Eisenhower Southwest Consortium for the Improvement of Mathematics and Science Teaching

Classroom Compass

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HIGHLIGHTS

Learning without Walls

> *Rick picked up an oyster shell from the sand and held it out to the crab. The crab reached out with its pincher and snapped—really crumbled—that shell. The shell could have been made of chalk. I was stunned by the force of that pinch.*
>
> Janet Lawrence
> Tahlequah, Oklahoma,
> high school science teacher

No matter how often you read about a natural force like the power of a crab's pinchers, experiencing it in action expands your understanding. Knowing that crabs catch their prey with pinchers is one thing, but watching a crab break the shell of a food source provides a memorable learning experience.

In February 1999 a group of educators gathered on the Texas Gulf Coast to broaden their understanding not only of the natural world but also of teaching about that world and helping students experience it. These teachers and principals came from the Mississippi Delta, the high plains of Oklahoma, the deserts of New Mexico, and Texas cities; they were taking part in a field experience sponsored by the Eisenhower Southwest Consortium for the Improvement of Science and Mathematics Teaching (SCIMAST).

Each year, teachers, project directors, and others connected with the 13 SCIMAST Professional Development Award (PDA) projects attend a Winter Meeting designed to encourage networking for across-project sharing so PDA leaders and their principals can develop better understanding of professional development.

For the 1999 meeting, the PDA participants wanted to focus on strategies for developing useful field experiences. SCIMAST staff wanted to explore how to use field work to extend classroom learning and build communities of learners. Capturing the qualities of a successful field experience by experiencing and reflecting on one together was the best approach to meeting all of our goals.

We met at Port Aransas, Texas, the site of the Marine Science Institute of the University of Texas and the home of one of the PDA projects. Located on a barrier island off of the Texas Coastal Bend, the site offers opportunities to study bays, the Gulf of Mexico, tidal flats, and shifting dunes. Yet to most of the participants, the Texas coast provided a novel environment for learning, one they knew little about and that differed from their home environments. Would this learning be useful to educators after they returned home? Would what they learned on the Texas coast be relevant to their teaching lives? The planners of this experience did everything they could think of to be sure the answers to these questions would be yes.

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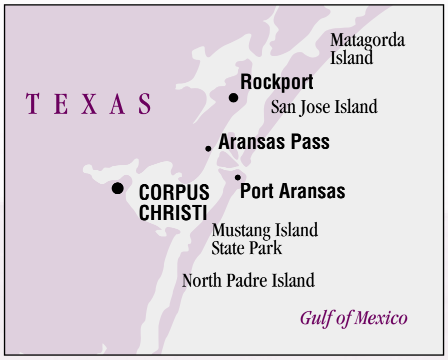

Planning

One higher education faculty member connected with a PDA site in Louisiana pointed out that "planning is the most important thing for making a field trip come off." Planning for this February meeting began in September. It involved coordinating between the SCIMAST staff and the director of the Marine Science PDA project. Activities had to flow from one to the other in a logical order; time had to be set aside for participants to think about what they had seen and relate it to their previous learning. Participants needed the opportunity to work with a range of colleagues.

Setting a field experience within the learning goals of a class is one of the most important things a teacher does when taking children for out-of-class learning. A successful field experience is never a last minute add-on to a class schedule but is always an integral part of class content.

For the SCIMAST staff the challenge of planning was to help the participants to focus on the broad environmental learning and to see how they could take this learning home with them. To do this we needed an overarching theme that would help the participants focus on what was to be learned.

Setting the Context and Expectations

As the overarching theme of the meeting, SCIMAST staff introduced the concept of a system and modeled a way to investigate the structures that support adaptation in birds and, by extension, other creatures. The participants developed their own definitions of the idea of a system and referred to these throughout the several days of the field experience (see activities, pp. 6-7). The first few activities shaped common experiences for participants as they learned about the physical setting, what kinds of organisms they would see, and what concepts they would use.

To make expectations clear, on the first morning SCIMAST gave each participant a general description of the assessment task they would perform at the end of the week, along with criteria and an evaluation rubric. At the end of the meeting the participants would have to show themselves and others what they had learned. The staff made sure that we highlighted the natural relationships that would be important. With this information, the participants knew what to focus on as they went about their work.

Brainstorming and reflection on their own experiences helped participants to sharpen their own ideas of what a field trip should be like. They then captured those ideas in a checklist and used it during the week as a check to see if their work was meeting their own expectations. (See pp. 4-5 for this list.)

The first experience to heighten the participants' awareness of what a field trip is really like was their change in role from teacher to student. "Right away, we began to experience and identify with our students' zones of discomfort. There were a lot of things out there I didn't want to touch," one teacher said. The wind blew in from the ocean, sand flew into their faces, and most of them were wet and chilled each day. Still, from the first moment their curiosity kicked in. Even after the boat trip was over and they had left the beach, they continued to talk about the discoveries they had made.

