2021 Virtual FSU Undergraduate Research Symposium

Presentations online from 11:00 a.m. to 1:00 p.m.

Panel Q&A Sessions from 1:00 p.m. to 2:00 p.m.

April 23, 2021

TABLE OF CONTENTS

THE ABSTRACTS

This Symposium includes 54 presentations featuring the work of 79 students from 10 different departments across the College of Education and the College of Liberal Arts and Sciences. Students were assisted by 24 faculty and staff mentors. The projects presented at this Symposium took place in 2019, 2020, and 2021 and include coursework and independent study activities. Abstracts are organized alphabetically by college, department and by project title. Each presentation includes the following information:

Project Title (Presentation Format: Digital/Digital with Audio/Oral)

Name(s) of presenting student(s)
Name(s) of contributing student(s) if applicable
Name(s) of faculty/staff mentor(s)

Digital Presentations include a digital file of a poster or artwork.

Digital Presentations with Audio include a digital file enhanced with an audio recording of an explanation of the project.

Oral Presentations include a video recording of the presentation with audio and, in some cases, video of the speaker(s).

COLLEGE OF EDUCATION

DEPARTMENT OF KINESIOLOGY AND RECREATION

A Multidisciplinary Approach to Holistic Development of Intercollegiate Student-Athletes (Digital Presentation with Audio)

Presenting Student: Makayla Parris
Faculty Mentor: Dr. Jacqueline Durst

Focused Clinical Question: How could a multidisciplinary approach affect the holistic development of intercollegiate student-athletes? **Data Sources:** The data was collected from electronic databases, with special mention of an ESPN survey. Key words used were holistic, athletics, student-athletes, athletic training, wellness, and intercollegiate. In these searches, the articles were selected based upon the exact relevance to the topic. **Study Selection:** The criteria used was different since the study is not comparative to any other specific interventions. The selection was based upon statistics from clinicians and healthcare providers in athletics. Each article had a general theme of collaborative care in the lens of various sports industry professionals who advocate for the overall health and wellness of their student-athletes. **Data Extraction:** The data showed that the majority of athletic trainers want to do more than they feel in control over for their student-athletes. This is due to a thinking error in athletic administration staff by mistaking certified athletic trainers as interdisciplinary instead of allowing other professionals to be a bridge between the medical and administrative staff for the purpose of the student-athlete. Everyone involved would be delegated to issues in relation to the general health of student-athletes. **Summary Measures:** The articles were measured based on similar points of view and medical opinions of athletics trainers, sports psychologists, sports nutritionists, team physicians, and strength and conditioning coaches. **Evidence Appraisal:** The methods used to select evidence from the articles were indicative of the quality of the research done by respected athletic healthcare professionals successful in their field. The type of evidence used from each study is between level 2-4 on the Oxford Centre of Evidenced-Based Medicine scale. **Search Results:** This research is still a widely unexplored and unaddressed topic, but the relevant articles and data found were strong. This lack of randomized controlled trials was expected. The weakness in a targeted student-athlete population for the non-chosen studies were apparent. **Data Synthesis:** The data conducted from this research has emphasized the issue of cultural incompetency within athletics which is reflected by intercollegiate student-athletes. As well as the existence of the multidisciplinary team, the team should also follow a holistic athletic healthcare model to ensure all needs are met within the daily life of the student-athlete. **Evidence Quality:** The researcher identified ten articles for appraisal but narrowed it down to six due to a changing specificity of the topic. The remaining articles best demonstrated the issue, the cause, and the effect. Four of the six articles are a level 2, with the remaining two articles a level 3 and 4. Most of the studies are non-observational cohort studies

with no design. **Conclusion:** In order for the entire athletic staff to accept that the student-athlete is more than just their body, collaboration is needed in order to gain the holistic view. The collaboration between the multidisciplinary team already consists of the athletic trainer, the injured athlete, the team physician, and the coaches. However, it could also be expanded to include the input of a sports nutritionist and a sports psychologist also within that primary multidisciplinary team (Arvinen-Barrow, 2015). Qualified specialists who are able to help progress the rehabilitation goals of the student-athlete should always be there to ensure a state of equilibrium for the student-athlete and within the multidisciplinary team.

Cancer Risks for Athletes Playing on Artificial Turf: A Critically Appraised Topic (Digital Presentation with Audio)

Presenting Student: Matthew Mannick
Faculty Mentor: Dr. Jacqueline Durst

Clinical Question: Are athletes who play on artificial turf at higher risk of developing cancer compared with athletes who play on natural soil? **Data bases:** Electronic databases were used from Pub Med, Google Scholar, Frostburg State University Library Database. Search terms included artificial turf, cancer risk, and athletes. **Study Selection:** Six articles were selected for further evaluation for this study. Criteria included scholarly peer reviewed articles from an electronic database. The criteria for selection were based on evidence of artificial turf and cancer risk with athletes. Even if there was little to no evidence of cancer risk, the article was used for further evaluation. **Data Extraction:** Data that showed some risk of cancer from athletes playing on artificial was used. Data on carcinogens from artificial turf that could cause cancer was used. Data on different ways of exposure of turf rubber was used and cancer risk of athletes playing on natural soil was used. **Summary Measures:** The data was organized in groups. One group of data showed that the chance of getting cancer playing on artificial turf was under the United States Environmental Protection Agency (US EPA) value of 1E-06. Another group showed that the risk of getting cancer was above the US EPA value of 1E-06. Another group showed mixed results in their literature review, it stated that cancer risk is relevant and some state that there is minimal risk. Another group was natural soil and risk of cancer playing on natural soil compared to artificial turf. The last group stated that there are carcinogens in turf but need further research on the carcinogens. **Evidence Appraisal:** The reviewer used the Oxford Centre for Evidence Based Medicine (CEBM) flow chart to appraise the six articles used in this study. Three articles are case control studies which are level 3 on the CEBM flow chart, and the other three are literature reviews which are level 5 on the CEBM flow chart. **Search results:** Initially, the reviewer identified 45 articles and full manuscripts were screened. six were included. **Data Synthesis:** Two articles state that even at a lifetime exposure the risk of getting cancer is minimal and is below the minimal and maximum numbers of the US EPA. Another study states that the cancer risk for playing on natural soil and artificial turf were below the minimum risk of the EPA. One study state that when artificial turf is exposed to 60 degrees Celsius weather, there is a notable risk of cancer through inhalation of Polycyclic aromatic hydrocarbons (PAH's). The last two studies used showed

that more research is needed but articles out there show some risk or no risk of cancer. **Evidence Quality:** Six articles were included; three were case control studies and three were literature reviews. Based on CEBM flowchart, three articles were level 3 quality of evidence and three were level 5 quality of evidence. **Conclusions:** Artificial turf does not pose a serious threat of cancer. The risk of cancer playing on artificial turf is one in a millionth chance, even with evidence that shows there are multiple carcinogens and metals in turf crumb. As long as the cancer risk stays under 1e-6 chance, the US EPA risk assessment on artificial turf states that the turf is safe to play on. Limited evidence states that the cancer risk is over the one and a millionth. Athletes actually have the same or slightly higher risk of getting cancer playing on natural soil compared to artificial turf. Natural soil has similar metals and chemicals found in artificial turf. Data showed that some natural soil field has a risk of 6.1e-6 but this value stays in the range of the US EPA risk assessment. Therefore, it is safe for athletes to play on artificial turf and natural soil with no worry of getting cancer.

Effects of Prehabilitation Exercises on Quadriceps Strength Post ACL Surgery: A Critically Appraised Topic (Digital Presentation with Audio)

Presenting Student: Clayton Washington
Faculty Mentor: Dr. Jacqueline Durst

Focused Clinical Question: In collegiate athletes, will pre-operative exercises increase quadriceps strength post ACL surgery compared to no prehabilitation? **Data Sources:** Studies were identified using electronic databases and contained key words “ACL”, “Rehabilitation”, “College Athlete”, and “Quadriceps strength”. **Study Selection:** Studies were included if they focused on post-operative ACL rehabilitation. Limitations were set around patient age. Data was extracted based on sample size and population, intervention, outcome measures, and results. **Summary measures:** Researchers found that prehabilitation quadriceps exercises had a significant impact on quadriceps strength when measured post-surgery. **Data Extraction:** Studies that were appraised based on the population (college athletes), intervention (pre-habilitation quadriceps exercises), outcome measure (quadriceps strength when comparing post-surgery /follow up to athlete’s baseline). **Evidence Appraisal**: Evidence was appraised based on the inclusion of random controlled studies. These studies eliminated bias. **Search results:** Out of the 21 studies screened, nine were included in this study. **Data Synthesis**: One study found that knee extensor strength deficits were significantly different between the groups, both at an angular velocity of 60°/s ($p=0.018$) and 180°/s ($p=0.033$). Patients in the PEG showed a significantly greater improvement in post-operative strength than patient in the NPEG at 60°/s, and180°/s. The PEG also showed significant improvement in the single hop distance test ($p=0.029$). Another study showed that results were had statistically significant differences ($p < 0.05$) were reported for quadriceps strength. One study found reported higher increases of the maximal quadriceps torque from baseline to pre-reconstruction and similar results for quadriceps strength. One study showed that quadriceps peak torque in the injured limb improved with similar gains in cross sectional area compared with baseline ($P = .001$). However, they found that this was not significantly increased compared with

the control group. Another study reported higher increases of the maximal quadriceps torque from baseline to pre-reconstruction. Another study found that there were no differences in quad strength, warranting the need for immediate surgery following ACL injury. **Evidence Quality:** Of the studies appraised seven studies was level 5 of evidence, two studies were a level 3 of evidence. Seven studies showed that preoperative squad exercises showed significant improvement in squad strength following surgery. Two studies found that the data was not significant enough to warrant approval. **Conclusions:** Based on the findings, early pre-operative quadriceps exercises have a significant impact on quadriceps strength post-surgery. Athletes that have an ACL injury should be prescribed with quadriceps exercises to reduce the loss of quadriceps strength.

