

**THE ROLE OF OUTREACH EDUCATION IN ACHIEVING
ENVIRONMENTAL LITERACY**

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A major paper submitted to the faculty of Virginia Polytechnic Institute and State
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MASTER OF FORESTRY

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April 4, 2003

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Keywords: Environmental Education, Outreach Education, Environmental Education
Needs Assessment, Environmental Literacy, Hunting Creek Watershed, UrBIN Project

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ABSTRACT

Teachers of all disciplines are instrumental in shaping the characters and behaviors of future citizens. One of the greatest challenges facing environmental educators is relating to a population that is increasingly insulated from the natural world. An environmental education needs assessment of schools located in an urban watershed found that inadequate educator knowledge of environmental issues, lack of state proficiency standards for environmental education, and lack of funding for environmental projects are barriers hampering the achievement of environmental education objectives. Respondents to the Hunting Creek Watershed Environmental Education Needs Questionnaire desire greater knowledge of and access to non-biased, science-based resources for teaching environmental education. Outreach environmental education can fill the gap created by lack of teacher certification, lack of curriculum standards, and diminishing education budgets. Environmental literacy can be achieved through use of the tools provided by outreach environmental educators.

GRANT INFORMATION

This study was funded by the U.S. Geological Survey (USGS). The environmental education needs assessment was undertaken by the College of Natural Resources of the Virginia Polytechnic Institute and State University (Virginia Tech) as a component of the Urban Biodiversity Research Project: Holmes Run/Tripps Run Watersheds (Federal Identifier # 1434-HQ-97-RU-01573 RWO 73), conducted jointly by the U.S. Geological Survey, Virginia Polytechnic Institute and State University, and the Metropolitan Washington Council of Governments. This multidisciplinary project to examine the effects of urbanization upon biodiversity was part of an Urban Biodiversity Information Node (UrBIN) administered by the USGS National Biological Information Infrastructure (NBII).

ACKNOWLEDGEMENTS

I recognize the following individuals for guidance in administration of the environmental education needs assessment of the Hunting Creek watershed and preparation of this report: David Trauger, Gerald Cross, James Johnson, Gabriella Belli, Gwen Ewing, Deborah Cash, Robert Slusser, Christine Cunningham, Neal Emerald, and Ravi Vukkadala of Virginia Polytechnic Institute and State University; Brian Czech of the U.S. Fish and Wildlife Service; Richard Neves, Michael Vaughan, and Holly Litos of the Virginia Cooperative Fish and Wildlife Research Unit of Virginia Polytechnic Institute and State University; Lief Horwitz, Robert Dietz, and Shannon Fennell of the U.S. Geological Survey; and Andrew Rosenberger of the Virginia Tech Conservation Management Institute.

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CHAPTER I. INTRODUCTION

Teachers in both formal and non-formal settings are instrumental in shaping the characters and behaviors of tomorrow's citizens (NAAEE, 2001a). Environmental educators have a unique opportunity to introduce communication, critical-thinking, and decision-making skills through the use of real-life environmental issues. The Tbilisi Intergovernmental Conference on Environmental Education in 1977 delegated to environmental educators the task of creating citizens with the awareness, knowledge, attitudes, skills, and empowerment to solve global environmental issues (UNESCO-UNEP, 1978; Hungerford and Volk, 1990). Twenty-six years later, environmental educators face far greater challenges in reaching a population that is increasingly insulated from the natural world. Finding ways to reconnect people to nature is critical in fostering the participation of scientifically and technologically literate citizens who can effectively solve environmental problems (Brewer, 2002).

Challenges to Environmental Education

The goal of environmental literacy is the acquisition of life-sustaining, responsible environmental action skills (Moseley, 2000). Even though environmental education is popular, it is not well integrated into overall education (NEETF, 2002). After more than thirty years of school-based and non-formal education, most adults lack basic environmental knowledge. Achievement of environmental literacy continues to be undermined by traditional instructive approaches to environmental education. Environmental education must provide meaningful contextual experiences that supplement and expand classroom instruction (NEETF, 2002; Woodhouse and Knapp, 2000). Emerging approaches to environmental education suggest that knowledge of ecological patterns and the human impact on natural systems is imperative to the formation of a citizenry who can actively participate in the democratic process of resolving environmental issues (Lieberman and Hoody, 1998; NEETF, 2002).

Each student commences the environmental education process with a unique predisposition to environmental issues generated by his or her background of experiences (Hungerford, et. al., 1980). As urbanization rapidly alters or depletes our remaining natural ecosystems, children become more reliant on "virtual" outdoor experiences. Societal trends frequently dictate that children can no longer safely explore the natural world. Population pressures decrease open or green spaces, while industrialization takes nature away from children by polluting streams and wetlands (Rivkin, 1997). Environmental educators must now determine how to best create a connection to the natural world largely lost to an entire generation. Without that relationship, the children of the 21st Century may not care enough or have the insight to resolve the growing list of environmental issues confronting them.

Role of Outreach Education

Outreach environmental education is a third-party extension of educational services and resources beyond those available and/or known to teachers in a formal school setting. It broadens the scope of an environmental education curriculum through facilitation of partnerships with natural resource professionals, coordination of educational workshops, and identification of educational media. Outreach environmental education can alleviate the burden that teachers experience in meeting the demands of preparing students to solve tomorrow's environmental challenges.

Environmental literacy entails more than knowledge of environmental issues. Environmental education's principles are focused on the development of conscientious citizenship. Today's teachers are charged with imparting scientifically sound, non-biased environmental information, while nurturing attitudes and behaviors to stimulate critical thinking and problem solving. Many barriers to environmental literacy exist, including insufficient teacher training and certification, inadequate state standards of learning, and inadequate funding for continuing teacher education. Outreach environmental education can assist in overcoming some of these barriers.

