

Geosciences at California State University, Long Beach (CSULB): Synergistic Earth System Science/Community-Research Based Education Partnerships

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The Geological Sciences department at CSULB is valued for high quality of instruction, faculty research, and a strong focus on student achievements and opportunities. Geological Sciences is also a major contributor to the general education and teacher preparation programs at CSULB. Faculty members have been successful in acquiring external funding for research and education programs from such entities as the National Science Foundation, ACS-Petroleum Research Fund, and the National Geographic Society Foundation, to name a few.

But perhaps of greater importance to the department's success has been the ability of department faculty to look outward – to see the possibilities of linkages to other areas of the university – toward creation of a new, more flexible identity. As Rick Behl of CSULB Geological Sciences noted in his recent GSA presentation: when faced with the need to recruit more students to major in geology, the department could have “circled the wagons” – tried to identify key competitors for scarce resources (i.e., student majors, research equipment, space), and fought for dominance. Instead, key faculty in the department opted to focus on interdepartmental and inter-institutional collaborations to expand the *total* numbers of students engaged in geosciences. These collaborations are characterized by attention to three important elements: (1) outreach & recruitment, (2) continuity within the educational pipeline transitions of high school, to community college, to university, and, (3) synergistic - *not forced* - sharing of resources

Aspects of what might be termed “geoscience” are taught in at least three departments housed within two separate colleges at CSULB. Although the bureaucratic challenges to forming a shared geoscience identity on campus are not insignificant, a thriving community *has* formed over the course of the last ten years. The three main departments that teach and do research in aspects of the geosciences include: geological sciences, geography, and anthropology (which houses the archaeology program).

Although there are many examples that could be cited, I have chosen to highlight three recent developments at CSULB that demonstrate the breadth and depth of partnerships in the geosciences. These examples serve to illustrate how the department of Geological Sciences, has been “propelled ...to its current position of strength” through both “intentional and strategic partnering.”

(1) **Environmental Sciences and Policy B. A. and B.S. degree.** After more than five years of in-depth and detailed consultations between faculty in variety of departments in the College of Liberal Arts and Natural Sciences and Mathematics, two exciting new undergraduate programs in Environmental Science and Policy emerged. The leaders of the new undergraduate major: Stan Finney, Chair of Geological Sciences, and Darwin Hall, Professor of Economics, collaborated to create a broad-based, project-oriented curriculum that brings together rigorous science preparation with humanistic and policy issues at the forefront. The program began in Fall 2003, and already has substantial enrollments. <http://www.csulb.edu/programs/es-p/>

(2) **IIRMES - Institute for Integrated Research in Materials, Environments, and Society.** This exciting collaboration between geology, biology, and archaeology faculty seeks to enhance the educational and research opportunities of students and faculty members who wish to pursue academic studies in a new interdisciplinary field that attempts to integrate the physical, natural and social sciences. Acquired & maintaining key instrumentation for student and faculty research has been achieved by Institute members through NSF MRI, CCLI, and standard research grants. Equipment holdings currently include: (1) Quadropole ICP-MS, (2) Time-of-flight ICP-MS with laser ablation, (3) Environmental Scanning Electron Microscope with EDS & WDX, (4) Gas-source light stable isotope mass spectrometer, (5) Optical and infrared thermoluminescence reader (dating), (6) Ground-penetrating radar, electrical resistivity, and magnetometer equipment. <http://www.csulb.edu/programs/iirmes/>

(3) **Geosciences Diversity Enhancement Program (GDEP).** For the past three years (2002-2004) faculty in the departments of geological sciences, geography, and anthropology at California State University, Long Beach have joined to offer an NSF-funded (GEO-0119891) eight-week summer research experience to faculty and students at Long Beach area high schools and community colleges. GDEP's goal is to increase the numbers of students from underrepresented groups enrolling in geoscience undergraduate programs. As GDEP has matured, research projects have become more interdisciplinary, and faculty research teams have expanded. In the first year, each CSULB faculty member tended to lead her/his project as a separate endeavor. By the third summer, faculty were collaborating in research teams. Several projects have involved community-based research, at sites within an hour's drive from the urban Long Beach campus. For example, last summer, four faculty linked together to conduct a comprehensive geography and geology study of an Orange County wilderness area, resulting in creation of maps, brochures, and websites for use by the general public. Another faculty group conducted geophysical surveys at an historic archaeological site in downtown Los Angeles, producing maps of underground features that will be incorporated into a cultural center and museum. Over the past three summers, the program has grown to involve more than 25 high school and community college students, and more than 30 CSULB, high school, and community college faculty. <http://www.csulb.edu/depts/geography/gdep/>

The story of geosciences at CSULB seems to mirror the evolving culture in the greater Los Angeles area: less of a melting pot...more of a multicultural stew. Each of the departments retains its separate identity, but collaborations form to benefit all partners in geoscience education at CSULB. Perhaps most intriguing are the close linkages now present between natural and social sciences, fulfilling the promise of earth system science education, and echoing one of the opening paragraphs in E. O. Wilson's **Consilience**.

“The greatest enterprise of the mind has always been and always will be the attempted linkage of the sciences and humanities.” (**Consilience**, Chapter 2: The Great Branches of Learning, E. O. Wilson)

**What you have read is (more or less) my own personal opinion, and reflects my particular perspective – that of an academic administrator who is also a geoscience educator. I would like to thank Rick Behl of the Department of Geological Sciences at CSULB, who generously shared his fall 2004 GSA presentation with me, and with whom I held helpful conversations about this essay topic. Thanks, Rick – many of the ideas presented here are yours/mine/ours. – Beth Ambos*

The Journey from Department to School: A Time and Space Odyssey

**E. Scott Bair, Chair
School of Earth Sciences
The Ohio State University**

Like Earth, academic geology programs evolve over time, sometimes despite the wishes of faculty and alumni. Academic evolution usually occurs as a result of internal driving forces. Internal forces driven by faculty retirements and enrollment trends facilitate slow, incremental changes in department curricula and research strands. Rapid, wholesale changes are rare and usually are driven by internal administrative decisions during periods of diminished (state) funding. External forces such as job opportunities and business trends infrequently drive changes in departmental research but certainly drive student enrollments. The evolution of our department over the past half century shows decades of slow internal change that is punctuated by rapid changes driven by administrative decisions and student enrollments. At present, we are experiencing a period of very rapid evolution as our department morphs into a *School of Earth Sciences*.

The first President of Ohio State, Dr. Edward Orton, was an ordained Presbyterian minister and a Harvard-educated geologist. The geology department was among the first academic units created within the university. Like many early geology departments at land-grant institutions, the composition of our faculty reflected the need for expertise and the dispersal of knowledge about the state's natural resources. At Ohio State, the first faculty members in geology had expertise in oil and gas exploration, coal and clay mining, clay mineralogy, paleontology, and glacial geology. A vestige of being one of the foundational departments of the new university, our two buildings are located on the main quadrangle. From the 1940's through the 1960's, we were a department consisting of 12 to 15 male faculty with a prominent emphasis and reputation in paleontology, stratigraphy, and sedimentology reflecting the fossiliferous strata cropping out along the Cincinnati Arch in western Ohio and the importance of the coal reserves and oil/gas fields in eastern Ohio.

In 1972, the Department of Mineralogy merged into our department adding five male faculty and forming the Department of Geology and Mineralogy. Although a mutual decision, it was a means of survival for the mineralogists who were no longer doing much research or advising many graduate students, and whose teaching had become almost exclusively service oriented. In 1988, the department changed its name to Geological Sciences. This reflected a change in faculty composition and an internal decision to evolve into a more balanced department by replacing retiring geologists and mineralogists with faculty in the more applied fields of geophysics and hydrogeology. In the late 1980's and early 1990's, the hydrogeology program grew rapidly through the competitive acquisition of an Ohio Eminent Scholar in Hydrogeology, backed by a \$1.2 million endowment, which in turn brought a third hydrogeology position. Two more positions in hydrogeology were added in the late 1990's. In the past 20 years, nearly half the graduate degrees awarded by the department have been in hydrogeology and a substantial percentage of the department's research revenues have come from these faculty.

The 1990's also saw the emergence of the paleoclimatology and polar geology groups in the department. These multi-department programs are affiliated with the Byrd Polar Research Center. The paleoclimatology group has achieved international fame for its ice core research. The main faculty member from our department in this group has published a staggering 11 papers in *Science*, all as lead author, and has won several university, national, and international prizes for his work. He was named by *Time/CNN* as one of the 'Top 10 Scientists' in the United States. Throughout the 1990's, faculty in our paleontology program received awards recognizing their research excellence. Our paleontology program was and continues to be rated among the top six graduate programs in the country by *U.S. News & World Report*. The 1990's also saw our geophysics and environmental geochemistry programs achieve prominence.

While specific research areas in the department flourished in the 1990's, as a whole, the department began a slow decline in graduate and undergraduate enrollments as employment in the domestic energy and mining

industries went through another cycle of major cutbacks. These seemingly incongruent trends in research success and enrollment decline continue to be part of the evolutionary challenge that all college and university geology departments face. During this period, state tax revenues also declined and state support of its public universities was significantly cut back. Our department lost one faculty line to retirement of a paleontologist but later gained a junior position in chemostratigraphy.

In the 1990's, Ohio State created a number of programs designed to help departments foster interdisciplinary research and achieve higher national ranking. These competitive programs were based on evaluation of internal proposals that were funded by 'taxing' indirect costs from research grants. Our department garnered two 'Academic Enrichment Awards' – one for hiring a half-time computer illustrator to help faculty teaching our service courses and another for hiring a stable isotope geochemist to work with faculty in the paleoclimatology and hydrogeology research programs. For a number of reasons, sadly, neither of these positions has been filled.

Being one of six departments in the College of Mathematical and Physical Sciences is a challenge. Because geology does not receive grant support at the same magnitude as chemistry, physics, and astronomy, our department is perceived by the upper administration as one of the weaker departments in our college. Our grants per faculty member and dollars per grant ratios are less than those of three other departments in our college. Yet, when we compare our yearly grant expenditure data with the other Big 10 departments of geology, our department consistently ranks third or fourth in annual grant expenditures and is usually one of only three departments whose grant expenditures exceed its total faculty salary. After years of being overlooked by Deans and other upper-level administrators, as a group we have developed a mild inferiority complex, which was reinforced by a previous Dean who told us "... like many boutique departments, geology is not central to the mission of the university." [How's that for *rapid devolution* – from a founding department to a boutique department in 100 years.]

Dean's move on, administrations come and go, and departments usually survive. Two years ago, with the hiring of a new Dean, our fate began to change. The new Dean encouraged us to diversify our research strands and funding streams, and to hire outstanding faculty at any rank to do this. He also prodded us to become a *School of Earth Sciences*. Last year, we hired three assistant professors: two female, one male. This year, we are making job offers to two faculty currently at other universities (one male, one female). We now have 25 faculty, could have 27 shortly, and likely will have 32 (27 male, 5 female) by the beginning of the 2005-06 academic year when the *School of Earth Sciences* opens. Five faculty in geodetic science, including an endowed Ohio Eminent Scholar in Geodynamics in the College of Engineering are transferring into our new school.

One progressive Dean can make a huge difference in the evolution of a department. The Dean is mortgaging the college budget on the premise that future increases in indirect costs recovered from increased grant revenues will pay for the additional faculty. This puts a great deal of pressure on the department to increase its grant revenues. It has required us to broaden our research beyond the geological sciences, to restructure our teaching assignments to provide additional research time for faculty with large grant commitments, and to develop a Strategic Plan, a School Plan, a Space Plan, and Patterns of Administration for governing the new school. These initiatives and planning documents necessitated creating several ad-hoc committees and holding lots of extra faculty meetings to broach & vent, discuss & vent, and implement & vent the necessary changes. [Did I mention the need for faculty to vent?] The most contentious of these changes has been the Space Plan, which needs to provide the new faculty with suitable and sufficient office and lab space to do the work needed to acquire tenure. This space usually comes at the expense of existing faculty who are not effectively using their space, unwilling to clean it up, and unwilling to part with it.

For our Department, the rapid evolution from a department to a school has been both a nightmare and a dream come true. When the transition is complete, we all recognize that the arduous journey will have been worth taking.

Department of Geology, University at Buffalo

Department Overview

Gregory S. Baker

As of Spring 2005, the University at Buffalo (UB) Department of Geology (www.geology.buffalo.edu) has 10 full-time tenured/tenure-track faculty, two research (non-tenure-track) faculty, and two adjunct (non-tenure-track) faculty instructors. The number of tenured/tenure-track faculty has remained about the same over the past 25 years, though we have hired one faculty per year for the last three years (mainly to replace faculty), and will be hiring this Fall to grow up to 11. We currently have 75 undergraduate majors (either BS or BA), the highest since 1990 and up from a low of 45 in 1998. Productivity—as measured by grants, publications, and numbers of graduate students (both Masters and PhD)—is on a similar upward trend.

We believe there have been two keys to our success and growth over the past 10 years. First, both previously existing faculty and faculty hired during that period have been highly productive in research. We currently average more than four publications per year per faculty member in prominent journals, and all but one faculty member has more than one active grant. The department average for grant support is about \$100k per year per faculty. This is greater productivity per faculty than several benchmark institutions. Based on this performance, it has been relatively straightforward to justify additional faculty lines to the administration as having greater “bang for the buck” than most other departments on campus, and has been an important factor in our growth.

The trend of increased productivity generally began with the hiring of an external department chair and subsequent implementation of a major change in departmental structure, although this could be either causal or coincidence since we only have anecdotal evidence. Regardless, the main decision of the new chair was to alter the departmental form from the one-faculty-per-specialty model (i.e., geophysics, structural geology, paleontology, petrology, hydrology, etc.) to being centered on a limited number of focus areas. Initially, there were two focus areas—environmental geology and volcanology—but we have recently increased the number of focus areas (mainly due to our increasing faculty size) to three by adding global change. The synergy of the faculty collected into the focus areas improved the graduate program (through availability of graduate courses), and has added healthy competition both among focus areas and among faculty within focus areas. Our positive departmental mentality is generally reinforced during day-long faculty planning retreats scheduled one- to two-times per year, at which time we revise our five-year plan.

