SUNY STEM Research Passport Program - 2015

Application Deadline: March 20, 2015
Term Period: (approximately) May 2015 – August 2015

BACKGROUND:
Today's global economy has increased the need for workers with STEM skills. Technological innovation improves the competitive position of U.S. industries, drives export growth, and supports high-quality jobs. Additionally, as a result of the diffusion of technology across industries and occupations, the demand for STEM-capable workers has increased even in traditionally non-STEM fields.

The President's Council of Advisors on Science and Technology (PCAST) asserts that the U.S. is putting its future at risk by forfeiting its historical strengths in STEM education. In their seminal report Engage to Excel: Producing 1 million additional college graduates with degrees in science, technology, engineering, and mathematics, PCAST challenges U.S. colleges and universities to prepare one million more STEM college graduates over the next decade. To meet the goal of an additional 1 million STEM college graduates in the next decade, the U.S. would need to graduate an additional 100,000 per year – a 33% increase over current rates.

SUNY has the unique ability to make a positive impact on this national goal. As the largest integrated university in the U.S., its 64 campuses provide access to almost every field of academic or professional study educating nearly 460,000 students in more than 7,200 degree programs. During the past two decades, undergraduate research experience has emerged as a best practice in STEM undergraduate education.

PROGRAM FOCUS:
The SUNY STEM Research Passport Program will provide undergraduate students from across the SUNY system with ten week research opportunities during the summer of 2015. Students are placed in STEM research positions in which they will perform research under the guidance of a SUNY faculty mentor and will receive a $3,500 stipend. Preference will be given to freshmen and sophomore students who are interested in exploring a career in the STEM fields.

Student participants are required to complete program surveys and submit a final report. They may be invited to present or speak about their experience at various events.

PARTICIPANTS RECEIVE:
- Stipend: $3,500

APPLICATION REQUIREMENTS:

- Applicants must be presently enrolled in a SUNY institution and have completed at least two semesters of college. Preference will be given to freshmen and sophomore students who are interested in exploring a career in the STEM fields.
- Underrepresented minority students are encouraged to apply.
- A brief personal statement in which the student discusses the reasons he/she wishes to participate in the program
- A copy of the student's undergraduate transcripts
- A confidential letter of recommendation from a professor or other professional (sent directly from the recommender) that discusses the student's potential for a research career
- Ranking of top four faculty mentored research experiences from opportunities listed on the following pages

TIMELINE

Completed applications and supporting documents must be submitted by March 20, 2015.

Applicants will be notified of the status of their acceptance by April 6, 2015.

TO APPLY:

Please go to the following link to apply for the 2014-2015 SUNY STEM Passport Program:
https://www.grantinterface.com/rfsuny/Common/LogOn.aspx

You will be prompted to create an account, for which your first name, last name, email address, and mailing address will be requested. Once you've created your account, you may click on the 'Apply' link under the 'Requests' tab on the left-hand side of the screen. To access the SUNY 4E Summer Scholars Program application, enter the code "STEM15" into the access code box.

*FOR ADDITIONAL LOGIN INFORMATION: Please see the tutorial on page 32-33.

RESEARCH EXPERIENCES

Descriptions and locations of the opportunities that are available in 2015 program are listed on pages 3-32. Applicants are required to select their top four choices in the online application. Placements of applicants will be based upon the applicant's background and expressed interest, in addition to availability at 2015 sites.

QUESTIONS

For further information, please contact Angela Wright at Angela.wright@rfsuny.org or (518) 434-7061.

RESEARCH EXPERIENCES:

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Separation and Purification of RNA

Biomedical projects need a high level of reproducibility when preparing samples for analysis in order to formulate accurate conclusions from biological samples. Development of high throughput methods is part of the scope of project. We will develop a sample preparation work flow that will involve RNA production by cell culturing, RNA extraction from cells and RNA enzymatic hydrolysis. The final hydrolyzed product will be prepared as a series of dilutions for calibration purposes.

The method would be first developed with RNA standards. Once a robust protocol is established we will transfer the method to be high throughput by using liquid handlers. Ultimately the goal is to develop a workflow to prepare RNA samples in 96 or 384 well plates that will be directly taken for analysis by using chromatography and mass spectrometry.
Student tasks:
- Learn how to work with RNA
- Make dilution series of DNA and RNA standards
- Characterization of DNA and RNA using liquid chromatography and UV detection
- Grow cells
- Extract RNA from cells

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Project 1: Biophysical Analysis of RNA and RNA Interactions with Single Molecule and Bulk Approaches # 1

My lab is working on several collaborations that involve understanding the kinetics and thermodynamics of RNA binding. There are a variety of analytical tools that can help understand the binding properties including thermal melting techniques and Isothermal Titration Calorimetry. We are currently applying these approaches to study the interaction of RNA with graphene, as well as to understand the binding of a ribozyme with its target RNA.

Interested students would learn how to use some analytical tools to study RNA and RNA interactions. A strong math background will be helpful in doing the data analysis.

Project 2: Biophysical Analysis of RNA and RNA Interactions with Single Molecule and Bulk Approaches # 2

One major focus of my lab is understanding molecular interactions at the single molecule level. We have pioneered a new instrument for single-molecule manipulation called the Centrifuge Force Microscope. This instrument applies

force to thousands of individual biomolecules or pairs of biomolecules, enabling investigation of mechanical structural probing for a single molecule, or force-dependent interaction kinetics for bound molecules. We are applying this technique to study the structure-function relationship in RNA, in which RNA can form complex structures based on sequence and in some cases interact with other molecules based on its structure.

Interested students will gain hands on experience in preparing, performing, and analyzing these experiments. Students with a strong math/physics background are especially encouraged to apply.

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Developing Privacy-preserving Technologies for Cyber-Physical Systems (2 Positions Open)

The Center for Forensics, Analytics, Complexity, Energy, Transportation and Security (FACETS) in the University at Albany actively conducts quality research on security, privacy, digital forensics and data analytics in a wide variety of contexts such as smart grid, intelligent transportation systems, social network, and supply chain management (operations research). In summer 2015, Dr. Yuan Hong and his students will work on tackling the privacy concerns in cyber-physical systems, (1) smart grid infrastructure, and (2) connected vehicles in the transportation systems. The team at the FACETS center will develop two categories of novel privacy-preserving technologies in each of these two areas. Specifically, first, novel optimization problems will be formulated and solved to securely implement the corresponding real-world applications or services with limited information disclosure – maximizing the utility of the application while allowing negligible amount of privacy leakage. Complexity analysis for the optimization problems will be given along with a practical and efficient solver. Second, cryptographic primitives will be composed to build a provable secure communication protocol for implementing the applications or services, where formal security analysis will be given to prove limited information disclosure. Experiments on analyzing real data collected in smart grid infrastructure and intelligent transportation systems will be conducted to evaluate the performance (efficiency, scalability, resilience, etc.) of the proposed new technologies. This project in FACETS center exactly covers all aspects of Science, Technology, Engineering and Math (STEM) and could accommodate great opportunities for undergraduate students to initialize their research potential and career in STEM fields.

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Studying the Use of Mobile App to Prevent Pressure Ulcer

According to the Agency for Healthcare Research and Quality more than 2.5 million people each year suffer with bed sore and it costs $9.1 – $11.6 billion in the USA. Bed sores also called pressure ulcer can develop in anyone with reduced mobility, such as being confined to a bed or chair. It is an injury to the skin that occurs when a patient lies or sits too long in the same position. Pressure keeps blood from getting to the tissue, causing cells to dies, and open sore forms.

Patients who are unable to get out of bed or spend most of the day in a wheelchair are at high risk of getting a pressure ulcer. People who cannot move certain parts of their bodies are also at risk for example a person who has difficulty moving his/her leg after a stroke. Older people are at high risk because their skin is thin and fragile.

We can reduce the risk by regular changes of position, good hygiene and skin care, a healthy diet and by intervening before it developed. The evidence based risk assessment tool Braden Scale is used to assess the risk of pressure

ulcer. The Computer Science Department has already established a collaboration with "Patient Data Science LLC". Patient Data Science has launched a "Pressure Ulcer Guide"-an android App. It is available in the Google play store for consumers URL: https://play.google.com/store/apps/details?id=com.PatientDataScience.pressureulcer&hl=en

The student will conduct an innovative qualitative study to investigate the use of the mobile app among the senior people. The student will closely help the senior people living in senior homes to download app at their mobiles and also help them to use the app to self assess the risk of pressure ulcer to them. They will collect and record the direct observations and collect the related data from the App, analyze it and publish the results in a local conference proceedings.

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Aphid-Like Biosensors for Ecosystem Studies: NANAPHID Proof of Concept

This proposal builds on a 2014 SUNY 4E award of the same title. The underlying concept derives from the need to measure flows and concentrations of sugars inside trees, in order to determine where the products of photosynthesis are being delivered. We can measure flows using sensitive pressure monitors, similar to monitoring blood pressure, but scientists are as yet unable to monitor sugars in live trees. The NANAPHID probes we are testing need to be very small and also need to be designed to keep the plants from shutting off sap flows (a natural wound response). In collaboration with biosensor experts at SUNY Polytechnic, we are testing new devices based on nano-engineering technology and modeled after aphids, which are insects able to feed on tree sap for long periods, by chemically bypassing the wound response.