"The experience made you grow and made you a better observer," a teacher pointed out, "not to mention making you a little braver because you finally understood more about that particular environment." "I know I became a better observer," said an Oklahoma teacher. "On the beach there was what looked like a lot of old twine spread all over. I just ignored it and went looking for the interesting stuff. Then Rick [director of the Marine Institute PDA project] told us that the 'twine' was the center core of a soft coral. That really opened my eyes and made me pay attention. After that I saw more things on the ground and in the sky than I had before."

Experiencing, Observing, and Recording

Participants divided into two groups; one set out for the bay in a small ship, the RV *Katy,* while the other group combed the beaches and landward sides of the dunes at the Padre Island National Seashore. Later in the week the two groups switched so all participants had a chance to work in both environments.

First, participants had to figure out what they were seeing. On the *Katy,* they used field scopes and more complicated devices, such as a microscope connected to a television monitor, to identify material collected from the bay by seines and dredges. Occasionally, though, no one—not even the Marine Institute staff—could identify what they had caught: "That was one reason the boat was such a good experience. We saw in concrete ways that everyone is learning all the time. We could go inside the cabin and look at things on the monitor and use the reference books that were stored there. Even more important we could talk to the staff people and to each other and work out our ideas about what these creatures were and what they did."

On the Padre Island beach, participants learned to use "normal stuff" as instruments for exploring. A piece of PVC pipe, marked off in increments, helped to establish the elevation of the beach. Participants used a measuring tape to measure distances and, then, with the horizon as a level, used the pipe to establish elevation. Careful field notes enabled them to develop a profile of the beach, dunes, and landward side.

"No one said to us, 'This is the way things are some place else,'" one teacher said. The learning was based on what could be seen, heard, touched in the immediate environment. "We only focused

on what was there. We were forced to focus on what was under our feet and immediately around us."

This field experience not only emphasized the immediate area around the participants but also brought home the concept of the ecosystem. On the morning of the third day, participants went as one group to the Lydia Ann Lighthouse. In the past, this lighthouse had guided ships from the Gulf of Mexico into Matagorda Bay. Now the old structure is several miles from the existing channel. From atop the building, the participants could see how the bay, the marshes, the dunes, and the landward side of the dunes all came together to form one large system. "We could see how each part survived independently but also depended on the other parts."

"One thing that really stuck with me," a teacher reported, "was seeing a huge ship go out of the channel [two miles away]." As the ship left the channel, it pushed tons of water ahead of it out to sea. After the ship had passed, water from surrounding creeks and other tributaries tried to fill the channel up again, but then, as the ship moved on out to sea, the sea water would rush back in. Eventually, the channel looked as full of water as it had ever been—and it was. "That whole process helped me remember that the system will keep trying to come to equilibrium and that all the parts contribute to each other."

Reflecting

Many field experiences lack time for reflection, even though learners must mull over the raw data they collect if they are to reach an understanding. During the Port Aransas meeting, a variety of reflection activities continued throughout the meeting.

The project-generated checklists were ongoing reflection tools. As the experience unfolded, participants could consult the list to see if the steps they had outlined were being met. They could also compare their experiences with those of others using the checklist as a common frame.

A different kind of reflection was the simulation of a town meeting, which gave the participants the opportunity to apply concrete information in a situation that resembled events of daily life. As one of the cumulating events at the end of the week, this simulation helped participants engage in a process requiring thought about how they would apply their observations and learning (see more complete description of the activity on pp. 6-7).

Assessing

On the last day of the meeting, the participants presented fifteen-minute illustrations of the process and components, inputs and outputs of the barrier island ecosystem. Groups presented their findings in skits or dramatizations. Whether presented as interpretative dance or mock television reporting, the models displayed the participants' understanding of the systems involved in the creation and preservation of the barrier islands.

Using a rubric of five traits, each with four criteria, participants considered how well each skit or dramatization portrayed an understanding of the Texas barrier island ecosystem. Since everyone had a copy of the traits and their accompanying criteria, the learning targets had been clear to all participants from the beginning of the field work. Participants used the rubrics as guides for self-assessment during the field work and to assess presentations on the last day. The presentations were concrete experiences that helped the whole group discuss performance assessment.

No matter what their ages, all learners need to connect field work to classroom learning, and assessment is a good means for helping them to see the connections. If learners keep the two separate, understanding gained in school may be harder to put into practice and the world outside the classroom may remain distinct from the science and mathematics taught there.

Putting the Learning into Practice

After returning to her classroom one Oklahoma teacher reports that, since the Port Aransas trip, she has focused more on her immediate locale for teaching students science. "In the past I tended to ignore the ground around us. Now I ask the students how many flowers they see in the vacant lot next door. When they tell me they see three or four, we go over there and get down on the ground and really look. They are astounded at how many

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flowers there really are in such a small space. We had not really been looking at what was around us."

