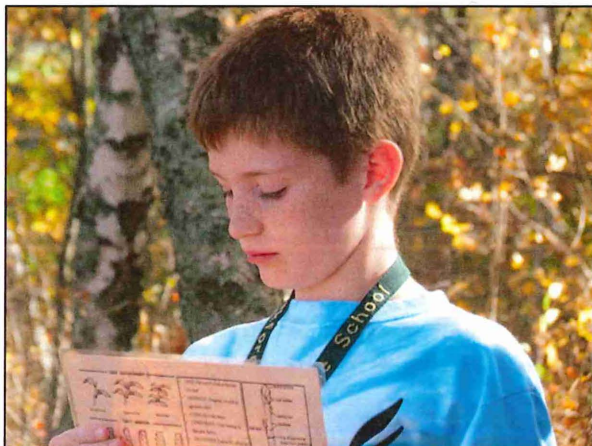


“Integrating Environmental and Outdoor Education in Grades 7-12”

Final Report

By Jeff Ledermann

June 28, 2013



Project Coordinator: Jeff Ledermann, Environmental and Outdoor Education Coordinator

Project Director: Beth Aune, Director, Academic Standards and Instructional Effectiveness

Minnesota Department of Education
1500 Highway 36 West
Roseville, MN 55113-4266
651-582-8200
<http://education.state.mn.us>

Funding Source: Environment and Natural Resources Trust Fund

Legal Citation: M.L. 2010, Chap. 362, Sec. 2, Subd. 8g;
M.L. 2011, 1st Special Session, Chapter 2, Article 3, Subd. 18.
Carryforward (b)



Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the *protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.*

Currently 40% of net Minnesota State Lottery proceeds are dedicated to building the Trust Fund and ensuring future benefits for Minnesota's environment and natural resources.

Cover photos: Rockford Middle School students discover the academic benefits and joy of environmental and outdoor education. Photo credit – Beth Russell, Rockford Middle School

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Introduction

Recent and emerging research indicates that students are increasingly disconnected from nature. Citing the challenges associated with a student population rarely exposed to the outdoors, the 2010 Minnesota Legislature appropriated \$300,000 from the Minnesota Environment and Natural Resources Trust Fund (ENRTF) as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR) to the Minnesota Department of Education (MDE). In cooperation with the Minnesota Department of Natural Resources, MDE hired a full-time coordinator to lead a project to train and support grade 7-12 teachers to integrate environmental and outdoor education (EOE) into the instruction of academic standards. Professional development and grants of up to \$8,500 were provided to six pilot schools to support 50 teachers and administrators in their use of the environment and outdoors as a context for student learning, which resulted in engaging over 1,000 additional students in EOE on a regular basis during the 2011-13 school years.

Beyond the original goals of the project, the project coordinator developed partnerships with several EOE providers to coordinate and offer five, additional, day-long regional workshops at minimal cost that were attended by 108 additional educators not from the pilot schools.

The project coordinator also developed and implemented Minnesota's participation in the first two years of the U.S. Department of Education's Green Ribbon Schools Program that recognizes schools for efforts to reduce their environmental impact and implement EOE throughout their curriculum. Minnesota led the nation with the most applicants in 2013 and seven Minnesota schools and districts were among 156 schools that have received the national award to date. Workshops led by the coordinator at the sites of Minnesota's three 2012 national honorees were attended by over 100 people.

Several promising activities were identified during the project, many of which were tested and evaluated. They included teacher training, mini-grants to schools, community partnerships, children and nature connections, green school programs, connections with MDE staff, school administrative support, and the need for a national EE program model. These activities, challenges and the project evaluation are described in detail in the report.

Training

Recognizing that teachers and administrators would be the key to implementation and sustaining the efforts to integrate EOE into Minnesota schools, training of educators was established early on as a priority of the project. With the support of an Environmental and Outdoor Education Advisory Committee (EOEAC, members listed in Appendix C) and three regional trainers, shortly after his hiring in March of 2011 the project coordinator began the task of establishing the criteria to select six pilot schools and establish the framework for the training. It was determined that offering high level training taught by some of Minnesota's EOE experts would be an extra incentive for schools to apply for the project's mini-grants. In addition, the two-day intensive training would provide them with the necessary background and skills to maximize the impact of the mini-grant funds.

Grantees

A sub-committee of the EOEAC met with the coordinator and regional trainers and quickly established targeted outcomes for the training of the teachers from the pilot schools. The project evaluator also helped survey the initial 32 educators from the project pilot schools to determine their needs for the training. With the input from the educators, the project coordinator set out to determine a location for the pilot training and solicit state EOE experts to participate. Drawing upon years of relationships and experience in the EOE field, he was able to find several partners willing to donate their time and resources to participate in the project, including staff from DNR, Master Naturalist Program, Jeffers Foundation, SEEK, Three Rivers Park District, Pheasants Forever, MDE Academic Standards Team and several local community partners.

Centrally located for most of the grantees to save travel expenses and transportation emissions, Camp Courage, a residential camp and environmental center in Maple Lake with diverse outdoor learning areas, was chosen as the location for the initial pilot training in December of 2011. Thirty-two teachers and administrators from the six pilot schools were able to attend. Eighteen more teachers from the pilot schools participated in later trainings. The initial training agenda (Appendix D) focused on building skills for EOE, state and local resources, examples of good EOE curriculum, alignment with the state academic standards and time to meet in teams to begin planning the process of integrating their projects over the next one and one-half years.



Figure 1. Exploring Camp Courage natural areas during a school forest lesson led by DNR staff at the pilot training.



Figure 2. Teachers measure tree circumference at Camp Courage. Mathematics is just one example of the many ways academic standards can be achieved within an environmental context.

Regional Workshops

Beyond the original goals of the project, the project coordinator also developed partnerships with several EOE providers to coordinate and offer five, additional, day-long regional workshops (see Appendix E for workshop flyer) at minimal cost that were attended by 108 additional educators not from the pilot schools. The workshops were held at environmental learning centers that donated space. These centers were Cascade Meadow Wetlands & Environmental Science Center, Rochester; St. John's University Arboretum, Collegeville; Como Park Streetcar Station, St. Paul; Audubon Center of the Northwoods, Sandstone; and South Central Service Cooperative, North Mankato.

The introductory EOE regional workshops developed with the DNR, Jeffers Foundation and other local partners have led to additional opportunities for coordinated workshops. In particular, the Jeffers Foundation has expressed interest in continuing to work with MDE on future workshops patterned after those developed during the project.



Figure 3. Teachers investigate natural landscapes at the Cascade Meadow Wetlands and Environmental Science Center in Rochester.

Various other presentations, meetings and outreach

In addition to the several EOE workshops and trainings, the coordinator has directly reached over 2,300 other educators through technical assistance and teaching, including participating in several workshops, programs and events. The coordinator also made regular efforts to promote activities related to the project and the benefits of environmental and outdoor education

whenever possible throughout the duration of the project. EOE information, resources and achievements, such as the Green Ribbon Schools honorees, were regularly shared through MDE's Superintendent mailings and department listserves and newsletters and listserves by SEEK, Minnesota Association for Environmental Education, Minnesota Science Teachers Association, Green Schools Coalition, Children and Nature Connection, Minnesota Sustainable Communities Network and many others.

The coordinator had occasional opportunities to do some media activities, including a 20 minute interview about the value of EOE on the April 1, 2013 show of the podcast, Mom Enough, which has a national following of several thousand listeners. The interview can be found at <http://momenough.com/2013/04/lets-get-outside-tips-for-parents-and-teachers-from-an-environmental-educator-and-creative-dad>. Local media from the communities of the pilot schools and Green Ribbon School honorees also developed several news stories covering the value of EOE activities.

Information about the project, including the final report and model lessons, will be posted on the SEEK (Sharing Environmental Education Knowledge) website at www.seek.state.mn.us, hosted by the Minnesota Pollution Control Agency.



Figure 4. EOE display at a healthy schools conference.

Pilot Schools

Selection of the six EOE project schools was done through an open invitation for proposals by MDE early in the 2011-2012 school year. The invitation was shared widely across the state, including SEEK, MDE's Superintendent mailing and several department and other organizational newsletters and electronic maillists. As required by the appropriation from the ENRTF, only programs targeting public school students in grades 7-12 were eligible to apply. Dozens of schools inquired about the project and MDE received 20 applications.

The applications were reviewed and scored by a team of internal and external education experts. Original awards of up to \$5,000 were awarded to Concordia Creative Learning Academy, Kennedy Community School, River's Edge Academy, Rockford Middle School, Simley High School and Waconia Public Schools. Attempts were made to solicit and choose a diverse group of schools. The pilot schools included two charters, an alternative learning center, community schools, large public schools, schools from urban, suburban and rural communities, new and old buildings and schools with a high percentage of youth from disadvantaged backgrounds.

After the initial training at Camp Courage, it became clear that due to the diverse training needs and interests of the pilot schools and the high cost and logistics, it wasn't feasible to bring the group together again for a large, combined training. Instead, with approval from LCCMR, MDE amended the original grant awards and offered each school up to an additional \$3,500 for professional development training and to adopt or revise their curriculum. Individual schools received up to a total of \$8,500 and total awards to all schools amounted to \$44,626.51. Projects ranged from gardening to water quality testing to additional teacher training to support curriculum revision and are highlighted over the next several pages. The pilot teachers reported that as a result of the mini-grants they engaged 1,037 students in studying the environment and going outside on a regular basis and will continue to reach a similar number of students each year.

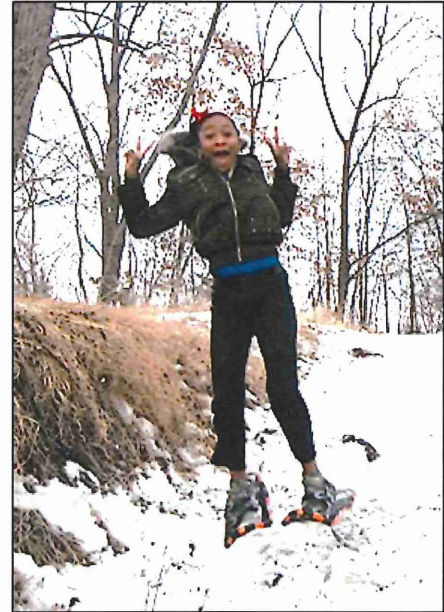
Concordia Creative Learning Academy

Address:

930 E Geranium Ave
St Paul, MN 55106
(651) 793-6624

Contact:

Jesse Maloney, Science Teacher
jesse@cclaonline.org



Concordia Creative Learning Academy is a charter school in the St. Paul School District. Four teachers were trained as part of the EOE project. Unfortunately, after the first year of the project, three of the four teachers left the school for other positions. However, the lead teacher has provided approximately 55 students with numerous new and innovative environmental and outdoor education experiences. The mini-grant funds were used for educational equipment and supplies, including microscopes and snowshoes. Water quality and watershed investigation was a primary focus of the project.

- Several science lessons were adapted to integrate outdoor, real-world components and other subjects, such as math and geography.
- In addition to water quality testing, they have built a gazebo, snowshoed several times, collected and made maple syrup and collected samples to study air quality.
- They plan to continue to take one outdoor trip per month in the foreseeable future.

The lead teacher reported the following:

"Students have really enjoyed their time participating in this project. Students were happy to combine water fun with work. They loved launching their rafts to test their occupant capacity and buoyancy. Students have used the microscopes for a number of activities since their arrival. They have grown their own mold and studied their spores. They have looked at the dust germs at the middle of snowflakes. Another benefit of the project is that students were required to create a large report based on data collected over a number of weeks. It was a difficult yet rewarding process. Students are more aware of the effects of runoff and littering. When we assessed whether they believe this project has influenced them to want to be better stewards of the environment with their new knowledge, 78% of students responded, "yes."

He added that involvement in the EOE project appealed to all students at CCLA, who come from a wide diversity of cultures and backgrounds.



Figure 5. CCLA student making Secchi disks for their water quality investigation.



Figure 7. Heading out on a snowshoe hike.



Figure 6. CCLA students preparing to launch the rafts they made for water quality studies.



Figure 8. A CCLA student with a nature discovery.

Kennedy Community School

1300 Jade Road
St. Joseph, MN 56374
(320) 363-7791
<http://isd742.org/kennedy/>
<http://kennedyee.weebly.com>

Contact:

Rick Wilson, Science Teacher
richard.wilson@isd742.org



Fifteen teachers working with 400 middle school students were engaged by the EOE project at Kennedy Community School, which is K-8 school in a rural area on the western edge of the St. Cloud School District. They primarily used their funding for trail construction in their on-site prairie and additional teacher training and curriculum revision.

- Students at Kennedy are now outside and using the prairie on a regular basis doing science, reading in the garden, taking measurements for Math, writing poetry, creating drawings, collecting samples, taking pictures for further research, and learning stewardship.
- Groups of teachers are working to take adapted lessons and match them to standards that correspond to grade level.
- They created a Weebly website for teachers and students that allows teachers to find ideas, resources, and pre-made plans to help them take their students outside.

Kennedy's lead teacher reported the following:

"This project has been incredibly beneficial to our staff and students. During our staff development sessions many of our staff came and learned about how to get students outside. Since then, many students in many grades have spent time outside learning about the flora and fauna. It has really opened our eyes to the opportunities to teach outside. Many of those participating do not think of spending time outside as "something extra" any longer. It is simply a part of what we do.

For our project, we really were searching for a means to get students outside to our prairie. Many just needed a starting point to welcome them out to this space. That is what our nature trail did for us. Many teachers are taking their students out quite regularly. In the past we would see a class outside and the students would want to know what they are doing. Now, when we see people in the prairie it is just a normal occurrence. In conjunction with the physical education teacher, she has revived an old program where the students count the miles they have walked on the trail. So, now students are able to enjoy nature while they exercise. Students have currently logged 1,160 miles!"



Figure 9. A frog found during science class at Kennedy.



Figure 10. Collecting water samples and taking notes at the pond near Kennedy.

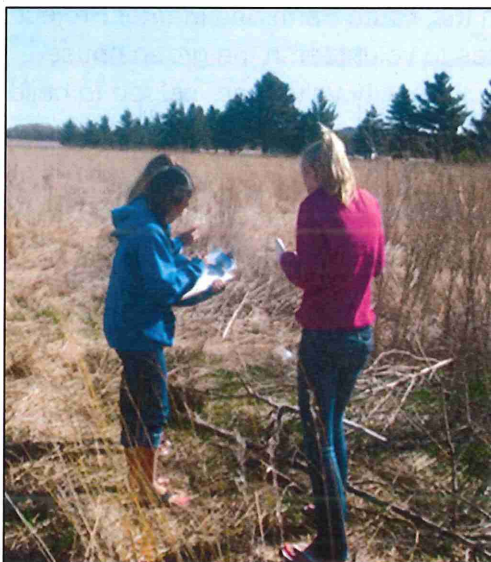


Figure 11. Kennedy students note changes on the prairie in early spring.

River's Edge Academy

188 West Plato Blvd., Saint Paul, MN 55107

Phone: 651-234-0150

<http://riversedgeacademy.org/>

Contact:

Meghan Cavalier, Executive Director

mcavalier@reamn.org



River's Edge Academy is a small, charter school with a diverse student body just across the Mississippi River from downtown St. Paul. Five teachers and 65 students participated in the EOE project. Funding was used for equipment and supplies for their new outdoor learning space, which has a gardening focus, and to support teachers making revisions to their curriculum.

- Several lessons were adapted to encourage use of the outdoor classroom. Lessons will continue to be created or modified to include environmental concepts or approaches.
- The students at REA installed and maintained seven raised bed gardens.
- Every class at REA has utilized the outdoor classroom.

River's Edge Academy's Director reports that:

"The EOE project was a spring board for River's Edge Academy to create a flexible and functional outdoor classroom. This space has allowed for safe and high quality learning! The school's gardens and chickens have been embedded into both the curriculum and school culture. Science classes, a gardening elective, and student interns supported this process. The school's collaborative relationship with the Youth Farm and Market Project was strengthened. Students had several opportunities to volunteer in the green house and participate in workshops. Over 20 parents and community volunteers helped to build and install the raised beds. This project has encouraged teachers to not only utilize the space, but also embed environmental themes into curriculum."

Bea Garden Planting Map

Plant (variety)	date planted	Plant spacing	row spacing	Planting depth
Peas (variety)	4/24/12	*24-36 in	*36-48 in	*1/4 in.
Carrots		*1-3 in.	*18-36 in.	*1/4-1/2 in.
Lettuces	4/24/12	*12-18 in	*18-36 in	*1/4-1/2 in.
Beans (variety)		*1-3 in.	*24-36 in	*1-2 in.
Peppers (variety)		*24-48 in	*48-72 in	*1 in.
Squash	4/24/12	*2-18 in	*36-48 in	*1 in.
Radishes		*1-12 in	*24-36 in	*3-4 in.
Broccoli				

Figure 12. REA's plan for a garden in their new outdoor learning area.



Figure 13. Thanks to the students' efforts, REA gardens flourished in the hot dry summer of 2012.



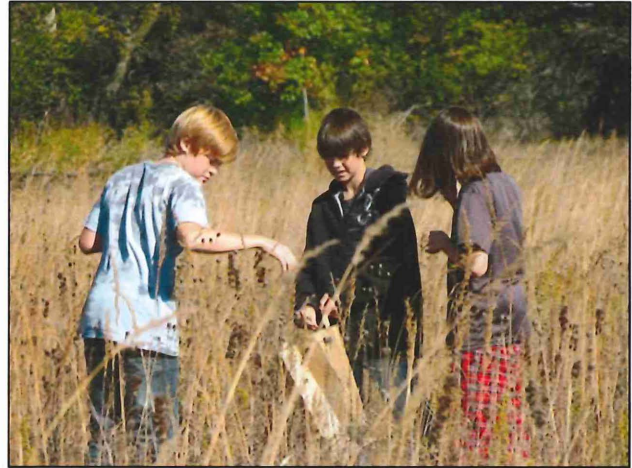
Figure 14. REA's outdoor space also includes feathered subjects.

Rockford Middle School – Center for Environmental Studies

6051 Ash Street
Rockford, MN 55373
763-477-5831
<http://rms.rockford.k12.mn.us/>

Contacts:

Jamie Madson & Beth Russell, Curriculum
Integration Coordinators
madsonj@rockford.k12.mn.us
russellb@rockford.k12.mn.us



Rockford Middle School is in a rural community just west of the quickly growing Minneapolis suburbs. After losing enrollment to neighboring schools, the district made the commitment to become a STEM (science, technology, engineering and mathematics) magnet with an environmental focus starting in the fall of 2011. The EOE project coincided exactly with their conversion and was extremely valuable to supporting and training their teachers through the transition. Twenty teachers and 360 students have been impacted by the EOE grant. Project funds were used for teacher training and curriculum revisions, and environmental themes were integrated into all grade levels and most classes. With a high level of support from the administration, a school-wide commitment and involvement of many community partners, the staff achieved a number of outcomes.

- The EOE project helped them connect with many community partners. They plan to continue to expand programming and partnerships with other EE providers.
- The school started a green team, organic recycling, put in two rain gardens and removed invasive species from their newly developed outdoor learning area. Student learning has extended to others as students have cut and treated buckthorn on the elementary school property, educated their families and neighbors to remove invasive species, and some families have installed rain gardens on their properties.
- RMS-CES is now a school focused around central themes at each grade level. All teachers collaborate on common ideas for each unit. Examples of theme units are force and motion, astronomy, ecology, raptors, and energy. Each of these TIE units connect standards from science to different core curriculum areas, as well as connect to environmental themes.
- RMS-CES enrollment has increased dramatically over the last couple of years.

