UNDERGRADUATE RESEARCH DAY

Research Week 2012

North Carolina Agricultural & Technical State University
Fort Interdisciplinary Research Center

Monday, April 16, 2012
SCHEDULE OF EVENTS

Posters from the College of Arts and Sciences .................................................. 9 a.m.

Posters from the School of Agriculture and Environmental Sciences ............... 10 a.m.

Posters from the College of Engineering ............................................................ 11 a.m.

Pizza lunch ............................................................................................................. 12:15 p.m.

Guest Speaker: Dr. Shirley Hymon-Parker, Associate Dean for Research,
School of Agriculture and Environmental Sciences

Posters from the School of Education and School of Technology ..................... 1:30 p.m.
Lunch speaker:

Dr. Shirley Hymon-Parker

*Associate Dean for Research, School of Agriculture and Environmental Sciences*

Dr. Shirley Hymon-Parker joined the A&T faculty in 2009 as associate dean for research in the School of Agriculture and Environmental Sciences. She previously spent 26 years rising through the ranks of academia at the University of Maryland Eastern Shore, where she served as professor, chair of the Department of Human Ecology, and associate research director.

In her present role, Dr. Hymon-Parker coordinates the activities of more than 50 researchers involved in projects dealing with current issues in the agricultural sciences. These include food safety, childhood obesity, sustainable energy, climate change, and human and community development. Today, the School of Agriculture and Environmental Sciences leads the university in research funding, bringing in over $20 million in 2010 – 2011.

Since coming to A&T, Dr. Hymon-Parker created the first Undergraduate Research Scholars Program in the School of Agriculture and Environmental Sciences at A&T, which is now in its third year.

A recognized leader in the field of family and consumer sciences, she has served as chair or co-chair of 25 professional committees and organizations and in many other leadership capacities for other professional and civic organizations. She received the American Association of Family and Consumer Sciences Distinguished Service Award in 2010, the organization’s highest distinction, and was recently elected to serve on its Board of Director for 2012-2015.

Her research interests include employment and industry trends in fashion retail, rural entrepreneurship, and, most recently, childhood obesity.

Hymon-Parker is a native of Warrenton, North Carolina. She received her Ph.D. in education policy planning and administration from the University of Maryland, her master’s in apparel design from Cornell University, and her bachelor’s from North Carolina Central University in Durham.
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Evaluating Common Open Source Software/ Free Software (OSS/FS) Tools

Jeffrey Anu, Rajeev Agrawal
Department of Electronics, Computer and Information Technology

Open Source Software / Free Software (OSS/FS) tools are programs written with the source codes accessible by users, can be modified by the users and easily redistributed without any legal repercussion. Open source software and its related works have long existed since the inception of computers. The goal of this research work is to evaluate the growing number of OSS/FS available on the market and how it can benefit educational institutions and outside users as a whole. During this research, we will be categorizing the various OSS/FS into its primary use, operating system that can support it, the frequency at which it is updated and available users of them. The second phase of the research will involve installing the programs on work stations to experience their use and stability. Exposing students to OSS/FS tools will broaden their knowledge base and also use the students as agents in spreading about their existence.

Turning Raw Data into a Useful Tool for Supporting Efficient Operations at North Carolina’s Largest Food Bank

Kyle Bailey, Melanie Payton, Lauren Davis
Department of Industrial and Systems Engineering

The food bank of Raleigh, North Carolina, is the state’s largest distributor of food for those at risk of hunger. Currently there is no tool that can be used to determine trends in donations and distributions. This information is important because it allows operations managers to predict where food will be most needed as well as identify the suppliers of the donated goods. The purpose of this research is to develop an information system that dissects historical transaction data to reveal any trends as well as indicate area where major changes may have occurred. The information identifies key statistics such as the types of donated goods, the most frequently received goods, and the percentage of food distributed per county. By assessing these trends, the food bank can be better prepared to support its area in a most effective manner.
Education for the Future: Learning IE Skills through Interactive Port Security Simulation Models

Alex Beauboeuf, Evan Tyler, Lauren Davis, Xiuli Qu
Department of Industrial and Systems Engineering

The maritime system is a vital part of the economy and our way of life. Disruptions in the system can be very costly and the role of the Department of Homeland Security to help prevent these from happening cannot be overlooked. The main objective of our work is to evaluate the effectiveness of an interactive simulation model of the maritime system created using AnyLogic software. We aim to spark student interest in this area while developing Industrial Engineering skills. Principles that will be taught include data analysis, queuing models, and the use of AnyLogic software based on information from the Port of Wilmington and the Port of Morehead City.

