



CONCORDIA
UNIVERSITY
OF EDMONTON



RESEARCH FORUM

APRIL 18, 2018

*“Research is a ceremony.
And so is life. Everything that
we do shares in the ongoing
creation of our universe.”*

—SHAWN WILSON

DR. VALERIE HENITIUK

VICE-PRESIDENT ACADEMIC
& PROVOST



WELCOME FROM THE VICE-PRESIDENT ACADEMIC & PROVOST

In my capacity as Provost here at Concordia University of Edmonton (CUE), I have the privilege of serving also as Vice-President Research. Despite the heavy administrative focus of these roles, research remains an integral part of who I am as a member of this academic community. Accordingly, I am delighted to welcome all colleagues and visitors to this Research Forum, which allows CUE to highlight the diverse and cutting-edge work being done by both faculty and students across our campus.

This is the third year that we have held a comprehensive research celebration, underscoring a rapidly evolving research culture. CUE's first research-focussed building, the Centre for Science, Research and Innovation will open this summer, located high atop Edmonton's spectacular river valley. Our Centre for Innovation and Applied Research, which links research to community and industry, will be housed in the CSRI, as will a brand-new Indigenous Knowledge and Research Centre.

CUE is home to the Canadian Centre for Scholarship and the Christian Faith, which runs an annual conference, along with a Centre for Chinese Studies. This university boasts thriving research clusters on topics

ranging from travel to wellness to a focus on women; a brand-new cluster on artificial intelligence was formed just this year. CUE held its first biannual celebration of authorship last fall, highlighting a fascinating range of book publications. Both faculty and students have presented at major conferences worldwide, disseminating knowledge and building networks. And faculty members have recently been successful in competitions with both SSHRC and NSERC.

As we prepare for the imminent opening of the CSRI, CUE can look with pride at the high-calibre work being presented at this Research Forum. Our students, whether graduate or undergraduate, are offered unparalleled opportunities to work closely alongside faculty on ground-breaking research, as well as on projects of their own. It is truly an exciting time to be involved with research on our lively campus, which is well on its way to becoming Canada's pre-eminent small university.

In closing, I would like to extend my warmest congratulations to all presenters at this exciting annual event.

DR. COLIN NEUFELDT

ASSISTANT VICE PRESIDENT ACADEMIC
& DEAN OF GRADUATE STUDIES



WELCOME FROM THE DEAN OF GRADUATE STUDIES

Best Wishes to All Participants in the 2018 Research Forum!

On behalf of the Faculty of Graduate Studies at Concordia University of Edmonton (CUE), I want to extend a warm welcome to all the participants in the 2018 CUE Research Forum.

The Research Forum gives students, faculty and staff an opportunity to highlight their research, learn about the accomplishments of colleagues, participate in stimulating academic discussions, and foster future research opportunities that will contribute to the intellectual life at CUE.

I know that the 2018 CUE Research Forum will prove to be an enriching experience for all participants, and I wish each of you every success in this very important celebration of Concordia's research accomplishments.

WELCOME FROM THE OFFICE OF RESEARCH SERVICES

**LAINNA ELJABI,
RESEARCH OFFICER**



The Office of Research Services is thrilled to be a part of the exciting and innovative research being done at CUE. By providing services and support to faculty and students, we foster and facilitate a vibrant research culture at the university. The Office of Research Services is committed to fostering research excellence through the following:

- Providing guidance and assistance to faculty researchers at all stages of research grant application and proposal development, providing information on funding opportunities and research funding agencies
- Providing guidance on the use of grant funds and ensuring compliance to sponsor and agency policies
- Facilitating collaborative and interdisciplinary research partnerships
- Communicating major grant program information and liaising with funding agencies, sponsors, and stakeholders
- Managing CUE Internal Research Grant programs
- Presenting workshops and information sessions on funding programs, grant writing, and developing successful research proposals
- Developing research infrastructure and policy that promote a strong research culture at CUE.
- Supporting the work of multidisciplinary research clusters that enable groups of investigators to draw upon the strength and expertise of various disciplines
- Promoting research activity and achievement, including events such as the annual Research Forum Poster Exhibition

DR. NEIL QUERENGESSER

DEAN, FACULTY OF ARTS



WELCOME FROM THE DEAN OF THE FACULTY OF ARTS

The Faculty of Arts is strengthened by research initiatives of faculty and students alike across all of its programs. These programs include Biblical and Christian Studies, Drama, English, French, History, Music, Philosophy, Political Economy, Psychology, Religious Studies, and Sociology. Many faculty complete individual projects such as books, or articles published in internationally recognized journals. These publications are often preceded or accompanied by related papers presented at major conferences. Research also happens through faculty members cooperating on applied or community-based initiatives involving practical data collecting, surveys, and the like. Faculty in the Fine Arts spend countless hours researching their respective fields to create the finest musical and dramatic productions. Many professors also are members of faculty-initiated research clusters meeting regularly to share their latest work with other members of the Concordia

community. Concordia's Institute of Christian Studies and Society hosts research presentations throughout the year on timely and thought-provoking topics. But we are proudest of the many students in Concordia's Arts programs who also make significant research contributions, including those whose work is displayed here today. Students in graduate Psychological Assessment programs and the undergraduate Applied Psychology program complete a variety of practical research projects. Students in our Masters of Arts in Biblical and Christian Studies program engage in significant research through their course work and theses that can lead to publication. And students in many other Arts programs are likewise being trained in the best and most effective methods of research in their areas of study. As the Dean of Arts I am very pleased to endorse the research presented at today's event as well as all the other ongoing research in our Faculty.

DR. INHEE C. BERG

ASSOCIATE PROFESSOR, PHILOSOPHY
AND RELIGIOUS STUDIES



THE GOSPEL TRADITIONS INFERRING TO JESUS' PROPER BURIAL THROUGH THE DEPICTIONS OF FEMALE FUNERARY KINSHIP ROLES

The early Christians believed that Jesus was buried according to Jewish customs. However, the question regarding the nature of Jesus' burial remains contestable and this leads our attention once again to the textual information of the Gospel traditions dealing with Jesus' death and burial scenes. As the Gospels uniformly disclose that Jesus is the embodiment of the divine Covenant, the authors must have been obliged to draw the picture of Jesus' burial in association to propriety rather than impropriety and honor rather than dishonor since dishonorable burial was the lot only for those who violated God's Covenant through their disobedience. For this, the Synoptic Gospels, particularly, feature women in the kernel accounts of Jesus' Passion as the intimate providers of essential funeral services necessary to mark Jesus' burial as being ritualistically acceptable. Although it seems laconic

and implicit in the Gospels' descriptions of these women's actions and intents, these women fill the noticeable void of the immediate family of Jesus and fulfill the familiar roles required in the rites of the passage.

BRONTE DIDUCK

STUDENT, PSYCHOLOGY

DR. YVONNE WONG

SESSIONAL INSTRUCTOR,
PSYCHOLOGY



EFFECTS OF SEX AND SPORT PARTICIPATION ON MENTAL ROTATION AND MENTAL IMAGERY ABILITY

A well-established male advantage is found in mental rotation (MR) ability, however, it remains unclear whether sex differences are influenced by biological or environmental factors. This research examines the effects of sport participation on MR ability and movement imagery (MI) ability in male and female athletes and non-athletes. To measure MR ability, three-dimensional cube figures were presented as either pairwise or multiple choice questions. Participants determined if the figure(s) were either rotated or mirror images of a target figure. MI ability was measured using an established objective test of movement ability (TAMI). As predicted, athletes outperformed non-athletes on all measures, and males demonstrated greater multiple choice MR ability. Interestingly, pairwise MR produced no sex differences. When only athlete scores were included, no sex difference was found in multiple choice MR ability, demonstrating that sport participation mediates female performance on multiple

choice MR. This supports the notion that (1) pairwise and multiple choice questions have different task demands (working memory, eye movement) and may implicate different cognitive processes that produce sex differences, (2) in females, environmental factors such as sport participation positively impact cognitive processes implicated in MR multiple choice ability. Given that athletes demonstrated greater MR and MI ability, and that MR and MI are fundamentally relevant for STEM disciplines, elucidating the relationship between sport participation, sex, and MR and MI ability could help improve educational standards and understand the sex disparities in the STEM field.

Research Advisor: Dr. Yvonne Wong

DR. TRAVIS DUMSDAY

ASSISTANT PROFESSOR, PHILOSOPHY
AND RELIGIOUS STUDIES



ALEXANDER OF HALES ON PANENTHEISM

Panentheism is among the most influential variations on classical theism found within nineteenth and twentieth century theology, a prominent perspective in the recent religion and science dialogue (especially in the literature on quantum physics and special divine action), and is increasing in prominence within analytic philosophy of religion. Existing works on the history of panentheism understandably focus primarily on proponents of the view (in its different versions) and their arguments in its favour. Less attention has been given to the history of arguments against it, and in particular little has been written on mediaeval Scholastic critiques. Here I summarize the criticisms levelled by an important (but under-studied) thirteenth-century Franciscan, Alexander of Hales.

I also assess the enduring value of his critique, arguing that it helps bring to the fore the importance of panentheism's link with a further metaphysical debate: that between spacetime relationism versus substantivalism.

TIA GALARNEAU

STUDENT , PSYCHOLOGY

ELIZABETH KUENZEL

STUDENT , PSYCHOLOGY

DR. BRYAN ROONEY

ASSOCIATE PROFESSOR , PSYCHOLOGY



THE EFFECT OF BODY LANGUAGE AND TONE ON LEARNING

It is widely held that dynamic, expressive presenters are more effective in teachers. This experimental study examines the influence nonverbal cues, such as tone and body language, have on learning new material. We examined this by showing participants one of two instructional videos on a topic that was unlikely one they had previously studied, the operation of fluorescent lights. Immediately following the video, they were given an 8-item multiple choice test. In one video the speaker displayed high tone (expressive tone, consistent volume, interested facial expression) and open body language (iconic gestures, upright sitting position, arms at side), whereas in the second video the speaker displayed low tone (monotone, inconsistent volume, disinterested facial expression) and closed body language (no gestures, slouching, arms crossed, self-touching). Participants included 67 university students who were recruited from an Introductory Psychology class

at Concordia University of Edmonton. The students who viewed the high tone and open body language presenter score significantly higher on the test ($M = 5.66$, $SD = 1.15$, $N = 29$) than those who watched the low-tone and closed-body language presenter ($M = 4.66$, $SD = 1.51$, $N = 38$), $t(65) = 2.83$, $p = .003$. These results indicate that the manipulation of a presenter's tone and body language can influence the information recalled by a class. This experiment demonstrates that a presenter using high tone and an open body language can enhance instructional effectiveness.

