

# Program & Abstract Submissions

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UNDERGRADUATE RESEARCH AND CREATIVE  
ACTIVITY FORUM (URCAF)



April 9, 2021  
VIRTUAL EVENT





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Taj Allen  
Faculty Mentor(s) James G. Bann  
Fairmount College of Liberal Arts & Sciences  
Natural Sciences & Engineering Poster Presentation

Investigating the role of domain 4 of the anthrax protective antigen on stability and immunogenicity

The anthrax toxin protective antigen (PA) is the major immunogenic component of the anthrax vaccine, and consists of four domains with the fourth being of particular importance. Anthrax toxin neutralizing antibodies have been shown to be primarily directed at domain 4, which is the domain responsible for binding to host cell receptors (CMG2 and TEM8) and thus preventing further toxicity. The methods that have already been performed consist of Circular dichroism (CD) spectroscopy and Gel filtration chromatography which has shown that the mutant protective antigen without domain four has no specificity towards CMG2, and is more stable than wild-type PA. Additional future testing includes seeing if the mutant will still form a heptamer which would show if domain four is required for its formation. The hypothesis of this study is that the reduced immune response to when CMG2 is bound is because CMG2 is blocking a key epitope or epitopes within domain four. As such, removal of domain four should elicit a significantly weaker immune response when compared to full PA that is that the majority of the immune response to PA is because of domain four.

Derek Baldwin  
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Natural Sciences & Engineering Poster Presentation

REVEALING PALLADIN'S ROLE IN METASTASIS BY DIRECTLY OBSERVING ITS INFLUENCE ON ACTIN POLYMERIZATION

Metastatic cancer cells sometimes break off from their point of origin and use motile structures composed of polymerized actin to travel elsewhere in the body. An actin-binding protein named palladin is often overexpressed in metastatic cancer cells. Previous research has shown us that a minimal actin-binding palladin (Ig3) causes an increase in actin polymerization rate. Now we aim to compare the effects on actin polymerization and organization by the Ig3 domain to that of full length palladin. The Beck Lab hypothesizes that palladin plays a major part in promoting the motility of cancer cells throughout the body by increasing polymerization and coordinating the structure of actin filaments. The focus of our research is to use Total Internal Reflection Fluorescence (TIRF) microscopy to directly observe actin filaments in the process of polymerization. Observation of these filaments should allow us to capture instances of filament organization and crosslinking, which would help us to understand how palladin influences actin filament organization and what structures it regularly organizes filaments into. In comparing the effects of full length palladin to those seen previously with Ig3, we have found significant changes in the rate of polymerization, instances of crosslinking and filament organization. We aim to move forward using image quantification programs to quantify crosslinking between filaments, which would allow us to better define palladin's ability to promote highly branched actin structures. Defining this capability would help us to understand palladin's responsibility in constructing invasive cellular structures that may ultimately provide insight into the role it has promoting the metastasis of cancerous cells.

Stephanie Bristow  
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Natural Sciences & Engineering Poster Presentation

## Thermal Performance Analysis of Bacteria and Bacterivore Interactions

Microbiomes have a significant role in global carbon emissions and can potentially shift in response to climate change. Bacterivores play a strong role in regulating soil biomes and therefore could alter the structure of these microbial communities if they were impacted by a slight change in temperature. We hope to estimate how bacterivores and their prey could shift their relationships in the presence of one another across a thermal gradient. We cultured the bacterivore protist *Paramecium aurelia* on 3 bacterial treatments (*E. Coli*, *S. enteritidis* and their combination). We then subjected each combined *P. aurelia* and bacterial treatment to a gradient of temperatures for 18 days.

Zachary Fischer\*  
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Natural Sciences & Engineering Poster Presentation

## Utilizing Matlab 's Neural Network and Tall Array Capabilities to Analyze and Predict the Lifetime of Commercial Aircraft

The owner of any given vehicle will choose to repair said vehicle until the costs of repairing it start to overtake the cost of purchasing a new vehicle. This concept of diminishing returns is especially true with commercial aircraft. Not only do aircraft companies need to understand when the continual fatigue on an aircraft is enough to warrant a new part or aircraft, but they also need to understand how long each part will last (one)4 ta esc (ae)4 (ssc (ae)







With the rising aging population, there is a predominant need of a ~~high~~ and prolonged ambulatory ECG monitoring system due to substantial growth of number of people suffering from chronic diseases which has a significant influence on the US mortality rate. Usage of an ambulatory ECG device would enable the often detection of abnormal and irregular heartbeats which are not often attainable by the Electrocardiogram (ECG) doctor's office. This study is focused on developing a compact ambulatory ECG device which would be more comfortable and ~~use~~friendly with the high quality of ECG signals in comparison to traditional ECG devices. In order to achieve the primary objective of this study, the leading step ~~was~~ ~~to~~ ~~find~~ the optimal position for the placement of ECG electrodes on the chest using simultaneous comparisons of ECG signals obtained from traditional ECG lead I and II. The second step of this study was to design and ~~develop~~ ~~a~~ miniaturized and flexible, Bluetooth-based circuit and ~~skin~~ ~~like~~ electrodes for detection and wireless transmission of ECG signals. As the third step, the fabricated monitoring device and electrodes were assembled on a thin elastomeric membrane to offer a smooth lamination to the skin for user comfort and ~~long~~-ECG monitoring. Finally, human subject tests were performed using the developed ECG device to demonstrate real time ambulatory ECG monitoring.

