predict fluid flow. The V2F model suggested that for larger yaw angles, a more advanced turbulence model may be needed. The side drag and lift are typically difficult to predict but showed some tendency to follow the trend for small yaw angles. The differences and similarities resulting from this comparison have aided in determining the usefulness and accuracy of the STAR-CD and ES-AERO software as well as potential gains in fuel economy for the tractor-trailer.

Verification and Application of a Thermosiphon Solar Water Heater Model. *JAY JOHNSON (University of Missouri–Rolla, Rolla, MO 65409) JAY BURCH (National Renewable Energy Laboratory, Golden, CO 89401).* Rising energy prices and global warming have sparked added interest in wind, biomass and solar technologies. Solar water heating can reduce domestic water heating costs by more than half and currently new Solar Domestic Hot Water (SDHW) systems are in development and production. Thermosiphon systems are a relatively mature technology, but there are still a number of uncertainties their behavior. Thermosiphon systems use the natural buoyancy of hot water to drive flow during the day, but at night cooler ambient conditions cause reverse thermosiphoning. The National Renewable Energy Laboratory (NREL) has developed a new model using TRNSYS software, which can smoothly transition between forward and reverse flows. Two of the new NREL components in this model were verified by comparing analytical results to the TRNSYS solution. Then using this model, reverse thermosiphoning was studied and quantified in different climates and loop geometries to understand the energy penalty of the typically ignored reverse thermosiphoning phenomenon. New passive solar thermal systems have the tank nearly coincident with the collector, so the penalty from reverse thermosiphoning was of particular interest. All modeling showed some level of reverse thermosiphoning regardless of climate or tank position. Although these systems are highly dependant on hot water draws, the reverse thermosiphon mass was nine times larger in low tank configurations, forward thermosiphon mass was 80% larger with the high tank configuration and hence the high tank configuration was capable of delivering 25% more energy annually than the low tank configuration. This points to using systems with high tank configurations, but attic limitations and the inconvenience of tank mounting may not always make such geometry feasible. This work quantifies the penalty and shows that such configurations, though not optimal, produce reasonable savings.

Environmental Science

A Comparison of Water Chemistry Between Natural, Modified, and Manmade Ponds within Brookhaven National Laboratory. *PRISCILLA RANDOLPH (North Carolina A&T State University, Greensboro, NC 27411) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory (BNL) is located in the center of the Long Island Pine Barrens. Within BNL's 5,265-acre site there are 26 wetlands. Included are coastal plain ponds, vernal ponds, recharge basins, and streams, making it an ideal ecological site to study water chemistry. We tested water samples from seven coastal plain ponds on BNL: four natural (BP1, BP2, BP6, BP9), one man-modified (BP7), and two manmade (BP13a, Meadow Marsh). Five water samples were collected from each pond. An eTrex Vista Cx Global Positioning System (GPS) was used to mark each water sample point. An YSI 659 MDS meter fitted with a multiprobe was utilized to determine temperature, pH, dissolved oxygen, conductivity, and turbidity at each sample point. Water samples were analyzed for sulfate, nitrate, iron, phosphorus, chlorine, calcium, magnesium, copper, tannin-lignin, chromium, molybdenum, aluminum, and suspended solids using Hach DREL/2000 and CEL/890 water test kits. Water samples were also analyzed for eleven different elements using an ICP-AES. The pH in the anthropogenic ponds was found to be more basic than that of natural ponds. Phosphorous, tannin-lignin, and hardness were elevated in the natural ponds when compared to manmade and modified ponds, but only the difference in tannin-lignin content proved statistically significant. The natural ponds were shaded by the canopy of the surrounding forest while the manmade and modified ponds where located directly in the sun. This had a affect on water temperature. The results of this research will give environmental scientists an insight into water chemistry and interrelationships between abiotic and biotic factors and will enable BNL to optimize the management of amphibian and reptile habitats.

A Comparison of Litter Densities in Six Community Types of the Long Island Central Pine Barrens. *DANA TIEVSKY (University of Rochester, Rochester, NY 14627) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* The condition of the Long Island Central Pine Barrens has been an area of ecological concern for the past three decades. In 2003, the Foundation for Ecological Research in the Northeast (FERN) was founded to support scientific research in the Pine Barrens. FERN's groundbreaking project is the Central Pine Barrens Monitoring Program, for which field research began during the summer of 2005 at Brookhaven National Laboratory. The purpose of this 10 year longitudinal study is to determine the current status of forest health in order to promote longevity and conservation in the Pine Barrens, as well as to learn what research should be done in the future. Litter densities from Pitch Pine, Pine-Oak, Oak-Pine, Coastal Oak, Scrub Oak, and Dwarf Pine habitats were compared in order to justify the succession of the Pine Barrens and prepare for future prescribed forest fires. Using Geographic Information System (GIS) and Global Positioning System (GPS) technology, random twenty five by sixteen meter plots of land were selected throughout eastern Long Island and then thoroughly surveyed. Litter and duff depth data were collected at four points along each of the ten line transects in the plot. Pitch Pine forests were found to have the most litter, with an average depth of 6.12 centimeters. Pine-Oak forests have an average litter depth of 6.03. Oak-Pine and Coastal Oak forests have comparable litter depths. Oak-Pine forests have an average litter depth of 5.01 while Coastal Oak forests have an average litter depth of 4.82. Scrub Oak lands have almost no litter with an average depth of 3.63 while Dwarf Pine Forests have an average litter depth of 2.49. A comparison of the vastly different litter densities of the six community types yields results that are consistent with the previously determined succession of the Pine Barrens and shows that litter density plays a key role in aiding forest succession. Data collected under the Central Pine Barrens Monitoring Program was used to determine a threshold for litter density, 4.82 cm. However, this trend is only from the first two years of research. In the future, a more accurate threshold can be determined in order to prescribe forest fires at appropriate times and preserve the Pine Barrens in the most effective manner.

***A Comparison of the Chemistry of Soil Surrounding Natural and Anthropogenic Ponds at Brookhaven National Laboratory.** *SHURRITA DAVIS (North Carolina A & T State University, Greensboro, OR 27411) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory (BNL) is located in the Long Island Pine Barrens, an area formed through decomposition and reworking of glacial materials. BNL has many wetland structures including costal plain ponds, vernal ponds, recharge basins, and streams. Some of these serve as breeding grounds for tiger salamanders (*Ambystoma tigrinum*), a species listed as endangered by the New York Natural Heritage Program. Anthropogenic habitats need to possess suitable characteristics with respect to soil and water chemistry in order to serve as successful breeding habitat for tiger salamanders. Soil is an important factor in controlling vegetation and water chemistry. In this study five ponds were selected for a study of soil chemistry: two natural and three anthropogenic. Nine soil samples were collected from each pond, eight around the perimeter and one from the pond bottom. Global Positioning System (GPS) was used to locate the sample points and ArcGIS was used to map the ponds and sample points. Soil samples were tested for pH, nitrate nitrogen, phosphorus, potassium, aluminum, ferric iron, magnesium, sulfate, calcium, and chloride using LaMotte Combination Soil and LaMotte Soil Micronutrient Kits. Soil moisture content was also determined. Soil color, texture, structure, consistency, and mottling were also observed and recorded. Five of the nine soil samples from each pond were digested using EPA method 3050B for Acid Digestion of sediment, sludge, and soil and then tested for copper, iron, molybdenum, magnesium, cadmium, aluminum, chromium, manganese, potassium and lead using an Inductively Coupled Plasma - Atomic Emission Spectroscope (ICP-AES). The natural ponds were more acidic then the anthropogenic ponds. The soil temperature is higher around the anthropogenic ponds (BP7, BP13, MM) than the natural ponds (BP9, BP6). Nutrient levels were low and consistent across pond types. Though these differences exist, both types of ponds accomplish the goal of providing suitable breeding sites for tiger salamanders (Ambystoma tigrinum). This information will serve as baseline data for BNL's natural resource manager and enable BNL to optimize the management of amphibian and reptile habitats

A Miniature Quartz Crystal-Based Device for Particulate Matter Monitoring with Real-time Data Acquisition. *ZHUO HUANG (Sacramento State University, Sacramento, CA 95819) MICHAEL APTE (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Exposure to particulate matter (PM) through inhalation has been associated with adverse health problems. Accurately monitoring of the mass concentration and chemical composition of PM are necessary for exposure assessment. Many current instruments in use involve complex operation and labor-intensive work to obtain necessary data

for studies, or involve costly systems to monitor a large population. One feasible solution to address these drawbacks is to develop low-cost, compact, and miniaturized real-time devices. The miniature system for particle exposure assessment (MSPEA) developed at Lawrence Berkeley National Laboratory (LBNL) is one approach available to the aerosol research community. MSPEA PM mass detection uses a quartz crystal microbalance (QCM). All the components including the quartz crystals for this system are off-the-shelf items, and can be easily obtained. The particle deposition mechanism used by this device is thermophoresis, while particles are retained on the sensors using and van der Waals forces. The QCM is constructed using an unexposed reference crystal oscillator and a PM-exposed sensing crystal oscillator, and a mixing circuit to that combines the oscillators' outputs into a beat frequency signal. A computer is used to incorporate the data acquisition operation, but eventually a microprocessor can replace the computer to miniaturize the device for personal monitoring at low-cost. Another monitoring feature of the MSPEA system employing ultraviolet and near-infrared optics is briefly discussed in this paper.

A Study of Seedling Numbers in Relation to Canopy Cover in Six Long Island Pine Barren Community Types. *EMILY EFSTRATION (University of Delaware, Newark, DE 19717) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Seedlings and saplings are important to forest health because they provide insight as to how the forest will develop and survive in the years to come. The canopy cover's density has much to do with how these seedlings and saplings will develop and survive. Canopy cover, density and the amount of seedlings were studied in different forest communities to help predict the future of these forests. Using a Geographic Information System (GIS) and Global Positioning System (GPS), points were selected at random and twenty five by sixteen meter plots were analyzed. By using a densitometer, the canopy cover was determined in each plot along ten transects at randomly determined intervals. Seedlings and saplings were counted in four belt transects as well as noted in the entire plot. The different communities that were compared include Pine Oak, Oak Pine, Pitch Pine, Coastal Oak areas, Dwarf Pine and Pitch Pine-Scrub Oak Woodland/Shrubland. In the Coastal Oak community, where the cover was found to be 96% hardwood cover and no pine cover, no seedlings or saplings found. On the other hand, in a Pitch Pine plot, with 72% pine cover and 1.5% hardwood cover, approximately 86 seedlings and 85 saplings were found. When this study is redone in ten years to determine the progress of the forest, the investigators will determine if human intervention is needed to aid in forest growth. If adolescent trees were found healthy and growing, this would show the progression of the Pine Barrens and would also prove that the forest is capable of recuperating without human aid.

A Study of Variations in Soil and Water Chemistry of Selected Ponds at Brookhaven National Laboratory. *JAMIE BRUNGARD, NINA KEAN, GEORGIA SAWYER (North Carolina A&T State University, Greensboro, NC 27411) DR. TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory (BNL), a 5,265 acre site, contains a variety of wetlands; included are coastal plain ponds, vernal ponds, recharge basins, and streams. Wetland habitats in Pine Barrens communities serve important ecosystem functions including providing critical habitat for the state endangered tiger salamander (*Ambystoma tigrinum*) and a number of other rare species. Survey techniques were used to gather information on soil and water chemistry of seven coastal plain ponds at BNL: four natural ponds, one man-modified pond, and two man-made ponds. Each pond was tracked using Global Positioning System (GPS) technology and mapped using ArcGIS. Five water samples were collected at each pond; nine soil samples were collected at five of the seven ponds. Water samples were analyzed for iron, sulfate, total chlorine, copper, aluminum, nitrate, phosphorus, tannin-lignin, suspended solids, hardness, total chromium, and molybdenum using HACH DREL/2000 and HACH CEL/890 water test kits. Soil samples were analyzed for pH, nitrate nitrogen, phosphorus, potassium, aluminum, ferric iron, magnesium, sulfate, calcium, and chloride using LaMotte soil test kits. Soil temperature, color, texture, structure, and consistency were also determined. A YSI 650 MDS meter with multi-probe was used to field-test water temperature, pH, dissolved oxygen, turbidity, and conductivity at each sample point. Water samples and soil extracts were also analyzed using an ICP-AES. The pH and temperature of the soil around the natural ponds was significantly lower than that of the anthropogenic ponds. The pH of the water from the natural ponds was significantly more acidic and the tannin-lignin content significantly higher than that of the anthropogenic ponds. We propose that these differences in the soil and water chemistry of the ponds can be explained by the nature of the surrounding vegetation. The presence of a tree canopy and dense shrub layer around the natural ponds reduces their exposure to solar radiation and increases the amount of leaf litter being added to the soil and water. This results in lower soil and water temperatures, lower soil and water pH, and a higher tannin-lignin content in the water of the natural ponds versus the anthropogenic ponds. The results of this study provide baseline data for monitoring pond health in the future and for assessing the suitability of ponds as breeding sites for tiger salamanders.

Adsorbent-Coated Polyurethane Foam as a Denuder and Size-Selective Inlet for Ambient Air Samplers. *JEFF DUARTE (University of California–Davis, Davis, CA 95616) LARA GUNDEL (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* For practical use, ambient air samplers for assessing human exposure to airborne particles must decrease in size and cost. One major step toward this change is replacement of large, adsorbent-coated glass denuders with small, cheaper adsorbent-coated PUF (polyurethane foam) denuders for capturing SVOC (semi-volatile organic compounds). The purpose of a denuder is to capture SVOC from the sampled air on its extractable adsorbent coat while allowing particles to pass through for collection on a filter. The purpose of this project was to determine if PUF could meet the latter requirement. It was hypothesized that PUF denuders could pass PM2.5 (particles with an aerodynamic diameter of 2.5 microns or less) and match or even exceed conventional glass denuders in SVOC capture because they have more surface area and are more compact. A bifurcated particle sampler that excluded particles larger than 2.5um was used on multiple 24-hour sampling runs in several configurations. Data were initially collected without any denuders, then in another configuration containing glass denuders on both sides to determine the variability of particle capture between the two columns, and then lastly with glass denuders on both sides as well as a PUF denuder on one side. The PUF denuder was placed downstream of the glass denuder so as to have normal SVOC capture. This allowed the focus to be solely on whether or not the PUF was allowing PM2.5 through. In earlier work with PUF denuders by M. T. Minjares, it was found that the filter downstream of the PUF had one third less mass then the filter with no PUF. Minjares had no upstream glass denuders, so her result was thought to be caused by either PM2.5 collection by the PUF or SVOC adsorption by the Teflon filter. In this follow-up experiment, upstream SVOC was collected by the glass denuders. The average PM2.5 concentration difference between the filters in the two columns in a non-denuded configuration was 8.6%. The average PM2.5 concentration difference between the two filters in the configuration with glass denuders on both sides and the PUF denuder on one side was 10.2%. With a mass measurement uncertainty of 3.6%, the difference between these two results is insignificant. The conclusions from this project are 1) the PUF does pass PM2.5 well and 2) the Teflon filter adsorbed SVOC. This is contrary to the prevailing belief that Teflon does not measurably adsorb SVOC, and it was causing the artifact that Minjares observed.