Research Advisor: Dr. Bryan Rooney

JHALAK KHURMA

STUDENT, SOCIOLOGY



OPINIONS TOWARDS THE PAROLE SYSTEM

This study will examine a causal model to determine the opinions surrounding the parole system (OPPAROLE). Using the Statistics Canada 2011 General Social Survey Cycle 23, which consisted of a sampling frame of 19,422 respondents, a secondary data analysis was conducted through the use of five exogenous and five intervening concepts. It was found through the research Sex, SES, and Location all played an indirect role in influencing the endogenous. The variables the five exogenous variables were able to influence OPPAROLE were Global Attitudes, Victimization, Level of Fear, and Security Measures. It was clear that Experience was the least effective in creating an influence on OPPAROLE.

Age and Ethnicity were the only two concepts that a direct role in influencing the OPPAROLE concept. However, while four out of five variables were positively able to influence OPPAROLE, Global Attitudes, attitudes about the justice system in general, proved to be the strongest intervening variable to influence OPPAROLE.

Research Advisor:
Dr. John Jayachandran

BETHANY MCMILLAN

STUDENT, HISTORY



UNPRECEDENTED OPPORTUNITIES FOR ADOLESCENT GIRLS IN THE THIRD REICH: THE BUND DEUTSCHER MÄDEL

Nazi Germany's Bund Deutscher Mädel was the German Girls' League within the Hitler Youth program. The BDM was created in order to prepare the future generations of the Volksgemeinschaft. Political indoctrination was a key component to the organization, yet it offered much more. This essay discusses how the program provided unprecedented opportunities for young women. Former members share a range of responses to the political elements suffused within the BDM. The League was as a moment of liberation for young women. The BDM provided opportunities

in athletics, and adventure, all while cultivating a sense of belonging for the young women of Germany. I plan to demonstrate this through the first hand accounts of BDM members.

Research Advisor: Dr. Tolly Bradford

MADISON PERKINS

STUDENT, HISTORY



TRENDS OF BLAME IN THE MINDS OF “KOREAN COMFORT WOMEN”

During the Second Sino-Japanese War (1937-45) a sexual gratification program was proposed by Japanese officials in order to reduce the stress of the Emperor’s warriors, deter the soldiers from raping women in areas the Imperial Japanese Army had captured, boost the morale of the soldiers, and prevent venereal disease. The implementation of this system forced many Asian women, 80% of whom were Korean, to become sexual slaves, or as they were commonly known, “comfort women”. This paper will not be an examination of the historical events that occurred, but instead will focus on the memory of the women and their contemporary feelings about who holds responsibility for their suffering. Drawing on interviews of surviving Korean “comfort women”, conducted from the early 1990s-late 2000s, it will argue that three patterns of blame emerge from the testimony of the former Korean

“comfort women”: (1) The women blame the Japanese and Korean recruiters/kidnappers responsible for their procurement; (2) Korean survivors blame the Imperial Japanese Army and Japanese government; (3) A minority of women blame Korea for being too weak to stop Japan from taking Korea’s daughters.

Research Advisor: Dr. Tolly Bradford

SHAYLA ROLPH

STUDENT , PSYCHOLOGY

BROOKE WINTER

STUDENT , PSYCHOLOGY

DR. BRYAN ROONEY

ASSOCIATE PROFESSOR , PSYCHOLOGY



ROMANTIC RELATIONSHIPS AND SELF-ESTEEM

Do those who are in a romantic relationship have higher self-esteem than those who are not in a relationship? We surveyed 70 university students from Concordia University of Edmonton to answer this question. Our hypothesis was that individuals in a romantic relationship have higher self-esteem than those not in a relationship. Respondents completed an online questionnaire where they identified if they were in a romantic relationship and then completed the Rosenberg Self-Esteem Scale (Rosenberg, 1965). This 10-item scale assesses self esteem with

a low score of 0 to a maximum score of 30. We found that students who were in a romantic relationship had a self-esteem score ($M = 20.22$, $SD = 5.28$) that was significantly higher than those who were not in a romantic relationship ($M = 14.43$, $SD = 6.41$), $t(68) = 2.00$, $p = .0247$. These results support the findings of previous research on how romantic relationships and self-esteem affect one another. From this non-experimental study, we can not conclude that being in a romantic relationship increases one's self-esteem, but we can report that there is a positive relationship.

Research Advisor: Dr. Bryan Rooney

KRISTINA STOCKS

STUDENT, ENGLISH

TED TALKS & GRADUATION ADDRESSES: INSPIRATIONAL MEDIA

This independent study analyzes the cultural value of contemporary TED Talks and convocation addresses. TED Talks are designed to influence and inspire a specific audience, and this study will examine the methodology, rhetoric, and techniques of such public discourse.

Discussion will focus on the effect that TED Talks have on those who watch them (via interviews), and what makes them go viral. In addition, the study will compare how speakers negotiate such sensitive topics as ideology, class structure, nationalism, ethnicity, sexual orientation, gender, and age.

Research Advisor: Dr. Conrad van Dyk

DR. JONATHAN STRAND

PROFESSOR, PHILOSOPHY AND
RELIGIOUS STUDIES



ANIMISM AND CONTEMPORARY PHILOSOPHY OF MIND

Indigenous cultures around the globe have often exhibited perspectives which have been called ‘animistic.’

‘Animism’ is defined as “The attribution of life and personality (and sometimes a soul) to inanimate objects and natural phenomena.” (OED)

The thesis of this presentation is that such perspectives and attributions are not as implausible as many in western (European-based) culture might assume, from the standpoint of the best, current (European-based) Philosophy of Mind. The origins and history of western Philosophy of Mind will be surveyed—going back to the ancient Greeks (Plato and Aristotle) and the early modern philosophers (Descartes, Leibniz, Locke). The best current thinking in Philosophy of Mind will then be discussed vis-a-vis animistic perspectives.

This will reveal that, in light of the best insights of contemporary Philosophy of Mind, animistic perspectives are not as implausible as many might think. Reference will also be made to the adoption of such perspectives among contemporary environmentalists.

DR. CONRAD VAN DYK

ASSOCIATE PROFESSOR, ENGLISH



THE NATURE OF WRITING: AN OPEN ACCESS WRITING GUIDE

I will be presenting the open access writing guide I have been working on for the past two years. The Nature of Writing (www.natureofwriting.com) is a comprehensive writing manual for students in high school and university. It combines videos, prose explanations, and countless exercises in order to enhance the teaching of English across the curriculum.

For more information about this project, please see <http://natureofwriting.com/about/>. This work has been funded by means of internal research grants and I am working in corporation with the Concordia Institute for Applied Research (CIAR). My poster will consist of an interactive computer screen where participants can try out the website for themselves.

DR. ALISON YACYSHYN

DEAN , MIHALCHEON SCHOOL
OF MANAGEMENT



WELCOME FROM THE DEAN OF THE MIHALCHEON SCHOOL OF MANAGEMENT

As Dean of the Faculty of Management, I am proud of the research produced by both students and Faculty at the 3rd Annual Research Forum.

Research is a priority for the Faculty of Management and the opportunity to share works in progress, or studies already completed, demonstrates the commitment to research at Concordia University of Edmonton. Collaborations with undergraduate and/or graduate students with Faculty also demonstrates synergy.

Undergraduate and graduate students (i.e. the Master of Information Systems Security Management (MISSM), Master of Information Systems Assurance Management (MISAM)) working with Faculty are of particular worthiness as they are budding researchers who are developing their skills while at CUE.

Besides poster presentations, the MISSM/MISAM Faculty who work with CUE graduate students, produce research that is of top quality published

in internationally recognized journals and this is commendable.

Faculty members who have collaborations with individuals from other institutions demonstrate that collegiate research builds bridges nationally and internationally. Student presenters are welcomed to the event and commended for sharing their research with others.

Congratulations to all who have participated in CUE's 3rd Annual Research Forum and may the day's event spotlight the researchers' amazing efforts that take place throughout the year.

BABAJIDE ADEGOKE

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY AND ASSURANCE
MANAGEMENT



AUTOMATED KEY SHARING IN THE AUTHENTICATION PROCESS OF LTE BASE STATIONS

Sensitive information like the International Mobile Subscriber Identity has been a problem on all generations of mobile telecommunication networks, i.e., 2G (GSM, GPRS), 3G (HDSPA, EDGE, UMTS) and 4G (LTE, LTE-A). Many cases of compromising users' privacy in telecom networks have been reported. Cases of rogue base stations capable of tracking users and collecting their personal data without the users' knowledge have emerged. The USIM of a mobile phone must reveal its International Mobile Subscriber Identity in plaintext when trying to establish connection with a base station for the first time. The International Mobile Subscriber Identity can be intercepted by attackers and this can amount to a passive or active attack. This paper proposes the use of a pre-shared key in the authentication process of LTE base stations to local users. This will result in

a first hop authentication procedure to verify if the base station is legitimate by the User Equipment, this authentication will protect the International Mobile Subscriber Identity from being sent to a fake base station during the Evolved Packet System Authentication and Key Agreement authentication procedure.

**Research Advisors: Dr. Fehmi Jafaar
and Prof. Rohn Ruhl**

YOUSEF ALABOUR

STUDENT, MANAGEMENT



ARTIFICIAL INTELLIGENCE IMPACTING THE AUTOMOTIVE INDUSTRY

Technology and people's interaction with vehicles is a hybrid occurrence that happens on a daily basis. On the one side, is the human error involved regarding speed, seatbelts, and distractions placed on purpose. The addition of Artificial Intelligence (AI) in self-driving cars has amplified safety for the mass. There is a rise in intensifying AI in the car industry, and it is becoming more competitive. Vehicular collisions have caused millions of deaths and injuries annually (including pedestrian involved deaths). The research leads to recommendations of AI's integration in vehicles, and if indeed it can start to save lives on the roads and reduce damage or deaths. The claim of reduction in the safety category on the road is a big promise. The numbers are significant in reducing the crashes on the road today, as the AI scenario generator controls interfaces and the mistakes that drivers make. Through AI, the maps, traffic controls, and even the weather has been mimicked at a high level of

realism. There are also object, and lane detectors in place- known as the sensor fusions, they are sensors built in that studies and predicts adjacent vehicles. For testing these cars with built in AI, it is a 3-dimensional virtual platform imitating the real world. AI is changing the automotive world.

Research Advisor: Dr. Alison Yacyshyn

KELSEY BELL

STUDENT, MANAGEMENT



DIVERSITY: THE RECESSION PREVENTION METHOD

In Alberta, economic reactions to global changes in the oil and gas industry can lead to economic recession. Little attention is paid to manufacturing industries, which can offset the effects of recession. Perhaps policy makers should provide incentives to diversify non-energy manufacturing in Alberta. Data-based research, a look at foreign currencies of Alberta's major trading partners, and some observations of labor data allowed an examination and analysis of trends. This has revealed that growth

in non-petroleum-based manufacturing could possibly create jobs and improve prosperity. Greater reporting on sub-sector manufacturing industries and related exchange rate fluctuations would improve information for policy makers.

