

# Senior Projects

2022–2023

**BASIS** SCOTTSDALE



## SENIOR PROJECTS & SENIOR RESEARCH PROJECTS

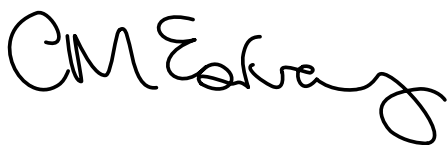
At this point in their senior year, BASIS Charter School students have completed a set of four BASIS Capstone classes to earn their BASIS Honors Diploma. In addition, many students are in the process of completing the prestigious College Board's AP Capstone Diploma™, a challenging, two-year sequence 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 a student's 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 project summaries 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.



Carolyn McGarvey  
Chief Executive Officer  
BASIS Ed AZ+



Patti Bezanson  
Chief Executive Officer  
BASIS Ed Texas



# Scottsdale SENIOR PROJECTS



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## FARHAN B.



### EXAMINING THE ARIZONA WATER CRISIS

**SUMMARY:** In the state of Arizona, water has emerged to the forefront as a critical issue. Areas of the state are finding themselves cut out of water grids, Lake Mead is sinking, and reservoirs are drying up. Farmers are finding themselves forced to draw from easily depletable groundwater reserves. Despite all of this, most people remain fuzzy on the details of the water crisis, even as key questions remain unanswered. In my project, I explored ways to bring further publicity to the water crisis, while also delving into key questions. What is the primary cause of the water crisis? How can we better allocate our current water reserves? Who is suffering the most and whose voices are not being heard? How can our elected officials help? How do we work to create a political and environmental structure that is more sustainable going forward, to prevent events like this in the future? Through working with Tomorrow We Vote, a nonpartisan civic engagement group, I was able to find the answers to these questions. Specifically, by conducting a series of interviews with key players in the realm of water, my project illuminates both where we are and where we are going.

• **BASIS ADVISOR:** Bonne de Blas • **ON-SITE MENTOR:** Brent Whiting • **LOCATION:** Tomorrow We Vote

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## EMILY C.



### EXAMINING SUSTAINABILITY IN SCHOOLS

**SUMMARY:** In recent years, sustainability has become a major topic of interest in the face of economic, demographic, and environmental issues. Sustainability refers to matters that will maintain a process over an extended period of time. In other words, people are seeking sustainability to meet this generation's present needs without compromising the ability for future generations to continue to meet their own needs. Many modern companies and organizations utilize more sustainable models and goals—for example, the United Nation's Sustainable Development Goals (SDGs) were established due to the increasing focus on sustainability. Despite this, sustainable methods are often more expensive and time consuming. How can lower income regions take advantage of or participate in sustainable activities? How can sustainability positively impact them? At Arizona Students Recycling Used Technology (AZStRUT), I contributed to their methods for sustainable recycling. My research focused primarily on the different strategies and approaches this organization utilizes to work towards sustainability. Additionally, I discovered the relationship that sustainability has with economic and social growth by assessing the impact that the organization has made in lower income regions in Arizona.

• **BASIS ADVISOR:** Dana Johnson • **ON-SITE MENTOR:** Bonnie Faulkinbury • **LOCATION:** AZStRUT

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## BRIDGET C.



### WEIGHTLOSS: STUDIES IN GASTRIC BALLOON DESIGN AND HEAT TRANSFER

**SUMMARY:** Obesity is defined as excessive fat accumulation that can lead to long-term problems and diseases such as diabetes, mortality, pancreatic cancer, and more. However, there are many weight loss methods used by doctors to treat obesity. Bariatric surgery, for example, involves surgically making changes to your gastrointestinal system to lose weight. Sleeve gastrectomy is a type of bariatric surgery where a part of the stomach is removed. Data shows that sleeve gastrectomy is an effective solution for weight loss, which has led to a rise in its use. Another bariatric surgery method is gastric bypass, where a small pouch is created from the stomach and is connected to the small intestine. The Singh lab hypothesizes that heat transfer via gastric balloon will induce a weight deficit in pigs. Prior to balloon placement, I studied the optimal conditions for heat transfer, including balloon volume, height of the outflow, and contact time, and measured inflow and outflow temperatures as a way to test calorie loss. I also helped make new gastric balloons for pig surgery. Additionally, I shadowed the pig surgeries (endoscopically placing the gastric balloon), and watched the first steps of sedated cooling in the pigs. Through my research, I was able to learn more about this method of weight loss: heat transfer via a gastric balloon.

• **BASIS ADVISOR:** Sheri Pierce • **ON-SITE MENTOR:** Megan Summers • **LOCATION:** Mayo Clinic

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## BRYSON C.



### PRACTICAL INTEGRATION OF MODERN TECHNOLOGY INTO EXISTING POWER GRIDS

**SUMMARY:** Everything runs on electricity. In our modern world, we try to create more ways of making that electrical energy. People have started to demand more of it as new technologies require electricity. To answer the growing energy demand, we try to discover new ways to produce it. From burning fossil fuels to the trend of sustainable energy, people have been looking for more solutions to energy consumption. However, when that exciting new energy gets discovered, how is it brought from its source to your home? At ASU's LEAPS (Laboratory for Energy and Power Solutions), I explored how energy gets distributed and looked into a solution to make it more efficient. This solution is in microgrids. Microgrids are fascinating ways of improving grid efficiency by allowing certain places to work when utilities go down by disconnecting from the central grid. The focus of my project is to inform you what these microgrids are, why they aren't more widely used, and how they can apply to modern-day infrastructure. I also introduce the factors that led to their conception. Through this project, I discovered ways to allocate energy efficiently and found out how microgrids help to create a seamless transition to low-carbon alternatives while still supplying the world with the energy we need.

• **BASIS ADVISOR:** Ryan Yanashima • **ON-SITE MENTOR:** Alexander Mobley  
• **LOCATION:** Arizona State University Polytechnic Campus

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## LORALAI C.



### THE EFFECT OF IMMUNE CELLS ON PATHOGENESIS OF AMYOTROPHIC LATERAL SCLEROSIS (ALS)

**SUMMARY:** Made famous by the diagnosis of Steven Hawking, Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disorder that results in muscular weakness that gradually spreads throughout the body. Due to the nature of the disease, not much is known about how it propagates, but there are a few leading theories. My project explores the role of the immune system in the disease. T cells, a type of white blood cell, are directly correlated with an increased amount of inflammation in the central nervous system, which is shown to speed up the spread of the disease. In addition to this, an increase in T cells with certain markers is shown to lead to the central nervous system being exposed to toxins that damage neural cells. I assisted in analyzing CD4+ and CD8+ cells at Barrow Neurological Institute with Dr. Bakkar. CD4+ and CD8+ cells are types of T cells and are commonly associated with an increase in inflammation. Hopefully, my research into the role of the immune system will shed light on the processes behind ALS and help in the search for a cure.

- **BASIS ADVISOR:** Nicholas Navarro • **ON-SITE MENTOR:** Dr. Nadine Bakkar
- **LOCATION:** Barrow Neurological Institute

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## DARYL D.



### EXPLORING SUSTAINABLE PUBLIC TRANSPORTATION

**SUMMARY:** Promoting public transportation is essential to the health and safety of our planet. The transportation sector accounts for the largest contributor to greenhouse gas emissions and traffic congestion continues to limit economic potential. To best understand how to reduce these emissions, this project looked at Phoenix light rail and bus transit networks. With an extensive understanding of the history and ridership trends of Phoenix's transit systems, I was able to analyze the economic and environmental impacts of these systems. Throughout this project, I focused on the emission reductions transit has made or is expected to make and the cost of the operation and any potential savings. While working at the engineering and consulting firm CivTech, I participated in ongoing projects that give me added insight into the data collection and planning processes that go into transportation planning.