An Alternative Nonvolatile Solvent to Dissolve Metals: The Mixture of Choline Chloride and Urea. *DORRA KRIDIS (The Cooper Union for the Advancement of Sciences and Art, New York, NY 10003) MARK FUHRMANN (Brookhaven National Laboratory, Upton, NY 11973).* The mixture of urea and choline chloride, two inexpensive, non-toxic, but high melting point organic solids in a specific ratio, produces an easy to make, colorless, and nonvolatile ionic liquid at 60°C. The prepared nonvolatile liquid is stable at room temperature. The goal of this experiment is to assess a comprehensive, environmentally friendly and efficient utilization of an ionic liquid (choline chloride and urea) and to determine the percentage of dissolved metal elements in the liquid; for example, aluminum, copper, iron, silica and zinc. In the present study, the Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-ASE) instrument is used to determine the concentration of dissolved metal in a diluted ionic liquid. The collected data is compared to the solubility of each metal in water at 25°C, 50°C and 70°C. The inexpensive ionic liquid is easily prepared where the number of moles of urea is half of the choline chloride. The reactants are the urea, and the choline chloride. The products present are an ionic liquid in the form of a salt and water. The novel ionic liquid chemical name is determined to be 3,5,5-triamino-4,6-dihydroxy-1,2,2-trimethylhexahydropyrimidin-1-ium chloride. The density of this salt is determined to be 1.14 g/ml. The solubility of metal oxides at 25°C, 50°C and 70°C such as copper oxide, zinc oxide, aluminum oxide and quartz are greater in ionic liquid compared to water. Solubility of elemental zinc, iron and copper also show a greater percentage over those in water. Aluminosilicate minerals also show a greater solubility in an ionic liquid compared to water. The potential structures of the formed ionic liquid suggest that it may be useful in catalysis when metals are added. The solubility results also

suggest that this ionic liquid could be applied to use as metal polishing and to remove metals from soil and other contaminated material.

Analysis of Secondary Organic Aerosols and Gas Phase Products from Ozonolysis of Alpha-Pinene in the Presence of an Organic Seed Aerosol. *SHAUN GARLAND (University of California–Davis, Davis, CA 95616) LIZABETH ALEXANDER (Pacific Northwest National Laboratory, Richland, WA 99352).* Ozonolysis of monoterpes such as alpha-pinene gives rise to not only primary oxidization products, like acetone, but also secondary organic aerosol (SOA) formation. Understanding the mass budget of volatile organic compounds (VOC's) converted into aerosols and what remains in the gas phase has impact in metropolitan areas, where ozone is in higher than normal ambient concentrations and presence of existing organic aerosols, in both air quality and models that deal with pollution. Previous studies have investigated the consequence of inorganic aerosols on aerosol yields. This study uses dioctyl phthalate (DOP) as a primary seed aerosol in an alpha-pinene/ozone reacting system to determine how its presence affects both SOA yield and gas phase concentrations compared to no-seed conditions. Concentrations of alpha-pinene and other primary oxidation products are tracked in real time by proton-transfer-reaction mass spectrometry to develop profiles that allow investigation into second order reaction rate constants. The presence of DOP was determined to lower organic aerosol mass yield as well as the gas phase yields of acetone. Second order reaction rates showed that DOP also does not have any kinetic impact on the alpha-pinene/ozone reaction. These results indicate that the presence of DOP aerosols provide a site for secondary reactions to take place, consuming organic matter that would normally form aerosols.

Analysis of the Habitat of Henslow's Sparrows Compared to Randomly Chosen Grassland Areas. *ANITA NUNEZ (University of Illinois, Chicago, IL 60607) ROD WALTON (Fermi National Accelerator Laboratory, Batavia, IL 60510).* The Henslow's Sparrow is state endangered and is at risk of extinction as a breeding species in Illinois. The population of this species has been decreasing due to the degradation and loss of grassland habitat. This is the second year of an ongoing study of the Henslow's habitat. It is important to study the vegetation of the Henslow's Sparrow's habitat in order to assess whether the land management plans at Fermilab are effective. Once the Henslow's were located, the vegetation comprising the birds' habitats was studied. Measurements of the maximum plant height, average plant height, and duff height were taken as well as ground coverage measurements (percents of grasses, forbs, duff and bare ground). For a control, randomly chosen grassland sites were located within Fermilab property. t-tests and two-sample variance tests were used to analyze the plant and duff height data, and Mann-Whitney Utests were used to analyze the ground cover data. The data suggested Henslow's Sparrows prefer areas with shorter maximum plant height than was found in the randomly chosen sites. Further, the data suggested these grassland birds prefer more duff and less bare ground when compared to randomly chosen sites. The two-sample variance tests showed there is lower variation in the maximum plant height at sites Henslow's prefer. This study's findings are in agreement with the previous study, which found Henslow's Sparrows prefer less bare ground as well as lower variance in the maximum plant height. The previous study also suggested that Henslow's prefer more grasses in their areas when compared to randomly chosen sites. For further research, this study should be repeated to further support the findings. It would also be interesting to study how large the Henslow's territories are.

Arsenic Removal from Ground Waters: An Investigation of the Effects of Temperature. *MARIA MELISSA QUEMADA (University of California–Berkeley, Berkeley, CA 94720) ASHOK J. GADGIL (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Arsenic, a naturally occurring element is a major contaminant in ground waters. Approximately 40 million people in Bangladesh and tens of millions more in neighboring countries are being poisoned by arsenic in their drinking water. The World Health Organization has set a standard of 10-µg/L arsenic in drinking water, while Bangladesh standard remains 50-µg/L. In California, approximately 600,000 households use water with arsenic concentrations higher than the required standard. Lawrence Berkeley National Laboratory has developed a technology for arsenic removal using coal ash coated with ferric hydroxide (media). This process enables the arsenic bind to the iron oxide complex that is coated around the ash particles, and thus lowers the arsenic concentration in drinking water. This technology has high efficacy and very cost effective. My goal in this project is to test the performance of this technology on U.S. waters over a range of temperature values and to test the arsenic removal capacity of the media using coal fly ash that are commonly found in the U.S. The temperature values I investigated were 4 and 35 degree Celsius. This was accomplished through a series of experiments that allowed me to find the time the process reaches equilibrium in the two temperature values I investigated. Once the equilibrium time was established, the process was repeated to obtain adsorption isotherm curves for the two different temperature values. The equilibrium times that were found were 4 and 16 hours for 4°C and 35°C respectively. The arsenic removal capacity was analyzed using an arsenic field kit test (Quick Test©) and the results were confirmed by Inductively Coupled Plasma Mass Spectroscopy analysis.

Aspen Tree Core Micro-Cat Analysis and Mutation Detection. *ASHLEY NEIL (Auburn University, Auburn, AL 36830) LEE GUNTER (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Among clonal organisms the actual genetic mechanism used to maintain diversity within the species is unknown; however they are suspected to have a higher mutation rate than plants propagated by seed dispersal alone. *Populus tremuloides* (aspen), with its wide distribution, persistence in the environment and extensive clonal structure, is a good model for studying this mechanism in plants. In this project, its proposed using the number of estimated somatic mutations to determine the absolute age of clonal aspen stands within Rocky Mountain National Park. Several parameters needed to be examined in order to determine if aspen has a high somatic mutation rate relative to other organisms, such as clone age, number of somatic mutations, dominant genotype, as well as the geographic distribution pattern correlated with the genetic structure. In an effort to establish clone age, individual aspen ramets were analyzed using an ultra high resolution x-ray computer tomography system. The super resolution of this system generates a clear and easily differentiated image of the rings of the collected cores. Therefore, an estimate of the clone age will be determined based on the rings reading from the image and the tree diameters. Thus far approximately 300 ramets have been examined. A correlation between the ramet ages and the diameters will need to be determined in order to calculate the age of an individual tree from its diameter. From earlier studies, it has been demonstrated that this technique is the best one to yield satisfactory results. The major objective in the genetic component of this study is to attempt to determine the rate of somatic mutation, and, if successful, to use it to estimate the absolute ages of several aspen clones in the Rocky Mountain National Park.

Assessing the Impact of the Apatite Injection Barrier on Benthic Macroinvertebrates and Periphyton at 100-N on the Hanford Reach of the Columbia River. *BEN MILLER (Birmingham-Southern College, Birmingham, AL 35244) ROBERT P. MUELLER (Pacific Northwest National Laboratory, Richland, WA 99352).* 100-N on the Hanford Site operated from 1963 until 1988. 100-N is unique from the other plutonium production reactors on the Hanford Site because of its multiple-pass cooling system, which circulated coolant through the reactor several times before depositing it into a series of liquid waste disposal facilities nearby. These multiple passes significantly magnified the contaminants present in the coolant, which has since leached into an unconfined aquifer adjacent to the Columbia River. In a remediation effort, an Apatite Injection Barrier (AIB) has been implemented along the shore at 100-N to impede an underground plume of Strontium-90. However, this technique is expected to release trace amounts of simple salts, as well as sodium phosphate and ammonium nitrate. To assess the impact of such a release on the Hanford Reach at 100-N, we collected communities of periphyton and macroinvertebrates from the nearshore region along vectors upstream, downstream, and adjacent to the site, as well as a reference area near the opposite shoreline of the Columbia River. A Phospholipid-Fatty Acid Analysis (PLFA) was also performed on the collected periphyton, along with a Shannon-Weiner diversity index. For the initial baseline calculations, we found very little significant difference in the composition of the benthic community between sample sites along the AIB and the reference sites across the river. Later collections of the macroinvertebrate and periphyton community will be assessed to understand what, if any, impact the AIB has on local biota.

Bacterial Diversity in Soil and Sediments From a Former Bombing Range (Vieques, PR). *ERNIE PEREZ (University of Puerto Rico at Mayaguez, Mayaguez, PR 00680) TERRY C. HAZEN (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* The U.S. Navy Atlantic Fleet Weapons Training Area (AFWTA) located in Vieques, Puerto Rico, includes land areas, waters and islets impacted by 63 years of military training operations. High-density universal SSU rRNA gene microarray analysis for Archaea and Bacteria were used to describe the microbial community structure of soil and marine sediment samples from Vieques and reference locations (Guánica Forest and Patillas). Total community DNA was extracted, PCR amplified and hybridized to an array encompassing 16S rRNA for over

8,900 distinguishable taxonomic units. Hierarchical clustering of the 100 most variable sub-families detected by the array demonstrated that variable sequences fell into six (6) primary response groups. Samples from sediments and soils are very similar between each of their kind. Furthermore, samples from closer geographical locations were more similar than distant sites. Higher numbers of OTU's were observed in soil samples with 193 to 318 sub-families identified in each sample. Bacteroidetes, actinobacterias and acidobacteria were the more common phyla detected in Vieques than reference samples. The presence of diverse groups of bacteria may indicate a great potential for natural or enhanced biological restoration. Understanding the function and community structure of highly disturbed ecosystems could assist environmental restoration strategies.

Baseline pH and the Variability of pH within Plots and Community Types of the Central Pine Barrens. *NEAL JACK (Pennsylvania State University, University Park, PA 16801) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* The Long Island Central Pine Barrens (CPB) is a valuable natural resource for its beauty, natural water aquifer and for being the habitat of many endangered and threatened species of plants animals and insects. The Foundation for Ecological Research in the Northeast (FERN) is an organization committed to the preservation of the Pine Barrens ecosystem by maintaining or improving the health of the forests located in the CPB. FERN, in conjunction with other organizations, implemented a ten-year longitudinal study on the health of the CPB. Data collected on the pH of the soil will provide a piece of the baseline health record for this ten-year longitudinal study. To establish a baseline health record for each forest type, several 16 x 25m plots were set up, according to established protocols, within each forest community type. Using a Kelway HB-2 Soil pH meter / moisture tester the pH of the soil was taken at eight points within each plot. The average pH of the forest types were 6.3 for Coastal Oak, Pitch Pine 5.9, Pine-Oak 6.0, Oak-Pine 5.9, Pitch Pine Scrub Oak 6.1, and 6.1 for Dwarf Pine. Analyzing this data and data collected at the end of the ten-year study will be valuable in determine the long-term health of the forest as well as the effect of human intervention such as acid rain pollution.

Benchmark Report for Homeland Security: Standards, Guidelines and Fate. *MEGAN WILLIAMS (University of New Orleans, New Orleans, LA 70148) MARGARET MACDONELL (Argonne National Laboratory, Argonne, IL 60439).* Because of the rise in terrorist attacks throughout the world, pre-emptive and response procedures are being identified to assure the safety of Americans. Exposure guides are being developed to support health protection of Americans for more than 150 threat contaminants that could be released into the drinking water and air following a terrorist attack. The contaminants evaluated are deemed a potential health threat by the Environmental Protection Agency-National Homeland Security Research Center (EPA-NHSRC). They consist of toxic industrial chemicals (TIC), chemical warfare agents (CWA), radiochemical agents and bacterial agents. Exposure guides which we develop are risk based concentration (RBC) reports and provisional advisory levels (PALs) reports. The RBC report identifies pre-existing benchmarks, occupational limits, fate, toxicity use and degradation products for the contaminants. The RBC report focuses on benchmarks for chronic or repeat lifetime contaminant exposure. PALs are exposure guides that answer the questions of how, what, when, where and how a contaminant will effect the drinking water and air.

Biomarkers and Treatment for Potential Contamination Response. *DANIEL RAHILL (University of Notre Dame, Notre Dame, IL 46556) DR. MARGRET MACDONELL (Argonne National Laboratory, Argonne, IL 60439).* The creation of Provisional Advisory Levels (PALs) for specific chemicals of possible threat was to compile valuable information regarding potential risk in preparation for possible contaminations, including those induced by terrorists. As there is risk of exposure to the PAL chemicals, indicators of exposure and treatment outlines are of great importance. Biomarkers to quickly identify a chemical contamination event have been developed in this ongoing study. Once identified either to a specific chemical or a family of chemicals, treatments are available. Both immediate treatment and more extended medical treatments have been provided. The treatments have been categorized by both severity and symptom. The treatments account for sensitive populations, children in particular. The treatments are most complete for the organophosphates, which, for example, are treated with intermittent doses of atropine and pralidoxime. The ultimate goal of the biomarkers and treatment is to prepare all populations for all severity levels in the event of a potential chemical release. Another issue of importance was the quality assurance of the PAL reports. Particularly PAL reports for methyl paraoxon and VX contained errors that needed to be addressed and corrected. The methyl paraoxon PAL required several components of fate and toxicity to be developed, oral and inhalation PALs to be updated and corrected, and dermal PALs to be created. The VX PAL contained inhalation PAL values that should be revised. The VX document also contains improper citations with several other documents that need clarification. The corrections were flagged in this ongoing study.

Bombing Sites Used for Military Training Activities. *NATALIA RAMOS (University of Puerto Rico, Mayaguez, PR 00727) TERRY C. HAZEN (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Bombing sites used for military training activities can have considerable amounts of contaminants and pose significant risks for people and the environment. Until 2003, the eastern part of Vieques, Puerto Rico, was used as a bombing range by the U.S. Navy. Since then, leaching of explosive compounds from unexploded ordnance represents a serious threat to the marine ecosystem. The contribution of microbial populations to natural attenuation of explosives, including sulfate-reducing bacteria (SRB) has been demonstrated in soils but little is known about their contribution in marine environments. Characterization assays were employed to assess the effects of explosive compounds (TNT, RDX, HMX) on *Desulfovibrio vulgaris* Hildenborough and five novel SRB isolates from marine sediments in costal waters adjacent to the former military facilities. Pure cultures were combined with media in a covered 96-well micro plate and the opacity was monitored in real time as the bacteria grew in a temperature-controlled plate reader. A dose-response curve was used to estimate minimum inhibitory concentrations (MICs) for TNT, RDX and HMX in 0, 1.5 and 3.0% (w/v) NaCl. Some of the bacterial isolates grew better in explosive-containing environments than in regular media. The chemotactic response to nitrocompounds was evaluated for *D. vulgaris* using a Palleroni chamber. *D. vulgaris* responded positively towards TNT, but not to RDX or HMX. Elucidating the diversity and behavior of SRBs to explosives in tropical sediments could help us understand the role of these microbial populations in explosive-contaminated marine environments.

