Schoolyard Inquiry for English Language Learners

ELL students learn life science concepts through outdoor inquiry activities

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This article presents outdoor inquiry activities to help English Language Learner (ELL) students learn life science concepts. As a public high school ELL science teacher, I use these place-based and scaffolded inquiry activities outside to reinforce concepts I teach in the classroom all year long. Through inductive outings, nature journaling, and multicultural gardening, my beginner and intermediate level ELLs gain science-inquiry skills and improve the language skills they need to succeed in an English-immersion public high school. These students also develop a sense of ownership and belonging as contributing members of our school community.

A growing population

The number of language minority students has more than doubled in U.S. schools in the past 15 years, increasing at seven times the rate of overall student enrollment (NCELA 2006). In 2007, we face statewide science assessments under No Child Left Behind. In our school, ELLs are required to pass three mainstream science classes and one standardized state science test before they can graduate. Clearly, ELL and science educators need to forge strong partnerships to ensure academic success for this growing population of students.

Challenges for secondary schools are even greater than primary schools because they have higher percentages of first-generation immigrants arriving with little formal schooling (Capps et al. 2005).With such limited backgrounds, even in their primary language, these ELL secondary school students appear to have more problems transitioning into new schools (Capps et al. 2005).

A synergistic relationship

Teaching Standard B of the National Science Education Standards calls for teaching inquiry and for teachers to "...recognize and respond to student diversity and encourage all students to participate fully in science learning"(NRC 1996, p. 32). But how do we teach inquiry if our students do not speak English?

The good news for science teachers with language minority students in their classrooms is that inquiry-based science employs many tried-and-true ELL instructional strategies. I was thrilled to discover this fact in a yearlong professional development course, "I Wonder," which I took two years ago at the Naturalist Center of the Smithsonian Museum of Natural History. [**Note**: For more information on "I Wonder" specifically, e-mail *natcentr@si.edu*.] Combining information learned from the I Wonder course with the methods already in my toolbox as a certified ELL educator (Figure 1), I was empowered to try inquiry-based science with my students.

Educators are questioning traditional approaches that maintain English proficiency is necessary before learning science. They argue instead that inquiry science and language acquisition have a synergistic relationship (Stoddart et al. 2002). Evidence that one domain enhances the other is growing (Amarah, Garrison, and Klentschy 2002; Fradd et al. 2002). Dobb maintains "There is a direct correspondence between the steps in the scientific process with its incremental demands for an ever expanding vocabulary and literacy skills and the levels of English proficiency" (2004, p. 15).

FIGURE 1

ELL and Inquiry-Based Science Learning Strategies for All Learners.

- *Hands-on*—Move away from the textbook to active experiences that use all senses and have personal meaning.
- *Risk-taking environment*—Establish a safe, positive classroom climate that eliminates fear of ridicule when students asking questions and making mistakes.
- *Scaffolding*—Proceed slowly along the continuum from directed inquiry to guided inquiry to full inquiry (Maata, Dobb, and Ostlund 2006). Use language appropriate to students' level and also slightly above.
- *Wait time*—Allow 15–20 seconds for quiet thinking about a question.
- *Variety of modes of communication*—Provide a rich variety of verbal, visual, behavioral, and graphic symbols to introduce new words and concepts.
- *Activate prior knowledge*—Attach personal experience to new information.
- *Collaborative learning*—Encourage teamwork among peers that is inclusive.
- *Problem-solving*—Move from rote memorization and drill to higher-order thinking with "quality questions" (Walsh and Saates 2005).

Place-based education

The Standards recognize the limits of the classroom environment for teaching inquiry. Teaching Standard D calls for using resources outside the school "...as a living laboratory… Whether the school is located in a densely populated urban area, a sprawling suburb, a small town, or a rural area, the environment can and should be used as a resource for science study" (NRC 1996, p. 45).

The outdoor activities' described in this article qualify as *place-based* education as described by Woodhouse and Knapp (2000) because they

(a) are experiential,
(b) provide content that is specific to the dynamics of the place,
(c) are multidisciplinary (science and language), and
(d) connect place with self and community.

Sobel reports "… this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens" (2004, p. 7).