- **BASIS ADVISOR:** Mason Waaler • **ON-SITE MENTOR:** Michael James • **LOCATION:** CivTech, Inc.

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## CANDICE E.

### FOLLOWING WATER DISTRIBUTION IN ARIZONA: CLASS, CASH, AND COLLABORATION



**SUMMARY:** In 1980, Arizona created the Groundwater Code (Code), establishing the Arizona Department of Water Resources and naming the state's Active Management Areas (AMAs) and Irrigation Non-Expansion Areas (INAs). AMAs are areas where overdraft, the depletion of water exceeding the recharge, is most severe. The Code itself was divided into five management periods, ending in 2025. With Management Period 5 coming to a close in two years, this project aimed to discover the perceived efficiency of groundwater policy by evaluating Management Period 3 (2000-2010). Since each AMA had its own unique tools and goals as well as two Order of Modification during Management Period 3, one phase of this study tracked the changes in policy over time to infer what has benefitted and what has restricted progress in Arizona's overdraft. The second phase of this study targeted public perception of water scarcity. Through evaluating newspapers, opinion pieces, and public statements, I created a narrative of how different regions in Arizona differ in views with regard to shortages in water. By comparing various views within the state, my research determined the correlation between groundwater policy and perceived water scarcity across different regions in Arizona.

• **BASIS ADVISOR:** Sheri Pierce • **ON-SITE MENTOR:** Dr. Kirk Jalbert • **LOCATION:** Arizona State University

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## ASUKA F.

### SYNTHESIS AND CHARACTERIZATION OF 24 WT% CEOX NANOGLUES ON SILICA SUPPORTS



**SUMMARY:** SACs are significant for their high activity, specificity of reactivity, and economical use of metals, which are realized in part through their use of dispersed single metal atoms as active sites. However, the single atoms exhibit high surface energy, a condition that threatens SAC stability and can result in the agglomeration of the single atoms, a development that lowers SAC activity. To prevent agglomeration, nanoglues were proposed. Nanoglues, metal oxide clusters that are dispersed on the support, have the purpose of attaching to and confining the single atoms to their surfaces. This project investigated the synthesis and characterization of 24 wt% CeO<sub>x</sub> (Cerium Oxide) nanoglues on SiO<sub>2</sub> (Silica) supports. In this project, CeO<sub>x</sub> and SiO<sub>2</sub> were used as the nanoglue and support materials, respectively, due to the significant redox properties of CeO<sub>x</sub> and high surface area and irreducibility of SiO<sub>2</sub>.

• **BASIS ADVISOR:** Merl Martin • **ON-SITE MENTOR:** Dr. Jingyue Liu  
• **LOCATION:** Arizona State University Material Physics Lab



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## RACHANA G.

### EXPLORING IDEAL IMAGING MODALITIES FOR HIGH-RISK BREAST CANCER



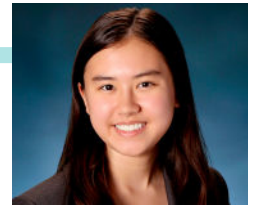
**SUMMARY:** Breast cancer makes up 12.5% of all cancer cases, with the highest incidence rate globally. Because of this, it is critical to examine new breast imaging modalities to prevent breast cancer before it metastasizes and becomes difficult to treat and survive. Current standards of imaging for high-risk breast cancer include full-field digital mammography (FFDM), or standard mammography, magnetic resonance imaging (MRI), and ultrasound. However, contrast-enhanced mammography (CEM), a more novel form of imaging, has emerged recently and uses iodinated contrast and technological algorithms to highlight lesions more clearly. In this project, under the supervision of Dr. Patel at Mayo Clinic, I researched and analyzed the effectiveness of these different imaging standards for different types of breast cancer and levels of breast cancer risk, as well as their feasibility for physicians and medical institutions, in order to better understand ideal methods for preventative screening. I also worked on a clinical research project assessing the patient experience of CEM for women who have undergone the diagnostic procedure using the testing morbidities index. This information can help in the implementation of a more affordable and accessible imaging modality that increases mammography access, in turn reducing rates of breast cancer.

• **BASIS ADVISOR:** Bonne de Blas • **ON-SITE MENTOR:** Dr. Bhavika Patel • **LOCATION:** Mayo Clinic

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## ELLA H.

### ATTACHMENT STYLES AND THE EFFECT ON LOCATION MONITORING



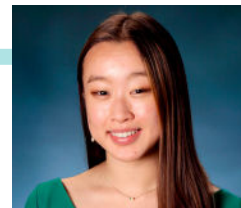
**SUMMARY:** Technology plays a massive role in romantic relationships. With dating apps and social media, people are able to stay in constant contact, share parts of their lives online, and monitor their partner. One type of monitoring behavior is location monitoring. My research focused on analyzing why people may monitor their partner's location. Specifically, I looked at rejection sensitivity, the development of a hypersensitivity to perceiving and overreacting to rejection. Rejection sensitivity may lead to behaviors such as jealousy and trust issues, which are commonly seen in romantic relationships and could provide some explanation for the reasons behind location monitoring. By reading into the existing literature, as well as analyzing data screenshots from ASU's @HEART Lab, which consisted of evidence of location monitoring through modern apps such as Life 360, Snapchat, etc., I looked for the behaviors mentioned before as themes within the data.

• **BASIS ADVISOR:** Amber Ellico • **ON-SITE MENTOR:** Trinity Strecker  
• **LOCATION:** Arizona State University Department of Psychology

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## CATHERINE J.

### #FINALLYLEGAL: UNDERSTANDING LEGAL ADULTHOOD



**SUMMARY:** Many young adults do not know their rights when they turn 18, leading to many future complications for their parents and family members. It is critical for young adults to know their rights for professional competencies in the case of danger. In the case of a Florida nightclub shooting, many college students were injured, leading to the local police department requesting President Obama to waive HIPAA, which was rejected. Since the college students did not fill out their Medical Power of Attorney, their parents could not access their medical information since they were young adults. By learning what it means to turn 18, I aimed to make legal information accessible to laypeople. Interning in an estate planning law firm, where legal adulthood is typically the most important, I summarized topics from Power of Attorney to credit cards in my blog posts.

• **BASIS ADVISOR:** Dana Johnson • **ON-SITE MENTOR:** Majorie Desmond • **LOCATION:** Desmond Law Firm

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## RUSHIL J.

### CURING CANCER THROUGH CANCER IMMUNOTHERAPY: GENERATING METABOLITE-DERIVED POLYMERS OF ASPARTIC ACID FOR TARGETED DRUG DELIVERY IN TUMORS



**SUMMARY:** Did you know that only 15-20% of patients have positive response rates to cancer immunotherapy drugs, according to Johns Hopkins Medicine? Currently, the field of cancer immunotherapy, especially cancer therapies such as T cell-based therapies, has shown success in treating certain tumors such as B cell lymphoma. However, with solid tumors such as breast cancer or prostate cancer, the effectiveness of immunotherapy needs further exploration. So, how can we generate particles containing drugs that will infiltrate cancerous cells? What will be the viability of this immunotherapy? The Acharya Lab at Arizona State University has been studying particles and macrophages to determine whether macrophages can precisely and accurately infiltrate cancerous solid tumors without bringing harmful effects to the patient. At the lab, I assisted researchers to generate specifically-designed particles, both microparticles and nanoparticles, such as paKG and PLGA, which contain certain drugs designed to target cancerous cells that have not been successfully treated using other forms of therapy in animal studies. Once particles and metabolite-releasing polymers of aspartic acid were generated, I then studied release kinetics to further analyze anti-tumor immunity, determining how the drugs are released in the body. I learned about the challenges that exist with implementing therapies and how rodent cells respond to drug therapy. I also wrote a review article on spatial omics. My hope is that my findings will advance cancer immunotherapy by evaluating the effectiveness of drug therapies in the progression of cancerous tumors to improve the cancer treatment process for patients.

