

and a graduate student who worked with me for three years is now teaching four sections of science methods each semester to preservice teachers. I am assured all her students will be learning about the geosciences.

URL: <http://oceanworld.tamu.edu>

#### ED41A-07 1020h

##### Engaging AGU Scientists in the Development of Multimedia Education Products

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Planet Earth Science Inc. was established by an AGU scientist with the specific purpose of bringing Earth System Science education to the secondary education level. Through the development of its multimedia education products it has engaged a number of AGU scientists, engineers, instructional designers and educators at every level of the development chain from instructional design to content writing, media development and class-room testing. This has allowed diverse communities to better understand each other and work at finding ways to collaborate more efficiently.

Specific experiences acquired through the development of the CODIE award winning instructional CD "Ocean Expeditions: El Nio," jointly funded by the Department of Energy and NASA, will be presented and lessons learned will be discussed with emphasis on scientists engagements.

#### ED41A-08 1055h INVITED

##### Project ASTRO: A Program to Link Astronomers with Teachers in Grades 4-9 and Families

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As a concrete example of how scientists can have a major local effect on science education, I report on a program at the Astronomical Society of the Pacific to link professional and amateur astronomers with teachers and families in their area. Begun in 1993, Project ASTRO is now operating in 12 regional sites around the U.S. and has trained over 1000 astronomer-teacher partnerships. Graduate students and recent PhD's seeking experience in education have been some of our most effective partners.

Astronomers receive training (together with their teachers) in a 2-day workshop that provides them with a wide range of effective teaching techniques, age-appropriate hands-on activities, and useful resources. They commit to making at least four visits to "their" classroom each year and work with their teacher to tailor a plan appropriate for their interests and the students' needs. A wide range of resource materials (including a video and a thick resource and activity notebook) is available from the project.

The 12 ASTRO sites have formed a national network for exchanging ideas and approaches, and helping to train new sites. A kit of training materials is available to help any institution that would like to start a site. Contact the author, or see: [www.astrosociety.org/project-astro.html](http://www.astrosociety.org/project-astro.html)

The project is currently engaged in a new enterprise, creating a series of workshops and take-home activity kits to engage families in doing astronomy and space science in evenings or weekends.

URL: [http://www.astrosociety.org/project\\_astro.html](http://www.astrosociety.org/project_astro.html)

#### ED41A-09 1115h

##### Maryland Summer Center for Space Science - A Collaboration Between Scientists and Maryland Teachers

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JHU/APL hosts the Maryland Summer Center for Space Science for 6th and 7th graders. Students learned to harness the power of technology and keep pace with the expanding knowledge of space science. Students experienced the process involved in planning/launching a simulated space mission, including design/fabrication of instrumentation for a spacecraft. They were part of a Mission Team that built a spacecraft scale model complete with instrumentation as a NASA Discovery Program mission. Students also created logos, poster sessions, budgets, E/PO plans, and even gave a full mission overview oral presentation to

their peers. JHU/APL offered an exciting environment for this study of applications in space. Students interacted with scientists, engineers, and program management. They examined instruments, visited test facilities, mission operations and clean room facilities. Two week program, G/T students, Maryland State Department of Education.

#### ED41A-10 1130h INVITED

##### From Laboratories to Classrooms: Involving Scientists in Science Education

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Scientists play a key role in science education: the adventure of making new discoveries excites and motivates students. Yet, American science education test scores lag behind those of other industrial countries, and the call for better science, math and technology education is widespread. Thus, improving American science, math and technological literacy is a major educational goal for the NSF and NASA. Today, funding for research often carries a requirement that the scientist be actively involved in education and public outreach (E/PO) to enhance the science literacy of students, teachers and citizens. How can scientists contribute effectively to E/PO? What roles can scientists take in E/PO? And, how can this be balanced with research requirements and timelines? This talk will focus on these questions, with examples drawn from the author's projects that involve scientists in working with K-12 teacher professional development and with K-12 curriculum development and implementation. Experiences and strategies for teacher professional development in the research environment will be discussed in the context of NASA's airborne astronomy education and outreach projects: the *Flight Opportunities for Science Teacher EnRichment* project and the future *Airborne Ambassadors Program* for NASA's *Stratospheric Observatory for Infrared Astronomy (SOFIA)*. Effective partnerships with scientists as content experts in the development of new classroom materials will be described with examples from the SETI Institute's *Life in the Universe* curriculum series for grades 3-9, and *Voyages Through Time*, an integrated high school science course. The author and the SETI Institute wish to acknowledge funding as well as scientific and technical support from the National Science Foundation, the National Aeronautics and Space Administration, the Hewlett Packard Company, the Foundation for Microbiology, and the Combined Federated Charities.

