Community Connections For Science Education

VOLUME I

BUILDING SUCCESSFUL PARTNERSHIPS

By William C. Robertson

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About the Author

William C. Robertson is an assistant professor of physics turned curriculum developer who has a master's degree in physics and a Ph.D. in science education. He has numerous publications on issues ranging from conceptual understanding in physics to how to bring constructivism into the classroom. Bill has developed K–12 science curricula, teacher materials, and award-winning science kits for Biological Sciences Curriculum Study, The United States Space Foundation, The Wild Goose Company, and Edmark. He is currently a freelance science education writer, reviewer of science materials, and teacher of online math and physics at the university level.

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We would like to thank all of the formal and informal educators who contributed their time and valuable information to the making of this book. Their input made this effort possible.

National Science Education Standards Matrix

Science Teaching, Professional Development, Assessment, Program, and System Standards

Standard	A	B	C
Science Teaching	Plan inquiry-based science program for their students (p. 30).	Guide and facilitate learning (p. 32).	Engage in ongoing assessment of their teaching and of student learning (p. 37).
Professional Development	Requires learning essential science content through the perspectives and methods of inquiry (p. 59).	Requires integrating knowledge of science, learning, pedagogy, and students; it also requires applying that knowledge to science teaching (p. 62).	Requires building understanding and ability for lifelong learning (p. 68).
Assessment	Assessments must be consistent with the decisions they are designed to inform (p. 78).	Achievement and opportunity to learn science must be assessed (p. 79).	The technical quality of the data collected is well matched to the decisions and actions taken on the basis of their interpretation (p. 83).
Education Program	All elements of the K–12 science program must be consistent with the other *National Science Education Standards* and with one another and developed within and across grade levels to meet a clearly stated set of goals (p. 210).	The program of study in science for all students should be developmentally appropriate, interesting, and relevant to students' lives; emphasize student understanding through inquiry; and be connected with other school subjects (p. 212).	The science program should be coordinated with the mathematics program to enhance student use and understanding of mathematics in the study of science and to improve student understanding of mathematics (p. 214).
Education System	Policies that influence the practice of science education must be congruent with the program, teaching, professional development, assessment, and content standards while allowing for adaptation to local circumstances (p. 230).	Policies that influence science education should be coordinated within and across agencies, institutions, and organizations (p. 231).	Policies need to be sustained over sufficient time to provide the continuity necessary to bring about the changes required by the *Standards* (p. 231).

D	E	F	G
Design and manage learning environments that provide students with the time, space, and resources needed for learning science (p. 43).	Develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning (pp. 45–46).	Actively participate in the ongoing planning and development of the school science program (p. 51).	
Professional development programs for teachers of science must be coherent and integrated (p. 70).			
Assessment practices must be fair (p. 85).	The inferences made from assessments about student achievement and opportunity to learn must be sound (p. 86).		
The K–12 science program must give students access to appropriate and sufficient resources, including quality teachers, time, materials, and equipment, adequate and safe space, and the community (p. 218).	All students in the K–12 science program must have equitable access to opportunities to achieve the *National Science Education Standards* (p. 221).	Schools must work as communities that encourage, support, and sustain teachers as they implement an effective science program (p. 222).	
Policies must be supported with resources (p. 232).	Science education policies must be equitable (p. 232).	All policy instruments must be reviewed for possible unintended effects on the classroom practice of science education (p. 233).	Responsible individuals must take the opportunity afforded by the standards-based reform movement to achieve the new vision of science education portrayed in the *Standards* (p. 233).

National Research Council. 1996. National science education standards. Washington, D.C.: National Academy Press.

What's Out There?

Because you are reading this book, we are going to make the bold assumption that you're interested in creating, improving, or solidifying a formal-informal partnership in science education. In this chapter, you will discover the opportunities that exist nationwide and in your locale for creating new partnerships or adding to your partnership repertoire. As with all the chapters in this book, we will address the issue both from the perspective of the formal educator and from the perspective of the informal educator.

Informal Science Education Opportunities

If you live in or near a relatively large metropolitan area, there are numerous fairly obvious informal education sites available—science museums, natural history museums, planetariums, zoos, aquariums, and parks. But what if you live in a small town or are looking for new and unique sites to visit with your students? Well, there are endless opportunities in either case. Below is an incomplete list of possibilities.