• **BASIS ADVISOR:** Ryan Carey • **ON-SITE MENTOR:** Dr. Abhinav Acharya • **LOCATION:** Arizona State University

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**BHAVYA K.**



### **STEM CELL RESEARCH: EXAMINING THE EFFECTIVENESS OF USING STEM CELLS FOR MYOCARDIAL REGENERATION**

**SUMMARY:** The functional result for millions of patients might be improved by heart regeneration using stem cell treatment. Promoting the engraftment of fresh, beating cardiac cells into the ischemic area of the heart following a myocardial infarction is an objective of cardiac stem cell research. The source of cells and the ways by which these cells enhance heart function are the main aspects of cell therapy for myocardial repair. Animals receiving stem cell injections into their hearts are showing some improvement in cardiac function. However, only a small percentage of the injected cells remain in the heart or develop into brand-new myocardium, and clinical studies have only revealed a modest increase in human heart function. The cell sources and mechanisms of cardiac improvement are two key elements of stem cell therapy which I reviewed in my research project. Although the initial excitement surrounding cell-based therapy focused on stem cell differentiation into cardiac myocytes, clinical trials have shown that most of the injected cells are not retained in the heart. Thus, the injection of stem cells has not yet significantly improved heart function.

• **BASIS ADVISOR:** Ryan Carey • **ON-SITE MENTOR:** Dr. Wuqiang Zhu • **LOCATION:** Mayo Clinic

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**DERRICK K.**



### **IDENTIFYING FACTORS CONTRIBUTING TO UNDERAGE TOBACCO SALES**

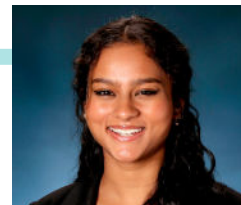
**SUMMARY:** Regions in Arizona from Scottsdale to Mesa have been shown to have underage tobacco sale rates significantly higher than the national average. Current data suggests that while underage tobacco sales have decreased in the past, in recent years, sales have been increasing. In order to limit the underage sale of tobacco products, given the lack of financial and personnel resources, specific areas of the state should be identified according to high levels of underage tobacco sales. In the interest of identifying such areas, I collected and analyzed the previous years of data regarding underage sale of tobacco products according to divided counties.

• **BASIS ADVISOR:** Ryan Yanashima • **ON-SITE MENTOR:** Erika Mansur  
• **LOCATION:** Office of the Arizona Attorney General

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## HARSHA K.

### RACE & RELIGION: THE POST-COLONIAL EXPERIENCE



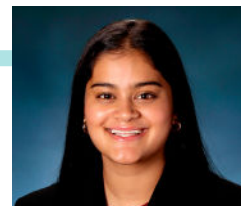
**SUMMARY:** Religion is a realm that is always experiencing some kind of difference, whether that be wars over which religion is more dominant, or the birth of a new denomination. One of the largest differences is the effect of colonialism and the resulting impacts on those colonized. Although conversations about religions are always had and always will be discussed, the minority experience in such religions rarely has a focus in those conversations. All faces of any religion can't be fully explained without a consideration for all groups of people within that religion. My project focuses on an overlooked group: Catholic Indians. After British rule in India, many in the South faced forced conversion along with religious sanctity within Catholicism. However, the nuances of these experiences along with intersections of caste and gender are rarely explored through the lens of colonialism. During my time at ASU, I examined the minority experience of Indians in Catholicism and compared it with similar experiences of the Mormon Latinx community in order to draw broader conclusions on post-colonial religious minorities.

- **BASIS ADVISOR:** Charity Taylor-Antal • **ON-SITE MENTOR:** Dr. Sujey Vega
- **LOCATION:** Arizona State University – Virtual

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## NIKHILA K.

### EXAMINING LUNG CANCER'S CONNECTIVITY WITH SKIN TOXICITIES



**SUMMARY:** The cancer research realm has played a part in the medical field since the very beginning. It is the biggest equation needed to be solved. Researchers and doctors worldwide allocate so much time to this area of research but we have not yet found the cure or the problem. Lung cancer is one of the most prominent and invasive forms of cancer. This has been prevalent since times of tobacco and smoking and has continued to surge throughout the years. There are so many types of cancers, and there are various factors that cause it. Different types of cancers have different outcomes and causes. This research focuses on a part of lung cancer, specifically the rate of survival of lung cancer patients who have skin toxicities versus those who do not. My research branches off an ongoing research paper concerning lung cancer patients. I looked into patients who either had or did not have skin toxicities in order to evaluate its connection to the rate of survival. This project used an individual database specifically programmed for this project called SDMS. Through this program, I was able to input detailed information about lung cancer patients to arrange and organize any updates and additional information on these patients.

- **BASIS ADVISOR:** Paul Flores • **ON-SITE MENTOR:** Dr. Ping Yang • **LOCATION:** Mayo Clinic

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## SHARVAREE K.

### EXAMINING THE ROLE OF ENVIRONMENTAL FACTORS IN ALS PROGRESSION



**SUMMARY:** Amyotrophic Lateral Sclerosis (ALS), or Lou Gehrig's disease, is a neurodegenerative disease associated with weak muscle activity as a result of decreased nerve cell function. Since the discovery of the SOD1 gene in 1993, studies have focused mostly on the genetics of ALS. Due to this, environmental triggers have yet to be significantly linked to the genetic expression and progression of the disease. Through the analysis of wastewater using liquid chromatography-mass spectrometry, I looked for chemical compounds that have been known to progress neurodegenerative diseases. Combined with a literature review of previous research and demographic changes in urban areas where the samples were taken from, I examined the connection between specific populations and Lou Gehrig's disease. Through this, I was able to see which populations were more susceptible using information such as wastewater contents, pollution, and demographic data. This allowed me to understand the different ways a disease can be contracted which could eventually help to discover cures and solutions to restore the environment in order to prevent further progression of the disease.

- **BASIS ADVISOR:** Ryan Yanashima • **ON-SITE MENTOR:** Melanie Newell
- **LOCATION:** Arizona State University Biodesign Institute

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## ALLISON L.

### COACHING PSYCHOLOGY FOR HIGH SCHOOL ATHLETES



**SUMMARY:** All great athletes have to start somewhere. Most of them start by learning the basics, whether that's from their parents, older siblings, or coaches. But what is the most effective way to teach these fundamental skills and how can we clearly communicate them to players? Furthermore, there are many other obstacles, both physical and mental, that we need to help athletes overcome. As a student athlete myself, I have dealt with a lot of these obstacles, and a crucial factor that always affected my performance has always been my mentality. This project gave me a better understanding of what affects athletic success and how coaches can help build players' mental strength. Furthermore, this internship also allowed me to learn more about different coaching strategies and how to maximize performance. Between physicality and mentality, establishing physical strength and mechanics is more straightforward compared to developing mental strength. For my project, I closely observed high school student athletes and analyzed the factors that contributed to their success. During my research, I was also able to closely examine the psychological aspects of coaching, which will help future coaches understand how to help high school athletes develop mental strength while improving their physical strength and coordination.