Research Advisor: Dr. Alison Yacyshyn

SHIKHAR BHATNAGAR

STUDENT , MASTER OF INFORMATION
SYSTEMS SECURITY MANAGEMENT

DR. YASIR MALIK

ADJUNCT PROFESSOR, MISSM

DR. SERGEY BUTAKOV

ASSOCIATE PROFESSOR, CHAIR,
INFORMATION SECURITY AND ASSURANCE



ANALYZING DATA SECURITY REQUIREMENTS OF ANDROID MOBILE BANKING APPLICATION

Mobile banking applications are at high risk of cyber attacks due to security vulnerabilities in their underlying operating systems. Android is the most popular operating system with feature like openness and customization. The Inter-Process Communication mechanism in Android enables applications to communicate, share data and reuse functionality between them. However, if used incorrectly, it can become attack surface, which allows malicious applications to exploit devices and compromise sensitive financial information. In this research, we studied fuzzing approach to analyze the data security of android mobile banking application during the inter process communication. Firstly, we automatically

constructed application behavior, later applied generative fuzzing to the information collected during behavior analysis to analyze the data leak vulnerabilities during the inter process communication. Experimental analysis and results shows the easily exploitable entry points in the applications under test.

CAESAR JUDE CLEMENTE

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY AND ASSURANCE
MANAGEMENT

IS PREDICTING SOFTWARE SECURITY BUGS USING DEEP LEARNING BETTER THAN THE TRADITIONAL MACHINE LEARNING ALGORITHMS?

The information age has brought unprecedented advantages, but it also has risks. These issues take the form of security breaches that have an extensive destructive impact in today's institutions. Software insecurity is being identified as one of the leading causes of these security breaches. In this paper, we revisit one of the strategies in solving software insecurity, which is the use of software quality metrics. We utilized a multi-layer deep forward network in examining whether there is a combination of metrics that can predict the appearance of security related bugs. We also applied the traditional machine learning algorithms such as decision tree, random forest, naïve Bayes, and support vector machines and compare the results with that of the Deep Learning technique. The results have successfully demonstrated that it was possible to develop an effective predictive model to predict software insecurity based on the software metrics and using Deep Learning. All the models generated have

shown an accuracy of more than sixty percent with Deep Learning leading the list. This finding proves that utilizing Deep Learning methods and a combination of software metrics can be tapped to create a better forecasting model thereby aiding software developers in predicting security bugs.

***Research Advisors: Dr. Fehmi Jaafar,
Dr. Yasir Malik***

HAJREDIN ILMI DAKU

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY AND ASSURANCE
MANAGEMENT



BEHAVIORAL-BASED CLASSIFICATION AND IDENTIFICATION OF RANSOMWARE VARIANTS USING MACHINE LEARNING

Due to the changing behavior of ransomware, traditional classification and detection techniques do not accurately detect new variants of ransomware. Attackers use polymorphic and metamorphic techniques to avoid detection of signature-based systems. We use machine learning classification to identify modified variants of ransomware based on their behavior. To conduct our study, we used behavioral reports of 150 ransomware samples from 10 different ransomware families. Our data-set includes some of the newest ransomware samples available, providing an evaluation of the classification accuracy of machine learning algorithms on the current evolving status of ransomware. An iterative approach is used to identify optimum behavioral attributes used to achieve best classification accuracy. During behavioral attributes selection process, accuracy of machine learning algorithms has been used to verify improvements on the results of classification. Two main parts of this

study are identification of the behavioral attributes which can be used for optimal classification accuracy and classification of ransomware using machine learning algorithms. We have evaluated classification accuracy of three machine learning classification algorithms.

***Research Advisors: Dr. Pavol Zavarsky
and Dr. Yasir Malik***

SAMIP DHAKAL

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY AND ASSURANCE
MANAGEMENT



BLOCKCHAIN FOR IOT DEVICE FIRMWARE INTEGRITY VERIFICATION AND UPDATE

There are various possible mechanisms for updating outdated, potentially vulnerable and exploitable, software and firmware on Internet connected devices. Delta updates, due to their well-known benefits, have become a common way of updating the software. Recently, several authors proposed the use of blockchain technology for updating the software and firmware. While both delta updates and blockchain technology are now used in different areas, this paper studies the feasibility of combining the two technologies for firmware updates on resource constrained IoT devices such as WiFi smart plugs and sensors. The paper identifies the scenarios where delta update may not work and proposes a new blockchain based IoT device firmware integrity verification and update mechanism. The proposed mechanism is based on integrity checking where the device firmware version and checksum is compared against the device firmware information stored in the tamper proof blockchain server before the device can

be added to the network, for determining the suitable firmware file for the device and when an anomaly is suspected. A mismatch indicates outdated or compromised device firmware and hence the actual firmware is forwarded to the device. The proposed solution aims to mitigate the attacks targeting the known firmware vulnerabilities in IoT devices by ensuring the device firmware is up-to-date while not compromised and the device receives the genuine firmware whenever a firmware compromise is detected.

***Research Advisors: Dr. Fehmi Jaafar,
Dr. Pavol Zavorsky***

THEODORE KREIN

STUDENT, MANAGEMENT



DIGITAL OILFIELD: USING DATA TO CRACK THE CODE

Oil & Gas (O&G) companies operate in a volatile environment where price fluctuations force operators to adopt strategies that enhance productivity and create competitive advantages. The nodding donkey (Pumpjack) was invented nearly a 100 years ago and its technology is virtually unchanged producing two resources: petroleum products and data. The data is collected on clipboards and stored on Excel spreadsheets in local field offices. Digital Oilfield (DOF) technology can become a catalyst to properly leverage O&G applications with the ability to improve productivity, accuracy, safety and efficiency up to 25%. Currently, only 3 - 5% of all O&G assets are digitally connected utilizing Big Data

and Artificial Intelligence. DOF technology can explore the 97% or \$3.4 trillion in net property, plant and equipment that are not digitally connected with a lean, streamlined, efficient and competitive business solution.

Research Advisor: Dr. Alison Yacyshyn

THEODORE KREIN

STUDENT, MANAGEMENT



REMODELING ALBERTA'S ENERGY INFRASTRUCTURE: PAST, PRESENT & FUTURE OUTLOOK

Alberta has the 3rd largest oil reserve in the world, with the ability to supply Canada's energy needs for more than 500 years. Crude Oil extraction, production, and exporting jobs have been an important economic driver throughout the history of the Province. Broad consensus from 12 secondary data sources compare WTI Crude prices and the number of Wells drilled (active) illustrating Alberta's reliance on this commodity. Crude oil demand and Conventional wellhead costs continue to rise, but the WTI Crude price has fluctuated drastically. This has directly resulted in an increase in well abandonment and decrease in investments, rig activity and profits. This

decline has turned the markets towards "Clean Energy" diversification. Using existing infrastructure this allows for the introduction of sustainable Geothermal energy, continual profits and helps the industry labor force transition into skilled renewable clean energy workers.

Research Advisor: Dr. Alison Yacyshyn

DR. MARK LOO

ASSOCIATE PROFESSOR,
MANAGEMENT



SEGMENTING ASEAN BY RELIGION: IMPLICATIONS FOR BUSINESS

A study into the Association of South East Asian Nations (ASEAN) is timely as western nations seek new markets at a time when Brazil, Russia, India and China (BRIC) signal overheated economies, Middle East and African markets face political instability, and the US and Europe struggle to recover from recession. With the third largest population in the world of over 600 million and half below aged 30, and an expanding middle class reaching 400 million, ASEAN has outperformed the global growth rate averaging over 5% annual GDP since 1980.

The US-ASEAN Business Council, formed in 1984, projects continuous growth of over 5% in the next decade. Many nations have formed alliances with ASEAN such as the APEC, TPP, RCEP, EU-FTAs and Mercosur-ASEAN. Recognizing the growing economic and strategic importance of ASEAN, the Canada-ASEAN Business Council was formed in 2012 to help expand Canadian businesses among the ten member nations.

However, the great diversity in ASEAN can be a challenge to foreign investors who treat ASEAN as similar to the European Union with commonalities, such as religion. This study identifies the religions in ASEAN and discusses managerial implications for investors seeking business with ASEAN partners.

JOHN LUSWATA

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY AND ASSURANCE
MANAGEMENT



ANALYSIS OF SCADA SECURITY USING PENETRATION TESTING : A CASE STUDY ON MODBUS TCP PROTOCOL

This paper presents an insight into attacks on Supervisory Control and Data Acquisition (SCADA) systems specifically focusing on systems that use the Modbus TCP protocol. A penetration testing approach is adopted using a novel penetration testing tool to (i) test the effectiveness and efficiency of the tool, (ii) examine the insider threat as well as the external threat through internal and external penetration testing respectively and (iii) rate the vulnerabilities identified through the penetration tests according to the Common Vulnerability Scoring System.

The study also examines and tests the existing security countermeasures that are unique to SCADA systems and outlines some recommendations that may improve security in SCADA systems. The experimental results showed that some of the attacks may severely impact integrity and availability.

***Research Advisors: Dr. Pavol Zavarsky
and Dr. Bobby Swar***

DJAHLIN JEAN- CLAUDE NIKOUE

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY MANAGEMENT



SECURITY EVALUATION METHODOLOGY FOR SOFTWARE DEFINED NETWORK SOLUTIONS

Software Defined Networking (SDN) has introduced both innovative opportunities and additional risks in the networking field. Among disadvantages of SDN one can mention its susceptibility to vulnerabilities associated with both virtualization and the traditional networking. Selecting a proper controller for an organization may not be a trivial task as there is a variety of SDN controllers on the market and each of them may come with advantages and disadvantages from the security point of view. This research proposes a comprehensive methodology for organizations to evaluate security-related features in SDN controllers. The proposed methodology can serve as a guideline in the decisions related to SDN choice and implementation adopt. The

vulnerability assessment proposed in this research is layered to evaluate each layer of the SDN architecture and each evaluation metrics defined in this research has been matched with the security controls defined in NIST 800-53. Through the series of tests on actual controllers the paper provides a sample on how the proposed methodology can be used to evaluate existing SDN solutions.

***Research Advisors: Dr. Sergey Butakov,
Dr. Yasir Malik***

JASJEET SINGH

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY MANAGEMENT

DR. YASIR MALIK

ADJUNCT PROFESSOR, INFORMATION
SYSTEMS SECURITY MANAGEMENT



A POLICY-BASED MULTI-LAYERED ACCESS CONTROL ARCHITECTURE FOR HEALTH RECORD SYSTEMS

The use of payment tokens, based on EMV® specifications and the Payment Card Industry token standard, both propels the spread of mobile payment technologies and improves the security of Mobile Payments including protection of the original payment information and primary account numbers. However, some researchers have demonstrated that attacks on payment tokens through decoding the magnetic secure transmission or near field communication signal allows an attacker to use stolen tokens to complete malicious transactions or to guess new tokens through analysis of the token format. The stolen tokens are then used to make fraudulent transactions.