Rockford's lead teachers report:

"Our school has moved farther in the direction of stewardship, with a focus on environmental issues. We have worked hard with our partners, our green team, and our buildings and grounds manager to reduce waste by 40% this year, use energy effectively, and to manage our grounds in responsible ways.

The most valuable piece for our school has been the opportunity to have time to work together with our staff to set goals, find curriculum, integrate themes, and make connections. Staff development funds have become increasingly scarce over the past few years, so having the time and ability to get away from the classrooms, connect with other teachers and professionals, and plan for future years was invaluable.”



Figure 15. Rockford's physical education curriculum includes lessons on orientation.



Figure 16. Rockford students experience nature using all of their senses.

Simley High School ALP

2920 80th St. E.

Inver Grove Heights, MN 55076

651-306-7000

<http://www.invergrove.k12.mn.us/simley.html>

Contact:

Kay Martin, Teacher, Alternative Learning Program

barghink@invergrove.k12.mn.us



Simley High School is a public school located within St. Paul's southern suburbs. Two teachers and 27 students from Simley's Alternative Learning Program participated in the EOE project. Funding provided educational equipment, supported curriculum revision and transportation to an offsite wilderness area a short drive from the school campus. It provided an opportunity for students to explore, experience and engage with nature in an undisturbed wilderness area, while mastering standards in a variety of content areas.

- Environmental themes were integrated into a variety of classes. Specific activities included observation skills, water and soil testing, tree identification, carbon footprinting and building teamwork.
- Students were challenged to investigate and think critically about a variety of environmental issues that impact their local community. Students listed challenges, identified environmental organizations, debated environmental issues and created solutions. They learned how to take, analyze and categorize samples. They built on observational skills and learned how to be a team member and leader.

The project leader reported that:

"The EOE project has provided many opportunities for students in our program that were not previously available. Our students have benefited from the classroom component of the project and the outdoor experience in a variety of ways. The integration of environmental themes into a variety of classes has provided an opportunity to enhance student engagement and support outdoor classroom activities.

The EOE project created multiple opportunities for students to focus on real world problems and investigate different solutions. The project has allowed our program to create a foundation for future activities across disciplines. We are fortunate to have access to water, forest and prairie areas near our school. These areas will allow us to continue to study natural areas. We will continue to integrate environmental themes into the content areas and use the equipment to engage students with the content and continue to foster these skills with students."

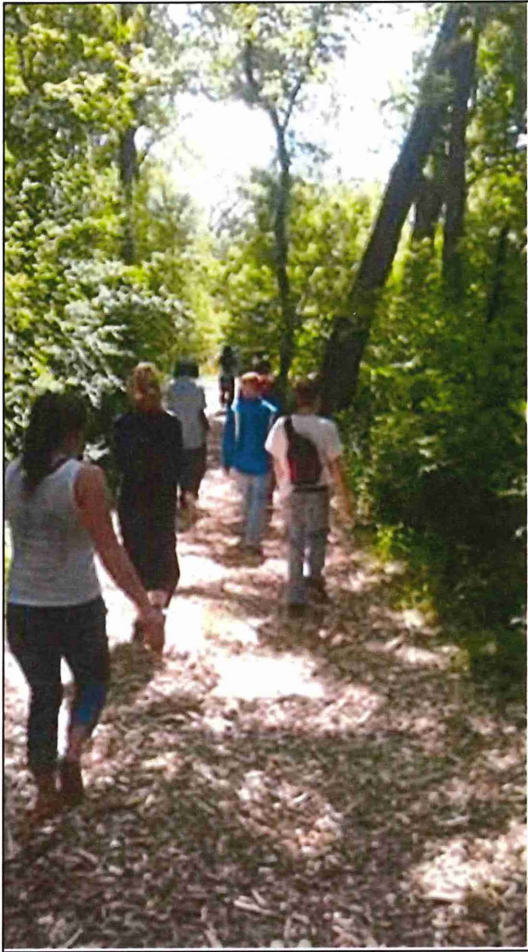


Figure 17. Simley students explore the amazing diversity at Darvan Acres Nature Center near their campus.

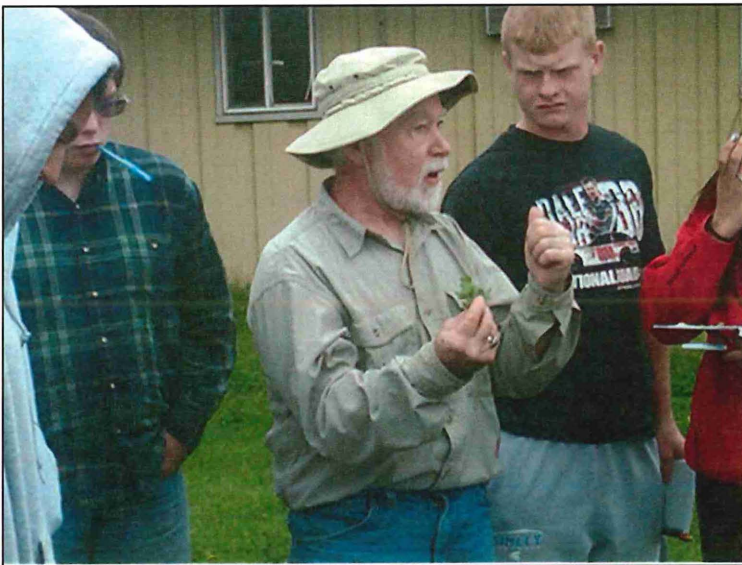


Figure 18. A community expert provides Simley students with a nature lesson.

Waconia Public Schools

1400 Community Drive
Waconia, MN 55387
952-442-0670
www.waconia.k12.mn.us

Contacts:

Michael Jensen, High School Science Teacher
mjensen@waconia.k12.mn.us
Richard Scott, Director, Grants and Development
rscott@waconia.k12.mn.us



Multiple teachers at both Clearwater Middle School and Waconia High school participated in teacher training during the EOE project. Mini-grant funding was primarily used by two teachers and 130 students at the high school for equipment to develop water quality studies in their environmental science classes. Participation in the project led to many outcomes:

- Environmental themes were integrated into a variety of classes at both schools and have influenced learning and programming throughout the district. At the high school fifteen lessons were adapted to involve environmental journaling, math and an emphasis on local water quality. Middle school teachers were also trained and integrated more EOE lessons that are reaching hundreds of other students. Elementary school staff have been inspired to do the same, and the district is striving to become a Green Ribbon Schools designee.
- It is estimated that 400 pounds of phosphorus were removed from the local watershed since 2011 through leaf clean-up efforts as part of the EOE project efforts.
- Approximately 30 acres of habitat (Bayview Woods and Waconia High School Ponds) were restored and improved for environmentally responsible use.
- Students were equipped to conduct quality water testing that can be used for the Volunteer Stream Monitoring Partnership Program. For many students, it was their first time in waders or in a canoe.

The high school teachers report that:

“The EOE grant has benefited not only the classes directly taught by teachers involved in the EOE grant, but also has had a broader impact on our entire district. In regards to individual classroom, the EOE grant has provided funding for water quality testing supplies that have provided a qualitative and quantitative aspect to our environmental courses. Integrating lesson plans around water and local water quality has given our students a chance to be out in the community making observations, collecting data, analyzing data, understanding critical links and associations between human behavior and environmental consequences and learning to take responsible social action to improve the environment.”



Figure 19 – Local daycare kids see how fun science can be at Waconia High School



Figure 20. Waconia students take measurements from a creek near the high school as part of science class.

Green Ribbon Schools

The project coordinator also developed and implemented Minnesota's participation in the first two years of the U.S. Department of Education's Green Ribbon Schools Program. The program recognizes schools across the country for their exemplary efforts to reduce environmental impact and costs, promote better health, and ensure effective environmental education. Minnesota led the nation with the most applicants in 2013 and seven Minnesota schools and districts were among 156 schools that have received the national award to date:

- Garlough Environmental Magnet School and Heritage Middle School, West St. Paul
- Jeffers Pond Elementary and Prior Lake – Savage School District, Prior Lake
- Kennedy Community School, St. Joseph
- North Shore Community School, Duluth
- School of Environmental Studies, Apple Valley

Over the two years of the program, Minnesota received 29 applications. Support for the program came from an advisory group of green school experts made up of representatives from several different state agencies and organizations with an interest in green schools. The advisory group refined the application template to make it relevant to Minnesota laws and resources, helped develop the evaluation criteria, reviewed and scored applications and helped with promoting the program to schools.

Minnesota's success in maintaining a high number of applications in year two was supported by workshops (Appendix F) led by the coordinator at the sites of Minnesota's three 2012 national honorees. Workshops in Duluth, St. Joseph and West St. Paul were attended by over 100 people in total. In addition to recognizing the host school for their efforts, the participants got the chance to see real-life programs at a designated Green Ribbon School, meet with several green school resource professionals and gather in small groups to discuss ideas and strategies in the award pillars (green building, health and safety, and environmental education) of their choice. Based on Minnesota's success with the Green Ribbon Schools program, Minnesota was often held up nationally for our efforts and the project coordinator was invited to speak at the 2012 National Green Schools Conference in Denver, CO and the workshop for national Green Ribbon Schools awardees at the inaugural celebration in Washington, D.C. in June of 2012.

In Minnesota and nationally, several of the designees were schools that fit the category of having a highly disadvantaged student body (defined as 40% or more of students on free and reduced lunch). These schools have recognized that establishing the priority of being a green school better engages their students and staff and can actually save their school money. Typically lacking funding, they make it a priority to tap into the capital in their community by forming partnerships. Those community partnerships often are with organizations and agencies interested in protecting the environment and result in many hands-on, real-world, civic-based, sustainable education programs.



Figure 21. Rose Chu, MDE Assistant Commissioner, welcomes participants to the Green Schools workshop at North Shore Community School in November 2012.

2012 National Green Ribbon Schools Honorees

Garlough Environmental Magnet School

1740 Charlton Street
West St. Paul, MN 55118
651-403-8100

<http://www.rschooldtoday.com/se3bin/clientschool.cgi?schoolname=school174>

Contact:

Susan Powell, Principal
susan.powell@isd197.org



Garlough Environmental Magnet School (GEMS) is a leader in the green/environmental school movement, winning numerous awards at the local, state, national and international level, especially in the area of environmental education. Educators and policy makers have visited Garlough from all over the Midwest, Washington D.C, New Mexico, Norway and Japan. Garlough has received many grants ranging from \$500 - \$100,000 from numerous organizations to further their green initiatives for children's education in environmental and sustainability literacy.

- Garlough has reduced greenhouse gas emissions by 40% and energy use by 22% from 2007-2011, garnering several Energy Star and other energy program awards. Besides behavioral changes, they utilize indoor temperature standards, and building automation system for heating, cooling and lighting for occupied and unoccupied building schedules.
- Water consumption has decreased by 26% for both irrigation and domestic use. During 2005 renovation they installed lead free fixtures, motion sensors to control water usage on toilets, urinals and sinks.
- More than 64% of solid waste is diverted from landfills. They have been composting lunch waste for six years. They have partnered with Dakota County and have recycle bins in every classroom, office and hallway. Classrooms have organic worm bins as teaching tools. Clear labeling is on all containers. Students collect shoes for GreenSneakers. E-waste is recycled by a certified recycler.
- Garlough has a no-idling policy that applies to all vehicles, promotes carpooling, participates in "Safe Routes to School" and partnered with Project Green Fleet, an initiative to reduce diesel emissions.
- The entire school "walks from school" to the school buses on a path through the woods every other Friday. Students participate in various "energizers" every 20-30 minutes during the day to elevate heart rate for optimal learning. Six classrooms are equipped with treadmills and 80 under-desk peddlers are distributed throughout our classrooms to provide a mode of movement for children who need it.
- School wide LIVEGREEN club promotes energy conservation and recycling through behavior changes with guidance of a dedicated teacher.
- Organic gardens, a fresh salad bar, commitment to healthy snacks, thirty minutes of daily recess on top of several weekly academic outdoor lessons immerse the

students and staff in quality nutrition, activity and authentic environmental lessons.

- Environmental and sustainability education holds all the pieces of what is done at GEMS together. An integrated curriculum across all subjects using nature and environmental science as the integrating force, provides opportunities for expansive use of ipods, ipads, laptops, probes, scopes, and expertly developed observation skills to practice and master math, science, engineering and technology skills. They visit Dodge Nature Center daily to supplement lessons with hands-on experiences at their working farm, wind turbine, orchard, apiary, pond and more. Our 20 Outdoor Wonder Learning Stations (OWLS) are aligned to MN State Academic Standards and each grade level has interdisciplinary lessons at these stations throughout their five years here focused on systems relationships.
- Each year, a major environmental theme is woven through curriculum on a rotating five-year cycle: Energy, Change, Cycles, Patterns, Systems; so that students will experience all in their K-4 tenure here. Garlough also has monthly school-wide environmental themes which are taken from the Minnesota Environmental Literacy Scope and Sequence.
- GEMS students are civically involved locally and internationally, having partnered with a school in Guatemala to support fresh water wells. They also have worked together collecting coats, shoes and pajamas to be donated for others in our community to re-use.



Figure 22. Garlough's new highly efficient heating system in the foreground has made the old boiler obsolete.

Kennedy Community School

1300 Jade Road
St. Joseph, MN 56374
(320) 363-7791
<http://isd742.org/kennedy/>

Contact:

Diane Moeller, Principal
diane.moeller@isd742.org



In 2006, the community of St. Joseph was outgrowing their little school, and knew they needed to go to voters to approve a building referendum. The community came out strongly stating that if it were built green, they would support it. After passage, work began immediately to design and build a green school, and in 2008 they opened the doors to a beautiful school certified at the Gold Level for LEED (Leadership in Energy Efficient Design).

Since that time, Kennedy Community School has been a leader in promoting other schools to go green. They believe it is part of their mission to help not only their school, but the larger community, to understand the possibilities and benefits of going green. Students and staff have given over 300 tours to groups. They are the subject of a US Green Building Council video production that is used to show other school districts how going green has paid off and were featured on the front page of the Education MN newspaper showing how energy savings can translate into resources and teachers.

- The school has a large geothermal system and has not fired their boiler in their first four winters and do not need compressors for air conditioning.
- The school design is heavy on utilizing day-lighting with very large windows throughout the building to access sunlight, and roughly twenty other components of green school building design that teach students and community and save resources.
- Many partnerships have been created through their process of going green. For example, a partnership with the US Fish and Wildlife Service has resulted in over 20 acres of prairie grasses that are the centerpiece of outdoor education programming. Many organizations partnered with them to create a reading garden that was the idea of our first class of eighth graders.
- An energy tracker website allows students and community members to go online to see what the best form of energy is on any given day. They can compare if their wind turbine or solar panels are producing more energy. These components were installed not to provide energy for the school, but to teach students about alternative energy sources. Community members have commented on how much they have learned from the energy website.
- Students have become the best ambassadors for being a green school. They are well versed in the importance of going green, the components of being green, and the good we are doing for our earth. Students have created websites in their science classes that compare various energy forms. They also conduct tours for

the community on Earth Day. People cannot believe such young learners are so knowledgeable about green concepts.

- Students were also instrumental in the Green Ribbon Schools application process and provided ideas for each of the pillars. Kennedy reports that becoming a Green Ribbon School reinforced their commitment to doing what is right and helps them to continue to be an example for others.



Figure 23. Green Ribbon Schools award flag hangs in Kennedy's cafeteria.

North Shore Community School

5926 Ryan Road
Duluth, MN 55804
(320) 363-7791
www.northshorecommunityschool.org

Contact:

Susan Rose, Director
srose@northshorecommunityschool.org



North Shore Community School, a rural charter school just a few miles from the beaches of Lake Superior, is situated on a 40 acre parcel of land and is home to 658 K-6 grade students. The operations, physical environment and instruction at the school are driven by a core purpose, the desire to excel in connecting students' learning with their natural and social environments. Despite the fact that the building is over 50 years old, significant accomplishments have been achieved as North Shore strives to make progress toward a "net zero" environmental impact.

- 95% of the school's grounds are devoted to ecologically beneficial, instructional use including rain, butterfly and vegetable gardens, as well as a Minnesota DNR supported school forest.
- 90% of campus-generated food waste is composted via a site-based vermiculture system.
- 100% of cafeteria trays and flatware are washable and reusable. 100% of used colored paper is recycled into student-made paper.
- The school participates in a Farm-to-School program and their school greenhouse supplies up to 20 pounds of mixed greens each year to the cafeteria. Each spring students tap maple trees on campus, gather sap and enjoy a pancake breakfast, served with maple syrup produced by their efforts.
- Students participate in a minimum of 170 minutes of physical activity and/or outdoor learning each week including 90 minutes of Physical Education.
- In an effort to increase civic engagement and environmental literacy, interdisciplinary learning is facilitated at each grade-level through year-long environmentally themed questions that consider both the social and natural environment. Teachers develop two to three Environment as Integrating Context (EIC) lessons each month.
- Place-based learning and curricular integration ideas are generated and enhanced during monthly grade-level meetings with the school's Environmental Educator.
- Environmental Education is offered to all students 60 minutes each week as a special subject, similar to PE.
- Environmental learning extends beyond standard programming; older students participate in elective classes that include Winter Outdoor Skills and Phenology Animation.
- Environmental themes are required components of school field trips; kindergartners travel to Tom's Logging Camp to study historical logging methods

and fourth graders visit the Lake Superior Marine Museum to explore the maritime heritage of Lake Superior.

- 90% of faculty participates in site-based professional development focused on environmental concepts and instructional practices. 100% of faculty are invited to attend in off-site trainings including Project Learning Tree, the National Green Schools Conference and the annual Minnesota Environmental Education Conference.



Figure 24. A typical scene at North Shore Community School, where students study outside many times a week.



Figure 25. North Shore has found creative ways for all students to access their outdoor learning environment in all kinds of weather.

2013 National Green Ribbon Schools Honorees

Heritage Middle School

121 Butler Ave
West St. Paul, MN 55118
651-403-7400
www.heritage.isd197.org

Contact:

Lisa Johnson, Sustainability Manager
lisa.johnson@isd197.org



Located in an inner-ring suburb of St. Paul, Heritage Middle School has a highly disadvantaged student body with 51% of students qualifying for free and reduced lunch and 15% with limited English proficiency. They have done exceptional work in greening up their buildings, despite having a building constructed in 1951. They also have a very strong E-STEM middle school.