Characterization of Cytochrome Mutants of *Shewanella Oneidensis* MR-1: Study of Initial Attachment and Biofilm Growth. *KYLEE MILCZAREK (Onondaga Community College, Syracuse, NY 13215) JEFF MCLEAN (Pacific Northwest National Laboratory, Richland, WA 99352).* The definition of a biofilm is: a community of microorganisms and extra cellular polymeric substance (EPS) attached to a surface (plastic, glass, mineral, tissue etc.). EPS can consist of protein, exopolysaccharide and nucleic acids. Biofilms can be detrimental and hard to remove but can also beneficial. The bacterium being studied in this investigation is *Shewanella oneidensis* strain MR-1. When *S. oneidensis* is grown into a biofilm it has enhanced capabilities to reduce metals and radionuclides from contaminated soils and waters. The scope of this project is to investigate and understand the effects that the deletion or inhibition of certain genes in the bacterial genome will have on the *S. oneidensis* strain MR-1, with respect to cell-surface attachment and biofilm formation. If the changes that occur with the deletion of certain genes can be understood, the purpose of the specific gene in question can be understood. This project investigates how these genes effect the growth of biofilms and ultimately their abilities to reduce metals and radionuclides. In order to observe these differences, the wild type (MR-1) and each of the mutants were labeled with fluorescent proteins, grown into a biofilm (which are typically 100-200µm in height), and imaged by use of a Confocal Laser Scanning Microscope (CLSM). The CLSM gives the ability to acquire three dimensional images of the biofilms and to measure their respective heights; the film height in relation to the wild type strain will be used as an indicator for how the genes effect biofilm growth as the culture grows on the sample substrate. The cultures were imaged by use of CLSM at three different time intervals: 0, 24, and 36 hours. The initial sample time point (t = 0) established the number of cells that initially attached to the substrate, the film height at t = 24 and t = 36 are then compared. Data from these images were analyzed to produce averages of the height and identify differences in the structure. The data analyzed from the mutant strain: mtrA (SO1777) shows a trend of no growth among the 24 and 36 hour time trials. This indicates that the strain mtrA (SO1777) may have a low capability to form a biofilm at any of the tested time trials. There are small indications of cell division on the later time trials but no significant growth was observed. The result presented here indicates that the gene removed from this particular strain may play an important role in the growth and formation of biofilms. Further testing is needed to confirm this result. The project seeks to achieve a deeper knowledge of how the genes involved in metal and radionuclide reduction play a role in biofilm formation. A better understanding about the genetic controls for biofilm formation in this bacterium will enable investigators to possibly engineer a form that will work best for waste

site clean-up. This type of clean-up will be environmentally friendly and cost effective.

Characterization of Immobilized Urease and the Potential for ^{90}Sr Sequestration. *DESIREE SWEET (University of Texas at Austin, Austin, TX 78712) YOSHIKO FUJITA (Idaho National Laboratory, Idaho Falls, ID 83415).* A new technique for ^{90}Sr sequestration in the subsurface is being investigated by the Idaho National Laboratory in collaboration with University of Idaho at Idaho Falls. The technique is based on the idea that urea hydrolysis, catalyzed by immobilized urease, will accelerate the rate of calcite precipitation in the subsurface. To prove the validity of this technique, the kinetics of the immobilized urease and calcite precipitation must be modeled. The effect of the precipitation on porosity and permeability must be seen, and it must be proven that the technique can capture ^{90}Sr. Urea Hydrolysis refers to the reaction of urea and water catalyzed by the urease enzyme. The products of urea hydrolysis are ammonia and carbon dioxide. Urease is an enzyme produced by environmental microorganisms that currently exist in the subsurface. Consequently, many problems associated with injection of a reactant can be avoided. A result of urea hydrolysis is that it increases the carbonate alkalinity, thus it is a particularly attractive remediation technique in subsurface environments which are saturated with respect to calcite, as the likelihood of calcite precipitation becomes even greater. The urea hydrolysis accelerates the rate at which calcite can be precipitated, which accelerates the rate at which ^{90}Sr may be coprecipitated, and removed from the subsurface.

Climate Change Effects on Decomposition Mediated by Species Composition Versus Plant Litter Quality. *MARLENE TYNER (University of Michigan, Ann Arbor, MI 48109) AIMEE CLASSEN (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Global change is rapidly modifying our planet, including altering ecosystem nutrient cycling. Until recently, research has focused on manipulating single climate change factors such as the effects of elevated carbon dioxide (CO_2) or elevated temperature on ecosystem processes. These factors, however, will not occur independently and are likely to alter ecosystem processes differently, perhaps mediating some of the effects. This project investigated how multiple climate change factors may alter decomposition in an old-field ecosystem. Specifically, it asked if climate change (elevated [CO_2] and temperature) would have a larger impact on decomposition via indirect changes in community composition or direct changes in litter quality. Three major findings resulted from this work: 1) Litter chemical quality change due to elevated [CO_2] or temperature does not alter decomposition rates; 2) Climate-driven shifts in species composition has an effect on decomposition rates; 3) These effects occur primarily in the early stages of the decomposition process, and decline over time. Taken together, these data suggest that climate change will have a larger effect on ecosystems by causing shifts in plant communities than it will by altering litter quality. Further, these results suggest that the effects afflicted on ecosystems by changing climates may be more varied and complex than previously thought, and current databases on ecosystem process changes may need to be expanded for more accurate modeling efforts.

Cold Flow Properties of Biodiesel. *KAITLIN THOMASSEN (State University of New York at Geneseo, Geneseo, NY 14454) DR. C. R. KRISHNA (Brookhaven National Laboratory, Upton, NY 11973).* Biodiesel has become one of the most promising alternative fuels; however, its relatively high cloud point (CP) temperature is one of the reasons limiting it from replacing the widespread use of fossil fuels in today's society. Reducing the CP of biodiesel is one the last major obstacles scientists need to overcome before the fuel can be marketed for consumers. Unfortunately, not much is known about the cold flow properties of biodiesel, their dependence on the source material from which biodiesel is made, and about methods to reduce the CP temperature. Previously, scientists have theorized that the higher the percent of saturated fatty acids in the source material from which the biodiesel is made, the higher the CP temperature. As part of this research project, samples of biodiesel made from soy, tallow, canola, and yellow grease were blended in different percent ratios to test this theory. Tallow and soy were blended together at 20%, 50%, and 80% ratios. Separately, yellow grease was blended with soy and canola was blended with tallow at these same ratios. These biodiesel samples were chosen due to the large contrast in the percent saturation. Soy and canola contain a low percent saturation, while tallow and yellow grease have a high percent saturation. The test results showed that CP temperature increased linearly as the percent of saturated components increased in the biodiesel samples. In addition, the CP temperature was found for No. 2 oil and biodiesel blends. B5, B20, B50, and B80 blends were made with yellow grease, canola, soy, and tallow-based biodiesel. The results showed that as the percent of No.2 oil increases in each sample the CP temperature decreases. The tests also concluded that making blends of No. 2 oil and biodiesel from different sources can yield a very different CP temperature. Furthermore, in the effort to reduce the CP temperature of biodiesel, a proprietary additive was blended with several types of neat and blended biodiesel samples. What was concluded from this proprietary additive is that CP was not effectively changed however, observation indicated that the pour point (PP) temperature seemed to have been lowered. In future research, the CP of different biodiesel types will be correlated with their chemical structure.

Comparison of the Populations of Common Wood-Nymph Butterflies in Burned Prairie, Unburned Prairie, and Old Field Grasses. *MARLENE HAHN (Loyola University, Chicago, IL 60626) ROD WALTON (Fermi National Accelerator Laboratory, Batavia, IL 60510).* Common wood-nymph butterflies are found throughout the United States and Canada. However, not much is known about how they overwinter or their preferences for particular grasses and habitats. In this study, the impact of prairie management plans on the abundance of the wood-nymph population was assessed as well as the preference of these butterflies to areas with native or non-native grasses. The abundance of common wood-nymph butterflies was determined using Pollard walks. The majority of the vegetation at each of the three sites was identified and documented. Using a 1 X 3 ANOVA, it was determined that there was a significant difference ($p < 0.0005$) between the abundance of common wood-nymphs in the European grasses site compared to the burned and unburned prairie sites. There was no significant difference between the burned and unburned treatments of the prairie on the common wood-nymph population. A multiple variable linear regression generated a model in which the temperature and weather affected the observed common wood-nymph butterflies per hour ($p = 0.026$). To verify these preliminary results, future studies need to repeat this experiment. Quadrat analysis of the vegetation from all three sites should be done in order to see if there is a correlation between common wood-nymph butterfly abundance per hour and the specific types or quantity of vegetation at each site. Another area of investigation is to determine how the observer's visual field is affected by the density or height of vegetation at each site.

Creating Code for Automed Demand Response. *ARRAN BLATTEL (Stanford University, Stanford, CA 94305) MARY ANN PIETTE (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Energy efficiency, conservation, and peak load management are important approaches to protecting the power grid, saving consumers money, and reducing impact on the environment. Demand Response (DR) is an attempt to curtail energy demand during the handful of days each year when the grid is strained. The local electric company, Pacific Gas & Electric (PG&E), created a voluntary program called Critical Peak Pricing (CPP), in which participants are asked to curb energy use for 12 independent summer days that PG&E deems are most likely to strain the grid. Participants receive lower electric rates on non-CPP days, but much higher rates during peak hours on CPP days, creating an incentive to reduce demand. Automated Demand Response (Auto-DR) is a novel approach focused on fully automating buildings participating in the CPP program, so during a CPP event their buildings will reduce its energy demands without any human interaction. The system works by using a computer program to continuously monitor CPP status posted on PG&E's server. When the program detects a CPP event in progress, it triggers pre-programmed energy saving strategies to take affect in the building such as dimming lights and reducing AC use. For buildings that are currently automated, post-event surveys are conducted to measure occupants' response to the changed environment from load reduction. This research also gives feedback to participants as soon as possible so they can see the correlation between their buildings' energy saving actions and their electrical shed. The main focus of this research is on studying the electrical demand of participating buildings evaluating how much they reduced their energy consumption. Over the past three years, this research has come to show that Auto-DR is a viable form of dynamic energy conservation, by consistently providing load sheds during CPP days. Due to the inherent lack of manual labor required to operate in this program and no reliance upon present personnel, Auto-DR may prove to be more efficient and cost-effective than DR for certain buildings.

Cumulative Risk Assessment: Environmental Fate, Physical-Chemical Properties, and Contaminant Toxicity. *JESSICA ENGLEHART (University of Maine, Orono, ME 04469) MARGARET MACDONELL (Argonne National Laboratory, Argonne, IL 60439).* In the event of a terrorist attack that utilizes chemical or biological weapons, the emergency response team needs a way to find information about the immediate risks and dangers present. In a scenario such as this,

Provisional Advisory Levels (PALs) currently undergoing preparation by Argonne National Laboratory would be of great help. These PALs are specifically designed to provide exposure guidelines for chemicals that have been deemed potential homeland security threats. If one of these chemicals were to be released to the water or air, a PAL would help first responders (e.g., individuals without an extensive scientific background) make a health-based decision about the level of danger that is present. Each PAL report is chemical specific, and multiple routes of exposure are analyzed in every document. The values for each PAL are determined by using studies from medical and scientific journals, government research, and other research publications. When as much information as possible has been compiled about each chemical, the most applicable material is used to develop the calculated PAL values that regulate the exposure guidelines. Although the derived PAL values are the designated purpose of the PAL report, other important components of the document include the chemical identification, physical-chemical properties, environmental fate, and toxicology data. The environmental fate is especially important to the report because many of the contaminants can rapidly break down into other components and chemicals. The resulting byproducts may be inert or even more toxic than the parent chemical. Specifically, the environmental fate of the nematicide fenamiphos is undergoing analysis. While examining the fate of a chemical, it is understood that multiple chemicals may be present at any given time after a contamination occurs. This topic leads into the study of cumulative risk, which is an issue currently under national perusal. PALs are an invaluable resource in a time when chemical and biological warfare are legitimate fears; however, there is no guarantee that only one chemical will be present during a contamination or release. This is why it is vital to further investigate cumulate risk and how exposure to multiple contaminants should be handled in a time of crisis.

Detection and Quantification of Dehalococcoides Strains from a Chloroethene-Contaminated Aquifer Using Quantitative Real-Time PCR (qPCR). *KELLY CHO, ALMA ZHOLI (University of Michigan, Dearborne, Dearborne, MI 48128) CHRISTOPHER SCHADT, SONIA TIQUIA (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Chlorinated solvents such as tetrachloroethene (PCE) and trichloroethene (TCE) are some of the most prevalent contaminants in groundwater in the United States. Recent studies have revealed that PCE and TCE can be reductively chlorinated to non-toxic ethene by specific dehalo-respiring bacteria from the genus Dehalococcoides. While Dehalococcoides have been found at a significant number of sites, these microbes may not be present in all groundwater environments. Hence, to promote complete dehalogenation of TCE and PCE, Dehalococcoides are often added to contaminated sites in a process known as bioaugmentation. The present study aims to determine the presence and abundance of Dehalococcoides strains in TCE/PCE-contaminated aquifer samples from Dover Air Force Base (DAFB) in Delaware that have underwent various treatment strategies, including bioaugmentation. Five samples were tested for the presence and abundance of Dehalococcoides 16S rRNA genes using real-time PCR (qPCR). The composition of Dehalococcoides in the samples were also determined by cloning and sequencing using PCR primers directed toward conserved regions of the gene within the group Dehalococcoides. Results of the qPCR experiment revealed an abundance of Dehalococcoides in all aquifer samples examined, indicating that this microbe may be wide spread in groundwater from DAFB, and perhaps active under each of the remediation strategies. Database searches of 16S rRNA-Dehalococcoides partial sequences indicated that the samples were dominated by gene sequences related to Dehalococcoides ethenogenes, Dehalococcoides sp. CBDB1, and several uncultured Dehalococcoides spp. This project is part of a larger effort to contribute to research and development of microbiological systems that influence parameters important to the clean up environmental contaminants such as PCE and TCE.

Determination of Aerosol Particle Size and Chemical Composition Using an Aerodyne Aerosol Mass Spectrometer. *RY FORSETH (University of Wisconsin–Madison, Madison, WI 53715) YIN-NAN LEE (Brookhaven National Laboratory, Upton, NY 11973).* Aerosol particles serve diverse roles in the earth's atmospheric processes including cloud formation, acid rain production and climate change through radiative forcing. In order to understand and predict aerosol's distributions and effects in the atmosphere, it is important to determine the chemical composition of aerosol particles, including nitrate, sulfate, ammonium, and organics, to elucidate their sources and formation mechanisms. Consequently, it is highly desirable to gather fast real-time data of atmospheric aerosol concentration and composition. To accomplish this, we have carried out experiments using a new real-time Aerodyne Aerosol Mass Spectrometer (AMS) to study ambient samples as well as laboratory generated aerosol standards of know composition. We have thus gained a better characterization of the AMS regarding its ability to quantify the individual chemical components and to differentiate classes of organic compounds. Specifically, the AMS was compared with a particle-into-liquid sampler-ion chromatography (PILS) technique to gauge the quantitativeness of the AMS's analysis. In addition, since the AMS mass fragment data contain information that can be used to classify organics depending on their degree of oxidation, we have performed AMS analysis of laboratory generated organic aerosols of different oxygen to carbon ratios to provide additional data to corroborate this analysis scheme. It was found that the AMS underestimates the mass loading of aerosol particles in both ambient and lab measurements, and ambient aerosols are comprised mainly of OOA. Fresh diesel emissions were found almost completely comprised of HOA. These finding direct us to conduct further studies to probe into why there is a discrepancy between the PILS and AMS. Finally, our findings illustrate a need to use different organic species of various degrees of oxidation and functional groups to gain insights into the chemical characteristics of OOA and HOA.

