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How Gender and Race of Geologists are Portrayed in Physical Geology Textbooks

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ABSTRACT

AGI estimates that 275,000 physical geology text books are sold in the United States per year. We selected 15 texts from nine different publishers. Data was collected from photos with scientists. Gender data was divided into male, female, and unknown. We noted if the individual was Caucasian, African-American, Asian, Latino, or unknown. Of the 307 geologists in the figures, 214 are male (69.7%), 61 are female (19.9%), and 32 are of undeterminable gender (10.4%). Out of 214 males, 168 are Caucasian (78.5%), 9 are racially diverse (4.2%), and 37 are unknown (17.3%). Out of 61 females, 51 are Caucasian (83.6%), 4 are racially diverse (6.6%), and 6 are unknown (9.8%). The books portray males as 3.5 times more likely to be geologists compared to females. This ratio significantly exceeds the current proportion of men and women entering the workforce (58% male and 42% female for B.S. degrees in Earth science) or the near equal proportions in the U.S. population. The books imply that Caucasian geologists are 15 times more abundant in the work force compared to their non-white peers. This ratio differs significantly from the data for recent graduates and the general U.S. population (about 3:1 for both data sets).

INTRODUCTION

Several studies indicate difficult times are ahead in the geosciences. Recent reports identify a looming shortage in the number of scientists in the United States, including geologists and geophysicists (COSEPUP, 2005; NSF, 2004). Educational studies in K-12 classrooms indicate that children envision scientists as a Caucasian males (commonly in lab coats) and science as the realm of "geeks" or the unattractive (Barman, 1997, 1999; Peters and others, 2006). Diversity in the geoscience is the lowest of any STEM field (Huntoon, 2005).

Often a student's first experience with geology is in a freshman-level general education college course. For

many departments these courses serve as a recruiting tool for potential majors. One component of the course is a text book to complement lectures and laboratory study. The American Geological Institute estimates that about 275,000 physical geology text books are sold per year (Keane, 2005).

The goal of this project was to involve a class of preservice Earth science teachers in science education research. We do not wish to highlight or criticize any single text but to look for overall trends. Specifically, we focused on two questions: Is there a bias in how scientists are portrayed in physical geology text books? And, if so, what are those biases? Our results indicate that white males are disproportionately portrayed as geologists in physical geology text books. The percentage of women and minorities shown is significantly below the percentage of these groups in the U.S. population or as recent recipients of B.S. degrees in Earth Science.

METHOD

We randomly selected 15 texts from nine different publishers. Data was collected on the number of chapters, the number of pages, the number of photos, the number of photos with scientists and the number of scientists in each photo. Gender data was divided into male, female, and unknown (indeterminable). For each gender we noted if the individual was Caucasian, African-American, Asian, Latino, or unknown (indeterminable). In photos where gender and/or race were difficult to determine the lead author and the student met and tried to reach consensus or placed the scientist in the photo in the appropriate unknown category. King and Domin (2007) present a statistical test of gender and race assignment but their methodology is essentially the same as this study.

We also looked to see if the text presented information about careers in geology and noted some of the photos with the best examples of diversity and examples that reinforced the perceived stereotype.

Title	Authors	Publisher	Ed.	Year	Ch.	Pages
Planet Earth and the New Geosciences	Schmidt, Harbert	Kendal Hunt	4th	2004	16	426
Dynamic Earth	Skinner, Porter, Park	Wiley	5th	2004	21	584
Geology an Introduction to Physical Geology	Chernicoff, Whitney	Pearson Printice Hall	4th	2007	20	679
Modern Physical Geology	Thompson, Turk	Thomson, Brooks/Cole	2nd	1997	22	520
Understanding Earth	Press, Siever	Freeman	3rd	2001	23	573
Earth, an Introduction to Physical Geology	Tarback, Lutgens	Prentice Hall	7th	2002	22	670
Earth Portrait of a Planet	Marshak	Norton	1st	2001	23	735
Physical Geology Earth Revealed	Carlson, Plummer, McGreary	McGraw Hill	6th	2006	22	580
Physical Geology	Plummer, Carlson, McGreary	McGraw Hill	11th	2007	22	617
Earth's Dynamic Systems	Hamblin, Christiansen	Pearson Printice Hall	10th	2004	25	759
Exploring Earth	Davidson, Reed, Davis	Orebtuce Gakk	2nd	2002	16	541
Physical Geology	Dolgoft, Anatole	Heath	1st	1996	21	577
Physical Geology Exploring Earth	Monroe, Wicander	Thomson, Brooks/Cole	5th	2005	20	644
How Does Earth Work?	Smith, Pun	Pearson Printice Hall	1st	2006	20	641
Physical Geology	Montgomery	Wm. C. Brown	3rd	1993	22	505

Title	Photos	Scientist	Male	MC	MAA	M-Asian	Latino	M Ukn
Planet Earth and the New Geosciences	157	1	1	1				
Dynamic Earth	556	30	28	14			3	11
Geology an Introduction to Physical Geology	698	27	18	16				2
Modern Physical Geology	575	14	8	6				2
Understanding Earth	590	17	13	13				
Earth, an Introduction to Physical Geology	638	29	21	10				11
Earth Portrait of a Planet	691	15	12	12				
Physical Geology Earth Revealed	621	11	6	5				1
Physical Geology	626	46	25	23				2
Earth's Dynamic Systems	621	30	24	18			3	3
Exploring Earth	665	12	8	6				2
Physical Geology	522	23	14	13		1		
Physical Geology Exploring Earth	473	24	16	13				3
How Does Earth Work?	605	27	19	17	2			
Physical Geology	535	2	1	1				
Total	8038	307	214	167	2	1	6	37
Exploring Geology	2528	67	37	32	1	2		2

Table 1. (Above and Next Page) Gender and race data from physical geology text books. Abbreviations: MC - male Caucasian, MAA - male African-American, M-Asian - male Asian, FC - female Caucasian, FAA - female African-American, F-Asian - female Asian.

