CHAPTER FIVE · CHANGING THE LEARNING ENVIRONMENT

"THE WORLD CANNOT AFFORD THE LOSS OF THE TALENTS OF HALF ITS PEOPLE IF WE ARE TO SOLVE THE MANY PROBLEMS WHICH BESET US."
—ROSALYN YALOW, NOBEL LAUREATE 1977

TO ACHIEVE LASTING CHANGE, A LIMITED PROJECT MUST REACH ALL "PARTS OF THE SYSTEM"—THE PEOPLE (STUDENTS, TEACHERS, PARENTS, COUNSELORS, ADMINISTRATORS, FACULTY, MENTORS AND INDUSTRY ROLE MODELS), THE PEDAGOGY (HOW MATERIAL IS TAUGHT), THE COURSE CONTENT (WHAT IS TAUGHT, WHEN), AND ORGANIZED SOCIAL SUPPORT NETWORKS. MANY PROJECTS REACHED FOR THIS IMPACT WITHIN THREE YEARS AT THE MAXIMUM AWARD LEVEL ($900,000).

ALSO INCLUDED HERE ARE WORKSHOPS OR CONFERENCES LOOKING AT SYSTEMIC AND SOCIETAL ISSUES, OR CONDUCTING STUDIES ACROSS INSTITUTIONS, OR INITIATING A PROGRAM ACROSS INSTITUTIONS IN ORDER TO EXAMINE ITS IMPACT WITHIN VARIED ENVIRONMENTS. SOME EFFORTS SOUGHT TO AFFECT POPULATIONS WITHIN A STATE (FOR EXAMPLE, PRE-SERVICE TEACHERS IN SCHOOLS OF EDUCATION), OR TEACHERS FROM MANY STATES WHO SPECIALIZE IN ONE DISCIPLINE (FOR EXAMPLE, TEACHERS OF COMPUTER SCIENCE IN HIGH SCHOOL), OR A COMMON GRADE LEVEL (FOR EXAMPLE, AN ONLINE COURSE FOR MIDDLE SCHOOL TEACHERS). NSF ALSO FUNDED STUDENT SUPPORT SYSTEMS THAT TRANSCEND ONE SETTING AND ONE GEOGRAPHIC LOCATION—FOR EXAMPLE, MENTORING PROGRAMS USING THE INTERNET.

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wrks

What works in
programs
for girls

005

C+C

Connections:
curriculum, career,
and personal
development
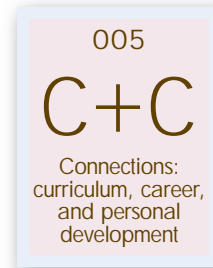
WHAT WORKS IN PROGRAMS FOR GIRLS

PARTICIPANTS AT A TWO-DAY WORKSHOP AT SANTA CLARA UNIVERSITY SHARED WHAT THEY'D LEARNED ABOUT WHAT WORKS—OR DOESN'T—IN PROGRAMS TO MOTIVATE HIGH SCHOOL GIRLS TO PERSIST IN SCIENCE, MATH, AND TECHNOLOGY. WORKSHOPS LIKE THIS HELP EDUCATORS REALIZE THEY ARE NOT ALONE AND GIVE THEM A CHANCE TO SHARE EXPERIENCES, PROJECT IDEAS, AND ADVICE ABOUT SETTING UP APPROPRIATE LEARNING ENVIRONMENTS.

Best practices for such programs, the participants found, include

- *Setting up a safe, comfortable, yet challenging environment for problem solving*
- *Including a project with tangible results that the girls can take away with them (something physical, like a bridge, or virtual, like a website they can connect to from home to show parents and friends their accomplishments)*
- *Finding ways to bolster girls' self-efficacy, a key to persistence in STEM*
- *Helping girls envision technologically related careers as part of their "possible selves"*

To address the difficult problem of assessing programs, participants developed draft assessment tools aimed at tracking girls' participation in STEM and began work on assessing self-efficacy. Any program to encourage girls' persistence can use the project's online survey capabilities. Local programs register through the website and are issued a program ID and password that participants in the program can use to complete the online surveys. The project hopes to follow up with each participant for several years, tracking their persistence in STEM and providing data on the nationwide impact of such programs. The project website also provides useful links to STEM programs for girls.

CODES: H, PD	SANTA CLARA UNIVERSITY
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http://www.scu.edu/SCU/Projects/NSFWorkshop99/	
HRD 98-77037 (ONE-YEAR GRANT)	
KEYWORDS: DISSEMINATION, RESEARCH STUDY, PROFESSIONAL DEVELOPMENT, WORK-SHOPS, BEST PRACTICES, ONLINE SURVEY, WEBSITE	

CONNECTIONS: CURRICULUM, CAREER, AND PERSONAL DEVELOPMENT

A PARTNERSHIP BETWEEN NORTHEASTERN UNIVERSITY (NEU) AND THE BOSTON-AREA PATRIOTS' TRAIL GIRL SCOUT COUNCIL, CONNECTIONS ENCOURAGES YOUNG WOMEN FROM MIDDLE SCHOOL THROUGH COLLEGE TO PURSUE TECHNICAL MAJORS AND CAREERS. THE SCOUTS BRING TO THE PROJECT THEIR EXPERTISE IN ALL-GIRL PROGRAMS AND GENDER SENSITIVITY. NEU, WITH ITS SIGNATURE COOPERATIVE EDUCATION PROGRAM, BRINGS EXPERTISE IN CAREER TRAINING AND STEM EDUCATION. THE PROJECT WILL REACH OUT TO IMMIGRANTS AND OTHER GIRLS WHO HAVE NOT PARTICIPATED IN SCOUTING OR BENEFITED FROM ALL-GIRL PROGRAMS.

Connections come through contact with one or more mentors, use of a structured e-mail communication and support network, and participation in regularly scheduled after-school and summer activities that connect curriculum, career, and personal goals. Middle school girls learn how important what they are learning is for high school; high school girls learn what STEM careers involve through their interactions with college women, faculty, and professionals in the field; and college women become career-ready and have a clearer understanding of their professional opportunities.

NUE faculty, staff, and students team with girls in Boston Girl Scout troops, their troop leaders, and their teachers in after-school activities and summer day camp programs at Computer Clubhouses at NEU and at the Patriots' Trail Scout site.

College participants are housed together on one floor of a residential hall, surrounded by peers with similar interests, and benefit from study groups and priority access to the Connections computer lab. *They can also participate in Math Excel, a program for NEU freshmen with demonstrated math ability. Twice weekly for a quarter, Math Excel students work in groups on challenging math problems related to their calculus course—a process that more closely resembles how most scientists and engineers work than the classroom usually does. This is a substantial time commitment but most students find the intense group work productive and enjoyable, and the challenge helps them do better in all their courses.* Participants can also
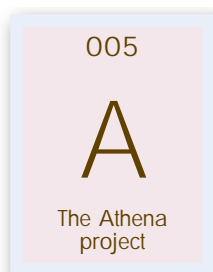
find work as a computer lab assistant or work weekly with middle and high school students. And Connections provides workshops on such issues as career and time management, interviewing, and negotiation.

E-mentoring allows women of high school age and older to be in touch by e-mail with one or more professional mentors (whom they can question about careers). Undergraduates also share their knowledge of college life and majors in STEM with Boston-area high school girls. Everyone is welcome at Connection social activities, which give participants a chance to meet face to face, but registering with Connections is required to participate in e-mentoring.

Activities for senior Scouts (grades 9–12) emphasize after-school troop activities, summer camp at NEU, mentoring, and summer co-op work. High school participants can participate in an e-mentor group, have access to a computer lab with state-of-the-art computer software, and visit NEU for Connections-sponsored events.

Activities for middle school Scouts (grades 5–8) emphasize after-school troop activities, summer camp, and Connections tutoring and mentoring. Girls in this age group play with cool computer software and engineering toys at the Connections computer clubhouse; learn how to program a robot using Lego's Mindstorms software; explore bugs, plants, and the like with a microscope that shows the objects on a computer screen; can learn hands-on about engineering and science in the Connections Build It! series; and can attend special events at NEU.

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www.mcs.csuhayward.edu/~mega/mc2001/mc2001.html HRD 98-13896 (ONE-YEAR GRANT)	
PARTNERS: PATRIOTS TRAIL GIRL SCOUT COUNCIL, GIRL SCOUTS OF THE USA, BOSTON COMPUTER MUSEUM, NEU'S COLLEGES OF ENGINEERING AND ARTS AND SCIENCES, DEPARTMENT OF COOPERATIVE EDUCATION, AND OFFICE OF RESIDENCE LIFE.	
KEYWORDS: EDUCATION PROGRAM, GIRL SCOUTS, CAREER AWARENESS, COOPERATIVE LEARNING, MENTORING, SUPPORT SYSTEM, PROBLEM-SOLVING SKILLS, ELECTRONIC MENTORING, SUMMER CAMP, AFTER-SCHOOL, HANDS-ON	

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A

The Athena project

THE ATHENA PROJECT
THIS COLLABORATION—WOMEN HELPING WOMEN AT DIFFERENT STAGES OF THEIR EDUCATIONAL AND PROFESSIONAL DEVELOPMENT—HELPED MORE THAN 100 GIRLS FROM FIVE MIDDLE SCHOOLS IN CALIFORNIA'S RIVERSIDE AND SAN BERNARDINO COUNTIES. THE ATHENA PROJECT PROVIDED AN EDUCATIONAL SUPPORT STRUCTURE FOR GIRLS IN MIDDLE AND HIGH SCHOOL, PROFESSIONAL DEVELOPMENT FOR MATH AND SCIENCE MAJORS AT THE UNIVERSITY OF CALIFORNIA AT RIVERSIDE (UCR), AND MENTORSHIP AND OUTREACH PROGRAMS. AS PART OF WOMEN-TO-WOMEN COUNSELING, COLLEGE UNDERGRADUATES MENTORED MIDDLE SCHOOL GIRLS, WHILE STAFF TEACHERS AND UNIVERSITY FACULTY MENTORED THE UNDERGRADUATES.

The project provided financial, academic, and mentoring support for math and science majors considering a teaching career. Data on factors that turn girls away from math and science were collected on both participants and members of a control group. University student affairs officers and department chairs in math, chemistry, physics, and biology helped recruit undergraduate women who might pursue careers in teaching, aiming to help them earn a California teaching credential or an advanced degree in STEM fields. These "Athena leaders" were advised to take certain math and science education courses and were steered into campus math and science clubs.

The Inland Area Math and Science Projects—to which roughly 3500 math and science teachers belong—hosted a four-week summer institute that brought together Athena leaders, professors, public school teachers, and county educators, strengthening participants' teaching skills and mastery of content (in the context of equity, diversity, and content standards). *As a result of the project, UCR added two classes to its undergraduate curriculum: mathematics education and liberal studies mathematics.*

Teamed with project teacher–mentors from the school sites to which they were assigned, the Athena leaders were paid a stipend for participating. They were also given eight college credits, professional books and videos, access to UCR's professional math and science resource center, an e-mail account, videos, and several professional books:

- *Biographies of Women Mathematicians and Related Activities* by Teri Perl. 1978.
- *By Nature's Design* by Diane Ackerman, Neill Williams, and Path Murphy. 1993.
- *Classifying Fingerprints: Real World Mathematics Through Science* by Nancy Cook. 1995.
- *Complete Origami* by Eric Kenneway. 1987.
- *Get It Together: Math Problems for Groups Grades 4–12* by Tim Erickson. 1989.
- *Great Ideas I Stole from Other People* by Pam Clute. 1997.
- *The History of the Cross in Religious and Political Symbolism* by Lynda J. Gettig. 1989.
- *Measuring Earthquakes* by Nancy Cook. 1995.
- *Multiculturalism in Mathematics, Science, and Technology: Readings and Activities* by Claudette Bradley and Julia Hernandez. 1993.
- *Plotting Pictures: Coordinate Graphing and Number Skills* by Paula Rozell. 1995.
- *She Does Math: Real Life Problems from Women on the Job* by Marla Parker. 1995.

After the summer institute, the Athena leaders practiced their newly acquired ideas and skills teaching, tutoring (there was more demand than the project could satisfy), and mentoring seventh and eighth grade girls at nine sites through Expanding Horizons, a U.C. extension program. They helped the girls improve their computer skills, arranged field trips to places like the Jet Propulsion Laboratory and the Los Angeles Museum of Technology (partly to see female role models on the job), talked with parents, and generally took charge of presenting math and science positively to the middle school girls. Influenced by the enthusiasm of Athena participants, the entire class at one school set a goal of trying to qualify for NASA's summer space camp in Alabama. Several career awareness activities were provided for the middle school girls and their parents, including math and science parent nights (attended by more than 2,000) and occasional radio programs.

This ambitious project encountered scheduling conflicts on overlapping summer projects and a delay in second-year implementation because of a state mandate requiring anyone having contact with students to pass a Justice Department background check and a TB test (with unclear instructions about who was to receive the information). The project also learned that it takes substantial effort to develop true collaboration between institutions, with the school districts playing an active collaborative role.

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HRD 96-19060 (THREE-YEAR GRANT)	
KEYWORDS: EDUCATION PROGRAM, PROFESSIONAL DEVELOPMENT, MENTORING, ROLE MODELS, TEACHER TRAINING, CAREER AWARENESS, SUPPORT SYSTEM	

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after

What works in after-school science

WHAT WORKS IN AFTER-SCHOOL SCIENCE

AFTER-SCHOOL LEARNING—AS OPPOSED TO CHILD-MINDING OR PURE RECREATION—IS A NEW AND GROWING EDUCATIONAL FIELD. AFTER-SCHOOL EDUCATION CAN PROMOTE POSITIVE BEHAVIORS THAT FACILITATE ACADEMIC, VOCATIONAL, AND SOCIAL SUCCESS, AND INCREASING NUMBERS OF INFORMAL, OUT-OF-SCHOOL PROGRAMS TRY TO ENGAGE AND SUSTAIN GIRLS' INTEREST IN STEM. AFTER-SCHOOL EDUCATION IS THE SUBJECT OF MUCH CURRENT RESEARCH BUT NONE OF IT HAS PROBED THE SPECIFIC NEEDS OF GIRLS, ESPECIALLY NOT IN TERMS OF ENGAGING AND SUPPORTING THEIR INTEREST IN STEM. WE DO NOT KNOW WHICH PROGRAMS SUCCEED IN DOING SO AND WHICH DO NOT.

We are moving toward a technology-based economy in which women are an increasing part of the workforce. In this project, three national nonprofit organizations experienced in bias-free after-school programs are organizing a working conference to create a research/action agenda to inform the development of STEM programs free of biases (against gender, race, ethnicity, and disability) that have contributed to educational inequality. Roughly 40 researchers, practitioners, and policymakers were to attend a multidisciplinary conference to be held at AAAS headquarters in Washington, D.C., on September 23–24, 2002. Results will be disseminated through journals and other publications, websites, listservs, and conferences of professional associations.

CODE: I, E, M, PD	EDUCATIONAL EQUITY CONCEPTS, INC.
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HRD 01-14741 (ONE-YEAR GRANT)	
PARTNERS: AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, ACADEMY FOR EDUCATIONAL DEVELOPMENT	
KEYWORDS: DISSEMINATION, AFTER-SCHOOL, INFORMAL EDUCATION, ENGAGEMENT, BEST PRACTICES, CONFERENCE, ACTION PLAN, POLICY, RESOURCE CENTER	

005

Bug

BUGS: outdoor
learning labs

BUGS: OUTDOOR LEARNING LABS

BUGS (BRINGING UP GIRLS IN SCIENCE) HOPES TO ENGAGE FOURTH
AND FIFTH GRADE GIRLS IN DENTON, TEX., IN SCIENCE THROUGH A
HIGH-INTEREST CURRICULUM OF ENVIRONMENTAL SCIENCES STUDIED
IN AN OUTDOOR LEARNING LAB. WITH SUPPORT FROM PARENTS AND
MENTORS, 30 GIRLS ARE PARTICIPATING IN A YEARLONG AFTER-
SCHOOL SCIENCE LAB AT SAM HOUSTON ELEMENTARY SCHOOL.

This University of North Texas (UNT), project is using Passow and Frasier's culturally fair matrix to identify gifted students among Denton's culturally diverse and often economically disadvantaged population. (Busing was one of the first problems the project had to address.) It has identified both participants and a contrast group for purposes of evaluation and has planned a series of educationally sound field trips to encourage the contrast group's participation.

The program will use six units (animal studies, land and water, microworlds, ecosystems, experiments with plants, and floating and sinking) from the Science, Technology, and Children curriculum. The STC curriculum is designed to make science relevant, interesting, and challenging and to foster the development of scientific reasoning and scientific attitudes such as curiosity, flexibility, respect for evidence, and sensitivity to living things.

Each learning/mentoring/support team will include a fourth or fifth grader, a female high school student from the Texas Academy of Mathematics and Science (who will be paid a stipend), and a woman from the University of North Texas faculty. Parents can participate in workshops about educational and career opportunities.