Case studies are a major tool used to teach data analysis and queuing models. They are a great method of teaching because they give students a real life example of when the skills necessary to complete it would be utilized. One case study on data analysis that describes port operations and asks students to use data about the type, origin, and amount of cargo to compute various probabilities has already been completed. The study also includes an excel data sheet from the Port of Wilmington that students will use to execute excel functions in order to further understand the data.

Also to assist in the classroom, the task of becoming familiar with AnyLogic and putting together a guide on how it is used has been implemented. So far, there has been success in learning and presenting how to create an animation both in 2-D and 3-D. To teach students how to do this, a step-by-step PowerPoint presentation explaining the process has been created. To expand on this presentation, a user guide on the many tools of AnyLogic and how they apply to Industrial Engineering is currently in progress.

The use of these tools together will surely help lead to a promising and more secure future.
Where Are the Healthy Dairy and Grains Options Found in Guilford County?

Jasmine Brodie, Kofi Adu-Nyako, Ralph Okafor  
Department of Agribusiness, Applied Economics and Agriscience Education

Obesity is on the rise in the US. North Carolina ranks tenth in adult obesity at 29.4%, and 11th for childhood obesity at 18.6 percent. The 2010 Dietary Guidelines recommend diets rich in fruits and vegetables, low fats and high in the whole grains. Constrained availability and high prices of healthy foods options is contributing to obesity through poor dietary intake.

The objective of this research project was to assess the availability, and affordability of dairy and grains in Guilford County.

We compared the availabilities and prices of food items obtained from a market basket survey for three store types—supermarkets, grocery, and convenience stores and by area income. Availability was scored as one, if food item was present in the store. The percentage of dairy and grains available in each surveyed store were calculated for the three store and income categories. To measure affordability, the lowest prices of the food items were recorded and converted to per ounce basis. ANOVA, with t-test at the 90% significance level, was used to analyze differences in food items availability and prices.

Dairy products availabilities were significantly twice higher in supermarkets than in the smaller type stores. Similarly, breads overall availability was highest for supermarkets compared to less than half of the supermarket level for grocery and convenience stores. The healthier whole wheat bread was less easily available in all store types. Dairy products were more affordable in supermarkets, followed by grocery stores and convenience stores respectively. Whole wheat bread prices tended to be higher in convenience stores, and relatively lower in supermarkets and grocery stores. Low fat 1% milk availability was about equal in all areas, lagging slightly in low income areas but surprisingly, more affordable. There were no significant differences in availabilities of dairy and grains according to area income levels.
An Overview of the 2011 Late April Tornado Outbreak

Delonte Duff, Yuh-Lang Lin
Department of Physics

An overview of the April 27-28, 2011 tornado outbreak was conducted to show the environmental conditions that led to a super cell thunderstorm which produced abundant tornado genesis in southeastern United States. Analysis looked at all available observational data, including surface observations, satellites, soundings, and radar imagery. RUC (Rapid Update Cycle) model output was also used to take a look at the climate conditions that spawned this significant tornado outbreak. The Late April tornado outbreak occurred while a mesoscale convective system produced from a cold front passing the southeast (the highest threat area). The climate study, conducted using RUC analysis, exposed many environmental conditions favorable to tornado genesis; such as high CAPE, a strong jet stream, a warm humid inflow from the Gulf and the Atlantic, and strong lifting associated with the cold front that was moving through the area; these conditions appear to be consistent with a conceptual model proposed by the AccuWeather forecast team and with the weather charts produced from the NWS (National Weather Service) Raleigh center.

Development of a Protein Based System for the Detection of Organophosphates Using the pH Dependence of Enhanced Green Fluorescent Protein

Jasmine Fluker, Jared Harris, Libby G. Puckett
Department of Chemistry

This project is designed to address a need for the detection of a general classification of organic molecules that can be found in pesticides and chemical warfare agents, namely organophosphates. Organophosphates (OP) are harmful neurotoxins that inhibit mammalian acetylcholinesterase, an enzyme that hydrolyzes acetylcholine, thereby affecting neuromuscular transmission. Even low-level exposure to these compounds can be detrimental to the environment and to human and animal health; therefore, their use is regulated by the EPA. It is estimated that organophosphates account for 38% of all of the insecticides used globally. This fact, along with the threat of chemical warfare agents, makes the detection of a wide range of
organophosphates necessary. Organophosphorus hydrolase (OPH), produced by the *Pseudomonas diminuta*, essentially detoxified the organophosphates and allowed the bacteria to survive. OPH has a broad specificity for organophosphates, thus making it a very popular enzyme for remediation of organophosphates that are found in pesticides and chemical warfare agents.

