# Clarkson University

# 3rd Annual Spring Research And Project Showcase

## April 13, 2019

Clarkson™

RAPS

# Table of Contents



Key
Presenter(s) in **bold**
Mentors *italicized*

Full Program available at
https://www.clarkson.edu/sites/default/files/2019-04/2019-RAPS-booklet.pdf

# 3rd Annual Spring RAPS Schedule

## Saturday, April 13, 2019

### Bertrand H. Snell B10L, B10M, 112, 118, 169, 175, 177, 212, 213, 214, 330, & Cheel Commons 113C, Cheel Arena

| | |
|---|---|
| 7:00-8:15 am | Registration – Presenters, Session Chairs, Judges<br>Bertrand H. Snell Atrium |
| 8:15-8:25 am | Opening Remarks<br>Anthony Collins, President<br>Bertrand H. Snell Atrium |
| 8:30-9:30 am | Oral Presentations – Session 1<br>Bertrand H. Snell Classrooms |
| 9:40-10:40 am | Oral Presentations – Session 2<br>Bertrand H. Snell Classrooms |
| 10:50-11:50am | Oral Presentations – Session 3<br>Bertrand H. Snell Classrooms |
| 12:00-1:00 pm | Lunch<br>Cheel Commons |
| 12:30-2:00 pm | Poster Session<br>Cheel Arena |
| 2:30-3:30 pm | Capstone Group Presentations<br>Bertrand H. Snell Classrooms |
| 4:00 – 5:00 pm | Award Ceremony (Cheel Arena)<br>Anthony Collins, President<br>Gina Lee-Glauser, VP for Research & Scholarship |

## Oral Presentation Session 1
## 8:30 – 9:30 AM
## Snell 169

# Chemistry I (Undergraduate)

| |
|---|
| 8:30-8:42 AM |
| **Alexander Harley;** ***Mario Wriedt*** <br> Nicotinic Acid Based Ditopic Zwitterionic Ligands for Metal-Organic Framework Synthesis |
| 8:42-8:54 AM |
| **Cindy Jiang;** ***Silvanna Andreescu*** <br> 3D Printed Hydrogel Bioink Based UV Sensors |
| 8:54-9:06 AM |
| **Austin Marshall;** ***Silvanna Andreescu*** and ***Abraham Samuel Finny*** <br> Cerium Oxide Nanoparticle Synthesis, Characterization and Reactivity |
| 9:06-9:18 AM |
| **Charlene VanLeuven;** ***Mario Wreidt*** <br> Solvatochromic Behavior of a Novel Zwitterionic Metal Organic Framework: A Mechanistic Overview |
| 9:18-9:30 AM |
| **Ana Witkowski;** ***Devon Shipp*** <br> Shape Memory and Self-Healing in Polyanhydrides |

## Session Chair: Monu Joy
## Judge: Art Melman

# Oral Presentation Session 1
# 8:30 – 9:30 AM
### Snell 175

## Biology & Biomedical Engineering (Undergraduate)

| |
|---|
| 8:30-8:42 AM |
| **Margret Dedloff;** ***Andrew David*** <br> Examining the Efficacy of Different Mitochondrial Genes in Distinguishing Two Species of Mussels |
| 8:42-8:54 AM |
| **Morgan McGrath;** ***Susan Bailey*** <br> Experimental Evolution of Pseudomonas fluorescens in a Heterogeneous Environment |
| 8:54-9:06 AM |
| **Katrina Stevens;** ***Heidi Hehnly-Chang*** <br> The Mother Centriole Protein, Cenexin, Regulates Preferential Segregation of Lagging Chromosomes in a PLK1-Dependent Manner |
| 9:06-9:18 AM |
| **Rachel Yerden;** ***Thomas Lufkin*** and ***Petra Kraus*** <br> A Regenerative Medicine Approach to Degenerative Disc Disease |

**Session Chair: Petra Kraus**
**Judge: Ginger Hunter**

# Oral Presentation Session 1
# 8:30 – 9:30 AM
## Snell 177

## Space and AeroSpace (Undergraduate)

| |
|---|
| 8:30-8:42 AM |
| **Joseph Chiapperi; *Pat Piperni***<br>Multilevel Application of CST Geometry in Airfoil Optimization |
| 8:42-8:54 AM |
| **Austin Bentley; *Craig G. Merrett***<br>Wind Tunnel Analysis of Channel Wing Configurations for eVTOL |
| 8:54-9:06 AM |
| **Carlie Fowler; *Joshua Thomas***<br>Looking for Extended Red Emission in the Dark Nebula LDN1780 and the Reflection Nebula NGC7023 |
| 9:06-9:18 AM |
| **Steven Latimer; *Suresh Dhaniyala***<br>Design, Build, and Test of a Small-Scale Solid Fuel Rocket |
| 9:18-9:30 AM |
| **Joseph Sakr; *Brian Helenbrook***<br>Olympics Luge Computational Fluid Dynamics |

**Session Chair: Josh Thomas**
**Judge: Kenneth Visser**

# Oral Presentation Session 1
# 8:30 – 9:30 AM
## Snell 212

## Public Health & Mental Health (Undergraduate)

| |
|---|
| 8:30-8:42 AM |
| **Hennessy Garcia; *Christina Xydias***<br>Toxic News Reporting on the Children of God Cult |
| 8:42-8:54 AM |
| **Danielle Piontkowski; *Lisa Propst***<br>Iridescent: A Novel |
| 8:54-9:06 AM |
| **Talea Wilson; *Lisa Legault***<br>Bridging the Gap: A Critique of Mental Health Policy Using Empowerment Theory |
| 9:06-9:18 AM |
| **Emily Yuodsnukis; *Laura Ettinger***<br>The Maternal Mortality Crisis in New York State: An Analysis and Proposed Solutions |

**Session Chair: Christina Xydias**
**Judge: Stephen Casper**

# Oral Presentation Session 1
# 8:30-9:30 AM
## Snell 213

## Computer Networks, Security, and Signal Processing (Undergraduate)

| |
|---|
| 8:30-8:42 AM |
| **Lewis Collum;** ***Mahesh Banavar***<br>Android Real-Time Sensor Data Visualization |
| 8:42-8:54 AM |
| **Anthony Dowling;** ***Yaoqing Liu***<br>Priority-Based Information Flow via Named-Data Networking |
| 8:54-9:06 AM |
| **Lee Taylor;** ***Daqing Hou***<br>Behavioral Biometrics for Web Account Protection |
| 9:06-9:18 AM |
| **Heidi Walko;** ***Stephanie Schuckers***<br>Feasibility of toe print recognition in children |
| 9:18-9:30 AM |
| **Marcus Griffith;** ***Mahesh Banavar***<br>Using Signal Processing Techniques for Velocity Detection Using Optical Flow |

**Session Chair: Mahesh Banavar**
**Judge: William Jemison**

# Oral Presentation Session 2
# 9:40 – 10:40 AM
## Snell 169

## Chemistry II (Undergraduate)

| |
|---|
| 9:40-9:52 AM |
| **Samuel Pyser;** ***Mario Wriedt***<br>Rational Design and Synthesis of a Rigid Zwitterionic Ligand and Discrete Complexes to Access Novel Zwitterionic Metal-Organic Frameworks |
| 9:52-10:04 AM |
| **Megan Carhart;** ***Silvana Andreescu***<br>Nanotechnology-Enabled Paper-Based Biosensor for Ethanol Detection |
| 10:04-10:16 AM |
| **Michael Chirgwin;** ***Mario Wriedt***<br>Green and Rapid Mechanosynthesis of Zwitterionic Metal–Organic Frameworks for Carbon Capture |
| 10:16-10:28 AM |
| **Steve Liebich;** ***Silvana Andreescu*** and ***Fatima Mustafa***<br>Selective and Rapid Colorimetric Assay for the Detection of E. coli Using NPs-Aptamer Conjugate Probe |
| 10:28-10:40 AM |
| **Seamus Ober;** ***Artem Melman***<br>Fabrication of Alginate Hydrogel Coatings on Enzyme-Functionalized Electrodes |

**Session Chair: Fatima Mustafa**
**Judge: Devon Shipp**

# Oral Presentation Session 2
# 9:40 – 10:40 AM
## Snell 175

## Environment and Sustainability (Undergraduate)

| |
|---|
| 9:40-9:52 AM |
| **Meghan Edmund;** ***Andrew David***<br>Effects of freshwater acidification on an invasive mollusc (Viviparus georgianus) in the Adirondacks |
| 9:52-10:04 AM |
| **Charles Maitland;** ***Steven Bird***<br>U.S. Carbon Tax Design: State Energy Profile, Household Income, and Urban/Rural Effects |
| 10:04-10:16 AM |
| **Laura Siddon;** ***Michelle Crimi***<br>Feasibility of Biodegradable Alginate Capsules as a Slow-Release Fertilizer Mechanism |
| 10:16-10:28 AM |
| **Michael Valleau;** ***Kenneth Visser***<br>Design of an RPM Control System for Small Ducted Wind Turbines* |

## Session Chair: Mohammad Hassen
## Judge: Erik Backus

* Sustainability Poster

# Oral Presentation Session 2
# 9:40 – 10:40 AM
## Snell 177

## Business and Economics (Undergraduate)

| |
|---|
| 9:40-9:52 AM |
| **Katherine Slocum;** ***Laurel Kuxhaus*** <br> Wheel Spikes: The Future Of Wheelchair Mobility In The Snow |
| 9:52-10:04 AM |
| **Karim Ahmed;** ***Cecilia Martinez*** <br> Assessing the Effectiveness of a Performance Measurement Framework for Non-Profit Organizations: A Nicaraguan Agroforestry Case Study |
| 10:04-10:16 AM |
| **Alison Davis;** ***Kenneth D. Visser*** and ***Chris Thornton*** (Company mentor) <br> SRC Internship Thesis: A Comparative Analysis of a Repeated Internship Experience |
| 10:16-10:28 AM |
| **Claire Liu;** ***Bebonchu Atems*** <br> Public Education Expenditures, Taxation, and Growth: Evidence from U.S. States |
| 10:28-10:40 AM |
| **Hannah Phillips;** ***Farzad Mahmoodi*** <br> The Impact of Long-Range Financial Planning on Demand Management in the Pharmaceutical Industry |

**Session Chair: Cecilia Martinez**
**Judge: Marshall Issen**

# Oral Presentation Session 2
# 9:40 – 10:40 AM
## Snell 212

## Psychology (Undergraduate)

| |
|---|
| 9:40-9:52 AM |
| **Nathalie Barr; *Lisa Legault***<br>The Victim-Perpetrator Link: How Childhood Trauma Shapes the Behavior of Sex Offenders |
| 9:52-10:04 AM |
| **Noah Chicoine; *Andreas Wilke***<br>Using Virtual Reality to Study Expectations of Clumpy Resources in Human Foragers |
| 10:04-10:16 AM |
| **Renee Levy; *Lisa Legault***<br>Sexual Recidivism: Can Treatment Help Predict and Reduce the Probability of Reoffending? |
| 10:16-10:28 AM |
| **Mackenzie Madison; *Lisa Legault***<br>Treating Deviant Arousal - The Basics of Arousal Reconditioning |
| **10:28-10:40 AM** |
| **Camryn Peets; *Lisa Legault***<br>Schizophrenia: An Alternate Version of "Our" Reality |

**Session Chair: Lisa Legault**
**Judge: Elizabeth Pienkos**

# Oral Presentation Session 2
# 9:40 – 10:40 AM
## Snell 213

## Modeling and Computational Methods (Undergraduate)

| |
|---|
| 9:40-9:52 AM |
| **Brendan Barrow;** ***Dhara Trivedi***<br>Determining Electronic Band Structure Using a Semiempirical Pseudopotential Method |
| 9:52-10:04 AM |
| **Chris Carter;** ***Sumona Mondal*** and ***Shantanu Sur***<br>Data-Centric Approach to Rheumatoid Arthritis (RA): A Bayesian Framework for Prediction of RA from Comorbidities |
| 10:04-10:16 AM |
| **Andrew Cook**; ***Sumona Mondal***<br>Characterizing Cancerous and Non-Cancerous Cells Through Movement Analysis Using the Kalman Filter |
| 10:16-10:28 AM |
| **Andrew Meier;** ***S.F. Wojtkiewicz***<br>Advances in Control of Civil Structures |
| 10:28-10:40 AM |
| **Alfred Worrad;** ***Marko Budisic, Sumona Mondal, Shantanu Sur***<br>Analysis of Formation of Cell Clusters In Vitro |

**Session Chair: Sumona Mondal**
**Judge: Nojan Bagheri-Sadeghi**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 169

## Biology and Biochemistry (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Eduard Dumittrescu;** ***Silvana Andreescu*** Electrochemical Monitoring of Neurotransmitter Concentration Dynamics in Live Zebrafish Embryos |
| 11:05-11:20 AM |
| **Jianlong Li;** ***Kenneth Wallace*** Developmental Regulation of Immature Intestinal Stem Cells by Secretory Cells in Larval Zebrafish |
| 11:20-11:35 AM |
| **Kangning Li;** ***Thomas Lufkin*** Transcriptome and Proteome Analysis of Intervertebral Disc (IVD) Cells |
| 11:35-11:50 AM |
| **Yaroslav Filipov;** ***Evgeny Katz*** Magneto-Controlled Biocatalytic Cascades with Logically Processed Input Signals – Substrate Channeling versus Free Diffusion |

**Session Chair: Thomas Lufkin**
**Judge: Andrew David**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 112

## Environmental Science & Engineering (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Bita Alipour Parvizian; *Shantanu Sur*** and ***Sumona Mondal***<br>Temporal Trend of Hexaboromocyclododecane In Fish Tissues From Great Lakes Using LC-HRMS |
| 11:05-11:20 AM |
| **Sadjad Fakouri Baygi; *Thomas M. Holsen, Bernard S. Crimmins***<br>Discovery of Emerging Halogenated Contaminants of Concern in Great Lakes Lake Trout |
| 11:20-11:35 AM |
| **Fiona Laramay; *Michelle Crimi***<br>Development of a Sonolytic Reactor for in Situ PFAS Remediation |

**Session Chair: Alicia Lamb**
**Judge: Al Rossner**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 118

## Fluid Mechanics & Aerosols (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Patrick Conlon;** ***Douglas Bohl, Selma Mededovic***<br>Investigation of The Induced flow An A Point to Plane Plasma Reactor |
| 11:05-11:20 AM |
| **Jie Dong;** ***Steve Wojtkiewicz***<br>Aeroelastic Real-Time Hybrid Simulation (AeroRTHS): Mitigation of Vortex Induced Vibration of a Tall Building Structure |
| 11:20-11:35 AM |
| **Colin Stutz;** ***Doug Bohl***<br>Development of an Optical Particle Sizing System for Field Testing |
| 11:35-11:50 AM |
| **Kavindra Kumaragama;** ***Shantanu Sur and Suresh Dhaniyala***<br>Optimized Generation and Characterization of Aerosolized Bacterial Spores |

**Session Chair: Doug Bohl**
**Judge: Pat Piperni**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 129

## Education (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Aditya Narayan Rajmane; *Richard Lasselle***<br>Differentiating Instruction in Technology Education Classroom |
| 11:05-11:20 AM |
| **Ashwaq Almatrafi; *Daqing Hou***<br>Designing of Persuasive Messages Templates for Encouraging Energy and Water Conservation Behavior |

**Session Chair: Richard Lassalle**
**Judge: Stephen Bird**

# Oral Presentation Session 3
# 10:50-11:50 AM
## Snell 175

## Material Science (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Sepehrdad Akbari;** ***Marilyn Freeman***<br>Electrical and Chemical Characteristics of Diamond-like Carbon (DLC) Thin Films Dielectrics |
| 11:05-11:20 AM |
| **Xiaoli Liu;** ***Chee-Keong Tan***<br>Electronic Properties of Monoclinic (InxGa1-x)2O3 Alloys by First-Principle |
| 11:20-11:35 AM |
| **Chethani Athukorala;** ***Suresh Dhaniyala, Shantanu Sur***<br>Engineered Microparticles for Targeted Pulmonary Delivery of Anti-Tubercular Drugs |
| 11:35-11:50 AM |
| **Cheng Wang;** ***Elizabeth J. Podlaha Murphy***<br>Electrodeposited Co-Mo-TiO2 Electrocatalysts for the Hydrogen Evolution Reaction |

**Session Chair: Elizabeth Podlaha Murphy**
**Judge: Phillip Christiansen**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 177

## Metal Organic Frameworks (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Juby Varghese;** ***Mario Wriedt***<br>Electrochemically Switchable Zwitterionic Metal-Organic Frameworks |
| 11:05-11:20 AM |
| **John Hadynski;** ***Mario Wriedt***<br>Rational Design and Synthesis of Rigid Zwitterionic Ligands to Access Novel Zwitterionic Metal-Organic Frameworks |
| 11:20-11:35 AM |
| **Monu Joy;** ***Mario Wriedt***<br>A Novel Zwitterionic Metal Organic Framework for Enhanced Carbon Capture |
| 11:35-11:50 AM |
| **Shefa Alomari;** ***Mario Wriedt***<br>Green and Rapid Mechanosynthesis of Zwitterionic Metal–Organic Frameworks for Carbon Capture |

**Session Chair: Mario Wriedt**
**Judge: Marilyn Freeman**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 212

## Modeling and Computational Methods (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Daniel Fuller; *Sumona Mondal, Shantanu Sur***<br>Bayesian Modeling of Rheumatoid Arthritis Comorbidly Interacting Risk Factors with Complex Survey Data |
| 11:05-11:20 AM |
| **Nojan Bagheri-Sadeghi; *Brian Helenbrook***<br>Simulation of Turbulent Flows with a High-Order Finite Element Method and a Modified k-omega Turbulence |

**Session Chair: Shantanu Sur**
**Judge: Marko Budisic**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 213

## Sensors & Signal Processing (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Kevin Mack;** ***Luke Rumbaugh, Mahesh K. Banavar, William Jemison*** <br> Underwater Ranging and Imaging with Time-of-Flight Cameras |
| 11:05-11:20 AM |
| **Keivan Bahmani;** ***Stephanie Schuckers*** <br> Fingerprint Presentation Attack Detection using Time-Series Captured Color Images |

**Session Chair: Stephanie Schuckers**
**Judge: Bill Thomsen**

# Oral Presentation Session 3
# 10:50 – 11:50 AM
## Snell 214

## Biomedical Sciences (Graduate)

| |
|---|
| 10:50-11:05 AM |
| **Grayden Shand;** ***Sumona Modal, Shantanu Sur***<br>Data-Centric Approach to Rheumatoid Arthritis (RA): How Interactions Between Comorbidities Influence RA Incidence |
| 11:05-11:20 AM |
| **Shatarupa Roychowdhury;** ***Jane E. Oppenlander***<br>Predictors of Cardiac Health and Diseases |
| 11:20-11:35 AM |
| **Chinmay Sahu;** ***Mahesh Banavar, Jie Sun***<br>A comparative study of cardiac rotor core estimation algorithms for AFib Ablation |

**Session Chair: Lisa Jeffers**
**Judge: Moshe Marko**

# Capstone Projects Presentations
# 2:30-3:30 PM

**Capstone Project Location & Topics**

| |
|---|
| **Snell 112** |
| • Syracuse Airport Car Rental Facility (CONRAC) and Runway Rehab |
| **Snell 118** |
| • St. Mary's Parish Hall Siting and Utilities |
| **Snell 129** |
| • Clarkson Science Center Energy Savings and Renovation |
| **Snell 175** |
| • Sustainable Doghouse Designs |
| **Snell 177** |
| • Clarkson Greenhouse Deconstruction and Reconstruction<br>• Ammonia Removal during Solid Waste Anaerobic Digestion Increasing Energy Generation and Reactive Nitrogen Recovery |

# Capstone Oral Presentation
# 2:30-3:00 PM

Snell 112

## 2019 Research and Projects Showcase (RAPS), Capstone Project

For the capstone project, our group was tasked with designing a Consolidated Car Rental Facility and a Runway Overlay for Syracuse Hancock International Airport. This project included meeting with POC's from C&S Companies who were acting as the client. Throughout the course of the project, submissions and presentations were given for each of the three phases: Proposal, Schematic Design, and Final Design.

Capstone Project Primary Mentor/Instructor/ Construction Engineering Management Program Professor of Practice and Executive Officer:
**Science Center, CEM Director, Erik Backus**

Course number associated with this effort (if any): CE490

Capstone Project Customer Organization:
**Syracuse Hancock International Airport / C&S Companies**

Capstone Project Customer POCs:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Heinl, Jared | Adjunct Instructor | 315-268-7701 | jheinl@clarkson.edu |
| Horth, Tom | P.E, C&S Companies | - | - |

Capstone Project Team Name (if any): Airport One Construction

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Fefee, Tyler | Spring 2019 | Project Manager/Leader |
| Albanese, Philip | Spring 2019 | Assistant Project Manager<br>Project Engineer |
| Burton, Jordan | Spring 2019 | Runway Overhaul Project Engineer |
| Kelsey, Brooke | Spring 2019 | Project Engineer |
| Matousek, Robert | Spring 2019 | Project Superintendent |
| Switser, Devon | Spring 2019 | Architect / Structural Engineer |

# Capstone Oral Presentation
# 3:00-3:30 PM

## Snell 112

### 2019 Research and Projects Showcase (RAPS), Capstone Project

The Syracuse Airport recently completed a major renovation of its main terminal, improving passenger experience while enhancing the aesthetics and function of building infrastructure. What the Airport authority now desires is the development of a consolidated rental car facility on-site at the land-side of the airport. In addition, the airport desires solutions for a new runway surface in order to extend the useful life of the main airfield runway. Teams will work with the Airport's program manager, Mr. Tom Horth, PE and Ms. Kirsten Cerro, PE of C&S Engineers to design and plan the construction phasing/execution of this challenging project.

Capstone Project Primary Mentor/Instructor:
**Adjunct Instructor, PE, RLA, Heinl, Jared**

Course number associated with this effort (if any): CE 490

Capstone Project Customer Organization (could be internal or external to Clarkson):
**Syracuse Airport Authority**

Capstone Project Customer POCs:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Horth. Tom | C&S Engineers, PE | | thorth@cscos.com |
| Cerro, Kirsten | C&S Engineers, PE | (315) 455 2000 | kcerro@cscos.com |
| | | | |

Capstone Project Team Name (if any): Gardt Engineering

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Tanner Geiger | Spring 2019 | Project Manager/Leader |
| Angela Coulter | Spring 2019 | Team Member |
| Austin Smith | Spring 2019 | Team Member |
| David Ross | Spring 2019 | Team Member |
| Evan Gally | Fall 2019 | Team Member |
| Ryan Archibald | Spring 2019 | Team Member |

# Capstone Oral Presentation
# 2:30-3:00 PM

## Snell 118

### 2019 Research and Projects Showcase (RAPS),
**Capstone Project**

Each year, countless pets and stray animals lose their homes due to natural disasters and the resulting conditions. Many organizations are tasked with rescuing and assisting these animals, however the animals require temporary shelters to survive. Our task is to design a doghouse for misplaced dogs after these natural disasters utilizing sustainable materials and allowing for fast assembly (30 minutes or less).

Capstone Project Primary Mentor/Instructor:
**Jared Heinl, PE, RLA-Adjunct Instructor**

Course number associated with this effort (if any): CE 490

Capstone Project Customer Organization (could be internal or external to Clarkson):
**Call of the Wild**

Capstone Project Customer POCs:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Thew, Spencer | Representative | 315-268-6507 | sthew@clarkson.edu |

Capstone Project Team Name (if any): Who Let the Dogs Out

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Bohnert, Meghan | Spring 2019 | Project Manager/Leader |
| D'Angelo, Matthew | Spring 2019 | Structural Engineer |
| Donovan, Tom | Spring 2019 | Consultant |
| Gentile, Austin | Spring 2019 | Civil Engineer |
| LaHart, Aaron | Spring 2019 | Civil Engineer |
| Richardson, Taylor | Spring 2019 | Structural Engineer |

# Capstone Oral Presentation
# 3:00-3:30 PM

Snell 118

## 2019 Research and Projects Showcase (RAPS),
**Capstone Project**

Ruff-Life Engineering has been tasked with designing and constructing a Sustainable Doghouse for use in disaster situations.

Capstone Project Primary Mentor/Instructor:
**Jared Heinl, PE, RLA-Adjunct Instructor**

Course number associated with this effort (if any): CE490-01

Capstone Project Customer Organization (could be internal or external to Clarkson):
**Call of The Wild**

Capstone Project Customer POCs:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Thew, Spencer | Owner | 315-268-6507 | sthew@clarkson.edu |
| | | | |
| | | | |

Capstone Project Team Name (if any):

Ruff-Life Engineering

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Corcoran, Samantha | Spring 2019 | Project Manager/Leader |
| Caggiano, Elizabeth | Spring 2019 | Project Superintendent |
| Frey, Braden | Spring 2019 | Structural Engineer |
| Mennig, Samantha | Spring 2019 | Designer |
| Shields, Travis | Spring 2019 | Civil Engineer |
| Wright, Lydia | Spring 2019 | Project Executive |

# Capstone Oral Presentation
# 2:30-3:00 PM

## Snell 129

### 2019 Research and Projects Showcase (RAPS), Capstone Project

The purpose of this project was to solicit proposals for the purposes of entering into a contract through competitive negotiations for the professional services of a Design Build firm (which includes both Architectural/Engineering (A/E) and Construction Management (CM) components), authorized to do business in the State of New York, with experience in designing and supervising the construction of sites for buildings, religious community work, utility work and storm water management structures. The DB Firm was to provide professional services for the project described in the RFP consistent with the Clarkson Design Manual, as revised, and latest directives issued by the project owner, concerning construction and professional services.

Capstone Project Primary Mentor/Instructor:
**Science Center, CEM Director, Erik Backus**

Course number associated with this effort (if any): CE 490-01

Capstone Project Customer Organization (could be internal or external to Clarkson):
**St. Mary's Roman Catholic Parish**

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Backus, Erik C. | Project Manager | 315-268-6522 | ebackus@clarkson.edu |
| Rev. Rocker, Stephen | Parish Leader | N/A | pastorsmsp@gmail.com |
| Stone, Fred | Engineer | N/A | fstone@twcny.rr.com |
| Corbett, James | Village of Potsdam, Department of Public Works | 315-265-4620 | jcorbett@vi.potsdam.ny.us |

Capstone Project Team Name (if any):

***Golden Crew Constructors***

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Whaley, Francis | Spring 2019 | Project Manager/Leader |
| Amann, Derek | Spring 2019 | Civil/Site Engineer |
| Clark, Marisa | Spring 2019 | Project Engineer |
| Gaebel, Andrew | Fall 2019 | Superintendent |
| Grasberger, Lauren | Spring 2019 | Environmental/ Stormwater Engineer |
| Winchester, Nate | Spring 2019 | CADD/Graphics Technician |

# Capstone Oral Presentation
# 3:00-3:30 PM

## Snell 129

### 2019 Research and Projects Showcase (RAPS), Capstone Project

St. Mary's Roman Catholic Parish in Potsdam, NY has developed a design for a new building to serve as their Parish Hall and to be sited on its property. This particular site has serious challenges, inclusive of those related to utility connections and storm-water. This project will require extensive storm-water design and careful site development in order to be approved by the Village of Potsdam planning board. Rev. Stephen Rocker is the primary client who will be represented by Mr. Fred Stone, PE and Mr. James Corbett, whom are parishioners in Potsdam.

Capstone Project Primary Mentor/Instructor:
**Science Center, CEM Director, Erik Backus**

Course number associated with this effort (if any): CE490

Capstone Project Customer Organization (could be internal or external to Clarkson):
**St. Mary's Church**

Capstone Project Customer POC's:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Father Rocker | Priest / Owner | | pastorsmsp@gmail.com |
| Stone, Fred | Owner Representative | | fstone@twcny.rr.com |
| Corbett, James | Owner Representative | 315-265-4620 | jcorbett@vi.potsdam.ny.us |

Capstone Project Team Name (if any): FHS Associates

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Mckenna, Devin | Spring 2019 | Project Manager/Leader |
| Zeronda, Rhein | Spring 2019 | Water Resources Engineer |
| Brinkmann, Justin | Spring 2019 | Civil Engineer |
| Gardner, Nicole | Spring 2019 | Environmental Engineer |
| Trau, Mathew | Spring 2019 | Project Engineer |
| Whaley, Matthew | Spring 2019 | Estimator/scheduler |

# Capstone Oral Presentation
# 2:30-3:00 PM

Snell 175

## 2019 Research and Projects Showcase (RAPS), Capstone Project

The purpose of this project is to enable the complete renovation of the existing building and re-assign space to departments all belonging to the School of Arts and Sciences. Clarkson is currently executing a master plan for the School of Arts and Sciences, a part of which will help to define the required laboratory spaces needed by the College and prototype lab spaces that can be used in future planning.

