BASIS CHANDLER **SENIOR PROJECTS** 2021–2022



SENIOR PROJECTS & SENIOR RESEARCH PROJECTS

At this point in their senior year, BASIS Charter School students have completed a set of four BASIS Capstone classes to earn their BASIS Diploma with Honors.. In addition, many students are in the process of completing the prestigious College Board's AP Capstone Diploma[™], a challenging, two-year sequence of AP Seminar[™] and AP Research[™], plus four other AP[®] Exams, all of which require extensive research, writing, and oral defense. The BASIS Diploma Senior Project marks the culmination of this hard work and perseverance.

Completed in the third trimester of their senior year, the Senior Project is unique, self-designed, and reflective of the students' varied academic interests and passions. Regardless of the discipline —business, art, humanities, science, engineering, social work, medicine, or law — each senior must develop and explore a research question. Creating an abstract that sets the tone of the research, participating seniors must submit a project proposal, and later, orally defend their methodologies.

Under the guidance of an external advisor who is a professional in their field, as well as a faculty advisor from their school, students dedicate 10–15 hours per week to the completion of their Senior Project. To document their journey, students post weekly blog entries about their experiences, successes, and challenges as they explore their guiding question. This journaling provides a unique viewpoint on the student activities and adds a reflective layer to their research process.

Throughout the development of the Senior Project, BASIS Charter Schools support their seniors every step of the way as they develop investigative skills and their own individual scholarly pursuits. The abstracts in this publication clearly illustrate each senior's ability to apply the knowledge, and intellectual curiosity they have acquired in the classroom to professional research methods and learning. At the successful conclusion of this project, students are eligible for a BASIS Diploma with High Honors, the most distinguished accolade offered by BASIS Charter Schools.

Each member of the BASIS Charter Schools network commends our seniors for their dedication, and motivation, not only for completing this Senior Project, but for their commitment to the BASIS Charter School Curriculum. Congratulations to them on this powerful achievement, and our best wishes as they move forward on their educational journey.

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Carolyn McGarvey Chief Executive Officer BASIS.ed AZ+

Peter Bezanson Chief Executive Officer BASIS.ed Texas



BASIS[®] Chandler SENIOR PROJECTS

AISHA A.

WHAT IS THE BEST WAY TO MOTIVATE STUDENTS IN THE CLASSROOM?



ABSTRACT: When you were a young student, what motivated you to pay attention, do homework, or study for tests? Was it receiving rewards like praise, candy, or pizza parties? Or was it avoiding things like failing, bad grades, or parents' scolding? These are types of extrinsic motivators known as positive reinforcement and negative reinforcement. One way or the other, students have to be calm, engaged, and encouraged to learn and these motivators are effective ways to control students' behavior. My research discovered which extrinsic motivator is more effective in managing the behavior of students in the classroom. My expectation was to find positive reinforcement to be the more effective extrinsic motivator. The project consisted of internet research, books, surveys, and observation. My external experience as an intern at the BASIS Chandler Primary South campus encompassed shadowing teachers to see real-life classrooms and extrinsic motivators that take place there. I surveyed elementary and high school students to compare age groups and determined whether positive or negative reinforcement is more effective. Classroom management can be a very challenging part of teaching. Especially in younger grades, students are still learning what behaviors are expected in the classroom. Keeping 20-30 students motivated to learn is not an easy task; educators all around the globe spend countless hours training and preparing for ways to optimize a student's learning experience. Diving into this topic is important to establish a better understanding of effective child development. Creating a successful future starts in the classroom.

BASIS ADVISOR: Angelica Sanchez • ON-SITE MENTOR: Christen Wolcott

• LOCATION: BASIS Chandler Primary South

AKHIL A.

THE REALITY OF RURAL HEALTH CONDITIONS AND THE FACTORS SURROUNDING THEM



ABSTRACT: I uncovered the underlying factors of why rural health conditions are so poor, and why people living in urban areas are unaware or have a predetermined idea of this. With my research, I promoted awareness and eventually created a plan to improve rural health conditions. This consisted of nutrition and accessibility to fresh food. I am interested in this topic because of the common misconception between what people think rural health is, and what it actually is. I have experience with working with the Produce on Wheels (POWWOW) fresh produce organization to help distribute fresh grown food. I took a public health class in which we discussed every aspect that could impact health including hospital availability, climate and natural nutrients. I have read many articles on nutrition for health and athletic performance prior to this project. This topic was worth researching because it had the potential to benefit people living in rural areas. At the bare minimum it gave me a better understanding as to why urban residents are healthier than rural residents. My internship at Pinnacle Prevention helped my research in a major way, because they have resources and research that I went off of. I discovered the best nutritious diet for rural residents, and found ways to make it attainable.

• BASIS ADVISOR: Patrick Kilmer-Webb • ON-SITE MENTOR: Adrianne Udarbe • LOCATION: Pinnacle Prevention

NAOMI A.

DOES THE EFFECT OF PET THERAPY ON HELPING AT-RISK CHILDREN DEVELOP SOCIAL SKILLS CHANGE BETWEEN AGE RANGES?