Grade III Acromioclavicular Sprain Recommendation for Treatment: A Critically Appraised Topic (Digital Presentation with Audio)

Presenting Student: Brooke Lafeyette
Faculty Mentor: Dr. Jacqueline Durst

Focused Clinical Question: In a 20-year old male collegiate ice hockey player, does the use of rehabilitation decrease the return to play timeline compared with a surgical repair for a Grade III Acromioclavicular joint sprain? **Data Sources:** In this research, the data collected were looked through electronic databases. The databases used were OneSearch, GoogleScholar, and PubMed. Key words that were used were Grade I and II AC joint separation, Grade IV and V AC joint separation, Grade III AC joint Separation, Grade III AC joint separation treatment. In these searches, the articles chosen were based off the abstract and what the research/study was testing. **Study Selection:** The criteria used had to be broadened outside of athletic patients due limited specific research for that population. The criteria were broadened to normal day-to-day life and returning to work/play. The patients tested had to be around their 20-30's years of age. The different studies had to be published in the 2000's. Articles selected had a comparative approach either conservative or operative. They also were comparing the different grades and the treatment protocol used. Specifically, to the Grade III AC joint sprain, the articles had to suggest a route to take for treating this type of separation whether it be conservative or surgical based off of other grades and their management route taken. **Data Extraction:** Specific outcomes looked into that 100% of the articles suggested the conservative approach for Grades I and II. Surgical management was 100% recommended for those with Grade IV, V, and VI. All the articles that were included in this research called the Grade III AC joint separation controversial based on the management technique to take whether it be the conservative or operative management. **Summary Measures:** The articles were grouped based on results seen in the study. They were grouped together by conservative management before surgical, surgical management initially, and inconclusive. **Evidence Appraisal:** The method used to appraise the articles that were going to be used in this study looked at the quality of research and what type of evidence used. In this research, the articles used had many different levels of evidence because the researcher wanted a variety of evidence and different studies to be used to have a conclusion on their clinical question.

The Oxford Centre of EBM was used to determine the type of evidence in each study. Out of the seven articles selected, most of the evidence levels included a combination of level 1 to level 4 evidence. **Search Results:** The strength of the search results and the articles found are the level of evidence of the studies, and the variety of studies found. Weakness include broadening the population to everyone around their 20-30's instead of keeping it to male collegiate athletes. **Data Synthesis:** The data conducted from this research has shown that most of the studies has concluded for Grade III AC joint sprains to start with the conservative management and then move forward to surgical if the patient has further issues or if they do not like the cosmetic look of the injury. The outcomes from both conservative and surgical management have similar results for range of motion and pain management but the recovery with the surgical procedure is slightly greater than conservative. **Evidence Quality:** The researcher initially identified 30 articles and found seven that met the criteria and evidence level needed. Two out of the seven articles were an evidence level of 1 which is very informative and valuable in research. The other articles were a level 3 or 4 which involved more case studies and retrospective reviews. **Conclusions:** The conclusive result showed that Grade III acromioclavicular sprains are a controversial type of injury that there is no "gold standard" treatment plan on how to manage the injury whether it be conservative, such as rehabilitation, or invasive, such as surgical. Articles in this support conservative management for Grade III acromioclavicular sprains as an initial treatment option. This is due to satisfactory results from patients who completed surgical and non-surgical treatments. In each case, patients reported similar results with range of motion, pain level, and back to day to day living with no issues. The downside of conservative rehabilitation management is the unappealing cosmetic look of the step deformity from the clavicle as well as continued pain after rehabilitation. The recommendation concluded is for conservative management treatment and if the patient still has issues such as pain after finishing the program, the surgical management would be recommended. The conservative management style has a slightly quicker return to play than the surgical procedure, but it depends on how the patient responds to the treatment.

MPFL Reconstruction Rehabilitation in College Age Male Athletes: A Critically Appraised Topic (Digital Presentation with Audio)

Presenting Student: Daniel Bittinger
Faculty Mentor: Dr. Jacqueline Durst

Clinical Question: In college age male athletes, would a 7-12 month rehabilitation plan compared to 4-6 month rehabilitation plan decrease the chance of re-injury after MPFL reconstruction? **Data Sources:** Databases searched were PubMed, Google scholar, and Frostburg State University Library online database. Search terms included MPFL reconstruction, Rehabilitation protocol, and college male athletes. Six articles were selected for evaluation for this study. **Study Selection:** The articles are peer reviewed scholarly articles from online databases. The criteria for selection of articles was the presence of data pertaining to the clinical outcomes of MPFL reconstruction surgery and the effects of rehabilitation on surgery success. Studies that concluded that more research was appropriate were used in the study. **Data Extraction:** Data that showed return to play guidelines

and functional testing following MPFL reconstruction was used. Data that followed a case study for a 23-year-old going through rehabilitation was used. Data that showed the rehabilitation variability following MPFL reconstruction was used. **Summary Measures:** The articles needed to include a varying range of rehabilitation lengths, patient reported outcomes, and compliance with rehabilitation protocols. **Evidence Appraisal:** The articles were evaluated using the Oxford grading scale. Inclusion criteria included a level 4 study with no animal subjects. The study should also have a majority of male athletes in their early to mid-20s. The individuals in the study should have had MPFL reconstructive surgery and not MPFL revision surgery. **Search Results:** The reviewer initially identified 52 articles and full manuscripts screened. Six were utilized. All of the articles that were chosen follow the criteria of being a level 4 and follow a majority of male athletes in the studies. **Data Synthesis:** Among the articles that were chosen, two of them are return to play, one is functional testing, one is the rehabilitation variability, one is a clinical outcome study, and there is one case study following a 23-year-old male athlete following MPFL reconstruction. **Conclusion:** MPFL reconstruction rehabilitation protocols range from 5-12 months when returning to sport. The data shows that re-injury rates were not affected by the length of rehabilitation.

Perilunate Dislocation in an Intercollegiate Football Player: A Case Study (Digital Presentation with Audio)

Presenting Student: Katherine Treff
Faculty Mentor: Dr. Jacqueline Durst

Background: A 22-year-old, male wide receiver with no significant history did not present to the Athletic Trainer at the time of injury. At the end of practice, the patient jumped to catch a ball and fell on an outstretched left hand. The patient did not perceive the injury as significant at the time of injury, but later noted immobilization of the hand, paresthesia, and diffuse swelling and tenderness. **Differential Diagnosis:** Initial evaluation presented as a scaphoid fracture, wrist sprain, or wrist strain. Upon further evaluation, there was concern for lunate dislocation or perilunate dislocation. **Treatment:** Status-post one day, the patient's symptoms became worse and noted a deformity of the left wrist. The patient became concerned about their injury and was admitted for radiographs. X-Ray identified a perilunate dislocation, without a fracture. A CT scan further revealed scapholunate dissociation. The perilunate dislocation was then relocated through closed reduction. The Athletic Trainer was notified, and the patient was disqualified from activity. Status-post 7 days, the patient underwent volar and dorsal capsuloligament repair and reconstruction of the scapholunate ligament. Status-post three months, cast and surgical hardware was removed. The patient was instructed to continue rehabilitation, focusing on range of motion. The patient has decided to Red-Shirt; however, he is participating in practices as tolerated with no contact. **Uniqueness:** Injury to the carpals, such as sprains, scaphoid fractures, and carpal tunnel syndrome, are common. However, perilunate dislocations are rare due the high energy axial force that is needed to cause the injury. Perilunate dislocations are especially rare in physical activity; the injury is more associated with motor vehicle accidents. **Conclusion:** Perilunate dislocation have positive outcomes when intervention is immediate. Delayed intervention can lead

to problems such as, post-traumatic osteoarthritis or damage to the neurovascular system which can compromise functional movement of the carpometacarpal joint and hinder the satisfaction of the patient. Therefore, literature suggests that perilunate dislocations should be diagnosed as soon as possible and early intervention demonstrates good results. It is important for coaches and athletes to effectively communicate with their Athletic Trainer so that injuries are not dismissed as insignificant.