Determining the Release Rate of Perfluorocarbon Tracers with Regards to Temperature. *TASHA PICCOLO (Marist College, Poughkeepsie, NY 12601) JOHN HEISER (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory uses perfluorocarbon tracers (PFTs) for atmospheric dispersion, leak detection, and measuring air ventilation rates in homes and commercial buildings. PFTs are used to tag air/gas and follow the movement of the air. PFTs are colorless, odorless compounds that consist of carbon and fluorine atoms joined by covalent single bonds. They are conserved, chemically inert, and biologically inactive. Therefore, they do not react with the atmosphere or other environments and are perfectly safe to use. One method of releasing PFTs to tag and track air is through the use of permeation sources. Permeation sources consist of a small glass vial partially filled with a PFT and fitted with a rubber membrane in its cap. The rubber membrane has a high solubility and diffusivity rate which allows PFTs to permeate through. A sampling of six different tracers were extracted and filled into permeation sources. The sources were divided into four groups; each group was contained in a constant temperature chamber with temperatures: 6°C, 20°C, 30°C, and 40°C. The 20°C temperature chamber held 15 of each tracer type, while the other temperature chambers held six of each tracer type. Every other day over a five week period, the PFT samples were weighed on a high precision balance to determine their rate of emission. The process of weighing each PFT determined the average weight loss at each weighing period and allowed calculation of the release rate at a specified temperature. As expected, the diffusion rate of each tracer was greatest in the 40°C temperature chamber. The greater release rate is due to higher vapor pressure produced in higher temperatures. By plotting the natural log (LN) of the release rate versus 1/Temperature (Kelvin), an equation was produced for each PFT which displayed the slope and y-intercept and expressed the specific release rate dependent on a given temperature. It is very important to determine the release rate of PFTs in regards to different temperatures so that the source term is well defined. Knowing the temperature dependency allows the calculation of the source term in a field experiment where the weather may change from very hot to very cold. This work is a small portion of other ongoing projects, such as the Urban Dispersion Project which uses PFTs to show how toxic gas might disperse throughout specific areas like New York City, and other projects using PFTs for ventilation and air exchange measurements in homes.

***Developing U.S. Census Bureau-Defined Regional MARKAL Modeling Energy Systems.** *CHRISTOPHER TEACHEY (Stony Brook University, Stony Brook, NY 11794) VATSAL BHATT (Brookhaven National Laboratory, Upton, NY 11973).* The MARKAL family of technology-rich, mathematical models is used to represent a national, regional, state, or municipal energy system while supporting long-term strategic energy and environmental planning. Because of an interest in examining energy technology options to acquire regional differences including energy resource stockpiles, energy system organization and inter-regional issues such as optimal emissions permit trading between United States regional energy systems for the purpose of reducing environmental pollution, it's now of concern to establish regional MARKAL models while using the United States Census Bureau divisions as a template. Using Microsoft Excel and the Visual Basic for Applications, the maintenance and collection of demand-side data from the Energy Information Administration's Annual Energy Outlook energy forecasts were tailored and input into each of the regional MARKAL models and the development of dynamic spreadsheets was necessary

and possible due to the extensive data to be aggregated periodically. This data was subdivided into the four primary sectors of demand which includes the residential, transportation, commercial, and industrial sectors. Among the demand data that was collected in each of these sectors includes forecasted energy projection figures and efficiencies of demand technologies. Once constructed and established, the multi-regional model will be used in an ongoing multi-year DOE project evaluating long-term impacts of the hydrogen production infrastructure on the U.S. energy market in addition to examining the key regional differences and inter-regional issues.

Development of Historical Water Table Maps of the 200-West Area of the Hanford Site (1950-1970). *TEENA KINNEY (Columbia Basin College, Pasco, WA 99301) DUANE HORTON (Pacific Northwest National Laboratory, Richland, WA 99352).* A series of detailed historical water table maps for the 200-West Area of the Hanford Site was made to aid interpretation of contaminant distribution in the upper aquifer. The contaminants are the result of disposal of large volumes of waste to the ground during Hanford operations which began in 1944 and continued on into the mid 1990s. Examination of the contaminant plumes that currently exist on site shows that the groundwater beneath the 200-West Area has deviated from its pre-Hanford west to east flow direction during the past 50 years. By using historical water-level measurements from wells around the 200-West Area it was possible to create water-table contour maps, which show probable historic flow directions. These maps are much more detailed than previously published water-table maps which encompassed the entire Hanford Site. The new water-table maps in this paper, focusing on just the 200-West Area, were contoured at one meter intervals and demonstrate the effects that specific waste disposal sites had on the water-table elevation and groundwater flow direction. Seven maps were created for years that would give the best representation of significant water-table changes. Time periods of significant changes were identified by examining historical water-level measurements that were taken periodically throughout the area. During the 1950s groundwater elevation and flow direction changed rapidly, so water table maps were made at two year intervals for the period 1950 to 1960. After the 1950s, far less rapid changes occurred in the water table, so maps were made at five year intervals from 1960 to 1970. The project ended with 1970 because detailed water-table maps of the 200-West Area already exist post-1970. The new series of maps show that groundwater flow direction has changed significantly over the past 50 years; shifting at some times and places 180 degrees from pre-Hanford flow directions. One may account for the past anomalies in groundwater flow direction beneath the 200-West Area by using a combination of the new map series and details about specific waste disposal sites. The new series of maps will be valuable as a reference during the clean up process of the Hanford Site.

Development of Preliminary Acute Oral Provisional Advisory Levels (PALs) for Phorate. *JENNIFER MATTLER (University of Florida, Gainesville, FL 32611) MARGARET MACDONELL (Argonne National Laboratory, Argonne, IL 60439).* Phorate is a highly toxic organophosphorus pesticide that inhibits acetylcholinesterase, an enzyme that degrades neurotransmitters that stimulate depolarization of nerves and muscles. Because it has been identified as a possible threat agent, concentration-based guidelines called Provisional Advisory Levels (PALs) have been developed for phorate. Draft PALs were developed using data such as the environmental fate, toxicokinetics, toxicodynamics, and symptoms of exposure in humans and animals. The preliminary PALs discussed were developed for oral exposure at three effect levels (no effect, moderate reversible effects, and lethality) for the acute (<24 hours) duration. Once a specific study dose was selected as the basis for the PAL, based on appropriateness for the given effect level it was scaled for a 70-kg adult who drinks 2 L of water per day and uncertainty factors (UFs) were applied to account for interspecies and human variation, database adequacy, exposure duration, and effect severity. The preliminary acute oral PALs 1, 2, and 3 for phorate were determined to be 0.3, 0.5, and 1.0 mg/L, respectively. These preliminary PALs are somewhat lower than the PALs for other organophosphorus (OP) compounds, which share a mechanism and general level of toxicity with phorate, indicating either possible over-conservatism in the preliminary PALs or greater toxicity for phorate compared to other OPs. With further study, the internal draft phorate PALs can be refined and also used to support extrapolations to determine PALs for other organophosphorus compounds that lack the necessary toxicological data.

Development of Sixth Grade Decomposition Curriculum to Meet National Science Education Standard: Science as Inquiry. *AMY MORRIS (Vanderbilt University, Nashville, TN 37235) MARGARET TORN (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* A curriculum on decomposition was developed to meet the National Science Education Standard: Science as Inquiry by helping students acquire abilities necessary to do scientific inquiry and understandings about scientific inquiry. Additionally, the curriculum was developed to collect data on changing decomposition rates across the nation for scientists studying climate change. To meet the Science as Inquiry Standard, the students will study the carbon cycle and feedback effects in relation to climate change to identify questions that can be answered through a scientific investigation of decomposition; conduct a scientific investigation to determine the decomposition rates of local leaf litter and a common substrate; use balances, ovens, probes, and computers to gather, analyze, and interpret data; use mathematics to make data tables, graphs, and equations to describe their data; use evidence to develop explanations and predictions; and present a final project to the class. To provide data on decomposition rates for scientists studying climate change, sixth grade classrooms across the nation to will follow a standard experimental protocol. The protocol will be repeated annually to provide data on how decomposition rates are changing. This summer, the experimental protocol was developed, as well as a timeline for executing the curriculum throughout the school year, sample worksheets to supplement the protocol, and a method for assessing students' abilities to do scientific inquiry and understandings about scientific inquiry. Further development of activities to teach content and experimental skills to students is needed. Students will benefit from a year-long project that emphasizes the Science as Inquiry Standard and will be able to help their world by collecting data for professional scientists to use to study climate change.

Disease Incidence of *Ustilago Bullata, Tilletia Fusca,* and *Pyrenophora Semeniperda* on *Bromus Tectorum* in the Hanford Site. *LUIS GARCIA (Eastern Illinois University, Charleston, IL 61920) DR. JANELLE DOWNS (Pacific Northwest National Laboratory, Richland, WA 99352).* In the wildland settings of the intermountain west *Bromus tectorum* is one of the most common invasive species, contributing to habitat degradation and increased wildland fire frequency. Control and eradication of cheatgrass in rangelands is a problem for many land management agencies and private land owners. Work described here is part of a cooperative effort to assess the potential use of indigenous fungal species as biocontrol organisms to this introduced annual grass. *Ustilago bullata* and *Tilletia fusca* are smut fungi that prevent seed set in infected cheatgrass plants and *Pyrenophora semeniperda* is an ascomycete fungus that kills cheatgrass seeds in the soil seed bank. To assess the incidence of the fungal pathogens in cheatgrass, three areas were surveyed in central Hanford and one site was surveyed on the Fitzner Eberhardt Arid Lands Ecology Reserve near Richland, Washington. To determine disease incidence for *U. bullata* and *T. fusca* we used a point intercept method, while extent of *P. semeniperda* infection will be assessed through examination of seed bank samples. We measured disease incidence from 40 plots at each site. No incidence of *T. fusca* was discovered at any of the sites surveyed. The average incidence of all sites of *U. bullata* was 15% and was highly variable ranging from 4%-20% and may be related to different environmental factors. Incidence of *P. semeniperda* will be determined when the seed bank samples are processed by the investigating scientist Dr. Susan Meyer at USDA Forest Service Shrub Laboratory, Provo, Utah. This research is a part of a larger study funded by the USDA Forest Service that combines data from other research areas in Washington, Idaho, and Utah.

Electrochemical Remediation of Arsenic Contaminated Groundwater. *SCOTT MCLAUGHLIN (University of California–Berkeley, Berkeley, CA 94720) ASHOK GADGIL (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Arsenic in drinking water impacts 100 million people worldwide, 50 million of whom are in danger of severe poisoning. The most dire situation is in Bangladesh, where 45 million cases of arsenic related poisoning makes it the largest case of mass poisoning in human history. Available methods of treating arsenic are too expensive, not effective enough, and often difficult to implement, making them inadequate for a poor, largely undeveloped country such as Bangladesh. Electrochemistry promises an innovative, effective, and inexpensive method for arsenic remediation of drinking water. The method is an improvement upon a known method of using Fe^{3+} to remove arsenic. The Fe^{3+} combines with As(V), forming an insoluble complex which then can be easily filtered out. The innovative step of electrochemistry allows for control over the amount of Fe^{3+} produced as well as electrochemical oxidation of the As(III) into reactive As(V) anion $[H_2AsO_4]$-, making the method far more effective. Tests on a simple laboratory setup show a drastic improvement in arsenic removal efficiency compared to arsenic removal based on simple rusting of metallic iron. Application of 70 mA current over 10 minutes

in our electrochemical cell reduced the arsenic concentration in 850 mL synthetic ground-water from 1000 ppb to less than 5 ppb, even without system optimization. This is compared to a similar setup with a rusted iron coil without application of electrochemistry which only removed down to 250 ppb in an entire hour. We completed a major goal for this summer in understanding the effects of experimental conditions on the system so that reproducible and consistent results can be obtained. Currently, tests are being performed at various current densities and durations to find the optimal electrochemical parameters for efficient oxidation of Fe into Fe^{3+} and effective removal of arsenic. Once the process is well understood, the method will be able to be very efficiently applied to a water filter applicable to areas with arsenic in the groundwater.

Endocrine Disrupter Effects on Fish Reproduction: The Evaluation of the Toxicity of PFOA, PBDE-47, and its Metabolite 3-OH BDE-47 in Fathead Minnows *(Pimephales Promelas).* *DANIEL HASKELL (University California–Santa Barbara, Santa Barbara, CA 93106) IRVIN SCHULTZ (Pacific Northwest National Laboratory, Richland, WA 99352).* Polybrominated diphenyl ethers (PBDEs) are commonly used as flame retardants in many consumer products and reports of their occurrence in fish and humans has steadily increased. Tetra- and penta-bromo congeners such as PBDE-47 are more bioaccumulative, but may also be metabolized into hydroxylated forms such as the PBDE-47 metabolite 3-OH BDE-47. It is unknown whether PBDE hydroxylated metabolites are more toxic to fish. Another compound that has become ubiquitous in the environment is perfluorooctanoic acid (PFOA). It is also widely used in industrial and commercial applications such as stain resistant carpeting. PFOA is very stable and is not known to be metabolized in animals and wildlife. In this study, I measured the effects of these contaminants on reproduction in fathead minnow breeding pairs orally exposed to each test chemical. Each treatment group was dosed via controlled feedings of brine shrimp (*Artemia sp.*) that previously had been incubated with each test chemical. Fecundity was tracked daily and used as an endpoint to evaluate reproductive toxicity. At the end of the exposure minnows were dissected and the gonads removed. The gonado-somatic index (GSI) and the condition index (CI) were also recorded to determine if there were any differences between treatment groups. Analysis of the results indicated there was no effect on reproductive performance or CI and GSI.

Evaluating Changes in Black Carbon Concentrations from California Diesel Emissions. *JEFFERY AGUIAR (University of the Pacific, Stockton, CA 95211) THOMAS KIRCHSTETTER (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* In this paper we show how changes in diesel fuel properties influenced black carbon (BC) concentrations and emission factors during the past 37 years. In our analyses we use data from the San Francisco Bay Area, where diesel traffic can be considered the primary source of BC aerosol. We estimate BC concentrations from archived Coefficient of Haze (COH) data, collected routinely since 1967 at a number of Bay Area locations. COH values are a measure of the attenuation of light by the collected filter deposit and are proportional to BC concentrations measured by commonly used optical methods. Our analyses of monthly and annual COH-derived BC concentrations show that the Bay Area BC mass concentration is an order of magnitude greater in winter than in summer. Our estimated diesel BC emission factors changed from about 10 g kg^{-1} in the late 1960s to less than 1 g kg^{-1} in 2000. The seasonality is caused by unchanging monthly diesel BC emissions modulated by synchronous area-wide changes in inversion heights. Despite the continuous increase in diesel fuel consumption, annual area-wide BC concentrations decreased from 3.5 μg m^{-3} in 1967 to about 0.9 μg m^{-3} in 2000. We attribute the BC concentration decrease to the changes in diesel technology and fuel composition—particularly sulfur content that occurred in the period. BC emission factors are possibly more influenced by fuel property than engine technology. The intention for the diesel sulfur reduction was to reduce the emissions of sulfur oxides, which lower the effectiveness of exhaust particle control devices. The observed BC reduction is, therefore, an unintended benefit of the fuel sulfur reduction and steady improvements in diesel technology.

***Generating Wind Rose Plots to Predict Weather Behavior within New York City.** *KATIE JOHNSON (St. Joseph's College, Patchogue, NY 11772) VICTOR CASSELLA (Brookhaven National Laboratory, Upton, NY 11973).* Every day, the public accesses weather information collected by a vast network of cooperative observers. A wind rose gives a very concise view of how wind speed and direction are distributed at specific locations to show wind character for a particular event or purpose. Within the New York City Urban Dispersion Program (UDP), a multi-National Laboratory and multi-Federal Agency research project, the major objective is to study how air flows in a city environment. The deep canyons beneath the tall buildings of New York City create challenges in predicting air flow. To study these air flow problems, Brookhaven National Lab (BNL), with help from the UDP, set up weather stations all around New York City to allow better estimates of where contaminants may travel and to enhance the city's emergency response capabilities. The objective is to have BNL continuously collect and store the data that is being sent from these weather stations, groups the information to create graphical wind roses using PERL programming and Lakes Environmental WRPLOT view software. In order for meteorologists to predict the different seasonal wind patterns more accurately at specific locations for the future to come, these wind roses show past to present weather behavior. The data is used to provide the scientific community with a better, more thorough understanding of local climate regimes and long-term trends in weather. Over time, the results and patterns of the winds at the observed locations are predicted more precisely by meteorologists to give the public a more accurate forecast in the future.