CHAPTER II. BACKGROUND

Barriers to Environmental Literacy

Standards of learning

Since the early 1990s, the educational reform movement in the United States has focused on setting standards for student achievement (Archie, 2001). However, many states, including Virginia, do not incorporate environmental education into standards of learning. In the absence of a formal state curriculum to support environmental education, teachers rely on an integrated approach which connects traditional science, social studies, math, and language arts to everyday experiences, thereby infusing the awareness, knowledge, critical-thinking, and problem-solving skills necessary to achieve environmental literacy. Archie (2001: 2) believes that environmental concepts and skills can be linked to achievement standards in a conventional curriculum, and that "these links allow environmental education to meet the standards set by traditional disciplines while synthesizing knowledge and experience across disciplines".

Achievement of environmental literacy depends on a comprehensive, cohesive environmental education curriculum that is implemented across all grade levels and is verified through state-level educational priorities and learning standards (Archie, 2001). As late as 1998, fewer than half of the states had correlated their state content standards with the goals and objectives of environmental education (Archie, 2001). With teachers focusing exclusively on learner outcomes, objectives, benchmarks, and essential skills necessary to pass the state standards of learning, it is unlikely that much time will be expended in the classroom addressing environmental education if it is not included in the state proficiency exams.

Funding

Government agencies, political officials, and concerned citizens recognize the need for stronger environmental education in the United States (Sarbanes, 2002). A national poll performed by Roper-Starch found that 95% of parents support the teaching of environmental education in school (Archie, 2001). However, the waxing and waning of

federal support for environmental education has historically challenged the success of meaningful environmental education programs at the state and local level (Archie, 2001). Educators cite the lack of funding as a major barrier to achieving environmental literacy (Aspinwall and Harrell, 2002).

Inadequate teacher qualifications

The greatest challenge to environmental educators is to translate the Tbilisi objectives into instructive reality (Hungerford and Volk, 1990). Numerous barriers must be overcome in order to achieve environmental literacy in the United States. The environment is dynamic; environmental awareness and knowledge must continually be updated. Unlike math, language arts, science, and social studies, environmental education places a responsibility on educators, who often have little or no environmental education background (McKeown-Ice, 2000), to remain apprised of current environmental issues and pedagogy.

Teacher training has been identified as a key factor in establishing and maintaining an effective environmental education program (Archie, 2001). Many teachers do not have adequate pre-service training to teach environmental education. A 1998 survey showed that only four states included pre-service environmental education training as criteria for teacher certification (Ruskey et al., 2001). A 2000 national survey conducted by the Survey Research Center confirmed a lack of adequate teacher training in environmental education, finding that only about 10% of the respondents had taken any courses in environmental teaching methods, and that only 26% had prior course work in environmental science, ecology, or environmental studies (Archie, 2001).

To test environmental literacy, identify barriers to effective environmental education, and evaluate the needs of teachers in an urbanized watershed in northern Virginia, the Virginia Polytechnic Institute and State University (Virginia Tech) College of Natural Resources at the Northern Virginia Center performed a pilot environmental education needs assessment of the Hunting Creek watershed.

The UrBIN Environmental Education Project

The Hunting Creek watershed spans portions of Fairfax and Arlington Counties and the cities of Alexandria and Falls Church in northern Virginia (Virginia Polytechnic Institute and State University, 2003). Hunting Creek's headwaters originate as Holmes Run and Tripps Run in the eastern portion of Fairfax County (Figure 1). They conjoin to form Lake Barcroft and exit the lake as Holmes Run. Four miles southeast of the lake, at the confluence of Backlick Run and Holmes Run, the stream name changes to Cameron Run. Further downstream, the main stem name changes to Hunting Creek, also referred to as Great Hunting Creek, at the point Hunting Creek Branch flows into Cameron Run. Hunting Creek empties into the Potomac River southwest of the District of Columbia. The Hunting Creek watershed is representative of the highly urbanized, "built-out" regions immediately surrounding metropolitan Washington, D.C. (Virginia Polytechnic Institute and State University, 2003).

In April 2002, a pilot environmental education needs assessment was undertaken as a component of the Urban Biodiversity Research Project: Holmes Run/Tripps Run Watersheds, conducted by the U.S. Geological Survey (USGS), Virginia Tech, and the Metropolitan Washington Council of Governments (MWCOG). This multidisciplinary project, the Urban Biodiversity Information Node (UrBIN), was part of a project administered by the USGS National Biological Information Infrastructure (NBII) examining the effects of urbanization upon biodiversity.

The goal of the environmental education component of the UrBIN project was to assess environmental education needs and provide instructional opportunities and resources to teachers at all 61 public (Appendix A) and private (Appendix B) schools within the Hunting Creek watershed. Of these 61 schools, there are 47 public schools and 14 private schools (Table 1). The public schools consist of 31 elementary, 9 middle, and 7

Figure 1. Map of the Hunting Creek Watershed



Table 1. Classification of Public and Private Schools in the Hunting Creek Watershed

Type of School	Public	Private	Total
Elementary	31 (8)	10 (3)	41 (11)
Middle	9 (5)	1 (0)	10 (5)
High	7 (3)	3 (1)	10 (4)
Total	47 (16)	14 (4)	61 (20)

Numbers in parentheses denote respondents to environmental education needs questionnaire

high schools. The private schools consist of 10 elementary, 1 middle, and 3 high schools. School enrollment in the Hunting Creek watershed totals approximately 41,000.