We are seeking one first- or second-year undergraduate to join us in our collaborative research this summer. The work will take place on the UAlbany campus and at our primary field study site, a biological research station in southwest Albany County. Student tasks and activities will include assistance with installing and maintaining field monitoring devices, mapping and measuring forest stands, and conducting experiments designed to study effects of lengthening growing seasons on forest ecology. Student applicants should have completed a full year of General Biology and General Chemistry, should have an interest in environmental science, and must be willing to work in rugged terrain under variable field conditions.

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Suppression of Cancer Drug-Resistance

The goal of the proposed research is to engineer and employ magnetic nanoparticle (MNP)-based theranostic materials for imaging and silencing of micro RNA-21, which is over-expressed in chemo-resistant breast tumor cells. MNPs are a well known drug delivery platform capable of penetrating cellular membrane. They can also be utilized as MRI contrast agents and fluorescent reporters when modified with chromophores. Chemo-resistance can be suppressed by silencing micro RNA-21 using complementary oligonucleotide strands, such as Locked-Nucleic-Acids (LNA), that form stable double stranded structures with the former thereby blocking its downstream pathological pathways. LNA strands exhibit superior affinity to complementary oligonucleotides than the native DNA or RNA and have improved duplex stability by dramatically increasing duplex melting temperatures. Ultimately the project will produce an image-guided therapeutic system capable of releasing the LNA payload in a controlled manner. This will be achieved by incorporating a releasable trigger which will be activated in vivo using bio-orthogonal chemistry when

the diagnostic component signals adequate accumulation of the MNPs in the site of interest. The project will encompass synthesis of the MNPs loaded with LNA through a bio-orthogonally releasable linker, testing of the bio-orthogonal LNA release in vitro and in live breast cancer cell line, MCF-7.

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A Xenon Bubble Chamber for Direct Dark Matter Detection

One very fundamental cosmic mystery, cutting across multiple disciplines, is the observation the majority of matter in our Universe is not in the form of stars, gas, or dust. The nature of this "dark matter" can be probed in Earth-based experiments. If it is a particle it can (rarely) scatter off nuclei, and this interaction can be used as the primary signature for detection. Xenon-based detectors lead this worldwide quest for directly detecting dark matter particles, and are continually improving their sensitivity. My lab's interests revolve around two such detectors, LUX and LZ, as well a model called NEST that simulates their response, and R&D toward a new, next-generation detection technology. My focus here is on this last point.

With no discovery of dark matter at high masses, and hints of low-mass signals, low thresholds are becoming increasingly important. With a hypothetically tunable threshold based on pressure and temperature, a bubble chamber could be the ideal detector to search for light-mass dark matter. It works by superheating a fluid, akin to raising the temperature of water above 100 °C in the microwave without it boiling. A superheated fluid is in unstable equilibrium, making it a sensitive detector of incoming particles. This technology has its own drawbacks, but by combining it with that of LUX/LZ the strengths of both approaches are merged. I propose to have 1 student working on simulating the behavior of a xenon bubble chamber and assisting with prototype construction, plus data analysis.

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Project 1: Video-tracking software development

Research in my lab focuses on the basic mechanisms through which the brain allows us to perform our daily activities, learn, and become better executers and thinkers. We accomplish this task by using a diverse toolbox, which combines single-cell electrophysiology, molecular biology, optogenetics and computer modeling. Recently, we have become intrigued by a specific neuronal circuit in the brain, which controls our ability to perform stereotyped actions. For a human, a stereotyped action could be washing our teeth in the morning, walking to school, etc. It may not seem like much, but neuropsychiatric disorders like autism and obsessive compulsive disorder occur when this circuit becomes dysfunctional. Our lab has recently established a mouse model to study this neuronal circuit. But how can we tell whether these mice can or cannot execute stereotyped actions? A stereotyped activity in a mouse's daily routine is leaking their fur and walking to eat their food. We have acquired videos to track these activities and started developing software for video tracking analysis. In this project, we would like to bring new impetus to the development of this software. The project is best suited for candidates with a background/interest in computer science. We provide an invaluable opportunity to join a multidisciplinary, enthusiastic environment in which people with different skills, background and culture work together with the common goal of deepening our knowledge of brain function.

Project 2: The Electrical Properties of Dopaminergic Neurons

Research in my lab focuses on the basic mechanisms through which the brain allows us to perform our daily activities, learn, and become better executers and thinkers. We accomplish this task by using a diverse toolbox, which combines single-cell electrophysiology, molecular biology, optogenetics and computer modeling. Recently, we have become intrigued by a specific neuronal circuit in the brain, which controls our ability to perform stereotyped actions. A major relay station in this circuit is a nucleus in the basal ganglia called the striatum. The striatum is composed of two major cell types with opposing roles on movement initiation. What we would like to know is how these cells establish their function in the developing brain. To do this, we perform patch-clamp electrophysiological recordings from dopaminergic neurons in the striatum in acute brain slices from mice at different stages of development. This project is ideal for people with an interest in electrophysiology and computer-intensive data analysis. Previous knowledge of basic concepts of electricity is ideal, but not a requirement. This research experience will provide an invaluable opportunity to join a multidisciplinary, enthusiastic environment in which people with different skills, background and culture work together with the common goal of deepening our knowledge of brain function.

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Project 1: Modeling and Simulation Studies of RNA # 1

The Advanced Computational Center at the RNA Institute is interested in molecular modeling and simulations of RNA molecules for 3D structure prediction of RNA and to obtain a molecular understanding of RNA structure-function relationship, especially in RNA-RNA, and RNA-protein interactions. Specifically, one of the projects the lab is involved is in understanding structural rearrangements of RNA in response to perturbations, such as binding of small molecules, ligands or proteins. This project is carried out in collaboration with Dr. Fabris' lab, who perform Ion Mobility Spectroscopy – Mass Spectroscopy (IMS-MS) of RNA molecules in the presence and absence of RNA binding molecules. IMS-MS experiments are capable of revealing the presence of dynamic structures (unlike crystallography) and structural changes based on their mobility values captured through their time of fights through a drift cell. To obtain a molecular understanding of these structural changes, we are performing molecular simulations of RNA molecules (in bound and unbound state), and determining mobility of the predicted structures using in-silico approaches. Specifically, we are working on modeling RNA in presence of intercalating molecules (ethidium, berberine), and metals ligands (Na+, Mg2+). Successful reproduction of mobility values would lead to predictions of 3D structures of RNA molecules with atomistic details and their rearrangements in response to binding events. A molecular understanding of structural rearrangements is important in a variety of biological processes, such as viral replication (HIV), and hence is critical for developing therapeutics that target specific RNA molecules.

Project 2: Modeling and Simulation Studies of RNA # 2

The Advanced Computational Center at the RNA Institute is interested in molecular modeling and simulations of RNA molecules for 3D structure prediction and to obtain a molecular understanding of RNA structure-function relationship, especially in RNA-RNA, and RNA-protein interactions. Specifically, one of the projects the lab is involved is in the development of accurate molecular models for post-transcriptional RNA modifications. RNA modifications play an important in gene regulation and replication, yet are not well understood. Therefore, we are developing molecular models for modifications that quantitatively capture their experimentally observed, such as base-pairing, base-stacking, hydrophobicity induced binding and association. This project is currently being carried out in collaboration with scientists in the Advanced Instrumentation Facility of the RNA institute, including Dr. Halvorsen and Dr. Basanta-Sanchez, who obtain the necessary experimental data for our approach. Dr. Basanta-Sanchez extracts and purifies RNA modifications in isolation and in stem-loop constructs using High Performance Liquid Chromatography – Mass

Spectrometry (HPLC-MS), and Dr. Halvorsen quantifies the stability of the RNA and its binding to hydrophobic surfaces, such as graphene, using UV-melting and Isothermal Titration Calorimetry (ITC), respectively. The molecular force-field parameters will be tuned to accurately reproduce the experimental observables. We are currently performing molecular simulations that enable determination of base-stacking propensities of modified nucleobases, and their partition co-efficient in an oil-water biphasic system. Developing accurate molecular models for RNA modifications will lead to prediction of 3D structures of RNA molecules that are post-transcriptionally modified, and to obtain a molecular understanding of their role in gene regulations and translation.

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Fabrication of a Triboelectric Energy Harvester

Wearable body sensors for vital body signs (such as heart rate) monitoring are now growing in numbers due to capability in very low power consumption. The limitation for the widespread use of these devices is their limited battery life. In MEMS and energy harvesting laboratory at Binghamton University, we investigate ways for self-powering these biomedical sensors by harvesting electricity from mechanical deformation. One approach is to use triboelectric generators that generate electricity from friction of two polymer surfaces. The two polymer surfaces are sandwiched between two conducting surfaces that generate an alternative current when the inner two polymer surfaces periodically contact each other. The concept of electricity generation is similar to generating electricity from rubbing a balloon on your hair, that is, electrostatic charges generate between the plastic balloon surface and your hair surface. The generation of the charge produced on the surfaces can be increased by increasing the polymer surface roughness. Therefore, we generate micro pyramid, cubic or line patterns on the two polymer surfaces to increase the surface area, that consequently enhances the total voltage and power produced. To fabricate these devices, Nanofabrication Laboratory at Binghamton University has all the facilities such as a photolithography machine, Reactive Ion Etching (RIE) machines, sputter evaporators, spin coaters, and electron beam evaporators. The undergraduate student supported by the SUNY STEM Research Passport Program will get trained to fabricate the layers of the triboelectric generators using microfabrication facilities at Binghamton University. Time permitting; some initial testing of the generator for performance evaluation will be conducted.

