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**STRATEGIC INITIATIVE**  
**Undergraduate Research Funding for**  
**STEM Majors at the University of Idaho**

*FINAL PROJECT REPORT*

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**Submitted to:**

**Higher Education Research Council**  
**Idaho State Board of Education**  
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**Boise, Idaho 83720-0037**

**Submitted by:**

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## Executive Summary

Undergraduate research is recognized as a high-impact educational practice that increases the rates of student retention and engagement. At the University of Idaho, it is practiced throughout all units on campus and it is centrally placed in the institution's strategic plan. The Office of Undergraduate Research is tasked with taking the lead in enabling research opportunities for undergraduates at the U of I. Among its roles, it manages various competitive student grant programs that directly support student research.

During FY2021, generous funding from the State Board of Education/Higher Education Research Council permitted the U of I to continue its Summer Undergraduate Research Fellowship (SURF) Program. This intensive 10-week summer research experience actively engages undergraduates in faculty-mentored, independent research. Each student is provided with a \$4,000 stipend in the form of a fellowship which allows them to devote full time effort to their projects. Each student is also provided with \$1,000 to help offset materials and supplies and other project-related expenses. Selection of student participants is a competitive process in which students submit research proposals to the Office of Undergraduate Research. State Board of Education funding supported 10 SURF awards during the summer of 2021.

Funding provided by the State Board of Education/Higher Education Research Council also allowed the Office of Undergraduate Research to support an additional undergraduate researcher during the academic year. This was accomplished through a competitive Undergraduate Research Grant awarded to the student during the spring semester of 2021. This grant supported a semester-long research project under the guidance of a faculty mentor. This grant was in the amount of \$1,000 for materials and supplies and other project-related expenses.

Almost all of UI students supported by State Board of Education funds attended and presented the results of their projects at the Idaho Conference on Undergraduate Research (virtual conference) in July of 2021. One student was unable to attend the ICUR conference due to the fact that her project required her to be in the field collecting data at the time of ICUR. In lieu of presenting at ICUR, this student will present the results of her work at the UI Undergraduate Research Symposium in April 2022.

As noted above, the SURF awards include \$1,000 each for project-related supplies. This year some of our student awardees did not spend the entire amount of their project funds. The on-going pandemic hampered some of the travel and conference presentations our students had planned and budgeted for. These unspent project funds are being returned to the SBoE.

End of project feedback from students and their mentors was overwhelmingly positive. Significantly, none of the undergraduate research projects described here would have been possible without the support provided by the State Board of Education/HERC. We sincerely thank the Higher Education Research Council and the Idaho State Board of Education for making these experiences possible for our students.

This final project report combines all of the student project reports funded by the SBoE awards into a single document.

## Final Project Report: Office of Undergraduate Research Spring 2021 Undergraduate Research Grant

**Grant Recipient:** Jeffrey Badigian, Biological Sciences, University of Idaho

**Faculty Mentor:** Paul A. Rowley, Assistant Professor, Department of Biological Sciences

**Project Title:** Antifungal Killer Toxin Production by Opportunistic *Candida glabrata*

### Project Description

This project began to identify antifungal killer toxin production in the opportunistic fungal pathogen *Candida glabrata*. This commensal organism is becoming a more and more frequent cause of vulvovaginal candidiasis, being the current second most common causal organism of this illness. Isolates had been known to secrete antifungal killer toxin proteins, proteins that are used by various organisms for competitive advantages amongst other uses. The encoding origin of these proteins was unknown and debated to be either genomically encoded or encoded on dsRNA viral satellites. The satellites then repurpose the transcriptional machinery of co-infecting dsRNA Totivirus to propagate and express themselves. Totivirus has been found to increase the virulence of other fungal pathogens, so the potential benefits *C. glabrata* may be acquiring from both toxin production and the totiviruses demanded further exploration.

### Project Accomplishments

To begin, 133 *C. glabrata* isolates from around the world were screened for killer toxin production; 18 killers were found, 16 of which were of clinical origin. The organisms that were the most sensitive to this toxin were the isolates that were most closely related to *C. glabrata*, suggesting a potential use for niche competition. The next step was to perform a dsRNA extraction to attempt to look for viral infection. All killer isolates, including the representative type strain *C. glabrata* CBS 138, tested negative for dsRNA infection. To begin the search for the encoding origin of these proteins within the *C. glabrata* genome, homologs of other known killer toxins were searched for. Four homologs to the *Saccharomyces paradoxus* K62 killer toxin were identified within the *C. glabrata* genome, a toxin that our lab has previously determined that *C. glabrata* isolates have a unique resistance to. Two of these homologs have been cloned into a nonkiller yeast, and both have yielded an active killer toxin when ectopically expressed. The other two remain to be cloned.

PHYRE, a protein folding recognition software, was used to determine a preliminary secondary structure of these four homologs, and they showed similarities to aerolysin-like toxins, a class of proteins known to be virulence factors for pathogenic organisms and have shown extreme toxicity against human cells. When grown on unbuffered media at pH 5.6, *C. glabrata* isolates have shown hemolytic activity, but when screened on media buffered to pH 7.2, this hemolytic activity disappeared. Killer toxins are more active at acidic pH values, so this hemolysis assay suggests that these killer toxins may show toxicity to human cells, though more research is still needed.

### Summary of Budget Expenditures

Supplies	Cost
Restriction enzymes	\$122.76
dNTP mix for PCR identification	\$62.21
Hydrogen peroxide	\$27.95
Syringes	\$46.15
PCR tubes	\$158.88
Kirby Bauer discs	\$36.25
Syringes	\$50.32
Miniprep kit for plasmid isolation of the homologs	\$253.52
Yeast extract for use in yeast media preparation	\$241.96
<b>TOTAL</b>	<b>\$1,000.00</b>

**Conference Presentations**

I presented a poster of my project at the 2021 Idaho Conference on Undergraduate Research (ICUR). I will also present my work at the UI Undergraduate Research Symposium in April of 2022.

**Acknowledgements**

I greatly appreciate the support that was provided by the State Board of Education/HERC as well as the University of Idaho's Office of Undergraduate Research through this spring semester Undergraduate Research Grant. This was a tremendous opportunity for me, and I truly value this experience in conducting research. This included a chance to collaborate with other students in science all across Idaho through the ICUR symposium which was a wonderful experience to be a part of. The Office of Undergraduate's support and that of the State Board of Education/HERC made this project and experience possible and is something I greatly appreciate and am thankful for.

**Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021**

**Fellowship Recipient:** Isaac Blake, Chemical Engineering, University of Idaho

**Faculty Mentor:** Matthew Bernards, Chemical and Biological Engineering, University of Idaho

**Project Title:** Synthesis of Polyampholyte Tissue Engineering Hydrogels via Ultra-Violet Light

**Abstract:** Polyampholyte hydrogels display promising properties to promote healthy regeneration of tissue due to their inherent ability to bypass the body's foreign body response. Research proving these claims has been based on chemically initiated hydrogels; however, more research needs to be conducted on hydrogels photopolymerized using UV-A light. All hydrogels used in this research were created with a constant w/v ratio of the photoinitiator LAP. Four polymerization times were tested for antifouling properties as well as shore hardness and percentage swelling. Initial formulation procedures were created, however, no antifouling properties comparable to chemically initiated hydrogels were reported. It was also found that UV photopolymerization times exceeding 1.5 minutes did not result in significantly different harness and swelling properties.

**Project description:** The main goal of the research conducted this summer was to create procedures for the synthesis of UV photoinitiated hydrogels. The Bernards lab has historically created hydrogels using liquid chemical initiators to start the polymerization chain reaction. However, using UV type A light to start polymerization has many potential benefits over chemical initiators. Briefly, UV photoinitiators require far less time to polymerize and are significantly less cytotoxic to living cells. Cytotoxicity is a very important thing to consider as one end goal of this research is cell encapsulation within a hydrogel for tissue repair scaffold purposes. The first thing that must be verified if a scaffold wants to be implanted in vivo is biocompatibility. The autoimmune response known as the foreign body response is responsible for removing anything deemed foreign in the body. The first step in this process is coating of a scaffold in non-specific proteins, often called "fouling". To remain biocompatible with the body, our hydrogels must be antifouling. To evaluate the antifouling properties of the gels made, each gel was exposed to a fluorescently tagged protein known as bovine serum albumin (FITC BSA). If the gel was in fact nonfouling, then no protein should be present on the surface after rinsing with a buffer solution. Along with antifouling properties, swelling and shore hardness was also measured. Because hydrogels are porous and contain many negatively/positively charged elements, they are subject to swelling when in the presence of other ions or water. Hydrogel volume was measured before and after a 24 hour soak in a phosphate buffered saline (PBS) solution. To measure harness, a shore durometer type OO was used. These instruments measure the resistance of a surface to an applied force. With all the above methods described, data was collected and is presented below.

**Data:** Antifouling results for the photoinitiated gels have not yet been successful. Figure 1 shows a comparison of photoinitiated gels to their chemically initiated counterparts, which have been proven to be antifouling. It is easy to see the bright green on the photoinitiated gels which implies the presence of the protein that has adsorbed to the surface. Our group has many hypotheses as to why this could be happening and have testing plans for the future. Both swelling and hardness results (Figures 2 and 3 respectively) show the same general trend. This trend was that after 1.5 minutes of UV light exposure time, the data starts to taper off and no significant change is observed. The most likely reason for this is that the gel has stopped polymerizing and all free radicals that could be created already have. In the future, testing will be done with increased amounts of photoinitiator or cross linker.

Figure 1: Photoinitiated gels (left) antifouling vs. chemically initiated gels (right)

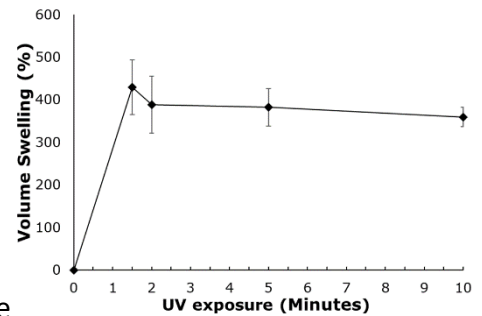
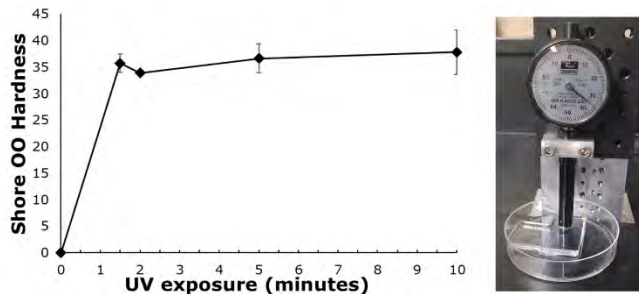


Figure 2: Volume swelling as a function of UV exposure time

Figure 3: Shore OO Hardness as a function of UV exposure time



**Budget Expenditure:**

Reusable biopsy punch: \$565

Lab consumables: \$435 (includes gloves, pipet tips, scintillation vials, well plates, TCPS dishes)

Stipend: \$4,000

**TOTAL: \$5,000**

**Conference Presentation:** I presented this research ICUR in July 2021. I will also be presenting a complete summary of findings at the UI Undergraduate Research Symposium in the spring of 2022 and at the NW Biomechanics conference in April of 2022.

**Acknowledgement:** I genuinely appreciate the opportunities I received through the Summer Undergraduate Research Fellowship supported by the Idaho State Board of Education/HERC. This summer research opportunity was momentous for my academic and personal endeavors. Without the support from the Idaho State Board of Education/HERC I would not otherwise have been able to have had this tremendous opportunity. Thank you.

## Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021

**Fellowship Recipient:** Sarah Burgett, Wildlife Resources Major, University of Idaho

**Faculty Mentor:** Janet Rachlow, Professor, College of Natural Resources, University of Idaho

**Project Title:** Unexpected properties of habitat altered by ecosystem engineers: A pygmy rabbit case study

### Abstract

Ecosystem engineers are species that influence availability of resources by physically altering the environment. Due to these physical changes, they may influence functional properties of habitat including visibility. Habitat structure can conceal animals from predators, but it may also disrupt sightlines, thus reducing an animal's ability to gather visual information. Pygmy rabbits (*Brachylagus idahoensis*) are ecosystem engineers in the sagebrush-steppe ecosystem of the western USA. They significantly influence the growth of vegetation by burrowing, browsing, and defecating within their habitat. However, no study has examined whether pygmy rabbit activity might also alter visibility. My objective was to measure how pygmy rabbit activity influences these functional habitat properties. I estimated visibility in habitat patches around burrow sites using lidar. I am now evaluating if pygmy rabbits influence visibility by comparing active and inactive burrow sites as well as quantifying visibility as a function of duration of burrow occupancy (i.e., number of years during which the burrow system was used). Preliminary results from 23 of the 40 patches suggest that duration of burrow occupancy results in larger viewsheds, however, the analyses are ongoing. Final results are pending due to the large volume of data collected. I expect to submit a manuscript detailing results of the project for publication in a peer-reviewed journal by spring 2022.

### Project Description

#### *Introduction*

Ecosystem engineers modify habitat structure, which can influence habitat properties including availability of resources for other species (Jones et al. 1997). Beavers (*Castor canadensis*) are a well-studied example of an ecosystem engineer; by cutting down trees and building dams they alter the hydrology of an area and create new wetlands (Jones et al. 1996). Although the activities of ecosystem engineers are known to modify habitat structure, it is unclear how changes in structure might influence properties of habitat that serve important functions for wildlife (e.g., provisioning of thermal shelter, security, or physical protection).

Visibility, the visual information accessible to animals in their environment, is one functional habitat property that is influenced by habitat structure. Vegetation that blocks sightlines alters the area from which visual information can be gathered. All the available sightlines and their spatial extents constitute the 'viewshed' (Aben et al. 2018). Animals as diverse as greater sage-grouse (*Centrocercus urophasianus*) and anoles (*Anolis aeneus*) are known to select habitat based on viewshed (Aspbury and Gibson 2004, Eason and Stamps 1992). Activities of ecosystem engineers that change vegetation structure may modify visibility. Such effects are likely to be especially pronounced for herbivorous ecosystem engineers.

Pygmy rabbits (*Brachylagus idahoensis*) are ecosystem engineers endemic to the sagebrush-steppe of the American West. They are obligate burrowers that use burrow systems year-round. By defecating and urinating around their burrows, they add nutrients to the soil promoting sagebrush growth. Pygmy rabbits also browse sagebrush shrubs throughout the year and forage seasonally on herbaceous plants, changing the habitat structure. Because burrow systems can be occupied for decades, the cumulative effects on sagebrush growth and reproduction increase over time (Parsons et al. 2016). These structural alterations to the vegetation likely modify the viewshed available to animals in the sagebrush-steppe ecosystem.

The goal of this study was to investigate if and how pygmy rabbits alter the viewshed around their burrow systems. My objectives were to 1) contrast size and variability of viewsheds in habitat patches with and without pygmy rabbit burrows; and 2) test whether duration of burrow occupancy is related to these viewshed properties. ***I hypothesized that pygmy rabbits would increase the viewsheds around their burrow systems through herbivory, and because sagebrush is a slow-growing plant, the effects would increase over time.*** I predicted that a) habitat patches with occupied burrows would have greater and more variable viewsheds than habitat patches without burrows, and b) the size and variability of the viewshed would increase with duration of occupancy. Alternatively, because nutrients are added to soil by fecal pellets, increased duration of use could result in greater understory regeneration around long-



occupied burrows. If this is the case, I predict that there will be a non-linear relationship in which the viewshed will increase initially and then decrease as duration of occupancy increases. Finally, I also expect that viewshed size will be negatively related to the distance from the burrow entrance because pygmy rabbits spend more time browsing close to the safety of their burrows.

## Methods

### Study Site

This study was conducted at Dr. Rachlow's long-term study site in the Lemhi Valley of eastern Idaho where she has collected census data on pygmy rabbit burrows from 2002 to 2018. The vegetation of this site is dominated by sagebrush, mostly Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) (Sanchez et al. 2009). At this site, rabbit burrows occur almost exclusively within mima mounds, which defined the habitat patches surrounding burrows.

### Field data collection

I determined the level of pygmy rabbits' activity (active or inactive) at censused mounds using methods established by Parsons et al. (2016) by looking for signs of digging and pellets. The last census was completed in 2018, and I assumed that mounds active in 2018 that were also active in my survey were continuously active during the intervening years. Using the census data and my survey, I divided the mounds into 4 categories (occupied for 4-6, 7-9, and 10-20 years, and unoccupied in all years). I randomly selected 10 mounds in each category for analysis.

At active mounds, I randomly selected one burrow entrance, and at all mounds, I randomly selected 3 sites for habitat sampling. At each site, lidar data characterizing 3D habitat structure were gathered using a Leica BLK360 terrestrial laser scanner placed at the eye height of a pygmy rabbits (~15 cm above the ground surface).

Because rabbit activity is known to influence sagebrush growth and regeneration, I also measured the three tallest shrubs to estimate shrub height on the mounds and counted the number of seedlings (<10 cm) in a 0.25m<sup>2</sup> plot at each site. I also measured the radius of the mounds to quantify patch size as a covariate.

### Data Processing and Analysis

I am estimating the viewshed at each site using the R package *viewshed3d*, which measures the distance that sightlines travel in every direction from the position of an animal within 3D lidar data (Lecigne et al. 2020). I will compare how the viewsheds change between and within the mounds using ANOVAs. I will also analyze the effects of duration of occupancy on the size and variation of viewsheds using generalized linear models.

## Results

This summer, I collected data at all 40 selected mounds, which included 150 lidar scans. I am continuing to process data, due to the large volume. At this time, I have calculated the viewsheds at 23 of the mounds, totaling 92 of the 150 lidar scans. Preliminary data analyses suggest that viewsheds increase with duration of occupancy as expected.

I plan on finishing data processing and analysis during the fall and will continue refining my manuscript for submission to a peer-reviewed journal (e.g., *Ecosphere*) in spring 2022.

## Summary of Project Accomplishments

I spent 4 weeks at the field site where I assessed, selected, and collected data from 40 mounds. I learned how to collect lidar and habitat data. Also, I participated in data collection for another project, which provided me with additional field research experience, including trapping and handling pygmy rabbits, and using radio telemetry. When not in the field, I learned how to process lidar data and used the *viewshed3d* package to compute viewsheds. I also attended the Idaho Conference of Undergraduate Research and presented preliminary results of my research.

## Summary of budget expenditures

Travel	\$950
Stipend	\$4,000
<b>Total</b>	<b>\$4,950</b>

## Literature Cited

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**Acknowledgement:** I truly appreciate the generous support provided the State Board of Education/Higher Education Research Council in the form of a Summer Undergraduate Research Fellowship from the UI Office of Undergraduate Research. This was a tremendous experience for me. Without this support from the SBOE/HERC, I would not have been able to participate in this research.

## **Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021**

**Fellowship Recipient:** Joshua Carey, Forestry and Sustainable Products, University of Idaho

**Faculty Mentor:** Lili Cai, College of Natural Resources, University of Idaho

**Project Title:** Effect of Lauric Arginate on the Growth and Morphology of Wood Decaying Fungi

### **Abstract**

Bio-based preservatives represent one of the most promising solutions for next-generation wood protection due to their sustainability, low environmental impacts and comparable antimicrobial efficiency to current non-bio-based counterparts. Herein, we reported the effects on the growth and morphology of Lauric Arginate (LAE), a fully biobased antimicrobial compounds, against four common wood decaying fungi using a soil block test alongside a series of light and fluorescence microscopy observations. Wood cubes of poplar and pine were treated with different concentrations of LAE, and their weights recorded, they were then placed in a culture bottle containing a feeder strip of one of four test fungi (two white rot and two brown rot). These bottles were then incubated for eight weeks, and their weights recorded again. During the incubation period, a set of microscopy observations was conducted on test fungi that had grown from a malt agar media that had been amended with low levels of LAE. These experiments revealed that, while LAE does prohibit mass loss due to fungi in our pine samples, it does not in poplar samples. Furthermore, no significant morphological changes could be detected at the cellular level during a microscopy test.

### **Project description**

#### Soil Block Test

Conducting a soil block test requires sample pieces to be cut into cubes measuring 14mm on each side, these cubes are cut out of two types of wood, a hard wood and a soft wood. For this experiment Southern Yellow Pine and Poplar were used as our test species. These cubes then had their oven-dry weight recorded before being treated with one of our three types of LAE (LAE 20, 2X and 25) each corresponding to a different concentration of lauric arginate that's suspended in the solution. After treatment the cube's wet weight is recorded and they are oven dried again to determine mass gain due to treatment. After acclimating back to relative humidity, the samples are ready to be placed in culture bottle for incubation. The culture bottles are constructed by being filled halfway with soil that has been autoclaved and sifted to remove any impurities they are then inoculated with feeder strips of one of our four test fungi and allowed a gestation period before our samples are introduced to allow for the fungi to take a foothold in its new eco system. In order to introduce the samples, simply place the cubes on top of the overgrown feeder strips and label the bottle. The assembled bottles need to be placed in an incubation chamber for eight weeks to allow the fungi to overtake the new material. After the incubation period the samples are removed from the bottle and cleaned of all fungi growing around the cube. The samples are then weighed again to determine their final mass loss and compare it to the control.

#### Microscopy analysis

All microscopy observation starts with the same structure for slide preparation, the main idea is to encourage the test fungi to grow off a piece of amended malt agar media and onto a microscope cover slide that can then be removed and transferred onto a clean slide and observed. In order to achieve this goal a specific construction was followed: inside of a petri dish a moist piece of filter paper is placed to provide water to the growing fungi, on top of that is a microscope slide resting on two slices of plastic netting to separate it from the filter paper, a square of amended malt agar media is placed on top of the slide which is then inoculated with test fungi by placing a small tuft of mycelium on each of the four side faces, finally a cover slide is placed on top of the malt agar square and the petri dish is sealed. After allowing the fungi to grow from the amended malt agar for a day or two depending on its rate of growth, the cover slide is removed and is either placed directly onto a clean slide or dyed beforehand depending on if the sample is to be used for light or fluorescence microscopy. These slides are then carefully recorded, and sample pictures are taken of the new growth tips that represent the morphology of the observed sample. These pictures are then carefully

examined for key differences between the amended and control groups to shed light on LAE's effects on the fungi's morphology and how it may disrupt fungal growth.

### Results and discussion

Upon reviewing the pictures taken during the microscopy trial, no clear morphological difference between the control fungi and the fungi that had grown off amended media. This could likely be due to the low concentrations of LAE that were used in the media, however when the concentration of LAE was increased no growth could be observed. These results lead to the conclusion that LAE is a fungistatic as opposed to a fungicide. The compound inhibits the growth of fungus without directly damaging any mycelium. Upon reviewing the results of the soil block test, the observed pine samples behaved as expected with a mass loss of 20% less than the control in the amended samples. However, the observed poplar samples saw an increase in mass loss of about 10% in the amended cubes. This could be caused by morphological differences between the two species of wood, or LAE's interaction with poplar once impregnated into the wood. Most likely, it is due to the preservative leaching from the poplar samples and into the soil.

### Budget Information

- Provided by a USDA NIFA grant (~\$1000)
    - Culture Bottles
    - Petri Dishes
    - Microscope Slides
    - 4000 ml beakers
    - Raw Poplar & Pine
  - Caliper to measure the dimensions of the wood samples (\$15.99)
  - Parafilm to wrap the petri dishes (\$168)
  - Stipend (\$4,000)
- TOTAL spent: \$4,183.99

### Acknowledgement

A special thanks to the Idaho State Board of Education/HERC for making all of this possible by providing funding via the SURF grant. It was a tremendous experience to be able to take part in, and without their support I would not be able to take part in this research.

