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Teaching With a Difference

CHAPTER ONE · TEACHING WITH A DIFFERENCE

AMONG MANY TRENDS IN IMPROVED SCIENCE AND MATHEMATICS EDUCATION ARE BETTER TECHNIQUES FOR ENGAGING LEARNERS. NEW PHILOSOPHIES OF LEARNING, SUCH AS CONSTRUCTIVISM,[1] UNDERLIE MANY OF THESE TECHNIQUES. THESE NEW APPROACHES MAY BE ADOPTED IN THE CLASSROOM OR IN INFORMAL EDUCATION SETTINGS, SUCH AS AFTER-SCHOOL CLUBS, SATURDAY ACADEMIES, SUMMER CAMPS, AND MUSEUM PROGRAMS.

THE PROJECTS DESCRIBED IN THIS CHAPTER EXPLORE SEVERAL NEW WAYS OF TEACHING THAT HAVE INDEED PROVEN TO ENGAGE ALL STUDENTS MORE, INCLUDING GIRLS AND OTHER GROUPS WHO PREVIOUSLY TENDED NOT TO BE DRAWN TO THE SUBJECTS:

- HANDS-ON ACTIVITY, USING TOUCH, SMELL, AND MOTION TO EXPERIENCE AND STUDY THE PHYSICAL WORLD
- WORKING IN COOPERATIVE TEAMS, WITH STUDENTS HELPING AND SHOWING EACH OTHER
- LOOKING AT REAL-WORLD CONTEXTS WITH A SCIENTIFIC EYE—CHEMISTRY IN THE HOME, ECOLOGY IN THE COMMUNITY PARK, THE PHYSICS OF SPORTS
- AN EMPHASIS ON PERSONAL MASTERY AND CONFIDENCE THROUGH PROBLEM-SOLVING
- EXPOSURE TO A DIVERSE ARRAY OF WORKING SCIENTISTS AND ENGINEERS, TO CAPTURE STUDENTS' INTEREST AND TO OPEN THEIR MINDS TO MANY ATTRACTIVE CAREERS

WHY ARE SO MANY PROJECTS EXPERIMENTING WITH NEW WAYS OF TEACHING? BECAUSE OUR EDUCATION STATISTICS SHOW THAT, IN TRADITIONAL SETTINGS, AT ABOUT MIDDLE-SCHOOL AGE, GIRLS TEND TO LOSE INTEREST AND CONFIDENCE IN MATH AND SCIENCE AND, UNTIL RECENTLY, HAVE PERFORMED CONSISTENTLY LOWER THAN BOYS ON MOST STANDARD SCIENCE AND MATH TESTS (THE "GENDER GAP"). ONCE SCIENCE AND MATHEMATICS COURSES BECOME ELECTIVE, GIRLS TEND TO ELECT TO TAKE FEWER MATH AND COMPUTER TECHNOLOGY COURSES, FOR EXAMPLE, WHICH LEAVES THEM BEHIND IN SKILLS AND CONFIDENCE. CHILDREN'S VIEWS OF SCIENCE AND ENGINEERING ARE NOT SOPHISTICATED, AND THEIR VIEW OF THEIR ROLE IS COLORED BY GENDER STEREOTYPES ("GIRLS ARE NOT GOOD AT MATH"). WE NEED AND WANT A COMPUTER- AND SCIENCE-LITERATE CITIZENRY AND A WORKFORCE EQUIPPED WITH HIGH-DEMAND SKILLS. NEW WAYS OF TEACHING ARE A RESPONSE TO THE DEMANDS OF OUR MODERN SOCIETY.

TRENDS IN THE LAST 10 YEARS ARE ILLUSTRATED IN MANY OF THE STORIES:

- INFORMAL EDUCATION'S INCREASING ROLE IN EXPOSING CHILDREN TO SCIENCE
- COLLABORATIONS BETWEEN SCHOOLS AND INFORMAL EDUCATION PROVIDERS (SUCH AS MUSEUMS AND GIRLS' PROGRAMS)
- SOPHISTICATION IN INFORMAL EDUCATION, INCLUDING AWARENESS AND REINFORCEMENT OF SCIENCE AND MATH EDUCATION STANDARDS
- RECOGNITION OF AND RESPONSIVENESS TO STUDENTS' CULTURAL DIVERSITY
- A BETTER UNDERSTANDING OF GENDER-RELATED EDUCATION ISSUES, ESPECIALLY AFTER TITLE IX
- TEACHERS' CROSSING OF TRADITIONAL BOUNDARIES BETWEEN INFORMAL AND FORMAL EDUCATION
- TECHNOLOGY'S INTEGRATION INTO EDUCATION.

SOME REFERENCES
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Clewell, Beatriz Chu, Bernice Taylor Anderson, Margaret E. Thorpe. Breaking the Barriers: Helping Female and Minority Students Succeed in Mathematics and Science. Jossey-Bass Publishers, 1992.
American Association for University Women, Educational Foundation. Tech-Savvy: Educating Girls in the New Computer Age. 2000

[1]The belief that we construct our own understanding of the world and use our own mental models to make sense of it and give it meaning. Curricula aim to match and challenge children's understanding of the world in order to develop their minds.

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Project parity

PROJECT PARITY

PROJECT PARITY ENGAGED FOURTH AND FIFTH GRADE GIRLS IN HANDS-ON SCIENCE ACTIVITIES AND EXPOSED THEM TO POSITIVE ROLE MODELS, TO COUNTER THE TENDENCY FOR BOYS TO DOMINATE CLASSROOM SCIENCE ACTIVITIES, ESPECIALLY THOSE INVOLVING SPECIALIZED EQUIPMENT. WORKING WITH THREE URBAN AND SUBURBAN CONNECTICUT SCHOOL DISTRICTS, THE TALCOTT MOUNTAIN SCIENCE CENTER STAFF ENGAGED GIRLS IN ACTIVITIES THAT COMBINED HIGH TECHNOLOGY WITH THE "HIGH TOUCH" OF HANDS-ON SCIENCE.

Building a simple circuit with batteries and bulbs, creating a multimedia presentation, and engaging in robotic engineering were some of the activities that built the girls' self-confidence and taught them how to use science equipment. After such single-sex activities, the girls who had worked in cooperative groups with other girls were observed by evaluators in mixed-gender groups during hands-on science activities. Girls in the "treatment group" were far more active participants in the mixed-gender groups than were those in the control group. Girls in the treatment group were more likely to come forward and share in group leadership rather than remain passive group members.

Given training in attitudes and parenting strategies, parents learned to encourage their girls to be more confident and self-reliant. They were invited to participate in some activities with the girls and were encouraged to work with them on science activities at home. Workshops helped make teachers and parents aware of social bias toward women in science and aware that experiencing the joy of discovery helps girls become interested in science.

CODES: E1	Talcott Mountain Science Center
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HRD 94-53719 (one-year grant)	
Products: A Parity handbook for developing a model program and a training videotape	
Keywords: demonstration, teacher training, parental involvement, gender equity awareness, cooperative learning, hands-on, role models, museum, engagement, self-confidence, mixed-gender	

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Ft2
Family tools and technology

FAMILY TOOLS AND TECHNOLOGY

MANY OUT-OF-CLASS GENDER EQUITY PROGRAMS HAVE BEEN SINGLE-SEX PROGRAMS, WHICH SERVE A USEFUL FUNCTION, BUT GIRLS AND BOYS ALSO NEED TO LEARN HOW TO WORK TOGETHER. GIRLS NEED A BROADER BASE OF EXPERIENCES, BOYS NEED TO LEARN TO RESPECT AND WORK WITH GIRLS AS EQUAL PARTNERS, AND TEACHERS, PARENTS, AND OTHER ADULTS NEED TO LEARN HOW TO CREATE AN ENVIRONMENT THAT WILL MAKE THESE THINGS HAPPEN.

This belief is at the heart of Family Tools and Technology (FT2), an after-school intervention program that trained 40 middle-school teachers to lead after-school programs for sixth grade students and their parents. The program targets girls in pre-adolescence, before sex role stereotypes about technology have solidified.

The teacher training emphasizes gender-equity awareness, information on workplace readiness skills, hands-on technology activities, and providing a forum in which girls' natural preferences for collaborative and inquiry-based learning can flourish

In the after-school program, girls, boys, and their parents problem-solve collaboratively, using tools and building models that illustrate STEM's everyday importance. The program focuses on technological challenges in pre-engineering, architecture, and physical science that are not usually found in the traditional elementary curriculum.

Family Science and Family Math engage parents and children in hands-on activities that lead to the discovery of basic math and science concepts—for example, discovering density by determining whether a variety of materials will float or sink in water. FT2 seeks both to discover the concept and extend it—for example, by having participants design and construct a rubber-band-powered barge to transport a given mass. Children and their parents jointly engage in such activities as using meters, working with electromagnets, fixing electrical appliances and toys, and programming a VCR—a true problem-solving activity! This is important for girls, who are less apt than boys to have fun doing the out-of-school science-related activities that can lead to an interest in—even a passion for—science.

The first phase of this project (1995–96) focused on a yearlong assessment of the effectiveness of the 14 FT2 activities, materials, and strategies in 12 elementary schools with about 240 families (70 percent being girls and their families). Teachers got 11 days of training in FT2 techniques, warm-ups, and challenges, so they could present and facilitate the warm-ups and challenges in the after-school sessions.

This model was ultimately quite effective at reducing gender stereotypes, increasing student use of tools and tool-related activities, and improving attitudes toward tools. But although both boys and girls found the challenges in the first six sessions to be "original, fun, and interesting," midway through field testing and data collection evaluator Patricia Campbell reported that gender stereotyping was actually increasing rather than decreasing in some students. Responses to the open-ended statement "Girls who use tools to problem solve and build models are ___" included "ugly" and "not nice" (from boys) and "don't use tools as well as boys" (from a girl). Several children thought girls shouldn't use tools because they might break a nail, or said girls need help using tools so they won't hurt themselves.

To provide immediate intervention, the second training sequence included specific gender-equity strategies, activities, role playing, and discussions of how best to address obvious gender stereotyping. When the gender stereotyping was addressed rationally, explicitly, and repeatedly, both girls and boys become less stereotyped in their responses to the open-ended questions, and the boys decreased their stereotypes even more than the girls did.

Streamlining the program

Because FT2 was expensive to implement, NSF funded a one-year follow-up project (1996–98) to determine if a model of FT2 that reduced the number of sessions from 12 to seven and the amount of teacher training from 11 days to five would have similar positive effects on students. Two cycles of teacher teams (14 teams) were trained and, after a five-day teacher training institute, conducted seven FT2 session programs—with a one-day follow-up training session and one onsite training session with a mentor present. (A 15th team conducted a six-session program.) The idea was to refine and streamline the program into a cost-effective, pedagogically sound five-day training session that could be easily disseminated and replicated, together with a leadership component that could prepare experienced FT2 teachers to train others to conduct the program.

Disappointingly, the FT2 learning activities in both phases of the project appeared not to affect children's interest in careers in science, technology, engineering, and math (STEM). Simply listing the titles of STEM-related careers or even bringing in one or two role models to talk to parents and children was not enough to effect change or stimulate their interest. Girls' and boys' career

In FT2 activities, learning proceeds through stages: questioning, investigating, evaluating, implementing, revising, and re-evaluating. When children and their parents build and test a rubber-band-powered boat, for example, they select the needed materials (including waterproof adhesives, fasteners, and rubber bands), take measurements, and test their craft, steps that require prediction, experimentation, and revision. In working together, sharing ideas, comparing results, and talking about them, families gain an intuitive grasp of science concepts (buoyancy, energy, motion, friction), apply mathematical principles (pattern development, weight versus volume), and discover engineering principles (strength, properties of materials).

In a typical session, toolboxes sit unopened on tables as participants get ready for the evening's challenge—in one session, assembling a hydroponic greenhouse. First they test the water to be used in the greenhouse with litmus paper, pick a plant, remove the soil from its roots, then guess the name and variety of "mystery tools" laid out on a table. At session's end, the family has a plant and a handmade greenhouse to take home—and some new skills. The third-grade teacher who facilitates the activities says, "I don't have all the answers. I'm just a problem-solver."

At other sessions, families have built cars, boats, and catapults out of Lego sets and have made kaleidoscopes out of toilet paper tubes (putting colors and beads inside mirrors). Each activity is based on a problem-solving model: accepting a challenge, reviewing criteria, gathering information and materials, brainstorming, planning, making, testing, and revising. The parents find the learning partnership a good way to spend time with their children. "It's a social kind of learning," said one mother, "and it gets my daughter to think," plus "my husband and I get the chance to be a kid again." Fathers hear "math and science" and their participation shoots up. Meanwhile, the challenges are tough enough for all age groups to learn. And by changing the dynamic between parents and teachers, FT2 builds parental support for education.

Children are naturally curious. This kind of hands-on learning turns them into active (rather than passive) learners—learning to ask questions and find their own answers. Instead of looking for "right" answers, they are encouraged to see problem-solving as a process and to feel free to make mistakes because they can learn just as much from their mistakes as they would by getting the answer right the first time. They also learn that if something doesn't work, they can do it again.

Parents appreciate the chance to spend enjoyable learning time with their children and to see how they learn, how they problem-solve, and how they work in a team. They often realize that they should give their children more of a chance to solve problems and work with tools rather than do so for them. Teachers learn to facilitate more than teach: to guide with questions rather than statements and to realize that it is not important that they have all the answers—in fact, that it is better to guide students in their discovery and to learn along with them.

interests remained limited and unchanged and still reflected gender stereotyping. Middle-school girls, often discouraged by the complex names of many scientific career titles, lost interest in them; career titles presented with one-line descriptions were often intimidating or at best confusing. Developing an effective career component will need more work—including finding a way to convey the "how" and "why" of professionals' career choices and somehow to convey their passion for what they do. But this program was a start.

The follow-up project produced Making a Splash: A Guide for Getting Your Programs, Products, and Ideas Out. This user-friendly guide helps individuals and organizations identify their goals and focus on their primary audience(s) as they undertake gender equity efforts in math, science, and technology. It offers ideas, information, and free or low-cost strategies to get the word out; provides sources of research on gender, math, and science; and suggests how program and project developers can evaluate the impact of their efforts.

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Publication: Making a Splash: A Guide for Getting Your Programs, Products, and Ideas Out	
Useful website: www.campbell-kibler.com	
Keywords: education program, after-school, problem-solving skills, teacher training, parental involvement, intervention, gender equity awareness, hands-on, collaborative learning, inquiry-based, real-life applications	

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SMART: learning by doing

SMART: LEARNING BY DOING

SCHOOL-BASED SMART (SCIENCE, MATH, AND RELEVANT TECHNOLOGY) IS AN EXEMPLARY, WELL-TESTED MODEL PROGRAM OF HANDS-ON SCIENCE ACTIVITIES TO MAKE MATH AND SCIENCE ACCESSIBLE TO GIRLS. DEVELOPED BY GIRLS INC., SMART IS BOTH A CONCEPT—DEMYSTIFYING THE NOTION OF SCIENCE AND WHO CAN DO IT—AND A CURRICULUM. COMBINING A CONCERN FOR EQUITY WITH AN EMPHASIS ON EXPLORATION, SMART ENCOURAGES GIRLS TO BE SKEPTICS, TO CHALLENGE PAT EXPLANATIONS, AND NOT TO TAKE ANYTHING FOR GRANTED. PARTICIPANTS BECOME "MATH DETECTIVES." THIS SAN LEANDRO, CAL., PROJECT SERVED 300 FOURTH AND FIFTH GRADE GIRLS.

Doing hands-on activities in small groups makes it possible for girls to experience activities teachers might shy away from delivering in classes of 30 to 35 students. In a unit on energy and patterns of change, for example, girls explore everything from heat energy (generated by composting organic materials) and solar power to electrical energy (circuits using batteries, wires, bulbs, and switches). To integrate these concepts and confront open-ended experiments, they might be asked to insulate a structure they have designed and built so that it will retain maximum heat energy.

Encouraging girls to learn and experiment—to take risks and learn by doing—in a single-sex environment, for even one hour a week, helps the girls feel empowered and self-confident enough to try things they otherwise would not try. The interest and enthusiasm shown by participating girls convinces many teachers that the hands-on approach really works—that everyone has a right to scientific understanding and the power that comes with knowledge.

A project manual offers guidance on implementing school-based SMART programs, detailing how they turned SMART from an after-school program into an in-school program. Many affiliates had not considered applying SMART in school because of the difficulty of working with school districts and principals. The manual spells out how to develop an age-appropriate, gender-equitable curriculum responsive to state and local district frameworks for science and math education. It emphasizes the importance of a strong working knowledge of local school politics and should be helpful for affiliates just beginning to establish relationships with local schools.

Several factors affect success in raising girls' levels of interest, motivation, and achievement:

- **Program inclusiveness**. Every fourth and fifth grade girl is involved in the program, eliminating the self-selection factor in other models.
- **Teacher involvement in planning**. Strong support from principals is essential, but the program needs to be a cooperative effort between teachers and the principal, not a top-down effort in which the principal dictates that teachers must participate. It is important to communicate with the teaching staff and gain its commitment before seeking support from the school's administration. In this project, teacher training in gender equity also got a significant turnout, involving all teachers in the building, not just those involved in the program.
- **Built-in teacher feedback**. Such a project takes more than a year, because teachers need training to become comfortable with hands-on activities as well as with back-up resources and personnel. It is helpful if the hands-on activities complement teachers' mandatory science programs. In-service training allows teachers to experience active learning first-hand, so they know what their students will be using and can confront their own feelings and attitudes toward science and math education.
- **Parental involvement**. Family-oriented activities were important in the original project because of their cultural impact on the substantial Hispanic population. Parental influence in discouraging the pursuit of math and science careers is well documented, but in this project parental involvement was fairly high. A newsletter to parents helped them understand many stereotypical issues that create barriers for young girls. At SMART Family Night, parents and guardians could experience SMART firsthand through participatory hands-on activities.

The SMART model and curriculum give girls the confidence to return to their coeducational classes and become leaders. Schools have reason to embrace the model, because boys also benefit from hands-on activities in smaller learning groups.

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HRD 94-53748 (one-year grant)	
Publication: School-Based SMART: Opportunities for Girls and Girls Incorporated Affiliates (a working guide)	
Keywords: demonstration, teacher training, parental involvement, gender equity awareness, experiential learning, hands-on, curriculum, exploration-based, self-confidence, manual; girls, inc., hispanic	

WHAT WE KNOW ABOUT WHAT WORKS

OPERATION SMART IS GIRLS INC.'S MOST POPULAR PROGRAM, CLAIMING TENS OF THOUSANDS OF PARTICIPANTS ACROSS THE NATION. BECAUSE OF IT, GIRLS ALL OVER THE NATION GET MESSY, EXPLORE, ANALYZE, DISSECT, HYPOTHESIZE, AND MAKE BIG, INTERESTING MISTAKES. FOR MORE THAN A DECADE, MOST PARTICIPANTS IN SMART WERE GIRLS AND YOUNG WOMEN OF COLOR. GIRLS INC. IS DEVELOPING A PLAN (MARTINEZ, HRD 01-14680) TO MAKE ITS PROGRAM MORE RELEVANT, ACCESSIBLE, AND EXCITING TO A NEW GENERATION OF GIRLS—INCLUDING THOSE WHO ARE DISABLED OR SPEAK ENGLISH AS A SECOND LANGUAGE—WHILE RETAINING WHAT STILL WORKS IN THE PROGRAM. HERE'S WHAT THE ORGANIZATION'S EXPERIENCED INFORMAL EDUCATORS KNOW ABOUT WHAT WORKS:

- Girls (especially in elementary school) like their science *messy*.
- Middle school girls like the *aesthetics* of math, science, and technology projects—the symmetry and decoration of their Lego® creations, for example, or the beauty of stars (as motivation for studying astronomy).
- Girls of all ages like their math and science to be *useful and relevant to their everyday lives*.
- Girls want *clubs, communities, and face-to-face interactions*. Internet connections may not be intrinsic motivators for girls the way they are for boys.
- A great way to squelch girls' interest in science is to "demonstrate" it while they watch. Another is to play "guess the right answer," as if all girls can do is master a completed body of knowledge.
- *Not all girls are alike*. Some already know they like math and science and just need connections made and barriers reduced. Some have yet to discover that math, science, and technology are for girls. Still others resist and have feelings and experiences we should listen to and learn from.
- *Blanket invitations to participate do not work on any level*. Each girl needs to know that she is special and that her discoveries are amazing, each adult needs to experience the wonder and remember the old days, each parent needs an individual welcome in his or her language and a thank-you for rearing an already curious child, and each tribal elder needs a personal visit and time to get to know that the people in the program are trustworthy and respectful.

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Smrt2
Teaching SMART

TEACHING SMART

GIRLS INC. (THEN GIRLS CLUBS OF AMERICA) DEVELOPED OPERATION SMART IN THE MID-1980S TO ENCOURAGE GIRLS' INTEREST IN SCIENCE, MATH, AND RELEVANT TECHNOLOGY. SINCE THEN, OPERATION SMART HAS EVOLVED INTO TEACHING SMART, A COMPREHENSIVE, EQUITY-BASED, THREE-YEAR TEACHER PROFESSIONAL DEVELOPMENT PROGRAM DESIGNED TO PRODUCE *SYSTEMIC CHANGE IN THE FORMAL CLASSROOM—TO CHANGE THE WAY ALL ELEMENTARY SCHOOLCHILDREN, BUT ESPECIALLY GIRLS AND MINORITY YOUTH, EXPERIENCE SCIENCE EDUCATION*. TEACHING SMART TEACHERS HAVE ADOPTED THE KEY TEACHING STRATEGIES PROMOTED BY THE NATIONAL SCIENCE EDUCATION STANDARDS: A HANDS-ON OR INQUIRY-BASED APPROACH TO SCIENCE ACTIVITIES THAT PROMOTE STUDENT DEVELOPMENT OF SCIENCE PROCESSING SKILLS.

Teaching SMART provides instruction and hands-on training for teachers in grades 3 through 5, to increase their awareness of (and comfort level using) equitable, hands-on, inquiry- and exploration-based approaches to teaching science. The program was first tested in elementary schools in western South Dakota, a largely rural population previously unserved by such a program. In 1996 the program was expanded to 13 sites around the country.

Grade 3 activities deal with simple machines, food groups, and fossils; grade 4 on catapults and fulcrums, senses, and rocks and minerals; and grade 5 on air pressure/movement of molecules, animal adaptations, and food chains and webs. Classroom kits include balloons, flour, cups, and batteries. Equipment kits contain such items as microscopes, beakers, funnels, dissecting kits, magnets, wires, hand tools, Ping-Pong balls, and light bulbs.

The program has had a consistent positive influence on teachers' attitudes and levels of confidence and comfort with hands-on science activities. By using more than a hundred lesson plans designed by Teaching SMART, *the teachers significantly cut their use of the didactic, teacher-centered activities—such as lectures, teacher demonstrations, and whole-class discussions—they were often trained to do. They increasingly used student-centered, hands-on lab activities, cooperative group work, and authentic assessments*. "My goal was to have 60 minutes or more of actual hands-on SMART activities," says one teacher, "and I did, because the kids wouldn't let me forget ever!"

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Publications: Articles by Claudia Douglas, Marsha Lakes Matyas, and Melanie Flatt: Moving Toward Student-Centered Activities: Proven Methods for Change and Teaching SMART: Evidence of Effectiveness.	
Keywords: demonstration, teacher training, gender equity awareness, hands-on, after-school, inquiry-based, professional development, self-confidence, achievement, cooperative learning, career awareness; girls, inc.	

In Teaching SMART, teachers are asked to practice Three E's and an F—Empowerment, Equity, Enrichment, and Fun—and students respond. More than 90 percent of the students involved give a thumbs-up to the Teaching SMART activities. They not only enjoy active exploration and discovery but also become more confident about their science processing abilities and more likely to believe that both men and women can do science. On tests, their knowledge of science content and their problem-solving skills improve. They show more facility with open-ended, higher-order questions.

Research shows that *without continual coaching and follow-up support, teacher training is unlikely to produce long-lasting improvements in teacher competence or student outcomes. Site specialists are trained to mirror-coach, a form of peer coaching. Peer coaching is an effective way to help educators transfer learned skills*—because an extra set of eyes and ears records what is going on in the classroom.

Mirror-coaching in Teaching SMART stresses

- *Cooperative grouping* (site specialists check to see if students know what role they were assigned—reporter, recorder, engineer—and if they understand their responsibilities, and get feedback on how well they were working together)
- *Group interactions* (recording the number of teacher interactions with the group, who initiated them, and how much time was spent with each group)
- *Language used* (for example, "guys," "the doctor, he") and questioning techniques (open-ended, as preferred, or closed)
- *Individual attention* (which students were questioned and got follow-up questions, and who initiated the interaction)

Teachers' growing awareness of the damaging effects of gender bias has been reflected in greater efforts to call equally on boys and girls (not "guys" and "gals") and to be more sensitive about seating, questioning, grouping, and task assignments. Student awareness has also grown. Boys demand their turn to stir cornbread batter, and girls ask to run the video equipment or help carry materials for guest speakers. Teaching SMART also encourages students to investigate careers that have been traditionally divided between the genders. In "Career Charades," for example, they draw the names of careers that they must then act out in pantomime. If a boy protests having to act out the role of nurse, as a "girly" job, the teacher might respond by describing a male nurse anesthetist, a former nurse in Vietnam, now making a handsome salary.

SECRETS TO TEACHING GIRLS SCIENCE

Assume girls are interested in math, science, and technology. Too many girls—and children of color—still get the message that math and science aren't for them. In SMART classes, girls jump at the chance to dismantle machines, care for and study insects and small animals, and solve logic puzzles. Instead of struggling to get the boys to share the tools, in an all-girl environment girls can focus on and enjoy the task at hand.

