students in a 9th grade Earth Science classroom where they will utilize an interdisciplinary, guided-inquiry based approach to address an environmental question (i.e. what is the health of the local watershed and what events and actions influence it?). The project is interdisciplinary, integrating environmental science, basic and applied biology (ecology and entomology), chemistry and computer science, and includes a combination of classroom, laboratory and field experiences. In order to extend the project's connection to include undergraduate science education, we field-tested the labs and activities in an introductory biology laboratory for non-science majors. We describe the scope of the activities and discuss the success of utilizing this approach to connect graduate level research to undergraduate and secondary science education. The authors would like to acknowledge the generous financial support of the National Science Foundation (GK-12 Program, award # 0841295).

RESTORATION OF DEGRADED WETLANDS IN AN URBAN SETTING: A COMMUNITY PARTNERSHIP. M. T. Muller[1], M. S. Semcheski[1], T. A. Egerton[1], C. L. Clark[1] & K. DuBois[2], [1]Department of Biology, Old Dominion University, [2]City of Norfolk. Considering the drastic loss of tidal wetlands in the Chesapeake Bay Watershed over the past century, a sense of environmental stewardship has began to percolate. Urban environments provide a distinctive suite of challenges for wetland restoration that requires cooperation from a number of city officials and community leaders. In the City of Norfolk, an aggressive plan to rehabilitate wetlands on city property has begun and consequently provided a unique learning opportunity for students from elementary age through graduate school. Restoration sites within Colley Bay in Norfolk, Virginia which is adjacent to Larchmont Elementary School and Old Dominion University have been identified. Elementary students have been growing the marsh grass, *Spartina alterniflora*, and will assist in the planting, while the ODU Biology Graduate Student Organization have made the technical plans and submitted all necessary permit applications. With funding from the City of Norfolk Wetlands Board and assistance from the Lafayette River Wetlands Partnership, this project promises to have significant positive impacts on the environmental quality and aesthetics of the area.

Environmental Science

ESTABLISHMENT OF A CRITICAL THERMA MAXIMA (CTMAX) FOR THE MAYFLY *ISONYCHIA BICOLOR* (EPHEMEROPTERA). C.A. Sims, B.S. Echols, J. Brunkow, W. Nuckols and D.S. Cherry. Department of Biology, Virginia Tech. A study of Critical Thermal Maxima (CTMax) for the mayfly, *Isonychia bicolor*, began in April 2008 and extended to October 2009. Organisms were collected using d-frame dip nets and hand picking techniques from Sinking Creek, Giles County, Virginia. Mayflies were subject to gradual temperature change and monitored for behavioral physical consequences of the increased thermal stress were observed including sporadic swimming and ecological death, defined as the inability to cling to surfaces. Results were compared with past research in order to address accuracy. In general the results showed that the mayflies were more sensitive to thermal changes. Mayflies are often

used in laboratories as test organisms to assess environmental stressors, however specific conditions have not been established to keep this organism in the best condition for testing. It appears that 34°C is the CTMax for this species.

MODELING FISH SPECIES DIVERSITY IN FORESTED AND URBAN STREAMS: A BASELINE FOR CLIMATE CHANGE. Eugene G. Maurakis (1,2), David V. Grimes (3,1) Suzy Short (1), and Amanda Schutt (4,1). (1) Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 (2) University of Richmond, VA 23173, (3) VA Dept. Environmental Quality, Richmond, VA 23060, (4) Center for Environmental Studies, Virginia Commonwealth University, Richmond, VA 23284. Objectives are to model fish species richness, diversity and evenness in watersheds of Quantico Creek (forested watershed) and Cameron Run (urban watershed) using biological, physio-chemical factors, and land use and human population data per intra-drainage stream order area. To date, 32 species of fishes (11 families) have been collected in 272 collections made from Nov. 2008-May, 2010. Overall, species richness, diversity, and evenness in forested areas are significantly higher than those in urban streams. Stream order, water depth, and month account for the variation in species richness in the forested watershed. In contrast, elevation and stream flow account for the variation in species richness in the highly modified stream beds of the urban watershed. Funded by the U.S. Department of Energy.

