### ED11B-0115 0830h POSTER

#### Northwest Tribal Interaction with Washington State University: Research and Education Opportunities Afforded Through the Center for Multiphase Environmental Research

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The under-representation of Native Americans in engineering and science at the student and practicing engineer or scientist level is a national problem. To begin addressing this problem Washington State University (WSU) has initiated discussio with local Native American tribes to strengthen the relationship between WSU and the tribes and to improve the educational opportunities available to tribal members. The Center for Multiphase Environmental Research (CMER) received a 1999 National Science Foundation (NSF) Integrative Graduate Education and Research Training (IGERT) grant to train Ph.D. students. The main goal of the program is to foster multidisciplinary research and education for future scientists and engineers in the broad field of study that incorporates the fate and transport of environmentally significant species between interfaces. We are also focused on recruiting and educating Native American students. CMER is committed to cultivating its relationship with Native American tribes by identifying the environmental concerns of the tribes and developing collaborative research efforts utilizing CMER's infrastructure. Through these collaborative projects the CMER hopes to better understand the social and cultural aspects important to the tribes and develop the familiarity needed to effectively enhance student recruitment. This poster highlights the CMER's interdisciplinary research and teaching efforts and focuses on Native American recruitment.

### ED11B-0116 0830h POSTER

#### A Mentoring Program for Native Students

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Working in conjunction with several Tribal Colleges, the NASA Goddard Space Flight Center has developed a model program for mentoring Native students. In this session we will share our approach with others who would like to develop effective mentoring for successful internship and recruitment plans. Our program has proven beneficial to the mentoring scientists in terms of moving forward on their projects, and to the students and Universities, in terms of gaining meaningful research experience and new pathways opening between our institutions.

## ED11C MCC: 3012 Monday 1020h

## Building Strong Geoscience Departments: Examples That Work I

*(joint with OS, C)*

***Presiding:*** **C A Manduca,** Science Education Resource Center, Carleton College**; R H Macdonald,** College of William and Mary

### ED11C-01 1020h

#### Earth Sciences at Boston University: Reorientation and Renewal

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Beginning in 1994 with the renaming of its Department of Geology as the Department of Earth Sciences, Boston University has invested much effort into developing a modern, energetic department that excels in its dual research and teaching mission. These changes required strong leadership at the departmental and senior administrative level, but they have resulted in a moderately sized program (9.5 full time faculty) that is competing with "Top Ten" institutions for graduate students and faculty, and which is also placing its undergraduates in the leading graduate programs. Most of the revitalization was achieved over a 5-year period in which across the board changes occurred in our undergraduate curriculum and during which we recruited junior and mid-level faculty on the basis of their scholarly abilities and for their belief in the culture of our new mission and program. The undergraduate curriculum, which had been oriented towards traditional geologic offerings, was greatly increased in rigor (requiring a full year each of calculus, physics, and chemistry) and redesigned to expand flexibility in the broad field of earth sciences. During the evolution of the curriculum, it was extremely important not to confuse "tradition" with "rigor". Undergraduates became more critically involved with our research mission through senior theses, a formal Undergraduate Research Opportunities program, and by work-study participation in the laboratories. By making the program more challenging, over the period of 3 years we doubled the number of majors and minors and increased the average GPA by 0.5 units. Now, after 8 years, we have nearly tripled our overall number of students, with further improvements in quality and intellectual diversity. The opportunity to replace departing senior faculty was achieved through effectively arguing to the central administration that modern earth sciences are an essential component of any leading institution of higher education. By persuading the administration to take advantage of targets of opportunity in hiring, we were able to recruit about 1/3 highly visible mid- or senior-level faculty and 2/3 junior faculty. Recruitment of an external Chair was the single most critical action, and was taken near the outset of the rejuvenation. Further hires were staggered over 5-8 years, to ensure compatibility and minimize transitional issues, and are continuing. We did not replace departing expertise with that same expertise and, above all, faculty with quantitative approaches to earth sciences were welcomed. Once on-campus, all faculty are involved in the various aspects of the re-building process, so that all are enfranchised and invested in the program. Based on AGI statistics, critical mass in earth sciences only begins to be realized at the level of 13-15 full time faculty. We have not achieved that number yet, but have created an integrated program by ensuring cross-fertilization across the scientific methods used by the various faculty. The key strategy was to ensure that regardless of a professor's specific orientation, the approach taken is relevant to a variety of disciplines (e.g., chemical diffusion in metamorphism is analogous to diagenesis). As a result, our research productivity has increased by an order-of-magnitude as measured by external grants and journal citations, with each faculty member now supporting 2-3 graduate students and their associated research costs. In less than 8 years, the department has not only changed direction and dramatically increased in student size and quality, but in the process it has gained a national and international stature that speaks well of our efforts to date and serves as a stimulus for further gains.

