2018

Saint Francis University

Pre-College Research Academy

Proposed projects

For more information or for questions please contact:

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Assessing the costs and benefits of occupational regulation

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Recent estimates suggest that occupational licensing affects nearly a third of the US workforce.[1] In July of 2015, the White House released a report documenting the costs and benefits of occupational regulation.[2] Occupations ranging from physicians and dentists to fortune tellers and florists require licensing in certain states. The goal of this research project will be to:

1) Document licensing requirements for all occupations in the US
2) Analyze the effects of licensing on labor market outcomes such as wages, employment, and mobility.
3) Identify the effects of occupational licensing on entrepreneurship
4) Estimate the effects of occupational licensing on the quality of services delivered to consumers.

Students interested in learning more about economics and public policy analysis are encouraged to participate. Students will have the opportunity to work side-by-side with both college professors and advanced undergraduate researchers. Students may have the opportunity to co-author policy reports documenting the costs and benefits of occupational regulation.

Study to take place for 6 weeks (June 4 – July 13)

Visualization of the Surface of Acid Mine Drainage

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Recently, my research, in collaboration with SFU Environmental Engineers, has focused on Acid Mine Drainage (AMD), the leading water pollution problem in Pennsylvania. Currently, more than 3,000 miles of water in PA are affected by AMD, mostly due to old coal mines. To remediate an AMD stream and return it to a natural state, Open Limestone Channels (OLCs) have been implemented in streams across our region. When the polluted, acidic water runs over limestone (a base) rocks, the pH is increased, forcing many of the metal pollutants out of the stream. We intensively monitored the Swank 13 Mine OLC for a number of years because the application of lab-based predications to field-scale treatment systems appear to systematically over-predict treatment effectiveness. Focusing on aluminum-dominated AMD, we found that both lab based and field based OLC systems removed Al and increased pH even though effluent pH never exceeded 4.8. <u>In order to better understand how OLCs function, our next step is to study the surface of the limestone with special attention on the coating that forms on the limestone rocks as acid/base reactions occur. We will have to use techniques such as Atomic Force Microscopy (AFM) or Scanning Tunneling Microscopy (STM) to study the rock surfaces.</u>

Study to take place for 4 weeks (June 4 – June 29)

Writing Empathy, Learning Compassion:
The Emotional Life of a Hospice Health Care Professional

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Empathy and concern for someone's suffering are the essential ingredients for compassion, this deeply shared humanity. We wish that all our health care professionals—from medical doctors to hospice caretakers—act with compassion when approaching us in times of illness. Because health care professionals understand what it feels like to be deeply hurt or suffering, they should naturally want others to be free from such pain. Teachers of would-be health care professionals strive to inculcate in their students a compassionate approach to health and healing. Compassion is often times a learned behavior. We learn to develop compassion and empathy over time, and they require hard work, selflessness, attention, and lots of listening.

During this summer academy, students who aspire to become health care professionals (PAs, PTs, OTs, nurses, or doctors) will engage in a different type of shadowing: we will collaborate with a local hospice, and we will observe the caretakers. We will get to know the doctors, nurses, and other medical staff, their families, and their stories. We will study medical records and specific kinds of illnesses that compel one to look for hospice care. We will study the ways in which health care professionals deal with emotions and experiences in ways that help them become more compassionate. Then, we will write poems, stories, or reflections about these experiences. Through our writing, we will begin to understand the ways in which health care professionals manifest their compassion and their empathy. We will use our writing to create a digital archive. In this way, students will be introduced to the mechanisms of compassion and the ways it actually shapes the life of a health care professional. Reflecting on it, they will create a philology of compassion.

Study will take place for 2 weeks in June and some meetings in August
June 8-13, 2018 students will meet on campus.
June 13-20, 2018 students will meet at the hospice.
Students will meet again face-to-face in the beginning of August, 2018.
(Students are required to have access to the internet for correspondence in July and August.)

Batteries from Bacteria: Power Production from Microbial Fuel Cells

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School of Scinces

Learn to build, monitor, and maintain a battery that harnesses bacterial power to generate electricity from wasted organic matter. Then work on making the energy we get from these systems bigger and better.

Study will take place for 4 weeks (May 21 - June 15)

Students would be expected to come to campus 3-5 days/week, in the afternoons until their school year is finished. We would likely ramp up for the last 1-2 weeks.

Cytochrome *c* Structure and Function: How does changing the microenvironment around the protein affect the electron transfer process?

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Cytochrome *c* is a vital protein in the electron transport chain needed for the production of ATP. Cytochrome *c* shuttles electrons between two membrane proteins and has to dock at their surface to pick up or drop off electrons. To help understand how cytochrome c functions in biological systems models are created to probe the protein chemistry. The models used to study the protein docking incorporate gold electrodes, gold nanoparticles, and self-assembled monolayers (SAMs). A SAM is one of the most widely used ways to study surface attached proteins. SAM's can be created by adsorbing alkanethiols (hydrocarbon chain with a sulfur) on gold electrodes. The SAMs being studied in this experiment mainly contain carboxylic acid and alcohol terminal groups ($HS(CH_2)_6COOH$); however, new SAMs containing peptide chains are being developed in our group. A carboxylic acid group is used to hold cytochrome *c* on the surface through the means of electrostatic attraction. To better understand the protein interaction with the SAM and the changes in the microenvironment around the protein electrochemistry is used to collect data. Electrochemical measurements are made on many different types of electrodes to determine whether cytochrome *c* interacts functionally with the surface of the modified electrode. If the protein is functional, the protein electron transfer rate and the formal potential can be determined. By changing conditions of the microenvironments we can probe what affects the proteins structure and changes it electron transfer properties (functional properties).