Let girls make big, interesting mistakes. Girls who are overly protected in the lab or on the playground have few chances to assess risks and solve problems on their own. In SMART classes, once-dreaded mistakes become hypotheses. Girls are urged to go back to the drawing board to figure out why their newly assembled electric door alarm doesn't work or why their water filter gets clogged. Supported by adults instead of rescued, girls learn to embrace their curiosity, face their fear, and trust their own judgment.

Help them get past the "yuk" factor. Girls who are afraid of getting dirty aren't born that way—they're made. Help them resist pressure to behave in "feminine" ways. Encourage them, for example, to get good and grubby digging in a river bed or exploring a car engine. Let them learn they have a right to be themselves.

Expect girls to succeed. In 1999, boys outnumbered girls 3 to 1 among students taking advanced placement tests in computer science. This gap reflects the barrier of low expectations girls face in male-dominated fields. Girls are capable of mastering math and science. Expect them to do so throughout high school and college.

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Making connections

MAKING CONNECTIONS

TO STOP PRE-TEEN GIRLS FROM AVOIDING MATH AND SCIENCE, THIS PROJECT TARGETED THIRD TO FIFTH GRADERS IN THREE URBAN DENVER SCHOOL DISTRICTS WITH INTERVENTIONS TO MODIFY THE CURRICULUM, DEVELOP TEACHERS' PROFESSIONAL SKILLS, AND CHANGE THE ATMOSPHERE IN WHICH GIRLS LEARN AND PERCEIVE STEM. THROUGH A GENDER-NEUTRAL MULTICULTURAL CURRICULUM AND BILINGUAL INSTRUCTION, THE PROJECT USED HANDS-ON MATH AND SCIENCE ACTIVITIES TO ENCOURAGE CRITICAL THINKING AND TO "MAKE CONNECTIONS" BETWEEN MATH, SCIENCE, READING, WRITING, AND HISTORY.

The book *Sweet Clara and the Freedom Quilt*, for example—about a fictional slave girl's patchwork quilt that cleverly directed runaway slaves to the Underground Railroad—linked history to math and became a base for engaging students in discussions of gender stereotyping. Asked if their great-grandparents were likely to have quilted or to have done a lot of math, few students could imagine their great-grandfathers as quilters or their great-grandmothers using much math. They read that in Cairo tentmakers were men only, and by fitting shapes together to make their own quilt/tiling/tessellation patterns they *learned that an everyday activity like quilt-making involves a lot of math, including geometric shapes. The unit was also a good opportunity for parental involvement.*

Training sessions helped 17 new and experienced teachers develop a deeper knowledge of math and science content, learn hands-on instructional techniques, and ask questions in a nonthreatening environment. In six workshops held after school and a summer week of all-day training, teachers learned how to use active learning kits and how a good teacher can unknowingly ignore girls. They planned to use what they learned and wanted to know more.

In the year-round component, classroom activities were implemented in a mixed-gender classroom setting, complementing the single-sex after-school enrichment activities. Staff modeling of the "Making Connections" curriculum was successful, but teachers who took the training weren't yet comfortable implementing it in their classroom and wanted more suggestions about how to integrate it into the curriculum as a whole.

Family Math and Science Nights were a good way to disseminate information about the program. Students who talked excitedly about the program awakened their parents' interest, often to the point of parents taking part in classroom activities.

The Summer Explorers program—three one-week math, science, and engineering camps for girls—ran four hours a day. Veteran teacher-participants facilitated the camps, with new participants assisting. Most of the teachers who took part in the summer camp had weak math backgrounds, and the camp helped them learn math concepts well enough to present them correctly.

They also learned about teaching. Some used disciplinary methods the girls considered "mean," and some came to realize that *worksheets (or "table work") didn't hold girls' interest as much as more active work did. Some teachers who thought the work was too difficult for the girls learned that the girls could do the work more easily if it was taught in smaller increments or in smaller groups*.

The materials lent themselves to use by girls with disabilities. So many activities involved touching, feeling, and building large objects that one girl with limited vision was fully able to participate. The girls, encouraged to write in their journals, provided useful feedback on the experience, but wanted more hands-on experiments and less writing.

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http://insidedenver.com/news/0301firl2.shtml	
PUBLICATIONS: MAKING CONNECTIONS SUMMER EXPLORER'S HANDBOOK; YEAR 1 TESSELLATIONS TEACHER'S GUIDE	
KEYWORDS: EDUCATION PROGRAM, TEACHER TRAINING, GENDER EQUITY AWARENESS, PARENTAL INVOLVEMENT, URBAN, INTERVENTION, BILINGUAL, EXPERIENTIAL LEARNING, HANDS-ON, MIXED-GENDER, DISABLED, MINORITIES	

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Icn

Interconnections

INTERCONNECTIONS

THIS GRANT SUPPORTED DEVELOPMENT OF INTERCONNECTIONS,™ A SERIES OF MECHANICAL-INTERACTIVE BOOKS THAT EXPLAIN ABSTRACT IDEAS THROUGH UNCONVENTIONAL FORMAT AND ANALOGY. DESIGNED FOR GIRLS 10 TO 12 (GRADES 5–7), THE SERIES EXPLAINS CONCEPTS SUCH AS MAGNETIC FIELD, ATOMIC STRUCTURE, AND PYTHAGOREAN THEOREM THROUGH METAPHOR AND IMAGERY AND SHOWS HOW THE CONCEPTS ARE CONNECTED. THE PREMISE IS THAT EDUCATION SHOULD BE A "NON-FLAT THINKING ADVENTURE"—THAT INTERCONNECTIONS WILL HELP GIRLS FIND THE ESSENCE OF CHALLENGING CONCEPTS INSIDE FAMILIAR THINGS. THREE PROTOTYPES HAVE BEEN TESTED WITH CHILDREN OF DIFFERENT AGES.

This effort grew out of Mitzi Vernon's market research in the 1990s into why girls aren't interested in computer games. *She found that girls' interests are consistently socially oriented; that girls tend to want things to be tangible, collectible, and communal and are inclined to create character and storyline as they play. There is an apparent correlation between their lack of interest in computer games and their general feelings about technology*.

A project called the Peninsula study (at Peninsula School in Menlo Park, Cal.) sought a new way to introduce abstract phenomena to young girls. Originally it did so through "character construction exercises": giving the girls a collection of geometrical shapes with plastic connectors and asking them to create something, so the researchers could investigate how girls would approach and interpret geometry. In this and subsequent exercises, *the girls almost invariably returned to images of faces or bodies, focusing on themselves: what they looked like and how they related to each other*. They also had an almost insatiable appetite for variety and embellishment, always asking for more pieces, more colors, more intricate shapes.

This investigation led to creation of *The Universe Is in My Face*, a mechanically interactive explanation of molecules and atoms that moves from large to small images: face to eye to iris (molecule to atom to electron). This was not a traditional book but a kit of interlocking panels—a puzzle for children to put together, to help demystify concepts. With *The Universe*, a series of boards in geometrical face shapes comes with magnets of various shapes and colors, which the reader manipulates. The mechanical format encourages the concrete, mechanical activity important to learning in young children. Key phrases in story development are located on the backs of various boards. The MagneWidget,™ a magnetic disc, illustrates the concept of magnetism, gives girls a concrete connection to new technology, and serves a practical purpose: Girls use it to play with the magnetic particles (which come in a pouch in a specially designed book bag). The storyline and hands-on engagement keep girls interested and rereading.

The project team decided that field theory should precede atoms as a subject and might be a better place to introduce the narrator, so the first book in the series is *Phoebe's Field*, which introduces Phoebe and the concept of *fields* (such as cornfields, magnetic and electric fields, and gravitational fields) and the *quarks* that make a field. Phoebe, invisible to the reader, is a navigational character who asks questions; the visuals in the story are everything she sees and the way she sees it. A second and smarter character, "Phleck," answers questions.

Book 2, *My Horizon*, discusses the field as a plane and geometry as a natural phenomenon as seen through the eyes of Pythagoras. Book 3, *The Universe Is in My Face*, takes the reader on a journey inside the iris of an eye to discover molecules, atoms, and electrons and the reason we see different colors in eyes. Books 4 through 7 will present the science of color (*Color Me Red*), the concept of light waves and waves of water and sound (*Wiggles in Space*), sound waves and music (*Wiggles in Time*), and Phythagoras' harmony in numbers (*Fields of Harmony*).

CODES: E, M, I	Virginia Polytechnical Institute and State University (Virginia Tech)	
Mitzi R.Vernon (vernon@vt.edu)	www.off-the-pageworks.com/	HRD 99-79287 (one-year grant)

Partners: Off the Page Works, Inc.; Barbara Ciletti (Oddysey Books); Lord Corporation (engineers David Carlson and Lynn Yanyo); Kathy Anderson (Journey Designs); Design Research Associates, Inc.; Girls Middle School (Mountain View, Cal.); Gilbert Linkous Elementary School and Blacksburg Middle School (Blacksburg, Va.).

Products: Prototypes for Phoebe's Field, The Universe Is My Face, and My Horizon

Keywords: demonstration, book series, hands-on, interactive, math, physics, connections

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As+

After-school science PLUS

AFTER-SCHOOL SCIENCE PLUS

AFTER-SCHOOL SCIENCE PLUS (AS+) GREW OUT OF ANOTHER SUCCESSFUL NSF-FUNDED SCIENCE ACTIVITY PROGRAM: PLAYTIME IS SCIENCE. BOTH WERE DEVELOPED BY EDUCATIONAL EQUITY CONCEPTS (EEC), A NONPROFIT ORGANIZATION THAT DEVELOPS EQUITY-BASED MATERIALS FOR CHILDREN AND CLASSROOMS AND OFFERS TRAINING FOR TEACHERS, ADMINISTRATORS, AND PARENTS.

Playtime Is Science (PS) is an early-childhood parental-involvement project that uses developmentally appropriate hands-on science activities for children, parents, and the classroom to bring science to a broader range of students and parents—to level the playing field for all students. It increases young girls' participation in science when science abilities and attitudes are first being formed—and when physical science activities barely exist in most classrooms. Playtime Is Science employs science activities that are fun and use inexpensive, recyclable items such as cooking oil, plastic bottles, empty boxes, and old socks. It has been successfully implemented in schools, community centers, and Head Start centers.

With After-School Science PLUS, EEC applied the concepts and activities of PS to after-school centers, designing 11 inquiry-based science activities for school-age students—activities that emphasized equity, career/role models, and literacy. AS+ was pilot-tested and field-tested in 1997 and 1998 in three New York City settlement houses. The AS+ activities include, among others, Oobleck: Solid or Liquid?, Sink and Float, Bubble Science, Building with Wonderful Junk, and Who Does Science?

The program gave students positive information about who does science, dispelled stereotypes about girls and women in science, and created opportunities for students to see science as part of their everyday experience. The students kept journals about science role models diverse in terms of race, ethnicity, gender, and disability. *Parents were involved so they could become science enthusiasts and role models for their children*.

AS+ provided staff development institutes, opportunities for parent involvement, and ongoing professional program support, coordination, and technical assistance. It developed and field-tested a model for staff development suited to the needs of group leaders/counselors. Group leaders typically are young people, part-time college students, or youth workers who lack the experience and education of classroom teachers. They enjoyed the hands-on activities as much as their students. "The most helpful part of the training," says one group leader, "was how to make science fun and understandable for kids." Without the training, group leaders were not always able to draw links between PS+ and gender equity or science careers in ways that students followed or understood.

The evaluator found that *doing AS+ in an after-school center increased the amount of equity-based science done in that center. With training, staff encouraged all students to participate in the activities. There was a perceptible improvement in student attitudes about girls who do science and both girls and boys became more aware of science careers* (although "doctor" remained the most frequently mentioned job, followed by "scientist" and "nurse"). The project also learned that it takes time and training for centers to take ownership of the program and to develop administrative support for it, and for staff to understand how to make the connections between science activities, equity, careers, and literacy.

All these issues and concerns were incorporated into the AS+ training model and guides. *After-School Science PLUS: Hands-on Activities for Every Student* provides tools for implementing inquiry-based science that meet the National Science Standards in after-school settings. The Planning Guide (for administrators) has sections on staff development, resources, and family outreach materials in English and Spanish. The Activity Guide (for group leaders) provides hands-on activities, career and role model materials, print and website resources, family letters in English and Spanish, and more. Each activity includes reproducible biographies of women and men of science from diverse backgrounds.

CODES: E, I, PD	Educational Equity Concepts
Barbrara Sprung (barbara@edequity.org) and Merle Froschl	www.edequity.org
HRD 96-32241 (one-year grant)	
Partners: United Neighborhood House of New York; Partnership for After School Education; the Stanley Isaacs Neighborhood Center, the Grosvenor Neighborhood House (single-sex groupings), and the Hudson Guild Neighborhood Center.	
Products: After School Science PLUS: Hands on Activities for Every Student; After School Science PLUS: A Planning Guide; Activity Guide.	
Keywords: education program, after-school, community-based site, staff training, gender equity awareness, parental involvement, hands-on, inquiry-based, role models, biographies, resource guide, bilingual, real-life applications	

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Nbs

Nosebag science

NOSEBAG SCIENCE

IN HELPING TO BRING GIRL-FRIENDLY SCIENCE ACTIVITIES TO GIRL SCOUTS IN THE HORNETS' NEST COUNCIL, DISCOVERY PLACE, INC., IN NORTH CAROLINA, DEVELOPED A "NOSEBAG SCIENCE" PROGRAM—SCIENCE ACTIVITIES THAT MAKE USE OF COMMON OBJECTS, PROVIDED IN A BAGGIE. ADDED AFTER THE ORIGINAL BRIDGING THE GAP GRANT PROPOSAL, NOSEBAG SCIENCE WAS DEVELOPED AS A CONCRETE WAY TO PROVIDE EASY, FUN, ACCESSIBLE HANDS-ON SCIENCE ACTIVITIES AND TO HELP SCOUTS EARN THEIR "WORLD OF TODAY AND TOMORROW" CONTEMPORARY ISSUES PATCH.

Girls can do Nosebag Science activities at troop meetings, day camp programs, and large events such as overnights and camporees. Scout leaders say that the girls decide which activities to select, but it was clear to interviewers that the girls are heavily influenced in that decision by what the Scout leaders feel comfortable with (an influence many leaders are reluctant to acknowledge).

It is important to make science fun for the girls, to convince leaders that science is important for their girls, and to make it easy for the leaders to do science activities. Among obstacles to success with science activities, mechanical issues (such as the cost and location of materials) and lack of training in science were easiest to address. Discovery Place could train troop leaders, give them materials (or make it easy to get them), develop step-by-step instruction cards, and so on.

Dealing with negative attitudes toward science was harder. Many leaders were not as comfortable with science-related activities as others; it interested but scared them and they wanted to be sure activities were safe. Troop leaders often saw science as a foreign language or culture. They feared being unable to predict or answer girls' questions or even to know where to look for answers. *Girls and leaders must be shown how fun, meaningful, and relevant to everyday life hands-on science activities can be*.

Troop leaders said they needed activities that work, are fun, are age-appropriate and badge-related, can be done in a single session, and require only readily available low-cost materials, especially materials that can be requested by e-mail and sent to the leaders. They wanted activities immediately relevant to the girls (they can "eat it, wear it, or use it") in the medium term (related to earning a badge or patch) or in the long term (related to their life or career). They wanted activities that sound interesting, meaningful, and challenging (not babyish) but not academic or bookish. They wanted simple, clear, complete instructions, letting them know step by step what to do, what would happen, what to do after that, what might go wrong, and what to do about it. They wanted a volunteer science consultant accessible at all times and were frustrated when one wasn't.

The project staff adopted a fun, collaborative approach to training—with leaders training other leaders, who in turn trained the girls—which gave those who felt "afraid" of science new satisfactions and self-confidence. Those who felt science didn't apply to them discovered how important it is in their lives.

This project was designed to empower local Girl Scout facilitators and leaders to plan, organize, and direct grassroots activities to encourage an interest in STEM. A Science Resource Center (or "Science Pod") was up and running the second year. The first program developed was "Critters, Creatures, and Other Things" for Brownies.

It takes an academic year (August–May) to implement Bridging the Gap locally: to introduce activities, empower leaders, and engage the girls. Exposing the girls to high-interest activities at council events helps start word-of-mouth. As of December 1996, 7,361 girls and 900 adults had been exposed to Bridging the Gap activities, and the Hornets' Nest Council was planning dissemination to councils around the country.

CODES: E, M, H, I, PD	Discovery Place, Inc. (Charlotte, N.C.); Hornets Nest Girl Scout Council
Marilynn Sikes (marilynns@discoveryplace.org), Patricia K. Blake, Jerald H. Reynolds, Beverly Sanford, and Patricia Baldwin	HRD 94-50006 (one-year grant)
Partner: Hornets Nest Girl Scout Council	
Materials available: Brownie leader guides and nosebag kits for My Body, Numbers and Shapes, Science in Action, Science Wonders, Senses and Outdoor Happenings. Junior level guides are available for World of Today and Tomorrow Dabller, Aerospace, Weather Watch, Geology, Science in Action, and Discovering Technology.	
Keywords: demonstration, staff training, support system, resource center, girl scouts, activity-based, hands-on, self-confidence, collaborative learning, engagement	

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Ssl

Science-based service learning

SCIENCE-BASED SERVICE LEARNING

PROJECTS THAT HELP PRESERVE A COMMUNITY STREAM OR GET HIGH SCHOOL STUDENTS EXCITED ABOUT HIGHER LEARNING HELP CEMENT TIES BETWEEN SCIENTISTS AND THE COMMUNITY, SAYS DEBORAH WIEGAND, WHO IN 1994 PIONEERED SCIENCE SERVICE LEARNING IN THE UNIVERSITY OF WASHINGTON CHEMISTRY DEPARTMENT. MORE THAN A THOUSAND COLLEGE STUDENTS HAVE PARTICIPATED—LEADING HANDS-ON SCIENCE PROJECTS IN AREA ELEMENTARY SCHOOLS, MENTORING AT-RISK KIDS IN SCIENCE ACTIVITIES, MONITORING WATER QUALITY IN AREA STREAMS, AND HELPING HIGH SCHOOL TEACHERS ON DNA SEQUENCING PROJECTS. THE CITY OF BELLEVUE "STREAM TEAM," FOR EXAMPLE, WORKS WITH LANDOWNERS ON WAYS TO CONTROL RUNOFF AND PROTECT THE CITY'S WATERWAYS. A STUDENT MIGHT SPEND WEEKS EXAMINING THE ECOLOGY OF A PARTICULAR SITE AND THEN RECOMMEND PLANTING NATIVE SPECIES THAT WOULD DO WELL LOCALLY.

Congress created the Corporation for National and Community Service in September 1993 to support, among other activities, service-learning initiatives in higher education (called Learn and Serve America). The idea was *to make service an integral part of the education and life experiences of the nation's students—to produce educated citizens, not just educated people*. UW started its science service learning project at a time when service learning in colleges mostly involved tutoring high school students. Wiegand saw *intergenerational community service learning with measurable academic outcomes as a vehicle to engage undergraduates actively in science and to expand their vision to include issues of scientific literacy, ethics, and objectivity as well as social and political influences on community scientific decisions*. The Association of American Colleges and Universities declared her approach a national model.

With service learning, students contribute positively to the community while learning. They also experience the value and necessity of service to others and the importance of bringing science back into the community. This course's nontraditional format dispels an "ivory tower" attitude by forcing students to do science off campus.

The three service learning courses UW's chemistry department offers are progressively more challenging. The first tightly structures how students take part in community service. In the second, which can be taken as many as six times, students are expected to take on independent projects relating to their service sites. For the third, they assume leadership roles in the work being done at their sites. Students who stay for two or three quarters get more from the experience than those who stay for one. The students enjoy general acceptance, whether working with teenagers in a high school classroom (where they serve as informal ambassadors, answering questions about university life) or with patrons of a senior citizens center.

In providing a community service, students in all three courses must apply principles and methods learned in the classroom, so that they understand the value of what they are learning and how to apply it in everyday life. They can work directly with a community group or nonprofit organization on science-based projects to benefit the community, help teachers and students implement ongoing community service projects (such as growing food for community food banks), or, working with local teachers, help generate hands-on activities to draw K–12 students into scientific inquiry related to community needs and concerns. They can be especially helpful on science-based activities involving measurable change—for example, water monitoring, stream revegetation, and salmon habitat efforts.

The course *encourages the students to take more responsibility for the outcome of their learning experience*. They reflect on their service experience in two essays and a final paper. Wrote one student, "Coming up with simple, but still accurate, explanations for complex situations was one of the greatest challenges of the course. . . . It forced me to reexamine my understanding of chemical principles and interpret them for a group of ninth graders."

CODES: U	University of Washington, Seattle
Deborah H. Wiegand (weigand@chem.washington.edu), Nan Little	
HRD 95-53448 (one-year grant)	
Partner: Fund for the Improvement of Postsecondary Education (FIPSE) (Department of Education)	
Keywords: demonstration, service learning, hands-on, mentoring, real-life applications	

001
Tsp
Traveling science programs

TRAVELING SCIENCE PROGRAM

THIS SERVICE LEARNING PROJECT CHALLENGED ELEMENTARY SCHOOL GIRLS (AND BOYS) WITH HANDS-ON SCIENCE ACTIVITIES UNDER THE GUIDANCE OF UNDERGRADUATE AND GRADUATE STUDENTS, WHO SERVED AS ROLE MODELS FOR THE YOUNGER CHILDREN AND HELPED DESIGN THE SCIENCE CURRICULUM—A WORTHWHILE OUTLET FOR THEIR TECHNICAL KNOWLEDGE.

The project provided science activities in extracurricular settings (in elementary science clubs, before- and after-school programs, and community-based science programs, including some in neighborhood centers serving low-income and minority children). Older children served as peer leaders ("scientist assistants") in these activities. Parents were invited to evening activities.

Three curriculum design teams developed curriculum packets—on edible chemistry (grades K–1), brain power (grades 2–3), and genetics (grades 4–6). Each curriculum packet contained some exploratory activities that could be completed within 15 minutes or less, some that took 30 to 60 minutes, and some that could be completed at home, with or without parental involvement.

Under "brain power," for example, one class activity might be to design helmets (made of packing materials) for raw eggs, which the students would "crash test" by rolling the helmeted eggs off a cardboard ramp. (The most obvious application of this exercise is to stress the importance of wearing a helmet during sports activities.) At home, the students might train a goldfish to swim to the surface for food.

Each design team consisted of one female scientist or engineer (faculty, staff, or postdoctoral), one woman from the Iowa science center's staff, and four to six female undergraduate and graduate students. Because of the emphasis on gender-equitable science, team members attended 90-minute training workshops on gender-equitable teaching, cooperative teaching and learning, and inquiry-based learning. *Under the team model of service learning, the undergraduate and graduate students benefited from goal-oriented mentoring and developed teaching skills in a supportive environment.*

CODES: U, E, I, PD	University of Iowa
Beverly Marshall-Goodell (bev-mgoodell@uiowa.edu), Andrea M. Zardetto Smith	
HRD 96-31243 (one-year grant)	
Partners: WISE, AWS, Iowa City Community School District, Iowa City Area Science Center, Inc., Creighton University	
Keywords: education program, hands-on role models, science clubs, after-school, community-based, service learning, gender equity awareness, cooperative learning, inquiry-based	

001
Sgs
Science horizons for Girl Scouts

SCIENCE HORIZONS FOR GIRL SCOUTS

THE MONTSHIRE MUSEUM OF SCIENCE, IN COLLABORATION WITH THE SWIFT WATER COUNCIL OF THE GIRL SCOUTS AND THE WOMEN IN SCIENCE PROJECT OF DARTMOUTH COLLEGE, DEVELOPED A PILOT PROGRAM TO ENCOURAGE GIRLS IN GRADES 7–9 TO KEEP STUDYING MATH AND SCIENCE BY BOOSTING THEIR CONFIDENCE AND INTEREST IN THE SUBJECTS. ROUGHLY 80 CADETTE SCOUTS FROM NEW HAMPSHIRE AND VERMONT PARTICIPATED IN THE PILOT PROGRAM.

The project provided for hands-on science education at the Montshire Museum of Science; visits to science labs at Dartmouth College, organized by "Women in Science" undergraduates conducting research projects there; and community-based science activities (developed by the Scouts, with help from the university students and museum staff). The project also conducted a workshop on gender equity issues for the Scout leaders and for teachers from the girls' home schools.

CODES: M, I, PD	Montshire Museum of Science
Gregory F. DeFrancis (greg.defrancis@montshire.org), Joy M. Wallace, Sally P. Crateau, Elizabeth Claud	
HRD 94-50593 (one-year grant)	www.vtc.vsc.edu/wit/links.htm#girls
Partners: Swift Water Council of the Girl Scouts; Women in Science Project, Dartmouth College	
Keywords: demonstration, hands-on, self-confidence, museum, girl scouts, informal education, role models, gender equity awareness	

001
Ttr
Tech trek

TECH TREK

TECH TREK USED THE TECHNICAL AND COMMUNICATIONS EXPERTISE OF PUBLIC TELEVISION TO DESIGN, DEVELOP, TEST, AND EVALUATE A MODEL PROGRAM TO ENCOURAGE MIDDLE SCHOOL GIRLS TO PURSUE CAREERS IN STEM. IN WEEKLONG SUMMER CAMPS FOR GIRL SCOUTS, WGTE'S RADIO AND TELEVISION STATIONS PROVIDED ENGAGING, COLLABORATIVE, HANDS-ON LEARNING ACTIVITIES THAT INCREASED THE GIRLS SCIENTIFIC LITERACY AS THEY EXPLORED SCIENCE AND TECHNOLOGY OPPORTUNITIES IN BROADCAST COMMUNICATIONS. A TOTAL OF 50 SCOUTS AND 10 SCOUT LEADERS ATTENDED TWO ONE-WEEK SESSIONS.

In June, campers, their parents and/or siblings, and the staff boarded buses for the Center for Science and Industry (COSI), learning about Tech Trek by video on the way. After icebreakers and a scavenger hunt of exhibits about communications, the girls built their own crystal radio. The trip to COSI also launched the Tech Trek camps held in July at WGTE's studios.