Cameron McGinley

Faculty Mentor(s): Sergio Salinas Monroy 4.6 (15.74.6 (15.61.6 (r ))TJg6 (r ))TJ (f)e)-10(C) Tc 0 Tw 4.19650.23 [(McG)8ns

medical costs associated with falls for older adults was estimated as \$56 billion dollars by 2020. In order to minimize adverse consequences of falls and provide adequate medical response and care, a reliable and immediate fall detection system is essential. Therefore, this research focuses on the development of a skin-wearable hybrid electronic system for fall risk monitoring, which offers signal fidelity for accurate fall detection and user comfort for long-term use. We have designed and fabricated the wearable device including a 6-axis motion sensor to collect motion data for different human activities (e.g., walking, running, and falls). A number of deep learning algorithms were tested using collected data to identify an optimized fall detection algorithm. The collective results will significantly improve the life quality and independence of older adults as minimizing adverse consequences of falls and related injuries.

Rupert Nunez

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Natural Sciences & Engineering Poster Presentation

### Spatio-Temporal Access to Healthy Food in Sedgwick County

Healthy food access and the local food environment have become an important issue for city and state governments. Since the 1990s, studies have been conducted across the world documenting the food environment at local, state and country wide scales. Most studies only analyze spatial accessibility, no studies have been found investigating the time-dependent availability of these sources.

The objective of this study was to create a detailed analysis of healthy food availability in Sedgwick county in terms of geographical location and time availability. We recorded the GPS coordinates and hours of stores and markets with produce available in Sedgwick county from Google Maps data. We extracted information about the population information using Census tract data from the Census Bureau. We then calculated distances from locations to the centroids of every census tract and estimated the following spatio-temporal accessibility measures:

- The number of stores within 2 miles for different time slots in a day per census tract.
- The timeweighted weekly accessibility index indicating the proportion of time during a week that a census tract has access to food.

Tableau was used to create custom maps displaying data.

The purpose of this multidisciplinary project is to develop a therapeutic sentence building app for people with aphasia, a language disorder in people recovering from a stroke or brain injury. In a preliminary study, people with aphasia learned the sentence building task and reported improved quality of life. However, the existing therapy task relied on the Windows software program DMDX and required a speech therapy clinician to provide feedback and cueing. The goal of the current project is to present the task in an Android app so that people with aphasia can practice the therapy task at home. The app teaches the user to construct complete grammatical sentences by presenting a series of word pairs and providing immediate feedback on which word can come next. The app provides assistance when needed and allows the user to select the difficulty level of the sentences. In addition to guiding the user through the sentence building task, the app will also gather reaction time and accuracy data to allow performance tracking. The significance of creating the app is that it will provide a new therapy tool to help people with aphasia improve sentence production.

John Randall  
Faculty Mentor(s): Brandon Buerge  
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Natural Sciences & Engineering Poster Presentation

## AERODYNAMIC PERFORMANCE OF NOTIONAL INFLATABLE AIRFOILS

In support of an ongoing project focused on investigating the fundamental nature of deployable wing technology for inflatable droppitc

Dang Tran  
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Natural Sciences & Engineering Poster Presentation

## From Natural Language Instruction To Domain-Independent Robotic Planning

Domain-independent planning is the fundamental component in Artificial Intelligence System and Cognitive Robot, which is used to make deliberative decisions in complex scenarios. Different from **specific** planners that are designed to solve hypothesized domains, **independent** planners are applicable on an arbitrary widerange of challenges: logistic system planning, temporal model checking, rescue robot planning, cognitive robotic decision making. Despite the significant efforts in developing general purpose planners, the current state-of-the-art planners are still domain-specific. This paper presents a novel approach to domain-independent planning by leveraging natural language instruction to generate domain-independent planners. The proposed approach is based on a deep learning architecture that takes natural language instruction as input and outputs a domain-independent planner. The proposed approach is evaluated on a set of domain-independent planning problems. The results show that the proposed approach can generate domain-independent planners that are applicable on a wide range of challenges. The proposed approach is a significant step towards domain-independent planning in Artificial Intelligence System and Cognitive Robot.

Sheilja Bhatt  
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## Transparent Solar Cell

With deposits of conventional sources of energy such as natural gas, coal, etc. depleting around the world, and increasing need of energy, scientists have begun turning to other sources. One of these sources is solar energy. The

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Natural Sciences and Engineering Oral Presentation

## CONTINUED DEVELOPMENT/TESTING OF IMPROVED METHODS AND NEW ANTIBODIES FOR IMMUNOHISTOCHEMISTRY

Immunohistochemistry has grown to become a powerful analytical technique to detect and localize the presence of specific cellular proteins at the molecular level. It has extensive uses within medicine to allow for greater efficacy when diagnosing patients, understanding diseases, and expanding possible treatment options. This study aims to apply the functionality of immunohistochemistry to better study the granular morphology of two different squamous cell carcinoma cell lines sources from head and neck cancer cell lines, CAL27 and FaDu, on two different commercially provided multiwell slides. Additionally, this study aimed to observe how different commercially provided primary antibodies would detect specific proteins (ERa, p53, Palladin) in both CAL27 and FaDu cells.

