SEAS Undergraduate Student Affairs and Global Programs,
the Engineering Student Council, and
the Columbia Undergraduate Scholars Program with
the Columbia Engineering Alumni Association Present
the Second Annual

Undergraduate Summer Research Symposium

THURSDAY, OCTOBER 3, 2013
5:00 - 8:00 PM
CARLETON LOUNGE, 4TH FLOOR MUDD

COLUMBIA | ENGINEERING
The Fu Foundation School of Engineering and Applied Science

Student Research Posters

Investigating the Role of Gate-16 in Erythropoiesis
Tolulope Akinade, SEAS '15, Biomedical Engineering

Effects of Channel Placement and Media Volume on the Properties of Large Engineered Cartilage Constructs
Kathleen Atkatsh, SEAS '15, Biomedical Engineering

Assaying Barrier Function in Human Pulmonary Bronchial Epithelial Cells
Sonia Bansal, SEAS '14, Biomedical Engineering

Mechanical Characterization of Ocular Tissue with Inflation Testing
Jessica Cohen, SEAS '14, Mechanical Engineering

Understanding the mechanisms behind the helicase activity of RNase R
Alan Czemerinski, SEAS '15, Biomedical Engineering

Enhancing the Oxyegen Storage Capacity of Three-Way Catalysts
Shirin Dey, SEAS '15, Earth and Environmental Engineering

Classification of Neocortical Interneurons
Naureen Ghani, SEAS '15, Biomedical Engineering

Mediation and Potential Circadian-regulation of Phagocytosis in Drosophila's Innate Immunity
Ankita Gore, SEAS '15, Biomedical Engineering

The Influence of Ion Aggregates on Super Ionic Conductivity
Yuri Gloumakov, SEAS '14, Biomedical Engineering

Modeling Cellular Response to Nanopatterned Bulk Metallic Glasses
Dorcas Huang, SEAS '16, Applied Mathematics

Tissue Localization of Cetuximab-IRDye800CW in Macaques Using Fluorescence Imaging
Asher Krell, SEAS '15, Chemical Engineering

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Kelly Liu, SEAS '15, Biomedical Engineering

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Point-of-Care Anemia Diagnostic Device for Expectant Mothers in Developing Countries
Ritish Patnaik, SEAS '16, Biomedical Engineering

CMAS Resistance of Ceramic Coatings for Next Generation Gas Turbines
Connie Phung, SEAS '15, Mechanical Engineering

Developing Techniques for Gene Knockdown During Embryonic Development in Planaria
Aishwarya Raja, SEAS '16, Biomedical Engineering

Deposition of Uniform Thin Films of (7,5) s-SWCNTs
Jonah Richard, SEAS '15, Chemical Engineering

Optimizing Prevention Budget Allocation for HIV Susceptible Populations
Andelyn Russell, SEAS '16, Operations Research

Assessment of the Functional Role of Endogenous Stores of Latent TGF-beta in Mechanically Loaded Cartilage Explants through the Novel Validation of the Specificity of a Small Molecule TGF-beta Inhibitor
Jay Shim, SEAS '15, Mechanical Engineering

Applying Machine Learning Techniques to Baseball Pitch Prediction
Corey Stafford, SEAS '15, Applied Mathematics

Molecular Characterization of *Staphylococcus aureus* Isolates Found at a Bayfront Cetacean Rehabilitation Facility
Manuel Tamargo, SEAS '16, Biomedical Engineering

Effect of Varying Concentrations and Application Periods of Chondroitinase ABC on Tissue-Engineered Cartilage
Eric Tong, SEAS '16, Biomedical Engineering

Synthesizing Superatoms as Building Blocks for Solid-State Compounds
Ari Turkiewicz, SEAS '15, Applied Physics

Integrated Membrane Permeability and Biochemical Assay for Microfluidic High-Throughput Screening
Byron Weiss, SEAS '15, Biomedical Engineering

Assessing America's Groundwater
Mary Williams, SEAS '15, Earth and Environmental Engineering

Electrode Implant Performance while Controlling for Frontal Limb Behavior
David Xing, SEAS '14, Biomedical Engineering

CP Davis Scholar Abstracts

Engineering Bridges in Morocco with EWB and Medical Software Development at Fluent, Inc.
Niger Little-Poole, SEAS '16, Operations Research

Great Minds in STEM Conference Abstracts

Synaptic Vesicle Protein Expression in Sprague-Dawley Rats Treated with the Pilocarpine Model for Mesial Temporal Lobe Epilepsy
Mayra Velazquez, SEAS '15, Biomedical Engineering

Exploring the Role of the Gate-16 gene in Erythropoiesis

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Erythropoiesis is the process in which red blood cells are produced and the maintenance of healthy red blood cells capable of carrying oxygen throughout our system is critical. When erythropoiesis is defective, it can lead to unfavorable conditions such as β-thalessemia and sickle cell anemia. Foxo3, a forkhead transcription factor, is essential in the regulation of enucleation, oxidative stress, and autophagy in erythropoiesis. In wild type mice, the Golgi-associated ATPase enhancer of 16 kDa (Gate-16) was found to be highly upregulated during terminal erythroid maturation, which was not the case in Foxo3-/- mice. Gate-16 is a gene present during autophagy. This led to an interest to elucidate the role of Gate-16 in erythropoiesis and the hypothesis that Foxo3 regulates Gate-16 directly and has a function during erythroid cell maturation. The focus of my summer research was to use two different approaches, gene knockdown and overexpression, to investigate the effect of Gate-16 during terminal erythroid maturation.Gate-16 was overexpressed or silenced by either cloning Gate-16 cDNA or short-hairpins targeting Gate-16, respectively, into murine stem cell-containing vectors tagged with the green fluorescent protein (GFP). Retroviral efficiency was first tested on NIH 3T3 cells and Gate-16 protein levels were evaluated by Western blots. The percentage of infected cells was evaluated by flow cytometry using fluorescein isothiocyanate to quantify GFP presence. These initial processes were necessary to obtain working Gate-16 retroviruses to transduce lineage negative fetal liver cells from wild type and Foxo3-/- mouse embryos to study erythroid maturation in vitro. The transduction efficiencies of the retroviruses was not optimal, ranging from 5%-12%, when the fetal liver cells were infected. The number of enucleated & red blood cells were evaluated by staining for TER-119+, CD34+, and Draq5+ cells during each day of maturation. Preliminary experimentation showed that erythroid maturation in wild type fetal liver cells was higher than in Foxo3 -/- cells. The effects of Gate-16 remain unknown since the transduction efficiency was not optimal. Studies are ongoing.