## **Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021**

**Fellowship Recipient:** Morgan Flynn, Movement Sciences, University of Idaho

**Faculty Mentor:** Chantal Vella, Professor, Dept. Movement Sciences, University of Idaho

**Project Title:** Associations between screen time and glycemic control in adults with and without type 2 diabetes

### **Abstract**

**PURPOSE:** To assess the associations between screen time (ST) and glycemic control, as measured by glycosylated hemoglobin levels (HbA1c), in middle-aged to older adults with and without type 2 diabetes. **METHODS:** Adults (mean±SD: age: 47.5±17.4y, BMI: 29.5±7.4 kg/m<sup>2</sup>) participated in the study. ST was subjectively measured through an 18-item screen-time questionnaire that categorized ST into weekday, weeknight, weekend, and background. Total sedentary behavior (SB) was subjectively measured using the Sedentary Behavior Questionnaire. A finger stick blood draw was completed to measure HbA1c. Participants completed a food frequency questionnaire online using the NIH Diet History Questionnaire III. Pearson correlation and linear regression analyses were used to assess the associations among the variables while controlling for age, sex, and dietary intake. **RESULTS:** Most participants were non-Hispanic white (80%), non-smokers (91%) and had family history of type 2 diabetes (43%). On average, participants spent 484.6 ±162.9 min·d<sup>-1</sup> in SB ( 50% of the waking day). Of this time, 446.7 ± 168.4 min·d<sup>-1</sup> were spent on a screen, with 45.0 ± 23.4 min·d<sup>-1</sup> occurring during the weeknight. Participants engaged in background ST 111.1 ± 132.8 min·d<sup>-1</sup>. Positive correlations (p<0.05) were found between HbA1c and weeknight ST (r= 0.409), and background ST (r=0.451). **CONCLUSIONS:** Participants spend large amounts of their day engaged in SB, which is consistent with national data. Moreover, of this time spent in SB, the majority is spent looking at a screen. Our preliminary findings suggest that increased ST, particularly weeknight and background ST, is associated with higher HbA1c and risk of type 2 diabetes.

### **Project Report**

#### **Project Description**

The aim of this project is to assess the associations between screen time and glycemic control, as measured by HbA1c. In addition, we hope to examine if these associations are different across healthy individuals in comparison to individuals with type 2 diabetes. We hypothesize that higher amounts of screen time will be associated with higher HbA1c, indicating worse glycemic control in both healthy and type 2 diabetic participants. We also hypothesize that excessive screen time may impact glycemic control of those with type 2 diabetes more than those who are healthy.

Previous studies have determined a childhood association between screen time and insulin resistance, with a paucity of data on this topic in adults. Children spending 3+ hours on a screen were found to have an increased resistance to insulin, which impacts glycemic control, in comparison to children spending only 1-2 hours on a screen (Nightingale, Rudnicka, Sattar, Cook, Whincup, & Owen, 2017). The importance of this proposed study is to determine whether various forms of screen time have a negative impact on glycemic control within an adult population. Moreover, having two participant groups, diabetic and non-diabetic, allows us to see if the associations between screen time and glycemic control vary among healthy and diseased individuals. For example, we will be able to determine if a given amount of screen time impacts glycemic control more in healthy or type 2 diabetic individuals. We can do this by looking at the slope of the relationship between screen time and glycemic control in each sample via statistical tests of interaction. For this study, we will also measure dietary intake and physical activity through surveys, as these factors can influence HbA1c. These findings will be significant in providing preliminary data to support recommendations for screen time reduction to decrease risk for future health complications.

**Summary of Project Accomplishments:**

Over the course of summer 2021, we have successfully recruited and completed data collection on 35 participants (13 men and 22 women), of which 26 were healthy controls, 4 had prediabetes, and 3 had type 2 diabetes. Unfortunately, there were not enough participants to look at differences in associations between healthy and type 2 diabetes participants so all participants were grouped together for analyses. The mean age and body mass index of our participants was  $47.5 \pm 17.4$  y and  $29.5 \pm 7.4$ , respectively. Most participants were non-Hispanic white (80%), non-smokers (91%) and had family history of type 2 diabetes (43%). Our preliminary findings show significant correlations between screen time and HbA1c. By separating the type of screen use (e.g., weekday, weeknight, weekend, and background), we show a positive correlation between weeknight screen time ( $r=0.409$ ) and HbA1c. Moreover, background screen time ( $r=0.451$ ) is also correlated with HbA1c. To better understand these associations, our regression analysis controlled for age, sex, and family history of type 2 diabetes. The associations between weeknight screen time and background screen time remained significant even with these variables controlled for ( $p < 0.05$ ). Comparatively, when we controlled for diet (total energy intake and total sugars), the associations, except the associations with background screen time, were reduced to non-significance ( $p > 0.05$ ). As a result, we see the impact that diet poses on glycemic control. Our preliminary findings suggest that increased screen time, particularly weeknight and background screen time, is associated with higher HbA1c and risk of type 2 diabetes.

This SURF grant allowed me to develop hands-on skills needed to work as a research assistant. I've gained administrative experience in participant scheduling and data entry. Moreover, I was given the chance to run study visits, ranging from explaining questionnaires to collecting physical data such as height, weight, and finger-stick blood draws. Lastly, I furthered my knowledge in statistical analysis. While putting together my poster, I developed a better understanding of correlation and significance. All of which was due part to the large amount of group work put in to succeed. Not only did I meet with my supervisors to review what I wrote, but my public speaking abilities were put to the test. The different types of ICUR sessions allowed me to practice a variety of ways to present my research. With the support of my mentors and the funds from the SURF grant, my research abilities had flourished. As I continue my career in research, I will be able to thank all those who supported my undergraduate studies.

**Summary of Budget Expenditures:** The \$1,000 provided for supplies was spent on supplies to collect blood samples and assay kits to measure HbA1c. This award included a \$4,000 stipend. TOTAL: \$5,000

**Conference presentation:** I presented a poster of my work at the UI Undergraduate Research Symposium in April 2017 and at the Idaho Conference on Undergraduate Research in July 2017.

**Other Pertinent Information:** This research project is a part of a larger study investigating the influence of physical activity, sedentary behavior, and diet on the gut microbiome and diabetic neuropathy. I will continue helping on this project through the fall.

**Acknowledgement:** I truly appreciate the generous support provided the State Board of Education in the form of an Undergraduate Research Grant from the UI Office of Undergraduate Research. This was a tremendous experience for me. Without this support from the SBOE, I would not have been able to participate in this research.

## **Final Research Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship - Summer 2021**

**Fellowship Recipient:** Julianna Martin, Geological Sciences, University of Idaho

**Faculty Mentor:** Elizabeth Cassel, Department of Geology and Geography

**Project Title:** Recurrence Intervals of Glacial Lake Missoula Flooding Events Using Radiocarbon Dating

### **Abstract**

The Great Missoula Floods were a series of cataclysmic floods caused by ice dam breakages on Glacial Lake Missoula during the late Pleistocene, 21,000 to 14,000 years ago. The periodic breaks and reformations of the Purcell Lobe of the Cordilleran Ice Sheet allowed floodwaters to move west following the Columbia and Snake rivers. These floods massively impacted the geomorphology and sedimentation of Idaho, Washington, and Oregon, creating the infamous Channeled Scablands of eastern Washington. The exact ages of these floods and the interval at which they occur are currently not well known, thus the drivers of these ice dam breakages have been loosely hypothesized. I sampled organic carbon from two locations to act as a source and sink record of the floods in order to date them, three samples were taken from each location to be dated. These samples were processed and pretreated in the Tectonics and Basin Analysis Lab on the University of Idaho campus but dating results have not yet been returned. By measuring stratigraphic sections in both Missoula lacustrine deposits and Pasco Basin flood deposits, flow properties of the floods dictate composition and layering of the sediment with sands followed by clays being indicative of a new flooding period, giving us insight into the number of flood intervals between extracted samples. Once dates are returned, I will be able to correlate flooding periods to a paleoclimate record in order to establish any climatic drivers of ice dam breakage. Due to the timeline of my research, my presentation has been pushed back to October of 2021 and a final poster has not yet been constructed.

### **Project Accomplishments**

1. Field training, procedurals, and preliminary data

Part of my project plan was to examine potential sampling locations based on the position of the glacial lake and flood deposits in the northwestern United States. I established the Glacial Lake Missoula lacustrine deposits in and surrounding Missoula, Montana, and flood deposits in the Pasco Basin, Washington as my primary sampling locations for field work. I also used this period to explore possible sampling techniques to maximize sample outputs and to limit modern carbon contamination.

2. Sample and data collection

Once at the field sites, I measured the stratigraphic section of each sampling location to establish water level changes and the introduction of new sediments via flooding events. In order to identify carbon within the deposits, I used hydrogen peroxide to react with any carbon present. Sampling was accomplished to minimize the amount of modern carbon contamination using nitrile gloves and storage in either plastic or glass containers. Other measures such as external sediment and root removal were used to limit the amount of contamination of modern carbon from the outcrops the samples were taken from.

3. Sample processing and pretreatment

I processed each sample in lab, extracting organic carbon and chemically pretreating them using an acid-base-acid reaction series as preparation for Carbon 14 lab testing through Kecks-CCAMS lab. Seventeen samples were extracted and processed, the best three from each sampling location were chosen for carbon dating based on their carbon content and stratigraphic location. Sample blanks and a date control sample were also prepared in the lab to be sent in with the original six samples.

### **Results**

No official results will be found until C14 dating results are returned and analyzed. At that point I will use those dates to establish flood intervals and investigate possible climatic drivers for flooding events.

### Summary of Budget Expenditures

<b>Supplies:</b>	<b>Cost</b>
Hydrogen peroxide (sampling)	\$10
Potassium Hydroxide (pretreatment)	\$30
Services:	
Carbon 14 Testing (6 samples)	\$620
<b>Subtotal (supplies)</b>	<b>\$660</b>
<b>Stipend</b>	<b>\$4,000</b>
<b>TOTAL</b>	<b>\$4,660</b>

### Conference Presentation

Due to the timeline of my research and as I outlined in my proposal, I was in the field collecting data at the time of ICUR. I will be presenting at the UI College of Science Student Research Expo in October of 2021 and the UI Undergraduate Research Symposium in Spring 2022.

### Acknowledgments

I would like to thank the State Board of Education/HERC for supporting undergraduate researchers like me via the Summer Undergraduate Research Fellowship. It has been a transformative learning experience that would not have been possible without the support of the SBOE. Thank you!



## Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021

**Fellowship Recipient:** Shalom Masango, Mechanical Engineering, University of Idaho

**Faculty Mentor:** Matthew Swenson, Mechanical Engineering, University of Idaho

**Project Title:** Evaluation of fatigue properties in rolled and formed aluminum sheet metal

### ABSTRACT

Aluminum components manufactured from sheet metal are used in numerous applications including electronics enclosures. Due to the limited data for fatigue properties of aluminum, engineers who create structural designs using aluminum sheet metal and formed sheet metal components have less data. The goal of this research is to use the sheet metal fatigue testing equipment to identify the fatigue properties of both flat and formed aluminum sheet materials. The experiment involves a proper set up of the device including sample loading, dimensional setup and centering, force measurement, software programming, and cycling verification. Each experiment is expected to span for several days. As this occurs, sample preparation for subsequent tests and data analysis will occur in parallel. Five separate sample sizes will be conducted on both flat sheet metal samples and formed sheet metal specimens. From this equipment, fatigue properties (S-N curves) will be generated for Aluminum alloy 5052 for both flat and formed sheet metal. This study will provide a methodology that will be formed for ongoing research of alternative aluminum alloys and other sheet metal materials.

### PROJECT DESCRIPTION

The goal for this research is to obtain S-N curves on both flat and formed aluminum sheet metal. A machine designed and made by former University of Idaho students is used during this process. This work was adopted from prior Capstone teams. Continuation of this topic was carried on due to limited data for fatigue properties of aluminum for engineers who create structural designs.

#### Method

1. Sample loading between rollers
2. Dimensional setup and centering of the rollers from 4.5 inches to 9 inches
3. Force measurement of the load cell
4. Software programming using Python and Raspberry Pi monitor
5. Cycling verification of the center rollers

Five separate samples were ran for each spacing. More runs would have been made if the number of cycles recorded for each run were not 15% within each other. The duration for the aluminum sheet metal to break ranged from 4 minutes to 60 hours. The machine does not have an automatic stop switch therefore it was not run overnight. In some cases, the machine ran overnight on the first day of sample loading as it would take more than 16 hours for the metal to break.

### SUMMARY

Figure 1: Before and after pictures of the sheet metal after undergoing fatigue



Figure 2: S-N curve for flat metal

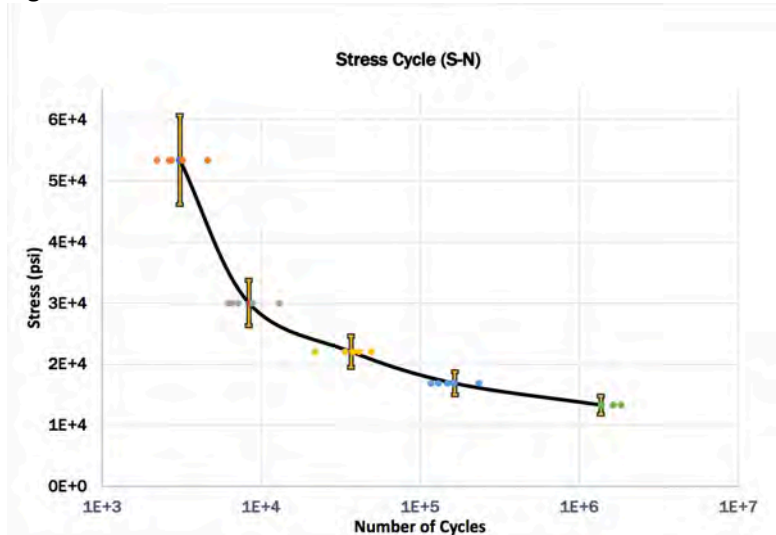
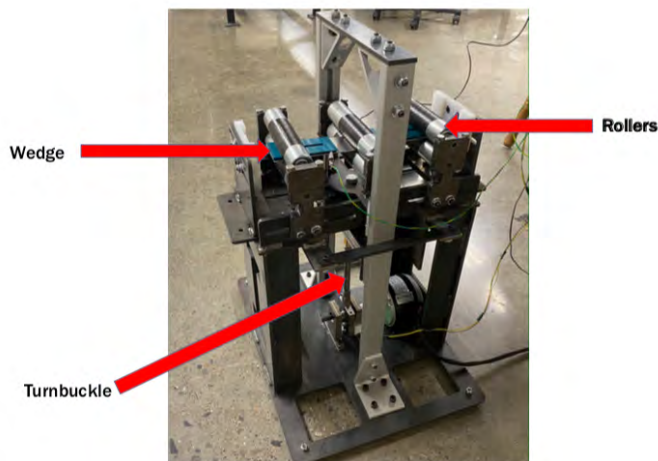


Figure 3: Stress Fatigue Machine



Modifications

A few modifications to the design were made for the break detection. A wedge was designed and 3D printed for a more visible separation when the metal breaks. All 6 rollers were wrapped with electrical tape to reduce conduction.

Challenges

Due to time constraints, there was little work done on the formed metal. It took a long time for the biggest spacings to break. A new turnbuckle was made from the machine shop for the formed metal and a durable wedge to hold the metal together.

**Summary of Budget Expenditures:**

Supplies:	Cost
Motor Drivers	\$26.98
Sample Prep Supplies (Allied)	\$342.60
PLA	\$29.65
Sample Prep Supplies (UI ChemStores)	\$50.52
Sample Materials	\$74.52
Electrical Tape	\$1.13
<b>Stipend</b>	<b>\$4,000</b>
<b>TOTAL</b>	<b>\$4,525.40</b>

**Conference Presentation:** I presented a poster of my work at the 2021 Idaho Conference on Undergraduate Research in July.

**Acknowledgement:** I am thankful for the financial support from the State Board of Education and Higher Education Research Council that made this Summer Undergraduate Research Fellowship from the Office of Undergraduate Research possible. Without this grant I would not be able to conduct this study. I am very thankful for the help from my mentor Dr. Matthew Swenson.

## **Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021**

**Fellowship Recipient:** Lenah Matz, Movement Sciences, University of Idaho

**Faculty Mentor:** Joshua Bailey, Assistant Professor, Department of Movement Sciences

**Project Title:** The effects of Sure Squat on lifting mechanics for individuals with a history of resistance training and non-resistant training.

**Abstract:** Context: The occurrence of knee valgus, anterior pelvic tilt, and subsequent quadricep dominance while lifting can lead to injury and hindered performance. Historically, a lumbar assistive device can be used to correct lifting form and increase performance. However, the additional correction of knee valgus and resulting quadricep dominance could also aid in injury prevention and performance improvement. Objective: To investigate the effects of an external corrective lifting device on muscle activation patterns and movement mechanics. It is hypothesized that while wearing the corrective device, movement mechanics will change causing adjustments in muscle activation patterns. Methodology: 12 apparently healthy participants completed both sessions, 9 with a history of resistance training (at least 1 year of free-weight training) and 3 without a history of resistance training in the last year. Data collection consisted of two sessions: 1) consenting, screening, familiarization of the corrective device and establishment of 5 repetition maximum (5RM) for lifting tasks (BS: Back Squat; DL: Dead lift). 2) performance of 3 trials of each task at multiple intensities (Body weight, 50% 5RM, and 100% 5RM). Device condition order was counterbalanced with odd participants performing each task without the device first and even participants performed with the device first. During session two, twelve Delsys surface electromyography (sEMG) sensors were attached to six muscle bellies bilaterally: Rectus Femoris, Bicep Femoris, Adductor Longus, Gluteus Maximus, Gluteus Medius, and Erector Spinae groupings. Movement mechanics were assessed using an 8-camera Vicon motion capture system synced with two AMTI force platforms. Participants were additionally instrumented with a full-body passive reflective marker set to represent skeletal motion. To ensure accuracy between models, reflective markers representing the pelvis (L/R ASIS, L/R ILCT, L/R PSIS) were measured from the marked points on the ground to ensure similar placement between conditions. For the BS and DL conditions, foot positions were outlined on the force platforms to reduce influence of foot position on differences between conditions. Participants self-selected their grips and shoe ware and asked to maintain that choice through subsequent trials. Following the completion of all tasks in both device conditions, participants completed a questionnaire about their thoughts on the device. Conclusion: It appears from the initial data that those who were in the non-resistance training identified a benefit using the device. It is unclear whether there is a benefit in lifting mechanics due to the data still being processed. From participant self-perceived device-aid during a task non-resistance trained individuals reported an increased awareness of form while wearing the device.

### **Project Accomplishments:**

1. Assessment of difference in perceived aid from correction between populations with and without a history of free-weight resistance training.
  - a. This was accomplished through a survey administered after successful completion of session 2. A notable amount of participants reported a perceived performance aid from the external corrective device; additional participant responses reported satisfaction based on questions regarding comfort, donning and doffing, and perceived fit. Though the population without a history of free-weight resistance training reported varying perceptions on device-performance aid. Overall, from the free-response questions provided in the survey participants had mixed reviews on if *Sure Squat* helped them during the tasks.
2. Assessment of muscle activation pattern and magnitude differences, lower extremity and trunk kinematics, and lower extremity joint moments between conditions of with and without the external lifting device.

- a. The muscle activation and the movement mechanic data are currently being processed. To assess the differences between device conditions, dependent t-tests will be conducted on all movement mechanic dependent variables. Muscle activation patterns will be assessed in terms of muscle activation onset and root mean squared values within phases of the tasks.

**Summary of Budget Expenditures:**

Item	Unit cost	Units	Total cost
<u>Rogue 45lb Ohio power bar</u>	\$ 280.00	1	\$ 280.00
<u>Oso Magnetic Rogue Barbell Collars</u>	\$ 70.00	1	\$ 70.00
<u>210lb Rogue US-MIL Spec bumper</u>	\$ 435.00	1	\$ 435.00
B&L engineering -double sided tape	\$ 15.00	5	\$ 75.00
B&L Engineering - shipping	\$ 9.82	1	\$ 9.82
<u>Cover-roll</u>	\$ 10.75	5	\$ 53.75
<u>Leukotape</u>	\$ 13.90	5	\$ 69.50
Stipend	\$ 4,000.00	1	\$ 4,000.00
TOTAL			\$ 4,993.07

**Conference Presentation:** I presented this research in part at the Idaho Conference of Undergraduate Research (ICUR) in July 2021. I will also be presenting my work at the U of I Undergraduate Research Symposium in April 2022 and at the NW Biomechanics conference in April of 2022.

**Acknowledgement:** I truly appreciate the opportunities I received through the Summer Undergraduate Research Fellowship program supported by the Idaho State Board of Education and the Higher Education Research Council. Participating in this summer research project was a tremendous experience for me and one for which I am grateful. Without the support from the Idaho State Board of Education I would not otherwise have been able to have had this tremendous opportunity, thank you.

# Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021

**Fellowship Recipient:** Gabriel Nelson, Materials Sciences, University of Idaho

**Faculty Mentor:** Mark F. Roll, Assistant Professor, Material Sciences Engineering, University of Idaho

**Project Title:** Synthesis of mesoporous silica nanoparticles for use in extrusion polymerization

**Abstract-** A polymer synthesis technique called extrusion polymerization uses mesoporous silica particles to crystallize polymers as they form. This technique circumvents postprocessing usually required to produce such materials. The goal of this project was to synthesize mesoporous silica particles using a variety of different techniques to study the effect of mesoporous silica nanoparticle structure on extrusion polymerization. Mesoporous silica nanoparticles were synthesized using TEOS and CTAB with the addition of structure directing salts. These salts produced structure variations that will lay the groundwork for variability in future extrusion polymerization experiments. Synthesized mesoporous silica was characterized using XRD.

## INTRODUCTION

“Arrays of silica nanochannels (ASNCs) are ordered mesoporous silica particles with hexagonal prismatic shape.<sup>1</sup>” These ordered mesoporous silica particles are synthesized in a process called “liquid-crystal templating”<sup>2</sup> in which micellar rods self-assemble into an array of cylinders that become the template for silica that is introduced into the system. After the silica is attached, the organic templates are removed leaving ASNCs.

These ASNCs can be used to conduct a special kind of polymerization reaction called “extrusion polymerization.” In this reaction, ASNCs act as a solid support for catalysts that drive polymerization reactions. Once a polymerization reaction is catalyzed this way the polymer will grow through the narrow channels of the ASNC which restricts the polymer’s tendency to coil. This restriction produces extended polymer chains and, combined with the order created by the honeycomb structure of ASNCs, synthesizes crystalline polymer fibers.<sup>3</sup> This process circumvents the usual postprocessing steps, such as extrusion or spinning, usually needed to synthesize similar crystalline polymer fibers.<sup>3</sup>

The goal of this work was to synthesize highly ordered ASNCs using different preparation techniques to identify the effect of their structure on extrusion polymerization that will be conducted in future research. Syntheses were conducted with the addition of  $\text{CaCl}_2$ ,  $\text{BaCl}_2$ , and TBABr that demonstrated varying effects on the structure of ASNC particles. These structural differences lay the groundwork for variability for future extrusion polymerization.

## RESULTS AND DISCUSSION

### Characterization

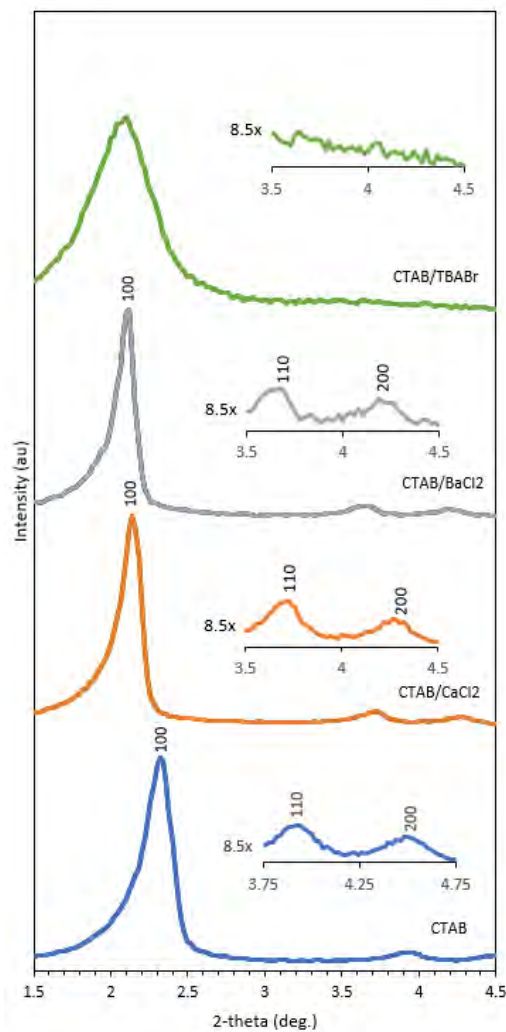


Fig. 1 XRD Patterns for uncalcinated ASNCs synthesized with CTAB/TBABr, CTAB/ $\text{BaCl}_2$ , CTAB/ $\text{CaCl}_2$ , and CTAB. Graphs are offset for clarity.