- Visit the local water treatment plant for an enlightening, and mildly disgusting, peek into the science behind recycling your water supply.
- Contact the division of wildlife or the state game and fish commission to inquire about possible involvement of your students in animal tagging programs, fish stocking and breeding, or environmental cleanup.
- Any number of businesses in your area should be happy to have your students learn the science behind what they do. Try a recycling facility, food manufacturer, or computer chip manufacturer. In rural areas, a trip to a farm or ranch, accompanied by a qualified individual such as someone from the local department of agriculture or a cooperative university extension, could lead to an understanding of the science of crop rotation, soil conservation, or animal husbandry.
- For older students, amusement parks provide an entertaining look into the principles of physics. Just type "amusement park physics" into any Internet search engine, and you'll have more information than you can handle.

Students tour the industrial site at Avery Island to learn how biology, chemistry, and physics are used in the production and bottling of Tabasco.

- Many areas have after-school science enrichment programs. Although most of these are for-profit companies that require student fees; some, such as ASPIRA (described in detail below), provide their own funding.
- Educational foundations whose main purposes are to promote understanding and awareness of science sites through education. Examples are the Chesapeake Bay Foundation, the Living Classrooms Foundation, and the United States Space Foundation.
- Local radio and television stations. The students can explore science topics, from the functioning of broadcast equipment to meteorology to the clever way they make it look like the weatherperson has a map directly behind him or her.

Of course, this is only a partial list. For more ideas—or to investigate some of these sources further—check some of the web sites listed at the back of this book. Now for a more detailed look at the kinds of things offered by informal science education sites, we profile below the sites that have contributed time, energy, and advice to help create this book.

Students learn better through the practical, hands-on activities available in the informal education sites.

At this point, we should mention one thing about the sites we profile in this book. They range in size from the small to the large, but don't include super-large sites that you might find in large metropolitan areas. Such informal science education sites typically have education departments with quite a large staff and many, many projects that involve science education at all levels. Unless you're dealing with a site in its first year or two of operation, chances are that a very large site has already established many partnerships and connections with local school districts as well as companies and educational organizations nationwide.

The fact that these large sites most likely already have long-standing relationships with formal educators doesn't mean you can't take advantage of the opportunities they offer. Your best bet is to call the site and get in touch with the education department. Explain that you want to involve your students in science education experiences outside the classroom. After being directed to the proper person in the department, you should be in business. The right person might direct you to someone in your school district who is in charge of an existing partnership, or he or she might be able to get you going.

The ASPIRA Association

Students need interesting and challenging out-of-school experiences to enrich studies, pique curiosity, and provide motivation.

Formed in 1961, ASPIRA is a nationwide association whose goal is to develop the educational and leadership capacity of Hispanic youth. The organization takes its name from the Spanish verb *aspirar*, "to aspire." With a national office in Washington, D.C., and associate offices in New York, New Jersey, Pennsylvania, Illinois, Florida, Connecticut, and Puerto Rico, ASPIRA provides various educational, enrichment, and support services to Latino youth and their families in schools, community centers, and ASPIRA clubs. Associate offices either manage their own alternative schools or develop partnerships with schools, community organizations, businesses, community leaders, and parents. One of ASPIRA's programs is the Math and Science (MAS) Academy. Through this program, ASPIRA offers after-school enrichment activities during the school year and summer for middle school students. They have a series of weekly hands-on math and science sessions; career orientation; visits to scientific institutions; role modeling and interaction with minority scientists; and parent involvement in a family festival. The MAS Academy programs use the *National Science Education Standards* as a guide. ASPIRA supports its programs with the MAS Institute, which is a three-day training session for teachers that helps them implement the programs for students and parents and provides them with curriculum materials to help them meet the national standards in their classrooms.

The MAS Academy recruits teachers and students from other ASPIRA programs, from neighboring schools, and through word of mouth. All that is required to participate in the program is an interest in math and science. You don't often find an easier entrance requirement! ASPIRA's website is *www.aspira.org*. There, you can find locale-specific information on all of their programs. Cost-free after-school enrichment, coupled with teacher training and parent involvement, is a valuable resource.