High Temperature Electrolysis for Production of Hydrogen. *PRISCILLA ZELLARCHAFFERS (Illinois Institute of Technology, Chicago, IL 60619) DR. RICHARD DOCTOR (Argonne National Laboratory, Argonne, IL 60439).* Hydrogen fuel production is a stepping-stone towards eliminating dependency on fossil fuels. A potential method for mass production uses High Temperature Steam Electrolysis (HTSE). HTSE is a thermo-chemical process that splits a water molecule into hydrogen and oxygen. It requires a solid oxide electrolysis cell (SOEC) that operates at 1100 K with an yttrium-stabilized zirconium electrolyte. Potentially, the Gen IV nuclear reactor will be used as a power source to meet temperature requirements without greenhouse emissions. Currently, two process simulations for large-scale hydrogen production using HTSE have been introduced by Argonne National Laboratory (ANL) using ASPEN computer software and Idaho National Laboratory (INL) using HYSYS computer software. The economic feasibility of both processes must be determined thus a cost analysis of fluid transport and heat transfer equipment is conducted, and the energy balance is calculated. From these energy calculations, it is discovered that the optimum energy balance occurs in ANL's feed case of 50% water and 50% hydrogen. From the equipment cost analysis, it is estimated that for ANL the total process equipment cost is $73 million, whereas for INL it is $40 million. For both, ANL and INL systems, the total initial cost of the electrolysis unit and the nuclear reactor is about half a billion dollars. Although a HTSE hydrogen production plant will involve huge upfront investments in resources, this comparative economic analysis provides a basis for HTSE system selection.

Human Health Risk Assessment in the Hanford Area. *CHRISTINE SCHULTZ (Washington State University, Pullman, WA 99163) TERRI MILEY (Pacific Northwest National Laboratory, Richland, WA 99352).* One of the goals of the City of Richland is to eventually use parts of the Hanford Site for non-industrial purposes, possibly as a golf course or a residential area. Although there has been an ongoing decontamination effort, the area is still too polluted to support these uses. In order to make predictions about future risk to humans in the Hanford Area and the City of Richland, and so the city can start making its growth plans, a thorough assessment of the current risk in the area is needed. Many types of data are gathered, and these data are run through various computational models. The parameters for the computer codes that implement the computational models are defined by an assortment of exposure scenarios. There are seven scenarios for how different people could be adversely affected by contaminants in the environment: drinking water (surface water and groundwater) only, residential farming, avid recreation, casual recreation, child recreation and an industrial worker. Each of the scenarios produces different results, as expected because of their distinct parameters. The scenarios are meant to reflect how various lifestyles can affect people's risk levels differently. Levels of risk for each scenario in each appropriate region were determined. Using maximum measured environmental concentrations, most of the scenarios were over the safe limit of risk in at least one sub-region, showing that the area is not yet safe for these exposures. With these results, and by comparing them with results of a similar study from the early 1990s, predictions for when the area will be safe can be updated. It is important this study be done frequently because the natural attenuation of contaminants is occurring at a slower rate than initially predicted.

Improving Lithofacies Interpretation through Systematization and Quantification of Borehole Geologic Data. *JAMES REIDER (Lock Haven University of Pennsylvania, Lock Haven, PA 17745) GEORGE LAST (Pacific Northwest National Laboratory, Richland, WA 99352).* Simulations of vadose zone flow and transport are a fundamental component of studies aimed at determining the extent

of waste contamination and movement beneath the Hanford Site. Historically, these simulations and models have represented the geologic framework and associated flow and transport properties through simple homogenous and horizontally stratified hydrogeologic units. Capturing the heterogeneity, small scale variability, and uncertainty within numerical models is receiving more emphasis due to increasing capabilities of computer systems and the need to develop more detailed and complete depictions of contaminant transport. The ability to improve resolution of numerical models and simulations is limited by the availability of data in a form favorable to computer processing. Geologic borehole information is, for the most part, qualitative in nature and not readily amenable to numerical analysis. Thus, efforts are being made to systematize borehole geologic data, to be used in a more quantitative manner. Detailed procedures have been developed to translate qualitative descriptive information into discrete semi-quantitative parameters, and to translate inconsistent quantitative and semi-quantitative data sets into common parametric data sets. A geologic data management system is being developed to manage these new "translational" data sets and integrate them with existing databases to support their synergistic analysis and improved numerical representation of the subsurface geology. Detailed procedures and uniformed translational processes allow for qualitative data from a variety of sources to be represented in a semi-quantitative and computer accessible form that is thorough, uniform, traceable, and defensible. This process is leading to the creation of a detailed representation of the geologic relationship between flow and transport properties of lithofacies and the stratigraphic sequence of those lithofacies beneath the waste disposal facilities at the Hanford Site.

Indoor Air Quality Study-Vapor Intrusion of Volatile Organic Compounds. *FRANK OGERO (Medgar Evers College, Brooklyn, NY 11225) DERECK SKEETE (Brookhaven National Laboratory, Upton, NY 11973).* Growing response to residential exposure to Volatile Organic Compounds (VOCs) and Semi Volatile Organic Compounds (SVOCs) have prompted concern by the EPA to promulgate regulatory limits for VOCs in residential homes. A major source of these fugitive VOCs are dry cleaners, service stations and leaking underground storage tanks. An immediate threat can be realized from the vapors that migrate into residences. This threat can pose chronic health risk for residents if the detectability level is low. The objective of this project is to validate the Johnson-Ettinger (JEM) model and other 2-dimensional and 3-dimensional models using the Brookhaven National Laboratory Air Infiltration Measurement System (BNL/AIMS) technique to determine the subsurface contribution of VOCs intrusion in buildings. Four PFT sources were deployed in building 830. Sources were left for approximately 48 hours in six zones. Passive samplers were used to trace the infiltration and exfiltration of PFT sources. Analysis of the samplers in the laboratory showed that the flow rate in three of the six zones were quite comparable. The hallway (zone5) had a relatively high concentration rate upwards of $6m^3/_h$. However, the crawl space had low source rates hence there was little detection of PFT sources. This miniature source and sampling tracer kit can measure infiltration rates on the order of 0.2 to 5 changes per hour over time-averaged periods of 1 day to several months or years.

Indoor Vapor Intrusion of Volatile Organic Compounds. *DERECK SKEETE (Pennsylvania State University, State College, PA 16801) JOHN HEISER (Brookhaven National Laboratory, Upton, NY 11973).* Growing response to residential exposure to Volatile Organic Compounds (VOCs) and Semi Volatile Organic Compounds (SVOCs) have prompted concern by the EPA to promulgate regulatory limits for VOCs in residential homes. A major source of these fugitive VOCs are dry cleaners, service stations and leaking underground storage tanks. An immediate threat can be realized from the vapors that migrate into residences. This threat can pose chronic health risk for residents if the detectability level is low. The objective of this project is to validate the Johnson-Ettinger (JEM) model and other 2-dimensional and 3-dimensional models using the Brookhaven National Laboratory Air Infiltration Measurement System (BNL/AIMS) technique to determine the subsurface contribution of VOCs intrusion in buildings. Four perfluorocarbon tracers (PFTs) sources were deployed in building 830. Sources were left for approximately 48 hours in six zones. Passive samplers were used to trace the infiltration and exfiltration of PFT sources. Analysis of the samplers in the laboratory showed that the flow rate in three of the six zones were quite comparable. The hallway (zone5) had a relatively high concentration rate upwards of $6m^3/h$. However, the crawl space had low source rates hence there was little detection of PFT sources. This miniature source and sampling tracer kit can measure infiltration rates on the order of 0.2 to 5 changes per hour over time-averaged periods of 1 day to several months or years.

***Investigation of Lyme Disease Spirochete, Borrellia Burgdorferi and Babesiosis Transmitted by Amblyomma Americanum.** *MELISSA TORRES (State University of New York at Stony Brook, Stony Brook, NY 11794) ROBERT SELVEY (Brookhaven National Laboratory, Upton, NY 11973).* Brookhaven National Laboratory is the home of three species of ticks: *Ixodes scapularis* (Deer Tick), *Amblyomma americanum* (lone-star tick), and *Dermancentor variabilis* (Dog tick). Lone-star tick is a species of tick that was almost non-existent at Brookhaven National Laboratory in the late 1980s. The ratio of Deer ticks to Lone-star ticks has dramatically changed within the past fifteen years due to the vast population of deer at Brookhaven National Laboratory. This is a concern for the employees and visitors at BNL because they may be at a higher risk of contracting lyme disease. Lone-star ticks are known carriers of ehrichliosis and a spirochete called Borrelia lonestari which gives a rash similar to the rash associated with Borrelia burgdorferi; however lone-star ticks are not known carriers by the State of New York Department of Health to carry the lyme disease spirochete or babesiosis. The known transmitter of lyme disease and babesiosis are deer ticks. Since both species of ticks feed off of the same infected mice and deer, this increases the possibility of the lone-star ticks acquiring and being able to transmit the lyme disease spirochete. Using Polymerase Chain Reaction (PCR) methods of locating specific DNA fragments we are able to analyze lone-star ticks for the Borrelia burgdorferi spirochete as well as babesiosis. We had a small sample size but according to our results all of the lone-star ticks returned negative for the lyme disease spirochete but surprisingly instead of an expected zero percent lone-star returned 10% positive for Babesiosis. We also tested deer ticks and they returned 10% for the lyme disease spirochete and another 10% positive for babesiosis. Due to the way we sent our samples out for analysis it was impossible to find out if there was a correlation with the two diseases. Our results did not return as expected and we now conclude that employees and visitors at BNL should be more aware of babesiosis since it is carried by two different species in the area.

Investigation of the Characteristics of Ponds and Vernal Pools used by Eastern Tiger Salamanders and Their Affects on Juvenile Recruitment. *CHAUNCEY LEAHY (Community College of Rhode Island, Providence, RI 02903) VALORIE R. TITUS (Brookhaven National Laboratory, Upton, NY 11973).* The Eastern Tiger Salamander (*Ambystoma tigrinum*) is endangered due to rapid over-development on Long Island. In order to protect this species, protocols must be developed to identify suitable habitat and habitat preservation requirements. Egg mass surveys can be used to evaluate the optimum conditions of ponds and vernal pools (i.e., temperature, pH, conductivity, etc.) used by tiger salamanders in order to reproduce. Linking egg mass surveys with juvenile recruitment can assist in creating models that predict how productive a pond/vernal pool has the potential to be. This research investigated the characteristics associated with ponds and vernal pools used by tiger salamanders for breeding to determine which ponds are the most productive and which ponds result in the greatest amount of surviving larva. Egg mass surveys were conducted 2000 through 2006 at thirty-seven pond and vernal pool locations throughout the Brookhaven National Laboratory property and juvenile recruitment data was collected at four of the ponds via drift fences and seining data. This is an ongoing project and more data is needed before a conclusion can be made.

Isolation of Lactate Dehydrogenase from a Filamentous Fungus. *JEANNENE RAVET (Walla Walla Community College, Walla Walla, WA 99362) ELLEN PANISKO (Pacific Northwest National Laboratory, Richland, WA 99352).* Lactate dehydrogenase is the enzyme responsible for catalyzing the production of lactate from the substrate pyruvate and causing the oxidation of nicotinamide adenine dinucleotide, reduced form (NADH) to nicotinamide adenine dinucleotide, oxidized form (NAD). In order to attain the production of high levels of lactic acid, the ideal growth conditions and strain of fungus must be determined. Through the use of a lactate dehydrogenase assay, the conversion of NADH to NAD from various fungal extracts is observed by spectrophotometry and recorded over a five minute period. From these results, the activity of the enzyme can be determined. Results did not consistently show lactate dehydrogenase or significant enzyme activity when uncharacterized fungal isolates CKF120 and CKF394 were tested against a control lacking the substrate sodium pyruvate. Various methods were tested to produce results; however, the possibility of contamination and the variability of filamentous fungi could contribute to the lack of lactate dehydrogenase activity. Currently, testing is being done on different conditions to determine which will cause lactate dehydrogenase to be highly expressed. Once found, the enzyme will be isolated from the cell

for further study, to potentially obtain the protein sequence, providing information to help achieve hyper productivity.

Linking Water and Energy Models to Acquire a Better Understanding of the Interrelation Between Energy and Water. *CARISSA SALVATO (Binghamton University, Binghamton, NY 13902) KENYA CROSSON (Brookhaven National Laboratory, Upton, NY 11973).* It is important to consider the amount of energy and water available when implementing new technologies. When investigating innovative energy technologies, water supply and water quality data are often overlooked, and energy is often assumed to be an unlimited resource for water treatment and conveyance. Markal Allocation (MARKAL) is an energy, environment and economic analysis linear programming model that is technology-rich and capable of assessing multi-scale energy systems over a user-defined time period. MARKAL is currently used to model energy demands and technologies in over 55 countries. Brookhaven National Laboratory is currently incorporating water supply and conveyance, water and wastewater treatment, and the associated technologies into a New York City version of MARKAL. However, an in depth analysis of watershed conditions (meteorology, land use, point and non-point sources, etc.) that significantly affect water supply and water quality cannot be accomplished with the MARKAL model framework. Thus, it is necessary to link a watershed model with MARKAL to create a decision support network that addresses energy-water issues. Research was conducted to find the most suitable watershed model. After reviewing the qualities of many different models, one was chosen. The model chosen was the Watershed Analysis Risk Management Framework (WARMF) because it could be easily obtained in Windows format and also due to its ability to integrate water quality, DEM and GIS. Data necessary to run the WARMF model was obtained from sources such as USGS (United States Geological Survey), EPA's STORET (Storage and Retrieval) and NADP (National Atmospheric Deposition Program). All necessary information has yet to be obtained in order to run the WARMF model, warranting further data searches. In further studies the WARMF model will be linked with the New York City MARKAL model. The economic and environmental results of these studies will illustrate the interrelationship between energy and water systems in metropolitan areas and lead to better management of energy and water resources, improved policies/regulations, and a better understanding of the economic and environmental impacts of energy and water technologies.

Lipid Production by Dunaliella Salina in Batch Culture: Effects of Nitrogen Limitation and Light Intensity. *CHAD WELDY (Western Washington University, Bellingham, WA 98225) MICHAEL HUESEMANN (Pacific Northwest National Laboratory, Richland, WA 99352).* Atmospheric carbon dioxide (CO_2) concentrations are increasing and will cause unknown deleterious environmental effects if left unchecked. The Intergovernmental Panel on Climate Change (IPCC) has predicted in its latest report a 2°C to 4°C increase in global temperatures even with the strictest CO_2 mitigation practices. Global warming can be attributed to in large part to the burning of carbon-based fossil fuels, as the concentration of atmospheric CO_2 is directly related to the burning of fossil fuels. Biofuels which do not add CO_2 to the atmosphere are presently generated primarily from terrestrial plants, i.e., ethanol from corn grain and biodiesel from soybean oil. The production of biofuels from terrestrial plants is severely limited by the availability of fertile land. Lipid production from microalgae and its corresponding biodiesel production have been studied since the late 1970's but large scale production was determined to be economically unfeasible due to the large costs of sterile growing conditions required for many algal species. This study focuses on the potential to use the halophilic microalgae species *Dunaliella salina* as a source of lipids and subsequently for biodiesel production. The lipid production rates were compared for *D. salina* cultured in replicate photobioreactors under high light and low light as well as nitrogen sufficient and nitrogen deficient culture conditions. The results show (a) cellular lipid content ranging from 16 to 44% (wt), (b) a maximum culture lipid concentration of 450 mg lipid/L, and (c) a maximum integrated lipid production rate of 46 mg lipid/L culture*day. The high amount of lipids produced suggests that D. salina, which can be mass-cultured in non-sterile outdoor ponds, has a strong potential to be an economically valuable source for renewable oil and biodiesel production.