Powder X-ray diffraction powder patterns (Fig. 1) show 3 peaks that can be indexed to the (100), (110), and (200) reflections on a hexagonal unit cell. The pore center distance  $a$  was calculated using Bragg's law ( $\lambda n = 2d\sin\theta$ ) and eqn (1).<sup>4</sup>

$$\frac{1}{a^2} = \frac{4}{3} \left( \frac{h^2 + hk + k^2}{a} \right) + \frac{l^2}{c^2} \quad (1)$$

Table 1 Data derived from XRD

	$d_{100}$ (nm)	$a$ (nm)
CTAB	3.81	193
CTAB/BaCl <sub>2</sub>	4.17	231
CTAB/CaCl <sub>2</sub>	4.13	227

#### *Effect of structure directing salts on yield*

Reaction time and the presence of structure directing agents significantly impact the yields of ASNC synthesis. Syntheses with CTAB/CaCl<sub>2</sub>, CTAB/BaCl<sub>2</sub>, and CTAB/TBABr show greater yields overall. Additionally, longer synthesis times also have larger yields (Table 2).

Table 2 Yield Data

	Reaction time (m)	ASNC:surfactant yield ratio
CTAB	90	0.178
CTAB	240	0.247
CTAB/BaCl <sub>2</sub>	95	0.344
CTAB/CaCl <sub>2</sub>	95	0.320
CTAB/TBABr	97	0.171
CTAB/TBABr	160	0.280

## EXPERIMENTAL

### *Recrystallization of CTAB*

CTAB was recrystallized to remove impurities from the surfactant. A recrystallization procedure<sup>5</sup> was developed that recovered an average of 82.5% of the initial CTAB mass as crystals and performed equally efficiently at larger scales.

### *Synthesis of ASNCs*

ASNCs were synthesized (with CTAB) using a procedure laid out by Zucchetto and Brühwiler. For a typical synthesis, recrystallized CTAB (4g, 11 mmol) was dissolved in a mixture of distilled H<sub>2</sub>O (76mL, 4.2 mol) and hydrochloric acid (37%, 60 mL) by stirring for

10 min in an Erlenmeyer flask. Once the CTAB was fully dissolved in solution, a structure directing salt was added, stirred until dissolved, then filtered. The solution was cooled to 0°C in an ice bath for 30 min, followed by the slow addition of cold TEOS (2 mL, 9 mmol) and additional stirring for 30 s. The mixture was left at 0°C in the ice bath for 90 min then filtered and washed with H<sub>2</sub>O. Amounts of 1.5g (13.5 mmol) of CaCl<sub>2</sub>, 2.81g (13.5 mmol) of BaCl<sub>2</sub>, and 9.67g (30 mmol) of TBABr were used in the syntheses as structure directing salts. CaCl<sub>2</sub> took 25 minutes of stirring to fully dissolve into the mixture while the mixture had to be heated and stirred for ~10 minutes to dissolve the BaCl<sub>2</sub> and TBABr. Additional experiments were conducted in which the reaction was left in the ice bath for up to 4 hours.

During the reaction the mixture progressively gets milkier until solid precipitates begin to fall out of the solution and onto the bottom of the flask. Initially, the reactions were filtered directly after they were taken out of the ice bath; however, more precipitates formed in the filtration waste overnight and were collected again. Further analysis is required to determine if these secondary precipitates are structurally different from the ASNCs acquired in the initial filtration.

### FUTURE WORK

The second half of the research still needs to be conducted. The two major experiments that remain are attaching polymerization catalysts to lab synthesized ASNCs and conducting extrusion polymerization reactions using lab synthesized ASNCs. Analysis will be done to identify catalyst attachment along with material analysis of polymers synthesized with the ASNCs. Anticipated characterization techniques are XRD, GPC, NMR, electron spectroscopy, and DSC.

### ACKNOWLEDGEMENTS

This work was supported by the Idaho State Board of Education in the form of a Summer Undergraduate Research Fellowship and included \$1,000 for project related expenses and a \$4,000 student stipend.

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[https://doi.org/10.1007/978-1-4899-0148-4\\_5](https://doi.org/10.1007/978-1-4899-0148-4_5)
- 5 For the recrystallization process CTAB (2g) was dissolved in heated methanol (6 mL). This solution was slowly added to ethyl acetate (75 mL) that had been heated to the point where it just started bubbling. Once fully dissolved, the solution was removed from heat and left to sit overnight so CTAB would crystallize out. Filtered and washed with ethyl acetate.
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**Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) - Summer 2021**

**Fellowship Recipient:** Riley Parr, Chemistry, University of Idaho

**Faculty Mentor:** Dr. Mark Roll, Assistant Professor, Department of Material Science and Engineering

**Project Title:** Stereospecific Emulsion Polymerization of Isoprene

**Background:** The United States synthetic rubber program is a significant historical and scientific event that took place from 1939-1945. At the beginning of World War II, the natural supply of rubber was cut off from Southeast Asia. The United States and its allies had to come up with a solution to this very quickly as much of the infrastructure in these countries depended on rubber. In addition to this, the U.S., and other militaries required huge amounts of rubber to build new vehicles and equip their soldiers. This made designing synthetic rubber one of the top priorities of scientists around the world. During this six-year time period several companies and thousands of scientists were able to design a general-purpose synthetic rubber called GR-S rubber and manufacture enough of this rubber to meet the needs of the U.S. and its allies. GR-S rubber is still one of the most used rubbers today. (American Chemical Society, 1998)

**Intro:** GS-R rubber is synthesized by copolymerizing emulsions of styrene and butadiene. This process is called emulsion polymerization and it is the same process that is being used in the Roll lab to make rubber. The connections between the polymer chains can be altered, this is known as stereoregularity. These stereospecific polymerizations are important because only one well defined backbone is produced. This means that the material properties of the rubber can be altered depending on which functional groups are added to change the geometries. (Hill, McDonald, and Roll, 2021)

The goal of this project is to lower the glass transition phase, reexamine the GR-S catalyst system using the cationic surfactants, and analyze the stereochemistry (cis vs. trans) Synthetic rubber works for a lot of the applications of natural rubber, but it is falters in terms of stereochemistry and molecular weight. Specifically, it does not have the ideal chemical structure, and the molecular weight is significantly lower than we'd like it to be.

Surfactant is a contraction for "surface active agent" This is a molecule that lowers the surface tension of a liquid, or the interfacial tension between two liquids. (Britannica, 2020). An emulsion (figure 1) is a mixture of two liquids that are normally immiscible by dispersing the lesser of the two liquids among the other liquid. An example of this would be oil and water, and emulsions usually become opaque even if the two liquids are clear. In an emulsion the monomer (isoprene in our case) becomes surrounded by the surfactant and creates what is called a micelle (figure 2). When the initiator (hydrogen peroxide) is added, these micelles polymerize the monomer within them and create polyisoprene

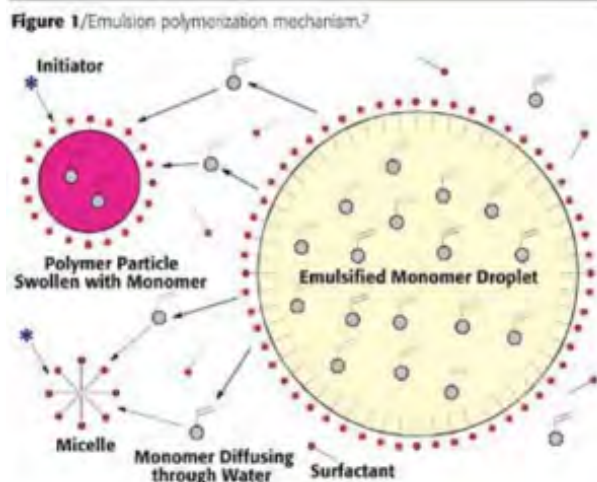


Figure 1

## Experimental Procedures

Recrystallization of Cetyltrimethylammonium bromide (CTAB)

The recrystallization ratio is 2g CTAB/ 4.5g methanol/ 75 mL ethyl acetate

1. Heat the ethyl acetate (75 mL) until bubbles start to appear.
2. Put the CTAB (2g) in a small beaker and slowly drop in methanol while stirring and heating until the solution turns clear (should require ~6 mL methanol).
3. When the ethyl acetate solution begins to bubble, slowly add the CTAB/methanol solution to the ethyl acetate using a pipette.
4. Allow the solution to stir and heat for a little bit longer, then remove from hotplate, cover with tinfoil, and let sit overnight (or until the CTAB has fully crystallized out).
5. Vacuum filter the solution to separate the CTAB crystals from the ethyl acetate.
6. Place CTAB crystals in vacuum pump to remove remaining ethyl acetate.

### Emulsion Polymerization of Isoprene

First make a surfactant solution by mixing 1.5g CTAB, 1.5g sodium pyrophosphate, 0.125g ferric sulfate, and 50g water. Sonicate this solution prior to use to de-gas it. Prepare the isoprene by adding barium oxide as a desiccant, and then filter this out with a filtered drip pipette.

To start the emulsion polymerization reaction, mix the surfactant solution, the isoprene and hydrogen peroxide in the following ratio:

5mL isoprene:10mL surfactant solution:0.2mL hydrogen peroxide

3.405g isoprene:10.625g surfactant solution:0.222g hydrogen peroxide

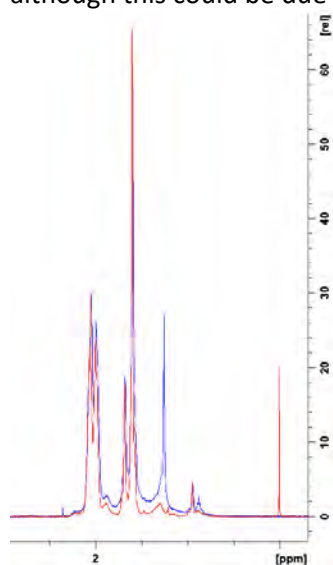
Then allow this to stir and react overnight.

When the reaction is complete, precipitate the polyisoprene in methanol and then filter out the solids.

When the isoprene polymerization reaction had finished, it was precipitated in methanol and then vacuum filtered and weighed. A small amount of the polyisoprene was left stuck on the sides of the reaction vial.

This will have slightly influenced the reported yield values as some of the material was left behind. The polyisoprene resisted dissolving in methanol, limonene and chloroform, however it did dissolve in toluene. This allowed us to remove the leftover material from the reaction vials.

We attempted to use a few different surfactants for the polymerization of polyisoprene, but only CTAB has worked so far. In addition to CTAB, we also used Tetrabutylammonium Bromide (TBABr) and didecyldimethylammonium bromide (DDABr). The TBABr did not create an emulsion with the isoprene and was therefore unable to polymerize. And the DDABr did not fully dissolve in the surfactant solution, although this could be due to impurities in the DDABr from the manufacturer.



To the left is the NMR spectra of the Polyisoprene that was synthesized in the roll lab using the CTAB method (blue) against the NMR spectra of Polyisoprene that had been previously synthesized. As you can see, the spectra very closely match, meaning we have created a polymer that has the ideal structure that we are looking for.

**Budget:** Approximately \$250 was spent on safety equipment, including gloves, and coats; \$225 was spent on laboratory reagents, catalysts and solvents; \$75 was spent on miscellaneous parts and supplies; and \$450 was spent on purchasing monomers for polymerization and their precursors. This fellowship included a \$4,000 stipend. TOTAL: \$5,000

**Acknowledgement:** I truly appreciate the support provided by the State Board of Education/HERC that allowed me to carry out research this summer. This has been a summer of huge growth for me, and it would not have been possible without support from the SBOE/HERC. Thank you so much!

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## **Final Project Report: Office of Undergraduate Research (OUR) Summer Undergraduate Research Fellowship (SURF) – Summer 2021**

**Fellowship Recipient:** Danielle Yama, Biological Sciences, University of Idaho

**Faculty Mentor:** Paul A. Rowley, Professor, Department of Biological Sciences

**Project Title:** The Investigation of the Suicidal Phenotypes of K1 “Killer Toxin” Truncations in *Saccharomyces cerevisiae*

**Abstract:** Common antifungal treatments such as fluconazole or miconazole are becoming less effective in treating fungal infections. The diminishing efficiency of such treatments is due to fungal pathogens developing an increased resistance to antimycotic drugs. Therefore, the use of antifungal “killer toxins” has become a recent focus of research in understanding how to combat these fungal infections in place of current antimycotics. This project examined the lethal effects of the K1 toxin to provide a better understanding of the K1 mechanism of action against fungi. K1 is a heterodimeric protein which consists of two different polypeptide chains: “alpha” ( $\alpha$ ) and “beta” ( $\beta$ ) which are linked by a single disulfide bond. It has been previously reported that the isolated  $\alpha$ -domain of the K1 toxin (K1- $\alpha$ ) is able to cause cell death when ectopically expressed by yeast cells. We have confirmed this phenotype by first cloning and then expressing the isolated K1- $\alpha$  domain in *Saccharomyces cerevisiae* using a galactose-inducible expression plasmid. This caused lethality when cells were grown on galactose media which induced the expression of K1- $\alpha$ . To understand the host proteins that are important for K1- $\alpha$  lethality, the systematic gene deletion collection library of non-essential genes in *S. cerevisiae* is now being screened for suppressor mutants. We have identified clones that appear to be resistant to K1- $\alpha$  expression and are in the process of identifying the gene deletions. This will lead us to a better understanding of the mechanism of action of the K1- $\alpha$  toxin and why it is cytotoxic to yeasts.

### **Project Accomplishments**

1. One of my goals was to determine which genes in *Saccharomyces cerevisiae* that when knocked out, would cause resistance to K1- $\alpha$ .

The yeast genome deletion collection library consists of strains of *S. cerevisiae*, each of which has a single non-essential gene that has been knocked out. When transforming this deletion collection library with the lethal construct, K1- $\alpha$ , I was able to find suppressor mutants that were resistant to this construct. By using the barcodes present in each strain from the deletion collection library, I was able to determine what those genes were that were knocked out.

**Results:** Some of the gene knockouts that were identified and confirmed played roles in salt tolerance, functions as components of the nuclear pore complex, degradation of cyclin-dependent kinase PHO85, DNA binding, transcription, and control of transcription factors.

2. Generate K1-[SS] $\alpha$  lethal construct which includes a galactose inducible plasmid, URA3 marker, and K1-[SS] $\alpha$  gene.

I had successfully cloned the K1-[SS] $\alpha$  gene, but I am currently undergoing the process of creating the pCR8 vector which would include the K1-[SS] $\alpha$  gene as well as the URA3 marker and a galactose inducible plasmid. My goal is to confirm the lethality of this construct so that I will be able to use it to transform the entire genome deletion collection library with K1-[SS] $\alpha$  using the same processes that I used when working with K1- $\alpha$ . I have not generated any results yet for this part of the project since I must still confirm that what I've generated is a lethal construct.

3. Determine which genes in *Saccharomyces cerevisiae* that when knocked out, would cause resistance to K1-[SS] $\alpha$ .

My goal is to transform the entire genome deletion collection library with K1-[SS] $\alpha$  and determine if there are mutants that are resistant to K1-[SS] $\alpha$ . I plan to begin this process once I've generated the lethal construct that includes the K1-[SS] $\alpha$  gene.

4. Compare the mechanisms of action of K1 toxin domains K1- $\alpha$  and K1-[SS].

I plan to compare the mutants that are resistant to K1- $\alpha$  to those mutants that are resistant to K1-[SS] $\alpha$ . This will show insight into the differences in the mechanisms—if there are any—between the two different constructs and provide us with a better overall understanding of the K1 killer toxin.

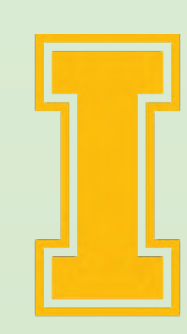
### Summary of Budget Expenditures

Supplies	Cost
Primers	\$123.20
UltraFlux SnapStrip, PCR Tube, 8-strip 0.2mL	\$79.44
Trichloroacetic acid, BioXtra	\$44.05
Aspirating Pipet, 2mL capacity, polystyrene, PK 400	\$144.80
Nitrile Gloves	\$123.31
Antifungal for transformations	\$201.00
Bleach and PEG	\$113.62
Gel run purple ladder and restriction enzymes	\$111.04
<b>Subtotal Supplies</b>	<b>\$940.46</b>
Stipend	\$4,000.00
<b>Total</b>	<b>\$4,940.46</b>

**Conference Presentation:** I presented a poster of my project at the 2021 Idaho Conference on Undergraduate Research (ICUR) and will also present my work at the U of I Undergraduate Research Symposium in April of 2022.

**Acknowledgements:** I acknowledge and greatly appreciate the support that was provided by the State Board of Education and Higher Education Research Council as well as the University of Idaho Office of Undergraduate Research in the form of a Summer Undergraduate Research Fellowship (SURF). I was able to gain valuable insight and experience in conducting research through this opportunity. Presenting at ICUR was also an incredible experience for me. The Office of Undergraduate's support and that of the State Board of Education made this project and experience possible and is something I greatly appreciate and am thankful for.





# Antifungal Killer Toxin Production by Opportunistic *Candida glabrata*

University of Idaho  
College of Science

Jeffrey T. Badigian, Lance R. Fredericks, Mark D. Lee, and Paul A. Rowley  
University of Idaho Department of Biological Sciences, University of Idaho, Moscow, Idaho, USA

## Candida glabrata and Killer Toxins

Candidiasis affects ~150 million people annually; *Candida glabrata* has recently emerged as the second most common cause of this illness, afflicting ~28 million people<sup>1</sup>. *C. glabrata* has been known to produce antifungal killer toxin proteins that inhibit the growth of competing fungi. The origin of these toxins in *C. glabrata* is unclear and could be either genomic, or via dsRNA viral satellites with help from a coinfecting Totivirus<sup>4</sup>. **This work aims to elucidate the origins and activity of killer toxins in *C. glabrata*.**

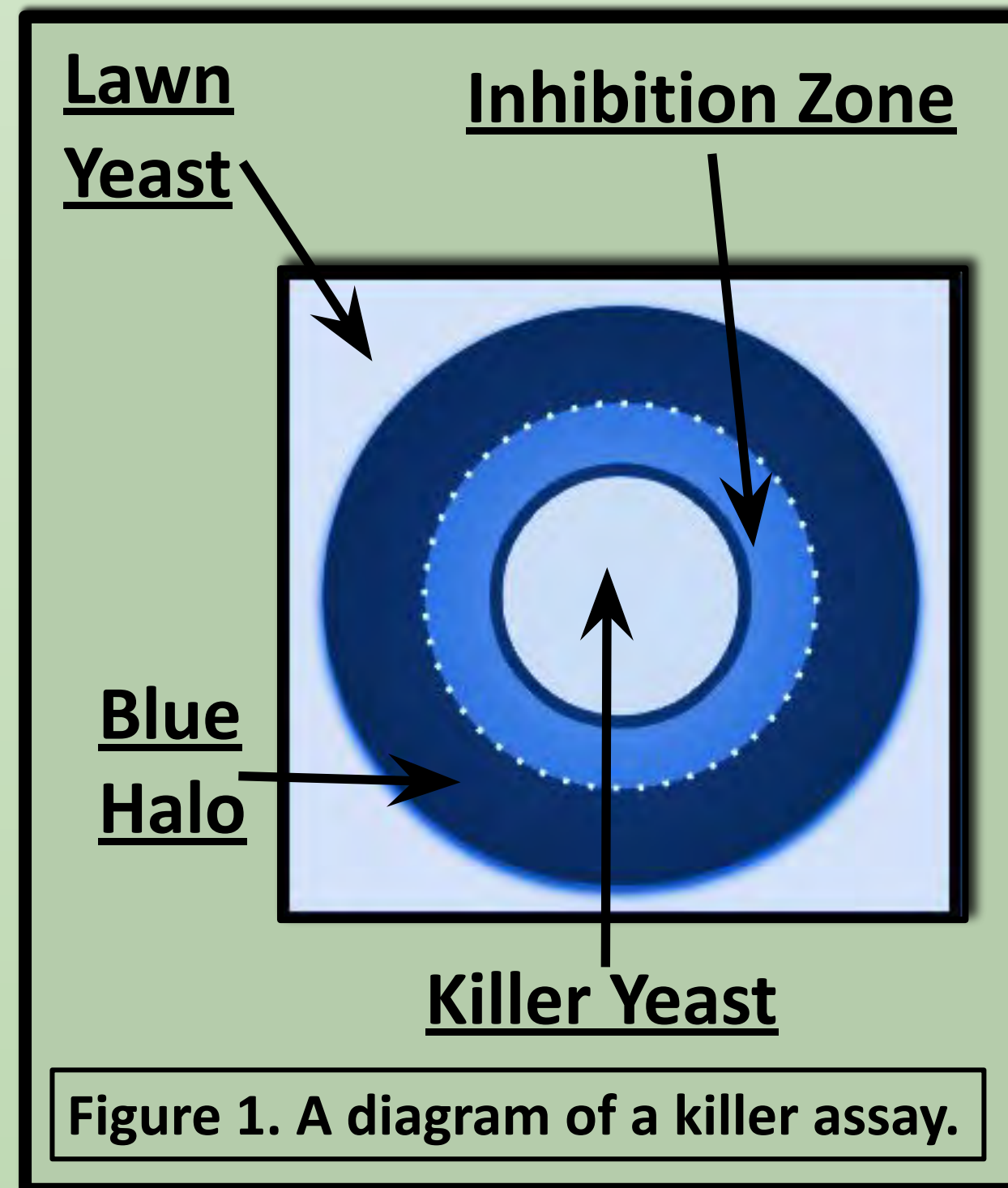


Figure 1. A diagram of a killer assay.

## Killer Screening

Killer toxin production was screened for in 133 *C. glabrata* isolates using 25 yeast lawns (Figure 1). 18 *C. glabrata* isolates (13.53%) exhibited killer toxin activity, 16 of which were clinically isolated (Figure 2).

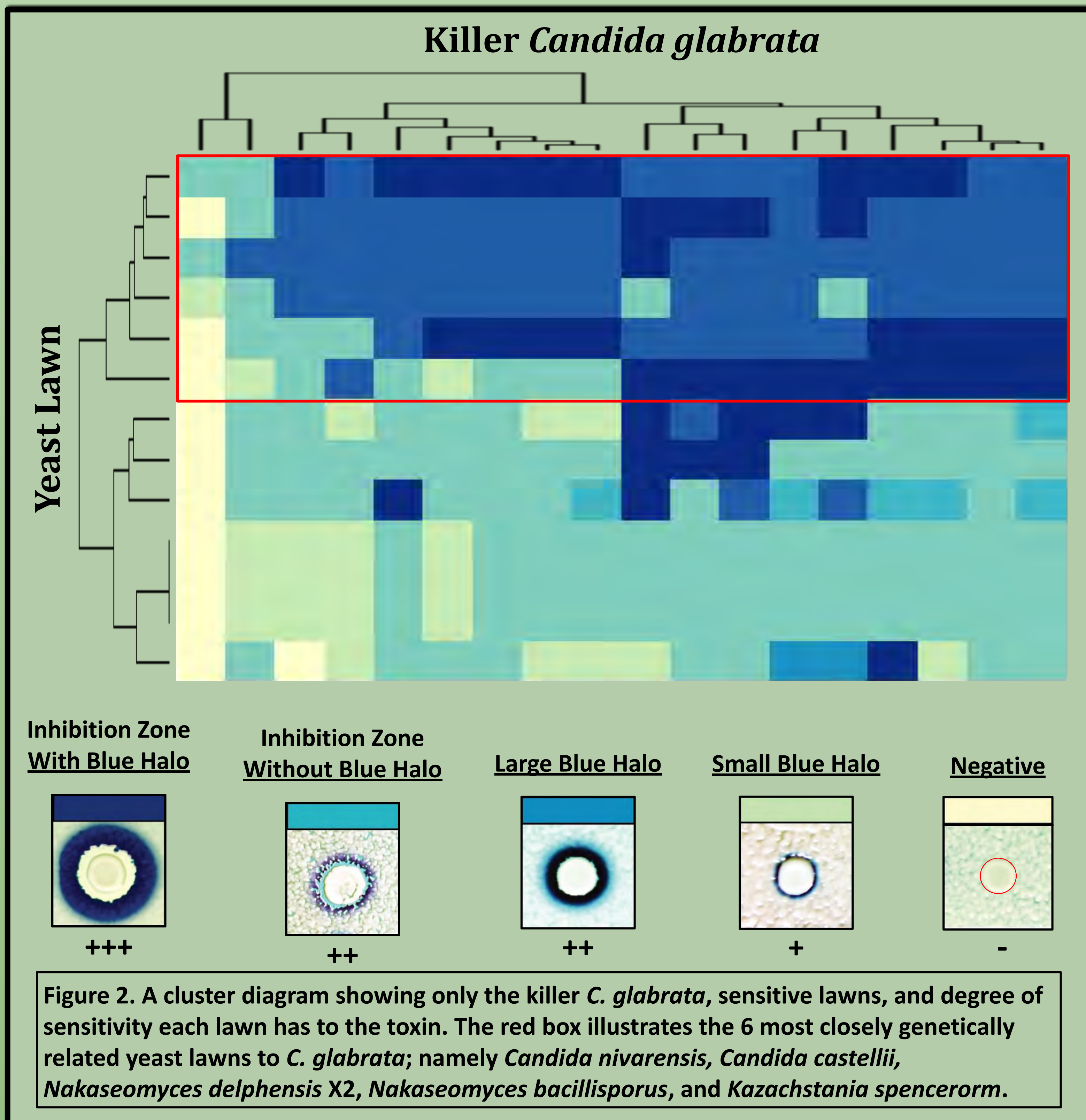


Figure 2. A cluster diagram showing only the killer *C. glabrata*, sensitive lawns, and degree of sensitivity each lawn has to the toxin. The red box illustrates the 6 most closely genetically related yeast lawns to *C. glabrata*; namely *Candida nivarensis*, *Candida castellii*, *Nakaseomyces delphensis* X2, *Nakaseomyces bacillisporus*, and *Kazachstania spencerorm*.