The second key to our success has been the increase in our student numbers (both undergraduate and graduate). The increase in graduate numbers has come from the increased number of faculty, but also from that fact that each faculty currently has, on average, more than six graduate students (both MS and PhD). Increased numbers of “paying” graduate students (i.e., either actually paying tuition or supported through a research assistantship) is the current focus of the UB administration, and thus represents an important area growth for us. Our follow-up on recent graduates indicates a high degree of accomplishment in their employment, whether geology-

related or otherwise, signifying (at least anecdotally) the level of success of our graduate program.

The increase in undergraduate numbers has mainly come from higher enrollment in undergraduate introductory geology courses. In general, we have found that about 6% of students in our introductory course sequence “become” geology majors (either BA or BS), and this has remained fairly steady for at least a decade. Thus, since our main introductory sequence has grown from 75 students in 1999 to 240 students in 2004, we have seen the number of new majors per year from that sequence increase from about 6 to about 14. In addition, we offer a second introductory course sequence and have seen similar increases in enrollment and subsequent increases in the number of majors, such that we now graduate 20-25 undergraduates per year. Other factors that may influence and attract geology majors include: (a) our popular field camp, which is situated in Colorado, Utah, and Wyoming (www.geology.buffalo.edu/fieldcamp); (b) our active graduate & undergraduate geology clubs that plan trips and “get togethers”; (c) the constant revision of the curriculum in order to make the course content and course sequences more relevant to today’s demands; and (d) the Buffalo Geosciences Program (www.bgp.buffalo.edu), which is a NSF-sponsored program—housed in our department—that is designed to enhance diversity in the geosciences. In general, our undergraduate population is 55% female and 45% male, and evenly divided between the BA and BS options. As a result of the growth in our undergraduate program, the administration has increased the number of Teaching Assistantships available for us to support our graduate students. The follow-up on our recent undergraduate students shows a high degree of success in employment (geology or otherwise) and/or graduate school within five years of graduation.

The trend of increasing student numbers began in 1998 with the hiring of two new Assistant Professors and another Assistant Professor the following year. Two of these new hires replaced departing professors in the two largest introductory course sequences, and the growth in those courses has largely been driven by their popularity, as reflected in significantly improved student evaluations. In addition, undergraduate advising changed during that time to include an “Advisement Week” every semester in which the Director of Undergraduate Studies had a mandatory meeting for a minimum of 15 minutes with each major in the program. Prior to this formalized advising, the department operated on more of an open-door policy but this often resulted in only the diligent students (who didn’t really need guidance) showing up. The mandatory undergraduate advising has resulted in a significant decrease in course conflicts and delayed graduation, and an increase in planning effectiveness for the following semesters’ courses (due to accurate foreknowledge of the headcount). In addition, students did not react negatively to the mandatory nature of the advising—in fact the opposite took place in which students are often telling the undergraduate studies director that “we can tell this department cares about us” and “I left my other major because they didn’t seem to care, and I heard it is different in geology.”

In sum, our department—though relatively small—is held in high regard within the university administration because of (1) our significant per capita research productivity and (2) the upward trend in numbers of undergraduate and graduate students. As of spring 2005, our department is healthy and appears to be continuing to move in a direction favorable to both the faculty and the administration.

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 11th 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.

Department of Geology and Geophysics, University of Utah

David S. Chapman

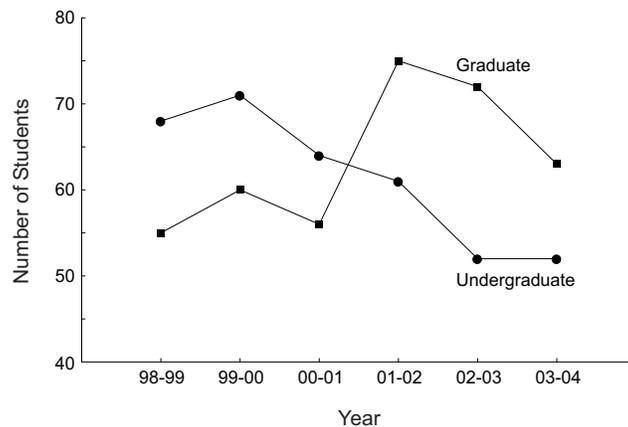
The standing of the Department of Geology and Geophysics at the University of Utah traces back to the 1970s. A combination of factors, including a strong chair who ruled for 12 years, a clear vision, rigorous hiring practice, and uncompromising emphasis on excellence in both teaching and research, established a departmental culture that has persisted through the last three decades. Maintaining that culture through a constant rotation of the chair (typically three year tenure), changes in the University's administration and funding paradigms, swings in undergraduate enrollment, and changing emphasis in funding areas, has been a challenge. Our responses to these challenges may mirror many other departments in the country.

Profile

The Department of Geology and Geophysics (GG) has 22 regular faculty, 2 lecturers, 8 research faculty, and 15 adjunct faculty. The faculty are active scholars, averaging 2.5 papers and 4 abstracts per year. Annual research funding hovers around \$3M. Over the past five years the department has averaged 61 undergraduate majors and 63 graduate students. The average graduation rate has been 17 B.S., 11 M.S., and 6 Ph.D. degrees.

We offer five undergraduate majors: Geology, Geophysics, Geological Engineering, Environmental Earth Science, and Composite Earth Science Teaching. Each, it is argued, offers separate career paths and is therefore an important aspect of maintaining an attractive opportunity for prospective students. Geology, Geological Engineering, and Environmental Earth Science, each at one time in the last two decades has accounted for the majority of our undergraduate majors. Overlapping courses serve multiple majors and so the marginal costs in maintaining them has never been a compelling reason to reduce our offerings to simply a single Earth Science degree.

The total number of majors in all options, however, is problematic. Whereas our students believe the student to faculty in GG of 6.4 leads to many benefits, the University must respond to pressures of much higher student to faculty ratio of 29.2 overall. The high quality and steady number of graduate students, about 75% US citizens recruited from top schools is considered a strength of the department and has provided some insulation against criticism about overall numbers.



Initiatives

Initiatives that provide students, staff, and faculty opportunities to grow intellectually and creatively, are a major part of any department's vitality. The three examples below illustrate how initiatives play a part in the current vitality of our department at the University of Utah.

1. Reviews of Earth Science – a new graduate seminar.

In 1999, we created a new course, Reviews of Earth Science, for all incoming graduate students. The student-centered seminar had many objectives: (a) to bring students of disparate backgrounds in the geosciences and related subjects to a common, high level of understanding in a core of knowledge in Earth Science, (b) to introduce new students to many faculty in the department, (c) to promote cooperative learning and a sense of community among graduate students, (d) to stress the importance of synthesis, integration, and presentation, and (e) to build and sharpen communication skills. Seven topics are addressed in the semester (Earth systems approach – Lake Bonneville as an example; tectonics of Western North America; 6 Billion and counting - humans as agents of geologic change; global energetics of the Earth (energy fluxes); global mass fluxes and cycles; lithosphere-hydrosphere interactions; geology and human health. Each topic is broken down into sub-topics with students responsible for obtaining data and presenting the data with some description to the group each week (typical AGU/GSA presentation). Three groups of students in the seminar were sufficiently motivated by this student-centered approach to continue with another semester centered on preparing for a field trip: New Zealand in 2000, East Africa in 2003, and Italy in 2005.

2. GK-12 project “WEST”

In 2003 the department was successful in landing an NSF GK-12 grant for a project titled WEST “Water, the Environment, Science, and Teaching.” WEST has created a partnership between the departments of Geology and Geophysics, Meteorology, and Biology (Ecology and Evolution), the Museum of Natural History, and the Salt Lake School District. In addition to the mandatory time in classroom, WEST graduate student fellows are organizing field trips, creating inquiry based field and classroom experiments, and participating in a graduate seminar on water and the environment.

3. Strategic Planning

As part of a university wide activity the department has developed a strategic plan with the goal of building and maintaining a competitive research program that produces top-quality undergraduate and graduate students with internationally recognized research programs and a modern teaching program. Strategic objectives include: (1) building integrated science and engineering alliances that provide interfaces among earth science, engineering, ecosystem science, and social science; (2) increase undergraduate experiences beyond the classroom; (3) increase the number of student majors; (4) increase the number of, and funding for, graduate students; (5) focus future faculty appointments on areas of selected strengths; (6) relocate the department in a new building with state-of-the-art facilities; (7) aggressively seek funding to meet instructional, computational, and instrumentation needs. Objective # 5, in particular, has energized faculty as we have recast the more classic titles of faculty positions in the past (economic geologist, igneous petrologist, seismologist, etc.) into five general areas of strength:

internal processes and dynamics of the Earth, surface processes and paleoclimate, water-Earth systems, Earth history and paleobiology, and Earth resources and exploration.

Department of Geological Sciences, California State University, Fullerton
Diane Clemens-Knott, Professor and Chairwoman

The Department of Geological Sciences at Cal State Fullerton is undergoing something of a renaissance: we have a young faculty (6 untenured; 4 tenured; 1 on-going hire; 1 planned hire), a 4-year-old master's program that's steadily expanding, and a relatively new science lab building. About 5 years ago, we decided on a theme that guides our faculty hires and curriculum design: Quaternary Geology. But despite recent changes, we're holding on to some ideals we hold dear. We're in a University that has always revered teaching excellence and teacher education; hires are made with the understanding that tenure requires excellent teaching. And we're in a college that has as its motto the fostering undergraduate research; in fact, we occupy a special place in the college as the one department that *requires* an undergraduate thesis...and we've done so for 30+ years. Finally, the new faculty continues the original commitment to field-based education: I estimate that a typical major spends a minimum of 22 weekends in the field, plus one-month of field camp. Virtually all faculty members conduct field-based research, though many are also engaged in lab- or computer-based research.

The students have a wonderful camaraderie. While this is, of course, their own accomplishment, there are a number of ways the department supports their solidarity. The field- and lab-intensive curriculum provides lots of time for student interaction. In particular, the Introduction to Field Techniques—the third class taken by most students—requires 5 weekend trips. By mid-semester the students have bonded, and they'll take most of their remaining coursework together. We provide a student lounge equipped with lockers, networked computers and printers; the club has provided a sofa, refrigerator, and runs an honor snack bar that benefits the entire department. Also, every three years we start a nighttime core sequence—in addition to enabling nontraditional students to earn degrees, the nighttime students appear to bond very strongly. Finally, whenever possible, we pay for students to attend and present at professional meetings and field trips, and encourage their grant writing efforts.

Unlike other departments in our college, we have no problems with retention of majors. This may be due to the field-intensive curriculum (with concomitant student bonding), required advisement each semester, and the intense, one-on-one mentoring that accompanies the required student-faculty research. Students know that local employment opportunities abound—in 14 years, I've never known a student to be unsuccessful in finding a career-track geoscience job. Moreover, students, faculty and staff seem to be happy in the department; this seemingly trivial characteristic seems to be a key to our success. But we do have a significant problem with the recruitment of majors: in the early 90's we had 80+ majors, and this number dropped below 30 a few years ago. We're crossing our fingers that an upswing is happening, with the latest count of undergraduate majors at 49. This year we're beginning a substantial recruitment effort that targets CSUF freshman. We developed a series of general-education, lecture-lab courses that we feel are high interest (e.g., Earthquakes and Volcanoes, Dinosaur World) and will be offered in ways that permit freshman first enrollment rights. Important aspects in course design include class size (60 seat lectures—half the size of our Physical Geology lectures—coupled with a required, 30-seat lab; freshman have difficulty getting seats in our impacted Physical Geology lab), a service-learning component (required by Freshman Programs and purported to improve student success in college), and a completely subsidized, weekend field trip.

Last month we received final approval for a redesigned undergraduate curriculum that requires fewer units (a University goal), addresses recruitment, and modernizes the content of the major:

- At two faculty retreats, we identified curricular problems and brainstormed about solutions.
- We surveyed our alumni regarding their perspectives of the program and industry needs.

- We drafted a list of learning objectives for the geology major.
- We scrutinized geology and related fields courses, and made appropriate changes, including
 - the addition of new portals into the major, as *substitutes* for Physical Geology (Earth's Oceans and Atmospheres, Earthquakes and Volcanoes, Dinosaur World), each of which meets the 100-level learning objectives that the faculty deemed necessary for future geology majors [all majors will still take Physical Geology Lab];
 - the addition of a course in hydrology and surface processes to the core;
 - a redistribution (but not diminishment) the field-time and writing practice;
 - and the option of alternate pathways through the related fields courses, which will enable students to tailor their science/math coursework to their particular interests in the geosciences, while not compromising rigor.
- We constructed (and continue to update) a 5-year course rotation scheme for the undergraduate and graduate curriculum that meets student, curricular and staffing needs, and allows for students (and faculty!) to plan their courses and activities with confidence.

Some additional strengths of the department include

1. Dollar-based budgeting: as long as we meet our teaching target within our budget, the Dean doesn't micromanage our course offerings or how we use our resources, putting the department more in control of its activities and future plans.
2. Committee design: Each tenure-track faculty is responsible for overseeing one subset of department community: everyone occupies a seat on either the Personnel Committee (tenured only), the Graduate Committee, the Undergraduate Committee, or the General Education Committee (which oversees the lecturers and GE students).
3. Lecturers: we currently have 13 M.S.- and Ph.D.-level lecturers with whom we're exceptionally pleased. In recent years, the GE coordinator has worked to provide them increased support on campus, in the form of offices, computers, and opportunities for professional growth. A few lecturers are participating in pedagogical research and creating a 100-level laboratory manual tailored to our university.
4. Department Personnel Document: working together over the course of a year, the faculty wrote a very detailed document that lays out the specific requirements for tenure and promotion. Though this 2-year-old document is slated for revision, it certainly has helped the untenured faculty design their personal pathway to successful tenure.
5. Earth Science week activities: over the last three years we've hosted a series of activities (including career forums, dinner speakers and overnight field trips), which we use to reach out to alumni and employers (as well as bring together students and faculty). These informal gatherings also have served to introduce alumni to the new faculty, and as a result many alumni have chosen to return to earn master's degrees.
6. Seminar series: during the past 4 years we have hosted a regular, bi-weekly seminar followed by a department-supported dinner that serves both scientific and socialization goals. Attendance is typically >40. Graduate students are required to attend for a minimum of two semesters. A contingent of biologists regularly attends the more environmental talks.

