studies their performance. A novel trustworthy computing model has been developed for enhancing trustworthiness, as well as served as the criteria to assess trustworthy computing systems.

POWER AWARE PARALLEL AND DISTRIBUTED COMPUTING USING HETEROGENEOUS SYSTEMS. S.V. Providence and A. Alexander, Department of Computer Science, Hampton University, Hampton, VA 23668. Energy efficiency is among the more important issues in supercomputing and high performance computing. We have a novel means of investigating power consumption on a cluster computer system. We examine the iozone package which is traditionally used to measure file system performance in Linux clusters and use it to give indications of power consumption proportional to file system activity. Typical method use dynamic voltage and frequency scaling which are describe in this paper. We then explain our approach and postulate its efficacy.

DISTANCE ANALYSIS OF GENE EXPRESSION PROFILE: USING GLOBAL SIGNATURES ASDIAGNOSTIC TOOLS. Lei Wang, Ganiraju Manyam, Boris Veytsman, Ancha Baranova. School of System Biology, George Mason University, Fairfax, VA. Center of Liver Diseases, Inova Fairfax Hospital, Falls Church, VA. Betty and Guy Beatty Center for Integrated Research, Inova Health System, Falls Church, VA. Department of Bioinformatics & Computational Biology, The UT MD Anderson Cancer Center, Houston, TX. The traditional protein or RNA biomarkers usually suffer from either low specificity or unsatisfactory reproducibility. Here we propose a novel approach that involves measuring global distance between entire gene express profiles of normal and diseased tissues. Psoriasis, a complex autoimmune disease which pathogenesis is still not fully understood, provides an excellent model disease in which only a portion of a patient's skin will be affected, making it possible to study the difference between lesions, uninvolved skin from patients and healthy skin from non-diseased controls. To address the performance of global distances as biomarkers, we analyzed the data generated by microarray experiments and used Mahalanobis distance as an estimation of the degree of differentiation. The effectiveness of global signatures was compared with that of traditional specific signatures, which are defined as highest ranked differentially expressed genes. We demonstrated that global distances of gene expression profiles can serve as reliable good classifiers, and therefore it is worth considering to use them as diagnostic tools.

Education

SERVICE-LEARNING IN ENVIRONMENTAL STUDIES: THREE SUCCESSFUL APPROACHES FOR UNDERGRADUATE EDUCATION. Woodward S. Bousquet, Environmental Studies and Biology Departments, Shenandoah University, Winchester, VA 22601. Over the past three decades, service-learning in higher education has expanded considerably. More high school students arrive with service experience, service is built into undergraduate courses,

and it is added to university mission statements and graduation requirements. However, to be effective, service-learning must not only meet a community's needs. It must also enhance student learning, advance the university's mission and match students' needs and skills. Three successful service-learning approaches used in Shenandoah University's environmental studies courses since 1994 involve preparing booklets and brochures, teaching through teaching stations, and forming research partnerships. Booklets and brochures have a lasting impact and give university students a tangible product to show others. Dividing a field trip for school children into separate teaching stations cuts down on planning time and helps university students hone their teaching techniques. Forming research partnerships with local nongovernmental organizations and government agencies can connect students' service with actual community needs and provide ongoing opportunities for future classes. All three of these approaches match student and institutional goals, fit the structure of their respective courses, and sustain themselves in the curriculum by building upon past projects' accomplishments.

SCIENCE ON A SPHERE® AT THE SCIENCE MUSEUM OF VIRGINIA. E. G. Maurakis, R. Conti, E. Alford, D. Olli. Science Museum of Virginia, 2500 W. Broad Street, Richmond, VA 23220. Objectives of this program are to use the interactive six ft diameter sphere and associated visualizations to educate the public about climate change using inquiry based methods, and evaluate program outcomes. The program focuses on the National Oceanic and Atmospheric Administration's (NOAA) learning goals in climate literacy: the sun is the primary source for earth's climate system, climate is regulated by complex interactions among components of earth systems; life on earth depends on, affects, and is shaped by climate, climate varies over space and time through natural and human-made processes, and human activities are impacting the climate system. Key messages are climate change is occurring, detrimental aspects are greater than beneficial aspects, humans are causing climate change, and humans can solve the problem. Funded by NOAA award NA10SEC0080023 and Science Museum of Virginia.

ON THE USE OF TECHNOLOGIES SUCH AS ALICE, GREENFOOT, AND SCRATCH TO TEACH COMPUTER SCIENCE TO HIGH SCHOOL STUDENTS. Bruce C. Chittenden, Computer Science, Governor's School for Science and Technology, New Horizons Regional Education Centers, 520 Butler Farm Road, Hampton, VA 23666. While all of these technologies are very effective at introducing the student to Computer Science each has its own strengths and weaknesses and the technology needs to be chosen very carefully based upon several factors. This paper examines the original design objectives of each of the technologies, the Computer Science concepts that these technologies present, and how these technologies are actually being used in the classrooms.

APPLICATION OF 21ST CENTURY LEARNING AND INNOVATION SKILLS AT THE SCIENCE MUSEUM OF VIRGINIA. E. G. Maurakis, E. Alford, R. Conti, E. Voelkel, R. Shires, and D. Smith. Science Museum of Virginia, 2500 W. Broad Street, Richmond, VA 23220. Objectives of this program are to examine the delivery of science, technology, engineering, and mathematics (STEM) information

using 21st century learning and innovation skills proposed by the Institute of Museums and Library Services (IMLS) in programs and exhibitions at the science museum. IMLS's skills being implemented and evaluated are critical thinking and problem solving, creativity and innovation, communication and collaboration, visual literacy, scientific and numerical literacy, cross disciplinary thinking, and basic literacy. Laboratory experiences (e.g. EcoLab), exhibitions (i.e., Science Unplugged), and programs (e.g. Summer STEM workshops) were evaluated using IMLS 21st century learning and innovation skills, meeting most of the IMLS skill categories.