Litter Position Appears to be the Most Important Driver of Decomposition at ORNL FACE. *REBECCA ROHA (Gettysburg College, Gettysburg, PA 17325) AIMEE CLASSEN (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Levels of atmospheric [CO_2] (carbon-dioxide concentration) are expected to double in the next century, therefore it is important to understand the effects of CO_2 on ecosystem processes such as decomposition. Decomposition plays an important role in the global carbon cycle, and will likely be impacted by climatic change. The Free Air Carbon-dioxide Enrichment (FACE) site at Oak Ridge National Laboratory (ORNL) provides a unique opportunity to investigate the effects of elevated [CO_2] on decomposition and carbon cycling. ORNL FACE is a sweetgum plantation consisting of two rings of elevated [CO_2] and three rings of ambient [CO_2]. This decomposition study was constructed to examine how changes in atmospheric [CO_2] may alter decomposition and carbon cycling in forested ecosystems. Three parameters were measured: (i) litter quality, (ii) decomposition environment, and (iii) decomposition position. Treatments include leaves that were naturally grown under either elevated or ambient atmospheric [CO_2]. Leaves from elevated and ambient rings were decomposed in like rings to test how [CO_2] might alter litter quality and decomposition. In an adjacent "common substrate" experiment, leaves from ambient rings were decomposed in all elevated and ambient rings to test if the effects of [CO_2] on microclimate or microbial communities would alter decomposition. Finally, leaves from ambient and elevated rings were buried in the soil profile to test if litter position impacted decomposition. Decomposition rates were determined by comparing the mass before and after decomposition (percent mass loss). This research resulted in three major findings: 1) The effects of elevated [CO_2] on litter quality had no impact on litter decomposition; 2) Decomposition of a common substrate did not differ between ambient and elevated plots, suggesting the change in soil environment due to elevated [CO_2] does not alter decomposition; 3) Due to earthworm activity, belowground decomposition occurred much faster than aboveground decomposition; thus, litter position appears to be the most important driver of decomposition at FACE. These data are important because modelers can use them to better predict the effects of elevated [CO_2] on forest carbon cycling in the future.

MARKAL Modeling for Energy in Census Regions and Divisions of the United States. *KIN MAN LEI (State University of New York at Stony Brook, Stony Brook, NY 11794) VATSAL BHATT (Brookhaven National Laboratory, Upton, NY 11973).* MARKAL, short for MARKet ALlocation, is a comprehensive energy/economic model that simulates a nation, region, or state's energy system by representing the technologies and demands for energy services that comprise it. The model finds the least-cost way to meet a given set of demands for energy services within the constraints of a user's available technologies and any environmental limits. Developing MARKAL involves building a bottom-up model of the region's energy system, and thus requires a tremendous amount of technical input data. These data are divided into two main parts, the supply side and the demand side. The supply side consists of data related to the resources used in each state to produce energy, such as natural gas, biomass, coal, oil and others. While the demand side consists of data regarding the technologies in use, their costs, and the assumption of their efficiencies. Most of the data can be collected from the Energy Information Administration, U.S. Census Bureau, U.S. Department of Energy and others. For the supply side data, each resource defines its own regions without reference to each other or to the national census regions. Consequently all supply side data for each resource must be converted to a uniform standard, which is the national census regions. After collecting all these data, they are inputted into the ANSWER software. This processes the input data, draws Reference Energy Systems diagrams, submits model runs, handles the numerous scenarios needed during an assessment, and facilitates analysis and interpretation of the model results. When the MARKAL model is formed, it can identify costs and benefits of alternative energy scenarios for future use, and also estimate the relative merits of specific technologies that are applied in an energy system of each census region.

Mercury Deposition on the Forest Edge and Beyond. *CHELSEA CAMPBELL (Western Kentucky University, Bowling Green, KY 42101) TERRY SULLIVAN (Brookhaven National Laboratory, Upton, NY 11973).* Mercury is a neurotoxin that, if ingested at high concentrations, can significantly effect physical, psychological, and behavioral problems including sleeping disorders, memory loss, and chronic fatigue. The Environmental Protection Agency has set many precautionary restrictions on fish consumption due to these health issues. Mercury is naturally occurring in the earth's crust, and therefore, is found in many minerals such as coal. Coal-fired power plants are the largest human contributors of mercury. As part of a larger program to investigate the impact of mercury releases from coal-fired power plants, a study is being conducted on mercury concentrations in tree leaves at Brookhaven National Laboratory (BNL). It is hypothesized that the mercury deposition could be higher in the trees on the forest edge, and therefore, acts as a shield to the trees inside the forest. To examine the impacts of forest edges and heavily traveled roads on mercury concentration in tree leaves, five locations within three

transects around BNL were designated sample sites. At each location, three types of trees were studied: Red Oak (*Quercus rubra L.*), White Oak (*Quercus alba L.*), and Scrub Pine (*Pinus rigida mill.*). The three transects were William Floyd Parkway, I-495, and a clearing at the BNL biology testing fields. The first location in each transect was taken on the perimeter, while the other four locations were set at 100-yard increments progressing into the forest. The samples were taken by hand from selected trees with low branches resulting in a deficiency of pine samples in some locations. Weekly collections were done for six weeks including a collection of leaf litter. Blind Duplicates were taken in the field and approximately 90 samples were collected in every round. Samples were measured in duplicate for quality assurance, and if necessary, triplicate measurements were taken, with a result of over 1,000 samples being analyzed. The moisture content was calculated after drying the samples at 60°C overnight. The Red Oak moisture content was found to be around 61% while the White Oak had a moisture content of 65%, and the pine was found to contain about 55% moisture. A Direct Mercury Analyzer (DMA-80) was used to determine the concentration of mercury in the leaf samples. The data analysis has begun on the first and second round of sampling to investigate comparisons between the rounds and the spatial trends.

Methodology Development for Monitoring the Diatom Pseudo-nitzschia Spp. in Coastal and Estuarine Waters of the Pacific Northwest. *ELYSE WALKER (University of South Carolina, Columbia, SC 29208) DANA WOODRUFF (Pacific Northwest National Laboratory, Richland, WA 99352). Pseudo-nitzschia* spp., a harmful algal specie found in Pacific Northwest waters can produce domoic acid, a neurotoxin that affects shellfish, marine mammals, birds, and humans if ingested in high doses. Instruments and techniques that can rapidly detect harmful species for screening purposes are useful as early warning tools. The goal of this study was to develop and test a procedure for identifying *Pseudo-nitzschia* spp. blooms in Sequim Bay, Washington. Weekly samples were taken from both an incoming and outgoing tide at the mouth of Sequim Bay and analyzed using an image analysis system, the FlowCAM©. These data were analyzed to create a protocol for monitoring *Pseudo-nitzschia* spp. and determining if bloom conditions were present. Based on knowledge of a June 2006 *Pseudo-nitzschia* spp. bloom in Sequim Bay, results indicate that a bloom may be occurring when more than 92% of particles <0.08 in aspect ratio are *Pseudo-nitzschia* spp. Based on this preliminary data, the FlowCAM© appears to be a useful tool for pre-screening of *Pseudo-nitzschia* spp. bloom conditions.

Non-Invasive Species Confirmation of Fox Populations at Brookhaven National Laboratory. *WENDY FINN (University of Rhode Island, Kingston, RI 02874) DR, TIMOTHY GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Information regarding the present day status of Fox populations on Long Island, NY is essential for an understanding of species diversity. Historically, Red Fox (*Vulpes vulpes*) and Gray Fox (*Urocyon cinereoargenteus*) occurred sympatrically on Long Island, NY. Although current population size estimates have not been established for either species it is speculated that the Red Fox has adapted to anthropogenic disturbances better than the Gray Fox. After the discovery of a deceased Gray Fox in the Relativistic Heavy Ion Collider at Brookhaven National Laboratory (BNL) in October of 2004, questions arose concerning the presence of this species in the area. To determine if the Gray Fox is utilizing areas of BNL as a home range, this study focused on observing mitochondrial DNA markers in feaces, which enable us to distinguish between the two species. A positive scat sample and camera trap shot have confirmed the presence of gray fox at BNL.

Potential for Amblyomma Americanum to Carry Borrelia Burgdorferi, and Babesia. *ZARREA PRADHAN (Stony Brook University, Stony Brook, NY 11794) ROBERT SELVEY (Brookhaven National Laboratory, Upton, NY 11973).* Long Island is the home to three species of tick: the deer tick *Ixodes scapularis*, the American dog tick (*Dermacentor variabilis*), and the Lone Star tick (*Amblyomma americanum*). Over the past few years the tick population has become dominated by *Amblyomma americanum*. The ratio of *Amblyomma americanum* to *Ixodes scapularis* at Brookhaven National Laboratory is about 8 to 1. New York State Center for Disease Control does not recognize *Amblyomma americanum* as a carrier of Lyme disease or Babesia, a protozoan that causes intestinal discomfort. Due to the increasing population of this species of tick, it would be beneficial to test for the presence of Borrelia burgdorferi, which is the bacterium that causes Lyme disease. *Amblyomma americanum*, are known to carry other Borrelia bacterium, specifically Borrelia lonestari which only causes a minor rash. In an attempt to determine if this species carries the spirochete Borrelia burgdorferi, several samples have been obtained at Brookhaven National Laboratory. The samples that have been collected have been sent to a lab where they were analyzed using PCR (polymerase chain reaction), a DNA amplification process, which tests the DNA for the spirochete bacterium Borrelia burgdorferi. Using the 609 ticks collected over a two and a half week period from various locations around the site, random samples were chosen for testing. These samples consisted of 10 *Ixodes scapularis* nymphs, 10 adult *Amblyomma americanum* females, 10 adult *Amblyomma americanum* males, and 10 *Amblyomma americanum* nymphs. The testing performed detected the presence of Borrelia burgdorferi and Babesia. The results showed the *Amblyomma americanum* that had been tested (a total of 30 ticks) were negative for the presence of Borrelia burgdorferi. The results also showed 6% of *Amblyomma americanum* were positive for the presence of Babesia, which they had not been know to carry prior to the testing. Of the 10 *Ixodes scapularis* tested, 10% were positive for Borrelia burgdorferi and 10% were positive for the Babesia. It should be noted that the sample size used in this study was very small. Only 4.9% of the ticks collected were tested due to funding limitations. In order to further support the claim that *Amblyomma americanum* does not carry Borrelia burgdorferi, further testing should been done using a larger sample size. In addition, further testing should also be done to try and estimate the percentage of *Amblyomma americanum* infected with Babesia.

Processing of Numerical Simulations of Fluid and Chemical Transport to Determine Kinetic Coefficients Using an Inverse Solution Algorithm. *SCOTT CESAR (Western Michigan University, Kalamazoo, MI 49006) JACK PARKER (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Chemical reaction kinetics and physical mass transfer can be described as rate equations that are dependant on such factors as mass transfer, permeability and dispersivity while also being affected by flow. Through modeling, the rate of a certain process may be conceptualized at a specific scale when seen at a given time. Computation models do not necessarily scale to a larger or smaller dimension readily and therefore complex coefficients are necessary for accurate modeling. Through refinement of variables, model accuracy can be determined with much greater efficiency. The purpose of this study is to model processes at different scales using scale-independent mathematical formulations with scale-dependant coefficient values or functions with scale-dependent intrinsic error. Laboratory data of batch and column experiments with specific fluid flows through porous media (weathered, fractured shale saprolite and pyrolusite) was obtained from previous research. The data was then manipulated through the use of Sigma Plot and Microsoft Excel to provide a suitable output form for further use. The new data structure was used to construct files for input into HydroGeoChem. The code was then modified through use of Fortran 95 to create an inverse solution algorithm for further modeling. The data files and Fortran code are then run using VisualPest to derive estimation of parameters to formulate mass transfer rate and correlations of coefficients for further statistical analysis. The first and only set of data analyzed at this point deals with the mass transfer of bromine through columns with soil sample collected locally. Two saturated undisturbed column experiments were performed and the results were analyzed. Simulation 1 gives an estimation of mobile zone porosity →and geometry factor a which utilized together with different scale experiments and simulation will be used to determine the scalability. In Simulation 2, no non-reactive tracer drop was seen during flow interruption, so mobile-immobile mass transfer simulation was not performed. No conclusion can be made from the data due to the limited number of viable analyses performed. More simulations must be conducted before substantiated results may be established.

Raman Spectroscopic Studies of Plant Species. *LAURA ROSSIER (Stony Brook University, Stony Brook, NY 11794) WEI WANG (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* This study examined the Raman spectra of leaves, flowers, and fruits at varying stages of decay in an attempt to identify various plant pigments and species based on their chemical and structural signatures. All Raman spectra were collected using a Renishaw micro-Raman system with a 300 mW near-infrared diode laser with 785 nm wavelength of excitation. Seven main vibrational bands occurred at ~1526, 1188, 1157, and 1602, 1326, 1287, 744 cm^{-1} for all samples; these bands were assigned to the C-C stretching mode, as well as other carbon bonding, of carotenoid and chlorophyll. The spectral peaks can act as references for the color of the plant material, regardless of the species of plant or plant part. Using the relative intensities of peaks associated with chlorophyll and carotenoids, samples can be roughly classified according to color. This study also observed a red carnation at different times over the course of a week as it was removed from water and allowed to decay. Over time the relative intensities of peaks distinctly changed. For the red carnation, the ratio

of the highest intensity peaks (I1188(carotenoid)/I1602((chlorophyll)) increased steadily with time and lack of water. Future studies will illuminate the nuances of the relationship between spectra of pigment and observed color by expanding the spectral database of colored plant material. In addition future studies will determine more exactly the rate of change for relative peak intensities, as well as determining the variation in the relative intensity of chlorophyll and carotenoid peaks for a variety of decaying plant materials. Potentially, surface enhanced Raman spectroscopy could enable identification of other plant molecules as well as providing a method for plant classification by species.

***Redesign and Update of the Brookhaven Atmospheric Tracer Sampler (BATS).** *MIGUEL LOPEZ, RAMON FERNANDEZ (Bronx Community College, Bronx, NY 10453) JOHN HEISER (Brookhaven National Laboratory, Upton, NY 11973).* The Brookhaven Atmospheric Tracer Sampler (BATS) is a versatile air-sampling instrument used to capture perfluorocarbon tracers (PFT) used in air infiltration and atmospheric transport studies. The updated BATS includes a new power control module (PCM), which can be programmed by computer via either serial connection or wirelessly through the World Wide Web. These units are assigned an IP Address so that they can be accessed from any computer terminal with an Internet connection, providing access to the functionality of the BATS at any time and distance. Each unit is equipped with a digital LCD screen with a real-time clock, date, and temperature meter, to allow for manual calibrations or changes in data collection settings. With unique timing, triggering, wireless capabilities and pumping modules, the BATS has now become a more efficient tool for precise tracer sample acquisition. Whereas outdated units were programmed to pull air through these tubes for a certain time period, renovated units are capable of pulling a measured volume of air through any of the 23 sampling tubes at a specified time, date and rate. In addition, the introduction of mass flow control reduces the time and cost involved in data analysis and greatly improves QA/QC. Each independent battery-operated BATS unit can be programmed to cycle on and off within a 24-hour period over seven days to provide time sequential sampling. The sampler consists of two modules—the pump control module and the interchangeable sampling module—located in the base and lid respectively. The lid or Air Flow Module (AFM) contains the sampling tubes, selector valve, and drive solenoid, while the PCM contains the batteries, control, and sampling pump. The AFM consists of 23 sampling catch tubes, each containing a carbonaceous adsorbent. The major differences between the old and new BATS are the new BATS has a web based microprocessor controller, mass-flow measurement, variable sampling intervals and flow rate with wireless internet access. We are in the process of bench testing new units prior to deployment in the field.