References

1. Akalın Y, Cansabuncu G, Çevik N, Öztürk A. Early Results of Early Intervention in Patients with Perilunate Dislocation and Fractured Dislocation. Kafkas J Med Sci 2019; 9(2):60–66.
2. Palmieri-Smith R M, Cameron K L, DiStefano L J, Driban J B, Pietrosimone B, Thomas A C, Tourville T W. The Role of Athletic Trainers in Preventing and Managing Posttraumatic Osteoarthritis in Physically Active Populations: a Consensus Statement of the Athletic Trainers' Osteoarthritis Consortium. Journal of Athletic Training 2017;52(6):610–623.
3. Pinho A B, Sobania R L. Perilunate carpal dislocation. Clinical evaluation of patients operated with reduction and percutaneous fixation without capsular-ligament repair. Rev Bras Ortop. 2017;52(4):402–409.

Strength Training Compared to Endurance Training for Muscle Hypertrophy and Knee Function in Adult Athletes: A Critically Appraised Topic (Digital Presentation with Audio)

Presenting Student: Keyonna Biggs
Faculty Mentor: Dr. Jacqueline Durst

Clinical Question: In adult athletes, will strength training increase muscle hypertrophy and overall knee function and stability during ACL rehabilitation compared to endurance training? **Data Sources:** Electronic databases were used to search treatment, ACL rehabilitation, strength, muscle hypertrophy and ACL reconstruction. **Study Selection:** Five articles were selected for further analyzation of this study. These articles need to be scholarly peer reviewed from a data based. The selection for these criteria were based on evidence of muscle hypertrophy with strength training versus endurance training. There was limited evidence on endurance training in correspondence to muscle hypertrophy in an ACL rehab program. Even though there is not much data of support the articles were still selected and included for analyzation to contribute to this study. **Data Extraction:** Data on Quad and Hamstring strength was used. Data on limb symmetry in muscular stature was used. Data on the peak torque and the maximum power of Quads and hamstring performing strength and endurance. **Summary Measures:** One of the group's data displayed that there were no significant differences in peak quadriceps and hamstring muscle strength in injured leg after seven months of rehabilitation compared to dominant leg. Another group study data showed how strength training increased hip flexor, adductor, and abductor strength. One other group study showed that strength training concentric then eccentric contraction caused greater muscle hypertrophy when used in ACL rehabilitation. A group study showed how whole-body strength training exercise significantly increased knee isokinetic strength causing maximum power

and torque of the muscles. The last article showed how proper rehabilitation needs to emphasis the importance of functional stability and good muscle function, which is produced through strength training. **Evidence Appraisal:** The articles were appraised by the CEBM, which is the Oxford Centre for Evidence Based Medicine flow chart. Two articles were level three, and three articles were level one. **Search Results:** The reviewer initially identified 30 articles and full manuscripts were screened. Five were included. **Data Synthesis:** One article state that implementing strength and conditioning training is lacking in ACL rehabilitations causing more athletes to not be improving in function or increase in muscle hypertrophy. Articles explain how emphasis on strength conditioning should be essential in ACL rehabilitation. The other article states that progressive strength training restores quadriceps and hamstring within seven months after ACL surgery in an armature male soccer player. One study said strength training significantly increases training effects on muscular regeneration after ACL reconstruction. One group study shows that quadricep muscle strength correlates with good outcomes after knee surgery due to implementing emphasis on strength training. The last article shows how lower extremity muscle strength after ACL reconstruction can be increased by incorporating strength training, and endurance training gave athletes more muscle stamina and less fatigue. **Evidence Quality:** Two articles are case study based and was strictly one case study based. The other three articles were all peer-reviewed articles. On the CEMB flow chart, the first two articles are on level three of quality. The last three articles were on level one of the charts. **Conclusion:** Strength training has the most effective benefits with muscle hypertrophy, knee functional stability, and overall good patient outcomes. Endurance training was incorporated in these studies which can help assist with improvement of ACL patients in rehabilitation. Although there is limited evidence that show the benefits of endurance training, most rehabilitation protocol includes it in correspondence with strength training to assist in overall conditioning of the athlete's body. Based on the data strength training significantly increased muscle hypertrophy and overall healing of proper knee functions. The data shows that ACL patients benefit more from programs that emphasizes strength training in their rehabilitation protocol. Most of these studies supported strength training as the basis to a rehab program and showed significant progress in athlete healing process. Therefore, strength training has more benefits compared to endurance training in relation to ACL rehabilitation.

Weber C Fracture and Medial Malleolus Dislocation in a College Football Player: A Case Study (Digital Presentation with Audio)

Presenting Student: Sylvia Watson
Faculty and Staff Mentors: Dr. Jacqueline Durst, Ms. Karla Schoenly

Background: Subject is a 24-year-old college football player with no previous history of ankle injuries. Subject turned out of a low tackle during practice resulting in his injury. Pain was reported in right distal leg with an obvious deformity to the medial malleolus. Athlete's cleat was cut during on field assessment to ensure there was no open fracture. Myotomes and dermatomes were evaluated and within normal limits. Vacuum splint was placed on ankle "as is", and EMS was called. **Differential Diagnosis:** Initial evaluation presented as a medial malleolus dislocation of the

right ankle. Concern for nerve damage and fracture of the fibula developed when athlete's pain subsided after the ankle was splinted in place. The suspected diagnosis of nerve damage was present from the displacement of the medial malleolus. Weber-Type C fibula fracture was identified after diagnostic screening. **Treatment:** Athlete was transported to a local hospital for x-rays and ankle reduction. Screening detected a Weber-Type C fibula fracture with tibiofibular syndesmosis tearing. Subject had surgery four days following injury to correct the positioning of the mortis as well as the fibular fracture. Two screws were placed at the distal ankle going through the fibula and tibia to keep the mortis of the ankle aligned and allow damage to the syndesmosis to heal. A fibular plate with five additional screws was placed to keep the ankle joint stable and ensure proper bone healing. Sutures were removed one-week postop, and hard casting was recommended for three weeks. Following cast removal, the athlete was instructed to remain non-weight bearing for an additional two to three weeks. **Uniqueness:** The decision to reduce ankle dislocations on the field is difficult to determine. Medial malleolus dislocations can be reduced with slight traction within the first minute of the injury; however, Weber-Type C fractures are not unusual with a medial malleolus dislocation. The decision to reduce this type of injury must be determined quickly and must be performed by trained medical staff. **Conclusion:** Weber-Type C fractures are often a secondary injury to medial malleolus dislocations. The external rotational trauma of the medial malleolus also causes tearing of the tibiofibular syndesmosis. Approximately one in seven ankle fractures are associated with an injury to the syndesmosis. It is important for athletic trainers to be prepared for this type of trauma injury especially in high contact sports. Communicating and practicing ankle reduction protocols with the supervising team physician is a critical component of the emergency action plan.

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF BIOLOGY

Cloning ospA for Plant (Arabidopsis) Expression (Digital Presentation)

Presenting Student: Eleanor Browne
Faculty Mentor: Dr. David Puthoff

Borrelia burgdorferi (Lyme disease) is a vector-borne disease that is both very common and capable of causing long term negative health effects. Because it is spread by deer ticks, which also bite mice and mice which then transfer infection between ticks, our goal is to design an oral vaccine capable of preventing mice from becoming infected and passing it amongst ticks. This was done by inserting outer surface protein A (ospA) of *B. burgdorferi* into a plant vector, pCambia 1201. *Agrobacterium tumefaciens* (recently reclassified as *Rhizobium radiobacter*), was used as a means of introducing the vector (bearing *B. burgdorferi* ospA) into *Arabidopsis thaliana.* The pCambia vector was introduced into *A. tumefaciens* competent cells after being purified from *E. coli* colonies which had undergone a similar transformation process, as *E. coli* is a more suitable bacteria for cloning. The successfully electroporated *A. tumefaciens* was then plated and colonies were picked and grown as liquid cultures. Those liquid cultures, of *A. tumefaciens* transformed with both the ospA bearing pCambia and a control pCambia, were used for floral dip of both a preliminary test group of Wisconsin Fast Plant (this test group only contained plants dipped using the ospA bearing pCambia, not a control) and *Arabidopsis thaliana* (both ospA bearing and a pCambia only control plants). These dipped plants' seeds, once dried, will be planted and crossed to ensure use of only plants which express pCambia in later testing, and to ensure that the process has been successful.