In addition to undergraduate recruitment, the major challenges to our department include faculty recruitment (due primarily to astronomical housing prices), limited space, budgetary uncertainty, and the challenges of fostering camaraderie and out-of-class interactions in a predominantly nighttime masters program.

Diane Doser
University of Texas at El Paso
Building Community at a Commuter Campus

The University of Texas at El Paso (UTEP) serves the urban border region of El Paso/Juarez (population 2+ million) where 60 to 70% of the population on the U.S. side speaks Spanish at home. UTEP is a commuter campus with most undergraduates holding one or more jobs to support their education. Thus it takes an average of 6 years to complete their BS degree and over 50% of students are the first in their family to graduate from college.

UTEP was originally established as a college of mines and metallurgy to train mining engineers primarily for work in Mexico. Thus geology classes have been taught at the university since its founding over 90 years ago. The Department of Geological Sciences was the first program at the university approved to offer a doctoral degree. The original program was geared to the oil industry, with a practical internship required; however these conditions were dropped in the mid-1980's. Thus the University looked toward our department for advice when it began to propose and develop other doctoral programs in the late 1980's and early 1990's. UTEP has also repeatedly recognized the teaching and research accomplishments of the department and individual faculty members.

The Department of Geological Sciences offers BS and MS degrees in geology and geophysics and a Ph.D. in geological sciences. In addition, we teach an earth science sequence required of most students receiving teaching certification, and are participating in an MS in teaching program with the first life/earth science cohort beginning their studies in fall 2005. We participate in interdisciplinary BS and MS degree programs in Environmental Science and a PhD program in Environmental Science and Engineering through teaching, research and student mentoring activities.

The department has involved undergraduate students in research projects for over 15 years, with considerable effort spent in the past 5 years to increase funding opportunities for these students. We have found that once students can be supported on research within the department they are able to spend more time on campus, they interact with faculty and other students on a more regular basis and feel part of the department's culture. Our recent analysis suggests undergraduate students who are able to engage in research are able to raise their grade points by an average of 0.5 and are able to shorten their time to graduation by at least 1 to 2 semesters.

In addition to research assistantships for undergraduates, we cultivate a close student community by promoting student professional organizations and other social interactions. Activities include outreach (e.g. celebration of Earth Science week with a department open house, participation in science fairs, visits to local K-12 schools), workshops and orientations (e.g. a pre-academic year orientation for graduate students, workshops on resume writing and life after college), professional development (support of student travel to regional and national meetings, especially when they are within a day's drive of El Paso) and purely fun events (the first week of the semester work afternoon/ice breaker, the end of spring department picnic).

The highlight of our yearly activities is a student run research colloquium that is now in its 19th year. This day-long event is organized and conducted by students as a professional forum to showcase their research. Students submit abstracts, produce an abstract volume, present papers or posters on their research, invite a guest speaker, plan coffee breaks and meals, and invite geoscience professionals from the oil, environmental and mining industry to serve as judges. Industry support has helped provide generous monetary awards to best student papers and helped defray the costs of meals. A Saturday field trip usually follows the colloquium. Not only do students have the opportunity to present research in a professional setting that is less intimidating to them, but they have the chance to interact with professionals throughout the day. Several oil company representatives that were invited have been so impressed with our students that they made it a point to add UTEP to the group of campuses that they recruited from in subsequent years. This year we are holding the colloquium early enough to use it as a recruiting tool for prospective graduate students, since we feel it is an excellent way for these prospective students to see what kind of research our students are conducting, to gauge student satisfaction, and to easily locate and interact with faculty, since all geology classes are cancelled the day of the colloquium.

Faculty within the department share a strong commitment to these activities that help bring our department together. Several run weekly research groups (which include both graduate and undergraduate students and even the occasional high school student who may work in the summer). Others teach workshops, host social events, and serve as field trip leaders, club advisors or advisors for colloquium.

The Geology Department, The Administration, and the Roots of Failure and Success

For the past five years, I have had the privilege to work on the academic administrative staff of the chief academic officer at my university. Over that time, I have been afforded the opportunity to observe a variety of interactions between academic departments and the central administration. These observations have served to solidify previously established personal notions of the characteristics of successful departments as well as to highlight the importance of some things I had not previously considered. The following is a brief description of some of the lessons I have learned about the complexity of relationships between central administration and the academic department.

We're from the administration and we're here to help you.

Commonly, central administration is viewed by the department as a burdensome annoyance, prone to capricious decisions, as the proliferators of useless memoranda and reporting requirements, and on occasion as a entity acting in an actively hostile manner towards the department. I cannot, unfortunately, assure you that in all cases those impressions are false. I can, however, suggest that in most cases such impressions are the product of a myopic appreciation of mission. When I entered into the first of the several positions I have held in the Office of Academic Affairs, many of my friends and colleagues teased me about "joining the dark side." The notion that I had been enticed by the evil empire of academic administration, while generally humorous, could not have been more inaccurate. I felt strongly at the time, and even more strongly now, that academic leadership was an art and a skill not taught to graduate students or junior faculty and it was a skill I desired to attain by trial of fire. So, if central administration is not in fact a malicious troll under the bridge to our future- what is it?

I am of the opinion that academic administration at the university level has five essential duties: the establishment of a core **vision**; the **filtration** of the vast volume of rules, regulations, and requirements demanded by state commissions of higher education and accrediting bodies; the **synthesis** of the wide ranging activities and accomplishments of the various academic units; the source and model of **leadership** development that will guide the future of the university, and finally the **manager** of an increasing scarce pool of resources available for sustaining and advancing the mission of the university.

When these duties are accomplished with skill, dedication, honesty, and integrity, the results for any department can only be beneficial. Of course, leadership requires decision making, and no decision of consequence can ever be both universally popular and universally beneficial. None-the-less, I feel strongly that a successful department must approach its dealings with its administration as synergistic collaborations rather than as antagonistic confrontations.

What we have here is ... failure to communicate.

Universities are intrinsically hierarchical in their organization: departments report to schools, schools to colleges, and colleges to the university. The details of this structure, while different at different institutions, share a common characteristic of all hierarchical organizations, the currency of organizational power is information and that information flows through the channels of communication. In my experience, a root cause of success, or failure, for a department, resides in the quality of communication that existed between the department and the higher levels of the academic hierarchy. There are several characteristics of quality communication: honesty, directness, timeliness, completeness, and most importantly the ability to listen. If the lines of communication are not open and if the quality of communication is poor, then information is not readily exchanged, and all decisions are made through a veil of inaccuracy and misinformation. The results of which can become catastrophic for the department.

What responsibilities does a department have to ensure that its communications with the central administration are successful? First, the department must be a skilled receptor of communication. That means listening carefully to the statements made by the administration and closely reading all written materials distributed. This need not be, however, a totally passive action. Rather, the department should actively engage in the review of academic proposals and drafts of policy documents. The vetting of such materials is an essential aspect of university

administration, and central administrators are constantly looking for meaningful, constructive feedback. Second, the department must respond to requests from the administration in a manner that is timely, accurate, and complete. If the administration can come to count on the department to respond to requests for information, data, or documents it goes without saying that a more positive outlook will be developed towards the department and its needs.

Assessment here, Assessment there, Assessment Assessment everywhere

The importance of effective teaching to the mission of the geology department can not be overstated. Clearly, everyone understands and agrees that quality teaching is of the highest priority – it is the central mission of all universities. However, the assessment of teaching effectiveness is complex. After all, what is good teaching? There is no single answer to that question. Unfortunately, there exists a commonly held misperception and misapplication of assessment, that is to say, assessment is not evaluation. Importantly, the goal of assessment is the collection of data, not the passing of judgment. As it turns out, it is rather difficult to assess teaching effectiveness; yet, there exists a fairly straight forward process to assess student learning. First, learning outcomes must be clearly articulated. What do you want students to know? Second, an assessment strategy must be established. How will you know if the students learned what you want them to? Third, student learning must be evaluated against an expectation. Was the level of learning they achieved satisfactory?

The ongoing movement towards more extensive and more complete assessment is driven by accrediting bodies and state commissions of higher education. In many states, budget shortfalls are causing state legislatures to begin to ask more detailed and probing questions about the efficiency, effectiveness and impact of the higher education process. Departments must learn to respond positively to these demands and use them as a springboard to a better, more effectively delivered, geology degree. One need only look to the intensity of assessment that currently occurs in public primary and secondary schools to see the not too distant future of higher education.

Plan your work, work your plan

Of the numerous administrative tasks with which geology departments are charged none seem to meet with as high a level of disdain and direct hostility as do processes of programmatic review and strategic planning. These duties often run counter to the philosophy and work habits of many geologists. With increasing frequency, allocation of new and existing university resources is driven by the accreditation requirements of professional and technical programs. As such, geology departments are challenged to justify their continued existence and fight for increasingly scarce resources. The rising tide of retrenchment and budgetary reduction can only be stemmed by serious reflection and well-considered action plans. It is the department's responsibility to align all of its academic and administrative reporting with the universities mission and goals. If the department cannot articulate its mission and priorities within the context of the university strategic plan, it is highly unlikely that adequate resources will flow back to sustain and grow the program. Finally, the department must be able to make a case for itself. What does it mean to be a well-functioning department? Faculty must agree on a set of critical measures of successful performance. Central administration is deeply appreciative of thoughtful, honest self-evaluation. Those departments that can define measures of performance in teaching, research, and service, as well as evaluate the level of performance achieved, will more often than not find that their administration is receptive to discussions of departmental needs.

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Building strength through curriculum reform and ‘community’ development

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Background:

McMaster University is a ‘research-intensive, student-centred’ university with over 18,000 full-time students. The School of Geography and Geology (SGG) was created in 1997 through amalgamation of the former departments of Geography and Geology. A large number of faculty retirements (20 out of a combined faculty of 30!), declining student enrolment in undergraduate geology programs, and budget constraints precipitated this event. When SGG was initially formed, many of the existing faculty members were already involved in research with an ‘environmental’ focus (e.g. environmental geoscience and environment & health) and it was decided to further develop this area of strength with a limited number of immediate new faculty hires. An ‘environmental’ focus for the School was particularly appropriate as McMaster is located in an urbanized and heavily industrialized region of southern Ontario where students and the community at large are concerned with environmental issues. Senior administrators committed to additional resources if undergraduate enrolments in the School increased and we have hired 14 new faculty members since 1998.

Undergraduate programs

One of the first tasks of the new School was to revise and restructure all undergraduate B.Sc. programs in order to meet changing societal and employer needs and to attract more students. Impending professional certification for practicing geoscientists in Ontario was an additional stimulus to curriculum reform. Prior to program design a series of surveys were conducted to collect information from in-program students, alumni, and potential employers regarding the characteristics of an ‘ideal’ geoscience graduate. Survey results showed that the ‘ideal’ graduate should have a broad geoscience background, but should be specialized in a particular field, should have been exposed to ample ‘hands-on’ (experiential) learning and should have well developed personal transferable skills (e.g., problem-solving, critical thinking, communication skills). This information allowed us to design a B.Sc. Honours program in Earth & Environmental Sciences (EES) that included a common ‘core’ program, specializations (Geosciences, Hydrosciences and Geochemistry), systematic personal skills development and opportunities for experiential learning. The program fully meets the academic requirements for membership of the Association of Professional Geoscientists of Ontario. This single B.Sc. Honours program replaced seven separate programs offered by the former Geology and Geography departments and is proving to be very successful. Student enrolments in the EES program, and in courses taught in the School, are increasing every year and the core-specializations program structure has now been adopted by all other departments in the Faculty of Science.

Senior administrators at McMaster recognize the positive effects of such innovative curriculum reform and are encouraging similar efforts to be made in other departments within the university. Innovative curricula and instructional methodologies are highly valued at McMaster (the McMaster medical school has received international acclaim for

its PBL approach) and SGG has gained a positive reputation for having developed a new and successful undergraduate program. Senior administrators seek faculty members from SGG to serve on numerous committees examining and implementing educational initiatives at McMaster.

Development of a successful 'department'

Creation of a successful undergraduate program has contributed greatly to the development of a strong geoscience 'department' at McMaster but is not the only factor involved. SGG developed with a focus on environmental geoscience, allowing development of a 'critical mass' of faculty in particular research fields and encouraging research collaborations. SGG faculty members bring in over \$2.8 million of research funding annually. Both graduate and undergraduate students are excited by 'environmental' applications of geoscientific research and our graduate program is strong. Many undergraduate students are employed each summer as research assistants, and gain first hand experience with field, laboratory and data management projects.

SGG was successful in obtaining modest funding for educational initiatives (from internal and external sources) that have helped in the growth of an 'educational culture' within the School that involves all members of the community and includes undergraduate and graduate students, teaching assistants, faculty, staff and administrators. The funding enabled SGG members to implement innovative teaching methodologies and enhance experiential learning opportunities and skills development in a number of courses. This funding also allowed the development of information sessions and workshops for instructors to exchange information and develop teaching skills. Teaching workshops are held for graduate and undergraduate teaching assistants at the beginning of each academic year. Both graduate and undergraduate students are also involved in community 'outreach' activities that include classroom visits to elementary and high schools. Members of the undergraduate student society have been particularly involved in the design and delivery of a 'Rock and Mineral Road Show' to Grade 4 students in local elementary schools.

The success of SGG is also related to the development of a distinct community to which individuals (students, faculty, and staff) have a 'sense of belonging'. Opportunities for active learning and small group learning have been particularly important for encouraging identity with the SGG community. Field trips and field camps are integrated into the EES program at all levels (even at level I with over 350 students!) and allow close student-faculty-staff interactions as well as invaluable practical experiences. A strong academic advising system, with a dedicated advisor and continual tracking of student progress also helps undergraduate students realize their value as members of the School. Regular social events and an active undergraduate student society create opportunities for informal interactions between members of the community.

The success of SGG is due to a combination of factors – enforced change (amalgamation of two departments), carefully planned curriculum reform and ongoing development, funding for educational initiatives and creation of a 'community' to which all members have a strong sense of belonging.

