A Demographic Survey Relevant to Earth-Science Teachers as Mentors and Role Models for Minority Students

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ABSTRACT
In the United States, from the late eighties to the present, there has been a drop in the percentage of Whites earning scientific and engineering PhDs. If this trend continues, by the first decade of the next century there will be a large shortage of scientists and engineers. This problem is accentuated because individuals from minority populations do not appear to choose these fields as a career. In using New Jersey's population as a microcosm of the nation and looking at middle- and high-school earth-science teachers and the students they teach, we find that the earth-science-teaching population is predominately White and does not always reflect the student population. As a result, there is little chance for a minority student to have an earth-science teacher from his or her own cultural or ethnic group as a mentor/role model. The data also indicates that about one in five earth-science teachers harbors feelings of racial or cultural bias, and about three out of ten feel no need to encourage minority students to enter science or engineering as a career.

Keywords: Earth science – general; earth science – teaching and curriculum; education – geoscience; education – precollege; geology – women and minorities.

Introduction and Background
The technological society we live in needs a ready supply of scientists, yet, from 1988 to the present, the number of Whites who have earned PhDs in science and engineering has dropped substantially (Culotta, 1993). If this trend continues, by the first decade of the next century this country will be short 400,000 scientists and 275,000 engineers (Neal, 1987; Holden, 1989; and Goodstein, 1993). But Koshland (1992) points out that this country’s Hispanic, Black, and Native American citizens are available in sufficient numbers to fill the gap but, for some reason, do not enter these professions. Using New Jersey as a microcosm of the nation, this study examined the demographics of earth-science teachers to see whether there are sufficient minority teachers to act as mentors or role models for minority students.

Minority Demographics
Blacks, a majority of whose ancestors did not choose to come to the United States (Almquist, 1979), make up the largest of the underrepresented cultural/ethnic groups in the United States. Currently they comprise 11.5 percent of the population, but by the year 2000 this number is expected to have risen to 13.3 percent (Gibbs and others, 1989). Lach (1992) notes that of the Black population fifty percent tend to live in cities and reside in public housing, many under impoverished conditions. A high percentage come from single-parent families. These individuals tend to be poorly educated, with no history of higher education, unemployed, and on welfare (Holden, 1986).

Hispanics are defined as all people of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race (Fox, 1992). Mexican Hispanics tend to be concentrated in California, Texas, Illinois (around Chicago), New Mexico, Arizona, and Colorado. Puerto Rican Hispanics can be found in every state, though they are most concentrated in the New York/New Jersey metropolitan area. Cuban Hispanics tend to be concentrated in and around Miami, Florida and northern New Jersey. Central and South American Hispanics appear to be concentrated in and around those cities where there are incoming flights from their home countries (Almquist, 1979 and Gibbs and others, 1989). Hispanics, with the exception of the Cuban group, often lack a high-school education, causing them to have high unemployment and to live near or in poverty. The high birth rate among this group indicates that they could outnumber the Black population by the end of the first decade of the next century (Cavazos, 1990).

As a group, Native Americans includes all American Indians, Alaska Natives, Aleuts, Eskimos, and Metis. Even though this minority group predates the coming of Europeans, they constitute only 0.8 percent of the population. The majority of Native Americans tend to live either on reservations or in cities. The high school drop-out rate is high and about one-third of the adult population is classified as illiterate (Gibbs and others, 1989). The low education level has resulted in high unemployment with a large portion living in poverty. Those Native Americans who do find employment usually do so as laborers, service workers, and domestics.

The Civil Rights Act of 1964, the Elementary and Secondary Act of 1965, and the Bilingual Act of 1968 formally ended color and language discrimination in our schools (Hakuta, 1986). In the early seventies, J. Stanford Smith of the General Electric Company suggested that minorities might help fill the growing need for scientists and engineers if there were corporate-sponsored and federally funded science and engineering encouragement programs (Sims, 1992). By the eighties, the growth rate of science and engineering employment was more rapid than general employment in the nation, and minorities were filling some of these positions. Hispanics and Whites were more likely than Blacks to become engineers. Blacks who
entered the sciences preferred the social and life sciences over the other disciplines. (National Science Foundation, 1982, 1985; and Chirichiello and Crowley, 1984). Yet today, even with the success of many of the federally funded and corporate-sponsored minority science- and engineering-encouragement programs, Blacks, Hispanics, and Native Americans constitute only about five percent of our scientists and engineers. (Sims, 1992, Fox, 1993; and Sims, 1993).