Study to take place for 4 weeks (June 4 – June 29)

The Neuroscience of Stress

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Stress affects a variety of physiological and psychological systems. Prolonged exposure to stress increase our susceptibility to illness, inflammation, and the development of pathological conditions such as depression, anxiety and dementia. The laboratory of Dr. Flaisher-Grinberg at Saint Francis University examines the behavioral and molecular mechanisms underlying susceptibility and adaptation to stress. Projects range from psychological assessment of behaviors in mice models of human functioning, to anatomical evaluation of stress-related changes in gene expression. Upon selection to the program students will receive the opportunity to acquire practical, hands-on experience in the field of molecular and behavioral neuroscience.

Study to take place for 3 weeks (June 11 – June 29)

Flow Visualization Utilizing Airborne Thermography

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In recent years, drones (more formally known as Unmanned Aircraft Systems or UAS) have become quite widespread both as toys and serious scientific research platforms. When compared to a manned aircraft, UAS have become a relatively low-cost, easy-to-deploy platform capable of mounting a variety of sensors, including visual, thermal, and multispectral cameras. While not a replacement for more traditional sensors for collecting information about waterways (such as a temperature probe physically placed in a stream), the use of UAS as a sensor platform enables data collection over much broader or otherwise inaccessible areas than is feasible with typical measurement methods. As such, UAS utilizing the aforementioned sensors have been used in a variety of applications, including: riparian vegetation mapping, topographical survey, fixed-point stream monitor diagnostics, analysis of floodplain hydrology, and visualization of groundwater flows.

To incorporate UAS-based remote sensing into our program, the SFU Environmental Engineering Department has acquired a DJI S900 hexacopter and is preparing it for use in flow visualization and other applications. Hence, this project proposes to do the following: (1) integrate thermal and visual sensors with the aforementioned UAS, (2) create a ground control station to enable in-flight data monitoring, and (3) develop a robust technique for using this system to map groundwater flows.

Study to take place for 2 weeks (July 23 – August 3)

Effects of a sensory friendly classroom on Kindergarten children's attention skills during classroom tasks (fine motor, visual motor)

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The project will study whether the implementation of a sensory friendly classroom can improve a Kindergarten students attention skills. This will be determined by establishing the sensory qualities of the environment as measured by the Classroom Sensory Environment Assessment (CSEA) as well as how this environment effects the child's functioning (measured by the Sensory Processing Measure, School Form). Practical recommendations for enhancing the sensory needs of the classroom will then be reviewed with the teacher by a certified, licensed occupational therapist and then implemented. Implementation of the practical, yet sensory-enriched classroom will take place for approximately five weeks. Outcomes will be measured at the end of the five weeks, again utilizing the Sensory Processing Measure, School Form.

The transition to Kindergarten is one that has gotten significantly more difficult with the increasing education standards, as children do not have as many opportunities to actively pursue their individual sensory needs. Children absorb and process sensory information from their environment and when their bodies do not get the sensory information that they crave or they get too much of this sensory information, they will often exhibit "negative" behaviors because they are not able to pay attention to the learning environment (teacher instruction, classroom tasks, etc). These negative behaviors can be detrimental to not only their early learning, but also their classmates, which does not set anyone up for educational success.

Study will take place during the summer and the school year according to the following schedule:

June/July 2018 – meet with students to review foundations of research as well as the specific the study and submit for IRB approval
August 2018 – meet with school principal and Kindergarten teacher
September 2018 – October 2018: implementation
November 2018 – data analysis
January/February/March 2019 – summary of findings; prepare for Pre-College Research Academy Conference poster presentation

Comparing the Microwave Assisted Synthesis of Tripeptides to Traditional Peptide Synthesis Methods

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Peptides consist of amino acids linked to each other by amide bonds. During the laboratory synthesis of peptides each coupling reaction involved in a traditional peptide synthesis takes an hour to complete. However, the use of a microwave has been shown to shorten the reaction times to less than half of that time. Therefore, it is possible to synthesize short peptides in a single day which would originally take multiple days to complete. By rotating the molecules, microwaves increase the frequency with which reactions occur. This not only saves time and increases yield, but also saves money and reagents, thus promoting the principles of green chemistry. The goal of this study is to develop and improve a "green" procedure for the synthesis of tripeptides which are needed for other investigations within the Chemistry Department. Though the use of a CEM microwave, the reaction time for each coupling step can be decreased, with the hope that the percent yield and the effectiveness of the peptide will improve. Several peptides will be made both using the traditional procedure proposed by R.B. Merrifield and an altered synthesis method making use of a CEM microwave to expedite the coupling reactions.

Study to take place for 3 weeks (June 4 – June 22)