Comparison of Antibiotic Sensitivity of *Burkholderia cenocepacia* and *Bukholderia cepacia* (Digital Presentation)

Presenting Student: Oghnekome Ukpu
Faculty Mentor: Dr. Kumudini Munasinghe

Burkholderia cepacia complex (BCC) was tied to various FDA drug recalls over the past few years and *Burkholderia cenocepacia* is one of the most clinically important bacteria of the BCC. Members of BCC are opportunistic pathogens in patients who are immunocompromised and have respiratory tract infections including Cystic fibrosis. A recent research showed that these bacteria can survive in oxygenic and anoxygenic environments. The main objective of this research is to find out *B. cepacia* and *B. cenocepacia* sensitivity for selected antibiotics and disinfectants using Kirby

Bauer Technique. Four replicates of each bacterial broth cultures were placed at 4, 15, 20, 37, and 85°C to find out their optimum temperature for the incubation, and both species had significant growth at 37°C. So that, Muller Hinton culture plates were incubated at 37°C and measured Inhibition zones to compare their sensitivities. In the study with the antibiotics, both species showed very strong resistance to a number of antibiotics including Penicillin, Ampicillin and Streptomycin. Chloramphenicol (30mg) was the only antibiotic that inhibited the growth of *B. cenocepacia* and *B. cepacia* with a 30mm, 27mm, 28mm, 20mm and 21mm, 20mm, 19mm diameters of inhibition zones, respectively. Tetracycline (30mg) also showed a slight growth of inhibition on the *B. cenocepacia* with diameters of 10mm and 12mm. In the study with the disinfectants, *B. cepacia* showed growth in the presence of Roccal, but its growth was inhibited by 409, household cleaner, and bleach with the diameters of 20mm, 16mm, 18mm, 13mm and 13mm, 15mm, 10mm, respectively. The opposite was found in *B. cenocepacia* as Roccal and 409 significantly inhibited the growth of this bacteria species with the diameters of 30mm, 29mm, 20mm, 19mm and 39mm, 27mm, 30mm, 35mm with the Roccal and 409, respectively. This study showed that *B. cepacia* and *B. cenocepacia* have significant resistance for many antibiotics as well as some disinfections.

Key words: *Burkholderia cepacia*, *Burkholderia cenocepacia,* Kirby Bauer Technique

Evaluation of Water Samples Using the Filtration Technique (Digital Presentation)

Presenting Student: Matthew Ward
Faculty Mentor: Dr. Kumudini Munasinghe

Water quality is essential for the health and safety of humans as well as the organisms that inhabit that area. Certain bacteria like fecal coliform and fecal streptococci can contaminate the water and affect different aspect of these organisms. If these bacteria were to be ingested by humans, possible health effects like hepatitis A and gastroenteritis can occur. This research focuses on the identification of bacteria in the Frostburg area and if the water would be considered safe. Water taken from the Sand Spring Run and multiple water sources around Frostburg State campus were sampled and tested for its contents. Multiple microbiology tests were used to identify the bacteria present with membrane filtration being the main source of results for the Fecal coliform and Fecal streptococci tests. With this test, water was filtered through a filter, leaving the bacteria on a filter pad. The filter pad would be placed on top of a selective media for the bacteria to grow. In addition to this test, a variety of other identification tests were performed. Gram-staining was done for any other bacteria present in the water to be identified. It was found that most bacteria were present in the Sand Spring Run. Results are still being run to identify the bacteria and will be later tested for fecal coliform and Fecal streptococci. From here, the research will be expanded farther out to look at other water sources in the area or other tests that are important for the safety of drinking water like ammonium, hexavalent chromium, or dissolved solids.

Key words: Water Testing, Membrane Filtration Technique, Coliforms

Extraction of DNA from Soil Bacteria and Fungi for the Next Generation DNA Sequencing (Digital Presentation)

Presenting Student: Caley Neville
Faculty Mentor: Dr. Kumudini Munasinghe

The microorganisms within the soil hold an important role in the global cycling of elements and the nutrient content that is available to support the ecosystems. Biological fertility of soil is a highly complex and dynamic component of soil fertility and is least well-understood component of soil fertility, as well. There are vast counts of soil microorganisms in a single gram of soil and a better understanding of these microorganisms is essential for human health as well as agricultural production. The main objective of this research was to identify the bacterial and fungal communities in the soils of Frostburg, Maryland and to participate in the global effort of identifying soil microbial communities. Next generation DNA sequencing is the most powerful tool to identify the diverse groups of soil microbial communities than regular biochemical reactions that have been used for the identification of microorganisms. The soil samples were collected from various environments in the Western Maryland area such as mature forest, wetland, grasslands, Frostburg State University arboretum, and the campus lawns. For each sampling site, twenty soil samples were collected using the soil probe and were mixed to make two replicates per each sampling site. Collected soil samples were transported to the microbiology lab at FSU and stored at 4°C until DNA extractions were performed. The extraction of DNA in bacteria and fungi were performed using earth microbiome 16s and ITS Illumina sequencing protocols, respectively. Bacterial and Fungal DNA were extracted using the Qiagen soil extraction kit with a 15,000g centrifuge at 4°C. Amplification of the DNA were performed using PCR with the nucleotide oligoes such as 806R reverse primer and 515s barcode primers and ITS1-F forward primer and kabir_ITS2rcbc barcode primers for soil bacteria and fungi, respectively. The soil samples will be sent to Genwiz next generation gene sequencing lab to identify bacteria and fungi with the performance of DNA purification, analyzing results of the Nanodrop, and Gel Electrophoresis.

Genetic Profiling and Correlation with Chemical Constituents in Hemp (Digital Presentation)

Presenting Student: Abigail Hunker
Contributing Student: Janai Heise
Faculty Mentor: Dr. David Puthoff

The objective in this research is to determine which combination of strain, location, and genetic diversity leads to the best productions of chemical compounds in hemp. One of the desired chemicals is CBD (cannabidiol), along with terpene compounds. Both are found in high concentrations in the female flowers. Medical hemp growers in Western Maryland provided field sites where hemp varieties were sampled when harvestable. Hemp flowers were collected to determine chemical composition, specifically CBD, THC, and terpene content. Leaves were

collected for DNA analysis. DNA samples were isolated using the Qiagen DNeasy Plant Mini Kit. PCR testing was conducted after each isolation so that any necessary changes to the isolation procedure may be made without significant delays in research. All hemp samples have been isolated, and 96 samples have been selected for further analysis. Future procedures will consist of PCR testing to generate DNA profiles of the selected hemp samples and matching DNA profiles with chemical profiles.

Host Morphological Traits and Parasite Population Sizes in Northern Fulmars (Digital Presentation)

Presenting Student: Maxwell Sykes
Faculty Mentor: Dr. Kate Sheehan

Animal populations respond numerically in accordance with the most limiting resources available to them. For parasites, space can be a limiting resource as host organ size restricts the amount of local habitat available for them to carry out metabolic and reproduction activities. Thus, the size of a host, and further, the size of individual organs within a host, can be deterministic in the population sizes of the various parasites that infect them. Further, the caloric resources available to parasites within these organs can similarly influence their populations. Here, we investigate whether there are links between morphological characteristics of the gastrointestinal tracts of seabirds (Northern Fulmar, *Fulmarus glacialis)* that are host to three major taxa of parasitic worms: nematodes, cestodes, and acanthocephalans. Further, we search for relationships between the physical size of the different components of the gastro-intestinal tract, the amount of digestate that each section contains (gross weight), and parasite population sizes within the gut. This information is helpful in potentially estimating the parasite load that a host might have given the quantity of digestate or non-tissue components of the gastro-intestinal tract. In performing searches for parasites within the gut, we conduct gross external exams of the whole body, quantitative necropsies, and also search through non-digestive organ systems in the body to document any other maladies, abnormalities, and infections. Although parasitic infections in non-digestive organs are rare, we share those methods and results here as well.

Investigations into the Roles of Organisms on Environmental Plastic Pollution (Digital Presentation)

Presenting Student: Zophia Galvin
Faculty Mentor: Dr. Kate Sheehan

A widespread problem that has been gaining attention from the environmental community recently, is the presence of microplastics in the foods that we, and wildlife, are consuming. Plastic waste enters natural systems through human activities like littering, by means of accidental or intentional dumping. As they weather, plastics become brittle and

eventually break down into smaller and smaller fragments that can be easily consumed by even small organisms. The fragmentation and degradation processes could also be encouraged by biological mechanisms. Here, we explore the possibility that plastics could be broken down by 1) the growth of biofilm on their surfaces, and 2) when they are exposed to digestive enzymes in the guts of organisms that eat them – either accidentally or intentionally. To do this, we recorded biofilm growth and the consumption of fluorescently labelled plastic particles by populations of copepods, marine microcrustaceans. We also chronicle the methods for maintaining copepod populations in culture, with emphasis on their survivorship, reproduction, and environmental needs. Lastly, we document the consumption of microplastics by these animals and compare the food availability of algal biofilm in treatment groups both with and without the addition of plastics. This baseline information will help us to better know how future experiments, that will involve animal behavior in response to the presence of microplastics, should be designed and carried out.

