Garden Mosaics

Students learn about cultural heritage and develop scientific investigation skills in a unique garden program

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Finding a way to make science relevant to students is one of the most challenging aspects of teaching. This is especially true for educators who work in urban settings where concepts such as biodiversity and ecosystems seem abstract and remote to students. Place-based learning, which uses students' neighborhoods as the focus for investigations and other forms of inquiry, can make science more tangible and interesting to youth.

In our city, Sacramento, California, natural areas for conducting outdoor science are distant from schools. To address this problem, educators use school and community gardens to teach students about the ecological and biological principles covered in the National Science Education Standards (see sidebar "Addressing the Standards," p. 48). School gardens—grown and maintained by teachers and students in the school—bring to life important scientific concepts, such as food webs of plants and insects, decomposition in a compost pile, and symbiotic relationships of microbes and plants on legume root nodules. Community gardens—areas in parks, retirement homes, apartment complexes, or even on school grounds, where neighbors in a community come together to grow food and learn from one another—offer an opportunity to place these biological lessons in a broader, often global context. Community gardens are often spaces where gardeners from different backgrounds and ethnicities cultivate a diversity of plants. By becoming involved in a community garden setting, students have the opportunity to meet older members of their community who have a wealth of gardening experience and learn about the rich cultural backgrounds that shape the elders' gardening practices.

Teachers at Grant Union High School in Sacramento use the *Garden of Ethnic American Treasures*—a community garden located on the school grounds—and resources from the Garden Mosaics program to teach science. Garden Mosaics, a program funded by the National Science Foundation, combines science learning with intergenerational mentoring, multicultural understanding, and community service. The program's mission is "connecting youth and elders to explore the mosaics of plants, people, and cultures in gardens, to learn about science, and to act together to enhance their community." The program resources include an interactive DVD for educators with live footage of students conducting the learning activities, a series of science fact and activity sheets, and a manual for educators. In addition to instructions for how to conduct the activities, the manual includes evaluation tips and assessment activities (see "On the web" for more information on the program and how to obtain the materials).

Inset opposite page: A student waters the plants at the Garden of Ethnic American Treasures in Sacramento, California. Photo taken by Mark Whitmore.

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i·m·science investigations

Students conducting the Garden Mosaics investigations develop interviewing, observation, and data-recording skills, and make important contributions to their community. Students share the results and photos of their investigations on the Garden Mosaics website, which is used for education and research by various individuals (discussed throughout this article). Because many of the investigations involve interacting with elder gardeners and other adults in the community, students also form positive relations with local role models.

The Garden Mosaics investigations are termed *i·m·science investigations* (see sidebar "Why the name *i·m·science*?" p. 46) and consist of four investigations—Gardener Story, Community Garden Inventory, Neighborhood Exploration, and Weed Watch. Although the investigations were designed primarily for youth programs conducted in cooperation with community gardens, they can be adapted to school gardening, environmental sciences, and other educational programs.

Gardener Story

The Gardener Story investigation gives students the opportunity to interview elders in their community. Using guiding questions, students ask gardeners about their plants, planting methods, pest management practices, soils, and how their cultural heritage influences their gardening. Students take photos and write stories about the gardeners, which are posted on the Garden Mosaics website. Visitors to the website can then enjoy the beautiful photos while learning about the diversity of gardeners and their practices.

In Sacramento, students interviewed Bay Vue, a gardener at the *Food for All* garden and a member of the Hmong community (many members of the Hmong community immigrated to the United States from Laos and Thailand). In the garden, over 200 Hmong families grow the same vegetables, flowers, and herbs that they grew in Laos and Thailand. One student said she had no idea before talking with Vue that Hmong families were farmers prior to immigrating to the United States. The student was in awe of how much food was grown in the small plots and didn't realize that gardeners possessed so much knowledge and experience.

Community Garden Inventory

The Community Garden Inventory investigation is a garden tour, during which students ask gardeners questions about crops and planting practices, and the social, cultural, and educational activities that take place in the garden. Students use a data form to record and send their findings to the Garden Mosaics website. The information collected by students will eventually be used by Garden Mosaics and the American Community Gardening Association to create an international database of community gardens. The information is also useful to website visitors wanting to learn more about the role gardens play in communities.

Before students conducted this investigation, they did not realize that in Sacramento alone there are 25 community gardens, 4 within their high school's neighborhood. In large cities such as New York, San Francisco, and Toronto, hundreds of community gardens exist, while smaller cities often have at least one community garden. All of these gardens are living laboratories where students can conduct research in a community context.

Students in Sacramento explored the *Food for All* garden, which contains long beans, bitter melon, mustard greens, Thai eggplants, cucumbers, basil, lemon grass, cilantro, chili peppers, corn, sorghum, and medicinal herbs. Students were amazed by the garden's beauty and productivity and equally impressed by the gardeners' hard work.

Neighborhood Exploration

Students can also conduct the Neighborhood Exploration investigation, during which they use aerial photographs, topographic maps, and a walk to learn about where in their neighborhood people can find places to enjoy nature, participate in cultural and social events, access fresh food, and get exercise. Students then produce a neighborhood collage using photos and maps, and share their results online.

Weed Watch

For the Weed Watch investigation, students gather data about the distribution of weeds in gardens. Consistent with the Garden Mosaics emphasis on science *and* people, the youth also ask the gardeners about their weed problems and how they control weeds. Students who conduct Weed Watch in urban vegetable gardens can submit their Weed Watch data to the Garden Mosaics website. Their efforts are helping Cornell University scientist Antonio DiTommaso learn more about urban weeds and develop a research program focusing on urban weed management. Students conducting Weed Watch also identify and measure plants, gain an understanding of plant competition and population dynamics, and learn that all weeds are not bad, and in fact many are edible.

