and risk such as seismicity, landslide and volcanic activity. Without the plan, the county will not receive any economical support from the central government.

In the county of Pasto, the largest city in the influence zone of Galeras volcano, the hazard map has been used to promote educational plan in schools, increasing public awareness of Galeras and its hazard, advise and persuade decision makers to consider Galeras hazard in the city development plans. On the other hand, the hazard map has been mistaken as a risk map and it has originated opposition due to the measurements taken as a consequence of the map.

This presentation deal with the gain experience of using the hazard map as a tool of information and planing and the confrontation that any decision implies with political, social and economic interest.

ED42B-0187 1330h POSTER

Digital Atlas for Utah Geothermal Resources

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In response to increasing interest in renewable energy sources in Utah, the Utah Geological Survey, in cooperation with other state agencies, is completing work on a new, interactive, digital publication based upon geographic information system (GIS) technology. Geothermal Resources of Utah-2001, which will be published on compact disk (CD), uses data derived from publicly available reports and data sets. Covering the state=s geothermal resources, the CD contains technical information on geothermal resources in Utah for scientists and engineers, but is also descriptive and interactive enough for general public use. Upon completion, the digital publication will contain (1) documents describing geothermal resource areas in Utah; (2) a 3,000-record database of thermal wells and springs; (3) digital maps of geothermal resources; (4) geothermal, geologic, geographic, cultural, and infrastructure-related spatial data (ArcView7) files; and (5) software to construct and view various GIS themes, maps, images, and reports. This paper describes the overall process of constructing the digital publication, and provides an overview of the structure and contents of the CD.

ED51A MC: Hall D Friday 0830h

AGU Scientists' Roles and Partnerships in Support of K-14 Education and Public Outreach: Part Two II *(joint with PA)*

Presiding: **C A Morrow,** Space Science Institute

ED51A-0215 0830h POSTER

A Menu of Opportunities for Space and Earth Scientists in Education (MOSIE)

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Space and earth scientists often report that they would be happy to become engaged in valuable education and public outreach (EPO) activity if they were offered a feasible way to get started. Motivated by the need to offer scientists useful ideas and options for EPO involvement, we have created prototype versions of two interconnected, web-based resources: 1) the Menu of Opportunities for Scientists in Education (MOSIE) and 2) the Roles Matrix". Our MOSIE prototype features EPO options collected from a small group of high-impact projects that are national in scope, with diverse geographic access, and ongoing opportunities for scientists to play valuable EPO roles. Featured projects currently include Project ASTRO, an NSF-supported national network of astronomer-teacher partnerships, and several traveling science center exhibits supported by NSF and/or NASA, such as MarsQuest, the Space Weather Center, and New Views of the Hubble Space Telescope. We are also featuring scientists from the MOSIE projects in our web-based "Roles Matrix", which includes profiles of actual space and earth scientists successfully engaged in EPO. The goals of this web-based Matrix are to: 1) recognize scientists successfully involved in education and public outreach (EPO); 2) raise awareness of the diversity of roles scientists can play in EPO besides classroom or public presentation; 3) document a representative sample of the ways scientists are currently involved in EPO; and 4) provide role models for scientists in personally rewarding and effective EPO involvement. We will evolve the Roles Matrix and MOSIE based on user feedback to maximize their value in promoting fruitful partnerships between EPO professionals and the communities in space and earth science. This work is supported by the NASA Office of Space Science and the NSF Geosciences Directorate.

URL: http://www.spacescience.org

ED51A-0216 0830h POSTER

Bridging the Gap: The Role of Research in Science Education

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Teaching in K-12 science classrooms across the country does not accurately model the real processes of science. To fill this gap, programs that integrate science education and research are imperative. Teachers Experiencing Antarctica and the Arctic (TEA) is a program sponsored and supported by many groups including NSF, the Division of Elementary, Secondary, and Informal Education (ESIE), and the American Museum of Natural History (AMNH). It places teachers in partnerships with research scientists conducting work in polar regions. TEA immerses K-12 teachers in the processes of scientific investigation and enables conveyance of the experience to the educational community and public at large.