- They have received several recognition and awards in multiple years for energy reduction and efficiency, including Energy Star.
- Implemented significant water usage reduction the last few years, including 69% reduction in domestic waster use and 3% reduction in irrigation use.
- Great efforts in waste reduction and recycling, including 62% recycling and organic composting. School's LIVEGREEN team held fundraisers to purchase a filtration station to promote reusable water bottles
- 20-25% of students walk, carpool, bike depending upon weather.
- School-wide vegetable gardens that are used by students to make fresh salads.
- School is an Environmental STEM Magnet School and follows environmental literacy standards that are designed into multiple elements of all teaching; multiple partnerships utilized for classroom lesson designs and Environmental Education professional development has been provided for entire staff; assessment is part of design to ensure environmental literacy is measured and supported.
- Conversations and lessons about environmental careers have been built into science curriculums in grades 5-8. Even the Language Arts teachers include green careers as part of their career exploration unit. The 5th and 7th grade students have weekly instruction from a trained naturalist who shares many green career pathways throughout the year.
- All grades have specific programs for civic and community involvement around environmental and sustainability issues. Major partners include Dodge Nature Center, Dakota County, and surrounding cities. Unique programs include water testing done in conjunction with local units of government, courtyard area

designed to showcase elements of prairie restoration and a butterfly garden with native regional plants. The student club, Livegreen, makes sure that sustainability is incorporated into all school policies and actions. The school's Community Education Dept. offers E-STEM classes throughout the school year to promote the magnet theme.



Figure 26. One of Heritage Middle School's many raised-bed gardens.

Jeffers Pond Elementary

14800 Jeffers Pass NW
Prior Lake, Minnesota 55372
952-226-0600
www.priorlake-savage.k12.mn.us/jp

Contact:

Karoline Warner, Principal
kwarnar@priorlake-savage.k12.mn.us



Jeffers Pond Elementary is a relatively new public school located in the outer suburbs southwest of Minneapolis. It was founded with a commitment to getting kids outside in the vast acreage and wonderful natural amenities around the school. Through a partnership with the Jeffers Foundation that donated the land for the school and provided environmental educational staff and resources for many years, they have established one of the finest examples in the country of integrating environmental and outdoor education throughout the curriculum of a traditional public school setting. They also are doing solid work in Pillars 1 and 2. Here are some highlights from their green school efforts:

- Sustainability and the environment are a context for learning at Jeffers Pond. Environmental issues are thoroughly woven into teaching and learning at the school – both for the students and the teachers. Strong leadership by the administration has been key to supporting an environmental education approach.
- The school has long-term commitment to energy efficiency and reduction. They participate in Schools for Energy Efficiency and Energy Star programs achieving a rating of 98, and undergo annual third party energy audit. They reduced greenhouse gases by 18% in 2012 and reduced energy use by 41% from 2007 to 2012.
- The school has achieved a 36% reduction in water use and the site contains a rain garden and butterfly garden planted in prairie grasses that serve as outdoor learning areas.
- Through a partnership with the Shakopee Mdewakanton Sioux Tribe, the school has implemented an organics recycling program that has helped them achieve a 79% waste diversion rate.
- They have worked with the City of Prior Lake to expand the sidewalk system and have consolidated bus routes.
- The school has hosted numerous environment and sustainability professional organization events, including MN Environmental Educators Conference. Teachers are involved in numerous environmental education professional activities, including writing Minnesota Weatherguide calendar lessons and Eco-time Morning Meeting cards.

- The school has a Green Team which meets monthly, with representative teachers from each grade level. The committee plans school initiatives focusing on Environmental Education and twice a year Green Teams from across the district meet to discuss their buildings goals and ideas. Also, at each staff meeting, time is set aside for a “Green Moment” where a teacher shares an Environmental Education idea, task, or initiative.
- School has offered a Junior Naturalist program for seven years to third, fourth, and fifth grade students through a partnership with Community Education, which includes regular meetings and exercises related to environment and sustainability issues.
- School holds annual school-wide Environmental Education Festival, in which each grade level has a theme, such as insects, water, trees, and geology and the whole day is dedicated to environmental and outdoor learning. Community partners, such as the local watershed district and county park staff participate in teaching.
- School has a partnership with the St. Catherine University EcoStar program that involves elementary classroom teachers hosting a pre-service teacher for seven weeks each school year with an environmental education focus. The school also works on environment and sustainability projects with many other local partners, including the Jeffers Foundation, the Spring Lake Watershed District, McColl Pond Environmental Learning Center, University of Minnesota Master Gardeners, City of Prior Lake, local sportsman’s clubs and the DNR.
- The school runs Eco Camp, an environmental education focused camp during the summer for kids. Teachers and after-school childcare staff participate in summer professional development so they are educated on the use of our EE equipment.



Figure 27. Jeffers Pond students test water quality in their campus creek.

Prior Lake – Savage Area Schools

4540 Tower Street SE
Prior Lake, Minnesota 55372
952-226-0031
www.priorlake-savage.k12.mn.us

Contact:

Amy Kettunen, Curriculum Coordinator
akettunen@priorlake-savage.k12.mn.us



The Prior Lake – Savage Area Schools (PLSAS) district is one of only 14 school districts in the nation to date to be awarded as an honoree in the Green Ribbon Schools program. PLSAS is a large, public school district with 11 buildings and 7300 students and is located in a fast-growing suburban area southwest of Minneapolis. Environmental stewardship is a major part of their official mission. Through a supportive administration and partnerships with the Jeffers Foundation, Shakopee Mdewakanton Sioux Community and many other local and regional organizations, PLSAS has made it a system-wide priority to reduce environmental impact, improve health and wellness, and interweave environmental education and sustainability practices as a context for learning in grades K-12. Green school highlights at PLSAS include:

- Prioritization and leadership of environmental education at the highest levels of the district has led to integration of environmental education throughout the curriculum. Jeffers Pond Elementary epitomizes these efforts that have now been integrated through every PLSAS school and has made them a national leader in the field of environmental instruction.
- They are very involved in Energy Star and have achieved 49% reduction in energy use district-wide since 2007. They have also achieved 21% reduction in domestic water use and an excellent 76% recycling/waste diversion rate by implementing recycling of organic materials.
- 18.3% of eligible graduates have completed an AP Environmental Science course.
- They have received green building certification for recent construction and renovation at two district buildings.



Figure 28. PLSAS students spend lots of time outside during their school years.

School of Environmental Studies

12155 Johnny Cake Ridge Road
Apple Valley, MN 55124
952-431-8750
<http://www.district196.org/ses>

Contact:

Dan Bodette, Principal
Dan.Bodette@district196.org



The School of Environmental Studies is an educational option of choice for 400 juniors and seniors in Independent School District 196, which is located in a suburb just south of the Twin Cities. They were a Minnesota finalist in the first year of GRS. They made improvements and became the top scoring school in 2013 with solid scores across all three pillars. Their EOE work in Pillar 3, which has been stellar since they opened the school in 1995, has no equal among Minnesota high schools. Here are highlights about their green school efforts:

- The school provides an exceptional amount of outdoor classroom activities, both local and globally. Community partnerships are key to supporting their hands on work in the community on environmental programs. They have an extremely strong focus on interdisciplinary environmental education learning, which is incorporated into curriculum and assessments.
- They have achieved a 31% GHG reduction in electricity, including a 16% energy reduction in just the last year. The school has on-site demonstration wind, and solar. Students monitor energy that feeds into the grid from the demonstration 20kw wind turbine and 2kw solar panels. The school is heated with waste heat from the neighboring Minnesota Zoo.
- They have reduced domestic water use by 50% and no municipal water is used for irrigation.
- A school pond was restored with native aquatic plants as a buffer around the perimeter and native prairie forbs and grasses have been planted in unmowed areas along parking lots and at the building entrance. Large areas of school landscape are unmowed and remain in their natural state.
- They have an organic community garden, orchard and apiary in partnership with Apple Valley citizens.
- They have a very high rate of waste diversion, which is at 76.49%. The increased use of web-based systems like Moodle is bringing them close to a goal of being a "paperless" school.

- 70% non-single passenger vehicle transportation to and from school by students. The school van runs on E-85 and they use mass transit for some remote site classes.
- The 12-acre school site contains a student-maintained trail system, heavily used for fieldwork. Students have class outside on average 5 hours a week. Sometimes they are outside for 3 hours daily for several weeks for pond, forest, biodiversity, and winter study units. They have an outdoor classroom that is used daily in the fall and spring and a small outdoor amphitheater. The school owns several canoes and a boat. Twice a year they have "field days" where the entire school is out canoeing, hiking and biking. Students work on many outside projects like gardening and buckthorn removal.
- All students take two full years of Environmental Studies, an interdisciplinary course integrating English, social studies, and environmental science, for three hours each day. Through reading a wide variety of environmental texts, writing many papers, engaging in student-centered discussions, and completing many field and research-based projects, over the course of two years students develop solid problem solving and critical thinking skills that will equip them to be environmentally literate citizens. All seniors are required to complete a three-part Capstone: a personal statement of environmental ethic, an environmental service project, and a public presentation about a significant environmental issue.



Figure 29. Demonstration wind turbine, solar panels and sustainable building with green roof, produced in partnership with the local electrical utility.

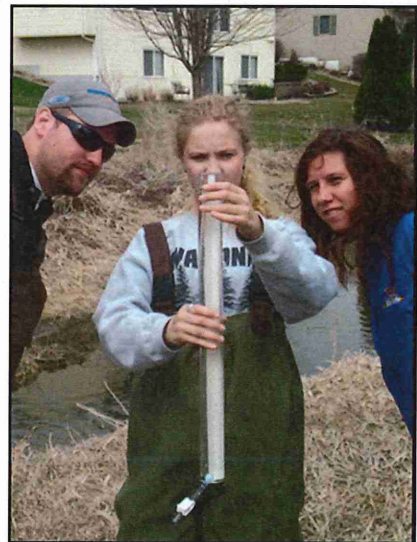
Evaluation

The evaluation of the project was conducted by a contract with the University of Minnesota – Duluth and was led by Dr. Julie Ernst. The goals of the evaluation were to determine the effectiveness of the project's professional development activities and the outcomes associated with the environmental and outdoor programs implemented through the project. Twenty-eight teachers and 354 students at the pilot schools participated in the collection of data for the evaluation. Teachers were asked to participate in surveys and also implement a significant amount of the evaluation with their students. Their participation was critical and much appreciated by the researcher and project coordinator.

The project was fortunate to have Dr. Ernst involved as she is nationally-recognized for her environmental education research. She is hoping to publish a research paper summarizing the evaluation of the project, which will hopefully help inform and guide future research in the environmental education field. Below is a summary of the highlights by Dr. Ernst. The full evaluation report can be found in Appendix A.

Teacher Training

Results suggest a multi-day workshop can be an effective way for increasing teachers' pedagogical knowledge and skills, as well as their self-efficacy beliefs, relating to integrating environmental and outdoor education (EOE) into the academic curriculum. This is consistent with teachers' suggestions relating to desired professional development outcomes, as their suggestions focused on pedagogical knowledge and skills, specifically integrating EOE into subject areas beyond science, aligning EOE with core subject area standards, managing students outdoors, navigating barriers associated with integrating EOE, teaching through an inquiry-based approach, and working as a team of teachers to implement a project across disciplines rather than as individual teachers implementing more isolated and short-term EOE activities. Their suggestions also seem to indicate a range of needs, reflective of varying levels perhaps, with some suggesting knowledge and skills oriented toward more "entry-level" needs such as help with aligning lessons or activities with standards or managing students outdoors, whereas others indicated a desire to learn how use team teaching to implement longer-term projects across multiple subject areas. These represent different forms of EOE, with somewhat differing associated procedural knowledge and skills. Thus, clarifying needs of teachers and intentions regarding the type of EOE integration to be achieved may be helpful in selecting or grouping teachers/school participants and designing professional development opportunities accordingly. The specific suggestions provided by teachers relating to desired outcomes, format, and resources also can be used to guide future professional development efforts.



Student Outcomes

Regarding student outcomes, Minnesota Comprehensive Assessment data suggests students were meeting academic standards in core subject areas, and potentially students in the EOE projects at two schools may be associated with stronger science and reading achievement than in comparable schools (with the effect on reading achievement moderated by gender at one school). Due to limitations associated with the data available and analysis approach used,



further research is needed to measure impact of EOE participation on academic learning in the core subject areas and on MCA performance. Teachers and students were consistent in their perception that participating in the EOE projects had a positive influence on their learning in science; participation may also have influenced learning in math, language arts, social studies, and physical education, but perceptions as to the degree of influence were not as strong as they were for science learning. In addition, teachers and students consistently perceived participation to have had a positive influence on academic engagement. Teachers attributed this influence on academic engagement and achievement to the outdoor/out-of-classroom learning experiences, active learning, novel topics and settings, real world projects and problem solving, student ownership in the projects, and connecting lessons and content together through team teaching across subject areas.

Other student learning outcomes included environmental sensitivity and an understanding of ecological systems. Teachers and students consistently perceived these outcomes to have been achieved through project implementation, and results further suggest a significant increase in understanding of ecological systems among participants. Perhaps strongest evidence of student learning outcomes stems from results from the Middle School Environmental Literacy Survey (MSELS). Data from the MSELS indicate 8th grade students from the two schools taking this assessment at the end of each school year of project implementation scored significantly higher than the national mean in the following areas measured on the MSELS: ecological knowledge; environmental sensitivity; general environmental feelings; issue analysis; intention to act; and pro-environmental behavior. Teachers provided suggestions that can be used to guide future integration of EOE into the academic curriculum.

Promising Activities

The original workplan for the EOE project required the identification of activities conducted during the EOE project that had the most potential or promise for sustaining EOE in Minnesota schools. The following potential strategies have been identified through either the formal evaluation by Dr. Ernst, input from the project coordinator, and/or input from the advisory committee.



Teacher training

While more educators would have been welcome at the trainings conducted during the project, the evaluation demonstrated they were highly effective. Research has long shown that educators are at the core of quality instruction, which is critical to student achievement. It may be even more important in the field of EOE, since very few current undergraduate teacher preparation programs integrate EOE into their curriculum. Consequently there is a backlog of current and incoming teachers that need to learn EOE skills and improve their environmental knowledge. In addition, teachers in the pilot identified the project approach to providing them with time to work as teams and individually to revise and adapt lessons was critical to helping them make the time to integrate EOE into their schools' curriculum.

Throughout the project, the coordinator stressed that all subjects and most academic standards could be taught with an environmental or outdoor context. By starting with the standards of their given content area, the project provided the training, resources and time for them to identify the opportunities to integrate EOE. Some teachers asked for model lessons they could easily plug into their curriculum. While they can help spur the thought process and potentially trigger ideas for teachers just beginning the EOE integration process, the coordinator believes in the end teachers need to revise and adapt lessons based on the standards to fit their own unique circumstances, including available outdoor and natural spaces in close proximity to the school; type, age and number of students; and resources available to support their EOE efforts. Training that provides the guidance and time to revise and adapt their plans will be critical for future teachers' ability to sustainably integrate EOE.



Figure 30. Teachers discuss integration ideas in teams with resource experts at training in Rochester

Mini - Grants

Not surprisingly, teachers and environmental educators have long requested additional funding to help support the integration of environmental and outdoor education. In the late 1990s, “designated funding for EE at the local level” was identified as a major statewide strategy in the [Second Edition of A GreenPrint for Minnesota \(August 2000\)](#). Over the last decade, however, available funding for educational programming outside of the core subject areas of reading, writing and mathematics has decreased significantly. Certainly, more money doesn’t solve issues in of itself, but participants in this project frequently identified lack of resources as a detriment to their ability to deliver EOE programming.



While a relatively small amount of funds (maximum of \$8,500 per school), educators appreciated the mini-grants that were available to them as part of this project to purchase equipment and supplies, spend time intentionally improving their lesson plans and support activities to get their kids outside. It is reasonable to believe that a statewide program with designated funding for environmental and outdoor education would go a long ways to supporting and increasing educators’ efforts to expand EOE programming.

Because of the inter-disciplinary nature of EOE, one of the historical challenges of funding EOE at the state level is the environmental community thinks the education community should fund it and vice versa. In fact, since environmental and outdoor education is best taught integrated through all subjects and programs, EOE programming could easily be integrated into many funding streams from either community. On the education side, there are many federal and state funding streams that could have potential, including Healthy Kids Act, Perkins funding for career tech education, STEM, early childhood, and allowing districts to levy for EOE akin to the current enabling legislation for community education and gifted and talented education. Similar opportunities exist with the state’s many designated environmental funds. With a history and connection with both the environment and education communities, perhaps the system that makes the most sense as a source for designated funding of EOE would be to dedicate a small portion of School Trust Land Permanent School Funds to EOE.

Action to fund EOE at the federal level has also received increasing attention the last few years, including introduction in Congress of the “No Child Left Inside Act,” potential executive action on a National Environmental Education Act, funding for NOAA Environmental Literacy Grants, work on a Healthy Kids Outdoors Act and others.

Community Partners at the State and Local Level

Involvement and connections with community experts and partners was critical to the success of this project. At the state coordinating level, the participation of many stakeholders and experts on the Environmental and Outdoor Education Advisory Committee was crucial to the development and implementation of the project. The project coordinator regularly drew upon the expertise of the members and relied on them to support many aspects of the project. Organizations, such as the DNR, Jeffers Foundation and Will Steger Foundation, were

especially valuable in providing resources, staff and support to training the educators in the project. By adding lots of value to the project, they helped the project be more effective and reach a wider audience. A state level advisory group to advise and support EOE programming is critical to getting involvement and support from Minnesota's diverse environmental and outdoor education community.

At the school and district level, involvement of community groups, resource experts and individuals has proven to be a key factor in the success of some of the best EOE programs in the state. Knowing this to be the case, the project trainings were deliberately set up to feature community resources and help the participating educators make connections with local organizations and individuals. These partnerships appear prominently in the schools featured in this report and include staff and individuals from parks, private nature centers, natural resource agencies (federal, state, regional and municipal), outdoor clubs, environmental organizations, businesses, and parents, retirees and community members that live down the street and want to help get kids connected to nature. These partnerships demonstrate that it "takes a village" to successfully and effectively integrate EOE into schools and should be highly encouraged in future programs.

Making Children and Nature Connections

Ever since its publication in 2005 Richard Louv's book, Last Child in the Woods, has touched a nerve and garnered tremendous attention on the issue of kids becoming increasingly disconnected with nature. Over the last few years, Louv has gathered much of the new and emerging research on this issue and made it and numerous other resources available through the Children and Nature Network (www.childrenandnature.org). Interest in the need to connect kids and even adults with nature is being discussed at many levels among educators, politicians and parents, presenting an excellent opportunity for schools to generate support for EOE initiatives.

One particular opportunity for schools that has appeared to really be gaining momentum in the last couple of years is the concept of natural play. When away from school, kids may not have access or take the time to go outside. However, schools can build child connections to nature by being more intentional about designing spaces for recess, play and learning that are filled with natural elements, such as rocks, sticks, sand, trees, and other plant materials. Climbing, sliding and activities that develop balance can also be accomplished through elevation changes and other interesting topographic features.

Several nature centers, parks and other play spaces in Minnesota and across the country have made it a point to get kids playing in spaces that are partially or completely natural, significantly changing the paradigm of how playgrounds are defined. Several designers and providers of natural play spaces have begun to respond to the interest. Excitement over natural play has arrived in Minnesota as evidenced by a workshop focused on natural play space design, hosted by the Minnesota Association for Environmental Education and the Minnesota Children and Nature Connection in early January 2013 at MDE. The workshop was attended by over 70 people, including many architects, park directors, early childhood providers and school staff, despite limited promotion of the event. Moving the standard definition of school playgrounds

away from pre-fabricated, built structures to natural play spaces has the power to calm, inspire and enhance creativity in Minnesota students while still providing exciting physical challenges.