In this research we examined Samsung Pay in order to design a novel theoretical security model using a fingerprint-based master key for unlock phone authentication, and transaction authentication and encryption. Samsung Pay is an application installed in a Secure

Element in a Samsung Android device. In our theoretical security model presented, this master key can be created using one biometric fingerprint pattern or two merged patterns. Sub-keys can then be generated from this master key that can be applied to transaction encryption, payment token encryption and to protect the payment token in the Secure Element in the phone where the mobile EMV® customer information is stored.

Research Advisor: Dr. Pavol Zavorsky

SAMUEL SORIANO

STUDENT, MANAGEMENT

VALUING SECURITIES WITH AI

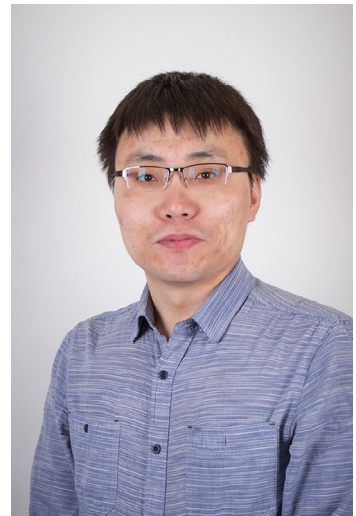
This project will examine how the efficient market hypotheses and technical analysis applies to Artificial Intelligence and how it can beat the market using these ideas. The research shows that majority of the players in the real-world exchanges are limited to human capabilities causing inefficiencies in real-world markets, and this creates a lag before the market can react to new information. As long as there are inefficiencies in the market, an advanced AI can beat the market as it has the potential to respond faster than all the people in the Market. Using this approach is limited to liquid markets where securities are bought and sold consistently and markets where players only have access to public information for an AI to beat the market. This research show that current AI does not have the capabilities to consistently beat the market as research has only begun in this field. In the future when AI can react to all information in the market appropriately, this is the point where it can consistently beat the market. Resulting in Artificial

Intelligence replacing the majority of players in the market as players transition to use AI for profit. The research shows that over time the profitability of the markets will be reduced the more efficient the market becomes as AI saturates the market.

Research Advisor: Dr. Alison Yacyshyn

YYIMING SUN

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY MANAGEMENT



A SURVEY OF PAYMENT TOKEN VULNERABILITIES TOWARDS STRONGER SECURITY WITH FINGERPRINT BASED ENCRYPTION ON SAMSUNG PAY

The use of payment tokens, based on EMV® specifications and the Payment Card Industry token standard, both propels the spread of mobile payment technologies and improves the security of Mobile Payments including protection of the original payment information and primary account numbers. However, some researchers have demonstrated that attacks on payment tokens through decoding the magnetic secure transmission or near field communication signal allows an attacker to use stolen tokens to complete malicious transactions or to guess new tokens through analysis of the token format. The stolen tokens are then used to make fraudulent transactions.

In this research we examined Samsung Pay in order to design a novel theoretical security model using a fingerprint-based master key for unlock phone authentication, and transaction authentication and encryption. Samsung Pay is an application installed in a Secure

Element in a Samsung Android device. In our theoretical security model presented, this master key can be created using one biometric fingerprint pattern or two merged patterns. Sub-keys can then be generated from this master key that can be applied to transaction encryption, payment token encryption and to protect the payment token in the Secure Element in the phone where the mobile EMV® customer information is stored.

Research Advisors: Prof. Ron Ruhl & Prof. Hamman

DR. ASHISH THOMAS

ASSISTANT PROFESSOR,
MANAGEMENT



HARNESSING THE POWER OF INTEGRATION AND ITERATIONS OF QUALITY TOOLS TO CREATE OPERATIONAL EXCELLENCE

Successful manufacturing or service organizations adopt some types of improvement methodology to achieve optimum performance. There is an ever-increasing demand for organizations to think lean by reducing waste and maximizing operational efficiencies. The repertory grid technique was chosen as the preferred method for gaining insight into the research questions. This RepGrid technique employed a cooperative inquiry using a case study approach to design a cohesive framework of tools that facilitates a lean platform. The primary objective of this study was to deepen an understanding of the different lean tools and practices employed in the production and service environment. This study provided significant insights into lean practices and the power of nested common tools which apply to multiple operational stages. The nested systems are the outcome of blending individual tools; while multiple nested systems constitute an integrated framework. An integrated network ensures continuity

and consistency of lean benefits through all stages of resilient operations. The study has highlighted that an iterative approach enables transformation systems to harness the cumulative impact of all individual lean tools on the complete system. The power of nested integrated systems facilitates organizations to achieve optimum performance, high quality, lower costs, and enhanced productivity consistently and uniformly.

NICOLAS VILLALOBOS

STUDENT, MANAGEMENT



HOW ARTIFICIAL INTELLIGENCE CAN PREDICT SUICIDAL TENDENCIES

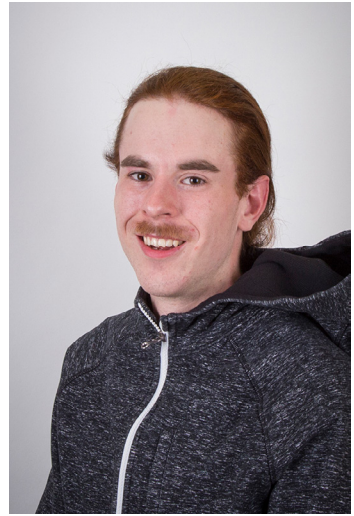
New advancements in technologies like Artificial Intelligence (AI), Big Data and Machine Learning are reshaping the world as they are applied to different areas like healthcare or human resources. AI can provide a potential opportunity to assist people who may experience suicidal thoughts. Suicide cases on social platforms like Facebook where some individuals have committed suicide while live streaming, are leading companies to develop AIs in recognizing patterns to identify the likelihood someone might attempt suicide. Linguistic (and qualitative) studies have demonstrated that depressed people with suicidal thoughts are more likely to use adjectives with negative connotations (e.g. “miserable”, “lonely”

and “sad”) as well as a significant use of the first-person singular pronouns rather than second or third-person pronouns. If the right algorithms are developed and implemented in a well-trained AI, it would be able to predict suicides and effectively help those in need.

Research Advisor: Dr. Alison Yacyshyn

ALEXANDER WHITFORD

STUDENT, MANAGEMENT



IDENTIFYING FAKE EDMONTON RESTURANT REVIEWS WRITTEN AUTOMATICALLY BY ARTIFICIAL INTELLIGENCE (AI)

The identification of Artificial Intelligence (AI) written reviews on Yelp.ca, for the top five restaurants in the Edmonton area is important for consumers and business owners alike. We must be aware of such things as AI written reviews. Generating and or creating any reviews, for major consumer forums such as Yelp, should be of concern as they are not regulated. This research focuses on ratings from 5 restaurants deemed some of the city's best locations, and they are not

immune to artificially generated reviews, that appear to be written by AI. The analysis indicates that there is an artificial presence in the reviews of higher end Edmonton restaurants.

Research Advisor: Dr. Alison Yacyshyn

DR. ALISON YACYSHYN

DEAN , MIHALCHEON SCHOOL
OF MANAGEMENT

CHERYL E. CABLE

FACULTY OF MEDICINE & DENTISTRY,
SCHOOL OF DENTISTRY (U OF A)



COMPLETE DENTURE EDUCATION AT THE UNIVERSITY OF ALBERTA SCHOOL OF DENTISTRY: STARTING WITH A STORY

“There is a knowledge translation gap within undergraduate dentistry education from didactic courses to laboratory and clinical sessions early in education. Dentistry students have a hard time understanding the applications from bookwork to clinical environments when they have never seen a clinical dentistry patient.

The Complete Denture course of 2017 was taught to second year dentistry students with a new format. Each lecture started with “Let me tell you a story”. A narrative of a clinical scenario describing the encounter in the format of a bedtime story. A specific lesson within the story was made to link to each didactic lecture that followed.

Student comments on the course at the end of the term were extremely positive and encouraging of this format. Curriculum changes are reflective of the power of storytelling to improve dentistry education. “

DR. ALISON YACYSHYN

DEAN , MIHALCHEON SCHOOL OF
MANAGEMENT

CHERYL E. CABLE

FACULTY OF MEDICINE & DENTISTRY,
SCHOOL OF DENTISTRY (U OF A)

SHANNON D. SCOTT RN

FACULTY OF NURSING (U OF A)



IS THERE IS A GAP BETWEEN WHAT IS TAUGHT AND WHAT IS IMPLEMENTED IN DENTURE PATIENT TREATMENT? UNDERSTANDING A KNOWLEDGE TRANSLATION GAP.

A 31 item questionnaire that explored undergraduate denture education in contrast to reporting dentists' clinical practices was administered to dentists using the Canadian Dental Association (CDA) OASIS online platform. oasisdiscussions.ca

An environmental scan was completed of all 10 Dental Schools in Canada regarding specialist, general dentist and denturist involvement in their undergraduate denture programs.

Question topics included: referral patterns, procedure steps completed, perception of education and patient care.

Results:

174 registered clinicians responded to Canadian Dental Association OASIS email survey

Less than 2% of respondents complete denture cases in the same way as taught in Canadian Dental Schools.

82.2% of clinicians do not take a radiograph.

84% do not fabricate posterior palatal seals

71% do not use facebow transfers to an articulator

86% do not do lab remounts with insert

94% reported that dentures should be taught in dental schools

59.8% reported that dentures are being taught "well" or "very well".

There is a disconnect between the comprehensive technique taught in academic institutions and the more efficient manner completed in private practice. Curriculum change is indicated.

DAVISON ZVABVA

STUDENT, MASTER OF INFORMATION
SYSTEMS SECURITY MANAGEMENT



ON THE CHALLENGES OF ACHIEVING IEC 62443 SECURITY REQUIREMENTS IN TIME SENSITIVE INDUSTRIAL NETWORKS

The IEC 62443 security standards introduce the concepts of zones, conduits, and security levels as a way of segmenting and isolating the sub-systems of an industrial control network. Network segmentation physically/ logically partition the control network into separate communication zones to restrict unnecessary flow of traffic between zones of different trust level. Firewalls with deep packet inspection capabilities for filtering industrial control protocols are indispensable elements in implementing important security principles, standards, and best practices of IEC 62443. While partitioning of the industrial control network and placement of multiple firewalls at various locations provides defense in-depth against cyber-attacks, it is important to consider the impact of these firewalls on nodes distributing time critical communications. This paper attempts to (i) study network performance impact introduced by the implementation of multiple firewalls in Modbus TCP/IP

industrial control networks following IEC 62443 security standards and (ii) evaluate if time constraint requirements for communications are achievable. The results reveal that the latency and jitters introduced by multilayered firewalls makes it challenging to achieve real-time communications in some industrial applications when strict IEC 62443 security standards are followed.

