

## WOMEN IN SCIENCE: DO WE IGNORE FEMALE ROLE MODELS?

When asked to recall the name of a female scientist, most people come up with Marie Curie or a name in the nursing profession. Women's accomplishments are usually ignored in the male-oriented history of science. The same is true for the Chinese, who are ignored in the European-oriented history of the world, even though they first invented or discovered moveable type, earthquake detectors, endocrinology, immunology, the germ theory of disease, and dietary deficiencies (Temple 1986). It was a woman, Mrs. Catherine Littlefield Green, who invented the cotton gin; Eli Whitney only marketed it. Women (Mary Montago and Anna Wessel Williams), not men, developed the first vaccines (Vare and Ptacek 1988).

Because of their roles in science, I try to mention women as often as men in my classes. For example, in my non-major general biology lecture class, I might drop the question, "Why didn't Rosalind Franklin share the Nobel Prize with Watson and Crick?" In my Natural History of the Vertebrates class I say, "Now that you have seen the movie and the National Geographic Specials, let's find out what Jane Goodall, Biruté Galdikas, and Dian Fossey really said in their published papers."

With the TV exposure of many female scientists, including Dr. Eugenie Clark's work with sharks (Clark 1951, 1969) and Dr. Sally Ride's trip into space (though she is seldom introduced as Dr. Ride!), I assumed that both biologists and non-biologists would by now be able to recognize and identify female scientists. I further assumed that some of the female scientists were serving female biology majors as role models (Klein 1989). I thought that this would be so because more than 50% of college students are female and over 30% of scientists are female. In addition, the need for more scientists of both sexes in the next decades is

critical both for science and for the total productivity of the United States (Vetter 1989). I, therefore, decided to ask students in several college classes to identify some female scientists for me. The results suggest that we haven't "come a long way, Baby!" and that we still have a lot of teaching to do!

Between 19 October and 30 November 1988, I presented 90 students in five college classes a list of names of female scientists (Table 1). I picked these names because, in the previous two weeks, each had been mentioned prominently on television (national nightly news or National Geographic Specials), in the *Los Angeles Times* newspaper, or in *Time*, *Newsweek*, or *U.S. News and World Report*. In addition, much publicity had preceded the release in mid-September of the movie, *Gorillas in the Mist*, based on the work of Dian Fossey. While not a scientist in the classical sense, Georgia O'Keeffe's paintings of flowers and skulls are as accurate as they are aesthetic and a show of her works in Los Angeles was heavily publicized in the media. During these two weeks, mathematician and computer specialist Dr. Grace Hopper's retirement with Admiral status from the U.S. Navy received wide coverage in both TV and print news. As a kind of "control," I put on the list the name of biologist and ornithologist, Dr. Margaret Nice. I expected, even though she was portrayed on TV the previous week, that only people interested in animal behavior might possibly recognize her and therefore her recognition would be low. If I were to do this again, to make the questionnaire more valid, I should give the same students a slightly longer list to include male scientists, but at the time, I was just interested in whether female biology students had female scientists as role models. This leaves the question of whether the students did not recognize female scientists, or whether they did not recognize scientists in general.

I, or a teaching assistant in charge of a lab, passed out a single page with 14 women scientists listed and

then made an oral statement that I was interested in their ability to recognize female scientists. The questionnaire was anonymous, except that I asked them to identify their major, year in college, and sex. The instructions at the top of the page were specific: "In a few words, please identify the following women. Please be specific so that I can tell if you really recognize the person or not! For example, just saying the person is a biologist or a chemist does not tell me that you know who the person is or what the person has done to achieve a place on this list!"

The results are presented in Table 1. Most of the papers were blank! A typical response was, "I don't know any of them." Some of the "near correct" allowed included: Marie Curie; "developed radiation," Ride; "teacher on space shuttle," Dr. Jeana Yeager, "Flew in Voyager with husband!" Not allowed for Yeager was "wife of Bob Yeager," "wife of Steve Yeager," "wife of Tim Yeager."