Small but Fierce

Department of Earth and Environmental Sciences, Vanderbilt University David Jon Furbish

We are by national standards a relatively small department: five tenured and tenure-track faculty, to grow to seven this year, plus three lecturers. Our specialties, by faculty member, include: geochemistry and experimental petrology; hydrology, geomorphology and fluid mechanics; igneous petrology and tectonics; paleoecology, sedimentology and ichnology; and environmental geochemistry. We have about 20 undergraduate students including several minors, and about 15 graduate students, two at the Ph.D. level. Our small size presents certain disadvantages. For example, we can offer only a limited breadth of courses to our students; and we do not have “critical mass” faculty groups as conventionally defined. But there are clear advantages, too. These center on our cohesiveness as a faculty-student community, a shared sense of our mission, and a clear vision for the future — compatible with the mission and vision of the College and University. I summarize these points below, notably as they pertain to our current efforts to grow an interdisciplinary graduate program while continuing to give ample attention to the quality of our undergraduate program, and in relation to faculty recruiting, and item that looms large in our identity. Suffice it to say, here, that in aiming at excellence we collectively agree that all cylinders have to be firing, at all times. As a small department within a university that places the quality bars quite high for both graduate and undergraduate education, we cannot afford otherwise. Oh... and we have our own version of critical mass.

Formerly the Department of Geology, we officially became *Earth and Environmental Sciences (EES)* in September 2004, a change set in motion several years ago following an external review of the Department by a blue-ribbon panel of scholars. This change was in part a reaction to the same issues — enrollments, visibility, an evolving scope of our science — prompting departments across the nation to consider changing their names. But most importantly, *EES* correctly reflects who we are, where we are aimed, and how we fit within the University. Specifically, our vision starts with the idea that Earth science in the 21st century involves engaging a strong, balanced presence both in the past (the interpretation of Earth’s dynamic history) and in the present (modeling processes in modern Earth and environmental systems). This view derives from the recognition that, among the natural sciences, ours is the quintessential interdisciplinary science, providing vital perspective on how Earth’s physicochemical template — involving processes whose range of operative timescales is second only to cosmology — simultaneously sustains and threatens life, and influences human interactions with Earth. *EES* therefore is committed to nurturing student interests spanning traditional and emerging Earth-science fields, emphasizing unifying themes and tools in the study of Earth and environmental dynamics. We are aimed at educating students wherein they gain both essential depth in their studies, and exposure to ideas and skills that facilitate communication across disciplines, such that they are poised to excel in a diversity of life opportunities in all sectors of society. Moreover, this vision permeates all aspects of how we do business, from recruiting new faculty, to the design and revision of courses and curriculum, to our mentoring of students at all levels.

Vanderbilt University is currently pursuing two goals that bear on our department mission and future. First, the University is investing significant energy and resources toward strengthening a cross-disciplinary culture on campus. This includes substantial seed funding for interdisciplinary

centers that bring faculty and students together from traditional departments and programs, colleges and professional schools, aimed at nurturing critical, emerging educational and research opportunities that cross traditional boundaries. Second, the University is aimed at significantly strengthening the research and graduate education component of its mission. (The University is ranked 25th in the nation in external funding, and 5th in the nation in external funding per faculty; all faculty in *EES* are currently funded by NSF.) For us these themes translate most notably to our recent entering of a one-of-a-kind educational alliance with the Department of Civil and Environmental Engineering, wherein we are jointly offering a Ph.D. program in *Environmental Science* aimed at excellence in research and graduate education in emerging areas of national priority. (*EES* historically has offered the M.S. as its highest degree.) A key element of this program is centered on Earth surface and subsurface system dynamics involving the intersection of engineering and geological timescales — a direct manifestation of the vision described above (<http://sitemason.vanderbilt.edu/ees/GraduateProginEnvironmentalSci>).

An important, parallel change at the undergraduate level includes the centering of the administration of individualized majors and minors involving environmental themes, available to students in the College of Arts and Science, out of our department. This change is aimed at increasing the visibility of this option as well as maintaining consistency in the supervision of students enrolled in this option. Simultaneously, the College has recently revised its general education curriculum. Whereas this does not directly affect our own majors curriculum, it does open certain opportunities to develop courses that are aimed at exposing freshmen and sophomores to particularly compelling topics in the Earth and environmental sciences. Nonetheless, an ongoing challenge that we face is maintaining the needed balance and intensity in our efforts in the context of a small science department where demands on the time of all its members are necessarily, continuously high in relation to sustaining essential activities in all areas of our mission.

Central to our departmental identity is the makeup of the faculty — our specialties, the courses we offer, our level of engagement in department, university and professional activities. And, fundamentally underlying this makeup is our recruiting effort. Adding one new member to our small faculty (or in the example of this year, adding two new members) can have a very significant impact on all aspects of the department, including its collective temperament. It is therefore no surprise that our faculty possesses a heightened sense of responsibility to identify and recruit the right individuals — and we do this very effectively. Our recruiting efforts involve the full faculty at all stages (an advantage of our small size). We do considerable homework on individual candidates, including making use of recruiting services at professional meetings, and soliciting input from numerous individuals outside those listed as references by candidates. Our deliberations are refreshingly candid, and involve thorough, holistic assessments aimed at evaluating whether candidates have a balanced commitment to excellence in research and teaching, at both graduate and undergraduate levels, notably including non-majors. Our assessments are also holistic in relation to evaluating the potential for candidates to interact with current faculty and students; and whereas we do not necessarily expect collaborations among new and current faculty to occur, we definitely aim for individuals possessing a flare for intellectual engagement across fields and specialties. Moreover, a key element of this process is a *continuing* discussion of where we are aiming as a department as we consider candidate specialties.

In addition to recruiting individuals who will likely excel within our program, our attention to the potential for intellectual engagement is particularly important, as this is part of an explicit strategy to artificially grow the (intellectual) size of our program. Using our current faculty as an example, each of us collaborates with at least one other faculty member in the department, and several of us collaborate with faculty in other departments. This involves Co-PI research projects,

student thesis projects wherein two or more faculty members are actively helping in the design and implementation of the project, or similar collaborations involving unfunded, exploratory projects. In addition, we have a nice departmental culture that aims to involve our students (both graduate and undergraduate) in work with our collaborators around the nation and internationally, sometimes involving student travel to the labs and field sites of these colleagues as well visits by these colleagues to Vanderbilt. These collaborations, within and outside the department, thus have the form of faculty-student working groups that evolve over time. In effect, this is our version of achieving “critical mass” in certain areas; and it has the very nice effect of teaching, by example, desirable (collaborative) research habits and skills.

So what, in summary, are our current challenges? Our immediate agenda includes growing the department with new faculty hires and student recruiting, and instituting our interdisciplinary Ph.D. program with Civil and Environmental Engineering — a challenge that requires maintaining a solid Earth-systems perspective in the curriculum while broadening student training to nurture effective communication with other disciplines. Our challenge also involves balancing this growth in graduate education with continued care given to quality undergraduate education. Our success rests on maintaining a shared sense of our mission and an intellectual setting where ideas, and individuals, thrive.

Dr. Steve Good
Department of Geology & Astronomy
West Chester University of the State System of Higher Education of Pennsylvania
A Regional Comprehensive University

University 13,500 students, southeastern PA (30 mi from Philadelphia)
Department 75 majors in 3 majors; 11 faculty (2 astronomers, 1 meteorologist, 8 geologists)
BS Geoscience (career path: environmental consulting, few to grad school), 40%
BS Earth Systems (career path: environmental consulting) 20%
BS Earth & Space Science (career path: PA teaching certification) 50%
MA Physical Science (Professional degree for in-service teachers)

Metrics of success (staff, space, resources):

- our department was awarded two faculty searches this year (we requested only one),
- 2000 square feet of office space was transferred to us from the Biology Department
- our department received a financial award based on productivity

Why Geology & Astronomy is valued on campus:

- Department Chair: high seniority among the other chairs, served as chair of our Dean's search, served as chair of campus tenure and promotion committee, produces effective department reports
- High profile of other faculty on campus, (productive researchers with undergrad students, participate in and facilitate campus pedagogical workshops, serve on campus governance committees often in leadership roles).
- Teach general education courses that are popular, engaging, and pedagogically sound (as recruitment venue for majors, and to maintain enrollments for FTE productivity)

Nature of the student community in the department. Students community development is achieved by a moderately active geology club (with about 4-6 functions a year), and by providing a student room in the department. Community enhancement will be further improved by a new common core of courses required by all of our majors (to encourage community building in labs and field trips).

Faculty Vision, Collaboration & Curriculum. Regional comprehensive university students tend to be career focused, and our department graduates have excellent career opportunities (in a thriving local geology consulting industry and growing school populations with teacher shortages). A curriculum revision that was driven by external mandates (see below under challenges) was implemented in the Fall of 2003. Internal department debate weighed the goals of graduate program expectations versus professional certification requirements (see below) within the context of a substantial credit reduction (all baccalaureate programs limited to 120 credits). Our department maintains communication with alumni working as geologists and teachers in the region. We use this communication to focus on knowledge and skills necessary for our students' success after graduation and to provide internship opportunities to current students.

Challenges turned to opportunities. University administrators are applying business models to determine success of departments. Business terms applied to academia include productivity, efficiency and accountability. Failure of academic departments to meet these challenges can result in business-style consequences (you're fired).

- Productivity is measured by class size and graduation rates. The PA State System of Higher Education (SSHE) has established an "FTE" ratio which mandates an average

class size of 23.25 and incentives to achieve 23.82. A second metric is the number of graduates from a department, with “low-enrollment” status conferred on programs graduating fewer than 12 students in the past year. Efficiency in SSHE has been implemented by a directive that undergraduate programs not exceed 120 credits. Accountability is measured by a department generated and university approved assessment plan and by external accreditations.

- The productivity mandates require that introductory classes be larger enrollment yet engaging in order to recruit majors. Productivity mandate also requires attention to recruitment, retention, and graduation. The efficiency mandate has required a curriculum overhaul to reduce BS program from 128 to 120 credits, and our BSEd program from 134 to 120 credits. SSHE accountability values standardized test results that compare our students’ results with other universities. BS students mostly enter environmental consulting and will have to pass the ASBOG Fundamentals of Geology test and complete required courses in order to achieve PA Professional Geologist Certification. BSEd students become earth science teachers and are required to pass the Praxis Earth Science Content Knowledge test, and complete required courses required by the PA Department of Education and by the National Science Teachers Association (part of NCATE accreditation). While the curriculum revision reduced credits, it also is designed to meet the competencies required for licensure of our students.

Recruitment and retention: Our department actively recruits prospective new students (at campus open houses) and from students in the general education science courses. We have attempted to facilitate program completion by transfers to the department (both native and community college transfers) To facilitate late program changers and post-baccalaureate career changers, we have taken four actions.

- The department developed the BS Earth Systems track that is a curricular hybrid of the BS and BSEd programs.
- The department provides experiences for freshman and sophomores to work with public school students; participate in faculty research; volunteer with the local USGS office, or intern with an environmental firm.
- We host a “Careers in the Earth Sciences Workshop”. We invite three alumni (a teacher, a USGS or EPA scientist, and a private sector environmental geologist) to briefly describe entry salaries, academic and experiential preparation, a typical day at work, etc.. We then have two breakout sessions, where students interact in small groups with 2 of the 3 guests. Freshman and Sophomore students who participate in the workshop are less prone to senior program changing and more likely to do internships.
- We have modest grants programs available for incoming students and for upper division majors from the generosity of an emeritus faculty member’s donation.

Christopher Keane
American Geological Institute
Disciplinary Health and Geoscience Departments

Geoscience Departments and Maintaining Disciplinary Health

The health of a discipline is dependent on two components – a broadly accepting and educated public and a corps of well-trained professionals in the discipline. The balance of these two factors often varies depending on specific circumstances. Some disciplines can lean on the broad - but general - understanding of their work, such as philosophy. Though there is not a large number of philosophers currently employed today, not only is there a large body of the population who have taken philosophy classes in school, but a public perception of the discipline's role is widely accepted. On the other extreme, many people in the public have never taken a physics course, nor truly understand the discipline, but they recognize the well-trained population of physicists at work both in academia and industry and the products of their work.

One may argue that the geosciences currently are lacking on both components of disciplinary health – geoscience presence in education continues to face negative downward pressures, and there exists a perception of a dwindling corp of professionals. Though both arguments may be partially correct, the data collected by AGI in its disciplinary health surveys indicate that geoscience departments play a defining role in the health of the geosciences and many are doing well. As of the start of 2005, there are 903 identifiable geoscience departments in the United States, with 879 granting some sort of degree. This is a substantial change from 1990, when 838 departments existed in the United States and only 652 granted degrees. So where is the crisis?

The crisis is that there are shifts of power and success factors in the universities, often driven by numbers of students and political perception of a subject area. One crucial component for the geosciences is bulk education of the public through introductory geoscience courses. The number of students taking an introductory level geoscience course has remained steady from 1990 to the present, with approximately 250,000 per year. Today, nearly 8% of all students currently enrolled in a college degree program have taken at least one geoscience course. What is changing is the proportion of students taking GEOLOGY compared to the broader GEOSCIENCES - from 245,000 in 1990 to 175,000 today. The rest are touching the discipline through tailored courses in environmental science, meteorology, and similar non-hard rock courses.

Likewise, enrollment of majors has also seen remarkable internal shifts. In the 15 years since the divorce of geoscience enrollment trends to energy prices, gross geoscience enrollment has largely remained steady at approximately 18,000. However, traditional geology enrollment appears to be collapsing, with enrollments around 10,000. This shift may be viewed as a strategic redefinition within the

discipline, however, the numbers also suggest a potential false economy. The growth in the number of departments since 1990 has largely been from increased geoscience teaching in geography programs and the formation of new environmental science programs with earth science components. However, in that same period of time, over 50 long-standing geoscience departments have merged, been eliminated, or otherwise have stopped teaching geoscience. As best can be determined from the data collected by AGI, many of those failed departments folded AFTER they attempted transitioning into environmental science programs. In chasing students, they failed to recognize their own strengths.

Historically AGI has been able to establish five categories of departments: major research, medium-sized programs, liberal arts, community college, and non-geoscience institutions. Traditionally, the major research programs produce the vast majority of faculty and industry professionals. Today, there are about 35 departments in this category at mostly major state universities with comprehensive B.S. and Ph.D. programs.

The medium-sized programs traditionally produce the majority of bachelor and a large proportion of the master's degrees in the geosciences. This category, numbering perhaps 450 departments in all, is where most of the recent turmoil has occurred, with closures such as George Washington University and marked decreases in enrollments. Medium-sized programs, which tend to be at state and private institutions of many sizes, including major universities and even some smaller private schools, is also where many of the environmental transformations have occurred, with limited evidence of long-term success.