ABSTRACT: When you think of pet therapy, what pops into your mind first? For many people the answer is the calming effect a pet can have during an anxiety attack, or how pets can be a positive force to someone suffering from PTSD. But pet therapy can also have an effect on our social interactions and building up necessary qualities to function in society. For more than 20 years, Gabriel's Angels has provided pet therapy to children in at-risk situations through visits to local Title I schools, domestic violence and homeless shelters, nurseries, and more. Their goal is to inspire empathy and compassion among other social qualities in the children through their interactions with the dogs. These visits with the pets help with the behavioral and emotional development among children who might not otherwise receive a healthy emotional upbringing. Gabriel's Angels serve ages 0-18, but is there an age where the impact is greater? My goal through this project was to discover whether or not there is an age range in children where pet therapy is most effective. I used observational research to measure this. I've created a chart where I can effectively record for each visit the changes in the children from beginning to end of each visit. With the results of my research, I will help Gabriel's Angels and other organizations like it to be better able to focus their efforts on where they're most effective and can have the most impact in people's lives.

• BASIS ADVISOR: Sandhya Jayaraman • ON-SITE MENTOR: Helen Tristano • LOCATION: Gabriel's Angels

PRANAV B.



ABSTRACT: Nearly every tailor and weaver in rural areas worldwide utilize a manual sewing machine to sustain their business and livelihood. Even one day of absence could mean a day without food on the table for their families. This is a common occurrence in these areas since working with manual sewing machines is hazardous, a risk for the workers' health and financial stability. Also, these machines are highly unproductive compared to the alternatives. It would be easier to plug in a machine or two and let the sewing happen automatically. The problem is that most rural businesses that depend on sewing for a livelihood are unable to access stable electricity to make it a sustainable solution. Renewable energy is a fix to these issues, easily powering multiple sewing machines with increased productivity and safety. However, with the limited funding and experience that most of these tailors and weavers have, which type of machine is the most reasonable to operate regarding effectiveness, profitability, and overall usefulness? SELCO is currently studying how renewable energy sewing machines that are flexible to the worker's needs. By researching renewable energy sewing machines, I discovered whether buying them was practical for rural workers for their particular needs.

• BASIS ADVISOR: Suresh Rajaram • ON-SITE MENTOR: Sneha Gokhale • LOCATION: SELCO Foundation



AAYUSH B.

THE USE OF NEURAL NETWORKS IN TRACKING CONTAMINATED FOOD



ABSTRACT: Do you ever check your food at grocery stores and wonder if it is contaminated? Accidentally buying contaminated food can be dangerous for everyone and it happens too often. This process can be made easier through developing research at the Arizona State University by putting dendritic tags, which can be thought of as security codes, on crops. These tags would then be scanned and compared to their original images throughout the process of getting the food into grocery stores. The tags form a link in the supply chain and their corresponding information in the database, so that if contamination is suspected, a scan will lead the user to the appropriate warning. When scanned, it will be compared to its original image and if it is contaminated the user will know and can take action. In this process, the current method of comparing these tags is just taking pictures of the dendrites and comparing them side by side, which is inefficient. My role in this research consisted of trying to find out if Neural Networks, programs used to compare data, can prove to be more efficient in scanning these dendritic tags over time. The research contained utilizing and testing several Neural Networks to see if there is one that works better than others. Through this research, it was determined whether Neutral Networks can actually make this process of checking for contamination in food more efficient or not.

• BASIS ADVISOR: Patrick Kilmer-Webb • ON-SITE MENTOR: Michael Kozick • LOCATION: Arizona State University

RISHI C.



MARTIAN MICROBES EAT DIRT: THE PLAUSIBILITY OF USING SINGLE-CELLED ORGANISMS TO TERRAFORM THE RED PLANET

ABSTRACT: With recent development in Martian travel technology from companies like SpaceX, determining how to make the Red Planet inhabitable is becoming a more and more prominent question. For humans to live on Mars for an extended period of time (think thousands of years), then one of the best long-term solutions would be to terraform the planet. Terraforming is the process of making another planet more Earth-like, which includes traits such as oceans, soil that can support life, and an oxygenated atmosphere. One way to start this process is by using some organic processors, soil microbes. Using these microbes, oxygen and minerals trapped in the Martian dust can become usable by more complex organisms. The specific kind of soil microbes that can be used are found in the Antarctic in dry permafrost, soil that is below freezing for 2 or more years with little to no ice content. The reason these bacteria are a viable candidate is that dry permafrost is much, much more common on Mars than Earth. The School of Earth and Space Exploration at ASU has recently acquired a sample of the microbes living in Antarctic dry permafrost and will study their optimal living conditions. Through their research, it is possible to then narrow down the locations where the terraforming process can start. This groundbreaking research will allow humanity to take its next step as a civilization and create a self-sustaining settlement on another planet.

- BASIS ADVISOR: Alex Harmatuck ON-SITE MENTOR: Elizabeth Trembath-Reichert
- LOCATION: Arizona State University School of Earth and Space Exploration

LINDA H.