Recognition for all 90 students was highest for Marie Curie (41%), Sally Ride (36%), and Dian Fossey (25%). The latter shows the value of the publicity of the movie; Jane Goodall got only 15%, as did Jeana Yeager. The only other person in double digits was Margaret Mead with 12%.

None of these numbers is very high, in fact they are so low as to be disturbing! When only 37 out of 90 students can identify Marie Curie and when fewer than a total of 10 students can recognize Grace Hopper, Kathy Keaton (who, as the successful publisher/editor of *OMNI*, does more to publicize science than many), Barbara McClintock, Biruté Galdikas, Rachel Carson, and Rosalind Franklin, these data suggest that we are not doing a very good job of identifying female scientists for our students. As expected, Margaret Nice was not recognized by anybody. Dr. Nice wrote the *Birds of Colorado*, a basic and classic two volumes on the behavior of Song Sparrows, and the critical paper on territoriality (Nice 1941). This paper

stimulated the modern approach to animal behavior and brought natural history into science and science into natural history.

Interestingly, Biruté Galdikas was not recognized by anybody, even though this Louis Leakey student and her orangutans have been on the cover of *National Geographic* as many times as Jane Goodall and Dian Fossey. More interesting was the fact that nobody in Human Anatomy knew Biruté Galdikas and Jane Goodall and only two knew Dian Fossey! Nobody in Animal Ecology recognized Rachel Carson! Non-majors knew only Marie Curie (8), Jeana Yeager (1), Jane Goodall (1), Margaret Mead (1), Dian Fossey (7), and Sally Ride (9). Georgia O’Keeffe was recognized by four Evolution, one Zoology, and one Human Anatomy student.

Females recognized an average of 2.3 and males 1.7 out of the 14 names. The females did much better than the males in General Zoology laboratory where there was a posi-

tive, enthusiastic female teaching assistant and in Animal Ecology where there were several highly motivated, career-oriented, re-entry women. Seven of the 11 people who recognized Margaret Mead were female, which may indicate the importance of her *Coming of Age in Samoa* and other books that may be read by high school students.

Some of the incorrect answers are enlightening! Some people incorrectly identified Marie Curie as developing the cure for smallpox, as working with Louis Pasteur on bacteria, and as using radioisotopes to mark DNA; Georgia O’Keeffe as a singer; and Barbara McClintock as an outlaw! One person identified Dian Fossey as an actress. This person thus confused the role of the scientist with Sigourney Weaver, the actress who played her in the movie. Several incorrect responses clearly indicate that female scientists, as females in general, are seldom recognized as separate from their other role of wife. In addition to the misidentifications of Jeana Yeager as the wife of Bob, Steve, or Tim, five thought that Rachel Carson was the wife of Johnny. Three thought that Rosalind Franklin was the wife of Franklin D. Roosevelt, and one the wife of Benjamin Franklin!

Do students know these names but not recall them? Do they recognize them when they do see them on TV? Is there something missing from the public portrayal of these women that they are not remembered, or that the students with their current values find them so unimportant that they don’t take note of them? Are the students’ interests, activities, and goals elsewhere? Are we doing our job of identifying successful female scientists for them? To check on the latter, I recently took a 7th grade intermediate reading vocabulary test (35 items arranged into groups of vocabulary words and 5 definitions where the student had to, within a group of 5, match definition and words such as amiable, anthropologist, lair, quarry, delta, unanimously), and gave it to my Evolution class. The results (range and mean of

percent correct): Evolution class: 40-94, mean = 82,  $N = 14$ ; 7th grade (Bell Intermediate School, Garden Grove, CA): 40-100, mean = 81,  $N = 33$ . Students learn discriminating skills in junior high school; these data suggest that often students just don’t take the time to find out what the meaning of a word actually is. Instead, they use context. The results of my female scientists questionnaire may indicate that the current bunch of college students are not using their discrimination or identification skills as much as their context skills.

