A Model for Science Learning

Calumet Environmental Education Program

CEEP successfully demonstrates how applying EE research to program design results in a positive impact on student achievement. Based on a systemic approach, CEEP integrates a rigorous, multi-year curriculum for students with content-rich teacher training, community and parent involvement and resource agency support. The longitudinal evaluation documents the level of dedication, long-term commitment and energy required of EE professionals, funders and all stakeholders if our programs are to truly make a difference in the lives of urban students.

Carol Fialkowski, Conservation Education Director, Field Museum (retired)

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A MODEL FOR SCIENCE LEARNING

The Calumet Environmental Education Program (CEEP) is a new model of conservation education that translates science into action for students and educators. Developed by The Field Museum's office of Environmental and Conservation Programs, CEEP began as a pilot project supporting teachers and students from Washington High School and its eight feeder elementary schools in the Calumet region of southeast Chicago. Through CEEP, students participate in a consecutive ladder of conservation education programs, linking and building process skills and content knowledge, grade level upon grade level.

The three year CEEP pilot project was initiated in 2002 with the expressed intention of evaluating this integrated environmental education model.

The Field Museum chose to pilot and test this model in the Calumet region largely because of the opportunities provided by the rich biological diversity of that region and the long- standing community tradition of environmental activism and conservation.

The Calumet region has been significantly environmentally challenged over the past several decades and has suffered the consequences of industrial pollution from former steel mills and municipal and industrial garbage dumps. Despite the challenges the area has faced, Calumet is also home to several hundred acres of forest preserves and recreational areas, a large lake and waterway system with rich ecosystems. Several

community environmental advocacy groups have worked to achieve major gains in the Calumet region, including the canceling of a landfill expansion project, the creation of the Marian Byrnes Natural Area and the upcoming opening of the Ford Calumet Environmental Center at Hegewisch Marsh. The natural biodiversity and the need for additional environmental improvements in the Calumet region, together with the existing infrastructure of organizations and leaders to implement these changes, made Calumet an attractive site for The Field Museum to launch its environmental education program.

See the Appendix for more information about Calumet.

CEEP PILOT OBJECTIVES

To reach the goal of achieving a practical model for sequenced environmental education The Field Museum focused in three areas:

A. Curriculum—Develop a consecutive, sequenced curriculum including in-class learning and fieldwork, and identify support networks to promote learning and skill development in students.

B. Teacher Training—Implement a new teacher training program connecting teachers from 4th–12th grades that focuses on ensuring that students are learning sequentially as they move through the CEEP program. Provide structure for teachers to share curricula and keep each other informed of student skill levels.

C. Evaluation—Evaluate the effectiveness of the CEEP program and measure its impact on students and teachers.

The CEEP model built upon the current Chicago Public Schools initiative to cultivate clusters of schools that work together to improve the effectiveness of education at every grade level. One significant advantage of having a common curriculum for a cluster of schools is that it makes it possible to provide common professional development for all the teachers in that cluster.

According to Juana Rivera Vidal, Principal, George Washington High School, students who participated in CEEP in elementary school, "got all these experiences and knowledge at the elementary school, and then when they came into our environmental program, they came in with a lot of knowledge and very enthusiastic...It brings a higher caliber of kids if they've been trained at the elementary level. You can do experiments that go to the next level in terms of analysis and comparisons, because all the higher level thinking skills have been developed at the elementary school."

In CEEP, subject matter students learn in their regular earth science, chemistry and biology classes was integrated into CEEP activities. Frequent field trips and hands-on experiences in local natural areas further supported the subject matter. Summer Institutes and Inquiry Group workshops enhanced teachers' environmental content knowledge, while giving them time to plan and integrate that content. During these workshops teachers practiced upcoming segments of CEEP curricula and networked with teachers from other grades and disciplines. Volunteers from local community groups like the Southeast Chicago Historical Society, Southeast Environmental Task Force, Chicago State University and their Calumet Environmental Resource Center offered a direct connection to priority conservation needs of the region.