URL: <http://www.seti.org/education>

#### ED41A-11 1150h INVITED

##### The Role of Scientists in the Education Program of JPL's Astrobiology Institutes: A PI's Perspective.

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Astrobiology is the study of life in the universe, a topic which has enormous public appeal. The NASA Astrobiology Institute consists of a geographically diverse but scientifically interconnected set of 15 research teams which promote, conduct and lead integrated multidisciplinary research in astrobiology. The Jet Propulsion Laboratory in Pasadena, CA now hosts two of the NAI research teams: one focused on in situ detection of life in our own Solar System, and the other, led by the author, focused on remote-sensing detection of life in extrasolar planetary systems. These two research efforts use very different techniques and expertise to address the overarching theme of the search for life elsewhere in the Universe. This research theme offers a compelling context and rich source of examples for learning fundamental concepts in earth and space science, physical science and life sciences. This talk will briefly describe the wide range of EPO products implemented and planned by the JPL astrobiology groups, and will concentrate on the diversity of roles the research scientists play in the EPO activities. This talk will also provide a Principal Investigator's perspective on the importance of EPO programs for astrobiology research, and the difficulties and triumphs encountered in implementing these EPO programs.

#### ED42A MC: Hall D Thursday 1330h

##### Showcase on Undergraduate Research in the Geophysical Sciences (joint with PA)

Presiding: K Grove, San Francisco State University; J Singer, Buffalo State College; R Johnson, UCAR/NCAR

#### ED42A-0163 1330h POSTER

##### Designing Undergraduate Research Experiences: A Multiplicity of Options

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Research experiences for undergraduate students can serve many goals including: developing student understanding of the process of science; providing opportunities for students to develop professional skills or test career plans; completing publishable research; enabling faculty professional development; or enhancing the visibility of a science program. The large range of choices made in the design of an undergraduate research program or opportunity must reflect the goals of the program, the needs and abilities of the students and faculty, and the available resources including both time and money. Effective program design, execution, and evaluation can all be enhanced if the goals of the program are clearly articulated.

Student research experiences can be divided into four components: 1) defining the research problem; 2) developing the research plan or experiment design; 3) collecting and interpreting data, and 4) communicating results. In each of these components, the program can be structured in a wide variety of ways and students can be given more or less guidance or freedom. While a feeling of ownership of the research project appears to be very important, examples of successful projects displaying a wide range of design decisions are available. Work with the Keck Geology Consortium suggests that four strategies can enhance the likelihood of successful student experiences: 1) students are well-prepared for research experience (project design must match student preparation); 2) timelines and events are structured to move students through intermediate goals to project completion; 3) support for the emotional, financial, academic and technical challenges of a research project is in place; 4) strong communications between students and faculty set clear expectations and enable mid-course corrections in the program or project design. Creating a research culture for the participants or embedding a project in an existing research culture can also assist students in completing a successful research experience. Outstanding undergraduate research experiences can take place in a wide variety of settings and serve a wide variety of student and faculty needs if projects are designed with these goals in mind.

#### ED42A-0164 1330h POSTER

##### Preparing Students for Geologic Research with a Junior-level Course

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A required research project for all seniors is a cornerstone of the undergraduate geology program at the College of William and Mary. To help prepare students for this experience, junior geology majors take a required one-credit course, Introduction to Geologic Research. The main goals of the course are to help students define their individual research project and to develop basic research and presentation skills. Specific objectives are to introduce the process of geologic research and to have students discuss and defend geologic research with peers and faculty and give formal oral and written presentations of the research proposal. The major products of the course include a research bibliography, a 10-15 page proposal and an oral presentation and defense of the proposed research. The

course is team-designed and -taught, with the five faculty members coming to a consensus about course content and assignments. All students undertake the same set of activities allowing all faculty and students to know and contribute to all proposed research. Individual class sessions include brief faculty research presentations and approaches to research problems, along with basic skills such as evaluation of research proposals, effective searching and analysis of primary literature, compelling graphics, informal research proposal defense and responding to questions raised, effective writing, effective oral presentations, and a final oral presentation and defense of the proposed research. We emphasize classroom activities with lectures kept to a minimum. For example, to learn to develop effective graphics, students evaluate figures taken from past senior theses and the published literature, individually plot given data, and then compare the resulting graphs. A discussion of the choices involved in creating figures along with suggestions by faculty completes the assignment. Assignments about specific skills (e.g., literature searching) are coupled with assignments that build toward the research proposal (e.g., an annotated research bibliography). Student evaluations provide feedback about the effectiveness of class activities; overall, students consider the course useful. By the end of the course, students have articulated the question they will address in their research, considered the methods they will use to address the question, and presented the significance of the proposed research. This team-taught course results in a plan for each student's research, provides a common introduction to geologic research, and develops a sense of a research community in the department.