The TEA program paired me with Dr. Peter Michael from the University of Tulsa to participate in AMORE (Arctic Mid-Ocean Ridge Expedition) 2001. This international mission, combining the efforts of the USCGC Healy and RV Polarstern, involved cutting-edge research along the geologically and geophysically unsampled submarine Gakkel Ridge. While in the field, I was involved with dredge operations, CTD casts, rock cataloging/ processing, and bathymetric mapping. While immersed in these aspects of research, daily journals documented the scientific research and human aspects of life and work on board the Healy. E-mail capabilities allowed the exchange of hundreds of questions, answers and comments over the course of our expedition. The audience included students, numerous K-12 teachers, research scientists, NSF personnel, strangers, and the press. The expedition interested and impacted hundreds of individuals as it was proceeding.

The knowledge gained by science educators through research expeditions promotes an understanding of what research science is all about. It gives teachers a framework on which to build strong, well-prepared students with a greater awareness of the role and relevance of scientific research. Opportunities such as this provide valaulble partnerships that bridge the gap between science education and research science, and the results can greatly impact the lives of many individuals.

URL: http://tea.rice.edu

ED51A-0217 0830h POSTER

Preparing College Students to Teach an Environmental Problem Solving Curriculum to Middle School Students

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An NSF-funded project-based program was implemented by Clarkson University in 2000 to increase the interest and knowledge of middle school students in science, math and technology through the solution of an environmental problem that is relevant to their local school community. Clarkson students developed curricula for 7th and 8th grade science and technology classes and then worked with the middle school students throughout the year to reduce to transform solid waste into healthy soil for plant growth. The solution to this problem provided a vehicle to teach fundamental science and math content as well as the process of doing science and solving problems.

Placing college science and engineering students in the classroom proved to be a great mechanism for engaging students in science topics and providing mentoring experiences that differ greatly from those that a practicing professional can provide. It is clear, however, that the students must be well prepared for this experience to maximize the benefits of university - school district partnership programs. The objective of this presentation will be to describe the training program that has been developed to prepare Clarkson students to work effectively in middle school classrooms.

The Clarkson students are trained for their classroom experiences during the summer before they enter the classroom. They receive three credits for the training, curriculum development, and teaching efforts. It is expected that the students have the necessary background in science and technology to teach themselves the content and environmental relevance of the problem they will be teaching. Lectures and workshops focus on how to transform this knowledge into a project-based curriculum that meets the needs of the teachers, while also exciting the students. Lecture/workshops include: team work; components of an effective class and teacher; project planning and management; problem solving process; inquiry based learning, deductive/inductive learning; creating unit/lesson plan; defining learning objectives; incorporating mentoring into program; NYS standards and science exam; and, assessment techniques. Journals are used to encourage the fellows to reflect on their learning and own educational experiences. An evaluation of the program by both Clarkson students and their partner teachers indicated that this training was appropriate for the students to enter the classroom as professional scientists and engineers. Their classroom interaction skills improved throughout the year.

URL: http://www.clarkson.edu/k12

ED51A-0218 0830h POSTER

The PRIME Partnership: 9th Graders, Graduate Students and Integrated, Inquiry-Based Science

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The PRIME program (Partnership for Research in Inquiry-based Math, science and engineering Education) is a collaboration between the UW Colleges of Education and Engineering and several Seattle-area school districts. This project, funded by the NSF GK-12 program, pairs UW graduate students from math, science and engineering disciplines with local middle school teachers. The graduate student spends a year working with the teacher, on projects designed to meet the needs and interests of the specific partnership and classroom. In the partnership, the graduate student spends 15 hours per week in the classroom, interacting with the students, as well as additional planning time outside of the classroom. Goals of the PRIME program are enriched learning by middle school students, professional development for middle school teachers, improved communication and teaching skills for the graduate students, and strengthened partnerships between the University of Washington and local school districts.