Participants in the BUGS after-school program will later attend a two-week summer program at the Elm Fork Environmental Education Center (the public education branch of UNT's environmental programs), where they will explore water in its journey from a waterfall through a river to a pond; native plants and animals in their natural habitat, a wetland; and the stories contained in rocks, minerals, and soils. Elm Fork will develop environmental science learning kits for the project, with technological assistance from the Texas Center for Educational Technology, for eventual dissemination nationwide in English and Spanish.

The girls will team with a computer pen pal at a distant site, to work together on science experiments using two-way audiovisual desktop conferencing tools, electronic chat rooms, and a project website. This will allow students with special needs at distant sites to be mentored and to participate in the outdoor lab by way of a virtual field trip. These distant students—students with emotional and behavioral problems from a school in Wichita Falls, Tex.; students from a school district in Bernalillo, N.M., that serves many Hispanic and Native American students; and students from a rural school district in Decatur, Tex.—will be able to take electronic "field trips" developed from activities videotaped during the first year of the BUGS project.

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eq
Gender equity training in teacher education

GENDER EQUITY TRAINING IN TEACHER EDUCATION

THIS THREE-YEAR PROJECT MADE TEACHER EDUCATORS AND TEACHER EDUCATION INSTITUTIONS NATIONWIDE MORE ATTENTIVE TO GENDER EQUITY ISSUES IN PRESERVICE (STUDENT) TEACHER EDUCATION. AT A FIVE-DAY SEMINAR, EIGHT NATIONALLY RECOGNIZED INSTRUCTORS OFFERED SESSIONS ON VARIOUS ASPECTS OF GENDER EQUITY IN STEM COURSES, PROVIDING PARTICIPANTS WITH MATERIALS, RESOURCES, AND TEACHING ACTIVITIES. THE 61 PARTICIPATING TEACHER EDUCATORS COULD NOW INCORPORATE GENDER EQUITY INTO THE MATH, SCIENCE, AND TECHNOLOGY METHODS COURSES THEY TAUGHT AT 40 COLLEGES AND UNIVERSITIES IN 28 STATES.

Teacher educators learned, for example, that *at the elementary level, where many teachers are not comfortable with math and science, it is important to help teachers understand their dislike of math and science so they don't transfer it to the girls in their classes. At the secondary level, where teachers like a subject and want to teach it, it is harder to get them to consider gender. It helps to convey that a "math and science for all" mentality—cultivating students instead of weeding them out—and instructional strategies that emphasize cooperation and integration over competition, help all children, not just girls and minorities.*

All participants received a grant of $750 for a gender equity project. Whether they worked on their action research projects alone or in small teams seemed to make no difference in the results. Participants posted their activities weekly on an active listserv and shared with their peers what they had learned and achieved, in bimonthly newsletters, frequent personal communications, and a three-day follow-up meeting.

Evaluation showed that *85 percent of the educators became more equitable in their teaching behavior (men changing more than women). The percentage of course syllabi containing gender equity nearly tripled.* The group collectively taught gender equity to about 5,000 preservice teachers and 5,000 others during the project period (1993–96), wrote about 40 publications on gender equity, and made about 250 presentations.

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HRD 92-53182 (THREE-YEAR GRANT)	
PARTNER: THE CENTER FOR ADVANCED STUDY IN EDUCATION (CUNY)	
PUBLICATION: *GENDER EQUITY RIGHT FROM THE START* BY JO SANDERS, JANICE KOCH, AND JOSEPHINE URSO (LAWRENCE ERLBAUM ASSOCIATES, 1997). EASY-TO-USE TEACHING ACTIVITIES AND MANY SUGGESTIONS FOR RESEARCH PROJECTS.	
KEYWORDS: TEACHER TRAINING, GENDER EQUITY AWARENESS, SEMINAR, RESEARCH PROJECT, EVALUATION, RESOURCE GUIDE	

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WS
Washington State gender equity project

WASHINGTON STATE GENDER EQUITY PROJECT

AFTER DECADES OF WORK IN GENDER EQUITY, WE KNOW WHAT CAUSES THE GENDER GAP IN STEM EDUCATION, AND WE KNOW STRATEGIES TO CLOSE IT. BUT EDUCATORS ARE NOT SUFFICIENTLY AWARE OF THE NEED FOR ACTION OR KNOWLEDGEABLE ENOUGH ABOUT STRATEGIES THAT WORK. THE WASHINGTON STATE GENDER EQUITY PROJECT WAS UNDERTAKEN TO HELP TEACHER EDUCATORS AND OTHERS ACHIEVE SUSTAINED STATEWIDE CHANGE IN GENDER EQUITY EDUCATION FOR PRESERVICE (STUDENT) TEACHERS.

The project goal was to transform the state's teacher education establishment—colleges and universities that certify new teachers, the state education agency, and state professional associations in math, science, and teacher education—by incorporating gender equity into existing instruction, policy, and procedures.

A collaboration among 11 organizations (including seven colleges and universities that collectively certify nearly 80 percent of the state's new teachers), the project is run by a steering committee that meets twice a year in person and twice by videoconference. A team formed at each organization to undertake a gender equity needs assessment.

A five-day seminar taught by national leaders was held in Port Ludlow in July 2000, with expenses paid for three members from each team. Participants valued networking, discussions, and interactive sessions, finding the material on networking, women's ways of knowing, and relevant gender issues most helpful. They viewed time and overloaded work schedules as the biggest obstacle to quickly implementing gender equity strategies. A second workshop was held at Central Washington University in 2001.

The project expects to reach nearly 6,000 student teachers—two thirds of those in the state. The test will be whether significant statewide increases in the number of girls taking regular and advanced electives in math, science, and technology are noticeable within five to ten years.

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http://www.wri-edu.org/equity/wash	HRD 98-14070 (THREE-YEAR GRANT)
PARTNERS: STATE BOARD OF EDUCATION, OFFICE OF THE SUPERINTENDENT OF PUBLIC INSTRUCTION, WASHINGTON EDUCATION ASSOCIATION, WASHINGTON ASSOCIATION OF COLLEGES FOR TEACHER EDUCATION, WASHINGTON SCIENCE TEACHERS ASSOCIATION, AND WASHINGTON STATE COUNCIL OF MATHEMATICS [(AGENCIES AND ASSOCIATIONS)]. CENTRAL WASHINGTON UNIVERSITY, EASTERN WASHINGTON UNIVERSITY, HERITAGE COLLEGE, ST. MARTIN'S COLLEGE, SEATTLE PACIFIC UNIVERSITY, SEATTLE UNIVERSITY, UNIVERSITY OF PUGET SOUND, UNIVERSITY OF WASHINGTON, WASHINGTON STATE UNIVERSITY, AND WESTERN WASHINGTON UNIVERSITY.	
KEYWORDS: EDUCATION PROGRAM, TEACHER TRAINING, GENDER EQUITY AWARENESS, SEMINAR, POLICY, BEST PRACTICES, WORKSHOPS	

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Hou

Equity initiatives
in Houston

EQUITY INITIATIVES IN HOUSTON
WITH TEACHERS' NEEDS AND GENDER EQUITY IN MIND, THIS COLLABORATIVE DEMONSTRATION PROJECT SET THREE MAJOR GOALS: IMPROVING THE CLASSROOM CLIMATE FOR GRADES K–12 SO GIRLS HAVE THE SAME OPPORTUNITIES TO SUCCEED IN MATH AND SCIENCE AS BOYS; CHANGING AND IMPROVING THE QUALITY OF INSTRUCTION IN ELEMENTARY MATH AND SCIENCE CLASSES TO SUSTAIN GIRLS' INTEREST; AND PROVIDING MIDDLE AND HIGH SCHOOL GIRLS WITH MEANINGFUL MENTORING RELATIONSHIPS AND ACADEMIC AND CAREER INFORMATION. TO CREATE A MORE POSITIVE SCHOOL ENVIRONMENT, THE PROJECT TRIED TO STRENGTHEN TEACHERS' KNOWLEDGE OF STEM SUBJECTS, PROMOTE EQUITABLE CLASSROOM PRACTICES, AND GIVE GIRLS ACCESS TO ROLE MODELS WITH WHOM THEY COULD READILY IDENTIFY.

Equitable classroom practices institute for K–12 teachers and administrators. *Although K–12 teachers were responsive to this institute, the project learned that teachers were more receptive to institutes that emphasize a particular content area into which are incorporated topics such as equitable classroom practices, classroom management, and curriculum modifications for diverse learners. Participants were more confident about their ability to effect change in their own classrooms*—by paying attention to seating arrangements and the gender composition of work groups, for example, by emphasizing cooperative learning and small group activities, and by incorporating material about women and minorities in science—*than in their ability to reach their colleagues.* It was important to give them a safe environment in which to discuss what can be controversial issues.

Science and math institute for elementary school teachers. Teachers showed significant gains in math knowledge both years the science and math training for elementary school teachers was offered, and the institute produced several leaders from among the participants. *One key to the institute's success was the emphasis on integrating math with science and children's literature (to teach measurement, estimation, and judging whether something is reasonable).* This approach sat well with participants, who were typically K–5 teachers who have to teach multiple subjects, so that *integrating math and science content was a palatable approach to teaching subjects they often don't feel comfortable teaching.* (The first day of the institute some participants were clearly upset about taking a math test, while others had no problem with it. One participant said that the institute was fun, except for the tests, but *even the tests reminded them how much children internalize grades and use them to judge their own worth.*)

Curriculum specialists responsible for K–12 math and science explained that *district elementary students had the skills to perform rote measurement routines, but not the conceptual framework needed to succeed at estimating and judging the reasonableness of answers based on measurements.* The topic of measurement is often taught as paper-and-pencil exercises, which do not give a student the manipulative experiences and analytical challenges needed to perform at higher cognitive levels. The staff decided to direct teacher development activities at improving the math and teaching skills needed to teach measurement and estimation to elementary students. Student-centered inquiries (for example, using manipulatives) were modeled throughout the institute. The teachers were treated as a community of learners responsible for their own learning, with a wealth of experience to contribute. Participants in one institute had more difficulty adapting activities for lower or higher grade levels, so the institute brought K–5 teachers from the year before to answer questions, share classroom management strategies, and explain how they had created and adapted activities in their classrooms.

In 2000 the project began emphasizing the use of new technologies to support instruction and, because some participants were unsure even how to use a computer mouse, offered both high-tech and low-tech presentations to minimize intimidation. Participants helped take the material into new areas.

Mentoring for girls in secondary schools. Teachers sponsored girls' science clubs at secondary schools. More than 700 girls participated over three years—double what the project expected. Club sponsors were given a handbook suggesting how to work with professional mentors and suggesting appropriate resources and activities for club meetings that mentors did not attend. Club sponsors earned a stipend and field trips were subsidized.

The sponsors engaged club members in mentoring relationships with women in professional STEM fields. Finding and recruiting adult mentors from academia and local industry was time-consuming, but once they were found, they usually agreed readily to participate—partly because their commitment was limited to meeting with girls six times a year. Most participants said the best thing about the science clubs was meeting with the mentors. The mentors were surprised at how responsive the girls were.

Reassessing district needs. *As an outgrowth of collaboration on this project, representatives from eight colleges and universities in the Houston area worked together with project staff for four months assessing critical district needs in Houston's middle school science and math education. In 1998–99, the new Texas Essential Knowledge and Skills (TEKS) became the mandated formula for K–12 instruction in Texas's public schools. Previously, science was taught "pancake style," layering ninth grade physical science on top of eighth grade earth science on top of seventh grade life science. Under the new guidelines, concepts from life, earth, and physical science were to be integrated at all levels under more unifying themes, such as "systems" and "patterns of change." Novice and veteran alike were being asked to integrate concepts and subject matter that many teachers were not prepared to teach or even interested in teaching.*

District middle school teachers needed help figuring out how to provide inclusive, effective instruction that met the diverse needs of English-as-a-second-language students and academically gifted students and how to include special education students in a science lesson. The teachers wanted to know more about project-based learning and how to design projects that meet the TEKS standards, encourage higher-level thinking, integrate technology, and use alternative methods of assessment.

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Sb

WISE women at
Stony Brook

WISE WOMEN AT STONY BROOK

THE INTELLECTUAL AND SOCIAL CLIMATE IN WHICH GIRLS AND WOMEN WORK HAS A STRONG INFLUENCE ON THEIR EDUCATIONAL AND CAREER DECISIONS. ESTABLISHED IN 1993 WITH NSF SUPPORT, WISE (WOMEN IN SCIENCE AND ENGINEERING) IS A COMPREHENSIVE PROGRAM TO ENCOURAGE WOMEN WITH A TALENT FOR, OR INTEREST IN, MATH, SCIENCE, OR ENGINEERING.

Faculty women from many disciplines have initiated several projects under the WISE umbrella. *Instead of dwelling on what is wrong with girls who do not pursue math and science, the WISE projects have encouraged systemic change—to make what educators teach more interesting and equitable.* The WISE projects have strengthened the pipeline of women going into STEM studies and careers by holding their interest through the crucial junior high to early college years and beyond. Most WISE projects at the State University of New York at Stony Brook *emphasize small-group activities and a team approach to research because women tend to learn and perform better where there is frequent interaction and socialization and often avoid careers in math and science because they view them as solitary.*

Pre-college projects. The first WISE Stony Brook projects focused on the transition from middle school and high school to the first year of college, reaching out to challenge girls who showed academic promise or interest in math or science, to support them in a positive women-to-women climate, and to sustain their interest, curiosity, and achievement in STEM studies.

Edith Steinfeld's model project targeted *middle school girls* in three Suffolk County school districts. It provided campus-based, community-based, and school-based activities year round for 100 girls a year, as well as teacher training for 16 advisers at eight middle schools. Parents were fully involved in program design and activities.

Girls participated in weekly or biweekly after-school science clubs at their local schools and science and career fairs and special summer programs at the university. The sixth and seventh graders also participated in a tenth grade symposium, so they could hear about the older students' research. School-year activities took them to Stony Brook's Marine Sciences Research Center, its Center for High Pressure Research, and Brookhaven National Laboratory.

In Wendy Katkin's project, each year 90 *high school students* and 18 teachers were bused to Stony Brook, the Brookhaven National Laboratory, or the Cold Spring Harbor Laboratory, where they met women working in various scientific fields. After participating in various hands-on activities, they were gradually engaged in research on topics ranging from recombinant DNA, material science, and superconductivity to radiation health and physics. *Students learned what science is by working in labs with scientists and with equipment they would normally not have had access to.* The tenth graders learned how to use the Internet and to make scientific

presentations. Eleventh graders worked on semester-long activities. Seniors had the option of doing lab research under a scientist's supervision, taking an introductory math or science course at the university, or participating in a study of gender issues in science. The summer between their sophomore and junior years, the students lived on campus two weeks, doing more fieldwork and visiting the New York Botanical Gardens, the Museum of Natural History, and Stony Brook's marine sciences research vessel. Their social time together helped them become a cohesive group.

Graduates of the WISE high school program have gone on to prestigious colleges and universities, often earning scholarships and entrance into special programs based on their achievements in the WISE program. Almost 40 percent of WISE graduates are studying the physical sciences, engineering, computer science, or math in college. Another 40 percent are studying the biological sciences, intending to do scientific research and go on to professional or graduate school.

WISE college projects. The WISE college program started as a mentoring program, each year pairing senior college students with 15 (later 35) freshmen women talented in math and science, chosen at random from entering students who scored 600 or better on their math SATs. The belief was that with older students as mentors and role models, younger students would be less likely to drop out of a field or switch to other majors because of rigorous programs or the pressure of surviving in a male-dominated field. The project hoped to engage undergraduate women in the excitement and challenge of math, physics, or engineering before they made decisions that would shape their subsequent educational and professional careers.

To supplement the students' regular academic program, the project began (with NSF funding) to offer participants *small study groups, close academic advising by faculty, a strong mentoring system, social support among WISE participants, an orientation to the university's science research milieu, and scholarships for their first year at Stony Brook. It created courses to teach them critical skills and expose them to a range of scientific disciplines. It offered them individual and group research opportunities. By supporting young female students and making them "feel more like a person than like a number," the program hoped to help students who chose science or engineering to stay the course—not to fall through the cracks, as female math and science students in large colleges so often do.*

The young women took coed classes, and the program reviewed their academic records and tried to place them at the right level in their courses. Girls routinely underestimate their ability in such subjects as math and physics, subjects traditionally viewed as men's turf. Every single one of the first 15 women in the program placed herself in math classes one or two levels lower than she could handle, despite having had four years of high school math and science and a 90+ GPA. The 13 students who were persuaded to take higher level math courses earned A's and B's. The two who decided to stay two levels behind made a C and a D—probably more out of boredom and laziness than for lack of ability. "Women sell themselves short," says principal investigator Wendy Katkin. "The program recognizes their potential and tries to develop it."

