provide a forum where teachers can share ways that they incorporate literacy and math into their units - an important concern for their school and district. Scientists are also brought into the classroom as part of the for-credit course program, and teachers co-teach alongside a graduate student scientist.

URL: http://www.science.umn.edu

ED61A-0016 0830h INVITED POSTER

Distance Learning and Teachers: Experiences from the Earth System Science Education Alliance

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In response to the need to improve scientific literacy of teachers and K-12 students in Toledo and Ohio, the University of Toledo joined the Earth System Science Education Alliance to offer the 5-8th grade Earth Science course in the fall of 2001 and summer of 2002. The use of the Internet for the delivery of higher education courses has dramatically increased especially at the University of Toledo where over 6,000 students a semester take distance learning courses. Although distance learning has become an important medium for traditional undergraduate students who often have jobs, in-service teachers have been slow to sign up for distance learning courses even though they need Masters degrees to keep their licenses. Teachers are more likely to take lecture-based courses or summer seminars. In our presentation we will discuss our findings from pre and post course surveys and experiences from our two course offerings. We will relate technical difficulties encountered through the delivery of the course as well as the bureaucratic barriers that had to be overcome.

ED61A-0017 0830h INVITED POSTER

Capturing Earth Science Learning Dynamics: Communication Interactions of ESE Teachers and Children Occurring in Online, Classroom, and Small-Group Environments.

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While the processes of schooling in science are usually measured in the resulting skills and products that students acquire or generate, another way to understand science learning is to explore the interactions and discourse that occur during actual learning activities. To investigate the dynamics of inquiry-based learning of earth science, we have explored the patterns that emerge in several learning environments: when teachers create dialog with other teachers in online ESE courses; when they teach earth science lessons in their classrooms; when they discuss their teaching perspectives in interviews; and when small groups of children engage in learning earth science together. By observing and scoring lesson exchanges, preserving online discussions, and documenting words and interactions in audio or video recordings, we are able to distinguish communication configurations that occur when teachers and children engage in the learning of earth science that would otherwise be invisible.

ED61A-0018 0830h INVITED POSTER

Earth System Science Online at Hampton University

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Earth System Science Online is an innovative web-based science course for teachers and future teachers. Supported by NASA and offered by the Interdisciplinary Science Center at Hampton University, this course targets students interested in an asynchronous web-based learning environment. Earth System Science Online allows participants to earn three hours of science graduate credit through their online explorations of the geosphere, hydrosphere, and atmosphere. The incorporation of specific problems-based case studies, allow students to investigate weather phenomena, deforestation, and the various instruments and satellite data systems that are used to collect and analyze this data.

This newly initiated web-based course delivers all lectures, text readings, and course assignments online. Assignments are given on a weekly basis, and participants are expected to conduct independent research that will enrich their online experience. The nature of the web allows registered participants to easily integrate text and graphics into their assignments and have access to their classmate's work. Participants meet online weekly and interact as a team. Team members take advantage of Hampton Universitys leadership in atmospheric sciences by meeting online to discuss course content with faculty and guest experts.

Hampton University, a Historically Black University (HBCU), has built a unique partnership between the scientists at the Center for Atmospheric Sciences and the educators at the Interdisciplinary Science Center. Both centers work closely together and partner with NASA to provide outreach efforts for several NASA satellite-based research missions. The ISC has been recognized for the quality of its professional development for teachers for over eighteen years. Earth System Science Online brings together a unique partnership of educators and scientists providing an innovative online course for teachers.

ED61A-0019 0830h POSTER

Online Student Learning and Earth System Processes

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Many students have difficulty understanding dynamical processes related to Earths climate system. This is particularly true in Earth System Science courses designed for non-majors. It is often tempting to gloss over these conceptually difficult topics and have students spend more study time learning factual information or ideas that require rather simple linear thought processes. Even when the professor is ambitious and tackles the more difficult ideas of system dynamics in such courses, they are typically greeted with frustration and limited success. However, an understanding of generic system concepts and processes is quite arguably an essential component of any quality liberal arts education.