- **BASIS ADVISOR:** Nicholas Navarro • **ON-SITE MENTOR:** Juliana Delsante
- **LOCATION:** Chandler Preparatory Academy



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## JACOB L.



### BEHIND THE SCENES: A SINGLE SPECIALTY MEDICAL PRACTICE

**SUMMARY:** According to the Asthma and Allergy Foundation of America, more than 50 million people in the U.S. experience various types of allergies each year. Allergies are the sixth leading cause of chronic illness in the United States. Specialized allergy clinics have been opened to relieve those who experience discomfort from allergies. My project documents my time at Allergy Asthma Clinic, where I analyzed business practices that reveal trends and shifts. Though there are general trends in allergies, there may be specific trends due to the location or clinic itself which I aimed to discover through my internship. I believe my research could benefit both people who suffer from allergies in Arizona, as well as allergy clinics such as Allergy Asthma Clinic. Trends such as seasonal allergies seem logical to most, but my focus was on discovering new trends relevant to Arizona specifically.

• **BASIS ADVISOR:** Steven Madler • **ON-SITE MENTOR:** Dr. Ivy Christ • **LOCATION:** Allergy Asthma Clinic

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## ARUN M.



### UTILIZATION OF QUANTUM COMPUTING TO IMPROVE REAL WORLD SIMULATIONS

**SUMMARY:** When quantum computers were first conceived of by Richard Feynman, the algorithm that motivated it was the simulation of quantum systems. Rapid performance of simulating quantum systems has applications from materials science to drug discovery. Since then, the theory for simulating a system, broadly known as Hamiltonian simulation, has improved to the optimal scaling. However, this requires devices with effectively perfect gates—something that is still far away. In the meantime, the current quantum computers can provide proof of concept speedups and may even suffice for outperforming classical algorithms. One method for performing Hamiltonian simulation on a quantum device is to use Trotterization. Trotterization is the overall measurement of a system from the combination of individual measurements. The goal of this project was to provide an improvement upon this method, whereby the individual measurements of the system in the Trotterization are grouped together into commuting cliques, an idea that has yet to be utilized for Hamiltonian simulation. The premise of the use of cliques is that grouping measurements together can provide a speedup for the overall simulation.

• **BASIS ADVISOR:** Brandon Hermann • **ON-SITE MENTOR:** Lana Gunderman • **LOCATION:** Virtual

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## SINDHURI N.



### THE BUILDING BLOCKS OF LEARNING: A STUDY OF HOW DAYCARES SUPPORT CHILDHOOD DEVELOPMENT

**SUMMARY:** The period of time between ages 1 and 5 years is widely regarded as one of the most critical stages for development and learning. This is due to the vast array of developmental milestones that occur during this time, including language and literacy, social and emotional, cognitive, and physical developments. Going into this project, I hoped to answer the question of how learning centers were structured and how they incorporated various methods and learning activities for young children to ensure that their developmental skills were developing and allowed for them to be ready for elementary school. Additionally, I wanted to examine how learning centers for children with learning challenges (autism, speech disorders, developmental disorder, etc.) were able to provide different activities, crafts, and programs to ensure that these children were able to develop in a manner that was well suited for them. To conduct my project, I collected data through observation of the children by taking notes of their behavior. As a result of my observations, I researched and observed the set goals of daycare per age group and looked into how daycares helped to achieve different types of development for each age range in the daycare setting to better understand how these developments were able to contribute to the readiness of the child for elementary school. This project serves as a reminder that everybody has their own developmental journey. It also provides some insight into the different programs and methods that learning institutions can provide for children if they have challenges in their developmental journey.

- **BASIS ADVISOR:** Morgane Leseul • **ON-SITE MENTOR:** Alyssa Jordan / Togba Goe
- **LOCATION:** Scottsdale Childcare and Learning Centers / UPWARD for Children and Families

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## KAIF P.



### FINDING AFFORDABLE HEALTHCARE

**SUMMARY:** Healthcare in the U.S. is expensive: Our country spends \$2.8 trillion on healthcare annually. Knowledge about the field is growing faster than ever, yet access and implementation of that knowledge is limited. A prominent explanation for this is the exploitation of pricing by drug companies, meaning many people with health issues are left struggling to pay for treatment. An example of this is the overpricing of insulin. Another explanation is the role that the law system plays in pressuring doctors to perform unnecessary tests to avoid being potentially sued. These problems both play a systemic role, so getting to the root of these issues is the best long-term solution for solving the rising cost of healthcare. A potential solution we could use is lean startups, which prioritize creating a product for as low of a price as possible by shortening product development cycles and rapidly discovering if a proposed business model is viable. The use of lean startup methodology in affordable healthcare is a topic of growing interest. So, my senior project explores the application of lean startup principles to address the challenge of making healthcare accessible and affordable for all. My research focused on identifying and analyzing the key components of lean startup methodology, such as customer discovery and validation, rapid prototyping, and iterative improvement. I examined successful case studies of lean startups in the healthcare industry and used these insights to propose a set of best practices for healthcare organizations looking to adopt lean startup principles.

- **BASIS ADVISOR:** Angelique Martin • **ON-SITE MENTOR:** Dr. Annapoorna Sreedhar • **LOCATION:** Mayo Clinic

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## MARGARET P.

### USING LANDSCAPE ARCHITECTURE TO MITIGATE EFFECTS OF EXTREME HEATING



**SUMMARY:** Nearly every region faces environmental challenges—hurricanes, earthquakes, droughts—but for Scottsdale, it is extreme heat. But in addition to forecasting these climate issues prior to when they happen, we can also take preventative measures to minimize their effects on civilians. For example, one proposed solution is the installation of green roofs, which—while more expensive—enhance a space both aesthetically and environmentally by attracting biodiverse wildlife and reducing heat flux by up to 72%. Other prevalent options are cooling pavements, which increase solar reflectance by upwards of 20%, and intentional tree plantation, which serves as a source for shade and promotes evapotranspiration. In my project, I conducted thorough on-site research of these landscape architectural strategies at Scottsdale City Council, particularly focusing on the potential of local government agencies to combat this environmental challenge with an aesthetic architectural design component. By the completion of my project, I learned about the city council's behind-the-scenes efforts for Scottsdale residents, and also applied my research to other cities seeking to minimize the effects of extreme heating.

• **BASIS ADVISOR:** Paul Flores • **ON-SITE MENTOR:** Lisa McNeilly • **LOCATION:** Scottsdale City Council

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## VIVIAN P.

### EXPLORING AVIATION



**SUMMARY:** Did you know that you can fly a glider solo two full years before the state of Arizona will let you get behind the wheel of a car by yourself? You can launch yourself on an exciting aviation career path at the tender age of 14! I centered my project around exploring the opportunities open to pilots. During my project, I worked towards my private pilot certificate for single-engine airplanes and explored various aviation careers. My goal was to take my first solo flight by the end of the project, and to prepare for the FAA private pilot written test, oral test, and checkride required to become a certificated private pilot. I was not necessarily aiming to add new knowledge to the aviation field, but to make already existing information more accessible to the public while developing the skills to fly both privately and professionally. I also provided information about possible scholarship opportunities that can make earning a pilot's license more accessible. I wanted to show the general public, especially my fellow BASIS Charter School students, the joy of flight and the variety of aviation career options available.

• **BASIS ADVISOR:** Angelique Martin • **ON-SITE MENTOR:** Shad Coulson • **LOCATION:** Arizona Soaring Inc.

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## EQRA R.