Keap1 Gene Expression in *Drosophila melanogaster* in Response to Bleach and Ascorbic Acid Treatments (Oral Presentation)

Presenting Students: Joshua Clem, Ian Macomber
Faculty Mentor: Dr. David Puthoff

Keap1 is a repressor of Nrf2 in the Keap1/Nrf2 endogenous antioxidation signaling pathway. Keap1 suppresses the activity of Nrf2 until an oxidative stressor is present, which abolishes the inhibition of Nrf2 by Keap1. Household bleach contains 6.15% sodium hypochlorite, a strong oxidizing chlorine compound. Ascorbic acid is an antioxidant and reducing agent commonly found in citrus fruits. Two small cohorts of *Drosophila melanogaster* were treated with 50µL and 100µL of bleach diluted with water to 13mL and added to food, respectively. A third and fourth cohort were treated with 50mg and 100mg of ascorbic acid in 13mL of water and added to food, respectively. A control cohort was treated with 13mL of water added to food. After treated larvae hatched, PCR using cDNA and primers complementary to the Keap1 coding sequence was performed. Gel electrophoresis confirmed the amplification of the keap1 gene. RT-PCR was performed to monitor Keap1 gene expression of treatments in comparison to the control.

Optimization of DNA Extraction and PCR Amplification of River Otter DNA (Digital Presentation)

Presenting Student: Naomi Tasker
Faculty Mentor: Dr. William Seddon

Informed management of wildlife populations often involves decisions based on habitat use, breeding behavior, and sex ratios of populations. Traditional sampling methods that rely on morphological, physiological, or biochemical measurements or sampling of tissues are invasive and

are often not practical for wild populations. We evaluated a DNA extraction technique to isolate DNA from river otter (*Lontra canadensis*) liver tissue. Extracted otter DNA was amplified using a previously developed PCR protocol that targeted segments of introns common to the X (Zfx) and Y (Zfy) zinc finger genes. The PCR products were then analyzed using agarose gel electrophoresis. Our data show that the length of the DNA fragments amplified from the X and Y chromosomes differ in size, and the different sized fragments can be resolved using gel electrophoresis. This study will provide baseline information that can be used to develop a sex determination protocol using DNA collected noninvasively from scat.

Perceived Anxiety and Salivary Cortisol Levels in Students Challenged with a Testing Stressor and Their Effects on Performance (Digital Presentation)

Presenting Student: Nathnael Tessema
Faculty Mentor: Dr. Franklin Hughes

Cortisol is a glucocorticoid that is produced by the adrenal glands, specifically the adrenal cortexes, which are located on top of the kidneys. It is known as a stress hormone due to the fact that it is released into the body at times of both physical and emotional stress. When released, the hormone helps to increase blood sugar which provides a ready source of fuel in situations where the body might want to react quickly to dangerous stimuli. Though elevated levels of cortisol in response to stress is a natural phenomenon, it could be suggested that increased cortisol levels in students with test anxiety could negatively impact test grades as there is a high density of receptors for said hormone through the regions of the brain involved in memory, cognition, and emotion potentially resulting in a deficit to working memory. In this study, participants were asked to provide two samples of their saliva utilizing a provided test kit. Baseline salivary cortisol samples were collected during a time that participants identified as relatively stress-free while the other sample was collected during a time of self-identified academic stress (TSIAS). For this study, this second sample was collected just prior to a scheduled science exam. Participants also rated their perceived stress at the time of collection of each sample utilizing the *Visual Analog Scale for Anxiety* (VAS-A). Participants were also asked to complete the *Test Anxiety Questionnaire* at baseline to help determine their level of anxiety. Saliva samples were analyzed utilizing an immunoassay kit designed and validated for the quantitative measurement of salivary cortisol.

Surveillance of the Lyme Disease Pathogen in Ticks from the Western Maryland Region (Digital Presentation)

Presenting Student: Mariah Pritts
Faculty Mentor: Dr. Rebekah Taylor

In an attempt to find out if Lyme disease is more prevalent amongst tick populations in certain areas of the western Maryland region. *Ixodes scapularis* ticks (black legged ticks) submitted from

private citizens were tested for the presence of *Borrelia burgdorferi*. DNA was extracted from the ticks was then used in a polymerase chain reaction (PCR) to identify *Borrelia burgdorferi,* the causative agent of Lyme disease. Specifically, the PCR amplified the outer surface protein A gene that is only present in the bacterium *Borrelia burgdorferi*. The ospA gene's presence was visualized through agarose gel electrophoresis of the PCR product. A positive result indicates that the tick has the ability to cause Lyme disease if it bites a host. The results of this study provide a generalized idea of where Lyme disease is more prevalent in western Maryland and surrounding areas.

Using PCR Analysis to Detect Possible *Borrelia burgdorferi* in Ticks from Western Maryland (Digital Presentation)

Presenting Student: Emma Helmstetter
Faculty Mentor: Dr. Rebekah Taylor

The purpose of this research study was to see what percentage of the tick population in this area carry the Lyme's disease pathogen, *Borrelia burgdorferi*. This could help the public when it comes to severity of precautions they should take in terms of their pets, children, and themselves while spending time outdoors. If the results show a high percentage it may encourage people in the area to check more frequently for ticks and take the possible adverse effects more seriously. This study was carried out using polymerase chain reaction analysis, known as PCR. Each tick DNA sample was put through two rounds of PCR analysis, which is called a nested PCR. The PCR was designed to detect ospA, a gene that is only found in the bacterium *Borrelia burgdorferi.* The results of the PCR were visualized using agarose gel electrophoresis. If the positive and negative control of the gel responded correctly, then any other bands that responded were considered accurate and indicated that the *Borrelia burgdorferi* was present in the tick.

Utilizing Undervalued Chicken By-Product as a Source of Collagen (Digital Presentation)

Presenting Student: Tucker Matthews
Faculty Mentor: Dr. Kumudini Munasinghe

Collagen proteins provide strength and elasticity to connective tissues, bones, cartilage, tendons, and ligaments and makes it the most abundant protein in the human body. Collagen is also used extensively in the biomedical, cosmetic, food, and pharmaceutical industries. These industries often obtain their collagen from marine or bovine sources, but application faces limitations due to the production cost and the odor. Chicken by-product is often thrown away but extracting collagen from the by-product utilizes an undervalued source and cuts costs required to extract collagen. The objective of this research was to extract collagen from chicken by-product to establish the method as a valid alternative to bovine and marine collagen sources. Chicken skins were collected from the Frostburg State University Cafeteria and stored them at 4°C in the

microbiology lab. The chicken skins were washed, cut, and pretreated with 0.1N NaOH for 24 hours in a 1:6 (weight/volume) ratio to remove non-collagenous proteins. The solvent was changed every 6 hours, and the chicken samples were washed with distilled water 3 times between each step. Samples were defatted with 10% butyl alcohol with a solid/solvent ratio of 1:6 (w/v) for 24 hours and the solvent was changed every 6 hours. The organic compounds were removed by soaking the defatted samples in 0.1N HCl with a solid/solvent ratio of 1:6 (w/v) for 24 hours. The collagen was extracted using a 1:6 (w/v) ratio of 0.5M acetic acid containing 20kU of pepsin. The solution was stirred for 48 hours at 4°C, then the mixture was filtered through cheesecloth and the filtrate was collected for precipitation. To precipitate the collagen, the filtrate entered a 2.6M NaCl solution with 0.05M tris hydroxymethyl aminomethane, and was centrifuged at 20,000g at 4°C for one hour. The collagen extract was salted out and pellets were dissolved in 0.5M acetic acid before being dialyzed against 10 volumes of 0.1M acetic acid and water. These procedures produced colorless, inodorous collagen extract. The results suggest chicken collagen is cheaper to produce and might perform better or equal to other collagen sources for many applications.

Key words: Chicken By-product**,** Collagen, Acetic Acid and Pepsin Extraction

DEPARTMENT OF CHEMISTRY

Determining the Sulfur Content in Different Hair Types (Digital Presentation)

Presenting Student: Oghenekome Ukpu
Faculty Mentor: Dr. Holly Currie

Hair is made of 50% protein. Most of this protein is in the form of keratin. Keratin is a fibrous protein and is known for its waterproof and protective properties. Human hair exists in different curl patterns ranging from naturally straight to very coily. Keratin is composed of 18% of cysteine. Cysteine is a nonessential sulfur-containing amino acid that can form disulfide bonds with other cysteine residues to form cystine.[2] These cystine bonds can link neighboring hair strands together and therefore influence the curl pattern of hair. For this research, different human hair types were analyzed using X-ray fluorometry to determine the sulfur content. It was hypothesized that curlier hair contains more sulfur than hair with a straight texture. The hair samples were ground into a fine powder cryogenically with the use of liquid nitrogen and the sulfur content was determined. Statistical analysis was used to determine if there are significant differences in the sulfur levels of the different hair samples.

