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The ability of scientists to communicate across cultural and linguistic barriers is crucial for the global economic sustainability and protection of the world´s oceans. Yet students with majors in the sciences and engineering constitute less than 2% of those who study abroad each year. And even rarer are students who study in countries where English is not the first language.

The Marine Language Exchange program is a case study of an international and interdisciplinary collaboration between faculties in the languages and the sciences who address this gap. A consortium of U.S. and European institutions including Eckerd College (Florida), University of Washington (Washington), University of Hilo (Hawaii), Université de la Rochelle (France), Université de Liège (Belgium), and Universidad de Las Palmas (Spain) is developing a multilingual, marine sciences exchange program in an effort to internationalize their Marine Sciences departments.

The program includes a three-week, intensive "bridge" course designed to reinforce second language skills in the context of marine sciences, and prepare undergraduate students for the cultural and educational differences of their host country. Following this immersion experience students from each institution enroll in courses abroad including marine sciences specialization for full academic credit. This session will review the Marine Language Exchange program activities since 2000 and will discuss the ideological and practical aspects of the program. The program successes, difficulties and future directions will also be presented. Different disciplinary approaches -Second Language Acquisition, English as a Second Language and Marine Science- prepare science students to contribute to the study and the management of the world´s oceans with an awareness of the cultural issues reflected by national marine policies. Based on this case study, other universities could initiate their own international and interdisciplinary collaboration to facilitate a better understanding of other planetary issues.

URL: http://www.marine-language-exch.org/

ED22A MC: 308 Tuesday 1330h

Evolution in the Classroom: Resources, Strategies, and Issues

(joint with PA)

Presiding: **E DeVore,** SETI Institute**; K O'Sullivan,** San Francisco State University

ED22A-01 1335h INVITED

Evolution: Its Treatment in K-12 State Science Curriculum Standards

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State standards are the basis upon which states and local schools build curricula. Usually taking the form of lists of what students are expected to learn at specified grades or clusters of grades, they influence statewide examinations, textbooks, teacher education and credentialing, and other areas in which states typically exercise control over local curriculum development. State science standards vary very widely in overall quality.[1,2] This is especially true in their treatment of evolution, both in the life sciences and to a somewhat lesser extent in geology and astronomy. Not surprisingly, a detailed evaluation of the treatment of evolution in state science standards[3] has evoked considerably more public interest than the preceding studies of overall quality. We here consider the following questions: What constitutes a good treatment of evolution in science standards and how does one evaluate the standards? Which states have done well, and which less well? What non-scientific influences have been brought to bear on standards, for what reasons, and by whom? What strategies have been used to obscure or distort the role of evolution as the central organizing principle of the historical sciences? What are the effects of such distortions on students' overall understanding of science? What can the scientific community do to assure the publication of good science standards and to counteract attacks on good science teaching?

1. Lerner, L. S., *State Science Standards: An Appraisal of Science Standards in 36 States,* The Thomas B. Fordham Foundation, Washington, D.C., March 1998.

2. Lerner, L. S. et al ., *The State of State Standards 2000,* ibid., January 2000.

3. Lerner, L. S., *Good Science, Bad Science: Teaching Evolution In the States,* ibid., September 2000.

URL: http://www.edexcellence.net

ED22A-02 1350h INVITED

Stay Tuned for Evolution.berkeley.edu

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Evolution affects every aspect of our lives and is the central organizing principle that biologists use to understand the world, yet there are few comprehensive resource packages available for science teachers that address both content and pedagogy. There are even fewer resources developed specifically to increase the understanding of evolution by students and the general public. Evolution.berkeley.edu will house a new website designed to address the need for more effective education about evolution and the nature of science among three target audiences: those who teach about science (K-12 teachers), those who are learning about science in the classroom (their students), and those who are at an informal stage of their learning (the general public). With funding support from the National Science Foundation and the Howard Hughes Medical Institute, this website is being developed by the University of California Museum of Paleontology and the National Center for Science Education. Its goals are to: 1. Improve teacher understanding of the nature of science, the patterns and processes of evolution, and the history of evolutionary thought. 2. Increase teacher confidence level to teach these subjects effectively. 3. Increase student understanding of the nature of science and engage them in the process of science. 4. Improve the public's understanding of the nature of science and the patterns and processes of evolution. 5. Increase student and public awareness of the importance of understanding evolution and its relevance to their lives.

For teachers, the site provides content knowledge in the form of five self-study units on the nature of science, the history of evolutionary thought, the scales and levels of evolution, the relevance of evolution to society, and the challenges to evolution. The site also provide classroom resources including a selection of effective approaches and teaching strategies and a searchable database of curricula, teacher-tested activities, and lesson plans that are consistent with those modeled in the National Science Education Standards.