### ED11C-02 1035h

#### Strategic Planning for Interdisciplinary Science: a Geoscience Success Story

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The Department of Earth and Atmospheric Sciences at Purdue University has engaged in a continuous strategic planning exercise for several years, including annual retreats since 1997 as an integral part of the process. The daylong Saturday retreat at the beginning of the fall semester has been used to flesh out the faculty hiring plan for the coming year based on the prior years' plans. The finalized strategic plan is built around the choice of three signature areas, two in disciplinary fields, (i) geodynamics and active tectonics, (ii) multi-scale atmospheric interactions and one interdisciplinary area, (iii) atmosphere/surface interactions. Our experience with strategic planning and the inherently interdisciplinary nature of geoscience helped us recently when our School of Science, which consists of seven departments, announced a competition for 60 new faculty positions that would be assigned based on the following criteria, listed in order of priority - (i) scientific merit and potential for societal impact, (ii) multidisciplinary nature of topic - level of participation and leveraging potential, (iii) alignment with Purdue's strategic plan - discovery, learning, engagement, (iv) existence of critical mass at Purdue and availability of faculty and student candidate pools, (v) corporate and federal sponsor interest. Some fifty white papers promoting diverse fields were submitted to the school and seven were chosen after a school-wide retreat. The department fared exceedingly well and we now have significant representation on three of the seven school areas of coalescence - (i) climate change, (ii) computational science and (iii) science education research. We are now in the process of drawing up hiring plans and developing strategies for allocation and reallocation of resources such as laboratory space and faculty startup to accommodate the 20% growth in faculty strength that is expected over the next five years.

URL: http://www.science.purdue.edu/COALESCE/

### ED11C-03 1050h

#### Building a Geoscience Program in an Adverse Fiscal Climate: Keys to Success

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Despite an almost 50 percent decline nationwide in undergraduate geoscience enrollment between 1995 and 2002 the Department of Geology at the University of Wisconsin - Eau Claire has experienced a 20 percent increase in the number of majors and minors studying geology over the same period. The department now has 90 majors/minors studying geology in an institution with 10,000 student headcount. In the face of declining State support for public higher-education and eroding university budgets, the Department of Geology has also added two faculty positions and over 1.3 million dollars in new laboratory equipment over the same period of time. Keys to building a successful program have been faculty recruitment and retention efforts, an increased emphasis on excellence in undergraduate collaborative research, attention to building a faculty and student community of scholars, and collaborative promotional work with other science departments. In addition considerable efforts have been devoted to explicitly recruiting top quality students from introductory courses and effectively using students to promote the department at the local, regional and national level. Recruiting top quality faculty is crucial and has required competitive salary packages, significant start-up funding and negotiating spousal hires within an extremely tight fiscal climate. Retaining faculty also requires attention to salary issues especially salary compression. One key to our success has been the undergraduate student's willingness to support high-priority academic activities such as collaborative research, technology initiatives and department capstone field experiences through a university-wide voluntary tuition surcharge. Many of the strategies that have been successful at UW-Eau Claire are transferable to other institutions.

### ED11C-04 1105h

#### Strength Through Options: Providing Choices for Undergraduate Education in the Geosciences

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Undergraduate major enrollments in the Department of Geosciences at Penn State have held steady over the past 5 years despite generally declining national trends. We have successfully recruited and retained new students through intensive advising coupled with innovative curricular revision aimed to meet an array of students' educational and career goals. Our focus is on degree programs that reflect emerging interdisciplinary trends in both employment and student interest, and are designed to attract individuals from underrepresented groups. In addition to a traditional Geosciences BS program we offer a rigorous integrated Earth Sciences BS and a Geosciences BA tailored to students with interests in education and environmental law. The Earth Sciences BS incorporates course work from Geosciences, Geography and Meterology, 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. We are working actively to recruit African-American students. A new minor in Science and Technology in Africa crosses disciplinary boundaries to educate students from the humanities as well as sciences. Longitudinal recruitment programs include summer research group experiences for high school students, summer research mentorships for college students, and dual undergraduate degree programs with HBCUs. 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. Enrollments in courses for non-majors have also increased substantially over the past 5 years, while those of other PSU science departments have decreased. We attribute this success to changes in pedagogic approaches, focusing on active learning exercises in large (200+) and small (< 75) courses. Innovative use of an electronic personal response system has also improved attendance, enrollment and student learning in our general education courses. This approach was developed by a fixed-term faculty hire in Geoscience Education. As per our departmental strategic plan, we plan to hire again in this area to further these successes and implement new approaches to learning and teaching in our undergraduate educational programs.

