HS-STEM Career Development Program

Homeland Security - Science, Technology, Engineering and Mathematics (HS-STEM) Career Development Program

This program is designed to support undergraduate and graduate students in developing the skills to become preeminent scientists in the homeland security scientific and technical community. This United States Department of Homeland Security funded program offers career development scholarships and fellowships, as well as forgivable loans with summer research and one year service commitments.

2008 Recipients

Tyshia Gwin - Biological Sciences

Advisor: Dr. David Sanders

Research Description: Tyshia, an undergraduate student, is working with the E3 glycoprotein of the Venezuelan Equine Encephalitis Virus (VEE), which is transmitted through a mosquito vector. Although there have been extensive studies on the virus, there is no approved vaccine or treatment. There has been much concern of VEE use as an incapacitating bioterrorism agent. The E3 protein, when it is associated with the E1 and E2 proteins, which are responsible for entry of VEE into cells, acts as a natural inhibitor of viral penetration into cells. Solving the structure of the E3 glycoprotein and determining its mechanism of action could potentially lead to synthesis of inhibitory molecules that could combat the virus if an outbreak occurred.

Rachel Suzanne Beard - Virology

Advisor: Dr. Erik Barton
**Research Description:** Gammaherpesviruses (γHV) cause various types of cancer in immunocompromised individuals. Due to the species specificity of human γHV, studying the human diseases caused by these viruses is difficult. Murine gammaherpesvirus 68 (MHV68) provides a working animal model to study these viruses in each stage of the viral life cycle. Her research focuses on elucidation of a Type I Interferon (IFNαβ) function during latency of γHV's using the MHV68 system. This information can be used to provide new methods of treatment for these viruses and ideally bring about the prevention of the cancers caused by these viruses.

**Nwokedi C. Idika - Computer Science**

Advisor: Dr. Bharat Bhargava

**Research Description:** The focus of Nwokedi’s research is to demonstrate the usefulness of the attack graph for dynamic network environments. An attack graph shows a network administrator all the known ways an attacker may leverage interdependencies among vulnerabilities to violate some set of security policies.

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**Kyle Montgomery - Electrical Engineering**

Advisor: Dr. Jerry Woodall

**Research Description:** In an effort to aid the rapid response and mitigation of power loss in disaster-stricken regions, a high efficiency solar cell would be of use for providing sufficient power from a small-area device. The primary method for increasing efficiencies in solar cells is through a multijunction cell. In this design, several semiconducting materials are stacked together—each one responding to unique portions of the solar spectrum. A key to boosting the efficiency of the multijunction cell is the integration of a high band gap solar cell in the 2.3 - 2.5eV region, which targets high energy photons and would be the top-most cell in the stack. Kyle’s research is focused on the design, growth, and fabrication of a new high band gap solar cell utilizing zinc selenide and gallium arsenide.

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**Daniel Richardson - Mechanical Engineering**
Advisor: Dr. Robert Lucht
Research Description: Lasers can be used to detect specific chemicals and track concentration levels. Daniel is focusing on a technique called Coherent Anti-Stokes Raman Spectroscopy (CARS) using ultra-short (femtosecond) pulses of light. This technique could be used for explosive, chemical, and biological threat detection.

2007 Recipients

During the fall of 2007, five graduate students were awarded scholarships. These students worked with academic advisors and career mentors to focus their research and career opportunities. With the goal of informing high school students about HS-STEM opportunities in college and beyond, these scholarship recipients partnered with local high schools to visit science, math and technology classes to speak about their college research areas and career aspirations.

David Blunck – Mechanical Engineering

“I have the opportunity to have a sustained focus on a research topic with important implications for aircraft security as a recipient of a Department of Homeland Security Scholarship. Doors have been opened that will allow me to continue to research areas important to the missions of the Department of Homeland Security even after I graduate.” - David Blunck, September 2008

Advisor: Dr. Jay Gore
Research Description: David is studying the effect of nozzle geometry on the decay of the infrared signature of the exhaust from a gas turbine. It is hoped that advanced nozzle geometries will make it more difficult for terrorists to use heat seeking missiles to lock onto and destroy commercial aircraft. Currently, he has measured the radiation from an axisymmetric (circular) nozzle and is preparing to measure the radiation from another nozzle shape.