ED22A-03 1405h INVITED

Resources for Teaching About Evolution from the U.S. Geological Survey

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As a scientific research agency, the U.S. Geological Survey (USGS) is in an ideal position to provide scientific information and resources to educators. The USGS is not a curriculum developer, nor an expert in pedagogy, yet the USGS does have a wealth of scientific information on subjects such as fossils, geologic time, biological resources and plate tectonics that naturally come in to play in the teaching of evolution.

Among USGS resources are the general interest pamphlets *Geologic Time*, *Dinosaurs: Facts And Fiction*, *Our Changing Continent*, and *Fossils Rocks, and Time*, and its accompanying poster, *Fossils Through Time.* In addition to printed versions, the pamphlets are available at no cost on the Internet at http://pubs.usgs.gov/gip/. The popular booklet, *This Dynamic Earth: The Story of Plate Tectonics*, available at http://pubs.usgs.gov/publications/text/dynamic.html, touches on evolution-related subjects such as Alfred Wegeners use of fossils to develop his theory of continental drift, "polar" dinosaur fossils found in Australia, marine fossils in the rocks of the Himalayas, and the use of fossil ages to determine rates of plate motions.

Paleontological research at the USGS is highlighted on the Internet at http://geology.er.usgs.gov/paleo/. The web site includes links to technical publications, profiles of scientists, a geologic time scale, a glossary, information on important fossil groups, and a list of non-USGS references on fossils: all very useful to educators.

A wealth of biological information and data can be found in the National Biological Information Infrastructure (NBII), a multi-agency collaborative program led by the USGS. In addition to data on the Nations biological resources, the NBII web site http://www.nbii.gov/ includes a section on systematics and scientific names (helpful for illustrating the evolutionary relationships among living organisms), and links to non-USGS curriculum materials. A fact sheet, *Unveiling the NBII as a Teaching Resource*, is available at http://www.nbii.gov/about/pubs/factsheet/pdf/education.pdf.

Evolution is a key theme in the scope of many USGS research activities. From the evolution of living organisms, to the evolution of geological materials and landforms, the USGS is a rich source of current, accurate, and relevant scientific information for teachers in todays classroom.

ED22A-04 1420h INVITED

Voyages Through Time: Everything Evolves

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Evolutionary change is a powerful framework for studying our world and our place therein. It is a recurring theme in every realm of science: over time, the universe, the planet Earth, life, and human technologies all change, albeit on vastly different scales. Evolution offers scientific explanations for the age-old question, "Where did we come from?" In addition, historical perspectives of science show how our understanding has evolved over time. The complexities of all of these systems will never reveal a "finished" story. But it is a story of epic size, capable of inspiring awe and of expanding our sense of time and place, and eminently worthy of investigating. This story is the basis of Voyages Through Time.

Voyages Through Time (VTT), provides teachers with not only background science content and pedagogy, but also with materials and resources for the teaching of evolution. The six modules, Cosmic Evolution, Planetary Evolution, Origin of Life, Evolution of Life, Hominid Evolution, and Evolution of Technology, emphasize student inquiry, and promote the nature of science, as recommended in the NSES and BSL. The modules are unified by the overarching theme of evolution and the meta questions: "What is changing?" "What is the rate of change?" and "What is the mechanism of change?"

Determination of student outcomes for the project required effective collaboration of scientists, teachers, students and media specialists. The broadest curricula students outcomes are 1) an enjoyment of science, 2) an understanding of the nature of science, especially the understanding of evidence and re-evaluation, and 3) key science content. The curriculum is being developed by the SETI Institute, NASA Ames Research Center, California Academy of Sciences, and San Francisco State University, and is funded by the NSF (IMD 9730693), with support form Hewlett-Packard Company, The Foundation for Microbiology, Combined Federated Charities, NASA Astrobiology Institute, and NASA Fundamental Biology.

URL: http://www.seti.org/education/vtt-bg.html

ED22A-05 1435h

Enhancing Evolution Education Through K-12 Curriculum Development and Public Outreach

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The American Geological Institute (AGI) has been actively involved in K-12 Earth science education for more than 40 years. Recent efforts at AGI have focused upon producing secondary science curriculum programs that target the National Science Education Standards (NSES) and working with Member Societies to create documents that enhance the public's understanding of evolution. National standards, which have driven reform of science education in many states, call for including evolution within the secondary curriculum. AGI's recently published curriculum programs, Investigating Earth Systems (IES) for middle schools and Earth System Science in the Community (EarthComm) for high schools, provide much-needed tools that help teachers address learning goals related to evolution. IES is a modular program that emphasizes inquiry, the nature of science, and five big ideas of Earth science, including understanding that the geology of Earth is

dynamic and has evolved over billions of years, and that the geological evolution of Earth has left a record of its history that geoscientists interpret. EarthComm builds upon these ideas to emphasize the study of the evolution of life and the planet using a community-based approach. Project CUES (Constructing Understandings of Earth Systems), a comprehensive middle school Earth science program to be tested in classrooms in the 2002-2003 school year, will focus student inquiry upon four key themes, including evolution and Earth history. In cooperation with the Paleontological Society, AGI recently released Evolution and the Fossil Record. The work discusses geologic time; change through time; Darwin's theory of evolution; evolution as a mechanism for change; the nature of species; the nature of theory; paleontology, geology, and evolution; and determining the age of fossils and rocks.