Capstone Project Primary Mentor/Instructor:
**Science Center, CEM Director, Erik Backus**

Course number associated with this effort (if any): CE490

Capstone Project Customer Organization (could be internal or external to Clarkson):
**Clarkson Internal**

Capstone Project Customer POCs:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Erik Backus (Clarkson) | Project Manages | 3152686522 | ebackus@clarkson.edu |
| | | | |
| | | | |

Capstone Project Team Name (if any): CZDET Engineers

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Zachary Roegiers | Spring 2019 | Project Manager/Leader |
| Meghan Edmund | Spring 2019 | Team Member |
| Emily Pietak | Spring 2019 | Team Member |
| Tyler Miller | Spring 2019 | Team Member |
| Donald Goodall | Spring 2019 | Team Member |

# Capstone Oral Presentation
# 3:00-3:30 PM

## Snell 175

### 2019 Research and Projects Showcase (RAPS), Capstone Project

Clarkson is interested in executing a complete renovation of the current Science Center on its Hill Campus. The Cora and Bayard Clarkson Science Center was originally constructed in the early 1970s using a Brutalist architectural style. The Science Center has served as the primary classroom building on the Clarkson University Potsdam Hill campus ever since. The Science Center also serves as the home of the School of Arts and Sciences as well as hosting the University Administration.

Capstone Project Primary Mentor/Instructor:
**Professor of Practice and Executive Officer, Backus, Erik C., P.E., LEED AP BD+C, ENV SP, FMP – Parish Hall and Science Center**

Course number associated with this effort (if any): CE490

Capstone Project Customer POCs:

| Name (Last, First) | Organization Position/Role | Phone Number | Email |
|---|---|---|---|
| Thorpe, Chuck | Dean of the School of Arts and Sciences | 315-268-6738 | cthorpe@clarkson.edu |
| Shipp, Devon | Professor of Biomolecular Sciences | 315-268-2393 | dshipp@clarkson.edu |

Capstone Project Team Name (if any):

Capstone Project Team Members (List all members of the team, project leader first):

| Name (Last, First) | Expected Grad Semester (e.g. Spring 2019) | Project Position/Role |
|---|---|---|
| Faber, Allison | Spring 2019 | Project Manager/Leader |
| Franke, Dustin | Spring 2019 | Team Member |
| Akhter, Amina | Spring 2019 | Team Member |
| Syrmanske, Ashleigh | Spring 2019 | Team Member |
| Plunkett, Andrew | Spring 2019 | Team Member |
| MacKnight, Mark | Spring 2019 | Team Member |

# Capstone Oral Presentation
# 2:30-3:00 PM

Snell 177

## 2019 Research and Projects Showcase (RAPS), Capstone Project

## Clarkson Greenhouse Reconstruction - An interdisciplinary capstone design class

Matt Hawthorne, Gerardo Dutan, James Czora, Lauren Carter, Abigail D'Angelo
Mechanical, Civil and Environmental Engineering, Engineering and Management

hawthomd@clarkson.edu

Clarkson University's current greenhouse is in dire need of renovation. It was designed and built in 2010 as a cold-climate, year-round greenhouse, but is currently unusable during the winter months. With financial support from the Sustainability Fund, an interdisciplinary capstone design class is developing detailed designs for the deconstruction of the current greenhouse and reconstruction of a more versatile and resilient structure. The cold-climate structure includes glazing only on the south wall for solar light and radiant gain, other walls are well insulated. Supplemental heating will be provided from the Cheel heating system. Several materials from the existing greenhouse and other spaces on campus will be reused in the new construction to complete the project within a reasonable budget and encourage sustainable design and use of materials. Several stakeholder groups have helped to define the design to make the space useful to them and generally more diverse. The greenhouse will include the Clarkson Keepers' observation bee hive to allow honey collection, education and observation of honeybees. The Garden Club, Engineers for International Sustainability, grounds crew and faculty from the biology department are all expected to be active users of this new facility.

Mentors: Profs. Susan Powers (ISE) and Erik Backus (CEE)

Key Words: greenhouse, sustainability, heating, design, solar

Poster #63, Sustainability Cheel Arena 12:30-2:00 PM

# Capstone Oral Presentation
# 3:00-3:30 PM
Snell 177

## 2019 Research and Projects Showcase (RAPS), Capstone Project

## Ammonia Removal during Solid Waste Anaerobic Digestion Increasing Energy Generation and Reactive Nitrogen Recovery

**Gabrielle Meyerson, Alexander Roberts, Brooke Atkinson, Steven Rhodes, Patrick Neu, Michael Protas, Luz Estefanny Quispe Cardenas**

Dept. of Civil and Environmental Engineering, Clarkson University
Dept. of Chemical Engineering, Clarkson University

Anaerobic digestion (AD) is one strategy for reducing the volume of food waste sent to solid waste landfills while simultaneously transforming degradable organic compounds into valuable and sustainable products, namely biogas and fertilizer. Ammonia nitrogen, a product of the metabolism of microorganisms involved in AD, inhibits biogas production, as it is toxic to the biogas-producing microorganisms. However, it is valuable as a fertilizer and is important to recover. To address this, the overall objective of this project is to design a pilot-scale ammonia removal and recovery process for food waste digestion to increase the environmental and economic value of the AD system through greater biogas yields and more valuable fertilizer production. Water chemistry analysis and speciation modeling is used to determine the optimal chemical makeup of a draw solution, which will facilitate ammonia removal from the digestate through a cation-selective membrane. A bubbling column coupled with two ammonia scrubbing units is being designed to work in tandem with the membrane system. The fluid mechanics of the digester are being re-designed to accommodate the new ammonia removal system. After the design is finalized, the system will be constructed, and operational life-cycle and economic assessments will be conducted for the modified system.

Mentors: Susan Powers, Institute for a Sustainable Environment, Clarkson University

Stefan Grimberg, Dept. of Civil and Environmental Engineering, Clarkson University

Keywords: Anaerobic digestion, biogas, ammonia nitrogen, fertilizer, food waste, capstone design, ammonia removal and recovery

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 1 – Biomedical Science (Undergraduate)

| | |
|---|---|
| **1** | **Althea Henderson;** ***Thomas Lufkin***<br>Ki67 mRNA vs. Ki67 protein – a better indicator for cell proliferation? |
| **2** | **Morgan Reynolds, Alfred Worrad**; ***Shantanu Sur, Marko Budišić***<br>Cues that may affect depression detection on social media |
| **3** | **Katey Hunt, Sarah Moran;** ***Damien Samways***<br>The Cytotoxic Effects of Ivermectin on Cervical Cancer Cells |
| **4** | **Margaret Dedloff;** ***Monica Cartelle Gestal***<br>The World's Smallest Escape Artists: Manipulation of the Host Innate Immune Response by Bordatella bronchiseptica |
| **5** | **Erika Abrantes, Timothy Low-Beer, Ella MacDonld, Lea Maney;** ***William Reiley***<br>Efficacy of Influenza Vaccine and Immunological Memory Development |
| **6** | **Liam Martin;** ***Sumona Mondal, Shantanu Sur***<br>Data-Centric Approach to Rheumatoid Arthritis (RA): Is Age a Confounding Factor for Some of the RA Comorbidities? |
| **7** | **Lilianna Mason;** ***Kenneth Wallace***<br>Notch Receptors Involved in Choice Between Intestinal Epithelial Enterocytes or Secretory Cells |

**Judge: Jane Oppenlander**

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena
## Section 2 – Biomedical Sciences (Graduate)

| | |
|---|---|
| **8** | **Zhen Cao;** ***Shantanu Sur, Sumona Mondal***<br>Rheumatoid Arthritis Associations with Income, Disability, and Access to Care on a National Scale |
| **9** | **Paola Girotto, Jelena Hadina, Sean Relyea;** ***Shantanu Sur, Sumona Mondal***<br>Data-Centric Approach to Rheumatoid Arthritis (RA): Exploring the Infectious Origin of RA |
| **10** | **Sam Trombly, Friska Elizabeth;** ***Shantanu Sur, Sumona Mondal***<br>Data-Centric Approach to Rheumatoid Arthritis (RA): Revisiting the Connection between RA and Diabetes |
| **11** | **Daniel Fuller;** ***Shantanu Sur, Sumona Mondal***<br>Bayesian Modeling of Rheumatoid Arthritis Comorbidly Interacting Risk Factors with Complex Survey Data |
| **12** | **Brandon Robertson;** ***Ali Boolani, Sumona Mondal***<br>Gait and Posture Association with Trait Moods: Energy and Fatigue |
| **13** | **Chelsea Yager;** ***Joan Caruso, Ali Boolani***<br>The Manifestation of Anger In Walking Gait |
| **14** | **Thevasha Sathiyakumar, Dinushani Senarathna, Runye Li;** ***Sumona Mondal*** and ***Ali Boolani***<br>Multivariate Study To Determine The Postural Correlates of Trait Mental and Physical Energy and Fatigue |
| **15** | **Chethani Athukorala;** ***Suresh Dhaniyala, Shantanu Sur***<br>Engineered Microparticles for Targeted Pulmonary Delivery of Anti-Tubercular Drugs |

**Judge: Thomas Lufkin**

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 3 – Signal Processing (Undergraduate)

| | |
|---|---|
| **16** | **Lewis Collum;** ***Mahesh Banavar***<br>Android Real-Time Sensor Data Visualization |
| **17** | **Carlie Fowler;** ***Josh Thomas***<br>Looking for Extended Red Emission in the Dark Nebula LDN1780 and the Reflection Nebula NGC7023 |
| **18** | **Marcus Griffith;** ***Mahesh Banavar***<br>Using Signal Processing Techniques for Velocity Detection Using Optical Flow* |
| **19** | **Andy Mahoney;** ***Mahesh Banavar***<br>Testing for stress with Voice Assistants |

## Judge: William Jemison

* Sustainability Poster

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 4 – Sensors and Signal Processing (Graduate)

| | |
|---|---|
| **20** | **Sandip Purnapatra;** ***Stephanie Schuckers***<br>Use of Cardiac Radar for Biometric identification |
| **21** | **Blaine Ayotte;** ***Mahesh Banavar, Daqing Hou, Stephanie Schuckers***<br>Fast Continuous User Authentication using Distance Metric Fusion of Free-Text Keystroke Data |
| **22** | **Priyanka Das;** ***Stephanie Schuckers***<br>Bioaging In Children : Iris Analysis |
| **23** | **Kevin Mack;** ***Luke Rumbaugh, Mahesh Banavar, William Jemison***<br>Underwater Ranging and Imaging with Time-of-Flight Cameras |

**Judge: Yaoqing Liu**

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 5 – Biomechanics (Undergraduate)

| | |
|---|---|
| **24** | **Duc (Tony) Nguyen; *Arthur Michalek***<br>Modeling Pressurization During Intradiscal Injection* |
| **25** | **Sarah Duclos, Samantha Denning; *Arthur Michalek***<br>Musculature and Histology in Remodeling Due to Repetitive Stress in Bovine Intervertebral Discs |
| **26** | **Giulia Mahoney; *Ali Boolani***<br>Effects of Feelings of Fatigue and Energy on Gait |
| **27** | **Maggie Stark; *Ali Boolani***<br>Manifestation of Anxiety in Gait* |
| **28** | **Jordan Cahill; *Ali Boolani***<br>Does Being A Woman In A Male Dominated School Affect You Physiologically? |
| **29** | **Megan DeRidder; *Laurel Kuxhaus***<br>Patient Specific Cervical Collar |

## Judge: Kevin Fite

* Sustainability Poster

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 6 – Education Research (Graduate)

| | |
|---|---|
| **30** | **Julieth Alvarez Garcia, Seema Teymouri; *Ali Boolani***<br>The Manifestation of Depression in Gait |
| **31** | **Yanling Lin; *Richard Lasselle***<br>Video Podcast - Digital technology empowers foreign language acquisition to help learners build language skills and culture competency |
| **32** | **Yuzhou Pan; *Richard Lasselle, Sherri Duan***<br>Teamwork In Chinese Exam Will Make Students Achieve More. |
| **33** | **Xu Yao; *Richard Lasselle***<br>How to Engage America Students to Learn Chinese Character |
| **34** | **Aditya Narayan Rajmane; *Richard Lasselle***<br>Differentiating Instruction in Technology Education Classroom |

**Judge: Stephen Casper**

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 7 – Psychology (Undergraduate)

| | |
|---|---|
| **35** | **Megan Porga;** ***Andreas Wilke***<br>A Virtual Reality Foraging Study |
| **36** | **Rachael Vaccaro, Jay Barker, Katherine Wettengel**; ***Jennifer Knack***<br>Cues that may affect depression detection on social media* |
| **37** | **Katelynn Mays, Sarah Moran;** ***Andreas Wilke*** **and** ***Jana Jarecki***<br>Domain Dependent Risky Decision Processes |
| **38** | **Renee Levy, Katie Colbert, Jay Barker;** ***Lisa Legault, Jennifer Knack***<br>Social Media Chatter Following Celebrity Suicides: Impressions College Students Form from Subsequent Posts* |
| **39** | **Sruti Akula;** ***Jennifer Knack***<br>Reading between the lines: Influence of age on depression-related impressions formed through social media |
| **40** | **Anise Sago;** ***Lisa Legault***<br>Impact of Body Image Messages on Women's Body Satisfaction and Self-Esteem |

## Judge: Xuan Li

* Sustainability Poster

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 8 – Biology & Ecology (Graduate)

| | |
|---|---|
| **41** | **Alicia Lamb;** ***Tom Langen***<br>Should I Stay or Should I Go?: Early Life Energy Consumption and Expenditure Affects Male Natal Dispersal in Sifaka Lemurs |
| **42** | **Lara Varden;** ***Thomas Lufkin, Petra Kraus, Shantanu Sur***<br>Ki67 mRNA vs. Ki67 protein - a better indicator for cell proliferation? |
| **43** | **Madeline Masi;** ***Evgeny Katz***<br>Electrocatalytically Triggered DNA Release from a pH Switchable Modified Electrode |
| **44** | **Morgan Prochaska;** ***Kenneth Wallace***<br>Growth and Organization of the Post-Embryonic Zebrafish Intestine |
| **45** | **Kavindra Kumaragama;** ***Shantanu Sur, Suresh Dhaniyala***<br>Optimized Generation and Characterization of Aerosolized Bacterial Spores |

**Judge: Susan Bailey**

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 9 – Evolutionary Biology (Undergraduate)

| | |
|---|---|
| **46** | **Katherine Tulowiecki;** ***Susan Bailey***<br>Evolution of Tradeoffs Between Growth And Dispersal In Populations of Pseudomonas Fluorescens Grown In Simple And Complex Environments |
| **47** | **Andrew Trudeau;** ***Andrew David***<br>Examination of The Relationship Between Two Caribbean Neritid Species Using DNA Barcoding |
| **48** | **Sara Cote;** ***Andrew David***<br>Genetic Evidence Confirms The Presence of The Japanese Mystery Snail, Cipangopaludina Japonica (Caenogastropoda: Viviparidae) In Northern New York |
| **49** | **Julia Rizzo;** ***Andrew David***<br>Physiological Effects of Hyperosmotic Stress On The Freshwater Gastropod, Planorbis Planorbis |
| **50** | **Kasie Stamp;** ***Andrew David***<br>Switched at Birth? In the Same Family, But Not Related. |

**Judge: Tom Langen**

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 10 – Mathematical Models & Simulations (Graduate)

| | |
|---|---|
| **51** | **Vijay Kumar Vitt Patel; *Sumona Mondal*** and ***Supraja Gurajala***<br>Air Quality Prediction using LUR Model: Parameter Reduction and Optimization |
| **52** | **Zheng Yang; *Sumona Mondal***<br>Multivariate Experimental Design for Google App Rating |
| **53** | **Chinmay Sahu; *Mahesh Banavar*** and ***Jie Sun***<br>A comparative study of cardiac rotor core estimation algorithms for AFib Ablation |
| **54** | **Mominul Hug; *Pat Piperni***<br>New Family of Airfoils for the Conceptual Design of Aircraft with Variable-Camber Wings |
| **55** | **Abdulaziz AlGhamdi; *Mahesh K. Banavar***<br>Parking Space Detection Using Machine Learning |
| **56** | **Wei-Cheng Lin; *Sumona Mondal***<br>Financial Mining and Stock Price Prediction |
| **57** | **Leila Nikdel; *Susan Powers***<br>The Value of Actual Occupancy Schedules for Building Energy Simulation in Student Housing |

## Judge: Brian Helenbrook

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 11 –Sustainability (Undergraduate)

| | |
|---|---|
| **58** | **Kati Gotch;** ***Shane Rogers, Alan Rossner*** Installation of an Aquaponics System and Educational Program at the Cornell Cooperative Extension* |
| **59** | **Dakota Bragg, Elisha Snow, Julia Coffin;** ***Susan Powers, Stephen Bird, Lisa Legault, Daqing Hou, Eric York*** Feedback and Messaging to Motivate Electricity and Water Conservation in Student Housing* |
| **60** | **Paul Barber, Megan Flory;** ***Stephen Bird, Erik Backus*** LEED for Communities In The New York Olympic Region* |
| **61** **(Two-posters)** | **Ben Buck, Louisa Ulrich-Verderber;** ***Stephen Bird, Erik Backus*** The Need for LEED in the New York Olympic Region: A Pilot Study for the Application of Sustainable Holistic Planning Systems in Rural Communities.* |
| **62** | **Louis Wil Hallstrom;** ***Stephen Bird*** Policy Options for Forest-Disturbance Adapted Species Management in The Adirondack Park |
| **63** | **Matthew Hawthorne;** ***Susan Powers*** and ***Erik Backus*** Clarkson Greenhouse Reconstruction - An interdisciplinary capstone design class* |
| **64** | **Elspeth Taylor, Ashley Jenkins;** ***Phillip Christiansen*** Is Hemp (Cannabis sativa) The Next "Super Food"? |

## Judge: Thomas Holsen

* Sustainability Poster

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 12 – Chemical Sensors (Graduate)

| | |
|---|---|
| **65** | **Abraham Samuel Finny; *Silvana Andreescu***<br>A 3D Printing Platform for Development of Bioink Based Wearable Sensors* |
| **66** | **Kevin Kirk; *Silvana Andreescu***<br>2D and 3D-printed sensors for the rapid detection of heavy metal ions in water and plants |
| **67** | **Fatima Mustafa; *Silvana Andreescu***<br>Paper-based colorimetric biosensor and application in food freshness and smart packaging* |
| **68** | **Zahid Wajdan; *Silvana Andreescu***<br>Development of Selective Sensor for On-Site Detection of Arsenic (V) in Environmental samples |

## Judges: Mario Wriedt

* Sustainability Poster

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 13 – Material Science (Undergraduate)

| | |
|---|---|
| **69** | **Meagan Arguien.;** ***Devon Shipp***<br>Thiol–Ene Emulsion Polymerizations: Formation of Functional Nanoparticles |
| **70** | **Rebecca Meacham;** ***Devon Shipp***<br>Dynamic Covalent Exchange in Polyanhydrides |
| **71** | **Brendan Barrow;** ***Dhara Trivedi***<br>Enhancement Mechanism in SERS: A Theoretical Point of View |
| **72** | **Jeremy Secora;** ***Mohammed Hassan***<br>Lanthanide-based Porous Sorbent for the Efficient Uptake of Phosphate from Water* |

## Judge: Sepehrdad Akari

# Poster Presentation Session
# 12:30 – 2:00 PM
## Cheel Arena

## Section 14 – Material Science (Graduate)

| | |
|---|---|
| **73** | **Shefa Alomari; *Mario Wriedt***<br>Green and Rapid Mechanosynthesis of Zwitterionic Metal–Organic Frameworks for Carbon Capture* |
| **74** | **Juby Varghese; *Mario Wriedt***<br>Electrochemically Switchable Zwitterionic Metal-Organic Frameworks* |
| **75** | **Farideh Hosseini Narouei; *Silvana Andreescu***<br>Fundamental Study of Heavy Metal Adsorption on Metal Oxide Nanoparticles |
| **76** | **Sepehrdad Akbari; *Marilyn Freeman***<br>Electrical and Chemical Characteristics of Diamond-like Carbon (DLC) Thin Films Dielectrics |
| **77** | **Shen Wei; *Dipankar Roy***<br>Galvanodynamic Examination of Electrochemical Tribocorrosion for Applications in Chemical Mechanical Planarization of Cobalt and Copper |
| **78** | **Cheng Wang; *Elizabeth J. Podlaha***<br>Electrodeposited Co-Mo-TiO2 Electrocatalysts for the Hydrogen Evolution Reaction.* |
| **79** | **Cody Johnson; *Dipankar Roy***<br>In-Situ Electrochemical Characterization of Post-CMP Cleaning Under Brushing Conditions |
| **80** | **David Santeford; *Dipankar Roy***<br>Electroanalytical Evaluation of Lithium Iron Phosphate as a Cathode Material by Galvanostatic and Cyclic Voltammetric Methods |

## Judge: Dhara Trivedi

* Sustainability Poster

# Efficacy of Influenza Vaccine and Immunological Memory Development

**Erika Abrantes[1,2], Tim Low-Beer[1,2], Ella MacDonald[1,2], Lea Maney[1,2]**

[1]Trudeau Institute

[2]Department of Biology, Clarkson University

maneylj@clarkson.edu

Influenza is a rapidly mutating virus affecting the respiratory system in humans, generating a need for annual vaccinations. Efficacy of the vaccine is not guaranteed, due to potential mismatches in the yearly viral strains that are incorporated into the vaccine and the circulating strains. The two primary licensed vaccines given on a yearly basis for influenza include the inactivated vaccine (IIV) and live attenuated vaccine, flu mist, (LAIV). The inactivated vaccine is a split virion containing purified hemagglutinin (HA) protein administered intramuscularly or intradermally. The live attenuated vaccine contains temperature-sensitive mutations, and provides a low dose of live pathogen intranasally, eliminating the need for adjuvants. Both vaccines trigger a humoral immune response to build up the appropriate antibodies to recognize and fight the infection, though at this time is unclear if the LAIV also induces a protective cellular response. Clinical observations have seen that LAIV is more effective in stimulating humoral immunity than the inactivated IIV in children, yet it provides no efficacy in adults. This study aims to identify if a pre-existing antibody response is responsible for eliminating the LAIV in adults rendering the vaccine ineffective and a potential reason that LAIV shows no efficacy in adults.

Acknowledgements: The presenters would like to thank Clarkson University, as well as the Trudeau Institute for sponsoring the Trudeau Semester and the TIRP project.

Mentor: William Reiley, *Chief Scientific Officer at TICRO BioServices at Trudeau Institute*

Keywords: Influenza Virus, Immunity, Hemagglutinin, Inactivated Vaccine, Live Attenuated Vaccine, Humoral Immunity

# Assessing the Effectiveness of a Performance Measurement Framework for Non-Profit Organizations: A Nicaraguan Agroforestry Case Study

**Karim Ahmed[1], Cecilia Martinez[1]**

[1]Department of Engineering & Management, Clarkson University
ahmedku@clarkson.edu

In the field of performance measurement, previous research focuses more on addressing what to do to effectively measure an organization's performance and less on describing how an organization can successfully implement a performance measurement system (PMS). Not surprisingly, many non-profit organizations (NPOs) are unable to implement meaningful performance measures since they lack the resources and expertise to implement a PMS. Even though data may be collected, it is oftentimes not effectively analyzed for data-driven decision-making. As a result, NPOs struggle to assess the impact of their programs and identify further development opportunities. Based on the the need for a system that is useful to non-experts, a PMS for NPOs was developed and piloted in ViviendasLeón (VL), an NPO operating in the rural communities surrounding León, Nicaragua. The objective of this research is to validate the effectiveness of this PMS with regards to accessibility. By working with VL's agroforestry program to solve their practical problem, our research is aimed to address the previous gap in literature by providing a PMS that describes how to measure performance. Further, the implementation with VL guided development to account for real-world constraints, able to be generalized with future work for NGO and NPO use.

Acknowledgements: School of Business, Honors Program, Clarkson University
Mentor: Cecilia Martinez, Department of Engineering & Management, Clarkson University

Key Words: Performance measurement, non-profit organizations, case study.

# Electrical and Chemical Characteristics of Diamond-like Carbon (DLC) Thin Films Dielectrics

**Sepehrdad Akbari and Marilyn Freeman**

Clarkson University, Center for Advanced Materials Processing

akbaris@clarkson.edu

There continues to be a need for very high energy density capacitors to enable smaller, lighter, cheaper energy storage and pulse forming networks for many applications. This demand has led to interest in the synthesis of thin insulator materials with very high dielectric strength. This study was one of several efforts to find a dielectric material suitable for fabricating very high energy density thin film capacitors. Diamond has the highest dielectric strength of all known insulators. The dielectric strength of diamond-like carbon (DLC) films is very near to diamond and is much easier and cheaper to synthesize. DLC can be deposited uniformly on a wide range of substrates, which makes it an ideal insulator for high energy capacitors. Thin film capacitors with DLC insulators has been fabricated and the electrical performance has been measured. Besides, Raman spectroscopy were used to determine the relative amounts of DLC components in the dielectrics.

Key words: Dielectric films, Plasma CVD, Energy storage, Dielectric breakdown, Raman Spectroscopy and Diamond-like Carbon (DLC)

Session 3, Material Sciences — Snell 175; 10:50 AM
Poster #76, Material Science — Cheel Arena 12:30-2:00 PM

# Reading between the lines: Influence of age on depression-related impressions formed through social media

**Sruti Akula[1,2], Meaghan Barker[3], Katie Colbert[3], Allison Morgan[3], Melisa Barden[4], Jennifer M. Knack[3]**

[1]Department of Biology, Clarkson University
[2]Department of Chemistry and Biomolecular Sciences, Clarkson University
[3]Department of Psychology, Clarkson University
[3]Department of Psychology, Walsh University
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Previous studies showed that people detect depression from mock social media posts and use this information to make inferences about the person posting. Inferences include: assuming the degree of hardships experienced, amount of control over events in life, quantity of friends, and quality of friends (e.g., Avery et al., 2018; Barker et al., 2018). Contextual cues such as number of likes, number of friends/followers, and time of post may signal and impact the types of impressions that a reader forms, including their ability to detect depression from posts. We examined whether the age of the supposed poster influenced college students' impressions of the poster, their expression of concern, and their offers of help. We used DSM-5 criteria for Major Depressive Disorder to create mock Facebook and Twitter feeds and randomly assigned participants to view a feed of an adolescent, emerging adult, or adult whose posts indicated they may be depressed. Students answered questions about (1) their impression of the poster (e.g., quality of relationships, experiences of hardship, degree of control) based on the feed and (2) their likelihood of engaging (e.g., "like," re-Tweet, comment) with individual posts from the feed. We expected posts from the adolescent and emerging adult will provoke more expressions of concern and offerings of help than posts from the adult.

Mentor: Jennifer M. Knack, Department of Psychology, Clarkson University

Keywords: Social Media Impressions, Depression, Offerings of Help, Expression of Concern, Twitter, Facebook.

Poster #39, Psychology Cheel Arena 12:30-2:00 PM

# Parking Space Detection Using Machine Learning

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A major problem with parking lots is the amount of time it takes to circle around to find parking. Parking space detection systems are becoming a necessity. Existing parking space vacancy detection systems use simple sensors at the entrance and exit of the parking lots. Unfortunately, those are not the most reliable systems because someone may park in an inappropriate way which leads to false results, and it also does not tell us where the free spots are. The purpose of this project is to design a camera based system in parking lots to detect vacant parking spots using machine learning. In this project, the goal is to identify basic geometry/structure of parking spaces, and employ a classification learner based on image processing to determine vacant parking spots. We will discuss the algorithm and display the results from a MATLAB implementation.

Mentor: Mahesh K. Banavar Department of Electrical and Computer Engineering, Clarkson University

Poster #55, Mathematical Models and Simulations Cheel Arena 12:30-2:00 PM

# Temporal trend of Hexaboromocyclododecane in fish tissues from Great Lakes using LC-HRMS

**Bita A.Parvizian[1], Sujan Fernando[2], Bernard S. Crimmins[1], Thomas M. Holsen[1,2]**

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Hexaboromocyclododecane (HBCDD) is a brominated flame retardant (BFR) that is commonly used as part of building insulation and in many common household items. The global production volume of this BFR reported to be 600,000 tons per year in 2001. Due to the toxic and persistent nature of this compound multiple regulatory agencies have started to monitor there levels in the environment and food. Therefore, as a part of Great Lakes Fish Monitoring and Surveillance Program (GLFMSP), an analytical method for measuring the concentration of three HBCDD isomers in fish tissues has been developed. Different extraction techniques were evaluated prior to analysis of the samples using liquid chromatography coupled to high resolution mass spectroscopy (LC-HRMS). Using the optimized method the geographical and temporal trend of HBCDDD have been established.

Acknowledgments: U.S Environment Protection Agency (EPA) Great Lakes Monitoring and Surveillance Program team and Elizabeth Murphy the Program manager.

Advisor: Thomas Holsen, Department of Civil and Environmental Engineering, Clarkson University

Keywords: Great Lakes, flame retardant, HBCDD, fish, contaminants

# Designing of Persuasive Messages Templates for Encouraging Energy and Water Conservation Behavior

**Ashwaq Almatrafi[1], Daqing Hou[2]**

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Overusing water and energy could have negative impacts on the environment and lead to water scarcity, and resource depletion. Resident's consumption behavior plays a significant role in increasing the problem since a quarter of the total energy usage in the US is consumed by them. They mainly tend to waste water and energy because of the lack of meaningful feedback on their consumption. Many efforts have been made to provide residents with a better understanding of their water and energy consumption. A remarkable study is what has been done by the team of the Smart Housing Project at Clarkson University. The study proves the importance of implementing behavioral and motivational interventions in changing user conservation behavior. The results of this study were a stepping stone to our project; we found a technical solution to create personalized and more user-engagement feedback messages for encouraging energy and water conservation. We created a diverse set of templates about total consumption, and consumption per appliance. Each template has a unique visualization to represent the consumption data, a motivational part, and applicable tips. We ended up with varieties of templates for energy and water conservation.

