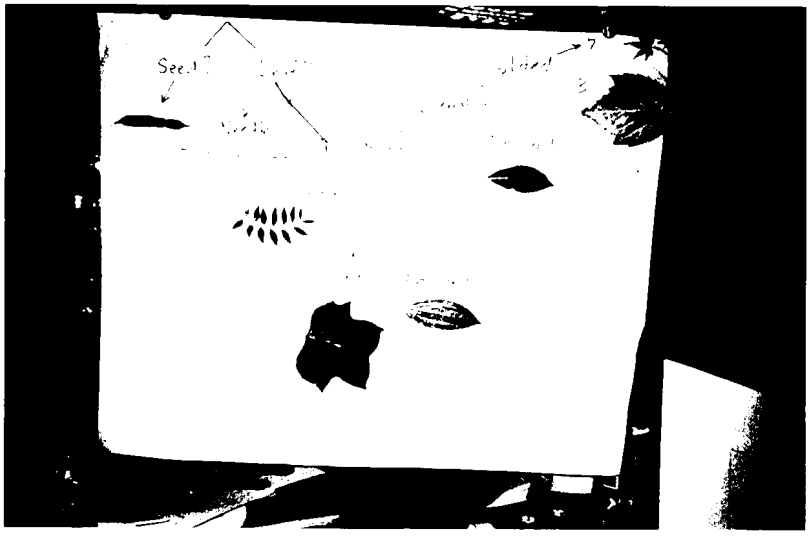
Innovative Ways of Integrating Global Change Education in K-12 Classrooms

• *Elena Sparrow*

Here in Alaska, we are breaking new ground in science education— by engaging K-12 students in global environmental change research, scaffolding their local studies with the knowledge and observations of Native elders and other community experts, and using standards-based science and math best practices to support the teaching and learning processes.

Our three-year project on "Global Change Education Using Western Science and Native Observations", recently funded by the National Science Foundation, has enabled us to start reaching students in urban Alaska and in rural Alaska, where there are more than 200 remote communities. To do this we first had to reach out to school teachers—by sending out flyers and application forms for the first two-week summer institute of the project, "Observing Locally, Connecting Globally" (OLCG) . We informed and invited teachers using regular mail, email, list-serves and phone calls.



Students classify leaves using a dichotomous key they designed.

We were gratified to have a tremendous response within Alaska, and from outside Alaska including Canada, Norway and Russia. This program had apparently attracted a lot of interest. A particular area of interest was the opportunity for students to participate in original research, in order to spark creative thinking using concrete simple observations, to work on scientific problems and conduct research on issues in their everyday lives. As one teacher remarked "Environmental studies, especially at the grassroots level, is a way to make science relevant to the students".

Another area of interest was the Global Learning and Observations to Benefit the Environment (GLOBE) program (*http://www.globe.gov*), a major component of the OLCG institute and the project. One teacher wanted to use GLOBE for teaching Earth Sciences, and another teacher to help students get science experience that is more than reading and doing simple experiments. "What I've seen of GLOBE is that it lets students act as scientists, performing activities that can be really used" (teacher application 2000). Others saw GLOBE as a way of involving students in long term environmental monitoring, learning more computer skills, posting data on the Internet and connecting globally.

Participants were also very interested in linking western science with Native knowledge and traditional science. One teacher fervently expressed "My students and their families have a great hunger for a connection to their Native culture that is not fulfilled because so much has been lost. Integrating Native knowledge in the classroom could be one step in trying to stem this loss." Another teacher saw the importance of combining western ways and Native ways of knowing as a means of gaining a richer and more diverse science base and a better way of integrating other subjects and content areas in the classroom.

Some teachers from rural areas with limited resources were looking for ways to enhance their

Middle School students determine dissolved oxygen levels in a local river.

science curriculum and expertise. Other teachers were interested in hands-on science methods and integrating science content, research and the Alaska standards for K-12 students. Others wanted more relevant ways to increase their students' environmental awareness and understanding of the global environment, and to integrate environmental studies in their curriculum.

We had a fairly rigorous application process for the program and teachers were asked to respond to questions about why they wanted to take part in the project and what they thought they could contribute to the project. Of the 18 teachers selected to participate in the program and in the first OLCG summer institute, four were high school teachers, eight were middle school teachers and six were elementary school teachers. Collectively, these teachers with diverse science backgrounds brought with them more than 90 years teaching experience, a keen interest in environmental studies and lots of enthusiasm for learning and teaching their students.

We had a fully packed schedule for the OLCG institute in order to cover the three main project components: 1) western science using research methods developed by the GLOBE program, 2) Native knowledge and observations, and 3) best science classroom teaching practices to enable teachers to engage their students in locally relevant environmental studies.

We jump-started the institute with a field trip on the Tanana River to Fox Farm, owned by Wes Alexander, the only five-time winner of the Yukon 800 Riverboat Marathon. The other expert Athabascan boat captains were Howard Luke—a well known and respected Native elder, who has lived nearby and earned a living off the river his whole life—and Sam Dimientieff, of the Demientieff Navigation family, who grew up delivering goods by boat and barges to communities on the Tanana, Yukon, Koyukuk, Iditarod and Innoko rivers. These Native experts regaled us with their personal experiences of living off the river and land, and enriched our understandings of earth as a system—the interconnections of water, soil, atmosphere and living things—all necessary in studying global change. As they skillfully piloted the boats on the river, they demonstrated how long-term, repeated careful observations and holistic/systems-thinking were critical not only to monitoring the environment, but also to navigation and survival.