The program continued when the grant ended. Only 50 students a year are accepted, so WISE gives students all the benefits of both a small community and a major university. Participants are part of a diverse, close-knit community, mingling with women from many different cultures. Most WISE women dorm together in Whitman College Residence Hall (where WISE students have priority), making study sessions and hanging out together that much easier. WISE's smallness makes connections easier.

WISE women do research earlier, get better grades, and earn more academic honors than other undergraduates. Networking within WISE has led many of our students to summer internships, scholarships, and employment. The point of entry into research is often a summer internship at Brookhaven National Laboratory.

THE FOUR-YEAR WISE WOMEN PROGRAM

The first WISE college program attended to first-year students. The next emphasized helping participants in years two through four further develop their quantitative and leadership skills and develop a sense of identity as members of a college of women scientists. Overall, the WISE student is expected to take the following courses:

Year one. Fall and spring semesters of freshman year, WISE students are grouped together in classes emphasizing research opportunities on campus and introducing students to research in different scientific fields:

- *Becoming a Scientist*, an introduction to Stony Brook with a special WISE section emphasizing research and other opportunities in STEM.
- *Introduction to Research*, in which students do hands-on research in a physical, social, and life science and in engineering, working in small groups with other WISE women—on projects ranging from "Long Island Vowels" (linguistics) to "Let's Make Diamonds" (geology, high-pressure research). *Experiencing this highly rated course causes one in seven women to change her intended major after discovering an interest in a subject or methodology.*
- *Two semesters of math and two semesters of science.*

Years two to four. After freshman year WISE undergraduates take the following courses:

- *The Social Dimensions of Science*, a course (developed with NSF support) that examines how social, cultural, political, and economic factors such as gender shape the way science is carried out. Students develop case studies, working with women researchers from Brookhaven National Laboratory
- Either *Mathematics Problems and Games* or *Connections in Science*, which emphasizes physics' importance to all the sciences.
- *Professional Development Seminar*, a course designed to bridge the gap between college and beyond, to explore the range of options in a field and how best to present oneself, in person and on paper, to graduate programs, fellowship committees, and prospective employers. Guest experts discuss résumé preparation, interviewing skills, business etiquette, and salary negotiation.
- *An advanced math or computer science course*, because women in science tend to meet only the minimum math and computer science requirements.
- *Senior honors thesis/design project*, satisfied through successful completion of a yearlong independent research project culminating in a substantial research paper or project design.

Students are also expected to attend three or more monthly evening programs a year and to play an increasing role in planning sessions and leading discussion groups.

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Get!

Get set, go!

GET SET, GO!

WORKING WITH TEACHERS, PARENTS, AND COMMUNITY SCIENCE MUSEUMS AND CENTERS, GET SET, GO! ENCOURAGED MIDDLE SCHOOL GIRLS' ACTIVE PARTICIPATION IN SCIENCE. THE WESTERN TRIAD SCIENCE AND MATHEMATICS ALLIANCE (WTSAMA) AT WAKE FOREST UNIVERSITY COLLABORATED ON THIS PROJECT WITH OTHER ORGANIZATIONS, INCLUDING 12 NORTH CAROLINA MIDDLE SCHOOLS.

Summer teachers institute. Forty-two experienced teachers committed themselves to activities designed to change awareness, expectations, and everyday practice among teachers, parents, and school administrators: gender equity training (GESA and Equals), EDC's "Equitable School Walk" and other awareness-raising activities, hands-on activities, and a mock Parent Night. They saw, and were given lab time to test and develop, family math and science activities. They shared strategies for recruiting and involving students in after-school science clubs. Veterans of earlier institutes returned to share their experiences—and to remain engaged.

Support personnel—including media center specialists—were encouraged to attend part of the institute, because of their instrumental role in *developing unbiased school resources*. Teachers and media specialists were encouraged to work together to evaluate science texts and other library resources for gender bias and stereotyping.

Teachers provided *feedback about the training as "a plus and a wish"—balancing praise with criticism*. A video gave them a clearer idea of what gender bias looks like, and time in the library gave them a rare, welcome opportunity to learn about hands-on activities. They wished for less initial paperwork, a copy of everyone's activities, and more time in the library.

Saturday science symposia. Students learned about academic opportunities at monthly Saturday symposia held at various colleges and universities. Women who apply science in their everyday work, often in untraditional occupations, sent the message to students that science is for everyone and can be found everywhere. After a presentation, participants broke into "role alike" breakout groups for students, parents, and teachers. Topics ranged from meteorology to forensic science, with special sessions on the science of Christmas trees; the physiology and nutritional needs of horses, sheep, skunks, and opossums; and how to grow and water gardens in a space station.

Undergraduate and graduate students facilitated hands-on activities for students. Parents learned about gender equity and inquiry-based science, enjoyed hands-on activities (sometimes from *WonderScience*), and took some activities home to do with their children. Teachers acquired activities, strategies, and tools to use in their science classes.

LESSONS LEARNED

Provide time for teachers to research resources. Teachers need experience with, information about, and materials for hands-on activities and typically have little time to search for them. It is important to designate time during an institute for teachers to research curricula and hands-on activities for their classrooms. It's worthwhile having project staff do the legwork of finding resources that teachers at the institute can review and order.

Explicitly communicate underlying principles and strategies, as those participating may not easily make connections. It is important in a hands-on session to make one or two key scientific concepts or processes explicit enough for deep understanding and not just do activities for activities' sake. Whether practicing strategies to accommodate diverse learning styles, modeling a parent night program, or conducting a hands-on activity, three steps will make principles more accessible to teachers: (1) *Do the activity*, (2) *tell teachers what you did* (this step is often skipped) and (3) *have them reflect on how they can apply that in their own classes or schools*. Similarly, on parent nights: (1) Do the activity, (2) explain to parents what concept or skill is being developed, and (3) explain why that is important for the education of their children (especially girls).

Coach role models. Scientists unaccustomed to speaking to middle school students must be told in advance that the science content is less important than how a scientist's experiences prepared her for her career in science. In connection with guest lectures, explicitly discuss gender equity issues, what courses students should take (starting in middle school), how girls can pursue viable careers in science, and how math and science are important to informed citizens.

Anticipate transportation problems. Attendance was lower when students and teachers left at noon and teachers remained for afternoon sessions. When teachers were adjourned at noon along with parents and students, attendance improved. *Teachers were the driving force in getting students to and from events.*

Give both teachers and students incentives to participate in Saturday activities.

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Encourage sustainable use of dissemination funds. One way to get community support for science clubs is to have Parent–Teachers Associations give a "science shower," encouraging parents and others in the community to provide as science gifts items on the science teachers' list of needed equipment and supplies.

Incorporate an explicit and continuing emphasis on gender equity. Information and research about gender equity issues should be systematically disseminated to participating schools. Teachers could meet for a swap-and-share session at the end of each academic year to share what classroom practices work.

Improve science displays. Classroom science displays seldom represent people, much less a diversity of people, and schools rarely have science displays in the hallways.

Fall teachers' conference. Most of the 123 teachers who attended this conference were still active at the end of the school year. It succeeded partly because *it was planned by teachers for teachers, who valued the ideas generated and shared, the free handouts and door prizes they could use in their classes (not novelty materials that don't fit in the curriculum), and the new contacts and resources. The conference strengthened their knowledge of content and helped them devise activities to make science less intimidating for girls—with the unexpected consequence of making the teachers feel more professional.*

Parent nights. Parent nights worked best when held in conjunction with other parent events, such as PTA/PTO meetings and holiday concerts and festivals.

Women's studies in after-school science clubs. One school kicked off its after-school club by having girls examine gender bias in their textbooks, using a checklist provided at the institute. Many teachers used Operation SMART program strategies and activities learned at the institute. The clubs that succeeded covered a wide range of topics and provided a variety of activities, including field trips and workplace visits. Women scientists (recruited by a women scientists advisory team) were partnered with each school, and teachers were encouraged to regularly involve various scientists with their after-school group.

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tri

Triad Alliance
science clubs

TRIAD ALLIANCE SCIENCE CLUBS

A SAN FRANCISCO PROJECT BROUGHT MIDDLE SCHOOL GIRLS, TEACHERS, AND SCIENTISTS (HENCE TRIAD ALLIANCE) TOGETHER IN A NETWORK OF SCHOOL-BASED GIRLS' SCIENCE CLUBS. THE AIM OF THE TRIAD PROGRAM WAS TO INTEGRATE PROFESSIONAL DEVELOPMENT AND ACADEMIC ENRICHMENT THROUGH THE LENS OF GENDER EQUITY.

The project built on a process of science education reform initiated at the University of California at San Francisco in 1987 by Bruce Alberts, a professor of biochemistry and biophysics and president of the National Academy of Sciences. The mission at the core of the volunteer program was to improve science instruction for all students in San Francisco's K–12 public schools. Most programs involve an integrated community of scientists and educators. A districtwide partnership (between UCSF and the San Francisco Unified School District) produced both the Triad project and City Science, another NSF-supported effort at systemic change in teaching.

Triad developed and sustained science clubs in four middle schools the first year, eight the next, and twelve the third and fourth years. Overall, 32 teachers and 49 scientists conducted enrichment activities with more than a thousand girls, with 12 to 45 girls (30 average) attending each

club meeting. Indeed, more schools, girls, teachers, and scientists wanted to participate than the program could support.

To increase girls' self-confidence, assertiveness, and commitment to science, *the project aimed to strengthen girls' skills in specific areas: persistence through frustration, resilience in the face of failure, familiarity with tools, the confidence to explore, and the ability to defend their position with evidence.* Activity-based science clubs were held twice a month at sponsoring teachers' schools for one academic year, co-sponsored by two scientists and one or two science teachers. Guided by the adults, at these meetings girls explored natural phenomena, asked questions, used tools, and conducted scientific investigations.

For the first three years, all participants in the Triad science clubs were girls. In 1997–98, three schools piloted mixed-gender clubs with both male and female sponsors. With the support of parents and the principal,

at one school a Triad teacher and a humanities teacher placed about 60 students in single-sex science/math and language arts/social studies courses. *In the single-sex groups it appears that students are more willing to talk with teachers about sexual harassment and other sensitive issues, boys are more on task, and girls participate more.*

The program was well received at schools with many at-risk students, including one school with many low-income Asian newcomers and another with many low-income African American and Hispanic students. At one school 90 girls showed up for the first meeting. When NSF funding ended, adult participants accepted a two-thirds reduction in stipend, the program and training were streamlined, and with support from the school system the clubs kept going in several schools.

The Triad project required a substantial time commitment and had the most clearly integrated goals for students, teachers, and scientists. Through an equitable framework for science teaching, the project set these *goals for teachers: to learn to encourage all student voices, to maintain high expectations, to delegate responsibility, and to be explicit about equity*. Teachers and scientists were selected through a competitive application process, received a stipend for sponsoring a club, and had a budget for supplies. Scientists attended a scientist orientation series. Teachers and scientists attended fall and spring retreats and five two-hour after-school professional development seminars.

Everybody benefited. Parents were happy about the Triad project, which improved public relations for both schools and science departments. Triad funds made it possible for science departments to buy up-to-date materials, which encouraged teachers to do more hands-on science activities. In the all-girls environment, girls became more confident and developed stronger leadership and more interest in science. Girls and scientists developed a strong rapport, and the girls became more skilled in setting up and doing experiments. Preliminary evidence suggests that their attitudinal changes persisted in mixed-gender settings.

Women teachers became better at communicating, mentoring, and problem-solving and came to understand more deeply the nature of science and scientific research and how science research contributes to society. Teachers uncredentialed in science experienced an even more pronounced gain in skills and teaching methods. With the luxury of access to scientific expertise and input from three competent adults in preparing club lessons, teachers could adapt hands-on lessons for their regular classrooms. *Working with female scientists demystified the scientific world for teachers, allowing teachers to imagine themselves as scientists, which motivated them to encourage more girls to become scientists.*

Participation in Triad revitalized teachers' work, making them more aware of new ways of teaching science. They began making more consistent use of gender-equity techniques already familiar to them and also learned new strategies—such as *grouping students by gender, allowing wait time with a slow responder before asking someone else to answer a question, alternating calling on girls and boys, and asking girls more open-ended, higher-order questions*. They wanted to develop tools to analyze their own teaching practices and to evaluate how those practices affected girls' achievements in science. To move student thinking from questions about the mechanics of physical activities to the underlying concepts, for example, they had to develop questioning skills or rethink the structure of the activity.

Women scientists came into the program to mentor girls and to gain teaching experience, which required developing new skills and problem-solving strategies. Classroom management was a challenge for them, both frustrating and rewarding. More than half said Triad made them more confident and better prepared to handle group situations and more than three quarters returned for multiple years. Many reported that the training Triad had provided was highly regarded by new employers and was instrumental in landing them academic positions in universities. They felt Triad had improved their teaching skills, confidence, teamwork, and comfort with leadership.

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An education
coalition
in Connecticut

AN EDUCATION COALITION IN CONNECTICUT
UNITED CONNECTICUT FOR WOMEN IN SCIENCE, MATHEMATICS, AND ENGINEERING WAS A COALITION TO UNITE CONNECTICUT'S EDUCATION PROGRAMS (K–16), COMMUNITY GROUPS, AND BUSINESSES IN WORKING TOWARD ATTRACTING AND KEEPING GIRLS AND WOMEN IN STEM STUDIES AND CAREERS.
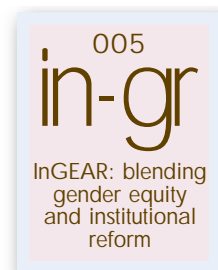
The project established a clearinghouse of information on Connecticut's gender equity programs, increased public awareness of gender equity issues, informed some of Connecticut's urban middle school girls about STEM careers, and increased their confidence about pursuing them. Professional women networked in a newly created chapter of Association for Women in Science. The project also provided training in gender-equitable teaching strategies for Connecticut math and science teachers and student teachers, K–16.

The project felt more sustained impact through its mentoring activities and information dissemination, which continued after the grant ended, than through its in-class programs, which did not. It published a resource guide on gender equity in Connecticut as well as tip sheets for parents (in Spanish and English) and for teachers and mentors on how to encourage girls in STEM.

CODES: E, M, H, U, PD	CONNECTICUT PRE-ENGINEERING PROGRAM, INC.
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HRD 94-50026 (THREE-YEAR GRANT)	
PARTNERS: AWIS, ST. JOSEPH COLLEGE, WESLEYAN UNIVERSITY WOMEN IN SCIENCE, WESTOVER SCHOOL, CONNECTICUT DEPARTMENT OF HIGHER EDUCATION, FAIRFIELD COUNTY COMMUNITY FOUNDATION, INC., GREATER BRIDGEPORT AREA FOUNDATION, PHOENIX LIFE, AND MANY CONNECTICUT PUBLIC SCHOOLS.	
KEYWORDS: DISSEMINATION, RECRUITMENT, RETENTION, RESOURCE CENTER, GENDER EQUITY AWARENESS, TEACHER TRAINING, MENTORING, RESOURCE GUIDE, BILINGUAL, PARENTAL INVOLVEMENT	

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in-gr

InGEAR: blending
gender equity
and institutional
reform

INGEAR: BLENDING GENDER EQUITY AND INSTITUTIONAL REFORM
BY CHANGING THE WAYS TEACHERS K–12 LEARN TO TEACH MATH AND SCIENCE, THIS THREE-YEAR PROJECT AIMED TO CHANGE THE WAYS GIRLS LEARN MATH AND SCIENCE. PERMANENT CHANGES WERE NEEDED IN GEORGIA'S MATH, SCIENCE, ENGINEERING, AND EDUCATION DEPARTMENTS TO GIVE GEORGIA GIRLS AND BOYS EQUAL ACCESS TO GOOD STEM EDUCATION AND EQUAL ENCOURAGEMENT TO EXPLORE STEM-RELATED CAREERS.

Teacher preparation programs—including instruction in science, engineering, and math—needed to be reformed and redesigned so that teachers entering K–12 classrooms knew how to interest girls in STEM. The project emphasized integrating gender equity and reform (hence InGEAR)—equipping faculty and teaching assistants with positive intervention strategies to support gender equity.

Georgia Tech led the project, working in collaboration with four universities: Clark Atlanta University, Georgia Southern University, Georgia State University, and the University of Georgia. The University of Georgia took the lead in developing a toolkit of materials for the five institutions, with website links to profiles of women in STEM.

InGEAR was not primarily a research project, but each partner undertook an institutional self-study. According to the Report on the Status of

Women at Georgia Tech, for example, GT had increased the number of female students and faculty and had improved the "campus climate" for women, but much remained to be done. Many improvements in gender equity had come about through deliberate, systemic efforts: changing the makeup of Student Services personnel (and hiring a director of diversity programs), establishing a women's resource center, offering a series of gender equity workshops, and holding a women's leadership conference. Such institution-wide efforts attested to GT's commitment to diversifying its student body to meet future workforce demands. GT compared favorably with its benchmark institutions in the number of women hired as assistant professor but lagged behind them in the number of women who became associate and full professors.