**Research Advisors: Dr. Pavol Zavorsky,
Dr. Sergey Butakov**

DR. PATRICK KAMAU

DEAN, FACULTY OF SCIENCE &
DIRECTOR, CENTRE FOR INNOVATION
AND APPLIED RESEARCH



WELCOME FROM THE DEAN OF THE FACULTY OF SCIENCE

Once again, welcome to Concordia University of Edmonton Research Forum 2018. As the Dean of Science, it gives me great pride and joy as we celebrate for the third year in a row CUE's research efforts and findings. Science continues to be well represented and I am profoundly excited about the breadth and depth of research in the Faculty. Undergraduate student research has flourished over the years supported by a very knowledgeable and dedicated faculty. The Faculty are engaged in research in all fields from biology to public health, some in basic research and others in applied research.

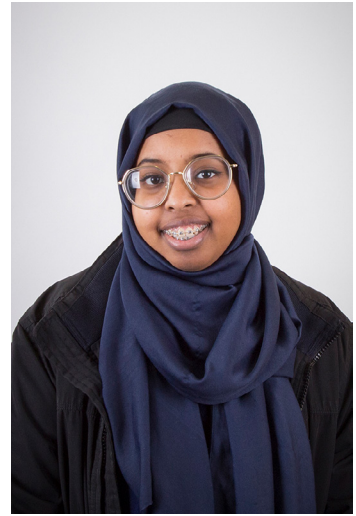
We continue to embark on a collaborative research culture in the Faculty of Science, be it with student projects or faculty-led research. Collaborative research effort between different departments in the Faculty of Science, namely Departments of Biological and Environmental Sciences, Public Health, and Physical and Mathematical Sciences is combining various areas of expertise in order to investigate a projects of considerable breadth. This is attested by the kinds of poster presentations from the Faculty of Science in 2018 research forum.

KHADIJA ABDULLAHI

STUDENT, BIOLOGY

MARIOLA JANOWICZ

ASSOCIATE PROFESSOR, BIOLOGICAL
AND ENVIRONMENTAL SCIENCES



EFFECT OF ATALUREN ON MYO7A NONSENSE MUTATION RESPONSIBLE FOR USHER SYNDROME

In-frame nonsense mutation is responsible for a majority of genetic diseases present today.

Premature termination codon (PTC), also known as nonsense mutation, causes an abrupt stop of translation by introducing the presence of one of three stop codons; UAG, UAA, and UGA. This occurs due to a single point alteration in the messenger RNA transcript. The earlier the mutation occurs in the gene, the more truncated the protein becomes. Truncated proteins are functionally defective and, as a result, are a cause of multiple disabilities. Nonsense mutations present in MYO7A are responsible for Usher syndrome type I, the most severe version of Usher syndrome. It is categorized by sensorineural hearing loss and retinis pigmentosa. Certain aminoglycosides and pharmaceutical drugs such as Ataluren, can induce the functionality and addition of an amino acid, thus continuing translation and producing a complete and functional protein by having the ribosomes read

through a premature stop codon in mRNA. In this experiment, we will compare for the first time the relative efficacies of the oxadiazole Ataluren in restoring the nonsense mutation in the USH1B gene, which encodes the protein myosin VIIA. We will be treating primary Usher fibroblast cell lines with Ataluren. The results will be analyzed using immunofluorescence microscopy to localize our protein and allow us to observe the expression of potentially restored truncated proteins using fluorescent dyes.

Research Advisor: Dr. Mariola Janowicz

KHADIJA ABDULLAHI

STUDENT, BIOLOGY



BLUE LED IRRADIATION OF MDA-MB-231 CELLS: INDUCTION OF APOPTOSIS THROUGH ROS MEDIATED SIGNALLING PATHWAY

Breast cancer is one of the most common cancers and is responsible for millions of deaths globally every year. Triple negative breast cancers are very difficult to treat because of their lack of estrogen, progesterone and human epidermal growth factor receptors. As such, these cancers are unresponsive to conventional hormonal therapies and are most commonly treated by means of neo-adjuvant and adjuvant chemotherapy. Previous studies show that blue LED's, due to a spectrum of wavelengths, possess anti-microbial, anti-inflammatory, apoptotic and anti-proliferative properties. Due to these properties, they have been used in treating acne and neonatal jaundice. In this experiment, we aim to study the effects of different wavelengths and exposure times of Blue LED on cancer cells, mainly to examine if an apoptotic process is indicated as well as understand phototherapy mechanisms in treatment of triple negative breast cancers. In this study, we irradiate MDA-MB-231 breast cancer cells with Blue

LED at wavelengths of 400nm, 450nm and 480nm at durations of ½ hr, 1hr and 2hr in order to induce apoptosis. The cells are irradiated and then exposed to alamarBlue viability reagent. Metabolic activity is visualized by alamarBlue viability reagent and is measured by absorbance spectrophotometry. Cells are treated with DAPI stain and visualized using a fluorescent microscope. No reduction in metabolic activity was observed in ½ hr treatment but a reduction in metabolic activity was observed at 400nm wavelength for 1 hr treatment; no reduction in metabolic activity was observed for 450nm or 480nm in 1 hr treatment. A reduction in metabolic activity was observed in all three wavelengths for the 2 hr treatment.

Research Advisor:
Dr. Deborah Hemmerling

ALLYSON APOLONIO

STUDENT, CHEMISTRY



SYNTHESIS AND REACTIVITY OF CONJUGATED ACYL SILANES

Conjugated acyl silanes are potential substrates for Brook-rearrangements, allowing access to conjugated-anionic π networks. Synthesis of these substrates is disclosed, using a three-step process. First, conjugated aldehydes are converted to dithianes. This is followed by silylation of the thioacetal

carbon. Finally, removal of the dithiane reveals the acyl silane. Reaction of these substrates with carbon based nucleophiles is also explored.

Research Advisor: Dr. Owen Scadeng

AMANDA AMAGWU

STUDENT, ENVIRONMENTAL HEALTH
AFTER DEGREE

AVIK SHARMA

STUDENT, ENVIRONMENTAL HEALTH
AFTER DEGREE

BAILEY ELZINGA

STUDENT, ENVIRONMENTAL HEALTH
AFTER DEGREE



WATER QUALITY ON FIRST NATION RESERVES

The disparity in the quality and safety of drinking water between First Nation reserves and non-reserves in Canada is a long-standing issue. Although access to water has greatly improved on reserves, most First Nation communities are subject to boil water advisories due to unsafe water sources. First Nation communities are significantly more vulnerable to water-borne diseases due to inadequate access to safe drinking water.

We examined the magnitude and extent of this problem, causative factors and possible solutions by interviewing environmental public health specialists involved in an ongoing water quality study on a reserve. Key issues relating to communication barriers, ineffective policies and funding structure were identified from reviewing published literature and reports.

As part of an ongoing case study in collaboration with the University of Alberta, we analysed water quality results

from a Cree First Nations community, north of Edmonton on a four-year long boil water advisory. Comparison with the Guidelines for Canadian Drinking Water Quality showed that the contaminant level of the water at this reserve exceeds most key safety parameters.

Due to the health risks posed by unsafe water, a solution to this crisis is urgently needed. We suggest a multifaceted strategy involving engagement of the First Nation communities in the revamping of existing policies, cultural sensitivity and source water management to combat both present and future drinking water issues. The uniqueness of each reserve requires personalised solutions to the water quality issues.

Research Advisor: Dr. Sandra Song

SAKSHI BHARDWAJ

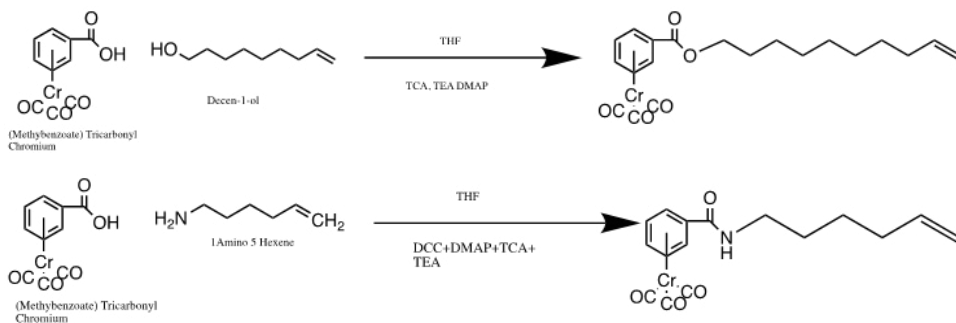
STUDENT, CHEMISTRY



ESTERIFICATION AND AMIDATION OF TRICARBONYL(BENZOIC ACID)CHROMIUM

The focus of this project was to synthesize alkene-terminated organometallic complexes which could be then be used to functionalize Si nanocrystals. The Yamaguchi esterification of Tricarbonyl(benzoic acid)chromium with decene-1-ol was investigated as a possible synthetic route

(Dhimitruka and Santalucia, 2006). The resulting product was characterized via IR spectroscopy. As an alternative route to an alkene-terminated product an amidation reaction was investigated via the DCC-coupling of tricarbonyl(benzoic acid)chromium with 1-amino-5-hexene (Neises and Steglich, 1978).



Research Advisor: Dr. John Washington

DR. ZOLTAN BERKES

ASSOCIATE PROFESSOR, PHYSICS



NARRATIVES IN PHYSICS TEACHING

Narratives are usually related to subject areas in humanities.

It is the subject of less discussion to show how sciences, physics in particular, also rely on narratives.

“Narratives” is an expression that is rarely emphasized as a methodological category in sciences. For example, the concept of “narrative framing” in describing natural phenomena and the subsequent creation of scientific models is fairly new. On the other hand, describing historical scenarios as a background to teaching (and learning) about theories in physics is probably the most direct albeit subtle reference to narratives.

In the learning process, students also get acquainted with the most common scenarios in which those theories can be applied. The tools are the traditional “word-problems”: these are narratives that provide practical examples to students.

This study investigates the role of narratives in both describing the physical process in those word problems, as well as the ways of choosing the fitting equations, “formulas,” with which to solve those problems. The importance of choosing the “right” narrative in finding the solution is demonstrated through two examples: the case of the first law of thermodynamics and a simple scenario from elementary mechanics.

CHARITY BLANEY

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



VERTEBRATE HABITAT SELECTION IN COVERED AND OPEN AREAS ON A GRADIENT OF PARKLAND FOREST TO FROZEN WETLAND

Varying amounts of vegetation on the landscape provide differing amounts of cover between habitats, even in areas that may be spatially near to each other. Vertebrate species have specific needs which strongly influence their selection and use of habitat, and amount of vegetative cover is often one such defining factor. Understanding the types of habitats animals select is important for identifying resource availability and habitat characteristics required by wildlife species. I am conducting a study in North Central Alberta of habitat selection in winter based on vegetative cover by making field surveys of use of forested, edge, and open areas by vertebrates. I seek to answer the research questions of which species use open and forested habitats during winter, whether they select one type more than the other, and whether there is evidence of edge effects in the survey areas. I count individual use in the 3 habitat types, and analyze my field data to discover if a significant difference exists

in usage of these 3 types of habitat. My goals for this research project are to increase understanding of habitat selection by vertebrate species in Northern Alberta during the winter season. I aim to contribute to knowledge regarding habitat characteristics that are important for wildlife success, specifically the need for vegetative cover in winter. I hope that my investigation will help provide increased knowledge of habitat needs that can be used functionally toward effective land management and habitat conservation efforts.