Keywords
erythropoiesis, Gate-16, autophagy, transduction, flow cytometry

Effects of Channel Placement and Media Volume on the Properties of Large Engineered Cartilage Constructs

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Osteoarthritis is a non-curable disease that commonly requires a prosthetic implant for treatment, but such implants come with numerous complications (Lambert 2013). As an alternative treatment option, we aim to engineer a disk of implantable cartilage of clinically relevant size with properties mimicking those of native human articular cartilage. Our cartilage constructs had 0, 3, or 12 channels and were cultured in 5, 10, or 15mL of media. We introduced the channels to improve nutrient diffusion and encourage the development of homogenous material properties. Media volumes were varied in an attempt to increase the minimum glucose concentration found at the center of the construct. In order to assess the properties of our constructs, we examined the glycosaminoglycan (GAG) and type II collagen (the two most prevalent matrix macromolecules in articular cartilage) content of our constructs, the DNA content and cell density, glucose and GAG concentrations in the media, and Young's modulus of elasticity. We measured the swelling of the constructs and performed histology to visualize chondrocytes and GAG and collagen content. Our constructs had an average normalized GAG content of 7.12 ± 0.28%GAG/wet weight, an average normalized collagen content of 1.60 ± 0.14%collagen/ww, and Young's moduli ranging from 278 to 333kPa. We were able to attain the highest levels of GAG found thus far in large cartilage constructs, low levels of collagen, and Young's moduli that were approximately half the values found in native cartilage.

Assaying Barrier Function in Human Pulmonary Bronchial Epithelial Cells

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Asthma is a chronic lung disease characterized by airway inflammation and pulmonary dysfunction. The incidence of asthma is increasing globally, fueling a need to better understand the disease and generate more effective therapies. Defects in the integrity of the bronchial epithelial barrier have been implicated in asthma pathogenesis, making modulation of epithelial barrier function a prospective target for therapeutic intervention. The aim of this study was to establish assays to characterize human bronchial epithelial barrier function under basal and treatment conditions. Transepithelial electrical resistance (TEER) and fluorescently-labeled dextran flux were utilized to quantify barrier integrity under basal conditions and in response to treatments that might mimic the asthmatic pulmonary milieu. First, to characterize the utility of the system, we demonstrated that barrier function was consistently negatively impacted with a known modulator of epithelial junctional integrity (EDTA). We then were able to demonstrate that in response to specific disease-relevant inflammatory stimuli, a positive correlation existed between reduced TEER and increased dextran permeability. This effect, however, was dependent upon treatment time and epithelial cell type. These preliminary findings indicate this system is amenable to assessing epithelial barrier integrity and, upon further optimization, may provide insight into this component of asthmatic pathology and serve as a screening tool for assessing activity of therapeutic intervention at this level.

Keywords
epithelial barrier function, asthma, transepithelial electrical eesistance (TEER), dextran flux

Mechanical Characterization of Ocular Tissue with Inflation Testing

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
To accurately measure the mechanical properties of biological soft tissues, it is important to recreate the in vivo conditions. The tissues of the eye wall, cornea and sclera, experience intraocular pressure (IOP) and maintain the eye's spherical shape and focal length. It is hypothesized that an alteration to the mechanical properties of the eye wall contributes to ocular disease. To be able to assess the mechanical properties of the eye wall and to test this hypothesis, a physiologically-relevant inflation testing rig was designed and built to quantify the material response of the eye wall to increases in IOP. The testing protocol developed here obtains measurements of the deformation of the tissue under controlled pressurization. This setup is flexible such that it can be used to characterize tissue material properties, to evaluate chemical treatments that strengthen the eye tissue, and to validate in vivo techniques for determining eye tissue strength.

Keywords
ocular, inflation, intraocular pressure (IOP), tissue, deformation

Understanding the Mechanisms behind the Helicase Activity of RNase R

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Ribonuclease R (RNase R, or RNR) is a 3' to 5' processive exoribonuclease found to be one of three mediators of ribonucleic acid (RNA) digestion in Escherichia coli. It has been discovered that RNR is unique in its ability to degrade highly structured RNA (double-stranded RNA and stem loops) by an intrinsic helicase activity (Vincent and Deutscher, 2008), without a need for adenosine tri-phosphate (ATP) consumption. This study strives to further understand the molecular mechanisms of RNase R activity by using the information of the X-ray crystal structure and an original time-sensitive assay that measures fluorescence anisotropy. RNA degradation is an important factor in gene regulation, thus the study of RNR can have a significant impact in advancing knowledge in the field of gene expression (Cheng and Deutscher, 2005). The establishment of this new assay will also allow for a novel quantitative model of RNR activity.

Keywords
enzyme, biophysics, RNase R, fluorescence anisotropy

Enhancing Oxygen Storage Capacity of Three-Way Catalysts

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Three-way catalytic converters found in many transportation vehicles are essential in adhering to EPA regulations requiring the control of carbon monoxide, hydrocarbon, and nitrous oxide emissions. As some materials used to synthesize the converter's catalyst (such as Cerium) or to enhance its performance (precious metals such as Platinum) are rare and/or expensive, alternative materials are currently being researched. We are investigating the ability of different materials to maximize oxygen storage capacity (OSC) of the three-way catalyst (TWC), which directly affects its conversion performance. The larger the OSC, the wider the air-to-fuel ratio and thus the better the ability of a catalytic converter to function in a variety of on-road situations. Primarily using a zirconia-heavy framework (thus cutting down on the use of Cerium, a rare and expensive metal), we are testing incorporation of alternative dopant materials by synthesizing samples of various dopant concentrations and calculating their OSC levels using thermo-gravimetric analysis. We also utilize various characterization methods such as BET (surface area calculation), Raman Spectroscopy, and X-ray diffraction to observe the effects of the dopant material on the TWC and its incorporation into the catalyst structure. We hope to achieve OSC levels similar to those of ceria-heavy solutions, thus optimizing both TWC cost and performance.