In addition to the environmental education needs assessment, teacher training workshops were offered through Virginia Tech for Project WILD, Project WILD Aquatic, and Virginia Wild School Sites. Teachers were also invited to attend the Access Nature and Schoolyard Habitat workshops offered through the National Wildlife Federation. Watershed Education Days, a large field event for schools and communities within the watershed, was designed to provide hands-on instruction in water quality monitoring and provide an understanding of the importance of water quality. Lesson plans addressing specific state standards of learning were identified by UrBIN project team members and posted on the UrBIN website (<http://dc-urbanbiodiversity.nbi.gov:90/>). The project website will become a primary mechanism for dissemination of environmental education information into the future.

CHAPTER III. METHODS

Virginia Tech's Conservation Management Institute (CMI) in Blacksburg, Virginia sent a packet containing a letter of introduction to the UrBIN project with a brief introductory questionnaire (Appendix C) and a "Frequently Asked Questions" sheet (Appendix D) to the principals of all 61 public and private K-12 schools within the Hunting Creek watershed. Several weeks later, an environmental education needs questionnaire (Appendix E) was mailed through CMI to science coordinators at the 61 schools. Due to low response, the questionnaire was mailed again from the College of Natural Resources at the Northern Virginia Center, located within the Hunting Creek watershed.

The environmental education needs questionnaire consisted of twenty-six questions addressing five categorical variables: current ecological knowledge of the Hunting Creek watershed, the status of environmental education in the watershed, the impact of Virginia Standards of Learning on the environmental education curriculum in the watershed, barriers to environmental education in the watershed, and future needs for environmental education in the watershed.

As private schools are not obligated to incorporate Virginia Standards of Learning into their curriculum, they were exempted from analysis on all questions pertaining to Standards of Learning. As questionnaire responses were received, an UrBIN project environmental education team member contacted each respondent to schedule site visits to gain further insight into current environmental education curriculum, explore outreach environmental education opportunities, and identify unique classroom needs.

CHAPTER IV. RESULTS

There were 10 respondents to the introductory questionnaire. Five responses came from private schools, and five came from public schools. All but one respondent indicated that teachers at their school included environmental education in their curriculum. All respondents indicated a desire to participate in the UrBIN project's environmental education initiatives.

Twenty respondents completed an environmental education needs questionnaire (Table 1). Four responses came from private schools, and sixteen came from public schools. The environmental education needs assessment revealed that fewer than half of the respondents knew that their school was located in the Hunting Creek watershed. Only 45% of the respondents correctly identified the various ecosystems found in the Hunting Creek watershed, and none of them correctly identified water pollution as the watershed's key ecological issue. These results indicate a lack of connection to and knowledge of the surrounding environment. The findings also demonstrate a need for both pre-service and in-service K-12 teacher certification requirements in environmental education.

Although sixteen of twenty respondents (80%) claimed to have adequate knowledge of ecological principles to teach students, none of the respondents correctly answered all three of the questions designed as an index of ecological knowledge of the watershed. None of those who claimed to have adequate ecological knowledge correctly answered more than one of the three ecological knowledge questions. Ironically, a respondent claiming not to have an adequate background to teach ecological principles correctly answered two of the three questions.

Although environmental education is currently absent from the Virginia Standards of Learning, an overwhelming majority (95%) of respondents to the Hunting Creek watershed environmental education needs questionnaire stated that their curriculum addressed ecological topics and that they used lesson plans specifically designed to address environmental education. Respondents cited "other teachers" as the most

frequent source of subject material for environmental education lesson plans (Table 2). Eighty-five percent of respondents used self-designed lesson plans to accomplish environmental education (Table 3). Included in this majority were all four respondents claiming not to have an adequate background to teach ecological principles.

Of the fourteen respondents using environmental education lesson plans to meet some of the Virginia Standards of Learning, a third felt some dissatisfaction with the ability of those plans to achieve the goals of the standards. Respondents were unanimous in their desire to obtain environmental education lesson plans specifically designed to address the Virginia Standards of Learning.

Eighty percent of respondents indicated that they attended training sessions to update environmental education knowledge and skills. The most frequently cited reason for not attending environmental education workshops was scheduling difficulties, followed by lack of knowledge about opportunities, and funding. Respondents learned of environmental education training opportunities predominantly through educator publications and by word of mouth (Table 4). Nearly half of the respondents stated that they learned of environmental education training opportunities via the Internet.

Every respondent indicated that his or her class could benefit from a more "hands-on" approach to environmental education. Seventeen of twenty respondents (85%) professed a desire to schedule classroom presentations by an outreach educator (Table 5). Additionally, an overwhelming majority indicated an interest in long-term monitoring projects, schoolyard habitat projects, interactive classroom exhibits, and field trips.

Two attempts to facilitate watershed-wide Project WILD and Project WILD/Aquatic teacher training workshops at the Virginia Tech Northern Virginia Center were cancelled due to low response. No attempts to execute regional Project WILD and Project WILD/Aquatic workshops were successfully completed. The Virginia Wild School Sites

Table 2. Sources of Subject Material for Environmental Education Lesson Plans

Sources of Material	Frequently Used	Infrequently Used	Never Used
Other Teachers	70%	40%	0%
Workshop Materials	60%	25%	5%
Textbooks	60%	15%	10%
Internet	40%	50%	0%
Professional Journal	40%	20%	20%
Non-Profit Organizations	35%	40%	5%
Newspaper Articles	30%	60%	0%
Word of Mouth	25%	35%	15%
Popular Magazines	20%	50%	5%
Television/Radio Reports	5%	40%	30%

n=20

Table 3. Sources of Lesson Plans Designed to Accomplish Environmental Education

Sources of Lesson Plans	Percentage of Respondents
Self-designed	85%
Designed by Other Teachers	70%
Designed by Non-Profit Organizations	30%
Designed by Federal or State Agencies	25%
Designed by Federal or State Education Organizations	10%

n=20

Table 4. Methods of Gaining Knowledge about Environmental Education Training Opportunities