VISUALIZING THE IMPOSSIBLE: 3D ANIMATION VS TRADITIONAL ANIMATION WITH THE QUADRUPLE AXEL AS AN EXEMPLAR



ABSTRACT: Hayao Miyazaki, the co-founder of the animation company Studio Ghibli, is renowned for his beautifully animated films including Spirited Away and My Neighbor Totoro. Miyazaki incorporates little CGI into his films despite the efficiency it brings, believing that hand-drawing is fundamental to animation. However, as other animation studios readily embrace CGI technology and overall animated film quality improves, animating primarily by hand becomes less and less sustainable. According to Toshio Suzuki, film producer and colleague of Miyazaki, My Neighbor Totoro took 8 animators eight months to complete; the film that Miyazaki is currently working on takes 60 animators one month to animate 1 minute. As animated film technology and quality improve, Studio Ghibli must make up for it by increasing frame rates and drawing more detail in each frame--a laborious task. Given the vast difference in efficiency between CGI and traditional animation, it's possible that animated films might not utilize hand-drawn animations at all in the future anymore. The goal of my research was to study methods of altering 3D animations to recreate a hand-drawn style of line art that viewers most prefer using the open-source 3D animation software Blender. With the help of Professor Jayasuriya at ASU's Imaging Lyceum, I created a series of animations with varying complexities of motion and adjust them to create different sets of line art styles. This project concluded with the analysis of each methods' pipeline and a qualitative survey on the "2D-ness" of the animations. The success of this project will allow animators to achieve a hand-drawn style in less time, relieving stress from overwork.

BASIS ADVISOR: Karyn Fought • ON-SITE MENTOR: Suren Jayasuriya
LOCATION: Arizona State University Imaging Lyceum

MARINA H.





ABSTRACT: Autism Spectrum Disorder (ASD), more commonly known as autism, is a complex neurodevelopmental disorder characterized by social and behavioral impairments. According to the Centers for Disease Control and Prevention (CDC), ASD is 4.2 times more prevalent among boys than girls. The Arizona Research for Improving Diagnosis (ARID) Lab at the University of Arizona's Department of Pediatrics has previously conducted extensive research on ASD for the Arizona site of the Autism and Developmental Disability Monitoring (ADDM) Network. ADDM, funded by the CDC, consists of 11 sites across the United States and collects data from education and clinic records to estimate the prevalence of ASD. Many previous studies have found that the current ASD diagnosis, typically done at age 8, is largely based on a male understanding and presentation of the disorder. Compared to males, females may express ASD differently, leading to many females receiving a significantly later diagnosis, misdiagnosis, and/or no diagnosis at all. In my research, we hypothesize that current estimates considering children at age 8 do not accurately represent the true ratio of males to females with ASD. If the study population includes older individuals, the ratio of males to females would likely be narrower than the current national prevalence data mentioned above suggest. Using data collected from the Arizona ADDM site, which includes individuals from 3-28 years old, along with performing statistical tests, we will demonstrate a more accurate estimate of females with ASD across the lifespan.

• BASIS ADVISOR: Karyn Fought • ON-SITE MENTOR: Argelia Benavides • LOCATION: University of Arizona

INCHARA K.

LOSING WEIGHT AND IMPROVING COGNITIVE HEALTH THROUGH INTERMITTENT FASTING



ABSTRACT: Obesity in the United States can be called an epidemic, as it is a common, serious, and deadly disease getting more and more prevalent. In fact, the US obesity rate for adults is a whopping 42.4% with an even higher percentage for adults between ages 40-54. Not only can obesity lead to physical health adversities, but it can also severely impair cognitive function and lead to irreversible conditions like dementia. Previous research has revealed that significant weight loss in obese adults leads to better cognitive performance and a better quality of life, reducing the risk factors for these life altering illnesses. Sustainable weight loss remains difficult through popular methods like dieting and regular exercise, but by enrolling mid-life adults with obesity to participate in a remotely delivered intervention, the Arizona State University lab team can determine the link between intermittent fasting and cognitive health - specifically if it is able to lower the various risk factors for dementia. Combining these results with previous studies will lead to an even broader understanding of how a person's lifestyle affects their future health and will hopefully play a role in reducing the prevalence of dementia as the seventh leading cause of death in the United States.

• BASIS ADVISOR: Patrick Hill • ON-SITE MENTOR: Dr. Dara James • LOCATION: Arizona State University

NIVEDH M.

ANALYSIS ON ARTIFICIAL INTELLIGENCE MODEL PERFORMANCE WITH LIMITED DATA



ABSTRACT: Machine Learning has become a powerful way by which computers can learn. The only requirement is that the algorithm has enough data to learn and understand from. However, there are many situations where there is insufficient data. Thus, the project is meant to uncover the various solutions that researchers have discovered and give an analysis on how effective these innovations are and in what situations do such optimizations have greater impacts. Situations like being able to classify rare diseases and create the optimal treatment plan reveal that Artificial Intelligence (AI) has the capability to solve these issues and that a thorough knowledge of how these AIs should be built, depending on their circumstances of limited data, could greatly improve the effectiveness of the program. In order to understand the various strategies that Data Scientists can use to still achieve high accuracies, I did a lot of research on the internet by looking into both older and more recent papers written by professors and students to get an insight into the plethora of possibilities that either have the potential to be expanded upon or have resulted in failure. I also understood the more nuanced areas by taking the time to understand how each of these possible solutions actually work from their description and code and be able to test them on numerous use cases as my own research. Thus, I discovered which solutions to minimal data have the largest impact in the corresponding situations.

• BASIS ADVISOR: Patrick Kilmer-Webb • ON-SITE MENTOR: Hemanth Venkateswara

• LOCATION: Arizona State University

AVINASH M.