The goal of our partnership was to develop an inquiry-based, 9th grade unit that integrates the pre-existing Earth Science and Chemistry units, and to assess the effectiveness of teaching Chemistry in the context of Earth Science. We have observed that students often become engaged and excited when they do hands-on activities that utilize the intrinsic understanding that they have of concepts that draw upon experiences in their daily lives. When science is taught and learned in one such context - in the context of the natural world - the students may gain a more solid fundamental understanding of the science that they learn. The day-to-day activities for this unit vary widely. We started each topic with a question designed to get the students thinking independently and to identify the preconceptions that the students brought into the classroom. Discussions of students' preconceptions served as a justification and springboard for the subsequent activities and experiments. Examples of questions used to spark student thought are: "What do you think the inside of the Earth looks like?," "What makes a volcano erupt?," and "Do mountains last forever?." We evaluated the effectiveness of this approach through a combination of classroom observations, formal and informal interviews, and surveys

ED51A-0219 0830h POSTER

Practice and Prospects for Involving Scientists in K-12 Education at the Center for Educational Technologies

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The Center for Educational Technologies and the NASA Classroom of the Future Program is dedicated to enhancing lifelong learning and teaching, particularly science education in K-12 classrooms. Over the past decade we have formed partnerships with organizations and individual scientists in astronomy, earth and planetary science, and biology to develop curriculum supplements, provide educator-leader professional development, and test classroom effectiveness of technologies such as high-speed computer networks, multimedia, and human-interface technologies. Our pedagogical approach is inquiry-based learning, emphasizing the use of real data to investigate real problems. Scientist partners have functioned as sources of data and cutting-edge scientific problems, as reviewers of scientific accuracy in our materials, and even as guest stars in video and CD-ROM productions. As a recently selected Broker/Facilitator for NASA's Office of Space Science, we are poised to enlarge our role as a bridge between the scientific community and the classroom. This talk will describe our past partnerships along with future possibilities and directions.

ED51A-0220 0830h POSTER

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The Los Alamos National Laboratory (LANL) Environmental Restoration Project is currently involved in clean-up of many legacy waste sites associated with work performed in the past at LANL. A growing part of the ER mission is to involve the public in the processes of monitoring, remediation, and stewardship. The challange of presenting complex environmantal analysis to the public is addressed via an educational exercise that uses web-based applications to allow interactive learning from a home computer. The presentation begins with discussions of the site history, regulations, and basic facts about VOCs. Measured concentrations of vapor phase VOC are shown on figures which clearly relate the plume to features of concern such as the water table and nearby surface facilities. Nature and extent are demonstrated with an animation that visually shows the relationship of the vapor phase VOC plume to the monitoring boreholes. Simulations of VOC vapor transport are describe and compared to data. Conclusions based on the data and modeling complete the exercise. We hope to use this type of educational tool in the future to provide the public with the knowledge they need to become more proactive in the process of remediating legacy waste sites.

URL: http://www.lanl.gov/orgs/ssr/ta54/

ED51A-0221 0830h POSTER

Using Remote Sensing Technology as a Tool for Educational Outreach and for Studying Global Climate Changes

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Geographic and scientific educations of primary and secondary school children have become topics of concern in Ohio and in the United States. One step towards improving a student's education is to render continuous, outstanding opportunities for teachers to become more knowledgeable by utilizing current technologies. The University of Toledo hosted a one-week, NASA and OhioView sponsored workshop entitled, Observing Earth's Systems from Space, for teachers from grades 5-12 during July 2000 and July 2001. Forty-nine teachers from Ohio, Michigan, and Pennsylvania with Earth Science, Social Studies, and Physics backgrounds attended. Each participant acquired new ideas, plenty of educational materials, and posters of satellite imagery to be used as aids in teaching remote sensing. The teachers received training on weather observing techniques, Global Warming issues, and basic remote sensing knowledge and analytical skills through: 1) presentations given by research scientists and community professionals, 2) integration of the learned material into practical, hands-on lesson plans, and 3) participation in a learning adventure, where their students collected real-time cloud and snow data at their respective schools while university research scientists gathered corresponding satellite imagery. A web-page was developed to continuously and globally share the data and results: www.utoledogis.org. The students entered their data on the web which eventually was sent to the research scientists. The data collected from the students have successfully assisted in the delineation of clouds and snow in satellite imagery and in the validation of cloud/snow remote sensing algorithms. The raw data and the corresponding satellite images are displayed on the web-page with the delineation of clouds and snow depicted. The participation in an actual, long-term research project has added another worthwhile dimension to the learning process for both the teachers and their students.