Method of Gaining Knowledge about Environmental Education Training Opportunities	Percentage of Respondents
Word of Mouth	65%
Educator Publication	65%
Newsletter	60%
Internet	45%
Meetings	20%
Never hear of training	5%

n=20

Table 5. Interest in Outreach Environmental Education Opportunities

Outreach Environmental Education Opportunity	Percentage of Respondents Interested
Classroom Presentations by Outreach Educator	85%
Schoolyard Habitat Programs	85%
Water Quality Monitoring	80%
Wildlife Mapping	75%
Nest Box Monitoring/ Bird Counts	75%
Interactive Classroom Exhibitions/Workshops	70%
Field Trips	70%
Amphibian Monitoring	60%
Project Learning Tree	55%
Project WILD/ WILD Aquatic	50%
Forest Inventory	50%

n=20

training for teachers from Clermont Elementary School was successfully accomplished on site with capacity attendance.

One attempt to execute "Watershed Education Days", an outdoor, two-day, "hands-on" exposition of water quality awareness and monitoring opportunities for schools and residents in the Hunting Creek watershed, was cancelled due to an unfortunate siege of domestic terrorism in the National Capital region.

CHAPTER V. DISCUSSION

Lessons Learned

Low response to both the introductory questionnaire and the initial mailing of the environmental education needs questionnaire raised several questions. Was the low response due to the fact that a mailing from Blacksburg was ignored by principals and teachers? Did they think that a project coordinated in Blacksburg, more than 200 miles away from the Hunting Creek watershed, held little relevance for their school? The second local mailing of the environmental education needs questionnaire captured almost twice as many respondents as the same questionnaire mailed from Blacksburg, Virginia. This is a highly unusual response to a second mailing and points to a predisposition toward involvement in local projects. Teachers who were interviewed indicated a desire to participate in local projects that could strengthen community ties. An on-line questionnaire may have provided a greater response.

The timing of teacher training workshops proved to be a critical determinant of success. Two efforts were made to facilitate teacher training, and both were unsuccessful. One workshop was scheduled on a weekday during the summer vacation months when teachers were possibly out of town or failed to receive the training session information. The other workshop was planned for a weekend during the Spring semester, when conflicts with other events or busy personal lifestyles could have taken precedence over career development. In the first case, notification was sent approximately one month prior to the registration deadline. In the second case, notification was sent approximately two weeks prior to the registration deadline. Greater success might be achieved if notification of the training sessions was sent further in advance. Teachers have many competing demands and make plans for professional improvement months, or even semesters, prior to the event.

A pre-arranged guarantee of a "professional enhancement" or "teacher work equivalency" day from the school district's curriculum supervisor might have stimulated greater interest in the training programs. Continuing education or college credits offered through

Virginia Tech might also have improved teacher attendance at these sessions. Although it was not within the scope of the UrBIN project to offer monetary assistance or grants to enable teachers to attend these workshops, stipends offered for teachers to attend workshops garner a greater response (NAAEE, 2001b).

As there is always competitive demand for teacher attention, workshops advertised to tie into education reform, state standards, and proficiencies seem to attract the greatest response (NAAEE, 2001b). Focus on environmental education lesson plans that address the Virginia Standards of Learning in the UrBIN workshop announcements might have provided incentive to attend the training workshops.

"Whole-school" training workshops had a better response rate than "watershed-wide" sessions, possibly due to the convenience of attending pre-approved training at one's place of employment as opposed to attending training off-site. This finding concurs with the North American Association for Environmental Education's assessment of educator training (NAAEE, 2001b). Repeated attempts are necessary to reach educators and complete programs and events. The hectic nature of a teacher's school day and personal life demands persistence in communication when scheduling events. Cancellations are to be expected, but with each effort to compromise and meet teacher requirements, trust is built in the partnership.

Overcoming Barriers

Analysis of the Hunting Creek environmental education needs questionnaire revealed some surprising and alarming trends. Teacher reliance on environmental education lesson plans designed by themselves or other teachers far outweighs reliance on scientifically sound and unbiased resources. Knowledge of ecology, or an ecological conceptual basis for decision-making, is an important variable in producing environmental solutions (Hungerford and Volk, 1990). The respondents to the environmental education needs questionnaire failed to demonstrate knowledge of ecological issues in the Hunting Creek watershed. These results indicate a clear need for professionally designed environmental

education lesson plans and greater teacher awareness of existing environmental education programs.

Outreach environmental education can bridge the environmental literacy gap created by insufficient, biased, or ineffective instructive sources by providing lesson plans that address specific state standards of learning. The U.S. Fish and Wildlife Service and the Wildlife Habitat Council are examples of agencies and organizations that provide scientifically sound environmental education lesson plans that can be found on the World Wide Web. Additionally, outreach programs, such as Project WILD, Project WILD Aquatic, Project Learning Tree, Access Nature, and Wildlife Mapping, are nationally recognized and widely available sources of environmental education lesson plans that can enhance an existing environmental education curriculum.

Through full utilization of existing grants and by careful examination of potential environmental education opportunities, schools can overcome the funding barrier to achieving environmental literacy. The Environmental Protection Agency and the National Oceanographic and Atmospheric Administration are examples of Federal supporters for environmental education projects, and there are numerous private, non-profit groups and foundations that provide grants or matching funds.