Each girl served as a member of a news team that was assigned a topic for a video report. They toured WGTE's TV and FM studios, learning about master control, production control, and so on, and interviewed their mentors. Monday they learned how to produce for television, experimented with the cameras, and wrote scripts and storyboards for their video reports. Tuesday they videotaped at the Toledo Zoo, with mentors there to review tapes and offer suggestions for second takes. Wednesday and Thursday they edited their reports and produced promotional materials for their programs (a print ad, a radio promo, and a video tune-in spot). At-home activities guided the girls through a critical look at TV programming and advertising. Along the way they kept track of expenses based on a WGTE rate card.

Thursday afternoon they explored the science behind broadcast technologies, moving through a series of hands-on activities that demonstrated persistence of vision, the principles of electricity, how sound and light travel, how TV screens show color, and how electromagnetic waves play a role in communications. Friday they worked with the studio cameras and production switcher to put the video reports together into a news program, complete with studio hosts.

There was a statistically significant improvement in the participating Girl Scouts' attitudes toward science; many of them reported changing their goals to careers in science and technology. They also became more skilled at using electronic equipment. WGTE offered grants of $250 to organizations interested in replicating some aspect of Tech Trek in their community. By July 1997, it had formed 45 partnerships with 116 organizations.

CODES: M, I,	WGTE TV-FM
Mary Richter (mary_richter@wgte.pbs.org)	
HRD 94-53076 (three-year grant)	www.wgte.org
Partners: Maumee Valley Girl Scout Council (Cadette Girl Scouts), SciMaTEC (University of Toledo), and COSI	
Products: Tech Trek how to handbook, curriculum guide, and a videoconference videocassette	
Keywords: demonstration, television, girl scouts, summer camp, hands-on, mentoring, broadcasting, videos, career awareness	

001
Mas
Mountaineering after-school and summer camps

MOUNTAINEERING AFTER-SCHOOL AND SUMMER CAMPS

IMPORTANT ACADEMIC DECISIONS ARE MADE DURING THE MIDDLE SCHOOL YEARS, WHEN GIRLS ARE MOST VULNERABLE TO LARGE DROPS IN SELF-ESTEEM, FEEL LESS CONFIDENT ABOUT THEIR ABILITY TO DO SCIENCE AND TECHNOLOGY, FACE MORE INTENSE PRESSURES NOT TO COMPETE WITH THE BOYS, AND BEGIN TO AVOID COURSES IN COMPUTER TECHNOLOGY.

To learn what type and degree of contact is most effective in increasing middle school girls' understanding of, and interest in, STEM, Washington State University will offer three types of informal science activities, each providing 30 hours of instruction:

- After-school camps that meet at a middle school two days a week for eight weeks
- Weeklong nonresidential summer camps that meet six hours a day on an urban university campus
- A week-long residential summer camp held at WSU's Camp Roger Larson, a residential research and teaching facility located on Lake Coeur d'Alene, Idaho

The project's mountaineering theme is appropriate in the Pacific Northwest, where outdoor activities are highly visible and strongly encouraged. Moreover, mountaineering integrates math, physics, physiology, communications, materials science, geology, environmental science, and computer technology.

Students will learn about the types of materials used for ropes, tents, packs, and other equipment; about why outdoor equipment is designed the way it is and what it took to develop those designs; about the use of computers in engineering design, GIS applications, and so on; about the formation and erosion of Mt. Rainier and its context within the Pacific Rim of Fire; about dehydration techniques and foods appropriate for outdoor activities; about physiological responses before and after a rock climb (with and without full backpacks); about basic first-aid skills and water safety; and so on. They will take a field trip to Wild Walls, a certified indoor climbing gym, for a climbing experience.

CODES: M, I, U	Washington State University, Pullman
Sylvia A. Oliver (olivers@wsu.edu), Michael S. Trevisian	
HRD 00-86440 (one-year grant)	
Partner: WSU Spokane's City Lab	
Keywords: demonstration, self-confidence, after-school, summer camp, informal education, mountaineering, field trips, experiential learning, teamwork approach, mentoring	

Experiential learning supports the learning styles of young women. Expeditions are highly interdependent, requiring teamwork and group problem solving—from route choice, selection of equipment, physical conditioning, food selection, and first aid preparation to actual route finding. Camps will be taught by a certified teacher, helped by local outdoors experts, with support from women science professionals—who will provide six months of electronic mentoring support after the camp experience.

Evaluators will try to learn whether or not the mode of delivering content material, combined with a strong mentoring program, affects the girls' disposition toward STEM courses and careers.

001
Sis
Sisters in sport science

SISTERS IN SPORT SCIENCE

EVERY DAY, GIRLS LEARN HOW TO RIDE A BIKE, THROW A BALL, OR JUMP ROPE IN AN UNTHREATENING, UNCOMPETITIVE ENVIRONMENT, UNAWARE OF THE MATHEMATICAL AND SCIENTIFIC PRINCIPLES EMBEDDED IN THESE ACTIVITIES. IN THE CLASSROOM, THEY LEARN PRINCIPLES UNRELATED TO THEIR EVERYDAY EXPERIENCES—OR THEY MAY LEARN ABOUT THE TRAJECTORY OF A GOLF BALL WITHOUT CONNECTING THAT PRINCIPLE TO THE PRACTICE OF HITTING A GOLF BALL. USING SPORTS AS AN ENTRÉE TO SCIENCE, THIS THREE-YEAR INTERVENTION AIMS TO HELP SIXTH, SEVENTH, AND EIGHTH GRADE GIRLS EMBRACE MATH AND SCIENCE PRINCIPLES THROUGH A CONNECTION WITH SPORTS. SPORTS ALSO TEACH HOW TO COMPETE, HOW TO PERFECT STRATEGIES FOR OVERCOMING OBSTACLES, AND HOW TO DEVELOP TRUST, RAPPORT, TOLERANCE, PATIENCE, AND PERSISTENCE.

The project expects to involve 540 girls from six Philadelphia middle schools (as well as teachers, college students, minority athletes, and mentors) in after-school programs, Saturday academies, special sport day events, academic and summer internships, and career connections. The first year, 126 girls participated regularly, but some weeks 300 come.

Forty curriculum activities driven by science and math standards are presented after school through five team sports (volleyball, basketball, soccer, hockey, and softball) and five individual sports (fencing, golf, tennis, and track—running and throwing), in five-week rotations. (The girls *love* fencing, because smaller girls can beat larger ones; they want the science and math behind it, to get better. The project quickly realized it should also have included jump rope, an important activity in the inner city.) Roughly an hour is spent on sport mechanics and an hour on the science and math behind them. After spending time on how to hit a tennis ball, the girls might spend the rest of the time on where the ball travels (trajectory, motion, and force). In basketball, they might study the math and science of the rebound effect.

After-school activities take place one afternoon a week, in 10-week sessions. A teacher from each school and two graduate students co-facilitate, supported by undergraduate education students and minority athletes. At the end of a sport's rotation, families join the girls in a special sport day event, where the girls explain the principles involved.

At the Saturday academies, a graduate student and a teacher from each school co-facilitate (supported by undergraduate education students and minority athletes) four-hour sessions: an hour on sport mechanics and three hours on the principles involved. The second year, the girls spend more time on the science and math—including time doing computer simulations. Parent volunteers help at after-school and Saturday activities. The girls also work on a research project that interests them, seeing their mentor once a week and keeping in touch with them online. Mentors are paid to participate, to help cover the cost of public transportation, meals, and so on. (It's important to select mentors with access to public transportation.)

On a competitive basis, 20 percent of the girls (45 to 50) are awarded summer internships to participate in the sport science career camp. There they revisit sport science and math, explore career connections, and conduct research on a sport (exploring, for example, how the speed of runners has increased greatly over time—although one girl might explore the biochemistry of it and another the technology that led to the increase in speed). The girls are partnered electronically with a scientist in the field of their choice and conduct an experiment to test their hypothesis. They get service credit at their school for participating in the camp.

CODES: M, U, I	Temple University
Penny L. Hammrich (phammrich@temple.edu), Tina S. Green, Greer M. Richardson	
HRD 00-02073 (three-year grant)	
Partners: Philadelphia School System, Temple College of Technology and Engineering, LaSalle University, and Black Women in Sports Foundation	
Keywords: education program, sports-based, after-school, internships, career awareness, mentoring, urban, intervention, parental involvement, research experience	

001

Sh!

Shampoos etc!

SHAMPOOS ETC!

AROUND THE ROOM'S PERIMETER, NUMBERED TABLES HOLD INFORMATION PACKETS, SCIENTIFIC EQUIPMENT, AND CONTAINERS LABELED "CITRIC ACID," "COCAMIDE DEA," "KATHON," "SODIUM CHLORIDE," AND "DETERGENT." AT TABLES FORMING A "U" IN THE MIDDLE OF THE ROOM, A TEACHER WITH A FRIENDLY SMILE WELCOMES STUDENTS TO "SHAMPOOS ETC!," AN INQUIRY-BASED SCIENCE WORKSHOP FOR MIDDLE SCHOOL GIRLS.

Soon 24 girls from sixth to eighth grade arrive, fill out questionnaires, and examine the equipment with curious skepticism. Half an hour later the room is buzzing with energy as the girls, four to a table, discuss how to measure various ingredients, who gets to use the cool pumps, pipettes, and cylinders to do the measuring (they quickly work out taking turns), what the various ingredients are (they read the explanations on the ingredients list), and why they have to take safety precautions, such as wearing gloves and goggles.

Two hours later, the groups come together and discuss their results. The groups have used the same ingredients but in varying amounts, testing their products to find out which shampoo cleans better, is more viscous, has a better pH balance. From this discussion, they hypothesize about what combination makes the best product.

Then they're pouncing on "Jeopardy!"-like buzzers, vying with one another to answer questions such as "What chemical is used to thicken shampoo?" and "What do you use to measure small volumes?" Finally, the room fills with laughter and chatter as each girl chooses and mixes in scent and color, then designs a label to personalize her product. These girls have spent all of Saturday morning doing science and loving every minute of it.

Shampoos Etc! is a project designed to spark middle-school girls' interest in science through the formulation of personal care products. In an area where few girls take chemistry and even fewer take physics, biochemist Anna Tan-Wilson *wanted to provide performance-based science lessons that teach concepts in the physical sciences so interesting to girls that they will be compelled to explore all the sciences, not just the biological sciences they seem to prefer. The project approaches science teaching from applications students are familiar with but probably never associate with the sciences learned in school*.

First, Tan-Wilson *wanted to isolate girls from boys because when boys and girls perform science experiments together, boys measure and girls write*. She figured middle school girls would be attracted to a program in which

they could make their own creams, shower gels, shampoos, and hair conditioners. And *the possibility of varying the formulas for the products lent itself naturally to teaching measurement, good lab processes, the process of inquiry, and the testing of hypotheses*—which in turn could lead to the study of concepts in the physical sciences. By becoming familiar with chemical terms and scientific equipment now, the girls would not be put off or intimidated when they came across them later. After gaining confidence in their lab work, when confronted with a similar project in future they would be able to plunge right in.

Before each workshop, the girls tour the Lander Company's personal care products manufacturing facility, which also provides ingredients for the experiments. Asked to check off properties they might consider when purchasing shampoo, students ticked off far fewer before the activities than after—when they checked fragrance, their own skin type, brand name, antibacterial agents, color, detergent action, foaming, and viscosity.

The project developed a workshop for middle-school teachers on how to incorporate Shampoos Etc! into classroom science. It emphasized the formulation of shower gels, renamed "liquid soap" to be more acceptable to boys. After suggestions from teachers at the workshop were incorporated, an outreach education specialist went to these teachers' classrooms, brought materials and equipment, and stayed to co-teach. This unit reached more than 500 students.

CODES: M, U, I	State University of New York, Binghampton
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HRD 99-08729 (one-year grant)	
Http://bingweb.binghamton.edu/~annatan/shampoo/	
Partners: Robertson Museum and Science Center, The Lander Co.; Union-Endicott School District.	
Adapted with permisssion from an article by Janice Endresen in the Binghampton Alumni Journal.	
Keywords: education program, museum, inquiry-based, personal care products, industry partners, informal education, field trips, teacher training, self-confidence	

001

fem

FEMME continuum

FEMME CONTINUUM

CONFIDENCE IS THE VARIABLE THAT CORRELATES MOST STRONGLY WITH ACHIEVEMENT IN MATH AND SCIENCE, ESPECIALLY FOR GIRLS. TO COUNTERACT WOMEN'S NEGATIVE FEELINGS ABOUT SCIENCE AND THEIR ROLE IN SCIENCE, HOWARD KIMMEL, HAROLD DEUTSCHMAN, AND DANA LEVINE (OF THE NEW JERSEY INSTITUTE OF TECHNOLOGY'S CENTER FOR PRE-COLLEGE PROGRAMS) DESIGNED AND IMPLEMENTED FEMME (FEMALES IN ENGINEERING, METHODS, MOTIVATION, AND EXPERIENCE). THIS RIGOROUS, INTENSIVE FOUR-WEEK PROGRAM OFFERED POST–NINTH GRADE GIRLS ACTIVITIES IN SCIENCE, ENGINEERING, MATH, ARCHITECTURE, COMPUTER SCIENCE, AND THE ENVIRONMENT.

Many intervention programs designed to encourage young women to enter STEM fields are discontinued after the trial period because they are no longer innovative or because they have "done the job." But NJIT, building on its success with FEMME, sponsored an Introduction to FEMME program for high-achieving or high-potential fourth and fifth grade girls from the greater Newark area. Then, in 1994, it launched the FEMME Continuum, to give post–fifth and sixth graders (Intro to Femme alumnae) otherwise unavailable opportunities to sustain their math and science achievement, self-esteem, self-confidence, and feelings of competence.

The nonresidential program included five spring workshops, four weeks of daily summer activities, and a follow-up session in September, with content developed to encourage inquisitive minds and introduce contemporary ideas. The summer program provided 60 hours of hands-on science and math and lab experiences; daily athletic experiences (including volleyball, swimming, water polo, and tae kwon do) that encouraged team building and cooperative achievement and challenged fear of failure; math and science study groups and cooperative learning; and field trips to places like the Newark Museum, the New Jersey Marine Science Consortium, the Franklin Institute for Science (in Philadelphia), the Beuhler Space Center, and Liberty Science Center.

Whether building rockets and Popsicle-stick houses (problem solving through teamwork), doing chemistry experiments, or being introduced to marine life, the students learned about scientific methods and improved in skills, persistence, and self-sufficiency. After classes in Word and Excel, the girls prepared a newsletter. They and their parents learned about college prep courses.

Of the original 41 participants, 38 completed the project and wanted to keep participating in NJIT's Women in Engineering and Technology initiative—a series of pre-college experiences designed to advance their academic preparation in STEM. Surveys showed they were more willing to make the effort to do well in science and math, and their percentage of correct responses increased on process skills tests.

The program's most effective component was the holistic, nontraditional approach to teaching. *The most effective tools in motivating girls 10 to 12 were hands-on instructional techniques, a thematic approach to teaching and learning, and exposure to women who were practicing scientists*. But the girls were also exposed to a college atmosphere and to other students of diverse ethnic and socioeconomic backgrounds and became more willing to experiment with active learning that involved taking risks.

In cooperative learning, success does not depend on quick response time or the loudest voice, but the project team learned an unexpected lesson—*that cooperative learning must be carefully monitored, because the most outgoing personality in the group tends always to be the leader.*

CODES: E, M, H, I, U	New Jersey Institute for Technology
Howard Kimmel (kimmel@admin.njit.edu)	HRD 94-50592 (one-year grant)
Keywords: demonstration, workshops, field trips, cooperative learning, career awareness, athletics, museum, self-confidence, achievement, intervention, hands-on, summer program	

001
Scx
Science connections

SCIENCE CONNECTIONS

THE PLUS CENTER (PROMOTING LEARNING AMONG THE UNDERREPRESENTED IN SCIENCE) AT THE COLLEGE OF ST. SCHOLASTICA OFFERS WEEKLONG AND MONTHLONG SUMMER SCIENCE PROGRAMS FOR GIRLS THAT EMPHASIZE GENDER EQUITY AND REGULAR INTERACTION WITH FEMALE ROLE MODELS IN SCIENCE. BUT THE ENTHUSIASM GIRLS DEVELOP DURING SHORT-TERM ENRICHMENT PROGRAMS IS RARELY SUSTAINED IN THEIR HOME AND SCHOOL ENVIRONMENTS. THIS IS ESPECIALLY TRUE IN RURAL COMMUNITIES, WHERE GIRLS HAVE LITTLE EXPOSURE TO FEMALE ROLE MODELS AND ARE UNLIKELY TO RECEIVE STRONG PARENTAL SUPPORT FOR SCIENTIFIC PURSUITS—AND WHERE TEACHERS ARE RARELY FAMILIAR WITH COOPERATIVE ACTIVITY-BASED LEARNING AND LACK EVEN THE RUDIMENTARY SUPPLIES AND EQUIPMENT NEEDED FOR HANDS-ON ACTIVITIES. ONE PURPOSE OF THE PLUS PROGRAMS IS TO *OVERCOME TWO STEREOTYPES: THAT WOMEN CAN'T DO SCIENCE OR, IF THEY DO, THEY MUST BE NERDS*.

Students and parents had rated FAST Camp (a weeklong summer enrichment camp for sixth and seventh grade girls) highly, and the girls appeared to be highly motivated to continue math and science studies after camp. But despite strong encouragement, only eight of 122 FAST camp graduates actually participated in a follow-up summer enrichment experience when they reached eighth, ninth, or tenth grade. The single follow-up session the PLUS Center provided was not enough to counter the peer pressure and lack of support these students experienced after their initial summer experience was over.

To prevent these "leaks" from the science and math pipeline, St. Scholastica involved teachers, families, and scientists in Science Connections, a model program designed to give girls enrichment opportunities that would sustain their interest in science during the impressionable middle-school years. The two-year program let sixth graders from the summer camp continue to be involved with a peer group and with role model scientists and activities until they entered the eighth grade (when the PLUS Center has programs that focus on eighth grade students). Each year, 25 participants—sixth and seventh grade girls (from predominantly low- and middle-income rural or minority families) who had already participated in the weeklong science enrichment program—participated in a monthly series of Saturday Science workshops during the school year and a Summer Science weekend.

The PLUS Center has developed a consortium of local educational institutions and community partners to expand and maintain a pipeline of youth and family programming for grades 4 through 12 (while improving teacher training) and to produce systemic reform in STEM education. Many PLUS programs serve primarily students of color and low-income youth, many from rural communities. Survey results indicate that 76 percent of Plus Center alums have graduated from high school, 63 percent of those graduates have gone on to postsecondary education, and of those who have declared a major, 68 percent have selected majors in math and science-related fields.

CODES: M, U, I	THE COLLEGE OF ST. SCHOLASTICA
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HRD 95-54497 (ONE-YEAR GRANT)	
PRODUCTS: THE LAKE SUPERIOR GAME, AVAILABLE FROM THE UNIVERSITY OF MINNESOTA SEA GRANT EXTENSION PROGRAM, COULD PROBABLY BE ADAPTED TO OTHER BODIES OF WATER.	
KEYWORDS: DEMONSTRATION, SUPPORT SYSTEM, WORKSHOP, SUMMER CAMP, HANDS-ON, PARENTAL INVOLVEMENT, ROLE MODELS, RURAL, ACTIVITY-BASED, COOPERATIVE LEARNING, TEACHER TRAINING, UNDERPRIVILEGED	

TYPICAL ACTIVITIES

Activities at the Saturday Science workshops featured, in turn, “MacGyver” problem-solving, a FAST Camp reunion, careers, kitchen science, computers, snow science, chemistry, and ecology. In the ”kitchen science” workshop, students and parents made ice cream in ziplock bags, using milk, which launched a discussion of what the salt does and how recipes might freeze differently, depending on the ingredients (variables). In a milk chemistry experiment, they added food coloring and dish detergent to whole milk at room temperature, creating a reaction that surprised and baffled both students and parents. In the ensuing discussion of variables, they discussed what might happen if the experiment were repeated with skim milk or buttermilk—and were sent home with an assignment to repeat the experiment comparing different kinds of milk products at different temperatures.

At the end of each workshop, the girls received a science or math puzzle (from Marilyn Burns’s books and the EQUALS book *Math for Girls*) to work on over the month; there was a drawing for a small prize from among those with correct responses. Families received two AAAS publications suggesting home activities, *Science Books and Films* and *Sharing Science With Children*. Teacher and parental involvement were emphasized as a vital link in the support network for each girl.

The Summer Science Weekend began with a chemistry magic show that included experiments with dry ice, helium, indicator solutions, and so on. Saturday morning problem-solving activities were followed by ”What’s My Line?” featuring eight female scientists who brought along one piece of equipment they use regularly. Saturday afternoon water activities included the ”Lake Superior Game,” in which a bucket of water that represents Lake Superior gradually becomes polluted and depleted as the game progresses, with game cues such as this: *I am a sixth grader. I go fishing with my friend. When we clean our fish we dump the guts in the lake instead of wrapping them up and throwing them away. We think this is okay because they are biodegradable.*

GIRLS FIRST

”WHEN YOU THINK OF SCIENCE YOU THINK OF BORING, BUT IT’S NOT LIKE THAT,” SAYS A GIRL WHO ONCE DISLIKED SCIENCE. HER ATTITUDE CHANGED WHEN HER MOTHER TALKED HER INTO JOINING FIRST (FEMALE INVOLVEMENT IN REAL SCIENCE AND TECHNOLOGY). UNDER A THREE-YEAR GRANT, THE CHABOT SPACE & SCIENCE CENTER SUPPORTED ALL-GIRLS AFTER-SCHOOL SCIENCE CLUBS IN SEVEN ELEMENTARY AND MIDDLE SCHOOLS IN THE OAKLAND UNIFIED SCHOOL DISTRICT, LATER ADDING THE CALIFORNIA SCHOOL FOR THE BLIND. SEVERAL SCHOOLS CONTINUED HOSTING FIRST CLUBS AFTER GRANT FUNDING ENDED. *WHEN GIRLS GET TO MEET OTHER GIRLS WHO LIKE SCIENCE, THEY SEE THAT IT’S OKAY TO BE GOOD AT SCIENCE. IN THE COMPANY OF GIRLS WHO SHARE THEIR INTERESTS, THEY CHALLENGE STEREOTYPES AND HELP MAKE SCIENCE THE ”IN” THING TO DO IN SCHOOL*.

FIRST offered girls a safe environment in which to develop the kinds of spatial and problem-solving skills boys learn by playing with building blocks or tool sets. It gave them a chance to engage in informal experiments and to ”get messy like boys do.” And it avoided the deadly didacticism of traditional science classes. ”We don’t just sit around, take notes, and memorize,” said a seventh grader. ”We learn things in a fun way, so we won’t forget.”

Clubs ranging in size from 10 to 35 girls met weekly or biweekly. Within the group setting, girls in one school played with building blocks, tinkered with tools, made solar ovens, and observed crayfish under microscopes. Girls in another school crafted their own airplanes and learned about variables and velocity. ”If I make a mistake, I don’t feel as embarrassed,” said a fifth grader. ”I don’t know why.”

HELPING THE VISUALLY IMPAIRED

How many of us have seen these hissing cockroaches and scorpions, let alone held them? Imagine the challenge visually impaired students face in trying to observe an insect directly. Through FIRST, girls at the California School for the Blind got a chance to touch and learn about certain insects' skeletal structures and characteristics. The giant African millipede felt like "a walking toothbrush, only better" and the walking stick from Thailand felt "kind of like rubber." This club designed and planted an organic garden for its adopted animals, including a desert tortoise, millipede, and dwarf rabbit.

Unable to look through the lens of a microscope or view the patterns on delicate seashells, students who are visually impaired have found themselves on the sidelines in science classes more because of people's attitudes than because of their visual impairment. *With the right combination of opportunities and expectations, students who are blind or visually impaired can participate in hands-on science if their teachers are resourceful*. Under Marcia Vickroy's leadership, the science club members did hands-on projects—such as making body glitter, lip balm, and scented soaps—that introduced them to chemistry and to valuable lessons about following directions, measuring, using scientific equipment, and making careful observations.

During the transition from elementary to middle school, the opinions of peers can make it difficult for a girl to take the lead in a science experiment or to assume her fair share of computer time. The girls-only setting helps students expand their interests and try new activities without feeling pressure to conform to stereotypes. "You can be more yourself because there's no one to say, 'Ha-ha, you did that.' Girls understand."

Such clubs provide a supportive environment in which girls can try out new roles. *Girls who are typically reserved in classrooms flourish in science clubs, speaking up and asking questions. And the skills and confidence developed in clubs often transfer to coed classrooms*. After a session designing and building, third-grade girls at one school returned to their classroom and began playing in the block corner previously occupied by boys. Moreover, boys were more likely to seek FIRST girls out as partners in cooperative activities, valuing the knowledge they brought to the situation. Field trips—to such places as Slide Ranch, the Berkeley Botanical Gardens, and the emergency room of a local hospital (to observe various diagnostic procedures)—helped round out the students' understanding of science. Although gender equity was important to FIRST, not all schools pushed the all-girls aspect of it, and boys often benefited indirectly.

With high expectations and hands-on experience, girls become leaders. FIRST girls played key roles, planning projects that addressed real local needs. Students at one elementary school alerted their neighbors to the dangers of dumping chemicals in storm drains. Students at a middle school created survival kits for natural disasters. In some schools, the girls in middle school taught what they learned to girls in elementary school. Survey results confirm that FIRST increased girls' confidence. Girls in FIRST were more likely than other girls, and boys, to agree with the statement "I am good at science."

Visiting scientists, who also served as role models, also helped girls and their families make informed choices about school and career options. Ask one of the girls in FIRST what she'd like to be when she grows up and you are likely to hear about a career in science.