"It's amazing really how many students have never even picked up a crawdad. Some have never even seen one because they don't really look around them. Schools don't help them learn how to look around them, at what is in their immediate world." This Oklahoma teacher said that her experiences in Port Aransas "opened my eyes and helped me open their eyes and change the students' idea of what makes up the environment." After she put into practice some of the ideas developed during the Gulf Coast experience, she found that her students not only noticed more in classroom field trips but also voluntarily brought in items they discovered on their own—unusual bugs, strange plants, interesting rocks. Her experiences on the Texas coast had been relevant to her teaching life in Oklahoma far from the sea.

Field Experience Checklist

As part of their reflection, the Winter Meeting participants created a master list of steps and considerations for creating useful and exciting field experiences. The following synthesizes the participants' lists and shows some of the connections with the SCIMAST-sponsored work.

Planning

Before going into the field, students need to understand the concepts underlying the experience. The site should be chosen to help students realize the relevance of their class work to field work. The teacher will pay close attention to the many details that ensure a safe and inclusive learning environment. Students also need an age-appropriate grounding in the topic and understanding of the objectives of the experience.

Issues around curriculum and instruction

- ✓ The goals of the field experience are clearly articulated.
- ✓ Ascertain the prior understandings of the students.
- ✓ Students understand the materials and instruments that will be used in the field. Let them "play" with the items to learn how to use them before they need to take important field readings.
- ✓ Students understand what is expected of them and how their learning in the field will be evaluated in the classroom. To accomplish this goal, students may need to see the actual assessment task and rubrics that will be used during or at the end of the project.
- ✓ If a field journal is required, students need to know what expectations the teacher has for it and how it fits into their evaluation.

Other details of planning

- ✓ Decide how students should work—individually, in self-selected groups, in assigned groups. Students working in groups will benefit if different learning and working styles are found in each group.
- ✓ Logistics must be clear: transportation, food, water, and safety concerns should be anticipated and answered. How many adults and drivers will be needed?
- ✓ What kinds of permissions, parental and administrative, are needed?
- ✓ Guides or docents at the site need to understand not only the subject matter but also how children learn. Examples of class work by the students will help them understand the level of the class.
- ✓ Safety requirements of the site have to be clearly explained.
- ✓ Do some students have special learning needs? Will some require extra help in the field? Are special education students included in this trip? Will other classes be invited to go along?

SCIMAST field experience.

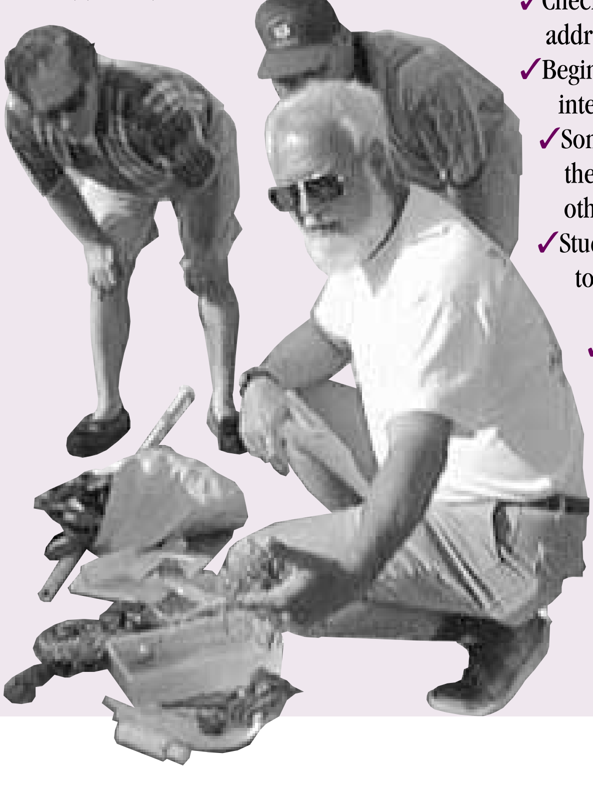
Much of what would have happened earlier in class had to occur on the first day of the Port Aransas meeting: some basic understandings of the area and the types of observations to be expected were established. Since the participants were all knowledgeable teachers and principals, conceptual information could be presented briefly. They did need to learn how to use some of the instruments—field scopes, the PVC surveying equipment. SCIMAST staff had assumed that participants would know how to use compasses, but some pointed out to us that they could have benefited from time playing with the instruments to refamiliarize themselves.

The SCIMAST staff made a special point of making sure the objectives of the meeting and the means of assessing learning were clearly articulated for all participants. The staff also devoted time to ensuring the work groups came together and split in such ways that each participant had time to be exposed to many different viewpoints and could check back with a stable group to share new learning.