Both CAL27 and FaDu cell lines were grown in mother plates that were then fixed onto multiwell slides (Corning and LabTekII CC<sup>2</sup>) prior to immunohistochemistry. An established immunohistochemistry protocol was established and evaluated regarding its specificity for each antibody tested according to the avidin:biotin:enzyme complex based detection system. The results revealed dramatic differences in: 1) Morphology of the CAL27 and FaDu cells based on which type of multiwell slide they were fixed upon (Corning, LabTekII CC<sup>2</sup>); and 2) Signal intensity between the two cell lines for the Palladin antibody.

Jonathan Coleman  
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## Creep of Ribbons in Honeycomb

Honeycomb cores are a low density manmade cellular material often used in the aerospace industry to make lightweight, stiff sandwich structures. Although core is manufactured in the form of flat sheets, the numerous walls composing its repeating pattern of hexagonal cells possess creep properties which allow it to be permanently shaped under heat into a desired three dimensional geometry. The objective of this research is to experimentally determine the creep properties of cell walls, which influence the bending capacity of the core. Single cell walls prebaked at 450°F for ten minutes were allowed to cool before being heated to a temperature ranging from 100°F to 425°F. After reaching this temperature, they were forcibly conformed to known radii between 0.125in and 0.75in and held in this state for five minutes. They were then removed from the oven and allowed to relax. The radius of curvature retained by each specimen was measured using a digital microscope. The results of the experiments point to a linear relationship between the amount of creep deformation experienced by the cell wall and the temperature at which forming takes place. This data will be critical to the development and calibration of numerical models used to simulate the formation of large core blocks.



James Davies

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activity in the upper arms, shoulders, and back was measured using electromyography. Muscle signals were normalized by comparing them to the maximum voluntary isometric contractions. Exoskeleton effectiveness per muscle and per task was quantified by comparing this normalized signal to the same signal in the no-exoskeleton condition. Participants rated subjective effectiveness on a 10-point scale and commented on the perceived usefulness and comfort of each suit. These metrics were used to search for a significant difference between the “central spine” and “open back” designs.

Andrea Martinez  
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## The Impact of Manufacturing Work Experience on Shoulder Muscle Activation Utilizing Shoulder Passive Exoskeletons

Work-related musculoskeletal disorders (WMSDs) of the upper limbs remain a challenge in the workplace where workers perform repetitive and forceful motions. A relatively new device that manufacturing industries are drifting attention towards are wearable passive exoskeletons in hopes of reducing shoulder injuries. Although some studies have investigated the effects of passive exoskeletons on experienced workers, the majority of the research exoskeletons impact on

conversion efficiency (0.5% vs 3.69%) but, when mixed in a 1:15 Titanium Oxide to Tin Oxide ratio a comparable power conversion efficiency of 2.7% is achieved. Additionally, the synthesized Tin Oxide, mixed in a 1:15 ratio with Titanium Oxide achieved a 2.09% efficiency. Ultimately, with further refinement of morphology, it is concluded that Tin Oxide is comparable to Titanium Oxide as an electron transport layer in perovskite solar cells.

Gissele Mosqueda

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Natural Sciences and Engineering Oral Presentation

## IDENTIFYING MOTIVATIONAL FACTORS AFFECTING ASSIST-AS-NEEDED REHABILITATION

Chronic diseases that lead to immobility frequently require rehabilitative therapy to restore mobility. However, the cost and lack of rehabilitative specialists make it difficult for patients to receive adequate care. One way to address these challenges is through home therapy that uses robot-assisted (AAN) devices, which are wearable devices that enhance physical performance. This approach relies on assist-as-needed (AAN) algorithms that determine when patients need physical aid to complete therapeutic exercises. The purpose of this study was to understand human engagement with robot-assisted AAN devices. A sample of 10 healthy young adults underwent an experimental session that consisted of three tasks of daily living that targeted dexterity. Participants completed the New General Self-efficacy Scale before each task. After each set of 5 repetitions, the difficulty of each task was manipulated, and participants made a Judgment of Difficulty (JOD). We found evidence that participants' JODs were informed by the objective difficulty of each task, the feedback they received in the form of task accuracy, and the physical effort they exerted. These three factors did not influence participants'

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Juan and I have been student teaching this semester. We're currently ~~the heads~~ of our classrooms. So, we work with students, in person and online, every day. However, neither of us have really shown our faces consistently to the online students. Some of them don't even know what we look like. Our students just finished their 3rd quarter of the school year with our ~~inconsistent~~ ~~teaching~~. And we have records of their participation from that whole quarter. During the next quarter, we were thinking we could more consistently show our faces to the online students and record if that gets more participation or feedback from them.

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