Benefits extended beyond the science clubs. FIRST teachers received books and science equipment that enriched classroom libraries and science and technology lessons—making it possible for some students to use a microscope for the first time. A summer institute for teachers conducted by the Community for Resources in Science provided training in gender equity and science inquiry, helping FIRST teachers engage every student in class activities and discussions. *Teachers met regularly throughout the project to exchange ideas and resources*. "This is where we review, reflect, and plan," said one teacher. "We learn about gender equity issues and gender neutral strategies, try out new science activities, and network with our colleagues. *If there is one thing I would keep going even when this project is no longer funded, it would be these meetings*."

CODES: M, E, I	Chabot Space and Science Center
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HRD 95-55807 (three-year grant)	
www.chabotspace.org/visit/programs/first.asp	
Partners: Fruitvale, Sequoia, John Swett, Thornhill elementary schools and Claremont, Bret Harte, and Montera middle schools in Oakland Unified School District; California School for the Blind (in Fremont) AWIS (East Bay chapter).	
Products: Girls FIRST: A Guide to Starting Science Clubs for Girls by Linda Kekelis and Etta Heber.	
Keywords: demonstration, hands-on, field trips, role models, after-school, science clubs, spatial skills, problem-solving skills self-confidence, career awareness, parental involvement, gender quity awareness	

001
Tkb
Techbridge

TECHBRIDGE

WITH TOOLS OR TECHNOLOGY, MANY WOMEN EXPERIENCE APPREHENSION INSTEAD OF JUST JUMPING IN AND GIVING THEM A TRY, AND IT DOESN'T HELP THAT MOST COMPUTER GAMES AND COURSE OFFERINGS ARE DESIGNED FOR BOYS. BUT TECHBRIDGE, A THREE-YEAR PROJECT TARGETED AT JUNIOR AND SENIOR HIGH GIRLS, IS DEMONSTRATING THAT GIRLS CAN BE INTERESTED IN TECHNOLOGY WHEN A PROGRAM INCLUDES

- ACTIVITIES THAT DEMYSTIFY TECHNOLOGY
- ACTIVITIES THAT BUILD BOTH SKILLS AND CONFIDENCE IN HANDLING TECHNOLOGY
- A SAFE PLACE TO LEARN AND WORK WITH COMPUTERS
- PROJECTS THAT ADDRESS GIRLS' REAL NEEDS AND INTERESTS
- TASKS THAT ARE CHALLENGING—BUT NOT TOO CHALLENGING.

Before- and after-school programs for middle and high school girls lie at the heart of Techbridge. A self-selected team of 17 teachers hosts Techhbridge programs serving about 170 students (and their families) at five Oakland middle schools and four high schools, with a project under way for the Fremont School for the Blind. Teachers welcome applications from girls who like math and science, are curious by nature, or see themselves as leaders.

Teachers can see the impact such clubs have on young girls' lives, especially in middle school, where it's not cool to be smart. The club sponsors create a comfortable space where girls can talk about report cards and academic achievement, with no fear of being teased, and can encourage each other to succeed.

Techbridge classes were expected to meet once every week or two, but several schools met more regularly or added lunchtime sessions to accommodate students who took school buses home. One school added a class that meets an hour before school and is fully enrolled, with two dozen girls who have had more than 150 lessons. At one school, half the girls enrolled show up even for a Friday afternoon session, hardly the most popular time to be at school. *One reason some girls attend is that there is no alternative after-school activity that is both physically and socially safe. After-school programs like Techbridge also give girls a chance to connect with caring teachers, which is difficult in classrooms where teachers have 150+ students a day.*

Learning is project-based. Lessons on hardware helped demystify technology for the girls, who are given a chance to take computers apart and learn the names and functions of hardware components. *This is the first time many girls have ever had a chance to tinker and use tools*. In some classes, as a follow-up lesson girls are asked to reassemble components and to install additional memory in their computers. Girls arrived in one class to find that the computers, hard drives, and mouses had been disconnected, and that it was up to them to figure out how to get their computers working.

Girls in urban settings where access to technology is limited, especially in middle schools, greatly benefit from access to computers. Some girls don't have computers in their homes or have inadequate equipment and software. An enrichment program like Techbridge gives them time to learn and explore computers and the various applications available. Multimedia projects often capture the interest of girls not already interested in computers.

Many program activities are based on ideas the girls proposed, such as designing school yearbooks or creating a girls' magazine—activities that sustain students' interest for months, allowing girls with varying skills and interests to work together and bridging cultural divisions. Girls were free to select the content, themes for which ranged from Asian Pride to Barbie and Ken to Techbridge.

A special-education student who struggled with academic subjects in the regular classroom successfully worked her way through a tutorial for creating a website, with the teacher referring other students to her as "the expert." *Without Techbridge, such a success would have been impossible, because academic skills are gatekeepers to computer course electives at her middle school. Such successes can turn around girls' behavior and attitudes*. That Techbridge is for girls only is critical for the ease with which girls try new activities.

Field trips and summer programs are social learning experiences. Girls participating in the summer Media Academy come to the Chabot Science Center for a week, working six hours a day to learn the ins and outs of digital video production. Many of them say that making the videos doesn't feel like work at all. That's exactly the *message Techbridge tries to get across: that being involved in technology doesn't mean sitting in front of the computer without friends—that you can have a good time with it*. A summer program will introduce girls to geographic information systems (GIS) and to art and technology projects through which they learn programming skills. Field trips to museums like the Tech Museum of Innovation in San Jose offer hands-on learning but are very hard to schedule during the regular school day in middle school and high school. Often scheduled on the weekend, they require that teachers give their personal time.

Technology is more than computers. Girls learned to use power tools in the school's woodshop, built phones and called home on them, and made electronic products from kits. On starting to assemble AM–FM robots, the girls in one group looked first at the kit instructions and then at the teacher, expecting her to tell them what to do—they had little patience for reading or following directions. But the following week they came in with all the radios playing and were astounded that they had done it. And then it got easier. By the spring, they were turning to each other for help putting together other kits, proud to be figuring things out for themselves.

Teachers learned the importance of selecting the right level of challenge. With radio kits that required considerable soldering, not a single kit worked at one school, while girls at another school proudly played music on their simpler, solderless radio kits.

How do the girls fare back in a coed classroom? *With the skills and confidence gained in the after-school program, where they feel safe and proficient, the girls are often leaders back in the classroom, and the boys sometimes ask them how to do something. Some girls even become advocates*, challenging teachers and asking them, for example, why they call more on boys than on girls. Meanwhile, boys, seeing what is going on, often wish for such a Techbridge of their own.

Role models are important. Girls who can identify with someone in a technical field find it easier to picture themselves doing similar work one day. Women working in STEM fields come to the clubs to work on projects with the girls and to discuss the paths they took that led to their current positions. *Finding role models was easy, but considerable planning, support, and*

follow-up are required to make their involvement smooth and successful. The Oakland-based Community Resources for Science helps train the role models, giving them *ideas for hands-on activities and tips for speaking to students in a way that doesn't come across as lecturing*. Techbridge is developing guidelines to make the process more meaningful for everyone.

Teachers need support. Some benefits extend to students (including boys) not participating in the programs, *Teachers learned, for example the importance of supporting problem-solving and encouraging girls to persevere instead of rescuing them.* Teachers involved in Techbridge attend monthly meetings at the Chabot Center to share resources, swap ideas, and hear speakers. Teachers find the meetings useful for networking across groups and learning what worked and what didn't. Many of them need technological training and support and want more hands-on lessons that demonstrate real projects and activities. Several teachers reported that their involvement in Techbridge provided much-needed resources and role models, a group of motivated students, freedom to try new projects, respite from stress, and the infrequent opportunity to get feedback about their teaching (from Techbridge staff).

Techbridge researchers will interview 30 girls and their parents to find out what role gender and culture play in technology and to learn how they might improve the Techbridge program. The program will know it has succeeded if the programs last beyond the three years of NSF support, if the host schools take over support for the prorgram (as happened in six of the seven schools that hosted the FIRST program), or if the business community provides support at specific sites. Progress is being made, but *much work must be done at the family level, because so many things about gender roles are unconscious. Parents want to do the right thing, and if given information and resources make the right choices. But many parents are unaware of the reasons girls are under-represented in science and technology.*

CODES: M, H, I, PD	CHABOT SPACE AND SCIENCE CENTER
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HRD 99-06215 (PLANNING GRANT) AND 00-80386 (THREE-YEAR GRANT)	
www.chabotspace.org/visit/programs/techbridge.asp	
PARTNERS: OAKLAND UNIFIED SCHOOL DISTRICT, CALIFORNIA STATE UNIVERSITY (HAYWARD), MILLS COLLEGE, LAWRENCE LIVERMORE NATIONAL LABORATORY, AND COMMUNITY RESOURCES FOR SCIENCE.	
KEYWORDS: DEMONSTRATION, TECHNOLOGY, SELF-CONFIDENCE, PROJECT-BASED, COMPUTER SKILLS, COMPUTER PROGRAMMING, FIELD TRIPS, SUMMER PROGRAM, HANDS-ON, TEACHER TRAINING, GENDER EQUITY AWARENESS, ROLE MODELS	

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Gsi

Girls in science

GIRLS IN SCIENCE

THIS CRANBROOK INSTITUTE OF SCIENCE PROJECT GIVES MIDDLE SCHOOL GIRLS AN OPPORTUNITY TO BUILD THEIR SCIENCE SKILLS AND ENCOURAGES FUTURE TEACHERS TO LEARN GENDER-FAIR TEACHING PRACTICES. THE PROJECT STARTED WITH INFORMAL SCIENCE ACTIVITIES AS VEHICLES FOR CHANGING CLASSROOM CLIMATES: WEEKLY AFTER-SCHOOL GIRLS-IN-SCIENCE CLUBS (ATTENDED BY 25 TO 30 GIRLS) AND AN ANNUAL EXPLORATHON—A ONE-DAY EVENT FEATURING HANDS-ON SCIENCE WORKSHOPS LED BY FEMALE SCIENTISTS. THE PROGRAM THEN TRAINED MORE THAN 60 OAKLAND UNIVERSITY STUDENT TEACHERS IN GENDER-FAIR BEHAVIORS AND TEACHING STRATEGIES.

Field supervisors and teaching peers wrote evaluations and video-monitored the student teachers in real classroom environments. The videotapes allowed the student teachers to see for themselves what aspects of their classroom demeanor were satisfactory or needed improving. A coding system helped evaluators track how well teachers maintained gender and ethnic equity in their own classrooms and the videotapes were all coded.

To disseminate knowledge about gender-equity issues, the project created a community-based Girls in Science resource room at the institute. This room—available to regular and student teachers, parents, youth leaders, and students—is stocked with books, papers, training manuals, and information about summer camps, workshops, science scholarships, and classroom activities that focus on girls and women.

CODES: PD, M	Cranbook Institute of Science
Janet Johnson, Dawn M. Pickard, Dyanne M. Tracy	
HRD 94-53112 (three-year grant)	
Partner: Oakland University	Product: A handbook for student teachers
Keywords: demonstration, teacher training, gender equity awareness, resource center, science clubs, museum, informal education, after-school, hands-on, workshops, videos	

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wia

Women in astronomy

WOMEN IN ASTRONOMY

SCIENCE TEACHERS KNOWLEDGEABLE ABOUT ASTRONOMY DEVELOPED THE IDEA FOR THIS PILOT AFTER-SCHOOL PROGRAM FOR MIDDLE AND HIGH SCHOOL GIRLS. THEY SAW A CHANCE TO COMBINE A MODEST, EXISTING VOLUNTEER PROGRAM WITH A MORE FULL-FLEDGED PROGRAM SERVING THE BROADER COMMUNITY.

The idea was to get adolescent girls interested in science through astronomy-related activities, including their own research for, and production of, a new planetarium show and video about women's contributions to the field. Involving adolescent girls in this creative project would teach them basic concepts of astronomy, the skills needed to contribute to science, and how to use computers for research and multimedia production. After eight months, the two teachers and 40 girls directly trained would provide a model for others who wanted to use active learning to tell their own stories of scientific achievement.

Project design was influenced by the work of researchers Elizabeth Cohen and Ann Brown, using especially their strategies for developing multiple abilities and distributed expertise to improve intergroup relations, to promote teamwork, and to create an end product—in this case, the planetarium show and video. (For example, Cohen's study of groupwork strongly suggests eliminating low-status designations for students.) It also built on Brown's work on involving students in their own research to improve their performance and capabilities.

CODES: M, H, I	CHABOT SPACE AND SCIENCE CENTER
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HRD 95-53488 (ONE-YEAR GRANT)	
www.chabotspace.org	
KEYWORDS: DEMONSTRATION, ASTRONOMY, AFTER-SCHOOL, RESEARCH EXPERIENCE, ROLE MODELS, VIDEO, TEAMWORK APPROACH	

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gpe

Girls for planet earth

GIRLS FOR PLANET EARTH

BUILDING ON THE HUGELY SUCCESSFUL WILDLIFE SCIENCE CAREERS PROGRAM, THIS THREE-YEAR PROGRAM FROM THE WILDLIFE CONSERVATION SOCIETY/BRONX ZOO WILL CAPITALIZE ON YOUNG WOMEN'S ENTHUSIASM FOR ANIMALS, NATURE, AND INFORMAL SCIENCE CENTERS TO GET THEM INVOLVED IN SCIENCE. IN A WORLD INCREASINGLY ALTERED BY HUMAN ACTIVITY, WHAT HAPPENS TO THE ENVIRONMENT IS TREMENDOUSLY IMPORTANT TO YOUNG PEOPLE. BY TACKLING SUCH RELEVANT REAL-WORLD SUBJECTS AS ECOLOGY AND ENVIRONMENTAL SCIENCE, GIRLS FOR PLANET EARTH HOPES TO INCREASE GIRLS' PARTICIPATION IN SCIENCE.

Many women professionals on the WCS and zoo staff are national and international leaders in their fields, so WCS is in a unique position to provide

- An annual Earth Summit, introducing 80 girls (aged 14 to 17, in teams of two and three) to environmental science, to regional environmental issues, and to careers and female role models in environmental science
- A series of service-learning projects through which Earth Summit participants will be encouraged to apply what they have learned in community-based projects that combine knowledge, service, and reflection
- A program of technical assistance to help girls with these projects
- A "virtual" clubhouse through which girls can communicate with one other about the program and environmental issues—and through which to showcase (and learn from) model community outreach and research projects

The program is expected to reach thousands of girls across the United States, with the help of its important partner organizations.

CODES: R, H, I	WILDLIFE CONSERVATION SOCIETY
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HRD 01-14649 (ONE-YEAR GRANT)	
PARTNERS: GIRL SCOUTS OF THE USA, THE NATIONAL 4-H COUNCIL, THE BOYS AND GIRLS CLUBS OF AMERICA, GIRLS INC., AND THE CHILDREN'S AID SOCIETY	
KEYWORDS: DEMONSTRATION, FIELD TRIPS, SUPPORT SYSTEM, CONFERENCE, CAREER AWARENESS, ROLE MODELS, SERVICE-LEARNING, INFORMAL EDUCATION, ECOLOGY, ENVIRONMENTAL SCIENCE, GIRL SCOUTS, 4-H; GIRLS, INC., PEER GROUPS, REAL-LIFE APPLICATIONS	

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Girls and technology

GIRLS AND TECHNOLOGY

IN 1995 THE NATIONAL COALITION OF GIRLS' SCHOOLS SPONSORED A THREE-DAY CONFERENCE FOR TEACHERS AT WELLESLEY COLLEGE. TEACHERS ENJOYED WORKSHOPS ON EVERYTHING FROM UNDERSTANDING SIMPLE MACHINES, TO ROBOTICS, TO BUILDING SOLAR-POWERED MODEL CARS, TO USING COMPUTERS FOR DATA COLLECTION, SIMULATION, AND COMMUNICATION. THEY HEARD FROM PRESENTERS KNOWLEDGEABLE ABOUT CURRENT USES OF TECHNOLOGY IN SCHOOLS, WHY GIRLS STILL LAG BEHIND IN STEM, AND WHAT EDUCATORS AND PARENTS CAN DO TO ENCOURAGE GIRLS' CURIOSITY, CONFIDENCE, AND INVOLVEMENT IN TECHNOLOGY.

Paula Rayman (of the Radcliffe Public Policy Institute) identified four factors that influence whether girls and women are attracted to science:

- **Interactivity.** The opportunity to play around with science is unquestionably important.
- **Social relevance.** Science needs to be presented in useful, meaningful ways, in a social context. Why, for example, is physics important in everyday life?
- **Software not based on violence or conflict**. There is not yet enough gender-neutral, life-affirming software.
- **Evidence that science is relevant to women's lives.** Parental involvement and support is crucial in confirming science's importance to girls' lives.

Three products useful to educators and parents emerged from the conference: a video, a resource guide, and an Idea Book, containing guidance and awareness-raising exercises for educators, guidelines for evaluating science books for stereotyping and bias, guides to online resources and software for girls, and hands-on activities for students in grades 1–8 and grades 9–12.

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HRD 95-52986 (ONE-YEAR GRANT)	www.wcs.org
AVAILABLE FROM NCGS'S USEFUL WEBSITE: VIDEO, RESOURCE BOOK, AND GIRLS & TECHNOLOGY: AN IDEA BOOK FOR PARENTS AND EDUCATORS	
KEYWORDS: DISSEMINATION, BEST PRACTICES, ENGAGEMENT, TECHNOLOGY, HANDS-ON, REAL-LIFE APPLICATIONS, PARENTAL INVOLVEMENT, VIDEO, RESOURCE GUIDE, CAREER AWARENESS, COLLABORATIVE LEARNING, SELF-CONFIDENCE	

TIPS FOR PARENTS AT HOME

Cultivate your daughter's interest in how things work by having her tinker, take things apart, and put things together. Keep expectations high. Children are natural scientists because they are inquisitive. Encourage her to learn how to repair the loose chain on her bicycle, program the VCR, take apart a broken appliance, change a tire. Work with her as she does these things.

Engage her in projects that develop spatial reasoning and analytical skills. Older girls may enjoy tinkering with a chemistry set or building a robot from a kit. For younger ones, try some at-home science experiments—many books at your local library include fun activities with step-by-step instructions. Better yet, have her do these things with her girlfriends.

Create a computer area within your home that is as accessible to your daughter as it is to your son.

TIPS FOR PARENTS AT SCHOOL

Ask your daughter's teachers about specific hands-on lessons in math, science, and technology. Find out what computer programs, materials, and equipment are available for her use and how often she uses them. If the teacher replies "not often," find out why not.

Talk with your daughter as she plans her class schedule each year.

Monitor her math, science, and computer course choices. Urge her to take more than the minimum requirements as these fields are often gateway subjects for future career choices. Encourage her to pursue physical as well as biological sciences. Talk to her teachers about which math and science courses will help prepare her for the widest variety of career choices.

Urge your daughter's school to plan special events with an emphasis on technology and women. Offer suggestions of local resources and other parents who might have experience in related fields.

Consult with your daughter's teachers. Make sure they are aware of the subtle messages that can steer girls away from computers.

Suggest that your daughter's teachers set aside time in the computer room just for girls. Or be sure that teachers make computer use a mandatory activity for all students.

TIPS FOR TEACHERS

Connect math, science, and technology to the real world and real people in their historical, philosophical, and functional contexts. Show them contributing to the good of the world.

Choose metaphors that reflect both girls' and boys' experiences. Balance the use of words like "master," "command," or "tackle" with words like "connect," "choose," or "embrace."

Monitor which students are at the computer most often, have their hands on the equipment, and are leading the experiments. Be sure the girls are as active as the boys. Require equal time on the computer as part of your assignments. Don't let only the boys act as experts in the computer class.

Brainstorm with students about all the careers that use technology. Help them develop a more inclusive definition of who will need to be computer literate. Develop a list of people in various occupational niches who use technology, such as architects, fashion designers, teachers, artists, musicians, choreographers, home design consultants, athletes, business people, and librarians.

Foster an atmosphere of true collaboration. Many teachers insist that a true group project is one in which no single group member could complete the project without the group's help.

Encourage girls to act as experts. When the teacher has all the answers, students rarely exhibit self-confidence. As students critique their own work and that of their peers, they begin to see themselves as scientists. The technique of the teacher refusing to act as an expert is a powerful learning prompt for students.

Experiment with alternatives to note taking. Girls often get so absorbed in taking down every bit of information that they miss out on discussions. Set aside some classes where no note taking is allowed, hand out lecture notes ahead of time, or rotate the note-taking responsibility, with notes shared afterward.

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Summerscape

SUMMERSCAPE

SUMMERSCAPE WAS A TWO-WEEK "TEACHING AND LEARNING" SUMMER CAMP THAT HELPED AN ETHNICALLY AND SOCIOECONOMICALLY DIVERSE GROUP OF MIDDLE SCHOOL BOYS AND GIRLS WHO HAD EXPRESSED AN INTEREST IN STEM EXPERIENCE SUCCESS IN SCIENCE AND ENGINEERING. GEORGIA TECH'S CENTER FOR EDUCATION INTEGRATING SCIENCE, MATHEMATICS, AND COMPUTING DESIGNED SUMMERSCAPE.

The camp was also an effective model for professional development in gender equity. Over two years, 32 teachers recruited from Metro Atlanta school systems learned about SummerScape, the National Science Education standards, inquiry-based science, collaborative learning, and gender equity. They also administered an attitudinal survey and a "draw a scientist" activity to their students and observed their SummerScape teammates in class using a simple coding instrument. The second year, they participated in four days of professional development, covering science content, with an emphasis on inquiry-based science. Curriculum units were designed to reflect real-world science and engineering problems and to give students hands-on technological experiences girls rarely encounter (e.g., wiring circuit boards and using soldering irons and electric drills).

Immediately after teacher training, the teachers were able to practice new teaching strategies in the low-risk environment of a two-week summer science camp. There they team-taught one curriculum unit to two 90-minute classes of about 20 students a day. In daily workshops, they learned more about gender equity, basic classroom equity issues, learning styles, multiple intelligences, alternative assessment, visual organizers, instructional models for organizing lessons, and action research.

During Year 1 the curriculum covered Electricity and Circuits (which involved building and racing a solar-powered car), Bottle Biology (activities using recycled plastic bottles and emphasizing creation-of-life science experiments), and Learning By Design (a design-based engineering curriculum). During Year 2 the curriculum was Civil Engineering and Earthquakes (rated the most significant and worthwhile by participants, this unit culminated in students creating balsawood towers and testing their strength with an earthquake simulation machine), Thinking Like Leonardo (designing, constructing, and testing a large chair of heavy cardboard), and Learning By Design.

To aid in judging teachers' progress, the project developed a scale of teacher awareness and concern about gender equity, as shown in the following table:

SCALE OF TEACHER AWARENESS AND CONCERN

0	**UNAWARE**	negligible awareness
1	**ATTENDER**	aware of literature, national statistics, what experts say
2	**REFLECTOR**	applies awareness to self, reflects own behavior
3	**MODIFIER**	actively monitors own behavior, changes own classroom practice
4	**DIRECTOR**	actively acts as agent of change in school or district

At level-1 awareness, teachers were learning about subtle, unconscious teacher bias based on student gender and were becoming aware of girl–boy interactions in the classroom. They were learning how important "wait time" and alternative assessment are and that gender-equitable cooperative groups benefit both girls and boys. They were also learning new content (basic electrical engineering and how to solder, for example). At level 2, they were thinking about their own practices. At level 3, they were making plans to change their classroom behavior.

During the school year, teacher participants were asked to conduct a gender equity workshop for staff at their school, to identify a related problem or question and investigate it using action research, to return to Georgia Tech for periodic SummerScape meetings (attended better if the project provided dinner and a room for teachers' children), and to submit a report and modified lesson plans. They were compensated in full if they completed the school-year component.

Action research projects—using observation sheets to code faculty–student interactions—tended to make true believers out of teacher participants. After even a short period of observation, it was clear that boys typically benefited more from teacher–student interactions than girls did. These SummerScape teachers presented their coded results to the teachers observed, and the total consolidated results at their gender-equity staff meetings, thereby deflecting criticism from their peers that the national data don't apply in their schools.

It's worth mentioning that one of these teams consisted of two African American men from a primarily African American school, who initially signed up for SummerScape because they weren't placed in another program. They came with open minds but were ignorant of the issue. They went back to school preaching about equity (by gender, race, and socioeconomic level). Using release days to do their research convinced them of the issues. *Generally, however, faculty in primarily minority schools resisted gender-equitable approaches because in their schools the high-achieving students tended to be African American girls. They believed it was African American boys who needed best practices, and it was difficult to convince them that gender-equitable practices benefit all students, not just girls*.

Strong teachers who teach in lower-risk school settings (schools with good leadership and supportive parents, where teachers feel valued as professionals and are not overwhelmed with job responsibilities) were able to implement the school-year component with little help from the project staff. Some teachers could have successfully implemented it if the project had built more hands-on assistance and emotional support into the program. A certain number of able, concerned teacher participants paid only lip service to the school-year component or disappeared from the program altogether. Time was a problem, compounded by the low priority some schools gave to gender issues. For effective school-year implementation, *it is crucial to have support from the school principal and not to have the school system "impose" participation*.

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HRD 97-11046 (one-year grant)	www.ceismc.gatech.edu/ceismc/programs/tlcamps/summer.htm
Partners: Board of Regents, University System of Georgia; Fulton County, DeKalb County, Henry County, and Clayton County School Systems; Atlanta Public Schools.	
Many project activities and resources are reproduced in InGEAR Professional Development Manual for Gender Equity in Collegiate Science, Engineering, Mathematics, and Education, available online at (www.ceismc.gatech.edu/ceismc/programs/ingear/homepg.htm) Videos used: Failing at Fairness (two videos from the Dateline TV show), Girls Can! (AAUW), Girls in the Middle: Working to Succeed in School (AAUW), and Gender Equity in the Classroom (Sadker).	
Keywords: demonstration, summer camp, teacher training, gender equity awareness, self-confidence, achievement, professional development, inquiry-based, collaborative learning, hands-on, engineering, real-life applications, workshop, gender differences, research findings	

WHICH WORKS BEST: SINGLE-SEX OR COED CLASSES?

