



# **Electronic Spring Undergraduate Research Festival**

**National Undergraduate  
Research Week  
April 20-24, 2020**

## **E-SURF 2020 Line-Up**

<b>Time</b>	<b>Wednesday, April 22</b>	<b>Friday, April 24</b>
<b>2:10</b>	--	Maria Carriel
<b>2:20</b>	--	Autumn Van Der Brink, Marie Ohlinger, Nick Schany
<b>2:30</b>	Mackenzie Conlon	Madison Purvis
<b>2:40</b>	Molly Matkovich	Marissa Mueller
<b>2:50</b>	Blake Holmes	Maram El-Geneidy
<b>3:00</b>	Jia Ern Ong	Jonah Alderson
<b>3:10</b>	Mikayla Eppert	Olivia Lullmann
<b>3:20</b>	Sawsan Daws	Julia Miller
<b>3:30</b>	Hannah Shrader	Yitong Li
<b>3:40</b>	McKenzie Rediehs	Renato Jensen

Thank you for joining ICRU's first ever E-SURF!

Follow this link to watch these amazing presenters:

<https://uiowa.zoom.us/j/92615582372>

Here are the rules:

1. Presenters will discuss their work for approximately 3 minutes, leaving 5 minutes for questions and answers.
2. Presenters may use their time however they would like, leaving more or less time for questions.
3. When the presenter asks for questions, the audience may use the "raise hand" function to ask a question.
4. The ICRU moderator will unmute the audience member until the question is answered.
5. The ICRU moderator will alert the room when the allotted 8 minutes is over.

## Wednesday

### **2:30 - Mackenzie Conlon**

Major: Biomedical Sciences

Class of: May 2020

Mentor: Dr. John Wemmie (Psychiatry)

#### *Assessing the role of ASIC1A in self-administration of cocaine in mice*

Drug addiction is common, deadly, and often difficult to treat. A better understanding of the biological processes driving addiction and drug seeking is needed. Previous work has implicated acid-sensing ion channel-1A (ASIC1A) in responses to drugs of abuse, suggesting a possible target for new therapies. ASIC1A is located throughout the brain and is activated by extracellular acidosis. Our previous studies with ASIC1A showed changes in cocaine-evoked behavior. Current techniques can manipulate the amount of ASIC1A expressed, allowing for elimination or overexpression of the protein. Eliminating ASIC1A in mice increased their preference for locations associated with cocaine, while overexpressing ASIC1A in rats reduced the amount of cocaine they self-administered. We hypothesized that *Asic1a*<sup>-/-</sup> mice would have increased cocaine self-administration compared to wild types. *Asic1a*<sup>+/+</sup> and *Asic1a*<sup>-/-</sup> mice learned to press levers to receive intravenous cocaine, allowing them to control their own dose. This animal behavior is thought to most closely parallel human drug use. Interestingly, consistent with our hypothesis, preliminary findings suggested that *Asic1a*<sup>-/-</sup> mice self-administered more cocaine than control mice. These results encourage future research into ASIC1A and brain pH. Further examination of their roles in drug craving and relapse could lead to promising breakthroughs and possible therapeutic targets.

### **2:40 - Molly Matkovich**

Major: Mathematics

Class of: May 2022

Mentor: Dr. Gordon Buchanan (Neurology)

#### *Effects of median raphe serotonergic neuron activation on EEG and seizure-induced death*

Epilepsy is a condition in which patients experience recurrent seizures that are potentially fatal due to a condition called sudden unexpected death in epilepsy (SUDEP). It is notable that most SUDEP cases occur while the victim is asleep. Seizures occur in a sleep-state dependent manner. Interestingly, almost no seizures happen during rapid eye movement (REM) sleep wherein theta brainwave rhythms are typical. This

suggests a protective mechanism. The neurotransmitter serotonin (5-HT) modulates seizure occurrence and therefore seizure-induced death. Median raphe nucleus (MRN) 5-HT neurons remain active during REM while other areas substantially decrease 5-HT activity. Therefore, we hypothesized that 5-HT neurons in the MRN control theta activity and affect seizure-induced death. To pursue this, optogenetics and maximal electroshock (MES) induced seizure trials were undertaken. Preliminary analyses revealed manipulation of 5-HT neurons in the MRN can alter theta brainwave activity. We also found that more mice survived MES induced seizures when such neurons were activated as opposed to inhibited. This research is expected to advance our understanding of seizure-induced death and theta activity in relation to the development of seizure-controlling therapies.