Although recent budget cuts have reduced spending on natural resource protection to 0.6% of the state's general fund (Chesapeake Bay Foundation, 2003a), Virginia Governor Mark Warner demonstrated support for environmental education through creation of an Environmental Education Commission to advise his office on all matters related to environmental education in the state (Chesapeake Bay Foundation, 2003b). The commission identifies and assesses needs and priorities for environmental education. Maryland Senator Paul Sarbanes addressed the obstacle of funding to environmental literacy by introducing the Chesapeake Bay Education Bill (S2675) to the 107th Congress in June of 2002. The bill would provide funding through grant assistance to support teacher training, curriculum development, classroom education, and "meaningful Bay or stream outdoor experiences" for all students in the six-state Chesapeake Bay watershed (Sarbanes, 2002). Teachers in the Hunting Creek watershed, 30% of whom

identified lack of funding as a primary reason for not attending environmental education training sessions, would benefit from this bill.

Creation of schoolyard habitat and outdoor classrooms and laboratories, where students can explore the ecology of their immediate surroundings on a daily basis, is a cost-effective means to complement current environmental education curriculum. The high cost and difficulty of arranging transportation in an urban area may preclude regular field trips, but pertinent ecology lessons are readily available in the schoolyard (Brewer, 2002). Frequently, ecological and conservation instruction tend to focus on exotic locations and animals, while valuable educational resources in the schoolyard are underutilized. Schoolyard habitat provides opportunities for responsibility and ownership, creating a connection to the natural world that will later translate into stewardship. Outdoor classrooms and laboratories can foster learning skills that otherwise might be gained only through costly off-campus field trips. Additionally, schoolyard habitat provides an atmosphere conducive to learning and an inviting setting for visits from outreach environmental educators, such as natural resource professionals and park naturalists.

Outreach environmental education can mitigate inadequate teacher environmental education background through on-site classroom presentations, teacher training workshops, assistance with curriculum development, identification of environmental education lesson plans that address state standards, and links to federal, state, and local natural resource protection agencies. Outreach educators can strengthen community involvement and facilitate interdisciplinary partnerships for a more meaningful educational experience.

CHAPTER VI. CONCLUSIONS

Environmental literacy is a prerequisite to global sustainability. Each citizen must possess awareness and knowledge of ecological concepts, ability to evaluate environmental issues, and action skills necessary to invoke environmental solutions. Today's reclusive urban lifestyles provide little opportunity to connect with the natural world. Teachers are tasked with imparting awareness, knowledge, positive attitude, and decision-making skills to future generations who will face numerous environmental challenges. These teachers are often both unfamiliar with the subject material and unprepared to employ the conceptual instructional methods mandated by environmental education guidelines and proficiency standards.

Environmental literacy is achieved by construction of personal knowledge through experience. Being "informed" of environmental issues is not adequate preparation to resolve the complex, fundamental problems that communities face. Environmental literacy infers not only the knowledge of environmental issues, but also the willingness and ability to analyze and act upon them (Education Development Center, Inc. and the Boston Schoolyard Funders Collaborative, 2000). In addition to stewardship, environmental education has been found to enhance overall academic achievement, critical thinking, and basic life skills (Archie, 2001; Kearney, 1999; Lieberman and Hoody, 1998; NAAEE, 2001a; NEETF, 2002; Sarbanes, 2002,).

The absence of environmental education in many state standards of achievement and teacher certification requirements could mistakenly be construed as evidence of its irrelevancy and illegitimacy in the modern educational curriculum. In order for environmental education to be recognized as a critical component in the formation of informed, responsible citizens with the ability to analyze and solve the daunting problems of the world in the 21st Century, environmental literacy must become a paramount goal. Outreach environmental education can play a vital role in achieving this objective.

REFERENCES

- Archie, M. (2001). Moving into the educational mainstream. *Infobrief*, 26. August 2001. The Association for Supervision and Curriculum Development. Alexandria, Virginia.
- Aspinwall, B. and Harrell, P. (2002). *Environmental education fund general survey; A survey of North Carolina teachers*. Report of survey done by East Carolina University Survey Research Laboratory. Greenville, North Carolina. 8p.
- Brewer, C. (2002). Conservation education partnerships in schoolyard laboratories: A call back to action. *Conservation Biology*, 16(3), 577-579.
- Chesapeake Bay Foundation. (2003a). Tight budget means tough fight to protect Bay priorities. *Save the Bay Newsletter*, 29(1), 9.
- Chesapeake Bay Foundation. (2003b). CBF educator named to environmental commission. *Save the Bay Newsletter*, 29(1), 3.
- Education Development Center, Inc. and the Boston Schoolyard Funders Collaborative. (2000). *Schoolyard learning: The impact of school grounds*. Boston, Massachusetts. 38p.
- Hungerford, H., Peyton, R. B. and Wilke, R.J. (1980). Goals for curriculum development in environmental education. *Journal of Environmental Education*, 11(3), 42-47.
- Hungerford, H. and Volk, T. L. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education*, 21(3), 8-21.
- Kearney, A. (1999). *Teacher perspectives on environmental education and school improvement*. Final Report done for The Evergreen Center for Educational Improvement. Evergreen State College. Olympia, Washington. 71p.
- Lieberman, G. A. and Hoody, L. L. (1998). *Closing the achievement gap; Using the environment as an integrating context for learning*. Report for the State Education and Environment Roundtable. Science Wizards. Poway, California. 12p.
- McKeown-Ice, R. (2000). Environmental education in the United States: A survey of preservice teacher education programs. *Journal of Environmental Education*, 23(1), 4-11.
- Moseley, C. (2000). Teaching for environmental literacy. *Clearing House*, 74(1), 23-24.