ED51A-0222 0830h POSTER

The National Aeolian Detritus Project, A Student-controlled, Standards-based Research Opportunity for Middle and Hight School Students

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Schools across the United States are adopting Standards-based philosophies and practices at a quickening pace. Two of the biggest challenges in this transition are the integration of concepts and the development of meaningful evaluation of student progress. The National Aeolian Detritus Project is a collaboration among Jamestown School, the University of Rhode Island, Hampshire College, the Rhode Island Space Grant Consortium at Brown University and the Rhode Island Nuclear Science Center. This Project provides students with an opportunity to integrate and enhance previous elements of instruction and allows them decision-making control over the direction of an extended research investigation. This project also provides opportunities for undergraduate community service development through University - Local School collaboration and mentoring.

Students first collect Aeolian Detritus, that is, randomly deposited airborne particulate matter (APM) by deploying flat sheet collectors. Retained APM is removed from the collectors with repulpable tape and concentrated by vacuum filtration. APM is initially identified by simple light microscopy, solubility, density, and magnetic response. More advanced identification includes ICP and Neutron Activation. With assistance from collaborating universities, students craft research questions based on these initial samples and develop investigation designs.

Sample research questions include: 1) Can insect infestations or possible defoliation events be predicted by identification of insect bodies, parts, and excrement? 2) What information can we collect about micrometeorites when typed, analyzed, and compared to NASA comet track data? 3) Can the distribution of flora be confirmed or modified based on pollen grain collection and mapping? 4) Can the distribution of mineral particulate matter be mapped by collection and comparison with wind patterns over known geologic features?

Schools correlate collection data with National Weather Service wind records and submit their results to the NADP data center for posting as GIS data on the NADP website. In this way, co-operating collection sites may identify large scale patterns.

As a result of pilot teacher training this summer, four test sites are being established to further refine the collection protocol and the extended research design process.

ED51A-0223 0830h POSTER

Exploring the Tuolumne River:An Interactive CD ROM on Fluvial Processes

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We have created an electronic field investigation to help students discover the dynamics of river processes using the example of the Tuolumne River, in Yosemite National Park. The experience simulates a field trip to Tuolumne Meadows, where the students make a series of visual observations based on ground and aerial photographs. We want them to build as full a set of objective observations as possible before they engage in interpretation. The program records the specific locations in the photographs where the observations have been made, allowing an electronic assessment of the diversity of the students' descriptions. Students also "acquire" real field data (bathymetry, flow and grain size distributions, and the outer bank position through time) in a two stage process: (1) they predict the bathymetry, the flow patterns, etc. based on a careful scrutiny of the photographs and (2) they "do the experiments" to get the real field data. The computer then evaluates the match in each case, and asks a series of tailored socratic questions to lead the students to a richer understanding. When the "observations" are complete, we help them organize a logically sequential Results Section, and then a self-consistent hypothesis. Finally, for further investigation, we provide a set of photographs of other ivers, each of which has a rich "story" of its own. Our goals for this project are: (1) to have students discover for themselves how rivers "work" at their own pace and level of sophistication, and (2) to model the scientific method so that it can applied to other geologic investigations.

ED51A-0224 0830h POSTER

Geology of Mars An Internet-Based Learning Module for High School and Beginning College Students

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Following the concept of classrooms without boundaries, a learning module to study Martian geology cooperatively through the Internet has been developed. This learning module contains two components: (1) webpages of content materials, and (2) an online discussion utility. The module is designed to address six geological processes that are either currently active or have occurred in the past on the surface of Mars. These processes include aeolian, impact cratering, hydro-, mass wasting, tectonic, and volcanic processes. Highlights of each process based on the observations obtained through the various NASA missions are briefly described. An introduction section that discusses the global properties of Mars is also included. Links to similar processes operating on Earth are provided when possible. Through these webpages, students are expected to learn the basic concepts about these geological processes and the conditions necessary for them to take place. These modules are designed to enable an instructor to choose either all or only parts of the processes in their classroom instructions. Associated with each geological process, a discussion forum is setup to enable students to conduct online discussions to enhance their learning. Together with each forum, some suggested discussion topics are provided. However, instructors are free to post their own discussion topics whenever deemed preferable. With this online discussion facility, students are able to discuss subject matters with students from other schools through the coordination of their instructors from the respective schools. To avoid the high costs of some commercial discussion software packages, a freeware called Ikonboard is chosen to facilitate online discussions. The Ikonboard is quite adequate in providing

all the essential elements for online discussions. Instructors can even assign students to separate discussion groups. Through the interactions with others from different geographical areas and with different life experiences, students are expected to find learning more interesting and thus can learn better about the scientific subject matters.