EVALUATING THE EFFECT OF NORMAL AGING ON BONNET MACAQUE HIPPOCAMPAL SUBFIELDS USING MAGNETIC RESONANCE IMAGING



ABSTRACT: In this project, the research team hopes to develop a model for normal aging in humans by studying the bonnet macaque, a monkey commonly found in Southern India. A unique characteristic of the bonnet macaque brain is that they don't seem to develop dementia with age. Because of its structural similarity to the human brain, the bonnet macaque brain can be used to make inferences about how the human brain should age normally. Building this model for normal aging in humans is crucial to developing better dementia treatments because if we understand how the brain changes with age under normal conditions, we can identify deviations from the norm as symptoms of dementia. By drawing the distinction between dementia symptoms and normal aging, identification of early-stage dementia could be facilitated, which means that treatment can be administered before deterioration of critical brain structures. The Multi-Scale Brain Imaging Lab (MSBIL) at the University of Arizona has collected high resolution MRI scans of 12 bonnet macaque brains at ages ranging from 12-33. By developing protocols to accurately isolate regions of interest that are believed to be susceptible to aging, such as hippocampal subfields, and analyzing the MRI data pulled from these regions of interest, MSBIL can determine whether there is any relationship between structural deterioration in the scans and macaque age. The team expects to see a correlation between hippocampal subfield deterioration and age, confirming existing theories that neurodegeneration occurs even in the absence of dementia.

• BASIS ADVISOR: Peter Heitzinger • ON-SITE MENTOR: Laurel Dieckhaus • LOCATION: University of Arizona

HERSH N.



DEVELOPMENT OF A USER-DEFINED SOFTWARE TO ANALYZE CARDIAC MUSCLE CELL CONTRACTIONS

ABSTRACT: Our heart is composed of cardiomyocytes, which are cardiac muscle cells that enable heart contractions. These heart contractions are directly responsible for pumping blood around the body so that our organs receive oxygen and can function properly. It is crucial to analyze cardiomyocyte contractions to understand how cardiomyocytes function, how their function is impaired by heart diseases (such as cardiovascular disease or cardiomyopathy), and how their function is altered in response to drugs. Although current methods for cardiomyocyte contraction analysis exist, most are time-consuming and require skilled manual intervention, extensive training and expensive proprietary equipment. The purpose of our research is to eliminate these concerns with the feasible alternative of a user-defined software for robust cardiomyocyte contraction parameters, such as the force and velocity of contraction, which can be used to assess heart health. This research has applications in disease modeling, drug testing, and treatment development for heart disease. Although more testing is required, cardiac arrhythmias, or irregular heartbeat, could potentially be detected using this software. This project was conducted remotely under the supervision of Dr. Jared Churko, whose cardiac research lab is located in the College of Medicine at the University of Arizona.

• BASIS ADVISOR: Suba Rajasekaran • ON-SITE MENTOR: Jared Churko, Ph.D.

• LOCATION: Department of Cellular and Molecular Medicine, University of Arizona

SANAH P.



ANALYSIS OF ANNUAL WELLNESS VISIT (AWV) DATA FROM PRE-COVID AND COVID YEARS

ABSTRACT: An Annual Wellness Visit (AWVs) is a preventive care service that addresses the well-being of patients and helps create a personalized care plan. Covered by the Medicare B Plan and other private Medicare Advantage plans, AWVs allow the elderly population to discuss potential health risks, family history, and specific concerns with their primary care providers (PCPs). From the information provided by the patient and feedback from the PCP, a Health Risk Assessment (HRA) is created. With a detailed HRA, PCPs can order additional labs and screenings for disease prevention. Ultimately, AWVs allow patients to catch potential health risks early and reduce healthcare costs in the future. While one AWV is covered by the insurance plans mentioned above, some seniors fail to show up to their scheduled AWV. Most seniors also need to be educated regarding their plans, therefore less AWV completion. With COVID-19 in recent years, it is most likely that it fueled a decline in AWVs. However, COVID-19 led the Centers for Medicare & Medicaid Services (CMS) to add AWVs to their list of telehealth (online) services. It will be interesting to see if patients take advantage of completing AWVs in the comfort of their homes using audio/video services. Patients were already skipping their AWVs, but with new measures will they continue to skip? To conduct my research and get better hands-on experience, I went to a private family practice in Tempe. Through data provided by that practice, I analyzed how COVID-19 has affected the overall completion of AWVs. By categorizing the different insurance plans, I planned on finding an increase or decrease for AWVs for patients 65 and older. With variables such as telehealth AWVs, I am curious to see what trends in AWVs COVID-19 will bring about. I hope that the results through my analysis will bring awareness to the importance of AWVs.

• BASIS ADVISOR: Angelica Sanchez • ON-SITE MENTOR: Sunita Parikh • LOCATION: Family Practice in Tempe

SAAHITHI P.

THE SUSTAINABLE FASHION MOVEMENT: REUSE, RECYCLE, REFASHION



ABSTRACT: With the rise of fast fashion, the fashion industry has caused a substantial amount of damage to our environment. The clothing industry is responsible for more annual carbon emissions than all international flights and maritime shipping combined. Especially with the current supply chain back up and progressing climate change, using resources sustainably is more important than ever, but the popularity of low-priced, trendy clothing undermines environmental protection efforts. The movement from fast fashion to sustainable fashion will reduce textile waste and environmental depletion while increasing fair and ethical treatment of workers. Working with the sustainability department at ASU to analyze business models in secondhand fashion brands, I investigated the perceived barriers to using secondhand clothing among Gen Z and determine whether using trendy clothing or recycling clothing is of more significance to Gen Z. By conducting this sort of research, we can contribute to the growth of secondhand and sustainable clothing brands to help create a more environmentally sustainable fashion industry.