Year 1, the SummerScape classes were either all girls or a mix of boys and girls, to permit analysis of the differences between class dynamics and interactions in all-girl and coed classes. More girls than boys enrolled in the camp but many of the coed classes were disproportionately boys. Year 2, the project decided it was important to analyze the dynamics of both all-boy and all-girl groups. During Year 2, all teachers taught both a single-sex class and a coed class and were asked to compare the classroom environments in single sex and coed classes and groupings.

To make notes about interactions in a group setting, teachers coded behavior using a student–student interaction observation sheet, recording (for each student) the frequency of social interactions and of academic interactions and whether they listened to others, waited until a speaker was finished before speaking, used an appropriate tone of voice, asked for help from peers, asked for help from the teacher, shared materials, made suggestions, or initiated solutions. Coding data (for a "snapshot" in time) were also collected for on-task and off-task behavior.

Classroom coding data suggest that *both girls and boys feel freer to interact and ask questions in single-gender groups. Boys especially interact more in all-boy groups than in coed groups, tending to be more asocial and off-task in coed than in same-sex groups.* (Girls appear to be a stabilizing influence on classroom behavior.) All-boy groups tend to be louder and rowdier than coed groups, whether on- or off-task, and off-task boys feel freer to be disruptive in all-boy groups than in coed groups.

Boys are less inclined than girls to ask for help from the teacher while working on a project, and are more likely to progress or experiment without consulting the written instructions. These characteristics were accentuated in the single-sex classrooms to the point that teachers in the all-girl robot-building class sometimes felt overwhelmed by the number of girls approaching them for assurance about each step in the sequence. This slow and deliberate construction style led some girls to not complete their robots by the end of camp. By contrast, many of the boys "completed" the robots without much concern for the written instructions, ending up with robots that didn't necessarily work properly.

In general, teachers loved the all-girl classes, thought the coed ones were generally fine, and disliked the all-boy classes. Virtually all students stated that they would prefer a coed class to a single-sex one.

Girls working in same-sex groups or classes tended to do quiet, calm, focused work according to written instructions, punctuated by specific, content-related questions to the teacher. Such behaviors produce the calm environment some girls prefer and lead to traditionally "satisfactory" results, which classroom teachers tend to value. But little high-risk experimentation takes place under these conditions, and in SummerScape a number of girls became bogged down in the instructions and in ensuring that each step was done properly.

When boys experiment without consulting the teacher, teachers get less immediate feedback about student progress during the project and more boys than girls do not complete the task "correctly," leading to the view that the groups of boys are "off task." But this type of free-form, independent behavior is central to scientific inquiry and should have ample sanctioned outlets within the educational system.

Clearly, both single-sex and coed groupings and classes present benefits and drawbacks. Middle school students report preferring coed groups, but within coed groups they tend to work primarily with members of their own sex. Even at that age they recognize that there are benefits to getting ideas from people who think differently than they do but also that diversity presents its own challenges.

After observing girls and boys tackle science and engineering projects, *the SummerScape staff had a dual wish: that the boys would read the instructions a little more often and perhaps show more concern for the final product, and that the girls would exhibit a bit more risk-taking behavior by not being so tied to the written instructions. Single-sex groups accentuated these tendencies and allowed students to stay within their behavioral comfort zone, leading to all-girl groups that were highly manageable and well behaved and to all-boy groups that tried the patience of the teachers*.

The project's conclusion about classroom grouping, based on the SummerScape experience: *Middle school students should be given the opportunity to work in both balanced coed and single-sex groups. Single-sex groups allow students to concentrate on content, to be freer in their interactions with their groupmates, and to work in a more focused way. The balanced coed group allows them to interact with the opposite sex (which as adolescents they like to do) and forces them to deal with a more diverse way of thinking and problem solving*. It also gives students a chance to learn to appreciate what students of the opposite sex bring to the table (and lets boys learn that girls can excel in math and science).

The worst grouping tactic is to have unbalanced coed groups with only one child of a particular sex. A child alone in a class of the opposite sex is likely to be ignored, interrupted, and generally disregarded by the other members of the group, gaining none of the advantages of either of the other types of grouping.

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Science is for us

SCIENCE IS FOR US

THIS PROJECT AIMS TO IMPROVE GIRLS' ATTITUDES TOWARD SCIENCE, KNOWLEDGE OF SCIENCE CONTENT, AND AWARENESS OF CAREERS IN SCIENCE. PARTICIPANTS WILL BE SEVENTH, EIGHTH, AND NINTH GRADE GIRLS FROM TWO OHIO AND GEORGIA SCHOOLS THAT SERVE MANY LOW-INCOME FAMILIES.

In after-school science clubs meeting once a week for two hours, 60 girls will engage in scientific inquiry on topics that require them to connect science to their lives. They will visit two female scientists in their labs once a month to learn about the women's research programs and discuss the girls' science club projects. As they move through the science club experience, the girls will map their personal career goals.

At the same time, teachers, parents, and school counselors will learn about female-friendly ways of teaching and fostering girls' interest in science. The teachers' component will show teachers how to create a gender-equitable science classroom and how to compensate for subtle gender bias in textbooks. Parents and school counselors will be taught to nurture the interest in science that the science clubs should generate.

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HRD 99-08776 (one-year grant) and HRD 01-96449 (one-year grant)	
Keywords: demonstration, after-school, science clubs, career awareness., underprivileged, field trips, real-life applications, role models, parental involvement, teacher training, gender equity awareness	

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Calculate the possibilities

CALCULATE THE POSSIBILITIES

THIS BALL STATE UNIVERSITY PROJECT FOR INDIANA GIRLS IN GRADES 11 AND 12 EMPHASIZED CAREER AWARENESS AND SKILL DEVELOPMENT IN STEM. THE FOUR-WEEK RESIDENTIAL PROGRAM ON THE BSU CAMPUS ENGAGED 24 GIRLS IN CAREER-RELATED ACTIVITIES, TECHNOLOGY TRAINING, AND COLLABORATIVE WORK WITH A BSU MENTOR IN BIOLOGY, CHEMISTRY, NUTRITION, PHYSICS, OR PSYCHOLOGY. JAZZERCISE, BOWLING, SOFTBALL, SWIMMING, AND HIKING ROUNDED OUT THE PROGRAM.

The girls were each given a T1-92 graphing calculator and learned how to use it to solve algebra, geometry, and statistics problems; they learned to use Lotus software to solve math problems and were introduced to e-mail and the Internet. They spent time in a university laboratory and afterward independently solved a related research problem at their home school, using the Internet and supported by an onsite resource teacher and their university mentor.

Through career training and seminars, visits to industrial sites, and panel discussions, the girls learned about their own values, preferences, and attitudes toward various STEM careers and opportunities. Through visits to Eli Lilly and other industrial sites, they learned firsthand what each STEM career and job opportunity requires and how to meet those requirements. All of the girls produced reports on careers for their school peers.

Participants valued meeting role models and learning what various careers required. They completed the "My Vocational Situation" inventory (Consulting Psychologists Press, Inc.) at the beginning and end of the project. Possible scores range from 0 to 18; a score above 13 indicates that the student is fairly clear about her career path. Average scores on the test rose from 9.47 to 12.09, indicating increasing clarity about what they might become.

Although none of the 12 participants who attended a reunion in 2000 had decided on a career in math, several had decided on careers in science and technology and all were grateful to have participated.

CODES: H, U	Ball State University
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HRD 95-53486 (one-year grant)	
Partner: American Association for University Women	
Keywords: demonstration, career awareness, role models, mentoring, field trips, hands-on, graphing calculator, athletics, summer program, math, computer skills	

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Douglass project's pre-college program

DOUGLASS PROJECTS PRE-COLLEGE PROGRAM

TO SUPPORT WOMEN IN SCIENCE, MATH, AND ENGINEERING, THE UNDERGRADUATE WOMEN'S UNIT OF RUTGERS UNIVERSITY ESTABLISHED THE DOUGLASS PROJECT IN 1986. TWO YEARS LATER, IT LAUNCHED THE DOUGLASS SCIENCE INSTITUTE FOR HIGH SCHOOL WOMEN, BRINGING 46 "RISING" ELEVENTH GRADE WOMEN FROM NEW JERSEY HIGH SCHOOLS TO DOUGLASS COLLEGE FOR A SINGLE-SEX RESIDENTIAL EXPERIENCE, HANDS-ON MATH AND SCIENCE LABS, FIELD TRIPS, AND WORKSHOPS IN MATH AND COMPUTERS. THE PROJECT GAINED RECOGNITION AS A STRATEGY FOR SERVING A DIVERSE GROUP OF WOMEN—HALF THE PARTICIPANTS WERE WOMEN OF COLOR—WITH A SINGLE INTERVENTION FEATURING STUDENT-CENTERED ACTIVITIES IN A SINGLE-SEX ENVIRONMENT. IN 1995 DOUGLASS EXPANDED THE PROGRAM TO A FOUR-YEAR SUMMER RESIDENTIAL PROGRAM STARTING WITH GIRLS ENTERING NINTH GRADE.

This NSF grant helped Douglass evaluate and modify the tenth grade program and develop the first year of the eleventh grade program. The program for ninth, tenth, and eleventh graders serves roughly 126 students (46 in ninth grade, and 40 each in tenth and eleventh). Students reside at Douglass College for one week, with seniors spending an extra week exploring careers and planning for college and choice of a major.

In labs, workshops, and field trips, students explore new horizons in math, physics, biology, chemistry, computers, engineering, and environmental and marine sciences. The institute helps them establish strong peer networks, and the supportive environment nurtures students intellectually, creatively, and socially. Participants learn about career options by talking with undergraduates, university faculty, and women working in the corporate world.

By recruiting average and above-average students from eighth grade who demonstrate curiosity and an enthusiasm for math and science—whether or not they have reached their potential—the project hopes to counteract the practice of reaching only the straight-A students. It aims to spark potential and nurture young women unsure of their capabilities and put them together with other young women with similar interests.

Activities provided for parents help them understand why such intervention programs exist and help them explore ways they can help their daughters make informed decisions about their education and careers.

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www.rci.rutgers.edu/~dougproj/dp_precollege_programs.html	
Partners: AT&T Foundation, Bell Atlantic-New Jersey, Bristol-Myers Squibb, Colgate-Palmolive Company, E. J.Grassman Trust, William Randolph Hearst Foundation, Hewlett-Packard Corporation, Johnson & Johnson, Johnson & Johnson Pharmaceutical Research & Development, L.L.C., Merck Institute for Science Education, PSE&G, the Turrell Fund, the Verizon Foundation, and Wyeth.	
Keywords: demonstration, hands-on, field trips, career awareness, peer groups, parental involvement, intervention, summer camp, role models	

THE CRITICAL HIGH SCHOOL YEARS

The high school years are important because by the end of that time more young women than men have opted out of math and science studies. From ninth grade on, boys express more positive attitudes toward math and science and more interest in science courses and careers, while girls take fewer advanced courses. Tenth grade is especially crucial for girls because they have completed their minimum math and science requirements for high school graduation and are beginning to choose what they will pursue in more depth.

Preliminary results of a longitudinal study begun in 1994 suggest that participants in the multiyear program continue to enroll and actively participate in their high school math and science courses, have raised their levels of educational expectation and continue to show high levels of perceived academic ability, *maintain their interest in math- and science-related careers, and express more confidence in their ability to succeed in those careers*. A three-year evaluation of the multiyear institute reports that it helped women "move away from an interest to a commitment to math and science." *It moved them "away from the 'nerd' image of mathematics and science and help[ed] them see that they are neither alone nor weird because they are good in math and science*."

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Project EFFECT

PROJECT EFFECT

MOST UNDERGRADUATE ATTRITION FROM STEM OCCURS AT THE END OF THE FIRST YEAR OF COLLEGE OR THE BEGINNING OF THE SECOND. WITH THIS IN MIND, THE PROGRAM FOR WOMEN AND GIRLS AT WASHINGTON STATE UNIVERSITY (WSU) DEVELOPED PROJECT EFFECT, WHICH USED SUPPORT, TECHNOLOGY TRAINING, AND CURRICULUM TO RECRUIT AND RETAIN WOMEN (AND HELP THEM SUCCEED) IN COLLEGE STEM PROGRAMS.

The Bridge Program. This fast-start program helped empower and teach survival skills to all women and ethnic minority men interested in math, engineering, architecture, physics, chemistry, or other science majors in which women and minorities are underrepresented. For five days, participants were welcomed, toured campus facilities (including STEM halls), talked with role models, were given a basic orientation to computers on campus, and attended study skills workshops in chemistry, math, and general studies. The Bridge students could go to the director of the Women in Engineering and Science Program and to older STEM students for advice. Many minority students were first-generation college students, so this network of advisers was invaluable as they came to understand the new environment of science and engineering courses. Scholarships and financial support were also available.

Tech Star seminars. Seven two-hour computer-training seminars (on the computer, Word, the Internet, Mathematica, Excel, PowerPoint, and Web pages) were offered to improve students' computer skills and confidence. Students participated in three or four group projects and got detailed references on each topic. The project also prepared information on how to train personnel to facilitate Tech Star seminars.

During the Bridge program, participation and enthusiasm were high. Once the semester began and time was short, participation in the free-standing Tech Star seminars dropped dramatically, but four of the seminars were used as labs for the Women, Science, and Culture course, where enthusiasm for the seminars again ran high.

Innovation workshops. These workshops for STEM faculty and teaching assistants were designed to encourage more equitable and inclusive teaching, curricula, and departmental climates. Having learned the reasons for academic attrition of women and ethnic minorities, the faculty learned about *strategies to reduce attrition, including collaborative learning groups, describing the work of female and ethnic scientists, relating class work to real-world problems, and recognizing and improving patterns of classroom interaction*. Half-day workshops were offered on creating a more inclusive STEM climate, on teaching strategies to reach all learners, and on issues of gender, race, and science.

Participants stated on pre-workshop survey questionnaires that their number one priority was to teach students higher order thinking skills, and that didn't change. Even before the workshops they were interested in changing their teaching practices, and they became more receptive to *innovative teaching techniques* that they had not listed on their pre-workshop survey, including *hands-on exploratory projects, in-class writing, bringing industry speakers into class, doing industry case studies, having open-ended labs, doing interdisciplinary group projects, holding group discussions, encouraging student presentations in large lecture classrooms, using structured teams for projects, and expanding the use of Web technologies*. About 65 percent of the participants were determined to change their teaching practices, voiced some reservations about being able to do so, but believed that unbiased communications and role models or mentoring were important for students.

Course on women, science, and culture. This 15-week course was designed to lay a foundation of support for first-year female and minority students' success and persistence in STEM majors. Participants attended two 50-minute discussion periods and one three-hour computer lab weekly. They learned about role models throughout the world who had been active in STEM and why their numbers were relatively few—how culture shapes who does science, what types of science are done, and what methods are used. Enrollment was low, but with enough demand the course would become permanent.

Through the pilot course, the university learned that assigning an average 75 pages of reading weekly was too much and that students found it helpful to be told the relevance of a homework assignment beforehand. Students highly rated in-class exercises and computer labs (except for students already skilled in computer use). The course raised the confidence of students who participated—during that critical first year in college, when self-confidence in math and science typically declines. In the end, students also found the workload manageable, mainly because the assignments were predictable.

Before the pilot course, STEM faculty designing and leading the course's case study labs were given a workshop on selecting and developing a case study of a role model and creating a hands-on lab where students would be challenged to engage in the scientific process: using the knowledge they already have, define a problem, gather information, create hypotheses, design an experiment or generate solutions, predict results, test, revise theories/predictions, manipulate variables and retest, draw conclusions, handle lab equipment, and come to understand some of the underlying concepts or processes.

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HRD 97-10713 (one-year grant)	www.sci.wsu.edu/wimse
Partner: WSU's Center for Teaching and Learning, Student Computing Services, Women in Math, Science, and Engineering (WiMSE), and Honors Program.	
Product: TECH STAR Seminars: A Self-Guided Approach to Computer Technology, ed. Claudia M. Pacioni, 1999	
Keywords: demonstration, achievement, seminars, mentoring, recruitment, retention, computer skills, self-confidence, workshops, role models, scholarships, teacher training, collaborative learning, gender equity awareness	

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Sisn

Southern Illinois support network

SOUTHERN ILLINOIS SUPPORT NETWORK

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE (SIUC) LIES AT THE CENTER OF THE 22-COUNTY REGION SOUTH OF INTERSTATE 64 KNOWN UNOFFICIALLY AS "SOUTHERN ILLINOIS." SIXTEEN OF THESE COUNTIES ARE MISSISSIPPI DELTA COUNTIES. THE MAIN INDUSTRIES IN THIS ECONOMICALLY DEPRESSED RURAL REGION ARE FARMING AND COAL MINING. MANY RURAL SCHOOLS ARE NOT EQUIPPED TO PROVIDE GOOD SCIENCE EDUCATION, ESPECIALLY IN PHYSICS AND CHEMISTRY. IT IS NOT UNUSUAL FOR TEACHERS ASSIGNED TO TEACH MATH, PHYSICS, AND CHEMISTRY TO BE UNTRAINED IN THESE AREAS. WITH SUPPORT FROM MANY PARTNERS, THIS PROJECT PROVIDED A RANGE OF EXPERIENCES FOR GIRLS IN THE AREA, FROM GRADE 4 ON, LEADING SUCCESSIVELY TO MORE INTENSE EXPERIENCES AND MASTERY AS THE GIRLS MOVE TOWARD COLLEGE.

In grade school, *the idea was to pique girls' curiosity*. In addition to hands-on activities, the NSF grant funded the first two fields trips for Girl Scouts in grades 4–6. Underwriting the cost of a trip to the St. Louis Science Center, one of the largest science centers in the country, more than doubled participation.

Expanding Your Horizons (EYH) conferences, sponsored nationwide by the Math Science Network, provide girls in grades 7–9 with a full day of hands-on workshops led by women faculty, graduate students, and practicing scientists, including veterinarians, physical therapists, and crime lab technicians. Participants can choose three workshops. Small-group activities are hands-on lab experiences, not lecture or observation, although at the 1998 conference parents and educators were allowed to observe two of the regular workshops (but not those involving their own daughters). EYH conferences, held annually, are highly successful activities that cost relatively little but require many volunteer woman-hours. A civil service worker is employed halftime to manage the enormous amount of paperwork involved in this fully institutionalized activity.

In some ways, the **Gateways workshops** (1998 and 1999) for girls in high school are extensions of EYH and in some ways they are summer camps. The workshops are longer and more complex than those in EYH, which means fewer (60 to 70) girls can participate but they work more intensively. Workshops are led by male and female faculty from SIUC's colleges of science and engineering and school of medicine.

WISE summer camps (1991 and 1996) provided two or three dozen high school seniors with hands-on, small group activities. Girls enjoyed meeting new people, hearing about science careers, and learning about the Internet and other new subjects (especially biology and zoology). Girls for whom the camp was residential were given room, board, and a stipend. This relatively expensive activity was not institutionalized. *The advantage of having mostly girls-only activities is that girls are assured of a hands-on experience they might not get in a mixed-gender classroom. The disadvantage is that girls-only activities are necessarily limited to extracurricular activities in public schools—and hence by time and money*.

Participants were expected to give a helping hand to younger girls. Parents, teachers, school counselors, and SIUC undergraduate and graduate assistants were also involved, learning how girls best learn science, what career opportunities are open to women, and what hands-on experiences they could do with girls. A database of local STEM activities was available to the community through schools, libraries, and community organizations.

The common denominator of all project activities was hands-on experiences in small groups with role models. Project activities demonstrated that students *love to be paid to learn*. (Being paid a stipend of $50 to $100 a day reduced the apprehension of students—or their parents—who might otherwise lose a day of work at a part-time or summer job.) *They also love to learn with their peers*. Girls who normally sit quietly through classes with outspoken males or inexperienced teachers—or who find themselves in a culture with few role models and discouraging comments like "why would you want to do that?"—find it enormously encouraging to attend workshops surrounded by peers as competent and excited as they are.

CODES: E, M, H, U, I	SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE
SANDRA L. SHEA (SSHEA@SIUMED.EDU), MARY H. WRIGHT, FRANCES J. HARACKIEWICZ	
www.scu.edu/SCU/Projects/NSFWorkshop99/html/wright.html	HRD 94-53099 (ONE-YEAR GRANT)
PARTNERS: WISE; SOUTHERN ILLINOIS SCIENCE, ENGINEERING AND MATH (SISEM) WOMEN AND GIRLS SUPPORT NETWORK; SHAGBARK COUNCIL OF THE GIRL SCOUTS; ST. LOUIS SCIENCE CENTER; CARBONDALE SCIENCE CENTER; SIUC'S UNIVERSITY WOMEN'S PROFESSIONAL ADVANCEMENT, SCHOOL OF MEDICINE, COLLEGE OF SCIENCE, AND COLLEGE OF ENGINEERING; MATH SCIENCE NETWORK	
KEYWORDS: DEMONSTRATION, RURAL, UNDERPRIVILEGED, HANDS-ON, ROLE MODELS, INTERNSHIPS, PEER GROUPS, WORKSHOPS, FIELD TRIPS, CONFERENCES, SUMMER CAMPS, CAREER AWARENESS, PARENTAL INVOLVEMENT, TEACHER TRAINING	

002

Ch

A Welcoming Learning Environment

CHAPTER TWO - A WELCOMING LEARNING ENVIRONMENT

PROJECTS IN THIS CHAPTER ILLUSTRATE ANOTHER KIND OF "INTERVENTION" AND INNOVATION IN THE EDUCATIONAL SETTING; THEY HIGHLIGHT HOW EDUCATORS CAN CREATE A SOCIAL SUPPORT SYSTEM FOR STUDENTS IN ORDER TO ENCOURAGE THEIR ENGAGEMENT OF SCIENCE AND MATHEMATICS. WE KNOW THAT EVEN NOW PARENTS, TEACHERS, COUNSELORS, AND OTHER ADULTS MAY THEMSELVES BE UNCOMFORTABLE WITH SCIENCE AND PERSONALLY UNAWARE OF SCIENTISTS AND ENGINEERS AS PROFESSIONALS. THERE MAY BE NEGATIVE MESSAGES FROM FELLOW STUDENTS ("DON'T BE SO NERDY"), FROM PARENTS ("I WAS NEVER GOOD IN MATH"), FROM COUNSELORS ("GIRLS DON'T NEED VERY MUCH MATH"), AND EVEN TEACHERS ("IT IS HARD").

WE HAVE LEARNED THAT EXPOSURE TO ROLE MODELS—ESPECIALLY "PEOPLE LIKE YOU"—HELPS STUDENTS IDENTIFY WITH A PROFESSION. EVEN BETTER, A MENTOR CAN OFFER A VOICE THAT IS PERSONAL AND INVITING. A MENTOR OFFERS INFORMATION AND FACTS THAT DISPEL STEREOTYPES AND NEGATIVE IMPRESSIONS AND PERSONALIZES THE ENCOUNTER WITH UNFAMILIAR TERRITORY. MENTORS CAN BE "NEAR-PEERS"—OTHER STUDENTS WHO ARE AHEAD IN CONFIDENCE AND SKILLS, OR JUST IN AGE AND MATURITY, OR ADULTS (PARENTS, COUNSELORS, TEACHERS, VOLUNTEERS).

IN MANY, MANY CASES, PART OF THE PROJECT AIMED TO BUILD A COMMUNITY AROUND THE STUDENTS, TRAINING EVERYONE IN NEW APPROACHES TO INCLUSIVE EDUCATION, IN AWARENESS OF TRADITIONAL BARRIERS, AND IN KNOWLEDGE OF GOOD PRACTICES. IN FACT, IT IS IMPOSSIBLE TO CHANGE THE WAY SCIENCE AND MATH ARE TAUGHT AND TO CHANGE THE SOCIAL NETWORKS WITHOUT CHANGING THE PEOPLE WHO INTERACT WITH AND INFLUENCE CHILDREN. WORKSHOPS FOR TEACHERS, COUNSELORS, PARENTS, MENTORS, AND THE WIDER STUDENT COMMUNITY ARE A MEANS TO THOSE ENDS. AN INFORMED AND COMMITTED COMMUNITY CAN DISPEL MISCONCEPTIONS THAT DISCOURAGE OR DRIVE INTELLECTUAL AND SCIENTIFIC INTEREST UNDERGROUND. AMONG MISCONCEPTIONS THAT NEED DISPELLING:

- GIRLS ARE NOT GOOD AT MATH
- GIRLS WHO ARE SMART WILL NOT BE POPULAR WITH BOYS
- SCIENTISTS AND ENGINEERS ARE NERDS
- THE WORK OF SCIENCE IS NOT FAMILY-FRIENDLY
- SCIENTISTS ARE OUT OF TOUCH WITH SOCIETY
- THE WORK OF SCIENCE IS TEDIOUS
- SCIENCE IS ONLY FOR THE TOUGH, EXTRAORDINARY STUDENT

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002

Ota

On the air with gender equity

ON THE AIR WITH GENDER EQUITY

TO ENGAGE, INFORM, AND INSPIRE LISTENERS, RADIO WAMC (ALBANY, N.Y.) WILL DEVELOP A WEEKLY SEGMENT AND FOUR REGIONAL CALL-IN SHOWS FOR NATIONAL DISTRIBUTION ON ISSUES, POSSIBILITIES, AND ROLE MODELS FOR—AND BARRIERS TO—GENDER EQUITY IN THE SCIENCES FOR GIRLS FROM KINDERGARTEN THROUGH EIGHTH GRADE. THE GENDER EQUITY SEGMENTS WILL BE INCORPORATED INTO WAMC'S AWARD-WINNING RADIO PROGRAM "51 PERCENT" (A SHOW ABOUT WOMEN'S ISSUES) AND PLAYED ON THE CALL-IN PROGRAM "VOX POP."