Several factors kept female faculty's retention and promotion rates low. The

tenure and promotion process did not recognize different career trajectories and rates of advancement, and both men and women viewed institutional practices and processes as unnecessarily political and arbitrary. Moreover, inattention to family-friendly policies (especially about maternity leave and onsite daycare) significantly affected all faculty who hoped to balance family and career. And despite important improvements, women at GT still faced specific institutional barriers and difficulties, there was no institutional mechanism for tracking and responding to their concerns across constituencies, and there were no procedures for dealing with sexual harassment or the subtler, more pervasive forms of gender harassment: casual (and deliberate) sexist comments, personality-based performance evalua-tions, differential workloads, or male-focused performance expectations.

Although teacher preparation programs did not undergo the full redesign the project had hoped for, professional development activities at Georgia Southern University, Georgia State University, and the University of Georgia led many teachers to modify the content of their courses and created a critical mass of faculty who consider gender equity a priority. At Georgia State, graduate research assistants (most of them doctoral students in the school counseling program) took David and Myra Sadker's training in how to use INTERSECT, an instrument for observing classroom interactions. *Instructors who were observed and debriefed (by their choice) about their classroom interactions showed more gender-equitable behavior afterward. Those who were observed but not debriefed did not show a change in behavior. Conducting the observations and debriefings profoundly changed the graduate assistants, who became acutely aware of subtle but pervasive gender discrimination in the classroom and in themselves and others.*

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gms
GEMS: learning gender equity online

GEMS: LEARNING GENDER EQUITY ONLINE

THIS COLLABORATIVE PROJECT IS RESEARCHING HOW TO DESIGN EFFECTIVE ONLINE DELIVERY OF GENDER EQUITY TRAINING IN MATH AND SCIENCE TEACHING AND HOW THIS LEARNING AFFECTS PARTICIPANTS' ATTITUDES AND PRACTICE. MAKING A DISTINCTION BETWEEN AN EQUITABLE COURSE AND A COURSE THAT TEACHES ABOUT EQUITY, GEMS (GENDER EQUITY IN MATH AND SCIENCE) ASKS: HOW MUCH CAN TEACHERS LEARN ABOUT EQUITY ONLINE? CAN THEY LEARN MATERIAL WITH A HIGH AFFECTIVE CONTENT ONLINE? WHAT ROLE DOES FACILITATION PLAY? DO MEN AND WOMEN BEHAVE DIFFERENTLY IN AN E-COURSE?

Working in collaboration with several partners, Education Development Center (EDC) will identify factors of course design and delivery that help improve attitudes and practices. The research centers on "Engaging Middle School Girls in Math and Science," a nine-week online course developed by EDC's WEEA Equity Research Center. Because learning styles could affect the design of software and how participants interacted with the material and each other, they added the capacity to take the Myers–Briggs test online, offering online feedback to those who take the test. Each partner agreed to recruit a cohort of participants (mostly middle school teachers), offer them the course, and participate in listserv discussions with GEMS staff and advisers. The project hopes to build a community of math and science teachers trained in gender equity who support each other as they translate a critical framework into strategies and activities for classroom change. It also hopes to develop leaders, build on current networks, and encourage sharing and community building—linking professionals in math and science, gender equity, and educational technology.

Moving the courses from the Web Board system originally used onto a Blackboard platform resolved students' problems navigating the system but required presenting the course content in different ways. Participants adapted easily and were soon communicating more actively than they had in earlier sessions, but they remained uncomfortable with the technology and often preferred hand-holding—someone walking them through the process over the phone—to receiving (and taking time to read) instructions by e-mail or in a chat room.

A number of teachers had trouble accessing and using the course technology, sometimes because low-end computers cannot open PDF documents and sometimes because America Online did not allow them to. Technology challenges both in schools and at home raised concerns that technologies used to present online courses may inadvertently lock out certain groups or individuals. Some people dropped the course out of frustration with slow technology.

At home or at school, participants often had trouble finding time to participate. At school, most of them do not have personal computers for their use alone, often have to compete with students for use of computers, and rarely have release time for the course, which they must fit into an already full schedule. At home, their computers may pose technical challenges, or they may have trouble finding time. Women tend to use the Internet late in the evening, after they've put their children to bed. Such a gender-related trend could affect how heavily women might participate.

Training in both facilitation and the use of technology is critical, and a separate online course was developed for facilitators, but some of them had problems with such tasks as registering the participants. *And skill at onsite facilitation did not necessarily travel well to the online environment, which requires that facilitators be more directive.*

CODES: PD, M	EDUCATION DEVELOPMENT CENTER (EDC)
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www.edc.org/GDI/gems/aboutgems.htm	HRD 00-02126 (THREE-YEAR GRANT)
RESEARCH PARTNERS: TERC INC. (CAMBRIDGE), WESTED (OAKLAND), EISENHOWER NATIONAL CLEARINGHOUSE (OHIO STATE), INTERCULTURAL DEVELOPMENT RESEARCH ASSOCIATION (SAN ANTONIO, TEX.), AND WEEA EQUITY RESOURCE CENTER (EDC, GENDER AND DIVERSITIES INSTITUTE).	
PRODUCTS: CREATING THE GENDER AND SCIENCE DIGITAL LIBRARY (HOUSING THE LEARNING MATRIX), AN INTERACTIVE, SELF-GUIDED PROFESSIONAL DEVELOPMENT SYSTEM AND ONLINE COMMUNITY TO IMPROVE STUDENT OUTCOMES IN SCIENCE.	
KEYWORDS: RESEARCH STUDY, ONLINE COURSE, GENDER EQUITY AWARENESS, TEACHER TRAINING, COLLABORATIVE NETWORK, EDC; TERC INC.	

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COU

Counseling for gender equity

COUNSELING FOR GENDER EQUITY

AAUW'S 1992 REPORT *HOW SCHOOLS SHORTCHANGE GIRLS* INCREASED INTEREST IN PROGRAMS TO ENGAGE GIRLS AND WOMEN IN MATH AND SCIENCE—FOR EXAMPLE, IN SUMMER CAMPS FOR GIRLS, TEACHER WORKSHOPS ON EQUITABLE EDUCATION, AND ACTIVITIES FOR GIRLS AND THEIR PARENTS. BUT SCHOOL COUNSELORS HAVE NOT BEEN INCLUDED TO ANY GREAT EXTENT IN THESE ACTIVITIES, ALTHOUGH THEY SERVE AS GATEKEEPERS FOR STUDENT PARTICIPATION IN ELEMENTARY SCIENCE AND TECHNOLOGY ACTIVITIES AND IN UPPER-LEVEL ADVANCED COURSES. COUNSELORS ARE AN IMPORTANT SOURCE OF INFORMATION ABOUT CAREERS, SCHOLARSHIPS, AND INTERNSHIPS BUT, LIKE THE REST OF US, THEY SOMETIMES MISS OPPORTUNITIES TO MOTIVATE GIRLS AND OTHER UNDERREPRESENTED STUDENTS IN AREAS WHERE THEY ARE NEEDED THE MOST.

This three-year project to provide training in gender-balanced education to Virginia school counselors featured an annual summer institute for 50 Virginia school counselors, mini-grants for school-based equity projects for girls, and in-service programs in Virginia school systems. The project also supported production of a resource-rich website and six video programs on gender-fair counseling and learning for a PBS series broadcast as part of a distance learning program through PBS's Adult Learning Service and the Virginia Department of Education Hour.

Developed for K–12 counselors by the Virginia Space Grant Consortium in collaboration with Virginia Tech, the project was selected for inclusion in the Annenberg/CPB Math and Science Project's *Guide to Math and Science Reform.*

At summer institutes on gender equity, counselors learned strategies for gender-fair counseling and learning, working with national figures such as David Sadker (co-author of *Failing at Fairness: How Our Schools Cheat Girls (and Boys)*, Roberta Furger *(Does Jane Compute? Preserving Our Daughters' Place in the Cyber Revolution)*, and Christine Darden *(Females and Engineering)*. They learned about cultural and sex-role biases and stereotypes and classroom diversity, the decoding of classroom
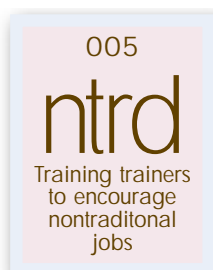
interactions, gender-biased issues in career information and exploration, why girls avoid technology courses, and how to guide them to opportunities in technology.

The project opened counselors' eyes and gave them the tools to provide leadership for girls in their schools. "The subtle gender bias was overwhelming to me," said one participant. "As I began to analyze my own behaviors, I was shocked to find how my perspective may have been a limiting factor to female students. I really feel an obligation to bring more awareness to my faculty as well as a commitment to stress the importance of science and math to students and parents." Mini-grants for school-based equity projects allowed them to act on what they learned.

005

ntrd

Training trainers to encourage nontraditonal jobs

TRAINING TRAINERS TO ENCOURAGE NONTRADITIONAL JOBS

ROUGHLY HALF OF YOUNG WOMEN WORK IN JOBS PAYING AN AVERAGE $338 WEEKLY, WHILE 60 PERCENT OF YOUNG MEN WORK IN JOBS PAYING AN AVERAGE $448. THIS $110 WAGE DIFFERENTIAL REFLECTS THE DIFFERENT KINDS OF WORK MEN AND WOMEN DO. YOUNG WOMEN WORK IN A NARROW RANGE OF OCCUPATIONS—REPRESENTING ONLY 1 PERCENT OF YOUNG PEOPLE EMPLOYED AS AUTOMOBILE MECHANICS, FOR EXAMPLE, 4 PERCENT OF AIRLINE PILOTS AND NAVIGATORS, AND 10 PERCENT OF ELECTRONIC TECHNICIANS. THE SCHOOL-TO-WORK OPPORTUNITIES ACT REQUIRES ALL STATES TO SET GOALS FOR PREPARING WOMEN FOR NONTRADITIONAL EMPLOYMENT. *WOMEN IN NONTRADITIONAL JOBS—DEFINED AS "OCCUPATIONS IN WHICH FEWER THAN 25 PERCENT OF THE WORKERS ARE WOMEN"—EARN HIGHER WAGES THAN WOMEN EMPLOYED IN TRADITIONALLY FEMALE OCCUPATIONS.*

The strategy of this school-to-work project was to saturate North Carolina's education system with school-to-work and gender equity workshops through a train-the-trainer model. The project's emphasis was on training teachers and counselors how to prepare girls for such nontraditional careers as electrician, computer network engineer, and automotive technician. In July 1998 the Institute for Women in Trades, Technology & Science (IWITTS) held a demonstration train-the-trainer workshop in Greensboro for 32 teachers (of math, science, technology, and vocational education), guidance counselors, and school-to-work coordinators.

To infuse gender equity into its train-the-trainers program, IWITTS developed a training video, "Futures: Preparing Young Women for High Skilled, High Wage Careers," related printed material, and Internet support strategies (especially a listserv) to be used with trainees and to disseminate the project's products and methods. Participants found the video particularly helpful. The video combines acted vignettes and interviews with real-life teachers, students, and parents to communicate practical strategies for getting female students interested in traditionally male-dominated classes and school-to-work activities, keeping them involved, and easing their integration into the workplace through *work-based learning experiences such as internships, job shadowing, cooperative education, apprenticeships, and school-based enterprises.*

After the train-the-trainer workshop the participants felt well equipped to train their peers and to work with students. They developed leadership teams and training plans. *The strategies they found most useful: showing videos of women in nontraditional jobs; touring technical colleges, technical training programs, and labs/technology classes; presenting career information; providing girls with female mentors and role models; engaging girls' interest through hands-on activities; eliminating harassment in the classroom and giving boys and girls equal attention in class; and preparing girls with realistic expectations and coping strategies. The most important thing they took away from the training was awareness:* Even if they were

doing the right things, they learned that other teachers weren't necessarily doing the same things, so they needed to intervene back at school.

In some cases the participants' training plans were put on hold because of time (and scheduling) barriers, changes in school priorities, and lack of administrative support. Most of the participants who responded to follow-up questions reported that they had shared resources with their peers and had provided informal training at their schools. Some had also presented at conferences and in distance learning opportunities. Only three participants made formal presentations to parent groups, but most of them discussed the project and its impact on their daughters informally with parents, who were highly supportive.

The low response rate to a post-project questionnaire makes it difficult to draw conclusions, but the participants who responded had positive things to report:

• The number of girls who selected traditionally male career majors increased dramatically—from 20.4 percent in 1998 to 49.6 percent in 1999.

• Counselors and coordinators who responded reported more girls enrolling in work-based learning activities—an increase from 18.8 percent of enrollment to 41.8 percent over one year. Responding vocational/technology teachers reported work-based activities increasing from 0 to 50 percent of enrollment for the same period.

• Responding vocational/technology teachers reported an increase in female students enrolled in nontraditional career courses—from 14.5 percent to 26.1 percent over a year.

Overall, it seemed that *counselors/coordinators and vocational/technology teachers were able to make more effective use of the project materials and strategies than math and science teachers were. Math and science teachers had little previous experience with work-based learning activities for students, and with the current stress on end-of-year testing it was very difficult for them to deviate from "just teaching the basics" in their classrooms. In future projects of this type, it might be wise to give math and science teachers extra administrative support so they feel freer to make changes in their classrooms, such as bringing in female role models to speak about their nontraditional careers.*

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WomenTech at community colleges

WOMENTECH AT COMMUNITY COLLEGES

THIS DEMONSTRATION PROJECT BY THE NONPROFIT INSTITUTE FOR WOMEN IN TRADES, TECHNOLOGY & SCIENCE (IWITTS) WAS A COLLABORATIVE EFFORT TO RECRUIT AND RETAIN MORE WOMEN IN STEM COURSES AT THREE COMMUNITY COLLEGES: COMMUNITY COLLEGE OF RHODE ISLAND (CCRI), NORTH HARRIS MONTGOMERY COMMUNITY COLLEGE DISTRICT (NHC, IN HOUSTON, TEX.), AND COLLEGE OF ALAMEDA (COA, IN ALAMEDA, CAL.). EACH COLLEGE TARGETED SIX TO TWELVE TECHNOLOGY PROGRAMS IN WHICH WOMEN WERE UNDERREPRESENTED.

For these colleges, the idea of recruiting women into tech courses would require more than a change in the schools' meagre marketing budgets. It would require a change in the institutional culture. Only one of the colleges actively marketed its school to prospective students and it was difficult to tell from its marketing materials how long it would take a student to complete a tech program, what the course prerequisites were, and how best to meet them.

The project developed publicity materials, a prototype "community college WomenTech page" for all three colleges, and additional marketing collateral. CCRI and NHC developed colorful brochures and full-color WomenTech posters and flyers for distribution on or near campus. CCRI developed a WomenTech page for its course catalog as well as Womentech buttons and a flyer for its Career Expo. Each college incorporated a WomenTech Career Expo into its annual recruiting efforts and sometimes lesser versions elsewhere—such as a WomenTech registration table during registration week and a WomenTech booth at a shopping mall Career Expo.

CCRI and NHC's college websites provided links to special WomenTech sites, giving the WomenTech project more visibility. Each WomanTech website has about 30 pages of content, with such features as biographies of women who are graduates of the technology programs, user-friendly information about the programs, answers to frequently asked questions

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(FAQs such as "Am I too old to start a tech career?"), links to support services and to relevant websites about women or minorities, and e-mail lists developed to recruit women.

Two years and four months into the project, *CCRI had increased female enrollment in its technology programs by 92 percent—from 39 women to 76—in the year and a half of project implementation.* Women enrolled in programs ranging from electronics to telecommunications, computer, and networking technology. *Data on the other two colleges were hard to come by. Indeed, gender-disaggregated data collection quickly became part of the project strategy.* Only one of the three colleges collected data by gender and by program area, none collected data on who finished college, and there was little tracking of how graduates were placed and at what average wage—figures that would help them sell their tech courses.

Many women don't come to college with the wiring, tool, and computer experience men have. CCRI developed an experimental six-week Tech Readiness class (for men and women), a bridge for students new to computing, which is now part of its regular offerings. Because poor math skills are a problem for many students, CCRI offered a math for technology course for the first time in 2002, the result of an unprecedented dialogue between the math and engineering/technology departments.

In February 2002 IWITTS launched WomenTechWorld.org, an on-line community for women technicians and students in technology, which got up to 11,500 hits a week. On its interactive website are biographies, news stories, a bulletin board, and FAQs. E-mentoring has been delayed by software problems. WomenTechTalk is a new national e-mail discussion group for "techie" women.