We present online student-centered learning modules that are designed to help students explore different aspects of Earths climate system (see http://www.cs.clark.edu/mac/physlets/GlobalPollution/maintrace.htm for a sample activity). The JAVA based learning activities are designed to: be assessable to anyone with Web access; be self-paced, engaging, and hands-on; and make use of past results from science education research. Professors can use module activities to supplement lecture, as controlled-learning-lab activities, or as stand-alone homework assignments.

Acknowledgement This work was supported by NASA Office of Space Science contract NASW-98037, Atmospheric and Environmental Research Inc. of Lexington, MA., and Clark College.

ED61B MCC: Hall D Saturday 0830h

Digital Resources for Earth and Space Science Education Posters

Presiding: **S Stockman,** Science Systems and Applications, Inc.**; B Aivazian,** Natrona County School District

ED61B-0020 0830h POSTER

The Digital Library for Earth System Education: A Progress Report from the DLESE Program Center

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DLESE is a community-owned and governed digital library offering easy access to high quality electronic resources about the Earth system at all educational levels. Currently in its third year of development and operation, DLESE resources are designed to support systemic educational reform, and include web-based teaching resources, tools, and services for the inclusion of data in classroom activities, as well as a virtual community center that supports community goals and growth. Community-owned and community-governed embody the singularity of DLESE through its unique participatory approach to both library building and governance.

DLESE is guided by policy development vested in the DLESE Steering Committee, and informed by Standing Committees centered on Collections, Services, Technology, and Users, and community working groups covering a wide variety of interest areas.

This presentation highlights both current and projected status of the library and opportunities for community engagement. It is specifically structured to engage community members in the design of the next version of the library release.

The current Version 1.0 of the library consists of a web-accessible graphical user interface connected to a database of catalogued educational resources (approximately 3000); a metadata framework enabling resource characterization; a cataloging tool allowing community cataloging and indexing of materials; a search and discovery system allowing browsing based on topic, grade level, and resource type, and permitting keyword and controlled vocabulary-based searches; and a portal website supporting library use, community action, and DLESE partnerships.

Future stages of library development will focus on enhanced community collaborative support; development of controlled vocabularies; collections building and community review systems; resource discovery integrating the National Science Education Standards and geography standards; Earth system science vocabulary; georeferenced discovery; and ultimately, AAAS Benchmarks. DLESE is being designed from the outset to support resource discovery across a diverse, federated network of holdings and collections, including the Alexandria Digital Library Earth Prototype (ADL/ADEPT), NASA education collections, the DLESE reviewed collection, and other community-held resources that have been cataloged and indexed as part of the overall DLESE collections.

ED61B-0021 0830h POSTER

Finding the Best Water Resources for the K-12 Classroom: A Preview of The Digital Water Education Library Project (DWEL)

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DWEL is the first major collection building effort to bring high quality, K-12 resources into the Digital Library for Earth Systems Education (DLESE). Efforts are currently underway to provide teachers, students and informal educators with easy, searchable access to over 500 exemplary digital resources related to the science, policy and economics of water by the end of 2003. A discovery tool will allow users to search the library catalogue by content area, grade level, resource type and the national science standards to obtain the resources they desire. Part of this presentation will focus on how to access this tool and specific ways to use it more effectively.

URL: http://dwel.dlese.org

ED61B-0022 0830h POSTER

Student Web Use, Columbia Earthscape, and Their Implications for Online Earth Science Resources

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For three years, Columbia Earthscape, www.earthscape.org, has served as a test bed for the development and evaluation of Web-based geoscience education. Last fall (EOS Trans. AGU, 82(47), Fall Meet. Suppl., Abstract ED11A-11, 2001), we described how librarian, scientist, instructor, and student feedback led to sweeping changes in interface and acquisitions. Further assessment has looked at the value of a central online resource for Earth-system science education in light of patterns of study.