#### ED42A-0165 1330h POSTER

##### Development of Instruments for Evaluating Changes in Attitude and Knowledge of Science of REU Program Participants

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Many science outreach and education efforts are based on the idea that these programs will positively impact the attitudes and understanding of science of the target audience. Although in many cases it is intuitively obvious that this is the case, it is desirable to measure the impact in some way. We are studying changes in knowledge of science and attitudes regarding science among participants in a summer REU program run by the Atlanta Consortium for Research in the Earth Sciences (ACRES). Instruments for measuring attitudes towards science exist in the education literature and we have applied several of these to our population as pre- and post- tests. However, we have observed that these instruments, having been designed for the general public, are not able to capture changes in our students attitudes because their attitudes were very positive and their understanding of the nature of science already fairly sophisticated. The existing instruments also failed to detect differences between our geoscience faculty and a group of college students with limited exposure to college-level science. Therefore, we are developing a new survey instrument and a set of open-ended questions for measuring attitudes towards and knowledge of science that will be appropriate for college science students. The survey instrument is based on clusters of statements representing a variety of philosophical positions, from which respondents must pick one statement. We compare the distribution of the choices made by a group of respondents with the distribution of choices made by a group of geoscience faculty. The first version of the instrument was able to differentiate between three different groups of students with different science backgrounds as well as detect small changes in our RUE program participants attitudes over the course of the program. Statistical analysis of responses to open-ended questions also differentiates between college students with different science backgrounds and detects some changes over the course of our program.

#### ED42A-0166 1330h POSTER

##### Research Experience for Undergraduates (REU) at the University of Toledo's Lake Erie Center: Environmental Studies of Lake Erie and Its Watershed

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For the past two summers (2000 and 2001), The University of Toledo's Lake Erie Center has hosted a Research Experience for Undergraduates (REU) program sponsored by the National Science Foundation (NSF). This program has given unique research opportunities to 22 undergraduate students to date from 12 colleges and universities and 9 states. Students participated in an interdisciplinary research project with the focus being environmental protection of the Maumee River that flows through Toledo into Lake Erie. The Maumee River and its watershed contribute one half of the sediment loading to Lake Erie. It is also a major source of contaminants that threaten aquatic habitats and drinking water supplies. Students worked with professors with expertise in a wide range of disciplines including Geography, Planning, Earth Science, Biology, Geology, Remote Sensing, and Environmental Law. Students contributed to the goals of the Lake Erie Center while finishing projects including the development of a wetland inventory from Landsat 7 imagery, water quality analysis of the Maumee River watershed and Lake Erie, testing plants for potential in phytoremediation, and agricultural field analysis from satellite imagery. In our presentation we will discuss the high and low points of our REU program from faculty participation and student mentoring to logistics of the program such as housing.

URL: <http://www.utoledogis.org/education/reu.html>

#### ED42A-0167 1330h POSTER

##### Validation of Aerosol Products from the Multiangle Imaging Spectroradiometer

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Validation of the retrieval algorithms for the Multiangle Imaging Spectroradiometer (MISR) has been a major activity of the MISR Team since MISR was launched in December 1999 onboard NASA's Terra satellite. Validation studies require field measurements to independently verify the assumptions that are made in the MISR calibration and retrieval algorithms. Of particular interest for the MISR Aerosol Team are the assumed aerosol particle and Earth surface properties used for inferring column-averaged aerosol properties from MISR measurements.

Two field projects in which MISR has participated are the Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS 2001) and the Southern African Regional Science Initiative (SAFARI 2000). Students were recruited through the Jet Propulsion Laboratory Undergraduate Scholars (JPLUS) and Caltech Summer Undergraduate Research Fellowship (SURF) programs to assist. The results from their research, such as what is described below, and their integration into the MISR Team will be presented.

During SAFARI 2000, MISR collected data off the coast of Namibia. These data are useful for validating MISR's aerosol retrievals because a calm ocean surface is dark in MISR's red and near-infrared bands and is much more homogeneous than a land surface on the scale of 1 to 10 km. After identifying high-quality MISR and intercomparison data that is co-located in space and time, we are addressing two key issues: (1) the assumed component particle microphysical models and (2) the contribution of scene variability on 100 m to 10 km scales. Intercomparison data were collected by instruments onboard aircraft that underflew MISR.