In *Closing the Achievement Gap*, a study of K–12 students in 40 schools in 12 states with place-based programs, Lieberman and Hoody report significant gains not only in science, but also in language arts, social studies, and math (1998). Standardized test scores, grade-point averages, and problem-solving skills also improved. Among urban schools with diverse racial profiles, standardized test scores in science and reading increased when place-based education was used as the core educational strategy (Glenn 2000). For secondary school students, additional benefits of these programs include improvement in attendance, decrease in classroom discipline problems, and fewer suspensions (Sobel 2004).

Scaffolded inquiry

Scaffolding is the term used for the language routines that help ELLs acquire cognitive academic language proficiency (CALP). Research shows it usually takes five years to reach CALP, and as much as 7–10 years for students with limited prior schooling (Thomas and Collier 1995).

Scaffolded inquiry refers to the developmental stages students pass through when they acquire inquiry sci-

FIGURE 2

Scaffolded Inquiry in the Schoolyard.

Type of inquiry	Activity	Question	Science skills	Language skills
Directed	Inductive outing, nature journal	What is a living thing? Is the Sun a living thing? What questions do I have about this tree?	Observe, classify, predict, record	Speak, read, and write new words; ask and answer a question; write a question
Guided	Multicultural garden	What plants grow in my country? Can they also grow here? How do I find out? Will the Monarch arrive in Mexico?	Observe, classify, predict, gather data, measure, record, analyze, problem-solve	Communicate prior knowledge; write answers; read maps; research; construct chart
Full	ELL science fair	What question can I answer using scientific inquiry?	Scientific inquiry	Write report; oral presentation

ence skills (Maata, Dobb, and Ostlund 2006). The basic foundation is directed inquiry, where the teacher provides the question. Gradually, students gain more independence in generating and answering questions, moving from guided to full inquiry. Figure 2 presents a scaffolding scheme I developed for the inquiry activities in this article.

Inductive outings and nature journaling

Inductive outings

To incorporate place-based, scaffolded inquiry in our ELL program, we begin the first month of school with a series of walks on the school grounds. Hill and Flynn would classify these walks as *inductive outings*—teacher-directed activities designed as scaffolds for asking and answering questions using scientific inquiry (2006).

We carefully observe objects and, with the help of peers and bilingual dictionaries, we record new vocabulary. I ask the question "Is the Sun a living thing?" We then discuss how the Sun compares with living things (e.g., it does not reproduce) and I help students discover answers (e.g., no, it is not a living thing). In teams of three to four students that I have carefully selected based on level of language proficiency, students ask and answer the question for each object they record. The question, "Is it a living thing?" becomes more sophisticated as students investigate objects such as acorns, fallen maple leaves, dead tree branches, and soil.

I instruct students to use their senses of sight, touch, and smell (e.g., for lavender, rosemary, and spicebush) to fully experience the living things we find and to leave them the way they are—alive. I also make a point of showing and telling students to avoid the one poisonous plant growing on our school grounds—poison ivy—and teach the mnemonic "leaves of three, leave them be."

Back in the classroom, students create posters of living objects with labeled drawings or pictures in magazines. Teams present their posters using simple sentence structure such as "A tree is a living thing." Teams can divide the jobs of drawing, labeling, and speaking among students who feel confident in these skills (in the first month of the school year). I assess student work based on each member's contribution to the team poster (e.g., was English used to write on the poster, speak in the presentation, or provide examples of living things?)

Nature journaling

To scaffold nature journaling, I begin by teaching students the parts of a tree (from chloroplast to branch) and drawing techniques (Figure 3) in the classroom. After students experience how fun blind contour drawing can be, we progress to modified contour drawing where students can look back and forth between their paper and the object (Hobart 2005).

In October, students select a tree or plant outdoors to draw throughout the year. They record the date, place, time, and weather conditions, and label the object parts as their vocabulary increases. For each outing, students must write one question under their drawing. More important than assessment of artistic skill, spelling, or correct grammar is whether student questions reflect expanding science content and deepening observations, understandings, or curiosity.

FIGURE 3

Blind Contour Drawing.

Materials: Natural objects from home or schoolyard, pencil, paper.

Directions: Look at the object closely. Draw it without looking at your paper. Draw the outside shape, without taking your pencil off the paper. Use your eyes to draw every detail. No peeking at your paper!

FIGURE 4

Quality Questions.

Materials: 20 photographs of plants around the world.