- NAAEE (North American Association for Environmental Education). (2001a). *Using environment-based education to advance learning skills and character development*. The National Environmental Education and Training Foundation. Washington, D.C. 25p.
- NAAEE (North American Association for Environmental Education). (2001b). *Lessons learned about educator training*. PDF file 34p.
As viewed on the World Wide Web at: www.eelink.net (accessed 12 January 2003).
- NEETF (National Environmental Education and Training Foundation) (2002). *Environmental learning in America; Working toward nationwide environmental literacy*. Bi-annual report 2000 and 2001. Washington, D. C. 28p.
- Rivkin, M. (1997). The schoolyard habitat movement: What it is and why children need it. *Early Childhood Education Journal*, 25(1), 61-66.
- Ruskey, A., Wilke, R., and Beasley, T. (2001). A survey of the status of state-level environmental education in the United States-1998 update. *Journal of Environmental Education*, 32(3), 4-14.
- Sarbanes, P. (2002). *Congressional Record*. Proceedings and debates of the 107th Congress, second session. Chesapeake Bay Education Bill-S.2675. June 25, 2002.
As viewed on the World Wide Web at:
http://sarbanes.senate.gov/pages/press/062502_chesapeake_bay_education_bill.html
(accessed 12 January 2003).
- UNESCO-UNEP. (1978). The Tbilisi declaration. *Connect: UNESCO-UNEP Environmental Education Newsletter*, 3(1). Paris, France. 8p.
- Virginia Polytechnic Institute and State University. Departments of Landscape Architecture and Urban Affairs and Planning. (2003). *Urban biodiversity in the Holmes Run/Cameron Run watershed; Landscape assessment and biodiversity planning considerations*. Blacksburg, Virginia. 69p.
- Woodhouse, J. L. and Knapp, C. E. (2000). Place-based curriculum and instruction: Outdoor and environmental education approaches. *ERIC Clearinghouse on Rural Education and Small Schools. ERIC Digest*.
As Viewed on the World Wide Web at:
<http://www.ael.org/eric/digests/edorc006.htm> (accessed 12 January 2003).

APPENDIX A. Profile of Public Schools in the Hunting Creek Watershed

Name of School	Type of School	Jurisdiction	2002 Enrollment
John Adams	Elementary	Alexandria	550
Patrick Henry	Elementary	Alexandria	560
Jefferson-Houston	Elementary	Alexandria	500
Douglas MacArthur	Elementary	Alexandria	530
Maury	Elementary	Alexandria	230
James Polk	Elementary	Alexandria	500
William Ramsey	Elementary	Alexandria	530
T.C.Williams	High	Alexandria	2000
Minnie Howard	9th grade	Alexandria	720
Francis Hammond	Middle	Alexandria	1240
George Washington	Middle	Alexandria	1050
George Mason	High	Falls Church	565
George Mason	Middle	Falls Church	431
Thomas Jefferson	Elementary	Falls Church	500
Annandale	High	Fairfax	2300
Falls Church	High	Fairfax	1400
Lee	High	Fairfax	1875
Jeb Stuart	High	Fairfax	1500
Thomas Jefferson	High	Fairfax	1640
Glasgow	Middle	Fairfax	1200
Holmes	Middle	Fairfax	840
Key	Middle	Fairfax	850
Poe	Middle	Fairfax	1200
Mark Twain	Middle	Fairfax	975
Annandale Terrace	Elementary	Fairfax	670
Bailey's	Elementary	Fairfax	900
Beech Tree	Elementary	Fairfax	450
Belvedere	Elementary	Fairfax	527
Braddock	Elementary	Fairfax	675
Bren Mar Park	Elementary	Fairfax	425
Bush Hill	Elementary	Fairfax	520
Cameron	Elementary	Fairfax	688
Clermont	Elementary	Fairfax	400
Columbia	Elementary	Fairfax	385
Graham Road	Elementary	Fairfax	430
Lynbrook	Elementary	Fairfax	475
Mt. Eagle	Elementary	Fairfax	320
Parklawn	Elementary	Fairfax	750
Pine Spring	Elementary	Fairfax	450
Rose Hill	Elementary	Fairfax	780
Shreewood	Elementary	Fairfax	450
Sleepy Hollow	Elementary	Fairfax	400
Springfield Estates	Elementary	Fairfax	600
Timber Lane	Elementary	Fairfax	625
Westlawn	Elementary	Fairfax	550
Weyanoke	Elementary	Fairfax	560
Woodburn	Elementary	Fairfax	425

APPENDIX B. Profile of Private Schools in the Hunting Creek Watershed

Name of School	Type of School	Jurisdiction	2002 Enrollment
St. Stephens	K-5	Alexandria	...
St. Stephens	6-8	Alexandria	...
St. Stephens	9-12	Alexandria	Total of 1100
St. Michael's	K-8	Annandale	500
Corpus Christi	K-8	Falls Church	640
St. James	K-8	Falls Church	720
Queen of Apostles	JK-8	Alexandria	270
Episcopal	High	Alexandria	400
Burgundy Farm	JK-8	Alexandria	285
Bishop Ireton	High	Alexandria	812
Browne Academy	PK-8	Alexandria	250
Immanuel Christian	PK-8	Springfield	460
Westminster	K-8	Annandale	300
Congressional	PK-8	Falls Church	485

APPENDIX C. Introductory Letter and Questionnaire to School Principals

Dear Principal, Headmistress, or Headmaster,

Did you know that your school is in the Hunting Creek watershed?

We are writing to inform you about a project that could involve your school.

The United States Geological Survey, Metropolitan Washington Council of Governments, and Virginia Polytechnic Institute and State University have entered into a joint project that will examine the effects of urban and suburban growth on the biological diversity (biodiversity) of the metropolitan Washington, DC region.