## Viral Screening

To determine if the toxin is virally encoded, a dsRNA extraction searching for the dsRNA satellites and totivirus was attempted on select killer *C. glabrata*; the positive control *Saccharomyces cerevisiae* YJM1307 was included. All isolates tested negative for viral infection, including type strain *C. glabrata* CBS 138 (Figure 3).

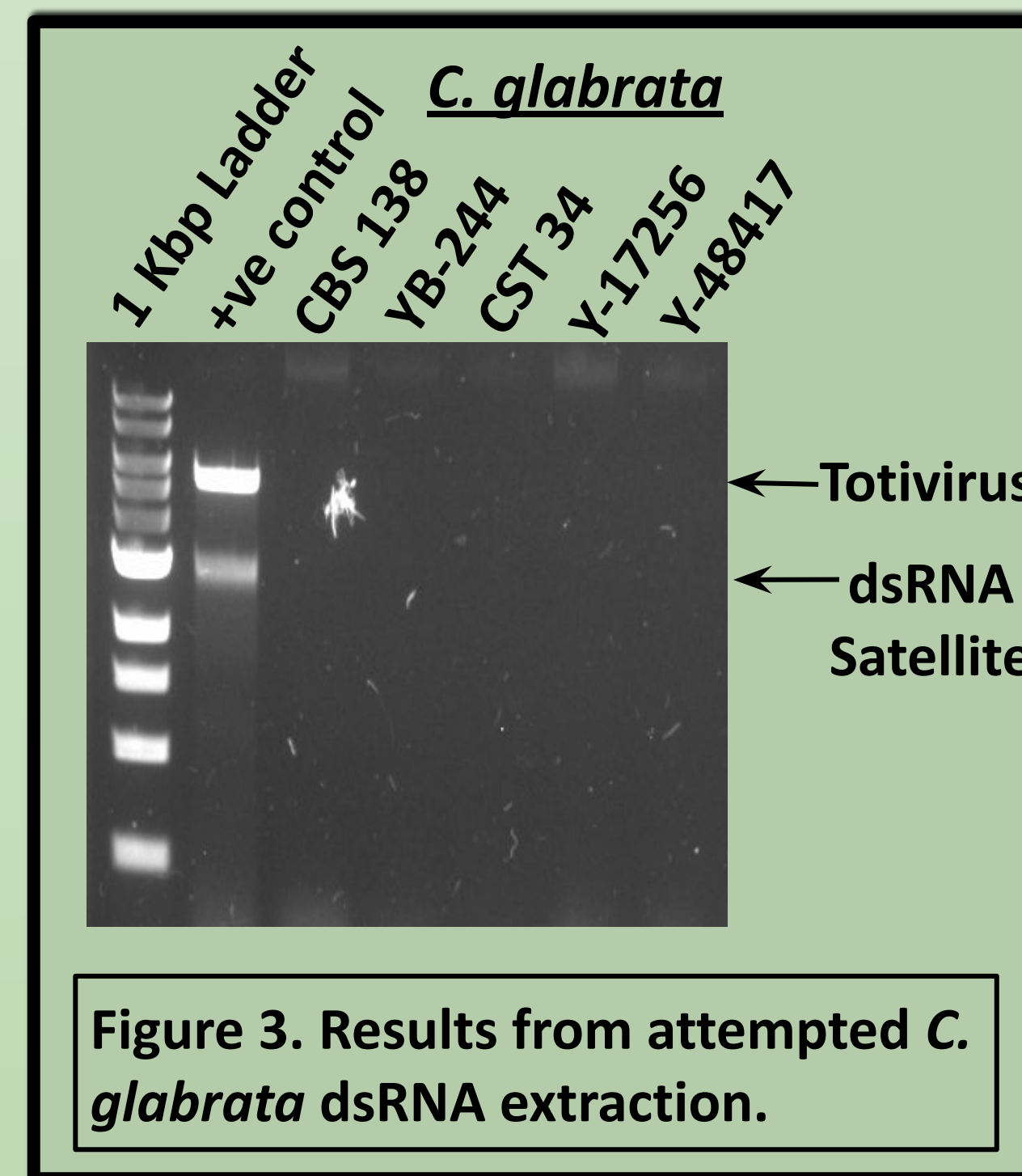


Figure 3. Results from attempted *C. glabrata* dsRNA extraction.

## Killer Toxin Genomic Search

Four homologs to a *Saccharomyces* K62 toxin were identified within the *C. glabrata* genome<sup>3</sup>. PCR diagnostics was used to determine which isolates contained these homologs which have been temporarily named K62-like toxins (Figure 4).

		Killer <i>Candida glabrata</i>																				
		WSC1 20	WSC1 21	WSC1 22	WSC1 24	WSC1 25	WSC1 26	WSC1 33	WSC1 36	WSC1 51	AR0323	AR0328	AR0334	ATCC 2001	CBS 138	CST 34	Y-17256	Y-48417	YB-244	BG2		
K62L Homolog	Gene A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	
	Gene B	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Gene C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Gene D	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	-

Figure 4. A table describing the K62-Like homolog prevalence in killer *C. glabrata* isolates and non-killer *C. glabrata* BG2. The negative control *S. cerevisiae* BY4741 was used.

## Protein Expression

Two of the K62-like homologs were cloned into a non-killer yeast strain *S. cerevisiae* BY4741. Both clones ectopically expressed an active killer toxin, indicated by the methylene blue zones (Figure 5).

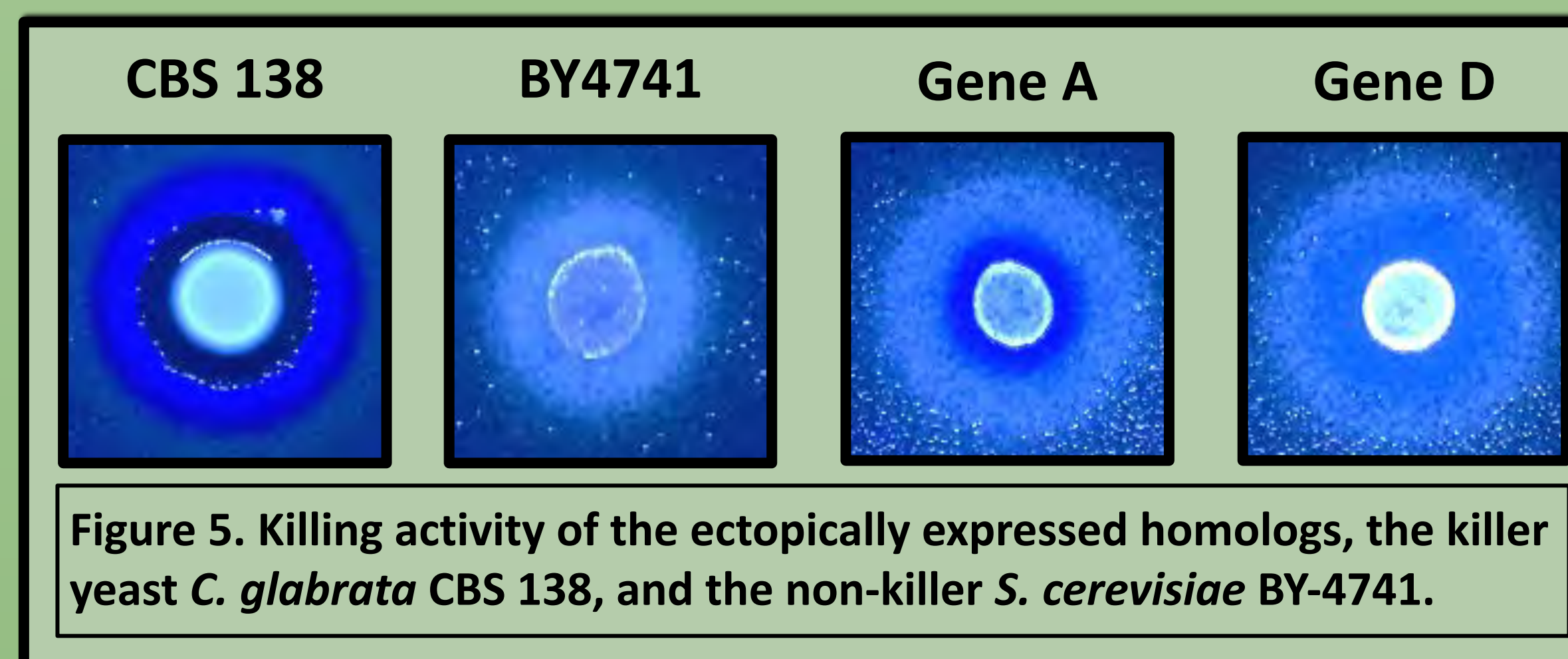


Figure 5. Killing activity of the ectopically expressed homologs, the killer yeast *C. glabrata* CBS 138, and the non-killer *S. cerevisiae* BY-4741.

## Killer Toxin Structure Modeling

Secondary structure modeling using PHYRE suggests that this *C. glabrata* K62-Like toxin is an aerolysin-like toxin; toxins known to be cytotoxic to humans, and are known virulence factors for human pathogens (Figure 6). These toxins are secreted as monomers that bind a target cell membrane, undergo a conformational change, and oligomerize to create the final pore forming toxin<sup>2</sup>.

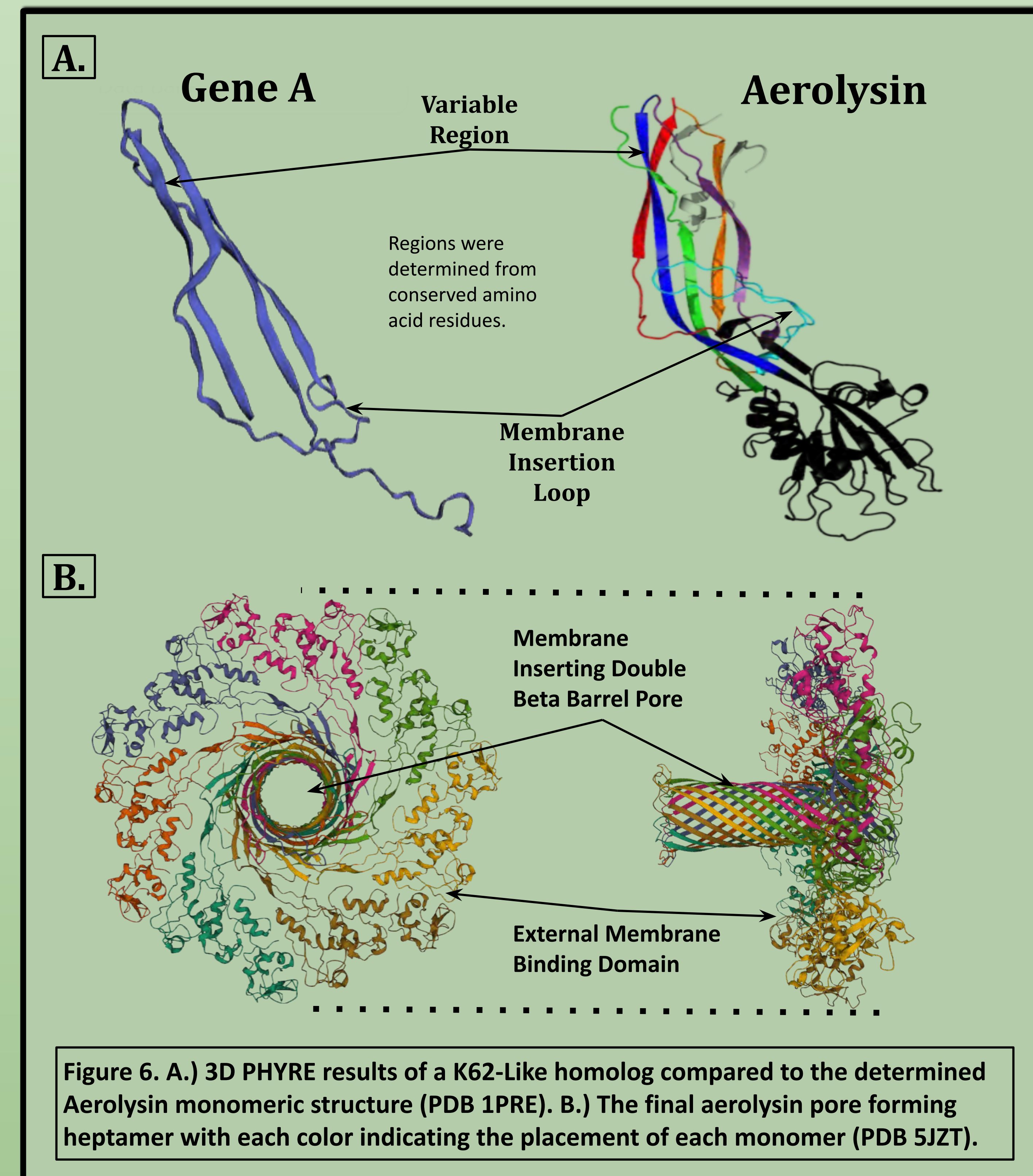


Figure 6. A.) 3D PHYRE results of a K62-Like homolog compared to the determined Aerolysin monomeric structure (PDB 1PRE). B.) The final aerolysin pore forming heptamer with each color indicating the placement of each monomer (PDB 5JZT).

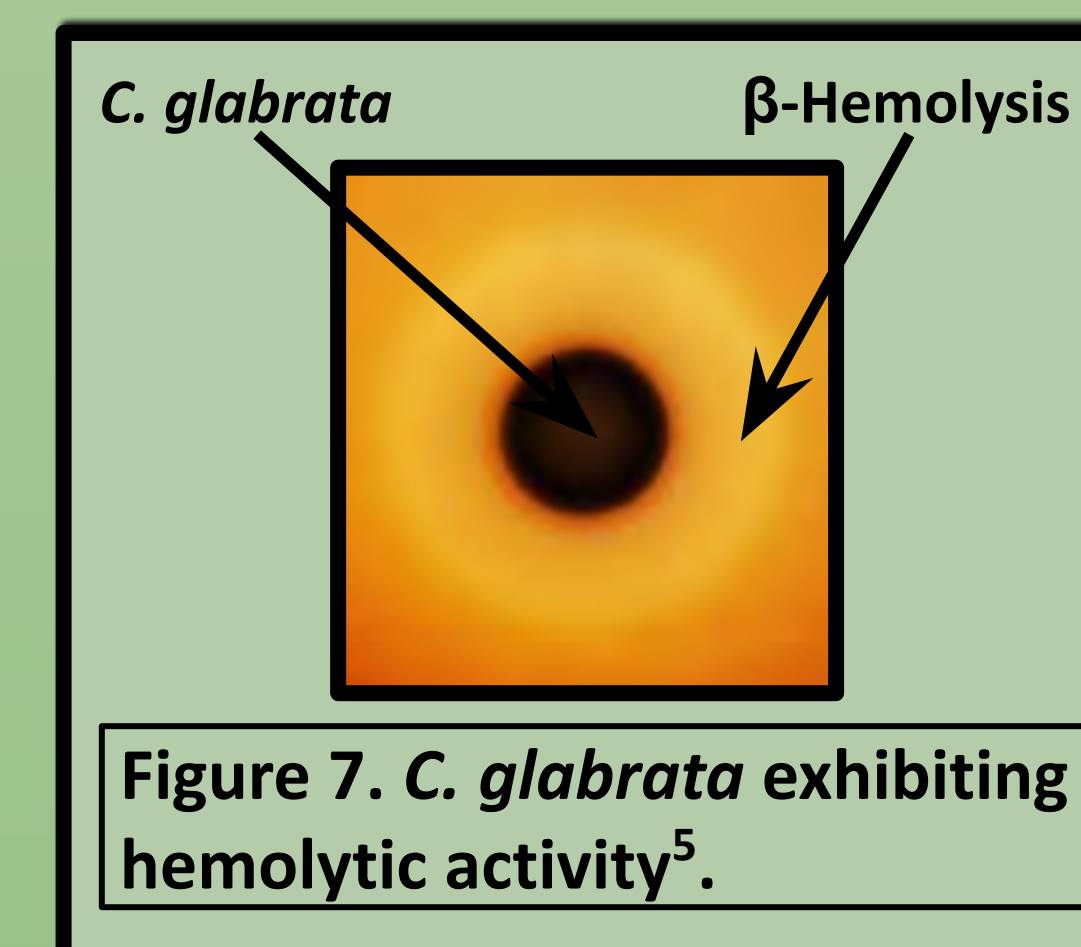


Figure 7. *C. glabrata* exhibiting hemolytic activity<sup>5</sup>.

*C. glabrata* isolates have been previously shown to cause hemolysis when screened on acidic media at pH 5.6<sup>5</sup> (Figure 7). When we screened at pH 7.2, there was no evidence of hemolytic activity, suggesting limited cytotoxicity of these proteins to human cells.

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- Funded by the University of Idaho College of Science Office of Undergraduate Research



# Evaluation of UV photoinitiated polyampholyte hydrogel properties



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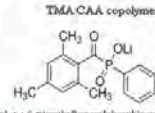
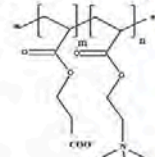
## Abstract

Polyampholyte hydrogels display promising properties to promote healthy regeneration of tissue due to their inherent ability to bypass the body's foreign body response. Research proving these claims have been based off chemically initiated hydrogels, however more research needs to be conducted on hydrogels photopolymerized using UV-A light. All hydrogels used in this research were created with a constant w/v ratio of the photoinitiator LAP. Four polymerization times were tested for antifouling properties as well as shore hardness and percentage swelling. Initial formulation procedures were created, however no antifouling properties comparable to chemically initiated hydrogels were reported. It was also found that UV photopolymerization times exceeding 1.5 minutes did not result in significantly different hardness and swelling properties.

## Background

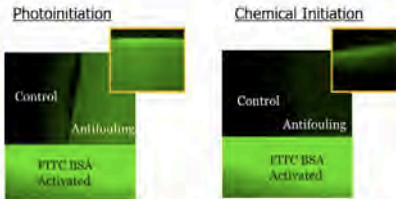
- Hydrogels contain a hydration layer that prevents non-specific protein adsorption.
- Antifouling properties have been proven with chemically polymerized gels
- Free radical polymerization yields a methacrylate backbone
- Photoinitiation offers unique benefits
  - Time
  - Cytotoxicity
  - 3D printing

(Haag 2020)

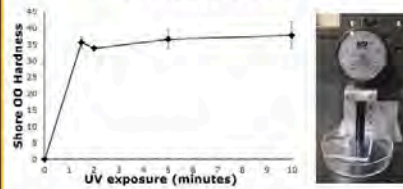


## Antifouling Abilities

- Gels were exposed to fluorescein isothiocyanate labeled bovine serum albumin (FITC-BSA) for 15 min
- Photoinitiated gels have not been able to show antifouling properties - Porosity

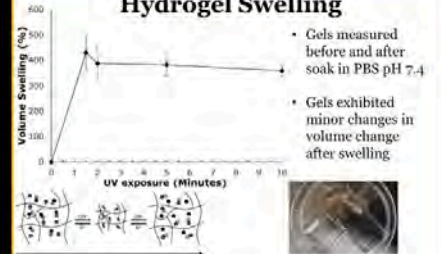


## Shore Hardness



- Gels were measured on a flat surface
- Shore hardness slightly but not significantly increased as UV exposure time increased past 1.5 minutes
- Shore hardness related to the amount of crosslinked gel

## Hydrogel Swelling



- Gels measured before and after soak in PBS pH 7.4
- Gels exhibited minor changes in volume change after swelling

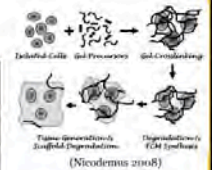
## Conclusions

(Haag 2020)

- Hydrogels showed no significant change in swelling or shore hardness past 1.5 minutes of polymerization
- Current gel formation procedures most likely have too little crosslinker or photoinitiator to maintain antifouling properties

## Future Directions

- Manipulation of crosslinker/photoinitiator concentration
- Cell encapsulation
- Mechanical Testing



## References

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## Acknowledgments

- This research was funded by:
  - An Undergraduate Research Grant from the Office of Undergraduate Research at the University of Idaho
  - An Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant #P20GM103408



# Effect of Lauric Arginate on the Growth and Morphology of Wood-Decaying Fungi



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University of Idaho

## Introduction

- Products used to make lumber rot-resistant serve one main purpose, to stop bacterial and fungal growth to prevent contamination of a structure. This can drastically increase the lifespan of a structure and preserve its structural integrity.
- Most common products that are used for this purpose are copper or arsenic based which can cause negative health and environmental effects to those in close contact.
- LAE is a non-toxic anti-microbial compound that's been rated safe for human consumption. LAE is used in hundreds of products across the country for its anti-microbial properties including food packaging, cosmetics, and dental products.
- We believe that LAE could serve as a replacement for the potentially toxic wood preservatives that are commonly used today.

## Malt Agar Test Method

Malt agar dishes amended with 3,6,9,12 and control inoculated with test fungi

Photos taken every 48 Hours for 14 days

Area calculation using ImageJ software

Figure 1: Flowchart of malt agar test method

## Microscopy Method

- All replicates were constructed as seen to the left
- After a growth period all cover slides were removed and transferred to a clean slide to be observed.

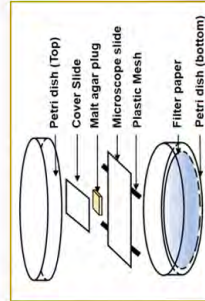


Figure 2: Diagram of a prepared microscopy sample

## Fungal Area Growth

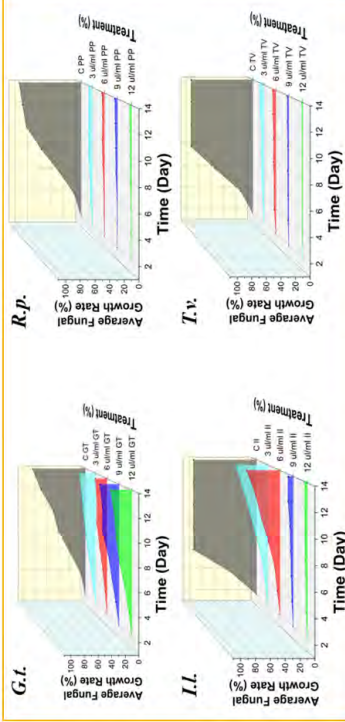


Figure 3: 3D line graph depicting the area growth of test fungi over a two-week period. This was obtained by charting the area from the pictures taken during the growth period. The data was then separated by species and charted.