Acknowledgements: I'm grateful to Daqing Hou and the team of Smart Housing Project for their feedback. Any errors are the author's.

Mentor: Daqing Hou, Department of electrical and computer engineering, Clarkson University

Keywords: Energy & Water Consumption, Efficiency, Feedback, Motivation, Persuasive Technologies, Message Templates

# Green and Rapid Mechanosynthesis of Zwitterionic Metal–Organic Frameworks for Carbon Capture

**Shefa Alomari[1], Michael Chirgwin[1], Mario Wriedt[1]**

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Metal-Organic Frameworks (MOFs) are hybrid crystalline porous materials that are composed of metal ions or clusters connected by polytopic organic linkers. MOFs are known for their enormous surface areas and large solvent-accessible voids. Due to their infinite connection possibilities of their building blocks, MOFs have versatile topologies, which can be tailored to meet the demands for different applications such as small-molecule storage and separation, catalysis, and sensing. Incorporating zwitterionic (ZW) linkers in the frameworks can introduce charged organic surfaces in their cavities leading to intermolecular electrostatic fields. Polarizable guest-molecules can be attracted by these fields yielding enhanced guest-framework interactions. Mechanochemistry has shown to be a rapid and green method to synthesize a wide range of popular MOFs at room temperature. This work demonstrates the use of mechanochemistry for the synthesis of a pyridinium-based ZW-MOF which is analog with the reported MOF UiO-67. Here we present the structural and physical properties of this new ZW-MOF in context with its carbon capture properties.

Acknowledgements: Thank you to Clarkson University, the NSF for funding this research.

Mentor: Mario Wriedt, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Metal-organic frameworks (MOFs), Zwitterionic ligands, Porous crystalline materials, Pyridinium derivatives, Mechanosynthesis

Session 3, Metal Organic Framework — Snell 177, 11:35 AM
Poster #73, Material Science — Cheel Arena 12:30-2:00 PM

# The Manifestation of Depression in Gait

**Julieth Alvarez Garcia 1 , Seema Teymouri 1 , Vicki LaFay 2 , Ali Boolani**

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This innovative study focused on identifying pre-clinical symptoms of depression in otherwise healthy adults by analyzing variations in gait. Previous studies have noted a link between major depressive disorder (MDD) and gait variability; however, little research has been done to identify the link between pre-clinical depression and gait variations. Recognition of physical cues of pre-clinical depression may allow for early intervention to reduce the risk of progression to MDD. This study analyzed variability in gait among adults 18 to 69 years of age without physical limitations. The participants completed the Profile of Mood Survey- Short Form (POMS-SF) to self-assess current mood states. Gait was evaluated with the APDM's Mobility Lab™, a system of small, body-worn sensors. A backwards elimination linear regression was used to find correlates of gait and depression. The regression model explained 28.0% of the variance (R 2 =.413, F(19,84)=3.113, p<.001). Greater feelings of depression were associated with decreased sway of the lumbar spine in the sagittal plane, increase sway of the lumbar spine in the coronal sway, increased lateral bending of the neck, increased postural correction, increased stride length, increased variance in step placement, greater turn angle, and decreased turn velocity during gait. Our results may help with the early identification of patients with pre-clinical depression, prior to MDD diagnosis.

Acknowledgements: We would like to thank Chelsea Yager, Phylicia Taladay, Christina Vogel-Rosbrook, and Maggie Stark with data collection

Mentor: Ali Boolani, Department of Physical Therapy, Clarkson University

Key Words: Gait, depression, pre-clinical depression

# Thiol–Ene Emulsion Polymerizations: Formation of Functional Nanoparticles

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Thiol–ene "click" chemistry is highly efficient and has been utilized in recent decades for both bulk polymerization and polymer modification. More recently, thiol–ene chemistry has been applied to heterogeneous polymerizations for the production of polymer particles. One significant advance of this research focus was the development of emulsion polymerization of different thiol–ene polymer compositions to form functional nanoparticles. It has been shown that the average particle diameter can be pre-determined by appropriate choice of reaction conditions, and size homogeneity (monodispersity) can also be achieved. Another development has been the functionalization of the nanoparticles, either through addition of functional thiol or ene moieties, or through post-polymerization modification, such as thiol-X based chemistries (e.g., thiol-Michael, thiol-ene reactions), or oxidation of the thioether bonds present in the polymer particles to form sulfoxide bonds.

Acknowledgements: The author would like to thank the Clarkson University Honors Program for their support.

Mentor: Devon Shipp, Department of Chemistry & Biomolecular Science, Clarkson University

Key Words: polymer, material, nanoparticles, oxidation, functionalization

Poster # 69, Material Science Cheel Arena 12:30-2:00 PM

# Engineered Microparticles for Targeted Pulmonary Delivery of Anti-Tubercular Drugs

**Chethani Athukorala**[1], **Hema Ravindran**[2], **Shantanu Sur**[3], **and Suresh Dhaniyala**[1,2]

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Tuberculosis (TB) is a global pandemic disease caused by *Mycobacterium tuberculosis* (Mtb), which commonly infects the respiratory system due to its highly aerobic nature and aerosol-mediated disease transmission. The bacterium is phagocytosed by alveolar macrophages but remains protected from the bactericidal attack primarily by its cell wall and bacterial adaptation to prevent its fusion to bacteria-containing phagosome. This necessitates a prolonged antibiotic treatment for bacterial clearance, however, such treatment leads to severe drug toxicity in other organs. As an advanced treatment, inhalational delivery of anti-TB drugs is gaining interest from its potential to deliver the drug efficiently into the affected lung regions without eliciting side effects. The objective of our study is aerosolized delivery of microparticles in deeper lung tissues. We have synthesized microparticle in the size range of 0.5-2 µm with a core-shell design where the core is made of negatively-charged biopolymer alginate loaded with anti-TB drug, surrounded by a shell of positively-charged PA nanofibers. The aerosolization technique was combined with various particle collection techniques to get a high throughput collection and improved quality. As a long-term objective, the generated microparticles will be tested to study their deposition dynamics in airway system using modelling and mice lung tissue distribution.

Mentors: Shantanu Sur, and Suresh Dhaniyala

Keywords: Tuberculosis; aerosol therapy; core-shell microparticles; alginate; pulmonary drug delivery; inhalation therapy

Session 3, Material Sciences — Snell 175; 11:20 AM
Poster #15, Biomedical Sciences — Cheel Arena 12:30-2:00 PM

# Fast Continuous User Authentication using Distance Metric Fusion of Free-Text Keystroke Data

**Blaine Ayotte, Mahesh K. Banavar, Daqing Hou, Stephanie Schuckers**
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Keystroke dynamics are a powerful behavioral biometric capable of determining user identity and for continuous authentication. It is an unobtrusive method that can complement an existing security system such as a password scheme and provides continuous user authentication. Existing methods record all keystrokes and use n-graphs that measure the timing between consecutive keystrokes to distinguish between users. Current state-of-the-art algorithms report EER's of 7.5% or higher with 1000 characters [1]. With 1000 characters it takes a longer time to detect an imposter and significant damage could be done. Here, we investigate how quickly a user is authenticated or how many digraphs are required to accurately detect an imposter in an uncontrolled free-text environment. We present and evaluate the effectiveness of three distance metrics individually and fused with each other. We show that with just 100 digraphs, about the length of a single sentence, we achieve an EER of 35.3%. At 200 digraphs the EER drops to 15.3%. With more digraphs, the performance continues to steadily improve. With 1000 digraphs the EER drops to 3.6% which is an improvement over the state-of-the-art.
References: [1] J. Huang, D. Hou, S. Schuckers, T. Law, and A. Sherwin. Benchmarking Keystroke Authentication Algorithms. *In Information Forensics and Security (WIFS), 2017 IEEE Workshop on*, pages 1-6. IEEE, 2017.

Acknowledgments: This work is supported in part by the NSF CPS award 1646542 (ASU Prime), and the Clarkson Niklas Ignite Fellowship; and is based on work supported by the Center for Identification Technology Research (CITeR) and the NSF under Grant 1650503.

Mentors: Mahesh K. Banavar, Daqing Hou, Stephanie Schuckers, Department of Electrical and Computer Engineering, Clarkson University

Keywords: Biometrics, continuous authentication, behavior-based, keystrokes, digraphs, fusion

# Simulation of Turbulent Flows with a High-Order Finite Element Method and a Modified $k$-$\omega$ Turbulence

**Nojan Bagheri Sadeghi[1], Brian Helenbrook[1], Kenneth Visser[1]**
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Use of two equation turbulence models with finite element methods (FEM) can be difficult as the turbulence variables can assume non-physical negative values during the iterative solution procedure which in turn can lead to convergence issues. A modified $k$-$\omega$ turbulence model has been recently proposed to overcome such difficulties. A simple 1-D implementation of the turbulence model for solving a fully developed-channel flow was first attempted with linear basis functions to study the effect of model constants and boundary conditions on the model behavior and to find efficient methods to get converged solutions. The results revealed that one of the turbulence constants which was chosen arbitrarily in previous works should be accurately estimated to get accurate solutions. Also the solution was sensitive to correct estimate of the distance of the first grid point from wall which is difficult to estimate for unstructured grids and is used to determine the boundary condition for $\omega$ on the wall. This turbulence model was then successfully implemented in a 2-D high-order finite element code. The results of the 2D code showed that an alternative boundary condition for $\omega$ that does not depend on the wall distance should be used to obtain grid-convergence.

Mentor: Brian Helenbrook, Department of Mechanical and Aeronautical, Clarkson University

Keywords: modified $k$-$\omega$ turbulence model, RANS, SUPG FEM, $\omega$ boundary condition, channel flow, turbulence modeling

# Fingerprint Presentation Attack Detection utilizing Time-Series, Color Fingerprint Captures

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Fingerprint capture systems can be fooled by widely accessible methods to spoof the system using fake fingers, known as presentation attacks. As biometric recognition systems become more extensively relied upon at international borders and in consumer electronics, presentation attacks are becoming an increasingly serious issue. A robust solution is needed that can handle the increased variability and complexity of spoofing techniques. This paper demonstrates the viability of utilizing a sensor with time-series and color-sensing capabilities to improve the robustness of a traditional fingerprint sensor and introduces a comprehensive fingerprint dataset with over 36,000 image sequences and a state-of-the-art set of spoofing techniques. The specific sensor used in this research captures a traditional gray-scale static capture and a time-series color capture simultaneously. Two different methods for Presentation Attack Detection (PAD) are used to assess the benefit of a color dynamic capture. The first algorithm utilizes Static-Temporal Feature Engineering on the fingerprint capture to generate a classification decision. The second generates its classification decision using features extracted by way of the Inception V3 CNN trained on ImageNet. Classification performance is evaluated using features extracted exclusively from the static capture, exclusively from the dynamic capture, and on a fusion of the two feature sets. With both PAD approaches we find that the fusion of the dynamic and static feature-set is shown to improve performance to a level not individually achievable.

Mentor: Stephanie Schuckers, Department of Electrical Engineering, Clarkson University

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# LEED for Communities in the New York Olympic Region

**Paul Barber [1], Ben Buck [1], Megan Flory [2,3], Louisa Ulrich-Verderber [4]**

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The LEED (Leadership in Energy and Environmental Design) for Communities (LFC) pilot program is a new Sustainability Planning System created by the US Green Building Council (USGBC). In August of 2018, fourteen students from Clarkson University's Adirondack Semester began work to implement and provide feedback for this pilot program in the rural, multijurisdictional, tourist-centric, New York Olympic Region (NYOR). NYOR is comprised of the Village of Lake Placid, the Town of North Elba, the Lake Placid Central School District, and the Olympic Regional Development Authority (ORDA). Four students continued work after the Adirondack Semester's conclusion to evaluate the certification process and the challenges of implementing an urban-focused sustainability program in a rural community. Afterward, a practical guidance document for the implementation of LFC was created to inform the continued certification of the Olympic Region and to assist future projects in communities with similar attributes.

Mentors: Erik Backus, Department of Civil and Environmental Engineering, Clarkson University
Stephen Bird, Department of Humanities and Social Sciences, Clarkson University

Key Words: LEED, LFC, Smart Cities, Sustainability Planning Systems, Smart Growth

Poster #61, Sustainability Cheel Arena 12:30-2:00 PM

# Social Media Chatter Following Celebrity Suicides: Impressions College Students Form from Subsequent Posts

**Katie Colbert, Jay Barker, Renee Levy, Jennifer Knack**

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This study was conducted to examine whether viewing Twitter posts about suicides of celebrities Kate Spade and Anthony Bourdain influenced the inferences college students formed about people from unrelated mock posts. We pulled posts from Twitter authored by celebrities and/or non-celebrities and that had a basis of either narrative (i.e., noting the impact either celebrity had on person posting), awareness (i.e., sharing the suicide hotline number), or insensitive (i.e., noting the selfish nature of suicide). College students ($N$ = 246) participated in an experiment where they read the Tweets, then browsed through various links, and finally viewed two sets of mock social media posts that displayed indicators of mild or severe depression. We found a significant post author X post content interaction on interest in being friends when viewing depressed posts. We also found main effects for degree of concern when viewing both mild and severe depressed posts. The results suggest social media chatter following publicized celebrity suicides may impact how subsequent unrelated posts containing indicators of depression are interpreted. This study will have implications for improving social sustainability by identifying how reactions to celebrity suicides on social media impact people's interest in learning mental health and how to help.

Mentor: Jennifer M. Knack, Psychology Department, Clarkson University

Keywords: Depression, suicide, social media, mental health, awareness, celebrity

# Enhancement Mechanism in SERS: A Theoretical Point of View

**Brendan Barrow**

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barrowb@clarkson.eduhen a photon interacts with a molecule, a portion of the scattered radiation will be inelastic. This interaction with vibrational states is referred to as Raman scattering. The spectrum of this scattering is unique for every molecule; however, the intensity is extremely weak. If the scattering intensity is enhanced by several orders of magnitude, it can be used as a powerful technique for determining structural information of molecules. A method of achieving this involves adsorption of molecules on metallic nanoparticle surfaces, called surface enhanced Raman scattering (SERS). Although SERS was discovered several decades ago, a complete theoretical picture of the enhancement mechanism is very active area of research. There are four primary mechanisms, from a theoretical perspective, contributing to the signal enhancement. Here, we present our brief study of these individual mechanisms. These mechanisms are intertwined and create a total enhancement; by studying each individually, we can get better insight of this powerful analytic tool for a single molecule.

Mentor: Dhara Trivedi, Department of Physics, Clarkson University

Keywords: Raman Spectroscopy, Surface enhanced Raman scattering, nanoparticles, density functional theory

# The Victim-Perpetrator Link: How Childhood Trauma Shapes the Behavior of Sex Offenders

**Nathalie Barr**

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The stigma around sex offending is widespread. Although sexual offending is a serious crime, it is important to understand the historical factors that cause the perpetrator to offend. Oftentimes, many of these offenders were abused in various ways as children including sexual, mental, emotional, and physical abuse. All of these factors play a role in the cognitive and emotional processes that occur before, during, and after their acts of sexual violence. In this presentation, I will examine, using the psychological literature, how childhood trauma has affected and shaped perpetrators lives. I will also draw from my experience interning with the Sex Offender Treatment Program at the St. Lawrence Psychiatric Center, in order to understand the connection between residents' history and their offenses. I will do this by analyzing different case files and observing therapeutic interventions used during their treatment.

Acknowledgements: I would like to thank Dinghy Sharma, Chief Psychologist at Bridgeview, for her assistance with providing us an excellent internship experience. She was always extremely helpful with helping me understand different scenarios to connect better with the residents.

Mentor: Lisa Legault, Department of Psychology, Clarkson University

Keywords: Childhood Influences, Abuse, Trauma, Sex Offenders, Stigma, Crime

# Determining Electronic Band Structure Using a Semiempirical Pseudopotential Method

**Brendan Barrow**

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Group IV compounds are natural material choices for electronic devices. It is crucial to understand bulk properties of their crystal structure using a detailed analysis. Such calculations can be computationally expensive, so it requires simplifications for viability. For this reason, only the valence electrons are examined, with the core electrons assumed to be tightly bound to the nucleus, resulting in a "pseudopotential" acting on the valence electrons. The energy band structure of these electrons is determined using a many-body solution to the Schrödinger equation using a Fourier expansion of plane waves. We outline the manipulation of this equation, such that it can be turned into a Hamiltonian matrix. We use a code written in MATLAB and knowledge of semiempirical parameters to solve the matrix and create an energy band structure for Silicon and Germanium. These materials of particular interest, as their energy band structure shows supporting evidence of an indirect band gap. This property of Silicon and Germanium means that any inter-band optical transitions involve both radiation-matter and electron-phonon interactions.

Mentor: Dhara Trivedi, Department of Physics, Clarkson University

Keywords: Semiconductors, Pseudopotential method, Band structure, Indirect band gap, Condensed matter theory

# Computational Analysis and Wind Tunnel Testing of a Channel Wing Configuration for eVTOL

**Austin Bentley[1] and Craig G. Merrett[1]**

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HopFlyt is a startup company based in Lusby, Maryland that aims to decrease traffic and pollution with the Venturi, a fully electric four-person aircraft capable of vertical take-off and landing (VTOL). The novelty of the Venturi's design is its eight Venturi shaped channels on its tilting wings and canards, each equipped with five bladed contra rotating propellers [1]. The Venturi's wing is replicated in SolidWorks and imported to ANSYS CFX, where the performance characteristics of the wing are calculated via CFD analysis. Different variations and possible improvements of the wing will also be examined to determine the benefits over conventional designs. In parallel with the simulations, validation tests will be conducted in a wind tunnel using an interchangeable 3D printed plastic model and the results will be used to extrapolate the power requirements for the full-scale design. Verification of the experimental findings will be completed through a comparison to findings from previous research done on the subject.

1. "Venturi," *HopFlyt*. [Online]. Available: https://hopflyt.com/venturi/. [Accessed: 20-Sep-2018].

Acknowledgements: The authors would like to thank Robert Deters at Embry-Riddle University for his insight regarding propellers and propeller flows.

Mentors: Craig G. Merrett, Department of Mechanical and Aeronautical Engineering, Clarkson University

Key Words: Electric, Vertical Take-off and Landing, Channel wing, Aerodynamics, Wind Tunnel, CFD

# Feedback and Messaging to Motivate Electricity and Water Conservation in Student Housing

**Dakota Bragg [1], Julia Coffin [1], Glen Pinkava [2], and Elisha Snow [1]**

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Clarkson University's Smart Housing Project has studied electricity and water consumption in student housing for five years. Because students do not directly pay for utilities, they are less motivated to conserve. Studies in past semesters have shown reductions as high as 21% in electricity consumption and similar reductions in hot water use when behavioral intervention is implemented through various modes including workshops, motivational messaging, and real-time feedback. Efforts though to communicate with and engage the residents proved to be a challenge to effective motivational messaging. This semester, we integrated responses from previous engagement focus group studies to inform a complete redesign of the on-going project's utility use feedback and messaging dashboards. Six automatically rotating screens were created that display apartment and circuit-level electricity and water usage data. Motivational messages applicable to the usage screens for that week are included in the dashboard screen. These include an engaging image and an action-oriented tip.

Mentors: Stephen Bird, Department of Humanities and Social Sciences, Clarkson University - Susan Powers, Institute for a Sustainable Environment, Clarkson University - Daqing Hou, Department of Computer and Electrical Engineering, Clarkson University - Lisa Legault, Department of Psychology, Clarkson University - Eric York, Department of Communication, Media and Design, Clarkson University

Keywords: UX design, motivational intervention, energy conservation, internet of things, energy behavior, housing

# Does Being A Woman In A Male Dominated School Affect You Physiologically?

**Jordan Cahill[1,2], Ali Boolani[2], JoAnn Rogers[3]**

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[2]Department of Physical Therapy, Clarkson University
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This study examined the gender differences in academics, mood, mental workload, sleep, food consumption, and physical activity of male and female students in a small, rural, engineering university. An online survey was used to collect data from participants (N=673). Data collection was as follows: the PSQI was used for sleep, POMS-SF for mood, food frequency scale for polyphenol consumption, and the mental and physical state and trait fatigue scale for mental work, physical activity, fatigue, and energy. Mann-Whitney U and t-tests were used to identify significant differences. The Chi Square test was used to determine differences between genders for the PQSI. As compared to women, men had higher state ($p=.004$) and trait ($p=.028$) physical energy, higher levels of physical activity ($p=.001$), consumed more caffeine ($p=.004$), and interestingly, consumed more chocolate ($p=.001$). As compared to men, women had higher state physical fatigue ($p=.025$), worse sleep quality ($p=.025$), higher mental workload on weekdays ($p<.001$), and interestingly, consumed more coffee ($p<.001$). Women report having higher mental energy and mentally worked harder on weekdays, but they were drinking more coffee, sleeping poorly, and had low physical energy and activity. Men were more physically active and energetic but consumed more junk food and caffeine overall.

Acknowledgements: Matthew Manierre, Department of Humanities and Social Sciences, Clarkson University, for assisting in data cleaning

Mentor: Ali Boolani, Department of Physical Therapy, Clarkson University

Keywords: Gender, Academics, Mood, Mental Workload, Sleep, Caffeine, Polyphenols, Physical Activity

# Creating a More Agile Artificial Voice Using Rheumatoid Arthritis Associations with Income, Disability, and Access to Care on a National Scale

**Zhen Cao**[1], **Daniel T. Fuller**[2], **Shantanu Sur**[3], **Sumona Mondal**[2]

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Chronic diseases and mental health conditions are both detrimentally impactful on the financial health of those afflicted. Conversely, debt and other financial pressures can increase stress, increase depression, and decrease the potential for a positive disease outcome. Rheumatoid Arthritis (RA) is a chronic and systemic inflammatory disease that affects roughly 1% of adults in the United States. Utilizing the National Health and Nutrition Examination Survey (NHANES), a complex stratified sampling survey, we analyzed the occurrence relationship of rheumatoid arthritis, primary care type, inability to work, and key personal monetary indicators such as the income-to-poverty-level ratio. Data was cleaned and processed in R before preliminary exploratory visualizations were conducted. Our parameters of interest were then imported into SPSS Statistics 25 where we made use of the Complex Survey Module in order to enable proper national-level inference through inclusion of survey weights, variance estimators, and Primary Sampling Units. The results of this analysis can be compared to Bayesian regressions of the data and the survey weights done in prior work to verify the interaction strengths between model parameters. Throughout the process of quantifying our key parameter associations several interesting aspects of the NHANES data and the complex survey analytical process came to light that may help other analyses of this type be performed in the future.

Mentors: Shantanu Sur, Department of Biology, Clarkson University
Sumona Mondal, Department of Mathematics, Clarkson University

Keywords: Rheumatoid Arthritis, NHANES, healthcare, Bayesian inference, complex survey, poverty

Poster #8, Biomedical Sciences Cheel Arena 12:30-2:00 PM

# Nanotechnology-Enabled Paper-Based Biosensor for Ethanol Detection

**Megan Carhart**[1], **Fatima Mustafa**[1], **Silvana Andreescu**[1]
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Paper-based biosensors are a cheap, simple, portable, and disposable option for chemicals monitoring. Alcohol content needs to be monitored in industries like; farming, food, beverages, and law enforcement. In this presentation, a new method is developed to incorporate nanotechnology into paper-based biosensing for ethanol. Nanoparticles have been used on cellulose filter paper with alcohol oxidase to detect trace amounts of ethanol. Chromogenic indicators generate a colorimetric response dependent on ethanol concentration. The response is quantified using online software. The method demonstrated high sensitivity, and the linear working range was found to 0.05-1% ethanol.

Mentor: Fatima Mustafa, PhD Student-BIOSEM Group, Clarkson University

Faculty Advisor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Nanotechnology, Biosensor, Alcohol Detection

# Data-Centric Approach to Rheumatoid Arthritis (RA): A Bayesian Framework for Prediction of RA from Comorbidities

**Christopher Carter,[1] Daniel Fuller[1], Sumona Mondal[1], Shantanu Sur[2]**

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Rheumatoid Arthritis (RA) is an inflammatory joint disease that often associates with many comorbidities, such as obesity and depression. In this work, we aim to better understand the complex relationship between RA and comorbidities through adequate quantification of the inherent uncertainty. Bayesian Inference provides the tools necessary to build this framework because it holds as a central tenet that "randomness" is a result of incomplete understanding about a situation, and therefore that the concept of randomness can be applied whenever there is a lack of certainty. Under the Bayesian approach, statistical parameters are not fixed quantities to be estimated, but are most appropriately described by probability distributions, which encode the uncertainty in the parameters given the observed data. Using data from the National Health and Nutrition Examination Survey (NHANES), we developed a Bayesian logistic regression model to understand how coexistence of comorbidities can influence the risk for RA. The model was fit to predict the incidence of RA from multiple relevant predictors such as BMI, depression score, and gender, while controlling for the effects of age and ethnicity. To account for the complex survey design used to collect the NHANES data, we apply a technique known as Weight Smoothing, a probabilistic correction to the Bayesian likelihood function.

Mentors: Sumona Mondal, Department of Mathematics, Clarkson University
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Keywords: Bayesian, statistics, arthritis, modeling, regression, survey

# Multilevel Application of CST Geometry in Airfoil Optimization

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A class and shape function geometry representation of a two-dimensional airfoil generates a set of coefficients associated with the order of the polynomials embedded in the shape function. In an optimization setting, these coefficients can be used as design variables, and their number and influence is determined by the polynomial order. Typically, the order of the polynomial is selected prior to the optimization and held fixed throughout. In the work presented here, it is proposed to employ multiple orders of polynomials in a multilevel representation of the airfoil. The motivation for this is the observation that the effectiveness of single-order polynomials is variable and often depends on the choice of the initial airfoil and the optimization algorithm, as well as the design objectives and constraints. In contrast, it is demonstrated that optimizations employing a multilevel airfoil representation tend to be more consistently successful in a wide variety of design problems. A series of airfoil optimizations are presented to illustrate the behavior of the new multilevel approach, and the results are compared with conventional single-order methods.

Mentor: Pat Piperni, Department of Mechanical and Aeronautical Engineering, Clarkson Unversity

Keywords: Optimization, Computational Fluid Dynamics, Airfoil Design, Aerodynamics, Automation, Aeronautical Engineering

# A Virtual Reality Foraging Study

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Our previous research suggests that the hot hand phenomenon, a tendency to perceive illusory streaks of clumps in sequences and grids, is a human universal tied to humans' evolutionary history of foraging. In past experiments, we showed that the hot hand phenomenon helps to explain the difficulty people have in reasoning about randomness in situations like gambling and games of hide and seek. In this new study, we examine the behavior and decision strategies made by humans in simulated foraging scenarios. By having participants search for carrots in a virtual reality environment, we will gain insight into how people decide where to search and when they give up searching at a local site. Recorded time and movement data will allow us to capture search patters when foraging for resources in different statistical patterns as well as what changes in search tactics occur when participants respond to the presence and absence of resources. Baseline cognitive tasks such as the Vandenberg Mental Rotation Task and the Money Road Map Test will be administered to account for variation in cognitive ability.

**Mentors:** Andreas Wilke, Department of Psychology

**Keywords:** Hot Hand, Clumpiness, Foraging, Virtual Reality, Searching, Bias

Session 2, Psychology — Snell 212; 9:52 AM
Poster #35, Psychology — Cheel Arena 12:30-2:00 PM

# Green and Rapid Mechanosynthesis of Zwitterionic Metal–Organic Frameworks for Carbon Capture

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Metal-Organic Frameworks (MOFs) are hybrid crystalline porous materials that are composed of metal ions or clusters connected by polytopic organic linkers. MOFs are known for their enormous surface areas and large solvent-accessible voids. Due to their infinite connection possibilities of their building blocks, MOFs have versatile topologies, which can be tailored to meet the demands for different applications such as small-molecule storage and separation, catalysis, and sensing. Incorporating zwitterionic (ZW) linkers in the frameworks can introduce charged organic surfaces in their cavities leading to intermolecular electrostatic fields. Polarizable guest-molecules can be attracted by these fields yielding enhanced guest-framework interactions. Mechanochemistry has shown to be a rapid and green method to synthesize a wide range of popular MOFs at room temperature. This work demonstrates the use of mechanochemistry for the synthesis of a pyridinium-based ZW-MOF which is analog with the reported MOF UiO-67. Here we present the structural and physical properties of this new ZW-MOF in context with its carbon capture properties.

Mentors: Shefa Alomari, Mario Wriedt, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Metal-organic frameworks (MOFs), Zwitterionic ligands, Porous crystalline materials, Pyridinium derivatives, Mechanosynthesis

Session 2, Chemistry II Snell 169; 10:04 AM

# Using Android Sensor Data to Manipulate 3D Graphics over a Real-Time TCP Wi-Fi Network

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Engineering problem solving begins by visualizing the problem. As the complexity of the problem increases, the clarity of typical visualizations, such as static 2D plots, decreases. Clarity can be increased, to some extent, using simulations, such that experimenters can visualize the problem in time and know what to expect. In general, static visualizations depict what happened and simulations show what may happen, but, real-time visualizations show what *is* happening. We are accomplishing real-time data modeling by sending sensor data from an Android device over Wi-Fi where it is used to immediately manipulate geometry in a 3D graphics software. Orientation data from the device, as one example, can be mimicked by a 3D object in the graphical environment. This allows the process of data analysis to be visually immersive. Furthermore, it allows experimental setup to be almost CAD-like, in that objects can be placed in the 3D graphic environment to better describe the context of the problem. Overall, we were able to setup a 3D graphic environment for which we can visualize sensor data coming from an Android device.