• BASIS ADVISOR: Patricia Pearson • ON-SITE MENTOR: Kevin Dooley • LOCATION: Arizona State University

ANANYA R.

HOW TRANSGENDER YOUTH IN SPORTS ARE IMPACTED BY LEGISLATION SURROUNDING THEIR IDENTITY



ABSTRACT: In the past few years, lawmakers have increasingly been pushing legislation to restrict transgender individuals' access to healthcare, gender-affirming bathrooms and participation in organized sport. Many laws and proposed bills specifically target transgender middle and high schoolers and bar them from participating in school sports under their gender identity. This project will examine the effects of this legislation on transgender youths' well-being and health. This research will aid efforts of the Arizona State University Trans and Nonbinary Sports Stories project, for which I am interning, in advocating for the rights of transgender youth across Arizona. The TNB Sports Stories project interviewed adults in communities that have transgender people in sports, as well as trans youth themselves, to determine how this legislation is implemented and its effects. Sports are an important facet of community-building and health for many youths and transgender youth shouldn't be barred from participating in such a crucial aspect of their community. In this project, we examined the rationale that legislators provided for pushing these bills and determined if there were other underlying political motivations that may lead to them supporting these bills. By working with activists and organizations supporting transgender people and giving them a voice, we can address lawmakers proposing these bills and spread awareness about some of their potentially damaging consequences.

BASIS ADVISOR: Jennifer Parchesky • ON-SITE MENTOR: Madelaine Adelman
LOCATION: The School of Social Transformation Arizona State University

SHREYA S.



EVALUATION OF DEMOGRAPHIC AND ACOUSTIC EFFECTS IN PREDICTING PARKINSON'S DISEASE FROM VOICE

ABSTRACT: Parkinson's Disease is the second most prevalent neurodegenerative disease in the world, affecting more than 10 million people and costing more than \$50 billion annually in the U.S. alone. The disease is characterized by a loss of motor control, causing symptoms like tremors, impaired balance, and paralysis. Without a cure, early diagnosis is critical to control its progression and improve the patient's quality of life. However, clinical evaluations for early-stage patients are not very effective to date, and there is an urgent medical need to develop more sensitive tools for detection. Machine learning algorithms have had some promising success in predicting Parkinson's from voice recordings, but few studies explore the practical challenges of implementing these algorithms. One such challenge is that variation in the recording devices affects the vocal features used to train the algorithms. Another problem is that Parkinson's symptoms vary widely between individuals, and factors like age, gender, and race can complicate the diagnosis. This project seeks to investigate the impact of recording systems and demographics on vocal features. Ultimately, understanding these sources of variation would be a significant step toward developing more robust and inclusive voice-based diagnostics for Parkinson's Disease.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Suren Jayasuriya • LOCATION: Arizona State University

PRATHYUSH V.

CHANGING AWARENESS INTO ACTION



ABSTRACT: The hardest thing for people to learn is how to motivate others, and that is why there are few good leaders in our world. Getting people to learn about a cause is easy because the internet provides the best place to send information, however, getting people to actively be involved in one's cause is where it's difficult. There are organizations in the Chandler area that focus on different problems such as giving help to people in need, environmental perseveration, and fun city events to promote engagement among people in the community. At Pinnacle Prevention, I will be learning about the concepts behind community engagement and finally being able to implement that knowledge in our very own project, "The Week of Wall Street." This project surrounds the concept of alley activation. Alley activation is changing dark and dangerous alleys filled with trash into walkable routes for people to enjoy especially is cities where there is an abundance of these alleys that people stay clear off. Our job in Pinnacle Prevention was to gain information from the locals about what they would want to see from this alley in the next two to four years when the city of Chandler starts to remodel it. This whole experience came with its problems however, we were still able to get a great turnout from the locals around. Now the question is: what is the best way to impact our community despite all the problems that may occur? This is an issue, not just in Chandler, but any place that wants to change. Is there a better way to go about alley activation? What other steps could we have taken to make it easier? How much were the locals interested in this alley that most people didn't even know existed and how would that impact the turnout? All of these questions will appear when people are trying to make a difference in their community. In my presentation I am displaying my experience and how that relates to community engagement projects all over the world.

• BASIS ADVISOR: Patrick Kilmer-Webb • ON-SITE MENTOR: Adrienne Udarbe • LOCATION: Pinnacle Prevention

SAHITHA V.

THE RELATIONSHIP BETWEEN CULTURAL IDENTITY AND ART THERAPY EFFICACY



ABSTRACT: Within therapy, it is important to consider differences in personal experiences, of which culture is a large part. With art therapy, the cultural relationships between an individual and art is an extra variable. Through understanding cultural variability, art therapy efficacy can be boosted and the chance of misdiagnosis reduced. Due to a lack of equivalence between cultures, it can be easy to misinterpret, leading to grave consequences. Cultural awareness and the promotion of multiculturalism can lead to increased effectiveness of art therapy. This project discussed the importance of considering diversity and variability between individuals of cultural backgrounds within art therapy in order to understand the appropriateness of art therapy as an intervention generally, along with adapting art directives and processes to better suit and provide for the needs of those of different culture in relation to personal experience and shaping views and the need to address the variable of culture in specifically art therapy. Through a survey in which data is collected on the perceptions and purpose of art, cultural values and relations and feelings throughout a drawing activity with an abstract prompt, relationships are drawn between art beliefs and cultural backgrounds. The results of the survey shows the importance of addressing cultural variability due to different views on art.