At the site

Once the class is at the site, other considerations come into play, but the teacher remains focused on ensuring that the students have the time and access to increase their understanding of the topic. Connections between curriculum and field observations will be strengthened in the field.

- ✓ All students have the opportunity to make meaningful observations.
- ✓ Record data in many ways—written notes and, where possible, tape recorder, videos, still photography, and collected artifacts and specimens.
- ✓ Stick to a pre-arranged schedule as much as possible but remain adaptable and ready for the serendipitous.
- ✓ Make sure equipment and materials are available, useful, and understandable.
- ✓ Provide opportunities for hands-on, active, and open-ended learning.
- ✓ Make sure knowledgeable people and other sources are accessible to the students.
- ✓ Do not be afraid to give occasional small lectures if they will advance student learning.
- ✓ Leave time for questioning and exploring.
- ✓ Make sure objectives have been addressed.



SCIMAST field experience. The work in the bay and on the beaches was hands-on with the objective of stimulating observations and reflection. Participants handled creatures and materials pulled up from the bottom of the ocean and walked the shoreline noting what had been left there and reflecting on the meaning of this material for the ecosystem.

The knowledgeable staff of the Marine Institute was always available to the Winter Meeting participants. Frequently, these marine scientists stopped exploring to explain a fine point to the whole group. SCIMAST staff recorded the experience with still photos, video camera, and written notes. Participants took written notes and were encouraged to use any other methods they could. Many of them carefully collected specimens to take back to their classes.

Back in the Classroom

Returning to school should resemble a field scientist's return to the laboratory. The project is not over; it has merely entered a new phase—one that involves experimenting, reflection, and discussion. While assessing may have been ongoing in the field, more formal assessments occur in the classroom.

- ✓ Check to see if objectives were addressed.
- ✓ Begin student analysis and interpretation of the data.
- ✓ Some general discussion will help the entire class learn from others' experiences and observations.
- ✓ Student learning should be allowed to branch off into other relevant areas.
- ✓ Incorporate field experience into subsequent curriculum and apply it to other subjects and situations.

- ✓ Make sure the rest of the school knows about the field experience and offer to work with other teachers.
- ✓ Arrange for assessment, evaluation, and closure.
- ✓ Show relation of this experience to future class work.
- ✓ Ask students to suggest improvements for next year's field work.
- ✓ Reflect on your ongoing assessment of the whole experience. How can you make the experience better next time?
- ✓ Set aside time for students to write thank-you notes to parents who drove or accompanied the class, guides, docents, and any other people involved with the field trip.

SCIMAST field experience. The participants could not return to the classroom as a group, but they did analyze and interpret their observations both in the field and later in work groups. Reflection and discussion were scheduled into the agenda and the learning was applied in the simulated town meeting. The participants discussed the ways their learning would affect their teaching and the conduct of their classrooms, how professional development would be affected by this experience, and how they could share what they had experienced with teachers in their home sites.

Activities

In the four days of the Winter Meeting, SCIMAST staff presented several activities to frame the participants' field experiences. The following summaries show how a few of these activities could be reworked for students of all ages. They could be used to introduce students to the field work or to help them sum up their observations.

Since the participants in the Winter Meeting have been coming together twice a year for at least three years, they know each other well. Even so they had not constructed a common understanding of the material to be studied. The first task SCIMAST staff faced was to offer ways to help the participants build shared assumptions about systems.

Describing a System

In the Winter Meeting. In small groups of three or four, the participants were given envelopes with the names of the general parts of a system (input, output, feedback mechanisms, components, subsystems) and the name of a specific system (circulation, transportation, legislative, school, hospital, McDonalds). The task for each small group then was to show how the specific system they received illustrated the general parts common to all systems.

The participants described the system they received on chart paper and then discussed it among the groups. At the end of the discussion each participant wrote an operational definition of a system. This definition was to be refined throughout the four days. In discussions the definitions were referred to and reworked until the last day.

In the Classroom. Even young students can recognize some parts of a system, although they may not have the vocabulary to name or describe those parts. Concepts introduced in class may need to be discussed again so students can rethink their understanding of systems. This activity may help students who have already been introduced to the concepts to think more deeply about them in relation to systems and the natural world.

Most students will need names of familiar systems. While it may stretch the thinking of adults and older students to discuss legislative and respiratory systems together, younger students may be confused if the teacher has not explained earlier how the systems resemble each other. In some cases the teacher may need to be very explicit in eliciting the similarities among the systems and helping children think about their commonalties.