We are creating the Urban Biodiversity Information Node (UrBIN) for use by your teachers. The Urban Biodiversity Information Node is a component of the National Biological Information Infrastructure (NBII, www.nbio.gov), a division of the U.S. Geological Survey

Through the UrBIN project's outreach environmental education division, Virginia Tech's Conservation Management Institute will be available to assist teachers with incorporating environmental education into their curriculum. Funding, in the form of competitive mini-grants available through the UrBIN project, will be provided for schools to become involved in existing environmental education programs. Information will be made available, through a web site currently under construction, on upcoming environmental education. There will also be numerous opportunities to enhance the existing curriculum through teacher training that will provide lesson plans that address the Virginia Standards of Learning (SOL).

During the next year, the UrBIN project partners will sponsor three "Watershed Education Days". These events will provide opportunities for school children, their parents, teachers, civic associations, and citizens at the local level to learn about the many functions of a healthy urban watershed ecosystem. Stream monitoring, survey, and rehabilitation techniques will be discussed and demonstrated. Participants will be able to take part in resource monitoring activities in the watershed in which they live and will be introduced to organizations that work at the local level to monitor and protect the natural resources there.

During the Spring 2002 semester, we will be creating a database of schools that are interested in participating in this project. We will be sending a questionnaire to those schools that express an interest in having teacher involvement in urban watershed education programs. Throughout the summer, we will be designing the programs and planning the schedule for the events in which we sincerely hope your school will become involved. During the Fall 2002 semester, we will host the Watershed Education Days and work with your teachers and students in achieving our shared goals for environmental education.

The UrBIN project partners are excited about this unique opportunity to become involved in the environmental education curriculum of your school. We hope that you will join us in exploring our watershed and collecting valuable scientific information that will be

used in making the decisions that affect the future of the natural resources of our community.

Please take a moment to complete the attached introductory questionnaire, so that we might determine your level of interest in participating in this project. We hope that you will not hesitate to contact us with any questions. Thank you for your support.

Sincerely,
The UrBIN Environmental Education Team

INTRODUCTORY QUESTIONNAIRE

- | | YES | NO |
|--|-------|-------|
| 1. Do your teachers currently include environmental education in their curriculum? | _____ | _____ |
| 2. Would your teachers be interested in participating in the UrBIN project? | _____ | _____ |
| 3. Please provide the names of teachers who are interested in participating in this environmental education opportunity. Please include phone number, e: mail address and preferred mode of communication. | | |

APPENDIX D. Frequently Asked Questions (FAQ) Sheet

UrBIN FAQ SHEET

Q. What does UrBIN stand for?

A. UrBIN stands for Urban Biodiversity Node. It is a component of the National Biological Information Infrastructure (NBII) (www.nbio.gov).

Q. What does the NBII do?

A. The NBII aims to supply urbanizing communities with the biological and ecological information that they need to make wise land use decisions. It will supply citizens' groups with useful information and assist teachers through identification and facilitation of training opportunities in environmental education.

Q. What is the UrBIN Project?

A. The UrBIN Project is a coordinated effort between the United States Geological Survey (USGS), Virginia Tech (VT), and the Metropolitan Washington Council of Governments (MWCOG). There are five tasks to be undertaken. They are:

1. GIS data acquisition and synthesis
2. Landscape characterization and spatial analysis
3. Information compilation and web site development
4. Environmental education
5. Biological and physical characterization

Q. What is the study area of the UrBIN project?

A. The UrBIN Project uses a watershed approach for its analysis, and the pilot study area is the Hunting Creek watershed.

Q. Who will the UrBIN Project involve?

A. The UrBIN Project will involve stakeholders from many disciplines within the watershed. City and county planning offices, the Northern Virginia Soil and Water Conservation District, city, county, and regional Park Authorities, citizens' action groups and community associations, the United States Fish and Wildlife Service, the United States Forest Service, schools located within the watershed, and many others will be participating in the study.

Q. How will schools be able to participate?

A. The Environmental Education component of the UrBIN Project will provide and opportunity for school children to participate in a "Watershed Education Day". This event will focus on water quality and will allow children to use the tools in the field to accurately obtain scientific data. Existing watershed monitoring programs will be identified, and opportunities to link classrooms with these long-term projects will be explored.

- Q. What other opportunities will the UrBIN Project provide for environmental education?
- A. The UrBIN Project Team will facilitate environmental education training sessions for teachers in programs that address the Virginia Standards of Learning.
- Q. How long will the UrBIN Project last?
- A. The UrBIN Project involving the Hunting Creek watershed is a Pilot Program. It will end in January 2003. The activities mentioned above will occur in the summer and fall of 2002. However, a web site is being created by the UrBIN Project Team which will continue to identify environmental education opportunities such as workshops, lesson plans, training opportunities, and links to environmental organizations with whom classrooms could establish long-term monitoring relationships.
- Q. Can the UrBIN Project respond to an individual school or teachers needs?
- A. Yes, the UrBIN Project Team will make every possible effort to meet the needs of each school or classroom. We are sending questionnaires to determine your existing environmental education curriculum and what your preferences and needs might be. We are willing to answer any questions you may have, and look forward to working with you.