**Analysis and Development of Energy Saving Techniques in United States Schools**

**Dante’ Freeland, LaRoy DuBois, Brittinie Williams, Nabil Nassif**  
Department of Civil, Architectural, and Environmental Engineering

There is a huge demand to save energy related costs in buildings. In this project, schools in the United States were analyzed in order to develop energy saving techniques that will be sufficient in saving energy and money. We went about examining ways to cut down on energy consumption by first running an existing school building through a department of energy software. Through the use of this software we were able to obtain a baseline cost for each month in the year and compare it to the actual energy bill from the school. By matching up these numbers, our information was validated by the baseline costs from the software matching up with the actual costs. After obtaining this baseline, we then chose to analyze two different mechanical systems within the building in which we could adjust to save energy costs. We took a close look at the relationship between using a VAV system versus using a heat pump system. We also examined how placing or removing the variable speed drive can also make a difference in energy consumption. These approaches will allow us to understand the relationship between the different system components and energy savings.
Use Eye Tracking to Test Usability of a Prototype Interface for Fluid Powered Rescue Robots

Ênio Frota, Paula França, Steven Jiang
Department of Industrial and Systems Engineering

Usability testing of a human machine interface involves measuring the ease of use, efficiency, comfort and learnability of its end-user. One approach that is instrumental in assessing usability is eye tracking. Eye tracking is a process that is used to understand the cognitive behavior of the end-user and to make informed decisions based on the results. In this study, eye tracking is used to evaluate the usability of a prototype interface designed for fluid powered rescue robots. Ten participants performed several tasks using the prototype interface. A Tobii T60 eye tracking device was used to analyze the participants’ behavior by tracking and measuring their eye fixations and eye movements. Results from the study will be used to identify opportunities to improve usability and to develop an efficient and user-friendly interface for fluid powered rescue robots.

Digital Humanities and Biltmore House: The A&T Biltmore Project’s Research and Photo-Reconstructions

Alicia Funderburk, Justin Jones, Christopher Martin, Caden Wright, Janet Seiz
Department of Visual and Performing Arts

Digital Humanities, a newly emerging field of research in the Humanities, has sought to meld advanced imaging technologies to the study of lost or difficult to view historical works of art. A & T’s Biltmore Project began in the Fall of 2010 with five Art honors students in Prof. Seiz’s Art 459 Baroque and Rococo Art class that decided to move from the classroom into the community for a research focus. Since that time, the original group plus additional members have been involved in documenting and researching the ceiling painting in the library at Biltmore House in Asheville, where over 20 feet in the air resides the largest 18th century Venetian painting in the United States. In order to better understand the context and meaning of this 64’ x 32’ masterpiece of Baroque illusionistic painting, a research archive of over 500 photographs has been compiled during three site visits.
The results of this project are the first complete photographic panorama of the entire multi-panel canvas as it exists today created and assembled from our photo archive. This enables a new and improved way of looking at this difficult to study work of art. The Biltmore Project Photo group also created two important historical photo reconstructions of lost aspects of the original work. One is a photo-reconstruction of the painting as originally situated in 1720 in the ballroom of the Pisani Palace in Venice, and the second is a photo-reconstruction of the missing side panel reconstructed from an archival photograph.

Our research was presented at the March 2012 Conference of the North Carolina Museum Council in Asheville, N.C.

In Search of Media Richness and Social Support Functions on the Home Pages of University Websites: A Content Analysis

Adrian Gray, Kim Smith, Arthea B. Perry
Department of Journalism and Mass Communication

Studentadvisor.com compiled a top-100 list in 2011 of colleges and universities it deemed were best at using social media to recruit high school students for college. See the list at http://www.studentadvisor.com/top-100-social-media-colleges

The authors used the list to examine the home pages of these universities to learn how such pages are used in the high-stakes recruiting game. We found that the majority of home pages--the 24-hour virtual university gateway--failed to adequately apply the principle of media richness, which is defined as the more media content resembles face-to-face communication the more people are more likely to engage with it. Content also failed to adequately fulfill the social support functions--the informational, emotional, esteem, tangible and social network needs--of young people. The authors argue that media-rich content that also meets the social support functions (needs) of high school students would make the home pages more appealing, resulting in increased campus visits and enrollment.
Healthy Food Access in Guilford County, North Carolina

Nicolase Ray Harris, Kofi Adu-Nyako, Ralph Okafor
Department of Agribusiness, Applied Economics & Agriscience Education

North Carolina is the tenth most obese state in the US (Trust for America’s, 2010). The adult obesity rate is 29.4 percent. Furthermore, N.C ranks 11th for childhood obesity with 18.6 percent children obese. Lack of access- healthy food availability and affordability in neighborhood food environment - is contributing to obesity through poor dietary intake, including inadequate fruit and vegetable (FV) consumption.