Acknowledgement: This work was supported in part by the NSF DUE award 1525224.

Mentor: Mahesh Banavar, Department of Electrical & Computer Engineering, Clarkson University

Keywords: Sensor-Fusion, Networking, 3D Graphics, Android

# Investigation of the Induced flow in a Point to Plane Plasma Reactor

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Plasma discharges have shown to be useful in several technical and industrial settings. For example, plasma discharges, and the associated chemistry, have been shown to be particularly effective in purifying water contaminated with many different chemicals (e.g. pharmaceuticals, PFOA, etc.) that are difficult to treat with common purification techniques. The current work utilizes a corona discharge plasma reactor where the plasma is discharged into Argon above an aqueous solution. This discharge creates a chemical reaction/degradation which takes place between the liquid and gas phases and induces fluid motion in the liquid phase. The goal of the project is to determine the relationship between the degradation rate of various chemicals of interest and their resulting flow fields. Particle Image Velocimetry (PIV) is used to measure the velocity field in the center plane of the aqueous solution induced by the plasma discharge in the gas phase. The results indicate that vastly different fluid motions in the liquid phase can be established depending on the chemical added to the aqueous solution, the conductivity of the aqueous solution, and the frequency of plasma discharges.

This research is funded through the National Science Foundation under its Plasma Physics Program. Award Number: 16171822

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**Acknowledgments:** Gunnar Stratton, Andrew Bluestein, Chase Nau-Hix. **Mentors:** Douglas Bohl, PhD., Department of Mechanical Engineering Clarkson University. **Key Words:** Corona Discharge, Particle Image Velocimetry, Point to Plane Discharge, Marangoni Flow, Degradation Rate, Velocity Field

# Characterizing Cancerous and Non-Cancerous Cells Through Movement Analysis Using the Kalman Filter

**Andrew Cook[1], Morgan Reynolds[2], Devin Kapper[3], Mahesh Banavar[4], Sumona Mondal[3], Shantanu Sur[2]**

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Cell populations are frequently heterogeneous and difficult to characterize properly. We are seeking to differentiate between cancerous and non-cancerous cells based on their distinctive movements when exposed to calcium. We investigated the effect of adding calcium to a mixed population of cancerous and non-cancerous cervical epithelial cells for four hours. The same cells will also be analyzed for six hours prior to the calcium chloride being added. The primary purpose of the calcium is to cause adhesion between the cells, allowing for a maintenance of structure in each population and restricting the natural spread of the cancerous cells. A previous study showed that a predictive model between cancerous and non-cancerous cells is possible based on velocity. With calcium affecting how cells interact and bind with each other it is possible that further differences in movements could also be shown. Analysis of these movements will be done using the Kalman filter: a statistical technique for predicting the state of its subject. A combination of ROC analysis and classification will be applied to the Kalman filter results to distinguish between cell types. The objective of the study is to contribute to the knowledge of differences between cancerous and non-cancerous cells.

Acknowledgements: Clarkson University Honors Program.

Mentors: Sumona Mondal, Department of Mathematics, Clarkson University
Shantanu Sur, Department of Biology, Clarkson University

Keywords: Kalman filter, cell classification, calcium chloride, cancerous, ROC analysis, data analytics

# Genetic evidence confirms the presence of the Japanese mystery snail, *Cipangopaludina japonica* (Caenogastropoda: Viviparidae) in northern New York

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The Asian mystery snails, *Cipangopaludina chinensis* (Chinese mystery snail) and *Cipangopaludina japonica* (Japanese mystery snail) are considered high priority invasive species on the east coast of the United States. In New York State there has been conflicting reports on the presence of *C. japonica* with only a single population ever recorded in the southern region of the state in the early 1980s. To address this issue, we employed molecular barcoding to determine whether *C. japonica* was indeed present in the state's waterways. Specimens were collected from multiple waterbodies in the Adirondack region of northern New York during the summers of 2016-2018. Molecular barcoding using the cytochrome c oxidase I (COI) gene unequivocally confirmed the identity of *C. japonica* with both Asian mystery snails showing a 100% identity match on the NCBI database, GenBank. Furthermore, both species clustered within separate and well supported clades with K2P interspecific genetic distances of 0.13 – 0.15 and intraspecific distances of 0.00 – 0.01. This study is the first to genetically confirm *C. japonica* from the Adirondack Park and to a broader extent New York State and also re-emphasizes the utility of barcoding techniques for aquatic invasive species (AIS) detection.

Mentor: Andrew David, Department of Biology, Clarkson University

Keywords:*Cipangopaludina, chinensis,* barcoding, CO1, conchology, phylogeny

Poster# 48, Evolutionary Biology Cheel Arena 12:30-2:00 PM

# BIOAGING IN CHILDREN: IRIS ANALYSIS

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Digital identity and need for convenient secure authentication have contributed to the proliferation of biometric recognition from late 1990s with applications in forensics, government sector (border-security, criminal investigation, national security applications) and commercial sector (security, banking, and personal identification). Biometric recognition technology relies on permanence and individuality of the biometric features inherent to individuals. Global ambiguity around the effect of ageing on biometric features in children is affecting applications. To the best of our knowledge, this is a state of art longitudinal study evaluating the merit of iris as a biometric in children using a self-developed data-set from 213 subjects aged between 3 to 14 years over a period of 2 years, the only available child biometric data-set worldwide for research. False-Non-Match-Rate (FNMR) increase from 0.38% to 4.21% with time at False-Match-Rate (FMR) 0.1%. Influence of time, dilation and enrollment age on iris biometric evaluation has been analyzed and their statistical importance evaluated. This study answers the following issues related to children- Does aging effect iris structure to a point affecting the use of iris for biometric recognition? Does iris changes to the extent that refutes the once-in-a-lifetime enrollment claim? Can we draw an age-limit based on evidence on the impact of aging?

Acknowledgement: We are thankful to the Potsdam Elementary and Middle School administration, staffs, subjects and the parents of the participants for helping us create the data-base for the study. This study is funded by Center for Identification Technology Research (CITeR).

Mentor: Stephanie Schuckers, Department of Electrical and Computer Engineering, Clarkson University

Keywords: Biometrics, Children, Aging, Iris, Statistical analysis
-Op, Sustainability, Professional Experience

Poster #22, Sensors & Signal Processing Cheel Arena 12:30-2:00 PM

# SRC Internship Thesis: A Comparative Analysis of a Repeated Internship Experience

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Internships provide undergraduate students with professional experiences outside of the classroom. Seeking internship and co-op opportunities early in the college career helps students maximize their number of professional experience opportunities prior to graduation. Likewise, when a student performs well at an organization, they may be offered a chance to return for a second professional experience with the same company. Thus, some students are faced with a difficult question: is returning to the same experience a valuable opportunity to gain deeper knowledge and achieve a more meaningful experience, or would these students be better served by seeking new experiences and diversifying their skills elsewhere. Following a successful experience in the Mechanical Department of SRC, Inc in the summer of 2017, I agreed to return to the same department for a consecutive summer internship. In this assessment, the work completed in each summer is detailed along with an evaluation based on criterion derived from previous studies of the internship process. The costs and benefits experienced first-hand in my internships demonstrate the overall advantage of the repeated internship. The advantages include increased challenge of tasking, greater satisfaction with work accomplished, and an enhanced sense of mentorship.

Mentors: Christopher Thornton, Department of Mechanical Engineering, SRC, Inc; Kenneth D. Visser, Department of Mechanical Engineering, Clarkson University

Keywords: Professional Experience, Repeated Internship, Professional Opportunities

# The World's Smallest Escape Artists: Manipulation of the Host Innate Immune Response by *Bordatella bronchiseptica*

**Margaret Dedloff[1], Monica Cartelle Gestal[2], Hira Hassan[2], Mariette Barbier[3], Clare Bryant[4], Olivier Restif[4], Eric T. Harvill[2]**

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Some pathogens can sense and respond to the host immune system. One group of bacteria known to manipulate the immune response is the *Bordetella spp.* When studying blood and serum responsive genes, we identified a sigma factor up-regulated in both conditions, and we hypothesized that this regulator might dictate adaptation to pressure from the immune system[1]. Here we identified the role of this sigma factor, the Bordetella Sigma Factor, or *bsr*, in manipulating the immune response. Through the use of a *B. bronchiseptica bsr* knockout and in vitro assays, we have found that *bsr* interferes with the innate response. *bsr* inhibits survival in macrophages by changing the dynamics of phagocytosis, causing macrophage death, and bacterial death and replication within the macrophage by interfering with cytokine and chemokine expression. Our results demonstrate that the *bsr* gene plays a critical role in *Bordetella* interaction with the innate immune system. A better understanding of this gene and will be valuable in efforts to create successful vaccines and treatments not only for *Bordetella spp*. but also for other bacterial species.

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Acknowledgements: Support for this research was provided by the National Science Foundation (grant # 1659683) through the Population Biology of Infectious Diseases Research Experience for Undergraduates, based in the Odum School of Ecology at the University of Georgia.

Mentors: Monica Cartelle Gestal, University of Georgia College of Veterinary Medicine and Eric T. Harvill, University of Georgia College of Veterinary Medicine.

Keywords: immunology, microbiology, human biology, cell interaction

Session 1, Biology & Biomedical Engineering Snell 175; 8:30 AM
Poster #4, Biomedical Science Cheel Arena, 12:30-2:00 PM

# Structural and Compositional Remodeling Due to Repetitive Loading in Bovine Intervertebral Discs

**Samantha Denning**[1], **Sarah Duclos**[1], **Arthur Michalek**[1]

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Residual strain in biological tissue results from tissue microstructure remodeling in response to repetitive loading. It is hypothesized that variations in loading patterns along the bovine tail result in differences in intervertebral disc annulus fibrosus (AF) microstructural remodeling. The hypothesis was tested by quantifying tail musculature using clinical computed tomography (CT) (n=5 tail segments), AF microstructure via polarized light microscopy, and AF composition via quantitative histology. Areas and moments of inertia for discs and muscle were calculated at each level from CT slices. Microstructure was assessed by measuring collagen fiber crimp period in the inner and outer AF. Composition was assessed with Sirius Red to identify collagen size, and both Methyl Blue and Safranin O to identify relative collagen and proteoglycan content. Results show decreasing muscle area and moments of inertia with distal levels along with a decrease in outer AF fiber crimp period. Histology data showed no significant difference in composition between level or region of the disc, however, there were differences between outer and inner AF. It is concluded that there is a larger accumulation of residual strain at proximal tail levels where peak loading is highest, which is driven by changes in microstructure rather than composition.

Acknowledgements: The authors would like to thank Clarkson University Honors Program for partially funding this project as well as Pete Edic (General Electric Research Corporation) for assistance with computed tomography scanning and Tri-Town Packing for providing specimens.

Mentor: Arthur Michalek, Department of Mechanical and Aeronautical Engineering, Clarkson University

Keywords: Tissue Remodeling, Residual Strain, Intervertebral Disc, Annulus Fibrosus, Histology, Collagen

Session 1, Biology & Biomedical Engineering — Snell 175; 9:06 AM
Poster #25, Biomechanics — Cheel Arena, 12:30-2:00 PM

# Patient Specific Cervical Collar

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Patients who suffer from cervical spine injuries will need to be placed in a neck immobilizer for a period of anywhere from 4 weeks to 6 months[1]. After seven iterations (SolidWorks, Dassault, Waltham, Ma) a 3-piece working porotype has been created. The CAD drawing of the chest, back, and chin pieces is scaled to the patient's neck dimensions, then is manufactured through 3D printing (N2 Plus, Raised 3D, Irvine, CA) Measurements are collected using a flexible tape measure. If physical contact is restricted the patient will stand in front of a grid background and photographs will be used to make measurements. To provide a custom fit, a rack and gear pinion is used to adjust the distance between the chin and chest pieces. The cervical collar is manufactured of all non-magnetic materials, allowing patients to undergo MRI without removing the brace. The chest and back piece are 3D printed in ABS to give stability and the chin piece is made of NinjaFlex to increase comfort. Range of motion will be analyzed with and without a collar using the Motion analysis (Qualisys, Gothenburg, Sweden) to verify the brace's ability to keep the neck immobile. The goal is to bring the cervical collar to market in collaboration with interested clinicians.

Acknowledgements:

Thanks to Sweet Briar College, for support to continue this work during Spring 2018.

Mentor: Laurel Kuxhaus, Department of Mechanical and Aeronautical Engineering, Clarkson University.

Keywords: Assistive technology; medical devices, Spine, Stability, 3D Printing

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# Aeroelastic Real-Time Hybrid Simulation (AeroRTHS): Mitigation of Vortex Induced Vibration of a Tall Building Structure

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An extension of hybrid simulation tests to wind engineering termed aeroelastic real-time hybrid simulation (aeroRTHS) was investigated to examine vortex induced vibration (VIV) in the cross-wind direction in tall buildings. This aeroRTHS approach combines computational simulations and wind tunnel testing. Using this new simulation method, the performance of a passive tuned mass damper (TMD) in suppressing VIV was investigated. In this study, a 1-meter tall rigid model was mounted on a 3D-printed platform which converted translational motions of a single-axis shake table to equivalent rotations at the base of the model allowing the model to behave in the wind tunnel as an aeroelastic structure. Pressure sensors were attached on both cross-wind surfaces of the test model to measure wind pressure in real-time. Parameter studies were conducted by varying the natural frequency and damping ratio of the building model and also by utilizing two different mass ratios of the TMD to the building superstructure. Results will be presented demonstrating the feasibility of the aeroRTHS method to investigating aeroelastic structures with/without TMDs. Further, the results will demonstrate that the augmentation of buildings with TMDs are an effective way to attenuate cross-wind vibration in tall buildings.

Acknowledgement: Authors would like to acknowledge the financial support from NSF CMMI-1732223 (Clarkson) and NSF CMMI-1732213 (UConn) and technical support from University of Florida NHERI EF.

Mentor: Steve Wojtkiewicz, Department of Civil and Environmental Engineering, Clarkson University

Keywords: Aeroelastic, Real-time Hybrid Simulation, Vortex induced Vibration, Pressure Measurement, Passive Tune Mass Damper, and Wind tunnel

# Priority-Based Information Flow via Named-Data Networking

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In time-sensitive applications, such as video streaming or command and control messages, operation can be slowed down by a congested network. In a conventional TCP/IP network, handling information priority levels is very complex and costly, because that architecture lacks a method for identifying individual data packets reliably. This causes time-sensitive applications to almost always be reliant on a potentially slow network. Named-Data Networking (NDN) is a new content-centric networking architecture, featuring name-based data retrieval, in-network caching, and built-in security. By using the naming feature of NDN, arbitrary priority levels can be assigned to individual information packets using the data name. Our research focuses on using this feature to create NDN forwarding strategies that allow for higher priority information to be delivered before lower priority information. We have created two preliminary forwarding strategies in NDN that achieve this goal. The first forwarding strategy operates over one link, allowing for higher priority information to be forwarded before lower priority information. The second forwarding strategy uses probability assignments for multiple links, allowing a percentage of packets with a given name prefix to be forwarded to each link, enabling parallel information flow.

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Mentor: Yaoqing Liu, Department of Computer Science, Clarkson University

Key Words: Computer Networking, Information-Centric Networking, Content-Centric Networking, Named-Data Networking, Information Priority

# Electrochemical Monitoring of Neurotransmitter Concentration Dynamics in Live Zebrafish Embryos

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Neurotransmitters are heavily involved at the level of individual organs and the central nervous system in functions related to signaling, stress response, and pathological disorders development. Reliable approaches for quantification of biomarkers in live organisms are needed to study their physiological and pathological pathways. However, the detection of neurotransmitters in live animals is a great challenge due to their low concentrations, high reactivity, short life-time, and matrix complexity in biological models. Customized electrochemical sensors offer an advantageous sensing approach due to potential for sensitive and selective measurements with superior temporal and spatial resolution. Here, we present the development of implantable electrochemical microelectrodes for *in vivo* detection of two representative neurotransmitters, nitric oxide (NO) and dopamine. Zebrafish (*Danio rerio*) embryos are employed as a biological model for detection of biomarkers at single organ level. A polymer-functionalized carbon fiber microelectrode has been used to determine the spatial distribution of NO along the intestine. An electrochemically pretreated carbon fiber microelectrode has been developed for time-dependent monitoring of dopamine in the brain. Nitric oxide and dopamine have been quantified under conditions of pharmacological manipulation. Our results demonstrate the potential of electrochemical sensors to generate information about neurotransmitter dynamics in biological settings.

Mentor: Silvana Andreescu, Department of Chemistry & Biomolecular Science, Clarkson University

Keywords: electrochemistry, microelectrode, neurotransmitters, dopamine, nitric oxide, zebrafish embryo

# Effects of freshwater acidification on an invasive mollusc (*Viviparus georgianus*) in the Adirondacks

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Acidification in aquatic habitats has seen sweeping negative effects across marine ecosystems. Likewise, freshwater ecosystems may see similar effects from climate change in terms of lower pH values caused by elevated $CO_2$-levels. In this study, we explore the influence of $CO_2$-induced freshwater acidification on *Viviparus georgianus*, a banded gastropod species invasive to the Adirondacks. We exposed *V. georgianus* collected from the Raquette River in Potsdam, NY to a pH significantly lower than their natural environment. Throughout the course of eight weeks, the organisms were assessed for length, weight, and survivorship. Because dissolved $CO_2$ has seen to limit the production of calcium carbonate, we investigated the link between shell repair and the stress of elevated dissolved $CO_2$. After mimicking a predation event with small incisions (0.5cm-1.0cm) located on the aperature, we investigated duration for shell repair in both a controlled and experimental setting. We show that there was a negative response in survivorship from a higher $CO_2$ concentration, while overall growth remained constant. However, the regeneration rates of *V. georgianus'* damaged shell were nearly identical. It is imperative to predict the impact of elevated $CO_2$ on freshwater ecosystems to prepare for the consequences of future water chemistry changes.

Acknowledgements: We would like to thank the Malacological Society of London for funding this study.

Mentor: Andrew David, Department of Biology, Clarkson University

Keywords: Climate, Change, Dissolved, Carbon, Dioxide, Calcium, Carbonate, Malacology, Aquatic, Ecosystems

# Data-Centric Approach to Rheumatoid Arthritis (RA): Revisiting the Connection between RA and Diabetes

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Rheumatoid Arthritis (RA) is an autoimmune, chronic inflammatory disease of the joints that affects approximately 1% of adults in the United States. Several studies have shown a strong association between RA and diabetes, with one disease increasing the risk of developing the other. In this work, we aim to explore any potential interaction effect of multiple diabetic markers on RA incidence using National Health and Nutrition Examination Survey (NHANES) data, which provides national-level representative data through a complex, multistage survey data. We consider fasting glucose, oral glucose tolerance, hemoglobin A1C, albumin, and insulin to evaluate the diabetes severity, and, C-reactive protein (CRP) and ferritin concentration to assess the systematic inflammation; these parameters are used as independent variables and RA occurrence as the dependent variable. We will present the Principal Component Analysis (PCA), to determine which of these diabetes-associated parameters have strongest association to RA. Furthermore binary logistic regression analysis will be shown to show the likelihood of RA as a function of these diabetic markers.

Mentors: Sumona Mondal, Department of Mathematics, Clarkson University
Shantanu Sur, Department of Biology, Clarkson University

Keywords: Rheumatoid Arthritis, NHANES, comorbidities, diabetes, C-reactive protein, autoimmune diseases

# Discovery of Emerging Halogenated Contaminants of Concern in Great Lakes Lake Trout

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Halogenated contaminants are typically the largest fraction of persistent, bioaccumulative and/or toxic (PBT) chemicals in the Great Lakes. Legacy halogenated contaminants (e.g. PCBs) have been monitored, but many additional halogenated compounds may still be undiscovered. To understand the impact of unknown PBT halogenated chemicals in Great Lakes, top predator fish (trout) were analyzed using an atmospheric pressure gas chromatographic (APGC) coupled with a quadrupole time-of-flight (QToF) instrument that produces soft ionization full scan high resolution mass spectrometer (HRMS) data. An Isotopic Profile Deconvoluted Chromatogram (IPDC) algorithm was developed to screen for halogenated compounds using the distinct identifiable mass spectral signatures in HRMS data. The IPDC algorithm was equipped with several data reduction techniques including a false positive prediction by neural network, a mass defect filter, a boiling point prediction, and a ranking system for candidate molecular formula. The IPDC algorithm detected approximately 202 features associated with legacy contaminants in Lake Michigan Lake Trout collected in 2016 sample and produced a list of 228 unknown isotopic features for future investigations. A temporal trend of the uncategorized halogenated futures were produced to compare between sites years (2005/2006 vs. 2015/2016) to determine spatiotemporal impact of halogenated and potential PBT compounds in Great Lakes.

Mentor: Thomas M. Holsen, Bernard S. Crimmins, Department of Civil and Environmental Engineering, Clarkson University

Keywords: Emerging contaminants, High-resolution mass spectrometry, Isotope profile calculation, Non-targeted screening, Data reduction, Atmospheric Pressure Gas Chromatography–Quadrupole Time-of-Flight.

# Magneto-Controlled Biocatalytic Cascades with Logically Processed Input Signals – Substrate Channeling versus Free Diffusion

**Yaroslav Filipov[1], Evgeny Katz[1]**
**Andrey Zakharchenko[2], Sergiy Minko[2]**

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Magnetic nanoparticles (MNPs) functionalized with various enzymes (amyloglucosidase, glucose oxidase and horseradish peroxidase) were used to perform biocatalytic cascades in two different states, solute suspension or aggregated, produced in the absence or presence of an external magnetic field. The biocatalytic reactions proceeded through bulk solution diffusion of intermediate substrates or substrate channeling, when the systems were dispersed or aggregated, respectively. The both pathways have shown very similar kinetics, unless the intermediate substrate was consumed by an additional biocatalytic process called "filter" for brevity. In the presence of the "filter" process, the diffusional process in the bulk solution was significantly inhibited, while the process based on the substrate channeling was still active. The systems were switched reversibly between the inhibited dispersed state and the active aggregated state by removing and applying the external magnetic field, respectively. The signal-controlled biocatalytic cascades were considered as Boolean logic circuits with the inputs consisting of biomolecules and the magnetic field on-off.

Acknowledgements: NSF grant.

Mentors: Professor Evgeny Katz, Department of Chemistry, Clarkson University

# A 3D Printing Platform for Development of Bioink Based Wearable Sensors

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The ability to manufacture functional sensors rapidly would be beneficial for numerous applications in healthcare, environmental monitoring, food, and cosmetic industries. However, sensors are inherently complex and often arranged into composite architectures composed of multiple components. Therefore new fabrication methods are needed to create sensors that could be manufactured rapidly. Emerging additive manufacturing methods like 3D printing and 3D bioprinting, enable printing different biomaterials into intricate 3D architectures which could be used for sensing. This work focuses on advancing the capabilities of biosensor fabrication. Specifically, a multimaterial bioprinting method capable of producing 3D biosensor constructs by co-printing hydrogel biocomposites, nanoparticles, enzymes and polymers. To demonstrate that such a platform could be used for this purpose, a new UV sensor was determined to be fabricated. To create a UV sensitive sensor that gives a colorimetric response to UV light, photocatalytic nanoparticles were used with dyes, which would degrade on exposure to UV thereby giving a colorimetric response to UV exposure. To test the versatility of this additive manufacturing platform, three different dyes were used as components of a printable bio-ink which was then be used to 3D print these sensors.

Faculty Advisor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Biosensors, 3D-printing, Bioinks, Bioprinting, Wearables, Additive Manufacturing

Session 3, Sensors & Signal Processing — Snell 213, 10:50 AM
Poster # 65, Chemical Sensors — Cheel Arena, 12:30-2:00 PM

# Looking for Extended Red Emission in the Dark Nebula LDN1780 and the Reflection Nebula NGC7023

**Carlie Fowler**[1], **Joshua Thomas**[1], **Adolf Witt**[2]

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Extended Red Emission (ERE) is a poorly understood optical photoluminescence that occurs in areas that contain interstellar dust and far-ultraviolet photons. It is thought that this process occurs only in areas that are mostly carbon-rich, rather than oxygen-rich. It is currently thought that ERE is produced by ionized polycyclic aromatic hydrocarbons, although there are contending theories. To get more insight into the ERE, two nebulae thought to exhibit this phenomenon were observed at Clarkson's Reynolds Observatory. A previous study in the literature shows that ERE was thought to be detected in LDN1780, but this original finding has not yet been confirmed. Further analysis will be done using other neblua that may or may not show extended red emission. Knowing the characteristics of nebulae that exhibit ERE will help solve a longstanding question in astrophysics about the chemical composition of the source of ERE.

Mentor: Joshua Thomas, Clarkson University Department of Physics

Key words: Extended red emission, Interstellar dust, LDN1780, NGC7023

Session 1, Space and Aerospace — Snell SN 177; 8:54 AM
Poster #17, Signal Processing — Cheel Arena 12:30-2:00 PM

# Bayesian Modeling of Rheumatoid Arthritis Comorbidly Interacting Risk Factors with Complex Survey Data

**Daniel T. Fuller**[1], **Chris Carter**[1], **Shantanu Sur**[2], **Sumona Mondal**[1]

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Rheumatoid Arthritis (RA) is a chronic and systemic inflammatory disease that affects roughly 1% of adults in the United States. It is among the most expensive disease for U.S. healthcare and yet its burden on rural populations has been drastically understudied. This effect in conjunction with a critical shortage of Rheumatologists in rural areas calls for increased research attention on means of reducing this care gap. There is a pressing need to focus on technology that will aid in identifying both the critical elements of care optimal healthcare delivery strategies for rural RA patients. With this goal in mind we have proposed and begun development of models for the RA comorbid disease system utilizing data obtained from the National Health and Nutrition Examination Survey (NHANES), a complex stratified sampling survey that permits national-level inference on key parameters from small samples. The extraction of important RA risk factors from the NHANES data aids in the construction of Bayesian weight-smoothed logistic regression models that will provide national level inference support on local RA patient data. Our work will contribute to the building of models for the creation of an educated plan of care for RA patients that will allow rural primary-care providers to make informed decisions regarding treatment and referral. This talk will cover the preliminary modeling decisions with the survey data as well as possible spatio-temporal model adaptations for local patient data.

Mentors: Sumona Mondal, Department of Mathematics, Clarkson University
Shantanu Sur, Department of Biology, Clarkson University

Keywords: Rheumatoid Arthritis, NHANES, Healthcare, Bayesian Inference, Rural Healthcare, Barriers to Care

Session 3, Modeling & Computational Methods Snell 212, 10:50 AM
Poster #11, Biomedical Sciences Cheel Arena 12:30-2:00 PM

# Toxic News Reporting on the Children of God Cult

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The beginnings of the Children of God (COG) seemed innocent in late 1960s California. It seemed like a bunch of Christian missionaries singing and preaching the word of God, under the leadership of David Berg. However, COG was really a cult that abused the words "love" and "sex." COG believed in spreading the word of God through sex, including behaviors of rape, molestation, and incest. The normalization of this behavior injured the mental health of many members of the COG community. News reporting added to this damage by focusing on the abuses of children, but not women. This was a problem because it devalued the pain the women felt and made it harder for women to move on. There was also too much emphasis on moral outrage rather than facts, missing an opportunity to heal. Based on an examination of news articles covering COG from the US, Thailand, and Argentina (1968-2005), I ask: how can the news better report on complicated environments like cults without appealing to the morality of the masses and excluding the pain of certain victims?

Mentor: Christina Xydias, Department of Humanities and Social Sciences, Clarkson University

Keywords: Cults, Sex, Gender, Humanities, News, and Abuse

# Data-Centric Approach to Rheumatoid Arthritis (RA): Exploring the Infectious Origin of RA

**Paola Girotto[1], Jelena Hadina[1], Sean Relyea[1], Grayden Shand[1], Sumona Mondal[2], Shantanu Sur[3]**

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Rheumatoid Arthritis (RA) is the most common inflammatory joint disease affecting about 1% adults in the United States. An autoimmune mechanism underlies the disease pathology and elevated serum levels of RA-related autoantibodies are often found in patients even before the arthritic manifestations. Infection is thought to be one of the triggers for autoimmunity, and the links to bacterial infections from the gut and respiratory system have been reported. In this study, we explore any potential association of RA with parasitic or viral infections using the National Health and Nutrition Examination Survey (NHANES) data collected in 2013 and 2014. NHANES includes laboratory-based examination for multiple parasitic and viral infections (e.g. toxoplasmosis, hepatitis C), and uses a complex, multistage sampling design to provide a nationwide estimate. Furthermore, we use this information to run a multivariate logistic regression to identify the significant predictors for RA. Our analysis would enable a better understanding of the degree of association between these infections and RA, providing valuable information for future study toward elucidating a causal relationship of RA development from immune provocation.