Keywords
industrial catalysis, emissions control, transportation

Classification of Neocortical Interneurons

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Determining the circuitry of the neocortex requires an understanding of its components, making a classification of neocortical interneurons necessary. Though neocortical interneurons are ideally positioned to control circuit dynamics, they remain poorly understood. GABergic interneurons, in particular, largely contribute to the vast morphological and physiological variability of the cortex. A neuronal classification system is essential to organize such information and the knowledge that is derived from it. To better understand the diversity of neocortical interneurons, we have created a classification scheme with PCA and cluster analysis based on a detailed anatomical and electrophysiological characterization of 59 GFP-positive interneurons from a somatostatin-positive mouse line. Each neuron was characterized by whole-cell recordings done by patch-clamping and complete 3D anatomical reconstructions. Using this data, we analyzed a series of physiological and morphological variables using unsupervised classification methods. PCA and cluster analysis of morphological variables revealed 3 groups of cells: one comprised of Martinotti cells, the other two composed of short asymmetric axons targeting layers 2/3 and medial bending. PCA and cluster analysis of physiological variables similarly revealed 3 groups of interneurons with respect to the action potential time course. Thus, we confirmed that there are indeed 3 subtypes of interneurons by performing quantitative classification of somatostatin-positive neocortical interneurons. Each of these 3 interneuron subtypes is furthermore characterized by a unique set of morphological and electrophysiological features that may make them particularly suited for a specialized function within the neocortical circuit.

Toll and Imd Pathways Mediate and Potentially Circadian-Regulate Phagocytosis in Drosophila's Innate Immunity

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Irregularities in circadian rhythms are known to drastically influence an organism's immunity. Studies have shown that nighttime workers with irregular circadian rhythms are at a greater risk of cardiovascular diseases, cerebrovascular disorders, mortality and immune-related health problems. Irregular circadian rhythms are correlated with reduced immune function, specifically phagocytosis; however, the molecular mechanism remains unclear. Previous studies have hypothesized a link between Drosophila's (or fruit fly's) two main immune signaling pathways, the Toll and imd pathways, and phagocytosis.

Here we show that during an infection, the two pathways mediate and potentially circadian-regulate phagocytosis. We demonstrated reduced immune function in imd and Toll mutants by infecting flies with Streptococcus pneumoniae. Injections of fluorescently-labeled dead Staphylococcus aureus and Escherichia coli in wild-type and mutant flies and subsequent phagocytosis quantification showed there might be a link between phagocytosis and the two pathways. Previously published reports indicate an up-regulation of phagocytosis in wild-type flies during the dark phase of their 24-hour circadian rhythms. Toll and imd pathway mutants do not exhibit time-of-day dependence of phagocytosis, which suggests that the two pathways might mediate circadian-regulated phagocytosis, but further experiments are needed to establish a definitive link.

These results provide a crucial step in determining the circadian-regulated mechanism of phagocytosis and the connections between the various components of Drosophila's innate immune system. Through such studies of circadian-regulated phagocytosis, we will gain a better understanding of the molecular mechanisms at work in conferring immunity to organisms with irregular circadian regulation and help address some of the health concerns regarding sleep deprivation.

Keywords
Drosophila, circadian rhythms, phagocytosis, immunity

The Influences of Ion Aggregates on Super Ionic Conductivity

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Superionic conductivity occurs when the overall charge of a system diffuses faster than the ions themselves, a phenomenon that has illusive properties in energy storage. This phenomenon has been exhibited in many metals and ceramics but not yet polymers. The advantage of polymers is that they do not conduct electricity, and under the right conditions, an ionomer salt system could be used in the next generation of smaller, safer, more energetically dense batteries. Using LAAMPS, open source simulation package, we analyzed these systems in hopes of understanding what causes some of them to exhibit superionic conductivity. In particular, the size and lifetime of ion aggregates were examined for correlations regarding this particular property. Size of an ion aggregate was determined by the maximum distance between two ions in an aggregate. Lifetime was determined by the persistence of an aggregate to maintain the same number of anions within 33% of its original content. Alone, the two parameters do not yield a clear causation, but when combined a trend begins to emerge. Results are not yet definitive, but further analysis could prove to be insightful.

Keywords
super-ionic, conductivity, polymers, batteries

Modeling Cellular Response to Nanopatterned Bulk Metallic Glasses

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Supervising Faculty, Sponsor, and Location of Research

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Abstract

Cells sense and respond to the mechanical properties of biomedical implantations; therefore using less rigid materials for implants can prevent reactions such as fibrotic encapsulation. Bulk metallic glasses (BMGs) are biocompatible materials with properties attractive for implants as they exhibit high strengths and hardness, yet due to their amorphous nature are flexible and therefore can be manipulated into specific topographies. One method of lowering the "effective stiffness," or how cells sense surface rigidity as opposed to the mechanical properties of the material, is to pattern the substrate with a nanorod array. When cells are seeded onto nanopatterned BMGs with sufficient effective compliance, the rods deflect under the contractility of the cells, providing evidence of lower effective stiffness. Mathematical modeling of cell-nanopattern interactions allows for in silico experiments that can predict changes in cell morphology in response to topography. In our mathematical model, we predicted the change in cell size after being placed on nanopatterned BMGs with nanorods of diameters of 55, 100, 150, and 200 nm through minimization of the free energy of the cell. Placing fibroblasts on nanopatterned BMGs reduced the surface area of the cell in contact with the substrate compared to fibroblasts cultured on flat surfaces. This model allows us to harness specific cell response by custom tailoring nanotopography by mathematical prediction rather than experimentally determining the dimensions of nanorods via trial and error. By fine tuning cellular response to the material properties and topography of a substrate, we can build systems such as stents and biosensors specific to biological functions without compromising the function or lifespan of the device.