The liberal arts programs, mostly at liberal arts colleges, perhaps 50 departments today, represent the long-standing core of geoscience programs. Though some departments have been lost, a number show growing strength in their enrollments. On average, these programs have maintained fairly traditional geoscience programs while providing flexibility in their program to address institutional needs.

Community college programs used to be an area of strength for the geosciences, providing introductory science classes to the general population. However, over 40 community college programs in the last 5 years have disappeared or stopped all teaching of the geosciences. This shift also has set in motion the trend towards only degree-granting departments surviving. In 1990 fully 20% of geoscience departments did not grant degrees. Today, that number is now only 3%.

Another category for consideration are the departments that do not exist! Only 21% of colleges and universities have any formal geoscience courses taught on their campus. Though many of these 3000 institutions represent a small percentage of the total college-age population, it also demonstrates substantial political, philosophical, and economic factors that geoscience departments must be geared to face.

What appear to be the disciplinary-level keys for long-term departmental success? Focus on building on the core competencies of the existing program is central. The large research programs continue to recruit and place student successfully, and continue to represent the source of nearly all new US-educated geoscience faculty. These programs have established critical mass and are generally part of the cultural framework of those institutions. The other area of strength is in the liberal arts programs which have maintained their core programs through time. One part of the success of these program may be based on the idea put forward by Ed Roy of Trinity University – Liberal Science Education. Though we do not consistently collect numbers on this, a reasonable number of liberal arts geoscience graduates go on to non-geoscience careers. This is a critical component of satisfying the needs of disciplinary health – these graduates represent the core of the geoscience-aware public, and in their capacities as doctors, lawyers, teachers, and other professionals represent important ambassadors for the discipline as they bring to bear their geoscience education on other endeavors.

The crisis is change. Departments needing to change rapidly for survival are not succeeding. Departments that build on their core competencies continue to demonstrate that they can move with the cultural shifts needed to continue to attract students. Though the student is now often viewed as “The Customer,” sometimes the customer is not always right.

Geology Department
Bowdoin College
Brunswick, ME
Ed Laine

Bowdoin is an independent, nonsectarian, coeducational, residential, undergraduate liberal arts institution founded in 1794. It is located in Brunswick, Maine, a town of 22,000 on the Maine coast. Study at Bowdoin leads to a bachelor of arts degree in one of about 40 departmental and interdisciplinary majors. Bowdoin enrolls approximately 1,625 students from across the country and around the world.

While geology was first taught at Bowdoin in the early nineteenth century and many Bowdoin students have gone on to distinguished careers in the geosciences, the department first granted a geology degree in 1991. For thirty years Emeritus Professor Arthur Hussey was the sole member of the department until in 1986 Ed Laine joined the department, as Director of Environmental Studies. In 1988, Peter Lea joined the department to support the Arctic Studies Program. All three members of the department were first housed under the same roof, a state-of-the art science facility in 1997. With Art Hussey's retirement in 1997, Rachel Beane joined the department. In addition we have a two master's level laboratory instructors, Joanne Urquhart and Cathryn Field.

As we have built a department over the past six years, we focused on pedagogy and improving our teaching and research instruction. In the past year all three faculty have been publicly recognized by the college for our excellence and innovation in these areas.

- Why is your department valued by your institution?

One primary reason our department is valued by Bowdoin because we have created three introductory courses that are viewed as *open, engaging, and challenging*. Each faculty member teaches an introductory course that can count towards the major, but is chiefly populated with students meeting the Inquiry in Natural Science Requirement. Each course has as its basis field research in the local area with themes of either bedrock geology (Rachel Beane), hydrology (Peter Lea), or oceanography (Ed Laine). Each course uses a field-based, hands-on approach to geoscience. Each has a lab course with regular field trips, and each has a project component in which students work in small groups on true research projects (i.e., the precise outcome is not known ahead of time, even to the instructors). Course enrollments are capped at 36 (two lab sections) and are well-subscribed.

Our courses are viewed as open because the quantitative side of science is primarily delivered by field research through which students develop ownership of their data. Students acquire and develop quantitative tools of science as they pursue answers to questions that actively engage them. We have neither expressed nor implied pre-requisites for our introductory classes.

We consciously build and maintain community in each of these courses, finding that the safer and more open learning environment that results from this effort encourages greater intellectual engagement. On campus students recognize this openness and it is one

reason our enrollments have been robust. Students come to Bowdoin expressing a wish to engage in collective activity such as athletic teams, community service, and social organizations. That our classes provide an academic outlet for this clearly expressed desire is viewed favorably by the administration.

Our classes are engaging because each has a primary basis in field research. Doing science is a significant component of each course. Set labs and field exercise are aimed at building the capacity of our students to carryout research projects. Significant dialog in the classroom, the topics in lectures/labs, as well as most writing and reflection exercises occur in pursuit of answers to questions raised by field research projects.

Many students come to Maine because of its location and these courses allow them to become intellectually engaged with the rocks, sediments, and waters of coastal Maine. Two of the courses are focused on local environmental problems through either community-based or problem-based service-learning. The chance to engage with community partners furthers our students' intellectual engagement with course material. Service-learning courses in particular seem to engage woman students. Over the past 5 years 63% of the students in our service-learning-based introductory oceanography course have been women.

Students are intellectually engaged in our introductory courses because we introduce them to many of our research tools. Introductory students work with our SEM/EDS/EBSD, Seabird CTD, RF ADCP, and aboard our small research vessel. We use ArcGIS, MS Excel, and MS Publisher in our labs.

Our courses are viewed as challenging because they provide realistic field research. Students are asked to address geological, environmental, and oceanographic problems whose outcome is not known. Initially they must learn enough science to understand the problem and enough about field technique and instrumentation to design with guidance an adequate field program. After they have designed and carried out their field program, they are encouraged to reflect upon their initial results and perhaps carryout further observations if they are needed. With data in hand they are then challenged to acquire quantitative skills to analyze their data. From there they have to write/rewrite reports, make public presentations, and in many cases high quality posters. We find that such an approach successfully teaches the value of scientific inquiry, inductive reasoning and discovery, while exposing students to field observations and analytic and quantitative analysis.

- What is the nature of your students' community in the department?

Our emphasis on project work has led us to actively build and maintain community in our classrooms. When students feel safe in our classrooms they become more comfortable in their roles as active learners. When confronted with difficult or unfamiliar concepts they ask for help from each other and get explanations from their peers.

Students serving as TAs in our introductory courses, departmental assistants, and students doing research projects have office space in the department. TAs often have office hours during the evening, volunteer to run review sessions before exams, and assist introductory students with their projects and posters. Giving our majors both space and responsibility is a signal to them the importance we place on intellectual endeavor,

our recognition of their hard won academic achievements, and our value for them as individuals.

- What is the common vision the faculty share for the department?

We are bound together by a passion for pedagogy and for improving our teaching and research instruction. All three of us have embraced a field-based, hands-on, inquiry-based approach to our teaching and have found differing ways to express our commitment. Peter Lea does community-based learning in which he involves his students in environmental/hydrogeological projects of community importance. He has adopted a vertically-integrated approach that involves selected junior high schools throughout the state in the discovery process. Rachel Beane has adopted an approach to bringing research into the classroom that uses the rocks of Casco Bay as her natural laboratory and which allows students to carryout their inquiry using state-of-the-art equipment such as a SEM/EDS/EBSD. Ed Laine uses service-learning as a method of connecting his students with community partners with environmental/oceanographic needs/problems in Casco Bay.

We operate by consensus and try to share the work load equitably.

- How do the faculty collaborate to achieve this vision?

As we came together as a department in the late 90's, our collaboration started with extensive sharing of methods and approaches to teaching. We talked about what works well and supported each other with ideas on how to approach vexing problems. Initially we would meet all day at the end of the semester to discuss and analyze our successes and failures. Over time such discussion has become part of the department culture and our meetings in this regard are less formal.

Having such a clear vision of where we want to go has made it easy to speak with a clear voice to the administration. We analyzed both the resources and training we needed to achieve this vision and have had a consistent policy in approaching the administration to achieve our goals. When the college has not been able to move quickly enough, we have sought outside funding from NSF and private sources. In addition to adding to our inventory of equipment and instrumentation, external funding has added to a service-learning coordinator/laboratory instructor to our staff

We also have been willing to experiment with new approaches. Much of our progress in Information Technology (IT) has come because we are known as a department with a clear vision and a flexible attitude. We have stayed at the crest of the IT wave *at Bowdoin at least*, because we have been willing to try new technologies before they are rolled out elsewhere on campus.

- What makes your curriculum strong and aligned with the needs of the students, faculty, and institution?

Our graduates are able to get into very competitive graduate schools. Others find entry level positions with environmental consulting firms or with the USGS. Students who do not do summer research on campus find interesting and challenging work, in some instances leading to independent study or thesis work when they return.

We believe that our success in this regard is due to adopting a curriculum that fosters problem-solving and inquiry. In addition, we know that our emphasis on training our students with state-of-the-art tools is a door opener. For example, students compose their resume around the projects they have worked on instead of the courses they have taken, citing or even including reports they have given to community partners, emphasizing skills they have acquired, and demonstrating their communicative abilities. Being able to talk about a student in these terms makes it very for us easy to write letters of recommendation or do phone interviews, even for first year students who have only completed an introductory course.

Many of our students come to Bowdoin expressing a desire to be in the outdoors and learn about Maine. They also express a need to connect to the community and give service. Our curriculum allows them to do all these things and to reflect upon their experiences in an academic context.

As faculty, our curriculum allows us to do the same things. Every week we have many opportunities to continue to learn in an inquiry-based mode. We get out into the field and explore Maine and we connect to our community. Our emphasis on state-of-the-art software and hardware makes us keep abreast of new developments. Our emphasis on curriculum and pedagogy leads us to learn what others are doing outside the college. The college recognizes our efforts publicly and we work with faculty both inside and outside the institution to help them improve. Rachel Beane and Ed Laine were recently chosen as mentors for new faculty. Ed Laine consults throughout New England on service-learning for the Campus Compact.

Adopting an inquiry-based curriculum has altered our role as teachers. Instead of just delivering canned lectures, frequently we arrive with “just in time” material, suited to the needs of students as they struggle with their projects. We are no longer the distant custodian of knowledge: we have become mentors of life-long learning habits. Several years ago, instead of adding a new laboratory instructor, we added a service-learning coordinator/laboratory instructor, Cathryn Field, whose job description includes working with community partners to create strong, reciprocal partnerships.

The college has recently gone through a thoughtful examination of required courses and has reorganized this part of the curriculum around a model of “modes of inquiry”. Our inquiry-based curriculum, especially our introductory courses, is viewed as a model for how to deliver courses satisfying the Inquiry in the Natural Sciences requirement and as a model for how all sciences might refocus their energies.

- What other departmental activities (e.g. research, recruiting and mentoring students or faculty, field trips) are important in making your department, your faculty, and your students successful?

Important to our success has been a new science building whose design fosters our new curriculum. We now reside in a building that was completed in 1997 and share this facility with Biology and Chemistry. Three years ago our space went through a

major series of alterations which were improvements. In both instances we worked very carefully with our architects to design a space that would allow us to comfortably achieve our vision of an inquiry-based curriculum. Faculty and staff offices as well as student spaces were designed to foster communication and collaboration. Many of our labs are designed to be used flexibly and to serve several roles during a single semester.

Rachel Beane's efforts have allowed the college to acquire an SEM/EDS/EBSD through a combination of NSF and college funding. This instrument package is managed as a shared facility used by the sciences, Classics (metallurgy of ancient coins), and Anthropology. Broad use of the facility throughout the college has led to technician support within the department and a comprehensive service contract supported by the college.

In years past Peter Lea and Ed Laine have accepted significant administrative activities in areas important to the goals of the college. Peter was the first Director of the Coastal Studies Center and helped establish this facility as a show piece of multidisciplinary endeavor for the college. Ed Laine was Director of Environmental Studies (a coordinate major) for over a decade and helped build ES into a popular program that at times includes 15-20% of the majors on campus. Their efforts, like those of Rachel Beane with the SEM, have linked the department formally and informally with departments throughout campus, enriching and informing all in the process.

Finally, we have actively mentored research students during the semester and especially during the summer. Using a combination of grants and college funds we have regularly have ten or more students in residence during the summer. Some are working on thesis work and others have just completed their first year and are learning the ropes.

Conclusion

Key to our success has been an intense focus on pedagogy. Adopting a field-based and inquiry-driven curriculum influenced most of the decisions we have had to make. The strong faculty and staff consensus behind this pedagogic focus allowed us to clearly state our needs both within and outside the college.

Lisa Lamb
University of St. Thomas

In the fall of 2000, Tom Hickson and I inherited a 2 faculty geology dept with 4 majors, no student or professor research, no field requirement, very little standard lab equipment for upper-division co and a curriculum based on the offering of the same large (124 students) but popular, intro physical course every semester with a major that consisted of 6 required allied courses and 7 required geology courses with no choices and with few field-based labs. It had been a 2 faculty/1 adjunct department for 30 years where only 1 faculty member had a Phd. and neither were expected to do research. The department had a strong tradition of helping students individually and had recently moved into a new building with wonderful classrooms.

Tom and I were hired at the same time and expected to:

- assess, overhaul and update the curriculum
- improve and maintain an excellent teaching record
- introduce and maintain an undergraduate research program
- grow the number of majors

In the first 4 years and with the help of great adjuncts, we:

- continued to serve students as individuals, meaning we worked very long hours which allowed us to be available to meet often with students one-on-one
- added new focused-topic introductory courses designed to address varying student interests and recapture the curiosity of those turned off by science, following the advice of Barb Tewksbury and the Hamilton curriculum.
 - o each prof teaches a course that they are most interested in but each one contains the same basic core geology material so that the course can fulfill a lab requirement but also serve as an entrée into the major
 - o we designed the courses to include many in-class, active learning components to improve the pedagogy
 - o we designed all new labs for each course, including a few outdoor labs that take advantage of nearby outcrops
- overhauled the major curriculum by attending a national PKAL workshop, gathering information on other geoscience departments, adding and developing new courses, giving students choices
 - o at the same time, worked with the Dept of Teacher Ed. to redo the Earth and Space Science co-major
- with the help and support of administration, purchased new lab and research equipment for introductory and upper-division labs
- added research programs which intimately involve undergraduates, took undergrads to national conferences, published with them
- implemented field experiences in all courses, ranging from 1 afternoon to several days in length
 - o many of these serve as the data collection phase for multi-week and semester-long projects within upper-division courses
- we emphasize liberal arts skills and preparation for any career first, geology content second.