The objective of this research was to assess the availability, and affordability of fruits and vegetables in Guilford County.

Data on availability and prices of food items from the market basket survey were used to conduct a comparison of food availability and prices in the three store types-supermarkets, grocery, and convenience stores and by area income. Availability was scored as one, if food item was present in the store and as zero if item was not available in the store. The percentage of fruits and vegetables available in each surveyed store were calculated as well for the three different store types. To measure affordability, the lowest prices of the food items on the day of survey were recorded and prices were converted to per ounce basis. ANOVA with t-test at the 90% significance level was used to analyze differences in food items availability and prices.

Overall fruits and vegetables and other food items surveyed were significantly more available at supermarkets and grocery stores than at convenience stores in Guilford County. In addition, food items were higher priced when available at convenience stores than at supermarkets and grocery stores on average. Our study also demonstrated that low income area neighborhoods in the county are at the most risk of consuming an unhealthy diet, due to the lack of availability of fruits and vegetables in stores accessible to them.
Hydraulic Excavator Ergonomics: Enhancing Work Visibility Using a Video Display Monitor

Lashawn Nevins, Eui Park
Department of Industrial and Systems Engineering

Awkward postures represent one of the major ergonomic risk factors that cause work-related musculoskeletal disorders among hydraulic excavator operators. Awkward postures subject operators to discomforts in areas such as the neck, shoulders and back. Examples include: a back discomfort due to the inherent nature of the job, especially when the operator has to bend over to see the ground they’re digging; a shoulder discomfort due to the locations of the controls; and a neck issue because the operator has to maintain eye contact with the work which is located at or below ground level. This work presents the design, analysis and results obtained from an ergonomic study - using the digital human modeling tool, Jack® - to investigate the effect of using a video display monitor in the cab to improve work visibility and reduce physical workload due to awkward postures to the head, neck, shoulders and lower back.

Quantum Well Energy Level using Optel_Zinc Blende

Nguyen Ngoc, Shanthi Iyer
Department of Electrical and Computer Engineering

The purpose of this abstract is to use the Optel_ZB software to calculate the energy levels in nano semiconductor heterostructures consisting of quantum wells (QW), superlattices to provide a guideline to the experimentalist growing the materials in a lab which takes a long period of time. Using the Optel_ZB software, we can specify the materials, the composition, and thickness of the materials to obtain the energy levels for the conduction and valence band for that particular material. With this software, we can also change the parameters of the global input file, for example, we can change the band structure model from 1 band Kronig-Penny to all the way up to a very complex 8 band model. In our research, we have tested the software for GaAs/AlAs QW to calculate the energy level and plot it for the QW using Gnuplot graphing program utility for Windows. With this, we instantly know how the changing in the composition and thickness of the materials affect the energy levels. We are still in the initial stage of testing out the software and this may facilitate the
Pathematics: Capturing and Nurturing the Mathematical Imaginations of Learners before the Critical Transition to Middle and Secondary School

Destenie Nock, Brittany McLean, Elizabeth Barber
Department of Electrical and Computer Engineering, Department of Family & Consumer Sciences

Our research documents the outcomes of Pathematics, an innovative method for engaging children in concrete problem-solving using a 9’ x 70’ Runway, for capturing the mathematical imaginations of learners before the critical transition to middle school and Secondary School. It represents the perspectives of an elementary school principal who advocated for its use at her school, and in an afterschool tutoring program which she helped design; its inventor, an aeronautics engineer who recognized weaknesses in school-based mathematics instruction; and faculty and student leaders of an afterschool tutoring program in which Pathematics has been employed for several years.

Pathematics in Practice: The development and current uses in schools will be explained along with its impact on learners. Representatives of an afterschool tutorial for will explain how it functioned within their program and explain efforts to capture learner outcomes.

STEM careers are out of reach for learners who don’t survive their academic careers, but re-tracking learner careers in school is possible if interventions come earlier. The experiences of those involved with Pathematics indicate that it holds potential to capture and nurture the mathematical imaginations of children in grades 3-5, who may not have had success with mathematics before. Re-tracking these learners for success with mathematics before the critical transition to middle school can provide them with greater access to Pre-Algebra, subsequent college prep courses, and opportunities to pursue STEM careers. Globally the same issues abide: learners in developing countries such as Malawi may be taught by teachers with little preparation, through the lecture method only in classes of 100 or more per teacher.
For these learners, Pathematics holds equal promise to even the playing field in terms of mathematical knowledge development.