AN INFORMAL SCIENCE APPROACH FOR RENEWABLE AND NONRENEWABLE ENERGY CONCEPTS. David B.Hagan, Science Museum of Virginia, 2500 W. Broad Street, Richmond, VA 23220. The Science Museum of Virginia is a center of informal science education, generally defined as "science teaching and learning that occurs outside of the formal school curriculum in places such as museums, the media, and community-based programs." (NSTA Position Statement: Informal Science Education). The museum's project presents components in several forms of media focused on alternative and conventional energy sources. These include *Question Power*, an original six-minute HD video presenting the challenge of discovering clean, abundant energy sources, *Watt Wall*, a large computer-driven museum wall display showing energy demand, and a set of K-12 curriculum materials. The curriculum materials include a 2' x 3' original detailed map of Virginia showing sites of sources of energy and delivery mechanisms, including alternative and conventional sources. The curriculum materials challenge common misconceptions about energy sources. Examples include: "Wind and solar energy will provide all energy needs in the near future", and "Conventional sources of energy will last indefinitely." The underlying premise of the K-12 materials is that every energy source has advantages and disadvantages. With increasing global demand, currently known clean sources of energy cannot be expected to serve the world's needs using present technology in coming decades. The search for solutions for the future lies with future generations.

BIODIVERSITY AND WATER QUALITY INVESTIGATIONS IN SCHOOLYARD MESOCOSMS. H. S. Houtz[1], A. B. Wright[2] & S. E. Marwitz[3], VCU Life Sciences[1], VCU Dept. of Biology[2], and Maggie L. Walker Governor's School[3]. Mesocosms are experimental water enclosures that support naturally occurring aquatic communities. Because they provide an easy means to manipulate variables, mesocosm arrays have been used since the early 1960's to address a variety of scientific questions. Although mesocosm research has had a long history, mesocosms are an underutilized teaching tool that can provide a practical way for school children to design and implement simple scientific investigations within school grounds. VCU's Environmental Outreach Education team has placed mesocosms in diverse habitats (wetland, forest, open field, etc.) at VCU's Rice Center and at 7 Richmond area public schools. Over the past 3 years, high school and middle school students have measured water quality and monitored colonization and development of macroinvertebrate and algal communities.

Ongoing student research projects aim to investigate the effects of canopy cover, habitat isolation, and nutrient additions on community structure. Data have been shared and analyzed collaboratively among the school systems. Biodiversity and water quality have varied greatly seasonally and spatially among the sampling locations, which range from inner-city Richmond to Charles City County, Virginia. This project was made possible by the Howard Hughes Medical Institute (HHMI).

Environmental Science

MODELING FISH SPECIES RICHNESS AND DIVERSITY IN LOWER PIEDMONT STREAMS. E. G. Maurakis[1,2], D. V. Grimes[3], A. Schutt[4], and S. Short.[1] [1]Science Museum of Virginia, [2]University of Richmond, [3]Virginia Department of Environmental Quality, [4]VCU. Objectives were to model fish species richness and diversity using biotic and abiotic environmental factors in Quantico Creek (a forested watershed) and Cameron Run (an urban watershed), Virginia. A total of 17 physical, chemical, and biological factors were used to construct mathematical models to predict fish species richness and diversity in each watershed. Fish species richness in Quantico Creek can be predicted using season, stream order, elevation, river km, stream width and depth, watershed size and percent undeveloped land cover. Fish species richness in Cameron Run can be predicted with stream gradient, stream flow, water temperature, and percent undeveloped land cover. Funded by U.S. Department of Energy Grant DE-FG02-08ER64625.

PRELIMINARY ANALYSIS OF BAY FILTER UNIT SUCCESS IN FREDERICKSBURG, VA. MICHAEL L. BASS, UNIVERSITY OF MARY WASHINGTON, FREDERICKSBURG, VA**.** Virginia Department of Conservation and Recreation (DCR) evaluates and approves manufactured treatment devices (MTD's) deemed reasonable methods of prevention, control and/or treatment of storm water runoff. Virginia's stormwater management programs are implemented under: Virginia Stormwater Management Law and Virginia Stormwater Management Regulations. DCR maintains the authority to regulate BMP methods used in Virginia to control stormwater runoff under the Virginia Technology Assessment Protocol (VTAP). The assessment protocol deals with the MTD's that are designed for, reducing stormwater runoff volume, reducing peak runoff rate and/or and reducing total phosphorous (TP). The goal of the VTAP regarding runoff quality control is to determine how much a specific MTD can remove total phosphorous (TP). MTD's seeking certification for runoff quality control in Virginia will only be approved for TP removal at this time, requiring 50% TP removal for influent with TP concentrations ranging from 0.15 mg/L to 0.5 mg/L. Additional requirements are 80% removal of TSS for influent with TSS concentrations ranging from 100 mg/L to 200 mg/L and > 80% removal of TSS for influent with concentrations greater than 200 mg/L. Baysaver Technologies, Inc has applied for interim approvals to use the Bay Filter System to meet Virginia requirements for treating stormwater runoff. Flow through the filter system in gravity-driven and self-regulating. The monitoring program is intended to demonstrate through field testing that Bay Filter is capable of