# EXPOSING HIGH SCHOOL AND UNDERGRADUATE SCHOLARS TO GEOSPATIAL INFORMATION TECHNOLOGIES AND WATER QUALITY MANAGEMENT

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## MISSION

Employers are looking for dedicated scholars with geospatial information technology (GIT) - (Remote Sensing, Geographic Information Systems & Global Positioning Systems) skills and experiences. Thus, high school and undergraduate students that complete internship programs and acquire a knowledge base in the geosciences will have a decided edge over other students competing in the new global job market of the 21st Century. It is important that scholars at a young age are exposed to this robust technology and informed as to how it is used to help manage water quality resources, and how it is used in other disciplines; the list of uses and applications grow daily. The mission of this internship program was to provide students, especially minorities, with a basic knowledge of research methodologies and GIT. Participating scholars gained technical, analytical, academic, scientific, and social skills that will prepare them for more successful collegiate participation, and a promising career in the subject matter area of their choice.

## PROGRAM OVERVIEW

During the summers of 2005 & 2006, 40 high school students, (grades 10-12 - figure 1 & 2) mostly minorities, participated in a two-week internship program. Interns received intensive training on water quality management and GIT. Interns were from high schools in MD, DE, NJ, VA, PA, and Washington, D.C. They were separated into five groups and prepared poster presentations highlighting their experiences during the internship. Experiential learning activities included mapping drainage ditches using GIS and GPS, and testing soil and water samples collected from these ditches for nitrogen, potassium, phosphorus, sulfur, and pH. Additionally, water samples were analyzed for electrical conductivity, salinity, and suspended sediments. Interns also participated in a rainfall demonstration to learn about the effects of rainfall on soil erosion. Interns also classified the different soil strata based on texture and color differences and conducted experiments with mesocosoms. A 2-day Environmental Systems Research Institute (ESRI) workshop was held where interns were introduced to ArcGIS taught by a UMES ESRI Authorized Instructor. This was followed by a 1-day lecture and hands-on training on GPS. All interns were required to keep journals, develop and present scientific posters on their assigned GIS and water quality management projects. A major objective of this internship was to provide high school scholars, especially minorities, with experiences on GIT, and exposure to assessment tools and methods used in water quality management. This internship also provided an excellent forum for recruitment of these scholars to the University.

Photo gallery of student engaged in laboratory and field activities during internship period

## HIGH SCHOOL INTERNSHIP PROJECTS & RESULTS

**Geographic Information Systems:**

Each intern group used the ArcGIS program to map the GPS locations of the soil & water data collected from various drainage ditches. A digital aerial of the UMES campus was used as a base map to locate the different ditches and plot sample points. The information was compiled and made accessible to each group of interns. Students then used ArcGIS to analyze the data by plotting and symbolizing the sample sites based on the values of the soil and water samples entered in the GIS table.

**Phosphorus:**

Most of the phosphorus values collected from soil samples were approximately in the 1 ppm range, which is a moderate P level for most soils. The water sample results showed phosphate levels between 2 ppm and 4 ppm. These are relatively high levels probably caused by the excessive rainfall received in the area the day before samples were taken and resultant runoff from the nearby farm fields which have high P levels due to long term poultry litter amendments.

**Soil Erosion:**

Interns learned that soil erosion is a naturally occurring process, caused by both water and wind, and a process which is generally overlooked. Effects of soil erosion include the loss of top soil, reduced crop production potential, reduced surface water quality, and stream/drainage ditch sedimentation. The intern groups measured the extent of soil erosion in five ditches. Soil erosion was tested in two ways:1) suspended sediment in water and 2) collected sediment in drainage ditch bottoms. On average, ditches with lowest flow were found to have the deepest sediment deposits and the least amount of water-suspended sediment.

**Nitrate-Nitrogen:**

Nitrate levels in water were lower than levels in soil, a likely result of the dilution induced by a storm the day before. Water nitrate concentrations were much higher in the deepest ditches in our study, the ones most likely to contain ground water. Nitrogen is present in ground water because of its solubility and leaching capability, which would explain the high nitrogen levels in the deeper ditches. More shallow ditches likely carry water from overland flow or shallow groundwater, water with limited soil contact relative to that in deep ditches, and hence reduced opportunity to pick up nitrogen. Increased nitrogen could guide to nutrient loading in the Chesapeake Bay and cause algal blooms. This could in turn reduce the amount of sunlight and oxygen available for fish and wildlife. From the results of this study, it does not appear that these ditches are contributing high nitrate levels to nearby streams.

**Acid/Sulfur:**

Sulfides were found in the deepest ditches. The increased depth of ditches causes them to be wetter ditches; environments where sulfur in its reduced state (sulfides) may persist. Sulfur may enter the ditches from below (a soil horizon of high sulfidic content has been observed below the UMES farm) or from runoff from nearby chicken houses.

pH measurements indicated that the acidity of soil and water samples in the ditches located at the UMES farm varied considerably. All ditches were acidic, with the highest level at 6.5 recorded at the shallow ditches, and the lowest pH levels (4.5) was recorded at the deeper ditches.

**Mesocosom Experiments:**

Students were exposed to how scientists use mesocosoms in research. Five Mesocosoms were constructed using soil profiles from the UMES farm ditches. Five groups of four students were assigned to a mesocosom that was treated with different substances (bleach, hydrogen peroxide, plain tap water, etc). These units were allowed to incubate for 24 hours; leachate was collected and analyzed for (P, nitrate, EC, pH). The results were tabulated and used to develop a poster and slide show based on the data collected.

Figure– 1. 2005 high school internship class

Figure – 2. 2006 high school internship class

## GIT UNDERGRADUATE INTERNSHIP PROGRAM

Twelve undergraduate students participated in a ten-week GIT Internship summer program during summers 2005 & 2006 (see figures 3 & 4). These students interned with local Maryland (MD) agencies, and at UMES-NOAA submerged aquatic vegetation (SAV) project. The internship commenced with an intensive two-day workshop; Introduction to ArcGIS. This was followed by a lecture and hands - on training on GPS. Some of the task performed by interns included; updating and correcting Somerset County, MD zones with the use of tax and road maps, editing and modifying flood maps for Somerset County, MD, creating data sets using ArcView to identify the length and pavement types of Somerset county, MD roads, determining pavement types, measuring lengths of county roads, and transferring these data into ArcView, updating hand drawn maps of the Somerset County Fire District to create updated digital district maps, creating a digital file of the UMES Farm which can be used in future planning and management, used GIS & GPS to locate areas were eelgrass (*Zostera Marina*) grew in the Chesapeake Bay and surrounding Coastal Bays, and where to collect seed stock for SAV seedling growth using greenhouse technologies, collecting wrack (washed up eelgrass that had been moved by wind and tide) and sediment from Assateague Island and The Isle of Wright, and separating and maintaining eelgrass seeds for germination experiments. These internships concluded with a poster presentation where student interns show-cased what they accomplished and learned.

Figure-3. 2005 undergraduate summer interns and GIS coordinator Tracie Earl

Figure– 4. 2006 undergraduate interns, faculty advisors and support staff

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