Ladder to Environmental Knowledge and Action

	Mighty Acorns Grades 4–6	Earth Force Grades 6–8	UrbanWatch Grades 9–12
Skills	Observing Communicating Measuring Classifying Predicting	Observing Communicating Collecting Data Classifying Predicting Interpreting Data Hypothesizing Investigating	Observing Communicating Collecting Data Classifying Interpreting Data Hypothesizing Investigating Experimenting
Illinois Learning Standards	Science 11A, 12B, and 13B LA 4A	Science 11A, 12B, and 13B LA 4A	Science 11A, 12B, and 13B LA 4A

"Teacher isolation is known to be a challenge in education. Horizontal and vertical teaming, where teachers have the opportunity to discuss educational concerns within grade levels and between grade levels, is the ideal that we strive for. Unfortunately, this occurs infrequently, especially between high school teachers and elementary school teachers. CEEP has created a model for teaming to take place around rich environmental science content that has greatly enhanced teacher dialogue in participating Chicago public schools."

Nijole Mackevicius,
External Resources Coordinator,
CPS Office of Mathematics and Science

technology and build camaraderie between grade levels. As a culminating event, CEEP students and educators attended an annual **Calumet Stewardship Day** with hundreds of other students to learn about the local environment directly from experts through hands-on experiences.

ASSESSMENT OF THE PROGRAM

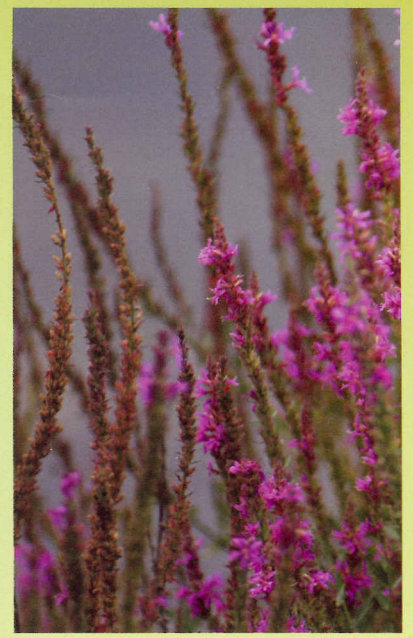
A comprehensive protocol was developed by TNI Consultants in Professional Development to measure CEEP's success in meeting its objectives. The assessment protocol was reviewed by an independent statistical consultant to verify that changes found in students and teachers participating in the program were a result of CEEP.

Assessment Protocol

The assessment protocol consisted of attitude and knowledge surveys given to students and teachers at the beginning (pre-test) and end (post-test) of the school year. This was done over three consecutive years to measure changes in attitudes towards the environment and gains in environmental and ecological knowledge[4]. Pre- and post-tests contained exactly the same questions. In addition, teachers were surveyed at the end of each year on their teaching style preferences and how they incorporated CEEP into their daily curricula. The surveys were specifically designed for students and teachers participating in the UrbanWatch, Earth Force and Mighty Acorns programs. A core group of 111 students participated in all three years of surveying. Additionally, a focus group of seven teachers was conducted in the spring of 2004 to identify program strengths, limitations and areas for improvement. In spring 2005, four

Oscar, a 5th grader, says, "Me and my dad go bike riding in Eggers Woods and I taught him about purple loosestrife and garlic mustard."

These two plants are examples of weeds that are invasive and are harming Calumet natural areas. See the photo below and on page 19 of purple loosestrife.



Sofia, a 7th grader, says, "I like putting the thermometer in soil. I didn't know it could change temperature and I didn't know that soil could be warm. I like testing water. We did this at Wolf Lake and found little worms and bugs in it."