Keywords

bulk metallic glasses, cell-nanopattern interactions, modeling

Tissue Localization of Cetuximab-IRDye800CW in Macaques Using Fluorescence Imaging

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Supervising Faculty, Sponsor, and Location of Research

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Abstract

Monoclonal antibodies targeting over-expressed receptors on cancer cells provide important mechanisms for tumor treatment. Cetuximab targets the epidermal growth factor (EGFR) that is often used alone or in combination with other therapies. Despite its widespread use since 2005 little is known about the specific regions within tissues where the drug is localized following administration. Fluorescence tissue imaging after systemic administration of cetuximab conjugated to a near infrared fluorophore provides a novel approach to address this question. The goal of this experiment was to examine and localize fluorescence in macaques treated with cetuximab-IRDye800CW, since this agent binds equivalently to macaque and human EGFR. Cetuximab was covalently linked to IRDye800CW with retained immunoreactivity. Male cynomolgus macaques (~3kg) were intravenously injected with either cetuximab-IRDye800 (treatment group, n=4) or cetuximab (control group, n=4) at a dose of 20.83 mg/kg over 1 hour. At necropsy on post-infusion day 15, a total of 38 tissue samples from each primate were collected, mounted, and stained for hematoxylin and eosin (H&E). Slides containing treatment and control tissue pairs were fluorescently imaged on the Odyssey (LICOR) scanning system using the same acquisition settings. Overlays were created with high resolution photographs taken of the H&E stained slides to determine localization of IRDye800 fluorescence in each tissue, as determined by comparing directly with control tissues. Fluorescence signal in each tissue section was further analyzed using ImageJ. The liver had the highest fluorescence signal consistent with high EGFR expression and known liver clearance of cetuximab. The brain and GI tract showed the lowest signal above background. Cetuximb-IRDye800 fluorescence was identified within the connective tissues of the testicle but not in the seminiferous tubules with a similar pattern to collagen staining. The lymph nodes also had particularly high localization of fluorescence concentrated in the medullary portion of the node however, little to no dye was found in the lymphoid tissue itself. Fluorescence localized within the connective tissue of the liver as well; however it was a much more diffuse pattern with additional dye remaining in the wall of the vessels and wall of the gall bladder. In the lungs the dye seems to have diffuse dye retention in the alveoli with some staining in the walls of the airways and vessels. Tissue taken from both the anterior and posterior skin had higher fluorescence in the epithelium of the hair follicles and a particularly high and diffuse pattern in all layers of the epidermis excluding the stratum corneum. IRDye800 fluorescence was detected 15 days after administration and after fixation and H&E staining. Specific fluorescence was identified in the connective tissue, vessel walls, and epithelial cells of the epidermis. The very low fluorescence of tissue from the brain is due to the blood brain barrier restricting passage.

Keywords

The Role of p53 in Human Mesenchymal Stem Cell Differentiation

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Supervising Faculty, Sponsor, and Location of Research
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Abstract

The tumor suppressor protein p53 has been referred to as the 'guardian of the genome'. The role of the protein includes inducing cell cycle arrest and apoptosis after DNA damage. Recently, p53 was found to play an important role in regulating stem cell proliferation and differentiation. The goal of the project was to see whether p53 can influence the human mesenchymal stem cell differentiation towards a variety of cell lineages. Human mesenchymal stem cells were isolated from liposuction materials and later induced to differentiate towards the osteogenic, adipogenic, smooth muscle, and endothelial cell lineages. A p53 activator (nutlin-3) and an inhibitor (cyclic pifithrin-α hydrobromide) were used in varying concentrations to observe p53's role during differentiation process. Results concluded that p53 is down-regulated in adipogenic, osteogenic, smooth muscle, but up-regulated in endothelial cell differentiation. The activator nutlin-3 can inhibit osteogenic and adipogenic differentiation, while the inhibitor pifithrin-α can enhance the differentiation. In a conclusion, p53 acts as an important player in hMSC differentiation, which might be used for regenerative medicine in the future.

Keywords
p53, human mesenchymal stem cells, smooth muscle cell, endothelial cell, differentiation

Java Objects Over Network (JOON): An Easier Java RPC Framework

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Remote procedure calls (RPC), commonly implemented in Java with the Remote Method Invocation (RMI) API, allow the invocation of methods of objects located on remote machines, an ability crucial to many distributed computing applications. We present Java Objects Over Network (JOON), a uniquely robust yet straightforward RPC framework. JOON aims to give the developer the most streamlined RPC experience possible. With as little as one line of code, JOON can start a thread exposing an object through a server socket, or can dynamically generate a local proxy for a remote object which then can be treated, for most purposes, as a normal Java object. All objects are compatible with JOON, including instances of classes provided by the Java Platform, and there is no requirement for objects to implement any interfaces or extend any classes. Features include automatically maintained object registries, concurrency control, and resilience to node failures and network partitions. Though lightweight and accessible, JOON is more powerful than any traditional RPC framework.

Keywords
distributed computing, remote procedure calls, remote method invocation, Java, reflection

Point-of-Care Anemia Diagnostic Device for Expectant Mothers in Developing Countries

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Two-thirds of all expectant mothers in developing countries have anemia, in which the body lacks enough hemoglobin. This condition is linked to high perinatal and maternal mortality rates. Current methods for diagnosing anemia in developing countries have largely been expensive, slow, and limited to major cities. For example, the gold standard of anemia testing, a complete blood count (CBC), is done in a lab setting. However, such a venue is impractical in rural areas of developing countries. Thus, there is a need for an inexpensive anemia diagnostic device that can be used in these areas.

This project introduces the prototype for an inexpensive anemia diagnostic device that can be used for point-of-care testing. This prototype aims to replicate the accuracy of Hemocue, the industry standard for anemia point-of-care technology, while boasting a lower price and increased portability. To do so, we have constructed a photometric chamber with a 565 nm LED, photodiode, and microfluidic channel to measure the absorbance of the sample. Light from the LED is absorbed by blood samples in the microfluidic channel. Transmitted light produces a current across the ends of the photodiode, which are then amplified to a discernible voltage. Therefore, we correlate the blood's absorbance to a hemoglobin concentration, allowing us to determine a voltage threshold by which to diagnose anemia.

Thus far, we have run preliminary lysing and calibration tests within our anemia diagnostic prototype. These tests suggest that we should lyse the red blood cells in our patient samples for accurate hemoglobin concentration readings. We are now exploring the use of dry lysing agents in the microfluidic channel. Ultimately, we aim to integrate the chamber within the mChip, a portable HIV/syphilis diagnostic system, to create a comprehensive antenatal care panel of tests that retails for $1 per test.