Mentors: Shantanu Sur, Department of Biology, Clarkson University, and Sumona Mondal, Department of Mathematics, Clarkson University

Keywords: Rheumatoid Arthritis, NHANES, comorbidities, parasitic infections, viral infections, multivariate logistic regression

# Installation of an Aquaponics System and Educational Program at the Cornell Cooperative Extension

**Kati Gotch** 1

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Changes are occurring in agriculture and how we grow our food based on the changing conditions of our world. Such changes as rising population growth and a reduction in space to place farmland. To keep up with these changes new ways of growing food are being developed. One way that allows food to continuously grow, one that is self-sustainable, and has multiple purposes is aquaponics. This is a system that involves using water that has fish feces in it from fish living in a tank. The fish feces are transformed into nutrients by nitrates. This water is pumped through piping into a media that holds plants. The plants take the nutrients, so they can grow then the fresh water is returned into the fish tank. The Cornell Cooperative Extension in Canton, NY is using the installment of an aquaponics system to teach children of local school districts the dynamics of aquaponics and its engineering principles. This project involves the design of the aquaponics system and the creation of education programs for children learning about the system.

Mentor: Shane Rogers, Department of Environmental Engineering, Clarkson University, and Alan Rossner, Institute For Sustainable Environment

Keywords: Engineering, Fish, Plants, Education, Design, Aquaponics

# Using Signal Processing Techniques for Velocity Detection Using Optical Flow

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Many algorithms exist in order to calculate optical flow, which is "the distribution of apparent velocities of movement of brightness patterns in an image. Optical flow can arise from relative motion of objects and the viewer."[1] Perhaps the best of these algorithms is the Horn Schunck method, which calculates optical flow by minimizing the error in the smoothness of the images. However in the calculation of optical flow, four values (velocity in the x and y direction, orientation, and magnitude) are generated for each pixel of each frame. This represents a large number of calculations. It is our goal to find a method to calculate velocity in real time from the optical flow data.

Acknowledgements: This work is supported in part by the NSF DUE award 1525224.

Mentor: Mahesh Banavar, Department of Electrical and Computer Engineering, Clarkson University

Keywords: Optical Flow

[1]; Determining Optical Flow by Berthold K.P. Horn and Brian G. Schunck

# Rational Design and Synthesis of Rigid Zwitterionic Ligands to Access Novel Zwitterionic Metal-Organic Frameworks

**John Hadynski[1], Mario Wriedt[1]**

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Metal-organic frameworks (MOFs) are crystalline porous materials composed of metal clusters or ions connected by polytopic organic linkers. These materials have high surface areas and large pore volumes and can be fine-tuned to selectively capture guest molecules. The incorporation of zwitterionic ligands in MOFs can introduce charged organic surfaces in their cavities leading to intermolecular electrostatic fields to polarize guest-molecules. This work entails a reaction route to synthesize three new rigid zwitterionic ligands by utilizing zincke coupling reaction of 4-picolinic acid ethyl ester with primary amine containing molecules: 3,5-diaminobenzoic acid, trans-1,4-diaminocyclohexane, and 3,5-dichloroaniline as well as subsequent reactions. Subsequent systematic investigations have also been proposed to synthesize novel zwitterionic MOFs in order to study gas adsorption as well as structure-property relationships to expand the understanding of materials chemistry in relation to real-life applications.

Mentor: Mario Wriedt, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Metal-Organic Framework, MOF, Zwitterionic, Carbon Capture, Organic Synthesis, Inorganic Synthesis

# Policy Options for Forest-Disturbance Adapted Species Management in the Adirondack Park

**Louis Hallstrom[1], Stephen Bird[2]**
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The Wilderness land use designation is intended to preserve forests and limit anthropogenic impact on the landscape within the Adirondacks to maintain its "forever wild" status under the New York Constitution. This designation is a challenge when attempting to maintain native species in the region that require forest disturbance. This includes species facing rapid decline in the Park, such as Rusty Blackbirds (RUBL), and to a lesser extent, the Spruce Grouse. While some resources are used to protect the Spruce Grouse because it is a game species with no current hunting season, other species are more vulnerable. For instance, Rusty Blackbirds lack classifications and funding to implement management plans and conduct research. We examine policy options to address this concern. Potential solutions include experimental management on private lands, incentives for private land owners to manage for RUBL habitat, and restricted, permit-based forest management plans for RUBL habitat on public lands if experiments are successful.

**Key Words:** Adirondacks, habitat, management, policy, Rusty Blackbird, Forest disturbance

**Acknowledgements:** This analysis and policy proposal was sparked by research that Louis "Wil" Hallstrom conducted in the summer of 2018 with New Hampshire Audubon in northern New Hampshire. We are grateful to the Senior Advisor for Science and Policy at New Hampshire Audubon, Carol Foss, and New Hampshire Audubon for their support. Thanks also to Director of Science at the Adirondack Watershed Institute, Michale Glennon, and Professor in Environmental Studies at Paul Smith's College, Bethany Garretson, for their insight during interviews. Any errors remain the responsibility of the authors.

**Mentors**: Carol Foss, Senior Advisor of Science and Policy, New Hampshire Audubon. Stephen Bird, Associate professor of Political Science, Clarkson University.

# Nicotinic Acid Based Ditopic Zwitterionic Ligands for Metal-Organic Framework Synthesis

**Alexander Harley** [†], **Juby Varghese** [†], **Hubert Bilan** [†], **Mario Wriedt** [†]

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As carbon dioxide levels in Earth's atmosphere continue to rise, there is an increasing need for its removal alongside other greenhouse gasses. Zwitterionic metal-organic frameworks (MOFs) synthesized from metal salts and zwitterionic ligands have been identified as possible candidates for carbon capture due to their ability to be fine-tuned to selectively capture carbon dioxide over nitrogen. In this work, Zincke reactions were used to synthesize a new zwitterionic ditopic ligand for zwitterionic MOF synthesis. The proposed ligand (L1) is structurally ridged with positive and negative charges distributed along the ligand creating a charged organic surface. Successful synthesis could open up a new family of MOFs with improved applications and gas sorption properties. Specifically, L1 and its regioisomer (L2) can be used to design an isostructural series of MOFs to investigate structure-property relationships related to carbon dioxide adsorption.

# Clarkson Greenhouse Reconstruction - An interdisciplinary capstone design class

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Clarkson University's current greenhouse is in dire need of renovation. It was designed and built in 2010 as a cold-climate, year-round greenhouse, but is currently unusable during the winter months. With financial support from the Sustainability Fund, an interdisciplinary capstone design class is developing detailed designs for the deconstruction of the current greenhouse and reconstruction of a more versatile and resilient structure. The cold-climate structure includes glazing only on the south wall for solar light and radiant gain, other walls are well insulated. Supplemental heating will be provided from the Cheel heating system. Several materials from the existing greenhouse and other spaces on campus will be reused in the new construction to complete the project within a reasonable budget and encourage sustainable design and use of materials. Several stakeholder groups have helped to define the design to make the space useful to them and generally more diverse. The greenhouse will include the Clarkson Keepers' observation bee hive to allow honey collection, education and observation of honeybees. The Garden Club, Engineers for International Sustainability, grounds crew and faculty from the biology department are all expected to be active users of this new facility.

Mentors: Profs. Susan Powers (ISE) and Erik Backus (CEE)

Key Words: greenhouse, sustainability, heating, design, solar

# *Ki67* mRNA vs. Ki67 protein – a better indicator for cell proliferation?

**Lara Varden, Althea Henderson, Shantanu Sur, Petra Kraus, Thomas Lufkin**
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Cell proliferation and growth is a basic criterion of living organisms; uncontrolled proliferation is a feature of tumor cells and of medical concern. Traditionally, Ki67, a nuclear protein associated with all active phases of the cell cycle, is used as a cell proliferation marker and detected by immunohistochemistry (IHC), a method based on the specific interaction of antibodies with epitopes of the target protein. In a cell, DNA is transcribed into mRNA, which is translated into protein. RNA in situ hybridization (RISH) detects gene transcription through nucleic acid hybridization, a method that is less vulnerable to off-target binding and more flexible in probe design than IHC or immunofluorescence (IF), a technique similar to IHC but with fluorescent tagging. We continue our investigation to determine if RISH detection of *Ki67* mRNA might be a better indicator to assess cell proliferative potential than Ki67 protein. Using cells of the bovine intervertebral disc (IVD) and comparing RISH with IF *in vitro*, we are assessing the potential of *Ki67* as a proliferation marker, using the data to further characterize cell lines derived from the annulus fibrosus and nucleus pulposus, and are investigating if *Ki67*mRNA expression can be more precisely linked to specific cell cycle stages.

Acknowledgments: This work was supported by the Bayard and Virginia Clarkson Endowment Fund granted to Thomas Lufkin.

Mentors: Shantanu Sur, Assistant Professor, Department of Biology, Clarkson University

Thomas Lufkin, Professor and Bayard and Virginia Clarkson Endowed Chair in Biology, Clarkson University

Keywords: Ki67, cell proliferation, RNA in situ hybridization, immunofluorescence, cell cycle, intervertebral disc

Poster #41, Biology and Ecology Cheel Arena 12:30-2:00 PM
Poster #1, Biomedical Science Cheel Arena 12:30-2:00 PM

# Fundamental Study of Heavy Metal Adsorption on Metal Oxide Nanoparticles

**Farideh Hosseini Narouei[1], Daniel Andreescu[1], Silvana Andreescu[1]**

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Metal oxide nanoparticles (MONPs) such as titania ($TiO_2$), ceria ($CeO_2$) and iron oxide ($Fe_3O_4$) are heavily used in consumer products and discarded in the environment with little regulation. Although these NPs are found to be relatively non-toxic, when released in the environment they can undergo transformation and interact with existing contaminants such as heavy metals which can drastically change their properties and toxicity profile. This work will discuss electrochemical studies to investigate the interaction of MONPs with inorganic arsenic species and characterize surface processes (e.g. oxidation, adsorption) at the level of individual particles. Examples of NP systems and studies to assess the effect of particle type, surface coatings and environmental composition will be provided along with the parameters controlling adsorption/desorption of toxicants, using electrochemical methods and a suite of spectroscopic procedures. We demonstrate the use of electrochemistry as a powerful tool to quantifying heavy metal adsorption and determining mechanisms that can be used to predict the interaction of NPs in the environment.

Advisor: Silvana Andreescu

Keywords: Key Word 1 Heavy Metal, Key Word 2 Metal Oxide Nanoparticles, Key Word 3 Environmental, Key Word 4 electrochemical studies, Key Word 5 inorganic arsenic , Key Word 6 adsorption

# The cytotoxic effects of Ivermectin on cervical cancer cells

**Katey Hunt**[1], **Damien Samways**[1], **Maurish Bukhari**[1]

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The American Cancer Society estimated 4,170 women will die from cervical cancer in the U.S. in 2018. Recent work screening FDA-approved drugs for anticancer effects suggested Ivermectin had anticancer efficacy; the concentrations used were too high to be clinically relevant and above the concentration this hydrophobic drug precipitates out of aqueous solution. Our research tests the hypothesis that Ivermectin, an anthelminthic used to treat river blindness by activating voltage-gated $Cl^-$ channels, has limited toxicity in treating cancer, mostly caused by precipitate damaging the plasma membrane. Calcium oscillations occur when cells are stressed via voltage-gated $Ca^{2+}$ channels, ER channels, or $Ca^{2+}$ ATPase pumps. It was proposed that Ivermectin's cytotoxic effects occur through a P2X channel pathway. Our cervical cancer cell lines (CXT2) do not express P2X channels, a family of plasma membrane receptors involved in purinergic signaling. $Ca^{2+}$ imaging was used to detect $Ca^{2+}$ oscillations in CXT2 cells when exposed to various concentrations of Ivermectin, P2X7 channel inhibitors, and adenosine triphosphate (ATP). The P2X7 channel inhibitors did not block the $Ca^{2+}$ responses. Our preliminary results indicate the concentrations of Ivermectin used did not form precipitate and had cytotoxic effects. Further studies may be to quantify Ivermectin's cytotoxicity mechanisms in cancer cells.

Acknowledgements: The McNair Program and Damien Samways.

Mentor: Damien Samways, Department of Biology, Clarkson University

Key Words: Cancer

# New Family of Airfoils for the Conceptual Design of Aircraft with Variable-Camber Wings

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Variable-camber wings have been the subject of research from the early days of aviation and have evolved into effective performance-enhancing devices that have seen implementation on mainstream commercial aircraft and numerous other applications. Although the design of such wings is well within the reach of existing design technology, conceptual design methods to enable the study of various variable-camber concepts and layouts at the early stages of design are still lacking. This type of activity is typically accomplished later in the design process with more time-consuming higher-fidelity tools, thereby limiting the extent of exploration achievable in early stages when the design requirements and the product development strategy are still evolving. In the methodology proposed herein, a new family of variable-camber airfoils is developed for a broad range of design requirements, and for which the performance can be extrapolated to three-dimensional wings. The aerodynamic properties of this new family of airfoils provide a database with which aircraft-level assessments of variable-camber concepts can be accomplished at the earliest stages of aircraft conceptual design. A summary of the methodology will be presented in the presentation along with sample results.

Mentor: Pat Piperni, Department of Mechanical and Aeronautical Engineering, Clarkson University

Keywords: Airfoils, Conceptual Design, Variable-camber, MDO, Aerodynamics, Fluid Dynamics

Poster #54, Mathematical Models and Simulations Cheel Arena 12:30-2:00 PM

# 3D Printed Hydrogel Bioink Based UV Sensors

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Ultra-violet (UV) rays cause irreversible damage to the body's largest organ; the skin. This is not an immediate concern for most people, because short-term exposure only causes a sunburn; but long-term exposure leads to more serious conditions. While there are measures available to prevent skin damage, like sunblock, it is still difficult to avoid the detrimental effects of the sun after extensive exposure. Furthermore, it is difficult to know when to reapply sunblock, which is why a cheap and effective UV sensor is needed. The aim of this study is to create a temporary sensor that gives a colorimetric response to UV light. This can be accomplished by using photocatalytic nanoparticles to change the color intensity of the sensor, which would indicate a subject's UV exposure. This study explores the effect of photocatalytic nanoparticles on three dyes: methyl orange, methylene blue, and malachite green. These compounds were used in a bioink to 3D print these sensors. The UV intensity of the sun was measured and mimicked in the lab to obtain an accurate estimation of the "life" of the sensor. These sensors exhibit high sensitivity towards UV radiation, and the has the potential to be used as a portable device.

Faculty Advisor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Mentors: Abraham Samuel Finny, PhD Student-BIOSEM Group, Clarkson University

Keywords: Sensors, UV Monitoring, Photocatalysis, UV Sensing, Biosensors, Dye Degradation

# In-Situ Electrochemical Characterization of Post-CMP Cleaning Under Brushing Conditions

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The fabrication of wafers for interconnect device technologies relies heavily upon chemical mechanical planarization (CMP), a process during which deposited materials are removed in a controlled manner by a combination of chemical slurries and mechanical abrasion. Because of the chemical complexity of the CMP slurries employed in this step, various residual species, debris, and contaminants remain on the wafer surface after processing. As a result, CMP processing is succeeded by a post-CMP cleaning (PCMPC) step, during which selective chemicals and mechanical brushes are employed to remove impurities from the wafer surface and protect it from defects. At present, characterization of PCMPC systems requires a combination of expensive imaging techniques and brushless beaker electroanalytical experiments. Addressing a commercial need for quick, cost-effective methods for characterizing PCMPC systems more accurately, an in-situ electrochemical method was developed to evaluate PCMPC systems under brushing conditions. By applying electroanalytical techniques including voltammetry and electrochemical impedance spectroscopy, CMP-pretreated copper and cobalt substrates were characterized in an electrochemical cell, with and without brushing, while submerged in a simple alkaline cleaner. Additional ex-situ experiments were conducted in an electrochemical beaker cell containing a neutral electrolyte to assess the effectiveness of the cleaning solution and brush.

Acknowledgements: Cody Johnson gratefully acknowledges his graduate assistantship from the Clarkson University Physics Department. He would also like to thank Michael White and Jun Liu of Entegris for providing the resources and guidance necessary for the success of this project.

Mentors: Dipankar Roy, Department of Physics, Clarkson University

Key Words: CMP, Post-CMP Cleaning, Copper/Cobalt Electrodes, In-situ Electrochemical Measurements, Brush Cleaning, Electroanalysis

# A Novel Zwitterionic Metal Organic Framework for Enhanced Carbon Capture

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Porous metal organic frameworks (MOFs) composed of metal nodes and multitopic zwitterionic organic ligands as linkers have received considerable attention due to their diverse applications in various fields such as gas storage, molecular separations, heterogeneous catalysis, and drug delivery. These crystalline materials encompass large pore volumes, high surface areas, and tunable pore surface properties make them unique in porous materials. The zwitterionic nature of organic linkers results in the formation of charged organic surfaces having potential to selectively polarize guest molecules. These properties make MOF candidates for the capture and storage of small molecules and the study of their fundamental structure-property relationships. In this work we developed a novel, flexible zwitterionic MOF displaying enhanced carbon capture properties. Hence, we present the structural and physical properties of this material in context with its selective adsorption characteristics.

Mentor: Mario Wriedt, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Metal-organic frameworks, Zwitterionic ligands, Porous crystalline materials, Carbon capture, Crystal structure from PXRD, Layering approach.

# 2D and 3D-printed sensors for the rapid detection of heavy metal ions in water and plants

**Kevin Kirk[1], Abraham Finny[1] and Silvana Andreescu[1]**

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Metal ion accumulation in water and plants can lead to harmful long term consequences on the environment, plant and ecosystem health. Measuring metal concentrations in the field using simple, easy-to-use analytical tools can enable rapid screening of samples for metal content and provide an estimation of the overall contaminant distribution and potential exposure levels. Our sensing element consists of polyethyeleneimine (PEI) which has chelating ability for metal ions and forms complexes of unique characteristic colors with increased selectivity for $Cu^{2+}$. The 2D sensors were produced by electrostatic assembly and multilayer printing of low volume PEI intercalated with polysodium-p-styrenesulfonate (PSS) on paper. The 3D sensors were fabricated using custom-made PEI-containing hydrogels of characteristic viscosity optimized to allow creation of robust stand-alone constructs. These procedures have the advantage of being fully scalable and compatible with roll-to-roll fabrication, enabling manufacturing on a large scale. The sensors are able to quantify $Cu^{2+}$ content in water and copper fungicide sprayed plants within 5 minutes with concentration limit of detection of 9.85 µM and 92 µM for the 2D and 3D sensors respectively. The application of this technology should enable rapid, more cost-effective measurements of metal accumulation, particularly copper, in water and plants.

Mentor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Sensing, analytical chemistry, 3D printing, environmental, manufacturing, copper

# Air Quality Prediction using LUR Model: Parameter Reduction and Optimization

**Vijay Kumar[1], Vitt Patel[2], Shantanu Sur[3], Suresh Dhaniyala[4], Supraja Gurajala[5], Sumona Mondal[1]**

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Air pollution is one of the most important public health risks, causing one in eight premature deaths globally [1], and consequently it has become mandatory to monitor ambient air quality. Conventional instruments for air quality measurements are expensive and difficult to maintain and hence these measurements are only available at low spatial resolution. Health-based studies require knowledge of air quality at high-resolution corresponding to the spatial scales at which air quality varies. Often researchers use a Land Use Regression (LUR) model to predict air quality at high resolution using a range of easily obtained information such as: meteorological properties, land use type, housing data, traffic, road density, etc. These models are often built using a brute-force approach, employing all available parameters, and consequently the models are too complex and specific to a single location. Here, we analyze high-resolution low-cost air quality data from Rochester NY, in conjunction with Land-use, traffic, and EPA data using Principal Component Analysis (PCA) and Analysis Of Variance (ANOVA), to identify optimal parameters for LUR models. This study will aid in building more robust and generic LUR models in the future. We will present the results obtained from our study in the conference.

1. World Health Organization Ambient air pollution: A global assessment of exposure and burden of disease 2016.

**Mentors:** Sumona Mondal, Department of Mathematics, Clarkson University, and Supraja Gurajala, Department of Computer Science, SUNY Potsdam

**Keywords:** LUR, Air quality, Regression, PCA, and ANOVA.

Poster #51, Mathematical Models and Simulations Cheel Arena 12:30-2:00 PM

# Optimized Generation and Characterization of Aerosolized Bacterial Spores

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Airborne particles, particularly those smaller than 2.5 µm can cause adverse health effects. Exposure to particles often have a stronger impact on health when the particles are biological in nature. For example, pulmonary infection by *Bacillus anthracis (Ba)* spores can result in death of an individual and thus, knowledge of their transport characteristics and fate in the environment is critical. We have developed and tested methods to generate, and characterize a surrogate for *Ba*, *Bacillus thuringiensis (Bt)*. We have successfully generated *Bt* spores at high purity (>95%) and used nebulization to aerosolize them. We explore the aerosolized particle characteristics under different spore suspension concentrations. Our aerosolized *Bt* spores are predominantly singlets with 0.72 µm aerodynamic diameter under low concentrations of the suspension, however, spore clusters of sizes large as 3 µm are observed at higher concentrations of the suspension. The spore sizes are confirmed with impactor-based measurements. Spore viability during nebulization and deposition was investigated and established using fluorescent stains acridine orange and propidium iodide. The validated spore generation process is being used in experiments to deposit single spores and clusters of different sizes on substrates to determine forces required to remove these biological particles from substrates of different compositions.

Acknowledgements: Defense Threat Reduction Agency to funding this project.

Keywords: Airborne particles, *Bacillus thuringiensis*, aerosolization, nebulization, spore viability

Session 3, Fluid Mechanics & Aerosols — Snell 118, 11:35 AM
Poster #45, Biology & Ecology — Cheel Arena 12:30-2:00 PM

# Should I stay or should I go?: Early life energy consumption and expenditure affects male natal dispersal in Sifaka lemurs

**Alicia R. Lamb[1], Patricia C. Wright[2]**
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In group-living species, juvenile social activity may increase skill acquisition and provide fundamental preparation for dispersal and integration into new groups. However, both social activity and the growth/development that facilitates successful dispersal can be energetically costly, representing a trade-off. This study explores how early life conditions, such as health, energetics, and sociality, are associated with natal dispersal in a long-lived primate (*Propithecus edwardsi*). I tested hypotheses on the importance of juvenile energy intake and expenditure, skill acquisition, and health on natal dispersal age in Milne-Edwards' sifaka. Using focal behavior data collected in Ranomafana, Madagascar from 1998-2008, I compared the effects of grooming, travel, play, and feeding on dispersal age [N=15]. Male dispersal age decreased significantly as percentage of total feeding bouts with the dominant female increased [Linear mixed effects model: $P<0.001$]. Additionally, dispersal age significantly increased as percentage of play and travel time increased [LME: $P<0.001$]. Females showed no statistically significant differences for any behaviors [Mann-Whitney U test, $P>0.1$]. In summary, traveling and playing are energetically costly behaviors, but feeding close to the dominant female may provide access to higher quality foods. These results suggest that the age males disperse is closely associated with energy consumption and expenditure while juveniles.

Acknowledgments: Data collection supported by National Science Foundation, Seneca Park Zoo, St. Louis Zoo, Fulbright Foundation, Margot Marsh Biodiversity, Earthwatch, Wenner Gren Foundation, Primate Conservation Inc.

Mentor: Tom Langen, Biology Department, Clarkson University

Keywords: Behavioral ecology, Natal dispersal, Energetic trade-off, Primate juvenility, LME modeling, *Propithecus*

# Development of a sonolytic reactor for in situ PFAS remediation

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Per- and polyfluoroalkyl substances (PFAS) have contaminated water supplies globally as a result of industry and fire training activities. PFAS are highly recalcitrant and common water treatment technologies cannot be used for their complete remediation. Recently, research has focused on destructive technologies, so-called because they can fully degrade PFAS. This research has focused on preliminary lab studies of a sonolytic reactor intended to be placed in a horizontal well. Passive flow into a horizontal well would eliminate the need for pumping. The design does not require media that must be regenerated or incinerated. The intention is to evaluate the reactor as a method of energy efficient PFAS degradation. PFOA and PFOS concentrations in heavily contaminated natural groundwater decreased 92% and 83%, respectively in 600 minutes under air rather than argon. Work continues to close the fluoride mass balance, treat PFAS contaminated groundwater (>90% degradation of PFOS), and tune operating parameters for maximum efficiency.

Colleagues: Blossom Nzeribe-Nwedo, Dinusha Siriwardena, Sujan Fernando, Alesia Haddad Carroll.

Mentors:
Michelle Crimi, Clarkson University, Engineering and Management.
Thomas Holsen, Clarkson University, Civil and Environmental Engineering.
Selma Mededovic Thagard, Clarkson University, Chemical and Biomolecular Engineering.
Ken Visser, Clarkson University, Mechanical and Aeronautical Engineering.
Jenn Guelfo, Texas Tech University, Civil, Environmental, and Construction Engineering.

Keywords: PFAS, Recalcitrant, Ultrasound, Remediation, Horizontal Well, Sustainability.

Session 3, Environmental Science & Engineering Snell 112; 11:20 AM

# Design, Build, and Test of a Small-Scale Solid Fuel Rocket

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This project investigates the theoretical design and realistic performance of a small-scale solid fuel rocket. Often, rockets on this scale—impulse class G or lower—are built by trial and error rather than designed with rigorous scientific and engineering principles. For this project, a theoretical model is developed for the purpose of building small, inexpensive rockets from common items. This model is used to analyze a self-designed class G rocket in order to verify the model. Theoretical design uses the principles of thermodynamics and fluid mechanics to model the combustion of the fuel, flow of exhaust, and resulting net thrust of the rocket. An experimental rocket motor is made out of aluminum and PVC tubing that uses a solid propellant made from potassium nitrate and sucrose. Net thrust and internal chamber pressure are measured during a static test and checked against model results. Successes and flaws of the model are determined by comparing the design's predictions to the actual performance of the rocket.

Acknowledgements: Clarkson Honors Program

Mentor: Suresh Dhaniyala, Department of Mechanical & Aeronautical Engineering, Clarkson University

Keywords: Rocketry, Design, Experimental, Theoretical Model, Combustion

# Sexual Recidivism: Can Treatment Help Predict and Reduce the Probability of Reoffending?

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Being able to predict the chances of a sex offender reoffending (recidivism) is a major challenge for society and treatment programs. Not all sexual offenders are prone to reoffending; approximately 15-20% of sex offenders reoffend within 5 years of being released. That number increases slightly as the number of years following release increase. Identifying and understanding the risk factors leading to recidivism is also a major challenge. Risk factors are categorized into static risk factors (risks that will always exist regardless of treatment) and dynamic risk factors (risks that can be amended based on treatment). These risk factors vary based on the offender and their background. Treatment programs such as Sexual Offender Treatment Program at the St. Lawrence Psychiatric Center (SLPC) have classes in which help in identifying those risk factors, both dynamic and static, and work with the residents to either overcome or manage them. These classes include relapse prevention, SO Process, and arousal reconditioning. However, the effectiveness of the treatments varies from resident to resident based on a multitude of factors. In this presentation, I will take knowledge from past literature and apply it to my observations made at the Sexual Offender Treatment Program at SLPC.

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Mann, R. E., Hanson, R. K., & Thornton, D. (2010). Assessing Risk for Sexual Recidivism: Some Proposals on the Nature of Psychologically Meaningful Risk Factors. *Sexual Abuse: A Journal of Research and Treatment*,*22*, 191-217. doi:10.1177/1079063210366039

Acknowledgements: I would like to thank Dinghy Sharma, Chief Psychologist at Bridgeview, for her guidance and support through my experience at the St. Lawrence Psychiatric Center.

Mentor: Lisa Legault, Department of Psychology, Clarkson University

Keys Words: Sexual Offenses, Dynamic Risks Factors, Static Risk Factors, Sexual Recidivism

# Developmental regulation of immature intestinal stem cells by a group of novel secretory cells in larval zebrafish

**Jianlong Li[1], Margaret Dedloff[1], Katrina Stevens[1], Lea Maney[1], Morgan Prochaska[1], Cintia, Hongay[1] and Kenneth Wallace[1]**

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The intestinal epithelium has constant turnover throughout the life of the organ with apoptosis of cells at the tips of folds or villi releasing cells into the lumen. Due to constant turn-over, epithelial cells need to be constantly replaced. Epithelial cells are supplied by stem cell niches that form at the base of the interfold space (zebrafish) and crypts (avians and mammals). Within the adult stem cell niche of mammals, secretory cells such as Paneth and goblet cells play a role in modulation of proliferation and stem cell activity producing asymmetric divisions. Progeny of asymmetric divisions move up the fold or villi, giving rise to all of the epithelial cell types. Although much is known about function and organization of the adult intestinal stem cell niche, less is understood about development of the immature stem cell compartment. Following smooth muscle formation, the intestinal epithelium folds and proliferation becomes restricted to the interfold base. Symmetric divisions continue in the developing interfold niche until stem cell progeny begin asymmetric divisions, producing progeny that migrate up the developing folds during the third week post- embryogenesis (zebrafish) and postnataly (mammals). Regulation and organization of epithelial proliferation in the immature stem cell niche may be regulated by signals comparable to the adult niche. Here we identify a novel secretory cell subtype associated with the developing stem cell niche that plays a role in modulation of epithelial proliferation through repression of the main signaling pathway that drives proliferation during both embryogenesis and the post-embryonic period. We find that this secretory cell subtype represses both EGF and IGF signaling during the end of embryogenesis and Wnt signaling during the post-embryonic period.