Developing a Method for Detecting Sitagliptin in Breast Milk Using Gas Chromatography-Mass Spectrometry (GC-MS) (Digital Presentation with Audio)

Presenting Student: Alexa Sowers
Faculty Mentor: Dr. Holly Currie

Sitagliptin is the active ingredient in Januvia and other type 2 diabetes medications. Sitagliptin has been shown to have negative side effects, such as pancreatitis and kidney damage. However, sitagliptin is still prescribed to breastfeeding women, even though it is not known if sitagliptin crosses into the mother's milk. The purpose of this research is to determine the concentration of sitagliptin in milk samples using an internal standard and gas chromatography-mass spectrometry (GC-MS). Institutional Review Board (IRB #H2021-009) approval has been obtained to allow the collection and analysis of human milk samples. The determination of sitagliptin in breast milk and any potential harmful effects on the child is an important topic that needs to be studied.

Empirical and Theoretical Determination of Myoglobin pI (Digital Presentation)

Presenting Students: Sophia Staggers, Nathan Perren
Contributing Students: Kirubeal Ashengo, Brandi Binkley, Sienna Grau, Malinda Grimm, Marshe' Hill
Faculty Mentor: Dr. Peggy Biser

Myoglobin is a protein that is responsible for carrying and storing oxygen in the muscle tissues of almost all mammals. It is important to look at how myoglobin might differ between mammals in sequence, structure, and other attributes. Therefore, this project focused on looking at the isoelectric point (pI) of myoglobin from a variety of animals. An isoelectric point is the point where the overall charge of a protein is zero. A comparison was made between empirically determined and theoretically determined pIs. The data that was collected for the theoretical pI was based on the residues that were at least 25% exposed to solvent. Theoretical pIs were calculated using a program created in LabVIEW while empirical pIs were taken from the literature. This project assessed whether the theoretical approach yielded pI results similar to the empirical for the various types of myoglobin, as well as which theoretical method was more accurate.

Hemp Flower DNA Isolation Optimization (Digital Presentation)

Presenting Student: Abigail Hunker
Faculty Mentors: Dr. Matthew Crawford, Dr. Holly Curie

Extracting high-quality DNA from medicinal plants in general, including hemp, is difficult not only due to differences in varieties, but the presence of large quantities of secondary metabolites, polysaccharides, and proteins such as tannins and polyphenols.[4] Another concern with DNA extraction of hemp is that commercial kits cost a significant amount yet produce low DNA yield.[3] This calls for further research in regard to a DNA extraction method involving chemicals that are available to be bought individually. In this work, DNA extraction procedures from the DNeasy Plant Mini Kit: Quick Start Protocol and the CTAB (cetyl trimethylammonium bromide) method are being compared to determine the highest DNA quality and yield. Future research will consist of modifying the extraction procedure that produces the best results.

Solid-Phase Synthesis of Potential Antimicrobial Peptides (Oral Presentation)

Presenting Students: Dylan Mannick, Sophia Staggers, Jacob Wilson
Faculty Mentor: Dr. Matthew Crawford

Antibiotic resistance is an issue that threatens the efficacy of antibiotic drugs currently available. Peptides present a sustainable alternative to traditional antibiotics because of their versatile

antimicrobial effects. Natural antimicrobial peptides have shown that they possess the ability to kill multi-drug resistant bacteria, fungi, and viruses. Two of the major drawbacks of natural antimicrobial peptides are enzymatic degradation and bioavailability. By creating antimicrobial peptides synthetically, it is possible to reduce enzymatic degradation of the peptides, reduce the cost of acquisition, and increase the overall bioavailability. Fmoc-protected amino acid residues were deprotected using 20% piperidine in dimethylformamide and added to peptide chains upon Tentagel Rink amide resin. The completed peptide sequences were removed from the resin using trifluoroacetic acid (TFA). Solid peptides were dissolved in diluted TFA and analyzed using high-performance liquid chromatography. The sequence OYFIFK was synthesized as a whole peptide. The peptide sequence ATVVIGTSK was synthesized not only as a whole peptide, but in shortened fragments as well. In future research, the antimicrobial potency of each peptide will be determined by measuring the zones of inhibition of bacteria grown on agar plates.

Streptavidin Magnetic Bead Immunoprecipitation of Lactate Dehydrogenase B (Digital Presentation)

Presenting Student: Jasmine Harper
Faculty Mentor: Dr. Peggy Biser

This experiment was performed to test the efficiency of the bioseparation of lactate hydrogenase B (LDH) from bovine heart with streptavidin magnetic beads as part of development of a biochemistry lab procedure. A biotinylated IgG polyclonal antibody is used to bind to LDH in the bovine sample. Then, the streptavidin on the magnetic beads binds to the biotin on the IgG, creating a magnetic bead assay. The magnetic beads with the LDH are separated from the sample with a magnet. Once eluted from the magnetic beads, the LDH sample's activity was tested by measuring the absorbance of NADH in a reaction mix of pyruvate, NADH, and phosphate buffer spiked with the LDH sample. A successful experiment would result in a declining linear regression of NADH absorbance, displaying that LDH was successfully separated with significant activity. In addition, further evidence of a successful immunoprecipitation would be characterized by the presence of LDH by a Western Blot and an Activity Stain.

Triticain-α: An Enzymatic Approach to Managing Celiac Disease (Oral Presentation)

Presenting Student: Joshua Clem
Contributing Student: Sienna Grau
Faculty Mentors: Dr. Holly Currie, Dr. David Puthoff

Celiac Disease (CD) is an autoimmune disorder characterized by the inability to digest gluten proteins in genetically susceptible individuals, resulting in chronic inflammation of the small intestine and mucosal damage. Genetic determinants of the condition are the presence of human leukocyte antigen (HLA) DQ2 and HLA-DQ8 encoding genes. The global prevalence of CD is around

1%. Currently, the only known treatment for CD is a gluten-free diet. Triticain-α is a wheat cysteine protease demonstrated in prior research to elicit glutenase activities in the immunodominant 33-mer α-gliadin-derived peptide in conditions simulating the gastric environment of the stomach. RNA was isolated from germinating Triticum aestivum, cDNA was polymerized, and the Triticain-α coding sequence was amplified with polymerase chain reaction (PCR). The obtained coding sequence was inserted into the expression plasmid aLICator Ligation Independent Cloning and Expression System. Triticain-α was expressed by isopropyl β-d-1-thiogalactopyranoside (IPTG) induction of the lac operon promoter in E. coli (BL2-DE3). Further analysis of enzymatic potentiality of Triticain-α will include the purification and incubation of the protein with gluten in gastric conditions. Gluten hydrolysis products will be identified to confirm glutenase activities of Triticain-α.

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGIES

Allergen and Taboo Foods Android Application (Oral Presentation)

Presenting Student: Linus Drissel
Faculty Mentor: Dr. Xunyu Pan

For my project I propose creating a mobile application that utilizes a smartphone's camera to view printed nutritional facts labels on the sides of most food products in supermarkets, read the ingredients list using text recognition software, and then to alert the user if the product contains any ingredients that they cannot consume based on an allergic reaction or other dietary restrictions by referencing a database which contains the variety of different names used for each product. The purpose of this application is to prevent someone who is either allergic to a particular food or has a dietary restriction or both to avoid buying a product that would violate these conditions and instead make a more informed choice quickly and efficiently. There are three main component of this application that would work together to accomplish this goal. The first component is the Android smartphone application that would be created to host the interface for the text recognition and the database request. This application would allow the user to select different categories of food restrictions that apply to them, such as a peanut allergy or a taboo on pork or shellfish consumption, and would scan the nutrition facts label and ingredients list. The second component is the text recognition algorithm that would be called from a text recognition library. This algorithm will translate the typed text on the side of the package into text which can be searched using the local food restriction database. The third component is the food restriction database, a local database that would be accessed upon scanning where the text read from the nutritional label would be sent and matched with words belonging to different or multiple groups of food restrictions. The application would then return the results to the user. Android applications are primarily programmed using Java, which is what I will be using to create the application in the Android SDK IDE. Tesseract is a free and open source text recognition library developed by Google that I will be using for the text recognition component of this project. The database of toggleable restricted foods will be created by me using SQLite, which is a version of the SQL database language adapted for use on Android. By combining these three components of the project I should be able to accomplish my goal and create an application that can help people screen out undesirable foods based on their ingredients.

DEPARTMENT OF ENGLISH AND FOREIGN LANGUAGES AND LITERATURE

Project Censored: What is Going Under Our Radar? (Oral Presentation)

Presenting Students: James Byers, Ciel LaBossiere-Little, Amaya McIver, Leah Perrin, Gabriella Sullivan
Faculty Mentor: Dr. Andy Duncan

Students in Andy Duncan's ENGL 355 (Socially Networked Journalism) routinely submit reports on under-reported news stories to Project Censored (https://www.projectcensored.org/), a California-based non-profit that relies on undergraduate volunteer researchers. Today, two current and three former ENGL 355 students will discuss this vital work.