Keywords
point-of-care testing, anemia, diagnostics, microfluidics, spectrophotometry

CMAS Resistance of Ceramic Coatings for Next Generation Gas Turbines

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Thermal barrier coatings (TBCs) in gas turbines and jet engines serve as critical intermediaries between high temperature conditions that the engines operate at and the metal components of the engines. However, as turbines and engines are built to be more and more efficient by operating at higher temperatures (>1300°C), the current industrial standard TBC, 7-YSZ, deteriorates at a faster rate. Furthermore, jet engines operating in desert regions are subject to increased deterioration and spalling of the TBC due to molten deposits resulting from the dusty environment. Our research seeks to find the relatively optimal TBC from the yttria-, tantala-stabalized zirconia system (YTaSZ) as a reliable alternative for 7-YSZ at these higher operating temperatures as well as against CMAS (sand) infiltration. Four YTaSZ compositions, representative of a progression between two phases and chosen for their relative stability and resistance to CMAS, were tested by exposing polished pellet samples to CMAS at simulated engine temperatures. The TBC samples were then examined for surface reactions and CMAS infiltration depth through electron microscopy and energy-dispersive X-ray spectroscopy. During experimentation, we found that the denser samples developed reaction products and crystalline grains which prevented the CMAS from penetrating into the TBC. However, the samples into which CMAS did percolate are theoretically more resistant to CMAS and will be further investigated using denser pellets. The potential of these stronger, more resistant TBCs as coatings for power generators and jet aircraft will not only lengthen the operational lifespan of these machines, but open the doors for the development of safer, more efficient turbines and engines.

Developing Techniques for Gene Knockdown During Embryonic Development in Planaria

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Supervising Faculty, Sponsor, and Location of Research
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Abstract

The processes involved in planarian regeneration have been studied for over 100 years. Planaria are useful models that can be used to study embryology, stem cell biology, and robust regeneration response. In particular, the Schmidtea Mediterranea (S. med) species of planaria has been used by researchers to elucidate the molecular basis for regeneration. This study is the first demonstration of gene knock down during S. med embryogenesis. A gene called ovo, which is required for the development and maintenance of eye tissue, is easily identifiable and produces a reproducible phenotype; its knock down leads to missing eyes. In past studies, ovo and other genes involved in the regeneration process have been successfully knocked down by RNA interference (RNAi) in asexual S. med adults. However, it has never been studied whether these genes can be successfully knocked down during planarian embryogenesis. This study sought to answer this question through proof-of-principle experiments that demonstrated RNAi knock down during S. med embryogenesis. Hatchlings at days 10, 16, and 18 were soaked in a 300 nM solution of ovo dsRNA and planarian culture media. After careful observation over a week, a majority of the hatchlings with the experimental treatment regenerated head regions without photoreceptors. Live images of the hatchlings were taken with a fluorescence microscope. Then, in situ hybridization assays were performed to qualitatively visualize the ovo gene expression pattern and assess the extent of knock down; these confirmed that the eyes did not regenerate and that ovo was not being expressed near the head regions. An in situ hybridization time course was also conducted, which demonstrated that ovo is expressed starting at 7 days and appears restricted to developing eye tissue. Whole animal qPCR results, which will quantitatively confirm the knock down, will be attained by the end of the month. This study paves the way for direct gene comparative studies for genes that control embryonic development and regeneration in planaria.

Keywords
gene knockdown, planaria, embryonic development, stem cell biology

Deposition of Uniform Thin Films of (7,5) s-SWCNTs

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Third generation organic photovoltaics have the potential to generate low cost electricity while simultaneously attaining high solar conversion efficiencies, thereby promoting further reduction in society's dependence on conventional energy sources. This project focused on the utilization of semiconducting single-walled carbon nanotubes (s-SWCNTs) as the donor material in our prototype OPV devices and involved a two-fold effort; first, a method was developed to selectively extract single chirality (7,5) s-SWCNTs from bulk CoMoCat SG65i nanotubes using Poly(9,9-di-n-dodecylfluorenyl-2,7-diyl) (PFO). Excess PFO was subsequently removed via ultra-centrifugation techniques, yielding a pure solution that was used to fabricate thin film devices in the latter half of the project. Thin films of (7,5) s-SWCNTs were deposited onto quartz/TiO2 substrates using an ultrasonic spray setup and characterized using UV-vis-NIR spectroscopy, Atomic Force Microscopy, Scanning Electron Microscopy, and time-resolved microwave conductivity. Our endeavors ultimately produced films that were progressively more uniform with each deposition due to the constant refinement of spray techniques, but were still inconsistent with initial expectations.

Keywords
photovoltaics, solar conversion, microscopy, spectroscopy

Optimizing Prevention Budget Allocation for HIV Susceptible Populations

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
In the 2012 Global Report, UNAIDS affirmed that 34.0 million people worldwide are HIV-positive. Yet this statistic does not reflect the disease prevalence of specific regions and countries, as 69% of all HIV-positive individuals live in Sub-Saharan Africa. To implement prevention plans, give treatment and provide support to infected individuals, UNAIDS reports that US $16.8 billion was spent in 2011. Though great advances have been achieved, the US $16.8 billion falls short of UNAIDS' goal of US $22-24 billion in annual spending for 2015. With limited resources for combating HIV, mathematical models are helpful tools for determining optimal budget allocation.

The objective of this project was to determine the optimal budget allocation for HIV prevention funds in a population with groups at high and low risk for contracting the disease. A simple deterministic model of transmission was constructed in Excel to simulate the disease prevalence in each group over five and fifteen years. Variables were incorporated to represent population growth, mortality, populations of individuals susceptible and infected with HIV, infectivity within and between the high and low risk groups, funds spent, and budget effectiveness. The model was designed to simulate a general population; additional variables and values can be included to align the model with a specific population. A linear approximation of disease prevalence was also created to directly determine disease prevalence. Results from the model demonstrated that the entire prevention budget should be spent on either the larger group or the group for which the budget is most effective. Dividing the prevention budget between high and low risk groups leads to a higher disease prevalence after five and fifteen years than allocating the entire budget to either group. With population-specific data, the model and linear approximation can assist organizations in causing the maximum decreases in HIV prevalence.

Keywords
mathematical, modeling, epidemiology

Assessment of the Functional Role of Endogenous Stores of Latent TGF-Beta in Mechanically Loaded Cartilage Explants through the Novel Validation of the Specificity of a Small Molecule TGF-Beta Inhibitor

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
An intriguing characteristic of articular cartilage is its exceptionally high content of the anabolic mediator, transforming growth factor beta (TGF-beta), which resides bound to its extracellular matrix. In healthy tissue, levels are reportedly as high as ~300ng/mL, 1-2 orders of magnitude above concentrations present in synovial fluid. These extracellular TGF-beta stores are overwhelmingly in the inactive latent form, suggesting that, as established for other tissues, extracellular activation is the critical rate-determining step for bioavailability. While it is well-established that TGF-beta enhances the chondrocyte matrix synthesis, few studies have explored the mechanisms behind its activation in articular cartilage, and thus, the functional role of these latent stores in the tissue remains unclear. Articular chondrocytes secrete a host of proteases that have been shown to enzymatically activate latent TGF-beta in other tissues, such as matrix metalloproteinases and serine proteases. This secretion increases during physiologic tissue loading and is further enhanced in response to injury, advancing the novel hypothesis of this study: physiologic dynamic loading of cartilage enhances the mechanical properties of the tissue, mediated by the action of activated endogenous TGF-beta.