STORMWATER MANAGEMENT AND EDUCATION CENTER AT THE SCIENCE MUSEUM. Eugene G. Maurakis (1,2) and Todd Janeski (3), (1) Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 (2) University of Richmond, VA 23173, (3) VA Dept. Conservation and Recreation, 203 Governor, St., Richmond, VA 23219. We are developing a regional environmental site design demonstration, education, and training center. We are retrofitting a highly visible community facility with low impact development stormwater management practices, monitoring their effectiveness, and developing a training/certification program that showcases those measures. These include: bioretention facilities, a Bayscapes garden, tree box filters, porous pavement, rainwater harvesting system, and a green roof. We will evaluate their performance through a quality assured monitoring program. To achieve the scale necessary to demonstrate their applicability, we will conduct a sewershed low impact development retrofit survey of the entire sewer drainage area of Shockhoe Creek (8000 acres, about 2/3 of the City of Richmond CSO system) to the James River. Recognizing the effects of climate change on stormwater planning, we will conduct a 2nd survey utilizing predicted increases in frequency and intensity of storm and drought conditions. And applying a cost benefit analysis, we will demonstrate their benefits in relation to the cost to address damages incurred by uncontrolled stormflows. Funded by the National Fish & Wildlife Foundation.

THE IMPACT OF DEVELOPMENT ON SYMBIOSES FROM THE POTOMAC RIVER VALLEY TO THE CHESAPEAKE BAY. M. Aziz, A. Carpenter, D. Griffith, L. Kinne, and C. Milling, George Mason University. Regional development in the Potomac River Valley (PRV) has placed stressors on local symbioses affecting

ecosystem services. Symbiosis can be defined as "two or more forms of life that interact." Many symbiotic relationships that provide ecosystem services exist in the PRV. These symbioses include plants with pollinators, oysters with submerged aquatic vegetation, and mycorrhizae with plants. Their services include: water filtration and habitat restoration. The last twenty years has shown tremendous growth in population in the Northern Virginia region, with counties growing up to 96 percent. Development as a result of this population expansion has led to increased stressors including habitat degradation and fragmentation, sedimentation, toxic and organic pollutants, and changes to flow regimens. This phenomenon has the potential to fundamentally alter symbioses and the ecosystem services they provide to humans. It is unclear how long the PRV ecosystem can be maintained given the effects of these stressors, but it is unlikely that the resilience is absolute. Society has prospects to help the ecosystem: education and implementation of new policies and technologies could allow the natural symbiotic relationships to continue and recover, ultimately benefiting the PRV.

PRELIMINARY ANALYSIS OF BAY FILTER UNIT SUCCESS IN FREDERICKSBURG, VA. Michael L. Bass and Marion A. Cross, University of Mary Washington, Fredericksburg, VA. Virginia Department of Conservation and Recreation (DCR) evaluates and approves manufactured treatment devices (MTD's) deemed reasonable methods of prevention, control and/or treatment of storm water runoff. MTD's seeking certification for runoff quality control in Virginia will only be approved for total phosphorous (TP) removal at this time, requiring 50% TP removal for influent with TP concentrations ranging from 0.15 mg/L to 0.5 mg/L. Baysaver Technologies, Inc has applied for interim approvals to use the Bay Filter System to meet Virginia requirements for treating stormwater runoff. A monitoring program is intended to demonstrate through field testing that Bay Filter is capable of removing contaminants from stormwater runoff. Results will determine if the filter meets stormwater regulations. The field testing program will collect discrete samples from the influent and effluent of the BayFilter. These samples will be analyzed using standard EPA protocols for total suspended solids (TSS), particle size distribution (PSD), nutrients as well as metal concentrations. Removal efficiencies will be calculated based on this data using standard scientific methods. Precipitation and flow records will be taken during these events as well. The testing program is anticipated to take 12-18 months to complete and will include at least 15 qualifying storm events. BayFilter systems to be monitored will treat the stormwater runoff from Trinity Episcopal Church property in Fredericksburg, VA. Stormwater runoff from the paved area transports dissolved, colloidal, suspended and settleable solids in a heterogeneous mixture, which includes metals, organic compounds and nutrients.

REPORT OF MONITORING FOR SELECT WATER QUALITY PARAMETERS IN THE STORMWATER MANAGEMENT PONDS FOR A COMMERCIAL DEVELOPMENT. Michael L. Bass, Marion A. Cross and Leah N. Sumner. Earth and Environmental Sciences, Univ. of Mary Washington, Fredericksburg, VA. In the 1990's the Silver Company built Central Park in Fredericksburg, Virginia. In the process 6.9 acres of wetlands were destroyed and had to be reconstructed in compliance with