Figure 31. Students cherish play time in O.H. Anderson Elementary's (Mahtomedi, MN) natural play space, "The Outback".

Green School Activities

With programs such as Hallberg Engineering's Schools for Energy Efficiency (SEE) program that has been active in local schools for several years, Minnesota has been a leader in the Green Schools movement. SEE and programs like it have saved some school district as much as \$100,000 per year in energy costs through efficiency upgrades and changing the behavior of staff and students to reduce energy use. With the endorsement of the Secretary of Education and development by the U.S. Department of Education of the Green Ribbon Schools program in 2011, Minnesota schools now also have the opportunity to be recognized locally and nationally for their great efforts to reduce the environmental impact of their buildings and grounds, promote policies and practices that protect the health and safety of their student and staff, and the delivery of educational programs that teach their students to be better stewards.

In addition to potentially saving schools thousands of dollars through waste reduction and conservation of energy and water, the implementation of green school activities provides real-world opportunities for students to learn about practices in their school building and campus grounds that are hands-on and can be integrated into multiple content areas. Many schools throughout Minnesota have engaged students in great educational and real-life lessons that include designing and planting raingardens, investigating and fundraising for renewable energy installations, developing and delivering nature lessons to younger students and leading efforts to educate staff and students to help the school reduce energy use by changing behaviors. Green school activities have great promise to educate students about the environment and provide hands-on experiences that will help them become better stewards in the future. Future resources should be provided to support school efforts to implement green school programs.

Connecting with MDE Programs and Staff

A position at MDE to integrate EOE has provided credibility and prioritization of EOE at Minnesota schools and within the department. It has resulted in better coordination among Minnesota's many EOE providers and plans exist for future coordination with MDE academic standards, multi-cultural and health program staff. MDE staff have identified many ways having an EOE coordinator position at MDE has impacted their work. For example, after connecting with EOE resources and training provided by the project coordinator, MDE content specialists are now providing English as a Second Language teachers with ideas that provide their students a real life context and reason to learn math, science and social studies.

Kari Ross, Reading Specialist at MDE, says, "An EOE position at MDE has had a positive effect on our division and our agency. The project coordinator has provided statewide leadership in his collaborative efforts to support the work of Academic Standards and EOE through fostering partnerships and opportunities for learning in many ways. He has collaborated in statewide professional development opportunities, facilitated workshops, advocated for a greener work environment, and overall, raised our awareness of EOE. Because of his influence and expertise, I am more aware of how EOE enhances academic education and the value of integrating EOE in any educational setting."

MDE's World Language Content Specialist reports that teachers at all levels often use a unit on the environment to provide a context and an insight into the culture and that having someone at MDE doing environmental and outdoor education validates their teaching. She adds the connections among content areas provided by an EOE position are invaluable and have inspired future work.

With an extensive background in green school activities, the EOE project coordinator has been instrumental in leading MDE staff in the implementation of Governor's Executive Order 11-13, which requires state agencies to reduce their environmental impact through a number of sustainability activities. The coordinator established a Green Team at MDE, represented the department at the Interagency Pollution Prevention Advisory Team and has helped lead several activities, including efforts to reduce the department's energy use and increase recycling.

Administrative Support Critical

There is little doubt to the project coordinator, who has over 25 years of teaching and working with schools and teachers as an EOE provider, that administrative support is probably the most important factor in whether schools comprehensively adopt and integrate EOE and green school activities sustainably. This factor was very evident in the schools that were the most successful in this project and was mentioned by many participants as a key component. Not only does administrative support provide encouragement to those educators working on the front lines and leading the project, but it sends a clear message to all the staff that EOE is a priority. It makes it much easier for educators to get the resources and cooperation needed to create and sustain a successful environmental and outdoor education program. Several of the administrators of pilot or Green Ribbon Schools shared stories of the benefits of these approaches, including increased enrollment, significant recognition in their communities and most importantly, increased achievement by their students. For EOE to successfully expand to other schools,

administrators and school leaders throughout Minnesota need to be trained in the values and benefits of environmental and outdoor education and green school activities.

Need for a National EE Program Model

In Minnesota and across the country, there is a diverse and large network of EOE providers that work at all levels of government, non-profits and businesses. There are many advantages to such a large group of organizations and individuals involved in EOE, but it also makes it more challenging to create a coordinated program endorsed by the vast majority of providers. While at MDE, the project coordinator has witnessed other education programs and interests that have successfully developed national models that have garnered wide spread support and implementation among schools. Once again, funding is a critical component of the sustainability of these other initiatives, but having an identifiable, research-based, comprehensive, packaged plan that is fully supported at all levels is critical to their success. The project coordinator believes that if the national environmental and outdoor education communities develop a widely-endorsed and coordinated EOE program model, it would speed up the adoption of EOE in Minnesota schools.

Challenges

Like most large endeavors, this project had some challenges. For the most part, they revolved around the difficulty of connecting with schools and teachers. Even within the pilot schools, the staff involved had so many priorities for their time they had a hard time finding time to maximize the potential of participating and completing the necessary components of the project. MDE's project coordinator and regional specialists were often frustrated that educators didn't more frequently take advantage of the opportunity to tap into their resources and connections to guide and support the pilot projects. Regional specialists have the potential to provide important support to teachers, but the short duration of this project and difficulty to connect with the pilot schools hampered their effectiveness. Schools around the state that have been able to establish long term relationships with EOE mentors over many years have proven to be very successful.

The lack of time, which could also be rephrased to say the lack of prioritization of EOE in the face of all the other requirements on teachers' time, was also evident in the challenges the schools and teachers faced in completing the reporting required for the project. Pilot participants eventually fulfilled the minimum reporting requirements, but often needed many reminders and a lot of revisions to get them to the point of report completion.

The hope at the beginning of the project was that all trained participants would complete one or more model EOE lessons to share with other educators. As readers will note, however, the number of model lessons attached (Appendix B) is small. Getting these from the teachers was extremely difficult. Teacher time was also certainly a factor in the low number of model lessons shared and perhaps more could have been done to provide clearer instructions, examples or incentives. However, an important factor influencing this process seems to be related to how many teachers approach curriculum development and lesson planning.

During planning for the trainings, project organizers decided that EOE integration would need to start with Minnesota's Academic Standards and teachers should identify how to use the environment or outdoors as a context to achieve the standards in their content area. It should not start with model lessons and then figure out what standards they achieve. Again, given time constraints, it seems many teachers often approach their EOE lesson planning by plugging in existing lessons from various sources, such as the DNR Projects (WET, Wild, PLT, etc.) or other sources. EOE providers frequently hear requests from teachers for model lessons. On the surface, that approach would seem an efficient way to integrate EOE and these model lessons can inspire many ideas of how to teach EOE. In the end, however, there is no replacement for teachers intentionally reviewing the standards associated with their content area, integrating the needs of their students and creating a plan that takes advantage of the outdoor spaces and environmental resources readily available on campus or in the community. To make EOE programs sustainable in schools, teachers will need training, guidance, resources and time to go through that process.

Acknowledgements

The Integrating Environmental and Outdoor Education project wouldn't have been successful without the input and support of many people. In particular, thanks go out to the following organizations and individuals:

- All of the pilot school teachers and administrators, who enthusiastically took on these projects without knowing how much work and reporting it would require for so little money. Despite being overworked and overwhelmed with their normal daily teaching routines, they completed all the necessary evaluations and provided all the necessary reports needed to complete the project without registering a single complaint. It was an honor to work with all these highly professional educators. Your communities and students are lucky to have you, and we all appreciate your willingness to teach them about the environment and get them outside!
- The EOE Advisory Committee and the many other partners that have supported project efforts the last couple of years, especially Paul Oberg and Sil Pembleton, Jeffers Foundation.
- Dr. Julie Ernst, University of Minnesota - Duluth – we were fortunate to have someone with such expertise play a major role in the project by directing the evaluation, which added greatly to the credibility and effectiveness of the project.
- Regional Specialists – Su Beran, Kim Kovich, Patty Born Selly. An extremely talented group of educators with years of experience delivering EOE, who provided time and effort to make sure the teachers in this project had all the necessary training and resources to effectively implement their projects.
- MDE Content Specialists and other staff that supported the project – Their knowledge, patience and support helped ramp up my system understanding and ability to make the project as effective as possible.
- MDE Green Team – For all your efforts to make MDE sustainable – Keep it up!
- DNR Education Staff, especially Dawn Flinn, Amy Kay Kerber, Laura Duffey, April Rust, Roland Sigurdson, Deb Groebner, Nadine Meyer for your support and participation in the project.
- Administration, Staff and Students (especially my own two children) at Mahtomedi Public Schools – Thanks for being my inspiration and providing the opportunity for me to try and put into practice all kinds of EOE and green school efforts. Lessons learned with you have been a great guide for me and have benefitted numerous other schools and students.
- Last, but not least, to my wife, Pam, who is one of the best and most dedicated teachers I have ever known and always puts what is best for her students first. Thank you for being my sounding board and always supporting all my “green” efforts, despite all the long meetings, never-ending community events and numerous dandelions in our yard.

Integrating Environmental and Outdoor Education in Grades 7-12

Evaluation Report

Julie A Ernst, University of MN Duluth
6/10/2013

Executive Summary

An evaluation of the Integrating Environmental and Outdoor Education in Grades 7-12 project was conducted to determine the effectiveness of the project's professional development activities and the outcomes associated with the environmental/outdoor programs implemented through this project. Using multiple instruments, data was collected from 28 teachers and 354 students.

Results suggest a multi-day workshop can be an effective way for increasing teachers' pedagogical knowledge and skills, as well as their self-efficacy beliefs, relating to integrating environmental and outdoor education (EE/OE) into the academic curriculum. This is consistent with teachers' suggestions relating to desired professional development outcomes, as their suggestions focused on pedagogical knowledge and skills, specifically integrating EE/OE into subject areas beyond science, aligning EE/OE with core subject area standards, managing students outdoors, navigating barriers associated with integrating EE/OE, teaching through an inquiry-based approach, and working as a team of teachers to implement a project across disciplines rather than as individual teachers implementing more isolated and short-term EE/OE activities. Their suggestions also seem to indicate a range of needs, reflective of varying levels perhaps, with some suggesting knowledge and skills oriented toward more "entry-level" needs such as help with aligning lessons or activities with standards or managing students outdoors, whereas others indicated a desire to learn how use team teaching to implement longer-term projects across multiple subject areas. These represent different forms of EE, with somewhat differing associated procedural knowledge and skills. Thus, clarifying needs of teachers and intentions regarding the type of EE/OE integration to be achieved may be helpful in selecting or grouping teachers/school participants and designing professional development opportunities accordingly. The specific suggestions provided by teachers relating to desired outcomes, format, and resources also can be used to guide future professional development efforts.

Regarding student outcomes, Minnesota Comprehensive Assessment data suggests students were meeting academic standards in core subject areas, and potentially students in the EE/OE projects at two schools may be associated with stronger science and reading achievement than in comparable schools (with the effect on reading achievement moderated by gender at one school). Due to limitations associated with the data available and analysis approach used, further research is needed to measure impact of EE/OE participation on academic learning in the core subject areas and on MCA performance. Teachers and students were consistent in their perception that participating in the EE/OE projects had a positive influence on their learning in science; participation may also have influenced learning in math, language arts, social studies, and physical education, but perceptions as to the degree of influence were not as strong as they were for science learning. In addition, teachers and students consistently perceived participation to have had a positive influence on academic engagement. Teachers attributed this influence on academic engagement and achievement to the outdoor/out-of-classroom learning experiences, active learning, novel topics and settings, real world projects and problem solving, student ownership in the projects, and connecting lessons and content together through team teaching across subject areas.

Other student learning outcomes included environmental sensitivity and an understanding of ecological systems. Teachers and students consistently perceived these outcomes to have been achieved through project implementation, and results further suggest a significant increase in understanding of ecological systems among participants. Perhaps strongest evidence of student learning outcomes stems from

results from the Middle School Environmental Literacy Survey (MSELS). Data from the MSELS indicate 8th grade students from the two schools taking this assessment at the end of each school year of project implementation scored significantly higher than the national mean in the following areas measured on the MSELS: ecological knowledge; environmental sensitivity; general environmental feelings; issue analysis; intention to act; and pro-environmental behavior. Teachers provided suggestions that can be used to guide future integration of EE/OE into the academic curriculum.

Evaluation Plan

Evaluation Purpose and Questions

The purpose of this evaluation was to determine the effectiveness of the project's professional development activities and the outcomes associated with the environmental/outdoor programs implemented through this project. A secondary purpose of this evaluation was to identify characteristics of effective environmental/outdoor education programs. This information is intended to be used for accountability purposes to inform LCCMR, the project funder, of the project impact. The evaluation results can also be used by the MN Department of Education and Department of Natural Resources to inform future efforts toward integrating environmental and outdoor education into secondary education as a means for improving academic engagement and achievement.

Evaluation Questions Relating to Professional Development

1. Did participation in the professional development workshops increase teachers'
 - a. Environmental sensitivity?
 - b. Environmental knowledge and skills necessary for informed environmental decision-making and action?
 - c. Attitudes toward taking students outdoors for learning?
 - d. Pedagogical knowledge and skill relating to integrating environmental/outdoor education into the academic curriculum?
 - Teaching in an outdoor learning environment
 - Selecting and accessing natural and/or built areas in community for academic learning
 - Teaching students in learning environments beyond the classroom
 - Finding organizations that can assist with supervision, instructional delivery, financial resources, equipment/materials
 - Managing safety and liability concerns
 - Accessing and selection EE/OE resources, activities, and materials to support my core subject areas instruction
 - Aligning EE/OE activities to meet the academic standards in my core subject area
 - e. Self-efficacy toward integrating environmental/outdoor education into the academic curriculum?
 - f. Belief that environmental/outdoor education is academically-relevant?
2. How useful were the tools/resources/content and skills introduced during the professional development workshops?
3. What resources/tools/content and skills introduced during the professional development workshops were used by teachers, and in what ways?
4. What are teachers' recommendations regarding future professional development relating to integrating environmental and outdoor education into secondary education as a means for improving academic achievement and engagement?

Evaluation Questions Relating to the Integrated Environmental and Outdoor Education Programs

1. Did students who participated in the environmental/outdoor education programs meet/exceed academic standards in science, math, language arts, social studies, and/or physical education?
2. Did participation in the environmental/outdoor education programs increase students':
 - a. Academic engagement?
 - b. Environmental sensitivity?
 - c. Understanding of ecological systems?

- d. Outdoor skills?
3. What characteristics of environmental and outdoor education programs are associated with influencing students' academic engagement and achievement in the core subject areas?
4. What are teachers' recommendations regarding future implementation of environmental and outdoor education as a means for improving academic achievement and engagement?

Evaluation Planning Matrix

Question	Data Collection Tool	Source(s) of Information:	Design and Sampling
Professional Development			
1. Did participation in the professional development workshops increase teachers' <ol style="list-style-type: none"> a. Environmental sensitivity? b. Environmental knowledge and skills necessary for informed decision-making and action? c. Attitudes toward taking students outdoors for learning? d. Pedagogical knowledge and skill relating to integrating EE/OE into the academic curriculum? e. Self-efficacy toward integrating EE/OE into the academic curriculum? f. Belief that EE/OE is academically-relevant 	Professional Development Teacher Questionnaire (self-report items measuring teachers' perceived development of these areas)	Teachers	One-group Pretest-Posttest-Delayed Posttest Design (pre and post Dec. 2011 workshop; end of school year 2); No sampling (all teacher participants in the ENRTF Project)
2. How useful were the tools/resources/content and skills introduced during the professional development workshops?	Professional Development Teacher Questionnaire (items that have teachers rate usefulness of tools/resources/content and skills)	Teachers	One-group Posttest Only Design (post Dec. 2011 workshop) No sampling (all teacher participants)
3. What resources/tools/content and skills introduced during the professional development workshops were used by teachers, and in what ways?	Professional Development Teacher Questionnaire (open-ended item)	Teachers	One-group Delayed Posttest Only Design (end of school year 1); No sampling (all teacher participants)
4. What are teachers' recommendations regarding future professional development relating to integrating EE/OE into secondary education as a means for improving academic achievement and engagement?	Professional Development Teacher Questionnaire (open-ended item)	Teachers	One-group Delayed Posttest Only Design (end of school year 2); No sampling (all teacher participants)
Integrated Environmental and Outdoor Education Programs			
1. Did students who participated in the environmental/outdoor education	MCAs in relevant content areas	Students	Nonequivalent Comparison Group Posttest Only

<p>programs meet academic standards in science, math, language arts, social studies, and/or physical education? Did they outperform peers who did not participate in the program?</p>	<p>EE/OE Program Teacher and Student Questionnaire (items measuring teachers' perceptions of student academic learning)</p>	<p>Teachers and Students</p>	<p>Intention to Treat Design (end of year 1; data from year 2 not yet available at time of project reporting); All participating program serve in treatment group; peers from same school/district and state scores serve as comparison groups</p> <p>Teachers: One-Group Posttest Only Design (at end of school year one and at end of year two); No sampling (all teacher participants)</p> <p>Students: One-Group Posttest Only Design (end of school year one and school year two for two classes in each school participating in "most" treatment); One-Group Pretest-Posttest Design (at beginning and end of school year two for youngest grade level participating in each program, student who hadn't participated prior)</p>
<p>2. Did participation in the EE/OE programs increase students':</p> <ol style="list-style-type: none"> Academic engagement? Environmental sensitivity? Understanding of ecological systems? Outdoor skills? 	<p>EE/OE Program Student Questionnaire (self-report items, measuring students' perceptions of these areas; direct measures of academic engagement)</p> <p>EE/OE Program Teacher Questionnaire (items measuring teachers' perceptions of these student outcomes)</p> <p>Middle School Environmental Literacy</p>	<p>Students</p> <p>Teachers</p> <p>Students</p>	<p>One-Group Posttest Design (end of year one and year two for two classes in each program/school participating in "most" treatment); One-Group Pretest-Posttest Design (at beginning and end of school year two for youngest grade level participating in each program, student who hadn't participated prior)</p> <p>One-Group Posttest Only Design (end of school year one and two); No sampling (all teacher participants)</p> <p>Nonequivalent Comparison Group Posttest Only Design</p>

	Assessment (direct measure; 2009 version of Hungerford, Volk, McBeth and Bluhm, 2006)		(two 8 th grade classes from two schools, compared against national baseline data; end of school year one and two)
3. What characteristics of environmental and outdoor education programs are associated with influencing students' academic engagement and achievement in the core subject areas?	EE/OE Program Teacher Questionnaire (teachers' perceptions of influential characteristics) Review and comparison of characteristics associated with schools with evidence of stronger v. less strong student outcomes	Teachers Program data	One-Group Posttest Only Design (end of school year one and two) No sampling (all teacher participants) --
4. What are teachers' recommendations regarding future implementation of environmental and outdoor education as a means for improving academic achievement and engagement? (what might encourage them to use more of an integrated for of EE/OE – across subjects where multidisciplinary projects v. integrated into isolated subjects?)	EE/OE Program Teacher Questionnaire (teachers' recommendations) and/or interviews/focus group	Teachers	One-group Posttest Only Design (after school year one and two) No sampling (all teacher participants)

Professional Development

Teacher Learning Outcomes

An understanding of what teachers learned through participating in the multi-day professional development workshop was addressed through the following evaluation question: *Did participation in the professional development workshop increase teachers' environmental sensitivity, environmental knowledge and skills, attitudes toward taking students outdoors for learning, pedagogical knowledge and skills relating to integrating environmental and outdoor education (EE/OE) into the academic curriculum, self-efficacy toward integrating EE/OE into the academic curriculum, and belief that EE/OE is academically-relevant?* Data was collected from 28 teachers using the teacher professional development questionnaire. The response-format for items on this questionnaire used a 5-point scale (1=strongly disagree to 5 = strongly agree). This questionnaire was administered before and immediately after the teacher workshop; this workshop was held after teachers had proposed a project idea and plan for implementation, but prior to the implementation of their projects. The questionnaire was administered again at the completion of the project (end of year two), in order to assess if these teacher learning outcomes were impacted through the mentoring they received during project implementation as well through the actual implementation of the projects (if mentoring and implementing the project become an avenue for teacher learning).