## Malt Agar (14 Day Samples)

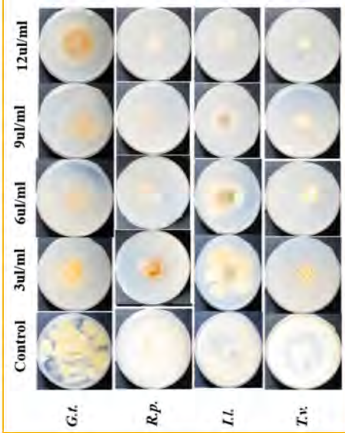


Figure 5: A selection of pictures taken during the growth period that we felt best represented the growth of each fungi across all concentrations of LAE.

## Results

- I.L., R.P., and T.V. all experienced over a 90% drop in area between the control and 12ul/ml groups
- G.T. only saw a 68% drop in area coverage
- No significant morphological change could be detected between a control and amended fungal culture in either a light or fluorescence microscopy test.

## Conclusion

- LAE has proven effective at limiting the growth of 3 out of 4 test fungi
- GT is more resistant than other fungi
- In areas where brown-rot fungi are more common LAE may not be an ideal wood preservative
- More experimentation needs to be done to determine if LAE is effective when impregnated into wood.

## Acknowledgements

Funding Provided by the University of Idaho Office of Undergraduate research SURF grant.

## Microscopy Pictures

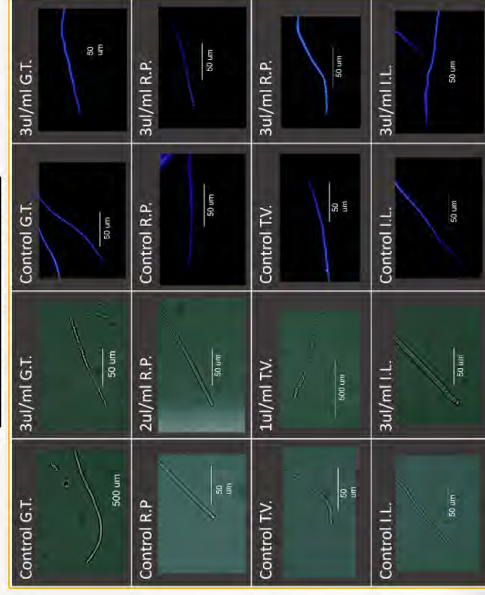


Figure 4: A selection of photos taken under a microscope of amended and control fungal groups.



## Introduction

- **Ecosystem Engineers** are species that influence availability of resources by physically altering the environment<sup>1</sup>.
- By burrowing, browsing, and defecating, pygmy rabbits (*Brachylagus idahoensis*) modify the vegetation structure of the sagebrush-steppe ecosystem<sup>2</sup> thereby altering habitat properties including concealment and visibility.
- Vegetation structure can provide concealment but also reduce visibility, which changes the range at which visual information can be gathered<sup>3</sup>.
- Visibility can be quantified by estimating the **viewshed**, which describes all the accessible sightlines and their spatial extents<sup>4</sup>.
- No studies have investigated how ecosystem engineers might influence viewsheds within the landscapes they inhabit.

## Objectives and Hypotheses

- Objectives:**
- 1) Quantify both visibility and concealment around burrow systems used by pygmy rabbits.
  - 2) Evaluate how duration and intensity of use by rabbits affect visibility and concealment around burrow systems.
- Hypotheses:**
- 1) Pygmy rabbit activity alters viewsheds around their burrow systems.
  - 2) Because rabbits spend more time close to burrows, their affect on viewsheds will increase with greater proximity to burrow entrances.
- I predict that viewsheds will be:**
- 1) greater at occupied versus unoccupied habitat patches;
  - 2) positively correlated with duration of burrow occupancy; and
  - 3) more extensive close to burrow entrances.



Figure 1. (A) Location of my study site, Cedar Gulch (~130 ha), in the Lemhi Valley in eastern Idaho. (B) Photo of the sagebrush vegetation at the study site.

## Methods

- Estimate **duration of burrow occupancy** (4-20 years) using annual census data collected at the study site (Fig. 1) and select occupied ( $n = 30$ ) and unoccupied ( $n = 10$ ) patches for sampling.
- Quantify habitat structure using a **terrestrial laser scanner** at the burrow and at three randomly selected sites per patch.
- Estimate **viewsheds** using the R package, **viewshed3D**<sup>5</sup>.
- Measure **concealment** using **image classification** (Fig. 3).
- Collect other measurements (size of the habitat patch, number of seedlings at sites, and sagebrush heights) as potential covariates.



Figure 2. (A) Terrestrial laser scanner in the sagebrush-steppe. (B) A laser point cloud of sagebrush vegetation on a mound gathered by a terrestrial laser scanner.



Figure 3. (A) Red sphere that approximates the size and shape of a pygmy rabbit. (B) Used to estimate concealment via image analysis that quantifies the percent of the sphere obstructed in a photo.

## Preliminary Results

- Classified duration of burrow occupancy into 3 categories: (4-6, 7-9, and 10-20 years).
- Collected and analyzed data from 23 of 40 patches to date.
- Burrows of intermediate duration of occupancy (7-9 yrs) had the highest mean viewshed values (Fig. 4).
- The means (± SD) of the 3 categories were: 4-6yrs: **260.2** (± 21.0); 7-9yrs: **296.9** (± 22.7); and 10-20yrs: **275.2** (± 30.3).
- Field work will be completed during July, and data analyses are ongoing.

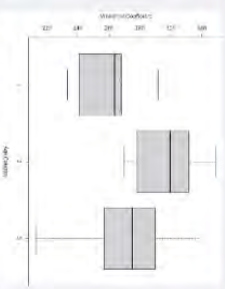


Figure 4. Box plot showing preliminary results of visibility measured as the viewshed coefficient at burrows occupied by pygmy rabbits for differing durations. Category 1 = 4-6yr, Category 2 = 7-9 yr, and Category 3 = 10-20 years ( $n = 23$  burrows).

## Next Steps

- Once all the data have been collected and processed, I will analyze it to determine if and how pygmy rabbit activity alters the viewsheds around their burrows.
- I will analyze how visibility changes with respect to distance to the closest burrow and duration of occupancy simultaneously.
- In addition, I will analyze how concealment changes with my predictor variables.
- I will prepare a manuscript for submission to a peer-reviewed journal that explores this ecosystem engineering behavior.

## Acknowledgements

Thank you to the **Office of Undergraduate Research at the University of Idaho** for funding this project.

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# ASSOCIATIONS BETWEEN SCREEN TIME AND GLYCEMIC CONTROL IN ADULTS WITH AND WITHOUT TYPE 2 DIABETES

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Exercise Physiology Research Laboratory, Department of Movement Sciences, University of Idaho

## Abstract

**PURPOSE:** To assess the associations between screen time (ST) and glycemic control, as measured by glycated hemoglobin levels (HbA1c), in middle-aged to older adults with and without type 2 diabetes. **METHODS:** adults (mean±SD: age: 49.1±16.4y, 70.8) participated in the study. Screen time was subjectively measured through an 18-item screen-time questionnaire. Total sedentary time was subjectively measured using the Sedentary Behavior Questionnaire. A finger stick blood draw was completed to measure HbA1c. Participants then completed a food frequency questionnaire online using the NIH Diet History Questionnaire III. Pearson correlation analyses were used to assess the simple and partial associations among the variables while controlling for age, sex, and dietary carbohydrates. **RESULTS:** The majority of participants were non-Hispanic white (88%), non-smokers (88%) and had family history of Type 2 diabetes (46%). On average, participants spent 509.6 ± 160.9 min d<sup>-1</sup> in sedentary behavior (SB; 53% of the waking day). Of this time, 444.8 ± 156.9 min d<sup>-1</sup> were spent on a screen. Participants engaged in background screen time 135.7 ± 149.09 min d<sup>-1</sup>. Significant positive correlations (p<0.05) were found between HbA1c and total SB (r=0.615), and ST (r=0.578), and Background ST (r=0.572). **CONCLUSIONS:** Participants spend large amounts of their day engaged in sedentary behavior, which is consistent with national data. Moreover, of this time spent in sedentary behavior, the majority is spent looking at a screen. Our preliminary findings suggest that increased screen time is associated with higher HbA1c and risk of type 2 diabetes.

## Background

Screen-based sedentary behaviors, such as smartphone and tablet use, have significantly increased in recent years. Engaging in screen time has been shown to promote unhealthy behaviors, such as snacking, and has been linked to an increased risk for chronic diseases, such as cardiovascular disease and diabetes (Wang, Li, & Fan, 2019). To reduce these health impacts, researchers have focused their studies on how individuals with type 2 diabetes are able to control glycemic levels through regular physical activity. What researchers are discovering is that a lack of physical activity and increases in total sedentary behavior are associated with higher amounts of time spent on a screen, which may impact glycemic control (O'Brien, Issartel, & Belton, 2018). Although there is a paucity of data on this topic, new research is emerging and demonstrating a relationship between screen time and glycemic control, but much is still unknown. The findings from this study will help bridge the literature gap regarding screen time and its role in an individual's level of sedentary behavior and their glycemic control.

## Purpose

To investigate associations between screen time and glycemic control in adults with and without type 2 diabetes.



## Methods

Participants were adults aged ≥ 18 years with and without type 2 diabetes

**Exclusion criteria:** irritable bowel syndrome, Crohn's, ulcerative colitis, celiac disease, colon cancer, multiple sclerosis, Parkinson's disease, Alzheimer's disease, type 1 diabetes, or currently pregnant or breast feeding.

### Measurements:

- Visit 1
  - Self-Reported Questionnaires:
    - Health History Questionnaire
    - Sedentary Behavior Questionnaire
      - Estimates and totals amount of sedentary behavior spent over multiple activities.
    - Screen Time Questionnaire
      - Quantifies the use of modern screen-based devices.
    - International Physical Activity Questionnaire (IPAQ)
      - Used to obtain comparable data on health-related physical activities at work, home and leisure.
  - Height, weight
  - Finger stick blood draw assessing hemoglobin A1c
  - Food frequency questionnaire using the NIH Diet History Questionnaire III
- Analysis: Pearson correlation analyses were used to assess the simple and partial associations among the variables while controlling for age, sex, and dietary carbohydrates.

## Results

A total of 24 adults participated in the study, 7 men and 17 women. Three (13%) participants had type 2 diabetes and 11 (46%) had a family history of type 2 diabetes.

TABLE 1. Descriptive statistics for the sample

VARIABLE	MEAN ± SD	RANGE
Age (y)	49.1 ± 18.4	21.0-79.0
BMI (kg/m <sup>2</sup> )	30.5 ± 7.6	14.5-56.9
Sedentary Behavior (min d <sup>-1</sup> )	509.6 ± 160.9	250.7-882.9
Screen Time (min d <sup>-1</sup> )	444.8 ± 156.9	120.0-660.0
Background Screen Time (min d <sup>-1</sup> )	135.7 ± 149.0	0-720.0
Leisure PA (MET min d <sup>-1</sup> )	189.2 ± 150.6	0-478.3
HbA1c (%)	5.6 ± 0.8	4.9-8.2
Glucose (mg.dL <sup>-1</sup> )	102.5 ± 37.4	77-268
Energy Intake (kcal)	1794.3 ± 731.9	712.4-3572.1
Total Carbohydrates (g)	187.2 ± 90.2	75.9-362.4
Total Fats (g)	78.7 ± 33.8	27.4-170.9
Total Protein (g)	77.9 ± 31.7	26.1-162.6

BMI, body mass index; PA, physical activity; HbA1c, glycated hemoglobin

## Results cont.

TABLE 2. Partial correlations between sedentary behavior, screen time and markers of glycemic control.

VARIABLE	HbA1c (%)	Glucose (mg/dL)
Sedentary Behavior (min d <sup>-1</sup> )	0.615*	0.740*
Screen Time (min d <sup>-1</sup> )	0.578*	0.520*
Background Screen (min d <sup>-1</sup> )	0.572*	0.782*

\*p<0.05 controlling for age, sex, and carbohydrate intake; HbA1c, glycated hemoglobin

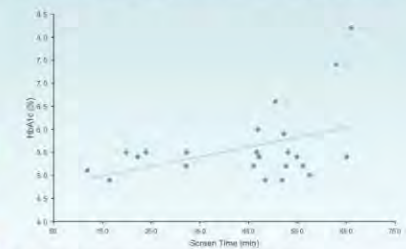


FIGURE 1. Correlation between screen time and HbA1c

## Discussion

- Participants spent the majority of their waking day engaged in sedentary behavior, which is consistent with national data.
- The majority of time engaged in sedentary behavior is spent looking at a screen.
- On average, most of an individual's total screen time was spent on a computer/laptop.
- Our preliminary findings suggest that screen time is associated with glycemic control and risk of type 2 diabetes.
- Further research is needed to develop successful interventions to reduce screen time and sedentary behavior in adults.



# EVALUATION OF FATIGUE PROPERTIES OF ALUMINUM SHEET METAL

## OBJECTIVE

Develop similar stress cycle (S-N) curves for structural aluminum alloys commonly used by Schweitzer Engineering Laboratories and other manufacturers. Help engineers make educated designs with aluminum with the aid of the S-N curve.

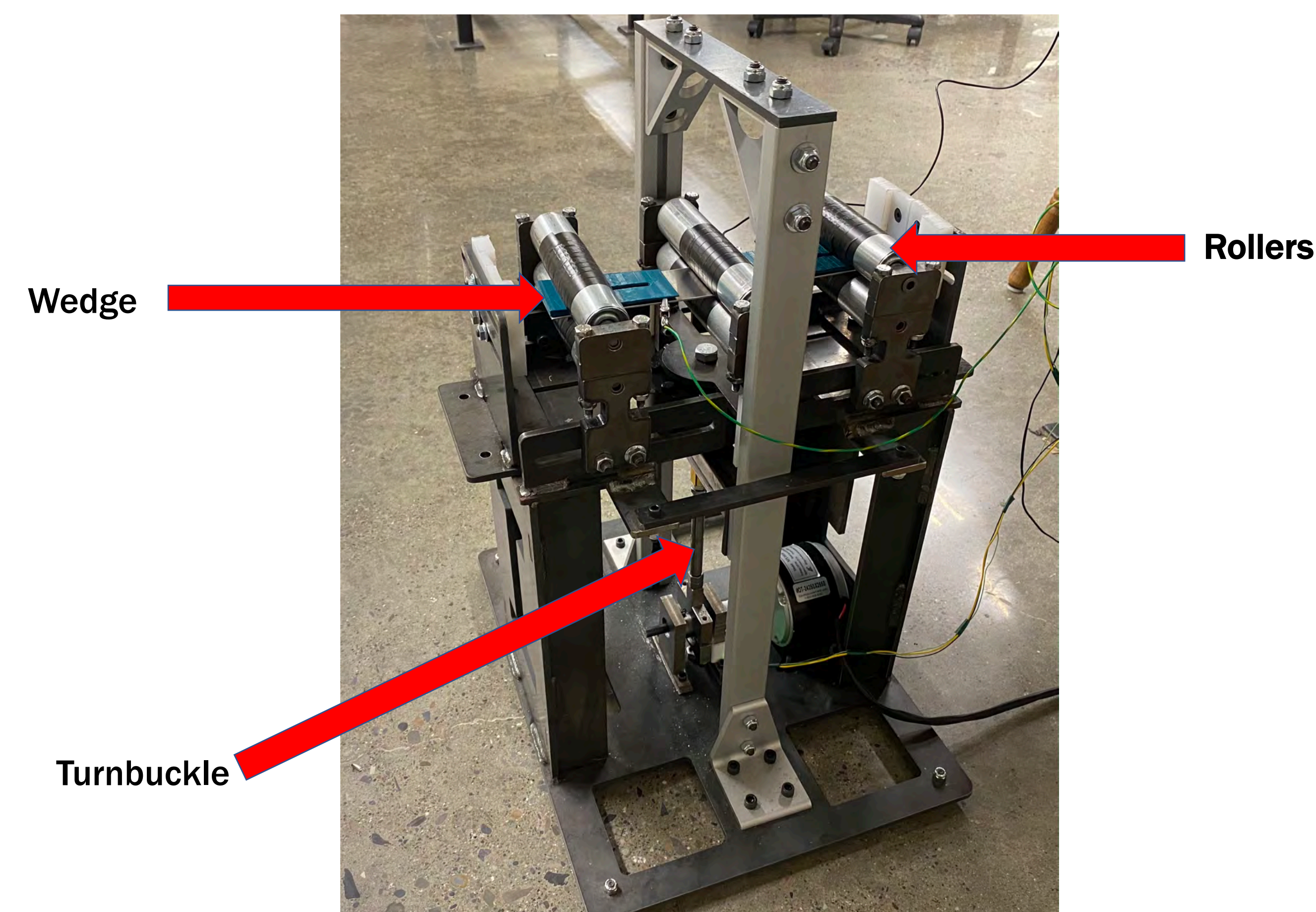
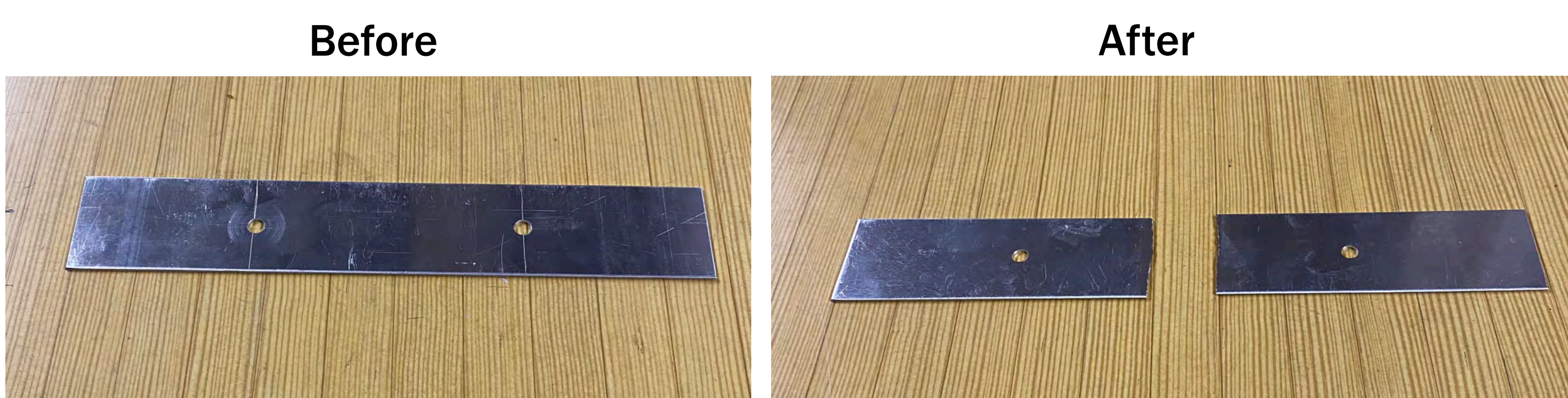
## BACKGROUND

- Adopted work from prior Capstone teams
- Limited data for fatigue properties of aluminum for engineers who create structural designs

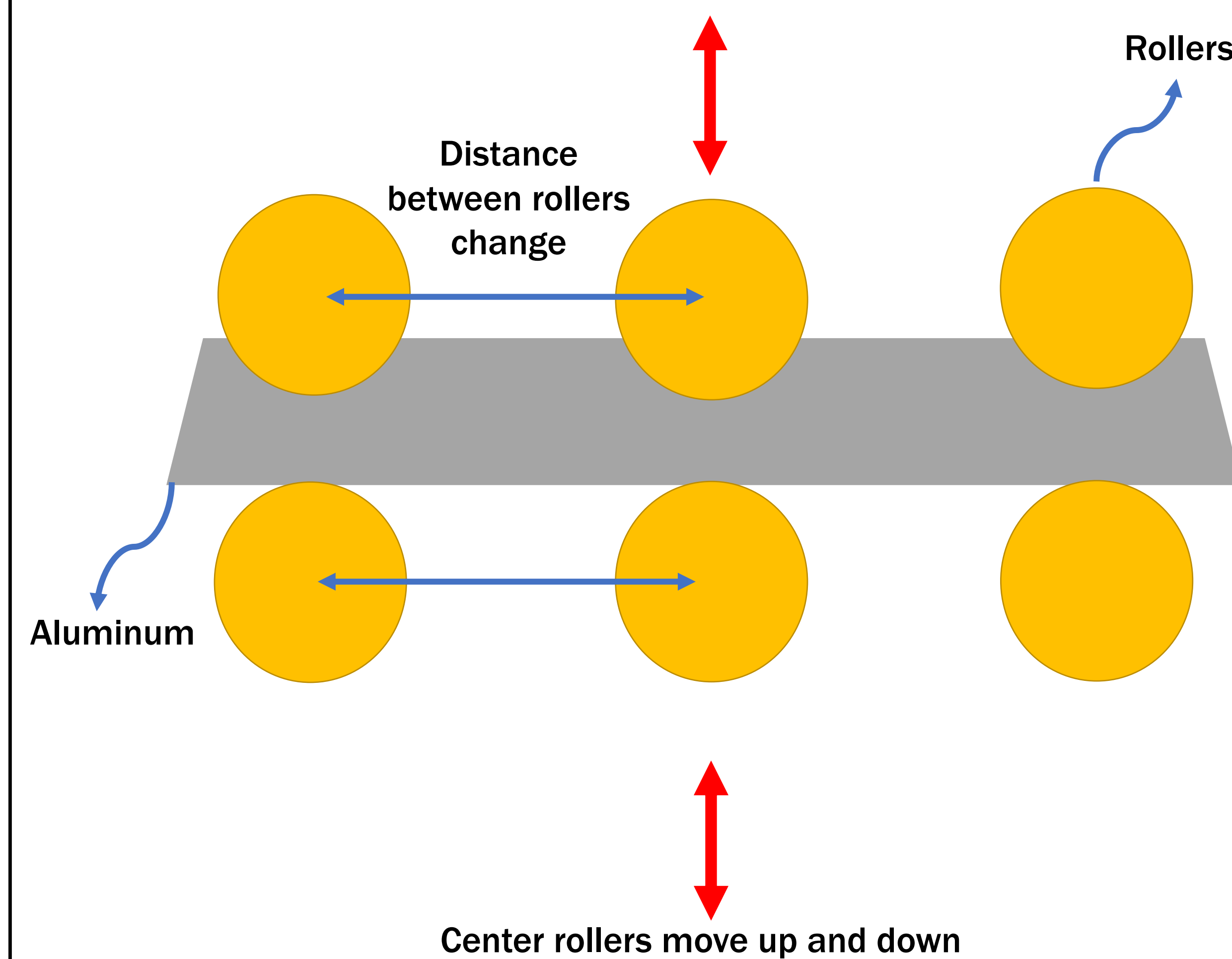
## MATERIAL

5052 H32 Aluminum

## EQUIPMENT



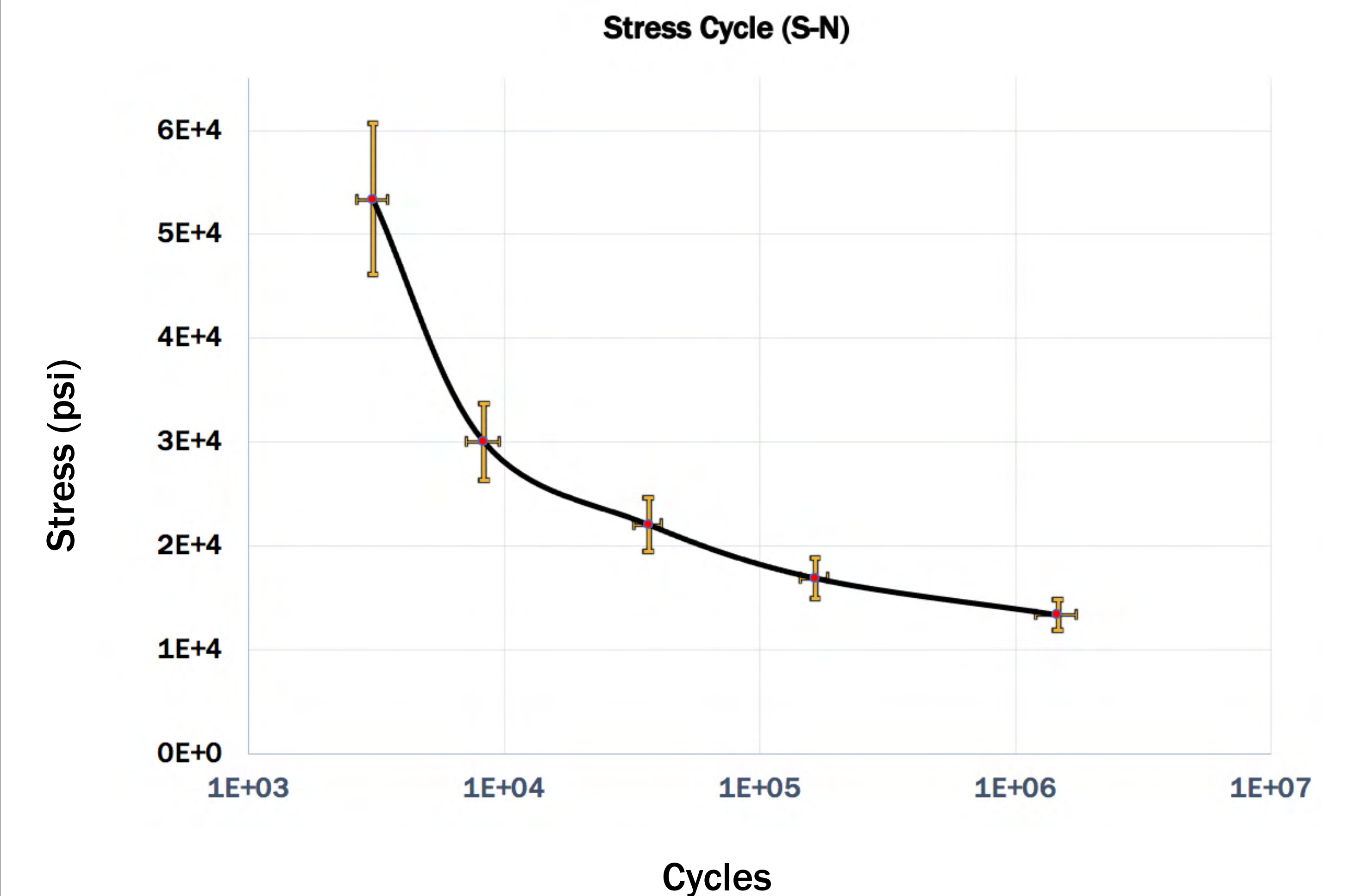
## FLAT METAL



## OPERATION OF MACHINE

- Python codes are entered on a Raspberry Pi computer to read data when the machine is running.
- An Arduino board is used to run the motor with C language.
- The middle rollers move up and down, putting force on the aluminum sheet metal.
- The Raspberry Pi records the number of cycles that the sheet metal goes through and the current flowing through the circuit.
- A break detection code reports a "break". This is when current no longer flows through the circuit because of a break detection.
- Stress of the metal is calculated using the following factors:
  - force required to deflect input deflection
  - total length
  - sample thickness
  - moment of inertia