Research Advisor: Dr. Mariola Janowicz

KRISTEN BRIDGETT

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE

COLIFORM BACTERIA, SPECIFICALLY STAPHYLOCOCCUS AUREUS, ARE FOUND ON CELL PHONES

For many of us the cell phone is a constant part of our day to day life. Many Students use their phones frequently throughout the day and if not careful students in the laboratory could be using and introducing bacteria to their phones. The purpose of this study is to determine if Coliform bacteria and Staphylococcus aureus are present on students' cellphones. Bacteria was collected from ten university student's phones using a sterile cotton swab before, and after laboratory sessions. The phone swabs were inoculated and grown on three types of medium: luria-bertani (LB) agar, eosin methylated blue (EMB) agar, and mannitol salt agar (MSA). The bacteria were then Gram-stained. Finally, an antibiotic sensitivity test was conducted using penicillin, tetracycline and streptomycin discs. In the antibiotic sensitivity testing, there was bacteria present that exhibited resistance to certain antibiotics. In this undergraduate laboratory, bacteria were shown to grow on phones. Therefore, phones can

be seen as fomites. The bacteria found could in the future have more prominent growth due to the areas that we keep our cellphones, in a warm snug pocket, is ideal for bacterial persistence. This research was an effective start to show that bacteria is present on phones outside the hospital and can be taken further in determining just what kind of bacteria is actually present on student's phones.

Research Advisor:
Dr. Deborah Hemmerling

ALLISON CRAWFORD

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE

CRAIG RICHTER

PROFESSOR, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



NEAR-INFRARED SPECTROSCOPIC ANALYSIS OF INTACT CANOLA SEEDS FOR EVALUATING SEED QUALITY

Canola (*Brassica napus*) is an important crop in Canada. The development of a high-speed, non-destructive, and reliable instrumental method to evaluate quality of canola seeds is of major interest to growers, processors and oilseed breeders. Near Infrared Spectroscopy (NIRS) has shown to be a promising method toward that end. Previous investigations have shown a good agreement between the reference data and NIRS predicted values for quality of canola seed. These calibrations were

specific to the growing locations and environmental conditions under which the seed was grown. This study examines the attributes of the near infrared reflectance spectra of intact seed of canola grown in Alberta and Manitoba. NIRS reflectance measurements were taken for various samples with different percentage of foreign material, moisture, as well as oil content.

Research Advisor: Dr. Xin Chen

DANIKA DEIBERT

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

MADELEINE WIEBE

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

JADE ROY-SPENCER

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

DR. KATHIE-ANNE WALTERS

SENIOR RESEARCH SCIENTIST (INSTITUTE FOR SYSTEMS BIOLOGY)



TRANSCRIPTOME ANALYSIS: SYNERGISM WITH STREPTOCOCCUS PNEUMONIAE AND 1918 PANDEMIC INFLUENZA VIRUS

This study delves further into the synergy of co-infection between the 1918 pandemic influenza virus and *Streptococcus pneumoniae*. Most mortality seen in this outbreak was due to the secondary bacterial infection. Transcriptome data was derived by comparing single agent infection *S. pneumoniae* with the transcriptome from *S. pneumoniae* in a co-infected lung. This data revealed that the co-infecting *S. pneumoniae* had a different transcriptional profile than when it infected alone. This study examines the preferentially upregulated transcripts of what appears to be novel genes, specifically to determine if those genes contribute to virulence. These genes were analyzed and mapped using BLAST programs. Once the

uncharacterized genes were located, adjacent characterized genes with known proteins were examined for their respective function. If the function is related to pathogenicity, the assumption is that the neighbouring uncharacterized gene has a similar function. The goal is to establish uncharacterized genes that could be related to the pathogenicity of the bacteria and subsequent synergism.

Research Advisor:
Dr. Deborah Hemmerling

HARVEENA DHILLON

STUDENT, CHEMISTRY



SYNTHESIS OF 1,4-DIENE-3-OLS WITH C-2 SUBSTITUTED ESTERS

1,4-dien-3-ols have the potential to act as substrates for the anionic equivalent of the Nazarov cyclization. The synthesis of these substrates is presented by using Gilman reagents to add into ynones in a conjugate fashion. The intermediate enolate could then be trapped with enals to form the desired substrates. It was found that methyl-2-hexynoate was a suitable alkyne starting material and a variety of different aldehydes were shown to be compatible with the conditions to provide a small set of

substrates. This method also provides easy points for diversification as the Gilman reagent, alkyne, and aldehyde all provide points for diversification to increase the library size with ease.

Research Advisor: Dr. Owen Scadeng

BRYNNE GOURLAY

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



IDENTIFICATION OF CONSERVED PROTEINS IN NOCARDIA BRASILIENSIS AND OTHER ACTINOMYCETOMA CAUSATIVE AGENTS

Mycetoma, a neglected tropical disease, is caused by a multitude of different microorganisms. This condition may be caused by both bacterial and fungal species, with the bacterial species suggested to spread more quickly through the body. Often untreated due to lack of medical access, amputation is ultimately a commonly relied upon resolution to avoid further complications in patients. *Nocardia brasiliensis*, although a rare pathogen, is the main culprit of actinomycetoma (bacteria-caused mycetoma). This underreported disease has not been fully explored. Currently, actinomycetoma has no preventative measures. Given the difficult patient accessibility of medical care, an effective, practical, pre-emptive approach is worth exploring. One such measure is the implementation of a broad-spectrum vaccine aimed at most, even all, mycetoma causative bacterial agents by targeting a conserved motif. I hypothesize that at least one *Nocardia brasiliensis* encoded protein is conserved

amongst other actinomycetoma bacteria. Using a bioinformatical approach, identified *Nocardia brasiliensis* proteins were used to search for homologs in other potential mycetoma-causative agents. Three key DNA replication proteins have been identified as potential candidates. Interestingly, homologs were identified in other *Nocardia* species, as well as *Rhodococcus*, *Actinobacteria*, and *Corynebacteriales* species. Furthermore, nucleotide sequences encoded by the three most common causative agents of mycetoma were also compared. From these analyses, the 16S ribosome was identified as partially conserved amongst them. These identified elements can now serve as a platform for future studies exploring them as potential vaccine candidate.

Research Advisor: Dr. Carla C. Salvado

SUKHMAN GREWAL
STUDENT, ENVIRONMENTAL PUBLIC HEALTH

PAULINA REDUCHA
STUDENT, ENVIRONMENTAL PUBLIC HEALTH

PAMELA GUTOWSKI
STUDENT, ENVIRONMENTAL PUBLIC HEALTH

RICHARD CASPA
STUDENT, ENVIRONMENTAL PUBLIC HEALTH



FOOD SAFETY: POLICIES AND PRACTICES IN CANADA

BACKGROUND: It is estimated that about 1 in 8 Canadians suffer from a foodborne illness (FBI) yearly, resulting in 11,600 hospitalizations and 238 deaths per year. Food safety is a global, shared responsibility, where various stakeholders join hands to achieve the common goal of making food safer.

OBJECTIVE: The objective of the research was to give an overview of different agencies and policies (including acts, regulations and standards) around food safety, which are applicable in various parts of Canada, including global schemes.

RESULTS: In Canada, food safety is a collaborative effort. Provincial agencies develop, implement and enforce food safety policies such as the Public Health Act for their province. Federally, Health Canada establishes policies and standards related to the nutritional composition, quality and safety of foods and CFIA is the enforcement agency. Globally, WHO and FAO use an

educational approach and don't have any minimum standards that food producers and processors have to comply with. Global Food Safety Initiative (GFSI) standards are an emerging third-party certification system, adopted by many businesses voluntarily to stay competitive, and cut cost and time associated with multiple audits.

Recent scientific advancements have introduced unconventional products, practices and technology like home delivery of grocery, meal kits and vertical farming. These present a grey area in terms of food safety as there are no policies or guidelines available for the industry or the inspection agencies.

CONCLUSION: With globalization and the complexity of food chain, it has become necessary to use the multi-barrier approach to prevent FBI.

Research Advisor: Dr. Sandra Song

KIM HONG
STUDENT, CHEMISTRY



KNOEVENAGEL AND UNKNOWN ALDEHYDES

The Knoevenagel reaction was identified as a potential new lab for the undergraduate organic curriculum. The need to adjust the standard lab procedure so it could be completed in a 4-hour lab period was addressed by adding a dehydrating agent in triethyl orthoformate. Furthermore, a variety of

aldehydes were tested to potentially add the aspect of unknown determination to the lab procedure by using TLC and NMR analysis without the need to run time-consuming purification techniques.

Research Advisor: Dr. Owen Scadeng

SYDNEY HUCULAK

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



THE EFFECT OF AN EXTREME CLIMATE CHANGE SCENARIO ON THE GROWTH OF A NATIVE SUBMERGED MACROPHYTE (MYRIOPHYLLUM SIBIRICUM) IN A NORTHERN ALBERTA LAKE

Macrophytes play a structuring role in lake ecosystems by creating crucial habitat for many zooplankton and fish species in the littoral zone of the lake. Therefore, changes in the abundance or biomass of macrophytes can alter community-level dynamics. Previous research has shown that macrophytes growth response to increased temperature is species-specific. However, there is currently a lack of research being conducted in this area in Alberta. This study focused on the effect of climate change on the growth of a native submerged macrophyte in a northern Alberta lake in an attempt to address this unexplored area of research. A 6-degree temperature increase was used to simulate an extreme climate change scenario in Alberta. *Myriophyllum sibiricum* and lake water were sampled from Lac La Nonne, Alberta. The filtered lake water and native macrophyte were used to create 10 L microcosms stored in environmental chambers. Growth, water quality, and chlorophyll a were

measured biweekly for a 4-month period. The final dry weight of *M. sibiricum* in both control and treatment microcosms was also measured. It was hypothesized that the 6-degree temperature increase would have a negative effect on *M. sibiricum*, causing a reduction in growth and biomass. Results show that biomass and chlorophyll a concentrations did not significantly differ between the control and treatment microcosms. However, the 6-degree temperature increase significantly reduced the growth of *M. sibiricum*. This suggests that Alberta lakes could see changes in macrophyte growth under an extreme climate change scenario.

Research Advisor: Dr. Mariola Janowicz

REETIKA JASWAL

STUDENT, CHEMISTRY



SYNTHESIS OF 1,3-SILYLKETO ESTERS

1,3-dicarbonyls are present throughout organic synthesis, but surprisingly these compounds have traditionally lacked acyl silanes as one of the carbonyls. Through the use of 1,3-dithianes as umpolung reactants, silyl carbonyls were synthesized attached to esters at carbon-3. Reactions of the 1,3-silylketo

esters were also conducted to compare their reactivity to traditional 1,3-ketoesters.