Results suggest participation in the professional develop workshop significantly increased teachers' pedagogical knowledge and skills relating to integrating EE/OE into the academic curriculum ($p < .001$) and in their self-efficacy toward integrating EE/OE into the academic curriculum ($p < .001$). Results suggest environmental sensitivity, attitudes toward taking students outdoors, and belief in the academic relevance of EE/OE did not significantly increase through participation in the workshop (there were observed differences, but these were not statistically significant). However, for each of these outcomes, teachers' pre-workshop scores were high, indicating they already possessed these desired outcomes prior to the workshop, with little opportunity for a workshop to further increase these areas. Teachers' environmental knowledge and skills did not appear to increase from pre- to post-workshop, however, this did not seem to be an emphasis of the workshop. Data from teachers collected at the end of the project implementation indicate the mentoring of teachers and the teachers' implementation of EE/OE projects/activities within their schools did not lead to a significant increase in any of professional development outcomes. This may be reflective of a "ceiling effect," as the post-workshop scores across the outcomes were high (4.21 – 4.71 on the 5-point scale), leaving little room for improvement during the course of the mentoring and project implementation. See Table 1 for scores from the pretest (prior to workshop), posttest (immediately after the workshop), and delayed posttest (end of year two).

Table 1

	Mean Score Prior to Workshop (SD)	Mean Score After Workshop (SD)	Mean Score at End of Project (SD)
Environmental Sensitivity	4.53 (.88)	4.67 (.48)	4.56 (.51)
Environmental Knowledge and Skills	4.05 (.19)	4.21 (.63)	4.28 (.46)
Attitudes toward Taking Students Outdoors	4.68 (.82)	4.71 (.46)	4.83 (.38)

Pedagogical Knowledge and Skills relating to Integrating EE/OE into the Academic Curriculum	3.48 (.62)	4.25 (.35)*	4.20 (.53)
Self-Efficacy toward Integrating EE/OE into the Academic Curriculum	3.61 (.92)	4.32 (.48)*	4.39 (.61)
Belief in the Academic Relevance of EE/OE	4.11 (.99)	4.39 (.57)	4.56 (.62)

Notes: response format was 1 = strongly disagree (that I have the particular trait, knowledge or skill) to 5 = strongly agree; * indicates a significant increase from prior measure; n = 28

Recommendations for Future Professional Development

Based on the professional development outcomes of participating teachers, it appears a multi-day workshop can be an effective way for increasing teachers' pedagogical knowledge and skills, as well as their self-efficacy beliefs, relating to integrating EE/OE into the academic curriculum. Professional development outcomes and activities designed to further teachers' environmental sensitivity and attitudes toward taking students outdoors, as well as their beliefs regarding the academic relevance of EE/OE may not be a good investment of time and effort, when the audience for these efforts are teachers who have chosen to participate in implementing an EE/OE project, as they likely already possess and are being motivated to participate by this environmental sensitivity, positive attitudes toward taking students outdoors, and belief in the academic relevance of doing so. For teachers who are told (not voluntarily chosen) to integrate EE/OE into their curriculum, a pre-assessment measure of these areas would be helpful in guiding what to emphasize and target within professional development efforts, so that time and effort are not expended on knowledge, skills, dispositions, etc. that teachers already possess.

Recommendations for future professional development additionally stem from these three evaluation questions: *How useful did the teachers' anticipate the resources, content, and skills introduced during the professional development workshop to be for their projects? What resources/tools/content/skills introduced during the professional development workshop were used by teachers and in what ways? What are teachers' recommendations regarding future professional development relating to integrating EE/OE into secondary education as a means for improving academic achievement and engagement?*

Data regarding the first question was collected from teachers immediately after the workshop. Ratings from the 28 teachers indicated they anticipated each of the components from the professional development workshop to be useful in their future implementation of their EE/OE projects. They anticipated the component on skills and ideas for outdoor classroom management, examples of EE/OE resources and curricula, and resources relating to how EE/OE supports academic achievement to be most useful regarding their proposed EE/OE project. See Table 2 for teachers' ratings regarding anticipated usefulness in project implementation.

Table 2

	Mean (SD)
Academic standards and how to align them with EE/OE	3.96 (.69)
Goals and objectives of EE/OE and characteristics of quality EE/OE	4.32 (.77)

Information/resources relating to how EE/OE supports academic achievement	4.50 (.64)
Skills and ideas for outdoor classroom management	4.61 (.57)
Project-based learning	4.11 (.74)
Examples of EE/OE curricula and resources	4.54 (.64)
Skills and ideas for finding and using community resources	4.32 (.55)

Note: response format was 1 = not useful to 5 = very useful; n = 28

When asked through an open-ended question at the end year one as to what resources, tools, content, or skills introduced during the professional development workshop they used and in what ways, teachers provided these responses:

- EE/OE materials and resources, including sample lesson plans/activities
- Project Learning Tree activities in lesson planning
- Skills relating to outdoor classroom management
- Journaling in an EE/OE context
- Connections with other schools, organizations, and leaders
- Skills for integrating subject areas and aligning EE/OE with standards
- Mentor input regarding designing and/or using an outdoor space

Many teachers did not respond to this item, which may be reflective of difficulty recalling specifically what was introduced in the workshop or lack of time for completing a relatively long teacher questionnaire and phrasing of this item in a way that would take time/effort to complete.

When asked at the end of the second year of project implementation what recommendations they had regarding future professional development efforts relating to integrating EE/OE into the curriculum as a means to improve academic achievement through an open-ended question at the end of both year one and two, teachers provided the following responses (responses were stated by one to three teachers; no response was indicated by the majority of teachers):

Suggestions relating to outcomes for professional development:

- Integrating EE/OE across the curriculum (in subjects beyond science)
- Knowledge/skills relating to navigating barriers to EE/OE integration
- Comfort level and skills in outdoor teaching, particularly classroom management
- Aligning standards with EE/OE
- Procedural knowledge and skills relating to inquiry-based instruction
- Procedural knowledge and skills relating to how to implement longer-term projects rather than one-time lessons or one-day activities
- How to integrate EE/OE as a team of teachers; how to involve multiple teachers across subject areas in implementing a project and how to navigate barriers to doing so

Suggestions relating to resources:

- Examples of cross-curricular lessons/units /projects, particularly for non-science teachers
- Ideas for integrating technology

- Examples of community resources, particularly names of speakers and experts that could be used for a particular activity or topic area

Suggestions relating to format/approach:

- Opportunity for schools to share their projects (how they evolved, what they plan to do)
- More time to process, reflect, and apply
- Demonstrate (rather than tell about) the lessons that teachers can do with their students
- Acknowledge the challenges associated with integrating EE/OE and empathize with teachers who are embracing the challenge of teaching outdoors
- Learning how and being inspired to integrate EE/OE through presentations from other schools as to how they are successfully integrating EE/OE across grades and subject areas (projects they have done, what they learned, how they navigated challenges, etc.)
- Time within the workshop to plan and incorporate ideas into curriculum, with an opportunity to get help from experts/mentors for ideas and feedback during the planning time about project in general as well as feedback regarding the incorporation of what they are learning into their project ideas and curriculum plans (such as feedback on and help with aligning with standards)
- Follow up sessions, such as a session to re-energize teachers as initial enthusiasm wears off, or on-going sessions every few months for teachers to share ideas and be supported in their work
- Site visits by mentors following workshop to provide feedback on project implementation

In summary, multi-day workshops can be an effective way for increasing teachers' pedagogical knowledge and skills, as well as their self-efficacy beliefs, relating to integrating EE/OE into the academic curriculum. Professional development outcomes and activities designed to further teachers' environmental sensitivity and attitudes toward taking students outdoors, as well as their beliefs regarding the academic relevance of EE/OE may not be a good investment of time and effort, when the audience for these efforts are teachers who have chosen to participate in implementing an EE/OE project, as they likely already possess and are being motivated to participate by this environmental sensitivity, attitudes, and belief. This is consistent with teachers' suggestions relating to desired professional development outcomes, as their suggestions focused on pedagogical knowledge and skills, specifically integrating EE/OE into subject areas beyond science, aligning EE/OE with core subject area standards, managing students outdoors, navigating barriers associated with integrating EE/OE, teaching through an inquiry-based approach, and working as a team of teachers to implement a project across disciplines rather than as individual teachers implementing more isolated and short-term EE/OE activities. Their suggestions also seem to indicate a range of needs, reflective of varying levels perhaps, with some suggesting knowledge and skills oriented toward more "entry-level" needs such as help with aligning lessons or activities with standards or managing students outdoors, whereas others indicated a desire to learn how use team teaching to implement longer-term projects across multiple subject areas. These represent different forms of EE, with somewhat differing associated procedural knowledge and skills. Their specific suggestions relating to desired outcomes, format, and resources can be used to guide future professional development efforts.

Project Implementation

Student Learning Outcomes

A primary desired outcome for this project was to support academic knowledge and skills at the secondary level. The following evaluation questions were used to assess this desired outcome: *Did students who participated in the EE/OE program meet academic standards in science, math, language arts, social studies, and/or physical education? Did they outperform peers who did not participate in the program?* These questions were addressed using data from the Minnesota Comprehensive Assessments, as well as data from items on the teacher and student questionnaires.

Addressing this evaluation question using Minnesota Comprehensive Assessment (MCA) scores as a measure of student achievement was challenging for several reasons. Data from the MCAs in science, math, and reading were obtained for the six participating schools for both the 2011 (year prior to project implementation) and 2012 (after first year of implementation). Due to the delay in compiling and report within the Minnesota Department of Education, scores from 2013 were not used, as data from spring testing is not available until later in the summer. The analysis of this data involved an intention-to-treat approach, as recommended by a data specialist within the Minnesota Department of Education. This approach is based on the initial treatment assignment and not on the treatment actually received. While the intention was to have all students across a grade or school participate in the EE/OE projects, participation instead varied from school to school and grade to grade as to how many students participated. In some schools, students in a particular grade or set of grades participated, but in other schools, participation seemed to be by teacher(s). Because test data available from the Minnesota Department of Education is at the grade level rather than classroom or teacher level, data from students who did not participate in the EE/OE project were unable to be removed in the analysis. Consequently, non-participating students' scores may have contributed to the grade-level scores that were considered "treatment averages."

Further difficulty in the analysis was due to several treatment schools not having a school district comparison (as they are the only school at that level – middle or high school – in the district). For these schools and for the two schools considered to be academies, a comparable school was generated through a function within the Minnesota Department of Education's website. It is unclear as to how a comparable school is generated and if there are factors that may have affected student achievement not accounted for in generating the comparison school. Further, because of the change in test form from 2011 (MCA II) to 2012 (MCA III), comparing growth or change in scores from the year prior to treatment to the treatment year is difficult, as test metrics changed across the test. In addition, some schools elected to use the MCA II in 2012, rather than the MCA III, making comparisons further challenging. To address this, the analysis looked at treatment schools in 2012 to see which schools scored higher than the school district or state average. For those schools showing averages higher than the school district or state, their 2011 averages in were compared against 2011 school district and state averages to determine if the year prior to treatment they were outscoring their district and the state average. It would be less likely that the school's higher-than-district or higher-than-state results could be attributed to the treatment, if the year prior, the school also scored higher than the district or state (at that particular grade level).

The results of this analysis suggest one school, Rockford, may have had higher 8th grade science scores in 2012 (year one of the project) than their comparison (non-treatment) school, in contrast to in 2011 where their average science score was slightly lower than the comparison school's average science score. This was one of the schools where the majority of students participated in the treatment, which suggests that participation in the EE/OE project at that particular school may be associated with improved science standardized test scores. The intention-to-treat analysis indicated that none of the other five schools outperformed comparable non-treatment schools, nor state averages; but results suggest test performance during the treatment year was relatively similar to performance the prior year. It is possible and perhaps likely that an effect of the project on test scores would not be seen until the second year of the project, as schools seemed to "do more" in the second year and likely implementation in the second year was improved from the prior year. Thus, until data from 2013 is available, and in light of the limitations to the intention to treat analysis approach, it is generally unclear as to the effects of participation on student achievement as measured by test scores.

One of the six schools, Kennedy, provided datasets directly from the test vendor, rather than through the Minnesota Department of Education's test data website. Schools can request rostering of data from the test vendor, with scores provided at the classroom and/or student level. A teacher at this school identified within the data set provided by the test vendor which students participated in the EE/OE project and which students did not (while removing information that could specifically identify individual students). This provided a way to compare participants from non-participants to investigate if there was a treatment effect at a grade-level within a school. Two-way analyses of variances (using the independent variables of participation and gender) indicated no significant difference between participating and non-participating students for science and math. There was a significant difference in reading scores between participating and non-participating students. This difference, however, was moderated by gender, with female students in the EE/OE project scoring significantly higher than female students who did not participate; male students in the EE/OE project scored significantly lower than male students who did not participate. It is not clear as to why there may have been this significant interaction of gender and participation, unless there is some underlying influence similar to why females tend to have more positive environmental attitudes and environmental concern than males. Further research would be needed to better explore the interaction effect of gender and participation on learning outcomes.

In summary, MCA data suggests students were meeting academic standards in core subject areas, and potentially students in the EE/OE projects at two schools may be associated with stronger science and reading achievement than in comparable schools (with the effect on reading achievement moderated by gender at one school). Due to limitations associated with the data available and analysis approach used, further research is needed to measure impact of EE/OE participation on academic learning in the core subject areas and on MCA performance.

For this evaluation, MCA data was supplemented by data from teachers and students as to their perceptions regarding the influence of participation in the EE/OE on achievement of academic standards. Based on data from 28 teachers at the end of school years one and two, teachers perceived their EE/OE projects to have helped students achieve academic standards in science ($M = 2.56$, $SD = .65$), math ($M = 2.16$, $SD = .60$), language arts ($M = 2.38$, $SD = .74$), social studies ($M = 2.05$, $SD = .72$), and

physical education ($M = 2.17$, $SD = .71$), with an average response on these items corresponding to a rating of somewhat to a lot (on a three point response scale, with 1 = not at all to 3 = yes, a lot). Based on the means and standard deviations, it appears teachers perceived their EE/OE projects helped students achieve science standards more so than standards in other subject areas.

Students at the end of school year one ($n=198$) indicated they perceived participating in their EE/OE project to have increased their academic learning somewhat, with response format options of not at all (1), yes, somewhat (2), and yes, very a lot (3). Students' perceived participation to most help them with science learning ($M = 2.27$, $SD = .70$). At the end of school year two, students who participated in the posttest-only assessment ($n = 158$) indicated participating in their EE/OE projects increased their learning in science somewhat to a lot, and their learning in math, language arts, social studies, and physical education somewhat. One open-ended student response to note: *I learned that I really work and learn better in the outdoors.*

At the end of year two, students ($n = 70$) who participated in the pretest-posttest assessment (students in their first year of participation who had not participated in school year one) had posttest ratings indicating they perceived participation in the EE/OE projects to have somewhat increased their science learning ($M = 2.35$, $SD = .53$); math learning ($M = 1.97$, $SD = .65$); language arts learning ($M = 2.12$, $SD = .73$); social studies learning ($M = 2.12$, $SD = .68$); and physical education learning ($M = 2.20$, $SD = .88$). See Table 3 for a summary of the means and standard deviations associated with these responses relating to academic learning.

Table 3

	Teacher Mean (SD)	Year 1 Student Mean (SD)	Year 2 Student Mean (SD)	Year 2 Student Post Mean (SD) from pre/post students
Science	2.56 (.65)	2.27 (.70)	2.35 (.68)	2.35 (.53)
Math	2.16 (.60)	1.97 (.78)	1.89 (.74)	1.97 (.65)
Language Arts	2.38 (.74)	1.88 (.81)	1.77 (.70)	2.12 (.73)
Social Studies	2.17 (.71)	1.80 (.77)	1.86 (.73)	2.12 (.68)
Physical Education	2.17 (.71)	1.86 (.82)	1.96 (.75)	2.20 (.88)

Note: on a three point response scale, with 1 = not at all to 3 = yes, a lot.

Did participation in the EE/OE programs increase students' academic engagement, environmental sensitivity, understanding of ecological systems, and outdoor skills?

Based on data from 28 teachers at the end of the school years one and two, teachers perceived their EE/OE projects to have had a positive influence on students' academic engagement ($M = 2.51$, $SD = .21$ on a 15-item scale); environmental sensitivity ($M = 2.51$, $SD = .51$ on a 4-item scale), and understanding of ecological systems ($M = 2.41$, $SD = .53$ on a 5-item scale). The response format for these items was 1, corresponding with not at all, to 3, corresponding to yes, a lot. All teachers indicated they felt the projects contributed to students' learning outdoor skills, with skills ranging from outdoor

recreation-related skills to skills that were more environmental learning, such as tree identification, tracking, gardening, and phenology.

At the end of school year one, students (n=198) reported that participating in their EE/OE project somewhat increased their academic engagement (M = 2.26, SD = .41 on the 15-item scale), environmental sensitivity (M = 2.32, SD = .51 on the 4-item scale), and understanding of ecological systems (M = 2.41, SD = .50 on the 5-item scale). The response format was 1 = not at all to 3 = yes, a lot. At the end of school year two, students (n = 158) who participated in the post-only assessment indicated they felt participating in the EE/OE projects increased their academic engagement somewhat (M = 2.19, SD = .42 on the 15-item scale), environmental sensitivity (M = 2.41, SD = .55 on the 4-item scale), and understanding of ecological systems (M = 2.36, SD = .44 on the 5-item scale). Students indicated learning outdoor skills such as survival skills (fire and shelter building), navigation, plant identification, tracking, gardening, and snow shoeing. Open-ended student responses to note: *This project encouraged me to teach my niece about the importance of taking care of the environment. Because of this class, I was inspired to go outside and pick up trash in my neighborhood with my niece; and I've learned to see outside the box, to see how everything is connected from a little bug to a big bear; I learned that your actions have a great impact on the world, so make good decisions. Several students noted teamwork or cooperation skills.*

	Teacher Mean (SD)	Year 1 Student Mean (SD)	Year 2 Student Mean (SD)
Academic engagement	2.51 (.21)	2.26 (.41)	2.19 (.42)
Environmental sensitivity	2.51 (.51)	2.32 (.51)	2.41 (.55)
Understanding of ecological systems	2.41 (.53)	2.41 (.50)	2.36 (.44)

At the end of school year two, students who participated in the pretest-posttest assessment (students in their first year of participation who had not participated in school year one; n = 86) had a significant increase in perceived understanding of ecological systems, $t(85) = 5.72$, $p < .001$, as measured on the 5-item scale with a response format of 1 = not much to 3 = a lot. There were no significant increases in academic engagement, environmental sensitivity, and environmental sensitivity as measured through an 11-item connectedness to nature. It is important to note that pretest measures in these three areas indicated a relatively high level of academic engagement, environmental sensitivity and connectedness to nature; thus, there may have been a “ceiling effect” with little opportunity for growth/change in these areas.