## **2:50 - Blake Holmes**

Major: Interdepartmental Studies

Class of: May 2021

Mentor: Dr. Songhai Chen (Pharmacology)

### *Resistance to endocrine therapy in E2+ breast cancer*

Over 75% of breast cancer patients are found to express estrogen receptors (ER+). These receptors drive tumor growth, making them ideal targets for treatment. Endocrine therapies, such as the drug tamoxifen, are widely used to treat E2+ breast cancer and have helped to improve outcomes for many patients. However, over 30% of patients develop resistance to these endocrine therapies as well as metastasis. The mechanism for this resistance is still not fully understood and uncovering it could significantly improve the outcomes for those with E2+ breast cancer.

We have identified new genetic determinants for the resistance to endocrine therapies using a unique genetic screen. We used a CRISPR-Cas9 mediated genetic knockout targeting 20,611 human protein-coding genes in the MCF7 breast cancer cell line. Each cell had one gene knocked out. These cells were then exposed to tamoxifen to select for cells that were resistant to the drug. The cells that survived were then injected into the mammary glands of nude mice. The mice were deprived of estrogen supplementation to select for estrogen-independent growth and tumor formation.

This screen has allowed us to identify two candidate genes, NFKB1 and NEGR1, that act as tumor suppressors. We have performed numerous experiments to confirm the role of these genes and elucidate their specific mechanisms. This data has the potential to improve treatment options and outcomes for those with E2+ breast cancer.

### **3:00 - Jia Ern Ong**

Major: Neuroscience

Class of: May 2020

Mentor: Dr. Lucy Wibbenmeyer

#### *Family needs and child depression are associated with ACE exposure in pediatric burn patients*

Adverse childhood experiences (ACE) are linked to negative health behaviors. How parent ACEs impact their children's health remains unclear. ACE exposure of parents and children who suffered burn injuries and its impact on recovery were assessed. Parents of burned children completed a survey with questions on parent and child ACEs, needs, and resiliency. Demographics, burn injury, hospital course, and follow-up data were collected. Family needs and outcomes of children with  $\geq 1$  ACE and no ACE were compared.  $P < 0.05$  was considered significant. Seventy-five children,  $6.0 \pm 5.2$  years old, were included; 59% were male, 69% white. Parent and child ACE exposure were correlated ( $r = 0.57$ ;  $p = 0.001$ ). Children  $\geq 5$  years were exposed to more ACEs than children  $< 5$  years ( $2.1 \pm 2.6$  vs.  $0.8 \pm 0.9$ ;  $p = 0.0025$ ); a similar pattern was noted between their parents ( $3.9 \pm 3.9$  vs.  $1.5 \pm 1.6$ ;  $p = 0.0005$ ). Needs were higher for families exposed to ACEs ( $2.4 \pm 2.4$  vs.  $1.3 \pm 1.8$ ;  $p = 0.042$ ) and children  $\geq 5$  years ( $3.0$  vs.  $1.4$ ;  $p = 0.04$ ). Families exposed to ACEs tended to not show up to clinic appointments more often (28.6% vs. 8%;  $p = 0.07$ ). Children exposed to ACEs were more likely to experience greater depressive symptoms (T-scores at 6 months post-injury was  $\geq 1$  ACEs  $42.7 \pm 10.6$  vs. no ACE  $32.8 \pm 1.6$ ;  $p = 0.006$ ). Families of burned children and children themselves, especially those  $> 5$  years, exposed to ACEs presented with a significant number of needs and depressive symptoms.