Karla Ann Combs – Biological Sciences
“Being a part of the HS-STEM Career Development Program has been an extraordinary experience. This program has allowed me to interact with professionals within homeland security and further my knowledge of all the possibilities a career within homeland security can bring.” - Karla Combs, September 2008

Advisor: Dr. Richard Kuhn
Research Description: Flaviviruses, single-stranded RNA viruses, such as yellow fever, Dengue and West Nile, are endemic throughout the world. Currently, effective therapeutics against these viruses are unavailable. One potential anti-viral target is the helicase, which resides in non-structural protein 3. Karla has been investigating the function of helicase helix 10 in the virus life cycle. From her research, this helix seems to have a function early in viral RNA replication and assembly of the infectious virus particle.

Laura Hughes-Baker – Biological Sciences

“The HS-STEM fellowship brings together scientists from many different disciplines giving me a much broader pool of knowledge that I can use when I need help solving problems. It has provided me with a network of scientists that I can utilize, making my research better. Additionally, once I graduate, I will already have a network in place to help me find the perfect job for me.” - Laura Hughes, September 2008

Advisor: Dr. David Sanders
Research Description: Laura’s research centers on the creation of an antibody against the Ebola virus glycoprotein receptor binding domain that could be used for potential therapeutic purposes, rapid infection identification, vaccine design, and to aid in crystallographic studies. Additionally, she is working on the identification of a cell line that is non-permissive to Ebola virus entry. This cell line will be used to test potential receptors. This will aid in designing therapeutic agents for treatment and elucidating the steps of virus entry.

Samuel Liles – Technology
"As a researcher and PhD student investigating the issues of cyber warfare and cyber terrorism, the community of colleagues within PHSI have supported and helped me immensely. As a working professional, the experience and opportunities afforded by PHSI have assisted me in bringing instant relevancy to my studies in the real world." - Sam Liles, September 2008

**Advisor:** Dr. Mark Rogers

**Research Description:** Samuel researches cyber warfare as a form of low intensity conflict.

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**Ross Maciejewski – Electrical/Computer Engineering**

"The HS-STEM Career Development Program provided me with the opportunity to work on a wide range of projects. Under the guidance of my HS-STEM mentor, I was able to further my research on disease outbreak monitoring and control and work on related applications in homeland security." - Ross Maciejewski, September 2008

**Advisor:** Dr. David Ebert

**Research Description:** Ross’ current research focuses on applying visual analytics to aid in the analysis of real time decision making. This includes aiding epidemiologists and first responders while improving economic decision making. His work has focused on using coordinated animal-human health monitoring to provide an early warning system with fewer false alarms for naturally occurring disease outbreaks, biological attacks, and chemical attacks. In order to better understand these data sets, models and measurements at different resolutions must be analyzed. To facilitate these investigations, he has created an application to provide a visual analytics framework for analyzing both human emergency room data and veterinary hospital data. This integrated visual analytic tool links temporally varying geospatial visualization of animal and human health information with advanced statistical analysis of multi-source data. Various statistical analysis techniques have been applied in conjunction with a spatio-temporal viewing window. Users of this system can view health data and trends across space and time in both human and pet populations. One goal is to analyze the benefits of using veterinary data to enhance syndromic surveillance predictions. This work has been in partnership with the Indiana State Department of Health and the Georgia State Department of Health. Details of his research and related publications can be found on his website [here](http://www.purdue.edu/dp/phsi/index.php/learning/fellowships).

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Shawn McKay – Mechanical Engineering

“The HS-STEM opportunity is unlike other DOD and NHS fellowships. It provides an active link into the DHS community through outreach programs, conferences, and interaction with other students in the program.” - Shawn McKay, September 2008

Advisor: Dr. Doug Adams
Research Description: Many DHS problem domains can be considered system-of-systems, collection of interacting distributed, heterogeneous, independent, physical, and non-physical elements. Shawn’s research is focusing on how decision makers can anticipate and manage undesirable consequences in system-of-systems.

Bryan Sims – Nuclear Engineering

“The HS-STEM program has been terrific for networking within the homeland security field. Between organizing trips to meet leading scientists and engineers, providing information on DHS related coursework, and working with student organizations to provide additional learning resources to Purdue students the HS-STEM program has been a major contribution to the young professional I am today.”- Bryan Sims, September 2008

Advisor: Dr. Chan Choi
Research Description:
2007 HS-STEM Grant Recipients

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