### ED11C-05 1120h INVITED

### Recruiting Minority Geoscientists: A 30 Year Success Story

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The University of New Orleans (UNO) is located in a city rich in diversity and industries that employ geoscientists. Thus, it is an ideal place to develop a strong diversity program in geology and geophysics. In 1974, Dr. Louis Fernandez received a grant from the NSF to formally develop a minority recruiting program. The focus of that initial program was a field trip for local minority high school students and that trip has gone continuously every year since then. It is still our best tool for recruiting outstanding minority students into our department. The initial NSF funding disappeared long ago and was replaced variously by support from private industry and creative use of departmental funds which kept the program alive through some lean funding years. As a result of this effort UNO has graduated more minority, particularly African-American, geoscientist than any other institution in the US for most of the past 30 years. The field trip is not the only reason for our success. Indeed, retaining and graduating students, regardless of their ethnicity, required a serious commitment to education on the part of our department. There are six universities in the city of New Orleans and several more within commuting distance from the city. Three of the six local universities are HBCU's with excellent reputations but, fortunately for us, no geoscience degree programs. There are several strong geoscience departments in the non-minority serving institutions in our area that attract many outstanding local students. To meet the competition, we have worked with local K-12 teachers, developed additional programs to interest local 7-12 students, and worked closely with our majors to keep them in the program and help them succeed once they are recruited. This has required a cohesive effort on the part of our faculty and students that is constantly changing to meet new demands as our department has expanded in size and developed its research activities sometimes at the expense of teaching. The result is something we are very proud of– 40% of our undergraduates and 20% of our graduate students are minority students. This is increasing each year, particularly the graduate enrollment, without any apparent decrease in non-minority enrollment or division within the student body.

URL: http://www.geology.uno.edu

### ED11C-06 1135h INVITED

### Faculty Activity to Reach Consensus and Develop the SF-ROCKS Outreach Program

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The Geosciences Department at San Francisco State University has prided itself on the excellent relationships among its faculty and students and on its proven ability to train students for careers in industry and academia. Yet, like many Geoscience departments, it recognized a need to generate higher enrollments in the undergraduate majors programs and to increase collaborations among departmental disciplines (in our case, geology, meteorology, and oceanography). To address these concerns, the department created a new outreach program that involves a majority of the faculty and that aims to increase the number of students (particularly those from underrepresented groups) who pursue a career in Geosciences at SFSU and who appreciate the role of the geosciences in their daily lives. The outreach idea was generated at a retreat of departmental faculty in January 2001. The department chair (Grove) used a classroom teaching technique to have faculty brainstorm ideas about increasing student enrollments and to reach consensus about actions to be taken. The faculty was divided into 4 groups of 3 members. Each group member spent 10 minutes brainstorming ideas and writing each idea on a post-it note. Group members then convened for 15 minutes to cluster their post-it note ideas into affinity groups. Each group subsequently had 10-15 minutes to present their ideas to the larger group, who then proceeded to decide on action items. From this activity came a clear consensus about the need for more outreach activities, and the faculty decided to submit a request for funding to a newly created NSF Geosciences program (OEDG—Opportunities for Enhancing Diversity in the Geosciences). Our proposal was successful and we received a 5-year grant to fund SF-ROCKS (Reaching out to Communities and Kids with Science in San Francisco), a program now in its second year and directed by the current department chair (White). The multi-layered program involves faculty and students from SFSU and City College of San Francisco with local high school teachers and their students (see session ED15 for high school student research results and program web site—http://sf-rocks.sfsu.edu—for more details). The program has created more cohesion among department faculty and has been an effective mechanism for engaging faculty and students from our range of Geoscience disciplines, and for providing college students with meaningful experiences in the discipline.