Scenario and Questions: You work at a local garden shop. A big truck arrives with these live plants for you to sell. You don't know what they are. Your boss gives you two tables to put them on. How would you divide them?

A customer asks "Can you help me? I want to buy plants that can live outside in my backyard (in your state)." How do you divide the plants now?

What plants grow in your country that can also grow here? Why?

My formative evaluations of student journals over the year consider the degree to which drawings reflect increasing detail and to what extent lower-level questions such as "What is the name?" evolve into "Where is chlorophyll?" or "Is photosynthesis still taking place in the leaf in winter?"

Nature journaling helps young people develop a sense of their role in the place they live (Leslie and Roth 2000). Many of my students are observing leaves changing color and snow falling for the first time and they are grateful to be given the time to experience these natural wonders fully. Students are always eager to go outside to observe and draw, relieved of being assessed solely on their speaking, reading, and writing skills.

ELL Science Fair.

The science fair is a *full inquiry* project and the biggest challenge my students experience. Our goal is to move away from inquiry that I have directed or guided toward an activity where students decide how to investigate their own questions using scientific methods. They must demonstrate scientific inquiry and all four language skills (listening, speaking, reading, and writing). Most teams select subjects where inquiry has already worked for them—germination, photosynthesis, and growing conditions of plants. Teams prepare for five months, knowing a rubric in advance that will assess their work and that participation in the scientific process accounts for half of their grade.

Sadly, not all teams completed their projects last year. Fueled by the successes of previous years, I expected more and reached for the full inquiry level. Several teams gave up when their experiments "didn't work." I realize now I neglected to construct the quality questions they needed to take risks. I expected teamwork to reach full inquiry but I did not provide individual students with the extra scaffolding they needed to serve their teams well.

Multicultural garden

The multicultural garden is a guided-inquiry activity in which students build science literacy by seeking answers more independently. It begins in the winter and continues for the rest of the school year for about one class period every other week. As a warm-up, I ask students to tell me about the plants that grow in their birth countries. Even the most reticent speakers will find English words to describe sugar cane, guava, mangos, coffee, tamarind, eucalyptus, and the roses growing in their grandmother's garden.

Simple quality questions (Figure 4) begin the process of identifying plants students want to grow in our school garden. Each student selects a plant from their home county that can also grow in the schoolyard based on prior knowledge and independent research on climate, soil, and growing conditions. By spring, students have the skills to germinate their own seeds, having created a window garden (see "On the web" at the end of this article) of beans during the winter. I use a rubric to assess the quality of students' independent plant research and records kept in lab notebooks on their observations, descriptions, and drawings of plants over a one-month period.

Final garden design depends on plant availability. Growing in our school garden now are Mexican sunflowers, common sunflowers, corn, peppers, and beans from seeds students germinated. Chinese Elm, butterfly bush, apple tree, hosta, daisies, rosemary, and lavender have been donated or bought with money students raised. While meeting inquiry and language objectives, we have created a sense of community in our school. Though our garden is small (50 m^2), it is a space for highly visible activities that create enthusiasm among mainstream teachers, administrators, and local residents.

For example, in the past a chemistry teacher repaired the masonry garden wall so that seniors from the regular environmental science class could paint the wall with colorful flags from around the world. Special education students filled the birdfeeder with seeds their department purchased. Before we even asked, the maintenance staff offered to water the garden over the summer. When our project was the subject of an Earth Day article in the local newspaper, the Ruritan Club (a civic service organization) appeared at our doorstep with garden tools and financial support.

When we return to school in fall, the Mexican sunflowers are in full bloom attracting monarch butterflies. We discuss migration, the difference between "native" and "alien," and the importance of Mexican sunflowers to migrating butterflies. Last year, we participated in the electronically based Monarch Watch education outreach program (see "On the web") and tagged adult monarchs.

To our delight, a monarch that we tagged with number GJL139 was found in El Rosario, Mexico, in March. It had traveled 1,912 miles!

Regarding safety, I am very cautious about selecting students who will be responsible for working in the garden on an ongoing basis. I give careful instructions on how to handle and maintain hand tools, hoses, mulch and soil amending mixtures, and heavy items. I always reward responsible behavior with more opportunities to work in the garden. I am also fortunate to have the luxury of a teaching assistant which enables me to ensure that garden work is always carefully supervised. If a teaching assistant or intern is not available, it might be possible to recruit parents or other teachers to help supervise. Working with students in the garden is such an enjoyable experience, it is never difficult to recruit volunteers!