### GENDER BIAS IN HEALTHCARE



**SUMMARY:** How deep does misogyny reach? An area where it is not often talked about is in the healthcare industry. I researched under Dr. Breanne Fahs, a professor at ASU, who leads her research group Feminist Research on Gender Studies, or FROGS for short. Under Dr. Fahs, my research explored the unconscious misogyny that is present in the interactions between patients and physicians in the gynecological field. I revealed whether there has been any unconscious bias within the field by using multiple sources, such as outtake paperwork and de-identified information. Specifically, my research focused on a lack of attention given to women's emotional needs and an ignorance that is directed towards women's complaints of their own body. Although there are countless examples of women who voice their experiences with these issues, I worked to find concrete evidence to bring legitimacy to these complaints. Through my research, I revealed how ingrained misogyny is, to the point where even professionals of the field fall victim to it.

- **BASIS ADVISOR:** Charity Taylor-Antal • **ON-SITE MENTOR:** Dr. Breanne Fahs
- **LOCATION:** Arizona State University Research Group: Feminist Research on Gender and Sexuality

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## SAKETH R.

### EXPLORING SECURITY WEAKNESSES WITHIN DLL-BASED PLUG-IN FRAMEWORKS



**SUMMARY:** In the current era of technology, extendibility has become a ubiquitous feature of modern software. Many applications, ranging from web browsers to image editors to office software and beyond, have grown to offer the ability to add custom functionality through the use of extensions. The popularity of third-party plugin systems has also skyrocketed in recent years, leading to a proliferation of these tools across a wide range of software platforms. However, by encouraging third parties to develop and release plugins in this manner, developers of these host applications have effectively opened the door for bad actors to take advantage of these interfaces to attack consumer devices through the arbitrary code execution these plugin systems enable. As such, over the last two decades, industry engineers and cybersecurity researchers alike have been constructing and iterating security measures that prevent such framework exploitation. A dominant and effective mitigation technique requires plugin developers to declare the specific additional permissions they would like their plugin to utilize, rendering the add-on physically incapable of performing actions outside of the scope explicitly authorized by the end user. As successful as this technique may be for mitigating and preventing attack surface, it relies on plugins to be created with interpreted programming languages, such as JavaScript, which execute substantially slower than their compiled counterparts, making this security system unviable in many speed-critical environments, such as those involving real-time media manipulation (3D modeling, music production, video editing, etc.). My project objective was to build proactive and retroactive solutions that could enable this powerfully effective permission declaration to plugin systems that are compiled directly and shipped as machine code.

- **BASIS ADVISOR:** Natasha Proctor • **ON-SITE MENTOR:** Zion Basque
- **LOCATION:** SEFCOM Lab at Arizona State University

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**AMRIT S.**

**INSIDE THE BUSINESS OF CONVENIENT SERVICES**



**SUMMARY:** One thing people tend to take for granted is their ability to buy gas and a meal at any time of day. Millions of people use gas stations and eat at places like Chick-fil-A everyday, yet most do not know how these businesses function. How do employees maintain each gasoline pump? How do they prevent catastrophic events like a gas leak from occurring? And at a fast food restaurant, how is food served quickly? How much food is lost at the end of every working day? These are some of the questions that I addressed in my project, diving deep into exactly how these businesses are run. I worked closely with my mentor to learn more about how he's able to turn a profit every year against local competitors like Circle K and Burger King. I feel that it is important to identify and recognize the hard work that goes into running local gas stations and fast food restaurants. People may turn a blind eye towards these places, but it was interesting to learn more about services we rely on.

• **BASIS ADVISOR:** Paul Flores • **ON-SITE MENTOR:** Kushwant Sihota • **LOCATION:** Virtual

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**ENAYA S.**

**IS PERCEPTION ALWAYS REALITY? A HOLISTIC STUDY ON ALZHEIMER'S PATIENTS**



**SUMMARY:** Perception, which is how the brain interprets and creates the meaning of the world around us and ourselves, is one of the guiding factors in our lives. However, a realistic perception is not a privilege for patients with Anosognosia. Anosognosia is a neurological condition where patients have difficulties perceiving the severity of their own illness. It is prominent in many patients with Alzheimer's disease and memory loss. When studied, these patients either deny the effects of their illness, or their descriptions are vastly different from those of their caregivers. Not only are the lives of the patients heavily affected by Anosognosia in Alzheimer's disease; it also gives great burden to the caregivers and family members when caring for the patients. I researched at Arizona Neuropsychological Services, a neuropsychology clinic that provides assessments based on mood, personality, and cognitive abilities to determine a diagnosis and evaluate the health of the brain. I surveyed both patients and caregivers at this clinic to find discrepancies in the descriptions of the patient's life to see how Anosognosia affects the quality of life of the patient. This project addressed if Anosognosia in Alzheimer's disease positively or negatively influenced the quality of life of patients. I observed if a discrepancy of the reported symptoms affected the caregiver's ability to care. I also evaluated certain methods and resources that are used to improve the progression of memory loss in patients and to alleviate caregiver distress.

• **BASIS ADVISOR:** Dr. Merissa Remus • **ON-SITE MENTOR:** Dr. Jeannine Morrone-Strupinsky  
• **LOCATION:** Arizona Neuropsychological Services



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**ESHA S.**

**YOUTH VOTING**



**SUMMARY:** Every election, a wave of new voters is introduced to the polls. But why do people choose to vote? What is their motivating factor? Is it the candidates themselves or the policies they stand for? By looking into the different generations of voters through their zip codes, I examined how voters of varying age groups tend to vote. With this data, I was able to see how age, race, status, and education affect voter behavior. Tomorrow We Vote is a nonprofit organization located outside the Phoenix capitol building that is dedicated to registering new voters and ensuring voters are educated about upcoming candidates. With this data, my project predicts future voter tendencies and turnout.

• **BASIS ADVISOR:** Dr. Mitra Sahu • **ON-SITE MENTOR:** Brent Whiting • **LOCATION:** Tomorrow We Vote

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**MAYA S.**

**LEAD ISOTOPE VARIABILITY: THE ANALYSIS OF SHOTGUN PELLETS**



**SUMMARY:** Trace elements that are not correctly analyzed may lead to false conclusions in criminal cases. This mostly occurs in cases where multiple weapons were fired and law enforcement is not able to associate a bullet with a particular weapon. This research project evaluates the ability of trace elements and lead isotopes to compare evidence lifts, shotgun pellets, and pellet fragments in shooting investigations. By working with inductively coupled plasma mass spectrometry (ICP/MS), one can determine the variability between the shotgun pellets and compare these to bullet holes, ricochet marks, and other evidence lifts found at a crime scene. Examining the isotopic values of different metals found inside shotgun pellets may provide further analysis of the source and trajectory of the pellet as well as the other pellets from the same fired shot. As the hard impact of the pellets leaves behind metal fragments in bullet wounds or areas hit through impact, the analysis of the pieces can provide a deeper look into the life of shotgun pellets. My hope is that this analysis will ultimately give way for better testimonies regarding shotgun pellets as well as shotgun-related evidence found at crime scenes.