• BASIS ADVISOR: Vidya Ananthnarayan • ON-SITE MENTOR: Prakriti Sharma • LOCATION: Lumiere Education

ELLA W.



RE-VISUALIZING DEGRADED ARTWORKS: CAN OUR FADING CULTURAL TREASURES BE SAVED?

ABSTRACT: In 1964, renowned artist Mark Rothko painted a series of crimson red murals. Today, the murals appear dull blue, faded after 50 years of unprotected exhibition. Colored art objects represent invaluable remnants of cultural heritage and history that are vulnerable to irrevocable damage caused by exposure to light if not exhibited carefully. Microfading tests are used to assess art fading risks by accelerating the fading process, yet they are often inaccessible and report numerical data which is difficult to interpret. This research sought to develop more robust and flexible methods to digitally simulate the appearance of an art object after light-induced fading using microfading data from Yale University IPCH. These visualizations may enable us to better understand and communicate shifts in the hue, value, and chroma of different colors in an artwork. We used these simulations to identify areas vulnerable to light fading damage and assist in restoration efforts. Moreover, we designed algorithms to predict the fading of art objects which lack microfading information by drawing from known data, thus increasing the accessibility of microfading. To extend the scope of the data, we mathematically modeled microfading data to extrapolate fading information past the testing period. By expanding the applications and interpretability of microfading tests, this work enables conservators to better recognize the severity and impacts of art fading, as well as implement informed exhibition choices to ensure that art objects are properly preserved along with our cultural heritage and history.

• BASIS ADVISOR: Joseph Bostaph • ON-SITE MENTOR: Katherine Schilling • LOCATION: Yale University

KATHERINE W.

PRESERVATION OF THE HONEYBEE SPECIES: UNDERSTANDING ACTIVE SENSING IN ANTENNAE

ABSTRACT: When we use our sense of smell, odor molecules are always carried by turbulent air or water, which means that both chemical and mechanical stimulation are present and always intertwined with one another. We hope to distinguish the two to determine modality in olfaction by using the honeybee brain, which is a well-established model for exploring brain sensory functions. The antennal lobe of the honeybee brain is the primary site of olfactory processing which receives input from ~60,000 olfactory receptor neurons distributed along the antenna. Using multichannel extracellular recording, a technique for measuring neuronal spikes in insect brains using silicon based multichannel probes and simulating a natural environment of odor plumes with different concentrations and airspeeds, we can track the honeybee's resulting neural patterns to the varying stimuli. After analyzing the neural data by creating rasters, histograms, and heatmaps on Offline Sorter and NeuroExplorer, we can determine if olfaction is bimodal through the interaction of mechanical and chemical stimulation and learn more about how exactly honeybees utilize their antennae to interact with their environment. As a result, we can unveil the significance and specific mechanics of the honeybee sensory system. In turn, we'll pave a path for safer handling and potential manipulation of honey bees for preservation of the species. Additionally, studying olfactory information processing in the honeybee brain can provide insights for how other animals' brains work, including the human brain. Bimodal olfaction could be a key to improve the efficiency of current algorithms for olfaction.

• BASIS ADVISOR: Kayla Karl • ON-SITE MENTOR: Hong Lei • LOCATION: Arizona State University



AMANDA X.

ANALYZING 2D GELS TO COMPARE PROTEIN COMPONENTS OF EQUINE BIRTH TISSUES



ABSTRACT: There is little currently known about the composition or origin of equine birth tissues such as the cervical mucus plug (CMP). However, this essential birth tissue has the potential of holding natural proteins with immunological, anti-bacterial, and regenerative functions. With 2D gels, a deeper understanding of the CMP may be gained. It has already been theorized that the CMP may hold proteins that inhibit urinary tract infection, E. coli, HIV-1, and more. Though the CMP is small and difficult to obtain in humans, pregnant mares hold larger and more compact samples, allowing for more scientific research to be conducted on such specimens. Alternate methods and a primary focus on the components of the equine CMP will provide a thorough analysis of the inhibitive potential in equine birth tissues that may provide prospects for future pharmaceutical drugs. AniCell Biotech is a start-up company that harvests the amniotic material discharged by pregnant mares to treat wounds. Given its current work with equine birth tissues and focus on regenerative medicine, my studies there will serve to extend the company's work with proteins further, as the CMP has often been neglected. By examining the proteins in other equine birth tissues and comparing them to those present in the CMP, we can investigate its regenerative potential. Nevertheless, the CMP differs from other birth tissues in its function as an antibacterial barrier between the foals and external environment, which presents an opportunity for inquiry into its other potential functions as well.

• BASIS ADVISOR: Cord Ivanyi • ON-SITE MENTOR: Christopher Bradley • LOCATION: Anicell Biotech Lab

MICHELLE Y.



ABSTRACT: Parkinson's Disease (PD) affects almost one million people in the United States and ten million worldwide, and these numbers are expected to continue rising. It occurs when the brain, specifically the substantia nigra, loses dopaminergic neurons. Unfortunately, it is usually diagnosed when patients reach a more severe state of having the disease. There's currently no cure for it, but this could change if there was a way to diagnose patients with it earlier. Recently, there has been more research on a novel method of a magnetic resonance imaging (MRI) technique called Quantitative Susceptibility Mapping (QSM). QSM relies on a chemical shift, thus allowing us to see changes in the brain quantitatively. QSM could more easily detect PD since it may more accurately capture the increase in iron levels in the brain that occurs when patients have PD. During the next few months, I worked with University of Arizona Associate Professor Dr. Nan-kuei Chen to learn about the QSM data processing pipeline, visualize the substantia nigra using ITK-SNAP, and code in MATLab to analyze data sets on QSM and that Dr. Chen's lab has provided. If the results suggest that QSM is an improvement for identifying PD compared to current methods, then this could allow for earlier diagnoses of the disease and pave the way for future research on a cure for it.