Preliminary comparisons of the column optical depth at 0.55 micrometer wavelength suggest MISR's inferred column optical depth agrees reasonably well with the aircraft measurements over the range that has been examined (0.2 to 0.7).

Most of this work was performed at the Jet Propulsion Laboratory, California Institute of Technology. Support was provided by the NASA New Investigator, JPLUS, and the Caltech SURF programs. A portion of this study was part of the SAFARI 2000 Southern African Regional Science Initiative.

#### ED42A-0168 1330h POSTER

##### The effects of geographic position on mineralogical changes during incipient weathering of arc related lavas from Moyuta Volcano, SE Guatemala

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Petrological processes do not only control the mineralogical composition of lavas, but surface processes also play an important role. The objective of this study is to document the mineralogical changes during the initial stages of weathering of andesitic lavas from Moyuta Volcano, SE Guatemala. The method of study includes a detailed petrographic analysis to identify initial stages of alteration and to identify mineralogical trends associated with microclimatic zones. Special care was taken to collect samples that showed no signs of pervasive weathering from the arc volcano. Moyuta represents relatively young volcanism from the late Tertiary and Early Quaternary periods.

The mineralogy of Moyuta is dominated by plagioclase, pyroxenes, and opaque minerals set in a matrix with varying amounts of glass. Despite the relatively fresh nature of the samples, the presence of alteration products was ubiquitous. The nature and amount of these secondary minerals (calcite and possibly clays) varied. Generally in all the samples, the pyroxenes show higher degrees of alterations than any of the other major minerals. Also a relationship exists in the samples between the pyroxenes and the opaque minerals. The altered pyroxenes commonly have opaque minerals in very close proximity to their crystal boundaries.

Some alteration patterns correlate to geographic position of the samples. Geographic factors considered are the amount of relative precipitation (high or low) and elevation (100 to 1200 meters above sea level). Samples collected in the SW side of Moyuta (high precipitation, low elevation) display lower degrees of alteration than samples collected from the SE (moderate precipitation, moderate elevation). All the samples collected from southern flanks of Moyuta (high-moderate precipitation, low-moderate elevation) show higher degrees of alteration than samples collected on the northern side (low precipitation, high-moderate elevation). Because the pyroxenes show signs of alteration in all the samples, the extent of alteration of the plagioclase crystals was used as a reference to the degree of relative alteration relative. A geographic correlation was also observed in the nature of alteration to the plagioclase crystals. Samples collected on the northern and eastern parts of Moyuta (low precipitation, low-moderate elevation) dominantly show alteration of plagioclase from the interior of the crystals. Samples collected from the southern part of the volcano (high precipitation, low-moderate elevation) dominantly show alteration along the boundaries of the plagioclase crystals.

The correlation of alteration patterns to geographic location, precipitation, and temperature are expected in the warm/wet climate of Guatemala. The mineralogical changes of the Moyuta samples will be used to develop criteria for identifying rocks that have been altered by incipient weathering. Further study will include a comparative analysis of the mineralogy and geochemistry of the fresh inner core to the altered outer rind.

#### ED42A-0169 1330h POSTER

##### Marine Terraces Near Bolinas, California, and Implications for Uplift of the Point Reyes Peninsula

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Marine terraces near Bolinas on the Point Reyes Peninsula (approximately 30 km north of San Francisco) were used to evaluate uplift in the region. These terraces are formed along emergent coastlines during sea level highstands. They consist of wave-cut platforms and overlying sediments. The back edge of the platform is the best approximation of paleo sea level. If the elevations of back edges are known, and the age

of the platform can be estimated, then a rate of uplift of the platform can be calculated. Our study focused on measuring back edge elevations and creating uplift models that can be tested by future dating. The Point Reyes Peninsula is part of the Salinian terrain. It is bounded on the east by the San Andreas fault and is folded into a large-scale syncline. Bolinas, at the southern end of Point Reyes Peninsula, is on the eastern limb of that syncline. We studied a flight of terraces near Bolinas to better understand the contraction component of deformation associated with this segment of the San Andreas fault. A Global Positioning System (GPS) was used to measure the elevation and location of platform back edges. Where platforms are covered by sediment, back edge elevations were calculated by using standard slope gradient estimates. We used our elevation data to create a profile of the terrace flight. To model the rate of coastal uplift, we used a standard technique of matching platform back edges to highstands on a sea level curve. We created a series of scenarios that use different assumptions for the age of the lowest terrace (e.g., isotopic stage 5a, 5c, or 5e). The scenario that seems to best fit the sea level data correlates the lowest back edge with the stage 5a highstand at 80 ka. Given estimated stage 5a highstand elevations of 19 m and 5 m below present-day sea level, we have calculated an uplift rate of 0.70.8 mm/yr. We are testing our best-fit hypothesis by dating sediments on the lowest terrace surface.