Students take current, minimum and maximum daily temperature readings within one hour of solar noon.

Back in the classroom, we tried to put into practice the ideas of long-term observations and systems thinking as we started on the GLOBE protocols and learning activities. This was combined with input from Inupiat elder Jonas Ramoth and Koyukon elder Catherine Attla, and other community experts like Dixie Dayo and Mary Shields. For each of the GLOBE areas of investigation (Hydrology, Atmosphere/Climate, Soils, Land Cover/Biology, and Earth Systems) we covered, we used the format of Native knowledge followed by GLOBE protocols. We believe the coupling of knowledge and experience of Native elders and other community experts with science instruction and research investigations, enhances the cultural well-being, science skills and knowledge of students. This belief seems to be shared by both Native and non-Native teacher participants as exemplified by their comments: "I've always been interested in combining science and Inupiaq knowledge," and " I've been looking for more connections with my local experts and am thrilled to be basing it around student-generated research".

During the institute, we addressed underlying philosophical and pedagogical concerns with regard to culturally responsive science teaching— through assigned readings, discussions, and modeling. The assignments we gave to the participating teachers required integration of Native knowledge along with GLOBE protocols. One of the most useful references we used was the *Handbook on Culturally Responsive Science Curriculum* (Stephens 2000).

We discussed and modeled best classroom practices, such as:

- establishing a constructivist learning environ ment,
- teaching and assessing to standards,
- inquiry learning in science,
- learning cycle model, and
- teaching and assessing for diversity.

At the end of each day we asked teachers to write their understandings and concerns from the day's activities. We adjusted the schedule of the institute daily as we became aware of the participants' needs.

The teachers learned and practiced calibration of instruments and GLOBE research procedures. They learned how to measure current, maximum and minimum air temperature, amount of solid or liquid precipitation, pH of rain or snowfall, cloud cover and cloud type, water temperature, pH, transparency or cloudiness, conductivity, salinity (dissolved oxygen, and nitrate content optional), soil temperature, moisture, pH and bulk density.

They also learned how to characterize soils (by determining the number of soil horizons, texture, structure, consistence and pH in each horizon),

Students enter data on the GLOBE data server, which can be accessed at http:// www.globe.gov.

establish a qualitative land cover site, determine exact site locations using a Global Positioning System unit, classify land cover using the Modified UNESCO Classification (MUC) system, do biometry and manual land cover mapping, and gather plant phenology data at the start and end of the plant growing season.

Additionally, teachers learned to enter and visualize data through the Internet on the GLOBE server. During the institute the teachers formulated their own research questions and working in small groups, conducted an inquiry study on their land

cover/biology plots. During the final evaluation presentations, the teachers encapsulated and demonstrated in a presentation what they had learned during the institute. We thoroughly enjoyed the various well thought-out and prepared presentations employing "multiple intelligence" (Gardner 1983), which ranged from Powerpoint slide presentations, poems, Native dance and singing, and puppet shows, to lesson plans and learning activities that can be used in their classrooms.

Participants were given instrument kits and materials that their students could use in conducting their local environmental studies. When teachers returned to their classrooms, we continued to support them through emails, phone calls and some school visits. With the guidance of these teachers trained in GLOBE, Native integration and best science classroom practices, their students are involved in global change research and have started taking environmental measurements at or near their schools. They join hundreds of thousands of GLOBE students in more than 90 countries, who have reported data from millions of measurements.

These global data sets are freely available via the Internet to the world-wide science community and to schools for student inquiry, scientific research, student-scientist partnerships and world-wide school-to-school collaborations. Students recorded, in addition to data they have collected, their thoughts regarding their involvement in the program (what they learned and what they liked or disliked). One high school student who was not enthralled about his program involvement reflected that what he was learning would probably be useful to him for a job later in life and that he would appreciate them more at that point. Overall, students' comments have been mostly positive.

Teachers submitted their reflections on their implementation of various parts of the OLCG institute and the Global Change Education program into their classroom. Some teachers shared their frustrations with program implementation stemming from other school requirements—such as new standards in all subject areas and the lack of time to do them all, or from the delayed arrival of needed hydrology research supplies coupled with freeze-up of the lake being studied, or bears frequenting their study areas putting a halt to their measurements. Other teachers shared successes they termed "stunning" or "awesome"—such as students really listening to a Native elder and being able to relate what they had learned in class to the things the elder was talking about—resulting in discussions that sparked high school students' interest, who then began quizzing 5-8th graders about their science activities. Others described the elation of students upon seeing their school on the map and their data on the GLOBE server, and inquiry activities where their students were learning from their observations and each other, and then began asking each other questions and figuring out answers—putting together pieces of understanding which were growing into larger concepts and coming up with more questions. Another teacher talked about how Native knowledge, GLOBE methods and best classroom teacher practices combined in a Salmon Study Unit that kept students busy and interested.

We are very much encouraged and enthused from the first year's results, but have a lot more to learn as we continue working with our teachers and prepare to work with additional teachers and their students. For more information about the program, contact:

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Also, visit our web site at *www.olcg.uaf.edu.*

References

Gardner, Howard. 1983. *Frames of Mind.* New York. Basic Books.

Stephens, Sidney. 2000. *Handbook for Culturally Responsive Science Curriculum.* Alaska Science Consortium and Alaska Rural Systemic Initiative, Fairbanks, Alaska.