Build a Bird

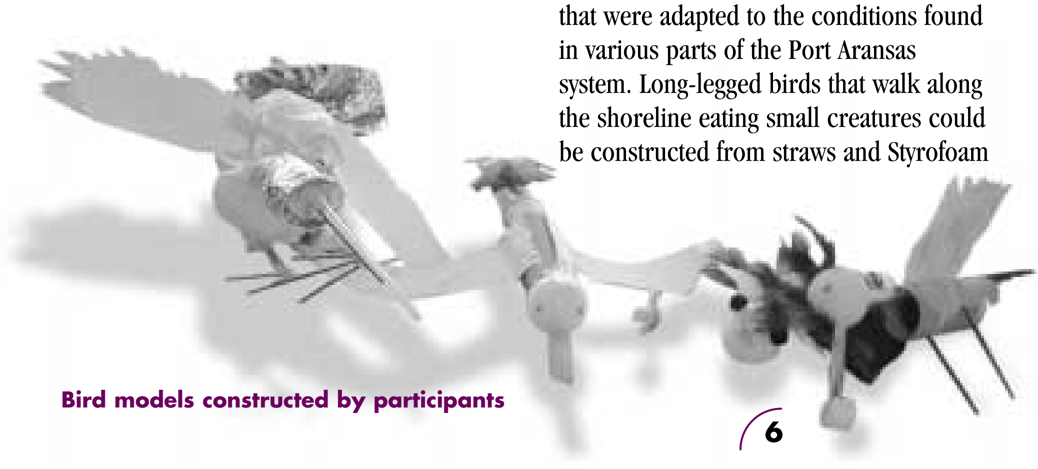
Marine Science Institute staff introduced the PDAs to the characteristics of the barrier island ecosystem and its resident species through maps, slides, and general descriptions. The participants then began to work on constructing models of birds that were adapted to the conditions found in various parts of the Port Aransas system. Long-legged birds that walk along the shoreline eating small creatures could be constructed from straws and Styrofoam bodies. Beaks could be fashioned from macaroni shells. Other items available in the array of materials—feathers, construction paper, beads, sequins, and any other items that appealed to their interests—could be used to form the entire bird.

The exercise gave participants an opportunity to demonstrate their understanding of how creatures' physical adaptations conform to environmental needs. Discussions, not only with the whole group but also during the creation of the models, showed shared depth of understanding. Participants worked out how structure and function were related in birds' anatomy and indicated that they knew, for example, that wading birds would need long legs and that the shape of its bill governs what a bird eats. Using these understandings they built workable models of, often fanciful, birds.

In the classroom. Students may be tempted to focus on the inventiveness of their creations, but conversations will reveal the quality of their thinking about habitat and adaptation. Moving from group to group while students are constructing their birds will help the teacher understand their thinking. Students can also explain their constructions to the whole group in presentations that become, in essence, performance assessments.

The Town Meeting Simulation

Based on an activity developed by Project Wild (see "To Zone or not to Zone" in the second edition of *Project Wild: K–12 Activity Guide;* available from Project Wild at 707 Conservation Lane, Suite 305, Gaithersburg, MD 20878), the Town Meeting simulation gave participants an opportunity to reflect on their observations and apply them in a realistic context. Participants would see that changing part of a system affects not only that system but also other systems and their interconnections. The exercise also made clear that all systems, both those created by humans and by nature, are interconnected. The simulation can be reworked for almost any age group. The role-playing aspects make it equally interesting for adults and younger children.



Bird models constructed by participants

A simulation such as this one could be the culmination of many different field trips. Students could debate planned changes in roads around a site, proposals to make an area into a park or to remove it from the park system, the creation of a nature preserve, delisting an animal or plant as an endangered species, or similar subjects connected with their field experience. Ways to adjust this simulation for school use will be discussed alongside descriptions of how it played out in the Winter Meeting rather than separately.

Introducing the Issues

Periodically, people in this part of Texas suggest that a channel should be reopened to connect Corpus Christi Bay to the Gulf of Mexico. Tourism businesses, fishing enthusiasts, and real estate interests support creating a channel. Many ecologists oppose the channel, as do those who worry about safety during a big hurricane, fiscal conservatives and taxpayer groups, and tourism businesspeople in smaller towns who fear that a channel would draw visitors to Corpus Christi and away from them.

While this activity may appear to be best suited to older students, it can be altered for children of all ages. As part of their introduction to the field experience, older students could identify and research the political, economic, and social issues of the site. The time devoted to research and presentation, the level of sophistication of the arguments, and the depth of detail presented will all be functions of the students' ages. Age-appropriate introductions will help young students deal with complex issues within this context. Children could use a simulation as an introduction to the topic rather than a summing up. A short simulation with different parts for each child might usefully introduce youngsters to broader concepts involved in their field trip.

Preparing to Debate

For the Town Meeting simulation, SCIMAST staff prepared extensive descriptions of the issues connected with the proposed Packery Channel and developed a stable of personalities to argue for each side. Supporters and opponents of the channel were more or less even in number. Participants were to argue before a mock city council made up of other participants.

Each participant was randomly assigned a character in the controversy as part of the information packet. If students develop their own materials, they may want to develop their own characters. Alternatively, the teacher may expect them, like debate team members, to be able to support any point of view.