The Middle School Environmental Literacy Survey (MSELS), the 2009 version of Hungerford, Volk, McBeth and Bluhm, MSELS (2006), was administered to 8th graders in two of the six participating schools at the end of school year one and at the end of school year two (n = 108). The selection of these two schools was based upon the comprehensive nature of their proposed EE/OE projects. Data from the MSELS indicate 8th grade students from the two schools taking this assessment at the end of each school year of project implementation scored significantly higher than the national mean in the following areas measured on the MSELS: ecological knowledge, $t(107) = 5.30$, $p < .001$; environmental sensitivity, $t(107) = 2.89$, $p = .005$; general environmental feelings, $t(107) = 3.96$, $p < .001$; issue analysis, $t(107) = 3.91$, $p < .001$; intention to act, $t(107) = 3.53$, $p = .001$; and pro-environmental behavior, $t(107) = 5.68$, $p < .001$.

See Table 4 for means and standard deviations for participating students and national averages (combined means from both years).

Table 4

	National Mean (SD)	Treatment Mean (SD)
Ecological knowledge	11.62 (3.32)	13.06 (2.81)*
Environmental sensitivity	30.11 (7.48)	31.74 (5.87)*
General environmental feelings	7.82 (2.06)	8.54 (1.77)*
Issue identification	1.29 (.95)	1.31 (1.39)
Issue analysis	2.86 (2.00)	3.66 (2.12)*
Action planning	7.86 (5.64)	8.79 (5.93)
Intention to act	41.10 (9.20)	43.69 (7.61)*
Pro-environmental behavior	35.14 (9.39)	39.11 (7.27)*

Notes: Treatment mean is from 108 participants from across both schools and years; national mean is from approximately 900 8th grade students nationwide (McBeth & Volk, 2010). Asterisks note where ENRTF means are significantly higher than national mean; significance value set at .006 to control for spiraling type I error rate (.05 /8).

Results by school and year are in Table 5. Results suggest 8th grade students at Kennedy in the project's second year scored significantly higher than the national mean in the following areas: ecological knowledge, $t(30) = 5.76$, $p < .001$; environmental sensitivity, $t(30) = 3.09$, $p = .004$; general environmental feelings, $t(30) = 3.72$, $p = .001$; issue analysis, $t(30) = 7.11$, $p < .001$; action planning, $t(30) = 3.01$, $p = .005$; intention to act, $t(30) = 5.10$, $p < .001$; and pro-environmental behavior, $t(30) = 6.33$, $p < .001$. In addition, students at Rockford in the first year of the project scored significantly higher than the national mean on ecological knowledge, $t(23) = 3.85$, $p = .001$.

Table 5

	Rockford Yr 1 Mean (SD)	Rockford Yr 2 Mean(SD)	Kennedy Yr 1 Mean (SD)	Kennedy Yr 2 (Mean SD)	National Mean (SD)
Ecological knowledge	13.29 (2.61)*	12.50 (3.01)	12.39 (2.50)	14.10 (2.76)*	11.62 (3.32)
Environmental sensitivity	30.83 (4.85)	29.17 (5.41)	34.17 (6.74) (not significant due to higher SD)	33.13 (5.45)*	30.11 (7.48)
General environmental feelings	8.57 (1.91)	8.23 (1.65)	8.42 (2.10)	8.90 (1.62)*	7.82 (2.06)
Issue identification	.71 (.91)	1.33 (1.36)	1.30 (.97)	1.93 (1.75)	1.29 (.95)
Issue analysis	3.17 (2.61)	3.03 (1.81)	3.48 (2.23)	4.72 (1.50)*	2.86 (2.00)
Action planning	5.67 (5.43)	8.33 (5.61)	8.22 (4.45)	11.48 (6.57)*	7.86 (5.64)
Intention to act	41.46 (6.26)	41.73 (8.27)	45.43 (9.51)	46.00 (5.35)*	41.10 (9.20)
Pro-environmental behavior	37.54 (6.76)	38.00 (7.66)	39.65 (9.28)	41.00 (5.15)*	35.14 (9.39)

Note: Asterisks indicated school mean scores that were significantly higher than the national mean, based on scores from approximately 900 8th grade students (McBeth & Volk, 2010); significance value set at .006 to control for spiraling type I error rate (.05 /8).

Program Characteristics Associated with Student Outcomes

To address the evaluation question, *What characteristics of the environmental and outdoor education projects/programs are associated with influencing students' academic engagement and achievement in the core subject areas?*, teachers were asked to respond to an open-ended item on the teacher questionnaire. Data from 28 teachers is summarized below, categorized by perceived influences on academic engagement first, followed by influences on academic achievement. Frequency of times a response was indicated by teachers varied; an asterisk notes a response was given by five or more teachers.

Characteristics/Components Influencing Students' Academic Engagement:

- Ownership in the project or in the place or space (in starting a garden on their own, getting to weigh in on decisions and do research to develop the plans; getting to help plan the course of the trail; having their "own" piece of space by the river and taking pride in caring for it);
- Outdoor learning/experience that excites, motivates, engages, and focuses students (students are excited to go outdoors and enjoy going outdoors; excitement becomes engagement in the classroom and motivates students to learn more about the environment; any outdoor experience heightens interest and motivation; students enjoy going outdoors and focus on the learning more; serves as a stimulus for learning)*;
- Out-of-classroom learning experiences that increase meaning and relevance for student learning (more buy-in to the learning at hand when they see it as relevant);
- Active or hands-on learning (for example, "doing" science) ;
- Novel topics/novel places/working on something students don't get to do at home (such as the pickling and dehydrating component of the gardening program);
- Having to transfer ideas from outdoor activities to indoor activities (or vice versa)

Characteristics/Components Influencing Students' Academic Achievement in Core Subjects:

- Solving real world problems;
- Hands-on or real-world learning that helps students connect to content; connections of curriculum in the classroom to the outside world (having the picture of the outdoors in their minds to recall and relate new information; applying math to real world activities instead of problems from a book requires students to construct knowledge and engage in using and applying math rather than just doing math; writing improves, as students can see and describe cause and effect from first hand experiences and are then able to write better descriptions ; having used their senses and make observations helps them write more descriptively; feel validated when writing about their observations)*;
- Whole-body experiences (these experiences engrains themselves into a student an in their memory; can be used as a reference point for learning the rest of the year;

- Writing activities addressing local environmental issues seemed to have increased academic achievement in science, social studies, and English;
- Having to analyze data and explain it helps them learn in multiple subject areas;
- Team teaching and tying lessons across subject areas;
- Having the outdoor learning reinforce core content knowledge and skills; and
- Learning about a place that they feel connected to (more engaged in writing assignments because they were writing about “their place”)

Recommendations for Future Implementation

The characteristics and components identified in the prior section can guide future integration of EE/OE into the school curriculum. In addition, guidance for future implantation stems from the following evaluation question: *What are teachers’ recommendations regarding future implementation of environmental and outdoor education as a means for improving academic engagement and achievement?* Data from the 28 teacher respondents is summarized below.

- Utilizing community partnerships;
- Investment and support from school leaders and community members ;
- More working as a team in grade levels, allowing for similar topics/activities addressing multiple curricular areas;
- Determining necessary standards and then determining projects that can apply to those standards (rather than determining projects and then finding standards, as that makes it difficult to authentically meet core academic standards);
- Include a variety of activities to support diverse learners;
- Determine how to help students transfer effort in the outdoors to effort in classroom work (right now our students love being outdoors, but have yet to realize that level of effort can carry over to classroom work);
- Continued support of mentors/experts who visit and provide feedback;
- Having access to a clearing house of lessons or “bank” of lesson plans that are cross-curricular; access to additional standards-based lessons ;
- Having students take pre- and post-assessments so students can see for themselves how much knowledge they’ve gained; and
- Use of field trips/visits off site to places relevant to concepts being studied

The projects schools proposed and implemented varied in the degree to which EE/OE was integrated across the curriculum and the degree to which the EE/OE implemented was longer-term projects involving multiple teachers (v. isolated lessons or experiences). Similarly, professional development needs and recommendations indicated a range of where “teachers were at” in terms of integrating EE/OE across the academic curriculum. Thus, the following question was included in this evaluation to guide future project implementation when the aim is toward a more systemic integration of EE/OE: *What would encourage or support teachers in integrating environmental and outdoor education across the academic curriculum (collaborating with teachers on multidisciplinary projects rather than*

integrating it into isolated subjects or lessons)? Teachers offered the suggestions below. An asterisk indicates a response given by five or more teachers.

Data from the teacher respondents are summarized below.

- Promoting recognition of and support for this form of learning among teachers and administrators through examples, student “testimonials,” or data that supports environmental and outdoor education’s effect on student achievement;
- Common planning time and planning time in general (time to plan together and even support/pay for planning together)*;
- Strong buy-in from all teachers;
- A format for teachers to share ideas, support each other, and collaborate with each other;
- Cross-curricular professional development opportunities and attendance as a team of teachers; and
- Follow-up grants to allow teachers to build on and improve upon the new ideas they have developed over the course of this pilot project.

Appendix B – Model Lessons

A collection of lessons produced by teachers in the EOE project.

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Patricia Heldt

School: Clearwater Middle School

Phone: (952) 442-2760

E-mail: theldt@waconia.k12.mn.us

Title of lesson: Local Weathering

Content area: Science

Grade level: 5

Learning objective: Students will identify signs of erosion and weathering as well as ways people engineered stopping erosion at local sites.

Standard or benchmark addressed (include any inter-curricular connections):

Science 5.3.1.22, 5.1.3.2.1, 5.4.4.1.1

Description of lesson and how it is adapted for EOE:

- Students will investigate weathering and erosion using stream tables. They will learn to change one variable at a time while engineering solutions to slow the effects of water.
- Students will take a bus tour of a river, a farm field, a marsh and a lake shore. Students will map out the erosion they see, as they did on stream tables, and note how people attempted to slow the erosion.
- Students will complete a choice activity applying how they would slow erosion at one of the bus sites.

Teacher's role (i.e. specific activities and instructional strategies):

- Teachers ask leading questions which facilitate students ability to notice and document how the water moves soil as it flows.
- Teachers will lead students on the bus tour. They will ask students to point out areas of interest.
- Teachers will provide students with the time and guidelines to safely search the bus tour sites for more signs of erosion and engineering.

Other resources needed:

Stream Tables, bus, river, lake, marsh, contour farmed harvested field, student packet,

How students are assessed:

See attached rubrics and choice activities

Suggested enhancements or extensions:

Analyze topographical maps of the local sites.

Draw in predictions of erosion or where they saw erosion.

Time considerations:

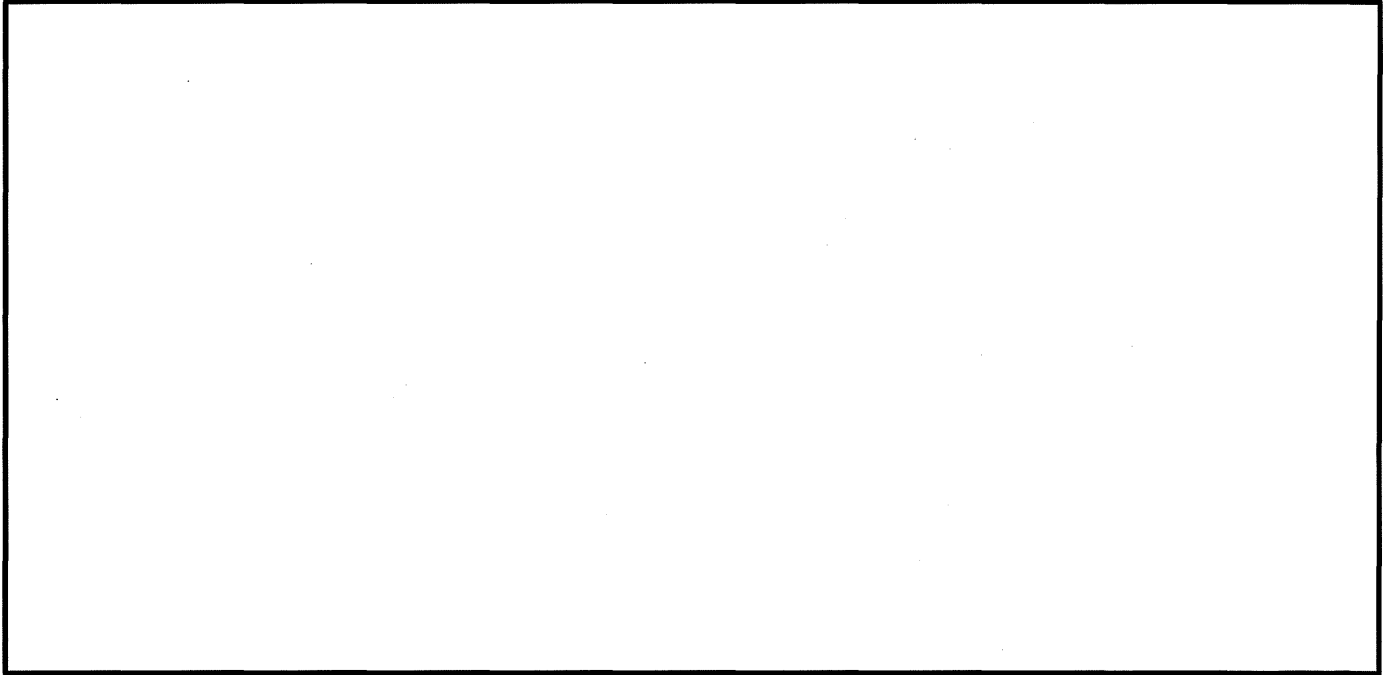
Three week unit

Three hour field trip (depending on distance traveled)

Two 75 minute periods for assessment

Bus Tour Site _____

Draw all living and non-living elements of the area that you see that cause or control erosion.



Describe the erosion that you see. _____

Describe natural elements of the area that slow erosion. _____

Describe human engineered ways to slow erosion. _____

How would engineer a way to slow the erosion. _____

Bus Tour Choice Activities

You may work as an individual or in a group of up to three people. Your partners may come from anyone who was on the bus with you. Each partner must write their own captions and be able to present to their class.

Circle if you are going to work alone or in a group.

Individual

Group: Partner 1 _____ Partner 2 _____

You may choose one activity to demonstrate your knowledge from the bus tour. 45 minutes of class time will be given to you to work. All other work must be finished at home. You must have a 60 second presentation which teaches your class what you learned.

Circle the choice that you are going to do.

Choice 1: Stream Table Design

Design a stream table to teach someone else what you saw at one of the erosion bus tour sites. Label each element with a flag (use the ones we used when we did stream tables in class or make new ones); write a caption explaining the weathering issue you saw and at least one solution that could solve it.

Choice 2: Putt Putt Golf Hole

Design a putt putt golf hole that will teach someone else what you saw at one of the erosion bus tour sites. Label each element with a flag (use the ones we used when we did stream tables in class or make new ones); write a caption explaining the weathering issue you saw and at least one solution that could solve it.

Choice 3: Creative Erosion Story

Write a creative story which will teach someone about what you saw at one of the erosion bus tour sites. Include the elements of weathering that you saw and how they could be solved. You may do this as a nonfiction or fiction story.

Stream Table Rubric:

	1	2	3	4
Stream table model example of Weathering	Model shows basic weathering in an unclear manner.	Model demonstrates basic weathering elements in a clear manner.	Model visually demonstrates weathering elements in a clear-precise manner.	Model visually demonstrates weathering elements in a clear-explanative manner.
Written Caption of weathering elements	Caption mentions weathering elements.	Caption relates weathering elements to the model.	Caption explains reasons for weathering shown in the model.	Caption thoroughly explains reasons and effects of weathering shown in the model.
Water in the model demonstrates water's natural course	Water does not mimic where it would go at one of the bus sites.	Water mimics with 30% accuracy where it would go at one of the bus sites.	Water mimics with 60% accuracy where it would go at one of the bus sites.	Water mimics with 95% accuracy where it would go at one of the bus sites.
Reflection on how you helped your group	Listed 3-4 adjectives describing how you helped or hurt your group.	Listed adjectives and verbs describing how you helped or hurt your group.	Explained using adjectives and verbs describing how you helped or hurt your group and the effects your performance had.	Explained using adjectives and verbs describing how you helped or hurt your group and the effects your performance had. Listing specific contributions you made.
Stream Table/ Bus Site relationship	Your model does not relate to what you saw on the bus tour.	Your model vaguely looks like one of what you saw on the bus tour.	Your model clearly represents one of the sites shown on the bus tour.	Your model clearly represents and is a scale model of one of the sites shown on the bus tours.

Putt Putt Golf Rubric:

	1	2	3	4
Putt Putt Golf Hole models example of Weathering	Model shows basic weathering in an unclear manner.	Model demonstrates basic weathering elements in a clear manner.	Model visually demonstrates weathering elements in a clear-precise manner.	Model visually demonstrates weathering elements in a clear-explanative manner.
Written Caption of weathering elements	Caption mentions weathering elements.	Caption relates weathering elements to the model.	Caption explains reasons for weathering shown in the model.	Caption thoroughly explains reasons and effects of weathering shown in the model.
Golf Ball demonstrates water's natural course	Golf ball does not move.	Golf ball mimics with 30% accuracy where water would go at one of the bus sites.	Golf ball mimics with 60% accuracy where water would go at one of the bus sites.	Golf ball mimics with 90% accuracy where water would go at one of the bus sites.
Reflection on how you helped your group	Listed 3-4 adjectives describing how you helped or hurt your group.	Listed adjectives and verbs describing how you helped or hurt your group.	Explained using adjectives and verbs describing how you helped or hurt your group and the effects your performance had.	Explained using adjectives and verbs describing how you helped or hurt your group and the effects your performance had. Listing specific contributions you made.
Putt Putt Hole/ Bus Site relationship	Your model does not relate to what you saw on the bus tour.	Your model vaguely looks like one of what you saw on the bus tour.	Your model clearly represents one of the sites shown on the bus tour.	Your model clearly represents and is a scale model of one of the sites shown on the bus tours.

Creative Story Rubric:

	1	2	3	4
Words allow someone to picture the effects of weathering.	Weathering description mentioned.	Reader is able to see basic picture of the effects of weathering.	Reader is able to picture what type of soil and weathering happened.	Reader is able to picture what type of soil and weathering happened and how the water would move.
Written description of weathering elements	Weathering elements mentioned.	Weathering elements described in detail.	Weathering explained in detail including reasons why it happened.	Weathering is thoroughly explained including reasons and effects of weathering shown at the bus site.
Story explains water's natural course	Description of water flow does not match where it really would go.	Description of water flow matches with 30% accuracy where it really would go.	Description of water flow matches with 60% accuracy where it really would go.	Description of water flow matches with 95% accuracy where it really would go.
Reflection on how you helped your group	Listed 3-4 adjectives describing how you helped or hurt your group.	Listed adjectives and verbs describing how you helped or hurt your group.	Explained using adjectives and verbs describing how you helped or hurt your group and the effects your performance had.	Explained using adjectives and verbs describing how you helped or hurt your group and the effects your performance had. Listing specific contributions you made.
Story/ Bus Site relationship	Your story does not describe what you saw on the bus tour.	Your story vaguely describes one of what you saw on the bus tour.	Your story clearly describes one of the sites shown on the bus tour.	Your story clearly describes in detail one of the sites shown on the bus tours.