- we supported resurrection of the geology club and participated in many weekend service trips to Will Steger's environmental conference center
- introduced students to different career paths via a speaker series What Do Geologists Do?
- hired a third person who is energetic, motivated and committed to working with undergraduates and who's field (paleoclimate, paleoceanography) helps us move in a more environmental direction in both course offerings and student research

We now have 18-20 majors and have doubled to quadrupled enrollments in most of our upper-division courses. We got permission to hire a 5-year limited term but full-time person (and our dean fought hard for it to be a tenure track position).

What we believe has worked and led to our increase in majors:

- enthusiasm, enthusiasm, enthusiasm
- caring about students as people, caring about their success whether or not they pursue a traditional geology career
- field-based labs (better learning, better building of comraderie)
- flexibility in the major; increasing our environmental focus; changing some traditional courses to focus on better student learning and improved core skills

Clark College Geoscience

Bob Mackay

Clark College is a two-year community college in Southwest Washington within the Portland Oregon metropolitan area. It was founded in 1933 and presently has an average enrollment of about 8,000 FTE students.

Approximately 30 % of the Clark College student population intends to transfer to a college or university to complete a Bachelors degree. Clark College presently has two geoscience departments: Geology and Meteorology. Both departments are part of the larger Physical Science and Engineering division which also includes Astronomy, Chemistry, Physics, and Engineering departments. The workload for our fulltime faculty is 15 contact hours per week.

The Geology and Meteorology departments serve approximately 300 and 120 students respectively each year. Most of these students take our introductory courses to fulfill their general science distribution requirements. We do have 15 to 25 students each year who plan on completing a four-year degree in a geoscience related field including Geology, Meteorology, Oceanography, Environmental Science, and Engineering.

Our primary strengths are:

- 1) Our introductory courses are laboratory-based courses giving our students solid interactive hands-on and heads-on experiences.
- 2) Our classes are quite popular, typically filling early in the registration process.
- 3) We have small class sizes (~40 students) to allow us the opportunity to get to know each student as a person.
- 4) Our physical science division is rather small (~20 faculty) so that we can easily interact with each other and share exciting information and new developments from our specific disciplines. In theory this helps expose students in Physics and Chemistry to geoscience career possibilities. In fact, since I teach both Physics and Meteorology I often use examples from the geosciences in my Physics class and sometimes “recruit” Meteorology students.
- 5) For a community college, we have a very strong college foundation with excellent community support. This helps us fund equipment purchases, travel, or special projects even when state budgets are tight.

Our primary weakness is that we presently do not have an organized effort to promote geoscience to our students. Many students take our courses, learn great things about the world around them, and generally become uplifted with their new knowledge and insights about the Earth. Some students get so excited that they actually explore geoscience career options. However, if we could reach a critical mass of students truly interested in geoscience related careers, then we might actually develop a community of geoscience students. This core student community would likely help develop even more interest and growth in geoscience careers. We actually may have such a critical mass of students but many are interested in different aspects of geoscience. That is, we may not have a critical mass of future Geologists, Atmospheric Scientists, Environmental Scientists, or geoscience Engineers taken alone, but collectively such a critical mass of students interested in studying Earth as a career may exist. Breaking through the boundaries between the different geoscience disciplines may very well be a key component to strengthening geoscience programs at two-year colleges as well as colleges and universities with smaller programs.

Central Michigan University

Dave Matty

Central Michigan University is classified as a doctoral/research-intensive university by the Carnegie Foundation and has a current on-campus enrollment of approximately 20,000 students. It is a rural institution located in a town of ~28,000, is far from major Michigan population centers, and is the northernmost state-supported university in Michigan's Lower Peninsula. Originally chartered as a Normal School for prospective teachers, CMU is now a rather large, comprehensive university that is listed among national institutions by US News. In my opinion, however, it is still searching for its identity.

The Department of Geology at CMU came into existence in the late 1960's primarily as a result of a geologist becoming the Dean of the former School of Arts and Sciences. At that time, geology was part of the Geography Department, and in 1971, with the Dean's urging, the geology faculty formed a new Department of Geology. Some of the antics that occurred as a consequence of this departmental split haunt both departments today, but more on that later....

In the early years of our department, there existed a good mix of faculty of different ages, specialties, and experience. All faculty were strongly student focused and maintained an "open door" policy that encouraged interaction with students. The tradition of mentoring undergraduate students in research projects began in the 1970's and continues to this day.

In the decades since, the department has evolved yet remained the same. Faculty have come and gone, and some have made more of a mark than others. Over the years, we have argued successfully for additional faculty, and the size of the department has grown most recently to 4 tenured, 3.5 tenure-track (one joint appointment), and 3 adjunct faculty. Facilities have improved. We occupy almost five times the space we had in the 1970's and our classroom and lab facilities were extensively remodeled about a decade ago. We have acquired and maintain a number of analytical and field instruments that many undergraduate-only departments would envy. We are well-funded by our administration, and our normal budget allows us to subsidize field trips, faculty development, and equipment purchase and upkeep. Our library holdings benefit greatly from the attention of our science librarian, who holds a MS in experimental petrology from the University of Chicago.

The support of the university, a stream of excellent students, and certain values shared among the faculty have shaped our department and have helped it to remain strong over the years. Of course, all faculty are recruited and selected on the basis of their potential to teach well and to maintain a successful (and hopefully funded) research program, but perhaps most importantly, we strive to hire new colleagues who demonstrate a strong student focus in their application materials and, especially during their interviews.

Because we share a dedication to our students as a common focus, we find that we are able to agree on more things that we disagree on. This saves time and helps us all to "row the boat" in the same direction. We have impromptu meetings almost daily to share new ideas for teaching, and where possible, for research. We all have a "try and see" attitude rather than an "it can't be

done” one. We value and capitalize upon the diversity of strengths represented among the faculty. Our faculty includes several winners of university awards for research and for teaching, but this does not affect interpersonal relations and all remain collegial and willing to help colleagues when needed. We have one of the highest per-capita publication records at our institution and the record of securing external funding is also good. We’re a team.

Our majors benefit from our attitude and our resources. We treat them as a vital part of the department, provide them with various learning, research, and service opportunities, and set high expectations of them. We encourage them to work with faculty on research projects and to present and publish their results. Likewise, we encourage them to investigate opportunities “outside the box.” In recent years, one of our students has served as an AGI Public Policy intern and another as a Mars landing site adviser. Other undergraduates have published papers, presented at a Penrose conference, at regional and annual GSA and AAPG meetings, and have won a number of “best poster” awards in undergraduate research sessions at national meetings. About half of our students move on to graduate studies and the remainder find employment with industry or state government. We invite comments from the students about how to make the program better and we listen to their suggestions. Our curriculum is still rather classical, but has evolved in response to the comments and needs of students, and also to suggestions from alumni who know the needs of the workplace. In response to such suggestions, two new majors courses have been incorporated into the curriculum in recent years. How to ensure quality in the face of dwindling budgets and increasing class sizes is a constant problem with which we grapple.

A fair number of our alumni stay in touch with us, and we communicate with them via newsletters and through alumni events. Many are invited back to speak to our majors. We initiated an alumni board to provide input on curricula and other matters, and we are slowly establishing an alumni network to help alumni help current majors and each other. Several alumni serve as mentors for our current students a few are very active within the department and the college; one helped form our student chapter of the AIPG (the first in Michigan) and another is the current Chairperson of our College’s Capital Campaign Committee.

The success of our faculty, our students, and our alumni bring recognition to our program both within and beyond the university. Employers seek our graduates and we have several “corporate sponsors” that support our program through grants, scholarships, and by preferentially hiring our graduates. We work closely with our public relations and government affairs offices in an effort to draw internal and external recognition to the successes of our program. These efforts are exceedingly important as they keep our program in the field of vision of state and federal legislators, as well as on-campus administrators.

While we have a lot to be thankful for and proud of, the department has its troubles. As state appropriations and university budgets shrink, administrative attention sometimes shifts from quality to quantity, which conceivably makes our relatively expensive program vulnerable to potential cuts, mergers, or elimination. We have averaged only 6-10 graduates per year for the past five years, despite efforts to recruit students from introductory courses, etc. This is not good. At the same time, we’ve appeased administrators with an enrollment growth of about 25% during that period. This is due mostly to new general education courses, but such growth takes its toll in the time that faculty expend on instruction. Arguably, to some extent, our small number of

majors may be related to the troubled birth of our department and to the continued existence of a separate “earth science” program in CMU’s geography department. Resolution of our role in CMU’s earth science teacher education program and in the non-teaching earth science program (if such a program continues to exist) are topics of current discussion and at the very least, we will be exerting a stronger voice at those tables in the near future. Given that we maintain a strong program with a small number of students and faculty at present, our next challenge will be to maintain that program in the face of our expanded presence in these other related areas.

SAFETY IN NUMBERS

Dallas D. Rhodes

In the hierarchy of academic disciplines, most geology programs are grouped with others such as geography, classics, music, and LOTS (Languages Other Than Spanish) that have uncertain futures. Understanding and accepting this fact has played a key role in everything the Department of Geology and Geography (DoGG) at Georgia Southern University has accomplished over the past seven years. The Department's faculty understands that the program's future depends on the perception of its "value" to the University. "Value" in this usage can have many meanings. An essential first step was determining what the institution valued most.

Between Fall 1998 and Fall 2004, Georgia Southern University's undergraduate enrollment increased from 12,386 to 14,092. At the same time that enrollment was growing by 14%, the State's allocation for the University System of Georgia (USG) decreased by nearly 25%. Providing the core courses became one of the greatest challenges for the University and was the area in which the DoGG was able to contribute immediately.

The Fall 1998 semester also marked the shift from a quarter system to a semester calendar for the USG. With the change in academic calendars, Georgia Southern was compelled to revise the core curriculum. The new core requires three courses in the sciences (Area D1, a traditional laboratory science course, Area D2, a discipline-based environmental course with lab, and Area D3, an enrichment course). No more than two of the courses can be in the same discipline. During the first two years of the curriculum, the DoGG shifted resources to the area of greatest demand, i.e. Environmental Geology lecture and laboratory (Area D2). Additional sections of the environmental course were added at the expense of the traditional physical geology course offered in Area D1 (where students showed a clear preference for the general biology course). The adjustments ended when all sections of both physical and environmental geology consistently filled.

Tailoring course offerings to the demand for core classes (in geography as well as geology) helped the Department's annual student credit hour production grow from 5,372 in Fall 1998 to more than 10,000 during the current academic year. Furthermore, most of the increase came from greater faculty productivity. During the 1998-99 academic year, the DoGG ranked 13th out of 32 departments with a productivity index of 231 Student Credit Hours (SCH)/Full Time Equivalent Faculty (FTEF)/Semester. By 2003-2004, the DoGG was the second most productive department in the University with 427 SCH/FTEF/Semester, an increase of almost 85%.

At the same time enrollments were increasing, the DoGG undertook a number of initiatives to enhance the quality of the core courses. Important among these were \$2.5 million in renovations to the building that housed both chemistry and geology and geography funded by NSF, the State, and University. An NSF grant provided funds for a well field and monitoring equipment. In-house laboratory manuals, emphasizing local issues and using the resources available in the Department were produced and instrumentation for the analysis of liquid and solid earth materials was obtained. A field trip to the Georgia coast was made available at no cost to all students in introductory level courses.

The number of students graduating from academic programs is another important measure of “value” at Georgia Southern. In Fall 1998, the DoGG had been placed on the list of programs to be monitored by the Board of Regents due to the small number of recent graduates. With only 23 majors at the time, the need to “grow” the program was obvious to everyone. Adding the first geography degree in the Department and initiating the GIS program helped to increase the number of majors slightly. The real change began when the DoGG found a model for the success we hoped to achieve.

The Department of Geology and Geography at Northwest Missouri State University (NWMSU), on a campus with fewer than half as many students as Georgia Southern, has over 300 majors. The DoGG invited a senior member of the faculty from NWMSU to consult on increasing the number of majors. In many ways the two departments’ activities were similar with the major exception that NWMSU actively recruits new geology and geography majors from all introductory level courses. Active recruiting and the success of their GIS program allows NWMSU to be among the largest undergraduate geography programs in the country.

In Spring 2001, the DoGG began actively recruiting majors and set a goal of having 1% of the undergraduates at Georgia Southern as geology or geography majors. Soon after recruitment started the number of majors in the program began to increase and that upturn has continued through the present. Last December (2004), the number of majors topped 100 (almost evenly split between geography and geology) for the first time in the history of the Department. The goal of 160 majors seems much closer to reality.

Other activities during the period contributed to the Department’s success. Adding a Bachelor of Arts degree in geography was particularly important to continued growth of that program. Far ranging field trips for majors have added greatly to our students’ breadth of experience. Social events, including an annual awards dinner and gatherings for alumni and current students during homecoming, have helped the students to feel a part of the Department. Undergraduate research experiences increased in quality and students began to present their work at professional meetings at all levels. All of these activities have helped to give majors a stronger attachment to the Department and have made them better recruiters of other motivated students.

The Department’s success in providing positive visibility for the University is also valued. The DoGG had a history of initiatives that included the founding of the Georgia Southern Museum, the excavation of the Vogtle whale (which has proven to be the oldest fossil whale in North America), and grants for teacher training including the St. Catherines Island Sea Turtle Conservation Program. The Department’s faculty has received multiple University Awards for Excellence in instruction, research, and service. They have leadership roles on campus and are active participants in the community and the profession. As hosts of the Southeastern Sectional Meeting of the Geological Society of America in Savannah in 2007, the Department will have its “debut” as a program that has transformed itself from a follower to a regional leader.

The Department is stronger by having geology and geography together. Two small departments would have great difficulty achieving all that has been accomplished by our larger, integrated programs. Geographers and geologists share courses, equipment, and facilities, and they enjoy a

breadth of learning not generally found in small single-discipline departments. Most important of all, the faculty share an understanding of what it means for the Department to be valued by the University.