section 404 of the Clean Water Act. Storm water management ponds were built with the wetland benches around them within Central Park and a mitigation site was created along Massaponax Creek in Spotysylvania County. This study monitored the storm water management ponds of Central Park. This background data will be used as preliminary info on nutrient loads in these ponds when the new DCR regulations are in place. Water quality monitoring was conducted on the storm water management ponds and the migrated wetland site. Dissolved oxygen, pH, temp., and conductivity were taken on site. Water samples were taken and tested in the laboratory for nitrates, phosphates, alkalinity and hardness. Testing was done on the same day as the samples were taken. LaMotte test kits were used for each test, and the nitrate and phosphate levels were measured with a colorimeter. The storm water management ponds exhibited normal ranges in chemistry values, with high nutrient levels in the Best Buy, Kohl's and Upper Target ponds still not exceeding EPA maximum dose levels. These ponds also exhibit higher alkalinity and water hardness levels and are constructed with culverts of concrete that is weathering, which could contribute to the elevations. Preparations are being made to monitor rainwater and surface runoff prior to entering the stormwater management ponds.

THE EFFECT OF RAIN GARDENS ON RUN-OFF WATER BACTERIA LEVELS. J. G. Felthousen, E. Wallace & Dr. B. Kreutzer, Department of Biology, Marymount University, Arlington VA 22207. A rain garden is a landscaped depression, designed to improve water quality by absorbing and filtering harmful substances in run-off water. In previous studies, rain gardens removed petroleum and fertilizers from run-off water. This study examined the effect of rain gardens on coliform bacteria found in run-off water. Coliform bacteria are medically important microorganisms often found in contaminated run-off water. During or immediately after rainfall, water samples were collected from two sites, a local rain garden and an adjacent parking lot. Each water sample was immediately transported to the lab and plated on differential media. After incubation, the rain garden and parking lot plates were assessed for coliform and non-coliform colony forming units. According to the results, after the rain garden was flushed with initial spring rains, some coliform bacteria levels dropped. To draw further conclusions, sampling must continue at local rain garden sites throughout the year.

PRELIMINARY ANALYSIS OF BAY FILTER UNIT SUCCESS IN FREDERICKSBURG, VA. Michael L. Bass and Marion A. Cross, University of Mary Washington, Fredericksburg, VA. Virginia Department of Conservation and Recreation (DCR) evaluates and approves manufactured treatment devices (MTD's) deemed reasonable methods of prevention, control and/or treatment of storm water runoff. Virginia's stormwater management programs are implemented under: Virginia Stormwater Management Law and Virginia Stormwater Management Regulations. DCR maintains the authority to regulate BMP methods used in Virginia to control stormwater runoff under the Virginia Technology Assessment Protocol (VTAP). The assessment protocol deals with the MTA's that are designed for, reducing stormwater runoff volume, reducing peak runoff rate and/or and reducing total phosphorous (TP). The goal of the VTAP regarding runoff quality control is to determine how much a specific

MTD can remove total phosphorous (TP). MTD's seeking certification for runoff quality control in Virginia will only be approved for TP removal at this time, requiring 50% TP removal for influent with TP concentrations ranging from 0.15 mg/L to 0.5 mg/L. Additional requirements are 80% removal of TSS for influent with TSS concentrations ranging from 100 mg/L to 200 mg/L and > 80% removal of TSS for influent with concentrations greater than 200 mg/L. Baysaver Technologies, Inc has applied for interim approvals to use the Bay Filter System to meet Virginia requirements for treating stormwater runoff. Flow through the filter system in gravity-driven and self-regulating. The monitoring program is intended to demonstrate through field testing that Bay Filter is capable of removing contaminants from stormwater runoff. The field test will demonstrate the removal efficiencies attained by the system for TSS, TP, Cu, Zn and other pollutants. This will then be used to confirm that the system meets stormwater regulations which require the removal of a minimum 80% of the total suspended sediment load and treatment of nutrients to the maximum extent feasible. The field testing program will collect discrete samples from the influent and effluent of the BayFilter. These samples will be analyzed using standard EPA protocols for total suspended solids (TSS), particle size distribution (PSD), nutrients as well as metal concentrations. Removal efficiencies will be calculated based on this data using standard scientific methods. Precipitation and flow records will be taken during these events as well. The testing program is anticipated to take 12-18 months to complete and will include at least 15 qualifying storm events. BayFilter systems to be monitored will treat the stormwater runoff from Trinity Episcopal Church property in Fredericksburg, VA. Stormwater runoff from the paved area transports dissolved, colloidal, suspended and settleable solids in a heterogeneous mixture, which includes metals, organic compounds and nutrients. These constituents result from atmospheric deposition, traffic activities, vehicular wear, pavement degradation and deicing, landscape maintenance and littering. The nutrient load from the site is expected to vary seasonally.