- Gabriella Sullivan will give a short presentation on what Project Censored is, its ultimate mission, and what it strives to do for media literacy among students and the public.
- James Byers, in "Native American Women Are Missing, and No One Is Watching," will discuss the growing numbers of missing and murdered indigenous women and the systemic problems that exacerbate the issue. James's report was selected as the No. 1 censored news story of the year in *Project Censored 2021: State of the Free Press,* published by Seven Stories Press.
- Ciel LaBossiere-Little, in "Singapore, Taiwan and Thailand Censor Social Media To Counter Fake News," will discuss Southeastern Asian governments' problematic attempts to counter what they consider unreliable coverage.
- Amaya McIver, in "Notre Dame vs. Al Aqsa Mosque: What Gets Covered and What Doesn't," will contrast the saturation coverage of the fire that ravaged Notre Dame Cathedral in Paris with the relatively meager coverage of the fire that ravaged a Muslim holy site in Jerusalem.
- Leah R. Perrin, in "Bees Can Help Cities by Monitoring Pollution," will highlight the scarcity of meaningful science coverage by reviewing an important 2019 finding at the University of British Columbia: Researchers collected valuable pollution data by testing the honey produced by Vancouver beehives.

DEPARTMENT OF GEOGRAPHY

Soil Catena Survey of FSU Arboretum Studying Effects of Regional Mining on Soil (Digital Presentation with Audio)

Presenting Student: William Deibert
Faculty Mentor: Dr. Phillip Allen

The effects of mining on soils can be drastic. This study is looking at the Frostburg State University Arboretum to see how it has been affected by the mining in the local area. A significant review of literature was completed to understand what the current consensus is at for how soil development processes after disturbances. In that process it was found that there have been multiple studies looking at how soils develop over time after there has been a major disturbance like open pit mining. In those studies, it was found that soils develop an A horizon within a couple of years, but a B horizon can still not be visible after 70 years. For the catena soil pits were dug every 20 meters. At each location, horizon data was collected, and a vertical portion of the horizon was collected, typically around the top 40 cm. In the laboratory, tests were run to calculate the organic content, particle size distribution, pH, and elemental composition. At this moment not all tests have been completed and the results are only partial. All the tests are all being run at two depths for every profile: 0-2 cm, and 20 cm. In a couple of profiles test are being conducted on a deeper layer which can vary between 40-50 cm. The only results that are currently available is for the organics test. In general, they are as expected, one result of note is in profile 1 the 20 cm test for organics was higher than the surface. Another profile that was an outlier is profile 10, this profile had a significantly larger amount of organic material compared to the other profiles. From the results so far, the land use history investigation, and the literature review on soil in a mining area; this soil looks to be either not as disturbed as expected or the disturbance was a significant time ago and there has been time to recover and have significant soil development.

Soil Salinity Study of Frostburg State University Campus (Digital Presentation)

Presenting Student: Alexander Scott
Faculty Mentor: Dr. Phillip Allen

Soil communities in Frostburg State University campus are under significant stress from regular use of salt-based deicing materials during the winter months. The effects of salt on soil are well known and understood, but it is the purpose of this document to study and record the impact of deicing materials on specifically FSU campus. With enough study, hopefully less invasive solutions to keeping paved surfaces clear can be practiced. This study analyzed 52 soil samples from different sections of campus, and seven water samples collected from the stream that passes through campus, Sand Spring Run. Half of these samples were collected before the first deicing

treatment of the year, and the second half were collected after. The soil samples were analyzed by the following tests: moisture loss, soluble salt conductivity, pH analysis, and x-ray fluorescence analysis. The soluble salt content and pH levels of the water samples were determined. After soluble salt analysis, it has been determined that a moderate amount of the damaged areas had high-excessive amounts of soluble salts in them before the first deicing treatment, and almost all of them had high-excessive levels during the winter season. In non-visibly damaged areas, the salt levels were overall low.

DEPARTMENT OF MATHEMATICS

Cauchy's Theorem and Applications (Digital Presentation)

Presenting Student: Bailey Brewer
Faculty Mentor: Dr. Mark Hughes

The term "imaginary numbers" was coined in 1637 by René Descartes as a derogatory phrase for a set of numbers once believed to be fictitious and unimportant, but through the transformative work of Augustin-Louis Cauchy and the many iterations of Cauchy's Theorem, the complex plane and imaginary numbers were shown to have great mathematical significance. We will prove Cauchy's theorem without the limitation of f' needing to be continuous by using Goursat's version of this theorem, or simply put the Goursat-Cauchy Theorem. By considering a triangular contour C, we can show that if f is analytic in a simply connected domain D and C is a simple closed contour that lies in D, then $\int_c f(z)\,dz = 0$. We will also extend Cauchy's Integral Formula to include non-simple closed curves by parameterizing and integrating along a simple closed curve using the Fundamental Theorem of Calculus and other facts from Calculus.

Eigen-Analysis of Filled Julia Sets (Digital Presentation)

Presenting Student: Andrew Goodrich
Faculty Mentor: Dr. Mark Hughes

We as human have a unique trait that conditions us to attempt to find and describe patterns in randomness or chaos. Gaston Julia used this skill and his understanding of mathematics to accurately describe and define the properties of complex functions. This birthed a new mathematical entity, called The Julia Set. The goal of this poster is to make the ideas of Gaston Julia more digestible using basic concepts covered in a Linear Algebra course. The mathematics will be thoroughly described both algebraically and graphically. The illustrated graphs were created using a Spyder Python program. The analysis ultimately shows that the eigenvalues of a bounded complex matrix will be contained within its Julia Set.

Magician Reveals Their Secret: Ensley Vallin 4 Card Trick (Digital Presentation with Audio)

Presenting Student: Ashley Armbruster
Faculty Mentor: Dr. Justin Dunmyre

In the Ensley Vallin 4 card trick, a participant is given four cards, one of each suit, and prompted to place them in alternating color order with the spade turned face-down, which we will call "dissenting". The participant is asked to complete two moves, a rotation and a pancake flip, as often as they see fit and in any sequence. Once the participant is satisfied with their sequence of moves, the magician invites the participant to complete a terminating move consisting of a sequence of pancake flips. Without looking at the cards, the magician tells the participant which card is now dissenting. We investigate the secret behind the trick and prove that if the setup and rules are followed, then the same card will always be dissenting after the terminating move.

DEPARTMENT OF PHILOSOPHY

Neutrality Fatality: An Examination of the Polarized Courts (Oral Presentation)

Presenting Student: Jessica Thayer
Faculty Mentor: Dr. David Atenasio

Polarization is a term we find ourselves quite familiar with these days. While different perspectives can be healthy, our nation has seen a level of divide that has started to destroy the very institutions on which this country was founded. The Framers envisioned the judicial branch to be a neutral arbitrator of the law, apart from the whims and emotions of the people. However, we now have a Supreme Court composed of politics instead of justice and rulings based on political preference rather than on constitutional interpretation. In an effort to save our great judicial institution, legal scholars Daniel Epps and Ganesh Sitaraman have proposed a “balanced bench” solution and legal scholars Roger Cramton and Paul Carrington have proposed a “term limit” solution. While both of these solutions are strong, they are in need of fine-tuning. In this presentation, I refine them to arrive at the best possible solution to the polarization problem.

DEPARTMENT OF PHYSICS AND ENGINEERING

Characterizing the Behavior of Sunspot Cycles (Oral Presentation)

Presenting Student: Andrew Goodrich
Faculty Mentor: Dr. Jason Speights

The Sun has countless impacts on our lives here on Earth. This includes our weather patterns and climate. With the growing concerns over anthropomorphic climate change, many have speculated that variations in the output of the Sun, rather than human behavior, currently play a more significant role. This research characterizes the behavior of 24 sunspot cycles to attempt to find long-term trends across the cycles that could possibly correlate with climate change. This is done using non-linear least-squares fittings of gaussian models that are altered by the first five terms of a Hermite polynomial. The Hermite polynomial terms skew the gaussian, account for irregular curves and double peaks, and adjust the width of the distribution of the modelled sunspot numbers in a cycle. All the results show no significant long-term trends across the sunspot cycles. This indicates that climate change is more about factors on Earth rather than its home star.
The Sun has countless impacts on our lives here on Earth. This includes our weather patterns and climate. With the growing concerns over anthropomorphic climate change, many have speculated that variations in the output of the Sun, rather than human behavior, currently play a more significant role. This research characterizes the behavior of 24 sunspot cycles to attempt to find long-term trends across the cycles that could possibly correlate with climate change. This is done using non-linear least-squares fittings of gaussian models that are altered by the first five terms of a Hermite polynomial. The Hermite polynomial terms skew the gaussian, account for irregular curves and double peaks, and adjust the width of the distribution of the modelled sunspot numbers in a cycle. All the results show no significant long-term trends across the sunspot cycles. This indicates that climate change is more about factors on Earth rather than its home star.

Climate Change in Frostburg (Oral Presentation)

Presenting Student: Cameron Nichols
Faculty Mentor: Dr. Jason Speights

The purpose of this research is to see if there were any detectable trends of global warming in Frostburg's weather patterns between 1998 and 2020. We did this because global warming has been a focus point for political talk and has become a vital reason for certain laws being passed. We used weather data provided by Dr. Latta from his at home weather station. This data is processed in Python and graphed to find the change of the data over the 22-year span. The results are consistent with a 2 degree increase in temperature per century, but the uncertainties are too large to justify any certain conclusions about the exact rate.