Louisiana Public Broadcasting

Like most Public Broadcasting System (PBS) affiliates, Louisiana Public Broadcasting (LPB) offers links to the entire range of PBS productions and a full slate of instructional television programming for teachers, and others, to use free of charge. Unlike the other informal sites featured in this book, however, LPB does not seek to attract students to its site. LPB forms partnerships by helping teachers use its technical expertise in the areas of satellite-delivered courses, compressed video, streaming video, and broadcast. In addition, LPB collaborates with the Louisiana State Department of Education, Louisiana State University, the National Science Foundation, and the like, to apply for grants and implement projects that further science education in the state. Examples of the results of those collaborations include:

- SATELLITE SIX, a federally funded grant that delivered graduate-level content coursework for uncertified science and math teachers to help them towards certification.
- Dr. Dad's PH3, a 12-part series on CD-ROM designed to encourage girls to look at science as fun, interesting, and exciting.
- PBS Scienceline, a web-based resource for teachers that helps them understand and implement inquiry-based science teaching and other aspects of the *National Science Education Standards*.
- Enviro-Tacklebox™, a series of middle school video modules on environmental education that is based on the NSTA publication, *Decisions Based on Science*.

Most teachers just don't have the experience to write and submit grant applications. If an informal site can help with that process, then that's a significant help.

As an explicit part of their mission, LPB looks for grant opportunities and partners to help them meet their goals. You can find out more about their programs and contact them via their website at *www.lpb.org*.

The National Aquarium in Baltimore

This is one of the major public aquariums in North America. It is owned by the City of Baltimore and operated by a private, not-for-profit corporation, National Aquarium in Baltimore, Inc. There are two major buildings: the Main Aquarium and the Marine Mammal Pavilion. The Main Aquarium has four levels of galleries with exhibits ranging in size from 100 gallons (380 liters) to 10,000 gallons (37,800 liters), circling an open space with a 275,000-gallon (1,040,000-liter) pool full of rays, small sharks, and big bony fish. The building is topped by a 5,000 square foot (465 square meter) South American Rainforest and an Amazon River Forest exhibit, which show the diverse group of animals that live in the water among the trees during seasonal flooding. Other exhibits include the Western Atlantic Coral Reef (335,000 gallons/1,270,000 liters) and the Open Ocean/Sharks (225,000 gallons/852,000 liters). The Marine Mammal Pavilion houses a dolphin show stadium that presents dolphins with a conservation perspective. It also has museum-style exhibits on marine mammals and their adaptations, a children's discovery touch pool that allows hands-on experiences with marine invertebrates under the guidance of a trained staff member, and two formal classrooms for hands-on programs. During the school year, the Main Aquarium is the site of school programs that are keyed to the Maryland State Department of Education Science Content Standards and the Science Outcomes and Indicators, as well as the American Association for the Advancement of Science (AAAS) Benchmarks for Science Literacy. Schools that do not schedule a regular education program receive a package of pre-, during-, and post-visit materials keyed to the Maryland State Standards, Outcomes,

and Benchmarks, allowing teachers to use the aquarium more effectively.

Roughly 200,000 students, teachers, and chaperones visit the aquarium each year, with half of those coming from the state of Maryland. Most Maryland students attend free due to a grant from the Maryland State Department of Education. The students covered by this grant include public, private, and home-schooled children. The education staff at the aquarium works with teachers, schools, school districts, and state science supervisors. They have an Adopt-a-School program that provides intensive teacher in-service, outreach, and in-house programming to particular Baltimore schools (two at a time) for several years. Grants from foundations such as the Howard Hughes Medical Institute provide teacher in-service to the Baltimore City Public Schools, and aquarium staff have served on city school textbook adoption committees. Through grants from the National Science Foundation, the education staff has developed and disseminated an aquatic science curriculum, *Living in Water*, both regionally and nationally.

The National Aquarium in Baltimore makes a significant effort to reach schools and teachers through mailings and a presence at regional science meetings, but you can contact them directly via their Website at *www.aqua.org*.