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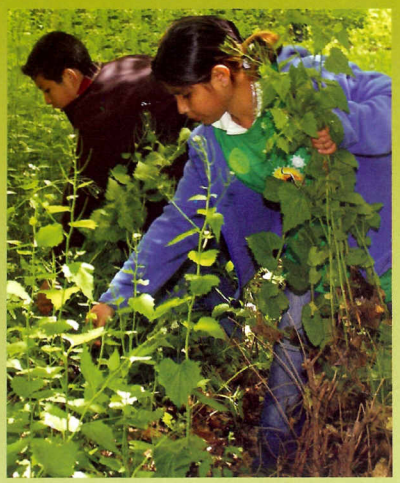

A 7th grade Earth Force student remarked, "Before I was careless, but since I learned this amazing stuff, I like to learn about the environment now. . . Before I didn't care or I ignored it, but now I wouldn't. . . the more people who help makes a difference."

student focus groups were conducted to determine knowledge gained and to identify how students use the information they are learning through CEEP. An important component of the focus groups was the exploration into whether or not students' attitudes had changed and whether or not they had taken any conservation action. Detailed results of the assessment are included on the accompanying CD.

Highlights of the assessment demonstrate the power of professional development and hands-on learning to effect change in both students and teachers. In urban school systems, the turnover of teachers and the movement of students among schools challenges those committed to sequential learning. According to Chicago Public Schools the mobility rate of teachers is approximately 30% annually and the 2005 mobility rate of students was 24%. The CEEP model succeeded despite the high mobility of administrators, teachers and students. The assessment showed that:

- Students and teachers in CEEP made statistically significant gains in knowledge about biodiversity, the local community and a number of specific environmental issues.
- Teachers participating in CEEP were able to compose teaching objectives specific to the environment focused on the goal of preparing students for further study about the environment.
- Teachers in CEEP reported feeling more confident about their knowledge of environmental issues and content.
- Teachers in CEEP coordinated with teachers at other grade levels to integrate the material.

Highlights of Student Results

According to post-surveys, students in the **Mighty Acorns** program showed a significant increase in their knowledge of the environment and were able to answer more survey questions correctly on post-tests than pre-tests. For example, students in the second level of Mighty Acorns were asked to "Write three items that plants and animals need to grow and reproduce." In the pre-test, about one third of students failed to give a single correct answer to this question. This dropped to 13% in the post-test. At the same time the percentage of students able to provide three correct answers to this question increased from 48% to 75%.

For the **Earth Force** students who were in the program for two years, the survey showed a higher percentage of correct answers to eleven of twelve questions. For example, students were asked to explain the importance of biodiversity, list two habitat types and their characteristics and showing two ways that fragmented habitats can be improved to protect biodiversity. On the pre-test only 24% of students could supply one or two correct answers to this question. This rose to 58% on the post-test.

Fifty-eight high school students participating in **UrbanWatch** took the surveys the first year, and 64 students took the surveys the second year. Because of this low number of participants, it was not possible to determine statistical significance of the program's impact on these students. However, in small focus groups, the students expressed their enthusiasm about their participation in UrbanWatch and said that the program provided a valuable learning experience. One UrbanWatch student talked about learning how to collect data in the field, "We gathered data on species diversity in the test area. We'd square off the areas and every ten meters we'd count the different types of species. Then we'd use equations to calculate diversity in the area...the whole experience made me want to learn about the environment."

Beyond the specific results shown by the surveys, principals and teachers have reported additional positive results. Dr. William Truesdale, Principal, Douglas Taylor School, said of the value of CEEP, "Students are working together cooperatively, higher order thinking skills and problem solving are being taught, and there's a payoff in our science fair projects. Kids are developing great science fair projects as a result."

According to Patrick MacMahon, Principal, Gallistel Language Academy, participating in CEEP also helped students improve their performance on standardized tests. Mr. MacMahon reports, "The 'hands-on' aspect of the CEEP program and its alignment with the Illinois Learning Standards has had a positive impact on our standardized test scores."

Marissa, a 6th grader in Earth Force, says, "I found the web of life interesting. . . . The circle of life affects every animal and plant. We took string and it was all connected. If one dropped theirs, it would affect the others. I learned how everything affects everything else. It was new to me; I didn't know that before."