Mentor: Ken Wallace, Department of Biology, Clarkson University

Key Words: zebrafish intestine; stem cell regulation; secretory cell; Wnt; EGF and IGF; proliferation

# Transcriptome and Proteome Analysis of Intervertebral Disc (IVD) Cells

**Kangning Li[1], Devin Kapper[2], Devika Channaveerappa[3], SumonaMondal[2], Costel Darie[3], Petra Kraus[1] and Thomas Lufkin[1]**

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Severe and chronic low back pain is often associated with intervertebral disc (IVD) degeneration, which severely impacts on the quality of life of patients and imposes a considerable socio-economic burden worldwide. Cell based regenerative medicine approaches have moved into clinical trials, yet IVD cell identities in the mature disc remain to be fully elucidated. Recently, we identified 10 novel biomarkers and demonstrated the heterogeneity in the outer annulus fibrosus (AF) and nucleus pulposus (NP) of the mature bovine coccygeal IVD, an accepted research model to study IVD mechano-biology and disc homeostasis, through RNA *in situ* hybridization (AP-RISH) and z-proportion test. Here we follow up on this data to visualize subcellular transcript location and to quantify mRNA transcript levels of these biomarkers by doing fluorescent RNA *in situ* hybridization (FL-RISH) and confocal microscopy. Lastly, we expand our research to investigate the proteomic profiles in the outer AF and NP. We identified 223 proteins in the outer AF and 135 proteins in the NP. Our work refines the molecular identity and deciphers the proteome of the outer AF and NP of the mature bovine coccygeal IVD, which can benefit the future regenerative medicine and tissue engineering strategies in human.

Acknowledgements: This work was supported by the Bayard and Virginia Clarkson Endowment to Thomas Lufkin.

Mentor: Thomas Lufkin, Department of Biology, Clarkson University

Keywords: Intervertebral Disc, Nucleus Pulposus, Annulus Fibrosus, Mass Spectrometry

# Multivariate study to determine the postural correlates of trait mental and physical energy and fatigue

**Dinushani Senarathna[1], Thevasha Sathiyakumar[1], Chelsea Yager[4], Phylicia Taladay[4], Runye Li[3], Shantanu Sur[5], Sumona Mondal[1], Ali Boolani[2]**

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Moods provide us with a complete conceptual scheme of understanding feelings. Trait moods are an individual's predisposition to a certain mood or feeling. Although many studies have examined trait depression, anxiety, and anger, the context of trait energy and fatigue remains less explored. This study operationalizes mental and physical forms of energy and fatigue as four separate mood traits and determines the relationship between postural control and these four distinct mood traits. We measured trait mental and physical energy and fatigue from a sample of N=130 subjects aged between 18-65 years who completed a series of self-reported surveys. For each subject, 33 different postural sway measures were assessed under four different test conditions, namely, eyes open/closed, feet apart, and standing on foam/firm surface. Assuming the normality of dependent variables from Large sample approximation theory, the multicollinearity is conducted to remove highly correlated variables. The multivariate multiple regression analysis is implemented to simultaneously test the associations between covariates and the model is further validated for statistical significance.

Acknowledgements: Authors would like to thank Seema Teymouri, Christina Vogel-Rosbrook, Julieth Alvarez, Maggie Stark and Giulia Mahoney for the help in the data collection process.

Mentors: Sumona Mondal, Department of Mathematics, Clarkson University
Ali Boolani, Department of Physical Therapy, Clarkson University

Keywords: Moods, Trait energy, Trait fatigue, Postural sway measure, Multicollinearity, Multivariate multiple regression

Poster #14, Biomedical Sciences Cheel Arena 12:30-2:00 PM

# Selective and Rapid Colorimetric Assay for the Detection of *E. coli* Using NPs-Aptamer Conjugate Probe

Steve Liebich, Fatima Mustafa, Silvana Andreescu

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Continuous interest in human health has driven the research and innovation towards rapid detection technology for pathogen and toxins. *E. coli* is considered one of the primary pathogens causing the majority of outbreaks in the United States. In spite of the sensitivity and reliability of conventional methods of detection, these methods are laborious and time consuming. In this work, we discuss the design of simple, rapid, nano-based biosensor for the detection of *E. coli*. Our assay is performed in a microplate by immobilizing amino modified aptamers as highly selective recognition elements towards *E. coli*. Bacteria are incubated, and sandwiched with a colorimetric probe containing redox NPs –aptamer conjugate. The detection mechanism is based on the oxidation of 3,3,5,5'- tetramethylbenzidine dye (TMB) by the probe. The colorimetric response of the assay is then measured and *E. coli* concentration is quantified.

Acknowledgements: This project is funded by NSF

Mentor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Biosensors, bacteria detection, colorimetric, nanoparticles, *E. coli*, aptamers.

# Financial mining and stock price prediction

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Thanks to the emerging techniques in recent decades, automated transaction has dominated the stock transaction market. More and more corporations utilize the so-called Artificial Intelligence to purchase and sell stocks with extremely high frequency. In order to understand the procedures under the hood, I collect multiple kinds of data from various sources around the world and use them to train a predictive model for predicting the closing prices of the following days. I plan to train my models with pandas, tensorflow and keras in python. I will primarily use Gated Recurrent Units (GRU) to learn the pattern hidden in the data. Also, in order to learn the decision pattern of my model, I will apply Local Interpretable Model-Agnostic Explanation framework to explain the decision strategy at a specific data point.

**Mentors**: Sumona Mondal, Department of Mathematics, Clarkson University

**Keywords**: Financial Mining, GRU, LSTM, LIME

# Video Podcast - Digital technology empowers foreign language acquisition to help learners build language skills and culture competency

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Language and digital technology are deeply linked together in a rapid evolution of communication technologies. Digital technology has enabled new forms of discourse, and new ways to create and participate in our communities. Today digital technology impacts language use, language pedagogy, language teaching, and language learning. My project is researching project-based learning and implementing lessons created by video podcast to learn and teach in the Chinese language classroom. I believe using the appropriate digital technology empowers foreign language acquisition to help learners build language skills and cultural competency. As an educator, I understand that I am a life-long learner who knows of how to use technology is necessary first step to develop effective technology-based learning activities for the classroom.

Acknowledgements: Director and staff at Department of Education, Capital Region Campus Clarkson University, Students of CHN 580, CHN 530 and Albany Chinese School for their support.

Mentor:Richard Lasselle , Department of Education, Clarkson University

Keywords: Digital technology, Video Podcast, Chinese, Foreign Language Classroom, pedagogy

# Public Education Expenditures, Taxation, and Growth: Evidence from U.S. States

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State governments in the U.S. have taken a prominent role in financing education. However, justifications for government involvement in financing education are varied, a common notion is that education expenditures are a key to sustained economic growth. Many papers in the growth literature have formalized a link between government education expenditures, human capital accumulation and long-run economic growth. While theory assigns expenditures a key role in growth, empirical support of the link is mixed. The disconnection between theory and data can be reconciled by taking a closer look at the theory. In nearly every model where growth is fueled by government education expenditures, a non-systematic relationship between expenditures and growth can arise. Spending increases growth while taxes may decrease growth, leaving the net effect ambiguous. We estimate a growth model for a panel data of 50 U.S states over the period 1963-2015, using revenue and expenditure data representing all levels of government. Using a structural vector autoregressive (VAR) estimation technique, we find a positive relationship between public education expenditures and long-run growth for U.S. states. The relationship holds only when controlling for taxation and thus emphasizes the importance of controlling for funding when considering the effect of expenditures.

Mentor: Bebonchu Atems

Key words: Economics, Education spending, SVAR, Honors Thesis, Taxation, Panel data

# Electronic Properties of Monoclinic $(In_xGa_{1-x})_2O_3$ Alloys by First-Principle

**Xiaoli Liu[1], and Chee-Keong Tan[1]**

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Gallium oxide semiconductor has drawn massive interests in recent years attributed to its extraordinary properties as an ultrawide bandgap semiconductor for high power electronics and deep ultraviolet photodetectors. Recent studies suggest the importance of gallium oxide-related compound materials for material design flexibility in device applications, but the literature is still highly limited at present. In this work, we report on the electronic properties of β-$(In_xGa_{1-x})_2O_3$ alloys with x up to 18.75% using Density Functional Theory (DFT) calculations. The effect of In-content on the band structures as well as the crystal structures of β-$(In_xGa_{1-x})_2O_3$ alloys is presented and discussed. Our analysis show that β-$(In_xGa_{1-x})_2O_3$ alloys exhibit indirect gap property, with the band gap reducing from 4.817 eV to 4.422 eV when the In-content increases up to 18.75%. The electron and heavy hole effective masses are obtained for the first time based on the band edge dispersions of the β-$(In_xGa_{1-x})_2O_3$ materials. Additionally, the effect of band parameters on the impact ionization processes using β-$(In_xGa_{1-x})_2O_3$ materials are analyzed. Our results indicate the potential for β-$(In_xGa_{1-x})_2O_3$ alloys to be implemented in the deep UV photodetector applications. The effect of In-content on the gallium oxide materials will be further discussed in detail.

Reference:
X.L. Liu and C.K. Tan, "Electronic properties of monoclinic $(In_xGa_{1-x})_2O_3$ Alloys by first-principle," AIP Advances, 9, 035318, 2019.

Acknowledgements: The authors acknowledge useful discussions with Ming-Cheng Cheng from Clarkson University.

Mentor: Chee-Keong Tan, Department of Electrical and Computer Engineering, Clarkson University,

Key words: First-principle, Band structure, $Ga_2O_3$, Indium gallium oxide, Effective mass, Ultraviolet

# Underwater Ranging and Imaging with Time-of-Flight Cameras

**Kevin Mack, Luke Rumbaugh, Mahesh K. Banavar**

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In addition to SONAR, the use of underwater optical sensors that can produce high resolution measurements at short range. In this work, we investigate the use of a modified Time of Flight (ToF) camera for use in an underwater environment. We benchmark the camera's ranging performance underwater with the infrared (IR) illuminators that come with the device. Since infrared radiation is absorbed by water, we then compare the performance of modulated blue/green illuminators to the original IR illuminator. The use of blue/green light results in better signal penetration and provides a performance advantage under water. Additionally, in underwater imaging, the signal is often dominated by backscatter. In an attempt to improve performance, signal processing algorithms are used to perform backscatter suppression and improve the effectiveness of the camera in the difficult underwater scenario.
Key Words: LIDAR, Backscatter, ToF, Infrared

Acknowledgement: This work is supported by the Office of Naval Research

Mentors: Luke Rumbaugh, Director of Underwater Lidar Lab, Department of Electrical and Computer Engineering, Clarkson University

Mahesh K. Banavar, Assistant Professor, Department of Electrical and Computer Engineering, Clarkson University

William Jemison, Professor, Department of Electrical and Computer Engineering, Clarkson University

# Treating Deviant Arousal - The Basics of Arousal Reconditioning

**Mackenzie Madison**

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How effective is arousal reconditioning for sex offenders? Arousal reconditioning can be defined as a behavioral technique that is used to lower the intensity of a conditioned sexual deviant stimulus and replace it with an appropriate stimulus. During my internship at a sex offender treatment program at St. Lawrence Psychiatric Center, I observed arousal reconditioning treatment for sex offenders. Arousal reconditioning is an important part of their treatment to help them function as a safe member of the community. There are three main aversives that are used, ammonia spray or pill, bitterroot, and thought diversion. The history behind these aversives goes back to the 1889 with Pavlov's theory of classical conditioning. The effectiveness of each aversive so far has shown to be effective but more research needs to be done. Within my internship, I was presented with an eye-opening experience and education on a population of the world that no one wants to speak of. During my presentation, I will include my personal observations regarding how sex offenders deal with their deviant stimuli and how adversives are used to treat their condition.

Acknowledgements: I would like to thank Dinghy Sharma, the lead psychologist at Bridgeview, for all the guidance she has given me.

Mentor: Lisa Legault, Department of Psychology, Clarkson University.

Keywords: St. Lawrence Psychiatric Center, Arousal Reconditioning, Classical Conditioning, Olfactory Conditioning, Sex Offenders, Treatment

# Testing for stress with Voice Assistants

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The purpose of this research is to detect stress from voice markers extracted from recordings using Google Home and Amazon Echo devices. This involves creating software that can record and save the voice data from these assistants and sending the audio through an algorithm that will determine whether or not the user is stressed. For both the Amazon Echo and Google Home devices, further development was required as the process for making an Echo application can only be made by using Amazon's AWS and Lambda services. The voice recorder is made in Python and the analysis algorithm is written in C++. New medical research has shown that certain diseases, such as Parkinson's disease, can be detected through changes in voice. This research can be used as a proof of concept. If we can successfully test for stress, then with an updated algorithm, we can test for other conditions. As of writing this no one has used voice assistants to analyze voice for stress or any other emotion, or to check for the early stages of diseases.

Mentor: Mahesh Banavar, Department of Electrical and Computer Engineering, Clarkson University

Keywords: Behavioral Biometric, Stress Detection

Acknowledgements: This work is supported in part by the NSF DUE award 1525224.

Poster #19, Signal Processing Cheel Arena, 12:30-2:00 PM

# Effects of Feelings of Fatigue and Energy on Gait

**Giulia Mahoney[1], Chris Towler[2], Ali Boolani[2]**

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The purpose of this study was to examine the associations between the temporal-spatial aspects of gait and feelings of energy and fatigue. Participants (N= 135) were given the Profile of Mood Survey (POMS) to measure feelings of energy and fatigue, and then completed a two-minute walk around a 6m track. Backwards linear regressions were used to determine the gait correlates of energy and fatigue. Feelings of fatigue were positively associated with increased hip circumduction, toe-off angle, rotation in the transverse plane, and movement in the coronal plane, while it was negatively associated with lower limb velocity, limb stance, arm swing velocity, sagittal plane range of motion, and lateral rotation of the lumbar spine. Fatigue also increased the turn angles, while decreasing turn velocity. Feelings of increased energy were positively associated with increased stride length, gate speed, acceleration, postural adjustment and gait asymmetry. It was negatively associated with stance time, lumbar sagittal range of motion, and arm range of motion. Our findings suggest that changes in feelings of energy and fatigue are associated with different aspects of temporal-spatial gait. Therefore, when assessing the determinates of gait, feelings of energy and fatigue should be considered.

Acknowledgements: We would like to thank Chelsea Yager, Phylicia Taladay, Seema Teymouri, Christina Vogel-Rosbrook, Maggie Stark and Julieth Alvarez with data collection

Mentor: Ali Boolani, Department of Physical Therapy, Clarkson University

Key Words: Gait, Fatigue, Energy,

# U.S. Carbon Tax Design: State Energy Profile, Household Income, and Urban/Rural Effects

**Charles Maitland[1], Stephen Bird[2]**

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Carbon taxes are gaining attention as an effective carbon pricing policy instrument that can reduce anthropogenic greenhouse gas emissions and reduce the threat of climate change. Designing an optimal carbon tax policy involves several considerations. The distribution of carbon tax revenue is arguably the most important aspect of an effective and feasible policy because voters are sensitive to the distributional impacts of economic policies. Revenue recycling methods can affect their perceived fairness of a policy. Three levels of revenue return policies, from no return to full return, were tested. However, other factors may have strong impacts. The nature of a given State's energy profile, urban or rural demographics, and income can all potentially affect the response to carbon taxes. We consider the social acceptability of carbon taxes by examining the degree of revenue return, and also the residential economic impact of each policy for household groups categorized by state, income, and residence in an urban or rural area. As other researchers have found, the results suggest that a revenue neutral policy that returns 100% of carbon tax revenue is the most socially acceptable, but it is important to break down the impacts by demographic subgroups.

Mentor: Stephen Bird, Department of Humanities and Social Sciences, Clarkson University

Keywords: Environmental Policy, Energy Policy, Climate Policy, Carbon Tax, Carbon Price, Climate Change

# Cerium Oxide Nanoparticle Synthesis, Characterization and Reactivity

**Austin Marshall[1], Abraham Samuel Finny[1], Nadia Cheng[2] and Silvana Andreescu[1]**

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Nanoparticles have emerged as a stable alternative to enzymes as the emerging antioxidant properties of certain types have come to light in the past several years. Cerium Oxide ($CeO_2$) nanoparticles (NPs) are employed as catalysts, abrasives and as therapeutics to fight infections. In biological systems, reactive oxygen species are formed during stress and can damage cellular functioning. $CeO_2$-NPs can be used as a probe for hydrogen peroxide. $CeO_2$-NPs react with hydrogen peroxide which leads to spectral changes as electrons from the outer edge of the particle are lost and a visible color change can be seen. The use of the spectral change is very important as it can be supplemented in place of enzymes when a specific ligand is attached to the NPs for detection of a specific chemical, just as enzyme oxidase biosensors operate. The important difference between $CeO_2$-NPs and oxidase biosensors is that the nanoparticles need no refrigeration or special handling, which is a tremendous advantage to this sensing method. The capability of a biosensor to be made from $CeO_2$-NPs is very likely because of the highly selective and reactive properties. This work discusses a specific method of synthesizing ultrafine cerium oxide nanoparticles and comparison of characterization to other synthesis methods.

Faculty Advisor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Mentor: Abraham Samuel Finny, PhD Student-BIOSEM Group, Clarkson University

Keywords: Biosensors, Cerium Oxide, Nanoparticles, Synthesis, Characterization, Reactivity

# Data-Centric Approach to Rheumatoid Arthritis (RA): Is Age a Confounding Factor for Some of the RA Comorbidities?

**Liam Martin[1], Grayden Shand[2], Sumona Mondal[1], Shantanu Sur[3]**

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Rheumatoid Arthritis (RA) is an autoimmune, inflammatory joint disease affecting approximately 1.5 million people in the US. A number of comorbidities are described for RA and understanding their interaction with RA is important to predict prognosis and therapeutic decision-making. In this work, we investigate how age may act as a confounding variable with respect to some of the currently reported comorbid associations. Using data from the National Health and Nutrition Examination Survey (NHANES) from 2007 to 2016, we are focusing on systolic hypertension and high body mass index (BMI), two common RA comorbidities. We are especially interested in deciphering how patient age might influence the strength of these associations since both RA and hypertension show an adult onset and the incidence increases with the population age. We are currently constructing a Randomized Block Design with control for age to evaluate whether hypertension and high BMI remain to be reliable predictors for RA as described in literature. Our results will help to provide a better insight on the role of age for the observed association between these comorbidities and RA.

Mentors: Shantanu Sur, Department of Biology, Clarkson University
Sumona Mondal, Department of Mathematics, Clarkson University

Keywords: Rheumatoid arthritis, comorbidities, Randomized Block Design, NHANES

Poster # 6, Biomedical Science Cheel Arena 12:30-2:00 PM

# Electrocatalytically Triggered DNA Release from a pH Switchable Modified Electrode

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Controlled DNA release bears significant applications in gene-delivery therapy, biosensors, biochips, and biocomputing. Among many methods of signal-controlled DNA release, electrocatalytically stimulated release has many benefits. This system offers control of the electrode-enzyme interface used for DNA release. Single stranded FITC-labeled DNA molecules were loaded onto pH switchable modified $SiO_2$ nanoparticles linked to a pencil graphite electrode that was functionalized with microperoxidase-11 (MP-11). The nanoparticles were modified with a linker, trigonelline hydrochloride, and 4-carboxyphenyl boronic acid. Trigonelline hydrochloride remains in a protonated state, used to electrostatically attract DNA molecules. By applying electrolysis to the electrode in the presence of hydrogen peroxide, the MP-11 is activated, consuming protons from the hydrogen peroxide, catalyzing the local pH shift at the electrode surface. The increase in pH causes 4-carboxyphenylboronic acid to deprotonate and switch from neutral to negative charge, electrostatically repelling DNA from the nanoparticles into solution. The fluorescence in solution was measured to determine DNA concentration.

Mentor: Evgeny Katz, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: DNA release, modified electrode, pH change, electrochemical signal, redox enzyme

# Notch receptors involved in choice between intestinal epithelial enterocytes or secretory cells.

**Lilianna Mason**[1], **Cass Orr**[1], **Morgan Prochaska**[1], **Kenneth Wallace**[1]

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Previously, we have found that cells in the embryonic zebrafish intestinal epithelium undergo a period of binary choice between enterocytes or secretory cells. As with mammals, we have found that the choice is initiated by expression of an increased achaete-scute like transcription factor, *ascl1a* beginning at 44 hpf. High levels of *ascl1a* initiate the secretory cell fate and appear to induce expression of the Notch ligand *deltaD* beginning at 50 hpf within developing secretory cells. Notch receptor activation between 64 to 74 hpf in surrounding cells appears to signal the enterocyte fate. Here we begin to investigate which of the four zebrafish Notch receptors are involved in signaling to distinguish between secretory or enterocyte development.

Mentor: Kenneth Wallace, Department of Biology, Clarkson University

Keywords: Zebrafish, Mutant, Notch, Intestine, *ascl1a*, Enterocyte, Secretory

# Experimental Evolution of *Pseudomonas fluorescens* in a Heterogeneous Environment

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Experimental evolution allows researchers to observe populations under laboratory-imposed conditions to draw conclusions about evolutionary processes. A drawback of experimental evolution, however, is that the oversimplification of lab environments leads to results that may not be accurate in the field. For example, evolving populations in the natural world may adapt to new environments through increased efficiency in both locating and consuming resources. Conversely, evolution experiments are often conducted in homogeneous environments with evenly distributed resources, so dispersal is unlikely to contribute to adaptive evolution. To more accurately model real-life evolutionary processes, this study examines an experimental environment in which dispersal has the potential to play a role. Replicate populations of *Pseudomonas fluorescens*— 12 in liquid media (M9 salts + xylose) and 12 in semi-soft agar (M9 salts + xylose + 0.2% agar)— evolved for four weeks. Populations evolved in liquid were expected to lose their ability to disperse, a trait unnecessary and metabolically expensive in their environment. In semi-soft agar, however, populations were expected to retain or improve their dispersal abilities, making them comparatively more fit. By contrasting fitness of evolved populations with that of their ancestors through a series of competition assays, we observe how heterogeneity can shape evolution.

Mentor: Susan Bailey, Department of Biology, Clarkson University

Keywords: *Pseudomonas fluorescens*, heterogeneous environment, experimental evolution

# Dynamic Covalent Exchange in Polyanhydrides

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In recent years, shape memory polymers have become increasingly popular, due to their ease of fabrication, low production cost, relatively low density, and high recovery of a permanent shape.[1] We are looking to demonstrate the shape memory characteristics of degradable polyanhydrides when heated above and then cooled below their $T_m$ (crystalline melt temperature). Preliminary work has shown that polyanhydride-poly(-caprolactone) composites are capable of exhibiting shape memory properties.[2] However, the shape memory was complicated by the exchange that the anhydride groups undergo at temperatures above ~ 60ºC which relieves stress in the polymer, causing poor shape recovery. This was overcome by using polymers with $T_m$ ~30-40ºC. Furthermore, at elevated temperatures this exchange process can lead to new permanent shapes because of the anhydride exchange. In the present work, we are looking to create all-anhydride polymers made using a monomer combination that also has low $T_m$ values to form a polymer that will successfully exhibit shape memory behavior. Additionally, at temperatures of 80-90ºC, we expect the exchange to occur quickly, which will allow for self-healing to occur. Stress relaxation in polymers with various monomer compositions will be measured to determine temperature ranges that can be used for either shape memory or self-healing.

Acknowledgements: The authors would like to thank the Clarkson University Honors Program and Corning, Inc. for supporting this research.

Mentor: Kelly Tillman, Department of Chemistry and Biomolecular Science, Clarkson University

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Keywords: polymers, polyanhydrides, self-healing, shape memory

# Advances in Control of Civil Structures

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Improvements in the design and function of structural systems is necessary given the poor state of national infrastructure. Semi-active damping devices offer benefits over current technologies, resulting in longer lasting and safer structures. Unfortunately, these devices have had a slow adoption rate and are not well understood in common design scenarios. This paper seeks to report potential improvements to the computations necessitated by these devices and showcase augmentation through damping in tall building design. First, Chebfun, a MATLAB toolbox, was cleverly used to yield better accuracy and computation speed when solving increasingly complex structural systems. Chebfun utilizes the ability of approximating smooth functions by Chebyshev polynomials, or chebfunctions. Chebfunctions can approximate smooth functions with error to numerical precision of $10^{-16}$, potentially offering the speed of a numeric solution and the accuracy of a symbolic solution. Second, the effects of installing a semi-active device in a rigid connection between two typical high-rise buildings were demonstrated using SAP2000, a 3-D modeling and finite element analysis software package. Through modeling, a better understanding of how semi-active devices affect the structural dynamics of tall buildings was attained. Ultimately, this research aids in the advancement of semi-active devices by both optimizing and better characterizing their wide range of uses.

Mentor: S.F. Wojtkiewicz, Department of Civil Engineering, Clarkson University

Keywords: Hazard Mitigation, Semi-active Damper, Control, Modeling, Chebfun, Skybridges

# Domain dependent risky decision processes

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This study explored the relationship between monetary rewards of modern life and the willingness to take risks across a set of evolutionary domains. The domains involved within-group competition, between-group competition, environmental exploration, status/power, parental investment, kinship, food selection, food acquisition, mate attraction, and mate retention. A sample of 112 participants judged their inclination towards, the benefits, and costs of behaviors like "pay one month's worth of your sibling's living costs so that he/she can concentrate on an academic achievement" (kinship domain). Actual, objective data about the current expected monetary consequences of those behaviors were obtained from statistical databases in the United States. Results show that participants' subjective benefits associated with engaging in risky behaviors across domains do not follow the modern-day monetary costs associated with the different behaviors across the evolutionary domains. Rather, risk taking is biased. Also, the perceived benefit of taking a risk, rather than its costs, is related to domain-specific risk taking. Respondents' inclination to engage in risky behavior risks correlated highly with previously-established domain differences in risk propensities as measured using the Evolutionary Risk Scale. This suggests that domain-differences in human risk seeking can only insufficiently be explained by differences in the monetary rewards across domains.

Mentors: Jana Jarecki, Andreas Wilke

Key Words: Risk propensity, Decision making, Behaviors, Evolution, Survey, Costs

# Paper-based colorimetric biosensor and application in food freshness and smart packaging

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Food safety monitoring has become necessary as foodborne diseases are increasing. Work to develop smart sensors and labels to indicate food spoilage or presence of harmful toxins is growing. This presentation will discuss design, development and application of a portable biosensor platform that integrates functional nanoparticles and biomolecules on paper for monitoring food quality and safety. To fabricate the biosensors, we use nanoparticles that have tunable redox activity, optical and catalytic properties and can transduce and catalytically amplify signals in chemical and biological detection schemes involving biomolecules. The presentation will discuss the assembly of nanoparticles and target-specific biomolecules in portable sensing platforms and provide examples of applications for food quality monitoring.

Acknowledgements: This project is funded by NSF, project No. 1561491.

Mentor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Biosensors, Food Safety.

Poster # 67, Chemical Sensors Cheel Arena, 12:30-2:00 PM

# Modeling Pressurization During Intradiscal Injection

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Intervertebral disc degeneration is a leading cause of low back pain, which is the single most expensive health care issue in the United States. As the disc is largely avascular, intradiscal needle injection is the most practical method for delivery of therapeutic agents used in treatments for such disease. Initial injection of fluid results in an increase in intradiscal pressure followed by a gradual decay as the injectate spreads throughout the tissue. Retraction of needle before the intradiscal pressure falls below a threshold will result in leakage, decreasing the efficiency of treatment. My work focuses on analyzing and modeling pressurization during the injection. Our most recent analytical model fits the experimental data excellently. It is a nonlinear differential equation describing fluid pressure inside the disc with nonlinear stiffness and permeable outflow. According to both the experimental data and our analytical model, the slow rate of depressurization following injection suggest high possibility of leakage after needle retraction. The post-injection recovery time required to prevent leakage is too long and thus, leakage is inevitable unless a better injection protocol can be developed.

Mentor: Arthur Michalek, Department of Mechanical Engineering, Clarkson University, 13699

Keywords: degenerative disc therapy, drug delivery, analytical modeling

# The Value of Actual Occupancy Schedules for Building Energy Simulation in Student Housing

**Leila Nikdel[1], Susan E. Powers[1], Alan Schay[2], Daqing Hou[2]**

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Building energy simulation tools use default occupancy schedules to predict energy savings and evaluate efficiency strategies. The objective of this study is to estimate uncertainties in building energy modeling results due to variable occupancy schedules among types of residents (university students vs. traditional residents). To derive an accurate occupancy schedule for students living in university housing, a geo-fencing app was designed and installed on the phones of 41 residents. Students' entering (or exiting) activity were tracked minute by minute over one semester. Individual occupancy schedules were created and random sets were combined to quantify the average minutes per day that 3 to 6-person apartments were unoccupied. Default ASHRAE occupancy schedule values overestimated unoccupied times in three-person apartments (default – 480 mins/ actual – 223 mins). With more than 3 residents, the default values underestimated unoccupied times (default – 0 mins/ actual – 193 to 40 minutes for 4 and 6-person apartments). An occupancy-based control system for HVAC system was tested in a multi-family building model provided by PNNL applying both the actual and default ASHRAE occupancy schedules in six climate zones (assuming 4 residents in each unit). The differences in energy consumption results for heating, cooling, and ventilation are 0.8-2.4%, 0.9-4.4%, and 8.1-18.8% respectively.