Some participants were cast as members of the city council, one as the mayor who presided over the meeting. In a classroom, these roles could be randomly assigned like the others or could be voted on from the class. After the role players have presented all sides of the controversy, the city council members and mayor vote on the project.

In the SCIMAST simulation participants were given 15 minutes to read their information on the channel controversy and 15 minutes to caucus in "for" and "against" groups. Students, of course, could take much longer working to find their own information and forming advocacy groups within the class. Preparing information on all sides of issues could be part of their pre-visit work or could be an assignment when they return to class from the field.

Even with very little time to prepare, the participants presented various positions fairly by drawing on what they had learned in the previous days. In a school, cooperation with the civics teacher or debate coach at this stage could make the field experience interdisciplinary.

Simulation as an Assessment

The simulation is an opportunity for student reflection. As individuals and in their groups they need to rethink what they have learned and what meaning it has for them. If it is presented after the field trip, the simulation can also be an assessment. As an assessment, it allows each student to display his or her learning from the field and understanding of the broader social and political issues connected with the environment. Students should be aware of what will be expected of them both before and during the field experience so they can be gathering their thoughts in an organized manner with the simulation as a goal.

The complexity of this activity can deepen for older students. Students may chose to present position papers and oral arguments as part of the simulation and as part of the assessment of their learning. Each student could prepare a portfolio of his or her own position paper and the research that lead up to it, observations made at the site, prepatory work that lead up to the field trip, or other evidence of learning. The final vote could also be included in all portfolios along with individual discussions of those results.

Closure

After the simulation was over, SCIMAST presented the participants with several prompts for discussion and reflection:

- How much of the debate on the Packery Channel actually focused on environmental issues?
- What role did economics and politics play in the debate?
- How can people learn to balance conflicting principles?
- How can we educate students to make good decisions in these types of situations?
- What happens when you have conflicting scientific data? How do you decide whom to believe? How do you establish priorities?

In a classroom setting these questions could become the basis of essays or classroom debates. One or more could form the core of an assessment protocol, perhaps as questions the teacher could use to organize feedback to the students.

Copies of the original town meeting activity are available. These copies are more extensive than the presentation here and include supporting materials developed by the SCIMAST staff. If you would like a copy, please contact
<mpowell@sedl.org>
or write
Classroom Compass,
Southwest Educational
Development Laboratory,
211 E. Seventh St.,
Austin TX 78701-3281.

Standards

The standards in both science and mathematics encourage connecting school work with experiences outside the classroom. The 1999 SCIMAST Winter Meeting emphasized science concepts more than mathematical. Mathematics, however, could have been the focus of the experience: The measurements of the beach could have been taken back to a classroom for comparison and charting. Creatures and plants sampled from the water could have been weighed and measured and these measurements could have been used to develop theories about the conditions in various parts of the ecosystem.

The following excerpts show how the standards connect classroom and field experiences.

National Research Council (1996). *National Science Education Standards.* Washington, DC: National Academy Press.

p. 43

Teaching Standard D: Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this teachers...identify and use resources outside the school.

Time, space, and materials are critical components of an effective science learning environment that promotes sustained inquiry and understanding. Creating an adequate environment for science teaching is a shared responsibility. Teachers lead the way in the design and use of resources, but school administrators, students, parents, and community members must meet their responsibility to ensure that the resources are available to be used.... appropriate use of scientific institutions and resources in the local community requires the participation of the school and those institutions and individuals.

p. 45

The classroom is a limited environment. The school science program must extend beyond the walls of the school to the resources of the community. Our nation's communities have many specialists, including those in transportation, health-care delivery, communications, computer technologies, music, art, cooking, mechanics, and many other fields that have scientific aspects. Specialists often are available as resources for classes and for individual students. Many communities have access to science centers and museums, as well as to the science communities in higher education, national laboratories, and industry; these can contribute greatly to the understanding of science and encourage students to further their interests outside of school. In addition, the physical environment in and around the school can be used as a living laboratory for the study of natural phenomena. 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. Working with others in their school and with the community, teachers build these resources into their work with students.

National Council of Teachers of Mathematics (1989). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: NCTM.

p. 84

In grades 5-8, the mathematics curriculum should include the investigation of mathematical connections so that students can...apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science, and business; value the role of mathematics in our culture and society.