This hypothesis is tested through the long term culture of cartilage explants which are maintained under dynamic loading or free swelling conditions while in the presence or absence of an inhibitor of endogenous TGF-beta activity. This analysis is facilitated through the preliminary identification of a small molecule inhibitor of the TGF-beta receptor ALK5 kinase, LY364947, which inhibits TGF-beta activity on chondrocytes without exhibiting any nonspecific effects on chondrocytes proteoglycan synthesis.

Results demonstrate that TGF-beta inhibition similarly decreases the mechanical properties of free swelling and dynamically loaded cartilage explants. This finding suggesting that endogenous TGF-beta activation is not induced by mechanical loading and that these endogenous stores function to maintain the tissue independent of mechanical loading conditions.

Keywords
cartilage, transforming growth factor beta (TGF-beta), dynamic loading, chondrocyte, inhibitor

Applying Machine Learning Techniques to Baseball Pitch Prediction

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Supervising Faculty, Sponsor, and Location of Research

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Abstract

Major League Baseball (MLB), a professional baseball league in the US and Canada, is one of the most popular sports leagues in the world. Partially because of its popularity and the wide availability of data from games, baseball has become the subject of significant statistical and mathematical analysis. Pitch analysis is especially useful for helping a team better understand the pitch behavior it may face during a game, allowing the team to develop a corresponding batting strategy to combat the predicted pitch behavior. We apply several common machine learning classification methods to PITCH f/x data to classify pitches by type. We then extend the classification task to prediction by utilizing features only known before a pitch is thrown. By performing significant feature analysis and introducing a novel approach for feature selection, moderate improvement over former results is achieved.

Keywords

pitch prediction, feature selection, ROC, hypothesis testing, machine learning

Molecular Characterization of *Staphylococcus aureus* Isolates Found at a Bayfront Cetacean Rehabilitation Facility

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Over a third of humans are colonized with the Gram positive bacterium, *Staphylococcus aureus*. Normally, *S. aureus* colonizes without infecting its host. However, is an opportunistic bacterium capable of causing a wide range of symptoms when infection occurs. Treating infections caused by *S. aureus* is much more challenging when caused by a bacterium that has acquired antibiotic-resistance, like Methicillin Resistant S. aureus (MRSA).Depending on the type of infection symptoms may vary from a simple rash to Toxic Shock Syndrome, or even death. The study of *S. aureus* and MRSA as a human pathogen is an area of active research, but less is known about its impact in marine life. On three separate days in 2011, *S. aureus* was isolated from environmental samples, human volunteer samples and pilot whales from a bayside marine mammal rehabilitation site. The isolates were identified with the use selective media (Baird Parker and Manitose Salt Agar) and biochemical methods, such as coagulase agglutination tests. PCR and real-time qPCR were used to confirm identification and further characterize isolated organisms. For example, species-specific gene gyrA was used to identify *S. aureus* while the presence of mecA indicated methicillin resistance. Isolates were further characterized by the presence or absence of virulence and adhesion genes. Staphylococcal cassette chromosome typing, multilocus sequence typing and pulse field gel electrophoresis were used to determine strains of *S. aureus*. Results indicate 15 different strains of *S. aureus* were isolated from collected samples. Interestingly, genetically identical strains were shared among humans, pilot whales, and the environment. This research supports the notion that *S. aureus* may be shed into the environment, such as seawater, where colonization and infection of new hosts could occur.

Keywords
Staphylococcus aureus, MRSA, PCR, pilot whales, microbiology

Effect of Varying Concentrations and Application Periods of Chondroitinase ABC on Tissue-Engineered Cartilage

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Osteoarthritis, a chronic malady characterized by joint pain and swelling, is caused by damage to articular cartilage. While many treatment options for osteoarthritis exist, these options focus on coping with the disability rather than fixing it. Present surgical options face many complications. The ideal treatment option for osteoarthritis is to develop tissue-engineered cartilage that is grown in vitro with autologous cells which is then used to replace the patient's own damaged tissue. This concept has been demonstrated in a canine model. Human cartilage with native mechanical properties, however, has not been developed. If collagen II production by chondrocytes is maximized, cartilage tissue with mechanical properties that more closely mirror the tension-compression nonlinearity properties found in native cartilage tissue can be created. To achieve this goal, chondroitinase ABC (cABC) is applied to temporarily remove proteoglycans from the cartilage matrix and give more space for collagen II to develop. The goal of this study is to determine an efficient cABC treatment technique for tissue-engineered cartilage. The "low" cABC treated group received daily feeding of 0.075 U/mL from day 14 to 21 followed by a replacement of chondrogenic media without cABC. The "high" cABC treated group received a onetime addition of 0.15 U/mL from day 14 to 16 followed by a replacement of chondrogenic media without cABC. At the end of 42 days, the constructs were analyzed using mechanical testing. The testing showed that high cABC treatment yielded significantly closer to native mechanical properties when compared to results of low cABC treatment and control. Biochemical and histological analyses confirmed that the proteoglycan and collagen II content were higher in the low and high cABC treated groups when compared to the control. All measures show that the most efficient application of chondroitinase ABC is the two day treatment of a higher concentration (0.15 U/mL).