Buffalo State's Earth Science Department: At the Intersection of Opportunity and Obstacles to Change

Jill Singer

Buffalo State College (BSC) is the largest comprehensive college in the State University of New York (SUNY) system (approximately 9,000 undergraduates and slightly over 2,000 graduate students) and is the only urban four-year campus in SUNY. Founded in 1871 as a Normal School to prepare teachers, it became a part of the State University of New York in 1948 and presently is a public, coeducational, liberal arts college. The college offers 79 undergraduate degree programs, 58 undergraduate minor programs and 40 graduate degree programs (many are in support of teacher certification and masters degrees in education). Nearly all of the students attending BSC are from New York State with more than 71% from the local Erie-Niagara county region. Most of the students commute and work at least part-time. Because of the combination of workload, less than full-time enrollment, and family responsibilities, students generally take five or more years to complete their undergraduate degree.

The Earth Sciences and Science Education Department is a combined department. The Science Education unit does not offer a degree program of its own, but is responsible for teaching a sequence of courses required for all secondary education majors seeking New York State certification in biology, chemistry, earth science and/or physics and for the supervision of these students in their semester-long student teaching placement. The Earth Sciences unit offers three undergraduate degree programs: B.A. Geology, B.S. Earth Sciences and B.S. Earth Science Education. Within the B.S. Earth Sciences program here are three tracks (environmental earth science, geology, and earth science education) designed to help students take a sequence of courses most appropriate to prepare them for either entry level employment (e.g., environmental consulting firm), secondary earth science certification, or pursue advanced degrees. There are approximately 100 students majoring in these programs, and more than half the students in the department are pursuing their earth science certification. The introductory courses offered by the department (geology, oceanography, astronomy, environmental earth science, geological hazards) are in high demand because they support the College's general education requirement.

The Earth Sciences half of the department recently conducted a thorough self-study and underwent an external review. Both strengths and challenges were uncovered and documented. The rest of this essay highlights some of these.

Among our greatest strengths are: accessibility of faculty to our students, easy access to a range of field areas, regular offering of required and elective courses, and faculty that consider teacher to be their primary responsibility. Faculty in the department engage in a variety of service activities at the campus level that include leadership positions on the curriculum committee and in the office of undergraduate research. Faculty are also visible in the community through their participation on environmental advisory boards and by their educational and outreach efforts at the K-12 level. The department has used retirements and faculty replacement opportunities to strategically strengthen the educational experience of our students by intentional hiring of junior faculty that demonstrate an interest and desire to engage our students in undergraduate research. This expectation is clearly articulated in our position descriptions and is reinforced in subsequent personnel actions (three and five year reviews and tenure/promotion). The increased emphasis on

providing high quality undergraduate research experiences for our students helps define our department and has contributed to the recognition of our department by our campus administration and other institutions.

There are some challenges that our department faces. Our small size makes it a constant challenge to provide our students with a solid grounding in the Earth sciences. For example, after the retirement of two hard rock geologists, only one faculty line was returned to our department. The impact of this reduction was the hiring of a geologist to teach mineralogy, petrology, structural geology, field geology, and tectonics. Unfortunately, this translates into our students taking many courses from the same person. While the faculty member is excellent, it is less than ideal for students. They are not benefiting from, and challenged by, multiple perspectives in both content and pedagogical methods.

The budget is certainly a reality we live with daily and certainly impacts our ability to restore lines, hire faculty, and fully fund field trips, but the budget is probably not our greatest issue. As many departments have dealt with in the past and will continue to deal with in the future, the department struggles with leadership issues, problems associated with at times strained faculty collegiality, and lack of a shared departmental vision. Rather than accepting the status quo, new and veteran faculty in the department see these challenges as opportunities to build strong initiatives to integrate education and research, to enhance ties to the community through addressing regional concerns, and to develop the kind of academic community that reflects our commitment to our students. Reflecting on nearly twenty years of experience as a faculty member at Buffalo State College, I feel that the defining characteristics of a strong department are frequent interactions among the faculty, a genuine appreciation and respect for different views on issues, and a shared vision for strengthening the department and providing students with the highest quality learning experience.

Winona State University
Geoscience Department
Submitted by: Cathy Summa

WSU Geoscience: Not your average B.S.

Winona State University (WSU) is one of seven four-year universities within the Minnesota State College and University (MnSCU) system. WSU was founded in 1858 as the first normal school west of the Mississippi and is still recognized regionally for its teacher-preparation programs. WSU is a comprehensive college offering a traditional liberal-arts based curriculum to slightly over 8,000 full-time undergraduate students. WSU also offers small graduate programs in nursing, education, and English. WSU students come primarily from the Minnesota-Wisconsin area. Nearly 70% of the student body is female, and close to 60% of the student body are first-generation college students. Ethnic diversity is minimal.

The Geoscience Department is the smallest department (by faculty numbers) in the College of Science and Engineering. We are a faculty of four (two tenured – one male professor, one female associate; two untenured male assistant professors). Despite our small faculty, we serve more than 60 majors and about 10 minors. We offer four different degree paths within the major: a B.S. in traditional geology; a B.S. in environmental geoscience (an interdisciplinary program with Biology and Chemistry); a B.S. in Earth Science teaching (leading to licensure at grades 5-12); and a B.A. in geoscience. The B.A. track requires that students complete a minor or double major in another field and connect that field to geoscience via an internship or research project. All tracks except the traditional geology track require that students complete some type of independent research. Students in this track are strongly encouraged, through the advising process, to pursue research.

In fall 2004, the natural science departments in the college moved into a new laboratory facility which provided greatly increased space (although still below national averages) and, for the first time, dedicated space for student-faculty research. Faculty teach relatively heavy loads – 12 hours/semester – and are expected to supervise student research in addition to their teaching load. In addition to serving our majors, we teach large numbers of general-education students, and carry the second highest load within the college in this regard (behind only Biology, which has 13 full-time faculty).

In terms of departmental success, I can identify several things. Most importantly, it is the collection of activities that make us successful – no one of these alone would do the job for us at this institution:

- 1) Our ability to hire two new positions at the same time. We had lost one member of the department to the Dean's office and had a series of one-year appointments to fill that position for four years. When the senior member of the department announced he would retire, we were able to convince our administration to hire both positions. We attended the national GSA meeting for recruiting purposes and used that opportunity to sell the department on the new building and incredible opportunity to be a part of a "new" department. We were fortunate to hire two quality faculty, who share our commitment to a field-based curriculum.
- 2) We brought in an outside consultant (Heather Macdonald) to help us work through identifying departmental goals and curriculum revision toward the end of the first year of having our new faculty join the department. Although the senior members of the department knew we needed to redesign our programs, we wanted to be certain to include our newly hired colleagues, so we postponed that planning until they joined us. Bringing an external consultant to facilitate the process eased what might have otherwise been perceived as sticky or difficult points during the process. We have continued to make progress toward our mutually identified goals.
- 3) We work hard to make geoscience a visible part of a liberal-arts curriculum, making the department important to more than just generating FTE. We are actively involved in interdisciplinary offerings across campus. Project highlights include a long-term travel-study program to Costa Rica, in which students from Marketing, Tourism and Geoscience are collaborating to research and design a sustainable tourism plan for residents of a small beach community; we are designing a program in Ecuador, in which students will study the historical migration of communities in relation to natural disasters; we team teach a sequence of courses for elementary education majors that integrate topics in the natural sciences around

environmental issues; and we collaborate with colleagues in the dance program to design pieces based upon the geologic parameters of fluvial systems (focusing on the Mississippi River). Our courses are required in major programs across campus, including Environmental Science (Biology and Chemistry), Global Studies, Law and Society, Recreation, and Elementary Education. We have worked with colleagues in disciplines outside the College of Science to develop courses that meet the needs of their programs and that also satisfy general education requirements. In addition to academic programs, we have been very active and visible in university committee and political work. This gives us broad representation and, most importantly, builds awareness of campus politics so that we are able to respond in ways that consider more than departmental or even college positions.

- 4) We actively recruit students to the program and have designed our curriculum to allow students greater flexibility to connect geoscience to other disciplines that interest them. Our departmental advertising slogan is "WSU Geoscience: Not Your Average B.S." We engage with middle- and high-school students, classes and teachers whenever the opportunities arise, and encourage groups to visit our facilities.
- 5) We enjoy strong administrative support for our work. As our new facility was being designed, we were able to position ourselves prominently in high-traffic areas because, in part, we have demonstrated our commitment to outreach and community education. In an area where the nearest science museum is 2.5 hours away, we take this role seriously and have worked to make our displays relevant and accessible to the non-scientist. Additionally, we positioned ourselves to anticipate opportunity and are ready to respond rapidly when they arise. It probably doesn't hurt that both the College Dean and the University Academic Vice President are geologists by training, but we don't believe that factor alone accounts for our success. In fact, we often feel pressured (not by the administration) to over perform to make certain that there is no question of "favoritism".
- 6) We have worked to build strong community within the department. Our faculty group genuinely enjoys working together, we enjoy working with our students, and our students really enjoy one another. We have dedicated student collaborative workspace in the new facility, which is separate from the student research space. Our majors consider one another "family" and really look out for each other. The more seasoned students help guide the newer majors through the program. Like many geology departments, communal living on field trips helps foster this community, but we also actively work to bring that same camaraderie to the classroom and labs.

Barbara Tewksbury
Department of Geosciences
Hamilton College, Clinton, NY

I have outlined in the essay what I believe to be the strengths of our department. In the course of commenting on each topic, I also address issues of how we got to where we are and where we still need to go. The Department currently has 5.5 FTEs (a structural geologist, a petrologist, a glacial sedimentologist, a paleontologist, and a hydrogeologist, and we share a geomicrobiologist with the Biology Department).

Our introductory courses are topical, rather than survey, courses

Since 1986-87, we have offered four to five topical introductory courses each year. These topical courses are narrow and deep, rather than broad and shallow, giving students a chance to delve into a topic rather than to approach it at a survey level. Course topics are engaging and relevant to students and illuminate geoscience topics and thinking. We do not offer standard survey courses in physical and historical geology, and we do not offer any dead-end courses. Any of the introductory topical courses provides an entrée into the major.

We currently offer the following introductory courses: The Geology & Development of Modern Africa, Global Environment Change & Wilderness, Ocean Science, Geology & the Environment, and Geology in the Field. In order to major in geoscience, a student must take one of the topical courses. A student is allowed to take only one of our intro courses. If s/he wishes to take a second course in geoscience, s/he must take a higher-level course.

By department agreement, each intro course covers four topics in one fashion or another: rock forming processes, geologic time, plate tectonics, and Earth systems. We have all agreed that we will take students with a wide variety of backgrounds into our intermediate and upper level courses, provided that they have had some exposure to the four topics listed above.

We made the decision in 1986 to change from the standard physical/historical survey courses to a topical approach for two reasons. First, we had seen a decline in numbers of majors, and we felt we had to do something proactive instead of just wringing our hands about it. Second, we agreed that we would prefer intro courses that were deep rather than broad so that students could tackle interesting problems in some depth, rather than spend their time at the superficial level in a wide range of topics. We believe that the change to topical courses has been very successful for us. Student satisfaction with the courses has been high, and the courses are stimulating to teach. Furthermore, having engaging, topical courses has allowed us to directly address the needs of all students, because 95% of students taking our introductory courses will not be career geoscientists. Our aim has been to offer interesting, exciting, and relevant introductory courses so that students will leave the course as better informed citizens, and we think we have succeeded.

The only drawback has been coping with the very wide range of backgrounds that students bring to intermediate and upper level courses. In 2001-02, we prepared an 8-sheet booklet outlining the Basics of Geology that every student in intermediate and upper level geology courses is expected to know and for which each student will be held accountable. These items include rock and mineral identification, rock forming processes, geologic time, basic plate tectonic processes, and Earth systems. Every course in the Department is supposed to be taught with the assumption that all students in the class have used the material to refresh their memories. While everyone in the Department (including the students) have viewed this as desirable and necessary, enforcement of what we adopted as Department policy has been uneven across courses in the Department.

Our introductory courses are small (16-30 students), and some are writing intensive or field intensive. The yield of majors from these courses has been impressive over the years – it is not uncommon for us to net 3-5 majors from an intro course as small as 16-20.

Our curriculum is structured to encourage people to major in geoscience even if they do not have geoscience career plans

Too many students see a major in science as appropriate only for those who have career interests in science, although most students view history or philosophy, for example, as appropriate majors for anyone even though most

of those who major will be neither historians nor philosophers. Our department has always believed in promoting a major in geoscience as an appropriate liberal arts major. Over the years, we have had many people go on to earn graduate degrees in business, law, medicine, public policy, and so forth. We, in fact, encourage it, and our curriculum is specifically designed with this in mind.

We believe that students who study geoscience at the undergraduate level should have experience in the major subdisciplines of geoscience and should not specialize. Hence, we do not have different kinds of “tracks” through the geoscience concentration. For those who do not go on to graduate study in geoscience, this broad background is crucial, because they will likely not be filling in any holes in their backgrounds in the future. For those going on to graduate school, we also believe that a broad background is essential, because most students specialize, rather than broaden, at the graduate level. For most students, if they haven’t had a basic course as an undergraduate, they won’t have it as a grad student. We use a broad offering of interesting elective courses to allow students a limited amount of specialization.

We currently require courses in mineralogy, sedimentary geology, petrology, paleontology, hydrogeology, and structural geology for a major. We feel that all are particularly important given the fact that we do not have survey courses at the introductory level. What any individual student misses in terms of exposure to topics typically covered in physical and historical geology has, we believe, been integrated into our required courses. We use elective courses to provide opportunities for students to study other subdisciplines as well.

The basic courses required for a major have little verticality, and students take the courses in different orders. Most intermediate level courses consequently are composed of students bringing a wide variety of preparations. We are willing to accept that challenge in order to allow our students the flexibility of starting a major during sophomore year and of going abroad for study.

While many schools require a year each of calculus, chemistry, and physics of their geology majors, we have consistently chosen not to require a full suite of courses in the supporting sciences and math for a major in geoscience. Our rationale is consistent with wanting to make a major in geoscience appropriate for those whose career directions are not in the geosciences. For those who want to pursue geoscience as a career, we have chosen the route of advising to stress the importance of taking courses in all of the supporting sciences before entering graduate school. Our requirement is that all majors take a year of math *or* physics *or* chemistry *or* biology *or* computer science. We feel that this was an appropriate compromise between requiring no supporting sciences and stressing the importance and utility of a strong background in the supporting sciences and math.