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SELECTED LINKS FOR 'TECHIE' WOMEN

Women in technology websites	www.womentechworld.org/links.htm#wtw
Women in technology listservs	www.womentechworld.org/links.htm#wtl
Minorities in technology websites	www.womentechworld.org/links.htm#mtw
Girls in technology websites	www.womentechworld.org/links.htm#gtw
SPECIALTY SITES FOR TECHIE WOMEN	
Association for Women in Aviation Maintenance	www.awam.org/
BinaryGirl.com	www.binarygirl.com/home.shtml
Construction Construction tradeswomen	hometown.aol.com/catstep16/myhomepage14profile.html
Female role models	www.genderequity.org/index.html
Greasergrrls (women motor enthusiasts)	www.greasergrrls.com/
Lady Auto Mechanics Club	www.ladyautomechanics.com/
National Association of Women in Construction	www.nawic.org
National Electrical Contractors, Women's Page	www.necanet.org/about/members/women.htm
Society of Women Engineers	www.swe.org
TechDivas	www.techdivas.com
Webgrrls	www.webgrrls.com/explorer.htm
Women Chemists Committee	membership.acs.org/W/WCC/
Women in Animation	women.animation.org/
Women's Automotive Association International	www.waai.com/
Women in Aviation Resource Center	www.women-in-aviation.com/
Women in Cable & Telecommunications	www.wict.org/
Women in the Construction Trades	www.expage.com/page/firewomen
Women in Engineering Programs and Advocates Network	www.wepan.org
Women in Technology International	witi.com/
Work4Women	www.work4women.org/

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mnt

Mentoring teams
of teacher
trainers

MENTORING TEAMS OF TEACHER TRAINERS

UNDER THE TEACHER EDUCATION MENTOR PROJECT, SIX EDUCATION PROFES-
SORS AND THE PROJECT DIRECTOR SERVED AS MENTORS FOR TEAMS FROM SEVEN
UNIVERSITIES NATIONWIDE. THE GOAL WAS TO PROMOTE CHANGE IN EDUCATION
PROFESSORS AND IN THE CULTURE OF COLLEGES OF EDUCATION, ESPECIALLY IN
PROGRAMS TRAINING STUDENT TEACHERS IN MATH, SCIENCE, AND TECHNOLOGY
EDUCATION—TO EXPAND THE POOL OF INSTRUCTORS QUALIFIED TO HELP K–12
TEACHERS NURTURE FEMALE TALENT AND PERSISTENCE IN SCIENCE.

The change agents were part of the institution because each of the seven institutions formed an internal team: the education dean and/or department chair, professors, students, university administrators, and/or cooperating school teachers. Each team assessed the need to improve or integrate material on gender bias in STEM methods and other education courses into their university's teacher education program. "What I think was most surprising to me was the subtle and deeply entrenched bias that seems to occur in a small rural community," said a principal. "Cultural and racial biases are easy to distinguish and articulate. Many people who are born, raised, and work within a very traditional sex-role context have difficulty recognizing subtle sex-role biases."

Special expertise and experience were transferred on the job. An external mentor—expert in math, science, or technology education *and* gender issues—worked with each team. The external mentors formed their own team, guided by the project director. To become effective advocates for change in their departments, colleges, and field placement schools, team leaders attended a seminar about institutional change, gender issues, and leadership. Empowered in content and process, they developed a mutual support group.

Just-in-time learning and ad hoc problem-solving were available at all times from a wide network. All team members exchanged messages about progress on an electronic listserv, sharing ideas, resources,

opportunities, feedback, and support. Mentors had a separate listserv. In the first two years the pyramid-style network reached dozens of faculty members, hundreds of student teachers, and, indirectly, dozens of K–12 schools and thousands of K–12 girls and boys—numbers that will increase with time.

The project has been a catalyst for change. Six colleges and universities reported changing the curriculum across courses to include gender equity in more coordinated ways. Three institutions reported greater consideration of gender equity in hiring, promotion, and tenure. Most (79 percent) of those involved reported major positive changes in how they themselves addressed gender equity in their classes. "At the beginning of this project," said one teacher on an equity team, "we felt we were pretty much aware of gender equity issues. Wow, were we wrong! We became more aware of gender equity issues in our teaching methods, our instructional materials, our terminology, and our classroom management."

005
cde
Coding student
teachers' class-
room interactions

CODING STUDENT TEACHERS' CLASSROOM INTERACTIONS

GENDER EQUITY HAS BEEN DIFFICULT TO INCORPORATE EFFECTIVELY INTO TEACHER TRAINING PROGRAMS. TOO STRONG AN EMPHASIS ON IT AND PARTICIPANTS SEE THE ISSUE AS A JOKE IN POLITICAL CORRECTNESS; TOO SUBTLE AN EMPHASIS (EMBEDDING EQUITY ISSUES IN CURRICULUM DEVELOPMENT OR CLASSROOM MANAGEMENT, FOR EXAMPLE) AND ALL BUT THE MOST INTUITIVE PARTICIPANTS CAN MISS ITS PRESENCE AND IMPLICATIONS. IN THIS THREE-YEAR PROJECT, THE UNIVERSITY OF DELAWARE (UD) STUDIED THE IMPACT ON HIGH SCHOOL SCIENCE TEACHING PRACTICES OF INCORPORATING GENDER EQUITY TRAINING INTO SECONDARY SCIENCE EDUCATION.

Experienced teachers involved with the project acted as "cooperating" (supervising) teachers for 20 of the student teachers ("grant teachers"). A contrast group of 39 "nongrant" student teachers was supervised by experienced but "nongrant" teachers, not associated with the project. Over three years, researchers observed and coded the classroom interactions of all 59 student teachers. Grant student teachers were also coded by their cooperating teachers, who sat and talked with them about what they saw.

The lessons were coded for the type and number of teacher interactions with students, questions asked by the teachers and by the students, type of teaching activity and time spent in that activity, and types of materials used. Observers noted the number and type of questions and the sex of the students answering the questions. (The study collected data on teacher-student interactions and on patterns of teacher questioning and student–teacher interactions.) Questions were coded as *knowledge-level questions* (for example, "What is a hermaphrodite?" or "What is the atomic weight of carbon?"), as *upper-level (higher order) questions* ("explain in terms of chemical bonding why ice, the solid, is less dense than water, the liquid"), as procedural questions ("Is this right?" "Will this be on the test?") and as nonacademic questions or instructions ("Please open your book" or "Are you still on the debate team?").

One goal of gender-sensitive teacher education programs is graduates who ask students of both genders both knowledge questions and upper-level questions. This is what the project found, on average:

- There were significant differences in how teachers in the two groups interacted with their students.
- For both grant and nongrant student teachers, *the majority of student– teacher interactions were knowledge-level questions* (61 percent for grant, 82 percent for nongrant student teachers). Girls were asked 63 percent of those questions in the grant classes and only 43 percent in the nongrant classes.
- In more than 75 hours of classroom observations, girls received no upper-level questions from nongrant student teachers—but *in more than 50 hours of observations in nongrant classrooms, observers recorded only five upper-level questions of any students. (It is a major concern that nearly the ONLY questions coded were knowledge-level questions and these were asked of only a small group of students*.) In grant classes, girls and boys answered the same number of upper-level questions—which accounted for 26 percent of teacher–student interactions. (This is atypical.)

- *There was a significant difference between the two groups in terms of student teachers asking knowledge-level and higher-level questions*. In the grant classes, 31 percent of the student teachers' questions to students were coded upper level, compared with only 1 percent of questions in the nongrant classes. There was no significant difference in procedural interactions.

- Before coding the student teachers' lessons, *the cooperating teachers believed that their student teachers were gender-sensitive and that they were asking a balanced mixture of procedural, knowledge, and upper-level questions of both boys and girls. After less than 30 minutes of coding, they realized how inaccurate their initial perceptions were. Their student teachers were asking mostly knowledge-level questions, were using target students, and were not, overall, gender-sensitive.*

- *The cooperating teachers needed to document these interactions. Teachers rarely recognize inequitable teaching practices. These cooperating teachers' initial perceptions were that the student teachers' performance was satisfactory. This perception changed only after they became engaged in data collection.*

- *By discussing the pattern of classroom interactions with the student teachers, the cooperating teachers in the grant classrooms were able to begin to influence their questioning patterns.*

- For student teachers in the nongrant classes, whose interactions were observed and coded by researchers from the university, *getting only quantitative data from university observers was not compelling enough for student teachers to revise their questioning patterns.*

Preservice and beginning teachers initially define good teaching in terms of classroom management and disciplinary procedures, and often rely on

teaching activities that keep their classes orderly and on task. Student teachers may focus on male target students to increase order and control in their classes and may be reluctant to use cooperative learning groups, lab activities, and discussions, or to wait longer for student answers, as those practices may produce less order in their practicum classes. *After a while, they enter a stage of focusing on their teaching. Finally, their attention moves away from themselves toward their students' learning. What their peers and their students say about their teaching influences neophyte teachers as they move through these stages.* "Cooperating" or supervising teachers strongly influence the next generation of teachers because they interact daily with student teachers. *The cooperating teachers who coded and discussed the student teachers' interactions with their students strengthened the neophyte teachers' gender-equitable teaching.*

Interviewed the summer after student teaching, the student teachers who had had constant quantitative feedback about their interaction patterns said they had been surprised by many of their patterns. One of them had sensed that three boys were dominating his class but didn't realize that one boy (M) dominated as much as he did. After the UD supervisor and cooperating teacher both noted the same thing, he realized that M got attention for comments and behavior designed to "get the teacher off track." All three boys took advantage of the student teacher's "global questioning" strategy by calling out answers to get attention. After this was pointed out to him, the student teacher ignored the group's off-task behavior and called-out comments and the boys gave up the behavior because it no longer got them the attention they wanted. *The interacting code gave him a good frame of reference for improving.*

Another grant teacher said that every two weeks or so her cooperating teacher coded her and then discussed what she saw. She would say, "Ok, you didn't really seem to call on Paul today. . . . You need to work on that." Discussing this kind of detail helped the student internalize the ideas of gender equity.

There is a balancing act between the real and perceived needs of the student teachers and cooperating teachers. Student teachers see the methods class and student teaching as critical (perhaps too critical) to their teaching career. They fear that a bad relationship with, and a poor recommendation from, their cooperating/supervising teacher will be devastating to their career, destroying their chances for a good teaching job. *Many student teachers seem to perceive student teaching more as a final exam than as a learning experience. Cooperating teachers, on the other hand, want students to see the big picture and profit from their own experiences. They see student teaching not as a test but as a period of challenge and growth. This difference in perception between the two led to considerable anxiety, which was not allayed by knowing each other ahead of time.*

Currently, preservice students and cooperating teachers do not perceive each other as colleagues but as the expert doling out good advice and the novice asking for quick answers. Students want time away from the cooperating teachers to vent their frustrations without fear of reprisals (perceived or real). At no time during focus groups did the student teachers discuss continuing to learn or improve their teaching skills after the student teaching experience; they just wanted to get through it with top marks. *Teacher training should find ways to put preservice students and cooperating teachers on a learning curve together—helping model for students the importance of lifelong learning. It should find ways to acknowledge that they will not be fully trained when they leave student teaching, and that the methods course and seminar merely give them exposure to critical methods and skills.*

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CODING EXPERIENCED TEACHERS, TOO

Most teachers who supervise student teachers have several years' teaching experience and may have completed their studies before gender equity was incorporated into teacher education. So it is important to observe and code classroom interactions of both experienced and new teachers. One cooperating teacher wrote in her diary, after being observed:

I had a real awakening. . . . I was showing a film, stopped, turned the projector off, and answered [a student's] question, and when the whole thing was over, [the observer] said to me, 'Did you realize that you never called on the right hand side of the room?' And I would have sworn that I had called on the right hand side of the room, but I hadn't. And then when the next class came in, I really became aware of the fact that I was standing by the projector and the projector was cutting that side of the room off. They might as well have gone on home. . . . I don't know how many years I did that without knowing. . . . I'll bet it was a long, long time. As a teacher, I learned a lot about my attitudes, who I call on, why I call on them. [I think] it was more than a gender equity thing. It's an overall equity thing. . . . the realization that you categorize students. . . . that you put them in little boxes.

005
new
New courses to
draw women into
science and
engineering

NEW COURSES TO DRAW WOMEN INTO SCIENCE AND ENGINEERING
TO MAKE SCIENCE AND ENGINEERING MORE WELCOMING TO WOMEN AND MINORITIES, TEXAS A&M UNIVERSITY HAS BEEN WORKING ON SYSTEMIC CHANGE IN ENGINEERING EDUCATION. ITS MAIN EFFORT IN THE FIRST AND SECOND YEAR OF THE CURRICULUM HAS BEEN TO CREATE *INCLUSIVE LEARNING COMMUNITIES—COMMUNITIES OF STUDENTS*, FACULTY, AND INDUSTRY WITH COMMON INTERESTS WHO WORK AS PARTNERS TO IMPROVE THE EDUCATIONAL EXPERIENCE. TO MAKE WOMEN MORE COMFORTABLE IN THE STEM ENVIRONMENT, THIS PROJECT DEVELOPED NEW CURRICULA AND IS CONDUCTING A SURVEY OF THE CAMPUS CLIMATE FOR WOMEN IN SCIENCE AND ENGINEERING.

Introduction to Women's Studies: The History of Women in Science and Engineering, which fulfills a three-hours humanities requirement, was introduced in 1995. Team-taught by seven people, it combines history and hands-on lab experiences designed to give first-year students—male and female, working in teams—more sense of belonging, comfort, and confidence.

A new junior-year course, Women in Organizations, covers the social structure of gender and knowledge, access and opportunities, the law, politics, and unwritten policies—fulfilling a three-hour social science requirement. Two new graduate seminars were offered on university teaching and research in STEM fields. One emphasizes career strategies and choices; the other, networking, personal interactions, and teaching and presentation techniques. A faculty workshop was given to heighten awareness about gender issues and to improve classroom instruction and personal interactions with students.

WOMEN'S STUDIES AND SCIENCE: CAN WE TALK?
ALTHOUGH AMERICA PRODUCES MANY OF THE WORLD'S GREAT SCIENTISTS, MOST OF AMERICA'S POPULATION IS NOT HIGHLY LITERATE IN SCIENCE. WOMEN, ESPECIALLY, "CHECK OUT" OF SCIENCE MUCH TOO SOON. THE PROJECT WOMEN AND SCIENTIFIC LITERACY ARGUED THAT IT WAS TIME TO MAKE SCIENCE MORE ATTRACTIVE TO WOMEN BY EXPANDING AND TRANSFORMING THE CONTENT AND TEACHING METHODS OF THE SCIENCE CURRICULUM IN HIGHER EDUCATION, WITHIN HUMANITIES AND SOCIAL SCIENCE COURSES AS WELL AS TRADITIONAL SCIENCE DEPARTMENTS.

005
talk
Women's studies
and science:
Can we talk?

The project's main goal was to bridge the gulf between science and women's studies by incorporating feminist science studies into science and nonscience courses, thereby setting up an interdisciplinary vocabulary among students, whether science majors or not. Feminist science studies have made us aware of the costs of excluding women and other marginalized groups from full participation in science, of the historical uses of science to justify inequalities, and of which areas of scientific research are studied and which are not. But while feminist science lies at the heart of this project, its *main thrust is to improve scientific literacy. It takes up the challenge posed by biologist Anne Fausto-Sterling, to break the cycle of reproducing a world "in which science seems an illegitimate place for women and gender studies seems an inappropriate enterprise for scientists."*

With leadership from AAC&U's Program on the Status and Education of Women, this initiative brought together 10 competitively chosen colleges and universities in a three-year curriculum and faculty development project. These schools were to make science more central to women's studies courses, to create two-way streets between undergraduate science departments and women's studies programs, and to foster systemic curriculum changes to improve the quality and scope of science teaching and learning.

Faculty development was important at all 10 sites, but models for faculty development differed greatly. At the University of Arizona (Tucson), for example, more than 100 faculty and hundreds of students participated in seminars, colloquia, and conferences. At Greenfield Community College, faculty attended teaching and assessment workshops and talked about what good teaching was and whether reaching female students was different

from reaching male students. At Bates College, faculty participated in seminars and retreats, presenting changes in their syllabi at one and discussing assessment at another. Combining summer reading groups with curriculum development was effective at the University of Rhode Island, where about 200 people attended a spring conference on "Diversifying the Culture and Curriculum of Science, Engineering, and Women's Studies."

Curriculum development, *to change both content and pedagogy, often emphasized connecting the subject matter to students' personal lives, developing practical applications of what students were learning, offering student-led discussions in which the student (not the teacher) was the classroom authority, building a caring and respectful community of learners, and developing classroom practices that featured hands-on science, problem solving relevant to students' lives, collaborative learning groups, journal keeping, and a more constructivist approach to teaching and learning.*

At the University of California at Long Beach, for example, two new education courses were introduced (Women in Science and Science and Society) and a third (Issues in Women's Health) was heavily revised. A Gender and Science course being offered at St. Lawrence University is being team-taught by women from the science faculty and from women's studies. Courses developed or revised at Portland State University were Experimentation: Texts and Test Tubes; The Politics of Gender; and Science, Gender, and Social Context. Portland State's course Biopolitics analyzes how gender relations affect the policy and politics of research and technology that affect women's reproductive health. At Rowan University, the new course Physics of Everyday Life emphasizes active learning and power shared between students and faculty. Digital Computer Design, which was previously standard lectures and labs, now includes computer simulations and each student is required to design, build, and test digital circuits. The University of Illinois at Chicago planned a multidisciplinary masters program in Women's Health Studies and is turning a lab program, Working with Chemistry, into a lab manual with an emphasis on action, reflection, and collaboration. The University of Rhode Island's new course, Women and the Natural Sciences, asks, How has science studied women? Who are the women scientists? And how is science socially constructed?