## RESULTS



## SUMMARY

- **Modifications:**
  - Wedges were 3D printed to physically separate the pieces after failure
  - Rollers were strapped with adhesive tap to reduce conduction
  - Design for the formed aluminum was improved upon for durability
  - Turnbuckle was made shorter to allow the design of the formed aluminum to accommodate the new setup
- Spacings of the rollers range from 2.25" to 4.5"
- It takes about 4 minutes to 60 hours for the aluminum to break after a certain number of revolutions

## FUTURE WORK

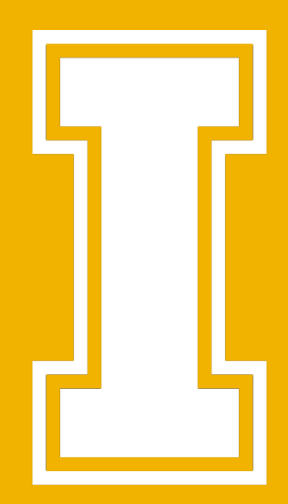
- Machine should automatically shut off after detection of sample failure
- Run more samples for the formed aluminum sheet metal
- Noise reduction

## ACKNOWLEDGMENTS

Lead Student: Shalom Masango  
Advisor: Dr. Matthew Swenson

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# THE EFFECTS OF AN EXTERNAL LIFTING DEVICE ON LIFTING MECHANICS



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Department of Movement Sciences

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College of Education, Health and Human Sciences

## ABSTRACT:

The participants were recruited for this study to investigate the effects of muscle activation patterns and movement mechanics through utilizing a wearable external corrective device, *Sure Squat*, which focuses on the lumbar and distal thigh regions while lifting. Additional comparison between recruited populations will be done to identify any practical changes.

Currently the mechanical data for this study is being processed; however, qualitative reports from participants who successfully completed both sessions are presented. A total of 12 participants have successfully completed both sessions, 9 with a current history in free-weight resistance training, and 3 without a history of free-weight resistance training in the last year.

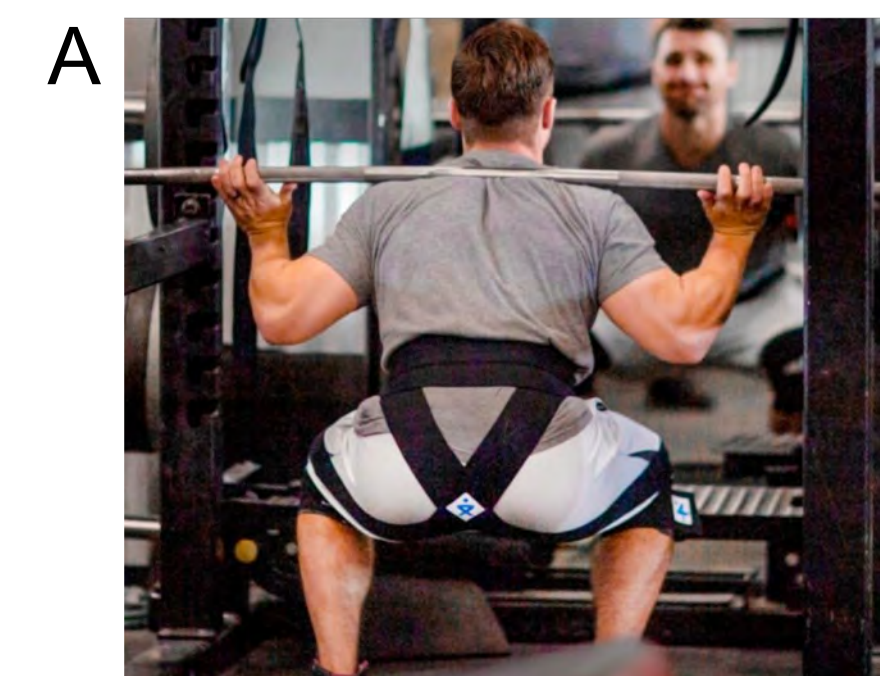


Photo (A) *Sure Squat* product in use

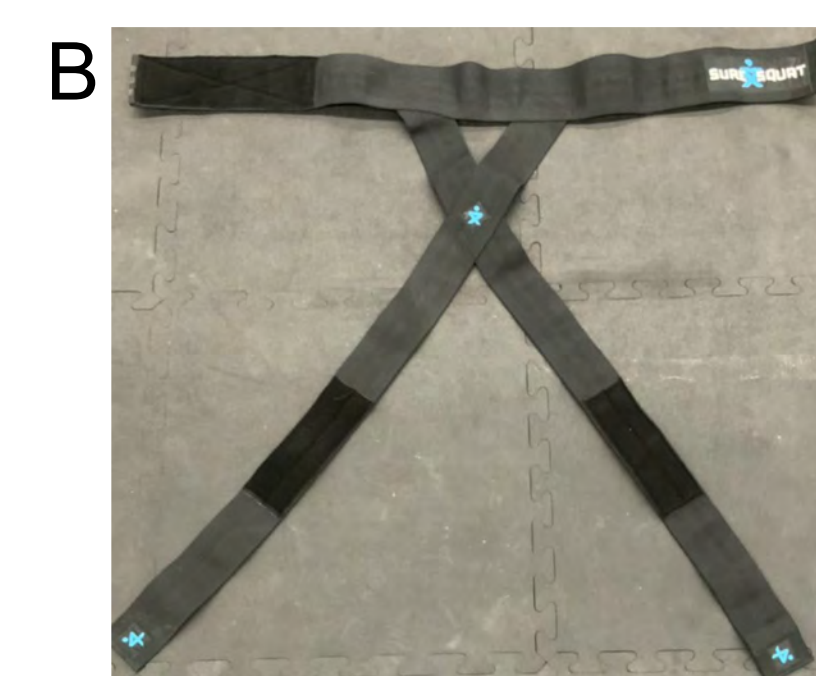
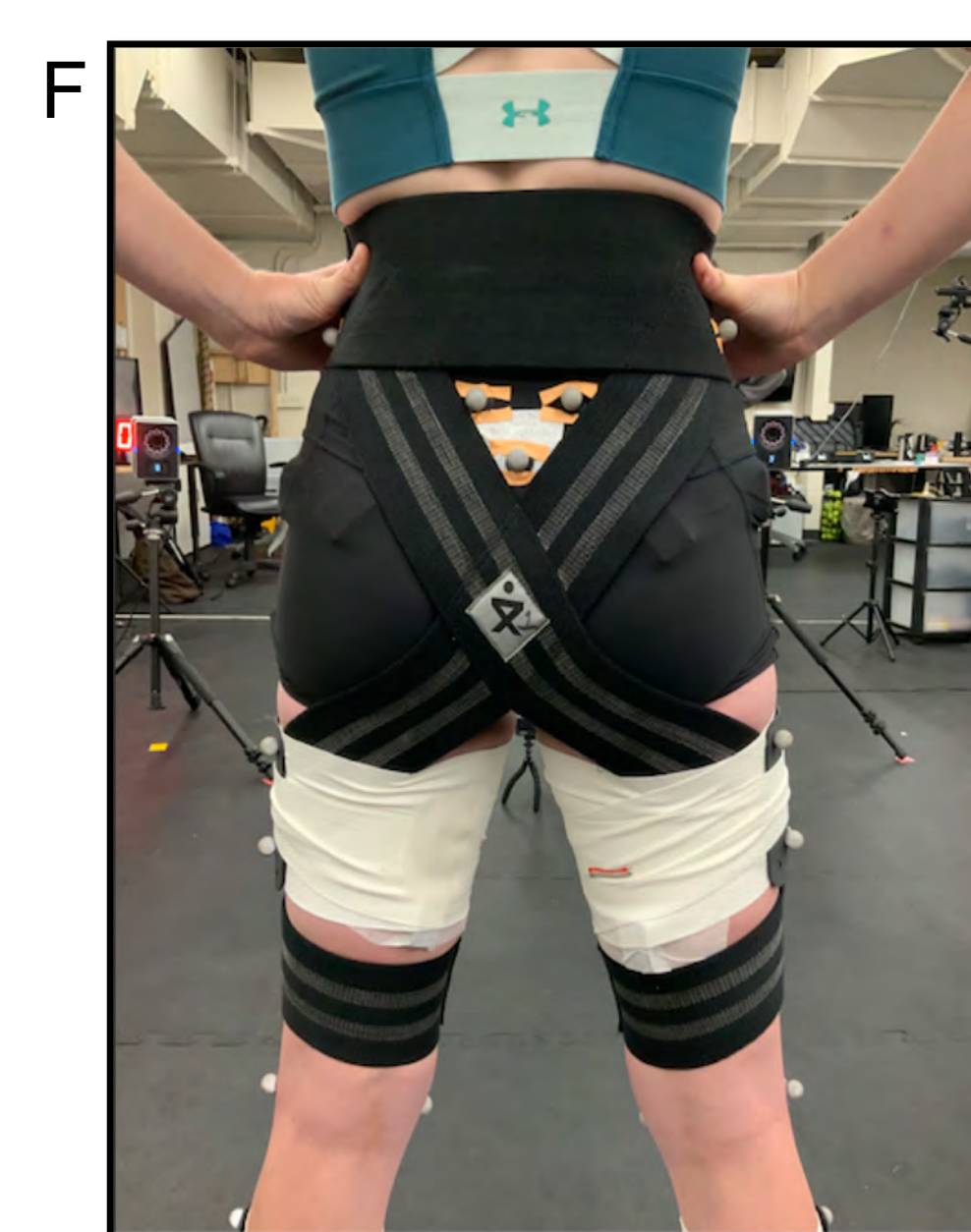
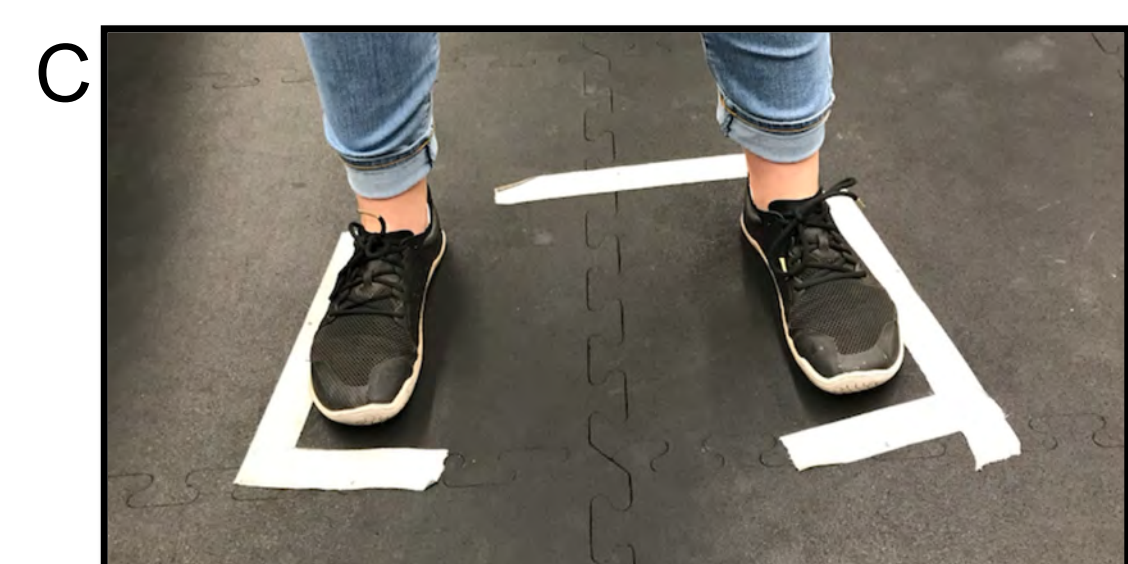


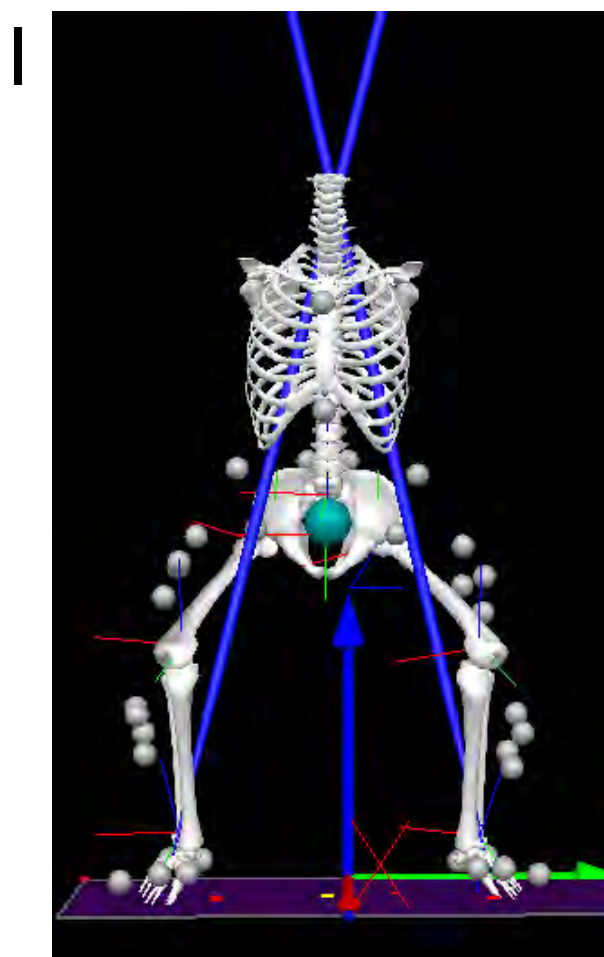
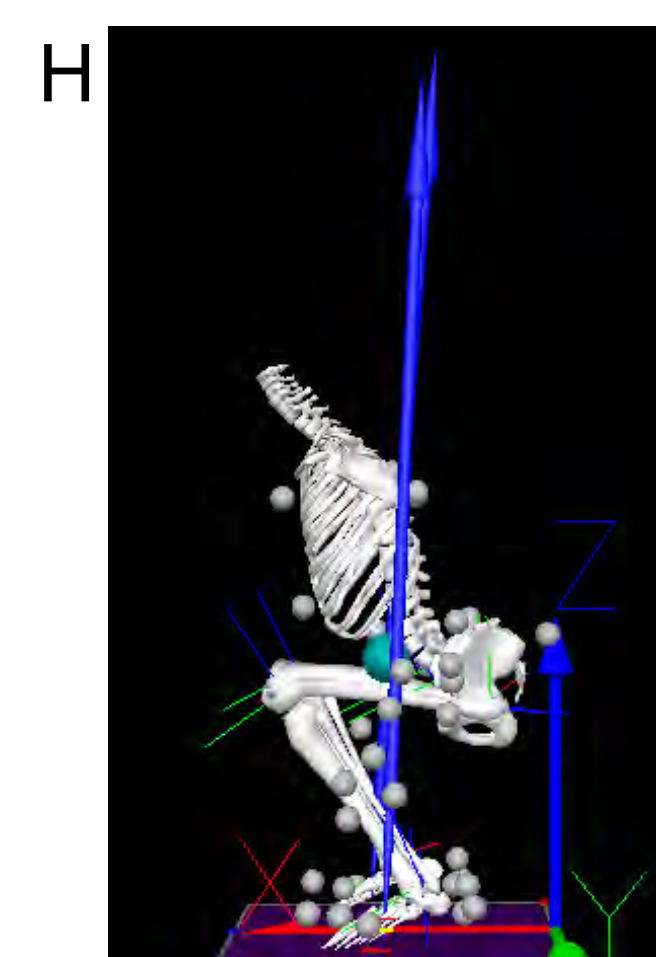
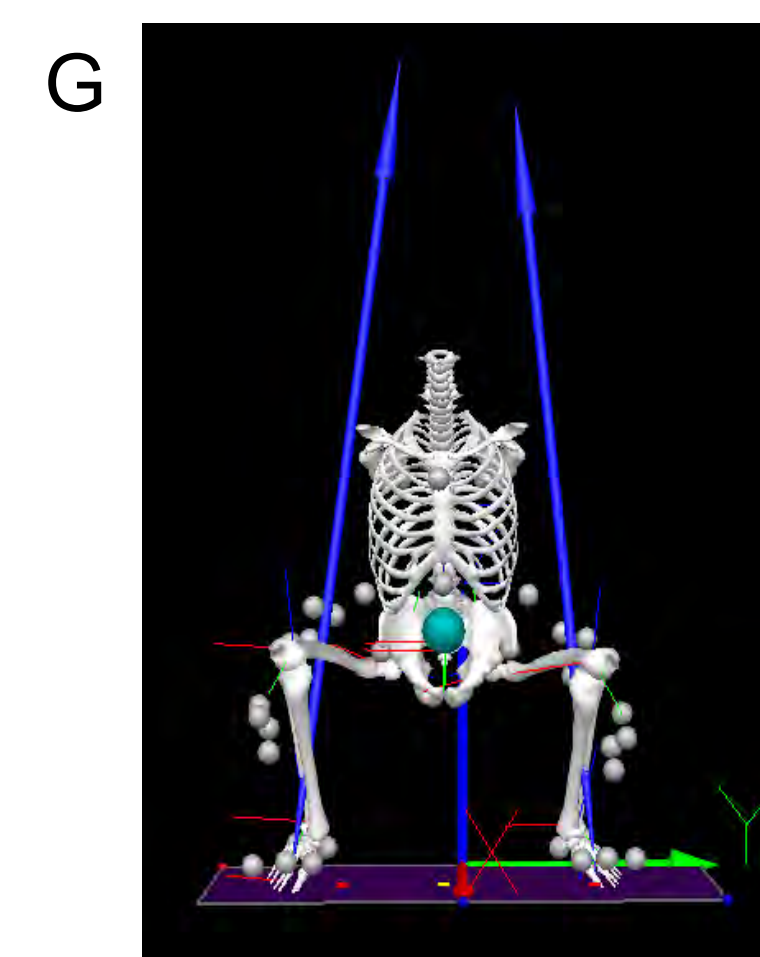
Photo (B) *Sure Squat* product

## METHODS:



Photos C-F. (C) Depicting method for marking pelvic reflective markers (D) Depicting method for marking squat and dead lift foot positioning (E) Anterior view with *Sure Squat* (F) Posterior view with *Sure Squat*

- Recruitment:** Participants were recruited using a convenience sample.
- Session 1:** Consent, screening, and familiarizing participant with protocols and activities. Activities: : countermovement jump (CMJ), drop jump into a countermovement jump (DCMJ) from 30 cm and 50 cm, determined 5RM (Repetition Maximum) for back squat (BS) and dead lift (DL).
- Session 2:** Completion of all tasks with and without *SureSquat* device (CMJ, DCMJ, BS (BW,50% & 100% 5RM), & DL (50% & 100% 5RM). Motion capture [Vicon] and muscle activation [Delsys surface electromyography (sEMG) sensors] were collected for 3 trials each to assess potential mechanical differences between conditions. Following completion of all tasks, participants completed a questionnaire to assess their feedback of the device.
  - sEMG locations: Rectus Femoris, Bicep Femoris, Adductor Longus, Gluteus Maximus & Medius, and Erector Spinae groupings.



(G)Visual3D graphic, frontal plane of squat, base of movement (H) Visual3D graphic, sagittal plane of squat, base of movement (I)Visual3D graphic, frontal plane of squat, ascent of movement

## DISCUSSION:

- Mixed reviews of product aid during all tasks were reported across participants**
- Mechanical changes are being analyzed**
- Future product development planned**

**ACKNOWLEDGEMENT:** Funding: Summer Undergraduate Research Fellowship (SURF) program, University of Idaho Office of Undergraduate Research.