A Sustainable Waste Management Solution for Scrap Tire and Swine Manure

Daniel Oldham, Ellie Fini
Department of Civil Engineering

In the U.S. annually 3.9 million tons of scrap tires are produced from which 1.36 million tons are recycled and 2.54 million tons are burned or land filled. It should be noted that land filled scrap tires can create a public health problem as a mosquito breeding area while burning them releases significant amount of greenhouse gases. In addition, more than 335 million tons of manure is produced annually in the U.S.; 40.2 million tons of this are swine manure. Swine manure is disposed of by storing it in lagoons. This process has several, significantly negative environmental impacts, particularly with respect to surface water and groundwater quality and to air quality as affected by odors and gaseous emissions from large-scale swine production operations. Therefore, the result of this paper contributes to nation’s movement toward sustainability by offering a simultaneous sustainable solution to manage both swine manure and scrap tires to help with environmental sustainability while producing added value products to help with economic prosperity.

African American Student Leaders Becoming Political through Service Learning

Bethany S. Penn, Brittany McClean, Blayre Penn, Liz Barber, Tom Smith
School of Education

This research documents how cadres of African American student leaders have learned to teach, to lead, and to navigate university and community micro-politics through engagement over time in a service learning tutoring program for learners from low income communities. This research documents the outcomes of our participation in the SMART PATH Service Learning for Social Justice Tutoring and Enrichment Program. Along with outcomes in terms of children’s learning, we
examine how we, as a cadre of African American student leaders, have learned to tutor, teach, lead and navigate university and community micro-politics, through engagement at multiple levels over time in a service learning tutorial for learners from low income communities. Using case study methods (McCall & Wittner, 1990) we draw on data collected across five years of the program’s existence. Layered evidence forms “thick description” (Geertz, 1973) of the shaping of attitudes, actions and knowledge bases. Ethnographic research techniques including field notes (Hammersley & Atkinson, 1983), pre/post surveys, interviews (Briggs, 1986) and “power sensitive conversations” (Bhavnani, 1993), photography and video. Program artifacts and forms of institutional documentation provide further data for qualitative analysis (Corbin & Strauss, 1990). Measures of tutee learning include a math mock test available online, the Elementary Spelling Inventory (Bear et al., 2007), running records (Fountas & Pinnell, 2000), the Writing Developmental Continuum (Raison & Rivalland, 1994), “Books I’ve Read” lists in child portfolios, reading and writing surveys, and term-end program evaluation surveys. Achievement data from the children’s schools include state test scores, school-based benchmark scores, and report card grades. Analysis draws on constructivist/interpretivist (Guba & Lincoln, 2005), critical theory (Giroux, 1982), and participatory (Guba & Lincoln, 2005) perspectives, with particular focus on implications for educating teachers whose practice holds promise for closing the achievement gap.

**Heuristics to Determine If a Set of Wang Tiles Will Tile a Plane**

**Kevin Perkins,** Zachary Barnett, **Kenneth A. Williams**

Department of Computer Science

Wang tiles are unit squares with colored edges. Restricting tiles to translational placement and like colored edge groupings, the Tiling Problem asks whether various set combinations of these tiles will tile an infinite plane. The Tiling Problem has been shown to be an undecidable problem, meaning that there exists no algorithm to always answer the problem. While you cannot always solve the Tiling Problem, this research has identified heuristics that can determine if over 99% of possible set combinations are able to tile or not tile an infinite plane. These heuristics are used to filter out uninteresting tile sets revealing sets that are possibly capable of aperiodically tiling an infinite plane. We intend to extend our filtering algorithms to detect more of the uninteresting sets in polynomial time. We also will be improving the efficiency of the algorithms in handling large combinatorial sets.
The Anomalies of the Atlantic Basin SST over a period of 154 years (1856-2010)