• **BASIS ADVISOR:** Ryan Yanashima • **ON-SITE MENTOR:** Dr. Gwyneth Gordon  
• **LOCATION:** Arizona State University

## MIHIR S.



### THE EFFECT OF MUSIC THERAPY ON COMATOSE PATIENTS

**SUMMARY:** Music therapy is a common practice for many patients suffering from a neurological disorder or disease. For instance, it is known to help patients with Parkinson's slowly regain motor skills, patients with dementia and Alzheimer's regain memory, and patients with epilepsy reduce the frequencies of epileptic episodes. In general, music has a great effect on the brain since it is known for affecting the activity of certain neurotransmitters, such as dopamine. However, reasons for this are unknown. With the hope of understanding the deeper effect of music on the brain, I partnered with Dr. Al Hasan, a neurologist specializing in epilepsy at HonorHealth, to ask the question of what extent does music affect our brains? Our focus was on comatose patients in the ICU, recording their stimulus-induced, rhythmic, periodic, or ictal discharges (brain activity) using an electroencephalogram. For our experiment, we had two controlled groups. With one, we recorded the brain activity of a normal day, with nurses coming in and out, along with visits from the patient's family. In the other control group, we blindfolded and covered the ears of the patients, trying to minimize the amount of activity stimulated in the environment. Finally, our experimental group had a playlist of classical music, including Western and Eastern classical music, played throughout the day while we recorded the brain activity. Comparing the data we obtained in all three groups, we were able to see music's impact on the patient's brain activity, and made conclusions about whether music could be used for treatment. The overall goal affiliated with this project was to learn more about music therapy, adding more data to preexisting data in the field, with the hope that this information could be beneficial for healthcare providers.

• **BASIS ADVISOR:** Ryan Yanashima • **ON-SITE MENTOR:** Dr. Yazan Al-Hasan • **LOCATION:** HonorHealth

## MONA S.



### LOOKING THROUGH ARTERIES: TRANSCRANIAL DOPPLER ULTRASOUND

**SUMMARY:** Acute stroke is the leading cause of disability and the second leading cause of death around the world. However, the Transcranial Doppler (TCD) Ultrasound, a painless and very useful test measuring blood flow that can detect strokes caused by blood clots, has limited usage in the field of neurology. Information on the role of the Transcranial Doppler Ultrasound in acute stroke care is not as readily available as it should be, thus, raising the question of its efficacy and utility. The TCD ultrasound is a noninvasive and quick way to monitor reperfusion (the process of restoring flow); however, impracticalities that have impeded its widespread use include its operator-dependent technique and its inadequacy of temporal windows (especially in female and elderly patients). Pieces of literature addressing the viable factors and impracticalities can be found in PubMed, Google Scholar, Cochrane, etc. Many articles displayed TCD's efficiency in assessing early recanalization in patients but also emphasize that its operator-dependency was a great limitation in the study. Thus, the objective of this study was to use previous research involving different clinical trials to successfully conclude the utility of the TCD ultrasound in acute stroke care. This study implemented an outcomes analysis using meta-analysis statistics to answer the question regarding its utility in an acute stroke setting not posed by other studies. Therefore, this research formed a new understanding of a different combination of techniques to help the TCD ultrasound become more widespread in stroke care and hopefully improve the likelihood of treatment success in acute stroke patients.

• **BASIS ADVISOR:** Ryan Yanashima • **ON-SITE MENTOR:** Dr. Oana Dumitrascu • **LOCATION:** Mayo Clinic

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## NANDITA S.

### DUCK DUCK DUCK! USING CHONDROID BONE TO EVALUATE AVIAN GROWTH RATES



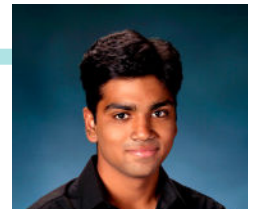
**SUMMARY:** Ducks are among the fastest growing species. But why is that the case? This project analyzed the effect of avian growth rates on tissue morphology. One way in which the fast growth rate of avian species manifests itself within skeleton tissue is through the formation of chondroid bone. Chondroid bone is a type of skeletal tissue prevalent in avian species that displays intermediary properties of both cartilage and bone. One key difference between cartilage and bone is that while cartilage can perform cell division through mitosis after cell differentiation, bone cannot. This project both examined the presence of chondroid bone and looked for mitotic capabilities within this tissue, therefore determining if chondroid bone is more similar to cartilage or bone in its proliferative capabilities. Understanding the properties of chondroid bone allows for further analysis into the growth rates of avian species. In order to conduct this research, I worked at Midwestern University's Research Center under Dr. Andrew Lee, Professor of Anatomy. I analyzed tissue samples from different duck specimens and tagged them with antibody markers through immunohistochemistry to determine if chondroid bone was present and capable of performing mitosis. This research into the mitotic capabilities of chondroid bone in duck species could lay the foundation for a future model examining growth rates in other avian species.

- **BASIS ADVISOR:** Dr. Merissa Remus • **ON-SITE MENTOR:** Dr. Andrew Lee
- **LOCATION:** Midwestern University –Virtual

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## PURVAJ V.

### UNCOVERING COMPLEXITIES OF CONGENITAL HEART DISEASES: INSIGHTS FROM GENETICS AND ENVIRONMENTAL RISK FACTORS FOR PARENTAL SUPPORT AND PREVENTION



**SUMMARY:** Congenital heart disease (CHD) is a fatal illness that affects around 1 in every 100 infants and is a leading cause of neonatal mortality. Although the causes of CHD are unknown, a mix of genetic and environmental factors are thought to play a role. CHD symptoms can range from minor structural deformities to severe cardiac anomalies, and treatments can range from medications to surgery. Identifying particular genetic factors associated with CHD might lead to better diagnostic procedures, targeted treatments, and better outcomes for afflicted infants. As part of my research project, I executed a case-control approach and sequencing, which can be used in genetic research to identify genetic polymorphisms linked to CHD. My research could possibly aid researchers in understanding the disease's underlying genetic origins and developing new diagnostics and treatments. By examining clinical data, genetic markers can also be utilized to predict the risk of CHD, identifying newborns at high risk of development and providing opportunities for early diagnosis. Prenatal genetic testing is crucial for infants with severe CHD, since early detection permits prompt treatment and effective prognosis, assisting parents in making informed decisions regarding their pregnancy and the child's health. The primary goal of this study was to achieve better outcomes for newborns and families impacted by CHD through advancement in genetic research and testing, identifying the fundamental causes, and enabling early intervention.

- **BASIS ADVISOR:** Ryan Carey • **ON-SITE MENTOR:** Dr. Scheller McLaughlin
- **LOCATION:** Phoenix Children's Hospital, Cardiology Department

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**RAMYA V.**



### **LOOKING BEYOND AGE: RISK FACTORS FOR ALZHEIMER'S DISEASE**

**SUMMARY:** When we hear the words memory loss, we have been conditioned to associate them with aging and declining mental capabilities. But what other factors contribute to Alzheimer's disease (AD)? Is it just age, or do environmental, genetic, and nutritional factors heighten our susceptibility to this disease in the future? To complete this project, I worked remotely with the ASU-Banner Neurodegenerative Disease Research Center, as they specialize in discovering new risk factors, biomarkers, and drugs for the detection and treatment of AD and related disorders. I read several studies conducted over the years to examine the extent to which genetic predispositions and exposure to different lifestyles and environmental elements have influenced the onset of Alzheimer's disease and to understand the mechanisms of how they operate. After analyzing and comparing the conclusions drawn by each of these studies, I wrote a comprehensive research paper to present my findings. According to a poll conducted by the Alzheimer's Association, over half of all Americans say mild cognitive impairment (MCI) sounds like "normal aging." This stems from a lack of awareness about how crucial early intervention is with respect to neurodegenerative diseases. Through this project, I hope to spread awareness for preemptive measures that could be taken to prevent this disease or delay its onset.