Pocono Environmental Education Center

> The Standards for Professional Development require that teachers learn essential content through the perspectives and methods of inquiry; that teachers integrate knowledge of science, learning, pedagogy, and students, and that the knowledge of this be applied to science teaching; that understanding and ability for lifelong learning is built; and that the programs for teachers be coherent and integrated.
>
> —*National Science Education Standards (NRC 1996, 55–72)*

Located in the Delaware Water Gap National Park (DEWA), the Pocono Environmental Education Center (PEEC) advances environmental awareness, knowledge, and skills through education. PEEC's classroom is 100 thousand hectares of national park and proximal public land on the Pocono Plateau in rural Pike County, Pennsylvania. PEEC formed a partnership with the National Park Service in the early 1970s and continues as a member of the PARKS program. The programs that PEEC provides include the following:

- Hands-on natural science opportunities in a national park
- Professional development for teachers and instructors
- Residential environmental education program for schools, Scout groups, and families
- *Ecotones*, a quarterly science education newsletter for educators

- Acting as a local, national, and international clearinghouse for environmental education and programs
- A Toyota USA Foundation-sponsored Summer Leadership Institute for 20 of the nation's outstanding science teachers

PEEC uses an inquiry-based approach to science, in which students choose and conduct their own environmental research projects. The students use an extensive set of process skills, first to gather data, and then to analyze it with the guidance of a mentor.

With more than half a million participants in over 25 years, PEEC continues to offer year-round institutes and workshops, ranging in topics from bird watching to photography to nature study to environmental education. Their programs support not only the *National Science Education Standards,* but also state science standards for Pennsylvania, New York, and New Jersey. You can contact them at *www.peec.org* or by calling 570-828-2319.

Santa Monica Mountains National Recreation Area

Located in the Los Angeles and Ventura Counties, Santa Monica Mountains National Recreation Area (SAMO) provides a place for teachers to take students where they can engage in meaningful field science. SAMO has more than 50 miles of coastline and 580 miles of trails for hiking, mountain biking, and horseback riding. With its close proximity to Los Angeles and its many educational institutions, the area provides a good place for students and scientists to learn firsthand about urban-wildland interactions; ecosystems; plants and animals; and the effect of urban areas on water, air quality, and biodiversity. All of the recreation area's education programs are curriculum based and were developed with teachers. The goals of the education programs are:

- To introduce and motivate students to learn about the major themes of the Santa Monica Mountains National Recreation Area.
- To introduce students to the National Park Service mission of preservation and protection of natural and cultural resources.
- To meet the academic needs of students and educators in the Los Angeles and Ventura County school systems.
- To develop public support for the management of the National Park System and SAMO.
- To introduce students to the outdoors.
- To introduce students to career opportunities.

All of SAMO's science education programs are tied to the *National Science Education Standards* and the California Benchmarks in science, math, and other relevant subjects. Their science education programs include the following:

- The Chumash: A Changing People, Changing Land. This is a hands-on program for third- and fourth-grade students that explores biodiversity and the limits of natural resources through the question, "Could the Chumash people (early inhabitants of the area) live on the land today in the way they did for thousands of years?"
- Parks As Laboratories: Studies of the Land, Water, and Air. This program for sixth- through eighth-grade students targets primarily urban students who have little contact with natural settings such as SAMO. The students conduct "health exams" of park sites through water, soil, and air-quality measurements.
- National Park Labs: Studies of Wildland Fire Ecology. This is a program for ninth- and tenth-grade students that integrates scientific concepts across disciplines to learn about fire ecology and resource management. The students conduct hands-on field experiments, record data, and analyze the data.

For more than 10 years, SAMO has worked closely in partnership with the Los Angeles Unified School District. School district and park-based funding sustain park programs. Teacher workshops and training have been conducted with support from California Lutheran University and the University of California at Los Angeles. SAMO advertises its programs through mailings and other traditional outlets, but it specifically targets students in economically underserved areas. The SAMO website is *www.nps.gov/samo/*.