#### ED42A-0170 1330h POSTER

##### Lithospheric bending and faulting: Application to trenches and mid-ocean ridges

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Some aspects of faulting at fast spreading ridges, such as the East Pacific Rise (EPR), are not consistent with the normal faulting traditionally attributed to lithosphere stretching (Buck 2001). After Roger Buck's analytic model predicted faulting from bending at fast spreading ridges and Del Bohnenstiehl's analysis of displacement-length (D to L) ratios showed that fast spreading ridges have substantially smaller D to L than slow spreading ridges (Bohnenstiehl & Kleinrock 2000), lithospheric unbending became a possible explanation for this inconsistency.

The mechanics of lithospheric bending have been examined for many years, but analysis has yet to be done on the relationship between bending and the strain required for faulting. Strain is a measure of material deformation, such as compression when an object is squeezed, or elongation when an object is stretched. When a plate such as lithosphere is bent, the concave side is put in compression while the convex side must be put in tension. If the faults occur as a result of bending, it is important to know what strain is large enough to produce the observed fault offsets. The ability to independently estimate strain, without using the fault itself, could be very helpful in understanding fault generation. There are two reasons for trying to understand the generation of faults. First, there is curiosity to explain observed geologic structures. Second, there is the possibility that insight gained in the mechanics of fault generation may help us better understand the earthquake cycle.

Due to the controversial nature of bending of lithosphere at fast spreading ridges, it was important to concentrate on an area where bending is widely accepted. Oceanic subduction zones offered the perfect environment in which to evaluate strain at the onset of faulting. The Aleutian Trench was chosen as our first place of interest because the side scan sonar data was readily available from the GLORIA survey of America's Exclusive Economic Zone (EEZ). These data provided us with the locations of fault scarps with sizes of 50 meters or greater. Excel and GMT were used to obtain sea floor bathymetry of a line normal to the trench. Using Matlab, the universal lithosphere deflection profile (Turcotte & Schubert, 1982) was fit to the bathymetry. This new curve showed the height of the forebulge (Wb) and the distance to the highest point of the forebulge (Xb) relative to the bathymetry. The second derivative of the new curve gave the curvature of the plate as a function of distance. The strain was then calculated as a function of distance by multiplying this curvature by one half the estimated plate thickness. Analysis of the GLORIA data showed that faulting begins 70 km from the trench where there is approximately 3% strain.

#### ED42A-0171 1330h POSTER

##### Total Dissolved Copper Determinations: Production by Natural Microbial Populations of Copper-complexing Ligands in a Major Harbor (Elizabeth River, VA)

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The Elizabeth River is one of the regions of the Chesapeake Bay that has extremely elevated amounts of copper, which can be toxic at high concentrations. We found total dissolved copper concentrations of 15nM to 25nM in the water at the Norfolk Naval Base Station. The toxic and bioavailable form of copper is the free cupric ion (Cu(II)) which can amazingly be complexed into non-toxic strong organic (ligand) complexes (usually denoted CuL). Cu(II) causes mortality at concentrations at or slightly below 10-9.9 M (Sunda et. al 1990). Phytoplankton have proven in the laboratory to produce ligands which complex the free copper ions. Previous studies have shown that there was a greater ligand concentration than total dissolved copper concentration found in the Elizabeth River in previous years. The research currently underway will show whether natural microbial populations in a major polluted harbor (Elizabeth River) produce strong Cu-complexing ligands and will measure the levels of ligands versus the levels of toxic copper ions. The determination of total dissolved Cu concentrations is a necessary piece of that research.