### **3:10 - Mikayla Eppert**

Majors: Biochemistry, Spanish

Class of: May 2020

Mentor: Dr. Sarit Smolikove (Biology)

#### *DNA Damage Repair and Chromosome Synapsis*

During meiosis, intentional double strand breaks are made in order to achieve gene conversion and crossover events. Various proteins collaborate in order to expose ssDNA for strand invasion. The helicase/5'-3' exonuclease DNA-2 and the 5'-3' exonuclease EXO-1 act redundantly in long-range resection of meiotic double strand breaks, and if they act redundantly that that would explain why there would be no observable phenotype when there is a deletion for only

one of these genes. It is hypothesized that if both *exo-1* and *dna-2* are deleted, there would be an expected, observable phenotype of no RPA-1 or RAD-52 loading and nonviable progeny/sterility of parent. In future research, we may compare these molecular mechanisms in meiotic DSBs (caused by SPO11) and induced DSBs from UV microirradiation.

### **3:20 - Sawsan Daws**

Major: Applied Physics

Class of: August 2020

Mentor: Dr. Caterina Lamuta (Mechanical Engineering)

#### *Mechanical Characterization of PtSe<sub>2</sub> Single Crystal*

Among two-dimensional (2D) layered transition metal dichalcogenides (TMDs) family, Platinum diselenide (PtSe<sub>2</sub>) has drawn attention due its unique semimetal to semiconductor transition when being reduced from bulk to monolayer thickness and has been shown to be a great candidate for nanoelectronics. The mechanical properties, such as hardness and the Young's modulus (modulus of elasticity) of monolayer and multilayer PtSe<sub>2</sub> have been theoretically calculated in previous studies by the Density Function Theory (DFT); However, experimental results are not yet determined. In this work, we study the hardness and Young's Modulus of bulk PtSe<sub>2</sub> experimentally with depth-sensing nanoindentation techniques. Our results show the material to have 5.66 GPa and 53.8 GPa in hardness and Young's modulus respectively, confirming the great suitability of PtSe<sub>2</sub> in optical applications and nanoelectronics and having the potential to enhance the performance of graphene, when composed together, in such applications.

### **3:30 - Hannah Shrader**

Majors: Biochemistry, Medical Anthropology

Class of: May 2021

Mentor: Dr. Carlos Chan (Surgery)

#### *Exploring the impact of intraoperative contaminated bile spillage on pancreatic cancer progression*

Pancreatic ductal adenocarcinoma (PDA) is one of the deadliest cancers and currently, surgery is the only curative treatment option. During surgery, spillage of bile from the gallbladder contaminated with gut flora into the peritoneal cavity is often unavoidable during. We aim to evaluate the effect of the bacteria from PDA patients' bile on pancreatic cancer cell growth. Pancreatic cancer cells were cultured with bile contaminated with different strains of bacteria.

Cancer cell survivability was determined. We found that all patient-derived bile samples significantly decreased cancer cell survival. However, contaminated bile further reduced cancer cell growth compared to uncontaminated bile. Bacteria alone did not have any effect on cancer cell survival. These data indicate that spillage of bile during surgery may not have a negative impact on cancer recurrence. We are continuing to investigate the underlying mechanisms as to how bile kills cancer cells and how bacteria modify bile content.

### **3:40 - McKenzie Rediehs**

Major: Nursing

Class of: December 2020

Mentor: Dr. Wen Liu (Nursing)

#### *Non-Pharmacological Nursing Interventions to Improve Mealtime for Dementia Patients*

Background: Individuals with dementia commonly exhibit challenging behaviors during mealtimes, leading to declined function and nutrition. While mealtime difficulties (MD) are influenced by multilevel factors and require multifaceted strategies, there is lack of evidence-based care approaches to improve MD. Targeted interventions grounded in research evidence are needed to guide the use of care approaches. Therefore, we conducted a systematic review synthesizing current evidence on MD and targeted non-pharmacological strategies in dementia between 2017-2019.

Objective: To update and integrate research evidence between 2017-2019 to our systematic review that was done for literature between 1990-2016.