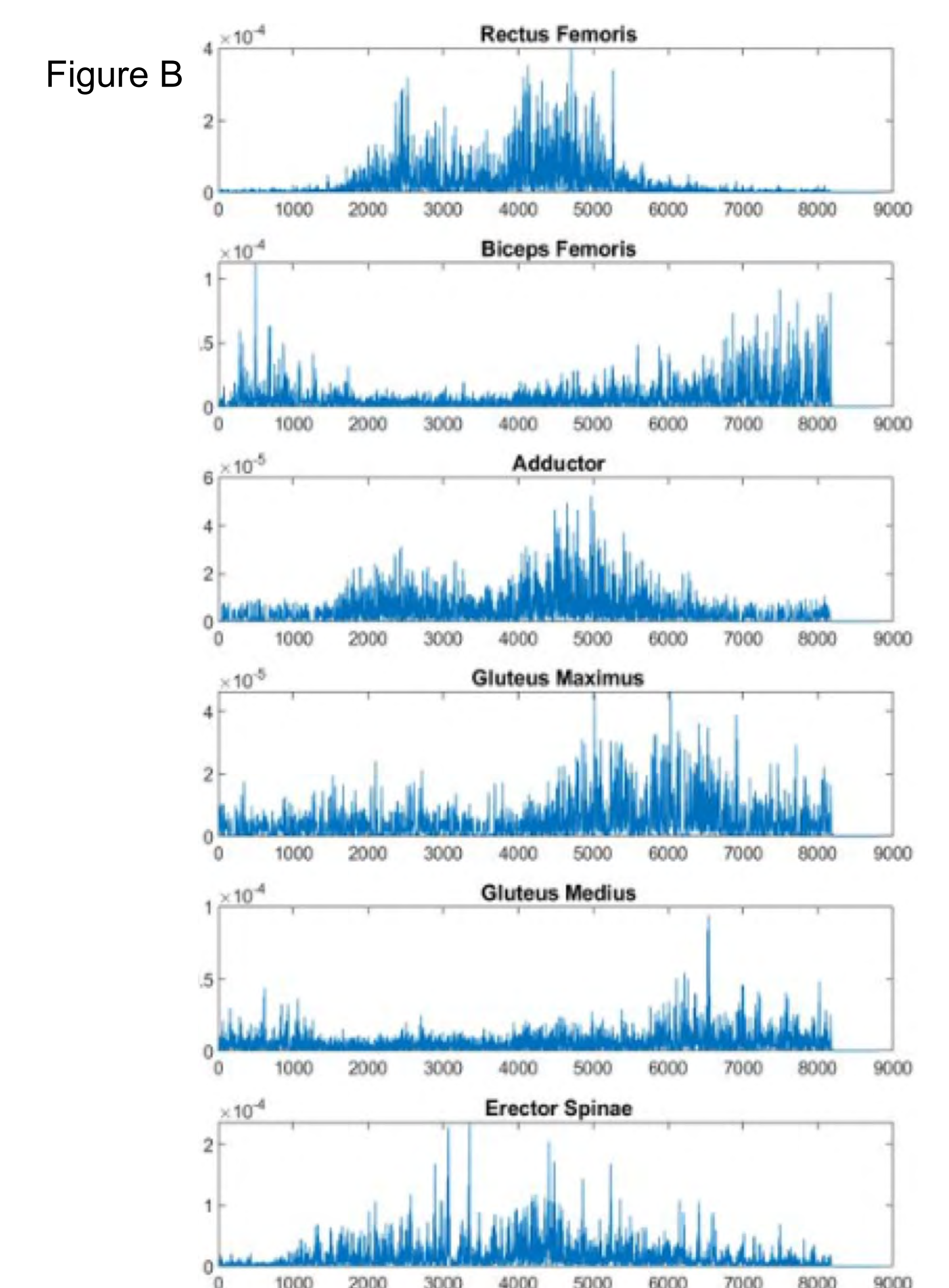
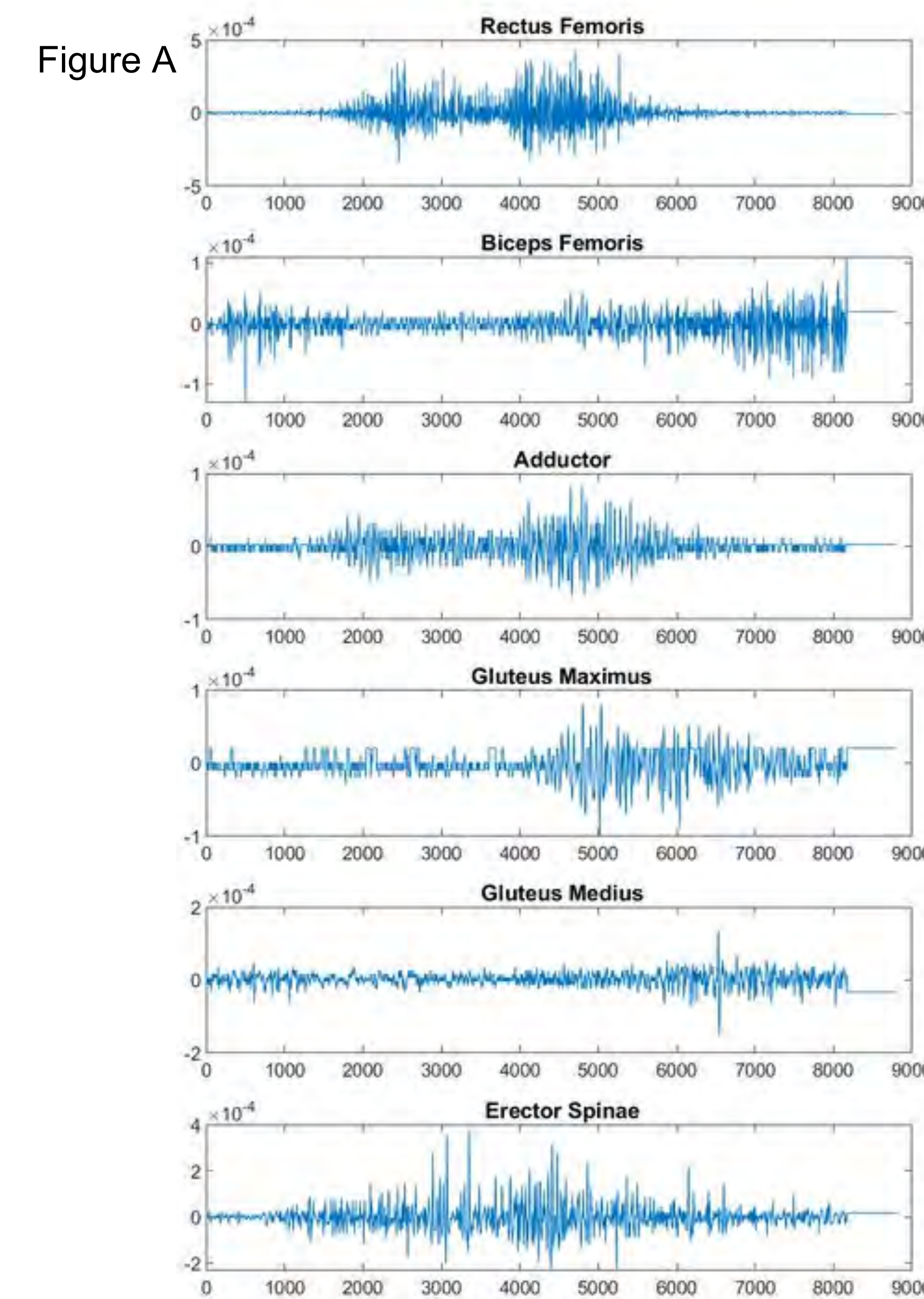
## PURPOSE:

To investigate the effects on muscle activation patterns and movement mechanics through utilizing an external corrective device focusing on the lumbar and distal thigh regions while lifting.

## BACKGROUND:

- Lifting heavy loads can insight an increased risk of injury, of specific concern: lumbar and knee pain and injury (4,5,1,2)
- External assistive devices have a corrective mechanical effect on lifting mechanics (1,3,4,7)
- Outside of performance, an additional need is identified for external assistive devices targeting workplace ergonomics (5)
- Project significance can advance current knowledge on knowledge on optimizing performance, increasing ergonomic practices in the workplace, and overall injury prevention when employing an external assistive device to the act of lifting loads.

## RESULTS:



*'It may take more time to get comfortable with the device.'*

*"Great idea, but doesn't work for me. I felt no difference"*

*'It helped by keeping my knees from dipping in during the squat.'*

Graph A

Sure Squat Participant Product Assessment, Post Session 2 Completion, 1-5 Assessment Scale					
4.1	4.8	4.5	4.0	3.7	
4.3	4.8	4.7	4.1	3.3	
4	4.8	4.3	3.8	4	
1	2	3	4	5	Question Number
■ No Hx Avg ■ Hx Avg ■ Both Population Avg.					

Table A

Sure Squat Product Assessment Question Topic	
1	Rating of Perceived Comfort While Using
2	Rating of Perceived Ease of Donning and Doffing
3	Rating of Perceived Fit
4	Rating of Perceived Product Feedback and Support While Using
5	Rating of Potential of Personal Future Use

Figures A-B. (A) sEMG signal demeaned, full back squat, unilateral (B) sEMG signal rectified, full back squat, unilateral.

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## INTRODUCTION

- Arrays of silica nanochannels (ASNCs) are a versatile tool in fields such as “sensor technology, drug delivery, catalysis, imaging, and light-harvesting” (1).
- The project focus is to synthesize ASNCs and find which synthesis techniques yield the best structure for extrusion polymerization.
- Extrusion polymerization is a process in which catalysts are attached to ASNCs, which forces the polymerization through the ASNCs and produces desirable material properties in the resulting polymer (2).

## EXPERIMENTS

- Recrystallizing CTAB
- Synthesized P123 structured ASNCs
- Synthesized CTAB structured ASNCs with and without structure directing salts
- X-ray diffraction characterization of ASNCs

## FUTURE WORK

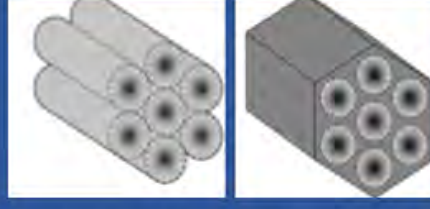
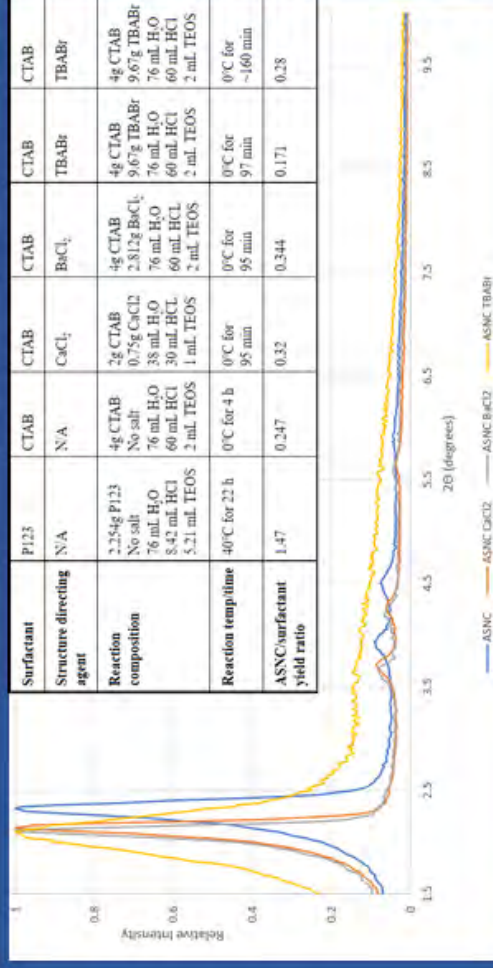
- Heat treatment of ASNCs to remove organic material
- Scanning electron microscopy
- Attaching catalysts to ASNCs and conduction polymerization

This work was supported by the University of Idaho Office of Undergraduate Research SURF grant

## ACKNOWLEDGEMENTS

## RESULTS AND DISCUSSION

- The table below shows a summary of different ASNC synthesis experiments
- The images (3) represent the surfactant micelles forming into a hexagonal array in silica
- The graph shows the results of x-ray diffraction characterization, which gives us information about the structural organization of our silica



## REFERENCES

- (1) Nicola Zecchetto and Dominik Brubwiler, Tuning the aspect ratio of arrays of silica nanochannels, *RSC Adv.* (2015) 5, 74638.
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- (3) Emma Björk, Synthesizing and Characterizing Mesoporous Silica SB-A-15: A Hands-On Laboratory Experiment for Undergraduates Using Various Instrumental Techniques, *Journal of Chemical Education*, 2017, 94(1), pp.91-94.



# Stereospecific Emulsion Polymerization

BASED ON CONTRIBUTION TO THE PROJECT: MARYKOLL, CONNOR HILL, SAGE NELSON

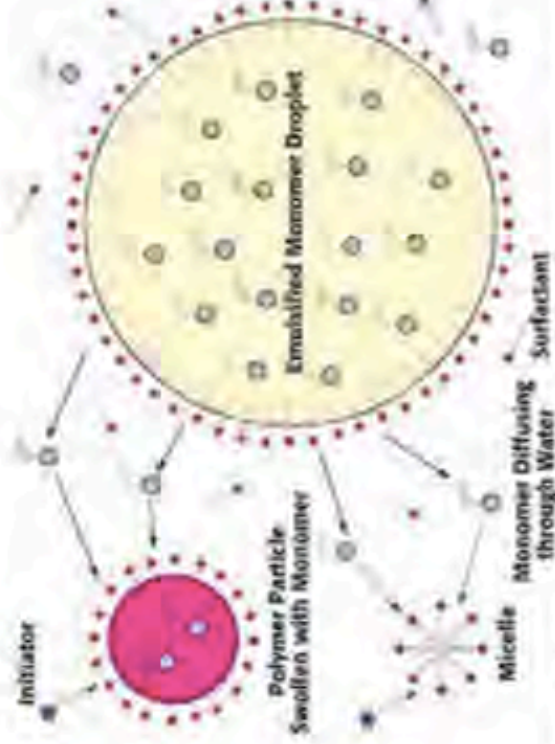


## INTRODUCTION

Until 1945 our main source of rubber was from plantations in southeast Asia. Around this time a general-purpose synthetic rubber (GS-R) was developed. This rubber is synthesized by polymerizing isoprene in soapy water. Even today though, we cannot match the quality of natural rubber in our synthetic versions. The focus of this project is to synthesize a rubber with a lower glass transition temperature than the current market standard.

## APPROACH

An emulsion of the monomer and water is created using a surfactant. The surfactant used here is CTAB, and the monomer is Isoprene. The figure from (Ron Lewarchik, The Fundamentals of Emulsion Polymerization, 2016) below shows the primary processes in this reaction



## Current Work

The type of surfactant we are using is called CTAB, it is most commonly used as a topical antiseptic. The CTAB is in a powdered form when we receive it, but it must be recrystallized to be used in the polymerization process, to do this, we:

1. Dissolve the CTAB in methanol
2. Heat up ethyl acetate to increase the solubility limit
3. Fully dissolve the CTAB in the ethyl acetate
4. Allow the ethyl acetate to slowly cool down

As the ethyl acetate cools down, the solubility limit decreases drastically, this causes the CTAB to crash out of solution in a crystalline form. This material can then be collected for use in future polymerizations. The yield for the CTAB recrystallization was consistently about 80%

The polymerization was conducted with the following steps.

1. Degas solution with the sonicator
2. Mix the surfactant solution and the monomer
3. Add hydrogen peroxide
4. Stir at room temperature for 12 Hours
5. Precipitate in Methanol to collect material

## FUTURE EXPERIMENTS

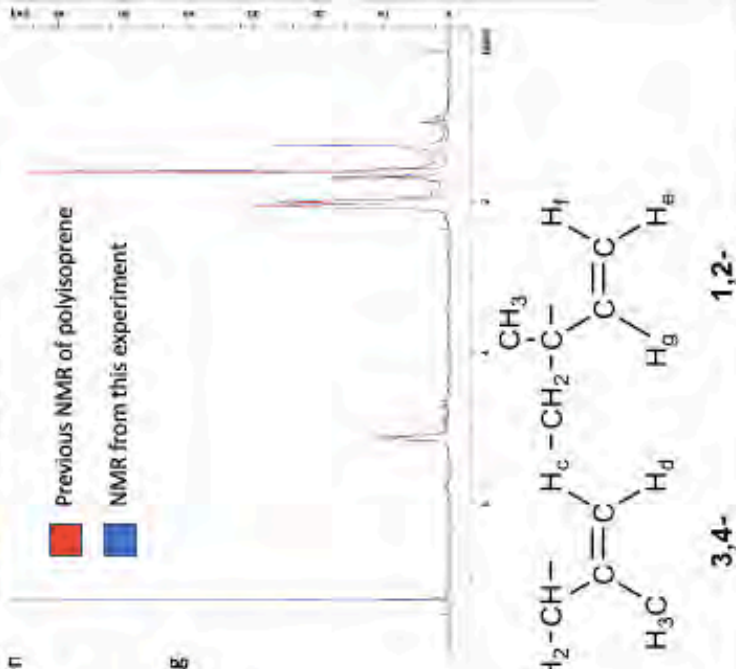
- Continue improving Isoprene Polymerizations
- Obtain more NMR data on new polymerizations and determine microstructure

## RESULTS

### Poly-Isoprene Yields

Over our first four reactions, the yields increased from 26% to 54%.

The proton NMR below indicated that polyisoprene was formed.





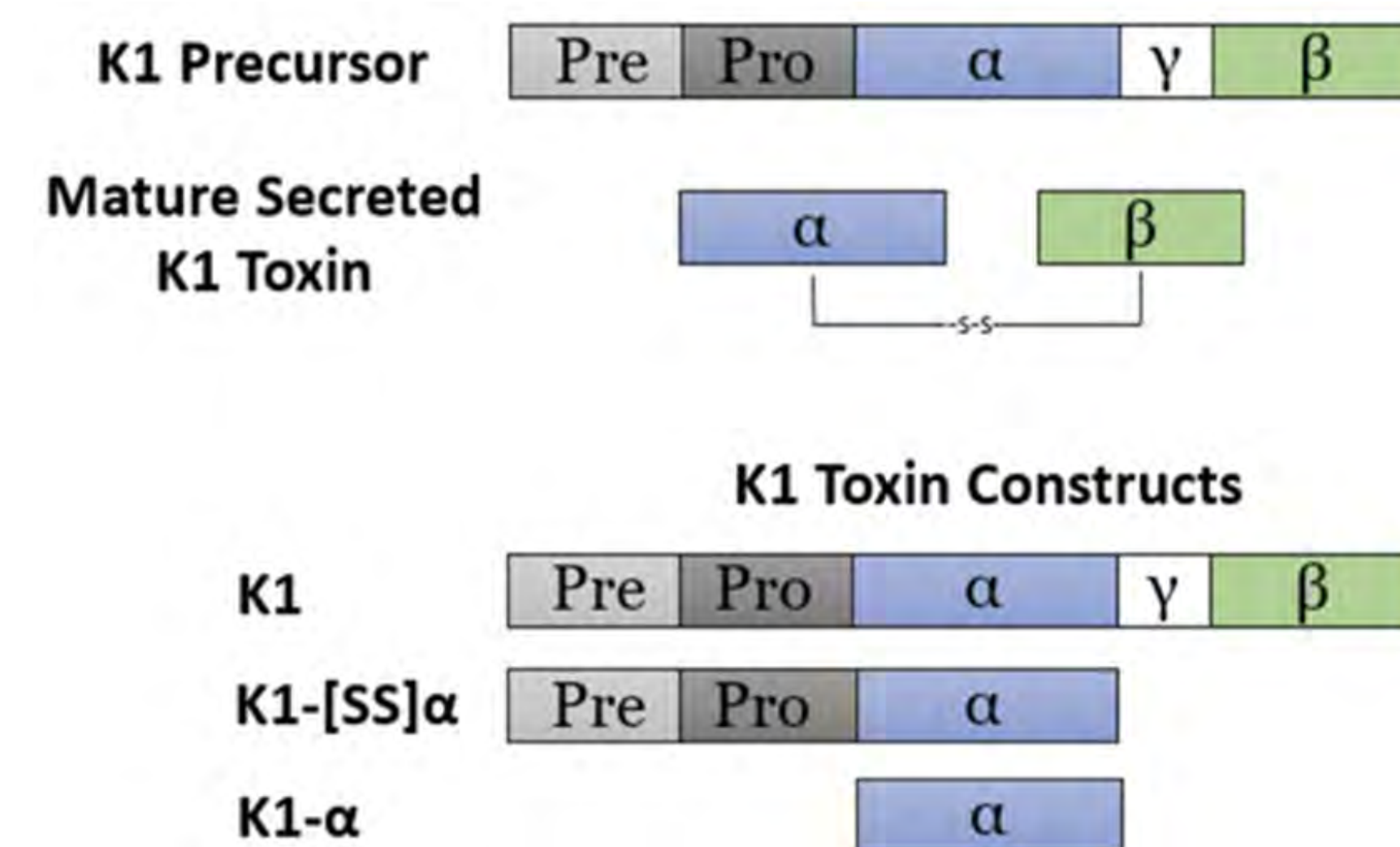
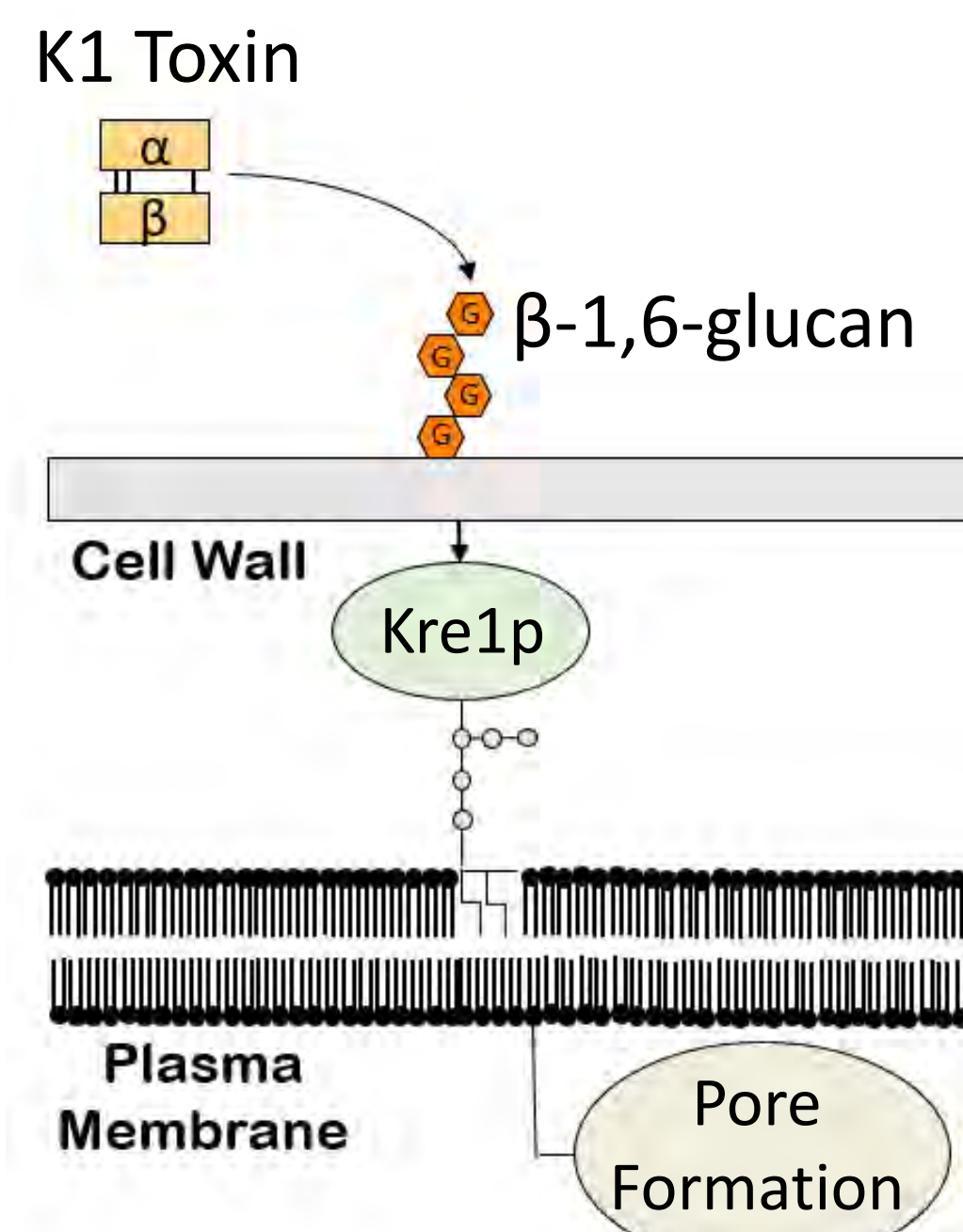
# Investigation of the Suicidal Phenotypes of K1 “Killer Toxin” Truncations in *Saccharomyces cerevisiae*

Danielle Yama, Mason Shipley, and Dr. Paul A. Rowley  
University of Idaho, Department of Biological Sciences



## INTRODUCTION

The current focus of this research within the Rowley lab is on the K1 “killer toxin” produced by *Saccharomyces cerevisiae* yeasts. Common antifungal treatments such as fluconazole or miconazole are becoming less effective in treating fungal infections such as *Candida glabrata* and *Candida albicans*—opportunistic pathogens that can cause life-threatening bloodstream infections in individuals with compromised immune systems. Therefore, use of antifungal “killer toxins” such as K1 has become a recent focus of research in understanding how to combat these fungal infections. K1—an antifungal protein secreted by *S. cerevisiae*—first binds to  $\beta$ -1,6-glucan at the cell wall and then interacts with Kre1p which is thought to lead to the formation of pores within the membrane and causes cell apoptosis. We do not fully understand the mechanism of suicide by these K1 protein domains. To fill this knowledge gap, we will test whether the deletion mutant strains of *S. cerevisiae* that represent a systematic collection of all non-essential gene deletions can suppress the suicidal phenotype of K1- $\alpha$  and K1-[SS] $\alpha$  which are responsible for mediating the toxic effect. This will provide insight into which non-essential gene deletions will provide resistance against K1- $\alpha$  and K1-[SS] $\alpha$ . This will lead us to better understand the mechanism of action of K1.