- **BASIS ADVISOR:** David Glosser • **ON-SITE MENTOR:** Dr. Paul Coleman
- **LOCATION:** School of Life Sciences at Arizona State University

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**ANNA W.**



### **LVST THERAPY AND ITS BENEFITS FOR ASD PATIENTS**

**SUMMARY:** LSVT BIG and LOUD therapy is generally used for patients diagnosed with conditions such as Parkinson's disease, cerebral palsy, or other types of disorders. However, as it is a relatively new approach to physical and occupational therapy, the effects of LSVT on patients with various disabilities is still being researched. However, not much research has been done regarding the effects of LSVT therapy for patients diagnosed with autism spectrum disorder (ASD). For my research, I interviewed both physical and occupational therapists at Spooner to develop a mock treatment plan for a patient with ASD, particularly focusing on LSVT BIG.

- **BASIS ADVISOR:** Nicholas Navarro • **ON-SITE MENTOR:** Tina Wilcoxson
- **LOCATION:** Spooner Physical Therapy Fountain Hills

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executive leadership of  
the BASIS Charter Schools  
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seniors for their perseverance**  
in their research, and for their  
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congratulations** to them for  
their achievements thus far,  
and these projects are only  
the beginning!





# Scottsdale SENIOR RESEARCH PROJECTS

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## ARPANA A.



### EFFICIENCY IN MEASURING CLONALITY IN CELLS WITH RETT SYNDROME

**SUMMARY:** Rett syndrome is a neurodevelopmental disorder that primarily affects young girls, caused by mutations in the MECP2 gene. This research project investigates the fibroblasts derived from Rett syndrome patients and the role of techniques PCR, qPCR, and RT-PCR to analyze clonal cell populations. The goal of this project was to advance our understanding of the molecular mechanisms underlying Rett syndrome and identify new therapeutic targets by exploring which mechanism is the most effective in accurately identifying clonal cell populations. Investigating the cells with Rett syndrome could aid in discovering a new biological pathway for this severe condition and provide insight on the molecular mechanisms of Rett syndrome.

- **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Sampath Rangasamy
- **LOCATION:** TGen Center for Rare Childhood Disorders

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## SHRIA A.



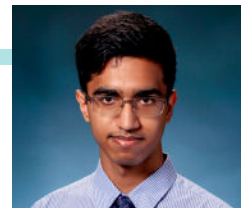
### INCREASING ACCESSIBILITY TO EXTRACORPOREAL CARDIOPULMONARY RESUSCITATION IN OUT-OF-HOSPITAL CARDIAC ARREST CASES: A COMPREHENSIVE PLAN OF ACTION

**SUMMARY:** Cardiac arrest, characterized by a sudden loss of heart function, is a public health crisis that affects over 356,000 people in the United States every year. Despite major advancements in public CPR training and defibrillation accessibility, the survival rate for cardiac arrest is still as low as 10%, according to the Sudden Cardiac Arrest Foundation. ECPR (extracorporeal cardiopulmonary resuscitation) is a procedure that combines CPR (cardiopulmonary resuscitation) and ECMO (extracorporeal membrane oxygenation). ECPR is expensive, invasive, and technically complicated, but in certain situations, this procedure could greatly improve the outcomes of patients with cardiac arrest. This project aimed to discover the steps that must be taken in order to standardize ECPR procedure and make it a more accessible treatment in out-of-hospital cardiac arrest cases. Some steps included standardizing ECPR eligibility criteria, ECPR settings, increasing public awareness and CPR training, and improving emergency services response times. Through a study of historical public health guidelines and current resources, this project proposed a comprehensive plan to expand the use of ECPR and help improve public health across the United States.

- **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Paul Bakerman
- **LOCATION:** Phoenix Children's Hospital Cardiovascular and Pediatric Intensive Care Units

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## RAHUL J.



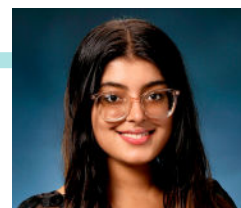
### VIABILITY OF TERT/TERC KNOCKOUT THERAPY AS TREATMENT FOR CANCER

**SUMMARY:** Around 10 million people die of cancer each year. As cancer stems from mutations on the genetic level, gene therapy presents itself as a promising treatment option. Physically testing each gene therapy through clinical trials would not only be exhausting and drawn-out; it would also be resource intensive. However, computational techniques using software to generate statistical models can be used to quickly map out and predict trends of specific genetic alterations, allowing for a quicker method of determining treatment efficacy. Using this technique, this project determines the efficacy of TERT/TERC knockout therapy as a treatment for cancer. TERT and TERC create hTERT and hTR, respectively, which are the two components of telomerase. Without the telomerase, the cancer cells will be unable to regenerate their telomeres, allowing for the gradual degradation of the carcinogenic DNA after every cell replication. This is especially effective in cancer as these cells replicate quicker than normal cells. This project involved using software to illustrate the DNA degradation trends in cancer cells affected by the TERT/TERC knockout therapy. The aim of this project was to provide more alternatives for cancer treatments to improve the lives and well-being of cancer patients around the world.

- **BASIS ADVISOR:** Ryan Yanashima/Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Radhika Vattikuti
- **LOCATION:** Arizona Endocrinology Center

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## SANAYA N.



### THE POLITICS OF ORBITAL DEBRIS

**SUMMARY:** Sputnik 1, launched in October of 1957 by the Soviet Union, was the accumulation of The Space Race, a vie for supremacy by two forms of government who sought to expand their domain of influence into the stratosphere—literally. Since then, more than 27,000 pieces of orbital debris, or “space junk,” have been identified and tracked by the Department of Defense’s Global Space Network (SSN), and many more are currently floating around the planet. Orbital debris, or “any human-made object about the Earth which no longer serves a useful function,” includes nonfunctional spacecraft, launch vehicle stages, mission-related debris, and fragmentation debris from Sputnik’s debut to the present day. Debris is a growing concern to the scientific community due to its increasing impact risk to existing and future space systems. Because of the high speed at which space debris circulates in Earth’s orbit, even tiny pieces can cause severe damage to operational spacecraft and satellites. Yet despite increasing discussions on space travel in recent decades, the pace at which companies like NASA are building removal devices needs to be faster. Some scientists contend that an effective debris removal plan requires policy action. As such, my research project focused on creating the best policies that can be implemented by the U.S. government to accelerate the clean-up of space debris.

- **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Matt Galuska
- **LOCATION:** Cassavant Machining Inc. (CMI)

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## MARIA L.



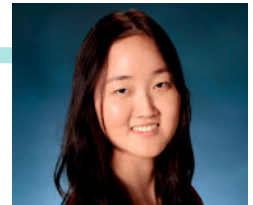
### **SPEAK WELL, SLEEP WELL: EVALUATING SLEEP HYGIENE AND ITS IMPACT ON COMMUNICATION SKILLS**

**SUMMARY:** Sleep impacts not only our physical health, but also our everyday behavior. While we do know that sleep has a substantial impact on our behavior and mental health, the exact scientific reasoning for it is still being studied. One aspect is communication. At the Children's Doctor, there are many regular patients between ages of 0-18 years that come in. I am surveying the parents of children from the age of 0-4 years old because the parents of this age group are accustomed to their children's sleep schedules and how their mood and communication skills are in the morning. The survey is 10 questions, implementing questions from the Pittsburgh Sleep Quality Index (PSQI). I am using questions from the PSQI because I have researched other sleep studies using this index as a reference to measure one's sleep hygiene. With this data, I hope to find a common underlying issue with the child's sleep hygiene and how that may have hindered their communication. With the varying age range, I have to modify the survey depending on the age because there are different stages of communication from the age of 0-4 years old. After the compiling of all this data, this helps promote better sleep habits by showing the value of sleep through its impacts of communication.

- **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Keramat Beshad
- **LOCATION:** The Children's Doctor

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## KATHERINE S.