Investigation tips

To ensure active learning during the *i·m·science* investigations, all students should have the opportunity to ask questions, listen, and record information. Students should be assigned roles such as recorder, photographer, and interviewer, and teachers should make sure that students review questions and practice mock interviews before conducting the investigations. Teachers should contact the garden coordinator or lead gardener to be sure he or she is aware of the goals of the program and will meet the teacher and students at the garden. As with any field trip, student safety must be teachers'

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A student from Grant Union High School participates in the Garden Mosaics program.

Why the name *i·m·science*?

The term *i·m·science* was chosen to describe the Garden Mosaics investigations because the term can be interpreted in three ways—it can mean *I Am Science*, *Information Mosaics*, or *International Mosaics*.

I Am Science refers to the belief that students and community members can contribute to science in important ways. Related to *Information Mosaics*, the small "i" has become a universal symbol for information and the "m" refers to the mosaics of plants, planting practices, people, and cultures in community and other gardens. Finally, *i·m·science* can also mean *International Mosaics* science. Garden Mosaics invites youth, gardeners, and volunteers from all over the world to share their knowledge of plants and growing practices and of the role gardens play in their communities.

FIGURE 1

Action Projects are designed by students and can be conducted on any number of topics.

Garden Research
Conduct a planting experiment, internet research, soil measurements, or observations in the garden.

Nutrition and Health
Host a garden banquet using foods from the garden, or a make a book of recipes from the gardeners.

Garden Enhancement
Plant flowers, construct interpretive signs, or build a wheelchair-accessible raised bed.

Food Systems
Celebrate the garden harvest, research aspects of the local food system, or create a neighborhood food map.

Art in the Garden
Make an art object with a gardening theme and present it to the gardeners at a gift-giving ceremony.

Land Use
Create a green map of your neighborhood, or talk to elected officials about the value of community gardens.

Garden Design
Design a new garden for your school or community center.

paramount concern, and teachers must supervise students at all times. It also is prudent to discuss the choice of gardeners students will interview with the garden coordinator. A class can conduct the Gardener Story and Community Garden Inventory as a one-time field trip to introduce students to the garden, or the gardener could be invited to the school to conduct the Gardener Story. The Neighborhood Exploration and Weed Watch can each be conducted over a two-to-three hour period, although it is ideal to repeat Weed Watch several times over the growing season.

Science Pages

Back in the classroom, the Grant Union High School students used the Garden Mosaics Science Pages to delve deeper into concepts and processes seen in the garden. The Science Pages, all of which are available on the Garden Mosaics website in English and Spanish, enabled students to learn more about specific crops, earthworms, insect life cycles, weed control, and other concepts that needed more time than the visit to the garden allowed. As part of a plant identification project, students used the Science Pages to research the

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Students in Garden Mosaics learn from elders about ethnic crops, such as Asian foot-long beans.

plants' scientific names, their native continent, and how they are grown and prepared for eating. Students learned what crops are genetically related to each other and were surprised by the fact that turnips, broccoli, collards, bok choy, and cabbage are all in the same genus. Students also used the "Conducting an Experiment" Science Page to begin a research project on soils, along with several soil Science Pages to learn about soil life, pH, and soil testing. Individual classes can also create their own science page about a plant or concept not yet included on the Garden Mosaics website.

Action Projects

To further connect to their community, students in Garden Mosaics conduct Action Projects, during which they apply what they learned during the investigations to a service-learning project (Figure 1, p. 47). One group in Sacramento conducted research that compared soil fertility in three gardens, while another group grew vegetables and donated them to a local food bank, and a third group worked with a landscape architect to design a garden that would teach youth about California native plants. A group from St. Paul, Minnesota, studied xylem and phloem, photosynthesis, and transpiration while creating a mosaic tabletop modeled after a stem cross-section. Students take photos and write stories about their Action Projects and post them on the Garden Mosaics website.

As the St. Paul group noted, there is so much "invisible science" that happens in gardens. It just takes a teacher to bring it into view. From all the Action Projects and other student data posted on the Garden Mosaics website, it becomes obvious that youth across the country are seeing the important role gardens play in their neighborhoods while at the same time learning to think like scientists. ■

Addressing the Standards.

The Garden Mosaics program addresses the following National Science Education Standards for levels 9–12:

Science as Inquiry

"Students develop the necessary skills to become independent inquirers about the natural world. Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments" (NRC 1996, p. 2).

Unifying Concepts and Processes

"Conceptual and procedural schemes unify science disciplines and provide students with powerful ideas to help them understand the natural world. Because of the underlying principles embodied in this standard, the understandings and abilities described here are repeated in the other content standards" (NRC 1996, p. 2).

Life Science

"Science subject matter focuses on the science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use" (NRC 1996, p. 3).

Science in Personal and Social Perspectives

"An important purpose of science education is to give students a means to understand and act on personal and social issues. The science in personal and social perspectives standards help students develop decision-making skills. Understandings associated with concepts (such as personal and community health, natural resources, and environmental quality) give students a foundation on which to base decisions they will face as citizens" (NRC 1996, p. 5).

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Reference

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

On the web

Information about obtaining copies of the Garden Mosaics interactive DVD for educators, program manual, color print Science Pages, and other resources is available online at *www.gardenmosaics.org*.