The UrBIN Project Environmental Education Team:

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APPENDIX E. Environmental Education Needs Questionnaire

Environmental Education Needs Questionnaire

1. What is the name of your school? _____

2. Which watershed your school is in?
Check All Correct Answers.

- a. Chesapeake Bay
- b. Potomac River
- c. Rocky Run
- d. Four Mile Run
- e. Holmes Run/Tripps Run/Cameron Run
- f. All of the above
- g. None of the above

3. This watershed is a part of which type of ecosystem?
Check All Correct Answers.

- a. Mixed hardwood deciduous forest
- b. Urban forest
- c. Fragmented forest
- d. Urban
- e. All of the above
- f. None of the above

4. What is the key ecological issue in this watershed?
Check All Correct Answers.

- a. Water pollution
- b. Air pollution
- c. Urbanization
- d. Loss of biodiversity
- e. Fragmentation of habitat
- f. Deforestation
- g. All of the above
- h. None of the above

5. Does your curriculum currently address ecological topics? Yes No

If answer is No, please answer Question #6, then skip to #8

If answer is Yes, please skip to Question #7

6. Why doesn't your curriculum address ecological topics?
Check all that apply.

- a. Not required
- b. Too controversial
- c. Inadequate teacher training in ecological topics
- d. Can't fit into schedule
- e. Other (specify: _____)

7. Do you use specially designed lesson plans to accomplish environmental education? Yes No
Who designs these lesson plans?
Check all that apply.

- a. Self-designed
- b. Designed by other teachers
- c. Designed by federal or state education organizations
- d. Designed by federal or state agencies
- e. Designed by non-profit or non-governmental organizations
- f. All of the above
- g. None of the above

8. Do you feel you have adequate background in ecological principles to properly educate your students in that topic? Yes No

9. Do you attend training workshops or classes to update your environmental education knowledge and skills? Yes No

If No, please skip to Question #11

10. How often do you attend environmental education training or classes?

- a. At least once per semester
- b. At least once per year
- c. At least every 5 years
- d. Less than every 5 years

11. The primary reason for not attending environmental education training is:
Check all that apply.

- a. Lack of funding
- b. Scheduling difficulties
- c. Lack of interest
- d. Lack of knowledge about opportunities
- e. Other
(specify: _____)

12. How do you learn about environmental education training opportunities?
Check all that apply
- a. Word of Mouth
 - b. Internet
 - c. Newsletter
 - d. Educator Publication (Journal, Paper, etc.)
 - e. Don't ever hear about environmental education training opportunities
 - f. Other (specify: _____)
13. Do you use environmental education lesson plans to meet some of the Virginia Standards of Learning? Yes No
14. How satisfied are you that your current environmental education programs adequately address the Virginia Standards of Learning?
Check one answer.
- a. Very satisfied
 - b. Somewhat satisfied
 - c. Somewhat dissatisfied
 - d. Very dissatisfied
 - e. Don't know
15. Are you interested in obtaining environmental education lesson plans that specifically address the Virginia Standards of Learning? Yes No
16. Do you think your class could benefit from a more "hands-on" approach to environmental education? Yes No
17. Where do you obtain your subject material for environmental education lesson plans? (Indicate frequency of use with the following codes:
1 = Frequent 2 = Infrequent 3 = Never)
- ___ a. Textbooks
 - ___ b. Professional Journals
 - ___ c. Popular Magazines (Newsweek, Time, Discover, etc.)
 - ___ d. Internet
 - ___ e. Workshop Materials
 - ___ f. Other Teachers
 - ___ g. Nonprofit Organization Publications
 - ___ h. Television/Radio Reports
 - ___ i. Newspaper Articles
 - ___ j. Word of Mouth
 - ___ k. Other(specify: _____)

18. Are you interested in having your class participate in long-term monitoring projects? Yes No
19. In which types of monitoring programs would you be interested?
Check all that apply.
- a. Water Quality
 - b. Wildlife Mapping
 - c. Forest Inventory
 - d. Amphibian Monitoring
 - e. Bird Count/ Nest Box Monitoring
20. What types of environmental education programs do you think could best augment your current curriculum?
Check all that apply.
- a. Interactive Classroom Exhibitions/Workshops
 - b. Classroom Presentations by an Outreach Educator
 - c. Field Trips
 - d. Monitoring Opportunities
 - e. Habitat Gardens
 - f. Other (specify: _____)
21. Are you familiar with the following environmental education training programs?
(Use the following code to indicate familiarity: F = Familiar U = Unfamiliar)
- a. Project Wild/Aquatic Wild
 - b. Project Learning Tree
 - c. Wildlife Mapping
 - d. Backyard/Schoolyard Habitat Programs
22. Are you interested in attending training sessions that will be facilitated by the UrBIN Environmental Education Team? Yes No
- If No, skip to Question #26
23. In what types of training opportunities would you be interested?
(Please indicate interest using the following codes:
I = Interested N = Not interested U = Uncertain)
- a. Project Wild/Aquatic Wild
 - b. Project Learning Tree
 - c. Wildlife Mapping
 - d. Backyard/Schoolyard Habitat Programs

VITA

Ann Elizabeth Wood-Arendt

Ann Elizabeth Wood-Arendt did undergraduate studies at Catawba College and Westhampton College of the University of Richmond and received a Bachelor of Science degree from the Medical College of Virginia in 1972. She received a Certificate of Natural Resources from Virginia Polytechnic Institute and State University in 2001. In the same year, she also completed a Fellowship with American Forests. She has been a volunteer naturalist and resource monitor for the Resource Management Division of the Fairfax County Park Authority since 1996.

Ann grew up just a few steps away from one of the tributaries of Holmes Run and has witnessed many irrevocable changes in the Hunting Creek watershed. She remembers many happy days spent in the exploration of the stream and its surrounding woodlands. The early experiences that she had there became the foundation of her deep love of all living creatures and respect for the land. She attributes her unending quest for knowledge and understanding of the natural world to her father, a botanist and meteorologist from Richmond, Virginia. He taught her not to judge anything at face value, but to look deep beyond the surface to discover its true value and meaning.