• BASIS ADVISOR: Suba Rajasekaran • ON-SITE MENTOR: Nan-kuei Chen, PhD • LOCATION: University of Arizona





SAHIL C.

PROTEIN AGING IN AMNION



ABSTRACT: Determining the 440 billion USD is the current value of the entire global biotechnology industry. Of which, 141 billion USD belongs to the US alone. Biotechnology is a broad term, which includes CRISPR (gene modification), human stem cell research, genetically modified plants and foods and much more. However, I looked at equine amnion based regenerative products for the animal health biotechnology sector. Previously, I said the entire US biotechnology industry—human, plant, and animal—is worth 141 billion USD, but the animal sector makes up about 11 billion USD, nearly 8% of the industry. By 2026, the animal sector is expected to grow to a value of 26 billion USD, more than doubling its current value. Specifically, diseases like canine and feline arthritis are emerging markets for equine amnion based regenerative products. The global canine arthritis market is 1.9 billion USD with an expected growth rate of 4% until 2029 in the US glone and a dramatic increase in Asia-Pacific. Currently, canine arthritis is treated with anti-inflammatory drugs. Whilst these veterinary treatments continue to represent higher sales, veterinary regenerative medicines are a rapidly emerging treatment option. The allogeneic stem cells in these products result in higher achievement rates against the diseases owing to its recent popularity. As for the feline arthritis market, the FDA approved the first feline arthritis pain treatment, indicating a new and untapped field. With the well-made progress of regenerative treatments in the canine arthritis market, these products could establish themselves as the primary treatment option for feline arthritis. While the demand for regenerative product is rapidly increasing, supply of the product remains the same and in some cases is even decreasing. Reasons for increased shortages include fewer manufacturers as some exit the market, auality control issues and scrutiny by the FDA which can halt production and initiate product recalls, increased demand, and a lack of raw materials. As a result of these challenges, I determined the most effective use of equine amnion based regenerative products with the goal of addressing these issues through the usability of products beyond their labeled expiration date. At AniCell Biotech, the location of my internship, I had access to equine amnion of different ages, so I could compare the effectiveness and protein activity of amnion as it ages. Along with the raw material, AniCell Biotech provides me with 2D gels, 3D gels, Western blots, and BCA Assays, which allowed me to quantitatively measure the protein activity within the amnion determining its shelf-life and extended use thereafter.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Christopher Bradley • LOCATION: Anicell Biotech Lab

PRANAY G.

CAN I PRODUCE AN ACCURATE MODEL TO PREDICT LIVER FAT PERCENTAGE TO INDICATE NASH IN PATIENTS USING CONFIRMATORY FACTOR ANALYSIS?



ABSTRACT: The project is focused on a Principal Component Analysis (PCA) to model an equation for Liver Fat percentage (PDFF) in patients at the Arizona Liver Center. The patient sample size of those who have received liver biopsies stands around 500, and data will be used from 250 of these patients to perform the PCA. Each patient was assigned a random number from 1-250 for anonymity purposes, and the patients' vital information data was stored securely on an external flash drive. The flash drive was disposed of to further privatize the patients' health information. There are multiple studies supporting the validity of Principal Component Analysis in reducing the dimensionality of a data set. There were around 30 variables that will be included in the covariance matrix to calculate the eigenvectors, eigenvalues, and the associations across the different variables. After performing the PCA, the other 250 patients were used to run a Confirmatory Factor Analysis (CFA) to validate the initial results. These patients were labelled 251-500 for anonymity purposes. Both these statistical processes were run using Python programming language. Finally, liver fat percentage was the output variable, as it is a value that gives insight into other possible liver issues such as liver inflammation, ballooning, and macular degeneration. Producing an accurate predictor of liver fat percentage has vast implications; such as more accurately determining the condition a patient's liver is in and if there is any medication or treatment necessary.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Prido Polanco • LOCATION: AZ Liver Health Center

ALVIN H.

PREDICTING THE INCREASED VOLUME OF HARDENED POLYURETHANE FOAM



ABSTRACT: With the rise of 3D printing as a more viable option for manufacturing, more research needs to be done into ways that it can be feasibly and efficiently utilized. An interesting aspect is the usage of 3D printing within the construction of buildings. Buildings need both insulation and cushioning, which is where foam is most commonly used. These foams are often used in the walls and beams of homes, which gain flexibility and durability with the implementation of these foams. For the sake of structural stability of homes, more research needs to be done into how foam can be properly incorporated into the construction of new 3D printed homes. My project focused on creating a formula that could potentially estimate the new volume of polyurethane foam as it transitions from its original liquid form to its cured, hardened form. Multiple trials were conducted with varying initial amounts of the liquid polyurethane foam, and the resulting final volumes after hardening were gathered and paired with their respective initial volumes. Using this data, I created a linearized graph which can produce a formula that can properly estimate the final volume that the hardened polyurethane foam takes up based on the given initial volume, and vice versa. The utilization of this formula can optimize polyurethane foam's implementation into 3D printed construction by reducing waste produced by excess foam and minimizing the cost of production.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Yizhen Zhu • LOCATION: Arizona State University

ABHINAV K.