Methods: We conducted literature search, screening, and data extraction following the same protocol as in our current review by searching five health-related databases (Pubmed, CINAHL, AgeLine, PsychINFO, Cochrane Library). A typology of MD and non-pharmacological strategies was developed.

Results: In this review, we identify 47 unique MD including functional, cognitive, and behavioral difficulties and 113 unique strategies at resident, staff, and environmental levels. We identified 10 MD to have 13 specific targeted strategies.

Dissemination/Impact: We will disseminate findings through presentations and manuscripts. The findings have great potential to facilitate our long-term goal to develop a behavioral intervention to reduce MD and improve nutrition in dementia.

Friday

**2:10 - Maria Carriel**

Majors: Neuroscience, Philosophy

Class of: May 2021

Mentor: Dr. Ece Demir-Lira (Psychological and Brain Sciences)

*Using oral storytelling intervention to promote early discourse visualization and comprehension*

Children's early reading comprehension is a strong predictor of their academic success. One central predictor for children's reading comprehension skills is their ability to visualize. Children do not only rely on words in a text for comprehension - they also create mental representations of the concepts and relations in a text by using their visual senses. Despite the theoretical emphasis on visualization skills for reading success, existing studies do not directly test children's visualization skills. Prior studies also do not explicitly measure associations between visualization skills and discourse skill. Overall, to our knowledge, there is no direct measure for narrative visualization in children. The first goal of our study is to develop a visualization measure for young children. Our second goal is to develop an intervention that could promote children's visualization skills. A possible candidate for supporting children's visualization skills is listening to oral stories. We will employ folklore stories specifically as they contain features (e.g. common tropes, little character development) that encourage the listener to both co-create and visualize the story in question. Therefore, the overarching goal of the study is to examine whether listening to oral folkloric stories can be used to promote visualization skills and in turn eventual discourse and reading comprehension.

**2:20 - Autumn Van Der Brink; Marie Ohlinger; Nick Schany**

Majors: Radiation Sciences Interest; Chemical Engineering;

Biochemistry

Class of: May 2023

Mentor: Dr. Scott Shaw (Chemistry)

*Microplastics in the Iowa City Waters*

This presentation describes the effects of microplastics and our group's process to determine their presence in Iowa City water. Microplastics are important because of potential negative impact on human and animal health. Our group collected samples from influent and effluent sources at the water and wastewater treatment plants in Iowa City. Our next steps are to quantify microplastics in the samples using Raman microscopy and identify the abundance, types of plastics, and possible sources. We plan to collect the plastic using sieves to filter the samples. Then we will compare the Raman spectra



of any found plastics to known spectra of common plastics to identify the type.

### **2:30 - Madison Purvis**

Major: Human Physiology

Class of: December 2020

Mentor: Dr. Massimo Attanasio (Internal Medicine)

#### *Creation of new cell lines using CRISPR activation to knock-down the GLIS2 gene*

In previous years it was discovered that disruption of the Glis2 causes progressive kidney disease in humans and mice. This means that we can use cells from mice to run experiments on. We found that the loss of Glis2 leads to cellular senescence, which leads to progressive loss of kidney function. We suspect that Toll-like receptor signaling can be inhibited to allow Glis2-defective kidney tubular cells to proliferate and differentiate. Put simply, this means we can potentially reverse the damage that is caused by progressive kidney disease. This theory would mean that the Glis2 gene could be manipulated for therapeutic treatment. To test this hypothesis, different sgRNAs were used to try and find the optimal cell line. SgRNAs are what direct the CRISPR activation. A method called QPCR was used to analyze the percentage of Glis2 knockdown cells that resulted from the activation of CRISPR in each cell line. By looking at these results, we can see what sgRNA was able to knockdown the greatest percentage of cells. This will allow us to look at the chromatin of these cells in the future to further analyze this gene and the effects of Toll-like receptor signaling inhibition.

### **2:40 - Marissa Mueller**

Major: Biomedical Engineering

Class of: May 2021

Mentor: Dr. Laura Frey-Law (Physical Therapy and Rehabilitation Science)

#### *Comparing Methods of Quantifying Physical Activity using Actimetry*

Actimetry is the study of objectively measuring of physical activity (PA), being used increasingly for clinical and recreational purposes.