Relative Abundance of Anurans on the Hanford Reach National Monument. *SHANNON BLACKBURN (Columbia Basin Community College, Pasco, WA 99301) JAMES BECKER (Pacific Northwest National Laboratory, Richland, WA 99352).* Breeding sites of three anurans, the bullfrog (*Rana catesbeiana*), Great Basin spadefoot (*Spea intermontana*), and Woodhouse's toad (*Bufo woodhousii*), a Washington state monitor species, were identified during call surveys at 23 pools and river shoreline locations along the south and west shorelines of the Hanford Reach of the Columbia River in Benton County. Call surveys were conducted from the beginning of February through mid-August to identify breeding sites for these species, breeding chronology, and establish baseline relative abundance. All three species used pool locations almost exclusively, with very little use of river shoreline locations. A total of 1,301 individuals of all three species were heard calling during the study period. The Great Basin spadefoot was the first species to begin calling, in late April, reaching its peak calling period in late May, and tapering off in early July. Woodhouse's toads began calling in early May, peaked during mid-May, and continued calling into late July. The bullfrog called from early May but did not peak until late July through mid-August. Great Basin spadefoot calls were most abundant, comprising 44.2% of the total, followed by Woodhouse's toad at 41.8%, and the bullfrog at 14%. Given general downward trend in anuran population numbers worldwide and the increase in species extinctions, it may be beneficial to continue monitoring populations at the Hanford Reach in order to follow long term population trends.

Removal of Arsenic from Contaminated Water by Means of Electrochemistry. *KRISTIN KOWOLIK (Santa Monica College, Santa Monica, CA 90405) ASHOK GADGIL (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* Millions of people worldwide do not have access to clean water. This problem is especially severe in Bangladesh where water is severely contaminated with arsenic. Chronic arsenic exposure has devastating health effects: cardiovascular diseases, cancers, and eventually death. Many methods of arsenic removal have been studied but most of these are too expensive and impractical to be implemented in poor countries such as Bangladesh. This project investigates electrochemistry as an affordable means of removing arsenic. Experiments are performed using a galvanic cell with iron and copper electrodes. These are immersed in synthetic groundwater spiked with an arsenic concentration of 1 ppm. Current is applied to the system and iron metal is oxidized to Fe(III). As an ionic species, iron will bind free arsenic in solution. After the electrochemical process, the treated water is filtered by means of vacuum filtration. One of the significant major tasks of the project was to develop an experimental protocol (methods, measurement techniques, experimental conditions) to obtain reproducibly consistent results, so this process can be investigated further. We showed that if certain conditions are met such as (1) optimal current density, (2) sanded iron electrode and (3) specific amount current and time, consistent results are obtained. An initial arsenic concentration of 1 ppm can be reduced to a final concentration as low as 5 ppb or less, in 1 L water by application of 90 mA current in 10 minutes. These results are very encouraging and provide great promise that electrochemistry is a powerful, and most importantly, an affordable tool in the remediation of arsenic from contaminated groundwater.

Reproductive Toxicity of PCB-77 and 4-OH PCB-66 in. *MARIO DELGADILLO-LARIZ (Cabrillo Community College, Aptos, CA 95003) IRV SCHULTZ (Pacific Northwest National Laboratory, Richland, WA 99352).* The reproductive toxicity of 3',3',4,4'-tetrachlorobiphenyl (PCB-77) and a representative hydroxylated metabolite, 4-OH PCB 66, was studied in fathead minnows (*Pimephales promelas*). The study consisted of three groups of sexually mature and actively spawning fathead minnows (FHM). One group of FHM's was orally exposed to PCB-77 by bioencapsulation in brine shrimp, *Artemia sp*. Bioencapsulation was achieved by placing adult *Artemia* in a flask coated with the test chemical. A second group of FHM pairs were orally exposed to 4-OH PCB-66, also by bioencapsulation. The exposure lasted 21 days. Their reproductive performance was tracked daily by measuring fecundity and compared to a third group of unexposed FHM's. At the end of the exposure they were terminated, their gonado-somatic index (GSI) and their condition index (CI) were calculated as a general measure of the overall health of the fish. My results show that PCB-77 and 4-OH PCB-66 had no reproductive toxicity; at no time during the exposure did any of the groups stop or even reduce spawning frequency. The GSI average for male FHMs exposed to PCB-77 and the male FHMs exposed to 4-OH PCB-66 was well within the typical GSI values: ~1% to 2% (1). The same is true for the female FHMs, the typical GSI values are: ~8% to 12% (1), which is what I observed. GSI and CI results show that all three groups of fish were at seemingly similar conditions which, was verified by their reproductive performance.

Risk-Based Assessments for Homeland Security Planning and Response. *MEGAN WILLIAMS (University of New Orleans, New Orleans, LA 70148) MARGARET MACDONELL (Argonne National Laboratory, Argonne, IL 60439).* As the potential threat of terror attacks elevates widespread concern throughout the United States, prevention and rapid response measures are being put in place to assure the security of Americans. Risk-based assessments are being conducted and provisional advisories levels (PALs) are being set for potential threat contaminants that may be released into the public drinking water supply and/or air. Risk-based assessments include the evaluation of new standard, existing standards and guidelines, fate and detection of contaminants and their degradation as they are often a precursor to the development of PALs. The contaminants in which we assess range from toxic industrial chemicals to radionuclides. PALs are advisories that answer the questions of who, what, when, where and how a contaminant will effect the drinking water and/or air if released. These contaminants identified are those that the Environmental Protection Agency-National Homeland Security Research Center (EPA-NHSRC) have deemed as a potential health threat to the American pubic.

Spatial Distribution of Iridovirus in the Eastern Box Turtle Population at Brookhaven National Laboratory: Implications for Transmittance Based on Home Range Size. *SARAH SNYDER (Unity College, Unity, ME 04988) VALORIE TITUS (Brookhaven National Laboratory, Upton, NY 11973).* There are currently four recognized genera of the icosohedrally symmetric iridoviruses that infect both invertebrates (Iridovirus and Chlorirdovirus) and poikilothermic vertebrates (Lymphocystivirus and Ranavirus). Ranaviruses have only been documented in a relatively few number of reptiles when compared to the number of viruses that have been documented in amphibians and fish. Relatively recent detection of ranaviruses in five species of

chelonians, including a virus outbreak in a population of Eastern box turtles (Terrapene carolina carolina) at Brookhaven National Laboratory, is especially alarming. This discovery poses a threat to box turtles in surrounding areas since the species is listed as Special Concern in the state of New York. To ascertain the current distribution of infected turtles at Brookhaven National Laboratory, cloacal and oral samples were collected and virus testing was performed using molecular genetic techniques. To further explore the potential transmission of the ranavirus within the box turtle population, determining individual home range size was necessary. Habitat quality, structure, diversity, individual preference, and population density all account for variation in size and spatial structure of box turtle home ranges. Due to this variability, it was crucial to determine home range size specific to the study area in question. Radiotransmitters were attached to 5 box turtles inhabiting the area of Ranavirus discovery and their daily movements and habitat preferences were recorded. Geographic Information Systems (GIS) was used to digitally map home range area in order to determine Ranavirus dynamics and the potential for disease spread within the box turtle population. Preliminary results indicate that the virus is likely present in the box turtle population at Brookhaven National Laboratory. Home ranges of turtles appear to be relatively small but overlapping which suggests favorable conditions for virus spread, depending on encounter rates and mode of transmission.

Successional Assessment of Columbia River Periphyton. *NINA SOVIK (Johns Hopkins University, Baltimore, MD 21218) AMORET BUNN (Pacific Northwest National Laboratory, Richland, WA 99352).* The Columbia River's hyporheic zone is an area of high biodiversity where river and groundwater mix. Periphyton is found at the surface/water interface and forms the basis of the food chain for the entire river. The periphyton community consists of the primary producers in the river environment, and the community includes photosynthetic organisms, such as diatoms and algae, bound together in a polysaccharide matrix. The composition of species succeeds, or changes, naturally over time. The presence of contaminants in the surface/water interface may affect some or all of the species comprising the periphyton community. Contaminants may change the succession of these organisms and the ultimate structure and function of the community. To understand the development of the community, a laboratory growth system was used to monitor succession without the presence of contaminants. Cleaned microscope slides were added to bins with flowing Columbia River water. They were exposed to a light cycle of 16/8 hours light/dark photocycle. The slides were colonized by organisms in the river water. Using a light microscope, slides were examined for a total of ten days, including every 24 hours for five consecutive days. They were photographed to document natural successional changes and trends in microbial diversity. It was found that the amount of biomass increased over time, and slides were completely obscured from view within two weeks. The increase in biomass corresponded to changes in species composition. During the early successional stages, the species composition was primarily diatoms (Navicula) and a few types of filamentous algae. After three days, more algal species and consumers (protozoans and rotifers) were observed. There was also an increase in filamentous diatoms (Cyclotella), and in the frequency of cell division among certain diatoms (Synedra ulna). This work is part of a larger study being done to understand the hyporheic regions of the Columbia River and how those regions may be affected by the presence of groundwater contamination at the surface/water interface.

The Adaptation of Soybean Plant Antioxidant Enzyme Activity Assays for a 96-Well Microplate. *BINGJIE LING (University of Virginia, Charlottesville, VA 22904) ALISTAIR ROGERS (Brookhaven National Laboratory, Upton, NY 11973).* Reactive oxygen species (ROS) such as superoxide, hydrogen peroxide, and the hydroxyl radical are produced in plants in response to stresses such as ozone, UV light, microbial attack, and low temperatures. To reduce oxidative damage to the cell, the plant produces antioxidant enzymes such as superoxide dismutase, catalases, peroxidases, and glutathione reductase to directly or indirectly detoxify ROS. There has been a tremendous tropospheric O_3 increase since the Industrial Revolution, and soybean plants are one of the most sensitive crops, with yields decreasing by nearly 50% at high concentrations of ozone. However, the response of plants to this rise in ROS under different conditions is unknown. Current methods for analyzing these enzymes use single-sample assays, but in order to analyze enzyme activities in large-scale field experiments, there is a need to increase the capacity and throughput. The aim of this project was to adapt these methods for a 96-well microplate. Similar concentrations of the assay components were used, but due to the significantly smaller volume employed by the microplate, these amounts were adjusted accordingly after every trial experiment. Other changes involved using different buffers, temperatures, and timing to optimize the reaction for small volumes. Kinetic absorbance data were obtained from a Bio-Tek® Microplate Reader and standard curves of concentration vs. absorbance were used. Enzyme activity was calculated and expressed in nmol min^{-1} mg^{-1} protein. Microsoft Excel templates were also created to facilitate data interpretation for future experiments. The five enzymes chosen for which to produce these high throughput assays were catalase, ascorbate peroxidase, dehydroascorbate reductase, monodehydroascorbate reductase, and glutathione reductase. These have been identified as important enzymes in ROS detoxification and the methods developed will provide a way to simultaneously assay many samples and determine the effects of ROS on the plant in various conditions. Eventually, programs can be designed for the Evolution P3 Precision Pipetting Platform, a robot that can further increase assay throughput.

The Effect of Climatic Warming on Forest Growth. *DANIEL WRESCHNIG (Albion College, Albion, MI 49224) CARLA GUNDERSON (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Climatic warming is predicted to affect forest migration, succession and growth, according to many computer models. The success of a modeling approach in understanding the effects of climatic warming has been hampered, however, by an incomplete understanding of the role acclimation-the adjustment of individuals to changes in environment-will play in the responses of trees subjected to future warming. To better understand the interaction between warming, acclimation, and growth, individuals from three species native to different temperature regimes (*Quercus rubra*, *Betula alleghaniensis*, and *Liquidambar styraciflua*) were grown together in open-topped warming chambers maintained at ambient, +2, and +4°C. Seedling height and diameter were measured intermittently during the growing season for four years, and average relative growth rates (RGRs) for each interval were calculated based on D2H (diameter X diameter X height) for each species by treatment. RGRs were tested via multiple regressions against condition variables, including growing degree days, average rainfall, average temperature, vapor pressure deficit, and photosynthetically active radiation (PAR). Initial results indicate that while temperature promotes growth in two of three species (including, unexpectedly, *B. alleghaniensis*, which models predict should not have grown under these experimental conditions at all), the strongest influence on growth may be PAR. Further study of warming and acclimation in trees will be necessary, as there is much species-specific information to be collected. While this study focused on three species, forest succession models contain many more, and it will be important to determine how plastic trees are in their response to warming to correctly predict their disposition over the next hundred years of climate change. It may be equally important to test different genotypes within species to understand how the character of species themselves may change as the climate warms.

The Effects of Drought on the Composition of Vegetation in Mitigation Wetland R at Argonne National Laboratory, Illinois. *JAMIE MODERHACK (Illinois State University, Normal, IL 61761) DR. KIRK LAGORY (Argonne National Laboratory, Argonne, IL 60439).* Wetlands are unique and vanishing habitats for plants and animals. In 1990, the construction of the APS facility at Argonne National Laboratory, Illinois led to the destruction of three wetlands in the area. A new 1.8 acre wetland was built to replace the three that were destroyed. This new wetland, Wetland R, has been previously monitored from 1992–1996 and 2002–2005, to ensure that its plant composition and diversity is comparable to the destroyed wetlands. During the 2005 monitoring process, the low levels of precipitation led Wetland R to dry up. Changes in hydrology can have a strong impact on the plants of a wetland, and thus the purpose of this year's study was to monitor Wetland R for changes in hydrology and vegetation with a specific focus on the effect of previous year's drought on plant composition. Ten transects were marked and five quadrats were randomly assigned to each transect. Each of the fifty quadrats was sampled and species name and percent cover were identified. The native status, the coefficient of conservatism or {C}value, and wetland status for all species identified were also documented. A total of 80 plants were identified during the sampling period. The number of species identified in Wetland R has continued to rise during the previous ten year monitoring period. In 2005 40% of the species identified were obligate wetland plants. In 2006 only 33% of the plants that could be identified by wetland status were obligate wetland species. Although Wetland R was able to support new vegetation and increase its species diversity in 2006, most of the vegetation was either facultative or upland species. As evidenced in previous studies, as water levels drop, facultative or upland plant species flourish while obligate wetland species tend to decline. This correlation was observed in the 2006 monitoring of

Wetland R. It is suggested that Wetland R continued to be monitored for diversity and whether the low water levels of 2005 will continue to affect the species composition and distribution in the future.

The Effects of Hypoxia on the Growth of Eelgrass *(Zostera Marina). *MIA PRINZEN (Long Beach City Community College, Long Beach, CA 90808) MICHAEL BLANTON (Pacific Northwest National Laboratory, Richland, WA 99352).* Dead Zones are areas where dissolved oxygen levels are so low that fish and shellfish cannot live and can cause mass mortalities of marine organisms. Since 2002, monitoring data from Hood Canal, Washington reveal that the zone of hypoxia (oxygen depletion) has increased in magnitude. Fish kills are more commonly reported than prior to 2002 due to hypoxia. If hypoxic conditions reach shallow subtidal and low intertidal zones, eelgrass (*Zostera marina*) in Hood Canal could be negatively impacted by decreases in growth and productivity. To assess whether hypoxia could affect the growth of *Z. marina*, two 10-gallon aquaria were set up with 10.5 liters each of sediment from Sequim Bay and planted with 30 *Z. marina* shoots. One tank contained flow-through raw seawater and supplemental air to increase dissolved oxygen levels. The second tank contained stagnant raw seawater to decrease dissolved oxygen levels. Temperature, salinity, dissolved oxygen, and pH were monitored five times per week using a water quality sonde. Light intensity was maintained above 200 $\mu mol/m^2s$ of Photosynthetically Active Radiation (PAR). During daylight hours, all shoots were cut at a uniform height before transplantation. The new leaf growth was removed by cutting at the height at which the initial cut was made. Then, all shoots with new growth within each tank were dried, weighed and averaged. *Z. marina* growth was gauged weekly. The *Z. marina* in the flow-through tank grew at twice the rate of the *Z. marina* in the stagnant tank for the first seven-day period and in the second seven-day period it grew thirteen times faster than the *Z. marina* in the stagnant tank.

