IDEAS

EDUCATION UNTAPPED HUMAN RESOURCE

Gender Gap on the Science Track

Because of stereotyping, girls don't receive the encouragement boys get to give science a serious try

By Simson L. Garfinkel
Special to The Christian Science Monitor
CAMBRIDGE, MASS.

PICTURE a second-grade class on a field trip to a science museum, poised before an exhibit on magnetism: The boys run up and play with the controls, while the girls remain in the back, watching.

This scene, repeated daily across the United States, is at the heart of a pressing educational problem, according to a growing number of scientists, educators, and government officials. In a world that is increasingly scientific and technical, America needs more scientists and engineers, but more than half the student population is taking itself out of the picture by not even trying.

The problem, says Marsha Lakes Matyas of the American Association for the Advancement of Science (AAAS), can be traced to something that she calls "the coatrack syndrome."

"The family will go to the science museum, Dad will help the kids do the experiments, and Mom will hold the coats," says Dr. Matyas, who directs the AAAS project on women and science.

The national problem is compounded by a decline in the size of the college-age population. Between 1980 and 2000, the number of 18- to 24-year-olds in the United States will decline 19 percent, according to the US Census Bureau. Although the population is expected to increase slowly after that, by the year 2010 one in every three 18-year-olds will be black or Hispanic, minorities that thus far have been largely excluded from studying science.

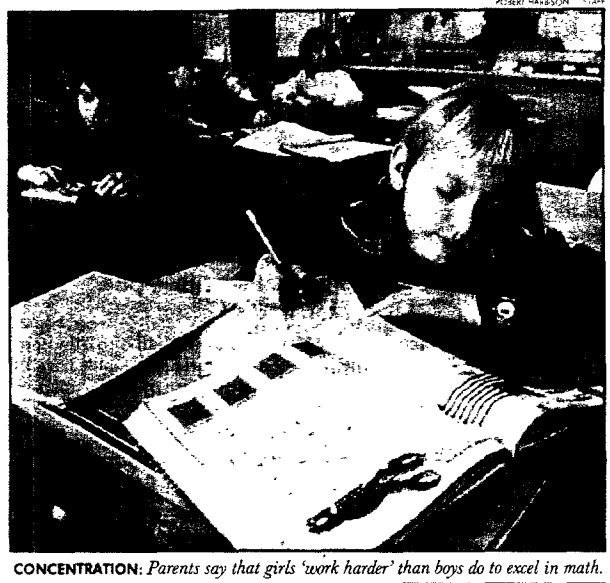
Last year, a congressionally mandated task force on Women, Minorities, and the Handicapped in Science and Technology concluded that if the US is to maintain its position as a world leader in science, more women and minority students must be attracted to the traditionally white, male fields of science and engineering.

What is happening instead, says Beverly F. Porter, a statistician at the American Institute of Physics, is that as fewer Americans come forward to fill spots at universities, those places are being taken up by foreign students. Between 1975 and 1987, says Ms. Porter, the number of physics graduate students with US citizenship at American colleges steadily decreased, while the number of foreign graduate students sharply rose.

Indeed, she says, the growing number of women receiving doctorates in biology and chemistry is almost entirely due to foreign women. Only half those students will pursue their careers in the US, Porter estimates.

A similar trend has been observed at the undergraduate level. "The proportion of US freshmen choosing science and engineering majors has been wobbling downward," the task force reports. "The drop has been little noticed because many foreign students have been enrolling in these fields."

"People are becoming more aware that there is a problem, particularly with minority students," says Matyas. "A lot of people think that the problem with girls is solved. It is far from solved . . . In fact, we are backsliding."



CONCENTRATION: *Parents say that girls 'work harder' than boys do to excel in math.*

After a decade of steady increases, the percentage of women choosing to major in engineering peaked at 17 in 1982, says Betty Vetter, executive director of the Commission on Professionals in Science and Technology, a nonprofit research group in Washington. "Since then, it has been between 15 and 16 percent every year."

Researchers believe almost unanimously that the problem isn't that girls aren't as good at math and science as boys — it's that they don't even try.