REPORT OF MONITORING FOR SELECT WATER QUALITY PARAMETERS IN THE STORMWATER MANAGEMENT PONDS FOR A COMMERCIAL DEVELOPMENT. Michael L. Bass, Marion A. Cross and Leah N. Sumner. Earth and Environmental Sciences, University of Mary Washington, Fredericksburg, VA. In the 1990s the Silver Construction Company built Central Park in Fredericksburg, Virginia. In the process 6.9 acres of wetlands were destroyed and had to be reconstructed in compliance with section 404 of the Clean Water Act. In order to meet the requirements, storm water management ponds were built with the wetland benches around them within Central Park and a mitigation site was created along Massaponax Creek in Spotysylvania County. The purpose of this study was to monitor the storm water management ponds of Central Park. This background data will be used as preliminary info on nutrient loads in these ponds when the new DCR regulations are in place. Water quality monitoring was conducted on the storm water management ponds and the migrated wetland site. Dissolved oxygen, pH, temperature and conductivity were taken on site using a YSI model 85 field multimeter. Water samples were taken and brought back to the lab at the University of Mary Washington. The samples were tested for nitrates, phosphates, alkalinity and hardness. Testing was done on the same day as the

samples were taken. LaMotte test kits were used for each test, and the nitrate and phosphate levels were measured with a colorimeter. The storm water management ponds exhibited normal ranges in chemistry values, with high nutrient levels in the Best Buy, Kohl's and Upper Target ponds still not exceeding EPA maximum dose levels. These ponds also exhibit higher alkalinity and water hardness levels and are constructed with culverts of concrete that is weathering, which could contribute to the elevations. Preparations are being made to monitor rainwater and surface runoff prior to entering the stormwater management ponds.

Medical Science

A BIOMARKER PANEL FOR NON-ALCOHOLIC STEATOHEPATITIS (NASH) AND NASH-RELATED FIBROSIS. Zobair M. Younossi[1,2,3], Sandra J. Page[2,3], Nila Rafiq[1,2], Aybike Birerdinc[2,3], Maria Stepanova[1,2], Noreen Hossain[2], Arian Afendy[1,2], Zahra Younoszai[1,2], Zachary Goodman[4] & Ancha Baranova[1,2,3], [1]Center for Liver Diseases, Inova Fairfax Hospital, [2]Betty and Guy Beatty Center for Integrated Research, Inova Health System, Falls Church, VA, [3]Center for the Study of Genomics in Liver Diseases, Molecular and Microbiology Department, George Mason University, Fairfax, VA, [4]Armed Forces Institutes of Pathology, Washington, DC. Non-alcoholic Fatty Liver Disease (NAFLD) is one of the most prevalent forms of chronic liver disease worldwide. Patients with NASH and NASH-related fibrosis, both intermediate stages of NAFLD, are at increased risk for progressive liver disease. Liver biopsy is used to diagnose these stages but has inherent risks; thus, a non-invasive alternative is greatly needed. This study examines the performance of a new, serum-based biomarker panel for NASH and NASH-related fibrosis. Serum from patients with biopsy-proven NAFLD was assayed for markers associated with the pathology of NASH and fibrosis. Regression models predictive of NASH, NASH-related fibrosis and NASH-related advanced fibrosis were then designed and cross-validated. The resulting models had AUC values > 80%, indicating high sensitivity and specificity. Together, these models formed a biomarker panel for NASH and NASH-related fibrosis that had good performance and was easy to use. Further testing on larger populations is warranted.

EXPRESSION OF CYTOKINES AND GASTRIC PEPTIDES IN MORBIDLY OBESE PATIENTS WITH NON-ALCOHOLIC FATTY LIVER DISEASE. Amanda C. Zirzow[1,2], Michael Estep[2], Noreen Hossain[2], Zachary Goodman[2], Hazem Elariny[2], Vikas Chandhoke[1], Ancha Baranova[1,2] & Zobair M. Younossi[2], [1]George Mason University, Fairfax VA 22030 and [2]Betty and Guy Beatty Center for Integrated Research, Inova Health Systems, Falls Church. Non-alcoholic fatty liver disease (NAFLD) describes the spectrum of conditions ranging from simple steatosis, the accumulation of excessive intercellular fat in hepatocytes, to non-alcoholic steatohepatitis (NASH), which is marked by necroinflammation and hepatic fibrosis. Although simple steatosis is relatively benign, 10 to 15 percent of the population will progress to NASH. Currently, the only way to diagnose NASH or to assess the stage of fibrosis is by obtaining a liver biopsy, which is invasive, expensive, and associated with