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Bioprinting Personalized Islets (2 positions open)

Creation of highly organized multicellular constructs, including tissues and organoids, will revolutionize tissue engineering and regenerative medicine. These lab-produced high order tissues and organs can be used for therapy or as disease models for pathophysiological study and drug screening. This project is designed to explore the feasibility of generating biologically functional islets from hiPSC (human induced pluripotent stem cells) multicellular assemblies that include instructive cells such as endothelial cells through 3D bioprinting. It is hypothesized that patient-specific pancreatic islets can be customly generated by differentiating hiPSCs within 3D printed multicellular

assemblies. It is proposed to generate personalized islets by patterning hiPSCs with endothelial cells, which provide instructive signals critical for hiPSC pancreatic differentiation and maturation, within 3D scaffolds. The goal is to generate personalized islets by printing patient-specific hiPSCs into 3D scaffolds patterned with endothelial cell-embedded vascular conduits. This project represents a new paradigm in tissue engineering and regenerative medicine, where an additive manufacturing technique is adopted for assembling a multicellular complex, leading to more strict spatiotemporal control in hiPSC pancreatic differentiation and maturation. This project will offer training opportunities for undergraduate students and help them gain knowledge on 1) the pancreas morphogenesis, 2) timing of phenotype transition of hiPSCs and hiPSC-derived endocrine cells, 3) relative subsets of various progenitor cells and their committed cells in the whole cell population, 4) signals that stimulate the differentiation of hiPSCs into pancreatic islet cells, and 5) the role of endothelial cells in promoting the differentiation and maturation of hiPSCs into pancreatic cells.

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LGN Purification Optimization

The protein LGN, named for its repeats of the amino acids leucine (L), glycine (G) and asparagine (N), plays a crucial role in cell division in mammals. Specifically, LGN is responsible for determining polarity, aligning the mitotic spindles, and guiding other proteins within the cell. Recently, LGN was found to be highly expressed in various breast cancer samples, making it a promising target for breast cancer treatment. The long-term goal is to express, purify and crystallize LGN to obtain a three-dimensional structure. Upon solving the structure of LGN, a deeper understanding of how LGN interacts with other proteins during cell division can be obtained. Additionally, drugs or other molecules can potentially be developed for the treatment of certain types of cancer. Through research conducted thus far at The College of Brockport, LGN has successfully been expressed bacterial E. coli cells and have purified to obtain ~60% pure protein using various chromatographic columns. The goal for the summer is to achieve ~95% purity so that LGN can be crystallized. The purity is determined by running protein gels, followed by staining all proteins with coomassie blue stain. By varying the conditions (i.e. pH of the buffer, amount of salt in the buffer, etc.) used for the chromatographic columns, the purity of LGN will be improved, getting closer to the goal of 95% purity. After that is achieved, many crystallization conditions will be set-up and monitored for the growth of protein crystals using a light microscope.

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Thiamine Deficiency in Salmonids from the Great Lakes

Dr. Rinchard and his research team are currently investigating thiamine deficiency complex (TDC) in the Great Lakes region. TDC leads to early life stage mortality of salmonid species and may also decrease the performance or survival of adults. TDC results from low thiamine concentrations that are thought to be caused by thiaminase (a thiaminolytic enzyme) in the diet of adult salmonines. Invasive alewives in the Great Lakes contain high thiaminase activity, and the ingestion of alewives by adult female salmonines is thought to lower their whole-body thiamine

content, resulting in too little thiamine to allocate to eggs. TDC may be a significant impediment to natural reproduction by native salmonid species (lake trout and Atlantic salmon) and may be an obstacle to their restoration. Participating students will be involved in a faculty-student collaborative research project comparing thiamine concentrations in lake trout and Atlantic salmon eggs. Students will gain hands-on laboratory experience (e.g., lipid extraction, gas chromatography/mass spectrometry analysis), develop statistical skills to analyze their data, and improve their scientific writing skills. As a culmination of the summer internship, students will prepare and present their research findings at a scientific meeting.

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A Longitudinal Citation Context Analysis: The Influence of Christopher Alexander

The goal of this research is to conduct a longitudinal citation context analysis to reveal the context surrounding citations to three books written by architect Christopher Alexander and his colleagues: The Timeless Way of Building, A Pattern Language, and The Oregon Experiment. The patterns movement in computing can be traced to Alexander's work by examining citations to his work. Practitioners and researchers in computing fields have spent decades documenting software design patterns and interaction design patterns. The benefits of such patterns have been discussed at length in the literature, but there has been very little empirical work to support the claimed benefits. In scholarly literature the cited references are assumed to have some type of relationship with the citing article. Although citation patterns alone do not reveal the nature or context of a citation, they indicate an influence and impact at some level. Citation analyses reveal that scholars in computing related fields have cited Alexander more than scholars in architecture. The three books mentioned above are closely related to one another. Alexander describes them as "an indivisible whole" yet they have very different citation patterns. It has been suggested that many have separated the patterns, as described in A Pattern Language, from the process described in The Timeless Way of Building, which was not Alexander's intention. A longitudinal citation context analysis will reveal how, in other words in what context, Alexander has been cited and may explain why we have not been able to see the proposed benefits.

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Three-Dimensional Metal Printing

Due to the high strength of metals compared to polymers, it is important to extend the three-dimensional (3D) printing technology from polymers to metals. However, due to the high temperatures associated with metal processing, this extension is not simple. This project will develop a novel 3D metal printing technology that is cost-effective and applicable to the printing of large metal objects such as cars. Current technologies of 3D metal printing are not applicable to the printing of large objects, due to their low deposition rate, high electric power requirement, low precision and/or high cost. The principle behind the novel printing technology has been developed by Professor Chung (SUNY faculty mentor) and an invention disclosure has been filed with the university (UB STOR Docket R-6934). It is estimated that the novel printing technology will allow the printing of a car in as little as 7 hours. The printer has already been designed and the first printer is expected to be built in the laboratory of Professor Chung by

May 2015. The student participating in this 2015 summer research project will use the printer to demonstrate the feasibility of the printing technology. A sophomore student participant is expected to be involved with this summer project under the direct supervision of Professor Chung, who has been conducting research on metals since 1989 and has 32 peer-reviewed archival journal publications on metal-based materials. Her laboratory in UB is well equipped with materials testing and processing equipment.

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Project 1: Metal Ion Homeostasis

Portals for metals to enter mitochondria

Although mitochondria are over half of all metal metabolism occurs in cells, how metals like iron enter mitochondria is uncertain. We have discovered that divalent metal transporter (DMT1) is on the outer membrane of mitochondria (OMM) in addition to on the outer surface of cells and on endosomal membranes. DMT1 appears to function in iron entry through the OMM. Two other transporters, Zip8 and Zip14, both Zn transporters, often supplement DMT1 in Fe transport. This project aims to see if Zip8 and Zip14 are also on the OMM; and if there, whether Zip8 and Zip14 also serve as portals for entry of Fe and Zn into mitochondria. A student who chooses this project will learn how to produce sufficient amounts of DNA encoding Zip8 and Zip14, how to detect the presence of Zip8 and Zip14 and how to fractionate cells to purify mitochondria and OMM. More importantly the student will learn the design of experiments to approach the questions involved in learning whether Zip8 and Zip14 can also serve as portals for metals to enter mitochondria.

Project 2: Metal Ion Homeostasis

How does the master regulator of iron homeostasis accomplish its task?

Hepcidin (Hepc), a peptide hormone, is the master regulator of iron homeostasis. Mammals cannot regulate iron loss so the way they control body levels of iron is to regulate entry into the body. Two transporters, divalent metal transporter (DMT1) and ferroportin (fpn), allow iron entry. DMT1 is on the luminal surface of the gut so it lets Fe enter the cells (enterocytes) of the GI tract while fpn is on the other side of enterocytes so it lets Fe exit cells to go into circulation in the blood. Hepc binds to fpn causing fpn turnover so Hepc regulates iron homeostasis at least by controlling exit from enterocytes. DMT1, however, also decreases when enterocytes are treated with Hepc. So our questions involve how this change occurs. Does Hepc also bind to DMT1 like fpn? Does Hepc only bind to fpn and fpn signal to DMT1 that DMT1 should decrease too? Is there yet another receptor for Hepc that can signal DMT1 to decrease? A student who chooses this project will learn how to work with cells that produce lots of DMT1 or fpn so that we can easily see how the transporter levels change after Hepc treatment. The student will also use a tagged form of Hepc so that we can track the hormone and learn how to do fluorescent microscopy and Western blots. More importantly the student will learn the design of experiments to approach the questions raised about how the master regulator regulates.

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Household Operations of Autonomous Vehicles and Vehicle Requirements

This project focuses on potential household level operations of AVs. First, this project will extend a decision making scheme of household activities to the operational dynamics of AVs. The main objective is to determine which activity by which family members should be performed considering the operational capabilities of AVs. A secondary objective is identify the number of AVs for a household to meet the activity participation and travel needs of a household, and resulting number of trips and vehicle-miles-traveled (VMT) at both household and global levels.