#### ED42A-0172 1330h POSTER

##### ARSENIC CONCENTRATIONS AND SPECIATION IN BLACKWATERS OF THE GREAT DISMAL SWAMP, SOUTHEASTERN VIRGINIA, USA

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Arsenic concentrations and speciation were measured in surface water samples collected from the Great Dismal Swamp in southeastern Virginia, USA using selective hydride generation and atomic adsorption spectroscopy. Phosphate concentrations were also determined in these surface waters using the molybdate blue spectrophotometric method. Great Dismal Swamp waters are characterized as blackwaters, having high dissolved organic carbon (DOC) concentrations that range from 445 M to 6304 M, with a mean (n = 12) of 3282±2165 M. pH ranged from 4.30 to 6.42, with a mean (n = 12) of 5.14±1.04. The inflow waters (Cypress and Pocosin Swamps) have higher pHs (mean of 6.32± 0.10 for n = 5) than waters from Lake Drummond and its immediate inflow and outflow ditches, where the mean pH (n = 7) is 4.30±0.04. Total arsenic concentrations in Great Dismal Swamp waters range from 2.18 nM up to 21.42 nM. Phosphate concentrations range from 0.18 M to 1.42 M, but are not correlated with arsenate concentrations (r<sup>2</sup> = 0.004). Arsenate typically predominates in oxic, surface waters. However, As(III) was detected at higher concentrations (1 - 17.72 nM, mean value of 8.00±5.80 nM for all samples, n = 10) in half of the samples from the lower part of the watershed (i.e., mainly in Lake Drummond and its outflow, the Feeder Ditch; mean of 12.89±2.89 nM, n = 5). No methylated species were detected in the selected samples analyzed for organoarsenical forms (monomethyl and dimethyl arsenicals). A strong correlation exists between dissolved As(III) concentrations and dissolved organic carbon concentrations (r<sup>2</sup> = 0.88), and this correlation is significant at greater than the 99% confidence level. The high abundance of As(III) in comparison to both thermodynamic predictions, and other surface waters, suggests that either there is a strong anoxic source of this form, or that the high DOC concentrations stabilize it via complexation and slower rate of oxidation.

#### ED42A-0173 1330h POSTER

##### Determination of Dissolved Organic Sulfur in Seawater, and its Distribution in the Chesapeake Bay

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Although there are measurements of specific organic sulfur compounds in marine waters, the total concentration of dissolved organic sulfur (DOS) is unknown. However, this poorly quantified component in the global sulfur cycle is the precursor to the radiatively important gas, carbonyl sulfide, and contains very strong ligands that complex trace metals, affecting their bioavailability/cycling. Nevertheless, the high concentration of sulfate in seawater (28 mM) has hampered efforts to determine DOS. In order to obtain DOS data for different marine regimes, we have developed a novel analytical method that employs: (1) sulfate removal using Ba, followed by ion exchange; (2) determination of the nanomolar concentrations of residual sulfate; and (3) reductive pyrolysis (combustion at 1050 C in pure hydrogen) of a treated (as in (1)) sample to quantitatively produce hydrogen sulfide from all forms of sulfur, which is then quantified using GC/fluorescence detection. A wide variety of model S compounds (e.g., DMSP, glutathione, taurine, marine and freshwater humics) have been analyzed to test the efficiency of the method with good results. The methods detection limit is 15 nM S, the precision is <10% RSD at 100 nM S, and it is highly linear (>2000 nM S).

To examine the estuarine distribution of DOS, water samples from the Chesapeake Bay were taken in July 1997 (earlier version of the method) and June 2001. These were 0.4 um filtered, placed in glass vials, and quick frozen for temporary storage (<2 months). In 2001, DOS concentrations in the Bay averaged 312±/75 nM S, in close agreement with those in 1997 except in the uppermost (riverine) Bay. The distributions show slightly decreasing concentrations from the riverine to the seaward end of the Bay. No obvious correlations with nutrients or chlorophyll are apparent. However, the distributions do appear to be affected by higher concentrations in the rivers (S-containing humic acids?).

#### ED42A-0174 1330h POSTER

##### Characterization of Dissolved Organic Matter in the Northwest River and the Formation of THM

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Given recent health and legal issues surrounding trihalomethane (THM) spikes in the Hampton Roads and Chesapeake drinking water supplies, we investigated the molecular characteristics of dissolved organic carbon (DOC) in the Northwest River / Currituck Sound system in southeastern Virginia / North Carolina with respect to trihalomethane (THM) formation. Past studies of THM-formation potential have focused on the aromatic humic and fulvic acid components of DOC (XAD resin isolates), usually comprising less than 50-percent of all dissolved organic material. Using a stirred-cell filtration unit equipped with a 500 Da nominal cut-off membrane, we isolated DOM from three sites along the Northwest River (feeds the Chesapeake Treatment Plant) down to 500 Da with a recovery of better than 90-percent. The sampling sites were selected so as to represent the potential contributions of organic material at the treatment plant intake pipe with samples taken just above the intake pipe, at the mouth of the river as it empties into Currituck Sound and at a point half-way between the intake and the Sound. The DOM fractions were characterized by HPLC using RI and UV detectors and by Curie-point pyrolysis GCMS for molecular fingerprinting. Raw, filtered (0.2um) water samples were used for THM formation analysis. Pyrolysis-GCMS fingerprints of the DOM isolates show that waters above and below the intake pipe were more similar in organic composition, while water from the Sound potentially contained more algae, due to the presence of a homologous series of fatty acids. THM formation in the raw waters was consistent with more fresh water (chloroform only) at the intake pipe and more saline water at the Sound (brominated chloroforms).