According to Fort and Varney (1989), students in grades 2-12 see scientists as mostly male, mostly white, and mostly beneficial, though many see them as fictional and often of the mad, Dr. Frankenstein mold. In their study of 1654 students, only 1% of the boy’s essays and only 8% of the girl’s essays concerned female scientists. Interestingly, these students seldom described members of minorities as scientists (Fort and Varney, 1989). This is partly understandable as, for much of the last few centuries, female scientists have been figured as invisible partners to fathers, husbands, lovers, or brothers (Schiebinger 1989). So, as Klein (1989) asks, “Where are the role models?” This study says they are there, but not recognized!

From 1960 to 1987, over 70,500 women earned the doctorate in science and engineering (Vetter 1989). Women’s investment in their doctoral education is often greater than men’s as they receive less institutional and federal support. When they complete their degree, they have difficulty getting permanent jobs and are paid less than their male counterparts. Female scientists with the Ph.D. in Biology and Environmental Science receive (at both the beginning and end of their careers) about 83% of the salary of males. Female medical scientists receive less than 75% of the salary of their male counterparts (Vetter 1989). As Vetter (1989) points out, it is clear that while the nation needs more scientists, fewer women are choosing careers in science. While the per-

**Table 1.** Number and percentage of all students ( $N = 90$ ) who correctly or near correctly identified the female scientists listed. Percentages are rounded off. Names are listed in order of percent correct, not as presented to students.

Scientist	Number	Percent
Marie Curie	37	41
Sally Ride	33	36
Dian Fossey	23	25
Jeana Yeager	14	15
Jane Goodall	14	15
Margaret Mead	11	12
Georgia O’Keeffe	7	7
Rosalind Franklin	4	4
Rachel Carson	2	2
Grace Hopper	1	1
Barbara McClintock	1	1
Kathy Keaton	0	0
Biruté Galdikas	0	0
Margaret Nice	0	0

centage of women earning doctorates has steadily increased from 10% in 1965 to 35% of all doctorates in 1986, the proportion of women who are employed in universities as full-time faculty is not rising as fast (Chamberlain 1988). Yet, in the life sciences, the number of females receiving B.A. and M.A. degrees is in fact about equivalent to the number of males. In the physical sciences, females represent only 25% of these degrees and in Engineering, women receive only 15% of the degrees (U.S. Department of Education, Center for Educational Statistics for 1984-1985).

As Gardner, Mason, and Matyas (1989) point out, persistence in science and mathematics is related to: confidence in one's own abilities, encouragement from parents, teachers, and peers, belief that learned skills will be needed later in life, and belief that it is possible for anybody, regardless of sex, race, or socioeconomic status to become a scientist or engineer. These authors also point out that research shows that female students tend to be less confident in their science and math abilities, receive less encouragement, don't think science and math skills will be useful to them in the future, and don't have any role models of women who have successfully overcome struggles of money, sex, or race to become successful in science. Yet public polls in Britain and the United States report that most people are more interested in science and scientific and medical discoveries than they are interested in sports

(Durant et al. 1989). Since the role models are there, but just not recognized, what can we do? We need to use curricula and teaching techniques, especially those that use female participation, to encourage women to enter science (Gardner et al. 1989). We also need to point out the role of women in history and science (Klein 1989). After all, it was Marie Lavoisier, not her tax-collecting, hence guillotined husband, who started modern chemistry. She wrote the text; he was dead! Beatrix Potter was the first to discover the true alga-fungus nature of lichens (though, because females were excluded, a male read her paper before the Royal Society). She was a successful scientific illustrator (Vare and Ptacek 1988) before becoming the author of *Peter Rabbit!*

There are role models out there, we just need to talk more about them! We need to point out that these female scientists are successful both financially and in status. We need to start it at the "Nancy Drew" age of junior high school or earlier! And we need to start doing it now!

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