Prescribed activity has emerged as a new frontier in preventative and rehabilitative medicine, where devices called accelerometers sense motion at the wrist/hip. While products like the Nike Fuel Band and Fitbit serve the general population, researchers rely on clinical-grade accelerometers (ActiGraph-GT3X) and software platforms (such as ActiLife) to convert raw accelerations to useful measures of daily steps, energy expenditure (EE) and time spent in moderate-to-vigorous activity (MVPA) for clinical analyses. Despite technological advances, a

lack of standardization in this conversion process remains problematic; the cumulative effect of algorithms and filters may not be well understood. Thus, the purpose of this study was to quantify how select analysis methods influence PA metrics. Data from 134 participants wearing an ActiGraph GT3X Accelerometer on the wrist for one week was evaluated using ten different equations, a wrist correction, and a frequency filter. Large variations in PA estimates were observed for EE ( $\leq 83\%$ ), MVPA ( $\leq 100\%$ ), and steps ( $\leq 40\%$ ). Although the methods examined were previously validated, they are not interchangeable, indicating that exact measures of PA are highly dependent on employed analysis specifications.

## **2:50 - Maram El-Geneidy**

Major: Interdepartmental Studies

Class of: December 2020

Mentor: Dr. Christopher Benson (Internal Medicine)

### *Acid-sensing ion channels (ASICs) contribute to remodeling after myocardial infarction*

Acid-sensing ion channels are highly expressed and are required for reflexes induced by cardiac and skeletal muscle afferents, and the carotid body  $\bar{A}$ i pathways that lead to sympathoexcitation. Evidence suggests that these afferent pathways are hyperactive in heart failure, contributing to fluid retention, arrhythmias, deleterious remodeling, and declining cardiac function. We hypothesize that mice lacking the ASIC3 gene might have improved cardiac function and less deleterious remodeling after myocardial infarction (MI), in particular because they would have less dysautonomia. 8-week old wild type and ASIC3<sup>-/-</sup> mice underwent surgery to ligate the left anterior descending coronary artery, or sham operation. Echocardiography was performed after surgery at 2 days and 3-4 weeks to measure left ventricular (LV) ejection fraction, LV dimensions, and infarction size. Separate cohorts of mice with a significant myocardial infarction determined by echocardiography underwent telemeter implantation to measure hemodynamic responses to methylatropine (2mg/kg), propranolol (2mg/kg), and chlorisondamine (12mg/kg), as well as heart rate and blood pressure variability and baroreceptor sensitivity 2 weeks post-MI to assess autonomic tone.

## **3:00 - Jonah Alderson**

Majors: Environmental Science, Biology

Class of: May 2020

Mentor: Dr. Heather Sander (Geography and Sustainability Science)

### *Changes in the Avian Community of Johnson County, Iowa (1907-2019)*

Birds are declining at alarming rates worldwide due to factors such as habitat loss, invasive species, and global climate change. Identifying how bird communities have changed over long time periods is vital to understanding these declines and to planning future conservation actions. We compared songbird abundance data from the early 20th Century and contemporary field-collected data for Johnson County, Iowa to test whether different songbird groups (based on habitat, diet, etc.) showed significant increases or declines. Our results indicate an increase in exotic species abundance which, although some loss of native species has occurred, has led to an increase in the number of species. Most groups did not exhibit a significant change in relative abundance; however, decreases occurred across many groups, except for exotics, non-migratory species, urban-tolerant species, seed-eating birds, and species known to make use of human resources such as bird feeders. Many factors may play a role in this, including: increased urbanization, loss of native grassland to agriculture, and other changes to the landscape. The results of this study contribute to existing literature on the massive changes in avian communities seen around the world, but shows how these changes may differ on a local scale.