Research Advisor: Dr. Owen Scadeng

DALLAS MCINTOSH

STUDENT, MATHEMATICS



MATH THESIS

The poster will be about my Math 400 thesis paper. The paper goes into game theory. Specifically, the thesis analyzes No-Limit Texas Hold-Em Poker. It shows how bucketing is implemented, and utilized in poker for creating a poker program/computer. Bucketing can also help with making a strategy, that is competitive against all player types.

The poster is just a generalization of the paper. Hopefully people who view the Math 400 poster will come away with the very least a better understanding of poker, and potentially that of strategy in poker.

Research Advisor: Dr. Rossitza Marinova

TONY MAK

**PROGRAM COORDINATOR,
PUBLIC HEALTH**

DR. SANDRA SONG

DIRECTOR, PUBLIC HEALTH



SOCIAL SCIENTISTS AS BROKERS IN PUBLIC HEALTH

Social sciences have made profound contribution to population health. However, today's public health field appears to have been "colonised by the individualistic ethic of medicine and economics". In view that technology is exploding, and that funding and resources are diminishing, social dimensions may be unheeded. Indeed, social dimensions continue to remain an integral part of public health. The authors illustrate and support the notion with a project in-progress related to drinking water quality in an indigenous community. By tradition, solutions to water quality problems focus on science and technology; nonetheless, finding the technical solution is only the first step towards health protection. Actual problem solving involves more than scientific knowledge but should encompass social and political factors. The dissemination and implementation of technology are complex, multifaceted, and are impacted by social contextual factors. In this project, a social scientist's

professional training has proven invaluable in addressing history, culture, values, economic and political factors in the community's fabric. Hence, reach, diffusion, translation and adoption are facilitated; the chance of success is improved.

While traditional approaches have failed to resolve the decade-long problems due to cultural (in)sensitivity, the new approach that considers social context seems to be promising. The project is on-going; the authors will continue to monitor. At this point, the community has accepted the proposition with full cooperation; water samples have been obtained, analyzed, and the proposed new technology is being refined to target specific parameters. Social sciences continue to play a role in public health.

“

TONY MAK

**PROGRAM COORDINATOR,
PUBLIC HEALTH**

DR. SANDRA SONG

DIRECTOR, PUBLIC HEALTH



“TELL ME A (GOOD) STORY AND IT WILL LIVE IN MY HEART FOREVER”; STORYTELLING AS A PEDAGOGICAL TOOL IN ENVIRONMENTAL PUBLIC HEALTH PROGRAMS

This project explores the use of storytelling as a pedagogical tool and the qualities required of an effective “storyteller” in Environmental Public Health programs. Environmental Public Health integrates (Environmental Health) Sciences and (Public Health) Services, and as the name implies, the public is the centre of the discipline.

Environmental Public Health programs, like other professional programs, are charged with preparing students for the real world. Human nature is unpredictable; Students must endeavour to link practice with science when interacting with the public. They can learn through “stories”. “Stories are data with a soul”. Storytelling is popular in professional programs; it raises enthusiasm, initiates engagement, improves comprehension, allows interaction and inspires learning. “Stories” are not new in public health. We have known them as “scenarios”, “case studies”, and others.

Narrative pedagogy encourages teachers and students to share stories, learn “data”, and translate experiences into knowledge. Stories are based on the lived experience of participants. The story quality and the telling process are important. Effective storytellers exude while sharing stories, and they can make a story a great story. The authors propose a study to determine the qualities required of an instructor to be a good storyteller who could excite and create rapport with Environmental Public Health students.

“

SHINA MALHI

STUDENT, CHEMISTRY



ORGANOCATALYSIS AND THE DIELS-ALDER REACTION

An undergrad lab was developed to incorporate modern organocatalysis and their use in the classic Diels-Alder reaction. Amine based catalysts lower the activation energy of the reaction while also being readily available, and amenable to enantioselective processes if desired. By using one of MacMillan's catalysts and a series of different dienes, a suitable lab was developed for the use of an advanced organic lab. This

lab will also incorporate the use of NMR techniques to elucidate the structure of the major isomer, as well as the isomeric ratio of the products.

Research Advisor: Dr. Owen Scadeng

ADAM MOGHRABI

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



FACTORS AFFECTING THE RECOVERY OF THE KEYSTONE SEA URCHIN *DIADEMA ANTILLARUM* IN THE CARIBBEAN

Diadema antillarum is a keystone species which faced a massive die-off in 1983 due to the rapid dispersal of an unknown pathogen. The die-off of this sea urchin has facilitated a phase-shift from coral-dominated reefs to algae-dominated reefs. *Diadema* has since been in a state of slow recovery. This research took place over four 8-week summer expeditions in 2014-2017 in two locations in Honduras. In Utila, an island with low *Diadema* density, low scleractinian cover, and high macroalgae cover;

highly representative of the rest of the Caribbean. This site was compared to the Banco Capiro off-shore reef system in Tela which has a high density of *Diadema*, high scleractinian cover, and low macroalgae cover. This research attempts to identify the barriers to *Diadema*'s recovery so that measures can be taken to restore the health of the Caribbean reefs.

Research Advisor: Dr. Sheri Dalton

LINDSAY MULLER

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



IDENTIFICATION AND ALIGNMENT OF HUMAN AND MOUSE SNPs IN THE DMD GENE USING A BIOINFORMATICAL APPROACH

Muscular dystrophy (MD) is a fatal, muscle wasting disease affecting individuals who have acquired a mutation in their dystrophin (DMD) gene. Some of these mutations are a single nucleotide alteration. Dystrophin is a vital part of a protein complex in skeletal and cardiac muscle tissue. The gene is the largest in the human genome, spanning 79 exons on the X chromosome. MD is X linked dominant, targeting mostly males that are affected by the one of the two most common forms, Duchenne muscular dystrophy (DMD) and Becker muscular dystrophy (BMD). Both DMD and BMD result from single nucleotide polymorphisms (SNPs). To date, there is no cure for the disease. Of the identified SNP mutations, the phenotype for many has not yet been characterized. To this end, identifying conserved regions between humans and mice would allow for further characterization of these SNPs, as dystrophinin in mice is functionally analogous. Therefore, I hypothesize that some of the human

SNPs in DMD are conserved in mouse DMD. Using a bioinformatical approach, I collected various SNP mutations, and using Ensemble, I then aligned the genes. Of the exons examined, 212 SNPs were identified, 17 of which were on exon 57. Furthermore, many of the human SNPs align with mouse DMD gene SNPs. This study will allow for further characterization of the DMD SNPs, as well as serve as a platform for future in vivo studies, opening opportunities to possible gene therapies for individuals with muscular dystrophy.

Research Advisor: Dr. Carla C. Salvado

MEGAN O'NEILL

STUDENT, ENVIRONMENTAL HEALTH AFTER DEGREE

ANCA NASTASE

STUDENT, ENVIRONMENTAL HEALTH AFTER DEGREE

OLUFUNMILAYO KOLA-EDEKERE

STUDENT, ENVIRONMENTAL HEALTH AFTER DEGREE

ERIC ILE

STUDENT, ENVIRONMENTAL HEALTH AFTER DEGREE

DR. SANDRA SONG

DIRECTOR, PUBLIC HEALTH



WILDFIRE AIR QUALITY ISSUES IN ALBERTA

Context: Canada has 347 million hectares of forest land and is prone to forest fires, with approximately 8,000 wildfires annually. Wildfire smoke has over 150 chemicals affecting air quality, and many are carcinogenic. The smoke spreads across large distances impacting the health of many Canadians.

Objectives: This study sets out to find the operational policy/guidelines related to air quality issues resulting from forest fires.

Methods: We consulted various online federal and provincial guidelines, reports, and documents. Key words include: air quality, emergency preparedness, budget, wildfires, smoke, pollution, public health, Alberta. Our analysis focused on strategies, communication, and operation.

Results: The latest federal budget showed commitment to work with provinces and territories to set stronger air quality standards, monitor emissions, and provide incentives for investments

that lead to cleaner air and healthier communities. The focus is to reduce industrial air pollution rather than wildfires. In Alberta, the focus is on public communication and emergency preparedness to control fires, rather than controlling fire smoke or creating clean air sanctuaries.

Conclusion: Air pollutants of concern are continuously monitored with the Air Quality Health Index, a federal and provincial government tool. It helps individuals understand health risks associated with current air quality and guide their activity level as required. Monitoring methods do not measure toxins of concern in wildfire smoke. Despite provincial communication efforts, most Albertan public do not know the health severity of wildfire smoke pollutants. Increased education will enable individuals to modify their behaviour to minimize their risk of inhaling wildfire smoke.

Research Advisor: Dr. Sandra Song

JACLYN REPCHUK

STUDENT, CHEMISTRY



FUNCTIONALIZATION OF SILICON QUANTUM DOTS WITH FERROCENYL ALKENE LIGANDS

Silicon nanocrystals (SiNCs) are non-toxic quantum dots with size- and ligand-dependent optical and electronic properties.¹ The preparation of hydride-terminated SiNCs developed by the Veinot Group at the University of Alberta is based on the thermal processing of hydrogen silsesquioxane under a reducing environment.¹ Functionalization of the SiNCs with a variety of ligands imparts both stability and optical tunability. For example, UV excitation (ca. 340 nm) of alkyl-terminated 3 nm SiNCs results in photoluminescence centered near 700 nm. Ferrocene, an organometallic compound, is well-known for both its stability and redox activity. The purpose of this study was to combine the photoluminescent (PL) properties of SiNCs with the redox properties of ferrocene via co-functionalization with alkene-terminated ferrocene derivatives (Figure 1).

Initial work focused on the synthesis of alkene-terminated ferrocene derivatives and their subsequent characterization via a variety of spectroscopic techniques (e.g. IR, NMR, UV-Visible). Hydride-terminated 3 nm diameter SiNCs were then co-functionalized with a mixture of 1-dodecene and the

corresponding alkene-terminated ferrocene derivative. Characterization included TEM and IR studies but was more heavily focused on PL Spectroscopy. The PL properties of the SiNCs were significantly affected by the presence of the ferrocene molecule.² The presence of ferrocene at the surface effectively quenches the UV excitation PL pathway, however, excitation into the visible absorption band of the surface ferrocene (ca. 510 nm) results in the return of photoluminescence at ca. 740 nm. This effect of surface ferrocene on the PL properties of the SiNCs is under current investigation.

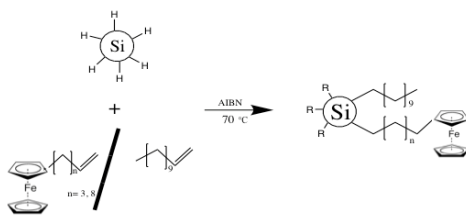


Figure 1. Co-functionalization of silicon nanocrystal with 1-dodecene/alkene-terminated ferrocene.