ED51A-0225 0830h POSTER

The Topography of Mars: Understanding the Surface of Mars Through the Mars Orbiter Laser Altimeter

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The Mars Orbiter Laser Altimeter has been orbiting Mars since 1997 and has measured the topography of Mars with a meter of vertical accuracy. This new information has improved our understanding of both the surface and the interior of Mars. The topographic globe and the labeled topographic map of Mars illustrate these new data in a format that can be used in a classroom setting. The map is color shaded to show differences in elevation on Mars, presenting Mars with a different perspective than traditional geological and geographic maps. Through the differences in color, students can see Mars as a three-dimensional surface and will be able to recognize features that are invisible in imagery.

The accompanying lesson plans are designed for middle school science students and can be used both to teach information about Mars as a planet and Mars in comparison to Earth, fitting both the solar system unit and the Earth science unit in a middle school curriculum. The lessons are referenced to the National Benchmark standards for students in grades 6-8 and cover topics such as Mars exploration, the Mars Orbiter Laser Altimeter, resolution and powers of 10, gravity, craters, seismic waves and the interior structure of a planet, isostasy, and volcanoes. Each lesson is written in the 5 E format and includes a student content activity and an extension showing current applications of Mars and MOLA data. These activities can be found at http://ltpwww.gsfc.nasa.gov/education/resources.html. Funding for this project was provided by the Maryland Space Grant Consortium and the MOLA Science Team, Goddard Space Flight Center.

ED51B MC: Hall D Friday 0830h

Approaches to Undergraduate Education in the Geophysical Sciences

Presiding: **S Stockman,** SSAI-NASA/GSFC**; R E Pandya,** West Chester University

ED51B-0226 0830h POSTER

Going Beyond the Lecture Class - Is it Worth it?

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Lectures, labs, and seminars dominate the course offerings at most American universities. Students have been learning successfully from these teaching methods for hundreds of years. Alternatively, in order to provide a more personally meaningful learning experience, educational researchers espouse a constructivist approach to learning. To demonstrate this approach, we will describe a case study of two courses, marine chemistry and biological oceanography, that were taught as a single interdisciplinary experience by Stanford University faculty. The courses incorporated an innovative curriculum using active learning methodologies including problem-based learning and teamwork, a set of interactive and facilitative teaching practices, customized technology that worked in the background to make the course effective and efficient, and a goal to reveal the interdisciplinary nature of the content in the two courses.

Videotapes of group problem solving revealed that students displayed higher order thinking skills. Students indicated in focus groups that teamwork provided a motivating, rich, learning environment. The communication technology supported both the faculty in the delivery and assessment of the course and the students in communicating with their teams. The technology was the glue that made the course work effectively and efficiently. The overall learning experience can be best expressed by the students themselves who said they felt like they were participating in real science for the first time.

ED51B-0227 0830h POSTER

Developing an Assessment Tool for Geology: Stage One, Student Interviews

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Questionnaires and targeted interviews were used to determine the extent of college student conceptual understanding in the geosciences. Specifically, introductory and non-major courses were targeted, with emphasis on three dimensions of Earth processes: Earths crust, Earths interior, and Earth through time. A review of the geoscience and education literature revealed only sixteen studies that are relevant to conceptual understanding in these three categories. A number of studies focus on definitions, such as the meaning of the term fossil. Some researchers also touch upon soil, water, and plate tectonics, and geologic time is the most closely considered concept. This study extends the available research, and reveals a number of preconceptions held by college-aged students. For instance, many students are unable to fully comprehend geologic time, have poor understanding of the causes of geologic events such as earthquakes and volcanoes, and have a non-scientific view of the interior of the Earth.