Football Receiving and Throwing Device (Oral Presentation)

Presenting Students: Nicholas Harris, Keegan Wolf, Amy Trembly, Nathaniel Owens
Faculty Mentor: Dr. Jamil Abdo

American Football is one of the most popular sports in the country. It is a highly competitive sport that rewards players who prepare and hone their skills. The popularity and competitiveness of football means there is a need for players to continuously get better at the sport. Traditional Football throwing machines have been able to suffice for the time being, but they have a number of drawbacks. The main one being that you need an operator for the machine to work. A football throwing machine that is able to be used by one person on their own time will better suit the needs of football teams because players can improve even when they aren't specifically at a practice. This project looks to solve these issues by giving the machine a way to catch a thrown ball as well as throw it. Through the application of many engineering design principles, this project will take a close look at the mechanics of current throwing machines, pin-point their flaws, generate different concepts, select the best option, develop a detailed design, and build a prototype. In this process many improvements were found. Design changes to the throwing mechanism, and the addition of a catching apparatus have resulted in a much different product then what is currently in the market. This new product will allow a player to practice throwing and catching alone.

Hands-Free Door Operating Mechanism (Oral Presentation)

Presenting Students: Joshua Smith, Wayde Yeager, Triston Eirich, Devin Williams
Faculty Mentor: Dr. Jamil Abdo

With the emergence of smart home devices in the last few years, the market for smart home automation has taken off. Common, simple household functions such as the flip of a light switch to turn a light on have evolved into smart devices that accomplish the same task by voice activation and remote operation via smartphone applications. The desire for these types of devices has increased and even though simpler methods exist, these smart devices appeal to consumers because they are convenient, appealing and satisfying. Humans have always looked for a way to "build a better mouse trap" and home smart devices are no different. Perhaps one of the most common household functions is the act of opening a door. Whether it may be carrying groceries inside, letting the dog out, or leaving for work with a hand full of paperwork and morning coffee, having an automated door appeals to the same degrees of convenience and satisfaction that other smart home devices offer. The market for a cost-effective, hands-free automatic door opener is alive and well. These devices bring forth yet another level of convenience, automation and satisfaction. Existing automatic door opening products are expensive, difficult to install, and not widely available to the consumer. Opportunities for improvement and competitive advantage exist. Offering a product with minimal installations requirements, easy to use, and a good array of

useful features have much probability for success. Incorporating remote activation via Bluetooth or WiFi connectivity could revolutionize the way consumers open doors in a world dominated by smartphones and smart technology.

Multilayered Assembly of Polymer Based Light Armor Systems (Digital Presentation)

Presenting Students: Robert Spitler, Richie DiGusieppe, Nathan Olen
Faculty and Staff Mentors: Dr. Jamil Abdo, Dr. Zhen Liu, Mr. Duane Miller

The goal of this capstone project is to create a proof of concept for a lightweight, polymer-only body armor plate to replace the metal and ceramic plates that are used today. To do this, our goal is to create an armor plate that is between 0.5 inches and 1 inch thick that can be used in any plate carrier that is currently used to hold body armor plates. To accomplish this, we will create as many thin layers of three different polymer materials as we can, within the range of the thicknesses above. We will then use a binding agent to hold the plate together. The materials that we will be using, and the binding agent, are as follows:

· Polycarbonate
· HDPE (High Density Polyethylene)
· Kevlar
· Liquid Polyurethane (binding agent)

Solar Powered Electrochromic Smart Tint (Digital Presentation)

Presenting Students: Daniel Morgan, Bria' Johnson, Lynch Jean Jr, Kaoutar Sahmoudi
Faculty Mentors: Dr. Oguz Soysal, Dr. Zhen Liu, Dr. Jamil Abdo

Heat gain and heat loss are contributing factors for about 30% of residential HVAC energy use which makes it important to select efficient windows that will cut down on energy consumption. Incoming light from the sun is composed of ultraviolet, infrared, and visible light, with infrared radiation producing heat, and visible light making up the intensity or brightness of light we experience. When sunlight passes through a material like conventional silica glass, it allows this intense light and heat to pass through rather than absorb or reflect it such as plastic or metal surfaces. Our team desires to employ the advanced knowledge of material properties, energy analysis and circuit design to create a feasible, cost effective and innovative energy efficient window that can be used in a number of difference industries including commercial, residential and automotive.

Solar Uninterruptible Recovery Energizer (S.U.R.E.) (Digital Presentation)

Presenting Students: Tochi Chigbu, Matthew Clough, Abdirisak Diria, Sungbuma Fofung, Anthony Kostopoulos, Amirah Townsend
Faculty Mentor: Dr. Oguz Soysal

The goal of the presented project is to design a solar powered portable unit intended to provide long-term uninterruptible power supply for a variety of electronic equipment. All presenters are graduating seniors engineering Majors in Electrical Engineering Concentration. They started developing this equipment in fall 2020 as a marketable product in the "Project Development in Electrical Engineering (ENEE481)" course. Completion of the design phase including computer simulations and preparation of the circuit board for manufacturing is the main objective of the "Capstone Design Project". Each student is assigned to design a separate type of converter to meet marketing and engineering requirements determined in fall semester in the ENEE 481 class. Tochi Chigbu and Sangbuma Fofung are working as a team to build the converters that will deliver the desired constant DC outputs from the variable DC generated by the photovoltaic (PV) module. Tochi is assigned to build a buck converter for 5-V USB output for power portable electronic devices. Sangbuma is building a step-up converter to supply the 12 – 15 volt distribution bus from an external 12-V battery or lighter plug of a car when sunlight is unavailable or insufficient. Matthew Clough and Anthony Kostopoulos are building the interfaces between the PV module and a 12-V DC output via the distribution bus. Matthew is designing the converter to supply the common bus from the PV module maximum power point (MPPT) operating conditions. Anthony is building the interface between the 12 – 15 V bus to fixed 12-V constant output.
Abdirisak Diria and Amirah Townsend are building the 120-V AC interface of the device. Amirah is building a rectifier to supply the distribution bus from the 120-V 60-Hz utility power. Abdirisak is building an inverter to supply 120-V, 60 Hz output from either the PV module or battery bank.
The three teams have collaborated to select a suitable PV module and a lithium-ion (Li-ion) battery cell available on the market considering the hand-held portability, safety, reliability, and cost affordability limitations. All design calculations and circuit tests by computer simulations are expected to be completed by the end of the spring semester.

DEPARTMENT OF VISUAL ARTS

Reshaping the Box: Sculptural Paintings (Digital Presentation)

Presenting Students: Carol Lusk, Cassidy Mark, Chelsey Pannell, Courtney Chambers, Darian Stouder, Erica Bennett, Julia Walsh, Lisa Whetzel, Shawna Hawkins, Tyrone Taylor, Yi Zhou
Faculty Mentor: Ms. Judith Dieruf

The rectangular, flat canvas format is a traditional form, but experimenting with irregular elements can challenge the sense of composition as well as the creative concept of what a painting IS. It encourages thinking about meaning, form and media and not just surface.
Sculptural Paintings can eliminate stretcher bars, add sculptural forms to the surface, alter shapes, incorporate pierced surfaces, stack forms, eliminate canvas, and add unexpected elements to form and content.

SPECIAL THANKS

Many projects featured in the Symposium were funded by Foundation grants, Faculty Development grants, PELEF grants, and the Student Government Association.

We would like to thank the following people who helped make the Virtual Symposium possible:

Mr. Troy Donoway, Information Technology, Chief Information Officer
Mr. Reid D. Bluebaugh, Associate Director of Information Technology Applications and Development
Ms. Stephanie Cesnick, Web Services Manager, Information Technology Applications and Development
Ms. Michelle O. Hixson, Office of Information Technology, Instructional Technologist
Ms. Stephanie Sindy, Program Management Specialist I, Office of the Provost
Dr. Rita M. Thomas, Office of Information Technology, Manager, Instructional Design and Technology
Ms. Sherry White, Writer/Digital Communication Specialist, News and Media Services

Most importantly, we would like to thank the Students and their Faculty and Staff Mentors for making the Symposium possible.

FSU Undergraduate Research Working Group

Karen Keller, Biology (Chair)
Jamil Abdo, Physics and Engineering
Phillip Allen, Geography
Matthew Crawford, Chemistry
Judith Dieruf, Visual Arts
Justin Dunmyre, Mathematics
Rebecca Flinn, Computer Science and Information Technologies
Robert Hein, Visual Arts
Erica Kennedy, Psychology
Zhen Liu, Physics and Engineering
Marc Michael, Mathematics
Duane Miller, Physics and Engineering
Eric Moore, Physics and Engineering
Jill Morris, English and Foreign Languages and Literature
Benjamin Norris, Chemistry
Xunyu Pan, Computer Science and Information Technologies
Rebekah Taylor, Biology