., Vincent, L. M., Anzalone, C., Huner, J., Wollard, D., Clement, T., DeRamus, A., and Blakewood, G. (2005). Hands-on activities and challenge tests in agricultural and environmental education. *Journal of Environmental Education*, 36(4), 10-22.
- Powers, A. L. (2004). An evaluation of four place-based education programs. *Journal of Environmental Education*, 35(4), 17-32.
- Randall, J. (2001). *Enhancing high school students writing skills with Florida biodiversity education*. Unpublished Master's Thesis. Gainesville, FL: University of Florida.
- Scales, P.C., Roehlkepartai, E. C., Neal, M., Kielsmeier, J. C., and Benson, P. L. (2006). Reducing academic achievement gaps: the role of community service and service-learning. *Journal of Experiential Education*, 29(1), 38-60.
- Secker, C. V. (2004). *Bay Schools Project. Year three summative evaluation*. Retrieved August 20, 2007, from State Education and Environment Roundtable (SEER) Web site:  
<http://www.seer.org/pages/research/BaySchools2004.pdf>

- Seever, M. (1991). *Knotts Environmental Science Magnet Elementary School: 1988-1989, 1989-1990, 1990-199 summative evaluation*. Kansas City, MO: Kansas City School District. (Eric Document Reproduction Service No. ED 350158)
- Seever, M. (1991). *East Environmental Science Magnet High School: 1990-1991. Formative evaluation*. Kansas City, MO: Kansas City School District. (Eric Document Reproduction Service No. ED 350156)
- Seever, M. (1991). *Nowlin Environmental Science Magnet Middle School: 1990-1991. Formative evaluation*. Kansas City, MO: Kansas City School District. (Eric Document Reproduction Service No. ED 350157)
- Seever, M. (1991). *Trailwoods Environmental Science Magnet Elementary School. Formative evaluation*. Kansas City, MO: Kansas City School District. (ERIC Document Reproduction Service No. ED 350159)
- Sheard, M., and Golby, J. (2006). The efficacy of an outdoor adventure education curriculum on selected aspects of positive psychological development. *Journal of Experiential Education*, 29(2), 187-209.
- Siemer, W. F., and Knuth, B. A. (2001). Effects of fishing education programs on antecedents of responsible behavior. *Journal of Environmental Education*, 32(4), 23-29.
- Smith, T. (1995). An experiential adventure school for adolescents. In B. Horwood (Ed.), *Experience and the Curriculum* (pp. 217-234). Boulder, CO: Association for Experiential Education.
- Strage, A. (2004). Long-term academic benefits of service-learning: When and where do they manifest themselves? *College Student Journal*, 38(2), 257.
- Using environment-based education to advance learning skills and character development*. (2001). Rock Spring, GA: North American Association for Environmental Education. (ERIC Document Reproduction Service No. ED 458145)
- Volk, T. L., and Cheak, M. J. (2003). The effects of an environmental education program on students, parents, and community. *Journal of Environmental Education*, 34(4), 12-25.
- Wang, W. (2000). *Service-learning: Is it good for you?* New Orleans, LA: Annual Meeting of the American Educational Research Association. (ERIC Document Reproduction Service No. ED 442439)
- Workman, A. (2005). *Effects of an integrated environmental education curriculum on the standardized assessment scores of elementary students*. Unpublished Master's Thesis. Duluth, MN: University of Minnesota.
- Yap, K. O. (1998). *A summative evaluation of Model Links: Final report*. Portland, OR: Northwest Regional Educational Laboratory.

## Appendix K: Additional References

---

- Bartosh, O. (2003). *Environmental education: Improving student achievement*. Unpublished master's thesis, Evergreen State College, Olympia, WA, USA.
- Bransford J. D., Brown, A. L., and Cocking, R. R., ed. (2000). *How People Learn: Brain, Mind, Experience, and School Committee on Developments in the Science of Learning*. Washington, DC: National Academy Press.
- Disinger, J. (1982). Environmental education research news. *The Environmentalist*, 2, 285-288.
- Gigliotti, L.M. (1990). Environmental Education: What Went Wrong? *Journal of Environmental Education* 22, 9-12.
- Hausbeck, K. W., Milbrath, L. W., and Enright, S. M. (1992). Environmental knowledge, awareness and concern among 11<sup>th</sup>-grade students: New York state. *The Journal of Environmental Education*, 24(1), 27-34.
- Kuhlemeier, H., Bergh, H. V. D., and Langerweij, N. (1999). Environmental knowledge, attitudes, and behavior in Dutch secondary school. *Journal of Environmental Education*, 30(2), 4-15.
- Marcinkowski, T. J. (1987). An analysis of correlates and predictors of responsible environmental behavior. Doctoral dissertation, Southern Illinois University at Carbondale, 1988. *Dissertation Abstracts International*, 49 (12): 3677-A.
- Palmer, J. (1993). Development of concern for the environment and formative experiences of educators. *The Journal of Environmental Education*, 23(4), 26-30.
- The North American Association for Environmental Education and The National Environmental Education and Training Foundation (NAAEE and NEETF). 2001. *Using environment-based education to advance learning skills and character development. A report, annotated bibliography and research guide*. Washington, D.C.: NAAEE and NEETF.
- Sia, A. P. (1984). An investigation of selected predictors of overt responsible environmental behaviour. *Dissertation Abstracts International*, 46A (3), 667.
- Tanner, T. (1980). Significant life experiences: A new research area in EE. *The Journal of Environmental Education*, 11(4), 20-24.
- United Nations Educational, Scientific, and Cultural Organization (UNESCO). (1977). *Intergovernmental Conference on Environmental Education Organized by UNESCO with the Co-operation of UNEP. The United Nations Environment Programme and its Contribution to the Development of Environmental Education and Training*. New York: UNIPUB.
- United Nations Department of Economic and Social Affairs, Division for Sustainable Development. (1993). *Agenda 21*. Retrieved December 3, 2007 from <http://www.un.org/esa/sustdev/documents/agenda21/index.htm>.
- World Commission on Environment and Development. (1987). *Our Common Future: Report of the World Commission on Environment and Development*. Retrieved December 3, 2007 from <http://www.liunet.edu/cwis/cwp/library/workshop/citapa.htm>.
- Wright, P. A., and Floyd, D. W. (1992). Integrating undergraduate research and teaching in environmental education: Ohio State's earth day project. *The Journal of environmental Education*, 23(4), 22-29.
- Zelezny, L. C. (1999). Educational interventions that improve environmental behavior. *Journal of Environmental Education*, 31(1), 5-10.