Formulating potential usage of AVs is difficult due to the lack of data at this early stage of AV development. Therefore, this study needs to be approached from a more fundamental perspective. Based on the well-accepted notion that travel is a derived demand from individual traveler's needs for activity participation and decisions of time allocation, we formulate a Household Activity Pattern Problem for Autonomous Vehicles (HAPPAV). The proposed model is an innovative extension of Vehicle Routing Problems (VRP) in which there are routing considerations of vehicles as well as travelers.

We plan to involve one undergraduate student to assist a Ph.D. student in literature review, data preparation, analysis, etc. While the proposed work develops state-of-art modeling innovations, we intend to create an opportunity for a top undergraduate student to experience a year-long in-depth research experience. Our goal is to groom a top undergraduate student in ISE department for a future researcher.

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UB STEM Summer Research Program (2 Positions Open)

Proposed project: LSAMP Summer Research Internship Program, UB Department of Chemistry

The University at Buffalo (UB) Department of Chemistry in collaboration with UB STEM Programs will host two students to participate in the LSAMP Summer Research Internship Program. Students will engage in a ten-week paid summer research project.

Dr. Luis Colon focuses his research in the field of analytical chemistry, with particular interest on separation science; which includes the development of chromatographic media for chemical separations, detection schemes for monitoring mass-limited samples, the use of nanotechnology in separations, and the development of new strategies to separate and analyze complex chemical or biochemical sample mixtures.

Dr. Michael Detty, a UB organic chemist, focuses research on organic, bioorganic, and materials chemistry. Dr. Detty's research areas include Synthetic Enzymes, Organic Dyes as Photosensitizers for the Production of Solar Electricity and Solar Hydrogen, and New Registration Systems for Biosensing Applications.

Each professor will mentor one student on ~30 hours of research per week. In addition, students in the program will:

- Participate in a weekly Research Methods Seminar
- Participate in "soft skills" workshops
- Present a poster detailing their research projects at the Posters at Davis Hall, Research Symposium

• Participate in oral and/or poster presentations at the national UB Undergraduate Research Conference, July 23-25, 2015
• Tour STEM industrial sites
• Receive information on graduate school preparation
• Participate in community service activities

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A Novel Sleep Sensor (2 Positions Open)

There is a growing recognition of adverse effects from poor sleep quality and sleep disorders. Subjects with sleep disorders are more likely to suffer from chronic diseases, such as heart disease, diabetes, and hypertension. To date, Polysomnography (PSG) and Actigraphy are the most primary sleep assessment methods. However, in these cases the user has to wear sensors to perform the sleep monitoring. Consequently, the obstrusion of the sleep monitoring device may cause the discomfort and decrease the sleep quality.

In order to address the above challenge, we will develop a non-contact, low-cost sensor based sleep monitoring system, called "SleepSense". SleepSense will incorporate (1). a novel sleep event recognition framework to discriminate the desired sleep events, such as breathing event, on-bed movement, and bed exit movement, and (2). a robust peak detection algorithm to extract the breathing rate. Based on these acquired information, we will obtain the movement distribution pattern and breathing pattern during the sleep, thus perform the sleep stage classification, which can be used to infer the sleep quality.

We are looking for two students in the project. One is with the electrical/computer engineering background, and interested in hardware design. The other is with the computer science background, and interested in mobile programming and signal processing. The project is clearly layout, and each milestone is well defined. Our lab will provide a comprehensive support and supervision during the project.

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Development of cost-effective Surface Enhanced Raman Scattering (SERS) Subtrates

One of the goals of my lab is to develop low-cost Surface-Enhanced Raman Scattering (SERS) substrates that can be potentially used to detect drug metabolites in fingerprint residues. Although blood and urine samples are reliable for detecting drugs or drug metabolites if sampled properly, the sampling processes are prone to adulteration and subject to invasion of privacy issue. Using fingerprints for a drug test may avoid these issues. A Raman microscopy can be potentially useful method for detecting drug metabolites from fingerprints and imaging latent fingerprints without a physical or a chemical treatment. Unique peak positions in a Raman spectrum can provide the chemical

information of substances. In addition, a 2D mapping can be constructed based on the intensities of Raman peaks collected from the multiple locations of a surface. However, one major drawback of Raman spectroscopy is its intrinsically weak signals, which makes it difficult for detecting low concentrations of analytes. Molecules can show enhanced Raman signals, known as SERS, when they are present in close proximity to the nanometer sized noble metal surfaces such as gold and silver. In this project we will examine the SERS effect of nanoparticle deposits prepared on different surfaces and further their applicability for detecting model metabolites from fingerprints.

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Forensic Investigation of Ignitable Liquid Residues on Household Materials by Gas Chromatography (2 Positions Open)

Arson is one of the easiest crimes to commit which can quickly cause huge monetary damages and loss of life. Arson can be problematic to forensic investigators, as the nature of flames can destroy a considerable amount of evidences at the crime scene. Previous studies have shown that ignitable liquids such as gasoline are used to start and speed up fire in many cases of arson. Therefore, the presence of trace of ignitable liquids in any areas where the fire originated indicates that the fire is not accidental, but probably caused by arson which demands further investigation by law enforcement.

Our research focuses on the chemical analysis of ignitable liquid residues in debris recovered from fire scene for forensic applications. For this goal, we will conduct an extensive research to detect and confirm traces of various ignitable liquids (gasoline, diesel, charcoal starter, thinner, etc) present in household materials (carpet, plywood, cardboard paper, cotton fabric, etc) which are either burned or dried at different temperature. Chemical analysis for the detection and confirmation of these ignitable liquids will be conducted via gas chromatography. Our preliminary experiments have shown that a trace amount of gasoline was detected from a cotton fabric sample even after 48 hours of drying at room temperature. Two students are expected to complete proposed research for 10 weeks. They will conduct sample preparation, the data collection, and analysis. New findings from this project will be presented at local/regional/national conferences and will be published in peer-reviewed forensic journals.

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Habitat, Population and Feeding Ecology of the Eastern Hellbender Salamander (2 Positions Open)

Our lab interests focus on wildlife conservation using a combination of genetic and ecological methods. Ongoing research projects include feeding ecology, conservation genetics, environmental DNA detection, habitat modeling, and disease surveillance of the Eastern Hellbender (Cryptobranchus alleganiensis). The hellbender is a highly elusive, fully aquatic salamander endemic to the eastern United States. This species has experienced population reductions throughout its range, and restoration through the release of captive-reared individuals has become a preferred conservation strategy in many locations, including New York. Understanding the factors influencing hellbender populations is vital to a successful restoration program, but there is much that remains unknown about the potential threats to hellbender recovery, particularly in the Upper Susquehanna watershed.

The proposed summer project will focus on increasing our understanding of several key factors that may influence the success of hellbender restoration, including habitat characteristics and food availability at both presently occupied sites and potential release sites. Summer research objectives may include analysis of substrate size profiles and

macroinvertebrate diversity, collection of water quality data, collection and processing of population genetic or environmental DNA samples, assisting with hellbender surveys, GIS mapping, and feeding ecology experiments in field and/or lab settings.

Students interested in this project should expect to work long days in difficult field conditions, including cold, heat, humidity and biting insects. Students must be comfortable working in aquatic situations (rivers and streams), camping for several days at a time, and handing animals, including amphibians, fish, crayfish and aquatic insects. Herpetological collectors should not apply and we do not share the location of our field sites. We will dismiss any student who does not comply with these conditions.

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GPR at Historical Sites in WNY (2 Positions Open)

The main research interest for the lab during Summer 2015 will be using ground penetrating radar (GPR) to reveal subsurface features at several historical sites in the Buffalo-Niagara region. For the potential summer project, data would be collected at Old Fort Niagara in Youngstown, NY, in order to locate buried foundations and other features of historical interest. This research would tie into ongoing research at the fort to compile a subsurface map that can be used to plan archaeological excavations. GPR data would also be collected at one or more cemeteries where tombstones no longer exist in areas where there are likely burials. Several similar projects have revealed locations of dozens of burials that were not known due to lost records, and these results help those cemeteries commemorate the lost burials and to plan future burials accordingly. The fort and cemetery sites would involve collecting GPR data in grids to create a 3D data block. A third component of the project is continued data collection along the Niagara Gorge to complete an ongoing project where buildings associated with the Buttery Elevators were located.

Together, these sites afford the opportunity for undergraduate researchers to learn about GPR techniques and applications, to become proficient in data collection using the equipment, and to use software to process and analyze the data. Because preparation, data collection, and processing and analysis would be distributed throughout the 10 weeks, students will be able to in their proficiency and independence from site to site.

SUNY COLLEGE OF NANOSCALE SCIENCE AND ENGINEERING

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Assessment of Nanoparticle Biodistribution Following Inhalation Exposure in an Animal Model (2 Positions Open)

The Brenner Research Team conducts occupational and environmental health and safety research related to engineered nanomaterials. This interdisciplinary team integrates preventive medicine, biology, toxicology, industrial hygiene, materials science, and metrology to investigate the human health impacts of exposure to nanoscale materials. Research interns have the opportunity to assist with projects at the interface of biology, toxicology, nanotechnology, and advanced imaging. Relevant background material will be provided, and they will be trained in

the lab to perform microscopy techniques with histological samples (animal tissue). They will work on one of two projects: 1) assessment of the translocation of nanoparticles and resulting neurological effects in a mouse model of inhalation exposure using enhanced darkfield and hyperspectral imaging techniques, and 2) assessment of the biodistribution of nanoparticles in a rat model of inhalation exposure using enhanced darkfield and hyperspectral imaging techniques. Both projects will require the student to: conduct a thorough nanotoxicology literature review relevant to the nanomaterials of interest; learn anatomy, physiology, and histology relevant to the exposure model; become proficient in darkfield and hyperspectral imaging; and prepare weekly progress reports (written) and updates (oral) for the team. The students will also be encouraged to prepare a final presentation and poster summarizing their work as well as contribute to manuscripts for submission to peer-reviewed journals.