Justin Riley, Yuh-Lang Lin
Department of Physics

Using the Kaplan Extended SST (Sea Surface Temperature) V2, the yearly summer months (June, July, August, September) anomalies of the North and South Atlantic basin SST through a period of 155 years (1856-2010) were compared to find trends during positive and negative years. Three yearly SST anomalies were found from three different regions; the entire Atlantic basin (Lon = -40 to Lon = 50, Lat = -90 to Lat = 20), the northern Atlantic basin (Lon = -90 to Lon = 20, Lat = 10 to Lat = 50), and the southern (Lon = -40 to Lon =20, Lat = -40 to Lat = 10). From these three yearly anomalies, three charts were constructed to represent the three different region of the Atlantic basin. The results show that there was rarely any positive SST anomalies until the year of 1928 in the southern Atlantic basin or the entire Atlantic basin (except for the year of 1878), based on the averages taken between the years of 1856-2010. In addition, the results show that the southern Atlantic basin SST was gradually increasing more from 1956 to 2010 than the northern Atlantic basin SST. Also the northern Atlantic basin SST anomalies plot was similar to the ENSO index data. More data and research is needed to compare the findings from the anomalies collected to other reliable data sources. Further investigation will include comparing the number and intensity of hurricanes through the same time period to the yearly SST anomalies data that has been collected.

An Excel GUI for the CO-Mediated Sickle Cell Polymer Melting Model

Taylor Rosemond, Liping Liu
Department of Mathematics

Sickle cell anemia is a blood disorder caused by a mutation in DNA that replaces the nucleic acid glutamine with valine. This replacement causes a change in the characteristics of hemoglobin that allows the monomers, the simplest units of chemically binding molecules, to stick together. These chains of monomers, called polymers, distort the shape and properties of the red blood cell. The malformed cells
do not efficiently pass through capillaries or transport oxygen to the body’s tissues. In order to make these cells more effective, the polymers must be broken apart. The process of breaking polymers apart is called melting. In this study, the melting was induced by immersing the polymers in a buffer solution containing carbon monoxide (CO). The mathematical model of this process is a system of ordinary differential equations. The purpose of this research is to study the effect of the CO amount on the sickle cell polymer melting and to explore various numerical methods/schemes on the sickle cell model to produce reliable numerical solutions. The investigated numerical methods include the traditional standard schemes: the forward Euler, the backward Euler, the second order Runge-Kutta, and the fourth order Runge-Kutta; and two non-standard finite difference schemes. A GUI (graphical user interface) has been developed in Excel to summarize the investigation on the CO effects and the numerical analysis on the CO mediated sickle cell model.

The Wireless Network Interaction System

Aric Slaughter, Michael Curd, Parris Moore, Shani Collins, Christopher Doss
Department of Electrical and Computer Engineering

The Wireless Network Interaction System is being created to allow the elderly to live comfortably within their own homes and give family members the ability to monitor their elderly relatives without someone physically being with them at all times. The system is being implemented using Passive Infrared Sensors to monitor motion, Ultrasonic Distance Sensors to monitor when a room has been entered or exited and actuators to control household appliances such as the oven or lights. The sensors will communicate with a web-based user interface, setup through an X-bee Internet Gateway, via X-bee radios. Each sensor is connected to an Arduino microprocessor, so that they may be easily programmed. The sensors and their respective Arduino boards are also wired to their own X-bee radio circuit. These radios allow for communication of each sensor to a separate X-bee radio circuit called the base station. Upon receiving the signals from the sensor circuits, the base station sends the gathered information to the X-bee Internet Gateway to be displayed on the user interface. The key features of this product all revolve around accuracy, user friendliness, and ease of access. This is to ensure that the system brings peace of mind to families everywhere.
The Role of ZO-1 Phosphorylation During Collective Cell Migration

Eboni Stafford, Laurel Rodgers, Alan S. Fanning
Department of Biology

Collective cell migration is an important biological process required for efficient epithelial wound healing. During wound healing, epithelial cells must maintain contacts with each other as well as regulate dynamic adhesions with the surface matrix. Zonula occluden-1 (ZO-1) is a multi-domain scaffolding protein that plays a role in tight junction assembly and regulation, and it has also been shown to interact with α5-integrin during cell migration in cancer cells. Integrins are transmembrane proteins that attach a cell to the surrounding matrix. ZO-1 must be phosphorylated at the S168 position in order to bind to α5-integrin. Based on previous studies within our lab, we know that ZO-1 or the close homolog ZO-2 is required for normal collective cell migration of Madin-Darby canine kidney (MDCK) cells. We hypothesized that phosphorylation of ZO-1 at amino acid S168 in MDCK cells is required for normal collective cell migration. To address this hypothesis we generated a ZO-1 S168A mutant construct which cannot be phosphorylated and transfected it into MDCK cells lacking endogenous ZO-1 and ZO-2. Wound healing of wild-type MDCK cells, Z2Z1 double knockdown cells, and cells expressing our mutated construct S168A was compared using a standard scratch wound healing assay. We assessed tight junction and cytoskeletal organization using fluorescence microscopy. Quantitative analysis of cell movements was performed to obtain speed and displacement of cells over time. We found that the morphology of mutant constructs was not significantly altered. The time required for wound healing in our mutant construct was not negatively impacted, suggesting that phosphorylation of ZO-1 S168 is not required for normal collective cell migration of MDCK cells.
Adiponectin Improves Peripheral Insulin Signaling in Female Mice

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Adiponectin is a cytokine secreted by adipose tissue that plays a role in glucose and lipid metabolism. Studies have indicated that low levels of circulating adiponectin are associated with obesity, insulin resistance, and cardiovascular disease. The objective of this study was to define the effect of adiponectin on pathways that regulate glucose and lipid metabolism.