Research Advisor: Dr. John Washington and Dr. Jon G.C. Veinot (U of A)

KAYLA SLOMAN

STUDENT, CHEMISTRY



SYNTHESIS AND APPLICATION OF CROSS-CONJUGATED TRIENONES

Cross-conjugated trienones serve as potential substrates for 8π electrocyclizations when converted to alcohols or treated with anionic silicon reagents. Synthesis of these cross-conjugated trienones was accomplished via sequential aldol condensations

and aldol reaction/dehydrations. The substrates were then converted to their corresponding alcohols to test for conditions for the electrocyclization.

Research Advisor: Dr. Owen Scadeng

JADE ROY-SPENCER

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

DANIKA DEIBERT

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

MADELEINE WIEBE

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

DR. KATHIE-ANNE WALTERS

SENIOR RESEARCH SCIENTIST (INSTITUTE FOR SYSTEMS BIOLOGY)



CHARACTERIZATION OF POTENTIAL VIRULENCE GENES IN STREPTOCOCCUS PNEUMONIAE

The 1918 influenza pandemic killed approximately 50 million people globally, with secondary bacterial pneumonia believed to be the prominent cause of death. The most common bacterial pathogen isolated from fatal cases was *Streptococcus pneumoniae* (SP), which has been found to have lethal synergism during influenza coinfection. The current understanding of how the bacterial virulence factors enhance pathology during coinfection is incomplete. Due to the inevitable reoccurrence of an influenza pandemic, a detailed understanding of the coinfection synergism is essential to minimizing or preventing mass mortality. Preferentially upregulated genes in the bacterial genome during coinfection were obtained. Using bioinformatics, those that were undefined were characterized in terms of size, location within the genome, and protein function. Based on the

function of the genes' product, potential target genes for CRISPR knockout were proposed for the purpose of assessing the knockout effects on bacterial virulence. This work will contribute to the understanding of enhanced pathophysiology of SP coinfection with influenza, therefore opening new research directions and treatment options.

Research Advisor:
Dr. Deborah Hemmerling

KASSIDY TURCOTTE

STUDENT, CHEMISTRY



GREEN WITTIG REACTIONS AND ISOMERIC RATIOS

An undergraduate lab was developed to introduce students to the use of NMR integration techniques to determine isomeric ratios. The Wittig reaction was identified as an appropriate reaction as it is known to regularly produce isomeric ratios that are not 1:1, while producing easy to view NMR signals. A carbonyl

Wittig reagent was synthesized as it showed compatibility with aqueous reaction conditions, making the process Green. A series of aromatic aldehydes were tested to find the most appropriate substrates for NMR integration.

Research Advisor: Dr. Owen Scadeng

JOSE VILLANUEVA

STUDENT, CHEMISTRY



1,3,6- TRIENE ELECTROCYCLIZATION

1,3,6-Trienes serve as potential substrates for 7-carbon-8 π -electrocyclizations. By substituting the 5 position with alkoxy substituents and using aromatic rings as one of the alkenes, the regiochemical outcome of the cyclization can be readily predicted and form synthetically useful products.

Synthesis of o-styryl-(1-allylsiloxy) benzene and their reactions are presented.

Research Advisor: Dr. Owen Scadeng

DR. JOHN WALSH

SESSIONAL INSTRUCTOR, BIOLOGICAL
AND ENVIRONMENTAL SCIENCES

CRAIG RICHTER

PROFESSOR, BIOLOGICAL AND
ENVIRONMENTAL SCIENCES

BIO 207 STUDENTS

2017/2018

CITY OF EDMONTON PEST MANAGEMENT LAB



CONDUCTING RESEARCH WITHIN THE INSTRUCTIONAL LABORATORY SETTING: DNA BARCODE BASED IDENTIFICATION OF ENGRAVER BARK BEETLES (IPS SPECIES) IN EDMONTON CANADA

DNA barcoding refers to the use of a sequence (DNA barcode) for the purpose of species identification. The barcode must be a region of sequence conserved across species, but variable enough between species that it acts as a unique identifier. To date, barcode sequences for 189, 000 species have been uploaded to the Barcode of Life Database.

An advantage of DNA barcoding is that it can be performed by non-taxonomists; opening the door on the scientific enterprise aiming to understand global biodiversity. Basic DNA isolation and the cost of sequencing (dollars/reaction) is all that is required. Instructional labs are well suited to barcoding projects because the resources are found together with a ready-made cohort of “citizen scientists”. In this way, teaching laboratories become vehicles for research and students are promoted past demonstration science to become part of the research community.

Over the 2017-2018 year, the Department of Biological and Environmental Sciences has been running a barcoding project within its Molecular Genetics course (BIO 207). Samples were obtained from The City of Edmonton’s Pest Management Lab, which conducts surveillance programs to monitor for the presence of economic and environmentally significant pests. Engraver bark beetles (Ips species) that were collected as part of the monitoring program were processed by the students and successful PCR amplifications of the COI region were sent for sequencing. Preliminary analysis suggests that DNA barcode based identification performed by students could significantly contribute to our understanding of this group of cryptic but impactful species in the Edmonton region.

Research Advisor:
Dr. Deborah Hemmerling

MADELEINE WIEBE

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

DANIKA DEIBERT

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

JADE ROY-SPENCER

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCES

DR. KATHIE-ANNE WALTERS

SENIOR RESEARCH SCIENTIST (INSTITUTE FOR SYSTEMS BIOLOGY)



GENOMIC ANALYSIS OF UPREGULATED STREPTOCOCCUS PNEUMONIAE GENES AS SEEN IN A COINFECTION WITH 1918 H1N1 AND STRATEGIES OF GENE KNOCKOUT USING THE CRISPR/CAS9 SYSTEM.

Nearly 50 million people died during the 1918 Spanish influenza pandemic. However, there is evidence that the main cause of death was not viral infection, but a secondary *Streptococcus pneumoniae* infection. Post-mortem samples of human lung tissue reveal mass thrombosis and inflammation of the lungs. When the coinfection was simulated in mice by Walters et al., similar lung pathology was observed, which was significantly more pronounced than results seen in mice solely infected with *S. pneumoniae* (2016). There is also preliminary evidence of a dysfunctional immune response during the coinfection, including an over-calling to neutrophils. A number of highly expressed bacterial genes were identified for significant days of the coinfection and these expression levels are not seen in isolated *S. pneumoniae* infections. This study examined the upregulation of uncharacterized bacterial genes observed by Walters et al. (2016) to determine potential mechanisms of the coinfection. In Phase 1, bioinformatics

was conducted on uncharacterized bacterial genes to determine potential roles in the coinfection, and previous research was collected to support the hypothesized roles of elements of interest. Phase 2 will consist of researching procedures and techniques to knockout uncharacterized genes of interest and successfully transform *S. pneumoniae*. Techniques under consideration include the CRISPR/Cas 9 system. This project will continue in late 2018 with bacterial transformation and the eventual reproduction of the 2016 Walters experiment to determine if genes of interest have a specific role in the coinfection.

Research Advisor:
Dr. Deborah Hemmerling

RYLEIGH-RAYE WOLFE

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



EFFECT OF WILDFIRES ON MOBILIZATION OF HEAVY METALS IN ALBERTA'S PEATLAND BOREAL FOREST.

Numerous studies in Europe and the US have found increased metal concentrations in soils after forest fires, however such type of studies in Canada's peatland ecosystems has been rare. With increasing frequency of wildfires in the peatland boreal forest over the last decades, there is an urgent need in studying the movement of harmful metals in peatlands because they are an important pathway to aquatic ecosystems. Highly mobile dissolved toxic metals within ash and soil can be transported to nearby water sources through erosion and storm run-off. This can directly affect water quality, threatening the health of humans and other organisms. We conducted a field study near Fort McMurray, Alberta that represents a snapshot of metal movement between vegetation and the soil after a wildfire event. Two sampling fields were selected to represent metal mobilization in a forested peatland before and after the 2016 Horse River Fire. From each the burned and

unburned peatland, soil samples were collected from the organic and the clay layer. Concentration of dissolved heavy metals (cadmium, copper, manganese, lead) in the samples were measured using Atomic Absorption Spectroscopy. Concentrations of cadmium, copper and lead were not detectable, therefore further statistical analyses focused on manganese. Higher, and statistically significant, concentrations of manganese were found in the burned peatland compared to the unburned. It was also found that a large portion of the total soluble manganese was adsorbed to the soil particles. Acidification allowed for release of these metals thus increasing the concentration of manganese detected. In all, wild fires do have potential to increase metal concentration (manganese) and mobilization, especially in acidic conditions.

Research Advisor: Dr. Xin Chen

OWEN WOYCENKO

STUDENT, BIOLOGICAL AND ENVIRONMENTAL SCIENCE



EVALUATING THE UNIQUENESS OF RNA THERMOSENSORS BY COMPUTATIONALLY MODELING THE DEGREE OF UNFOLDING AT THE SHINE-DALGARNO SEQUENCE OF THE LISTERIA MONOCYTOGENES-ENCODED VIRULENCE FACTOR PRFA

RNA thermosensors (RNATs) are cis-acting structural elements found in prokaryotic mRNAs which mediate differential gene expression by unfolding with respect to temperature elevation. Within RNATs, the conserved Shine-Dalgarno (SD) sequence is masked by intramolecular base-pairing. Unfolding at this subsequence exposes residues for ribosome binding, and thereby increases translation initiation efficiency. Regulation of RNAT-containing transcripts prevents superfluous protein production outside host organisms. The gene *prfA*, which encodes the master transcriptional activator of the *Listeria monocytogenes* virulence regulon, is RNAT-regulated. RNAT sequences are not conserved around the SD, therefore searches for novel RNATs in virulence-associated transcripts require biophysical parameters, yet to be determined. Considering this, I hypothesize that the degree of unfolding at the SD uniquely distinguishes RNAT-containing transcripts. To test this hypothesis, I

used a program to generate an unbiased statistical sample of suboptimal RNA structures from the Boltzmann ensemble (RNAsubopt, $n=1000$). I calculated the fraction of structures in this sample that were single-stranded at the SD across the temperature interval 10-60°C. To evaluate the validity of this approach, I measured how this fraction changed depending on the selected sequence length, the selected SD subsequence length, and the stability of base-pairs within the SD. I then sampled transcripts randomly from *Escherichia coli* str. K12 ($n=50$) to statistically compare calculated fold changes to that of the *prfA* RNAT (20 versus 50°C). Fold change in SD openness was not a good predictor of thermosensing ($n=33$, $p=0.852$). Collectively, these results show that different biophysical models are required to distinguish RNATs as unique structural elements.

Research Advisor: Dr. Carla C. Salvado

**For Additional Information on the Office
of Research contact:**

**Valerie Henitiuk
Vice-President Academic & Provost
vpacademic@concordia.ab.ca**

Or

**Lainna ElJabi, MA
Research Officer
lainna.eljabi@concordia.ab.ca
780 479 9215**



concordia.ab.ca