Shenandoah National Park

Shenandoah National Park sits along the Appalachian Trail and Skyline Drive in western Virginia. Its diverse ecosystem is a reservoir for the area's native plants and animals, and its watersheds preserve the area's water quality and scenic values. Known publicly for its outdoor recreational opportunities, the park used a grant from the Parks As Classrooms initiative to develop an educational program starting in 1991. The park has programs for students in grades K through 12 that are tied to the Virginia Standards of Learning and the *National Science Education Standards*. Shenandoah produces a semiannual education program newsletter that reaches more than 500 local educators, providing program updates, ideas and resources, and evaluation results. The park also provides programs and workshops for university and adult audiences, in cooperation with James Madison University College of Education and College of Integrated Science and Technology.

Shenandoah has a work group entirely dedicated to education programs, which works with teachers and other partners to develop appropriate and relevant curriculum-based programs. The park holds four to six teacher workshops each year to provide participants with guidance and instruction on implementing the park's programs.

Shenandoah National Park has established a particularly strong partnership with McGaheysville Elementary School. All 500 of the school's students attend a park

program during the year, and the school hosts an open house that showcases what the students have learned with the park throughout the year.

You can contact the park through their website at *www.nps.gov/shen/* or by calling 540-999-3500.

Formal Science Education Opportunities

To someone in charge of education at an informal education site, it might seem funny to think that certain kinds of formal educators represent "opportunities." After all, there are lots and lots of teachers, schools, and students out there to attract to your site. Well, for starters, let's just take a look at why you want to get *any* formal educators to your site.

The most obvious reason is that reaching out to formal educators is an easy way to further the science education of your local community, however large you consider that community to be. If the mission of your site isn't all about furthering science education, then you wouldn't be reading this book!

A second reason to reach out to formal educators is that it will probably increase attendance at your site from the general public. Students who have a good experience are likely to bring their families back for a second or third visit. Also, when word gets out that you're doing good things for schools, the community as a whole is more likely to patronize your valuable establishment.

A third reason is to promote any educational items you sell to keep your site afloat. These can be curriculum materials intended for the classroom or retail items you have in your gift shop or on your website. Students who have done a cool hands-on activity as part of a field trip are likely to pick up a science kit that contains that activity and others. Remember, if you think it crass to introduce commercialism into this venture, consider that if your site doesn't meet the bottom line, you won't be furthering *anyone's* understanding of science.

Now, in the first paragraph of this section, we mentioned that *certain* formal educators represented opportunities. Just as it is possible for a teacher to make a bad choice of a site for a field trip, it is also possible for a site to make a bad choice in forming a partnership with a teacher. The word *partnership* is key here. We're talking about a long-standing relationship—be it with a teacher, school, or district—that results in visits that are predictable, stable, and reliable. In other words, no unpleasant surprises. Your goal is to educate the community, not see how stressed out you can make you and your staff. We'll have specific recommendations for how to choose formal educators in a later chapter. For now, we'll provide profiles of formal educators who have formed successful partnerships with informal sites and whom we'll hear from later.

Andrea Bowden, Supervisor, Office of Science, Mathematics and Health Education, Baltimore City Public Schools

Andrea R. Bowden is Supervisor K–12 of the Office of Science, Mathematics and Health Education for the Baltimore City Public School System (BCPSS). During her 32 years with BCPSS, she has served in several capacities as a central office administrator and as a science teacher in five high schools. She coordinates curriculum production, assessment, professional development, instructional support, special programs, and environmental programs. Additionally, she manages major federal grant initiatives such as National Science Foundation Teacher Enhancement in Mathematics, Safe and Drug Free Schools, and AIDS-HIV Education; and state-funded grant initiatives such as Eisenhower Professional Development, Service Learning, and Environmental Education. She has directed the NSF-funded summer SANDALS program at the College of Notre Dame of Maryland to prepare students for careers in science, mathematics and technology. Dr. Bowden has also taught graduate courses for Johns Hopkins University.

Dr. Bowden was the first Maryland recipient of the Presidential Award for Excellence in Science Teaching in 1983. Among her other awards are Outstanding Science Supervisor in Maryland and the Bene Merenti (for good works) Medal from the College of Notre Dame of Maryland. She has served in leadership capacities in a number of professional organizations at the state and national level, including president of both the Maryland Association of Science Teachers and Biology Teachers, District III Director of NSTA and chair of the National Science Teachers Regional Convention in Baltimore in November 2000. Dr. Bowden has been a member of many boards, including those of the National Aquarium and the Maryland Science Center. Recently the Chesapeake Bay Foundation named her the Outstanding Environmental Educator of the Year 2000.