ED51B-0228 0830h POSTER

Integrating Real-time Earthquakes into Natural Hazard Courses

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Natural hazard courses are playing an increasingly important role in college and university earth science curricula. Students' intrinsic curiosity about the subject and the potential to make the course relevant to the interests of both science and non-science students make natural hazards courses popular additions to a department's offerings. However, one vital aspect of "real-life" natural hazard management that has not translated well into the classroom is the real-time nature of both events and response. The lack of a way to entrain students into the event/response mode has made implementing such real-time activities into classroom activities problematic. Although a variety of web sites provide near real-time postings of natural hazards, students essentially learn of the event after the fact. This is particularly true for earthquakes and other events with few precursors. As a result, the "time factor" and personal responsibility associated with natural hazard response is lost to the students. We have integrated the real-time aspects of earthquake response into two natural hazard courses at Penn State (a 'general education' course for non-science majors, and an upper-level course for science majors) by implementing a modification of the USGS Earthworm system. The Earthworm Database Management System (E-DBMS) catalogs current global seismic activity. It provides earthquake professionals with real-time email/cell phone alerts of global seismic activity and access to the data for review/revision purposes. We have modified this system so that real-time response can be used to address specific scientific, policy, and social questions in our classes. As a prototype of using the E-DBMS in courses, we have established an Earthworm server at Penn State. This server receives national and global seismic network data and, in turn, transmits the tailored alerts to "on-duty" students (e-mail, pager/cell phone notification). These students are responsible to react to the alarm real-time, consulting other members of their class and accessing the E-DBMS server and other links to glean information that they will then use to make decisions. Students wrestle with the complications in interpreting natural hazard data, evaluating whether a response is needed, and problems such as those associated with communication between media and the public through these focused exercises. Although earthquakes are targeted at present, similar DBMS systems are envisioned for other natural hazards like flooding, volcanoes, and severe weather. We are testing this system as a prototype intended to be expanded to provide web-based access to classes at both the middle/high school and college/university levels.

ED51B-0229 0830h POSTER

An Earth Summit in a Large General Education Oceanography Class

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An Earth Summit approach in UCSBs undergraduate physical oceanography course has raised student interest level while it also supports the course goals of increased learner awareness of the process of science, and critical analysis of scientific claims. At the beginning of the quarter, each group of students chooses a country to represent in the Earth Summit. During the course of the quarter, these groups relate each of the class themes to their chosen country. Themes include 1) ocean basins and plate tectonics, 2) atmospheres, oceans and climate, and 3) fisheries. Students acquire and utilize Earth data to support their positions. Earth data sources include the "Our Dynamic Planet" CDROM (http://oceanography.geol.ucsb.edu/ODP_Advert/odp_onepage.htm), NOAAs ocean and climate database (http://ferret.wrc.noaa.gov/las/), WorldWatcher CD (http://www.worldwatcher.northwestern.edu/) and JPLs Seawinds web site (http://haifung.jpl.nasa.gov/index.html).

During the atmospheres, oceans and climate theme, students choose from 12 mini-studies that use various kinds of on-line Earth data related to important global or regional phenomena relevant to the course. The Earth datasets that the students access for their analysis include: winds; atmospheric pressure; ocean chemistry; sea surface temperature; solar radiation; precipitation, etc The first group of 6 mini-studies focus on atmosphere and ocean, and are: 1) global winds and surface currents, 2) atmosphere and ocean interactions, 3) stratospheric ozone depletion, 4) El Nino, 5) Indian monsoon, and 6) deep ocean circulation. The second group focus on the Earths heat budget and climate and are: 1) influence of mans activities on the climate, 2) the greenhouse effect, 3) seasonal variation and the Earths heat budget, 4) global warming, 5) paleoclimate, and 6) volcanoes and climate. The students use what they have learned in these mini-studies to address atmospheric and climatic issues pertinent to their specific Earth Summit countries. For example, students representing the country of Chile might model their investigations after a)winds and surface currents, b)atmosphere and ocean interactions, c) stratospheric ozone depletion, d)El Nino; and/or e)volcanoes and climate.

Please join the "Oceanography" interest group of DLESE to discuss, develop, and access oceanography related mini-studies that use earth data (http://oceanography.geol.ucsb.edu/dlese/wg_oceanog/Index.html).

URL: http://oceanography.geol.ucsb.edu/AWP/Class_Info/GS-4/Labs/Labs Index.html