Minority Performance in School

Selvin (1992) notes that, by the fourth grade, mathematics test scores among many minority students are below Whites of the same age, and this trend appears to continue on up through middle school. By high school, only twenty-five percent of the minorities taking algebra succeed in the course and are eligible for the more advanced mathematics and science tracks needed to pursue science or engineering on the college level. Schwartz (1987) and Massey (1992) note that on the middle- and high-school level there exists a prejudicial attitude among White teachers towards minority students, where lack of confidence or poor academic preparation is seen as indicating a lack of intelligence or potential. This results in many minority students not being encouraged to take college-preparatory courses. Instead, they are being tracked into low-level, vocational or trade-oriented curricula (Wharton, 1984).

At the middle- and high-school level there may be two other reasons why some minority students do not take the more rigorous college-preparatory science and math courses. First, as Sims (1992) notes, some well meaning teachers and counselors will counsel some minority students, in order to maintain their GPA, not to take the more difficult math and science courses which, according to Marrett (1981), prevents these individuals from reaching their full potential. Second, there is peer pressure. As noted by Gibbs and others (1989) and Culotta (1992), because of tracking, minority students in the lower tracks tend to see their peers in the upper tracks as “acting White” and do not accept them. In many cases the minority student is also not accepted by the White population in the upper tracks, and this nonacceptance can cause feelings of inadequacy and isolation which may affect their attitude towards advanced high-school science and math courses. As Culotta (1992) notes, between their sophomore and senior year in high school, many minority students lose interest in science and engineering as a possible career choice.

Influences on Minority Student Performance

For young people, it is during the middle- and high-school years that they obtain the necessary skills and knowledge to function in a technological society (Weis, 1984). Mentors and role models, such as teachers in our middle schools and high schools, are in a position to influence adolescents since adolescents tend to react more positively to the adults who work with them as coaches, sponsors, counselors, or other role models (Mosqueda and Palaich, 1990). As Flaxman and others (1988) note, the skills needed to be a successful mentor or role model are largely the same skills used by teachers: good observation skills, a willingness to provide feedback, and the ability to be empathetic but not judgmental. Yet gender and race also play a factor in this relationship. Flaxman (1988) also points out that males prefer to be mentored by males, and Blacks are almost always mentored by Blacks. This may be because the mentoring/role-model relationship works best between individuals who are not separated by social differences (Archer, 1988).

Research appears to indicate that there are five reasons why minorities do not go into the sciences, math, or computer technology (Schwartz, 1987; Marinez and Ortiz de Montellano, 1988; Otuya, 1988; and McDonald and others, 1990):

1) Lack of role models: Black, Hispanic, Asian, and Native American teachers are absent in the subject area.
2) Cognitive differences: The teacher does not recognize that minorities process information and approach problem solving in different ways than educators believe is the norm.
3) Racial and cultural bias: The teacher feels that certain groups are superior in their science/math ability or feels that certain groups cannot achieve academic success in the areas of math and science.
4) Poor preparation: The teacher feels that the student has not been properly prepared in the areas of math/science or computer technology in prior grades.
5) Outside influences by family or peers: There is no strong parent support for interest in science, math, or computer technology. The peer group sees the person interested in science, math, or computer technology as different and pressures the individual to conform.

But of these five reasons, Rivera (1981), Otuya (1988), McDonald (1990), and Sims (1992) concluded that the primary influence is the lack of professional role models or mentors.

New Jersey’s Cultural/Ethnic Demographics for Earth-Science Teachers: A Microcosm of the Nation

When New Jersey’s cultural/ethnic population is broken down, one finds that it is a diverse group consisting of 74.9 percent White, 12.7 percent Black, 9.2 percent Hispanic, 3.3 percent Asian, and .2 percent Native American (United States Department of Commerce, 1994). A survey of earth-science teachers in New Jersey was conducted to determine the cultural/ethnic demographics of earth-science teachers and the students they teach.

Methods

Six hundred eighty-one surveys were mailed to the members of the New Jersey Earth Science Teacher’s Association. They were asked to answer questions related to gender, age, teaching experience, education, and cultural/ethnic background, and whether they were currently teaching earth science. Of the 681 surveys sent, 153 were returned. From this number, 117 of the respondents stated that they were currently
assigned to teach earth science. It is understood that the percentage of the responses is based on the surveys received from the members of the New Jersey Earth Science Teacher's Association. There may be individuals who do not belong to the New Jersey Earth Science Teacher's Association and did not receive a copy of the survey, or, if they did receive a copy of the survey, did not respond to it.

**Results**

The results of the survey (Figures 1-7) show the cultural/ethnic makeup of the 117 respondents who identified themselves as teaching earth science and the cultural/ethnic makeup of the earth-science classes they teach. The responses were added to get a numerical value for each and a percentage of each was tabulated. To achieve a breakdown of the cultural/ethnic demographics of earth-science teachers in urban, suburban, and rural areas, questions related to the school-district type and the cultural/ethnic makeup of the respondents were cross-referenced. To get the cultural/ethnic breakdown of the classes in urban, suburban, and rural districts, survey questions related to school-district type were cross-referenced with the cultural/ethnic makeup of the respondents classes.