WAMC will create, produce, air, and distribute the weekly segments and call-in shows regionally through its 10-station network and nationally and globally via Public Radio, ABC satellites, and Armed Forces Radio—with compact disks available for stations not connected by satellite. The programs can also be heard over the Internet at the WAMC website <www.wamc.org> or at <www.ThePublicRadioStation.com>. This project could reach more than 300,000 listeners a month in WAMC's regional area alone, plus which "51 Percent" is heard over 125 radio stations nationally.

WAMC is collaborating with an advisory board of professional women nationally known for their involvement with gender equity and with the Capital Area School Development Association, a study council affiliated with the school of education at the State University of New York in Albany.

CODE: I, E, M	WAMC Northeast Public Radio
Mary Darcy (mdarcy@wamc.org)	www.wamc.org
HRD 01-14472 (one-year grant)	
Partners: Capital Area School Development Association; State University of New York, Albany.	
Keywords: dissemination, gender equity awareness, barriers, role models, radio, engagement	

002

T-grl

TechGirl: a website for middle school girls

TECHGIRL: A WEBSITE FOR MIDDLE SCHOOL GIRLS

SUPERVISED UNDERGRADUATE STUDENTS WILL DEVELOP THIS DYNAMIC, EVOLVING WEBSITE DEVOTED TO HELPING MIDDLE SCHOOL GIRLS LEARN HOW SCIENCE AND ENGINEERING BENEFIT SOCIETY AND ENCOURAGING THEM TO CONSIDER CAREERS IN THE FIELD. INCLUDED ON THE WEBSITE WILL BE

- Biographical sketches of women in different science and engineering settings and at different stages (including high school and college and at the start and peak of their careers).
- Advice on developing their careers, from choosing courses and activities in high school to picking a college and major to choosing a career.
- Challenging games, puzzles, and brainteasers (developed by college undergraduates) that expose girls to different aspects of science and engineering—for example, estimating the number of electrical devices in a home that could be powered by solar cells on the roof, given some basic information (electrical engineering); estimating the number of people who could commute into San Francisco across the four-lane Golden Gate Bridge during rush hour, knowing that in the morning there are three lanes heading in and in the afternoon three lanes heading out (civil engineering); or estimating the number of pounds gained by drinking one soda a day for a year (biology).
- Engineering Encounters, a role-playing game (analogous to the popular Oregon Trails or to the board game Life) in which girls simulate how their life could develop through high school, college, and their career. Presented with a series of choices, they choose responses that result in their life taking different paths. Playable online or from a CD, the game allows girls to assign their own values (in points) to the goals of Happiness, Fame, or Wealth; at the end of the game they can find out if they met their goals based on their game decisions.

Many young women are turned off by technical fields as not supporting goals they value, including ecology, family, and personal communications. This website will underscore the positive aspects of technical careers.

Two major programs at Arizona State University—Women in Applied Science and Engineering and the Minority Engineering Program—will collaborate on the website, after extensive feedback from middle and high school girls, their teachers and counselors, college girls in WISE, engineers who mentor for WISE, and college students in the minority engineering program. A Hispanic version will be provided.

CODES: I, M, H, U	Arizona State University
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HRD 00-86452 (one-year grant)	
Partners: WISE; Office of Minority Engineering Programs	
Keywords: demonstration, career awareness, role models, website, engineering, computer games, Hispanic, bilingual	

002 Jt The adventures of Josie True

THE ADVENTURES OF JOSIE TRUE

IN TESTING BETA VERSIONS OF COMPUTER SOFTWARE GAMES, MARY FLANAGAN NOTICED THAT GIRLS WERE DRAWN TO NARRATIVE SECTIONS WHILE BOYS RACED TO COMPETE FOR THE PRIZE, CLEARLY MORE CONTENT THAN MOST GIRLS WITH SOFTWARE THAT FEATURED VIOLENCE AND COMPETITION. RESEARCH HAD SHOWN THAT THE WEB HAS BECOME A PLAYGROUND FOR GIRLS BECAUSE IT EMPHASIZES CONTENT, WRITING, AND CORRESPONDENCE. BUT ON THE SHELVES OF COMPUTER STORES, MARY FLANAGAN SOUGHT BUT NEVER FOUND GAMES FEATURING "GIRLS WITHOUT BLONDE HAIR, BLUE EYES, AND ROSY CHEEKS." MOST EDUCATIONAL COMPUTER GAMES ARE DESIGNED FOR AND MARKETED TO WHITE KIDS, ESPECIALLY BOYS. SOFTWARE FOR GIRLS ENTERTAINS RATHER THAN EDUCATES—AND OFTEN FEATURES FASHIONS, MAKEUP, AND SHOPPING. "WHILE SOME MIGHT ARGUE THAT BARBIE GAMES ARE GETTING GIRLS ONLINE, WE NEED TO ASK OURSELVES JUST WHAT IT IS THAT BARBIE GAMES TEACH KIDS," FLANAGAN TOLD ONE REPORTER.

Flanagan moved from commercial software to academia so she could take risks rather than crank out game after game for boys. She saw a serious need for learning materials for nonwhite, nonmale audiences—material that was fun, pertinent, interesting, and, if possible, free. Research suggested that *girls, unlike boys, do not like gadgets for gadgets' sake. In educational software, they are drawn to strong content, a good story line, credible and inspiring "get to know" characters, and hands-on activities in a context that makes sense to them*. They are fascinated with the idea of traveling around the world, communicating with the people they meet, and meeting people who are different linguistically and culturally (often wanting to know what they eat). Girls want to use communications technology to have conversations with others like themselves. They want a *backstory*: information about characters and about what motivates them to do what they do. "And that's what *Josie* is about."

In the Josie True project, Flanagan's team is creating a user-friendly, multicultural, Web-based adventure game for pre-adolescent girls, aged 9 to 11. To provide content with which minority girls can identify, *The Adventures of Josie True* features a spunky 11-year-old Chinese American girl, Josie True. In the first game, Josie's science teacher (also an inventor) disappears and Josie sets off to find her.

Her search takes her across time and space: to Chicago and Paris in the 1920s. There she meets Bessie Coleman, the first African American aviatrix. Originally from Texas, Coleman relocated to Chicago, where she worked as a manicurist and as manager of a chili parlor while saving money to get her pilot's license. In the early '20s Coleman went to Paris to get her training and license because African American women were not permitted in any U.S. flight schools, and she returned to France later for training as a stunt pilot. These elements of her life story become factors in the adventure game featuring Josie.

Josie's adventures lead the user to various activities, such as correctly identifying classified objects, expanding a chili recipe (containing fractions) to serve more people, and translating U.S. dollars to French francs.

Both technical and multicultural, the game provides true and fictional ethnic heroes and role models while teaching about science and women's history. It is also designed to appeal to different learning styles. Girls who want to start an activity right away can select from a menu of options. Girls who want to follow the storyline can follow where the characters in the story lead them. Learning is embedded in the narrative.

CODE: I, M	UNIVERSITY OF OREGON
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www.josietrue.com	
HRD 99-79265 (ONE-YEAR GRANT)	
PARTNER: STATE UNIVERSITY OF NEW YORK, BUFFALO	
THE ADVENTURES OF JOSIE TRUE IS VIEWABLE FREE ONLINE AT www.josietrue.com	
KEYWORDS: DEMONSTRATION, SOFTWARE, ROLE MODELS, MINORITIES, ADVENTURE GAME, HANDS-ON	

002

Pro

Profiles of women in science and engineering

PROFILES OF WOMEN IN SCIENCE AND ENGINEERING

SEVERAL BOOKS HAVE DOCUMENTED THE LIVES OF WOMEN SUCCESSFUL IN SCIENCE BY TRADITIONAL STANDARDS (E.G., NOBEL PRIZE WINNERS) AND WOMEN FOR WHOSE WORK MALE COLLEAGUES TOOK CREDIT (E.G., ROSALIND FRANKLIN, CHIEN-SHIUNG WU, AND JULIA HALL). THIS GRANT SUPPORTED COMPLETION OF *JOURNEYS OF WOMEN IN SCIENCE AND ENGINEERING: NO UNIVERSAL CONSTANTS*, A FIELD GUIDE TO 88 WOMEN IN SCIENCE IN ENGINEERING, BASED ON PERSONAL INTERVIEWS—"VOICES FROM THE FIELD."

In first-person narrative profiles, contemporary professional women speak candidly about the different paths they took to various fields of science or engineering, the discrimination they may have encountered, their work environment, their strategies for balancing family and career, and their *own* definitions of achievement and success.

These women—only some of whom are famous—come from many different racial, ethnic, and socioeconomic backgrounds. Marine science educator Judith Vergun worked 15 years as a fashion model before returning (divorced, with three children) to earn a Ph.D. in ecology, with a special interest in Native American and Native Alaskan tribal lands and areas. After graduating from the Bronx High School of Science, mathematician Bonnie Shulman spent 12 years hitchhiking, studying beat poetry, writing, and living on welfare as a single mom before returning to college at the age of 30.

Women with disabilities candidly assess the impact of these disabilities on their personal, educational, and professional lives. Biologist Jane Dillehay, deaf since birth, became dean of the College of Arts and Sciences at Gallaudet University, a college for the hearing-impaired. Psychiatric geneticist Judith Badner speaks about growing up with achondroplastic dwarfism and the ways in which dwarfism shaped her personal, educational, and professional choices. Temple Grandin, an authority on the design of livestock handling equipment and systems, has written extensively about how her autism—she thinks in pictures instead of language—has helped her understand what makes cattle afraid.

Some of the women have led lives of public service, including Rhea L. Graham (the first African American woman to serve as director of the Bureau of Mines), former surgeon general Joycelyn Elders, and Air Force Secretary Sheila Widnall. Some achieved relative celebrity, including Nobel laureate and medical physicist Rosalyn Yalow, biologist and university president Jewel Plummer Cobb, and Susan Love, surgeon, oncologist, social activist, and author of the bestseller *Dr. Susan Love's Breast Book*. Also included are profiles of young scientists just starting out in their careers, including academic scientists with eclectic interests.

This book should help dispel the stereotype of the scientist as a nerdy white male in a lab coat—as well as any notion that the path to a career in science and engineering is the same for everyone. As the subtitle suggests, there are "no universal constants."

CODES: I, M, H, U	Carnegie Mellon University
Indira Nair (in0a@andrew.cmu.edu)	HRD 95-55832 (one-year grant)
Partner: The Sloan Foundation.	
Products: Journeys of Women in Science and Engineering: No Universal Constants by Susan A. Ambrose, Kristin L. Dunkle, Barbara B. Lazarus, Indira Nair, and Deborah A. Harkus. Temple University Press, 1997.	
Keywords: demonstration, biographies, role models, publication, career awareness	

002

Hu

Putting a human face on science

PUTTING A HUMAN FACE ON SCIENCE

WHETHER A WOMAN IS WILLING TO PURSUE A CAREER IN SCIENCE USUALLY DEPENDS ON WHETHER SHE CAN PICTURE HERSELF AS A SCIENTIST WITHOUT UNACCEPTABLE CONFLICT AND CAN INTEGRATE THE ROLE OF BEING A WOMAN WITH THAT OF BEING A SCIENTIST. THE COMMON IMAGES OF SCIENTISTS DISPLAYED IN THE HALLS OF SCIENCE—"DEAD GREATS" IN CAPS AND GOWNS—REINFORCE THE POPULAR PERCEPTION OF SCIENCE AS A DRY AND DUSTY OCCUPATION DOMINATED BY ELDERLY WHITE MALES. MOST FEMALE STUDENTS HAVE FEW ROLE MODELS IN THE FIELD AND FIND IT HARD TO IDENTIFY WITH CONVENTIONAL IMAGES OF SCIENTISTS.

The PDK poster project is using visual media to challenge stereotypes. The project developed and printed 36 gallery-quality posters—co-designed by Pamela Davis Kivelson (PDK) and Inga Dorosz—that put a far livelier and more heterogeneous face on science. Instead of formal portraits of Olympian genius, the posters include images of people (especially women) involved in the joy and excitement of intellectual exploration. Thumbnail images of the posters can be viewed at the project website.

One goal of the project is to encourage scientific literacy and to promote the public's awareness and appreciation of science and technology. By humanizing the image of science and scientists, making that image less threatening and intimidating, the project hopes to help everyone see science and engineering as part of the human enterprise and its practitioners as people like themselves. It also hopes to help girls and young women see science and research as inviting, exciting, and rewarding academic and career choices.

The Stony Brook math department has developed a website that teachers can use as a study guide and that students can use to find hands-on educational activities, biographical information about the women portrayed in the posters, and other educational resources.

CODE: I, E, M, H, U	University of California, Los Angeles
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www.physics.ucla.edu/scienceandart	HRD 96-22321 (one-year grant)
www.math.sunysb.edu/posterproject/www/biographies/index.html	
Partners: Alfred P. Sloan Foundation, Allied Signal, State University of New York at Stony Brook	
The 18 x 24 posters can be viewed and ordered at (www.pdksciart.com)	
Keywords: dissemination, role models, posters, website, hands-on, biographies	

002

W[4]

Women for women: a mentoring network

WOMEN FOR WOMEN: A MENTORING NETWORK

THIS COMPONENT OF STONY BROOK'S WISE PROGRAM MATCHES 20 UNDERGRADUATE AND GRADUATE STUDENTS WITH 55 MIDDLE SCHOOL GIRLS, WHOM THEY MENTOR. DURING THE SPRING TERM, WISE OFFERS A SEMESTER OF MENTOR TRAINING AND PREPARATION FOR VARIOUS RESEARCH PROJECTS AS A THREE-CREDIT INDEPENDENT RESEARCH COURSE. IN THE FALL, IT RECRUITS MIDDLE SCHOOL STUDENTS TO PARTICIPATE IN A MENTOR-LED CAMPUS-BASED RESEARCH EXPERIENCE DURING THE FALL AND SPRING.

University student mentors bond with their middle school protégées during a two-week summer program. During the school year mentors work with the middle school students on a science research project. Advisers at each middle school support the students and actively engage in the research. A special event in May highlights the students' research results.

Two or three mentors, working together, design each research project the middle school students later work on. Among the projects one year were the following:

Photos and fangs (dental anthropology). To learn about primates and dental and general anatomy, students section, polish, and photograph a primate tooth to study the enamel—learning darkroom techniques along the way. Teeth grow incrementally, in a growth pattern analogous to that of tree rings, and the short- and long-period lines may be imaged using several forms of microscopy.

Breeding bettas and bytes (biology, computer science). Students explore how breeding betta splendens (Siamese fighting fish, whose genetics can be easily manipulated) relates to biology, botany, zoology, evolution, ecology, genetics, geology, chemistry, art, computer science.

Making a BMW (mechanical design). Using the computer software IDEAS, students design model cars and, using a technique called "rapid prototyping," build the model in a lab at SUNY Farmingdale.

The heart of the matter (biology). Using medical equipment and anatomical models, students dissect a frog or a fetal pig to learn about the cardiovascular system and how different activities and stimuli affect the heart rate.

An investigation on horseshoes (material, engineering). Students study the forces applied to a horseshoe throughout its life span, as well as properties that affect how materials withstand environmental stress.

Lights, camera, action! (astronomy, physics). Students build a camera, take pictures, develop the film in a darkroom, and produce pictures. Along the way, they learn about the principles of light and also (using telescopes, models, and discussion) of astronomy.

Fractals (mathematics). (A fractal is an object inside of which are embedded infinitely many copies of itself.) Students learn the concepts of fractals and fractal sets, create fractal objects and discover their properties, and learn to measure distances on earth using surveying equipment and Lenart spheres.

DNA detectives (genetics, biology). Students learn basic cellular DNA concepts through lab experiments, learn techniques of microscopy and gel electrophoresis, and examine how ultraviolet radiation causes mutations in cells.

CODES: M, U		STATE UNIVERSITY OF NEW YORK, STONY BROOK
EDITH STEINFELD (EDITH.STEINFELD@SUNYSB.EDU), LOIS ROMAN	www.wise.sunysb.edu (CLICK ON WOMEN FOR WOMEN)	HRD 99-08736 (ONE-YEAR GRANT)
PARTNERS: WISE, COLLEGE OF ENGINEERING AND APPLIED SCIENCES, DEPARTMENT OF TECHNOLOGY AND SOCIETY (SUNY); BRENTWOOD AND RIVERHEAD SCHOOL DISTRICTS; THE BOARD OF COOPERATIVE EDUCATIONAL SERVICES (BOCES); LONG ISLAND POWER AUTHORITY.		
KEYWORDS: DEMONSTRATION, MENTORING, RESEARCH EXPERIENCE, SUMMER PROGRAM, HANDS-ON		

002
Edg
Project EDGE: mentoring and teacher awareness

PROJECT EDGE: MENTORING AND TEACHER AWARENESS

THIS THREE-YEAR PROJECT FROM THE ROCHESTER INSTITUTE OF TECHNOLOGY (RIT) EMPHASIZED MAKING SYSTEMIC CHANGES IN TEACHERS' INSTRUCTIONAL STYLES, CONNECTING YOUNG WOMEN'S LEARNING IN STEM FIELDS WITH REAL-LIFE CAREER EXPERIENCES, AND SHARING RESOURCES AND DATA WITH OTHERS. PLANS WERE TO RECRUIT 100 HIGH SCHOOL STUDENTS, BUT BY THE THIRD YEAR 167 HIGH SCHOOL STUDENTS HAD ENROLLED (UP FROM 98 THE FIRST YEAR).

Teacher bias was addressed in summer workshops for teachers and some vice principals, following the model mentioned in Myra and David Sadker's 1994 work, *Failing at Fairness: How America's Schools Cheat Girls*. David Sadker was an instructor. Recognizing that teachers tend to be isolated from researchers (and vice versa), RIT made teachers the first line of attack against classroom inequity. Teachers were trained to use non-gender-biased teaching strategies, and several classroom observers were trained to be coders (coding teacher-initiated and student-initiated questions and interactions and the type and level of response). Becoming their own investigators—observing, videotaping, and coding teacher behavior in the classroom—helped them become sensitive to bias in their behavior with their own students.

This project gave seven local high schools an early opportunity to work in interactive distance learning technologies. RIT gave the seven schools computers and free links that allowed students to converse electronically with project staff, mentors, and each other. Both girls and teachers learned computer skills, interacting with each other and with mentors through e-mail and chat rooms. Chat rooms were held on Fridays from 11 a.m. to 12:30 on interactive First Class conference software, which had to be used in the schools. RIT's technician had to provide more training and interaction for five of the seven schools because the teachers had only marginal computer skills.

The mentoring gave students a chance to realistically view their career options. Computer interactions enabled girls to converse with RIT staff, professionals, and mentors in ways that were uninhibited by age, appearance, or subject discipline. But the project investigators also learned that early and fairly frequent face-to-face interaction gave participants more of a sense of the "real" people with whom they were conversing.

Students also interacted with mentors and role models through live, interactive teleconferencing, on a two-way audiovideo fiber-optic link capable of simultaneously broadcasting to four sites. The system allowed impressively frank student-to-student and student-to-mentor dialogues, giving the girls insights into racial, cultural, gender-based, and socioeconomic stereotyping. Because technical problems and the necessity for fixed broadcast schedules hampered this activity, in the third year the project switched to monthly face-to-face meetings at a designated school.

CODES: H, U, PD	Rochester Institute of Technology
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HRD 94-53088 (three-year grant)	
Partners: Seven high schools	
Keywords: demonstration, teacher training, gender equity awareness, distance learning, interactive, mentoring, career awareness, role models	

HOW TO BE A MENTOR (OR MENTEE)

MENTORING PROGRAMS HAVE BECOME POPULAR AS A WAY OF RECRUITING AND RETAINING WOMEN AND MINORITIES IN SCIENCE AND ENGINEERING. MENTORS CAN BE POSITIVE ROLE MODELS FOR STUDENTS AND YOUNG PROFESSIONALS, BROADENING THEIR HORIZONS AND PROVIDING PRACTICAL GUIDANCE. THEY CAN ACQUAINT ASPIRING PROFESSIONALS WITH THE WORK ENVIRONMENT AND HELP THEM WITH RÉSUMÉS, MOCK JOB INTERVIEWS, AND PROFESSIONAL CONTACTS. *BUT MENTORING SKILLS DO NOT ALWAYS COME NATURALLY, WHAT PASSES FOR MENTORING IS OFTEN NOT TRUE MENTORING, AND MANY WOMEN AND MINORITY STUDENTS NEVER EXPERIENCE MENTORING.*

002
How
How to be a mentor (or mentee)

The University of Washington's Center for Women in Science and Engineering (WISE—now the Center for Workforce Development), developed and evaluated a curriculum for training mentors and mentees. The goal was to improve mentoring practices by building on and formalizing the university's successful undergraduate mentoring program.

The project developed the Curriculum for Training Mentors and Mentees in Science & Engineering, which includes individual handbooks for students (including graduate students), faculty, and professional scientists and engineers. Graduate students helped write the curriculum, video script, and bibliography.

Four pilot sites were selected: the University of Washington, University of Michigan, Carnegie Mellon University, and Pacific Lutheran University. The curriculum materials have been adopted by 300 academic institutions, corporations, and government agencies. The materials spell out and clarify goals, objectives, and expectations for mentoring relationships; suggest topics for mentors/mentees to discuss and activities to engage in; and identify what students need to learn (such as how to publish), how mentors can help mentees, what the mentor gets out of the relationship. They stress the importance of explicitly relaying positive experiences back to the mentor, giving tips about verbal and nonverbal language. The materials are useful for women in science and engineering, but not in the liberal arts. They have been customized for organizations such as the National Park Service and have also been purchased by professional organizations and corporations.

A manual provides guidelines on what to cover in training. To provide successful training in mentoring, the trainer should have experience either in training or in mentoring (and preferably both); the training should be kept short (one to two hours); and it should be required for mentors. Male mentors may need to be made aware of gender, racial, and cross-cultural bias and ways they may be unintentionally discouraging their mentees; they may also need help dealing with female issues of confidence and inexperience. The key to successfully implementing a mentoring program is probably to build it into an existing program. For organizations with few resources, no mentoring program, and little time, portions of the training materials can be used independently.

WISE's mentoring program received the 1998 Presidential Award in Science, Engineering, and Mathematics Mentoring and the 1998 National WEPAN Women in Engineering and Science Program Award.

CODES: U, PD	University of Washington, Center for Workforce Development
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www.engr.washington.edu/cwd	HRD 95-53430 (one-year grant)
Partner: Fund for the Improvement of Postsecondary Education (FIPSE); Women in Engineering Program Advocates Network (WEPAN, Inc.)	
The Curriculum for Training Mentors and Mentees in Science and Engineering is available from WEPAN (www.wepan.org) or by e-mail (wiep@ecn.purdue.edu)	
Keywords: demonstration, mentor training, mentoring, role models, career awareness, manual, gender equity awareness	

002
Eye²
Eyes to the future: telementoring

EYES TO THE FUTURE: TELEMENTORING

THE GENDER GAP IN BOTH ATTITUDE AND ACHIEVEMENT IN SCIENCE PROGRESSIVELY WIDENS FROM AGE 9 THROUGH THE SENIOR YEAR IN HIGH SCHOOL. *MIDDLE SCHOOL IS A TRANSITIONAL TIME FOR ALL STUDENTS, BUT GIRLS IN PARTICULAR HAVE DIFFICULTY ADJUSTING TO THE LOSS OF PERSONAL TEACHER RELATIONSHIPS COMMON IN ELEMENTARY SCHOOL*. EYES TO THE FUTURE (BASED AT TERC INC.) *INTERVENES WITH MIDDLE SCHOOL GIRLS OF ALL ABILITIES DURING THIS TRANSITION, BEFORE THEY HAVE CHOSEN OR RULED OUT POSSIBLE FUTURES FOR THEMSELVES*.

This multi-age mentoring program uses the Web to link middle school girls with local high school girls who have stayed interested in science and technology and with women who use STEM in their careers. The project provides urban middle school girls with enriched science experiences, a broader knowledge of possible options in high school and their careers, and personal relationships with female role models who can give them emotional and academic support.

Eyes to the Future began in 1997 as a pilot program in telementoring supported by the Arthur D. Little Foundation. Fifteen middle school girls and five high school girls communicated electronically with five adult women (a boat builder–engineer, an ecologist, a veterinary technician, a pediatrician, and a geologist). In an extended pilot project the next year in the Boston area, 15 middle school girls met weekly in after-school clubs co-facilitated by a teacher and adult mentors (an astronomer, engineer, biologist, and women in medical fields). Girls in this phase of the pilot communicated electronically but also spent about four weeks engaging in science and technology investigations, communicating about their projects with their high school and adult mentors. Selections from discussions with their mentors were included in their personal electronic scrapbooks, portions of which appeared in a collaborative electronic book.

The pilot's continued success led to the project's full implementation as a three-year NSF-funded program. The project expanded to reach middle school girls from two Somerville schools and three Brookline schools. No prior experience with technology was required. Adult mentors were from earth, space, and sea sciences, such as astronomy, ecology, marine biology, forestry, and archaeology. High school mentors were recruited from among academically talented and motivated local eleventh and twelfth grade girls.

AFTER-SCHOOL ACTIVITIES

The middle school girls met weekly in an after-school club, where they communicated electronically with their high school and adult mentors. Each team of three middle school girls, one high school girl, and one adult had its own private discussion area on the project website. Middle school girls, high school mentors, adult mentors, and teachers had their own separate discussion areas. The website also supported collaborative writing and the sharing of information about science projects. The middle school girls wrote articles about their mentors, about what science is like in high school and in the workplace, about their experiences in the program, and about what it's like to be a girl in middle school today—to post on their websites. They took on the role of investigative reporter, producing an online magazine for other girls their age.