### **FALLING OUT OF POSTURAL INSTABILITY: THE CONTRIBUTION OF SOMATOSENSATION TO STANDING BALANCE IN PARKINSON'S DISEASE**

**SUMMARY:** Parkinson's disease is the second-most common neurodegenerative disease in the world, affecting almost 1 million people in the United States. And these numbers are continuously increasing, as Parkinson's is one of the world's fastest growing neurological disorders. The disease is characterized by a progressive loss of motor and sensory control, resulting in symptoms like postural instability, impaired gait, tremors, and falls. Falls among people with Parkinson's are especially debilitating, as they can result in fracture risk, increased progression of the disease, and even death. However, current preventative strategies do not adequately target rehabilitation for falls. Previous research has found that the somatosensory system, consisting of tactile sensation (which is responsible for feelings of touch and pressure) and proprioceptive feedback (which is important in joint position sense), is crucial for reactive balance control. The primary goal of this project was to determine the unique contribution of somatosensation to standing balance in people with Parkinson's disease. Participants at the Gait and Balance Disorders Lab at ASU were asked to maintain their balance while standing on a treadmill and feeling vibrations underneath (to disturb tactile sensation) and on top of (to manipulate proprioception) their feet from coin-sized vibration devices. I also hoped to identify predictors of somatosensory impairment during standing balance. This could help determine how much worse or better people with Parkinson's were with tactile and proprioceptive manipulation. The results of this study could lay the groundwork for designing treatments that could improve balance control and prevent falls.

- **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Daniel Peterson
- **LOCATION:** Arizona State University

## SAHIL S.

### DEVELOPING SOLUTIONS TO HOUSING INACCESSIBILITY IN PHOENIX



**SUMMARY:** Since the Great Recession of 2008, which hit the Phoenix area particularly hard, housing prices across Arizona have climbed, pricing large numbers of people out of their homes. With property values rising, many residents are becoming priced out of their mortgages, which is uniquely concerning in a time of gentrification in urban areas. These circumstances place low-income and BIPOC residents most at risk of homelessness. Despite previous constraints being placed on it, racialized housing persists. Housing development in Arizona has been limited to metropolitan and suburban Phoenix, leaving urban Phoenix without adequate attention. To study housing inequality in the region, I used similar research methods as studies in Austria, Germany, and California. The purpose of this project was to link certain factors, such as investor sentiment, corporation involvement, subsidized housing, economic growth, and government attitudes towards housing, to changes in housing prices. To achieve this purpose, I examined policy passed by both the Phoenix City Council and the Arizona State Legislature regarding housing over the past three years. Through these inquiries, my research aims to answer the question, "Which factors are associated with fluctuating housing costs in urban Phoenix?"

• **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Yassamin Ansari • **LOCATION:** Phoenix City Hall

## TVISHA V.

### SHHHH! CHARACTERISTIC STUDY OF TRIGGER SYMPTOMS OF MORNING ONSET MIGRAINES AND THE RELATIONSHIP TO SLEEP



**SUMMARY:** Every night, the world scrambles to find a good night's sleep. Mothers are tucking in their children. Fathers are reading storybooks to their kids. Teenagers set their alarm clocks for school. Grandparents turn off the television before turning in for the night. In a matter of minutes, their brains shut off, leaving their body to reset for the morning. However, after three hours of waking up, many people experience intense waves of pain centered around the base of their skulls called migraines. In fact, migraines and sleep have always had a deep-seated connection, but the connection has always seemed to blur the lines of correlation. 35 million Americans suffer from migraines; 18% of men experience them in their lifetime, and 43% of women experience them. Migraines have no specific cause or origin. Many people often go undiagnosed for their entire lifetime. Almost 70 million Americans experience sleep disorders, the most common being insomnia. There is a direct correlation between insomnia and migraines. Frequently, patients that experience sleep disorder experience migraines. A bad night's sleep will cause migraines, and migraines cause a bad night's sleep. However, in clinical studies, there is a contradiction regarding the use of sleep regulation to improve migraine pain. There are statements about sleep being a way to help migraine sensitivity, and there are statements saying REM and Stage III sleep cause more migraines. The goal of my project was to reveal which stage of sleep can most improve migraine pain and sensitivity.

• **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Jill Rau • **LOCATION:** Arizona State University

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## CALISTA W.

### FRAME BY FRAME: ANALYZING YOUTUBE VIEWERS' ENGAGEMENT WITH ONLINE PHYSICS VIDEOS



**SUMMARY:** From universities to high schools, the tendency to drop out of physics as soon as possible has dominated the mindset of students across the nation. However, since understanding physics on a meaningful level is fundamental to furthering the scientific and technological development of modern society, educators have started searching for teaching methods that better engage students with physics. In particular, YouTube videos related to physics have been shown to increase students' engagement and interest in the subject matter being taught. To determine which characteristics of physics YouTube videos are most engaging to viewers, I created and implemented a program coded in Python that retrieved physics videos and their engagement metrics from the YouTube Data API. I conducted an analysis to identify which video aspects correlated most strongly with the highest number of views, likes, and comments for a given video. The implications of this study indicate a promising step for physics instructors to take toward improving students' perception of and interest in physics.

• **BASIS ADVISOR:** Shannon James-Kolodin • **ON-SITE MENTOR:** Dr. Peide Ye • **LOCATION:** Purdue University – Virtual

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## TRISTAN C.

### GREAT WORKS THEATRE: ADAPTING CLASSIC LITERATURE INTO AN ANIMATED MEDIUM



**SUMMARY:** What makes a work of fiction a classic? Is it the message contained within its pages? The characters? Maybe it's a certain immaterial something—heart. Or maybe it's simply the number of lives a book can reach. Every day, more and more kids are returning their books to the shelf and booting up their laptop onto YouTube, TikTok, and a myriad of other social media sites. The goal of my Independent Creative Project was to identify half a dozen culturally significant works of literature that have either fallen from the public zeitgeist or simply never reached a large enough audience, and translate them into the medium of animation. This series of colorful and eye-catching animations for YouTube represents the final project of my work, and may further the cultural outreach these great works are able to attain. Through my project, I explored the distinct and uncommon lenses of critical analysis as well and provided viewers with an introduction to more advanced literary analysis and critique. As an integral part of this project, I interned under the Director of Production at Ambient Skies, a local film company, who advised me on my burgeoning filmmaking skills on both an artistic and logistical level.

• **BASIS ADVISOR:** Bonne de Blas • **ON-SITE MENTOR:** Rebekah Nylander • **LOCATION:** Ambient Skies



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**SHAN B.**



## **EXAMINING THE EFFECTS OF PATIENT TREATMENT DURING TIME AT HOSPITALS**

**SUMMARY:** After the pandemic, the healthcare system has become a much more significant part of many people's lives. Vaccines and treatment for COVID have been crucial in helping people and have prevented significant further damage from happening. Although healthcare without a doubt has been extremely beneficial to most of our lives, there are still many ways that it can be improved. My project focuses on one of these ways, specifically proper etiquette around patients. How patients are treated is just as important as curing them when it comes to recovery, and patients with positive attitudes tend to be treated much faster than those without them. By working with Banner Health and ASU, I helped create a program where students can volunteer to immerse themselves in the healthcare system. While developing this program, a class in which students learn about the proper etiquette used in hospitals was also created. Through the classes and experiences that students will receive in this program, our goal is that the next generation of healthcare workers will have a better understanding of healthcare. And with this understanding, they will not only be able to treat patients in an improved manner, but also find new ways to innovate the healthcare system, making treatment improve in many ways.

• **BASIS ADVISOR:** Bonne de Blas • **ON-SITE MENTOR:** • **LOCATION:** Banner Health and ASU – Virtual



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