The final part of the survey (Figures 8-9) was a free-response section consisting of two questions. First, the respondents were asked why they feel Blacks, Hispanics, and Native Americans do not pursue science or engineering as careers. All comments were grouped into one of the six categories: 1) lack of role models; 2) cognitive differences; 3) racial and cultural bias; 4) poor preparation; 5) outside influences by family; and 6) outside influences by peers. Of the 153 respondents, 83 gave a written response for this section – a total of 145 comments. The comments were categorized to get a numerical value and a percentage was tabulated.

Finally, the respondents were asked how they encourage minority students to consider science or engineering as a career. Of the 153 respondents, only 101 replied – a total of 126 comments. All comments were grouped into one of four categories: 1) no special activity is scheduled; 2) provides career education; 3) incorporates teaching techniques to interest minority students in science; and 4) provides examples (past and present) of minorities in math/science. The comments were added to get a numerical value and a percentage was tabulated.

**DISCUSSION**

**Distribution of Cultural/Ethnic Groups**

The results of the survey indicated that the dominant cultural/ethnic make up of earth-science teachers is White (Figure 1). The data indicate that for every nine White earth-science teachers, there will be one earth-science teacher who falls into a minority group where Hispanics tend to outnumber Blacks. The data suggest that there are no Asian or Native American earth-science teachers.

Urban School Districts: The data from the demographic survey indicate that in urban districts 93.33 percent of the earth-science classes are taught by White teachers. The remaining 6.66 percent are urban earth-science classes taught by Black teachers. The data also indicate that there may be no Hispanics, Asians, or Native Americans teaching earth science in the urban districts (Figure 2). When the cultural/ethnic distribution of the students in urban earth-science classes is examined (Figure 3), it is found that it is primarily Black and Hispanic with Asian or White students making up only ten percent or less of the total student population. With a predominately White staff teaching earth science, one can conclude from the data that in New Jersey's urban districts a Black student has very little chance of having a Black earth-science instructor with whom he or she can identify. As for Hispanic and Asian students, they appear to have no apparent chance of having an individual from their cultural/ethnic group teaching them earth science.

Suburban School Districts: In suburban earth-science classes, the data from the survey indicate that 98.90 percent of the teachers are White. The remaining 1.09 percent are Black, Asian, or Hispanic. There appear to be no Black, Asian, or Native American teachers currently
teaching earth science in suburban schools (Figure 4). The data from the survey also indicate that suburban earth-science classes are predominately White, with Black, Hispanic, and Asian students making up less than ten percent of the total student population (Figure 5). It appears that in New Jersey’s suburban school districts, Black, Hispanic, and Asian students have very little chance of having an earth-science teacher from their cultural/ethnic group.

Rural School Districts: In rural districts, the data from the survey appear to indicate that the population of the earth-science teaching staff is predominately White (83.33%) with only a small percentage (8.33%) being of Hispanic origin. There appear to be no Native American, Asian, or Black earth-science teachers (Figure 6). The data from the survey also indicates that rural earth-science classes are made up of primarily White students with Black, Hispanic, and Asian students making up ten percent or less of...
the total student population (Figure 7). So it would appear that there is little chance for Black, Asian, or Hispanic students to have a member from their cultural/ethnic group teach them earth science.

Why Blacks, Hispanics, and Native Americans Do Not Pursue Science or Engineering as a Profession

Of those who responded to the reaction on their feelings as to why Blacks, Hispanics, and Native Americans accounted for so few of this country’s scientists and engineers, over fifty percent felt that outside influences and lack of role models had the greatest effect (Figure 8). But, the wording of almost one out of five (20%) of the written responses indicates that there is a "...supposed superiority of one group or... inferiority of another group...[based] solely on skin color or race...." (Beswick, 1990, p. 1). This leads to the third issue, the possibility of racial or cultural bias towards a minority group on the part of the respondents.

How the Respondents Encourage a Minority Interest in Science or engineering as a Career

Finally, there is the issue of the manner by which the respondents encourage minorities to look at science or engineering as a possible profession (Figure 9). Of the respondents, 71.43 percent indicated some kind of action is taken, by either the teacher or school, to encourage minorities to consider science or engineering as a career. However, almost three out of every ten comments indicated that respondents treated all of the students alike and saw no need to single out any particular group to make them aware of career choices.

Conclusion

The data from the demographic survey indicate that the overwhelming majority of earth science teachers are White and these statistics do not change by district type. The data also indicate that one in five of the instructors of earth science harbor feelings of cultural or racial bias towards minorities and three out of ten see no need to provide them with any kind of encouragement toward science or engineering as a career. So it is unlikely that minority urban, suburban, and rural students will benefit from an earth-science teacher role model/mentor from their cultural/ethnic group.

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for ideas, check out www.earthsciweek.org