### **3:10 - Olivia Lullmann**

Major: Neuroscience

Class of: May 2022

Mentor: Dr. Lyndsay Harshman (Pediatric Nephrology)

#### *Decreases in Cognition in Children with ESKD Following Renal Transplant*

Progression from chronic kidney disease (CKD) to end-state kidney disease (ESKD) has been associated with decreases in IQ and executive function. Many children that develop ESKD as a result of congenital anomalies of the kidney and urinary tract (CAKUT) or glomerulonephritis require a renal transplant before age 18. This study sought to describe the longitudinal in cognition relative to the time of kidney transplant. Wechsler test appropriate for age and developmental level was used to evaluate the cognitive ability of 8 children with ESKD (19 m.o. to 16 yr) both prior to transplant and one year following transplant. The study found a significant decrease in full-scale IQ one year following renal transplant ( $p = .005$ ). The study also found a significant decline in average processing speed in ESKD patients ( $p = .002$ ). This suggests that impairments in executive function may be driving the continued decline in IQ following kidney transplant.

### **3:20 - Julia Miller**

Major: Biomedical Sciences

Class of: May 2020

Mentor: Dr. Rainbo Hultman (Molecular Physiology and Biophysics)

#### *Brain Network Mechanisms of Migraine*

Being the 2nd most disabling illness in the world, migraine is a complex neurological disease that alters sensory perception and processing. However, the mechanisms underlying migraine are not well understood, particularly with regard to how activity from multiple brain regions are coordinated to result in a migraine episode with symptoms spanning multiple modalities. Here, we use a neurophysiological approach utilizing a rodent model of migraine to provide better insights into underlying migraine mechanisms. Human and rodent studies have shown that calcitonin-like gene related peptide (CGRP) can induce symptoms consistent with migraine. We used behavioral methods such as the von Frey test and the Light Aversion test to quantify changes in cutaneous allodynia and photophobia respectively. We also built electrodes to be implanted into the brain in order to provide multi-site extracellular recordings from freely behaving mice. Our results indicate that CGRP induces central and peripheral cutaneous allodynia as well as photophobia. Our goal is to integrate this data to develop an electrical connectivity map of migraine in order to help make newer and more targeted therapeutics.

### **3:30 - Yitong Li**

Majors: Computer Science, Mathematics

Class of: May 2020

Mentor: Dr. Brandon Myers (Computer Science)

#### *Accessible Tools for Students with Visual Impairment for Logic Circuit Design*

Logic circuit design is an important part of computer science study. However, since it relies heavily on visual components, such as drag-and-drop programming, iconic buttons, and circuit structure, it is not accessible to students with visual impairments. Our modification will help improve the accessibility of an software, Logisim, for students with visual impairments.

### **3:40 - Renato Jensen**

Majors: Biochemistry

Class of: May 2021

Mentor: Dr. Marcelo Correia, Dr. E. Dale Abel (Internal Medicine)

*Mice With Induced Skeletal Muscle DRP1 Deficiency Resist High-Fat Diet-Related Obesity and Diabetes*

The skeletal muscle of type 2 diabetics exhibits dysfunctional, fragmented mitochondria. Dynamin-related protein 1 (DRP1) is a protein involved in the mitochondrial division process. Here, we've engineered mice with an impaired ability to produce DRP1 in skeletal muscle (DRP1 deficient mice), and shown that they are partly protected from high fat diet-induced obesity and diabetes. We found that our DRP1 deficient mice exhibited increased insulin and glucose tolerance, as well as relatively increased energy expenditure. We also saw activation of a cellular stress pathway in our mice, the ER-stress response. FGF21 is a hormone that plays a part in regulating metabolism, and it is produced by the ER-stress response. We hypothesized that activation of the ER-stress response was causing the skeletal muscle to release FGF21 into the blood, in turn causing the observed changes in energy expenditure and glucose metabolism in our mice. However, we found that the amount of FGF21 actually circulating in the blood of our DRP1 deficient mice was not elevated. In conclusion, we have shown that our skeletal muscle-specific DRP1 deficient mice are resistant to high fat diet-induced obesity and diabetes, perhaps due to energy expenditure elevated by hormones other than FGF21.