The project supported the development of various resources—including bibliographies, sample syllabi, and research on the effects of

curricular change on all students, with particular attention to women. As completed, they will be made available on AACU's website. Selected syllabi for feminist science studies can be found at <www.aacu-edu.org/womenscilit/ syllabi.cfm>.

Assessment. The feminist model for assessment focuses on improving learning and teaching by being student-centered, using multiple quantitative and qualitative methods of assessment, viewing achievement from many perspectives. Feminist assessment asks such hard questions as "Who has the power to determine the questions? What methods are most appropriate to embrace the many voices and ways of speaking? What methods help reveal the unspoken?" Because assessment can be used politically and may injure those taking part, participants expect to be part of the assessment process from the beginning to the end of the project. Each site was committed to developing its own assessment design to demonstrate that they take the task of reforming curriculum seriously.

Changing the way courses are conducted is a slow, complex task, but evidence is building that many faculty members are interested in collaborating on teaching and research in science and gender and that busy faculty can find time to work with each other to develop interdisciplinary courses—and enjoy the process.
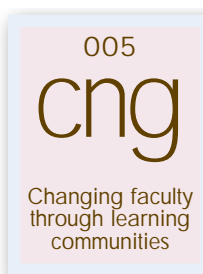
Most sites tried to get student assessments of new courses and modules. At Bates College, four focus groups were conducted to learn more about student experiences in introductory science courses. *Both male and female students said they didn't get enough feedback on exams, women felt more intimidated than men did in large classes, women were more interested than men in having courses demonstrate practical applications of science in their lives, and more women than men failed to see the connection between labs and class content.*

To help faculty in their work, the project developed a national advisory board, two national conferences on curriculum and pedagogical development, a newsletter filled with curricular examples and resources, a moderated e-mail discussion list, and annotated bibliographies. As follow-up to an initial conference, participants communicated with each other through the project listserv (SCI-LIT), problem solving and sharing resources. Each of the 10 participating institutions was encouraged to set up a campus-based listserv.

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cng
Changing faculty through learning communities

CHANGING FACULTY THROUGH LEARNING COMMUNITIES

THE DWIGHT LOOK COLLEGE OF ENGINEERING AND THE COLLEGE OF SCIENCE AT TEXAS A&M ARE USING LEARNING COMMUNITIES TO CHANGE EACH FACULTY MEMBER'S KNOWLEDGE, PERSONAL VISION, COMMITMENT, AND INTERACTIONS WITH STUDENTS. THE FACULTY IS THE MOST CRITICAL INGREDIENT IN LEARNING ENVIRONMENTS ON UNIVERSITY CAMPUSES, *AND DEVELOPING MORE LEARNER-CENTERED EDUCATIONAL ENVIRONMENTS REQUIRES HELPING FACULTY DEVELOP THE FRAMES OF MIND AND INTERPERSONAL SKILLS ESSENTIAL TO A GOOD LEARNING ENVIRONMENT.*

Changing how women are treated, how the classroom is managed, how classes are taught, and how graduate students are mentored depends on the cumulative efforts of many faculty members.

To create more inviting and welcoming learning environments, it is not enough to bombard faculty members with messages such as "Be inviting!" or "Be welcoming!" Instead, it is important to identify how the faculty needs to change, to nurture those changes in all faculty members, and to convince all faculty members that they must practice new ways of teaching to create a welcoming learning environment.

As faculty members develop a stronger personal vision, work to realize that vision, invite students' intellectual development, and articulate the mental models they want students to master, the project should observe changes in attitudes about learning, teaching, and the role of women and minorities in STEM. The project should also see more faculty participating in project-sponsored workshops and faculty learning communities and should see more women enrolled and retained in both undergraduate and graduate studies in physical sciences and engineering.

005
eng
Making engineering more attractive as a career

MAKING ENGINEERING MORE ATTRACTIVE AS A CAREER

THE ENGINEERING INDUSTRY MUST RECOGNIZE DIVERSITY AS A PRODUCTIVITY ISSUE, CONCLUDED A CONFERENCE HELD IN 1998—NOT JUST FOR EQUITY'S SAKE, BUT TO IMPROVE PRODUCTIVITY AND PROFITABILITY AND TO BETTER REFLECT IDEAS AND PERSPECTIVES IN THE MARKETPLACE. CONFERENCE PARTICIPANTS GENERALLY AGREED THAT WOMEN'S *COMPETENCE AS ENGINEERS IS NO LONGER BEING QUESTIONED*—THAT IT IS TIME TO ADDRESS *WHY ENGINEERING-RELATED LEARNING- AND WORKPLACES ARE NOT ATTRACTIVE TO WOMEN AS THEY ARE CURRENTLY ORGANIZED AND MANAGED.* CONFERENCE FINDINGS WERE SUMMARIZED IN TERMS OF ROOT CAUSES AND BEST PRACTICES.

Low expectations for women. *Culturally based values and understandings that affect men and women from infancy on perpetuate certain beliefs: that men are smarter, more committed, and harder workers, and "belong" more in the workplace, and that mathematical talent—the basis for all science and technical fields—is more innate than learned and is gendered (a belief common in the United States but not everywhere). Cultural values shape and can inhibit girls' and women's beliefs in their own ability and their behaviors when confronted with discriminatory practices and with sexual harassment.* Even when women themselves do not recognize discrimination's presence, it marginalizes and demoralizes them.

Except for Howard University, universities lag behind industry in mandating diversity as a goal. Best practices: Organizational leaders must value—not just tolerate—inclusive practices and a diverse labor force. Leaders must see themselves as teachers and active participants in change. Management must understand and address the gender inequity embedded in standard institutional practices and must act on that understanding with rigorous evaluation, discussion, and action plans.

Unreconciled demands of the workplace and family life. The inability to balance work, family life, and community services causes many women to leave engineering, but growing demands in the workplace and at home are also a problem for men. *Industry has taken the lead on developing policies and procedures to address these issues. Universities lag behind. Best practices—such as telecommuting, flex time, rewards for time spent in community*

service, and clock stoppage (stopping the "tenure" clock for family and other responsibilities and extending the probationary period)—should be incorporated into university practices.

A disjointed pipeline. The academy and industry have not coordinated efforts to attract girls into the engineering curriculum and women into the profession. Many excellent programs have not yet been exported. Industry looks to academe to provide solutions, especially in pre-college areas. *Best practices: Develop a shared, holistic understanding of how education and work reinforce each other and how both must be reformulated to develop the skills and attitudes needed to succeed in school and work.*

A silent profession. *The public does not understand, and the media misrepresent, engineering as a profession and the role engineers play in society.* Many young people don't know what scientists, engineers, and other technical workers really do, the problems they address, or the creativity and uncertainty involved in their work.

Best practices: Develop and promote the image of engineering as a broadly applicable, socially conscious, people oriented, and high paying career—through pre-college programming, public relations efforts, and day-to-day interactions with people outside the profession. Educate editors, publishers, producers, reporters, and media researchers about engineering's role in the world and the distinctions between engineering and science disciplines.

A communication gap between sectors. Many universities have developed strong theoretical and research-based models of root causes for failure to recruit and retain women in engineering, and strong support programs, but much of this information has not breached the walls of industry or is considered irrelevant. At the same time, academics typically don't share the pragmatic mentality of their colleagues in industry.

At the conference, industry participants were amazed at how much time it takes to make a change in academia, while university participants were surprised at industry's lack of access to the "standard literature" and to common knowledge about gender socialization, education, and work bias. Both groups were unaware of how each approaches the problems of underrepresentation. *Best practices.* Form alliances between industry and academia and develop a common language and set of assumptions among engineering employers, educators, and researchers. Lack of a common language means that mutual problems are too often left unexplored and transferable solutions are left unexploited.

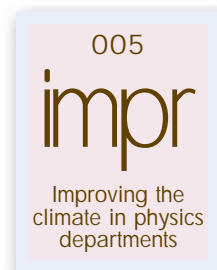**IMPROVING THE CLIMATE IN PHYSICS DEPARTMENTS**

TEAMS OF WELL-RECOGNIZED WOMEN PHYSICISTS CARRIED OUT SITE VISITS TO PHYSICS DEPARTMENTS IN 12 PUBLIC AND PRIVATE RESEARCH UNIVERSITIES TO IDENTIFY PROBLEMS COMMONLY EXPERIENCED BY WOMEN FACULTY AND STUDENTS, TO RECOMMEND INTERVENTIONS FOR COMMON PROBLEMS, AND TO ADDRESS OR SUGGEST SOLUTIONS TO PROBLEMS SPECIFIC TO THE DEPARTMENTS VISITED.

005

impr

Improving the climate in physics departments

The visits showed that *the climate for women in physics departments— ranging from welcoming to hostile, but often "chilly"— varies greatly from one institution to another.* The study found that *as the proportion of female physics faculty and students increases, the climate generally improves.*

Female faculty and students faced a number of hurdles. In a few departments, teams learned about cases of sexual harassment; in others, senior women on the faculty had become isolated from important decision-making. But the most common problems came from an accumulation of "small indignities" (such as demeaning comments, requests to take on secretarial duties, and exclusion from departmental social activities) that erode self-confidence and self-esteem.

Since most of the departments visited had one or at most two women on the faculty, female students lacked role models, so teams often recommended hiring additional women faculty. Other team suggestions included better communication between women and the department chair, efforts to develop a stronger sense of community within the department (one more welcoming to women), and including more women

as colloquium speakers—to serve as role models and give students advice on such issues as how to combine family and career.

Some issues related to the department climate were not gender-specific: *poor teaching, poor mentoring, the autocratic attitudes of departmental chairs and senior professors, and the faculty's inattention to and lack of respect for physics students.* Many students felt their faculty mentors were neither well informed nor sufficiently helpful about their own students' career development.

Each team provided a written report to the physics department visited with specific suggestions. Six-month follow-up reports from the departments showed that many of the suggestions had been adopted. A later poll showed that many departments had hired new female faculty members and made other major reforms. In most cases, the climate for women had improved considerably.

The principal investigators concluded in 1994 that to *improve the climate in physics departments, the faculty must be genuinely concerned about providing a welcoming and supportive environment for their colleagues and students. Constructive attitudes, a caring approach, open communication channels, and goodwill can go a long way toward creating successful students and faculty members—both male and female.*

In another part of the project, the American Institute of Physics (AIP) conducted a national survey of undergraduate and graduate physics students to learn how male and female students rated the environment of their physics departments. AIP's 1993 report concluded that there *were very few gender differences in the responses from undergraduates. At the graduate level, only a third of the graduate students rated their department as encouraging self-confidence. More males than females reported good collegial relationships with their advisers. Compared with U.S. males, proportionately fewer non-U.S. males and U.S. females reported that their advisers treated them like colleagues.*

The site-visit program is still active. Visits have been made to 24 colleges and universities, with one return visit after a 10-year interval. As more women enter the field of physics, the climate for women should continue to improve.

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phy

Why do some physics departments have more women majors?

WHY DO SOME PHYSICS DEPARTMENTS HAVE MORE WOMEN MAJORS?
IN 1998, WOMEN EARNED MORE THAN HALF THE BACHELOR'S DEGREES AWARDED IN THE LIFE SCIENCES, 40 PERCENT OF THOSE GRANTED IN MATHEMATICS, BUT ONLY 19 PERCENT OF THOSE AWARDED IN PHYSICS. THAT 19 PERCENT IS DOUBLE WHAT IT WAS 25 YEARS AGO, BUT PHYSICS STILL LAGS BEHIND THE OTHER SCIENCES IN ATTRACTING WOMEN TO THE FIELD AND KEEPING THEM THERE.

Despite several national initiatives and many informal and formal departmental efforts to draw more women and other underrepresented groups into physics, in some schools as many as 40 percent of the physics majors are women and in others the proportion is well below the national average.

To learn what works in attracting and retaining women as undergraduate majors in physics, a team at Colorado College is studying 10 undergraduate physics departments with average to heavy participation by women. The schools selected—both public and private—offer a bachelor's degree in physics but no graduate degrees. At least two of them are historically black.

The project's goals are to

• Study some of what the physics community has tried, to learn what works to get more women majoring in physics

• Investigate the unusual success some primarily undergraduate institutions have had in cultivating women physics majors

• Identify common errors in programs and practices that could be corrected if they were recognized and understood

• See whether and how innovations in physics teaching have improved the climate for women

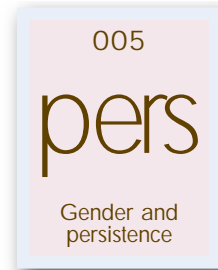• Communicate project results back to the physics community

The study team—two physics professors, one social science professor, and one student assistant—are collecting demographic information about the faculty and students in each department. In a two-day site visit to each department they will visit classes and labs and interview students, faculty, and administrators. They will investigate the departmental climate, the quality of teaching and advising, the style of classes, and other factors that have been said to make some physics departments more comfortable for women. Departments in which women's participation is high will be compared with those in which it is average, to determine what works to keep participation high. Results of the study will be published in a peer-reviewed journal and publicized in talks, journal articles, and on the Web, in hopes that the physics community will evaluate and improve its efforts to draw women into the field.

GENDER AND PERSISTENCE

THIS STUDY EXAMINED THE RELATIONSHIP BETWEEN GENDER AND PERSISTENCE, WITH ATTENTION TO STUDENTS' IMAGES OF SCIENTISTS AND ENGINEERS, THEIR ATTITUDES TOWARD GENDER EQUITY, AND THEIR PERCEPTIONS OF THE CLASSROOM CLIMATE FOR DIVERSITY. IT LOOKED AT THREE DIFFERENT MEASURES OF STUDENTS' PERSISTENCE: STUDENTS' INTENTION TO STAY IN THEIR MAJOR, TO GO ON FOR A GRADUATE DEGREE, AND TO HAVE A LONG-TERM CAREER IN SCIENCE OR ENGINEERING.

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pers

Gender and persistence

Athough there is a significant relationship between gender and persistence—with women being less likely to say they intend to persist—the reasons for this are unclear and depend on the kind of persistence being measured. The relationship disappeared when the study considered the students' images of scientists and engineers. *Those who had positive images of scientists and engineers were more likely to say they would persist, whether they were men or women. Positive attitudes toward gender and racial equality as well as positive classroom experiences also improved the odds of students having high degree aspirations.*

And *when they controlled for field of study, gender was no longer related to any of the three measures of persistence. Students' intentions to stay in their major were related to their attitudes toward gender equity and to their field (biology or engineering, in this study), but not to their gender. Students' intentions to get a graduate degree were related to their images of scientists and engineers and their field, but not to gender.* In other words, for students in this study, several components of persistence were statistically significant beyond a simple relationship between gender and persistence.
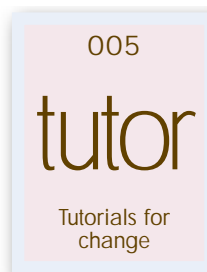
Knowing this fruitfully complicates our understanding of why women are underrepresented in science and engineering and points toward more specific ways of promoting women's participation. Intervention programs may need to differ depending on both the targeted field and the level (majors, graduate study, careers).

Programs to increase the percentage of women among *tenure-track engineering faculty* may differ significantly from programs to increase the percentage of women among *tenure-track biology faculty*. *Engineering majors can get well-paying jobs in the private sector with only an undergraduate degree, but in biology graduate and postdoctoral study are needed to get well-paying jobs in the private sector.* Many contemporary programs—and research projects—are not designed to consider how different fields of study require differing length of training and career structures for professional practice.

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tutor
Tutorials for change

TUTORIALS FOR CHANGE

THIS PROJECT WILL PRODUCE ONLINE TUTORIALS DIGESTING RESEARCH ON GENDER'S ROLE IN STEM CAREERS. SUCH TUTORIALS DO NOT CURRENTLY EXIST. SCIENCE-BASED INFORMATION ABOUT INADVERTENT BIAS IN EVALUATIONS OF MEN AND WOMEN IS AVAILABLE IN TECHNICAL SOURCES BUT IS UNKNOWN TO MOST STUDENTS AND EDUCATORS. THIS PROJECT WILL PRODUCE A SUITE OF 15-MINUTE TUTORIALS THAT CAN BE INCORPORATED INTO WORKSHOPS, BRIEFINGS, CLASSROOM DISCUSSIONS, WEBSITES, AND ONLINE COURSES AIMED AT THOSE STUDYING WOMEN'S UNDERREPRESENTATION IN STEM. THE CONTENT, DRAWING ON MANY RESEARCH FINDINGS AND RESULTS, WILL REPRESENT A SUBSTANTIAL (AND ACCESSIBLE) COMPLEMENT TO THE MANY BRIEFINGS AND REPORTS THAT SUMMARIZE MAINLY STATISTICS.