"It starts from the time they are little," says Marilee Jones, associate director of admissions at the Massachusetts Institute of Technology. "Girls are not perceived as being scientists, little kindergarten scientists. Little boys are."

Girls, Ms. Jones says, "get all those little cues, they get all the social stuff, and by the time they reach high school, they get discouraged from taking the math courses, and automatically they [are] not qualified to come to a place like this, even if they change their minds at the last moment."

This all happens, says Jacquelynne S. Eccles, a psychologist at the University of Colorado, "despite the fact that females, in general, get better grades in math and science than males."

For the past 12 years, Dr. Eccles has been studying a collection of 15 school districts in southeastern Michigan — from the inner cities to farming communities — following students from fifth grade through the first year of college. She is attempting to learn how student, teacher, and parent attitudes about math and science have affected the pupils' courses of study.

"The role that parents and teachers seem to play is underestimating the girls' potential in math and science . . . and being less likely to encourage girls who have talent in math and science to go on, develop those talents and skills, and consider occupation in those fields," she says.

Eccles found that girls consistently had more confidence in their English ability than in their mathematics skills. This was true, she says, even among girls who were enrolled in advanced math courses.

"These data suggest that most females underestimate their math ability as they get older and feel increasingly more confident about their English abilities," she says. Eccles and her co-workers traced these beliefs to the words and actions of the students' parents. By looking at the differences between parents of boys and parents of girls who performed equally well in mathematics, Eccles has arrived at some surprising conclusions:

Why Girls Shun Physics

CAMBRIDGE, MASS.

PHYSICS, in many ways the most exacting of the sciences, has had special problems recruiting women to its ranks.

While the number of first-year physics graduate students in the United States increased between 1979 and 1987, that increase was almost entirely made up by foreign students, says Beverly F. Porter, a statistician at the American Institute of Physics.

Ms. Porter sees a "physics track," which starts with the first high school physics course and extends to postgraduate research. But the overwhelming majority of women never even take the first steps along that path.

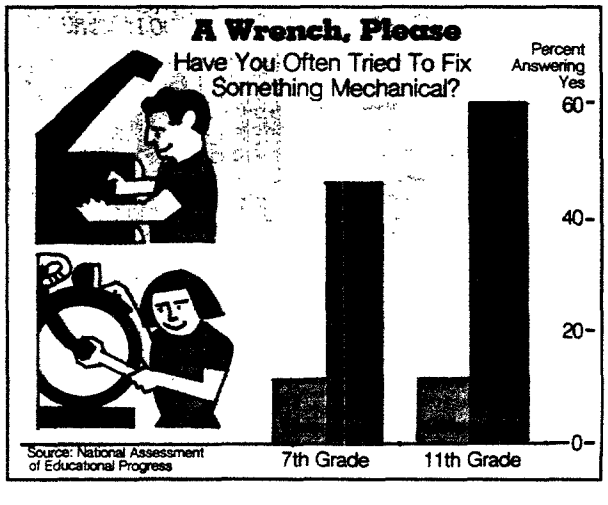
In a study of high school students, Porter found that 25 percent of boys took high school physics, but only 13 percent of the girls did. "It is the major differential at the high school level," she says.

Porter believes that while one factor in causing women to drop out of physics is a lack of math, math isn't the entire picture. "Even those girls who score very high on mathematics tests do not take physics," she says. "Clearly something else is involved."

That "something else" might be a "lack of hands-on experience" with simple machines. "The experience of fixing mechanical things, working with mechanical things," stimulates interest in physics, Porter says. It's an experience most girls don't have.

Once students go "off the physics track," Porter says, they tend to stay off. As a result, only one of seven US bachelor degrees in physics go to women, and only one of every 20 working physicists is a woman.

—S.L.G.



• Parents of girls think that their children have to work harder in mathematics than parents of boys do, even when teachers of the students think both groups are working equally hard.

• Parents of girls think it is more important that their daughters take subjects like English and American history than courses in mathematics.

• When boys do well in mathematics, their parents usually ascribe the performance to natural talent and skill. When girls do well, parents are more inclined to praise their daughter's "hard work."