We require a senior project of all majors

Since the late 1980s, we have required a senior project of all of our majors. Some students do typical field or laboratory research projects, others develop curriculum modules for pre-college courses, and still others have done innovative interdisciplinary projects integrating geoscience and chemistry, archaeology, art, public policy, biology, and so on. Our primary aim is to have students select a senior project topic that will be a culminating experience for their geoscience education *and* be a project that relates to their own interests and career goals. This has been a highly successful aspect of our department, because students work on something they’re genuinely interested in.

We hold a GSA-style presentation session during the evening each spring at which all students give formal presentations of their senior project. Faculty from other departments attend. Our students’ senior project presentations are well-known on campus for being professional and impressive.

We have strong interdisciplinary connections

We offer cross-listed, interdisciplinary courses with the Archaeology, Africana Studies, History, and Biology departments. We are one of a very few schools to offer an undergraduate major in Geoarchaeology. The Department has also been a major contributor to the interdisciplinary minor in Environmental Studies, and we have made a conscious effort to support the program through the courses we teach and the ways in which we teach our courses. We also currently share a geomicrobiologist with the Biology Department, and he teaches a course in our department on geomicrobiology as well as advising senior projects. We have also just changed the name of our department from the Department of Geology to the Department of Geosciences to reflect the broad range of courses that we teach and the topics that we cover both in courses and in research.

Essay for Geoscience Departments Workshop

February 24-26, 2005

by Al Trujillo, Associate Professor and Chair, Earth Sciences Department

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What Makes Palomar's Earth Science Department Such a Strong Geoscience Department?

Palomar Community College is a public two-year community college in northern San Diego County, California. Palomar's district covers an area of 2555 square miles (an area slightly larger than the state of Delaware) that includes a population of nearly 750,000. Palomar is one of the largest of the state's 108 community colleges and has an annual enrollment of more than 30,000 part-time and full-time students.

The Earth Sciences Department at Palomar enrolls over 3000 students each year and includes the disciplines of astronomy, geography, geology, and oceanography. It also includes a vocational program in aeronautics. One of the key strengths of the Earth Sciences Department has been its strong field programs.

The Earth Sciences Department at Palomar College has been committed to field-based and other experiential education modes for over 40 years. Faculty in the Earth Sciences Department share a common vision of the importance of field studies to quality instruction. Due to our prime location with rapid access to a variety of field sites, we have been offering a steadily increasing variety of in-class and weekend field trips, multi-day field courses, and other hands-on experiences to our students. These field experiences incorporate a wide range of costs, distances, physical environments, and academic levels.

Our success in offering field experiences is closely tied to strategies that maintain and enhance student interest and administrative support for field experiences. For example, our success in generating wide student participation is closely linked to promoting field experiences as an integral part of learning and providing a wide range of field opportunities. In addition, we have developed effective and specific logistical procedures that optimize organization and safety in the field.



At Palomar, we have been fortunate to have had strong administrative support for our field programs. One of our strategies of proactively maintaining this administrative support is to participate in the hiring process of administrators. Another strategy is to emphasize the pedagogical value of field instruction within our curriculum. For instance, we note that field experiences address key core skills in communication, cognition, information competency, social interaction, and personal development and responsibility that are difficult to address in typical classroom settings.

Even with good student participation and strong administrative support for field instruction, the following issues are items of concern:

- increasing bureaucratic regulation from agencies such as the U.S. Forest Service and the National Park Service that can hinder access to field locations
- rapid urbanization limiting access to nearby field locations
- an increasingly less traveled and more urban student population that has little experience with the outdoors
- increasing legal considerations
- increasing costs

In spite of these issues, the Earth Sciences Department at Palomar College continues to maintain a vibrant field program.

Change in the Department of Geological Sciences at Arizona State University

Workshop on Geoscience Departments: Developing Pathways to Strong Programs for the Future

James A. Tyburczy, Professor and Chair

11 February 2005

From its beginnings in the late 1950's, the Arizona State University Department of Geological Sciences has grown to be a leading research and teaching unit on campus and nationally. The first M.S. degree was awarded in 1965 and the first Ph.D. in 1974. In the 1993 NRC survey our Department ranked 26th and in 1999 the U.S. News and World Report rated the Department 25th in the nation. Since then we have added 7 new faculty members and have expanded strengths in planetary sciences, geochemistry, biogeochemistry, geophysics and geoscience education. The Department has 26 tenure-track faculty members (21 full time equivalents), about 60 graduate students and about 60 undergraduate students. We offer B.S., M.S., and Ph.D degrees in Geological Sciences.

From its inception, the Department has benefited from strong leadership that demanded high levels of research activity. At the same time, it was recognized that a growing department needed to find niches wherein it could excel. For ASU these areas became planetary sciences-cosmochemistry-meteoritics-astrobiology and geochemistry-mineralogy-petrology. Other areas of strength and investment include biogeochemistry, astrobiology, volcanology, geoscience education, and geophysics. These areas have served us well, but have lead to a department with uneven coverage. We have a long and productive tradition of interdisciplinary science; we have had faculty members with joint appointments between Geological Sciences and the Department of Chemistry & Biochemistry continuously for over 40 years. As part of a young and growing university and owing to faculty participation in a number of planetary missions, our external research funding led the university for most of the last 15 years, with current annual funding of approximately \$10 million. Our departmental strengths have been built from strong individual research programs.

Our undergraduate program is currently fairly traditional and strong in field work. Our capstone summer geology field camp course has recently been divided into a 3-semester unit spring term course on mapping basics followed by an intensive 3-week, 3-unit summer course of advanced mapping. This allows undergraduates more options for summer activities and employment and makes the sequence (all or part) more attractive for graduate students who may benefit from it. Over 40% of our undergraduates participate in research. Our introductory courses serve over 1200 students per semester.

Approaches that we have employed that we feel are successful in advancing the department include 1) annual peer evaluations in which every faculty member evaluates every other member, 2) annual evaluations in which teaching is a significant part, 3) faculty searches that are generally targeted broadly to attract the best candidates, 4)

encouraging geoscience education research which has an effect of improving teaching throughout the department..

Current challenges, as in many departments, include modernization of the undergraduate curriculum, building on strength versus expanding into important areas in which we are not currently so strong, maintaining strength in field geology particularly in the graduate program versus satisfying the focused needs of faculty research, space needs and physical fragmentation of the department, maintaining and increasing undergraduate enrollments, and enhancing the success and graduation speed of the many undergraduate majors who come to us from the community college system.

A new administration at ASU has challenged our department to advance its competitiveness nationally. We are responding to this opportunity with a proposal to form a new School of Earth and Space Exploration that will bring together the faculty of Geological Sciences and Astronomy (currently in the Department of Physics & Astronomy) along with systems engineers and other disciplines to form a unit with 'exploration of the universe' as one of its core themes. Major changes to curriculum, degree programs, and research climate will come about by having science and engineering students work side by side in a learning community environment from the moment of their entry to the university. The objective is to train scientists with experience in engineering and engineers with experience in science. Such a school would be attractive to undergraduate and graduate students, would foster trans- and multi-disciplinary research efforts, and would provide graduates in high demand in any field. This broad view is still very much a work in progress. There are significant challenges ahead as we move forward to develop and implement this vision. We are working toward possible deployment in the 2006 or 2007 time frame.

Like geology itself, perhaps an earth science department can be studied through the dictum that “the past is the key to the present.” It also leads to a view of the future because the present is the future’s past. Let’s start with some facts about the present. In reflecting on the successes and strengths of the Department of Geology & Geophysics at UW-Madison, I focus on our people – faculty, current students, staff, and alumni – because therein is our strength, but I discuss as well our physical facilities and financial resources.

The Department of Geology and Geophysics at the University of Wisconsin-Madison is comprised of 21 faculty, 24 academic technical and administrative staff, 68 graduate students, 4 postdocs, 2 visiting scholars, 56 undergraduate majors, and 2500 alumni. We are a research-intensive department with a synergistic commitment to graduate education. We are committed strongly to our undergraduate majors and to non-science students who take our introductory courses, and we are committed strongly to outreach particularly through an active Geology Museum. We are proud of the number of our undergraduates who go on to receive the Ph.D., the number of our Ph.D.’s who serve on faculties at colleges and universities in the U.S. and internationally, and the number of alumni who have illustrious careers in government and industry. We are proud of the awards won by our faculty, the dedication and loyalty of our staff, and we are proud to award annually the honor of distinguished alumni to one or more of our graduates.

We are housed attractively in Weeks Hall, which was completed initially in 1974 with two major additions completed in 1981 and 2004. The Geology Library is part of the building. Major laboratory capabilities include an electron microprobe, mass spectrometers for stable and radiogenic isotopes, ion microprobe, SEM, fluid inclusion geothermometry, and rock physics equipment. Field capabilities exist for geophysics, GPS, and hydrogeology. Finally, the department enjoys state-of-the-art lecture halls, seminar rooms, and computer system. All these activities are supported capably and enthusiastically by academic and technical staff. Except for a partial building grant from the NSF for Phase 1, all the construction has been from private money. Phases 1 and 2 were made possible through the generosity of Lewis G. Weeks; phase 3 was a mix of funding from the Wisconsin Alumni Research Foundation, the College of Letters and Science, the Albert and Alice Weeks Bequest, and individual gifts from alumni, friends, faculty, and staff. In terms of critical events, clearly the substantial endowment from the Weeks family in the early 1970’s through the early 1990’s is an important source of the department’s current position of strength. Our Board of Visitors, which was formed in the early 1990’s, provides on-going support for mentoring students, organizing reunion symposia, and fund raising. The ability to leverage internal university funds for startup packages for new faculty and federal funds for equipment, to hire post-docs, to endow professorships, and to offer more attractive financial support packages for graduate students all come from the flexibility of private funds.

An important strength of the department is that faculty research broadly covers most of the central subdisciplines of the earth sciences --- hydrogeology and surficial geology (Anderson, Bahr, Mickelson); geophysics and structural geology (Allen, DeMets, Goodwin, Thurber, Tikoff, Wang); mineralogy, petrology, geochemistry and geomicrobiology (Brown, Johnson, Roden, Sahai, Singer, Valley, Xu); sedimentology, paleontology, and paleoceanography/paleoclimate (Byers, Carroll, Geary, Kelly, Simo). The median age is 47, there are 16 men and 5 women, and we have no targeted minority faculty. The faculty participate in many interdisciplinary activities across campus, most notably the Geological Engineering Program and the Gaylord Nelson Institute for Environmental Studies, and in turn, affiliate faculty from other campus departments, the Wisconsin Geological and Natural History Survey, and the U.S. Geological Survey contribute to the teaching and graduate education mission of the department. Emeritus faculty – Bentley, Bowser, Christensen, Clark, Clay, Craddock, Dott, Maher, Medaris, and Pray – stay connected with departmental activities through social and/or continuing scholarly activities. Nearly two-thirds of the faculty were hired since 1986. One of the great strengths of our department, which is recognized by not only members of the department but outsiders as well, is the congenial and collegial atmosphere. GeoClub, which consists principally of graduate students but undergraduates as well, organizes many social events and an orientation field trip each year. We are a happy department and with apologies to Tolstoy, I do not believe happy departments are all alike. I believe each happy department becomes happy in its own way. Among faculty one practice, which engenders harmony, is a democratic decision-making process in which assistant professors participate fully. Faculty and shared governance, which is a Wisconsin tradition, extends beyond the majority rule principle in that most decisions are really by consensus. A new chair is elected every three years.

I will close with the most difficult issue that confronts our department, which is the importance of (obsession with?) national rankings such as the 1993 NRC report and the annual US News survey. Our success is relative; we cannot ignore the fact that we rank around 20th among geoscience departments nationally. While our ranking does not pose a threat to our existence, it is uncomfortable because a number of departments in our college rank in the top 10. In practical terms we are concerned that it might affect our ability to recruit and retain the best faculty and graduate students. Internal discomfort can arise because differences of opinion and ideology are exposed, which can threaten harmony, when facing important questions. In which subdisciplines do we choose to recruit faculty? How should department resources be deployed among faculty and programs? Can these decisions be made within a consensus framework? We are in a period of dynamic change internally with several new faculty and externally with new funding opportunities such as Earthscope. It's great to be a Badger. On Wisconsin!

**DEPARTMENT OF GEOLOGY
SAN JOSÉ STATE UNIVERSITY
SAN JOSÉ, CA**

John W. Williams, Professor and Chair

The Department of Geology is housed in San José State University, which was founded in 1857, and is the oldest public institution of higher education in California. The department consists of 10 tenure, tenure-track faculty, two technical support staff, and an office administrator. Typically 2-3 part-time faculty members augment the teaching staff along with 10-12 graduate teaching associates and student assistants. This team offers degrees at the BS and MS level.

The quality of the department is reflected by:

- continually evolving curriculum tied to professional practice,
- carefully selected faculty with interests in quality teaching, research, and professional activities,
- a critical mass of faculty to provide coverage of the science of geology,
- multiple faculty involved in earth science education,
- an appropriate blend of theory and practical application of geology,
- a team approach to task solving within the department by faculty,
- involvement of all faculty in all levels of teaching; general education, upper and lower-division major classes, and graduate offerings,
- diverse student population in terms of gender, age, work experience,
- outstanding location including the opportunity to use geologic setting of California for instructional and research opportunities,
- outstanding location providing opportunities for students to gain employment during their academic years and post graduation, and
- a department actively involved in curriculum and other university wide issues,
- physical resources (building, equipment) to support educational activities, and
- continuity of leadership.

Evidence of the success of the San José State University includes:

- success by students in getting employment in the profession, including repeat solicitations for students by employers,
- success by students in gaining admission and successfully completing additional graduate education,
- success by students in passing the state licensing examinations for the professional practice of geology,
- diverse applicants to graduate school by students from wide geographic areas nationally and internationally,
- national and international recognition of faculty and their activities in diverse research and professional activities,
- success of faculty in grants acquisition, and
- success of students in university and system-wide research and thesis competition,
- a stable faculty and staff,

- an environment conducive to collegiality and productivity,
- university recognition for work in general education, curriculum, and research,
and
- US Geological Survey library repository for earth science education materials.