Mentors:

Susan Powers, Institute for a Sustainable Environment, Clarkson University

Daqing Hou, Department of Electrical and Computer Engineering, Clarkson University

Keywords: Occupancy Schedule, Building Energy Simulation, Student Housing, HVAC System, Geo-fencing, EnergyPlus

Poster #57, Mathematical Models and Simulations, Cheel Arena, 12:30-2:00 PM

# Fabrication of Alginate Hydrogel Coatings on Enzyme-Functionalized Electrodes

**Seamus Ober[1] and Artem Melman[2]**

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Biofouling resulting from cell adhesion to enzyme-functionalized sensor electrodes degrades sensor performance and longevity [1]. Alginate, a biocompatible polysaccharide, may be cross-linked by trivalent metal cations to yield a hydrogel which is known to inhibit cell adhesion [2]. In this work, we investigate the potential of alginate hydrogel as an antifouling material to improve the lifetime and performance of enzyme-functionalized electrodes in biosensors. We study the effect of thin alginate hydrogel coatings on the enzyme activity of enzyme-functionalized electrodes as an indicator of its effect on biosensor sensitivity. Using UV spectroscopic and electrochemical characterization, we examine the enzymatic activity of GDH-functionalized electrodes with thin electrodeposited alginate hydrogel coatings. The effect of the alginate coating thickness (measured using fluorimetry) on the enzymatic response is also studied.

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Key Words: Electrochemistry, Alginate, Cell Adhesion, Biosensing, Biofouling

# Teamwork in Chinese exam will make students achieve more

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Mandarin is a language that students sometimes may feel it is very difficult to learn. I want to change this situation by testing students in groups.

Some students perhaps will stay away from Mandarin even they are interested in. I believe the Mandarin exam is one of the factor that has a influence on students' opinion. Under this situation, I think arrange students to have exams in groups will help to build up their learning confident and change their opinion.

After searching and reading some valuable articles, I found students who have exams in groups will not only have better grades, but also have better communication and teamwork skill. Also, some students may have test anxiety, which may influence their examination status. So in my perspective, testing students in groups will help solve these problems.

I think students taking exams in groups will both help them get higher grades and build up their learning confident. By using this method I believe more and more students will change their opinion about learning Mandarin and will choose to learn Mandarin if they have interests on it.

Mentors: Sherri Duan, Department of Mandarin, Clarkson Universtiy
Richard Lasselle, MAT, Clarkson University

Key Words: Mandarin, teamwork, group test, learning Mandarin attitude, future work of students, examination anxiety

# Schizophrenia: An Alternate Version of "Our" Reality

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Schizophrenia is a chronic and severe mental disorder that affects how a person thinks, feels, and behaves. People with schizophrenia often feel they have lost touch with reality, but what is reality? A straight answer is everything that appears to our five senses – everything that we can see, hear, etc. Yet this ignores such entities as electrons, the recession and the number 7, which we cannot sense but which are very real. Reality is something that is agreed upon amongst the "normal" population. What about the experiences that appear to one's senses that do not appear to anyone else's? In a way, people with schizophrenia are not disconnected from reality, but rather they experience their own. Rather than label these people with a list of symptoms, treatment should focus on understanding sensory experiences and what they mean to the individual. Phenomenology is the study of "phenomena": things as they appear in our experience, thus the meanings that they have. This presentation focuses on understanding schizophrenia in a psychiatric hospital setting with a phenomenological approach. Using my own observations of schizophrenic residents from the St. Lawrence Psychiatric Center, I will also highlight effective treatment and suggest possible phenomenological – based treatment methods.

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Acknowledgements:

I would like to thank Cheryl Countryman for her guidance and assistance for the duration of my professional experience at the St. Lawrence Psychiatric Center. I would also like to thank Elizabeth Pienkos, Clarkson University, for her helpfulness and advising with this presentation.

Mentor: Lisa Legault, Department of Psychology, Clarkson University

Keywords: Schizophrenia, Psychology, Phenomenology, Mental Health

# The Impact of Long-Range Financial Planning on Demand Management in the Pharmaceutical Industry

**Hannah Phillips**

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This research examines historical Long-Range Financial Plans (LRFP) from a pharmaceutical company to determine the accuracy of the forecasts, identify forecasting trends, areas for improvement, and create recommendations. The research focuses on a demand management (DM) perspective to establish the current state of LRFP accuracy. Additionally, this research establishes ways LRFP can be advanced to increase the accuracy of demand forecasting. Accuracy in demand forecasts is crucial because DM ensures customer demand is met. Context for this research in the pharmaceutical industry and supply chain management is established in order to highlight the importance of long-range forecasting in pharmaceuticals and the challenges associated. The data analysis compares the historical LRFPs to actual sales and analyzes the results to identify trends based on seven categories. The most important results from this analysis are: forecasts are more accurate on an aggregate level, the Branded Trade brands have the most accurate forecasts, the Delisting and Established Brands categories have the least accurate forecast. Based on these results, the key recommendations are: involve DM earlier in the LRFP process, focus on the first three years of the forecast, implement statistical models to enhance the forecasting process, and increase supply chain flexibility.

Acknowledgements: I would like to express my gratitude to Farzad Mahmoodi for his support and guidance in the thesis writing process. I am also thankful to my supervisor at Company X who was a great supporter and advocate.

Mentor: Farzad Mahmoodi

Key Words: Pharmaceuticals, Demand Management, Supply Chain Management, Forecasting, Long-Range Forecasting, Demand Forecasting

# Iridescent: A Novel

**Danielle Piontkowski**

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Nate is at the peak of his life; he's a regular player on his university's volleyball team, has a steady relationship with a girl who he believes could be his soulmate, and is friends with a group of guys who – like himself – work hard on the weekdays so they can enjoy the social aspect of college at its maximum on the weekends. He constantly feels as though he's on top of the world – and, if this is the precursor to the rest of his life, he's thrilled for what every day has in store. However, when his best friend Brandon attempts to take his own life, Nate suddenly begins to question everything he thought he knew about his friend, his peers, and even himself. With his previous views shaken, Nate is forced to consider his own actions and behaviours as he struggles to understand the reasons behind Brandon's attempted suicide.

Follow Nate's journey of self-discovery as he comes to understand just how multifaceted depression is and begins to realize the impact that seemingly trivial behaviours can have on an individual struggling with mental illness.

Acknowledgements: Acknowledgments go to the Clarkson University Honors Program for sponsoring this project, as well as Stephen Casper of Clarkson University and Brian Hauser of Clarkson University for providing feedback and advice during the revision phase of this project.

Mentor: Lisa Propst, Department of Humanities and Social Sciences

Keywords: Literature, Fiction, Mental Health, Depression, Coming-of-Age, Creative Writing

# Growth and Organization of the Post-Embryonic Zebrafish Intestine

**Morgan Prochaska[1], Jianlong Li[1], Kenneth N. Wallace[1]**

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Post-embryonic maturation of vertebrate intestines involves substantial growth and changes in epithelial proliferation patterns. General patterns of zebrafish intestine maturation have been described but additional details of epithelial development are needed. The zebrafish intestine has the same general organization as mammalian and avian intestines with stem cells niches at the base of folds or villi. From the stem cell niche, progeny migrate up the folds, differentiate into all epithelial cell types and undergoing apoptosis at the tips, making it a useful model for intestinal development. Here we demonstrate a two-step maturation of the intestine during the 4 weeks of post-embryonic development to the juvenile form. The first two weeks (6 to 19 dpf), are characterized slow growth of the length of the intestine and symmetric cell divisions where proliferating cells remain at the interfold base. The second two weeks, (20 to 33 dpf), are characterized by the switch of developing stem cells to asymmetric cell divisions and migration of progeny cells from the interfold base up intestinal folds. Apoptosis is observed at fold tips by the end of the fourth week at 33dpf. Secretory cells increase in number and interdigitate the proliferative cells at interfold bases to increase in numbers during the third and fourth weeks. This work provides a basis for understanding when and where changes occur in the developing intestine, suggesting timing for when signaling pathways will act to alter development and proliferation patterns in the vertebrate intestinal epithelium.

Mentor: Dr Kenneth Wallace, Department of Biology, Clarkson University

Keywords: Development, Intestine, Proliferation, Secretory cells

# Use of Cardiac Radar for Biometric identification

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**Abstract:** Most biometric technology requires a specific gesture, e.g. placing of fingerprint or placing a device in front of a face. There is a desire for authentication which does not require a specific gesture, and which continually authenticates an individual to promote further security and reduce risks associated with insider threat. The purpose of this work is to evaluate the use of radar to capture the cardiac signature for biometric recognition purposes. The data for this study is acquired by a 2.4 GHz radar system from the human subjects. Monostatic (where same antenna is used to transmit and receive data) radar system is being evaluated. After Collection, data was pre-processed in different steps to obtain cardiac signal. Our aim is to prepare a feature set from the cardiac radar data (E.g. Spectrogram and/or Wavelet transform) that could be fed into deep neural network for identification purposes. This set up has potential to replace contact-based Electrocardiogram (ECG) system to measure electrical heart activity.

Acknowledgement: Coulter, CITeR

Mentor: Stephanie Schuckers, Department of Electrical and Computer Science Engineering, Clarkson University

Keywords: Cardiac, Biometrics, Filters, Signal Processing, RADAR

# Rational Design and Synthesis of a Rigid Zwitterionic Ligand and Discrete Complexes to Access Novel Zwitterionic Metal-Organic Frameworks

**Sam Pyser[1], John Hadynski[1], Mario Wriedt[1]**

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Metal-organic frameworks (MOFs) are crystalline porous materials composed of metal clusters or ions connected by polytopic organic linkers. These materials have high surface areas and large pore volumes and can be fine-tuned to selectively capture guest molecules. The incorporation of zwitterionic ligands in MOFs can introduce charged organic surfaces in their cavities leading to intermolecular electrostatic fields to polarize guest-molecules. This work entails a reaction route to synthesize a new rigid zwitterionic ligand by modifying 3,5-diaminobenzoic acid as well as two discrete complex precursors to novel zwitterionic MOFs. Subsequent systematic investigations have also been proposed to further synthesize novel zwitterionic MOFs in order to study gas adsorption as well as structure-property relationships to expand the understanding of materials chemistry in relation to real-life applications.

Mentor: Mario Wriedt, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Metal-Organic Framework, MOF, Zwitterionic, Carbon Capture, Organic Synthesis

# Differentiating Instruction in Technology Education Classroom

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Different pedagogical approaches have been practiced and studied to improve efficiencies of students to meet these current day standardized testing scenarios, but the research is limited to traditional teaching methodologies. Differentiating instruction is one such methodology which is used by teachers to satisfy various needs of individual students as well as give them an opportunity to meet expectations and objectives which are set by standardized tests. Differentiation has always been a tricky thing for me as a teacher to achieve, in my Elementary School Technology Education classes, the focus was always Project Based Learning, and a lot has not been written on the topic on how to differentiate in a classroom which heavily focuses on project based learning. This curriculum project aims to study and analyze various research which are done on differentiating instruction, It compares how research is done in the fields of science and math as they are inter-related with technology education. It aims to find a pattern in between those methodologies and translate it to my pedagogy of Technology Education.

Acknowledgement: Director and Staff at Department of Education, Capital Region Campus, Clarkson University for their support in logistics. Students of TECH 580 - M.A.T. Project for their help in proofreading and support.

Mentor: Richard Lasselle, Department of Education, CRC, Clarkson University.

Keywords: Differentiation, Instruction, Technology Education, Classroom, Project Based Learning.

# Temporal Evolution of Cervical Cancer Cell Dynamics In Culture

**Morgan Reynolds[1,2], Alfred Worrad[3], Marko Budišić[4], Shantanu Sur[1]**

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Cellular motility plays a key role in many biological processes such as development, wound healing, and cancer invasion. However, it is extremely challenging to study the cellular processes and interactions that drive this characteristic movement in vivo. Cell culture offers a simple, controllable experimental model to understand certain aspects of individual and collective cell dynamics. Here we aim to investigate the temporal course of cervical cancer cell dynamics and aggregation in culture. Cells were first stained with a fluorescent dye, followed by time-lapse imaging over extended periods, and then tracked using TrackMate plugin in ImageJ software to analyze their spatial location, velocity, and total traveled distance. To increase the robustness of our analysis, we are currently developing methods to track cells from a large area by stitching multiple neighboring imaging fields. Additionally, we are optimizing our fluorescent labeling and image acquisition technique to minimize the phototoxicity to cells. Finally, the experimental data is being used to construct a Vicsek model, which would provide us the information regarding cellular interactions with neighboring cells. Our study will help us to better understand the nature of short and long-range interactions of cervical cancer cells developed over an extended period of culture.

Mentors: Shantanu Sur, Department of Biology, Clarkson University
Marko Budišić, Department of Mathematics, Clarkson University

Keywords: Cell behaviour, cell tracking, Vicsek model, population modeling, topology, topological modeling

# Physiological effects of hyperosmotic stress on the freshwater gastropod, *Planorbis planorbis*

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In this research project the fitness of the gastropod species *Planorbis planorbis* was tested in a series of salinity gradients. The purpose of this project is to determine the hyperosmotic limits of the freshwater snail, *Planorbis planorbis*. Our first step in studying these snails was determining the LC-50 in terms of salinity concentrations. This was carried out over a series of experimental salt concentrations [0 g/L, 0.5g/L, 1g/L, 2.5g/L, 5g/L, 10g/L, 12g/L, 14.5g/L, 17g/L, 20g/L]. A long-term experimental phase was initiated for 15 days where snails were subjected to two salinity treatments under the 50% mortality dosage established [3g/L and 6g/L].We placed ten snails in each tank and measured their change in lengths (growth rate) and weight (in air) for fifteen days. To mimic a predation event, we chipped the shell of the two largest snails in each tank to determine if salinity had an effect on shell regeneration time. This data on mortality, and changes in shell length and weight along with shell regeneration times will provide insights into the hyperosmotic limits of *Planorbis planorbis.*

Mentor: Andrew David, Department of Biology, Clarkson University

Keywords: Molluscs, Salinity, 50% Lethal Concentration

Poster# 49, Evolutionary Biology Cheel Arena 12:30-2:00 PM

# Gait and Posture Association with Trait Moods: Energy and Fatigue

**Brandon Robertson[1], Stephen Lewis[1], Aishwarya Vashishtha[1], Chelsea Yager[2], Phylicia Taladay[2], Sumona Mondal[3], Ali Boolani[4],**

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**Background**: Studies have typically explored state moods, rather than the stable trait qualities, and their associations with gait. Fatigue and energy as enduring properties are assumed to be factors in gait and posture.
**Objective**: The purpose of this study was to explore the associations between trait physical energy, trait physical fatigue, trait mental energy, trait mental fatigue, and gait among people between the ages of 18-69.
**Methods**: Participants (N=126) were recruited from a small town in northern New York. Surveys assessing trait moods were completed after the completion of a 2-minute walk around a 6m track. Inferring normality of dependent variables by Large Sample Approximation theory, highly correlated variables were removed through multicollinearity tests. A Chronbach's alpha test was used to check for internal reliability of the trait measures. Multivariate multiple linear regression models were conducted using R Studio 3.3 and multivariate linear regression was found through the pandas module in Python 3.
**Results**: From the regression analysis, it was found that the factor with the highest effect on Trait Physical Energy was Trait Physical Full of Pep, with a contribution of 73.4% of the variance. Likewise, Trait Physical Exhausted accounted for 82.9% of the variance in Trait Physical Fatigue, as Trait Mental Full of Pep was responsible for 75.4% of the variance in Trait Mental Energy. Lastly, Trait Physical Worn out contributed to an 85.7% variance in regard to Trait Mental Fatigue.

**Mentors**: Sumona Mondal, Department of Mathematics, Clarkson University
Ali Boolani, Department of Physical Therapy, Clarkson University

**Acknowledgements**: Authors would like to thank Seema Teymouri, Christina Vogel-Rosbrook, Julieth Alvarez, Maggie Stark and Giulia Mahoney for the help in the data collection process.

**Keywords**: Gait, Posture, Trait Mood, Fatigue, Energy

# Predictors of Cardiac Health and Diseases

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According to the Centers of Disease Control, heart disease is responsible for 610,000 deaths in the USA every year. To put things into perspective cardiovascular diseases accounts for 1 in every 4 deaths. Many medical conditions like high levels of cholesterol, high blood pressure, and diabetes is are some of the significant risk factors that have been known to put people at a higher risk of being affected by heart disease. Publicly available data on potential risk factors for heart disease have been analyzed on 14 attributes of heart disease to predict cardiovascular events or find indicators of heart health.

Mentor: Jane E. Oppenlander, Assistant Professor of Operations & Information Systems, David D. Reh School of Business

Keywords: Cardiac Health, Multivariate Data Analysis, Heart Disease, Epidemiology, Logistic Regression, Indicators of health

# Impact of Body Image Messages on Women's Body Satisfaction and Self-Esteem

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Media and advertising push the concept of the 'thin ideal' – creating unrealistic definitions of beautiful bodies. Past research suggests that this type of messaging has a deleterious impact on women by making them feel like they must look a specific way to be considered beautiful [2]. As a result of this pressure, women experience losses to their perceived body image and self-esteem [1]. The purpose of this experiment is to provide a solution to these toxic forms of media by exploring whether body-image messages can be framed positively so as to promote body satisfaction. Using a broad theoretical framework designed to optimize motivation and health (Deci & Ryan, 2002), we developed four distinct body-related media messages designed to target four different types of body-focused motivation. One hundred and twenty women aged 18 to 21 were exposed at random to one of the four messages (i.e., self-acceptance; other-acceptance; conditional acceptance; and the typical thin ideal). After viewing the message, body satisfaction and self-esteem were measured. Data will be analyzed to determine the effect of each type of message on body satisfaction and self-esteem, with the aim of bolstering women's health and also providing useful positive marketing strategies.

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Mentor: Lisa Legault, Department of Psychology, Clarkson University

Keywords: Women, Body Image, Self-Esteem, Eating Disorders

# A comparative study of cardiac rotor core estimation algorithms for AFib Ablation

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The irregular heartbeat at the root of AFib has been observed as reentrant rhythms induced by spiral waves. Spiral waves are of two types: rotors and multiple waves. Eliminating the center of the rotor or wave core using treatments such as ablation therapy has been shown [4] to be effective in treating AFib. This work presents four algorithms that analyze and identify the source of the atrial fibrillation (AFib) for two different classes of spiral waves. Using sensors at known locations on the surface of the heart, the sensors record the times which the spiral wave passes them. With these data, the first algorithm uses concepts from rotational dynamics and node localization, while the second algorithm relies on the geometry of the sensor placement, in order to estimate the center of the rotor. The third algorithm uses angle properties to estimate the rotor core. In the fourth case, estimated time difference measurements are used to estimate the spiral wave core in the simulated Fitzhugh-Nagumo based heart model using a modified time difference of arrival (TDOA) algorithm. All the algorithms are validated using simulations and their performance is evaluated and compared.

Mentors: Mahesh K. Banavar, Department of Electrical and Computer Engineering, Clarkson University, and Jie Sun, Department of Mathematics, Department of Physics,Clarkson University.

*Index Terms: Localization, FitzHugh-Nagumo, atrial fibrillation, rotors, UNLOC, TDOA.*

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# Olympics Luge Computational Fluid Dynamics

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The oral presentation will cover the research on the aerodynamic optimization of the Olympics luge rider-sled system. The system was studied under realistic race speeds; approximately 67 mph, or 30 m/s. The assembly details of the working model will be illustrated. The model was constructed from a separate sled model developed by Brian Heckendorf, and the human rider CAD model developed by Alessandro Lai. Ultimately, the optimal orientation of the rider was to be determined so that the drag force on the system is minimized to maximize the speed of the system to gain an edge on other riders in a race. ANSYS Fluent was used with the Spalart-Almaras turbulence model to perform simulations on the sled-rider model. The validation for the work will be presented using the example of the boundary layer flow over a flat plate. The optimal orientation was based on the lowest drag coefficient. This orientation could not be determined as the statistical error was about as large as the numerical error in the data, and as conclusion could not be drawn. The only certain conclusion was that the approximate area drag coefficient on the Luge is about 0.022.

# Electroanalytical Evaluation of Lithium Iron Phosphate as a Cathode Material by Galvanostatic and Cyclic Voltammetric Methods

**David R. Santefort**[1], **Cody A. Johnson**[1], **Shen Wei**[1], **M. C. Turk**[1], **and Dipankar Roy**[1]

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Previous studies have utilized electroanalytical techniques to assess liquid electrolytes for Li-Ion batteries (LIBs) using various combinations of carbonate solvents with lithium salts. From the results of these studies, one solvent combination in particular, ethylene carbonate (EC) and ethyl methyl carbonate (EMC), can be identified as useful for further studies involving anode and cathode materials. This work aims to characterize lithium iron phosphate (LFP) as an active cathode material to be used with this simple electrolyte composed of a 1:3.5 ratio of EC and EMC, with 0.1 M lithium perchlorate ($LiClO_4$) salt. A quantitative evaluation of this electrolyte-LFP half-cell is obtained in a three-electrode cell configuration by following a diagnostic approach using galvanostatic cycling (GC), slow scan cyclic voltammetry (SSCV), and Ragone analysis, coupled with scanning electron microscopy (SEM). All measurements are analyzed in the context of forming the solid electrolyte interphase (SEI), a passivation layer consisting of decomposed electrolyte on the electrode surface that helps to facilitate the transport of $Li^+$ ions. Results of this work demonstrate the usefulness of electroanalytical techniques for analyzing cathode and anode LIB materials, particularly in the context of SEI formation, laying a pathway for future characterizations of these materials.

Acknowledgements: David Santefort gratefully acknowledges his graduate assistantship from the Clarkson University Physics Department that made this work possible.

Mentors: Dipankar Roy, Department of Physics, Clarkson University

Key Words: Lithium Ion Batteries, Electroanalysis, Lithium Iron Phosphate, solid electrolyte interphase, Galvanostatic Charge/Discharge, Cyclic Voltammetry

# Lanthanide-based Porous Sorbent for the Efficient Uptake of Phosphate from Water

**Jeremy Secora, Mohamed H. Hassan, Silvana Andreescu**

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Phosphate-based fertilizers are in widespread use around the world to increase agricultural yields in areas that would otherwise be unable to sustain substantial growth. With the amount of phosphate being added to soils, it is no surprise that much of the phosphate not utilized by plants is leeched out of the soil and accumulates in waterways; called eutrophication. With so much phosphate in the water, harmful plants and algae can suddenly grow much faster, leading to algal blooms and potential ecological harm. To mitigate eutrophication caused by runoff, smart sorbent materials are being developed in order to remove phosphate from water bodies. Among these materials, a lanthanide-based porous material was selected due to its exceptional stability, high surface area, microporous structure and its exceptional ability to remove phosphates from water. The material was synthesized and well-characterized where its adsorption kinetics and isotherms indicate the remarkable adsorption capacities over the current state-of-the-art porous materials. The interaction of phosphate with the metal oxide nodes was investigated and is considered the main key factor for the uptake. The phosphate ion selectivity and the material's regeneration ability were also investigated. These results suggest the use of this material as a highly effective and durable material that can participate in solving the problem of eutrophication.

Mentor: Mohamed H. Hassan, PhD student, Department of Chemistry and Biomolecular Science, Clarkson University

Faculty advisor: Silvana Andreescu, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Porous materials, Lanthanide, sorbent, Phosphate, eutrophication

# Data-Centric Approach to Rheumatoid Arthritis (RA): How Interactions Between Comorbidities Influence RA Incidence

**Grayden Shand[1], Daniel Fuller[2], Carly Lovelett[4], Maren Wolf[4], Eyal Kedar[4], Sumona Mondal[2], Shantanu Sur[3]**

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Rheumatoid arthritis (RA) is a chronic, inflammatory joint disease with a complex repertoire of effects on multiple body systems. In addition, patients suffering from RA are predisposed to several comorbidities such as depression and obesity. While the link of RA to individual comorbid conditions are well-studied, the impact of their coexistence on RA is not well understood. In this work, we use the data from the National Health and Nutrition Examination Survey (NAHNES) to investigate how the interactions between depressions, high body-mass index (BMI) and hypertriglyceridemia, three well-known comorbidities of RA, influence the incidence of RA. We find that the presence of high BMI or hypertriglyceridemia along with depression synergistically increases the association with RA. Furthermore, the strength of these associations is strongly dependent on the concentration of C-reactive protein, an inflammatory biomarker. These findings provide us new insight on the complex interactions between RA and its comorbidities and the important role of inflammation in this process.

Mentors: Shantanu Sur, Department of Biology, Clarkson University
Sumona Mondal, Department of Mathematics, Clarkson University

Keywords: Rheumatoid arthritis, comorbidities, C-reactive protein, NHANES

# Feasibility of Biodegradable Alginate Capsules as a Slow-Release Fertilizer Mechanism

**Laura Siddon[1], Michelle Crimi[2,3]**

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Efficient food production is important for the human population to thrive. There is a need for ecologically friendly fertilization to grow food in a sustainable and efficient manner. The purpose of this research is to develop a slow-release nitrogen fertilizer in the form of a capsule. These capsules were specified for individual plants with high nitrogen needs. These capsules were created using three different methods to create variety among the release rates. One was a single-layer alginate bead, the second was a layered alginate bead, and the third was made of a mixture of chitosan and alginate. Single-layer alginate capsules were able to produce an average release of 43 mg N/L after 72 hours. The multi-layer alginate capsules were able to produce an average release of 48 mg N/L after 72 hours. The capsules fell within the target range of 45-55 mg N/L after 72 hours. Chitosan-alginate capsules were not able to be created. The alginate capsules sustained a steady release for four days in a soil-like environment. The capsules require further research to create a marketable product.

Mentors: Michelle Crimi, Department of Engineering and Management and Institute for Sustainable Environment, Clarkson University

Keywords: Sustainability, Agriculture, Fertilization, Environment

# WHEEL SPIKES: THE FUTURE OF WHEELCHAIR MOBILITY IN THE SNOW

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The 1.25 million manual wheelchair users living in areas of North America with over 5 inches of snow [1] face mechanical challenges in the winter, including the front wheels getting stuck in snow and decreased traction of the rear wheels, leading to decreases in access to buildings and quality of life [2]. There is currently no product on the market that addresses winter mobility challenges. The goal of designing and prototyping the Wheel Spikes was to produce a product that increases mobility in snow and ice while preserving mobility on dry or indoor surfaces. Wheel Spikes are a rear wheel attachment with spikes to increase traction in snow using grips on the interiors of the wheels. Designed using Solidworks (Dassault Systemes, France), a prototype for Wheel Spikes has been made out of 7 gauge steel in the Clarkson University Machine Shop. The spikes are retractable and allow for indoor use without removal. The Wheel Spikes will be tested for improvements in speed, transfer of snow indoors, and weight (no more than ten percent of the chair itself so that users can still lift it). Wheel Spikes will provide the solution users need and at an affordable price.

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Acknowledgements: This material is based upon work supported by the National Science Foundation under Grant No. GARDE-1510367 (Kuxhaus, Erath, Fite).

Mentor: Laurel Kuxhaus, Department of Mechanical & Aeronautical Engineering, Clarkson University

Keywords: Medical Devices, Wheelchairs, Prod. Devel., Assistive Tech.

# Switched at Birth? In the Same Family, But Not Related.

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The Spionidae contains hundreds of different genera, and this study focuses explicitly on comparing the *Polydora* complex, a group of polychaete worms, to other spionids to determine whether they are monophyletic and therefore represents an accurate taxonomic grouping. We hypothesised that these Polydorids would be far enough away in related distance from the other Spionidae to be considered their own family. The Polydora-complex consists of related genera that are united by an enlarged fifth segment with large modified spines. However, due to substantial spine polymorphism, the complex is not regarded as monophyletic by annelid taxonomists. To resolve this issue a molecular phylogeny of the Spionidae using COI and 18S gene datasets was constructed along with pairwise genetic distance calculations and a maximum likelihood tree. Also, the morphological structure of the fifth segments was observed from representatives of each of the nine genera (material borrowed from the National Museum of Natural History). Both the molecular phylogeny and genetic distance estimates robustly to support a monophyletic origin of the *Polydora*-complex.

Mentor: Andrew David, Department of Biology, Clarkson University

Keywords: Polychaeta, Spionidae, Genus Polydora, Natural history Morphology, Annelid worms, Large Modified Spine

# Manifestation of Anxiety in Gait

**Maggie Stark, Rebecca Martin, and Ali Boolani**

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The purpose of this study was to identify gait patterns associated with anxiety. Participants (N=128) completed Profile of Mood Survey (POMS) to assess anxiety over the last 30 days and were then tasked to walk for 2 minutes around a 6m track. A backwards linear regression model was utilized to identify gait correlates of anxiety. The model predicted 28.8% of variance ($R^2$=.380, F(13,88)=4.415, p<.001). Increased anxiety was associated with decreased gait speed, sagittal plane movements, transverse plane movements and hip movement in the frontal plane. It was also positively associated with an increased in axial frontal plane motions. Our results indicate that as symptoms of anxiety increase may be associated with more narrow base of support which may cause the increased lateral motions. Future research should focus on whether with increased anxiety there is a greater supraspinal input that overpowers the learned central pattern generators of reflexive gait.