The Role of Dead Trees in a Healthy Forest: Quantifying the Abundance of Snags in Six of the Central Pine Barrens Communities. *WENDOLIE AZCONA (Bronx Community College, Bronx, NY 10453) TIMOTHY GREEN (Brookhaven National Laboratory, Upton, NY 11973).* The Long Island Central Pine Barrens (CPB) has a variety of forest communities including Coastal Oak Forest, Oak-Pine Forest, Pine-Oak Forest, Scrub Oak Forest, Dwarf Pine Forest, and Pitch Pine Forest. To determine the future management practices the Foundation for Ecological Research in the Northeast (FERN) started, a forest health-monitoring project in 2005 to evaluate Pine Barren forest health indicators including snags. To assist land managers in preserving and protecting this natural recourse many forest health's indicators were recorded but not limited to pH, canopy cover, sapling numbers and snags. Snags are standing dead trees which are an important forest health indicator because they provide habitat for wildlife. The purpose of this research is to quantify the abundance of snags in six forest community types to determine in which community type they are most prevalent. Using Global Positioning System (GPS) and Geographic Information System (GIS) technology, random plots (16 x 25 meters) were selected. The quantity and average diameter at breast height (dbh) of snags in each community type were recorded for each plot. Results show that among the six community types, snags are more likely to be found in Oak pine forest followed by Coastal oak, Pitch pine, Pine oak, Scrub oak, and Dwarf pine Forest. Oak-pine and Coastal oak are two of the community types in which the greatest average dbh exist. The research of 2005/2006 will be repeated in 2015 to determine changes over time. This will serve as a baseline data to show changes over time and provide data for the management of the CPB of Long Island.

The Use of 16S rDNA Gene Libraries to Describe Microbial Communities in a Uranium Contaminated Sites. *KELLY CHO (University of Michigan–Dearborne, Dearborne, MI 48128) CHRISTOPHER SCHADT, SONIA TIQUIA (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Libraries of 16S ribosomal DNA (rDNA) genes provide powerful insights into microbial ecology. Previous studies have demonstrated that consortia of microbes can effectively promote the precipitation and removal of uranium from contaminated groundwaters. The Field Research Center at Oak Ridge National Laboratory contains field-sites contaminated with various levels of metals and radionuclides, nitrate and of varying geochemical characteristics. To characterize the composition and diversity of the resident microbial communities in the groundwater samples at the site, a PCR-based cloning approach was used. Four sampling sites (GW-835, GW-836, FW113-47 and FW-215) that encompass a wide range of uranium concentrations and geochemistry were studied. Bulk community DNA was directly extracted from the groundwater samples. The 16S rRNA fragments were amplified from the bulk community DNA using PCR primers directed toward conserved regions of bacterial rDNA. Amplicons were then cloned and sequenced. Altogether, 800 representative 16S rRNA clones were sequenced. The 16S rRNA partial sequences for each gene library were aligned using ClustalW multiple sequence alignment, and were used for phylogenetic analyses. BLASTn similarity searches were also carried out to compare 16S rRNA sequences to those previously known and available from GenBank. The most highly contaminated groundwater source site, FW113-47 (pH 3.47; 23,409 mg nitrate L^{-1}; 60.36 mg uranium L^{-1}), had limited diversity with diversity increased along the contaminant gradient in the shale pathway with decreasing contaminant levels. Overall, our preliminary results indicate that there is enormous heterogeneity in the microbial communities across the FRC and that their composition is strongly influenced by pH and contaminant (i.e., nitrate, uranium) levels. This work is a small portion of a much larger project to develop a framework that will allow for the comprehensive discovery, visualization and understanding of how microbial population and community structures, geochemical factors, as well as the types and extent of contamination interact, to influence field scale natural attenuation processes.

The Use of Mark-Recapture to Estimate a Population of Cherry-Faced Meadowhawk *(Sympetrum Internum)* at a Vernal Pool on Brookhaven National Laboratory. *DIANNA RODRIGUEZ (Suffolk County Community College, Brentwood, NY 11717) TIM GREEN (Brookhaven National Laboratory, Upton, NY 11973).* Dragonflies are insects of the order Odonata, suborder Anisoptera. Of the 3000 species known world wide, more than 100 species occur in the state of New York and 32 have been identified at Brookhaven National Laboratory. Odonates play a role in maintaining the delicate ecosystem of vernal pools and other bodies of water such as marshes, streams, and wetlands. Tracking and monitoring Odonates can be extremely difficult due to their relatively short lifespan, numerous populations, and extraordinary flight speed. To observe and monitor Odonates, the use of a tracking system is needed to keep accounts of specific species populations. Using a simple form of Mark-Recapture, the Odonates are caught in nets, and marks are drawn on their wings with non water-soluble markers. During a course of ten weeks, the method of Mark-Recapture was employed and perfected, considering there has been no previously documented use of it on Odonates there was a necessity to perfect the method to optimize results. Once perfected the system was used during the final four weeks, concentrating on one species, the Cherry-Faced Meadowhawk (*Sympetrum internum*) at one pond. Using the Mark-Recapture method we have found that the method can be successfully employed on Odonates with positive results. A total of 168 Cherry-faced Meadowhawks were captured with 32 individuals recaptured at least once. Using the program NOREMARK, two population estimates were generated, one estimate using the numbers of captured and recaptured Cherry-faced Meadowhawks, and one that also added a variable to account for emigration and immigration. The program estimated about 300 Cherry-faced Meadowhawks inhabit pond 7, without including emigration and immigration. Including the variable for immigration and emigration, the program estimated the population to be over 500 Cherry-faced Meadowhawks inhabiting pond 7. The method of Mark-Recapture has proven useful in the study of Odonates and may be used for future population estimates of other Odonate species. This research is part of an ongoing project that was started in 2003 to observe the Odonate populations of the Brookhaven National Laboratory and will be continued until an accurate account of species is created. Additionally, three new species of Odonates, not previously documented, were added to the list of those found at Brookhaven National Laboratory.

Thermophoresis and its Thermal Parameters for Aerosol Collection. *ZHUO HUANG (Sacramento State University, Sacramento, CA 95819) MICHAEL APTE (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* The optimal particle collection efficiency of a prototype environmental tobacco smoke (ETS) sampler based on the use of thermophoresis was determined with a particle phase "titration" in a 24 m^3 environmental chamber. This sampler's heating element was made of three sets of thermophoretic (TP) wires of 25 µm in diameter suspended across a channel cut in a printed circuit board. Two collecting surfaces were mounted, one on each side, to form a flow channel of 1 mm high with the TP wires suspended in the middle, 500 µm from each surface. The separation of between the heating element and the room temperature collection surface was determined in a numerical simulation based on Brock-Talbot model. Other thermal parameters of this TP ETS sampler were predicted by the Brock-Talbot model for TP deposition. The theoretical thermal parameters were examined and were used to characterize the TP ETS sampler's collection mechanism. In addition, by heating the wires we determined

their temperature-resistance relationship. From the normalized results the optimal collection ratio was expressed in terms of applied voltage and filter mass. We raised the operational voltage from 1.0 to 3.0 V, and we found that the collection efficiency was increased by a factor of five for both theory and experiment.

Toxicokinetics of PBDE-47 in Fathead Minnows *(Pimephales promelas).* *DANIEL HASKELL (University of California–Santa Barbara, Santa Barbara, CA 93116) IRVIN SCHULTZ (Pacific Northwest National Laboratory, Richland, WA 99352).* Polybrominated diphenyl ethers (PBDEs) are commonly used as flame retardants in many consumer products and reports of their occurrence in fish and humans has steadily increased. In this study, we experimentally measured the uptake, retention and maternal transfer of PBDE-47 in fish. Minnows were orally exposed to PBDE-47 by controlled feedings of brine shrimp (*Artemia sp.*) that previously had been incubated with PBDE-47. Female minnows were given a single oral dose and terminated at selected times to characterize the uptake and tissue distribution of PBDE-47. A separate group of PBDE-47 dosed females were used to study the maternal transfer of PBDE-47 to eggs. The latter experiment paired a dosed female minnow with a control male to induce spawning. My results indicate that PBDE-47 is rapidly and well absorbed from the minnow gastrointestinal tract. Peak blood plasma and carcass levels occurred around 12-24 hrs after dosing although smaller amounts were detected after the first sampling time of 0.5 hr. Measurement of the maternal transfer of PBDE-47 to eggs indicates this is an important elimination route for females, with approximately 11% of the body burden being eliminated in a typical spawn. In contrast, non-spawning females appeared to have a greatly reduced capacity to excrete PBDE-47.

Validity of Observing Fine Root Density Using Minirhizotron Tubes. *JOEY ROBERTS (Middle Tennessee State University, Murfreesboro, TN 37132) DR. RICHARD J NORBY (Oak Ridge National Laboratory, Oak Ridge, TN 37831).* Minirhizotron observation tubes allow nondestructive, in situ, estimates of fine root dynamics in natural ecosystems. All minirhizotron users make a major assumption: that root length measured by the minirhizotron tube is representative of root production at the site. Root production and turnover measurements are important components of C sequestration and are frequently used at many sites, including Oak Ridge National Laboratory's Free-Air CO_2 Enrichment (FACE) facility. This study aimed to answer the question: are there altered root patterns along minirhizotron tubes when compared to root production in the bulk soil? This study took advantage of a unique opportunity to destructively sample unused minirhizotron tubes that have been in place for 9 years at the facility. Fine (=2mm diameter) root biomass density (mg dry weight cm^{-3}) measurements were destructively collected along the minirhizotron tube-soil interface on three tubes and in the adjacent bulk soil. First, intact soil cores were collected by coring straight through the butyrate tube. Correspondingly, soil cores were taken 5 cm away from each tube in the adjacent soil. Sampling was done at a vertical depth of 40 cm. In all, two soil cores were taken per plot for a total of six samples. Soil disks (2 cm by 2.54 cm) were sliced off at the soil-tube interface, and fine-root biomass density was quantified. Results from this study showed that in all three plots, fine root biomass was lower at the tube-soil interface than in the bulk soil. These data suggest that the presence of the minirhizotron tube may be underestimating root density at ORNL FACE.

Vineyard Optimization through Novel Characterization and Cluster Analysis: Applications of Geographic Information Science in Precision Viticulture. *JAMES WOLF (University California–Santa Barbara, Santa Barbara, CA 93106) SUSAN HUBBARD (Lawrence Berkeley National Laboratory, Berkeley, CA 94720).* With viticulture and other agriculture comprising a significant portion of the California economy and water budget, accurate and precise information regarding soil and hydrological characteristics is crucial. With regards to viticulture, the science of growing wine grapes, 90% of the United States' wine is produced within California. Furthermore, California is the nations greatest consumer of developed water, with roughly 80% of that water allocated to agricultural production. This research combines a wide array of data collected from both traditional and novel techniques into a single analysis. Traditional data acquisition techniques explored in this project include surveying of topography for elevation, slope, and aspect analysis, soil pit drilling for analysis of soil texture and chemical composition, and Time Domain Reflectrometry. These traditional techniques offer discrete sampling which necessitates interpolation between sample points. Novel techniques, on the other hand, provide more continuous data collection. Such techniques include Ground Penetrating Radar, electromagnetic measurements, Cone Penetration Testing for soil behavior types, and Normalized Difference Vegetation Index. From these data, properties that are important to the production of wine grapes such as soil moisture and texture can be estimated. To manage the data collected, a Geographic Information System was developed. Then the Hierarchical Ordered Partitioning And Collapsing Hybrid algorithm was applied to look for clusters of similar values, with the ultimate goal of delineating management zones within a single vineyard. In this way, a wine grower can optimize production by precisely planning where higher quality grapes will be most suitable for planting. Also, in order to optimize water resource management, water balance simulations can be performed within the defined management zones to explore the impact of different irrigation strategies.

Wind Energy: Changing the Future One Gust at a Time. *SHARLA BOARDMAN (Brigham Young University, Provo, UT 84606) GARY SEIFERT (Idaho National Laboratory, Idaho Falls, ID 83415).* This project was focused on improving the possibilities of wind power in southeast Idaho. The main objectives were to set up anemometers, calculate wind data, create a kiosk proposal for a local wind farm, and accumulate lesson plans and activities for the Idaho National Lab (INL) wind outreach program. In order to accomplish the objectives the team went into the field to set up an anemometer tower. An anemometer is an electronic device that measures the constant wind speed for one month's time. Over a years time the team would return to the site each month to replace the chip and collect the previous month data from the chip. The data was then recorded into a program called Symphonie Data Retriever which uploaded the information to the INL website. The next step in the project was to take this knowledge about anemometers and correlate it with lessons and activities for elementary and secondary education students. These lessons provided students the basic concepts about wind power and renewable energy. These concepts are found in most state education standards. The Outreach website now houses lesson plans for grades K-12. A college lesson plan curriculum is currently under development. Another focus for this summer included the proposal for the Wolverine Creek Wind Farm. This kiosk includes design plans for a visitors' information center, as well as the information that would be most beneficial to the viewers. The idea for the kiosk was presented without any design or cost constraints. Initially, a brainstorming session was held to determine possible structure layouts for the informational area. Once several plans were formulated, cost analysis as well as feasibility was required to compile and create a professional proposal. The Outreach website provides critical wind energy information to students at all educational levels. Once the students obtain this wind energy education, they are better prepared to make future decisions that affect the environment.

General Sciences

An Analysis of Chlorine Gas Release. *KARA BROWN (University of California–San Diego, La Jolla, CA 92092) GEORGE FULTON (Lawrence Livermore National Laboratory, Livermore, CA 94550).* Chlorine is an extremely reactive and harmful gas that can cause a myriad of health problems within seconds of exposure. This report is an analysis of current chlorine safety regulations in place at Lawrence Livermore National Laboratory for Building 153. It was found that the rapidity at which usable amounts of chlorine gas could be released into the main workspace of the building that the emergency response alarm for a leak needed to remain active. The calculations go through a series of different possibilities including the concentration of chlorine gas with multiple size cylinders, the difference that ventilation makes, and the amount of time it would take the ventilation to get the concentration of chlorine gas down to different airborne exposure standards such as the IDLH, STEL, 8-Hour TLV, or Mean Odor Threshold.

***Arc Flash.** *YEVHEN RUTOVYTSKYY (Three Rivers Community College, Norwich, CT 06360) SWAPNA MUKHERJI (Brookhaven National Laboratory, Upton, NY 11973).* Analyzing BNL electrical distribution system. Determine the incident energy, boundary requirements, and the personal protective equipment necessary tin order to minimize the possibility of electric shock to personal. All the calculations are done by using PTW (Power Tools for Windows) software and based on measured data or information, obtained from the manufactures labels (such as: operating voltage, breaker size, size of the wire etc.) After completing this project we expect to come up with a universal label that will be posted on all electrical equipment that exists at BNL. New label will contain the name of the panel, warning statement "Arc Flash Hazard!!!" and category PPE (Personnel Protective Equipment).

Assessing the Impact of Aerosols on the Radiation Budget in the Sahel Using the Shdompp Radiative Model. *NIMISHA GHOSH ROY (University of Washington, Seattle, WA 98006) TOM*