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To cite this article: Steve Mattox, Michelle Bridenstine, Bridget Burns, Emmeline Torresen, Alex Koning, S. Paul Meek, Matthew Ritchie, Neil Schafer, Lindsay Shepard, Angela Slater, Tamara Waters & Amanda Wigent (2008) How Gender and Race of Geologists are Portrayed in Physical Geology Textbooks, *Journal of Geoscience Education*, 56:2, 156-159, DOI: [10.5408/1089-9995-56.2.156](https://doi.org/10.5408/1089-9995-56.2.156)

To link to this article: <https://doi.org/10.5408/1089-9995-56.2.156>



Published online: 31 Jan 2018.



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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 | Dolgoff, 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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