Keywords
cartilage, osteoarthritis, chondroitinase ABC, tissue engineering, regenerative medicine

Synthesizing Superatoms as Building Blocks for Solid-State Compounds

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Molecular clusters – spherical groupings of atoms with an inorganic inner core and an organic outer shell – are a unique class of materials exhibiting collective electronic properties that lie between those of single atoms and bulk solids. Many chemical properties of clusters arise out of the particular aggregation of their constituent atoms, and are retained under electrochemical transformations. Furthermore, the robustness of cluster chemistry allows one to tune the properties of these clusters by design. Molecular clusters can in this sense be treated as superatoms, effectively extending the Periodic Table. This work describes efforts to expand the library of molecular clusters, and to leverage their unique electronic properties to build solid-state compounds with superatoms replacing atoms as discrete subunits. Several routes toward synthesizing clusters with a core comprised of early transition metals and oxygen were explored. Titanium and vanadium precursors were each reacted with a series of oxo-transfer agents and ligands under a variety of reaction conditions and screened for cluster formation. Solid-state compounds were targeted by two independent strategies: (1) mixing of electron-rich and electron-deficient clusters to encourage electron coupling or transfer and subsequent co-crystallization, and (2) chemical functionalization of the organic outer shell to enable covalent bond formation between clusters.

Spectroscopic data suggest that certain syntheses of titanium-oxide clusters were successful; however, single crystals of such clusters have yet to be isolated, precluding structure confirmation. Preliminary experiments have yet to yield solid-state compounds using the first strategy, although evidence has been observed for electron transfer events. Various means to install active functional groups on clusters are presently being optimized before solid-state compounds are pursued by the second strategy. This study has deepened our understanding of cluster formation and laid the groundwork for the development of a new class of solid-state compounds with high potential for electronics applications.

Keywords
molecular clusters, solid-state compounds, electron transfer, self-assembly

Integrated Membrane Permeability and Biochemical Assay for Microfluidic High-Throughput Screening

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
High-throughput screening (HTS) is a powerful tool for drug discovery. Current HTS centers use specialized robotic systems to evaluate a library of compounds for activity in either a biochemical or cell-based assay, with each "hit" suggesting a potential drug-precursor. Conventional biochemical high-throughput screens lack many of the benefits of cell-based assays, such as integrated functional screening for membrane permeability and cytotoxicity. We are developing next-generation biochemical HTS assays that integrate the benefits of cell-based assays in a microfluidic-controlled platform operating at the picoliter-scale. We explored the use of synthetic lipid bilayers as a means of incorporating a membrane permeability screen into a protease activity assay. Preliminary data indicate that lipid treatment results in a target that is separated from the test compound, consistent with our goal. With further development, we hope that this will allow for the incorporation of membrane permeability assessment into biochemical high-throughput screens.

Keywords
biochemical assay, drug discovery, high-throughput screening, microfluidic, membrane assembly

Assessing America's Groundwater

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
In the United States, groundwater is an important natural resource. About 20% of all water withdrawals in the USA come from groundwater (USGS, 2005). Through collection and analysis of groundwater data in the US, climate, geological and water use factors were analyzed to see their effects on raising, maintaining and depleting groundwater levels. Water table elevations are important to look at because they are widely used for estimating aquifer recharge, the understanding of which is key to better groundwater management. Seasonal, decadal, and centennial trends of water table level changes, precipitation events, and temperature were analyzed across the entire continental USA from 1950-2009. Most papers have done case studies of smaller regions of the United States or analyzed surface water instead of groundwater. This study also aims to look at the response time of groundwater to those specific stimuli and what factors affect that time lag such as well depth and lithography of the soil. The significance of our project lies in our contribution to the existing efforts by creating a database that is more thorough, spans a longer period of time, and on a continental scale. This database will then aid us to form more informed hypotheses based on observed trend and statistical analysis.

Keywords
groundwater trends, climate, aquifers, withdrawal

Electrode Implant Performance while Controlling for Frontal Limb Behavior

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Supervising Faculty, Sponsor, and Location of Research
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Abstract
Currently, the standard for developing neural prosthetic devices involves implanting the patient with chronic recording electrodes to detect action potentials generated by cortical areas in the central nervous system. However, to address the safety and performance standards of these devices, the long term reliability of these electrodes must be assessed. This study improves upon previous work which characterized the firing rate decay of electrodes using a mouse model. The previous study did not account for behavioral variability within recording sessions, while this study controls for mouse behavior by implementing a video recording and behavioral classification system based on the commercial software, Homecage Scan (Cleversys, Inc). A mouse was implanted with a commercially available optrode (Neuronexus, Ann Arbor, Michigan) in the motor cortex area corresponding to the front limb and resultant signals were acquired in 20 minute recording sessions for three months. Behavioral classifications were matched to the electrophysiological data and firing rate was calculated only during the time periods where the mouse was moving its front limbs. Resulting firing rate decay plots demonstrate a marked difference between using the whole recording and using only front limb motion time periods. They also demonstrate the characteristic rise in firing rate detection during the first few weeks after implantation before stabilizing. As of the writing of this abstract, no significant decay in firing rate has been observed, which is consistent with previous observations. With this model, we will provide a more accurate representation of electrode decay which will serve as a baseline to for testing against possible decay factors such as immunology response or electrode degradation.

Keywords
electrophysiology, behavioral classification, intracortical electrodes, mouse model

CP Davis Scholars Abstracts

Engineering Bridges in Morocco with EWB and Medical Software Development at Fluent, Inc.

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Supervising Faculty, Sponsor, and Location of Research
Columbia Engineers Without Borders, Ait Bayoud, Morocco, Fluent Medical, Inc., New York

Abstract
Engineers Without Borders

Ait Bayoud is a small rural community of subsistence farmers in Morocco. It is situated on the Tagawowt River in the HaHa Province . Every year the river floods during the rainy season, isolating the west side of the river from the east. However, all the medical and education services are located on the east side of the river. So every year, citizens of Ait Bayoud are isolated from vital community services. To address the flooding of the Tagawowt River, the community suggested a bridge project to EWB-USA CU so that the river could be safely and consistently crossed during the rainy season. Along with professional structural engineers, various Peace Corps volunteers, and a host of community leaders and workers in Ait Bayoud, the students of the Morocco project have worked to fund, design, and source materials for the implementation of a 210ft suspension footbridge.

In the summer of 2011 and the winter of 2012, two assessment teams gathered technical data and determined a bridge site. In the summer of 2012, implementation of the bridge began. Over the course of 6 weeks, our team of students and professional mentors worked alongside local workers in Ait Bayoud to clear and prepare the bridge sites, mix and pour the concrete foundations and towers, and install each of the bridge's main cables. This past summer, two more implementation teams ventured out to Morocco with the goal of completing the first Tagawowt Bridge. I participated as a member of Implementation Team #1. At this point we had a bridge with no decking. The bridge had towers and cables however. Our goal, as Team #1, was to complete as many tasks as possible so that when Team #2 arrived, they could work solely on decking. We spent the first week doing assessment work such as inventory, surveying, and wood assessment. We painted the decking planks and replaced tools/wood that had not survived the year in storage. Next we installed new safety features such as anchor rebars. This required rock drilling into bedrock and installing this rebar. We spent the second week primarily dealing with rope tensioning. The bridge cables had been placed but not installed at proper tensions. We were tasked with retensioning each cable to the correct tension. This required the construction of a cable pulling system that allowed us to tension the cables using large amounts of force.