URL: http://tornado.sfsu.edu/

### ED11C-07 1150h

### Integrating Research and Education: Preparing Graduate Students to Teach

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The link between research and teaching at all levels is increasingly recognized, and can be an attractive as well as an effective part of a graduate program in geoscience. At Brown we have a strong partnership between our department and the university's teaching center. The Sheridan Center for the Advancement of College Teaching provides resources and programs to help grad students improve their effectiveness as TAs and their qualifications for obtaining a teaching-related job, as well as to promote and facilitate improved teaching by faculty. Departments are encouraged to designate faculty and grad student liaisons to the Center and to take advantage of Center programs (including seminars on topics such as Persuasive Communication, Cognitive Diversity, Developing a Syllabus, Assessment, and Teaching Portfolios) and resources (such as books, tapes and videos and Individual Teaching Consultations), as well as to develop their own discipline-specific programs. The Geol. Sci. Dept. has been an active participant in Center activities from the start, but we have also developed our own activities and programs. Each year two geo faculty and two grad students serve as official liaisons to the Center, in addition to organizing and running a variety of programs within the department, including: orientation sessions for new graduate students and first-time TAs, 'microteaching' practise sessions with constructive feedback for new TAs, mid-semester discussion and feedback sessions for current and more experienced TAs, as well as lunch meetings for all interested faculty and grad students to discuss aspects of teaching. These activities have increased the awareness and effectiveness of teaching and learning in our department, for example promoting faculty and TAs to implement syllabi with stated goals, in-class active learning exercises, small group projects, a greater number and variety of writing assignments, and greater diversity in assessment. The effectiveness of our program depends in part on the University-backed Center to provide certain resources and general programs, but also on having a core of several faculty and grad students within the department who are strongly committed to the program. Another key element is the dedicated involvement of undergraduate TAs and Writing Fellows who are an invaluable part of our teaching teams. Overall we have found that the emphasis on teaching improvement is a strong recruiting tool in our graduate program, as well as significantly strengthening the credentials of our MS and PhDs.

### ED11C-08 1205h

### A Coordinated Approach to Curricular Review and Development in Undergraduate Geoscience Programs: Using a Matrix to Identify and Track Skills and Skill Development

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One approach to curriculum review and development is to construct a matrix of the desired skills versus courses in the departmental curriculum. The matrix approach requires faculty to articulate their goals, identify specific skills, and assess where in the curriculum students will learn and practice these skills and where there are major skills gaps. Faculty members in the Geology Department at Carleton College developed a matrix of skills covered in geology courses with the following objectives: 1) Geology majors should begin their "senior integrative exercise" having practiced multiple times all of the formal steps in the research process (recognizing problems, writing proposals, carrying out a project, reporting a project in several ways); 2) Geology majors should learn and practice a variety of professional and life skills life (e.g. computer skills, field skills, lab skills, and interpretive skills).The matrix was used to identify where in the curriculum various research methods and skills were addressed and to map potential student experiences to the objectives. In Carleton's non-hierarchical curriculum, the matrix was used to verify that students have many opportunities to practice research and life skills regardless of the path they take to completion of the major. In William and Mary's more structured curriculum, the matrix was used to ensure that skills build upon each other from course to course. Faculty members in the Geology Department at the College of William and Mary first used this approach to focus on teaching quantitative skills across the geology curriculum, and later used it in terms of teaching research, communication, and information literacy skills. After articulating goals and skills, faculty members in both departments developed more specific skill lists within each category of skills, then described the current assignments and activities in each course relative to the specific components of the matrix and discussed whether to add assignment or activities. We have found that much conversation among faculty and change within courses happens simply as a result of compiling the matrix. One effect of the use of the matrix is that faculty in the department know fairly specifically what skills students are learning and practicing in their other geology courses. Moreover, some faculty members are better suited by background or inclination to teach certain sets of skills. This coordinated approach avoids unnecessary duplication and allows faculty to build on skills and topics developed in previous courses. The matrix can also be used as a planning tool to identify gaps in the curriculum. In our experience, the skills matrix is a powerful organizational and communication tool. The skills matrix is a representation of what the department believes actually happens in the curriculum. Thus, development of a skills matrix provides a basis for departmental discussions of student learning goals and objectives as well as for describing the existing curriculum. The matrix is also a graphic representation, to college administrators and outside evaluators, of the "intentionality" of an entire curriculum, going beyond single courses and their syllabi. It can be used effectively to engage administration in discussions of departmental planning and needs analysis.



## ED12A MCC: Level 1 Monday 1330h

## Building Strong Geoscience Departments: Examples That Work II Posters *(joint with OS, C)*

***Presiding:*** **C A Manduca,** Science Education Resource Center, Carleton College**; R H Macdonald,** College of William and Mary

### ED12A-0117 1330h POSTER

### Strong Geoscience Departments in Research-Intensive Universities: How do you Know you are One and how Much Planning is Needed to Stay One?

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How do you know your geoscience department is strong? Can it stay that way without conscious planning, relying instead primarily upon day-to-day decisions? The University of Arizona is a member of the American Association of Universities (AAU), a self-selected group of 63 of the most research-intensive public and private institutions in the United States. We