Andres, a 6th grader, says, "In Earth Force I learned about plants – how they grow on forest floors, and I did a report about it. Earth Force is my favorite thing...I remember from 5th grade what I did in class and I say 'I know all this stuff.' I learned answers to questions in math on tests this year. Earth Force helps me to remember things I learned. It refreshes my memory."

An Urban Watch student said, "We made beetle traps so we could identify types of beetles in the area. We cored two trees to determine their age. We used a GPS to mark locations where we worked and mapped them. That way we can locate every species of tree and see how many there are. We learned to identify trees just by looking at the leaf. That was pretty cool."

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In 2005, 59.3% of Gallistel's students school-wide met or exceeded ISAT standards in science, up from 54.3% in 2004 and 46.5% in 2003. In 2005, 51.6% of 4th graders met or exceeded standards in science, up from 46% the previous year. Among 7th graders, the number was 67%, up from 61.3 % the previous year. Because not all students participated in the CEEP program, these improvements cannot be credited entirely to CEEP, but they do suggest the program's power to improve science knowledge.

Highlights of Teacher Results

According to the surveys, teachers participating in CEEP significantly increased their knowledge of local environmental issues and content, increased their inclusion of local biodiversity into their teaching objectives and report higher confidence levels when teaching about environmental subject matter. Responses to specific questions on the surveys significantly improved from the year one pre-test to year three post-test.

Knowledge Gains

- Teachers were asked to describe the importance of interdependence of plants and animals in an ecosystem. On the pre-test in year one of the program only 53% of teachers answered correctly. By the post-test at the end of the three-year pilot 94% of teachers correctly answered the question.
- The percentage of correct answers to the question, "Why is conservation of natural resources important in the Calumet area?" increased from 20% to 100% in year three of the program.
- Teachers' responses, when asked to give two examples of stewardship, rose from 13% correct answers in year one pre-test to 81% in year three post-test.
- After participating in CEEP's professional development workshops, teachers' ability to identify and explain a local invasive plant species improved from 7% on the pre-test to 94% on the post-test. When asked to do the same for invasive animal species the improvement was from 27% to 67%.

Teaching Objectives

- Teachers also reported integrating teaching about the environment across their curriculum. This increased from 25% in the year one pre-test to 56% in the year three post-test.
- From 2002 to 2005, the survey results also showed 42% change in the number of teachers who reported having students participate in nature observation.

"In grade school, I thought that science was boring and dull. I hated it. All I remember from science is reading the lesson and answering questions and then studying for a test. I was never a science person. But when I went to the [CEEP] summer training and field trips, science was enhanced – more hands-on. I look forward to teaching it to students."

A 4th and 5th grade CEEP teacher

- In the beginning of the program only 19% of teachers reported preparing students for further study about the environment. By the end of the third year in CEEP, 69% of teachers reported doing so.

Teacher Confidence

- At the end of the three years there was a 42% increase in agreement with the statement: "I am comfortable with my current level of knowledge about environmental issues." There was a 96% increase in agreement with the statement: "I am comfortable answering student questions about environmental issues in Calumet."
- There was a 79% decrease in the number of teachers who agreed with the statement: "Lack of knowledge makes it difficult to include content about nature or the environment in my teaching."
- Surveys showed a 52% rise in the number of teachers who reported increased comfort in developing classroom activities about the environment.
- The surveys showed an 18% increase in number of teachers who reported being comfortable collaborating with the teachers in grades higher than their own.[5]

Susan Real, a 4th grade teacher, comments, "The other 4th grade teacher and I work really well together. We both do Mighty Acorns. Last year, after we were done with one of the lessons, we did forms with animal tracks. We had tables set up out in the hallway and we had both classes out there. The kids made their own impressions of the tracks. We always know what the other grades are doing. The 7th graders are going to restore an area near the school this year and the 4th graders are going to raise butterflies to help them."