ED42A-0175 1330h POSTER

**Environmental Change in Lake Miraflores for 1750 Years**

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Diatoms were analyzed in a sediment core from Lake Miraflores, a small lake in north-central Nicaragua. Environmental conditions for the past 1750 years were inferred by analyzing changes in the total number of diatoms and in the relative abundance of centric and pennate diatoms. Although centric diatoms outnumbered pennate diatoms throughout most of the core, the percentage of centric diatoms decreased from the bottom to the top of the core. The decrease in centric diatoms was correlated with a decrease in total number of diatoms, and it indicates that eutrophication has not affected this relatively isolated lake. The decrease in centric diatoms and increase in benthic-dwelling pennate diatoms suggests that lake depth has decreased throughout the past 1750 years. There was a particularly high number of pennates at 170 cm, which may be correlated to an extreme drought that occurred in other areas of Central America from about 800 to 1000 AD.

ED42B MC: Hall D Thursday 1330h

**Informal Education: A Powerful Tool in Science Literacy II (joint with PA)**

*Presiding:* C A Morrow, Space Science Institute; M Carlowicz, NASA/GSFC

ED42B-0176 1330h POSTER

**Project Planet Earth: A Joint Project Between the NASA/Goddard Space Flight Center and the Girl Scouts of Central Maryland.**

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Scientists of the NASA/GSFC and the staff of the Girl Scouts of Central Maryland (GSCM) have teamed up to introduce more girls and young women to earth system science. The girls now have the opportunity to earn the specially designed Planet Earth Council Patch. The Patch program includes a set of requirements tailored to the specific age level of the girl and the resource material to help the girl complete the requirements. At completion of the requirements the girl is awarded a patch to sew onto the back of her sash or vest. Girls do hands-on physical experiments, practice taking data, visit science centers and perform skits in order to complete the requirements. In addition to the Patch program, Project Planet Earth continues to encourage strong collaboration between the Girl Scouts of Maryland and NASA/GSFC. Girls volunteer at the GSFC visitor center during community events and in turn scientists are called on as keynote speakers and consultants for the Council. A special science interest group is forming for the teenage Girl Scouts of the Council that will network with scientists and help these young women pursue their interests, find internships and make career decisions.

ED42B-0177 1330h POSTER

**Girls on Ice: An Inquiry-Based Wilderness Science Education Program**

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We developed a wilderness science education program for high school girls. The program offers opportunities for students to explore and learn about mountain glaciers and the alpine landscape through scientific field studies with geologists and glaciologists. Our purpose is to give students a feeling for the natural processes that create the alpine world and provide an environment that fosters the critical thinking necessary to all scientific inquiry.

The program is currently being offered through the North Cascades Institute, a non-profit organization offering outdoor education programs for the general public. We lead eight girls for a weeklong expedition to the remote USGS South Cascade Glacier Research Station in Washington's North Cascades. For four days, we explore the glacier and the nearby alpine valleys. We encourage the girls to observe and think like scientists through making observations and inferences. They develop their own experiments to test ideas about glacier dynamics and geomorphology. In addition to scientific exploration, we engage the students in discussions about the philosophy of science and its role in our everyday lives.

Our program exemplifies the success of hands-on, inquiry-based teaching in small groups for science education in the outdoors. The wilderness setting and single gender field team inspires young women's interest in science and provides a challenging environment that increases their physical and intellectual self-confidence.

URL: <http://www.staff.washington.edu/epettit>

ED42B-0178 1330h POSTER

**The Space Place: Adventures in Informal Education and Lessons Learned**

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Informal education settings provide unique opportunities to convey Earth and space science learning to a variety of audiences. The NASA Space Place suite of outreach products and activities include deliverables to both the formal and the informal education arenas. The question is, how can Earth and space science efforts best create high-quality products and activities for the informal education sector and how can these products and activities be effectively disseminated to these audiences?