Students should have many opportunities to observe the interaction of mathematics with other school subjects and with everyday society. To accomplish this, mathematics teachers must seek and gain the active participation of teachers of other disciplines in exploring mathematical ideas through problems that arise in their classes. This integration of mathematics into contexts that give its symbols and processes practical meaning is an overarching goal of all the standards....

p. 85

This persistent attention to recognizing and drawing connections among topics will instill in students an expectation that the ideas they learn are useful in solving other problems and exploring other mathematical concepts.... Curriculum materials can foster an attitude in students that will encourage them to look for connections, but teachers must also look for opportunities to help students make mathematical connections.

p. 86

"Connected" mathematics should not be disconnected from students' daily lives....As students in grades 5–8 become aware of the world around them, probability and statistics become increasingly important connections between the real world and the mathematics classroom. Weather forecasting, scientific experiments, advertising claims, chance events, and economic trends are but a few of the areas in which students can investigate the role of mathematics in our society. Statistics offer students insights into problems of social equity. Perspective, proportion, and the golden ratio are ways of learning mathematics in the context of art and design. Whatever the context, a vital role of mathematics education is to instill in students an attitude of inquiry and investigation and a sensitivity to the many interrelationships between formal mathematics and the real world.

Resources & Opportunities

The University of Texas Marine Science Institute

The University of Texas Marine Science Institute has a web site with pictures of the institute and its surroundings, weather and tide information, stories about recent work and events, and other items of interest.
<http://www.utmsi.utexas.edu>

Helen Ross Russell, *Ten-Minute Field Trips*

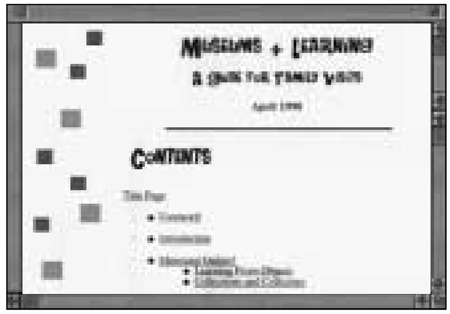
In six topical chapters, this book presents more than 200 short field trips that can be taken within the immediate environs of a school. The book includes classroom activities to precede the field trip, suggestions for teacher preparation, and a list of possible trips. The material is appropriate for grades K–8 and for all settings—urban, suburban, or rural. This book will be valuable for teachers who are new to the idea of short, localized field trips.
Washington, D.C.:
National Science Teachers Association, 1998. 176 pp, $21.95
(10% discount for NSTA members)

Schoolyard Ecology

Great Explorations in Math and Science (GEMS) publishes *Schoolyard Ecology* for grades 3 to 6. This teachers' guide emphasizes the schoolyard as a small ecosystem and integrates mathematics and science skills. The activities also wed inquiry-based learning with stewardship of the natural world. Contact the
Lawrence Hall of Science
University of California
Berkeley, Berkeley, CA
94720-5200
or call (510) 642-7771

Science Scope, January 1999

Two articles in the January 1999 issue of *Science Scope* (published by the National Science Teachers Association) could help in developing long-term projects on birds. Jean L. Pottle has an article on crows with materials and activities that cut across disciplines. "Beak Adaptations" by Frank W. Guerrierie uses scissors, slotted spoons, staple removers, chopsticks, and other common items to simulate beaks and help students understand how these appendages are adapted for bird's ultimate uses. This project is similar to one used at the SCIMAST 1999 Winter Meeting.



Wilma Prudhum Greene (1998). *Museums and Learning: A Guide for Family Visits*

Washington, DC: U.S. Department of Education and Smithsonian Office of Education.
As its subtitle indicates this pamphlet is intended to help parents get the most out of family trips to museums, zoos, botanical gardens, and other informal science settings. Teachers will also find useful tips in the text and many resources in the Bibliography and Resources. A single copy costs 50 cents and can be ordered from
Media and Information Services
of the Office of Educational
Research and Improvement
Department of Education
555 New Jersey Ave., NW,
Washington DC 20208-5570
Alternatively, the entire text can be downloaded from the web site at
<http://www.ed.gov/pubs/Museum/>.

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Classroom Compass is a publication of the Eisenhower Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST) project, sponsored by the U. S. Department of Education under grant number R168R50027–95. The content herein does not necessarily reflect the views of the department or any other agency of the U.S. government. *Classroom Compass* is distributed free of charge to public and private schools in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas to support improved teaching of mathematics and science. The Eisenhower SCIMAST project is located in the Southwest Educational Development Laboratory (SEDL) at 211 East Seventh Street, Austin, Texas 78701; (512)476-6861/800-201-7435. SEDL is an Equal Employment Opportunity/Affirmative Action Employer and is committed to affording equal employment opportunities to all individuals in all employment matters. Publication design: Jane Thurmond, Tree Studio.

S C I M A S T

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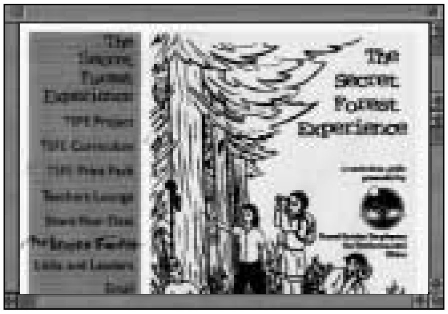
Eisenhower SCIMAST supports mathematics and science education in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas with a combination of training, technical assistance, networking, and information resources. The project is funded by the U.S. Department of Education's National Eisenhower Program and works in partnership with the Eisenhower National Clearinghouse (ENC), a national resource center for increasing the availability and quality of information about instructional resources for science and mathematics educators.