David W. Burchfield, Ed.D., Principal, McGaheysville Elementary School

David Burchfield has served as a principal of McGaheysville Elementary for seven years. Prior to becoming an administrator, he served as a first- and second-grade teacher, and administered an early childhood grant in Albemarle County, Virginia. He earned his doctorate in administration and supervision from the Curry School at the University of Virginia. David has served as an educational consultant and led workshops dealing with early childhood and elementary instructional practices, and for the past four years has been an instructor in Ohio at Muskingum College's "Educating Children Summer Training Institute." He has published articles and chapters on developmentally appropriate practices, and his classroom was featured on a NAEYC/NCREL video, "Developmentally Appropriate First Grade: A Community of Learners." He lives with his wife Bonnie and three daughters in Massanutten, Virginia, and can be reached at *dburchfield@rockingham.k12.va.us*.

Sheila Hodges, Science Teacher, Delaware Valley High School

Sheila Hodges is a science teacher at Delaware Valley High School in Pike County in Northeastern Pennsylvania. The area is considered rural with a major urban influence due to its proximity to New York City. Sheila teaches biology and environmental science to students at the high school level, and is also the advisor of the Delaware Valley High School Environmental Club. Sheila was previously employed as an environmental specialist for a private engineering firm and as an archeologist. Hodges has both a BS and an MS in biology. She was voted the 1997 Conservation Educator of the Year and was the recipient of the 1999 Northeast Pennsylvania Environmental Partnership Award. Hodges and the Environmental Club received this award for their outstanding accomplishments and teamwork in achieving excellence in environmental protection through partnerships with the school, the community, and local businesses.

Sheila is also a Penn State Master Gardener and, as such, has volunteered over 180 hours of community work in the past year. DVHS Environmental Club members work with other Master Gardeners to clean up and restore various estates in the Delaware Water Gap National Recreation Area. Hodges has received her sixth consecutive grant in the past five years. The monies received are being used to purchase water quality equipment to aid in the research of local streams and lakes. Another grant was used to obtain a state of the art weather system monitored by local TV stations.

Henry Ortiz, Environmental Field Science Education Specialist, Los Angeles Unified School District

Henry Ortiz works as one of several science advisors for the Los Angeles Unified School District. He coordinates most of the K–12 environmental education programs in that district. These programs include: Field Science Training for Teachers, The GLOBE program (Henry is the Los Angeles GLOBE program franchise coordinator), National Parks Studies In Wildland Fire Ecology, The Parks As Laboratories Program, Trout in the Classroom, The Temescal Canyon Field Science Program, The Yosemite and Eastern Sierra Teacher Institutes, and the Fort MacArthur Marine Science Program. Henry has a Biological Sciences background and he has taught at the high school and middle school levels. He is a science trainer for the GLOBE program and has trained teachers in Spanish and English in national and international trainings. He is also a trainer for the University of Hawaii's Fluid Earth/ Living Ocean oceanography and marine biology programs and for the UCLA Leadership In Marine Science (LIMS) and Science Standards with Integrated Marine Science (SSWIMS) programs. Henry serves on several committees, including the California Environmental Education Advisory Committee. One of his main goals is to ensure that every student in his school district is provided with an opportunity to participate in an environmental education program at one point throughout his or her academic journey.

Faimon Roberts, Assistant Director for Science, Louisiana State Systemic Initiatives Program

Faimon Roberts taught middle school science and mathematics for 22 years before becoming the Assistant Director for Science with the Louisiana Systemic Initiatives Program (LaSIP). He has been the National Science Teachers Association District VII Director, Past-President of the National Middle Level Science Teachers Association, and the current treasurer and a Past-President of the Louisiana Science Teachers Association and president of the Louisiana Association of Science Leaders. Mr. Roberts directs the science professional development and leadership programs for LaSIP. During 1992–2000, he administered 123 science professional development projects (for $15.6 million) that have provided long-term professional development to over 4,700 teachers. He is also the lead person in the Developing Educational Excellence and Proficiencies (DEEP) in Science effort to provide science leaders to assist schools and districts in their efforts to increase student achievement.