Columbia Earthscape aimed to create an authoritative resource that reflects the interconnectedness of the Internet, of the disciplines of Earth-systems science, and of research, education, and public policy. Evaluation thus has three parts. The editors and editorial advisory board have evaluated projects for the site for accuracy and relevance to the project?s original context of Earth issues and topical mini-courses. Second, our research sought patterns of student use and library acquisition of Internet sources. Last, we asked if and how students benefit from Columbia Earthscape. We found, first, that while libraries are understandably reluctant to add online resources to strained budgets, almost all students work online; they vary almost solely in personal Web use. Second, Web use does not discourage use of print. Third, researchers often search Columbia Earthscape, but students, especially in schools, prefer browsing by topic of interest. Fourth, if they did not have this resource, most would surf, but many feel lost on the Web, and few say they can judge the quality of materials they used. Fifth, students found Columbia Earthscape helpful, relevant, and current, but most often for its research and policy materials. Many commented on issue-related collections original to Columbia Earthscape.

While indeed we intended our Classroom Models and Sample Syllabi primarily as aids to instructor course design, we conclude, first, that students stick anyway to assigned materials and projects. Second, these assignments put students in need of materials not originally meant for education and not easy for students to evaluate. Third, an online resource must not choose simply a card-catalog or search model. In short, many have asked how scientists can support education and outreach and how curricula can integrate research and policy; but students already demand those connections, and a central online resource can help scientists, students, and the public by itself making them.

URL: http://www.earthscape.org

ED61B-0023 0830h POSTER

A Didactical User Guide for E-Learning in Science

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Development of e-learning courseware differs in many ways from conventional teaching, for example in terms of the role of tutors and students. Not all contents are suitable for e-learning; the construction of interactive graphs and complex animations is time-consuming and should be efficient and advantageous over an in-class lectures. Learning goals and tests are more important in e-learning than in conventional teaching; tests may be conditional, i.e. progression may be made dependent on successful completion of a test. Prior to production of an e-learning course, it is advised to develop a didactical concept, especially if e-learning strategies are missing in an organisation. The expectations on readily available pedagogical guidelines and didactic concepts from the point of view of science content providers are high. Here, concepts of e-pedagogy are introduced, and the highlights of a Didactical User Guide for E-Learning produced by Berne University, Switzerland and published by h.e.p. Publ. Switzerland in fall 2002 are presented. Selected didactic elements such as interactivity, communication, role of tutor and student are illustrated with an e-learning course on tropospheric ozone.

ED61B-0024 0830h POSTER

Advanced Search Options in the ADS Abstract Service

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The Astrophysics Data System (ADS) provides access to the astronomical literature through the World Wide Web. It is a NASA funded project and access to all the ADS services is free to everybody world-wide.

The ADS Abstract Service allows searching of four databases with abstracts in Astronomy, Instrumentation, Physics/Geophysics, and the LANL Preprints with a total of almost 3 million references in the databases. The system also provides access to reference and citation information, links to on-line data and other on-line information, and to on-line electronic journals.

Three advanced feedback queries are available from the bottom of the ADS results list (in addition to regular feedback queries already available from the abstract page and from the bottom of the results list):

1. Get reference list for selected articles: This query returns all known references for the selected articles (or for all articles in the first list). The resulting list will be ranked according to how often each article is referred to and will show the most referenced articles in the field of study that created the first list. It presumably shows the most important articles in that field.

2. Get citation list for selected articles: This returns all known articles that cite one or more of the articles in the first list. The resulting list shows the articles that cite the most articles in the first list at the top. The articles with the most citations are presumably the review articles in the field of study that created the first list.

3. Get also-read list for selected articles: This creates a list of articles that were also read by the readers of the articles in the first list. This list will show what articles are currently being read in the field of study of the first list and will give an idea of which articles are currently considered important for this field.

Combinations of these second order queries (e.g. first a citation query to get the review articles, then a reference query to get all the references in the review articles) can further enhance the utility of this new capability.