We hypothesized that male and female transgenic mice (Adiponectin-Tg) that overexpress adiponectin will be protected from insulin resistance resulting from high fat feeding. Wild-type (WT) and adiponectin-Tg mice were placed on either a high fat diet or a low fat diet for eight weeks. Food consumption and body weight were monitored for six months. Serum insulin levels were determined by an insulin enzyme-linked immunosorbent assay (ELISA). Liver and adipose tissue levels for Akt were assayed using Western blot analysis.

Mice on a high fat diet consumed more food compared to the low fat diet mice for both genotypes (both WT and adiponectin-Tg). Although, food consumption for WT and adiponectin-Tg mice on a high fat diet was comparable, the WT mice stored more fat. Additionally, female adiponectin-Tg mice maintained low insulin levels despite being on a high fat diet and obese. Compared to WT mice, the levels of Akt were significantly higher in all adiponectin-Tg female mice, suggesting amplified insulin signaling in adipose tissue. Male mice had significantly higher levels of insulin for both diet types. Adiponectin-Tg female mice had lower levels of Akt in the liver compared to their WT counterparts, suggesting that peripheral effects are dominant in female mice.

These studies suggest that there is more efficient redistribution of adipose tissue from the liver in female mice. Adiponectin may contribute to the protective metabolic effects existing in females by promoting subcutaneous storage of fat, and may thus enhance peripheral insulin signaling in female mice.
Specific Detection of Disease-Related MicroRNA Biomarkers

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MicroRNAs (miRNAs) are small non-coding RNAs that regulate gene expression by either degrading or suppressing the activity of target messenger RNA (mRNA). They have been acknowledged as important regulatory factors for pathogenesis, thus the detection of disease-related miRNA biomarkers has become a unique approach to disease diagnosis. Due to the small size of miRNA, there is a great deal of similarities in sequences between different microRNAs. To achieve higher specificity and accuracy on the detection of miRNA biomarkers, we have recently developed a new assay named Capture Template-dependent Extension (CTE).

In the CTE assay, specific microRNA was first hybridized with a complementary DNA probe. To ensure the correct microRNA biomarker was captured, the captured microRNA was then extended by using the DNA probe as a template and the enzymatic activity of DNA polymerase to incorporate a dideoxynucleotide to the 3' end of microRNA. In order to achieve the highest accuracy, the extended microRNA was directly measured by using mass spectrometry. The developed CTE method has been successfully applied to the analysis of specific human microRNAs (hsa-miR-153 and hsa-miR-183) that are clinically associated with brain cancer.

One of the focuses in our current research work is to simplify the protocol for carrying the CTE assay. Specifically, the enzymatic activity of different polymerases and an alternative method for preparing the microRNA samples prior to the mass spectrometric measurements are being evaluated.

Empowering Global Literacy: Focusing on Ecological Factors Impacting Literacy in Malawi and Haiti

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In Domasi, Malawi, and Anse-A-Veua, Haiti, children struggle to stay in school. Issues including hunger, lack of safe drinking water, and the need for instruction in a language they can understand, keep children from attending and learning in school.
Our participatory action research (Cochran-Smith & Lytle, 2009) addresses factors that keep children from school success in Malawi and Haiti.

In Malawi, we support teacher development of skills in Literacy in the Mother Tongue through sharing techniques such as word study, language experience approach, translating commercial big books into local languages, creating original multi-lingual big books. As in other parts of Sub-Saharan Africa, in Malawi staying in school saves lives. One child in ten, ages birth through fourteen years old, tests positive for HIV/AIDS, with staying in school this forms the only correlate of remaining disease free.

In Haiti, we explore solutions to restoring clean drinking water for schoolchildren. There, 45% of the population lives without clean drinking water. This lack of a safe water supply directly affects literacy and student learning because not only do learners lack water to drink, but this lack also prohibits schools from providing quality feeding programs, which we have learned would aid in keeping students in school. With clean drinking water available at the school site, far more children and youth can attend school.