Virginia Valian is uniquely qualified to prepare the tutorials, as the author of *Why So Slow?*, a thoroughly researched and persuasive explanation of women's slow advancement in the professions. A cognitive psychologist who has developed new courses on gender, Valian is a popular presenter on the topic. She has already developed a website for prospective graduate students in Hunter College's master's program in psychology.

The tutorials will be developed as PowerPoint slides with voiceover narration and annotated bibliographies. They will be mounted on Hunter's server, available to anyone with access to the Web. Each will include a questionnaire for site visitors to fill out (voluntarily), an opportunity to e-mail Valian queries and comments, and questions and answers drawn from those e-mailed messages.

CODE: U, PD	HUNTER COLLEGE, CITY UNIVERSITY OF NEW YORK (CUNY)
VIRGINIA V. VALIAN (VVVHC@CUNYVM.CUNY.EDU)	
HRD 01-20465 (ONE-YEAR GRANT)	
KEYWORDS: DISSEMINATION, ONLINE TUTORIALS, GENDER EQUITY AWARENESS, BIBLIOGRAPHY, RESEARCH FINDINGS, CAREER AWARENESS, QUESTIONNAIRE	

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@risk
Preparing at-risk undergraduates for graduate school

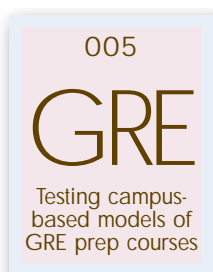## PREPARING AT-RISK UNDERGRADUATES FOR GRADUATE SCHOOL

IN 1989 BAYLOR COLLEGE OF MEDICINE CREATED SMART, A 10-WEEK SUMMER MEDICAL AND RESEARCH TRAINING PROGRAM THAT, EVERY YEAR SINCE, HAS GIVEN ASPIRING SCIENTISTS FIRSTHAND EXPERIENCE IN LAB SETTINGS AND OPPORTUNITIES TO ATTEND RESEARCH SEMINARS AND OTHER EDUCATIONAL ACTIVITIES. THROUGH BAYLOR'S GRADUATE SCHOOL OF BIOMEDICAL SCIENCES, UNDERGRADUATES FROM ALL OVER THE COUNTRY—MANY OF THEM WOMEN AND MINORITIES—GET A CHANCE TO LEARN ABOUT SUCH SUBJECTS AS BIOENGINEERING, BIOPHYSICS, AND COMPUTATIONAL BIOLOGY.

In 1996, an NSF grant funded this add-on to SMART, a model project providing additional experiences and opportunities for eleven women (seven from minorities). The participants were all undergraduates in Houston colleges, candidates for doctoral studies who were considered at risk—earning C's in science courses or taking fewer science courses than normal. Participants did lab research (10 of them with female mentors) on projects that ranged from analyzing mouse embryos to measuring stress on muscle fibers. They could attend a daily seminar series and talks on such basics as how to apply to graduate school. During the school year they could keep working in a lab and could attend the national AAAS meeting.

The project also developed a SMART prep course for the Graduate Record Exam (GRE). The study section had decided to eliminate funding to send the women to a commercial prep course, so the project leaders developed a course themselves. They analyzed commercial materials, selected the most effective parts from different resources, and created skills workshops targeted at different areas of the GRE. *After investing 40 to 60 hours in the pilot prep course, 10 women raised their scores from 30 to 50 percentile points.* The mean increase was 371 points, with a median of 420. Seven of the 10, some with scores as low as the 20th percentile, raised their analytical scores to above the 90th percentile. Five participants got official GRE scores consistent with or better than their scores on their final practice exam.

The most important effect of the SMART GRE Prep Course was to increase the participants' confidence. Two of the women have entered graduate programs and two have entered law school. The Prep Course has been continued through funding from an NIH Initiative for Minority Student Development. And *now that Baylor College of Medicine realizes that the skills tested on the GRE can be taught, it places less weight on GRE scores in admissions decisions.*

CODES: U, PD	BAYLOR COLLEGE OF MEDICINE
GAYLE SLAUGHTER (GAYLES@BCM.TMC.EDU)	
www.bcm.tmc.edu/smart	HRD 96-31519 (ONE-YEAR GRANT)
PARTNERS: RICE UNIVERSITY, TEXAS SOUTHERN UNIVERSITY, UNIVERSITY OF HOUSTON	
PRODUCT: SMART GRE PREP COURSE	
KEYWORDS: DEMONSTRATION, RESEARCH EXPERIENCE, SEMINARS, GRE PREP COURSE, CONFERENCES, SELF-CONFIDENCE	

005
GRE
Testing campus-based models of GRE prep courses

TESTING CAMPUS-BASED MODELS OF GRE PREP COURSES
BAYLOR COLLEGE OF MEDICINE, WHICH DEVELOPED THE SMART GRE PREP COURSE UNDER A PREVIOUS NSF GRANT, IS LEADING THIS EFFORT TO IMPROVE, TEST, AND EVALUATE COURSES TO PREPARE STEM MAJORS AT FIVE WOMEN'S COLLEGES FOR THE GRADUATE RECORD EXAM. USING MATERIAL FROM THE SMART COURSE, THE FIVE SITES WILL PROVIDE NEW MATERIALS AND APPROACHES TO TESTING THE COURSE IN VARIOUS CONTEXTS.

All partner institutions have a copy of the draft guidebook for the SMART GRE prep course. The project is analyzing the skills tested on each GRE question answered by the students, to develop tools for analyzing their strengths and weaknesses and preparing individualized study plans for the GRE exam. It is developing verbal exercises for students with scores below 400 on the verbal section of the GRE, and female-friendly logic problems, portraying women and minorities in leadership roles.

Data from preliminary regression analysis suggest a strong positive correlation between a student's undergraduate grade point average (GPA) and her GRE score on both an initial and final diagnostic exam.
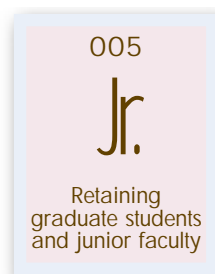
Regression analysis revealed no correlation after the prep course, which suggests *that the course will help all students, regardless of incoming GPA, improve their GRE scores.*

CODE: U, PD	BAYLOR COLLEGE OF MEDICINE
GAYLE SLAUGHTER (GAYLES@BCM.TMC.EDU)	
HRD 00-80662 (THREE-YEAR GRANT) AND 99-06394 (PLANNING GRANT)	
PARTNERS: MOUNT ST. MARY'S COLLEGE, SPELMAN COLLEGE, TEXAS WOMAN'S UNIVERSITY, WELLESLEY COLLEGE, AND WESLEYAN COLLEGE	
PRODUCT: DRAFT 175-PAGE GUIDEBOOK FOR DEVELOPING AND CONDUCTING GRE PREP COURSES	
KEYWORDS: DEMONSTRATION, GRE PREP COURSE, EVALUATION, MANUAL , RESEARCH STUDY	

RETAINING GRADUATE STUDENTS AND JUNIOR FACULTY
FEW INTERVENTIONS TO SUPPORT AND RETAIN WOMEN IN SCIENCE AND ENGINEERING HAVE TARGETED GRADUATE STUDENTS AND JUNIOR FACULTY, DESPITE SIGNIFICANTLY HIGHER ATTRITION RATES FOR FEMALE DOCTORAL STUDENTS THAN FOR MALE CANDIDATES AND DESPITE THE PERSISTENTLY LOW NUMBER OF WOMEN ON STEM FACULTIES. MOREOVER, NO INTERVENTIONS AIMED AT SUPPORTING WOMEN GRADUATE STUDENTS IN STEM FIELDS HAVE BEEN DESIGNED BY WOMEN WITH DOCTORATES—AN IMPORTANT FLAW, AS MIT'S 1999 STUDY FOUND THAT DISCRIMINATION "*DID NOT LOOK LIKE WHAT WE THOUGHT DISCRIMINATION LOOKED LIKE.*"

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Jr.
Retaining graduate students and junior faculty

The women's studies program at Iowa State University hosted a conference *on The Retention of Women Graduate Students and Early Career Academics in Science, Mathematics, Engineering, and Technology* in October 2002. This regional conference brought together scientists and women's studies scholars—two groups that seldom interact yet have much to learn from each other. The conference explored feminist science studies (the interaction between women's studies and science fields), feminist critiques of science, and the experiences of women graduate students and faculty in science fields.
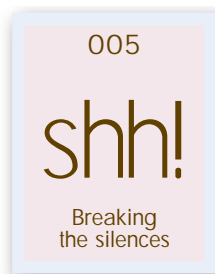
Papers were invited on

- Rethinking strategies for retention of women graduate students and junior faculty in science and engineering
- Re-evaluating the work done in scientific fields (publishing, negotiating the workload, classroom climate, grants, fellowships, postdoctorates, salaries, promotions, and support)
- Transforming the culture and organization of science
- Understanding and changing the structure of higher education
- Issues for underrepresented groups of graduate students and faculty women in science (especially women of color, international women, and women with disabilities)

Five to seven people from about 20 Midwestern land-grant colleges and universities were invited to participate—women's studies faculty, women doing research on women in STEM fields, and faculty and graduate students in science and engineering. These teams exchanged relevant research findings on the barriers to graduate and faculty women's full participation in science and engineering and collaborated on developing potential reten-

tion strategies for their universities. Each team was expected to construct a plan of action for its own institution, to implement it in the months after the conference, and to report on it at a follow-up forum a year later. Conference proceedings and follow-up activity are being disseminated on the Web and in print.

005

shh!

Breaking
the silences

BREAKING THE SILENCES

SCIENCE OFTEN OPERATES UNDER UNACKNOWLEDGED RULES, NORMS, AND EXPECTATIONS. AND THE INTENSE POWER IN FACULTY–STUDENT RELATIONS CAN LAST WELL BEYOND GRADUATE SCHOOL. MANY GRADUATE WOMEN ARE KEENLY AWARE OF, AND ARTICULATE ABOUT, THE CULTURE AND INSTITUTIONAL PRACTICES OF SCIENCE BUT ARE RELUCTANT TO SPEAK UP ABOUT THEM. THIS FACULTY–STUDENT RESEARCH AND ACTION PROJECT AT THE UNIVERSITY OF ARIZONA WAS DESIGNED TO BREAK THOSE SILENCES.

One of their first discoveries was that *graduate education is structured less around the classroom than around a protégé–master model*. In this one-to-one model, interpersonal communication and relationships are central, and social markers of gender, class, ethnicity, and sexuality are ubiquitous—but talking about interpersonal communication, relationships, and social markers is forbidden.

They came to realize that graduate education is unique, with a "student" clearly subordinate to the faculty and in search of training from them, yet leaving school as a "colleague" to the very same faculty. Undergraduates learn about science and might even learn how to do experiments and interpret data, but graduate students learn how to "be" a "scientist." For this, they must learn to present themselves as credible professionals—network, design and carry out research projects, choose interesting and productive research topics, give talks, discuss science with colleagues, procure grants, publish results, recruit and motivate good students. So *what began as a study of women's experiences in*

graduate education became a look at scientists as knowledge-makers, who value *not* talking about and *not* recognizing the social world they create, maintain, and reproduce. *How does this culture function? How does it reinscribe particular notions of gender, race, and class with the next generation of aspiring scientists*?

Phase I, an institutional analysis, used questionnaires and interviews to determine how gender dynamics are "operationalized" in graduate education and what roles are played by male and female graduate students, post-docs, faculty, and department heads. Who determines the shaping of everyday science? The running of labs? The research questions asked? The methodologies employed? How do the power dynamics shape the participation of the different groups and in what ways?

Phase II featured a facilitated conversation between 20 faculty and 20 female graduate students about the strengths and limitations of graduate education for women, with an emphasis on gender issues. Four departments (math, chemistry, molecular and cellular biology, and

ecology and evolutionary biology) were chosen because they had supportive chairs and represented different forms of research. *It was important to the success of this part of the project—especially to student frankness—that students and faculty communicated through the facilitators and that participants' identities remained anonymous to the other group.* In a framework developed by Mary Wyer at Duke, two facilitators met separately with two faculty groups and two student groups in 20 two-hour sessions.

Student experiences varied somewhat (often shaped by lab groups and departments) but *students were astonished at how similar some experiences were across departments*. Persistent student issues were the lack of, and the need for, greater communication between faculty and students. There was departmental variation but *on the whole students felt there were not enough occasions for faculty–student interactions. Overall, they did not believe faculty cared.*

Faculty viewed their relationships with their students as particular and idiosyncratic. Anecdotes students offered as symptomatic of larger currents in graduate education were usually said by faculty to reflect problems of individuals. Students tended to view becoming a scientist or mathematician as a particular, constructed, and sometimes arbitrary process. They were interested in challenging and reinterpreting who could be a good scientist. Faculty tended to see the process as natural, involving the growth and maturation of something already inside the students in incipient form—a growth on which they had only limited influence. Their understanding of what happens often left little room for criticism in the sense that it emphasized a "stay if you fit in, leave if you don't" perspective. To faculty, a student should be able to tell that s/he is "cut out to be a scientist" if graduate education seemed to come easy, be reasonable and rational. If not, the student was not meant to be a scientist.

Powerful insights came from an exercise in which each group was invited to name the unwritten rules governing graduate education. Students developed an extensive set of rules that demonstrated their commitment to being "good" and competent scientists—for example, don't complain, even about real problems; don't have a personal life; pretend to be like your adviser; being a woman is a liability; you don't have input, even on decisions that affect graduate school (even when asked); don't exhibit "feminine" behaviors.

Students questioned the necessity and efficacy of many of these rules. Why must you work all the time? Why are research positions seen as a more "valuable" career track than teaching positions? Why are certain behaviors not allowed? Why is scientific culture silent on issues of gender? Why can you not have a personal life? Students consistently challenged the lists of rules and through that critiqued the scientific culture's prototype of the ideal "scientist." *The students were willing to follow rules to do science; what they challenged was whether all of the rules defined by contemporary scientific culture produced good science—or, more important, whether not following those rules always produced bad science*. They saw phase III as a place to envision a different scientific culture, one not hostile to their identities as women, one structured to create imaginative, empowered, and productive graduate student experiences.
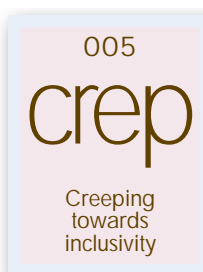
In phase III, a subset of the faculty and students came together for an extremely successful open dialogue, aimed at re-envisioning graduate education, which highlighted the importance of communication as a way of clearing each group's misperceptions of the other. Demonstrating that faculty and students could develop an open, honest, and constructive dialogue, this group developed constructive recommendations for change, posted at <http://w3.arizona.edu/~ws/science/nsf>.

This project personally transformed many of the participants, but translating the recommendations into institutional change and transforming others within their departments proved difficult—because not all members of each department participated in the whole experience. A one-hour seminar or forum that brings faculty and students together does not recreate the process. *To transform a department is extremely difficult because it requires breaking silences that have developed historically within the culture of science*. Change requires concentrated work within a few departments, involving a significant number of faculty and graduate students, and in some cases all faculty.

005
crep

Creeping
towards
inclusivity

CREEPING TOWARD INCLUSIVITY

A NEW YORK ACADEMY OF SCIENCES CONFERENCE ON WOMEN IN SCIENCE HELD IN 1972 SET FORTH GOALS FOR *ACCELERATING WOMEN'S SUCCESS IN SCIENCE.* A FOLLOW-UP CONFERENCE IN 1998 ASSESSED PROGRESS MADE AND RECOMMENDED WAYS TO ACCELERATE IT BASED ON RESEARCH AND "BEST PRACTICES" FOUND IN CORPORATE, GOVERNMENT, AND ACADEMIC INSTITUTIONS. *FOR ALL THEIR DIVERSITY, THE PARTICIPANTS AGREED THAT PROGRESS HAD BEEN MADE BUT HAD NOT GONE FAR OR FAST ENOUGH. AS NOBEL LAUREATE DUDLEY HERSHBACH PUT IT, "WE ARE CREEPING TOWARD INCLUSIVITY IN SCIENCE."*

More women are enrolling in science and engineering studies, for example, but they drop out at proportionately higher rates than men do. Self-interest, civil rights legislation, and competition for talented women have compelled measurable progress in government and the private sector but the *elite colleges and research universities have proven virtually impervious to change.* Science and society require the broad talent and wisdom that can be ensured only by increasing diversity in the workforce and workplace. And the shared perspective of the conference was that *diversity doesn't just happen; it must be abetted by substantive changes in the attitudes, policies, and practices that inform how we educate the workforce and how the science workplace is managed.*

Some problems and solutions might lie in the institution of science itself. Aggressive, competitive behavior may be an asset in academia, but *in industries that require increasingly complex teams seeing long-term projects through to fruition there will be more need to form collaborative relationships between departments and disciplines. Can the scientific community nurture and develop a sense of cooperation and collaboration in a culture of competition?*

The workplace needs more women scientists and technologists but *many women drop out because they find the workplace incompatible with their needs and priorities—the work itself based on male ways of doing science, with other styles denigrated as unscientific.* If higher salaries, increased prestige, elevated status, and more challenge are not what women value most, organizations hoping to attract women may have to design incentives women find rewarding, such as collaborative effort, a supportive workplace, quality of life, and a better "fit" between their professional and personal life.