URL: http://www.agiweb.org/education/

ED22B MC: 308 Tuesday 1505h

Geoscience Graduate Degrees: Preparation for a Global Job Market?

(joint with PA)

Presiding: **J Giesler,** AGU**; A Staudt,** Harvard Univ**; C Johnson,** Scripps Institution of Oceanography

ED22B-01 1505h

Earth and Space Science PhDs: Class of 2000

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The American Geophysical Union (AGU) and the American Geological Institute (AGI) have been collecting data on recent PhDs in the geosciences for 5 years (1996-2000). Over these years continual improvement has been recorded in the job market through indicators such as time to find employment and starting salaries. As these indicators continue to improve, so too does the perception of the job market in general. There are several characteristics that are unique to PhDs in the geosciences. Unlike physical science graduates, there is a significant number who have been working full-time at least one year prior to earning their PhD. Recent graduates employed prior to graduation are heavily concentrated in Solid Earth Geology (41%) followed by Atmospheric Sciences (19%) and Oceanography (12%). A second distinguishable feature of Earth & space science PhDs is their age. Each year there is a higher percentage of recent graduates over the age of 40: 16% in 1998, 20% in 1999, and 23% in 2000. In 2000, the average time between earning a B.S. and starting a graduate program was 4.6 years. Both 1999 and 2000 show a drop in the overall numbers of postdoctoral appointments. This suggests that greater than 50% of the recent graduates are finding full-time permanent employment. Of the geoscience subfields, oceanography has greatest number of people obtaining employment outside the field.

ED22B-02 1520h

Technical and Soft Skills Expectations During the Transition from Recent Graduate to New Hire

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Employer-applicant skill compatibility represents a major component of the career development process, particularly for new entrants to the job market. Newly minted geoscientists largely bring a distinct set of skills learned during their formal education and training, which combined with a broader view of the person are evaluated for career potential in today's major employers. University departments possess a strong view of their role in educating future geoscientists, including the skill sets imparted, the basis of education provided, and the expectation for how their students will evolve into colleagues in the profession. Regretfully, based on numerous surveys by both the American Geological Institute's Human Resources program and other independent studies, the formally transferred skills and expectations do not necessarily match those of many geoscience employers. While academia has increased its focus on increasing technical skills and greater specialization, most geoscience employers have further increased the technology gap between themselves and academia, leading most employers to seek broadly trained and well-educated graduates. Additionally, soft skills represent an area of major disagreement between what is considered important and what is considered feasible in a formal education. While debate continues both within industry and academia over the ideal set of soft skills, the great variance in soft skill demands lead to better opportunities for matching of graduate to employer. This debate further enhances the ongoing discussion of the role of the university, the importance of employer needs, and the health of the geoscience discipline within society. Fundamentally, the hiring and career development process remains as sequence of compromises for both the employer and the recent graduate.

ED22B-03 1535h

Is That Graduate Degree Worth It? Comparing the Recruitment of Undergraduate and Graduate Degree Job Applicants

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One could argue from a business prospective that colleges and universities are not working hard enough to train students for life in the business and civic world, at either the undergraduate or graduate levels. What is it that employers are looking for in students? How different are the skills and attributes employers are looking for between undergraduate and graduate students? How unique are the geosciences in this respect?

At the undergraduate level recruiters have spoken loud and clear about what they want. According to the dean of the business school here at the University of Arizona, recruiters at the undergraduate degree level in business base less than half of their hiring decision on specific content knowledge in the discipline, and correspondingly more than half on the so-called soft skills ... ability to apply knowledge in new situations, ability to think critically, ability to communicate with others in both written and oral forms, ability to work in teams, ability to work with a diverse set of employees and customers (especially, but not limited to, the global job market), etc.

How true is this at the graduate level, where students have typically spent 4-6 years specializing in a discipline? Is there a set of fundamental knowledge that employers are looking for at the graduate level? Are the so-called soft skills correspondingly less important?

I will present results from a survey of graduate programs and industry recruiters addressing these questions, and highlight the areas of overlap and difference between undergraduates and graduates looking for jobs. I will concentrate specifically on jobs in the oil industry and on both masters and Ph.D. programs.

ED22B-04 1550h

Postdoctoral Positions and Career Growth

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Career choices begin to diverge at the time the doctorate is received. A variety of career options are available to pursue including positions in academia, government, and industry as well as non-traditional services.