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Assessment of Occupational Exposures to Engineered Nanomaterials Using Advanced Analytical Methods

The Dunn Research group investigates structure-property relationships in engineered nanomaterials (ENMs). The use of ENMs in an ever-increasing range of consumer and industrial products has increased the possibility of occupational exposure to potentially harmful materials. There are no standard protocols for identifying ENMs in air or water samples; current procedures are adaptations of decades-old asbestos identification by transmission electron microscopy, which do not address some of the size- and structure-specific issues unique to ENMs. Thus the main goal of this project is to compare existing best-known direct visualization methods for ENM identification and characterization to each other alongside a new method for higher-throughput screening using a standard library of ENMs. The best adaptations of those methods will then be applied to samples obtained in real-world exposure scenarios in the field. The research intern will have the opportunity to assist with sample collection and preparation as well as data analysis from transmission electron microscopy (TEM), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), and hyperspectral imaging. The student will be responsible for maintaining a database of relevant background material provided, conducting literature searches for related publications, and preparing weekly progress reports (written) and updates (oral) for the team. The student will also be encouraged to prepare a final presentation and poster summarizing their work as well as contribute to manuscripts for submission to peer-reviewed journals.

Peck, Joshua
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The Effect of Environmental Enrichment on Alcohol Abstinence and Stress-Induced Relapse in Rats

Broadly, my research interests are in the pursuit of understanding the environmental and neural mechanisms underlying drug addiction. Currently, our work involves exposing drug addicted subjects to environments that are enriched with abundant stimulation and rewards in order to observe the effects that environmental enrichment may have on future drug seeking and taking in rats. We are finding that when stimulation or reward is derived from a source other than the drug itself (enrichment), there is a significant decrease in future responding for drug, thereby supporting drug abstinence. Further, the basic and applied significance of my research has both excited and

motivated some of my current undergraduate students to be actively involved in my research projects. Moreover, my research assistants are interested in understanding how our results could lead to the development of effective treatment outcomes for human drug addicts. Therefore, I'm excited to provide a SUNY undergraduate the opportunity to be a part of this growing research over the summer of 2015. This summer's research will seek to determine if the implementation of environmental enrichment after alcohol self-administration training has occurred reduces or eliminates continued alcohol consumption in rats (abstinence) and protects against stress-induced relapse. The successful candidate can expect to learn the basic and applied significance of behavioral neuroscience in the field of alcohol addiction. Further, they will learn how to design and conduct a research project in alcohol addiction and convey their new found knowledge in a scientific manner.

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Plant Ecology Summer Research

In the Ecology lab at SUNY Delhi, we study local plant species, their distribution and abundance, and the relationship they have with environmental conditions. The primary focus is on forest understory plants, but we have also examined invasive plant species and animals that affect the distribution of plants. Recent projects involve the effects of reduced winter snowfall on ferns, and belowground movements in the spring wildflower, trout lily. Recent student projects have examined the susceptibility of the invasive plant, Japanese knotweed, to spring frost, and the role of salamanders in moving spores of ferns. These two projects resulted in manuscripts that are currently In Press and In Review at peer-reviewed journals. The overall goal of the lab is to better understand the traits of species to permit predictions of their future abundance and to help inform management decisions, while providing research experiences to SUNY Delhi students.

The research project that SUNY Delhi students conduct this summer will depend on their interests and the resources to which we have access. Some potential projects are 1) photosynthetic capacity of older white pine needles, 2) the number of species supported by dead wood in a forest, 3) moss preference for deciduous or evergreen trees, 4) depth of soil and its effect on tree death, 5) role of variation in habitat in supporting biodiversity of the forest understory, 6) widths of buffer strips necessary to reduce Japanese knotweed presence, 7) factors controlling plant heights in old fields, and 8) ability of salamanders to move fern spores in their feces.

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Birds and Beavers: Do Pond Characteristics Impact Bird Diversity and Use?

The student will help collect field data on summer bird use of beaver ponds in the central Adirondacks. Focal species are songbirds, ducks, herons and other wetland birds. The project objective is to determine which beaver pond characteristics (e.g., age, size, surrounding vegetation, landscape position) are related to bird diversity and occupancy for use in modeling and long-term monitoring of a largely intact ecosystem.

Research Questions include: Which bird species use which ponds, when and how frequently? How does the temporal beaver activity pattern (some ponds are occupied every year, some every few years, others only once) influence the bird community? Are there certain methods (e.g., sound recorders, cameras) that enable avian species detection?

The Adirondack Ecological Center has 30 years of beaver activity/occupancy data for 35 sites. The student will be invited to present and publish results with mentor Stacy McNulty, a wildlife ecologist with 20 years of experience studying vertebrates and forest communities. See http://www.esf.edu/EFB/faculty/mcnulty.htm.

The candidate should be enthusiastic about working mornings and outdoors in all weather but does not need experience with bird or vegetation identification. He/she will learn species ID, survey methods, use of GPS and GIS and data management. He/she will work with a team of scientists and graduate students from SUNY ESF. There will be additional opportunities to assist in loon, mammal and other field research and monitoring projects. A valid driver's license is preferred, as travel to field sites is necessary.

AEC is in Newcomb, NY and hosts many students, researchers and educators at its housing, dining and laboratory/computing facilities (www.esf.edu/aec). AEC is located on the Huntington Wildlife Forest biological station, a 15,000 acre experimental forest with abundant lakes, streams, mountains and access to camping, hiking and more in the High Peaks and Upper Hudson region.

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Research Experience 1: Synthetic Approaches for PHA Biodegradable Polymers # 1

The Nomura Research Group at SUNY-ESF is the foremost authority on biopolymer research at the interface of chemistry and biology in the Central New York region. Our group has expertise in multiple aspects of the production of biopolyesters, which involve research areas spanning the gamut between microbiology, metabolic engineering, biochemistry, chemical synthesis and polymer physical characterization studies.

Poly-[(R)-3-hydroxyalkanoates] (PHAs) are attractive biopolymers owing to their biodegradable and biocompatible profiles and varied physical properties. Previously, our lab engineered a bacterial strain (E. coli LSBJ) to produce PHAs with controlled repeating unit compositions. Expanding on this prior research, our group has been enthusiastically exploring our strain's flexibility to incorporate synthetic fatty acids and produce chemically tractable materials to broaden their application in multiple areas of research.

We have planned an immersive experience for the STEM Fellow in the production of synthetic biopolyesters for their potential as materials employed in biomedical applications. The STEM Fellow will explore the chemical synthesis and polymerization of a panel of synthetic fatty acids containing chemical functionalities such as terminal organoazides and linear/cyclic strained alkynes (triple bonds). These functional groups will facilitate the material's derivatization with various therapeutically relevant molecules such as paclitaxel (chemotherapeutic), thiostrepton (antibiotic and antimalarial), and biotin (Vitamin H). Our synthetic routes have been designed to exploit the flexibility of commercially available starting materials to efficiently procure a multitude of chain lengths and functionalities. By using different size repeating units we hope to control not only composition but also the physical properties of our materials.

Research Experience 2: Synthetic Approaches for PHA Biodegradable Polymers # 2

The Nomura Research Group at SUNY-ESF is the foremost authority on biopolymer research at the interface of chemistry and biology in the Central New York region. Our group has expertise in multiple aspects of the production of biopolyesters, which involve research areas spanning the gamut between microbiology, metabolic engineering, biochemistry, chemical synthesis and polymer physical characterization studies.

Poly-[(R)-3-hydroxyalkanoates] (PHAs) are attractive biopolymers owing to their biodegradable and biocompatible profiles and varied physical properties. Previously, our lab engineered a bacterial strain (E. coli LSBJ) to produce PHAs with controlled repeating unit compositions. Expanding on this prior research, our group has been exploring our strain's flexibility to uptake natural and synthetic fatty acids to metabolically modify them and yield value-added chemical compounds.

We have planned an immersive experience for the STEM Fellow in the in vivo production of enantiopure ß-hydroxy fatty acids for their application in the synthesis of various substituted ß-lactones, key substrates in the synthetic ring-opening polymerization of polyhydroxyalkanoates. The STEM Fellow will explore the basics of our engineered strain's metabolic pathway and the sterile techniques required to handle it, as well as become proficient with the isolation and thorough spectrometric and chromatographic characterization of all biosynthetic ß-hydroxy fatty acids. Time permitting, the STEM Fellow will also be introduced and guided through the application of synthetic strategies to access ß-lactones from the ß-hydroxy fatty acids isolated, thus providing them with a rigorous and rounded overview of the many facets of a modern research laboratory.

