

## **Curricular and Structural Approaches to Keeping an Earth Sciences Department at the Forefront**

**Timothy J. Bralower, Professor and Head  
Department of Geosciences  
The Pennsylvania State University**

Established in 1913, but with roots that extend to the founding of the University in 1855, the Department of Geosciences is part of the College of Earth and Mineral Sciences, one of the original colleges of the University. The college contains, in addition to Geosciences, the Departments of Meteorology, Geography, Materials Science and Engineering, and Energy and Geo-Environmental Engineering. The Department of Geosciences was formed by the merger of three former departments: Geology, Geochemistry, and Geophysics. The most recent NRC ranking placed the department 11<sup>th</sup> among Ph.D. granting departments. US News most recently ranked our programs in Geochemistry, Hydrogeology, and Sedimentology and Stratigraphy in the top 5.

The Department has 31 tenure-track faculty members, 98 graduate students (65 Ph.D. and 33 MS), and 110 undergraduate majors. In addition to a traditional Geosciences BS program, we offer a rigorous integrated Earth Sciences BS and a Geosciences BA that is tailored to students with interests in education and environmental law. The Earth Sciences BS incorporates course work from Geosciences, Geography and Meteorology, and requires completion of an interdisciplinary minor (e.g., Climatology, Marine Sciences, Global Business Strategies). A new Geobiology BS program will attract majors with interests at the intersection of the earth and life sciences. The curriculum includes both paleontological and biogeochemical coursework, and is also tailored to accommodate pre-medicine students. Research is a fundamental component of every student's degree program. We require a capstone independent thesis as well as a field program for Geosciences and Geobiology BS students, and we encourage all students to pursue research as early as the freshman year. A new 5-year combined BS-MS program will enable outstanding students to carry their undergraduate research further before pursuing employment or doctoral programs. Finally, we have recently hired a faculty member in geoeducation to lead a major reform of our core BS curricula. In this review we will identify key skills, reduce redundant information where pedagogically ineffective, increase connections among classes, and review prerequisite courses, with the goal of maximizing the number of paths through our majors. This review will also identify courses where we can improve the quality and quantity of active learning.

Our graduate program is highly competitive, with close to 200 applicants a year for about 20 positions. We have, on average, 28 TA lines that play a key role in directing active learning in large general-educational laboratory courses with total enrollments of over 1600 students per semester. All graduate students in Geosciences are expected to acquire breadth of knowledge in the geosciences, a fundamental and advanced knowledge of their subdiscipline, and skills in the areas of data collection and quantitative analysis. Toward that end, all students must select one of the approved courses in each of the following areas: Geosciences Breadth, Disciplinary Fundamentals, Data Gathering, and

Quantitative Analysis. Graduate students organize a student colloquium each spring semester with monetary prizes for the best talks and posters in a number of categories. Our graduates have been highly successful in obtaining employment in academia, government and industry. At least six petroleum companies visit the department annually.

The Department is widely regarded as a leader in a number of research areas and a trendsetter in defining emerging research directions, especially through cutting-edge programs at the interface of disciplines, for example in Earth System Science. The innovation of our faculty has recently reaped major rewards in funding, with significant awards granted for BRIE (Biogeochemistry Research Initiative for Education; NSF-IGERT), PSARC (Penn State Astrobiology Research Center; NASA), Petroleum GeoSystems (funded through a consortia of oil companies), CEKA (Center for Environmental Kinetics Analysis; NSF Environmental Molecular Science Institute) and Africa Array (a new initiative to promote geophysics training and research in Africa with NSF funding). Research programs in the Department involve over \$3 million per year in expenditures. We recently have made significant advances in broadening and strengthening our expertise through faculty hires in emerging areas such as geobiology and in fields that have traditionally been key to our national reputation (hydrogeology and petrology). In addition, a search in the rapidly evolving field of solid Earth geoscience is in progress. To accommodate the new faculty, the Department also has made a large, long-term investment in laboratory renovation.

Several College- and University-wide programs enable the Department to be successful in recruiting faculty. Institutes in Environmental Sciences, Life Sciences, and Materials Sciences have promoted faculty hires at the boundaries of disciplines such as astrobiology, geomicrobiology, global change, and environmental geochemistry. These institutes also encourage collaboration among faculty in different departments. The College and University also have facilitated the hiring of women and minorities with special opportunity funds. Finally, the College has a formal spousal hiring policy providing matching funds that allow the Department to make competitive offers.

Several strategies stand out as enabling the success of our programs. (1) When a faculty member retires, the College immediately returns the salary of a junior-level hire to the Department. (2) All recent faculty searches are aimed at broad disciplines. This produces a pool of high-caliber applicants and also has successfully allowed us to recruit top female professors. (3) Our Promotion and Tenure committee reviews every pre-tenure faculty member each year, providing strong guidance and mentorship. (4) Every faculty member is evaluated each year on teaching, research, and service, promoting excellence in the classroom as well as in scholarship. (5) The Undergraduate and Graduate programs both have an Associate Department Head, a Staff Assistant, and a Program Committee that is charged with oversight of curricular issues and advising.