

# A real-world plan to increase diversity in the geosciences

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**Statistics** on underrepresented minorities show that blacks, Hispanics, and American Indians earn only 2.1%, 3.3%, and 0.6%, respectively, of the PhDs awarded annually in the physical sciences. Various organizations have been trying for many years to increase the representation of minorities in the geosciences. A 2005 report by the American Geophysical Union and the American Geological Institute stated that less than 4% of PhDs in the geosciences were earned by minorities over the previous five years. The report also said that in the period 1973–2003, only 313 Hispanic Americans, 135 African Americans, and 49 Native Americans earned PhDs in any of the geosciences, which include Earth, atmospheric, and ocean science. NSF data for the period 1973–2005 show that 16 061 geoscience PhDs went to US citizens and permanent residents.

Several committees and special task forces have published studies and reports about diversity in science, technology, engineering, and mathematics (STEM) and generated several excellent recommendations. Unfortunately, a list of recommendations does not equate to a real plan that can be executed. However, we believe that a long-term implementation plan to solve the lack of diversity can be developed. Our four-phase, 20-year plan is based on empirical data, experience, observations, and statistical data analysis that incorporate various recommendations gained from past studies and reports.

The lack of diversity is a complex problem that involves social, economic, and institutional factors, both academic and employment. For example, the average time it takes from baccalaureate to doctorate degree in Earth and space science is 9.8 years. So it will take nearly 10 years before a changed approach is reflected in a substantial increase in the number of PhDs in those fields. In our opinion, a quick fix is highly unlikely

under present conditions and current practices.

Our plan is based on key attributes found in a study of two programs—the undergraduate meteorology degree program at Jackson State University in Mississippi and the PhD program in atmospheric science at Howard University in Washington, DC. JSU has had a meteorology program for 31 years and produces about one out of every four undergraduate degrees in atmospheric sciences earned by African Americans. The HU program in atmospheric sciences (HUPAS), initiated in 2002, produces the largest classes of African-American and Hispanic PhDs in atmospheric science on record. Although those efforts are contributing significantly to increasing the number of minority students in the atmospheric sciences, they alone cannot remedy the situation. Additional help is needed.

## Four-part plan

Our long-term diversity plan attacks the problem in four phases; each phase lasts five years, and each has a different focus. Assets, resources, and human capital added in each phase will include undergraduate scholarships, student development, graduate assistantships, faculty incentives, increased library resources, and improved physical plant. Host institutions of the degree programs will be required to enter into a formal agreement to institutionalize the new programs after the initial five years.

Phases I and II tackle two of the largest obstacles—access to programs and successful completion of the undergraduate degree. The two phases are built on empirical data, experience, and observations of the undergraduate JSU meteorology program. Currently, JSU is the only historically black college and university (HBCU) to offer a bachelor's degree in meteorology. Between 1991 and 2001, HBCUs granted 45–50% of all bachelor's degrees in the physical sci-

ences that went to African Americans. Only a small fraction of those degrees are in the geosciences because only a small number of HBCUs offer geoscience degrees.

**Phase I.** New geoscience undergraduate degree programs should be established in strategic locations where the chance of attracting underrepresented groups is increased. For example, North Carolina Agricultural and Technical State University is developing an undergraduate major in atmospheric sciences.

**Phase II.** Once students enter the undergraduate programs, a culture of success must be in place to ensure they succeed and to instill a desire for students to attend graduate school. Key elements of the JSU program include mentoring, exposure to professionals, peer interaction, faculty-supervised undergraduate research, knowledge of various graduate programs, career options, practical training through summer internships, and work experience gained during the academic year at the National Weather Service office in Jackson.

**Phase III.** The major objective of Phase III is to maximize the number of PhDs awarded to students from underrepresented minorities. Its goals are: to increase the number of students entering the graduate pipeline, and institutionalize a system to help graduate students complete their programs of study, and reduce the time between entering graduate school and graduating with a PhD. HUPAS has many of the same features as the JSU undergraduate program. The five core elements of HUPAS are as follows:

- ▶ A supportive mentoring environment that extends throughout the institution
- ▶ Competitive research programs with clear linkages to career opportunities in the federal government and the private sector
- ▶ Involvement in the academic and re-

search training by concerned role models who have backgrounds similar to those of the students

► Development of extended networking opportunities to combat marginalization and alienation in professional meetings, in organizations, and across the larger scientific community

► Linkages to feeder programs at colleges with strong undergraduate academic programs coupled with research internships, extended faculty collaborations, workshops, reciprocal campus visits by faculty, and seminars. Whenever possible, the linkages are enhanced by faculty and student exchanges.

**Phase IV.** Workforce diversity is emphasized in this phase. Incentives should be provided to employers to ensure that the new group of PhD geoscientists will gain employment. Workforce diversity must include hiring under-represented minorities into professional positions such as staff scientists, tenure-track faculty members, project managers, and team leaders. It is also important to employ minorities in high-visibility positions, such as presidents, vice presidents, executive directors, program managers, program directors, and lead scientists on large-budget science projects, where they will

serve as role models.

In the class of 2004, African Americans and Hispanics earned 2% and 4%, respectively, of the 3916 bachelor degrees granted in the geosciences. In the same year, African Americans earned 5 and Hispanics earned 10 out of a total of 804 PhDs awarded in the geosciences; the corresponding percentage of minority geoscience PhDs was the lowest among all STEM PhDs awarded. Our projections show that by implementing the four phases outlined above, nearly 500 PhDs in the geosciences can be earned by minorities over 20 years, bringing the numbers into parity with population demographics.

HBCUs tend to play a large role in African Americans' receiving degrees in STEM areas. In 2004, HBCUs produced close to half of the African Americans with BS degrees in physics. However, in the geosciences, they produced about 12% of the BS degrees earned by African Americans, presumably because most HBCUs do not offer degrees in the geosciences.

To increase the number of access points into the geosciences, the Pennsylvania State University is collaborating with JSU through the NSF Opportunities for Enhancing Diversity in the Geosciences program to establish an

undergraduate degree in Earth system science that is expected to officially begin in 2008. The collaboration, which will be the first degree program in Earth system science at an HBCU, will provide funded opportunities for JSU faculty and undergraduates to conduct research with Penn State faculty members and will provide adaptable course materials from Penn State to JSU. Qualified JSU graduates are also guaranteed fully funded assistantships in the Penn State College of Earth and Mineral Sciences. Most important, the involved faculty members from both institutions have a strong commitment to work together to improve both of the programs through collaborative grant writing, research, and educational endeavors.

Physics and the geosciences are seriously lagging behind the other STEM areas in diversity. Our scientific communities need to make firm commitments to organized efforts if there is ever going to be any real hope of changing the situation. We have put forth what we believe to be a realistic plan that can put the US on track to significantly increasing diversity in the geosciences. We welcome dialog from all societies, funding agencies, institutions, and individuals who are working to increase diversity in the sciences. j















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