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Patricia Heldt

School: Clearwater Middle School

Phone: (952) 442-2760

E-mail: theldt@waconia.k12.mn.us

Title of lesson: Wetland

Content area: Science

Grade level: 5

Learning objective: Students will know the parts of a wetland and how they work together to filter water.

Standard or benchmark addressed (include any inter-curricular connections):

Science 5.4.2.1.1, 5.4.1.1.1

Description of lesson and how it is adapted for EOE:

1. Students visit a pond and a wetland near the school. Students write down all living and non-living elements they see.
2. Students predict the niche of each element of the wetland they noted.
3. Students read the information on Wetlands and take notes on why they are important.
4. Students read the Magic School Bus on Water Sanitation.
5. Students compare the parts of a wetland to the parts of a water cleaning station.
6. Students build a model to replicate each part of a wetland in a clear plastic tub.
7. Students note how their wetland model will clean water.
8. Students place an eye dropper in their wetland against the plastic.
9. Students add one teaspoon of red food coloring and observe what happens immediately, after five minutes, after thirty minutes and after twenty four hours.
10. Students compare how their model cleaned the dye to how water is cleaned in a wetland.

Teacher's role (i.e. specific activities and instructional strategies):

Wetland Investigation

- Lead students to wetland or wetland, point out points of interest in the area.
- As leading questions which make students think about the parts of a wetland and how they help one another.
- Check that students have documented the living and non-living parts of a wetland.

Reading Materials

- Hand out the MN Wetland packet, chapter 3 Minnesota Waters-Wetlands and Groundwater. Instruct students to read it as a group, to note the main ideas and supporting details of each section with a heading.
- Discuss the different parts and importance of a wetland with the class when everyone has completed their notes.
- Read Magic School bus to the class.
- Compare the similarities and differences between wetland areas and water purification center.

Wetland Investigation

- Have all bins, eye droppers and any wetland materials you are providing organized for students. (You may want to provide sand, peat moss, plant matter, and water for students. I have students bring in their own materials but have options for them to use if they forgot.)
- Review the parts of a wetland and what role they play.
- Instruct students to fill in the wetland worksheet. Make sure they note how their model replicates the wetland.

Other resources needed:

MN DNA Wetlands Chapter 3

Magic School Bus Water Purification

Clear Plastic Bin for each group

Red Food Coloring

Eye dropper per group with the top removed

How students are assessed:

Students compare how their model wetlands work to how actual wetlands work.

Suggested enhancements or extensions:

Project Wet wetland analogy sheet

Time considerations:

One period for wetland tour

One period for reading materials

One period to build and observe the wetland. Students may finish readings while doing observations.

Wetlands and Wetlands

Describe what living plants and animals live in wetlands.

Animal	Habitat	Niche (job or how it helps the ecosystem)

Plant	Habitat	Niche (job or how it helps the ecosystem)

Describe what non-living things live in wetlands.

Non-living Object	Where it is found	Niche (job or how it helps the ecosystem)

Wetlands and Water Purification

As you read the Magic School Bus note how cities clean water.

Look at your wetland notes. What parts of a wetland do the same job.

You will make your own wetland. What will you use to model or replicate each part of the wetland.

Part of Water Purification	Part of the Wetland	How they clean water	How you will replicate this in a model

Build a wetland in a clear tub.

Place an eye dropper in the wetland. Check that it is touching the clear plastic.

Add one teaspoon of red food coloring. Observe how your model cleans the ink.

Time Interval	Observation
Immediate	
Five Minutes	
Thirty Minutes	
Twenty-four Hours	

How does your model demonstrate how wetlands clean water?

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Michael Jensen

School: Waconia High School

Phone: 952-442-0670

E-mail: mjensen@waconia.k12.mn.us

Title of lesson: Stream Monitoring

Content area: Environmental Biology, Biology, Ecology

Grade level: 9-12

Learning objective: Students will be able to successfully...

1. Measure stream width and depth
2. Measure water temperature
3. Identify habitat and influences on local stream health
4. Measure stream velocity
5. Measure stream clarity

Standard or benchmark addressed (include any inter-curricular connections):

9.4.4.1.2

Describe the social, economic and ecological risks and benefits of changing a natural ecosystem as a result of human activity.

9.4.2.1.2

Explain how ecosystems can change as a result of the introduction of one or more new species.

9.3.4.1.2

Explain how human activity and natural processes are altering the hydrosphere, biosphere, lithosphere and atmosphere, including pollution, topography and climate.

9.3.4.1.1

Analyze the benefits, costs, risks and tradeoffs associated with natural hazards, including the selection of land use and engineering mitigation.

9.3.2.3.1

Trace the cyclical movement of carbon, oxygen and nitrogen through the lithosphere, hydrosphere, atmosphere, and biosphere.

9.1.3.1.1

Describe a system, including specifications of boundaries and subsystems, relationships to other systems, and identification of inputs and expected outputs.

Description of lesson and how it is adapted for EOE:

This lesson involves sampling and collecting data for local stream monitoring. These lesson involve students in the hands on collection and analysis of data and connecting with local and state agencies to communicate data.

Teacher's role (i.e. specific activities and instructional strategies):

1. Scout local streams and lakes
2. Lead students in pre instruction sampling methods
3. Lead students in day of sampling methods
4. Engage students in collection of multiple data sets and analysis

Other resources needed:

1. Waiters – set for 1 per 2-3 students
2. 100 ft tape measures – 1 per 2-3 students
3. D-nets – 1 per 2-3 students for invert collection
4. Thermometers
5. Floating object – tennis ball, fishing floats, blow up beach ball, etc.

How students are assessed:

1. Formative Unit Test
2. Summative journal entries

Suggested enhancements or extensions:

1. Use D-nets for invert collection → biodiversity index study
2. Extend stream data collection to local lakes

Time considerations:

1. Scouting – 1 class period (70min) with or without class to get a sense of the area of study
2. Sampling - 2 class period (70min) for steam characteristics, temperature, velocity, invert sampling, etc.
3. Analysis – 2 class period (70min) for group collaboration and anaylsis

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Michele A. Melius (History/Geography) and Britta DeVinny (Science)

School: Clearwater Middle School Waconia, MN 55387

Phone: 952-442-0650 ext. 3198

E-mail: mmelius@waconia.k12.mn.us

Title of lesson: The Edible Festival at the MN Landscape Arboretum (7th Grade Field Trip)

Content area: Science, History and Geography

Grade level: 7th grade

Learning objective:

Our goal was to provide an authentic learning activity that allows students to observe and experience, first-hand, the scientific process that goes into developing plants that can withstand Minnesota climate and soil.

Standard or benchmark addressed (include any inter-curricular connections):

Minnesota State Science Standards: Grade 7:

7.4.2.1.1 - Identify a variety of populations and communities in an ecosystem and describe the relationships among populations and communities in a stable ecosystem.

7.4.2.1.2 - Compare and contrast the roles of organisms with the following relationships: predator/prey, parasite/host, and producer/consumer/decomposer.

7.4.2.1.3 - Explain how the number of populations an ecosystem can support depends on the biotic resources available as well as abiotic factors such as the amount of light, water, temperature range, and soil composition.

7.4.2.2.1 - Recognize that producers use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

7.4.2.2.2 - Describe the roles and relationships among producers, consumers, and decomposers in changing energy from form to another in a food web within an ecosystem.

7.4.4.1.1 - Describe examples where selective breeding has resulted in new varieties of cultivated plants and particular traits in domesticated animals.

7.4.4.1.2 - Describe ways that human activities can change the populations and communities in an ecosystem.

Minnesota State Standards: Grades 4-8

V. Geography

A. Concepts of Location

Standard 2. The student will identify and locate major physical and cultural features that played an important role in the history of Minnesota.

Benchmark 1

C. Physical Features and Processes

Standard 3. The student will identify and locate geographic features associated with the development of Minnesota.

Benchmark 1.

Standard 4. The student will identify physical characteristics of places and use this knowledge to define regions, their relationships among regions, and their patterns of change.

Benchmark 3.

D. Interconnections

Standard 1. The student will give examples that demonstrate how people are connected to each other and the environment.

Benchmark 2

Standard 5. The student will describe how humans influence the environment and in turn are influenced by it.

Benchmark 1.

Description of lesson and how it is adapted for EOE:

Incorporating lesson ideas from *Food for Thought; Connecting Minnesota Geography, Agriculture and Communities* curriculum, we began the unit by discussing the difference between weather and climate. Using a variety of resources, such as; maps, images, articles, and Google Earth, we gathered data creating layers of information. This allowed us, while on the fieldtrip, to compare and see what correlations and causal relationships exist among the patterns of data examined earlier. Students were required to keep a daily journal in class as we went through the lessons. They were then asked to bring these with when visiting the Arboretum and Apple Farm experts so that their research could be documented. These journals were part of the Edible Festival packet that we created with the help of the Arboretum's Education team.

****This was the first time that we tried teaching cross-curricular lessons.** The description given was our goal, we achieved most of what we had hoped to accomplish-time was our main problem because science is first semester and geography is second. From this experience, we know how to better prepare the students for the fieldtrip next year.

Other resources needed: The Arboretum provided most of the items needed. I brought a few items that would be linked to the history of the area-Chaska Brick.

How students are assessed:

After the field trip we met as a class to share and discuss individual findings. The students were asked to show their understanding by creating a Mind Map which teaches them how to structure information, helping them to better analyze, comprehend, synthesize, and communicate their experience.

Suggested enhancements or extensions:

There are many ways to extend this lesson. Incorporating Native American tribes and their farming practices, getting more in depth with the creating of hybrid, Minnesota hardy seeds and plants, and including elements of climate change.

Time considerations: This was a 3 hour field trip that could have easily been a full day. Prior to the field trip, Science and Geography spent 5 days/70 minutes per class, introducing and discussing the subjects so that the experience would enhance their understanding and give it relevance.

Model Environmental and Outdoor Education Lesson Plan

Lesson Title: Macro Photography

Name: Beth Russell

School email: russellb@rockford.k12.mn.us

School Forest: Rockford Middle School

Grade(s): 6-8

Objective(s): Students will understand the function of the macro setting on their digital camera, take pictures from multiple perspectives, and manipulate the images using photo-editing software.

Standards: (NETS/ISTE)

1. Creativity and Innovation: Students will demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. 1b: Students will create original works as a means of personal or group expression.

4. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking to plan, conduct, and manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Equipment needed: Classroom set of cameras (students can share) and computers to download and edit images.

Procedure:

This lesson assumes students have discussed and worked with photography composition concepts such as rule of thirds and perspective.

1. Explore images online (via Google image search) of macro photography. Ask students to explain what the images have in common or what makes them unique.

2. Explain macro photography: sharp, focused images of an object up close and personal! Most digital cameras have macro settings; quite often it is expressed with a little flower detail on the settings button. Macro photos must be taken with the lens close to the subject without zooming.

3. Hand out cameras and have students find the correct setting; then go outside and take pictures with the following guidelines:

- use rule of thirds
- take multiple pictures of a subject from different angles
- play around with use of light/shadows
- look for interesting textures, colors, or patterns

4. When students come back inside, have them choose their own top two pictures from the camera. Students can upload photos to their computer or to the teacher's computer. Once photos are uploaded, the class can discuss the hour's best images.
5. The next day, students will be working with photo editing. In GoogleDocs (or Microsoft Word), have students create a table with columns labeled "before" and "after." Students should upload their best photo from the previous day to the "before" column.
6. Students will then upload their photos to an online editing website such as www.pixlr.com . Using this site, students can explore a variety of photo editing tools. One students are satisfied with their changes and edits, they will upload the new photo to their table labeled "after."
7. Students will then write a paragraph explaining:
 - the steps they took when finding, composing, and taking the image
 - why they chose this particular image
 - the steps they took while editing the photo
 - how the mood, feeling, or tone changed from one image to the next

Assessment: A rubric can be used to score students on:

- composition of original photo
- creation of table in GoogleDocs (shared with teacher) or in Word
- use of photo editing tool (pixlr.com)
- explanation of the photography and editing process

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Jesse Maloney
School: CCLA
Phone: 651 793 6624
E-mail: jesse@cclaonline.org

Title of lesson: To Consume or Be consumed

Content area: _MS Science_____

Grade level: ___7th___

Learning objective: Students will understand the relationship between predators/prey and will know that producers are the start of all food webs/chains, that primary consumers eat producers and that secondary consumers eat primary consumers

Standard or benchmark addressed (include any inter-curricular connections):

2. Interdependence Among Living Systems	1. Natural systems include a variety of organisms that interact with one another in several ways.	7.4.2.1.1	Identify a variety of populations and communities in an ecosystem and describe the relationships among the populations and communities in a stable ecosystem.
		7.4.2.1.2	Compare and contrast the roles of organisms with the following relationships: predator/prey, parasite/host, and producer/consumer/decomposer.

Description of lesson and how it is adapted for EOE:

NOTE: In preparation for this lesson, students have designed and engineered pvc marshmallow shooters. (see attached template). They should also have a basic understanding of how plants grow through photosynthesis.

This lesson is best suited for outdoors and is most effective in wooded or tall prairie grass areas.

Students are shown all of the plants and trees in the area. They are asked how these plants grow. Students will probably say “the sun, and rain”. Don’t forget to remind them that the very act of them answering is helping the plants grow (CO₂ from their breath). The combination of those 3 things helps a plant “*produce*” its own food by photosynthesis. That is why they are called PRODUCERS.

Let students know that many organisms get their energy by eating producers (plants). See if students can name or identify some of these organisms. These might include rabbits, woodchucks, caterpillars, deer, birds, etc. These animals are HERBIVORES. Since they are the first organisms to eat or *consume* in the food chain/web, they are also called PRIMARY CONSUMERS.

Now explain that many animals eat or consume those primary consumers. If they are the *second* set of organisms to *consume* in the food web/chain, ask students what they think they are called. That’s right, SECONDARY CONSUMERS.

Tell students there are names for organisms in these eat or be eaten relationships. The PREDATOR eats the PREY. A good way to remember who’s who in this relationship is that if you are running from something that wants to eat you, you “pray” that you don’t get caught! To not get caught, many of these organisms use CAMOUFLAGE to hide.

Teacher’s role (i.e. specific activities and instructional strategies):

Now divide students up into two groups. Tell them that one group is going to be scared rabbits (you can also use deer, ducks, etc.) and that they will be the prey. Then tell them that the other group will be the hunters (predators). The hunters will be using their marshmallow shooters to hunt the rabbits in the woods/grass. The rabbits will be using camouflage to hide. If the rabbits can go for 5 minutes (in a designated area) without being shot by a marshmallow then they will be successful in survival. Hunters can flush out rabbits and the rabbits can run and hide again, they just can’t get shot.

Have the predators count down 2 minutes while the rabbits go into the woods and hide. At the end of 2 minutes, the predators go in to hunt the prey. Start your 5 minute countdown and see which of the prey lives to eat producers another day!

At the end of the round, switch roles.

Other resources needed:

Stop watch, marshmallow shooters, camouflage clothing

How students are assessed:

Ask students which role they like to play more: PREDATOR/PREY. You might also ask them which one they would rather be in nature and why. The following day you might want to give a quiz using the vocabulary words underlined above.

Suggested enhancements or extensions:

See what happens when you have less predators and more prey or vice versa. For each surviving rabbit, have 2 more rabbits enter the next round because of their rapid reproduction. Introduce other predators like dogs into the game (they would hunt without shooters). Try the activity with and then without camouflage.

Time considerations:

40 minutes minus travel time.

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Sarah Oppelt

School: River's Edge Academy

Phone: 651-234-0150

E-mail: sarahoppelt@gmail.com

Content area: Biology- Elective

Grade level: 9-12

Learning objective: I can plan and build a rain barrel set-up for the school garden.

Standard or benchmark addressed (include any inter-curricular connections):

9.1.2.2.1 – Engineering Design

9.3.4.1.2 – How human activity is affecting the hydrosphere

9.4.4.1.2 – How ecosystems are affected by human activity

9.4.4.2.4 – How water quality affects health.

Description of lesson and how it is adapted for EOE:

The students developed a plan and installed rain barrels in the school garden area. The students learned about rain barrels and how they could be used in the garden and their benefits for water quality. This activity fit well with their prior studies of water quality and watersheds and our connection to the Mississippi River in Science class. The lesson gave them an opportunity to connect their understanding of water quality to an action plan for steps that they can use to make a difference. The students were directed in finding the best directions and plan for rain barrel installation. They turned this information into a proposal for the rain barrels that was then approved by school administration. The installation was a great activity for students that don't always succeed in a traditional academic setting. The students learned how to use new tools and solve problems during the installation.

Teacher's role (i.e. specific activities and instructional strategies):

I started with a lesson on rain barrels and their relationship to water quality. The students had some background knowledge from water quality lessons in science class and electives. I also arranged a visit to another school that had rain barrels as well as other garden features so the students could see how other schools had developed their rain barrel and garden plans. I provided quality resources for students to do basic research on rain barrels and to develop their plan for the school. Most of the activities were student-directed with teacher feedback.

Other resources needed:

Rain barrel information guides (County, Watershed Districts), building supplies for the rain barrels, and tools.

How students are assessed:

The assessment included the rain barrel project plan (see attached) and the installation of the rain barrels on the school property. Students also shared their rain barrel project at a school presentation night.

Suggested enhancements or extensions:

There could be more math done to figure out the area of the roof and capacity of rain barrels and how many barrels would be need to meet the capacity of the roof runoff.

Time considerations:

This lesson occurred during an intensive class that was all day long, which allowed for more undivided time to work on the plan and installation or the rain barrels. This could be completed over many class periods, or during a voluntary after school time, depending on the size of the project.

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Rick Wilson

School: Kennedy Community School

Phone: 320-363-7791

E-mail: richard.wilson@isd742.org

Title of lesson: Pondwater Organism Investigation

Content area: Ecology

Grade level: 7

Learning objective: Students will find organisms in pond water and research them. They will take that information and create food chains and food webs from them.

Standard or benchmark addressed (include any inter-curricular connections):

7.4.2.2.3- Total amount of matter in an ecosystem remains constant

7.4.2.2.2- Roles and relationships between producers, consumers, and decomposers

Materials Needed: ice cream pails (pre made with holes drilled in the bottom, and lines attached to them {use cotton twine} to swing out into the water), lab sheet, pond water organism identification sheet

Description of lesson and how it is adapted for EOE:

Students will preview the lab, including looking at the organisms that are likely to be found in your area. Students will go out and spread themselves out in the appropriate area. They will throw their buckets in a responsible manner to try to collect organisms. They record the organisms found and the numbers of organisms found.

Students then research briefly, about those organisms and construct a food web from what organisms they have found.

Teacher's role (i.e. specific activities and instructional strategies):

Create the fishing buckets, model how to appropriately toss the buckets, learn how to tie a slip knot, structure the lab for success; pick a relatively warm day.