Acknowledgements: Chelsea Yager, Phylicia Taladay, Seema Teymouri, Julieth Alvarez, Christina Vogel-Rosbrook, and Giulia Mahoney

Mentors: Ali Boolani, Clarkson University Physical Therapy Department, Clarkson University

Keywords: Anxiety, Gait, Tension

# The Mother Centriole Protein, Cenexin, Regulates Preferential Segregation of Lagging Chromosomes in a PLK1-Dependent Manner

**Katrina Stevens[1], Erica Colicino[2], Michael Bates[3], Judy Freshour[2], Heidi Hehnly[2,3]**

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Cell division, or mitosis, is the process by which duplicated DNA and centrosomes are separated into two newly formed daughter cells. Due to the mechanism of centrosome duplication, there is one centrosome always inherently older than the other, resulting in an asymmetry across the mitotic spindle. A common error that can occur during mitosis is lagging chromosomes, when sister chromatids are not evenly distributed between the two daughter cells. Many proteins are present to ensure the high fidelity of this process such as polo-like kinase 1 (PLK1). PLK1 is a mitotic kinase that binds to scaffolding proteins throughout the cell. One of its scaffolds, cenexin, is located on the oldest centriole's appendage. This appendage along with cenexin is asymmetrically distributed between the two mitotic centrosomes. Where one mitotic centrosome is the oldest (cenexin positive) and the other is the youngest (cenexin negative). Our studies documented that there is an increased number of lagging chromosomes in cervical cancer cells that predominately lag toward the oldest mitotic centrosome. I further examined how the inherent asymmetry in the mitotic centrosomes determines the direction of lagging chromosome missegregation in cancer cells and concluded that this missegregation is dependent on a relationship between PLK1 and cenexin.

Mentor: Heidi Hehnly-Chang, Department of Cell and Developmental Biology, Upstate Medical University; Department of Biology, Syracuse University

Keywords: Mitosis, Centrosomes, Cenexin, PLK1

Session 1, Biology & Biomedical Engineering Snell 175, 8:54 AM

# Development of an Optical System for Particle Sizing

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Particle sizing equipment is not new technology and is commercially available. Most devices sample the flow to measure the particles and can reliably measure solid particles, however they lack the ability to accurately measure liquid aerosols. There was a desire to develop a system that could interrogate the flow for liquid aerosols without disturbing it. The High Magnitude Shadow Imaging (HMSI) system consists of equipment and software from LaVision. The system uses a pulsed laser directed into a diffuser to illuminate a test volume, which is captured by a camera with a long-distance microscope. The camera captures shadows created by the particles and treats particles and aerosols the same. The system was tested at Clarkson University to verify its ability to accurately measure particle sizes and concentrations using glass beads in water and a spray nozzle creating water droplets. The HMSI system was also deployed in four field tests: Jack Rabbit II, Diligent Brazos, Humble Jasmine, and CENTAUR IEW-DBSI. No usable data was collected at these tests by the HMSI system. The underlying issues have been addressed and the goal for future work is to verify the system's ability to perform in field testing conditions.

Acknowledgements: This work was funded by the Defense Threat Reduction Agency.

Mentor: Doug Bohl, Department of Mechanical and Aeronautical Engineering, Clarkson University

Keywords: Particle Sizing, Optical Measurements, Field Testing, Aerosols

# Is hemp (*Cannabis sativa*) the next "super food"?

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The U.S. Farm Bill of 2018 removed industrial hemp (*Cannabis sativa* with less than 0.3% tetrahydrocannabinol in the dry mass) from the controlled substance list, making human consumption of plant materials from Cannabis legal in many parts of the country. While cannabis seeds have been sold as snack foods and as food supplements for some time, several groups have recently been promoting hemp leaves and its potential derivatives as "super foods". ("Is Weed the new Kale", https://interestingengineering.com/weed-new-kale-study-shows-benefits-raw-weed). We recently obtained hemp leaf samples from two different Northern New York sources and have carried out preliminary nutrition analyses for comparison with kale and spinach from a local supermarket. This involved looking at proteins, dietary fiber, minerals (ash), crude fats, and sugars to determine hemp's potential as a new food product in dishes like salads, which it shows promise for.

Mentor: Phillip Christiansen, Department of Chemistry and Biomolecular Sciences, Clarkson University

Keywords: Industrial Hemp, Super Greens, Preliminary Nutritional Analysis, *Cannabis sativa*, consumption, food industry

# Behavioral Biometrics for Web Account Protection

**Lee Taylor[1], Daqing Hou[1], Stephanie Schuckers[1]**

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The vast majority of websites rely on a credential based authentication system. However, this system is vulnerable to phishing attacks, database breaches, and poor password hygiene. Therefore, a method is proposed to protect users even if their credentials have been compromised. By collecting mouse and keystroke data during a user's web session, various features can be extracted that are unique from person to person. Although behavioral biometrics such as mouse dynamics are not quite as accurate as physiological biometrics, physiological biometrics require extra hardware, which is costly. As such, physiological biometrics may be an unavailable protection for some users. Additionally, behavioral biometrics are virtually impossible to imitate, provide continuous authentication any given session, and offer an efficient, low cost, and unintrusive layer of authentication that will not present any negative impact on the user's browsing experience. The concept of mouse and keystroke dynamics is not new, and as such, this experiment focuses on the replicability and optimization of previous methods to improve accuracy and usability.

Mentors: Daqing Hou, Department of Electrical and Computer Engineering, Clarkson University

Acknowledgments: NSF CNS-1314792

# Examination of the Relationship Between two Caribbean Neritid Species Using DNA Barcoding

**Andrew Trudeau[1], Andrew David[1]**

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DNA barcoding is a relatively recent technique which has been developed to facilitate identification of species using genetic markers, rather than traditional morphological means. Mitochondrial genes are commonly used for this purpose as they tend to be highly conserved, meaning that there will not be much variation in the gene between members of the same species, but differences will appear between species. Here, we use DNA barcoding to examine the relationship between two related species of marine snails based on two genetic markers (CO1 and 16S). It has been disputed whether these two snails truly are separate species, or whether they represent a single genetic unit. The results of our genetic analysis seem to indicate the later, as Bayesian analysis of the sequence data placed both species into a single, well supported clade, and we observed no barcoding gap when examining the genetic distances between individuals in our data set. These results show the benefits of using genetic data to infer species relationships, rather than traditional morphological methods. Modern methods have the advantage of being precise and reliable, requiring little to no expertise on the species being identified; whereas traditional methods rely on much more subjective measures and require a high degree of familiarity with the species being identified.

Mentor: Andrew David, Department of Biology, Clarkson University

Keywords: Nerita tessellata, Nerita fulgurans, COI, 16s, Bayesian Analysis

Poster #47, Evolutionary Biology Cheel Arena, 12:30-2:00 PM

# Evolution of tradeoffs between growth and dispersal in populations of *Pseudomonas fluorescens* grown in simple and complex environments

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Populations evolving in complex and heterogeneous environments may evolve to better utilize the available local resources (increase growth rate), or to move more quickly to find resources (increased dispersal rate), or some combination of both. Which of these evolutionary routes is taken may depend on how complex the environment is. We test the effects of environmental complexity on the evolution of replicate populations of *Pseudomonas fluorescens.* Populations evolved for two weeks in either 1) a well-mixed liquid environment (simple) or 2) a semi-soft agar environment (complex). We expected that in an agar environment, bacterial cells would do better if they could move around to acquire food resources, whereas in the simple well-mixed environment locomotion was unnecessary and costly. After 2 weeks, we reverse the treatments to look for evidence of adaptive tradeoffs between the two types of environments. The agar-evolved populations were placed in liquid and vice versa, and then allowed to evolve for a second 2-week period. We present results showing how these populations evolved in response to a complex versus simple environments and potential evolved tradeoffs between growth rate and dispersal.

Mentor: Susan Bailey

Keywords: Experimental Evolution, Pseudomonas fluorescens, Spatial Structure, Dispersal Evolution

# The Need for Improved Sustainability Planning Systems Research and Frameworks for Rural Communities

**Paul Barber [1], Ben Buck [1], Megan Flory [2,3], Louisa Ulrich-Verderber [4]**

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The LEED (Leadership in Energy and Environmental Design) for Communities (LFC) pilot program is a new Sustainability Planning System created by the US Green Building Council (USGBC). In August of 2018, fourteen students from Clarkson University's Adirondack Semester began work to implement and provide feedback for this pilot program in the rural, multijurisdictional, tourist-centric, New York Olympic Region (NYOR). NYOR is comprised of the Village of Lake Placid, the Town of North Elba, the Lake Placid Central School District, and the Olympic Regional Development Authority (ORDA). The implementation of LFC in this unique community exposed the difficulties of applying urban-focused sustainability programs to non-urban communities. It also revealed a substantial gap in sustainable planning research in non-urban contexts and a lack of sustainable planning frameworks for non-urban communities.

Mentors: Erik Backus, Department of Civil and Environmental Engineering, Clarkson University, and Stephen Bird, Department of Humanities and Social Sciences, Clarkson University

Key Words: LEED, LFC, Smart Cities, Sustainability Planning Systems, Rural, Non-Urban

# Cues that may affect depression detection on social media

**Rachael Vaccaro, Jay Barker, Katherine Wettengel, Allison Morgan, Katie Colbert, Jennifer Knack**

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The objective of this study was to identify factors that impact detecting depression via social media. We examined how the time of the post, the content of the post, and the level of engagement (i.e., number of likes and comments) impacted how depressed college student participants perceived the supposed poster. College students ($N$ = 184) participated in an online experiment to examine the association between predicted indicators of depression and how the participants perceived the poster. As expected, there was an engagement main effect on the number of friends the poster was perceived to have on Facebook. In addition, high engagement on Facebook mock posts led to marginally higher estimates of friendship quality compared to low engagement and students who viewed Twitter mock posts made in the evening perceived the poster as having experienced marginally more severe hardships than students who viewed posts made during the day. The results suggest that college students may use cues, particularly time of posting and engagement, beyond the content of the post to determine the mental state of the poster. Further research is needed to determine what cues are used and in what situations they are used.

Keywords: Depression detection, social media, cues used to detect depression

# Design of an RPM Control System for Small Ducted Wind Turbines

**Michael Valleau**[1]

**Kenneth Visser**[1]

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Wind is a growing area of the energy industry and has the potential to meet a significant portion of the world's energy demand. An integral part of any wind turbine is the mechanism to control its speed. Over-speeding can cause catastrophic damage to turbine generators and other critical equipment. Many methods of speed control exist, but few are applicable for use in a small ducted wind turbine (DWT). Most existing methods of speed control for small wind turbines are inefficient in that they drastically reduce, or stop entirely, electricity generation when the mechanism is operating. This study will develop an over-speed control mechanism for Clarkson University's newly designed 3.5 kW DWT to prevent damage from high wind velocities as well as to maximize the turbine's generation during such scenarios.

# Solvatochromic behavior of a novel zwitterionic Metal Organic Framework: A Mechanistic Overview

**Charlene VanLeuven[1], Monu Joy[1], Mario Wriedt[1]**

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Metal Organic Frameworks (MOFs) are recognized as an excellent class of porous crystalline materials due to their large pore volume, high surface area, and structure tunability. The polytopic zwitterionic organic linkers and various metal nodes are tailored to meet the demands for different applications. The zwitterionic nature of organic linkers leads to the formation of charged organic surfaces having potential to selectively polarize guest molecules and solvents. The solvatochromism is a key concept for various applications including sensing is rapidly gaining popularity in the field of MOF chemistry. This work demonstrates the design and synthesis of a novel flexible zwitterionic MOF having solvatochromic effects, and a complete mechanistic profiling is also provided based on the molecular and electronic structure.

Mentor: Monu Joy, Mario Wriedt, Department of Chemistry and Biomolecular Science, Clarkson University

Keywords: Metal-organic frameworks, Zwitterionic ligands, Porous crystalline materials, Solvatochromism, Layering approach, Flexible MOF.

# Electrochemically Switchable Zwitterionic Metal-Organic Frameworks

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Metal-organic frameworks (MOFs) are crystalline structures composed of metal clusters or ions connected by polytypic organic linkers with resulting topologies, pore environments, and functionalities which can be fine-tuned. An emerging subclass of MOFs are composed of zwitterionic linkers which introduce charged organic surfaces along MOF cavities leading to intermolecular electrostatic fields. Polarizable guest-molecules can be attracted by these fields significantly enhancing host-guest interactions giving rise to well-defined adsorption properties. Although MOFs are deemed insulators, in this work we induce conductivity in a series of zwitterionic MOFs through the growth of a series of freestanding thin-films on a conductive substrate and their infiltration with electrolytes. This approach enables using electrochemical stimulus for the reversible generation of pyridinium radicals - an unprecedented platform to access redox-active sites in MOFs. The zwitterionic MOF thin film can switch between the states of charged and uncharged pore surfaces through radical formation creating a stimulus-responsive material with tunable adsorption properties. These electrochemical investigations coupled with the development of advanced thin film growth techniques will open-up new avenues for the systematic design of novel multi-functional materials with redox-switchable and multi-stimuli responsive properties, such as smart windows, the selective capture and release of active ingredients and/or environmental pollutants.

Acknowledgements: Thank you to Clarkson University, the NSF, and Corning Inc. for funding this research.

Mentor: Mario Wriedt, Department of Chemistry & Biomolecular Science, Clarkson University

Key words: Metal-Organic Frameworks, MOFs, Electrochemical, Electrochromic, Thin-films, Conductivity

Session 3, Metal Organic Framework — Snell 177, 10:50 AM
Poster #74, Material Science — Cheel Arena 12:30-2:00 PM

# Development of Selective Sensor for On-Site Detection of Arsenic (V) in Environmental samples

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There are several researches have been done for the detection of As (III) in neutral pH by electrochemical methods. As (V) is not electroactive in nonacidic media there is a need for its direct detection in natural waters. Current work demonstrates the direct detection of As (V) for its on-site determination by modified glassy carbon electrode. Glassy Carbon Electrode (GCE) was electrochemically modified with poly (aniline-*co*-*o* aminophenol) and decorated with Nano-Au particles (Nano-Au/ PANoAP /GC) electrode. Conditions were optimized for sample; Modification of GCE with PANoAP was performed using cyclic voltammetry at 0.05 V/s under the potential window -0.2 to 0.6, followed by the amperometry deposition of Nano-Au particles at -0.5 potential for 45s. As (V) was later determined by anodic stripping voltammetry under optimized conditions. The SWASV parameters used were as follows: preconcentration potential of -1.6 V; preconcentration times for 4 min, for As (V) concentrations; 10 s equilibration time; 40-100 Hz frequency; 25 mV potential pulse amplitude; 5 mV potential step height; and a potential stripping ramp from -0.2 V to 0.6 V. This step was preceded by a conditioning step at +500 mV for 30 s. The calibration curves show linearity range of 50 to 250 μM ($r^2 \geq 0.99$). The methodology can be applied onto the surface of low-cost screen-printed electrodes and detected.

Keywords: As (V) detection; on-site monitoring, electrochemical detection; PANoAP; conducting polymers.

# Feasibility of Toe Print Recognition in Children

**Heidi Walko[1], David Yambay[1], Stephanie Schuckers[1]**

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Biometric recognition allows a person to be identified by comparing feature vectors derived from a person's physiological characteristics. Recognition is dependent on the permanence of the biometric characteristics over long periods of time. There was been limited work evaluating the footprint as a potential biometric. This paper presents a longitudinal study of toe prints in children to understand if this biometric modality could be used reliably as a child grows. Data was collected and analyzed in children ages 4- 13 years over five visits, spaced approximately six months apart, giving two years of data. This is the first footprint collection spanning this broad age range in children. Footprints were segmented into separate toe prints to examine whether current fingerprint recognition technology can provide accurate results on toe prints. Data was analyzed using two available fingerprint matchers, Verifinger and Bozorth3 from NIST Biometric Image Software (NBIS). Verifinger provides the best verification match scores using the toe prints, especially when using the hallux, the large toe. Additional longitudinal data is being collected to further these results.

Acknowledgements: Thanks to David Yambay for mentoring; thanks to Stephanie Schuckers for mentoring; thanks to CITeR for sponsoring.

Mentor: Stephanie Schuckers, Department of Electrical and Computer Engineering, Clarkson University

Keywords: biometric, security, children

# Electrodeposited Co-Mo-$TiO_2$ Electrocatalysts for the Hydrogen Evolution Reaction

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Hydrogen, an environmentally sustainable energy carrier, can be effectively produced by water electrolysis from solar and wind energy power sources. A key limiting factor of the hydrogen evolution reaction (HER) is the electrocatalyst. Transition metal materials such as Co-Mo alloys are promising HER electrocatalysts in alkaline for its cost-effective and earth-abundant attributes, but the catalytic performance is typically 1~2 orders of magnitude lower than platinum.[1] Here, Co-Mo-$TiO_2$ composites were fabricated by introducing micro-scale $TiO_2$ particles were into Co-Mo alloy thin films by galvanostatic electrodeposition, and the HER electrocatalytic properties assessed, in order to better understand the role of added $TiO_2$ particles. During electrodeposition, the metal ion partial current densities were enhanced with the inclusion of the particle, resulting in a higher current efficiency. The composites' electrocatalytic properties for the hydrogen evolution reaction (HER) were examined in a 1 M NaOH electrolyte. The alloys containing $TiO_2$ exhibited an enhanced HER with the exchange current density values nearly 1 $mA/cm^2$, comparable with platinum. The overpotential of Co-Mo-$TiO_2$ composites were also significantly lower compared to their alloy counterparts. The Tafel slope analysis suggested a Volmer-Heyrovsky reaction mechanism.

Mentor: Elizabeth J. Podlaha, Department of Chemical & Biomolecular Engineering, Clarkson University

Keywords: Sustainable energy, Hydrogen Evolution Reaction, Electrodeposition, Electrocatalyst, Thin Films, Co-Mo-$TiO_2$.

**Reference:**

1. McCrory, C. C.; Jung, S.; Ferrer, I. M.; Chatman, S. M.; Peters, J. C.; Jaramillo, T. F., Benchmarking Hydrogen Evolving Reaction and Oxygen Evolving Reaction Electrocatalysts for Solar Water Splitting Devices. *J. Am. Chem. Soc.* **2015,** *137* (13), 4347-4357.

Session 3, Material Sciences — Snell 175, 11:35 AM
Poster #78, Material Science — Cheel Arena 12:30-2:00 PM

# Galvanodynamic Examination of Electrochemical Tribocorrosion for Applications in Chemical Mechanical Planarization of Cobalt and Copper

**Shen Wei, David E Simpson, Dipankar Roy**

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Chemical mechanical planarization (CMP) is an essential step of multilevel metallization used in the fabrication of integrated circuits. For the highly complex and delicate device structures of the sub-10-nm technology node, CMP relies on chemically prevalent planarization. In this approach, the overburdens are removed/flattened under low-pressure abrasion, where (electro) chemically controlled tribocorrosion serves as a means to structurally weaken the surface layers being processed. Understanding the detailed corrosion features of these systems is crucial to successfully designing the associated CMP slurry chemistries, but this task is often confounded by the high level of electrochemical noise intrinsically generated by these systems. Potentiodynamic polarization (or cyclic voltammetry, CV), the electroanalytical technique commonly used in corrosion studies of CMP systems is particularly affected by current noises, which makes it difficult to reliably evaluate the corrosion parameters. The present work explores an alternative approach to the analyses of CMP specific corrosion parameters by using galvanodynamic polarization (or cyclic galvannometry, CG). While CV applies a voltage at the test interface and measures the resulting current, CG applies the probe current and measures the resulting voltage. Using the current- controlled mode it is possible to avoid the interfering current noises in CG based measurements of corrosion parameters.

Mentor: Dipankar Roy, Department of Physics, Clarkson University, Potsdam, NY 13699-5820

Keywords: CMP, Cobalt, Copper, Tribocorrosion, Galvanodynamic, Voltammetry,

# Bridging the Gap: A Critique of Mental Health Policy Using Empowerment Theory

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The New York State Office of Mental Health (OMH) focuses on creating polices to develop a system of quality care that responds to the individual needs of adults and children in appropriate settings. OMH changes their polices on safety guidelines annually in order to maintain their facilities and take preventive measures for any harm or damage that may occur. Though there are policies that ensure safety, some of these regulations limit patients' treatment options. In this presentation, I will discuss the relationship between patient and policy in terms of the insight I have gained during my internship at St. Lawrence Psychiatric Center, including my own observations of program administration. I will explore the impact of policy change and mandates on long-term care residents and discuss their resultant treatment progress, subjective experience, and coping strategies. Finally, I will explore the patient-centered perspective of empowerment theory as a solution to bridge the gap between patients and policy.

Mentor: Lisa Legualt, Associate Professor of Psychology

# Shape Memory and Self-Healing in Polyanhydrides

**Ana Witkowski[1], Rebecca Meacham[2], Kelly Tillman[1], Devon Shipp[1,3]**

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In recent years, shape memory polymers have become increasingly popular, due to their ease of fabrication, low production cost, relatively low density, and high recovery of a permanent shape, as compared to shape memory alloys.[1] We are looking to demonstrate the shape memory characteristics of thiol-ene polyanhydrides when heated above and then cooled below the $T_m$ (crystalline melt temperature) of the polymer. Preliminary work has shown that polyanhydride-poly(□-caprolactone) composites are capable of exhibiting shape memory properties,[2] and when the $T_m$ of the polymer is ~30-40°C, the polyanhydride group's ability to exchange and reform a new permanent shape occurs at a slower rate. We are looking to create an all-anhydride polymer made using a monomer combination that also has this $T_m$ in order to form a polymer that will successfully exhibit shape memory behavior. At temperatures of 80-90°C, we expect the anhydride exchange to occur quickly, which will allow for self-healing to occur. This can be mechanically tested and compared through stress/strain plots. The self-healing property of this material will aid in the customizability of the polymer when used in a biomedical application. This material could be potentially used to help minimize the size of surgical incisions.

Mentor: Kelly Tillman, Department of Chemistry and Biomolecular Science, Clarkson University

(1) Jeon, H. G.; Mather, P. T.; Haddad, T. S. *Polym Int* **2000**, *49*, 453.
(2) Lawton, M. I.; Tillman, K. R.; Mohammed, H. S.; Kuang, W.; Shipp, D. A.; Mather, P. T. *ACS Macro Lett* **2016**, *5*, 203.

# Analysis of Formation of Cell Clusters In Vitro

**Alfred Worrad**[1], **Morgan Reynolds**[2]

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Understanding collective cell migration is extremely important in the context of wound healing and cancer spread. Our motivation is to study how collective cell behavior is affected in the presence of an environmental stressor such as hypoxia and or calcium concentration. In particular, a critical transition from a disordered state to one that is coherent. This transition can be difficult to detect and analyze, due to the complex nature of the cells' interactions. The presentation will demonstrate two tools: order parameters, originating in statistical mechanics, and persistent homology, originating in topological data analysis. The order parameters characterize the coherence of the system based on the similarity of cells' velocities. Persistent homology identifies topological features, such as connected components and empty regions of space, and tracks them over the course of time. We apply these tools to the Vicsek model of cell aggregation and several experimental data sets that track the movement of cervical cancer cells cultured on a Petri dish.

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Mentors: Marko Budišić, Department of Mathematics, Clarkson University. Sumona Mondal, Department of Mathematics, Clarkson University. Shantanu Sur, Department of Biology, Clarkson University.

Key Words: Collective Behavior, Persistent Homology, Vicsek Model, Order Parameter, Cell Aggregation

# How to Engage American Students to Learn Chinese Character

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Chinese characters are difficult for American students. To solve this challenge, I propose to design a series of positive and funny activities in real class to engage American students to learn Chinese characters. These activities are based on a unit project emphasis that teacher does severe teaching actions. These teaching actions and lesson content are based on three theories-- "Character-based" "word-based" "sentence-based." I try to combine different situation to teach Chinese character and work best to help students learn as more as a Chinese character. Each lesion is connected, and each teaching activity is meaningful. These methods can be classified as three functions. The first one is to hook students to learn Chinese character, the second one is to assisted teaching, and the last one is to help the teacher to check the teaching efficiency. At the end of the unit, I hope to receive the outcome that students not only enjoy learning Chinese character but also have acquired 80% useful Chinese character so that they can read, listen, write and speak these characters.

Acknowledgments: I would also like to show my gratitude to all of the researchers and Linguists for sharing their pearls of wisdom with us during the unit project of this research. I am also immensely grateful to Professor Sherri Duan, Richard Lasselle and all of the education department of Clarkson campus region professors who was teaching me for their comments on an earlier version of the manuscript, although any errors are our own and should not tarnish the reputations of these esteemed persons.

Mentor: Richard Lasselle, Department of Education Program, Clarkson University.

Keywords: Teacher Action, Engage, Various Strategy, Chinese Character, useful.

# The manifestation of anger in walking gait

**Chelsea Yager[1], Dylan Bradley[2], Joan Caruso[1], Ali Boolani[3]**

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A person's gait is the result of a complex interaction between anatomy, physiology, neurology, pathology and injury. Gait represents alterations or compensations to basic movement. Anecdotally, evidence suggests that there is a change in gait with anger. Participants (N=136) were measured for their current feelings of anger using the Profile of Moods Survey (POMS). They were then tasked to walk around a 6m track for 2 minutes and gait was measured using APDM monitors. A backwards linear regression identified 43.1% of the variance ($R^2$=.569, F(25, 78)=4.124, p<.001). Results indicate that as feelings of anger increase, there is increased asymmetry in walking gait with the upper and lower extremities compensating for each other. Overall, subjects had increased gait speed, but their lower extremities compensated throughout the walk by decelerating, and their trunk and neck increased rotational movement, flexion and extension while liming lateral movement to maintain upright gait. As feelings of anger increased, subjects also took wider turns during their 6m walk. Our results suggest that the manifestation of anger in walking gait may be similar to what is anecdotally suggested in that people who are angrier walk faster, lift their legs higher and overall have less control of their bodies.

Mentor: Ali Boolani

Acknowledgements: We would like to thank Phylicia Taladay, Seema Teymouri, Julieth Alvarez, Christina Vogel-Rosbrooks, Maggie Stark and Giulia Mahoney for helping with data collection.

# Multivariate Experimental Design for Google App Rating

**Zheng Yang[1], Sumona Mondal[2]**

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For most Android mobile app developers, App rating (AR) has become a critical criterion as plenty of customers would like to check the rating to decide whether they download the app or not. Even for free mobile apps, one more download can generate a little bit more revenue for them. Therefore, analyzing which factors have strong impact on AR becomes more useful for app producers. All the information listed in Google Play Store is a valuable resource for analyzing which part of data may influence AR score to increase. Despite the usefulness of this information, most developers do not utilize this information, which is available for free to everyone. In the Google Play Store dataset, there are more than 10 different variables per app. If app producers intend to increase their own AR score effectively, they should only focus on 3 to 4 main factors which have stronger relationships and contributions compared to others. The main purpose of this project is to find which variables correlate to the highest AR. The data for this project comes from Google Play store from 2013 to 2018. It contains both categorical and numeric variables. The main technical model to use is Analysis of Variance (ANOVA). ANOVA will provide the most efficient way to filter the most significant variables which will have strong correlations to rating score. The result will provide the statistically significant variables showed in Google Play Store with high rating score. Once app producers know the research result from this project, they should have more specific directions on which factors they need to improve to increase overall rating score of their apps.

Mentor: Professor Sumona Mondal, Clarkson University

Key Words: Google Play Store, ANOVA, App Rating

# Regenerative Medicine Approach to Degenerative Disc Disease

**Rachel Yerden[1], Petra Kraus[1], Thomas Lukin[1]**

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Approximately 30 million individuals a year are affected by Degenerative Disc Disease (DDD), which is characterized by degenerated IVDs. DDD typically results in severe and chronic back pain and decreases an individual's quality of life. Though there are currently many strategies for ameliorating the symptoms of DDD, there is not a cure. We hypothesize that a possible cure could be formulated using regenerative medicine techniques to rebuild a human IVD. In this study, we aim to develop an understanding of the characteristics of the bovine intervertebral disc (IVD), which is an accepted research model for the human IVD. Data elucidated from these studies will be used to develop a procedure to grow bovine nucleus pulposus (NP) and annulus fibrosus (AF) cells on a 3D scaffold. This study addresses the following objectives: characterization of the cell lineages of the IVD, development of a single-cell quantitative and qualitative assay for cells in culture, and proposition of a procedure for scaffold development. These results will be used to advance the field of regenerative medicine in regards to the human IVD.

Acknowledgements: I would like to thank the Lufkin Lab for hosting my research experience and developing my research knowledge and techniques. I would also like to acknowledge the contributions of the Clarkson Honors Program, CUPO, and the ASPIRE program. This work was supported by the Bayard and Virginia Clarkson Endowment Fund granted to Thomas Lufkin.

Mentors: Profs Thomas Lufkin and Petra Kraus

Key Words: Regenerative medicine, intervertebral disc, degenerative disc disease, biomedical engineering, transcriptome, cell characterization

# The Maternal Mortality Crisis in New York State: An Analysis and Proposed Solutions

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Currently, New York State is facing a big crisis in women's health. The state maternal mortality rate, which has been defined as the number of maternal deaths per every 100,000 live births in any given year, has been steadily increasing over time. This presentation will explore the leading cause of maternal deaths and how certain groups are more at risk than others. Additionally, it will examine the solutions being implemented in other states across the country and will describe the initiatives that can be taken at both the local and state level to reduce maternal deaths.

Mentor: Laura Ettinger, Department of Humanities and Social Sciences, Clarkson University

Keywords: maternal mortality, maternal death, public health initiatives, public health legislation, New York State


**Thank You to everyone who participated and attended!**

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