Harvard University's Project Access reported differences between what men and women mean by "good science"—not so much in ways of thinking or methods of inquiry as in ways of behaving and of organizing scientific work. Science is a social system, and understanding these differences in social modes or styles is important in understanding the participation and performance of women and other underrepresented groups in science.

Inclusion has to do with economics, said Roberta Gutman (Motorola). The number of women vice presidents at Motorola had risen from two in 1989 to 43 in 1998, while Harvard's chemistry department had only one tenured woman on its faculty—and only 7 percent of the professionals in the 25 top-ranked university chemistry departments in the country were women.

Recruiting women is not enough, said Mary Mattis (Catalyst)—it's what you do with them when you get them. Representing the government, Beverly Hartline said it was little steps that would drive women's opportunities to higher levels. *To retain women and minority professionals, what makes a difference is collegiality, credit for contributions, supportive mentoring and recognition by peers and senior colleagues (regardless of gender), opportunities for advancement, visibility, and leadership, and a balance between career, family, and personal life.*

Women often delay publishing their research until they have the "whole picture," said Cynthia Friend, a Harvard chemistry professor, *so they tend to publish less often than men do, which reduces their chances for promotion and tenure.* She urged women to publish data that is "interesting" and provokes questions instead of waiting until they have all the answers.

Countering academic resistance to change are such support systems for early-career women scientists as the Clare Boothe Luce Program, which funds about 60 tenure-track positions at colleges and universities around the country. Another tactic for fostering change, said Lilian Shiao-Yen Wu (from IBM's Thomas J. Watson Research Center), could be to devise a system for ranking and rating academic institutions and departments for climate and policies on promoting women's retention and advancement.

That *progress for women scientists and engineers is slowest in academia* is a critical issue for the future of science, as many participants noted. *Women are opting out of a university system that they find oppressive, with ethics, values, styles, and behaviors incongruent with theirs, with funding and job constraints that prolong the time it takes to complete a doctorate or that relegate young scientists to underpaid and powerless postdoctoral positions.*

Women more than men are choosing to work outside the academy. It's no longer a matter of figuring out how women (and others who have been excluded) can be made to "adjust" to an alien environment. Participants at the conference envisioned a scientific enterprise inviting to everyone with the talent and desire to participate. *This is not a woman problem but a problem for science and engineering.* So long as women's talents and abilities are not fully used, our scientific and technical enterprises lose and our economy is diminished.

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Equity, science careers, and the changing economy

EQUITY, SCIENCE CAREERS, AND THE CHANGING ECONOMY

ACHIEVING EQUITY FOR WOMEN WILL REQUIRE FUNDAMENTAL CHANGE IN THE ORGANIZATION OF THE SCIENTIFIC WORKPLACE, CONCLUDED SPEAKERS AT A SYMPOSIUM RADCLIFFE'S PUBLIC POLICY INSTITUTE HELD IN 1995 ON *SCIENCE CAREERS, GENDER EQUITY, AND THE CHANGING ECONOMY.*

Even though women represented an increasing percentage of the American workforce, they remained underrepresented in the sciences. Scientific careers remained synchronized to traditional work patterns, making it difficult for women responsible for childcare or eldercare to pursue careers in science. And for girls and women (especially women of color), there were far too few female models of success in science.

Meanwhile, *although the annual number of science engineering doctorates had increased about 40 percent over 20 years, the likelihood of pursuing traditional research careers at major universities had been declining.* Science and engineering students who wanted academic positions, faced with reduced prospects for careers in research universities, were frustrated and disappointed, especially in the field of physics. Clearly *graduate education should be reshaped to reflect the reduced likelihood of finding positions in university research.*

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Balancing the equation

BALANCING THE EQUATION

ALTHOUGH WOMEN HAVE MADE SIGNIFICANT HEADWAY IN SUCH DISCIPLINES AS LAW AND MEDICINE, THEIR ADVANCES IN MORE TECHNICAL FIELDS HAVE STAGNATED— EVEN ERODED—IN RECENT YEARS, ACCORDING TO "BALANCING THE EQUATION: WHERE ARE WOMEN AND GIRLS IN SCIENCE, ENGINEERING, AND TECHNOLOGY?"
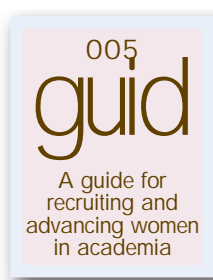
This publication from the National Council for Research on Women (NCRW) reports, for example, that there has been a marked decline in women's participation in college-level computer sciences—from 37 percent of undergraduate degrees in 1984 to fewer than 20 percent in 1999. And while women made up 46 percent of the workforce in 1996, they held only 12 percent of the science and engineering jobs in the nation's businesses.

There would be no shortage of scientists and engineers in this country if women and minorities were encouraged to move into this part of the workforce. Change is possible, but complex. NCRW's report recommends that colleges and universities *design curricula that take an interdisciplinary approach to learning and demonstrate the real-world relevance of coursework, since both approaches have been shown to boost female enrollment and*

retention. It recommends that institutions *do away with "gatekeeping" courses intended to weed students out of computing, physics, and engineering and replace them with courses that invite students into those disciplines. Programs shown to improve women's enrollment and retention, notes the report, also generally benefit their male* counterparts. What's good for women and girls is good for men and boys, and does not help one gender at the expense of the other.

NCRW is a working coalition of 77 U.S. research centers with connections to more than 1,500 organizations and networks worldwide concerned with improving the status of women and girls. This report was initially to be a special edition of *Issues Quarterly* (IQ), a publication NCRW launched in 1994.

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A guide for recruiting and advancing women in academia

A GUIDE FOR RECRUITING AND ADVANCING WOMEN IN ACADEMIA
THE COMMITTEE ON WOMEN IN SCIENCE AND ENGINEERING (CWSE), NATIONAL RESEARCH COUNCIL, OF THE NATIONAL ACADEMY OF SCIENCES, HAS RESEARCHED THE BEST POLICIES AND PROGRAMS ACADEMIC INSTITUTIONS HAVE IMPLEMENTED TO RECRUIT, RETAIN, AND ADVANCE WOMEN IN SCIENCE AND ENGINEERING IN ACADEMIA. THE GUIDE IS A PRACTICAL TOOL FOR REPLICATING SUCCESSFUL PROGRAMS AT OTHER ACADEMIC INSTITUTIONS.

CWSE used formal and informal networks to identify the most successful programs for each level: recruiting undergraduates; reducing attrition during freshman and sophomore years; recruiting, retaining, and advancing graduate students; and encouraging the transition to postdoctoral fellowships. The guide was prepared for college and university presidents, deans, provosts, and other administration officials, department chairs, faculty, and others who want to draw more women into science and engineering.

The committee got in touch with granting organizations, disciplinary societies, academic administration societies, faculty groups, and nonprofit advocacy organizations. It reviewed programs from public and private organizations of all sizes.
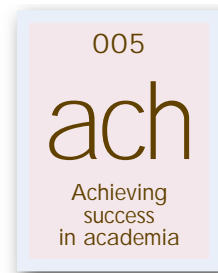
Programs were asked to provide data on how much women's participation increased as a result of their programs. Once it identified the most successful programs, the committee made site visits to interview students, faculty, and administrators involved in those programs—to learn what they did and how they did it. In describing effective practices, the guide identifies no institution by name.

The Academy has disseminated tens of thousands of previous NAS guides worldwide. *On Being a Scientist* (a guide to science ethics) has been reprinted in several languages. The committee' guide was modeled on the NAS guide to mentoring (*Advisor, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering*), on which many faculty mentoring programs are based.

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Achieving
success
in academia

ACHIEVING SUCCESS IN ACADEMIA

HOW MANY WOMEN TEACH ENGINEERING COURSES? HOW MANY TEACHING ASSISTANTS ARE WOMEN? VERY FEW, AND IN SOME MAJORS AND INSTITUTIONS, NONE. YET RESEARCH INDICATES THAT UNDERGRADUATES BENEFIT SIGNIFICANTLY FROM FEMALE MENTORS. TO BEGIN TO ADDRESS THIS PROBLEM, THE WOMEN IN ENGINEERING PROGRAMS & ADVOCATES NETWORK (WEPAN) HELD AN ENERGIZING, THOUGHT-PROVOKING THREE-DAY SEMINAR AND E-MAIL DISCUSSION GROUP ON "ACHIEVING SUCCESS IN ACADEMIA," WITH A FOCUS ON NAVIGATING THE TENURE TRACK.

In June 1997, 34 nontenured tenure-track faculty and 28 graduate students pursuing careers in academia—nearly a quarter of them women of color—came to the Crystal City Marriott in Arlington, Va., from 29 U.S. institutions to learn how to succeed in academia from deans, tenured faculty, and other experts. Participants valued the rare opportunity to interact and form networks with other women—colleagues or mentors. "What an incredible experience it is to be in a room with 62 other female engineering faculty and Ph.D. students" said one of them.

Difficulties women face in pursuing a graduate degree or tenure include *being accepted and mentored by senior male colleagues and balancing work and family. Conference participants concurred that to succeed, it is imperative to develop relationships with effective mentors, advisers, and colleagues, to become knowledgeable about the politics of your institution, to have a support system, and to work hard.* Do all that and you can overcome the challenges of being a woman in a traditionally male field and have a rewarding and diverse career. But to increase technical women's clout in academia, it is important to get more women on the faculties of engineering departments.

On a scale of 1 to 5, participants rated the conference 4.6 overall (very effective). Most highly rated were talks on navigating the tenure track, strengthening research grant proposals (private and federal), and dealing with tough times. (Some said more specifics on negotiating start-up packages, balancing teaching and research, managing graduate students and teaching assistants, and handling problems with students—such as slacking and cheating—would have been helpful.)

Judging from evaluation responses, participants valued speakers who frankly shared their personal experiences, speakers who reaffirmed that the road may be hard but is drivable, and speakers who believe women can write the book rather than read the old one. They welcomed the shift in tone halfway through from a rather negative picture of the field to a much more positive tone. They liked a balance between networking opportunities and professional/personal presentations. They liked getting some perspective on their careers, hearing new tips and strategies for achieving success, learning what to ask for and how to maneuver the system effectively. They wanted to know what issues their peers were facing. And they wanted clear handouts.

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Collaborating across campuses

COLLABORATING ACROSS CAMPUSES

THE COMMITTEE ON INSTITUTIONAL COOPERATION'S WOMEN IN SCIENCE AND ENGINEERING (CIC WISE) INITIATIVE ADDRESSED THE GOAL OF ACHIEVING GENDER EQUITY IN STEM ON 15 PARTICIPATING CAMPUSES BY ENLARGING THE POOL OF UNDERGRADUATE WOMEN PURSUING GRADUATE STUDIES IN STEM (PARTLY BY PROVIDING THEM WITH STRONG ROLE MODELS), BY INCREASING THE NUMBER OF WOMEN WHO PURSUE FACULTY CAREERS AND WHO ADVANCE THROUGH THE FACULTY RANKS, AND BY IMPROVING THE EDUCATIONAL CLIMATE FOR ALL WOMEN IN SCIENCE, ENGINEERING, AND MATHEMATICS.

Over three years, 553 STEM women and men participated in three student leadership conferences designed to help women develop the leadership and survival skills needed to succeed in academic environments. Participants reported gaining confidence, a sense of community, useful strategies, and the motivation to pursue their academic goals.

More than 200 faculty members and professional administrators attended "Best Practices" professional development workshops designed to help participants identify, adapt, and institutionalize best practices for recruiting, retaining, and advancing women in STEM. The emphasis was on how to transfer a successful project to a new institution and on how to provide the sustained support needed to fully implement the project on a new campus. Information about program content, climate, management, infrastructure, finances, and assessment was provided in enough detail so that attendees could adapt these programs on their own campuses. Workshops addressed classroom climate, undergraduate research and living/learning programs, mentoring, and staff development in WISE offices and provided vital networking opportunities across campuses. Most survey respondents reported taking action on return to campus by communicating ideas, initiating new programs, or expanding old ones. Some lacked authority to do so, and many reported that WISE-related work was just beginning on their campuses.

Travel grants of $250 from the CIC (matched by the institutions) were awarded to 412 students (20 percent of applicants) to help them present research findings at scientific conferences. *Presenting posters and papers at professional conferences is important to professional socialization in STEM disciplines but the cost of attending such meetings often prevents students from participating.* Travel grant recipients reported gaining confidence, exposure, and expanded networks. For some, it led to publication or to postdoctorate or faculty positions. *Women need to be visible at all major scientific conferences, both to benefit individually and to help erode stereotypes,* said many grant recipients.

There is strong evidence that all three activities of the CIC WISE initiative benefit both individuals and (most) institutions. How much the initiative affects a campus depends on the extent to which participants return to implement programs (the multiplier effect) and the institution's capacity to support the growth of WISE activities. Even low levels of participation can reap big returns in a "fertile" institution, whereas individuals returning to "arid" institutions rarely increase campus capacity. Progress toward institutionalizing WISE differs at various CIC institutions. Four participating campuses seem to be operating on a stable footing, and most are working toward institutionalization. Three have shown only minimal progress.

The CIC WISE panel coordinated activities across the CIC and promoted efforts on individual campuses. Conducting these activities through a consortium of similar institutions made them more effective, visible, credible, and accountable in ways not possible if the campuses had acted independently. *The advantages of a consortium appear to have been achieved: to bring new partners up to speed, to make WISE issues more visible, to leverage success through combined institutional support, and to achieve cooperation in a competitive environment.* The consortium and its activities have strong support from provosts and deans, who recognize how important it is to address the shortage of women in science.

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The team
approach to
mentoring junior
eaconomists

THE TEAM APPROACH TO MENTORING JUNIOR ECONOMISTS

ESTABLISHING MENTOR RELATIONSHIPS IS MORE DIFFICULT FOR FEMALE THAN FOR MALE ECONOMISTS, PARTLY BECAUSE OF THE LIMITED POOL OF SENIOR WOMEN IN THE FIELD WITH TIME TO SPARE FOR MENTORING. A ONE-ON-ONE MALE–FEMALE MENTORING RELATIONSHIP CAN BE MORE DIFFICULT THAN A SAME-SEX RELATIONSHIP, PARTLY BECAUSE WOMEN HESITATE TO APPROACH MEN ABOUT GENDER-RELATED CONCERNS; BOTH FEMALE REQUESTS AND MALE RESPONSES MAY BE MISCONSTRUED. MOREOVER, *TRADITIONAL MENTOR RELATIONSHIPS ARE HIERARCHICAL, AND THERE IS SOME EVIDENCE THAT WOMEN—ESPECIALLY WOMEN OF COLOR—LEARN BETTER FROM THEIR PEERS.* THIS PROJECT TESTED THE RELATIVE EFFECTIVENESS OF A TEAM APPROACH TO MENTORING (COMPARED WITH A ONE-ON-ONE APPROACH) TO HELP 40 NONTENURED FACULTY WOMEN MOVE TOWARD TENURED POSITIONS IN ECONOMICS.

At a two-day workshop designed to jumpstart the development of mentoring relationships, eight teams of nontenured faculty were matched with eight senior economists—tenured faculty women. The senior economists would not be overburdened with the attention the eight women needed because the other team members would help provide it. *The aim of the team mentoring was to help junior economists reach the rank of associate professor by teaching them the tricks of the trade about writing grant proposals, conducting publishable research, and earning the credentials needed for promotion into the upper ranks of major Ph.D.-granting institutions.*

During the workshop (held at a 1998 meeting of the Allied Social Science Association), the teams rotated from small-group sessions to large-group sessions and back again. In the small-group sessions, one junior woman would summarize the work of another and the whole team would discuss it. The senior woman listened and provided more political than technical advice.

In the larger group sessions, two teams met to discuss the tricks of the trade. The four "CCOFFE klatches," as they were called (creating career opportunities for female economists), discussed doing research and publishing the results, grant writing, networking, and balancing personal and professional lives. By the end of the two-day period, each junior economist had heard valuable career information and guidance from all of the senior economists and with the help of their teams had developed

short- and long-term action plans for gaining tenure.

The corporate world has successfully used teams to improve productivity, and schools have used cooperative learning groups to improve classroom performance. Cooperative learning groups share their resources and expertise to achieve a common goal that each member is equally responsible for. Did the team approach to mentoring work?

Project evaluators compared the progress of participants in the team approach with that of "matched pairs" in a control group of junior economists similarly situated in the profession, at similar points in the tenure process, with similar levels of achievement. Participants in the CCOFFE workshop made significantly more progress, publishing almost twice as many articles as women in the control group, making presentations at almost twice as many conferences, and being awarded more grants. The test will be whether the CCOFFE participants will be disproportionately awarded tenure in the coming years.