Proceedings of the 2005 Puget Sound Georgia Basin Research Conference

The effects of field science research integrated into K-12 curriculum.

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Keywords: Field Science, Education, Research, Policy, Public Awareness, Citizen Participation

Washington Department of Fish and Wildlife, as a partner in the public private Pacific Education Institute has studied the role of K-12 students in field science research to understand their potential contribution to agency science questions.

The Pacific Education Institute is an academically research based environmental education (EE) non-profit organization. PEI helps teachers and students become environmentally literate citizens and advance environmental stewardship. PEI's experiential programs develop decision-making abilities about the environment while deepening critical thinking and problem solving skills. The Institute supports K-20 teachers and school districts, providing integrated subject-based environmental education. The PEI board of directors represents a collation of public and private stakeholders consisting of leaders of education associations, natural resource agencies, business and industry, non-profits, and Dr. Terry Bergeson, Superintendent of the Office of Public Instruction.

The environmental education program at Washington Department of Fish and Wildlife centers on the PEI environmental education frameworks or benchmarks that describes environmental literacy in terms of a performance and is specific about what students should know and be able to do found in the Pacific Education Institute Technical Report Number 1 (PEI TR#1 2004). The PEI Environmental Education Frameworks describe:

- Social and Natural Systems Understanding (Systems Analysis) where students examine how natural and human systems interrelate by identifying problems, understanding stakeholder interests, evaluating trade-offs and generating alternative solutions
- Research-based Inquiry where students analyze research, develop research questions, design and conduct an investigation and recommend an action
- Language, Visual and Performing Arts where students investigate how creative expression communicates ideas and values through different media and reveals cultural values and varying societal perspectives
- Civic Participation where leadership skills are expanded and tested as students collaborate to develop plans that contributes to the resolution of a local, regional and international issue.

The frameworks described above provide a plan for curriculum development for teachers. These frameworks also organize how an agency or organization can be of value to the education of a student. Schools can require that community members wishing to "educate" about their component of the environment, organize their education experience that involves understanding systems through their research questions and design, offering research experiences and providing opportunities to participate in environmental stewardship in the community. Research on schools participating in environment based field studies also report decreased discipline problems and increased motivation and engagement of students when provided these real work opportunities (Lieberman & Hoody 1998).

Along with the frameworks, PEI designed assessment tools (PEI TR# 5 2004) modeled on the state's science tests (WASL's). These new assessment tools now provide Washington's K-12 educators and Environmental Education Program Managers in agencies and organizations with a means to evaluate the success of programs to address student understanding of systems and improve student achievement.

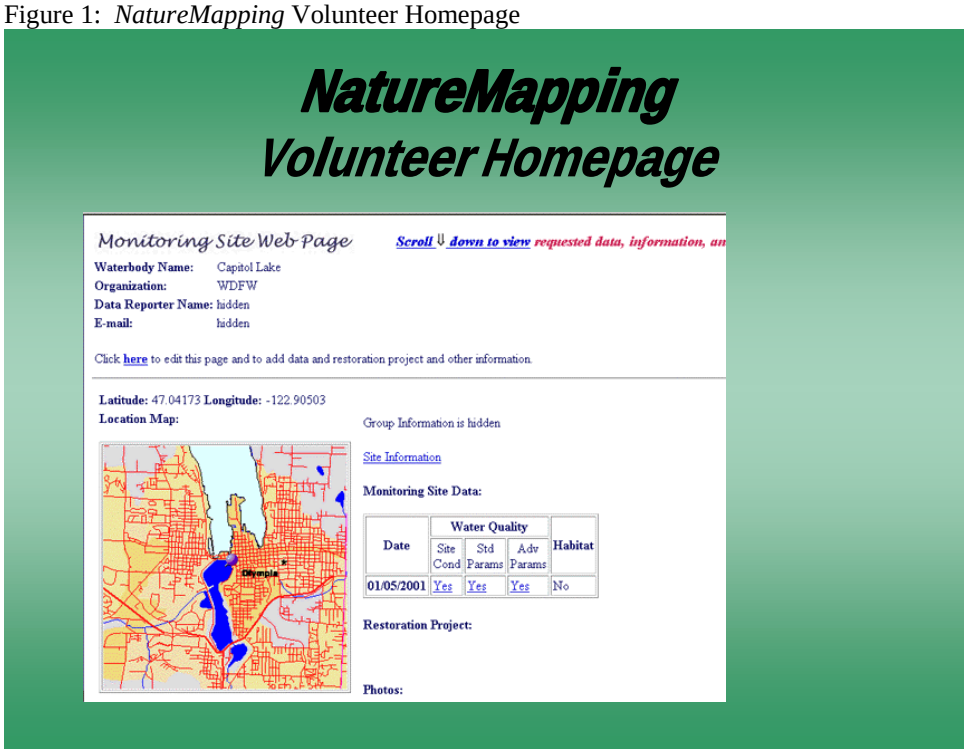
In 2002, PEI sponsored research compared WASL scores of schools that incorporate EE programs with schools that do not. The research demonstrated that schools with EE programs had consistently higher WASL scores than demographically equivalent schools with traditional curricula. The study of 77 pairs of schools provided a clear trend or pattern indicating the environmental education is one factor that improves student learning at a school building level (PEI TR# 6 2004).