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Interactive Effects of Climate Change and Invasive Invertebrates on the Great Lakes Ecosystem

Climate change and aquatic invasive species (AIS) are large ecological threats to the Laurentian Great Lakes. Well-publicized introductions of AIS (e.g., zebra and quagga mussels) have already fundamentally altered the Great Lakes ecosystem, and climate change projections predict dramatic changes in environmental conditions such as water temperatures, mixing regimes, and oxygen concentrations. Until recently, the interactions between climate change and AIS have been generally overlooked in the Great Lakes.

We are investigating the ecosystem effects from the introduction of a non-native oligochaete, Branchiura sowerbyi, in Lake Erie and how a changing climate may alter the impact of this invasive (NOAA funded). Specifically, we are testing how this large invasive worm influences competition between native benthic (bottom-dwelling) macroinvertebrates, including chironomids and a historically-threatened mayfly, Hexagenia. Experiments are being conducted in our new state-of-the art experimental facility to simulate different climate change conditions and quantify effects on the invertebrate community (e.g., growth, survivorship, competition)

Through the STEM Research Passport Faculty Mentor Program, an undergraduate will have the opportunity be an integral part of our team by assisting in this research, performing experiments, and learning laboratory and field methods. The student will work side-by-side with a Ph.D. graduate student and myself, and be included in lab meetings and other career-building opportunities. Results of the experiments will be used to develop an ecosystem model that aims to understand how competition among these species may be influenced by warmer water temperatures and decreased amounts of oxygen, as predicted by climate change in the region

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NIR Analysis of Willow Biomass

The SUNY College of Environmental Science and Forestry (ESF) is at the forefront of developing new woody feedstocks and processing technologies to convert renewable biomass into a portfolio of fuels, chemicals and biodegradable plastics that will ultimately replace products derived from petroleum. ESF recently received a $3.0 million grant from the Department of Energy to improve the production and harvesting logistics involved with plantation grown shrub willow (Salix spp.) as a feedstock for energy and bioproducts. Shrub willow is a woody plant that can accumulate biomass 5-10 times faster than a "hardwood" species growing in a forest. As a result, it is very attractive for many applications which involve converting woody biomass into its constituent sugars which can then be fermented into ethanol, useful for blending with gasoline, or other chemicals or bioplastics. Willow wood is composed of at least 3 polymeric components called cellulose, hemicellulose and lignin. The relative abundance of each determines the optimal application of willow whose composition can vary with breeding and other growth conditions. In this project, we will employ Near Infrared Spectroscopy to determine the composition of willow using a state-of-the-art hand-held device that can be deployed in the field. The student intern will record spectra on samples obtained from willow field trials, prepare and test samples of known composition and will then utilize a chemometric approach that enables a "predictive" model to be developed which can estimate the composition of an "unknown" willow sample in just a few seconds of analysis time.

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Willow Biomass Crops as a Source of Renewable Energy

Driven by the challenges of rural development, energy independence and environmental sustainability, research on willow biomass crops for renewable energy and environmental applications has been ongoing at SUNY College of Environmental Science and Forestry SUNY-ESF since 1986 (www.esf.edu/willow). Shrub willow is a short rotation woody crop that produces large amounts of harvestable woody biomass at a rate 5 – 10 times faster than natural forests. Willow can be grown on idle or marginal lands, stimulating rural development while also producing numerous environmental benefits. It is a carbon-neutral renewable energy source that does not increase greenhouse gas emissions in the atmosphere. Willow can reduce soil erosion, mitigate water pollution, increase wildlife habitat and

biodiversity, and be used for bioremediation applications such as vegetative landfill covers and treatment of organic wastes. Monitoring of willow growth both above and below ground is essential to understand the potential of these systems and the associated economic and environmental implications. This position will provide opportunities for students to engage in a range of projects in central and northern NY where willow parameters such as height growth, leaf area index, below ground root growth, water quality and soil characteristics are being measure. In these projects willow is being grown as a sustainable source of biomass and as a bioremediation system on former industrial land. The data collected is being used to improve the environmental and economic performance of these systems and to assess their overall sustainability.

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Modeling, Simulation and Optimization of a Manufacturing and Assembly Line (2 Positions Open)

Manufacturing and assembly operations are an integral part of a supply chain process. This 10-week research project will provide a detailed look into a manufacturing and assembly line process, and examine ways to eliminate waste to achieve a lean process. Waste in a manufacturing and assembly operation can be in the form of wasted time, parts, and over-processing. The goal of the research project is to develop a computer-based model of a manufacturing and assembly line and simulate the model using a discrete-event simulation software. Based on the simulation results, the wastes in the process will be identified; and methods to eliminate or reduce wastes will be proposed. A series of manufacturing and assembly line layout scenarios will be modeled and simulated; an optimization process will be carried out to identify the optimum process layout to achieve lean manufacturing.

Throughout the 10-week research project, students will learn about manufacturing and assembly line processes, types of wastes, and methods to reduce and eliminate these wastes. In addition, students will learn how to use a discrete event simulation software and perform a multi criteria decision-making analysis to select an optimum production line layout.

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Summer Research Project in Vanadium Redox Flow Batteries

Vanadium redox flow batteries (VRFB) have received high attention due to their potential for large scale energy storage systems. The electrolyte used in VRFB is not only the ion-conductor, but is also the energy-storage medium. The electric energy is stored and released by changing the oxidation states of the vanadium electrolyte solutions. The charging and discharging processes are fully reversible. A feasibility study of vanadium redox flow batteries was conducted in summer 2014. A preliminary battery cell was designed and constructed. The cell was able to withstand the acidic solution. Electrolyte for the batteries was also developed and proven to be able to hold electrical charge and deliver power upon loading. The objective of the proposed student project is to investigate the effect of cell

design used in VRFB systems. The project will involve one student who is interested in engineering, technology, and chemistry.

The student will be trained in vanadium redox flow battery technology in the first two weeks. He/she will be given necessary reading assignments and will be required to present his/her understanding of VRFB materials, designs, and systems after the first two weeks. Once the student has the basic knowledge of the subject, he/she will start designing the test setup and collecting data for the project. The goal is to determine the most effective cell design for VRFB systems.

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Energy Saving Smart Home (2 Positions Open)

Goal:
To attract and motivate undergraduate college students to develop "Smart Home" projects using analog and digital programmable devices as part of their student research experience.

Motivation:
"Smart Grid" initiatives (including "Smart Meter", "Smart Home") seek to enable energy providers and consumers to intelligently manage their energy needs through real-time monitoring, analysis, and control. The U.S. Department of Energy has identified "sensing and measurement" as one of the "five fundamental technologies" essential for driving the creation of a "Smart Grid"[1]. At the heart of the advanced technologies for smart grid lies the powerful technology of programmable devices such as Field Programmable Gate Arrays (FPGA) and SoC (System on Chip).

Project Plan:
In the first part of the project, the students will research journal and conference papers in the area of Smart House [2]. They will work on developing electronic circuits incorporating sensors and actuators used in typical Smart Meters and Smart Homes applications. They will use PC-based equipment performing sensing and measurements of various electrical quantities, without the need of expensive laboratory equipment [3].
In the second part of the project, a creative Energy Saving Smart Home application will be developed using programmable devices (FPGA and/or microcontroller based platforms) and the electronic circuits incorporating sensors and actuators previously designed and tested. The students will write the software for the platform controlling the Smart House application.

References:
[1]www.energy.gov. "International Journal of Smart Home", published by Science&Engineering Research Support Society, ISSN: 19754094
[2] M. Radu, "Developing Hands-On Experiments to Improve Students Learning via Activities outside the Classroom in Engineering Technology Programs" in the proceedings of IEEE Integrated STEM Education Conference, Princeton University, 2014

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Synthesis of New Single Crystals through Solution Growth

Our laboratory is devoted to the synthesis of new materials for energy applications, and our expertise is in the growth of single crystals from solution. We are currently investigating new compounds for high temperature turbine applications as well as magnetic materials that may exhibit quantum criticality. This summer, the accepted student will learn the following: to read binary and ternary alloy phase diagrams; to grow intermetallic single crystals from molten metal and salt fluxes; to prepare the crystals for structural, transport, and magnetic measurements; and to analyze x-ray diffraction data. Students will synthesize and characterize a new or previously unstudied compound. Students will work primarily in the Department of Physics at Farmingdale State College but may also perform a portion of their research at Brookhaven National Laboratory in the Condensed Matter Physics and Materials Science Department. Students must be able to transport themselves to and from these campuses.

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Mass Balance Assessment of Chloride of the Skaneateles Lake Watershed using STELLA Modelling Software (2 Positions Open)

Historical data shows that the chloride concentration in the eastern most Finger Lakes (i.e. Hemlock, Canadice, and Skaneateles) has increased to the point where the NY-Department of Environmental Conservation (DEC) has made the recommendation to "control inputs of salt to the watershed", which suggests there is a need to model chloride content. A study of the Mohawk River watershed shows that road salt used for deicing accounts for 90 to 95% of its chloride concentration. This research project proposes to investigate the potential impact of human activities such as road salting on the increasing salt concentration in the Skaneateles Lake watershed. The primary research objective is to develop a mass balancing model of chloride using the modelling program STELLA, by measuring the inputs (tributary contribution, surface run-off, anthropogenic sources, etc) and outputs (tributary removal, stratification, biological activity, etc.) providing an overview of the chloride flux. Once a baseline mass balance is developed, providing a robust model of summer chloride behavior; future iterations could be developed to include more complex seasonal influences such as springtime runoff.