The ADS can be accessed at:
http://ads.harvard.edu

The ADS is funded by NASA Grant NCC5-189

URL: http://ads.harvard.edu

ED61B-0025 0830h POSTER

Students On-Line Atmospheric Research

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Students On-Line Atmospheric Research (SOLAR) is one of NASAs educational outreach programs. SOLARs primary role is to support educational outreach activities for NASAs Stratospheric Aerosol and Gas Experiment III (SAGE III). SAGE III is the latest version of a series of solar occultation experiments, which include SAGE I and SAGE II. The SAGE III instrument was launched on a Russian METEOR 3M spacecraft in December 2001, and is now monitoring the global distribution of aerosols, ozone, clouds, and other important trace gases in the upper atmosphere. The SAGE measurements are critical to improving the understanding of global climate forcing as well as atmospheric chemical processes in the upper atmosphere.

The SAGE experiment addresses interesting science problems related to the Earths atmosphere. Many exciting science and technology topics from SAGE can be developed and incorporated into K-12 curriculum materials to enhance student interest in science. In addition, technologies employed by the SAGE measurement technique give rise to ideas for science projects that involve student participation. The SOLAR outreach program helps to bring these topics and ideas to the classroom by focusing on helping teachers become familiar with current research in the atmospheric sciences, and helping them integrate SOLAR developed educational materials into their curriculum. SOLAR gives special presentations at national and regional science teacher conferences and conducts an annual summer teacher workshop at the NASA Langley Research Center. Members of the SOLAR team also visit schools give classroom presentations and presentations to special student groups.

This poster highlights some of the key features of the SOLAR program and presents descriptions of student projects, teacher workshops, and SOLAR resources.

ED61B-0026 0830h POSTER

Introducing the Atmospheric Visualization Collection

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The Atmospheric Visualization Collection is a digital library collection, a section in the NSFs National Science Digital Library. The collection has two essential components. The first is an archive of images based on data from the Atmospheric Radiation Measurement (ARM) program. The second is a collection of educational material based on atmospheric science concepts that use these data images.

The data image archive focuses on the ARM Southern Great Plains (SGP) site, which has the largest collection of ground-based remote-sensing atmospheric instruments. Our visualization tools are automated to create the data images for both archival and real-time uses. ARM instrument mentors and ARM scientist as well as other scientists involved in campaigns at the ARM SGP site review our visualization work for scientific quality.

While the archive of weather images was initially created for scientists, collaboration with teachers has identified many of the barriers to educational use. This revealed the need for more educationally friendly interfaces into our weather images and the need for greater documentation. One of the results is our geophysical focus area interface, allowing teachers and students to access these data images.

The visualization tools used to produce these data images are available through an open source repository. Testing with undergraduate students has demonstrated the usability of these tools with data from the ARM Archive for class projects.

While the task of reviewing and improving user interfaces continues, we have reached a stage where educators and students can easily access our atmospheric data images. An initial set of peer reviewed lesson plans based on these data images has been the basis for workshops to introduce teachers to the AVC. To further involve these teachers a Lesson Plan Sandbox. The Lesson Plan Sandbox allows teachers to submit their lesson plans to share with others, to review lesson plans submitted by other teachers, and to add improvements to existing lesson plans while keeping a copy of the previous version. All of this is done using only a browser. The most recent development is a lesson plan interface that lets users search lesson plans by the appropriate National Science Education Standard level or by keywords.

The AVC seeks to provide research data in an accessible manner to both the research and educational communities. Currently the AVC averages 250-300 unique users per week with visitors from over 50 countries. While some users are from the scientific community, many of the users are students and teachers who are independently pursuing their scientific interests in atmospheric science.

URL: http://www.nsdl.arm.gov

ED61B-0027 0830h POSTER

Interpreting the Hydrology of a Desert Mountain Stream to a General Public: Using Multimedia to Enhance Informal Experiential Education

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Sabino Canyon near Tucson, Arizona draws over 1 million visits per year. The centerpiece of the canyon is Sabino Creek, an ephemeral stream fed by seasonal snowmelt and monsoon rains. Frequently asked questions by canyon visitors include: How can a stream flow in the desert environment? Why are the surrounding mountaintops so much cooler and wetter? How can the stream flow without recent rain or snowmelt? Where does the water go?