When students go on to college, Eccles says, "the girls who had confidence in their [mathematical] ability but placed low value on math didn't enroll in advanced math classes."

Almost paradoxically, boys who similarly placed low value on math nevertheless enrolled in the courses. "It's because boys get the message that [math] is important, even if they don't think that it is important, from their parents and their counselors, and enroll in the advanced math classes. The girls don't get that message. If they say they want to drop it, the counselors say 'OK.' "

Eccles's findings are making their rounds through the education community. "It's extremely useful information that people ought to have and don't," says Ms. Vetter in Washington. "Nothing is going to change . . . until parents and citizens and the whole nation recognize that our girls are not inferior to our boys and that they are people we need to use. We have to stop putting them down and encourage them in the same way that we encourage boys."

Doing so, concluded the task force, is going to take the combined efforts of parents, educators, and even the news media.

"Parents can help out a lot," says Matyas, by "taking the kids to science museums and making sure that the girls participate, too." Avoid the coatrack syndrome, Matyas says. "It's as important for kids to see that Mom is competent in math and science as it is important for them to see that Dad is competent."

Parents also need to make sure that their daughters get the chance to do science and math activities. For instance, even though the Girl Scouts now have science, math, engineering, and computer science badges, troop members often don't pursue them, Matyas notes.

At the junior high school level, parents should make sure that their children know and do their homework. They should also "find out when tests are. You don't have to have any science or math expertise to make sure that your kids have a good night's sleep the night before and have breakfast before-hand, yet the difference on test scores is dramatic."

Some schools are now experimenting with the idea of automatically enrolling students in college-track math and science courses unless a parent or guidance counselor says otherwise. (Most schools typically assign students to lower-level courses by default.)

"The school systems are finding that the difference is tremendous," Matyas says. "People who would never single out a young woman and say, 'She's talented enough to do algebra,' would never say, 'She shouldn't do algebra.' "

But more than anything else, parents have to keep their expectations high.

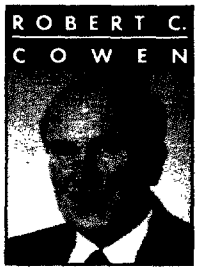
SCIENCE COMMENTARY

Full-Speed Funds for Space Station

ONCE again, the United States is playing a dangerous game with its manned-space-flight effort.

It's called budget stretchout. To play this game, Congress cuts a program's annual budget below the originally planned amount needed to stick with the program's authorized design and schedule. But it doesn't cut the budget enough to kill the program outright.

That's the kind of false economy that helped inflate the cost of the space shuttle and led to technical compromises that a presidential commission called a factor in the Challenger disaster. Now Congress is threatening to do the same thing to the space station.



President Bush wants $13.274 billion for the NASA fiscal 1990 budget. That includes $2.2 billion for space station Freedom. It's a steep rise from Freedom's $900 million for 1989. But it is in line with the scheduled rise in annual funding that the program's congressionally approved plan calls for.

Now there is pressure in Congress to renege on that funding schedule. A Senate resolution calls for a $1.3 billion cut in general science and space. A substantial part of that would come out of the Freedom allocation. This has prompted nine congressmen to send a letter to the House Budget Committee, warning that "this year is a crucial year in the development of the station and a year when the funding must increase to keep the program on track." It adds, "A cut of this magnitude may not 'kill' the space station, but it would so handicap its development that cancellation becomes a real option."

While outright cancellation seems unlikely, Congress may well trim several hundred million from Freedom's 1990 funds. NASA could absorb such a cut and continue the Freedom program. But the stretchout game would begin.

Here's what's involved. In seeking original approval for any major program, NASA and its contractors plan the hardware and mission design in great detail — right down to nuts and bolts. They also plan a detailed development and funding schedule. Once this is authorized, they proceed along that course. When Congress cuts the program's budget below its scheduled level for a given year, NASA and its contractors have to go through the whole costly planning process over again. They come up with a revised design and schedule that may itself have to be redone if there are further budget stretchouts.

The stretchout game forces NASA to spend much of a program's funds on planning and replanning. The short-term budget savings are illusory. They only delay the program and inflate its cost. They may also lead to unwise design compromises, as they did with the shuttle.