Other resources needed:

Bring a scissors/knife and extra twine. The students are going to get the buckets tangled. Its easier/faster/more efficient to cut the line and re-tie it, so students can get back to work. Keep the line to reuse later or cut up and leave for birds to use for their nests. (Be sure to explain to students that you are not littering, but allowing nature to reuse the material)

How students are assessed:

Students will be assessed based on their level of engagement. It is not guaranteed that students will catch anything. Even if so, it may be hard to build a food web from it. Students will have filled out their lab sheet, researched any organisms they DID find and constructed as much of a food web or food chain as they can.

Suggested enhancements or extensions:

Students can look to include surrounding ecosystems in their food web. Perhaps amphibious creatures can be included that interact with the pond water organisms.

You could also hold Pond Water Elections. Each student would select which of the organisms found (all organisms, not just the ones they were able to catch) would make the best president of the pond. When they make their choice, place them into their groups. They will then work together to craft a speech or debate points to present to the class.

Time considerations:

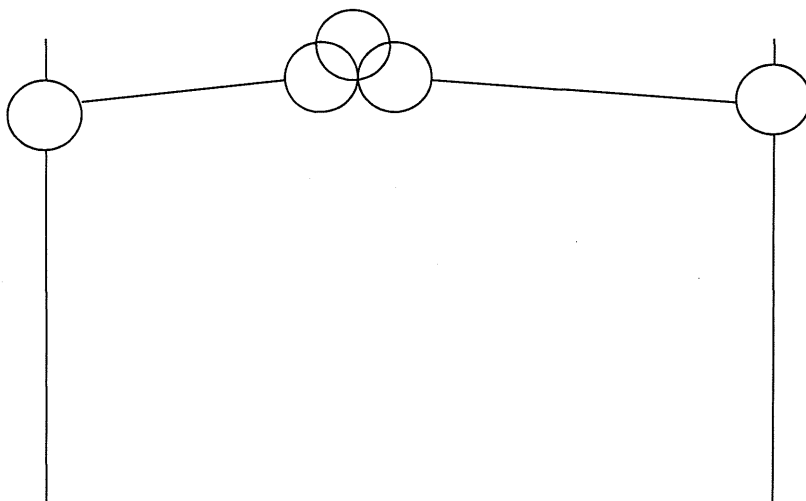
The instruction and fishing should take two class periods, depending on your group and your location. The research and food webs should take no more than one class period. If you choose an extension activity, obviously allow for extra time.

Bucket Construction
their wrist

Slip knot that goes around

(like a wii remote), so the
bucket stays)

Slip Knots



Use slip knots on each end of all of the lines

Drill 1/8" holes

It keeps everything tight and they are easily fixed if they come out.

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Kay Martin & Krishna Yuvaraj

School: _Simley High School

Phone: _651-306-7118

E-mail: yuvarajk@invergrove.k12.mn.us

Title of lesson: Identify organisms in the environment

Content area: Biology

Grade level: 11-12

Learning objective: Students will be able to identify natural ecosystems ranging from microscopic to macroscopic scales.

Standard or benchmark addressed (include any inter-curricular connections):

Natural systems include a variety of organisms that interact with one another in several ways.

Description of lesson and how it is adapted for EOE:

Students collected water samples from a local pond then identified the organisms both plant and animal within the samples under microscopes. Students identified trees in the same. Students' looked at how energy flowed through tropic levels in this area.

Teacher's role (i.e. specific activities and instructional strategies):

The teachers' role was very limited. We explained the days activities and expectations. Our role after that was to help where needed but this was primarily a student lead activity.

Other resources needed:

Waders, collection jars, micro/macro identification tables, tree identification tables, microscopes

How students are assessed:

Ability to follow directions, use of identification tables, use of microscopes

Suggested enhancements or extensions:

Better dichotomous keys would be good. Take water samples at various depths. Try this again in a different forest with different species.

Time considerations:

This took 2 days but could easily be extended to 4 days depending on size of the area and number of students.

Model Environmental and Outdoor Education Lesson Plan

Teacher name: Randy Bergman

School: Noble Academy

Phone: (763) 592-7706

E-mail: rbergman@nobleacademy.us

Title of lesson: Seeing The Woods from the Trees

Content area: Mathematics/Science

Grade level: 7

Learning objective: Students will be able to calculate the diameter, radius, and approximate height and the approximate density of trees in the Camden Neighborhood of North Minneapolis using perpendicular angles and formulas for a circle, area, volume, and density.

Standards or benchmarks addressed (include any inter-curricular connections):

MN Math Standards-2007

7.1.2.3 - Understand calculators and other computing technologies often truncate or round numbers.

7.1.2.5 - Use proportional reasoning to solve problems involving ratios in various contexts

7.2.1.1 - Understand that a relationship between two variables, x and y , is proportional if it can be expressed in the form $y/x = k$ or $y = kx$. Distinguish proportional relationships from other relationships, including inversely proportional relationships.

7.2.2.2 - Solve multi-step problems involving proportional relationships in numerous contexts.

7.2.2.3 - Use knowledge of proportions to assess the reasonableness of solutions.

7.2.4.1 - Represent relationships in various contexts with equations involving variables and positive and negative rational numbers. Use the properties of equality to solve for the value of a variable. Interpret the solution in the original context.

7.3.1.1 - Demonstrate an understanding of the proportional relationship between the diameter and circumference of a circle and that the unit rate (constant of proportionality) is. Calculate the circumference and area of circles and sectors of circles to solve problems in various contexts.

7.3.2.2 - Apply scale factors, length ratios and area ratios to determine side lengths and areas of similar geometric figures.

MN Science Standards-2009

6.2.1.1.1

Explain density, dissolving, compression, diffusion and thermal expansion using the particle model of matter.

7.4.3.2.3 - Recognize that variation exists in every population and describe how a variation can help or hinder an organism's ability to survive.

7.1.3.4.2 - Determine and use appropriate safety procedures, tools, measurements, graphs and mathematical analysis to describe and investigate natural and designed systems in a life science context.

8.2.1.1.2

Use physical properties to distinguish between metals and non-metals.

8.1.3.4.2 - Determine and use appropriate safety procedures, tools, measurements, graphs and mathematical analyses to describe and investigate natural and designed systems in Earth and physical science contexts.

Description of lesson and how it is adapted for EOE:

Students work in groups or 3-4 to measure the a) width, b) area density, and c) heights of four trees. To do this, students need to know the a) proportional relationships between circumference and diameter or how to use a caliper, b) measure the length and width of an area being measured by:

1. Marking five points along a line on the string
2. Laying another string perpendicular to the main string at each point to make four quadrants
3. Find the closest tree to the point measuring 4 inches across at 4 feet from the ground
4. Determine the width of the tree by dividing circumference by π or using calipers
5. Measure the distance in meters from the starting point to this tree and write it down
6. Repeat this method with three other trees in the other quarters for that point
7. Repeat again for the points created along the same line

8. Add together the distances from the four trees to the point and divide the distances by four to find the average distance of the trees to each point
9. Repeat this procedure for the remaining points
10. Add these average distances for all five points and divide by five to find the overall distance of the trees in meters
11. Multiply the average distance in meters by itself to find the average area each tree occupies
12. Divide 10,000meters squared by the average tree area to determine the tree density per hectare
13. Determine the height of each tree using its shadow by indirect measurement
14. Calculate the average height of the trees times the average diameter and multiple this by the density to find the approximate total space density occupied by trees in the cubic space
15. (optional) Draw a scale model of the area and compare/contrast it with the entire 1 or 10 kilometer satellite image using Google maps per urban tree density

Teacher's role (i.e. specific activities and instructional strategies):

The teacher models measuring techniques to the students. The teacher assigns students to cooperative learning groups with the following roles and responsibilities:

- A. Leader/Facilitator and Note-Taker—Is responsible for making sure every student does their part, laying the string around the area being measured for density, and for recording accurate measurements in the notebook.
- B. Measurer —Is responsible for measuring the circumference, width (if using calipers), and length of shadows as well as measuring the string for the area being measured.
- C. Calculator—Is responsible for calculating the width, distance, and height of trees using indirect measurement and expressing the values in meters and hectare.
- D. Scale Model Drawer/Organizer (optional role—see extensions)—Draws scale models of the outside and perceived inside of the trees being measured, shadows, as well as all large items in the four-quadrant area being measured.

Other resources needed:

- Outdoor Notebooks & Sharpened Pencils
- Metric Measuring Tapes
- String

- Sunshine
- Trees
- Calipers (optional)
- Calculator (optional)
- Google Maps (optional)

How students are assessed:

The teacher has a selected tree with fairly easy measurements that has been pre-calculated for an authentic assessment of student skill in finding the diameter, radius, and approximate density. Additional practice problems, quiz and unit assessment questions are given throughout the unit to assess understanding of math and science standards using the same or similar contextualized problems.

Suggested enhancements or extensions:

Math Extensions to Address Additional Standards:

-Make scale drawings and compare studied area(s) with other areas using Google maps

7.3.2.3 - Use proportions and ratios to solve problems involving scale drawings and conversions of measurement units.

-Make a circle comparison chart and/or graphs comparing the tree density to other landmarks/objects (houses, streets, lawn...)

7.4.2.1 - Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology.

Science Extensions to Address Additional Standards:

-Convert from Metric to English Units. Use scientific notation.

6.1.3.4.2 - Demonstrate the conversion of units within the International System of Units (SI, or metric) and estimate the magnitude of common objects and quantities using metric units.

-Write an persuasive essay using the data for increasing, maintaining, or decreasing the tree density in Minneapolis. Compare tree density in Minneapolis with St. Paul and/or other cities.

7.1.3.4.1 - Use maps, satellite images and other data sets to describe patterns and make predictions about natural systems in a life science context.

7.4.2.1.3 - Explain how the number of populations an ecosystem can support depends on the biotic resources available as well as abiotic factors such as amount of light and water, temperature range and soil composition.

-Explain why tree density is greater in one city or area than another. Use research and historic documents to validate claims.

7.4.4.1.2 - Describe ways that human activities can change the populations and communities in an ecosystem.

8.1.1.2.1 - Use logical reasoning and imagination to develop descriptions, explanations, predictions and models based on evidence.

Time considerations:

Demonstration of measuring techniques and using indirect measurement can be done before going outside and even the day before to build background. Students should have had prior knowledge of circle and density formulas before this activity. By using Calipers and Calculators the activity can be completed in a 50 minute session when students work in structured groups of three or four with clear roles and understanding of procedures. Having formulas readily available solved for different variables in student journals is an adaption that also increases student productivity time. In order for all students to complete the assessment additional time may be needed as well.

Appendix C - Environmental and Outdoor Education Advisory Committee

Ms. Janine Kohn
National Education
Specialist
Pheasants Forever, Inc.
and Quail Forever

Mr. Kim Kovich
Teacher, Science
Champlin Park High
School

Mr. Dan Bodette
Principal
School of Environmental
Studies

Mr. Dave Benke
Director, Prevention and
Assistance
Minnesota Pollution
Control Agency

Mr. Ryan Bronson
Conservation Manager
Federal Cartridge/ATK
Ammunitions Group

Mr. Mike Sodomka
Principal
Humboldt Senior High
School

Ms. Andrea Lorek Strauss
Extension Educator,
Environmental Science
U of M Extension,
Rochester

Dr. Mark Zmudy
Associate Professor
University of MN – Duluth

Mr. Tracy Fredin
Director
Center for Global EE
Hamline University

Ms. Becky Rennie
Teacher, Science
Perham High School

Ron Hustvedt
Social Studies Teacher
Salk Middle School

Ms. Lee Ann Landstrom
Director, Eastman Nature
Center
Three River Parks

Mr. Joe Cannella
Development Director
Minnesota Deer Hunters
Association

Ms. Molly Malecek
Assistant Director
Deep Portage
Conservation Reserve

Mr. Pete Cleary
Naturalist/Curriculum
Coordinator
Dodge Nature Center

Ms. Mikaela Kraemer
REI

Mr. Karl Kaufmann
Teacher, Science
Pillager High School

Mr. Vern Wagner
Anglers for Habitat

Mr. John Olson
Science Specialist
MDE

Mr. Jack Wachlarowicz
Teacher, Special
Education
White Bear Lake High
School, North Campus

Ms. Amy Markle
Minnesota Association for
Environmental Education

Ms. Dawn Flinn
Education Coordinator
DNR

Mr. Joshua Leonard
Education Director, Valley
Branch ELC

Ms. Kristen Poppleton
K-12 Education Program
Manager
Will Steger Foundation

Mr. Roland Sigurdson
MinnAqua Specialist
DNR

Ms. Laura Cina
Managing Director
Minnesota Renewable
Energy Society

Ms. Amy Kay Kerber
Forestry Education
DNR

Appendix D – Pilot Training Agenda

EOE Training Schedule – Camp Courage, Maple Lake, MN

Dec. 8-9, 2011 - Woodland Campus

12/7/11 – JL

Dec. 8	Activity	Leader	Outcome
8:30 am	Registration	Terry Alvarado	Name Tags, Cabin Assignments, reimbursements, Louv Book, journals and kits
9 am	Welcome, Introductions, Agenda, Project outcomes	Jeff Ledermann, Kim Kovich	Resource people (list), logistics (meeting room, parking, meals, bathrooms, outdoors – clothing, hiking), diversity, project overview (handout, expectations), expenses, CEUs, tables, history, Jeffers, meet each other
9:45 am	Standards Overview/Journaling	Charon Tierney, MDE Language Arts Specialist	Better understanding of standards, prepared to do journaling during training
10:45 am	Break		
11 am	Evaluation	Julie Ernst, UMD	Research background and expectations for evaluation during project
12:00 pm	Lunch - Outdoor Classroom Video?	Jeff Ledermann	With administrators (Jeff meets with administrators after lunch – reporting requirements, data needs, future stuff)
1 pm	Taking kids outside	Cara Rieckenberg, Prior Lake-Savage, Kim Kovich	Skills and helpful ideas to manage classrooms outside
2 pm	Project-based learning and inquiry	Doug Paulson, John Olson, MDE	Skills and understanding of how to apply projects to standards
3 pm	Break		
3:15 pm	Team planning time	With trainers/coaches	Team building activity (Patty R.), consensus on project goals
5 pm	Break		
5:30 pm	Dinner		
6:30 pm	Team time	With trainers/coaches	Identify alignment with standards, by content area
8 pm	Nature lesson		Lessons around the Campfire
9 pm	Recess		Journal Homework – One thing you will apply from today in your classes and one colleague that you will share resources with

Dec. 9	Activity	Leader	Outcome
7:30 am	Breakfast		
8 am	EE/OE Samplers, NAAEE Guidelines, MAEE, SEEK, copies of curricula on hand	Patty Selly	Knowledge of quality EE/OE, resources available
10 am	Break		
10:15 am	School Forest and PLT activity	Amy Kay Kerber	Future School Forest training options, 2 free PLT guides
11:30 am	Lunch	With community reps	
12:30 pm	Finding Community resources	Su Beran, Teams with coaches	Community mapping by school
1:30 pm	Team Time	Teams with coaches	Next steps, future training plans
2:45 pm	Evaluation/Wrap-up	Jeff Ledermann	EOE can be integrated into the standards, Expectations for rest of the EOE project, Evaluation Form
3 pm	Depart		

Appendix E – Regional EOE Workshops Flyer



Teachers and Administrators,

Do you and your students suffer from “Too Much Screen Time” or “Nature Deficit Disorder”?

The PRESCRIPTION is to take your kids outside!

Emerging research from across the country is showing that using the environment and the outdoors as an integrating context for learning results in higher student test scores and academic performance, more advanced critical thinking skills, greater achievement motivation and more responsible behavior by students in their school and community.



Join us for an Introduction to Integrating Environmental and Outdoor Education in Grades K-12: “Teaching Outside the Box”

One Day Regional Workshops for K-12 Teachers and Administrators

Cost: \$10/person

- Wednesday, July 11: Rochester – Cascade Meadow Wetlands & Environmental Science Center
- Tuesday, July 31: Collegeville – St. John’s Arboretum
- Monday, Aug. 13: St. Paul – St. Paul Parks and Recreation, Como Streetcar Station
- Saturday, Sept. 29: Sandstone – Audubon Center of the North Woods

Presented by the Minnesota Department of Education in partnership with our workshop hosts and supported by:



Minnesota's home of environmental education resources

Designed for school teachers and administrators from any content area that are NEW to integrating environmental and outdoor education into formal classrooms.

Delivered by environmental and outdoor education experts, participants in the workshops will:

- learn about the value and benefits of integrating environmental and outdoor education (EOE) into formal education programs
- learn how EOE can be integrated into multiple content areas and achieve academic standards
- build knowledge and skills to take kids outside
- receive hands-on training on quality EOE programs from state experts
- receive free EOE materials and resources, including a journal, outdoor exploration kit and membership in MAEE
- identify other resources and community partners near your school and begin plans to further support efforts to integrate EOE into your school
- receive clock hours certificates from Minnesota Department of Education

Participants will spend a large amount of time outside in varied terrain - dress appropriately for the weather conditions.

Workshops attendance is limited to a maximum of up to 60 attendees per workshop depending on space available at each site, so register soon!

Workshops will start with registration at 8 a.m. and end at 4 p.m. Lunch is included in your registration.

Please bring a copy of your classroom curriculum and a reusable water bottle (no disposables).

Appendix F – Regional Green Schools Workshop Flyer



Presents



Green Schools Workshops

Regional Workshops for K-12 Administrators, Staff, Teachers and anyone else interested in making schools more healthy, efficient, and effective.

Workshops will be held at Minnesota's 2012 Green Ribbon Schools National Award Winners:

- Monday, October 29: St. Joseph – Kennedy Community School
- Monday, November 5: West St. Paul – Garlough Environmental Magnet School
- Wednesday, November 28: Duluth – North Shore Community School

See first-hand the benefits of green schools and learn about resources available in the areas of green buildings and energy, health and safety and environmental education.

Cost: Free. Clock hour certificates available.



Presented by the Minnesota Department of Education in partnership with our workshop hosts and supported by:



Minnesota's home of environmental education resources



Designed for school teachers, administrators, school business officials, buildings and grounds staff, school board members, informal educators, environmental groups, parent and community volunteers, legislators and local officials and anyone else that has an interest in making their school more green.

Delivered by green school experts, participants in the workshops will:

- identify ideas, resources, mentors and support in their efforts to implement green school initiatives
- learn about the Green Ribbon Schools (GRS) program, including the benefits of green schools and the three pillars of the program:
 - Pillar One – Reduce environmental impacts and costs
 - Pillar Two – Improve the health and wellness of students and staff
 - Pillar Three – Provide effective environmental and sustainability education
- see Minnesota's 2012 Green Ribbon Schools National Winners and hear from staff and students

The following agenda is planned for each workshop:

- 3 p.m. – Registration and exhibits open
- 3:30 p.m. – Welcome and Overview of Green Schools – GRS process and pillars, hear from 2012 GRS national winners
- 4 p.m. – Break-out sessions and school tours
- 5 p.m. – Exhibits and networking
- 6 p.m. – The End

2012-13 Green Ribbon Schools Timeframe:

December 19 –Green Ribbon Schools application deadline

February 15 – MDE forwards nominations to U.S. Department of Education

April 22 – U.S. Department of Education announces awards

June 3 – Green Ribbon Schools Awards ceremony in Washington, DC