Student research will include collecting environmental data (flow data, chloride concentration, pH, invertebrate population, dissolved oxygen, etc.), titrimetric analysis of samples in the laboratory and, finally, development of the computer model using STELLA. This project will include both field and lab work; with a major focus on understanding the activity in and around the lake and within the lab a focus on proper analytical techniques to determine water quality.

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Modern constraints on single-field inflation models in light of Planck 2015 and BICEP2 (2 Spots Open)

Recent observations from the Planck experiment have further constrained cosmic inflation models, and the discovery of gravitational waves from BICEP2, if attributable to inflation, would be direct evidence for inflation. Planck's 2015 data release narrowly defines the scalar spectral index, and in particular further clarifies that the spectrum is red-tilted. This provides unprecedented opportunities to study inflation models. With recent research into quadratic inflation as our motivation, we propose to study a wide variety of single-field models, considering non-minimal coupling to gravity, in light of Planck 2015 and BICEP2.

The student will help examine simple single-field inflationary models, using numerical techniques to determine how realistic such models are in light of modern cosmological observations from the Planck and BICEP2 experiments. The student will be introduced to numerical techniques, including root-finding by Newton's method. The student will gain invaluable programming experience which can be applied to a wide variety of STEM fields and problems. We will emphasize the basic cosmological observational parameters, which are related to the given potential, with only first-semester calculus and physics as prerequisites. The student will produce a poster of the basic physics and numerical techniques used. This project will provide a niche for students interested not only in Cosmology but in many theoretical and/or computational fields, for which there are often few undergraduate opportunities.

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Recovery from Acid Rain and Fish Introduction in the Sky Lakes, Shawangunk Ridge, SUNY New Paltz.

Lakes within managed forests are largely protected from the impacts associated with human-dominated land uses, and thus present an opportunity to study the indirect impacts of humans on lake ecosystems. This project will be based in the Sky Lakes, a collection of five lakes within managed lands on the Shawangunk Ridge in the Hudson River Valley of New York State. We will seek to link acid rain and fish introductions as the drivers of lake ecosystem change. Based on 25 years of pH data, three focal lakes, Minnewaska, Awosting, and Mohonk, all showed decreases in lake acidity but at different rates indicating multiple drivers of this change. We will sample all three focal lakes regularly for a variety of physical, biological, and chemical parameters including pH to make comparisons across the Sky Lakes. We also will ask if a newly introduced fish species into a previously fishless lake (Minnewaska) has caused ecosystem wide changes to the lake structure and function. We predict that the addition of a trophic level controls ecosystem and community modifications through a trophic cascade. A trophic cascade would result in increased algal biomass and decreased water clarity mediated by decreasing zooplankton size and biomass. We will sample lake biology including fish and zooplankton communities to determine if the trophic cascade is occurring. This project will enable us to learn about lake ecological connections via recovery from acid rain and introduced species and will link to management decision making at the New York State Park Preserve level.

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Environmentally Benign Routes to Nanoparticle Synthesis, Characterization and Film Formation

One nanometer (one billionth of a meter) is a transition point where the macroscopic properties of materials start to evolve from atomic properties. Nanoscience refers to the fundamental understanding of material properties, and synthesis and engineering of materials at this length scale. Over the last two decades advances in nanoscience have engendered innovations in a wide range of technologies including healthcare, biology, environment, and conservation of materials and energy. This project will focus on the growth of nanoparticles as the building blocks for nanomaterial based devices. Techniques have been developed over the last decade on the colloidal synthesis of many different types of nanoparticles composed of heavy metal cores. We will, however, focus on environmentally benign and rational synthesis routes that require low nucleation temperature. Using such techniques we will colloidally synthesize CuS and Ag2S nanoparticles that are composed of relatively lighter metal core. We will measure the absorption spectra of these nanoparticles and learn how to determine the size of the particles from their optical properties. Finally we will develop methods to fabricate films of these nanoparticles which will take us within few steps of electronic and optoelectronic devices incorporating nanoparticle arrays. Research will be carried out in the recently established Nanoscale Technology in Sustainable Energy Laboratory in the Shineman Center at SUNY Oswego, and participants will have the opportunity to work closely with the PI and senior students, and contribute to novel method developments.

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Cloud Security Research Laboratory (2 Positions Open)

The focus of the Cloud Security Research Laboratory is to advance the state of security of multi-tenant virtualized environments. Our current focus is on network security within these environments, particularly evaluating different environments to see how vulnerable they are to certain networking threats such as eavesdropping on client network traffic, gaining unauthorized access to co-located systems, as well as degradation or denial of service of network resources. Both attack methods as well as mitigation and hardening techniques are being explored. We are seeking two motivated undergraduate students with a background in network security to assist with continuing our research over the summer. Duties will include assisting with experiments and data collection as well as helping to maintain the lab infrastructure.

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Geometry and Symmetry based Mathematical and Computational Methods for Partial Differential Equation (2 Positions Open)

Exterior calculus developed by Cartan several decades ago has become the standard language of differential geometry and has gradually been gaining acceptance as the superior formulation of vector calculus in scientific and engineering community. It expresses the operators of gradient, divergence and curl in terms of more fundamental operators and separates the quantities that are invariant under coordinate transformations from quantities that are not invariant; something that is simply not possible in the traditional calculus language.

Building on the foundation of modern differential geometry and in particular exterior calculus, geometric mechanics reformulates mechanics, in particular Lagrangian and Hamiltonian mechanics, in the language of geometry. Formulating the problems in the language of geometrical mechanics has enabled researchers to develop new numerical methods, which preserve geometrical structures.

In a Nutshell, discrete exterior calculus, finite element exterior calculus and variational and geometric integrators, all aim at bridging the gap between the traditional numerical methods and analytical methods preserving symmetry and geometry.

Examples of such problems include problems from biomedical engineering, material science, and micro and nano biology.

Students will work with faculty on a question of their choice with examples given below.
1. Comparing Discrete Exterior Calculus and Finite Elements for some toy examples.
2. Understanding the discrete divergence operator and other operators of the basic equations of fluids, mechanics, and electromagnetism.
3. Implementing discrete exterior calculus routines for problems on curved surfaces.

Preference will be given to students with basic knowledge in multivariate calculus, differential equations, and familiarity with a programming language.

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Investigation of Machining Dynamics Using Continuation Analysis
The lab's focus is on analytical, numerical, and experimental investigations of dynamical systems with a particular interest in applications to energy systems and machining processes. One of the important aspects of the lab's work is the investigation of the changing behavior of a solution to a dynamical system as one of the parameters is varied. These solutions can be traced using continuation analysis which can be used, for example, when designing wind turbines to investigate the deflection of the turbine blade as its span is increased. Although continuation analysis is a powerful tool, learning its basic implementation only requires some background in calculus and differential equations. This makes it an ideal gateway for engaging freshmen and sophomores in research.

The student will learn about continuation analysis and will apply it to study the oscillations of the tool/workpiece during cutting operations on an engine lathe. The interest here is in understanding the oscillations of the tool and/or

the workpiece as the diameter of the workpiece is reduced by the cutting tool. The student will then be challenged to research the literature for a dynamic system that they are interested in and apply continuation analysis to it. The student will check the accuracy of the results using numerical simulations. In addition to introducing the student to research, this project has the potential of transforming into a longer term project that can empower the student to continue pursuing more challenging questions.

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Mathematical Modeling of Blood Flow in the Retina of the Eye (2 Positions Open)

The Mathematical Modelling Lab at SUNY Poly, Utica, specializes in the development, analysis and verification of mathematical models and the current focus is on modelling the blood flow in the retina of the eye. This research has the potential to advance our understanding of various eye pathologies and help improve existing treatments and discover new treatments. For examples, our physically based modelling, based on first principles, coupled with the most advanced analytical and numerical solution techniques, has predicted that changes in the curvature of the retina of the eye lead to significant changes in the blood flow, which in turn may play a significant role in primary open-angle glaucoma.

The Summer 2015 Student Summer Project will involve the student in the current improvements to the model. The blood flow in the retina of the eye is modelled as a Darcy flow through a hierarchical porous medium and is described by the extended Darcy equation. This equation is similar to the traditional Darcy equation, which can be used for example to model the flow of water or oil through sand, but it is extended by an additional variable, which represents the various blood vessels: large arteries, small arteries, arterioles, capillaries, and the various size veins. In other words, the model describes not only the spatial flow, but also the hierarchical flow, from arteries, through capillaries, to veins.

The student will have the opportunity to participate and to contribute to all aspects of the project and to focus on one particular area of their choice, appropriate to their level. The prerequisites are a solid background in mathematics, minimally at the level of calculus, and preferably including linear algebra, differential equations and multi-variable calculus, familiarity with a programming language, preferably Python, and an interest in applied mathematics, including mathematical modelling and scientific programming.

Sharma, Narayan
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Cytochrome P450 (2 Positions Open)

My research goal is to understand enzyme structure - function relationship and regulation. Currently my research is focused on Cytochrome P450. Cytochrome P450 (CYP) represents a large family of enzymes that catalyze important reactions involving metabolism of a variety of substances including therapeutic drugs, environmental toxicants and carcinogenic chemicals.