Finally, we built the traveler. The traveler is a tram that rides on the suspension cables of the bridge. The traveler allowed Team #2 to ride out onto the middle of the bridge span and install the decking planks. While the traveler was designed and tested at Columbia during the school year, it wasn't feasible to try to ship it to Morocco. So our team was tasked with learning the design, finding the pieces, and reconstructing the traveler onsite. Overall, Travel Team #1 had a successful trip. We completed enough tasks so that the second team finished the bridge on schedule. While we did have some setbacks, such as discovering our dynamometer was nonfunctioning, we persevered. Today a bridge stands over the Tagawowt River, allowing safe passage for the many families of Ait Bayoud.

For more information visit our website: http://morocco.cuewb.org/ or our Facebook page:
https://www.facebook.com/pages/Engineers-Without-Borders-USA-CU-Morocco/300910299942360

Also visit our Summer Travel Blog: http://ewbmoroccotravelblog.wordpress.com/category/summer-2013-implementation-trip/

Fluent Medical, New York City, NY

Fluent Medical, located in New York City, makes intuitive software tools for physicians. We focus on software that helps improve patient care and safety, physician productivity and financial returns for practices and hospitals. Fluent Medical designs and implements the cloud based iPatient suite of medical tools. iPatient Signout is the most notable of Fluent Medical's offerings. iPatient Signout is a cloud based patient handoff solution allowing doctors to facilitate transitions in a quick, inexpensive, and efficient way. The Joint Commission Center for Transforming Healthcare has mandated systemized and standardized hand-offs for physicians and all staff who are involved in shift work and transfer of care. Mistakes and omission of information in the transition of care account for up to 80% of all avoidable hospital mistakes. The importance of better tools in medicine, which lead to less accidents and more saved lives is what attracted me to Fluent Medical. When I began working for Fluent Medical in June, as a Business Analyst Intern, Fluent Medical was in the process of reinventing its web presence. As such, the majority of my initial tasks were related to launching to 2.0 version of the website. Some of tasks included but were not limited to extensive QA testing, copywriting, and web interface design. The goal was not only to make a "prettier" website, but one that was easily usable for the doctors we reach out to, many of whom are older and not entirely comfortable with technology. Working on the web presence allowed me to learn the many facets of Fluent Medical's software and products. As my knowledge of iPatient, Fluent Medical's clients, and even competitors increased, my tasks also increased. As an engineering student with a technical background I was tasked with reading medical facilities' Request for Proposals (RFP). My Columbia education combined with my new knowledge of the technical aspects of Fluent Medical's products allowed me to read these RFPs and determine if iPatient could technically serve their needs. This role expanded over time and not only was I reading RFPs but also learning government compliance standards such as HIPAA, IPASS, PQRS or the Department of Defense's DIACAP standards. My task being to figure out if/how Fluent Medical could become compliant with these technical standards.

By the end of my summer at Fluent, my knowledge of healthcare technology had grown to levels I had never expected. The CTO, realizing this, tasked me with investigating new markets for the company to expand to as well as doing preliminary market valuations for the markets Fluent Medical was already invested in. I had to the chance to pitch a few new product ideas to the CTO and CEO of the firm. Fluent Medical is a software startup relying on venture capital funds to finance daily operational costs. Working in a software startup allowed me to learn the details of starting and sustaining a business. During this summer alone, I witnessed Fluent Medical expand from an 8 person team to 15, almost doubling the staff. My work at Fluent Medical has not ended with summer. I was invited back to continue work with the team during the Fall Semester of 2013. While the 2.0 website that I worked on in June has been launched, we are already far in the process of designing and implementing version 3.0. The hope is to launch version 3.0 before the end of autumn.

For more info on Fluent Medical, visit: http://fluentmedical.com/

Great Minds in STEM Conference Abstracts

Synaptic Vesicle Protein Expression in Sprague-Dawley Rats Treated with the Pilocarpine Model for Mesial Temporal Lobe Epilepsy

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Supervising Faculty, Sponsor, and Location of Research
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Abstract

Epileptogenesis is the process in which the brain develops chronic epilepsy after an initiating event. Epileptogenesis develops during the latent period after a brain becomes status epilepticus (SE). During this period, there are major molecular and physiological changes in several areas of the brain, including the hippocampus. Synaptic vesicle proteins 2 (SV2) are important hippocampal neuronal glycoproteins that are targeted by novel antiepileptic drugs. Although the exact function of SV2 remains unclear, it appears that these proteins play a major role in epileptogenesis. Consequently, we decided to analyze the expression of SV2 isoforms in the hippocampus of Sprague-Dawley rats treated with the pilocarpine model of MTLE. Preliminary studies indicate a down regulation of SV2A expression in human and animal models of epilepsy. We hypothesize that other SV2 isoforms will also exhibit changes of expression in epileptic versus control animals. Our goal is also to determine at what point in time during epileptogenesis SV2 rearrangement occurs. To evaluate our hypothesis, we calculated the expression of SV2A, SV2B, and SV2C isoforms using immunohistochemistry, western blot, and qPCR techniques. Our results support the hypothesis that SV2 isoforms are abnormally expressed during epileptogenesis. It is thereby important to consider seizure-mediated changes in pharmaceutical target expression during epileptogenesis in order to improve effectiveness and design disease-modifying antiepileptic drugs at different stages of the epilepsy. From our results, it is obvious that major changes in SV2 isoform expression occur during the latent period. Currently, most drugs target patients at the post-latent period. Congruently, it seems appropriate now to develop drugs that can target patients during the latent period to possibly halt the process of epileptogenesis in patients at risk.

This research abstract was accepted for presentation in the annual Great Minds in STEM Conference being held from October 3rd-5th in New Orleans.

Keywords
SV2 isoforms, pilocarpine, Mesial Temporal Lobe Epilepsy (MTLE)

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