Title	Female	FC	FAA	F-Asian	Latino	F Ukn	Race/ Gender Ukn	Career
Planet Earth and the New Geosciences								
Dynamic Earth	2	2						no
Geology an Introduction to Physical Geology	5	4				1	4	no
Modern Physical Geology	4	3				1	2	no
Understanding Earth	4	4						yes
Earth, an Introduction to Physical Geology	6	5				1	2	yes
Earth Portrait of a Planet	3	2			1			yes
Physical Geology Earth Revealed	2			1		1	3	yes
Physical Geology	11	11					10	yes
Earth's Dynamic Systems	6	6						no
Exploring Earth	1	1					3	no
Physical Geology	3	2				1	6	no
Physical Geology Exploring Earth	8	7				1		yes
How Does Earth Work?	6	4		2			2	yes
Physical Geology								no
Total	61	51		3	1	6	32	
Exploring Geology	17	17				1	10	yes

RESULTS

Table 1 shows the results of our study. Only 307 (3.6%) of the 8,573 figures in these books showed geologists. The number of photos in each book that showed geologists ranged from 1 to 46 with an average between 20-30. Some figures included more than one geologist. Of the 307 geologists in the figures 214 are male (69.7%), 61 are female (19.9%), and 32 are of undeterminable gender (10.4%). Out of 214 males, 168 are Caucasian (78.5%), 9 are racially diverse (4.2%), and 37 are unknown (17.3%). Out of 61 females, 51 are Caucasian (83.6%), 4 are racially diverse (6.6%), and 6 are unknown (9.8%). Our study demonstrates gender and racial bias in this set of text books.

DISCUSSION

What would be an appropriate number of females and non-white scientists in the U.S.? We chose two data sets for comparison: the data on gender and race for recent graduates obtaining a B.S. degree in Earth science from a U.S. institution (NSF, 2004) and the population demographics for the entire country from the U.S. Census Bureau, (<http://www.census.gov>). The data for students recently earning a degree is a snap shot of the current geoscience workforce and reflects decades of efforts to attract women and minorities to geoscience careers. The data for the U.S. population reflects the composition of the entire country and, perhaps, serves as an ideal standard for comparison.

In regards to gender, physical geology text books portray males as more than three times more likely to be geoscientists compared to females. This ratio significantly exceeds the current proportion of men and women entering the workforce (59.1% male and 40.9% female for B.S. degrees in Earth science) or the near equal

proportions in the general U.S. population (48.9% males, 51.1% females).

When race is considered the misrepresentation of Earth scientists in Physical Geology text books does not improve. The text books imply that Caucasian Earth scientists are 17 times more abundant in the work force compared to their non-Caucasian peers. The percentage of minority graduates with a B.S. degree in Earth science is comparable to the text book data (9.7% vs. 8.6%, respectively). However, the Earth sciences are unfortunately noted for their poor representation of minorities (Huntoon, 2005). The ratios from our data and the NSF race data differ significantly from the data for the U.S. population. For the U.S. population the ratio of Caucasian to non-Caucasian individuals is about 3:1. Using the U.S. data as an ideal target, the text books are significantly lacking in minority representation (24.8% vs. 8.6%, respectively). A similar study of general chemistry textbooks (King and Domin, 2007) noted that persons of color were included "well below their representation in American society."

Perhaps the gender and race of the lecturer might serve as a potential model for diversity in the geosciences. Unfortunately, at the Ph.D. level only 30% of geologists are female. Furthermore, in the last five years only 4% of Ph.D.'s have been earned by minorities. The opportunity for women and minority students to have instructors similar to them is small.

One text has started down a promising path. The 11th edition of Plummer, Carlson, and McGeary (2006) includes photos of eleven Caucasian female geologists actively collecting data in the field. The text includes 46 photographs of geologists. The authors also dedicated one page to "Geology as a Career" and referred to AGI's career website (<http://www.agiweb.org/careers.html>). No other text has made this modest effort. Most texts show a few female Caucasian geologists or perhaps one

or two racially diverse geologists. None of the books we examined included a photo of a female African American geologist.

These patterns are certainly not the result of any conscious efforts by our peers. In general, authors select photos from their own collections or the best available slides from photo distributors. Searches of the DLESE (<http://dlese.org/library/index.jsp>) and AGI websites (<http://www.earthscienceworld.org/images/>) yielded few useful photos. Google images provided several useful images but copyright issues must be addressed. Based on our research, we would like to humbly suggest the following actions to begin addressing gender and race bias in physical geology textbooks:

- Bring awareness to the authors and publishers of the bias in these texts,
- Construct a free online database of photographs including diverse geologists (perhaps featuring our own students),
- Suggest authors include career information, such as the Association of Women Geologists (<http://www.awg.org/index.html>), National Association of Black Geologists and Geophysicists (<http://www.nabgg.com/>), and the Society for the Advancement of Chicanos and Native Americans in Science (<http://www.sacnas.org/>),
- Suggest authors include career profiles, especially of diverse geologists.

With a pool of hundreds of thousands of potential geologists in our classrooms we must present our science as available to all. We are part of a dynamic and interesting endeavor. Our public "face" needs to better reflect the people we serve and the community we wish to be.

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