A postdoctoral appointment is worth considering as preparation for a career in academia or basic research. The postdoctoral appointment can expand the recent graduate's background and broaden their scientific perspective and reputation. Postdoctoral experience may even be essential to be competitive for some faculty and research laboratory appointments.

However, there is a wide range of postdoctoral choices to consider. There are many opportunities for postdoctoral appointments in universities, and emerging opportunities in some corporate laboratories. We will mention opportunities in federal laboratories such as the National Research Council programs in NASA, NOAA, EPA, and the Dept. of Defense, which are open to U.S. citizens and in some cases to non-U.S. applicants, to pursue research in all areas of the Earth and space sciences. And there are exciting new interdisciplinary programs such as the NASA Astrobiology Institute, as well as international opportunities including the von Humboldt fellowships in Germany and similar programs elsewhere in Europe, Japan, and other countries.

URL: http://www.national-academies.org/rap

ED22B-05 1605h

Global Job Opportunities with a "Super-Major" Oil and Gas Company

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Shell International Exploration and Production Company is one of the world's largest private employers of geoscientists with approximately 1500 geophysicists and geologists employed worldwide. The companies of the Royal Dutch/Shell Group together produce, process, and deliver energy to consumers. Operating across the globe, in more than 130 countries and with more than 100,000 staff, Shell companies are guided by values developed over more than a century of successful enterprise.

Responsibilities and Career Path - As a processing or research Geophysicist, you will use proprietary methods to prepare 2D and 3D seismic data volumes for the direct detection of hydrocarbons, the delineation of reservoirs or to define the stratigraphic and structural framework of the subsurface. As an exploration or development Geophysicist, your business will be finding commercially viable oil and gas reserves by using 3D seismic acquisition, processing, and interpretation techniques. Your advanced geological models of the subsurface will drive drilling proposals, optimizing appraisal of hydrocarbon resources. As a production or surveillance geophysicist, your 4D seismic interpretations and geological models will drive drilling proposals and optimize the production and depletion of existing oil and gas accumulations. Up to seven steps in the technical career ladder are possible. Team leader and management candidates are chosen from Shell's technical workforce based on technical and business acumen demonstrated on the job.

Projects - Geophysicists work as part of multidisciplinary teams on projects that typically last from 18 to 36 months. Teams are responsible for projects that may vary from $1 million to hundreds of millions in scope. Accountability and responsibility varies according to individual experience level and team structure.

Lifestyle - Geophysicists are mainly office-based, with business travel requirements rarely exceeding 2 weeks per event. In the U.S., Shell allows flexible daily office hours, and employees may choose an optional 9-hour work schedule that provides alternate Fridays off. Company pension and benefit programs are competitive with the best that industry has to offer.

Degree requirements: Shell recruits Geophysicists for the global staff pool from approximately 20 universities in the U.S. Universities are chosen based on the curriculum of the school, the size of the student enrollment, and the regional location of the school. Geophysicists generally must have at least an MS degree to qualify for Shell employment. Electrical Engineers and Physicists who are recruited as seismic processors are required to have at least a BS degree. Recruiting targets vary annually based on company need.

URL: http://www.shell.com/careers

ED22B-06 1620h

Working for a not-for-Profit Research and Development Organization in the Earth Sciences

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The Southwest Research Institute (SwRI) is an independent not-for-profit applied engineering and physical sciences research and development organization. This means that SwRI owes no allegiance to organizations other than its clients. As a not-for-profit organization, SwRI reinvests its net income into the organization to improve, strengthen, and expand facilities and to support internal research and development projects. Located in San Antonio, Texas, on 1200 acres, SwRI employs nearly 2800 staff and occupies nearly 2,000,000 square feet of office space. Its business is about equally divided between commercial and government clients, most of whom have specific scientific and technical problems that need to be solved in a timely, cost-effective manner. Governmental clients include local, state, and federal agencies and foreign governments. Commercial clients include local, national, and international businesses. Earth science disciplines at SwRI include geology, geophysics, hydrology, geochemistry, rock mechanics, mining engineering, and natural hazard assessment. Our overall approach is to systematically examine client problems and develop solutions that may include field work, laboratory work, numerical modeling, or some combination of these approaches. This method of problem solving places a strong emphasis on interdisciplinary teamwork. The work environment at SwRI strikes a balance among the freedom to attack technically important problems, consistent support to professional development, and a strong commitment to meeting client's deadlines and goals. Real problems with real consequences are routinely solved on a tight schedule. The diversity of clients gives exposure to an extraordinarily wide range of problems. Successful employees have sound technical backgrounds, are flexible in accommodating varying clients needs, bring creativity and energy to problem solving and applications of technologies, can work on multiple tasks in parallel, and can communicate