They conducted enriched science activities and took the time to reflect and communicate about them. At after-school clubs, they engaged in earth, sea, and space sciences activities, both with and without their mentors. The third year, they designed rockets powered by balloons, explored local biodiversity, and tested various water samples to determine their pH, salinity, and chlorine content. They also explored local science institutions where their adult mentors work.

MENTORING RELATIONSHIPS

High school girls can see middle school girls' concerns from the viewpoint of someone who has "been there" recently. Carefully selected junior- and senior-year mentors can offer valuable advice about staying involved with science and math, including tips on studying, the consequences of course choices, coping with academic stress, and how to find math and science clubs and supportive teachers. They also provide assurance that they will be there to welcome the eighth graders when they arrive at the high school.

Adult mentors provide a fresh perspective on the relevance and real-life applications of school math and science. Many middle school girls know little about STEM-related arts, trades, and professions and rarely see their current classes in the context of possible careers. They often lack confidence in their ability to succeed and know little about specific specialties, such as biology or physics. In Eyes to the Future they benefit from year-long relationships with adult mentors, learning how they chose their careers, how they use science and math at work, what schooling is needed for such a profession, and what it feels like to be a woman in these fields.

CODES: M, H, I	TERC Inc.
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HRD 99-06153 (three-year grant)	
Partner: Arthur D. Little Foundation	
Products: Two booklets: Eyes to the Future: Guide for High School Mentors and Eyes to the Future: Guide for Middle School Students	
Keywords: education program, after-school, telementoring, teacher training, career awareness; TERC, Inc., mentoring, urban, role models, clubs, self-confidence, publication, website, real-life applications	

002
Tel
Telementoring teens

TELEMENTORING TEENS

WHEN THE EDUCATION DEVELOPMENT CENTER'S CENTER FOR CHILDREN AND TECHNOLOGY (CCT) RECEIVED FUNDING FOR THIS PROJECT IN 1994, THE NOTION OF USING THE INTERNET FOR ONLINE MENTORING WAS NOVEL. BUT CCT SPECULATED THAT THE INTERNET MIGHT BE AN APPROPRIATE MEDIUM FOR ADDRESSING ADOLESCENTS' FEARS AND OBSTACLES AND PROVIDING THEM WITH VALIDATION AND SOUND ACADEMIC AND CAREER ADVICE. IN COLLABORATION WITH THE DEPARTMENT OF ENERGY'S ADVENTURES IN SUPERCOMPUTING PROGRAM, CCT PILOT-TESTED TELEMENTORING WITH GIRLS 14 TO 19 (GRADES 9–12) IN TEN SCHOOLS IN FIVE STATES (ALABAMA, COLORADO, IOWA, NEW MEXICO, AND TENNESSEE). IT RECRUITED 216 STUDENTS (MANY OF THEM 16 AND 17), PAIRING 153 OF THEM WITH 141 ADULT MENTORS—ALL WOMEN, MOSTLY IN TECHNICALLY ORIENTED CAREERS—WHO HAD COMPLETED ONLINE TRAINING IN MENTORING.

The project intended to focus on career mentoring, but it quickly became clear that *preoccupation with conflicts about their personal lives was integral to any academic and career issues most girls had. They valued the opportunity to explore personal issues in a personal way*. Mentors helped students deal with the daunting transition from high school to college, discussing such issues as selecting college courses, balancing personal relationships and academic interests, and overcoming personal or financial obstacles that got in the way of achieving specific goals. In the best cases, telementoring allowed mentors to respond to students' specific, immediate needs and concerns. The project found that *career mentoring online requires addressing girls' immediate interests while simultaneously broadening their relatively narrow understanding of how their interests relate to the world of work*.

More than three quarters of the students found their telementoring experiences rewarding and half felt their mentors had influenced their ideas about science and technology. Mentors' perceptions varied, but 91 percent were willing to mentor again. How satisfied the mentor and protégée felt depended on how often they communicated.

Students who started with negative perceptions of women in these fields were pleasantly surprised to find that their mentors were well rounded. Many students were more inclined to pursue internships and other career-enhancing activities after telementoring, perhaps because their mentors suggested taking a more proactive role in their own career development.

Students and mentors had different perceptions of worthwhile conversations about careers in science and technology. Mentors had high expectations for such discussions, and often felt they hadn't provided consistent enough guidance; students felt they had gained insight into the exciting possibilities of lifestyles in these fields, especially when conversations about career options emerged organically from a discussion of students' and mentors' immediate interests and hobbies. A discussion of music, for example, might lead the student to recognize the importance to a music career of understanding computers.

E-mail appears to be a powerful medium for exploring the complex processes adolescents go through in defining their aspirations. What mentors regarded as casual chat, students often viewed as meaningful exchanges. Mentors wanted to affect the students' career aspirations, but they probably had more influence on their college course-taking behavior.

For many young women in the project, especially in Alabama and Tennessee, traditional values of marriage and family loomed large in their immediate futures. Mentors who could accept and work through these issues with students often found themselves exploring broader issues about life choices, which ultimately affected how students approached their career aspirations.

CODE: H	EDUCATION DEVELOPMENT CENTER (CENTER FOR CHILDREN AND TECHNOLOGY)
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www.edc.org/CCT/telementoring	
HRD 94-50042 (THREE-YEAR GRANT)	
PARTNERS: DEPARTMENT OF ENERGY'S OFFICE OF SCIENTIFIC COMPUTING; NATIONAL TESTBED PROJECT	
NATIONAL SCHOOL NETWORK TELEMENTORING RESOURCES AND LINKS: http://nsn.bbn.com/telementor_wrkshp/tmlink.html	
KEYWORDS: DEMONSTRATION, EDC, CAREER AWARENESS, TELEMENTORING, WEBSITE, PEER GROUPS, SELF-CONFIDENCE, SUPPORT SYSTEM	

002

met

MentorNet: e-mail and mentoring unite

MENTORNET: EMAIL AND MENTORING UNITE

E-MAIL'S POPULARIZATION LED CAROL MULLER, CO-FOUNDER OF DARTMOUTH UNIVERSITY'S WOMEN IN ENGINEERING AND SCIENCES PROGRAM, TO CREATE MENTORNET, A NATIONAL ELECTRONIC INDUSTRIAL MENTORING NETWORK FOR WOMEN IN ENGINEERING AND SCIENCE. COMMUNICATING ELECTRONICALLY REMOVES MOST OBVIOUS MARKERS OF STATUS DIFFERENCE, INCLUDING THOSE ROOTED IN GENDER AND HIERARCHY. STUDENTS OFTEN FEEL LESS INTIMIDATED OR HESITANT ASKING QUESTIONS ON E-MAIL THAN THEY MIGHT IN PERSON OR ON THE PHONE. EMAIL ALSO MAKES IT EASY TO COMMUNICATE THOUGHTFULLY AND DELIBERATELY AND PROVIDES A RECORD OF COMMUNICATION. STUDENTS CAN REFER TO THEIR MENTORS' PAST ADVICE WHENEVER THEY NEED TO, AND MENTORS CAN EASILY KEEP TRACK OF STUDENTS' CONCERNS.

A marriage of e-mail and mentoring, MentorNet allows mentoring relationships to flourish where geography, time, or financial constraints might otherwise hamper or prevent them, and it can be especially helpful for students at colleges physically distant from industries in which they are interested. Previously, many people who were willing to serve as mentors lacked the time or other resources to physically meet with a student, and many students didn't have the time to take advantage of mentoring if it required several hours out of a day. MentorNet alleviates time and travel constraints and provides operational economies of scale by offering its services to students at many universities.

MentorNet draws from a pool of volunteer industry mentors to pair male and female professionals in industry with undergraduate and graduate women in STEM. The mentorship lasts one year but often continues unofficially. Careful matches—usually based on educational background and career interests—and training in mentorship are important. Poor rapport between mentors and protégées is uncommon, but when it happens it tends to sour protégées on further mentoring.

A five-year evaluation provided strong evidence that MentorNet supports and promotes the retention of women in STEM majors and careers. MentorNet protégées felt MentorNet was a good use of their time, promoted their ability to network and seek jobs, improved their career awareness, and increased the probability of their seeking mentors in the future. Many participants felt it encouraged them to complete their academic degrees and boosted their confidence of success. Of women who responded to the survey, 53 percent of the 1998–99 protégées either continued with their 1998–99 mentor or applied for a new mentor.

CODES: U, PD	San Jose State University Foundation
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www.mentornet.net	HRD 00-01388 (three-year grant)
MentorNets' many partners (including AWIS) are listed on its website	
Keywords: demonstration, electronic mentoring, engineering, mentor training, retention, career awareness, self-confidence	

002

OPT

OPTIONS

OPTIONS

THROUGH A COMBINATION OF CLASSROOM WORK, CAREER EXPLORATION, AND HANDS-ON ACTIVITIES, THIS DEMONSTRATION PROJECT HOPES TO INTEREST 70 FRESHMAN HIGH SCHOOL GIRLS A YEAR (TEN EACH FROM SEVEN SCHOOLS) IN CAREERS IN MATH AND SCIENCE. THE GIRLS ARE EXPLORING THEIR OPTIONS IN SHELBY COUNTY, TENN., WHERE ONLY ABOUT 1 PERCENT OF THE FEMALE GRADUATES SHOW AN INTEREST IN PURSUING COLLEGE DEGREES OR CAREERS IN STEM. OPTIONS TARGETS GIRLS WITH AVERAGE TO ABOVE-AVERAGE ABILITY IN MATH AND SCIENCE.

For four years, learning communities of students, teachers, and mentors will engage in specific after-school, summer camp, and professional development activities. The first year of the program, the girls spend two days a month after school and one week during the summer completing hands-on projects led by volunteers from the Memphis Zoo, Memphis Pink Palace Museum, and FedEx. The second year, they are mentored by local women. The third they are offered paid after-school internships at local corporations and organizations.

Professional development workshops will be designed to change teachers' and counselors' attitudes and skills—in particular to train high school math and science teachers in gender-equitable teaching. The project's emphasis is to encourage girls to explore their options, but the objective of the learning communities and professional development is to increase the number of all students who enroll in science and math classes, choose math and science college majors, and pursue careers in STEM.

Everyone should benefit from the program. For educators, OPTIONS will identify factors that inhibit women's academic and career choices in science and math and will help them adopt better approaches. Girls will learn about the vast opportunities available to them and will learn to problem-solve in small groups. Corporations will be able to interact with educators in the design and evaluation of industry-specific intern programs to prepare the next generation of workers and to generate enthusiasm for that work. And everyone will benefit from the increased emphasis on science and math classes and career opportunities.

Says one participant, who plans to become a pilot, "I don't see a lot of women in math and science careers, but I don't think society's stopping us."

CODES: H, PD	Shelby County Schools, Memphis, Tenn.
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HRD 01-20860 (three-year grant)	
Keywords: demonstration, project-based, teacher training, gender equity awareness, mentoring, internships, career awareness, industry partners, after-school, professional development, problem-solving skills, self-confidence	

002

com

Community-based mentoring

COMMUNITY-BASED MENTORING

IN 1990, THE ASSOCIATION FOR WOMEN IN SCIENCE (AWIS) ESTABLISHED A FORMAL MENTORING PROJECT WITH FUNDING FROM THE ALFRED P. SLOAN FOUNDATION. AN NSF GRANT HELPED AWIS EXPAND THAT PROGRAM BY ESTABLISHING COMMUNITY-BASED MENTORING PROGRAMS FOR UNDERGRADUATE AND GRADUATE WOMEN AT 12 SITES NATIONWIDE. LOCAL CHAPTERS COLLABORATE WITH LOCAL CHAPTERS OF OTHER NATIONAL SCIENTIFIC ORGANIZATIONS TO OFFER A SETTING WHERE PROFESSIONAL MENTORS AND STUDENT PROTÉGÉES CAN EXCHANGE INFORMATION.

One-on-one mentoring offers a unique personal experience, but matching professional mentors and student protégées takes considerable time and effort. Small groups can offer the comfort of individual mentor–student interactions and facilitate peer interactions as well. Large-group activities allow students and mentors to network effectively and sample a broad range of advice and backgrounds, among both peers and more experienced scientists.

The activities graduate students found most useful in a 1993 survey reflect their interest in career opportunities: professional conferences, lectures and seminars, and luncheons with guest speakers give graduate students a chance to network with more established scientists and learn about their fields of interest. Also useful were small discussion groups, which most graduate students preferred to one-on-one mentoring, because discussion groups give them a chance to share problems and concerns with their peers and have their experiences validated. Graduate students' preference for group events and group mentoring reflect their interest in exchanging professional advice and concerns with other women scientists rather than in solidifying a tentative commitment to a scientific career.

AWIS compiled resource packets on the six topics students said they considered most important in group programs: career opportunities and options, selection of academic course work, research opportunities, professional contacts and networking, self-image and self-confidence, and balancing work and family. Mentoring helped participants resolve the women/scientist dilemma. Often women cannot see themselves pursuing science because they see conflict between the roles of scientist and the traditional roles of wife and mother. Most (94 percent) of the students said they planned to get married and 77 percent planned to have children. It was important that these students meet women who were managing and transforming those roles to meet their needs.

It will take years to learn if mentoring reduces women's attrition rate in science, but as a result of the AWIS mentoring project, the percentage of graduate students who reported being committed to or certain of a career in science increased from 84 percent to 89 percent. The percentage of women of color reporting themselves as committed to, or certain of, science careers rose from 70 percent to 82 percent, while the percentage for white women remained relatively constant, 82 percent to 88 percent. Overall, *minority women seem to have been more tentative in their initial commitment to scientific career than white women, and the AWIS mentoring project may have been more critical to their retention*.

CODES: U, PD	Association for Women in Science
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www.awis.org/mentoring.html (where you can find links to the project's many partners)	
HRD 94-53754 (one-year grant)	
Publications: Mentoring Means Future Scientists, A Hand Up: Women Mentoring Women in Science, and Grants at a Glance.	
Keywords: demonstration, mentoring, conferences, community-based, seminars, role models, career awareness, resource center, retention, self-confidence, research experience	

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X

age

Mentoring through cross-age research teams

MENTORING THROUGH CROSSAGE RESEARCH TERMS

UNDER CONSERVATIVE ATTITUDES PREVALENT IN RURAL AREAS, GIRLS ARE RARELY ENCOURAGED TO STUDY MATH AND SCIENCE OR TO PURSUE CAREERS IN STEM. THIS CROSS-GENERATIONAL MENTORING PROJECT—WHICH SERVED EIGHT EXTREMELY RURAL, ECONOMICALLY DISADVANTAGED COUNTIES IN CENTRAL MICHIGAN—CHANGED MANY GIRLS' ATTITUDES ABOUT CAREERS IN STEM AND OPENED MANY ADULTS' EYES TO HOW GIRLS ARE TREATED IN THE CLASSROOM AND HOW MUCH MORE THEY ARE OFTEN CAPABLE OF DOING.

In a two-year period, more than 500 girls from grades 5 through 12 joined undergraduate and graduate women, parents, teachers, and research professionals on 70 research teams. Women on the team provided mentoring, encouragement, and academic support for their younger "colleagues" as they all worked together on a common research project. Adults who helped supervise and mentor girls gained confidence in themselves and learned a lot about encouraging girls to continue in science.

A fall kick-off event brought research teams and professionals together. Mornings, teachers and research professionals met to discuss logistics. Girls and their parents came in the afternoon, to hear and ask questions of a panel of professional women, who talked about how they prepared for their careers and what it was like to be a woman in their field. Then the teams got acquainted and decided what to research.

Research topics covered fields from math, physics, engineering, and aeronautics to geology, health sciences, and microbiology. Most projects had a very practical aspect: One group invented and tested an electric bicycle; another looked at recycling plastics; one studied the physical fitness, dietary habits, and sedentary recreational activities of fourth through tenth graders; one tried to identify substance abuse in students in grades 6 through 12, compared with national norms; one studied the reading habits of junior high students. Some took on additional topics such as the orbits of astronomical objects and the movement of spaceships between and around them.

The girls learned about college, did original research with a professional researcher, and developed poster presentations about their findings, which they presented at a research exposition. In the process, they learned about statistical analysis, scientific method, and how to make a professional presentation. Many surfaced as leaders on their Odyssey of the Mind and Science Olympiad teams. Many of the girls have since entered college, are pursuing STEM-related majors, and attribute much of their confidence and success to their involvement in the research projects.

The project was *revitalizing for teachers. It was the first real research experience many elementary and student teachers had ever had—and their first exposure to equity-based programs*. Several male participants learned that their communication styles were not particularly encouraging to girls and ended up carrying new behaviors back to their own classrooms. To reach other classroom teachers, the project acted as a test site for Operation SMART, which trained a consultant from the Science/Mathematics/Technology Center to work with teachers in grades 3–5.

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HRD 95-54494 (one-year grant)	
Partners: College of Graduate Studies (CMU), Central Michigan Science/Mathematics/Technology Center, local school districts	
Keywords: demonstration, rural, multi-generational, underprivileged, career awareness, gender equity awareness, research experience, teamwork approach, mentoring, self-confidence, parental involvement, field trips	

002
RSE
RISE:
research internship
in science and
engineering

RISE: RESEARCH INTERNSHIP IN SCIENCE AND ENGINEERING

SOCIAL SCIENCE RESEARCH SUGGESTS THAT *ROLE MODELING IS MOST EFFECTIVE WHEN THE MODEL IS PERCEIVED TO BE "MOST LIKE" THE PERSON HERSELF. THIS UNIVERSITY OF MARYLAND INTERVENTION HELPS NEW UNDERGRADUATES SEE THEMSELVES IN ANOTHER UNDERGRADUATE—AND LOOK AHEAD TO THE POSSIBILITY OF BEING A GRADUATE STUDENT AND A FACULTY MEMBER*. THE EXTERNAL FACTORS THE PROJECT ADDRESSES INCLUDE THE ISOLATED AND "CHILLY CLIMATE" OF SCIENCE, THE UNDERSUPPLY OF WOMEN TO SERVE AS MENTORS AND ROLE MODELS, AND THE CRITICAL MASS OF FEMALE STUDENTS AND FACULTY NEEDED IN STEM DEPARTMENTS.

RISE offers a hands-on introductory program for freshmen and an enhanced team research experience for upper class students. The idea is that the first experience will excite and prepare entering freshmen women, who then move on to an extended research internship involving close contact with successful women scientists and engineers.

Upper class students participating in all-women research teams are mentored either by faculty women or by advanced (undergraduate or graduate) students, women who are paid and trained to significantly mentor or teach undergraduate women. The setting for student teamwork and mentoring is the research program of the faculty member involved.

RISE supports faculty women by paying them and training them to be involved in the project (so their efforts don't become a shadow job). Mentoring of undergraduates involves work they want to do anyway—their own research—so they continue to make progress in their own research and on the tenure track while supporting younger women. Built into the project is significant recognition for faculty from their deans and the provost.

The entire research team (the faculty member, RISE fellows, and up to four RISE participants) take part in training: workshops in mentoring, teamwork, and enough basic social psychology to help them understand why the intervention should work. *The chief internal barrier to success and persistence in STEM is students' underestimation of their own abilities (what the literature calls "self efficacy"). Mentors can help by affecting young women's sense that they can "do science."*

This project could bring some of the advantages of a single-sex learning environment (epitomized by women's colleges) into the more mainstream higher education of the College Park campus. Many features of the program—role model hierarchies, mentor training, all-female research teams, and the notion of a two-level program—are replicable.

CODE: U	University of Maryland
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HRD 01-20786 (three-year grant)	
Keywords: demonstration, research experience, internships, role models, intervention, barriers, self-efficacy, hands-on, teamwork approach, mentoring, barriers, teacher training	

002
Bcc
Building bridges
for community
college students

BUILDING BRIDGES FOR COMMUNITY COLLEGE STUDENTS

GENERALLY, STUDENTS AT COMMUNITY COLLEGES ARE LESS LIKELY THAN OTHER COLLEGE STUDENTS TO EXPERIENCE RESEARCH AND MENTORING THAT LEAD TO RESEARCH-BASED SCIENTIFIC CAREERS. VALENCIA COMMUNITY COLLEGE'S BRIDGES PROGRAM HELPED PREPARE 22 YOUNG WOMEN FOR UPPER DIVISION SCIENCE STUDIES AND CAREERS AND HELPED THEM MAKE INFORMED COURSE SELECTIONS AND CAREER CHOICES.

BRIDGES is an acronym (for building and replicating an innovative demonstration model to facilitate gender equity in sciences) but it also means the bridge the community college provides between high school and university-level studies for millions of students each year—especially students from nontraditional populations.

Ten students were selected (on the basis of their personal motivation and career goals) from Apopka High School in Orange County, Fla. Twelve students (ranging in age from 17 to 29) were selected from Valencia. The women were racially and ethnically mixed and from different backgrounds; their career choices ranged from medicine, nursing, and veterinary medicine to chemical and biological research.

The project developed a 10-week course in research methods, offering lectures and labs in three subjects: biochemistry (with labs in protein and DNA electrophoresis, DNA and restriction enzyme mapping, and enzyme kinetics), biology (with labs in microscopy, histology, and anatomy and a tour of the electron microscopy lab at Orlando Regional Medical Center), and chemistry (labs in the use of high-performance liquid chromatography and various types of chemistry computer software). A slightly modified version of the course is now an important part of Valencia's science curriculum.

Valencia's faculty examined existing courses for possible gender bias, and a mentoring program paired high school and college participants on the basis of their academic goals and extracurricular interests. Pairs worked as lab partners in the research methods course and maintained regular contact outside the lab. Valencia sponsored three informational seminars, at which noted female scientists from the science faculty and the local community spoke to the group about their work, their educational backgrounds, and the demands of juggling career and family. Students were in touch not only with these scientists and their mentors but also with counselors who gave the students useful advice about careers, financial aid, and university transfer procedures.

An education specialist interviewed students by phone throughout the semester to monitor the success of the mentoring program and students' opinions about the projects. Students who completed the research methods course were paid a stipend and awarded a framed certificate.

CODE: U	VALENCIA COMMUNITY COLLEGE
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HRD 95-55734 (ONE-YEAR GRANT)	
PARTNERS: UNIVERSITY OF FLORIDA, ORANGE COUNTY PUBLIC SCHOOLS, AMERICAN ASSOCIATION OF WOMEN IN COMMUNITY COLLEGES (VALENCIA CHAPTER)	
KEYWORDS: DEMONSTRATION, COMMUNITY COLLEGE, CURRICULUM, MENTORING, RESEARCH EXPERIENCE, CAREER AWARENESS, MINORITIES, ROLE MODELS	

002

Wze

WISER lab research for first-year undergraduates

WISER LAB RESEARCH FOR FIRST-YEAR UNDERGRADUATES

HIGH DROPOUT AND SWITCH RATES AMONG UNDERGRADUATE WOMEN INTENDING TO MAJOR IN THE SCIENCES AND ENGINEERING DEPLETES THE POOL OF INTERESTED, QUALIFIED, AND PREPARED STUDENTS—FURTHER EXACERBATING THE PROBLEMS OF WOMEN'S UNDERREPRESENTATION IN THESE FIELDS. THE PERIOD OF HIGHEST ATTRITION AT PENN STATE AND OTHER INSTITUTIONS IS THE FIRST YEAR, ESPECIALLY THE FIRST AND SECOND SEMESTERS AND THE SUMMER TRANSITION TO THE THIRD SEMESTER. BECAUSE RESEARCH PLACEMENTS AS A RETENTION DEVICE TYPICALLY COME TOO LATE IN STUDENT CAREERS FOR MAXIMUM EFFECT, IN 1996 PENN STATE INITIATED WISER, AN UNDERGRADUATE RESEARCH PROGRAM FOR FIRST-YEAR STUDENTS IN SCIENCE AND ENGINEERING. OVER FIVE YEARS, WISER PLACED ABOUT 250 FRESHMAN WOMEN IN RESEARCH LABS IN THE SCIENCES AND ENGINEERING.

WISER is for both gifted and average students entering science and engineering. WISERs' SAT scores follow a standard bell curve: 95 percent have cumulative scores of 1400 or less; 74 percent, 1300 or less—refuting the notion that undergraduate research experiences are suitable only for the academically gifted or that only such students will apply. Some faculty and administrators resisted first-year student placements, predicting dire consequences, if not the program's outright failure. But most of the faculty was supportive—even excited—at the prospect of young students in the lab. Those who participate tend to keep accepting WISERs and recommend the program to other faculty.

Faculty members receive up to 30 applications, interview as many students as they have time for, and give their first through third choices to the WISER administrator. Applicants may apply to as many as three labs and state their first three choices after their interviews. The WISER office matches the student and faculty, trying to give everyone her or his first choice. About a third of the applicants—mainly those in the life sciences—cannot be placed. The project emphasizes placements in engineering and the physical sciences, where women are more likely to be both isolated and underrepresented at every stage.

WISER is an adaptation of the research component of a more comprehensive retention initiative, the Women in Science Project (WISP) at Dartmouth College. After Penn had decided on research placements as an intervention, it learned that a model for such a program already existed at Dartmouth College, initiated by Carol B. Muller and Mary Pavone. WISP incorporates formal mentoring, e-mentoring, a newsletter, tutoring, scientific poster sessions, advising, and paid research placements, which sometimes take place in off-campus locations such as hospitals. It was a much more ambitious and comprehensive program than Penn State was prepared to offer. Could the research placement component be separated from WISP's integrated approach and still have a positive effect?

Dartmouth is a small, elite, private, teaching-oriented university, and Penn State is a large, multisite, state-affiliated, research-oriented university—yet Dartmouth and Penn State's main campus share certain features: a high residential (not commuter) student population, a paid staff to administer STEM retention programs, staff adept at collaborative (not competitive), cross-discipline projects, and the institution's acknowledgment that it could not keep blaming the poor retention of undergraduate students in STEM on K–12 schools.

And Dartmouth administrators were generous and trusting in handing off material that could be considered proprietary. With the WISP administrators' permission (and diskette), Penn copied WISP's timetable, its student handbook describing research opportunities, and its application form. This alone allowed Penn to get the program up and running in weeks rather than months or years.