Partnerships

For both students and teachers, the inquiry approach feels risky in a classroom of ELLs. Place-based, scaffolded activities outdoors have provided my students with safe territory for exploring the world of asking and answering questions and engaging in the scientific process. Thanks to the "I Wonder" course I took with science teachers at the Smithsonian Naturalist Center, I found courage and ways to answer my question "How do I teach inquiry if my students don't speak English?" To learn the pedagogical strategies that promote learning a second language within science, teachers need professional training and a lot of support between science and language departments on a regular basis. These partnerships are imperative as the numbers of language minority students rise in our high-stakes high school environments.

The success of my students in regular science classrooms is still unfolding. Last year, all my ELLs passed their science classes but not all passed the standardized state tests. Very fortunately, our school system has added another year of sheltered science instruction. The extra year will give me more time to develop the quality questions I need to engage every single one of my students in full scientific inquiry. ■

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References

Amarah, O.M., L. Garrison, and M. Klentschy. 2002. Helping English learners increase achievement through inquiry-based science instruction. *Bilingual Research Journal* 26: 213–239.

Capps, R., M. Fix, J. Murray, J. Ost, J. Passel, and S. Herwontoro. 2005. *The new demography of American schools: Immigration and the No Child Left Behind Act.* Washington, DC: Urban Institute.

Dobb, F. 2004. *Essential elements of effective science instruction for English learners*. Los Angeles, CA: California Science Project Publication.

Fradd, S.H., O. Lee, F.X. Sutman, and M.K. Saxton. 2002. Materials development promoting science inquiry with English language learners: A case study. *Bilingual Research Journal* 25: 479–501.

Glenn, J.L. 2000. *Environment-based education: Creating high performance schools and students.* Washington, DC: The National Environment Education and Training Foundation.

Hill, J.D., and K.M. Flynn. 2006. *Classroom instruction that works with English language learners.* Alexandria, VA: Association for Supervision and Curriculum Development.

Hobart, A. 2005. Sketching in nature. *The Science Teacher* 72(1): 30–33.

Leslie, C.W., and C.E. Roth. 2000. *Keeping a nature journal: Discover a whole new way of seeing the world around you.* North Adams, MA: Storey Publishing.

Lieberman, G.A., and L.L. Hoody. 1998. *Closing the achievement gap: Using the environment as an integrating context for learning.* San Diego, CA: State Environment and Education Roundtable.

Maata, D., F. Dobb, and K. Ostlund. 2006. Strategies for teaching science to English learners. In *Science for English language learners,* eds. A. Fathman and D. Crowther, 37–59. Arlington: NSTA Press.

National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs (NCELA). 2006. How has the limited English proficient student population changed in recent years? *www.ncela.gwu.edu/expert/faq.*

National Research Council (NRC). 1996. *National science education standards.* Washington, DC: National Academy Press.

Sobel, D. 2004. *Place-based education: Connecting classrooms and communities.* Great Barrington, MA: The Orion Society.

Stoddart, T., A. Pinal, M. Latzke, and D. Canada. 2002. Integrating inquiry science and language development for English language learners. *Journal of Research in Science Teaching* 39(8): 664–687.

Thomas, W., and V. Collier. 1995. Language minority student achievement and program effectiveness. *California Association for Bilingual Education Newsletter* 17(5): 19–24.

Walsh, J.A., and B.D. Saates. 2005. *Quality questioning.* Thousand Oaks, CA: Corwin Press.

Woodhouse, J.L. and C.E. Knapp. 2000. *Place-based curriculum and instruction: Outdoor and environmental education approaches.* Charleston, WV: ERIC Clearinghouse on Rural Education and Small Schools.

On the web

Clare Walker Leslie's Guide to Sketching Trees: *www.lessonsforhope.org/pdf/Guide_to_Tree_Sketching_PDF.pdf*

Smithsonian Institution Naturalist Center: *www.mnh.si.edu/education/naturalistcenter.htm*

Monarch Watch: *www.monarchwatch.org*

Schoolyard Habitats: *www.nwf.org/schoolyardhabitats*

Window Gardens: *www.biology.duke.edu/cibl/exercises/window_gardens.htm*