This session will describe the approach by a small outreach team for NASA's New Millennium Program (NMP) Space Place effort. The Space Place teams approach has been three-fold: 1) develop a suite of products designed to appeal to (and educate) the informal education audience, 2) disseminate these products through leveraged distribution channels which serve the informal education community, and 3) invite participation by missions beyond those within NMP, but rather NASA-wide for a richer and broader message, and a greater variety of content

The informal education audience served by the Space Place can be found in science centers, museums, planetariums, libraries, community centers, and community organizations. This informal education audience seeks to be entertained as well as to be educated, and this audience often includes multiple generations. Personnel at informal education venues may or may not have a science background, may or may not have significant training in conducting activities, and may, as often as not, be volunteers. As a result of valuable lessons learned, Space Place materials developed for informal education settings attempt to be adaptable for multiple age groups, and easy to administer.

Dissemination to the informal education community could be a daunting effort. But another lesson learned by the Space Place team is the value of alliances with national organizations within that community. These alliances make distribution of the Space Place activities and products both economical and comprehensive.

While the Space Place effort started as a New Millennium Program effort, it was quickly expanded to all NASA missions who wish to participate. The team soon realized that the informal education community wanted a variety of content not just more and more information about a few missions, but rather a continuous infusion of new content from new missions. This expansion of the Space Place program allows any mission to take advantage of the existing Space Place infrastructure and alliances and provides the much-needed variety of materials that the informal education community desires.

This poster session will provide an overview of the Space Place effort within the informal education community, and will illustrate some of the valuable lessons learned by the team in working with this rich and varied community.

URL: <http://spaceplace.nasa.gov>

ED42B-0179 1330h POSTER

**Community Based Astronomy: Bringing families and communities together**

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Astronomy in K-12 formal education is still largely underrepresented as a science. Yet, it is arguably one of the most engaging and entertaining of the physical sciences. Many school systems have been slow to adopt curriculum frameworks that include astronomy. Even when astronomy is required either as a distinct subject or hidden within the category of "Earth science", many teachers spend little time on it in their classrooms since they have no formal training in this subject.

A community based, informal astronomy education model that incorporates resources from government agencies, industry, local colleges, science centers and planetariums, families, civic groups, schools, and amateur astronomy clubs can provide a solution and be highly effective in creating sustained learning environments in this discipline as well as fostering an atmosphere of general acceptance and promotion of astronomy by whole communities. In addition, the opportunity exists to reinforce the teaching of astronomy in schools through the involvement of these groups in an informal education setting.

This paper will discuss a Community Based Astronomy program that has been implemented in Montgomery County, Maryland. The tie-in to formal education through both schools and systemic reform initiatives will be presented. In addition, detailed guidelines for running astronomy clubs in conjunction with family astronomy nights will be provided.

ED42B-0180 1330h POSTER

**Global TIE Observatories: Real Time Observational Astronomy Through a Robotic Telescope Network**

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Astronomy in grades K-12 is traditionally taught (if at all) using textbooks and a few simple hands-on activities. Teachers are generally not trained in observational astronomy techniques and are unfamiliar with the most basic astronomical concepts. In addition, most students, by High School graduation, will never have even looked through the eyepiece of a telescope. The problem becomes even more challenging in inner cities, remote rural areas and low socioeconomic communities where educational emphasis on topics in astronomy as well as access to observing facilities is limited or non-existent.

Access to most optical telescope facilities is limited to monthly observing nights that cater to a small percentage of the general public living near the observatory. Even here, the observing experience is a one-time event detached from the process of scientific enquiry and sustained educational application. Additionally, a number of large, "research grade" observatory facilities are largely unused, partially due to the slow creep of light pollution around the facilities as well as the development of newer, more capable telescopes. Though cutting edge science is often no longer possible at these sights, real research opportunities in astronomy remain numerous for these facilities as educational tools.

The possibility now exists to establish a network of research grade telescopes, no longer useful to the professional astronomical community, that can be made accessible through classrooms, after school, and community based programs all across the country through existing IT technologies and applications. These telescopes could provide unparalleled research and educational opportunities for a broad spectrum of students and turns underutilized observatory facilities into valuable, state-of-the-art teaching centers.

The NASA sponsored Telescopes In Education project has been wildly successful in engaging the K-12 education community in real-time, hands-on, interactive astronomy activities. Hundreds of schools in the US, Australia, Canada, England, and Japan have participated in the TIE program, remotely controlling the 24-inch telescope at the Mount Wilson Observatory from their classrooms. In recent years, several (approximately 20 to date) other telescopes have been, or are in the process of being, outfitted for remote use as TIE affiliates. Global TIE integrates these telescopes seamlessly into one virtual observatory and provides the services required to operate this facility, including a scheduling service, tools for data manipulation, an online proposal review environment, an online "Virtual