The NSF STC for Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA) has partnered with the USGS and the USDA Forest Service to develop static displays and a touch-screen electronic kiosk for the Sabino Canyon Visitors Center that explain what streamflow is, where the waters of Sabino Creek originate, where they go, what conditions produce flash flooding, and the hydrology of sky island environments. The kiosk, and an associated Web site, also give current weather and streamflow conditions at various points in the canyon, plus typical and extreme conditions for the current date.

Designing displays that attract and inform a diverse mix of visitors with varying levels of interest, reading levels, and attention spans is a major challenge. We have integrated static displays featuring light boxes with a touch-screen kiosk featuring graphics, animation, video, sound effects, and voice-overs. Optional sub-titles are in five languages. The goal is to attract visitors to the display and then meet their various interests and information needs.

Hydrology is a foreign subject to the great majority of people, and opportunities to informally educate them are relatively scarce. This presentation will show how current multimedia technology can be combined with proven methods of informal experiential education to communicate some basic hydrologic principles.

URL: http://www.sahra.arizona.edu/sabinocanyon

ED61B-0028 0830h POSTER

Communicating Pacific Rim Risk: A GIS Analysis of Hazard, Vulnerability, Population, and Infrastructure

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Exploding population and unprecedented urban development within the last century helped fuel an increase in the severity of natural disasters. Not only has the world become more populated, but people, information and commodities now travel greater distances to service larger concentrations of people. While many of the earths natural hazards remain relatively constant, understanding the risk to increasingly interconnected and large populations requires an expanded analysis.

To improve mitigation planning we propose a model that is accessible to planners and implemented with public domain data and industry standard GIS software. The model comprises 1) the potential impact of five significant natural hazards: earthquake, flood, tropical storm, tsunami and volcanic eruption assessed by a comparative index of risk, 2) population density, 3) infrastructure distribution represented by a proxy, 4) the vulnerability of the elements at risk (population density and infrastructure distribution) and 5) the connections and dependencies of our increasingly 'globalized' world, portrayed by a relative linkage index.

We depict this model with the equation, Risk = f(H, E, V, I)

Where H is an index normalizing the impact of five major categories of natural hazards; E is one element at risk, population or infrastructure; V is a measure of the vulnerability for of the elements at risk; and I pertains to a measure of interconnectivity of the elements at risk as a result of economic and social globalization. We propose that future risk analysis include the variable I to better define and quantify risk.

Each assessment reflects different repercussions from natural disasters: losses of life or economic activity. Because population and infrastructure are distributed heterogeneously across the Pacific region, two contrasting representations of risk emerge from this study.

ED61B-0029 0830h POSTER

Mapping Natural Disasters: Inquiry at its Best

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Mapping natural disasters utilizing GIS technology is a unique tool for learning earth science. Aided by this visualization enhancer, students can better associate disasters locations and magnitudes to the underlying natural forces that generate them. Furthermore, the extent of the damage can be tied to a combination of physical and social parameters and thus can be used to integrate earth science with other disciplines, such as statistics, health and social sciences. All these associations can be applied to real life situations that make the student investigations more authentic, while they help in their understanding the complexity of real-world phenomena.

Examples of inquiry-based activities (e.g., volcanoes, hurricanes, earthquakes, floods) and special projects ranging from middle school to college level are included. Inquiry is integrated to every aspect of the study of natural disasters: Natural disasters form a collection of periodic but unpredictable events, while predicting natural disasters offers a very productive path for student inquiry as they investigate the evolution of monitoring and warning equipment. An additional advantage is that the monitoring and reporting of these events in a timely and comprehensive manner are now accessible from Internet sites.