We measure our success by:

- Conducting end of project focus group interviews with in-country participants. (Both)
- Teachers/school personnel emailing or writing four times a year to provide follow ups and needs. (Both)
- Measuring the increase in clean and drinkable water. (Haiti)
- Obtaining attendance records from school personnel. (Haiti)
- Observing teachers’ use of LMT strategies introduced. (Malawi)
- Monitoring resulting grade 8 scores and rates of students allowed to attend secondary school. (Malawi)
Air Cooled vs. Water Cooled Chillers within the 7 ASHRAE Climate Zones

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For our research we chose to compare air cooled vs. water cooled chillers within the various regions of the United States. We wanted to see which type of chillers would be the most economical within the climate region. We started by using a 10,000 square foot building and changed the cooling system and pump types within Equest to fit Climate Zones 1-7 of ASHRAE. From this study we found that air cooled chillers were the best possible chillers for any of the seven regions. This is due to the size of the system. Buildings larger than 100 square feet tend to use water cooled chillers because of the size and also the amount of individuals within a commercial building.

Transcriptional Activity of DNA Variants with Total Cholesterol, HDL-C, and LDL-C

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High levels of low-density lipoprotein cholesterol (LDL-C) and total cholesterol, and low levels of high-density lipoprotein cholesterol (HDL-C) are major risk factors for cardiovascular disease. Cholesterol levels are affected by some variants in DNA, including single nucleotide polymorphisms (SNPs). Some SNPs affect the regulation of gene transcriptions. Recently, SNPs at new genomic regions have been identified to be associated with cholesterol levels. Our goal is to identify the underlying functional SNP(s) that affect transcriptional activity of a nearby gene leading to an increase or decrease in cholesterol levels. We predict that cholesterol level associated SNPs can affect transcriptional activity in hepatocytes and that the two alleles at these SNPs can have different effects on transcriptional activity. For this project, we tested three cholesterol-associated SNPs chosen primarily based on SNP association with cholesterol level and SNP location within hepatocyte open chromatin, suggesting that the SNPs may affect promoter or enhancer activity. Approximately 200 base pairs of sequence surrounding each SNP was sub-cloned into a pGL4.10
vector for promoter SNPs or a pGL4.23 vector for the enhancer SNP. HepG2 cells were transfected with the vectors and a dual-luciferase assay was performed to measure the amount of light output corresponding to each allele. SNP rs7943121, located in a predicted promoter at the SPTYD1 gene, showed evidence of strong transcriptional activity yet no allelic expression difference. SNP rs116910, located at the FAM117B gene also in a predicted promoter, showed transcriptional evidence of a promoter with a possible allelic expression difference. SNP rs737337, located at the DOCK6 gene in a predicted enhancer, and tested in both the forward and reverse orientations, showed evidence of enhanced transcriptional activity with possible allelic differences in the forward orientation and no allelic differences in the reverse orientation. In conclusion all three cholesterol-associated SNPs affect transcriptional activity in HepG2 cells, and SNPs rs11692610 and rs737337 (in the forward orientation) showed the greatest potential for expression differences between alleles; these results need to be confirmed. We have possibly identified variants that affect transcriptional activity and may influence inter-individual variation in cholesterol levels.

Energy Consumption Analysis of West Wilkes Middle School

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The Architectural Engineering Department HVAC Research team was presented with a problem from West Wilkes Middle School HVAC, in which HVAC system inconsistencies were identified between two identical schools. Both schools are in the same city; however one of the schools is located on the eastern side while the other is located on the west side. Both schools have the exact same usage, floor plan, schematic, HVAC systems, and population. However the energy consumption between the different locations is very significant. The HVAC research team will analyze and compare the causes for such a significant difference in energy consumption. The focus of this team will be on establishing a baseline for usage at the West Middle School, then begin changing and compiling alternatives to reduce the consumption of the school as well. The first step is to collect as much specific data about the school from is basic location, cardinal orientation, all the way to system and building components. Step 2 is inputting the collected data into eQuest and to generate a baseline energy consumption report. From this report the team will begin step 3; determine the factors causing the inconsistencies in the HVAC
systems. Step 4 will be to run multiple simulations, changing the heat pump source. Step 5 will analyze the differences in the air, water loop and the ground heat pump sources. Finally step 6 will compile plausible solutions and conclude that the ground heat pump works better at the specific western middle school. The ground heat pump is the most efficient source for this HVAC system because it reduces the power consumption, which ultimately reduces the cost. These solution proposals addressing the major efficiency differences in the identical schools with identical systems and energy saving corrections will be compiled in graphical format for presentation.