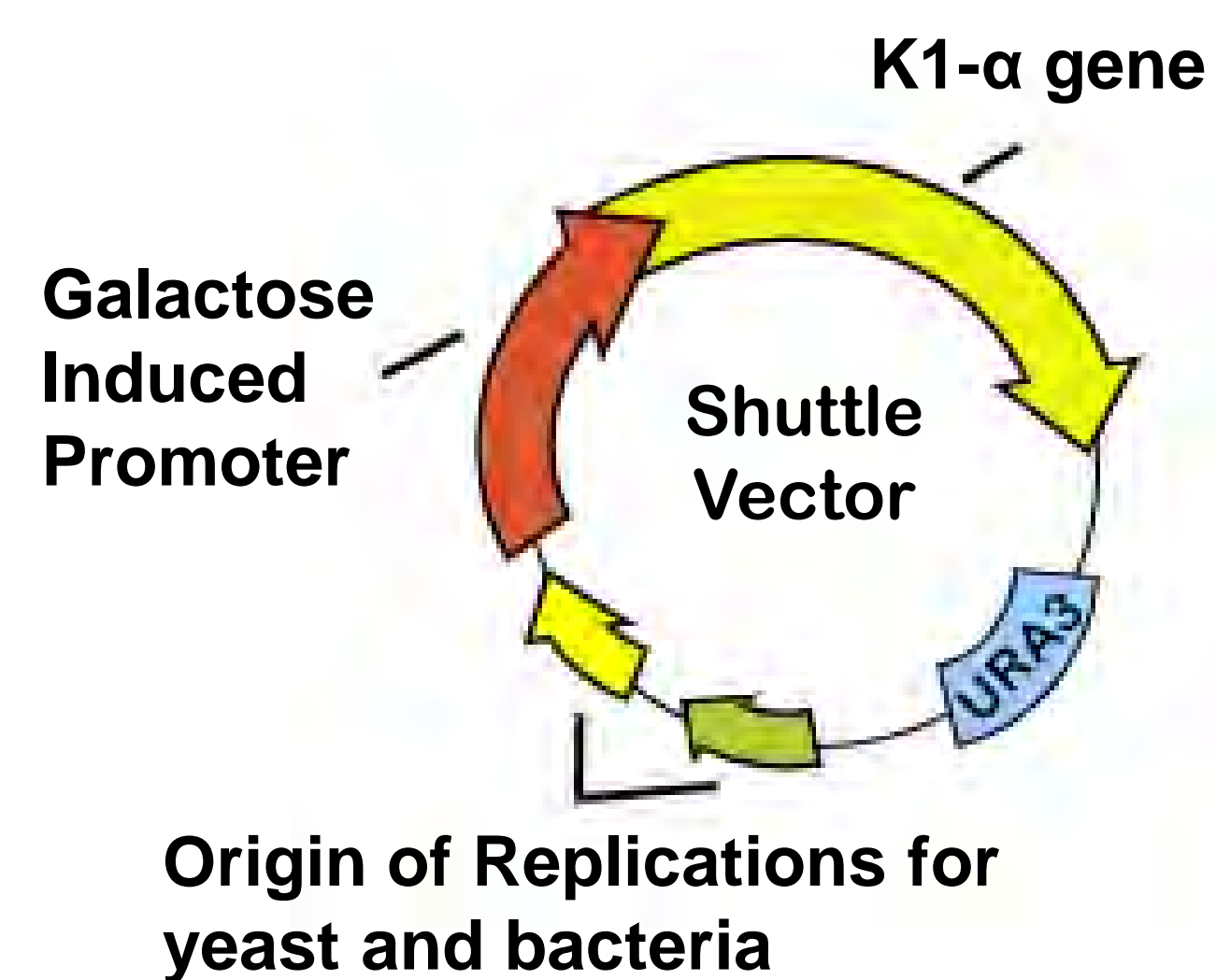


## HYPOTHESIS

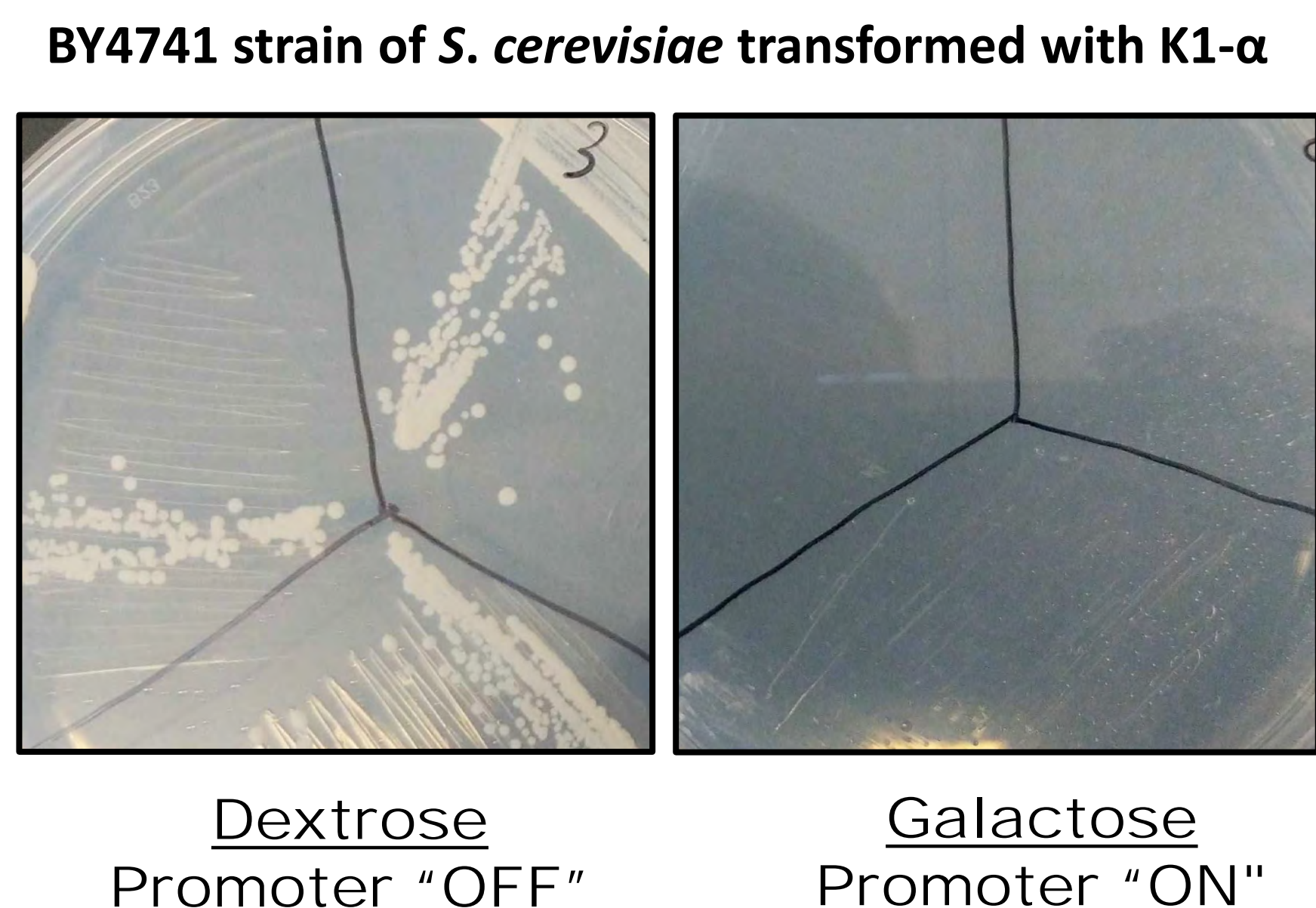
We hypothesize that the deletion of specific nonessential genes in *S. cerevisiae* strains will yield suppressor mutants that are resistant to K1- $\alpha$  or K1-[SS] $\alpha$  toxins. We expect those genes involved in ER protein export, protein transportation, or membrane function may prevent the lethality of *S. cerevisiae* cells due to K1- $\alpha$  or K1-[SS] $\alpha$ .

## AIM 1: VALIDATE THE LETHALITY OF K1- $\alpha$ AND K1-[SS] $\alpha$ IN *S. CEREVISIAE*

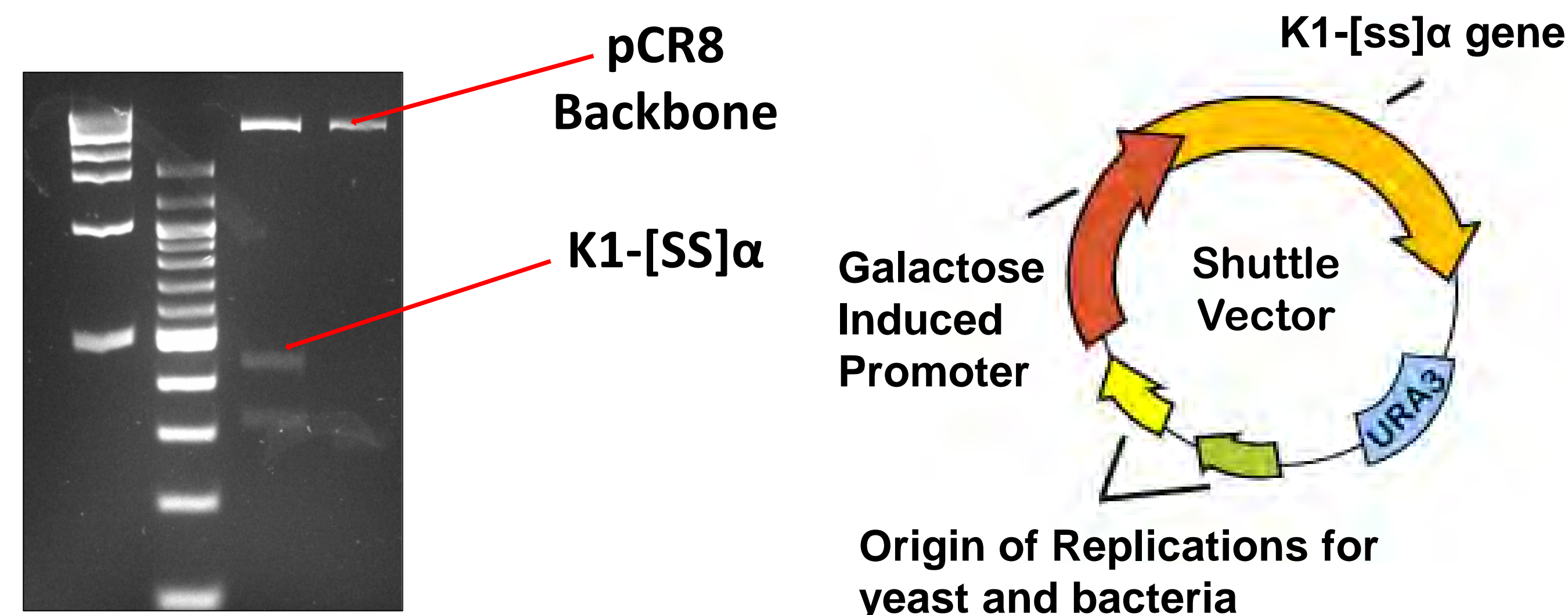
To confirm the toxic effects of K1- $\alpha$  and K1-[SS] $\alpha$  in the Rowley Lab at the University of Idaho, we constructed our own expression plasmid. The K1- $\alpha$  gene was introduced into a galactose-inducible expression plasmid containing the auxotrophic selection marker URA3 and used to transform the wild type BY4741 strain of *S. cerevisiae*.



*S. cerevisiae* strain BY4741 was transformed with K1- $\alpha$ . Cells that were plated on media containing dextrose were expected to show growth (left) while cells plated on media containing galactose would induce the galactose-promoter, causing the expression of K1- $\alpha$ , resulting in lethality (right).

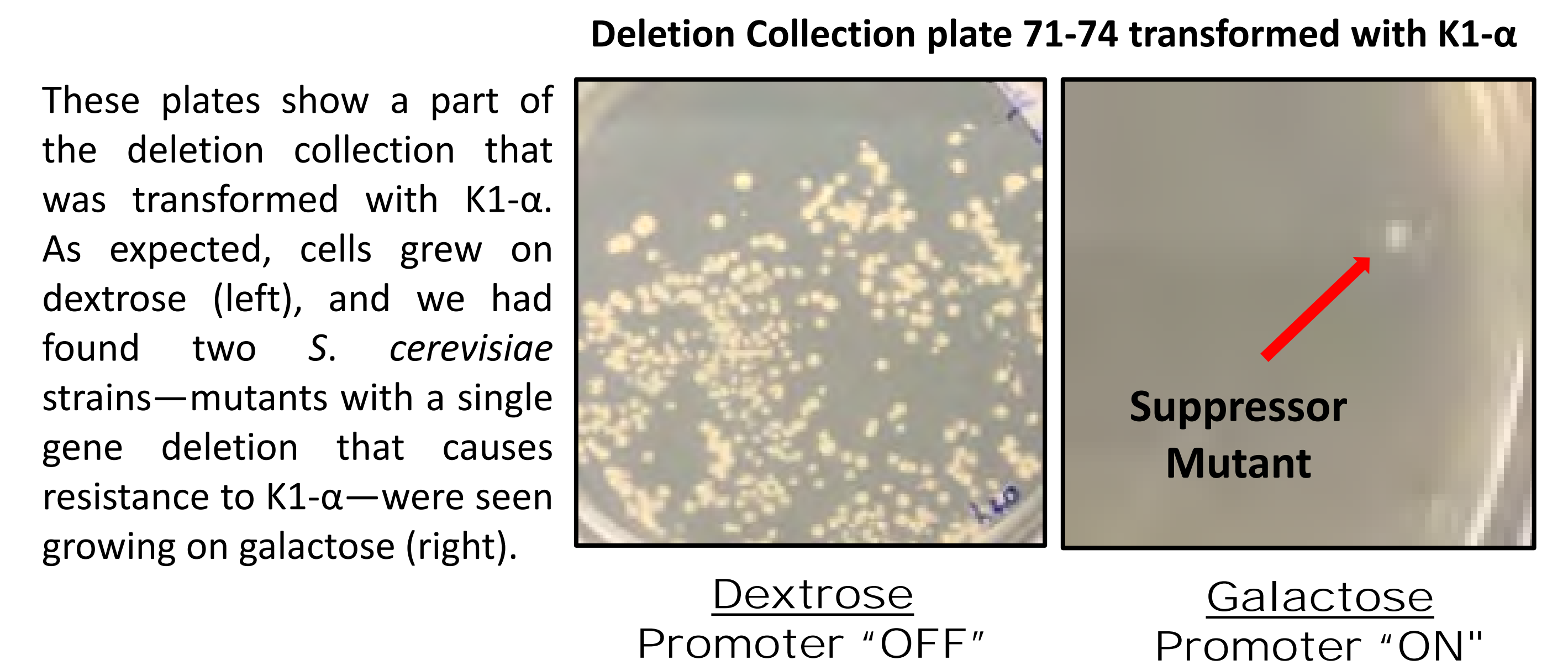
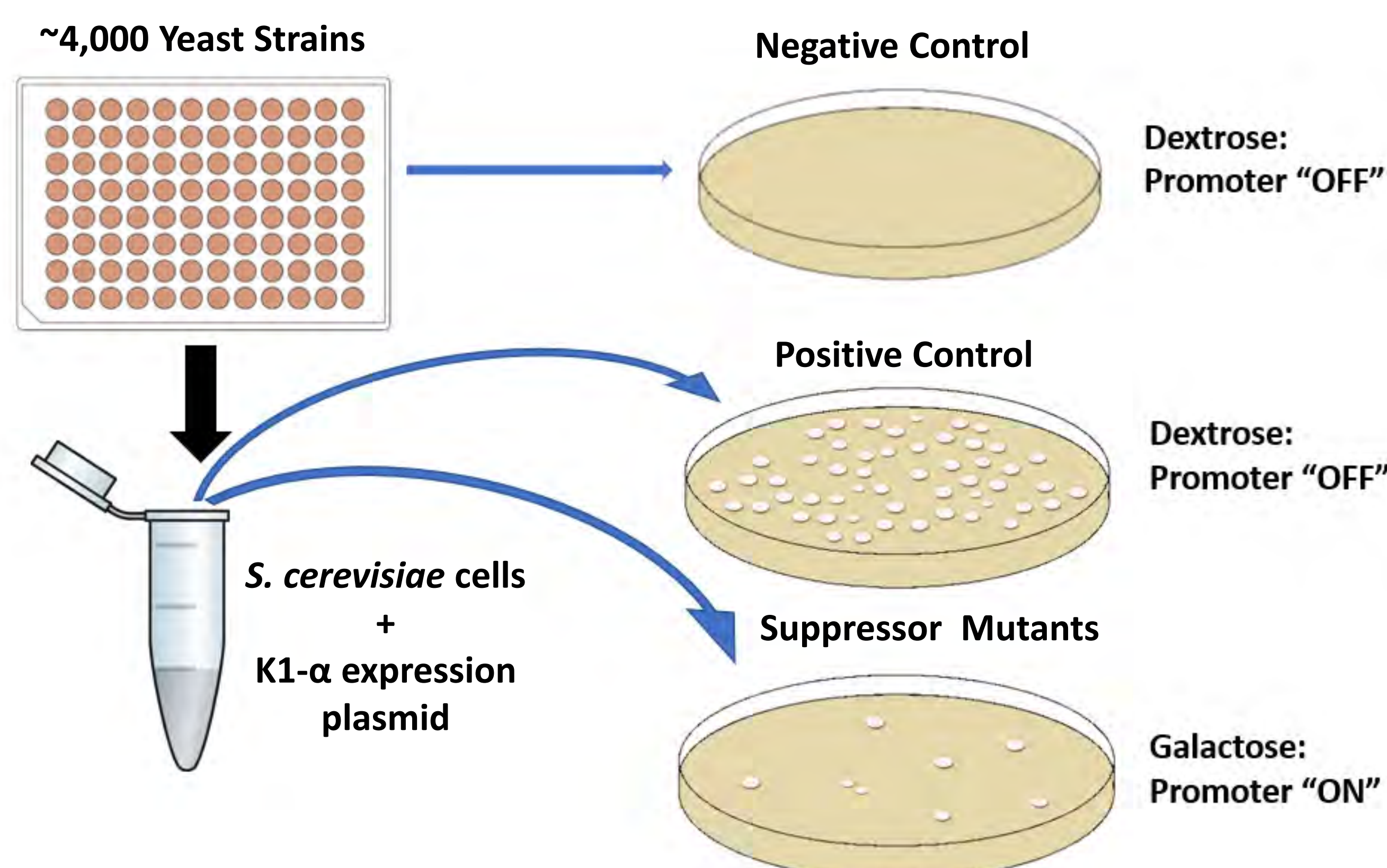


K1-[SS] $\alpha$  has been isolated and cloned using the PCR8 vector. *Escherichia coli* was then transformed with the K1-[SS] $\alpha$  construct and will undergo gateway cloning in order to create the full expression plasmid including the galactose induced promoter and origin of replication for yeast and bacteria. BY4741 *S. cerevisiae* strain will then be transformed with K1-[SS] $\alpha$  following the same process as K1- $\alpha$ .

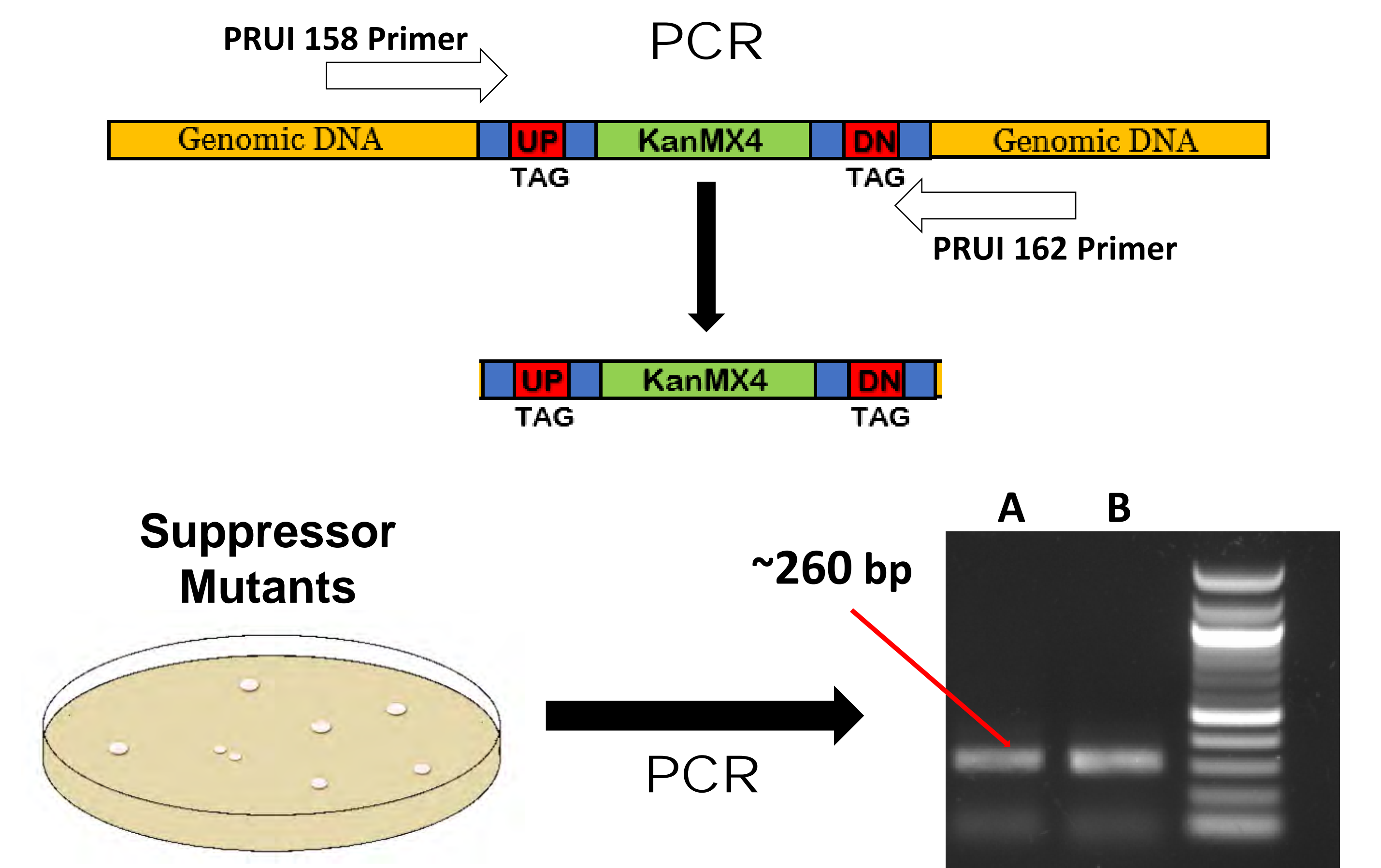


## AIM 2: IDENTIFY WHICH NON-ESSENTIAL GENES WITHIN *S. CEREVISIAE* THAT CAUSE RESISTANCE TO K1- $\alpha$ AND K1-[SS] $\alpha$

We transformed the entirety of the genome deletion collection library with K1- $\alpha$ . This library consists of ~4,000 different *S. cerevisiae* strains, each of which has a single non-essential gene that has been deleted from its genome.



These plates show a part of the deletion collection that was transformed with K1- $\alpha$ . As expected, cells grew on dextrose (left), and we had found two *S. cerevisiae* strains—mutants with a single gene deletion that causes resistance to K1- $\alpha$ —were seen growing on galactose (right).



PCR products with visible bands were sent for Sanger Sequencing. With KanMX4 serving as a marker, all single nonessential gene deletions can be identified. This process is used to identify those genes that when knocked out, cause resistance to K1- $\alpha$  or K1-[SS] $\alpha$ .

## ACKNOWLEDGEMENTS

This project was supported in part by a SURF award from the UI Office of Undergraduate Research

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