The SCIMAST resource center, located in Austin, is open to visitors Monday through Friday, 8:00 A.M. to 5:00 P.M. The center houses a multimedia collection of science and mathematics instructional materials for grades K–12. It is located at the Southwest Educational Development Laboratory, on the third floor of 211 East Seventh Street, Austin, Texas 78701. SCIMAST-sponsored access centers in all five states provide access to ENC and SCIMAST materials, science and mathematics curriculum materials, and network opportunities that let teachers share their experiences.

A toll-free number, **1-800-201-7435,** provides callers with information and assistance concerning instructional materials for mathematics and science classrooms.

Resources & Opportunities, *continued*



Secret Forest Experience Curriculum

Available on the web or in print, the *Secret Forest Experience Curriculum* includes an educator's web site and printed curriculum for middle school teachers, and a four-page magazine and supporting web site for elementary school children. The curriculum emphasizes field studies, hands-on activities, and learning community connections to deepen students' understanding of forest ecosystems and connect them with others involved in this field of study. This material is presented by Forest Service Employees for Environmental Ethics; contact them at
PO Box 11615
Eugene, OR 97403
<http://www.afseee.org/sfe>

Virtual Field Trips on the Web

Many sites on the web claim to offer virtual field trips to natural areas or to institutions like museums. The site at **<http://www.geologylink.com/fieldtrips/>** covers natural areas from around the world. In addition, it has many informative links. Unfortunately, even high school students will find most of the material difficult. Teachers, however, could use many of these pages to plan classroom discussions or, in certain cases, to preview and plan an actual field trip. The site includes field trips to the Avery Island Salt Domes in Louisiana, the Albuquerque area and Carlsbad Caverns in New Mexico, and Enchanted Rock, the Permian Reef, and Big Bend National Park in Texas. The site also has interesting links from the Oklahoma Geological Survey page, but Arkansas is not covered.

Digital Field Trip to the Wetlands

Tasa Graphic Arts offers a CD-ROM titled *Digital Field Trip to the Wetlands.* Single users pay $99; a network license (one CD for ten machines) is $549; and a lab pack (five CDs for five machines), $249. Schools that have the money to invest in this CD-ROM could use it as an introduction to actual field trips. The material could also introduce students to an environment that is not immediately accessible in their home area. The CD-ROM includes student materials and workbook files that a teacher can modify.
Tasa Graphic Arts
9301 Indian School Rd. NE, Suite 208
Albuquerque NM 87112-2861
(800) 293-2725 or (505) 293-2727
The company has a 30-day review period for educational institutions only.

"Inch by Inch, Row by Row: A Garden Overview for Teachers and Parents"

The web page "Inch by Inch, Row by Row: A Garden Overview for Teachers and Parents" presents an overview of why and how a class or entire school might plant an educational garden. A single class can use a garden for a specific purpose or it can be used by the entire school for many purposes. Not only science and mathematics, but also art, history, language arts, and other subjects can be the focus of the garden, which can be an integrated experience from the time the children enter the school until they leave it.
Access the web site at **<http://www.nmnh.si.edu/garden/seasons/garden_overview.html>**.
The Los Padillas School in Albuquerque maintains a garden using the community resources and traditions of the area. This project receives SCIMAST funding and can be accessed at **<http://www.sedl.org/pitl/scimast/pda/albuq.html>**

Bat Conservation International (BCI)

Bats are an important component of Southwestern ecology. Bat Conservation International (BCI) maintains a web site at **<http://www.batcon.org/>**. The organization has a book, *Educator's Activity Book about Bats,* that incorporates field work into classroom study about these creatures. In addition, BCI offers a kit called *Discover Bats!* The kit includes a handbook, video, and opportunities for computer-aided research. Lessons are divided into three difficulty levels: beginner, intermediate, and advanced. Call BCI for information at **1-800-538-BATS**.

Science Centers on the Web

Most of us will probably never need to know about the hands-on science center in Vaxjo, Sweden, but **<http://www.cs.cmu.edu/~mwm/sci.html>** does attempt to present all known web pages of child-centered science centers and museums. This page would be useful for families planning vacations, but teachers can use it to check out the offerings, costs, and other data on local institutions. Much of the information and techniques from linked web pages might also be useful in the hometown classroom. Many centers are reviewed with reports on the experiences and impression of adults and children (at least one of the adults is always an engineer). Not all centers in the Southwest are on this page, but a fair sampling is presented and several are reviewed.

SCIMAST publishes a guide to regional science-rich resourses:
URL <http://www.sedl.org/pitl/scimast/srr.html>