ED61B-0030 0830h POSTER

Cooperative Public Outreach - It can be Accomplished

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The U.S. Department of Agriculture, Forest Service (Santa Catalina Ranger District of the Coronado National Forest), the U.S. Geological Survey (Water Resources Discipline, Arizona District), and the National Science Foundation sponsored Science and Technology Center (Sustainability of semi-Arid Hydrology and Riparian Areas) have created a series of exhibits on the hydrology of Sabino Creek, an ephemeral stream within the Sonoran Desert (USA) visited by over 1 million people annually. A clear set of educational objectives established at the beginning of the process and interagency cooperation resulted in a cohesive grouping of exhibits while minimizing single agency dominance. The multimedia exhibits are a collection of visual displays along with a touch-screen kiosk that has animations and other links that expand along many avenues to educate people on ephemeral streams, sky islands, siltation, and ground-water recharge within the Sonoran Desert. In addition, the exhibit incorporates real-time climate and streamflow data collected by four science agencies. The real-time data incorporated into the kiosk and linking web page is used to educate visitors about the natural environment within Sabino Canyon and inform them about flash-flooding and fire dangers. Thus, before entering the canyon, a visitor can view the exhibit and readily determine the air and water temperature, stream activity, and several other current and historical environmental variables. In summary, the cooperative efforts between the agencies resulted in a series of exhibits that are far more beneficial to the public than if the efforts had been attempted separately.

ED61C MCC: Hall D Saturday 0830h

Teaching the Teachers: What Have We (They) Learned? I Posters *(joint with OS, GC, PA)*

Presiding: **J Thieman,** NASA Goddard Space Flight Center**; S Stockman,** Science Systems and Applications, Inc.**; F Ireton,** Science Systems and Applications, Inc.

ED61C-0031 0830h POSTER

REVEL* sails in a new direction. (* Research and Education: Volcanoes, Exploration and Life)

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The REVEL Project started as an education and outreach program designed to integrate elementary to high school science teachers into fully-funded research cruises that study the full spectrum of processes associated with submarine volcanoes. Since its inception at the University of Washington in 1996, REVEL provided 47 science teachers an opportunity to explore the nature of mid-ocean ridge volcanism and the life it supports along the Juan de Fuca spreading center in the Pacific Ocean. Two of these outstanding teachers have explored the seafloor in the submersible Alvin and one became a teacher-leader mentoring new educators in the program during their sea-going experience.

The program focused on exposing science educators to the scientific process through direct interaction and collaboration with scientists on board research cruises. As a result of their combined, sea-going and research experiences, these educators injected into the classroom the issues and ideas associated with this rapidly growing research effort, and a first-hand exposure to the approaches, successes, failures and essential tenacity that are the integral components of successful research into the unknown. The "ripple effect" of their personal experience has reached far beyond their own classrooms as they have exposed thousands of students and hundreds of science teachers to the scientific process. They have also shared the excitement of interdisciplinary exploration of the deep crustal processes capable of supporting extensive microbial activity within the volcanically active portions of the earth at regional and national conferences. The REVEL Project developed an extended community of teachers and researchers who can communicate and work together to ensure the successful translation of the research experience to the classroom.

Building on the lessons of the first five years, REVEL has evolved into a professional development program for K-12 science educators. Teams of teachers recruited nationally will collaborate over a period of 3 years to the study of the planetary ocean system at the scale of a tectonic plate as the contextual basis for capturing the interest of their students and the public. Starting in 2002, REVEL and its new partner the NEPTUNE Project will 1) Facilitate the active participation of teachers in cutting-edge, sea-going ocean research 2) Recruit teachers at the national level 3) Provide participants with activities over multiple years for a sustained effort 4) Evaluate REVEL as a model for teachers experiencing research.

The presentation will emphasize the lessons learned for effective teachers professional development programs in earth and ocean sciences.

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URL: http://oceanweb.ocean.washington.edu/outreach/revel

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A graduate physics education research course for teachers

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Physics and physical science (including space science) is perhaps the most difficult topic for the secondary schools to teach because of the lack of well-prepared teachers. To be well prepared to teach this subject teacher must have both a knowledge of physical science and some knowlegde of congitive science as it relates to the teaching of physical science. In this talk I will describe a graduate course in physics education research currently being offered to middle school and