Many Penn State students come from small or rural school districts where they are highly visible and often sought out because of their academic talent. *The assertive behavior needed to successfully negotiate a research placement at a competitive institution such as Penn State is considered rude or even foreign to rural values, especially for women. So rural women (and some men) can miss out on unparalleled opportunities to fast-track their careers. The strength of the WISP application and selection process was that it used a format familiar to students: writing applications and going to interviews to which they were invited*.

Preliminary data show a 50 percent reduction in dropout and switch rates among WISERs, compared with their matched cohorts, at least during the first three semesters when retention of science and engineering students is most at risk.

Unlike the Dartmouth program, WISER offers almost nothing in the way of support services beyond the initial matching of faculty and student. It is up to the student to make her way through an interview, to negotiate a satisfying research experience once placed, and to maintain contact with the faculty member after the two-semester placement has ended.

Interestingly, a spin-off of the program at Abington College, a two-year branch campus of Penn State that is becoming a four-year institution, has returned to the Dartmouth model of high ancillary support activities—with great success. Abingdon values a retention program that directly benefits a few undergraduate students daily more that it values a one-day K–12 program that benefits hundreds of girls. Dissemination to the Abington College site has produced perhaps *the most interesting outcome of all. It has stimulated new research activities among the faculty, brought recognition to faculty already doing research, and helped integrate adjunct faculty*.

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HRD 96-32186 (one-year grant)	
Partners: Pennsylvania Space Grant Consortium, Penn State at Abington-Ogontz	
Keywords: education program, retention, research experience, engineering, physical sciences, intervention, mentoring, electronic mentoring, internships, rural	

SUPPORTING WOMEN IN GEOSCIENCE

002
Geo
Supporting women in geoscience

TO INCREASE THE NUMBER OF WOMEN COMPLETING GRADUATE STUDIES IN EARTH SCIENCES, *IT IS IMPORTANT TO OFFER ENCOURAGEMENT AT THREE CRITICAL TRANSITION POINTS: AS THEY ENTER COLLEGE, WHEN THEY ARE SENIORS ABOUT TO GRADUATE, AND IN THE EARLY YEARS OF GRADUATE SCHOOL*. BY NURTURING FEMALE LEADERS IN GEOSCIENCE WHO CAN SERVE AS ROLE MODELS TO YOUNG WOMEN ENTERING UNIVERSITY IN LATER YEARS, THIS UNIVERSITY OF ARKANSAS PROJECT AIMS TO INCREASE THE NUMBER AND VISIBILITY OF WOMEN IN THE EARTH SCIENCES.

Project activities designed to improve their self-confidence and self-reliance include mentoring and the development of a support network of peers that can be used throughout the women's careers in geoscience. The project also emphasizes developing the skills needed for success, such as written and oral communication, team-building and leadership, and good study habits and organization. Project activities include a weekend field trip for entering female geoscience majors; a 10-day field experience for senior undergraduate and graduate women; *a mentoring ladder in which freshmen are guided by upperclasswomen who are counseled by graduate students, who in turn are supported by a faculty member*; scholarly seminars given by female students of all levels; attendance at national meetings and a role-model lecture series that brings prominent female geoscientists to campus.

The activity that has had the broadest impact to date is the role-model lecture series. Three women are brought to campus each semester to give the Friday afternoon colloquium in the department of geosciences. The students decide whom to invite and handle bringing the speakers to campus. Each speaker has said she came because the request came from the students themselves, so it was an opportunity to be a role model and interact with female students. So far the students have chosen only professors—but professors at different stages of their careers (assistant, associate, full) and at different types of institutions (public, private, research oriented, and comprehensive). Speakers have lunch with the undergraduate and graduate women, give a formal scientific talk in the afternoon, and are guests at a reception for the whole department that evening. Both the luncheons and receptions are well attended.

Conversation at the lunches—sometimes quite lively—ranges from the relevant scientific discipline to the realities of finding jobs for two-career couples and the difficulties of balancing careers and family. *Many of the students are surprised and relieved to discover that the speakers also faced, and sometimes still face, challenges similar to their own. Differences in perspective between full professors and junior women newer to academe enlighten and encourage the students. After these discussions, the students clearly feel they can and will pursue graduate studies, despite any earlier misgivings*. For several students, direct contact with a speaker during her visit has led to e-mail exchanges about graduate school.

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Keywords: demonstration, role models, geosciences, self-confidence, mentoring, peer groups, field trip	

002
Fell
Undergraduate research fellowships

UNDERGRADUATE RESEARCH FELLOWSHIPS

A 1996 STUDY OF *FIVE UNIVERSITIES KNOWN FOR RETAINING WOMEN AND STUDENTS OF COLOR IN THE SCIENCES REPORTED THAT CERTAIN PRACTICES WERE COMMON TO THE FIVE INSTITUTIONS: UNDERGRADUATE RESEARCH OPPORTUNITIES, HIGH LEVELS OF FACULTY–STUDENT INTERACTION, AND AN EMPHASIS ON UNDERGRADUATE EDUCATION*. FUNDING CUTS HAVE REDUCED THE NUMBER OF FELLOWSHIP AWARDS AVAILABLE FOR UNDERGRADUATE RESEARCH, HOWEVER, SO INDIANA UNIVERSITY'S UNDERGRADUATE RESEARCH FELLOWSHIP PROGRAM FOR WOMEN IN THE SCIENCES PROVIDED RESEARCH EXPERIENCES FOR UPPER-DIVISION UNDERGRADUATE WOMEN WHO HAD SHOWN INTEREST AND POTENTIAL IN THE SCIENCES.

Upper division participants did 40 hours of research during the summer of 2001 and 10 hours a week during the fall and spring semesters—interacting with faculty who served as mentors and role models. Introducing more undergraduate women to lab work is expected to help retain women in the sciences, build their confidence in their scientific abilities, and make them more competitive for graduate school and the job market.

The program provided training in scientific research and lab skills, as well as in presentation and communication skills, to upper-division women students in the sciences. Lab researchers presented their lab research and experiences at an event organized by the Women in Science Program and presented posters on their research at WISP's annual Women in Science Research Day. They could also compete for three monetary awards to be used for attending or presenting their research at national or regional conferences.

Other factors important to the retention of women in the sciences include frequent contact with faculty in classrooms and laboratories, faculty concern for individual students, and an interactive (rather than competitive) classroom environment. Bloomington's WISP program has had considerable success with research internships, mentoring, and support networks for retaining women in the sciences. This project also provided mentoring opportunities, peer support networks, and role models for women science students, starting in sophomore year. Upper-division mentors were matched up with sophomore students interested in pursuing science majors.

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Keywords: demonstration, retention, research experience mentoring, role models, self-confidence, internships	

TRAINING GRADUATE STUDENTS TO DEVELOP UNDERGRADUATE RESEARCH PROJECTS

002
dev
Training graduate students to develop undergraduate research projects

MOST TEACHER TRAINING OF GRADUATE STUDENTS EMPHASIZES CLASSROOM INSTRUCTION. GRADUATE TRAINING RARELY ADDRESSES THE NEED TO DEVELOP SKILLS IN DESIGNING AND SUPERVISING UNDERGRADUATE PROJECTS. STONY BROOK, WHICH RECEIVED AN NSF RECOGNITION AWARD FOR INTEGRATING RESEARCH AND EDUCATION, HAS A LONG TRADITION OF RESEARCH COLLABORATION BETWEEN UNDERGRADUATES AND FACULTY.

In this project, it found that *the best way to train graduate students in how to supervise science and engineering research is to require every Ph.D. student to develop one teaching module based on his or her research as an integral part of the Ph.D. program. This forces the students to explain the social and scientific context of their research in terms freshmen can understand; to identify a research project that can be completed in two to three weeks, one outcome of which is important to the project; and to define and develop an educational experience—all of which are important to the professional growth of scientists in training*.

In a one-year project, Hanna Nekvasil (in Geosciences) designed a two-semester seminar on the design and supervision of undergraduate research projects. Graduate students were trained to develop and direct short undergraduate research projects and got experience doing both. The interdisciplinary modules in applied research could be repeated by undergraduates in subsequent years. The idea was partly to help women going on in academia to understand the integral relationship between teaching and research, to foster the skills needed to carry out these activities, and to enlarge women's social and intellectual community by fostering collaborations between disciplines and with high-tech R&D scientists.

The course, which met weekly, yielded six projects, five of which were implemented in the hands-on course for freshmen, Introduction to Research. The projects involved hands-on research involving synthetic lavas, exercise's ability to attenuate the human body's response to stressors, DNA fingerprinting, pollution and environmental policy, and the chemistry of photosynthesis.

Undergraduates were able to carry out projects in areas of science with which they were unfamiliar and to which they would not otherwise have been exposed as undergraduates. One in seven students said they planned their intended major from their participation in these projects. They learned about research topics, methodologies, and skills, benefiting greatly from various hands-on experiences and from the collaborative approach to research. They greatly preferred the team project approach to doing research by themselves.

Pairs of graduate students from different disciplines (in new and emerging fields) learned to design research modules and supervise teams of five to six undergraduates, considering such factors as the undergraduates' science backgrounds, how much time they had to spend on the project, and available facilities and materials. They gained skill in promoting an inquiry-based, problem-solving approach to teaching and strategies for encouraging frequent interaction and collaboration among team members. And they valued the chance to work with graduate students from other disciplines.

The project brought home the mutual benefits of graduate–undergraduate interactions, the need for graduate students to be placed in instructional roles (yet the difficulty of finding time to do so), and the difficulties of providing undergraduates with research experiences. For this reason, Nekvasil developed a new required course that places undergraduate geology majors (both male and female) with graduate geochemistry students. Each graduate student becomes primary instructor in the optical identification of minerals for a small group of undergraduate students.

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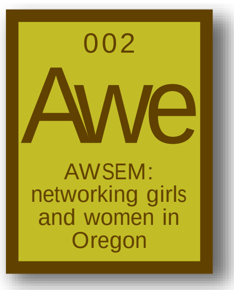
Partners: Center for Biotechnology, Collaborative Laboratories, Symbol Technologies, Inc.	
Keywords: demonstration, hands-on, research experience, collaborative learning, inquiry-based, problem-solving skills, geosciences	



AWSEM: NETWORKING GIRLS AND WOMEN IN OREGON

IN OREGON, HIGH-TECH CORPORATIONS HAVE SURPASSED THE TIMBER INDUSTRY TO BECOME THE STATE'S NUMBER ONE EMPLOYER. ALARMINGLY, THESE SAME COMPANIES ARE CURRENTLY FORCED TO HIRE OUTSIDE THE STATE FOR 50 PERCENT OF TECHNICIANS AND 90 PERCENT OF ENGINEERS. AND WOMEN, WHO MAKE UP 45 PERCENT OF THE WORKFORCE, CONSTITUTE ONLY 16 PERCENT OF SCIENTISTS, 10 PERCENT OF COMPUTER SCIENTISTS, AND 4 PERCENT OF ENGINEERS. STUDIES ATTRIBUTE THIS UNDERREPRESENTATION TO LACK OF ENCOURAGEMENT, SUPPORT, AND ROLE MODELS FOR GIRLS IN SCIENCE, ESPECIALLY DURING THE MIDDLE SCHOOL YEARS. GIRLS AS TALENTED AS BOYS IN MATH AND SCIENCE, AND AS EXCITED ABOUT SCIENCE IN CHILDHOOD, BEGIN TO LOSE INTEREST IN MATH AND SCIENCE AROUND THE AGE OF 12. THEY DROP OUT OF MATH AND SCIENCE CLASSES, CLOSING THE DOORS ON MANY CAREER OPPORTUNITIES. THIS LOSS OF TALENT IS A QUIET CRISIS IN AMERICA.

AWSEM (advocates for women in science, engineering and mathematics) developed a model of advocacy and curriculum to encourage girls to pursue their early interests in the sciences. It began in 1994 as a project of the Saturday Academy, a community-based effort that in 1996 received the Presidential Award for Excellence in Mentoring for its support of students from groups underrepresented in science and engineering. AWSEM brings together parents, educators, and women professionals in science-related fields to kindle and support young women's interest in STEM. Regional networks of community leaders work together to dispel pervasive negative attitudes about girls, women, and science; to create local networks of public and private institutions that give young women more science opportunities; and to establish a vertical mentoring system that links middle and high school girls with female college students, teachers, parents, and professionals—to establish sustained contact between young women and science practitioners.

The AWSEM model of advocacy assumes that the most effective way to encourage girls in the sciences is to create meaningful interactions between girls and role models in a wide variety of careers. Girls meet peers with similar interests in after-school clubs where they do fun, hands-on science projects, get to know college women in STEM disciplines, and get to work with experienced women professionals, from aeronautic engineers to zoologists. AWSEM's slogan: "*Making connections between inquiring young minds and accomplished community professionals to solve real problems*."

AWSEM maintains a network of 18 after-school science and math clubs in the Portland metropolitan area where middle and high school girls meet with each other and with college-age women to pursue their interests in science. It tries to locate these clubs in schools serving high minority and low-income populations, and schools with high dropout rates—typically getting outside funding to support the clubs. Monthly site visits to local science institutions such as the Oregon Regional Primate Research Center allow girls to spend their day working with groups of women professionals, getting a hands-on introduction to the excitement and diversity of science careers and the women who pursue them.

AWSEM supports regional advocacy efforts with products, curriculum, and information. It held training for teachers and group leaders, with special sessions on robotics engineering to help them help girls explore computer-controlled Lego robots in their clubs and classes. AWSEM's website features hands-on science and math activities, gender equity research, and links to career information and other science sites.

Participating in AWSEM has changed many girls' and parents' attitudes toward STEM careers and courses as well as their behavior. The girls' grades, activities, TV habits, and plans for education reflect a heightened interest in STEM and STEM professionals. The undergraduates and professionals who mentor benefit from the support network that develops among them when they work together on a project. In developing the interactive site visits, the leadership teams learn how to communicate their careers and subjects to a lay audience of students.

THE M.A.D. SCIENTISTS CLUB

In April 1996, after a monthly meeting of the Lane County Regional Gender Equity Committee, two members were reflecting on how—despite math and science's clear importance to girls' self-esteem, education, and careers—girls were opting out of the more difficult math and science classes at a greater rate than boys. These girls and their parents seemed unaware of the lifelong implications of this action.

"These girls need an advocate," said Mary H. Thompson, publisher and co-author of a series of books on women and science. "Who do you think has the greatest vested interest in a young girl's welfare and future?"

"Their mothers!" said Marjorie DeBuse, director of the Lane County Saturday Academy and mother of a young daughter.

Thus began The M.A.D. (mothers and daughters) Scientists Club program.

Using seed money allocated from the Saturday Academy's NSF-funded AWSEM program, Marjorie added The M.A.D. Scientists Club to the U of O Talented and Gifted Institute's Super Summer program. Mary developed the curriculum and took the first group of mothers and daughters through hands-on science activities, discussing issues the girls were encountering that made it difficult for them to admit to liking their math and science classes.

The M.A.D. Scientists Club brings fourth and fifth grade girls and their mothers (or another significant adult woman) together to do hands-on science experiments and activities, to learn about women scientists throughout history, and to be introduced to gender-related issues that can reinforce positive attitudes about math and science in the girls and their mothers. The program consists of an organizational meeting, six science sessions, and an optional "Mom Talk."

Sessions are coordinated by a trained facilitator who provides the curriculum and helps organize the science activities. Sciences covered are chemistry, structural engineering, physics, astronomy, mathematics, and geology/paleontology. Activities in The M.A.D. Scientists Club are drawn from *The M.A.D. Scientists Club Facilitator's Manual* and Mary Thompson's *The Scientist Within You: Experiments and Biographies of Distinguished Women in Science*.

Mothers enjoy the opportunity to get away on a special outing with their daughter, spending time together learning about science in a comfortable learning environment (especially when science has intimidated them or left a bad taste in their mouth), watching their daughter get excited about science activities, getting involved with other moms, and learning how many doors science can open for their daughters and how to help their daughters grow.

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www.awsem.org	www.alphaci.com/mads/4-progr/progr.htm (MAD Scientists Club) · HRD 94-50030, HRD 97-14862 (three-year grants)
Partners: Portland State University, Oregon Graduate Institute, Oregon University System, Oregon State Department of Education, Women in Technology International (WITI), Oregon Robotics Tournament and Outreach Association, Solar Energy Association of Oregon, Expanding Your Horizons, the Institute for Science, Engineering, and Public Policy, and countless local organizations.	
Materials available from AWSEM website: Action Kit; Directory of Practitioners: Role Models for Young Women; Passport to Science; Site Visit Handbook; and Curriculum Guide.	
Keywords: education program, role models, parental involvement, support system, after-school, clubs, field trips, hands-on, career awareness	

002

WB

WISE beginnings

WISE BEGINNINGS

FIRST-YEAR COLLEGE STUDENTS OFTEN BELIEVE THAT INTRODUCTORY SCIENCE CLASSES ARE DESIGNED TO ELIMINATE STUDENTS NOT GOOD ENOUGH TO DO SCIENCE. *SOME FACULTY ALSO BELIEVE THAT STUDENTS LEAVE SCIENCE EARLY BECAUSE THEY LACK CERTAIN ATTRIBUTES OF ABILITY OR CHARACTER, AND THAT THEIR LEAVING IS PART OF A NATURAL WEEDING-OUT PROCESS. BUT STUDIES REPEATEDLY SHOW THAT MANY STUDENTS WHO LEAVE THE SCIENCES ARE INTELLIGENT AND STRONGLY MOTIVATED BUT DISCOURAGED BY THE COMPETITIVE CULTURE AND THE BELIEF THAT A DEPARTMENT IS MAKING EARLY NEGATIVE JUDGMENTS ABOUT THEIR ABILITIES. THE CHILLY CLIMATE IN MOST SCIENCE CLASSROOMS—AND THE WAY SCIENCE IS USUALLY TAUGHT—ESPECIALLY LEADS MANY WOMEN TO LEAVE SCIENCE FOR MORE CONGENIAL ACADEMIC FIELDS*.

Brown University initiated the successful Women in Science and Engineering (WISE) program to improve the environment for undergraduate women studying science. It launched WISE Beginnings to provide strong support during that year when undergraduate women are first exposed to college-level science and form their opinions about whether or not to become scientists.

More than 300 students participated in facilitated study groups for introductory chemistry, engineering, physics, and calculus courses. The first year of the program, students of color facilitated most of the study groups, to address the dearth of women of color in the WISE program and in the sciences generally. In its third year, the study groups became open to all students. WISE developed a comprehensive training program on group facilitation for study group leaders (using the supplemental instruction model of group facilitation). It also created events for first-year science students for orientation day and for WISE Day, at the beginning of the second semester.

On the Women in Science website, first-year students could read: "One important thing to remember as you are going through introductory science courses is that everyone has a different learning style. The way your course is taught may not be conducive to the way you learn. It is important to try to find study techniques that fit your learning style. Also, the college grading system is very different from the high school one. Medians on exams here are often low, but this does not necessarily reflect any change in intelligence, or ability to do science." Advice on the website aimed to dispel common first-year myths about college science.

Nearly a quarter of the undergraduate population became involved. More than 50 science faculty worked actively often in collaboration with students, to make their courses to more accessible to all students, including traditionally underrepresented groups. Provided with guidance on reforming science education, *many faculty were persuaded that by shifting the pedagogical focus away from a competitive, "weeding out" model to a cooperative, welcoming, stimulating model the sciences would retain more talented students. Science classes had previously tried to engage students in competition, but students often respond more positively to an atmosphere of cooperative learning—small groups of students working together to solve problems, complete a task, accomplish a common goal, ask questions, discuss ideas, learn to listen to others' ideas, offer constructive criticism, and so on*.

Some professors now find it useful to talk to classes about the weeding-out theory, explaining that any weeding out that goes on goes on during the admissions process, and that they expect all their students to do well. When a professor expresses high expectations for a class, students often have more confidence in their own abilities and perform better. To address grade anxieties, some instructors stress that performance in introductory courses is not necessarily an indicator of future performance or ability—that students could earn low grades in introductory science courses because of a weak high school science background or problems making the transition to the college environment, among reasons that might have nothing to do with science ability. By encouraging apprehensive students to take a course on a pass/fail basis, they allow students to explore a subject of potential interest without having to worry as much about the grade—and to base decisions about their future on how much they are learning and their interest in the subject matter instead of on how good a grade they earn in an early course.

To move toward collaborative work, instructors increasingly designed more cooperative and discovery-oriented introductory courses that explore interesting topics yet cover the basics. To personalize large, impersonal classes, they began encouraging more study groups—formal and informal, in class and out. They began to adopt the student-as-learner model, with the teacher as coach. They tried to help students develop the skills in critical thinking and group work that scientists use every day in research and to see that science is not static.

Engineering 3, for example, was a team-taught introductory course that typically weeded out significant numbers of women and students of color, *who found it too boring or difficult. The group that overhauled the course found that instructors were teaching to the "top" of the class (students who already excelled in AP physics and AP calculus and were proficient in computer programming) and ignoring the less well prepared majority of students in the middle and at the bottom*. They split off an advanced class for students already familiar with much of first-year engineering and, for the rest of the students, developed 10 hands-on labs closely connected to the weekly lecture. They encouraged collaborative work, introduced two design contests to make things interesting, assigned students to homework study groups based on dorm location, gave out class e-mail addresses to make communication easier, prepared a course handbook on basics and tips for working productively, and established an ombudsperson position (filled by a junior or senior engineering student) to give the instructors ongoing feedback and to address student concerns. The traditional stream of student complaints about the course ended.

As a result of these efforts to encourage study groups and to change the way science was taught, the retention rate for women in science at Brown increased significantly, from 59.9 percent in the class of 1994 to 67.4 percent in the class of 1996.

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www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity	HRD 94-53676 (one-year grant)
Useful links: www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/Equity_handbook.html www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/toc_wisb.html www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/sme_links.html	
Keywords: demonstration, study groups, cooperative learning, self-confidence, exploration-based, hands-on, retention	

WISP: DARTMOUTH'S SUPPORT PROGRAM

IN 1993, DARTMOUTH LAUNCHED AN INNOVATIVE MODEL PROGRAM TO ENCOURAGE NEW STUDENTS WITH HIGH INTERESTS IN STEM TO RETAIN THOSE INTERESTS, BY IMPROVING THEIR EXPERIENCE IN STEM COURSES, ESPECIALLY THEIR FIRST YEAR. DARTMOUTH'S COMPREHENSIVE WOMEN IN SCIENCE PROJECT (WISP) PROVIDED EARLY HANDS-ON RESEARCH EXPERIENCES, MENTORING, ROLE MODELING, TUTORING, ACCESS TO INFORMATION AND ADVICE, A NEWSLETTER, SCIENTIFIC POSTER SESSIONS, AND THE CHANCE TO BUILD A SENSE OF COMMUNITY IN THE SCIENCES. MENTORING, IN WHICH WISP PIONEERED, TOOK MANY FORMS: FORMAL AND INFORMAL, FACE TO FACE AND ELECTRONIC, AND WITH PEERS, UPPERCLASSWOMEN, AND PROFESSIONALS IN INDUSTRY.

As interns, first-year students spent up to ten hours a week for two terms working with science faculty members (or researchers in nearby industrial or government laboratories) assisting in ongoing research projects—opportunities usually reserved for upper-class science majors preparing for graduate work. NSF funding helped cover stipends to ensure the participation of economically disadvantaged students. Interns were given a student guide written by a former intern. At year's end they could present their work in poster sessions at Dartmouth's annual science symposium. In 11 years, 787 first-year women participated in research internships and 219 faculty and researchers volunteered as WISP intern sponsors. (Graduate students and post docs often served as supervisors and "assistant sponsors.") All of Dartmouth's science departments, including the medical school, participated, as well as such off-campus institutions as the Veterans Administration Research Center and the U.S. Army Cold Regions Research and Engineering Laboratory.

Realizing that they wanted to share information and advice with younger students, two junior science majors initiated WISP's peer mentor program in 1992. Over the years this student-directed program has touched the lives of close to 1500 Dartmouth women.

WISP also pioneered an e-mentoring program that paired undergraduate and graduate women in STEM with industrial scientists and engineers, using mainly e-mail to communicate and build relationships. WISP developed the industrial e-mentoring program so that experienced mentors could help young women connect their classroom studies to the world of work. *The mentors most available to women on rural college campuses are those in the academic profession, but many students eventually seek employment in business and industry. Expansion of the Internet and the increasing prevalence of e-mail on college campuses and in industrial workplaces diminishes the limitations of time and location and opens up new mentoring possibilities*.

Protégées and mentors alike found their telementoring relationships viable, valuable, and personally rewarding. They saw electronic communication *as an ideal medium for quick and easy communication between people in different time zones or remote locations and on different schedules. Written messages allowed protégées to express themselves more thoughtfully, to feel less intimidated, and to preserve the correspondence (because it was sometimes reassuring to go back and reread what the mentor said later)*. There were some limitations, too. E-mail could feel impersonal; conversation and the exchange of ideas may flow more easily in face-to-face or phone conversations than in asynchronous communication; and it is harder on e-mail to maintain an open, spontaneous discussion, to guide a conversation, or to correct a misinterpreted question or comment. *Clearly e-mail has to be supplemented with occasional phone calls and personal visits over meals and at the mentor's workplace*. Some mentors recommended videoconferencing for virtual face-to-face conversations, gatherings, and group discussions.

WISP's model e-mentoring program led to and became part of MentorNet, the national e-mentoring program sponsored by WEPAN and funded by the AT&T and Intel foundations.

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www.dartmouth.edu/~wisp/	HRD 93-53764 (one-year grant)
Guide to first-year research internships: www.dartmouth.edu/~wisp/student_guide.pdf Dartmouth's science teaching website: www.dartmouth.edu/~wisp/faculty/home.html	
Keywords: demonstration, retention, hands-on, research experience, mentoring, role models, internships, electronic mentoring, industry partners	