THE REBIRTH OF SMALL BUSINESSES IN POST-COVID ARIZONA



ABSTRACT: Small businesses constitute one of the largest sectors in the United States, and it heavily impacts the economy. In Arizona, small businesses encompass 44.5% of the state's private workforce. Since the beginning of the COVID-19 pandemic, these small businesses have been struggling to pay their rent for business spaces, and many have found their revenue decreasing drastically. It's clear that small businesses have been in a terrible situation for the last couple of years; however, as COVID restrictions reduce for both businesses and consumers, how will businesses react? Strategically prepared small businesses will be ready to jump at post-COVID opportunities and work towards long-term growth. Through the employment of various statistical analyses on certain components of a small business budget, we can determine which strategic approaches lead to economic growth. This research will address the two or three strategic focuses for post-COVID small business growth in Arizona.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Brandon Ames • LOCATION: Anicell Biotech Lab

AAYUSH M.

SMILE! YOU'RE ON CAMERA: USING FACTOR ANALYSIS TO DETERMINE THE IMPACT OF BODY-WORN CAMERA IN ARIZONA DUI CASES



ABSTRACT: In the United States, body-worn camera (BWC) technology has been introduced to combat controversy over allegations of misconduct by officers, with issues ranging from excessive use of force to evidence processing. The goal of these body cameras is largely to preserve additional evidence for the litigation process and to ensure that police officers adhere to departmental and constitutional regulations, ultimately reducing civilian complaints and providing material to discipline officers in the event that issues arise. However, much of the existing literature on BWC technology addresses civilian-officer interactions, and the research that actually evaluates its role in judicial proceedings generally relies on qualitative speculation over empirical analysis. Therefore, this paper seeks to utilize factor analysis, a quantitative process through which large amounts of interrelated variables can be reduced into a simple model that describes the most significant factors in a given case. For the purposes of this research, evidence contained in various legal proceedings and BWC footage of DUI arrests can be measured and used in a factor analysis to determine the information that affects client outcomes the most. Under The Law Offices of Brandon White, a criminal defense firm that represents cases from the entire state, a more accurate sample can be obtained to study this phenomenon. The results from this review can inform not only leaders of large-scale social movements advocating for changes in policing, but also law enforcement, prosecutors and defense attorneys throughout the Arizona criminal justice system.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Brandon White • LOCATION: Law offices of Brandon White

NANDINI R.

ANALYZING VALUE PRIORITIES AS PEOPLE AGE

ABSTRACT: Our values influence our daily decision making and are the key to understanding what differentiates us from the people around us. Values are able to direct people's actions, behavior and personality, and in any given situation, people will act differently based on what they value. Some notable examples of this are people voting based on candidates' personalities, behaving at school/work, and countless others. As people grow, they develop a set of ethical norms, beliefs, and values that together constitute their individual philosophy. This philosophy has the potential to shift as time passes, making measuring how values change over time may be one way to analyze individuals' personalities, personal changes and growth. This study is attempting to find a correlation between age and personal vs. work values by looking at a balance in those two types of values in people of different ages. People (ages 10-60) all around Arizona were given a short, 8-question survey and asked to respond to the best of their ability. This survey was used to measure respondents' placements on a spectrum between personal and work values and final spectrums from all age groups will be compared against one another to see if a possible correlation exists between age and value balance. Analyzing this is another step closer to identifying when important experiences take place during a person's life and how stable those shifts are, whether they are just a phase in a person's life or a stable change.

BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Neal A Lester, PhD
LOCATION: Project Humanities – Arizona State University



ELIZABETH W.



DO FOOD LABELS ENCOURAGE HEALTHIER EATING?

ABSTRACT: Poor diet is a leading cause of poor health in the United States and globally. How the provision of the nutritional information of food products affects consumers' food choices is pertinent to examine when obesity is a major health problem in the U.S. Over the last decade, considerable attention has been paid to nutrition labeling of food due to its expected contribution to consumer's informed choices towards meeting dietary guidelines. However, whether or not consumers value and use nutritional information is still unclear. Adolescents are at a point in their life where they need more total nutrients, yet the majority still consume inadequate diets. Furthermore, teenagers are faced with tremendous pressure from their social environment to look a certain way. Obesity has also been raising health concerns for today's youths. Thus, high school students are a crucial population to study how the knowledge of nutritional information affects their food consumption. Establishing positive dietary habits is essential for long-term good health, and high school adolescents are the ideal population to educate about healthy eating practices and a positive attitude toward health messages on food labels. This study focused on Arizona high school students in the Phoenix-Tuscon metropolitan area. By looking at the food choices of students when they don't know the food's nutritional information compared to their food choices when they are aware of the food's nutritional information, we observed differences in eating behaviors that are attributable to the knowledge of nutritional information.

• BASIS ADVISOR: Jesse Nims • ON-SITE MENTOR: Dawn Earlywine • LOCATION: Honorhealth





The teachers, executive leadership of the BASIS Charter Schools network commend all of our seniors for their perseverance in their research, and for their hard work throughout their **BASIS Charter School journey.** We give our most heartfelt congratulations to them for their achievements thus far, and these projects are only the beginning!



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