PEI's current research compares the scores on the Environment Integrated WASL-type EE tests for fifth and eight grade students. Student scores of the WASL-type EE tests indicates a solid relationship with the same student scores on the math, writing and reading WASL state test scores. Our researcher Dr. Catherine Taylor states that these important findings demonstrate a solid relationship between performance on integrated environment-based assessments and student achievement on WASL tests (PEI TR#7 2005). These results confirm that there is a strong relationship between the performances of students on the WASL and environmental education experiences that intentionally integrate subject area learning through environmental themes.

The opportunity for natural resource based agencies and organizations is to organize their K-12 education programs to provide opportunities for field investigation and environmental restoration and conservation. The Washington Department of Fish and Wildlife has committed to developing citizen science opportunities for schools and the public to have both an experiential education and stewardship value. This commitment grew out of ten years of experience, developing the NatureMapping Program jointly with the University of Washington (UW) Fish and Wildlife Cooperative Research Unit, to offer schools and the public opportunities to participate in research and conservation.

NatureMapping, a program now run by the University of Washington, piloted a study with WDFW and Department of Ecology (DOE) in 1999 to understand how schools and citizen scientists would respond to the opportunity to collect water quality data and report the data regularly. UW NatureMapping had developed as interactive website with WDFW and DOE, where water and stream habitat data could be reported on a home page with a map showing the exact location (Figure 1). Water quality programs involving students and adults were contacted to invite their participation. After the first nine months, the data received from these citizen scientists were evaluated to determine the scientific value of the data and to refine the database.

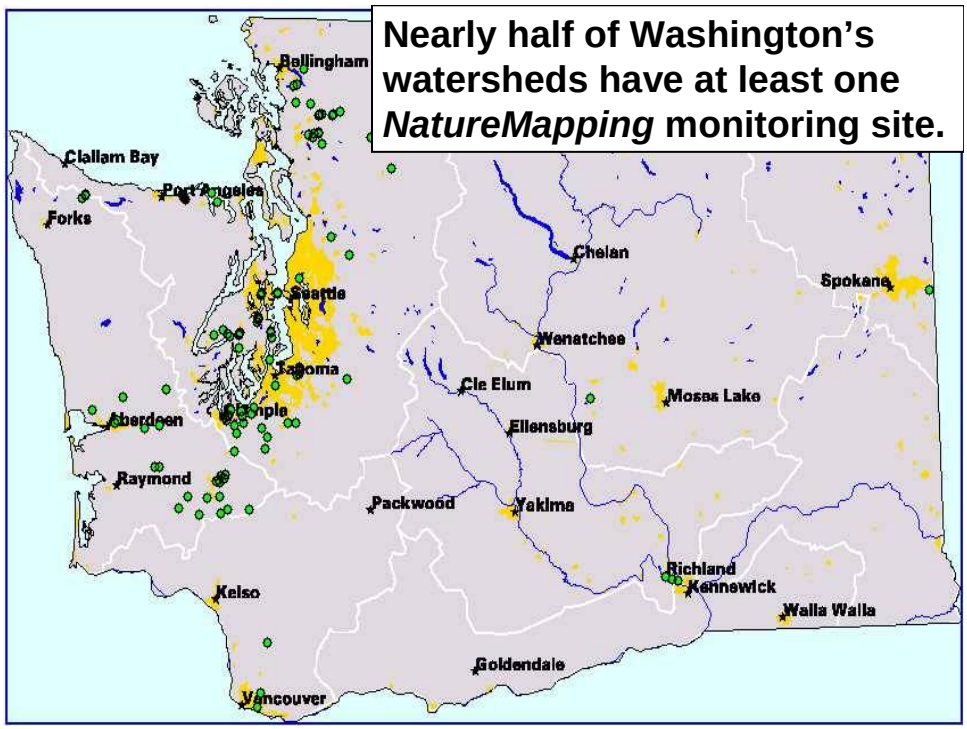
Figure 1: *NatureMapping* Volunteer Homepage



The data analysis revealed that 91 groups reported data, reflecting 3141 volunteers and 13,971 volunteer hours. Nearly half of the state's WRIA's had at least one NatureMapping entity collecting and reporting data on water and streams (Figure 2). The majority of those groups reporting were schools along with supporting community groups. Their level of expertise reported consisted largely of Level 1 (34%) & Level 2 (30%) on a scale of 1-4, with Level 1 having minimal training and equipment and Level 4 being expert. NatureMappers were comfortable collecting and reporting water quality and stream attribute data,

although there were less reports but good attempts to report on high level water quality and habitat parameters, which required more training.

Figure 2: Washington State Map showing locations of entities reporting to the NatureMapping Water Module



The opportunity is clear for natural resource agencies and organizations to benefit from the need of schools and coordinated volunteer groups to participate in research and stewardship that contributes to the environment. Schools benefit from the support provided by agencies and organizations to undertake research and stewardship in several ways. Schools in partnership with natural resource based agencies and organizations can connect student learning to the community in real ways that contribute to student understanding of systems that sustain their quality of life.

Pacific Education Institute Technical Report Number 1: Environmental Education Frameworks that Integrate Washington State's Learning Standards. 2004
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