CYP2A13, a cytochrome P450 (P450) enzyme, is encoded by a functional member of the human CYP2A gene subfamily. CYP2A13 enzyme is found in human respiratory tract and lung. In-vitro studies have shown that heterologously expressed CYP2A13 has a comparatively high metabolic activation of a major tobacco-specific carcinogen, 4-(methyl nitrosamino)-1-(3-pyridyl)-1-butanone (NKK).

I am also interested in genetic polymorphism of human P450 genes in order to identify the genetic basis for inter individual differences in efficacy of drug and extent of toxicity due to environmental xenobiotics. The aim of this study is to identify any genetic polymorphism of the CYP2A13 gene, which may change the catalytic efficiency of the enzyme.

The proposed study in my lab during summer 2015 will be carried out in two phases. In the first phase, in silico identification of SNPs in CYP2A13 which have not been characterized and likely to cause a functional change based on structural modeling will be carried out. The SNPs in CYP2A13 that are identified will be selected for functional studies, and for this purpose, in the second phase, site directed mutants will be created from cDNA of CYP2A13 and will be expressed through heterologous expression system using SF9 insect cells.

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Detection and Quantification of Nanoparticles in Industrial Wastewater (2 Positions Open)

The Wei laboratory investigates issues related to water quality, water chemistry, wastewater treatment, nanomaterials and application in treatment or remediation, and environmental sustainability. Research interns have the opportunity to assist with a project at the interface of environmental science, engineering, chemistry, and nanotechnology. They will work with faculty at both the Utica and Albany campuses of SUNY Poly on a project to investigate the utility of magnetic silica microspheres (MSMs) in capturing engineered nanoparticles in industrial wastewater. MSMs are monosized silica microspheres with magnetic properties due to an embedded iron oxide nanoparticle core. Relevant background material will be provided, and they will be trained in the Wei lab (Utica) to perform techniques to achieve: modification of the surfaces of MSMs, capture and release of nanoparticles from industrial wastewater, the development of quantification methods for nanoparticles using MSMs. Students may also spend time in the Brenner lab (Albany) learning basic metrology and microscopy techniques and observing industrial processes that generate nanomaterials in wastewater. The students will also be encouraged to prepare a final presentation and poster summarizing their work as well as contribute to manuscripts for submission to peer-reviewed journals.

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Image Processing in Vision Science (2 Positions Open)

The interior surface of the eye, known as the fundus and including the retina, optic disc, macula, fovea, and posterior pole, is the only part of the body where microcirculation can be perceived directly. As such there has traditionally been a great deal of interest in the diagnosis and evaluation of conditions such as cardiovascular disease and diabetes, which impact the human circulatory system, by using non-invasive image capture and both manual and automatic processing techniques. Digital non-mydriatic fundus photography has been shown to be cost effective in the evaluation of diabetic retinopathy.

Our group is working in two complementary areas: blood flow modeling and image processing techniques.
As modelers we study the relation between perfusion pressure and ocular blood flow in the retina, and the effect of alterations of ocular curvature on retinal hemodynamics.

Within the realm of image processing, we study techniques for the automatic segmentation of the vascular structure in retinal fundus images. Our immediate goal is to produce a suite of software programs in the OpenCV/Java environment to implement segmentation schemes and assess their quality. We are also developing a software environment for the acquisition and segmentation of retinal images in the android operating system, suitable for tablet PC's and Smart Phones.

Participating students will help program the implementation of vessel segmentation in the JAVA/OpenCV environment with the goal of producing working code in the Android Operating System, suitable for Tablet PCs and Smartphones. Last summer we successfully supported 6 students in an REU.

Middleton, Elizabeth
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How Do Antimicrobial Peptides Work?

Bacterial resistance to antibiotics is a growing problem, especially in hospitals and other healthcare settings. Traditional antibiotics target specific bacterial pathways, so bacteria can develop resistance to antibiotics when a mutation occurs in that pathway. Antimicrobial peptides are part of the immune system of most organisms and have wide-ranging activities against bacteria, viruses, and other infectious agents. Antimicrobial peptides (AMPs) often target the outer membrane of a microbe, making it difficult for the microbe to develop resistance. AMPs may therefore provide an alternative to traditional antibiotics and lessen the problem of antibacterial resistance.

In this research project, we will study the AMP Maximin 3 from the toad Bombina maxima. Maximin 3 has broad activity against bacteria, viruses, and other microorganisms, but is also toxic to mammalian cells. We will prepare lipid membranes using extrusion to model both bacterial and mammalian membrane compositions. We will then use fluorescence anisotropy to measure the binding of Maximin 3 to these membranes and determine what membrane factors affect binding. This research will expand our understanding of how AMPs target particular organisms and help promote the development of AMPs into antibiotics.

Davalos, Liliana
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Genetics of Sensory Adaptations in Bats

Lab Research Interest: The Dávalos lab focuses on assessing the performance of molecular variants found in organisms with extreme sensory and dietary adaptations. Evolving sensory structures that let a bat find flowers, fruit, or more accurately find insect prey can be very advantageous. Our goal is to discover the genomic mechanisms behind the astounding specializations of bats to elucidate how intrinsic biological characteristics shape interactions with mutualistic plants and with insect prey. The target group of bats—New World Noctilionoids— includes species with extreme dietary adaptations including dedicated blood feeding, nectarivory, and strict frugivory. These specializations demand both a range of sensory adaptations to locate food, and place tremendous demands on the metabolic performance of bats. In both cases, these are expected to leave signatures of genetic adaptation in relevant genes.

Potential Research Project: Each student will collect data for one or two genes involved in sensory signaling, such as: USH1C, SPRY2, Pcdh15, Cldn14, Kcnq4, Myo6, Otog, Prestin, Crx, Rh1, AScl1, OR11H7P, Trpc2, Fezf2, NGFB, and VR1. Students will select the most promising of the candidate genes, and focus on sequencing 1-2 exons based on the functionality of the protein encoded by the candidate gene or genes. The students will conduct comparative analyses of the major subgroups of noctilionoid bats that have modified sensory modes (e.g., constant-frequency echolocation, modification of heat reception in vampire bats). The students will analyze rates of molecular evolution, protein-coding changes associated with sensory specialization, and any stop codons or frameshifts that potentially cause pseudogenization with their new sequences.

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Cancer Cell Lines Have Natural Variants Showing Innate Drug Resistance (2 Positions Open)

Cellular plasticity in epithelial cancers has been associated with progression and resistant to anti-cancer therapies. Several forms of plasticity have been documented. The most well studied is the epithelial mesenchymal transition (EMT), a transcriptional reprogramming process that is characterized by the combined loss of epithelial cell junction proteins and cell polarity; e.g., E-cadherin, and the gain of mesenchymal markers, for example vimentin, fibronectin and Zeb1. It has become evident that cancer cells can de-differentiate through activation of specific biological pathways associated with an epithelial-to-mesenchymal transition, to gain the ability to migrate and invade. These findings have impacted current concepts for cancer treatment and prevention. For example cellular sensitivity to multiple targeted therapies, chemotherapy and radiotherapy was shown to be governed by the extent to which cells have undergone an EMT-like transition. Resistance associated with cellular plasticity and heterogeneity has been observed in multiple adenocarcinoma and squamous carcinoma tumor tissue types. Our laboratory has a long standing interest in overcoming drug resistance in mesenchymal stem-like tumor cells and in understanding the mechanisms by which these cells evade the immune system.

The aim of this summer project is to 1) isolate naturally occurring mesenchymal subpopulations within four lung cancer lines driven by the oncogenes EGFR or KRas, 2) to verify epithelial and mesenchymal states by expression of marker proteins, and 3) isolate RNA and analyze RNA expression data for the elucidation of signaling and alternative splicing pathways which differentiate naturally occurring epithelial and drug resistant mesenchymal cell states.

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Using Big Data to Maximize the Impact and Potential of Nanomedicine

The Woodson Research group investigates science and technology policy and international development. Nanotechnology for health applications (nanomedicine) is a promising area for advance. Scientists and clinical researchers are developing nanomedicine applications in drug delivery systems, diagnostics, implants and prosthetics and it is estimated that nanomedicine is a US $100 billion market. However, governments and foundations often do not have the tools to analyze whether their programs have resulted in new products with high efficacy. In collaboration with the Brenner Research group (SUNY Poly CNSE), this project seeks to fill critical knowledge gaps regarding medical nanotechnology, health statistics, and equity by building a searchable nanomedicine database of publications, patents, funding and global health statistics to find trends in nanomedicine R&D and patterns for future technology forecasting. Research interns have the opportunity to start a new project examining nanomedicine and make significant contributions to two research teams. The student will be hosted by Stony Brook University with the opportunity to research-related time at the SUNY Poly CNSE campus in Albany. This project will require the student to: collect data, merge datasets and begin analyzing it. The student will prepare weekly progress reports (written) and updates (oral) for the team. Knowledge of Excel is required and some knowledge of software like Access, Stata and R is helpful. At the end of the summer, the student will have the opportunity to present their research and contribute to manuscripts for submission to peer-reviewed journals.

SUNY STEM Passport Program
How to access the application

1. Visit: https://www.grantinterface.com/Common/LogOn.aspx?eqs=ph_BjRFP96v7pK3S5uUjYg2
2. Create and account and/or log in.

3. Click Apply.

4. Enter STEM15 in the Access Code box and click Enter.

5. Click the link that appears to open the application. Depending on your settings, you may need to cut and paste the link it into a new browser.