This time, there's more at stake than just a NASA program. Station Freedom is a true international endeavor — with Canada, Japan, and the European Space Community acting as United States partners.

Space activity is entering an era when virtually all major endeavors will require international partnerships, because of their scope and cost.

The Freedom program is a trial run at developing a blueprint of how to carry out truly international space projects.

If Freedom is substantially delayed and replanned — let alone canceled — the name of the United States will be mud in the international space community. The country's erstwhile partners would regroup and carry on without it. They are no longer dependent on the United States to make their own mark in space.

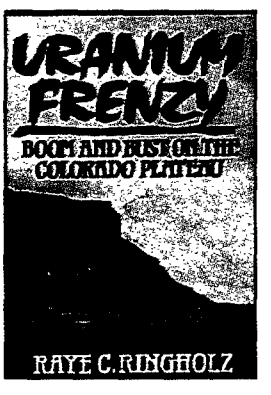
Congress should refrain from tinkering with the Freedom program. For once, the US should stick with a program plan and bring it in on time and within its originally authorized cost.

BOOKS

Prospectors on the Nuclear Minerals Frontier

URANIUM FRENZY: BOOM AND BUST ON THE COLORADO PLATEAU
by Raye C. Ringholz
New York: W. W. Norton
310 pp., $18.95

By Keith Henderson



CHARLIE STEEN was a figure right out of the 1850s, rushing off to the Western mountains to strike it rich. He lived on beans, slept in a tent, and prospected tirelessly. But he poked the cliffs and buttes in the 1950s, and his quest wasn't gold, but uranium. When his eureka came, it was a true mother lode, destined to make him a millionaire and launch the West's last great mineral rush.

Following Steen's discovery of a rich vein of pitchblende near Moab, Utah, in 1952, prospectors combed the government-owned high desert of the Colorado Plateau. Claim markers sprouted on barren, sagebrush land that had no proven uranium potential at all, but happened to be in the rough vicinity of a bona fide strike. This activity was consciously generated by the United States government. Uncle Sam found himself in an intensifying cold war and in need of a nuclear arsenal — and thus of a sure supply of weapons-grade uranium ore. Washington provided the land for prospecting and a guaranteed market for all the yellowish rock the modern argonauts could haul out of their shafts.

"Uranium Frenzy" chronicles the rush for buried wealth, drawing largely on press reports and interviews of those days. It's a lively account, if a bit disjointed and inelegant at times. Raye Ringholz patches together three or four separate narratives under the uranium theme.

Steen's personal history is the most intriguing of these. He is a salty character, bristling with Western independence. Charlie became a legend in his region. His Mi Vida mine spawned an empire of uranium holdings. His Utex company parties were splendidly wild; his temper explosive. After leaving Utah in the early 1960s, put off by Mormon morality and state taxes, Steen and his wife, M. L., settled near Reno, Nev., and built their dream mansion. The Internal Revenue Service soon followed, serving a tax bill in the millions. The dream had burst. Charlie blamed it on friends' bad advice to diversify his business holdings, set his jaw, and went back to the hills in search of another fortune. Ringholz also writes of the freewheeling penny stock boom that financed the uranium hunters. This breed of quick-money scheming produced its own club of millionaires — as well as legions of small-time losers, who bet their life savings on worthless uranium stocks. The law caught up with the slick stockbrokers, too.

The saddest story line traces the health controversy surrounding uranium mining. A few government inspectors, men of conscience, suspected from the beginning that poorly ventilated mines were subjecting men to serious damage from concentrated radon gas. Not until the 1970s, when dozens of miners had already died, did the story surface through press exposés and congressional hearings. By then it was too late for many families, whose battles for compensation dragged on and were never fully won.

For most readers, this book will be a window on an episode of Western history that — though recent — remains obscure. It's a quirky tale, yet it connects with issues still very much with us: concern over nuclear power, both military and industrial; wild, speculative stock dealings; toxicity and worker safety. The frenzy, it seems, has just taken new forms.

■ *Keith Henderson is on the Monitor staff.*