

Senior Projects

2022–2023



BASIS PHOENIX



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



Phoenix SENIOR PROJECTS

SIMONE B.



THE INTERRELATIONSHIP BETWEEN HERPETOFAUNA AND THE CHANGING ENVIRONMENT

SUMMARY: Herpetofauna is a term that collectively refers to the reptiles and amphibians inhabiting a certain region. Many reptiles and amphibians are keystone species and are relied on by other species. They fulfill multiple ecological roles in both aquatic and terrestrial ecosystems, including nutrient cycling, food web balancing, habitat modification, seed dispensing, and even pollination. As the environment becomes altered by global climate change and modernization, though, herpetofauna populations are affected in kind. After volunteering at the Phoenix Herpetological Sanctuary, the largest reptile sanctuary in the United States, I gained an interest in the conservation of these species and their importance to the world. This was the main idea behind my project: the interrelationship between herpetofauna and the environment, and the effect herpetofauna loss has on the ecosystem. I focused on rattlesnakes for this project. I interned at the Phoenix Herpetological Sanctuary to learn more about the species and the rattlesnake removal program, a service where people can call Sanctuary staff to relocate a rattlesnake from their property. I interviewed staff about the importance of having rattlesnakes in Arizona, how they have been negatively affected by mankind, and the process behind their relocation. By analyzing these results and their implications, I was able to draw more attention to the importance of herpetofauna and the use of education to clear misconceptions over more undesirable species. I also highlighted how the conservation of these species is integral to preserving the ecosystem, since they benefit not only other species but humans as well.

• **BASIS ADVISOR:** Wendy Sandor • **ON-SITE MENTOR:** Alex Roszkowski • **LOCATION:** The Phoenix Herpetological Sanctuary

VIVIAN C.



DOG AND CAT DIETS: OWNERS' PERCEPTIONS VERSUS PETS' NUTRITIONAL NEEDS

SUMMARY: Pets are beloved members of our families. However, we often feed our pets scoops of processed, store-bought kibble without a second thought. Is kibble sufficient? Some owners ask themselves this question and instead adopt homemade, vegan, or raw diets based on misinformed internet findings. Are these unconventional diets sufficient? The lack of understanding of pet diets among owners is demonstrated through a few statistics. For instance, ~45% of dogs and ~50% of felines between ages 5–11 are overweight. ~80% of dogs and ~50% of cats suffer from dental disease within their lifetime. Both are attributed to diets, particularly grains. The purpose of my research was to explore owner perception of pet diets and to understand aspects of the nutritional needs of dogs and cats, such as levels of kibble, grain-free diets, supplements, raw diets, and overweight pets. I also surveyed pet owners at Sugarloaf Veterinary Clinic who answered questions regarding their own pet's diet and ranked kibble and treat brands based on how healthy they believed it to be, judging brands only by the packaging. Based on these responses, I discovered what misconceptions owners have, and I used that as a guide for what topics to focus on in my research. Owners received a painting of their pet as an incentive to complete the survey. In the end, I summarized my research into an easily digestible guide to educate owners on their pets' nutritional needs and ultimately improve the health of dogs and cats.

• **BASIS ADVISOR:** Wendy Sandor • **ON-SITE MENTOR:** Dr. Amrit Rai • **LOCATION:** Sugarloaf Veterinary Clinic

SAMANTHA F.



EQUINE NUTRITION AND ITS EFFECTS ON COLIC

SUMMARY: Colic, one the leading causes of illness and death in equines, is acute abdominal pain caused by a gastrointestinal problem. Nutrition and environmental factors play a major role in both preventing colic and for overall health and wellness in horses. Horses have large, complex digestive systems with a small stomach and small and large intestines with many divots and crannies for food chunks to get lodged in, blocking the normal flow of digestion. If the impaction of food is not released then gas is produced, resulting in pain or colic. I've been working with horses for the last eight years and over time I've noticed how prevalent colic is. My own horses have had colic incidents that resulted in necessary veterinary treatment. Over the last two years, I've worked hard to rectify this situation by changing their diets and moving them to different boarding facilities. During my research, I observed potential colic incidents on farm calls with veterinarians and interviewed other veterinarians and barn managers. In the course of my project, I witnessed surgery and other forms of colic treatment. I then compiled a data set encapsulating each professional's opinion on the optimal diet for horses along with any supplements or routines (exercise schedules or environmental factors that should be minimized or maximized). My primary object was to decipher how horse owners can provide the best conditions and nutrition for optimal horse gut health and avert colic episodes.

- **BASIS ADVISOR:** Wendy Sandor • **ON-SITE MENTOR:** Kim Oest and Dr. Katheryn Browne
- **LOCATION:** Southwest Equine Hospital

MEGHANA G.



EUTHANASIA - BIOETHICAL ISSUE

SUMMARY: Euthanasia, also commonly referred to as physician-assisted suicide, stands as one of the top five current bioethical issues in modern healthcare. My research assessed several doctors' attitudes towards euthanasia through a complicated set list of 10 questions. This helped me further my previous research of analyzing bioethical articles which detailed the pros and cons of euthanasia. While some people believe a person should be willing to decide if they want to continue to live their life, others believe it is not in the best interest of a person since pain can be alleviated and "suicide devalues human life." Through my interviews I learned how euthanasia raises issues upon the professional versus ethical dimensions of the doctor-patient relationship, through using the five pillars of bioethics. Autonomy, non-maleficence, beneficence, fidelity, and justice are the five pillars of bioethics used to validate ethical issues. Although these ethical values don't directly address the right to be euthanized, it is important for medical expertise to help enhance their client's quality of life, respect their choices, and keep their confidentiality. Through my research, I have gotten differing opinions on euthanasia, which helped my audience understand how a physician's responsibility is to make more complicated decisions than just selecting the appropriate treatment and diagnosing injuries and illnesses.

- **BASIS ADVISOR:** George Baumgartel • **ON-SITE MENTOR:** Dr. Bradley Golner • **LOCATION:** Remote

HIMAJA J.



DEMYSTIFYING FANTASTICAL WORLDBUILDING

SUMMARY: Urban fantasy, a genre that explains the existence of magic and depicts the mythical coexisting with us, transports readers to the hidden world surrounding our own. Despite being integral to the genre, creating a world of the impossible among the ordinary poses quite a challenge. Given the overwhelming nature of the information surrounding creating an urban fantasy world, it has become difficult for aspiring writers to filter through, understand, and employ informative materials regarding urban fantasy worldbuilding. At its base, writing is a vague yet unique creative process, making it difficult to generalize completely. Therefore, it is necessary for informational sources to simplify the urban fantasy worldbuilding process to its core, conveying and explaining the most impactful elements of the fantastical world that matter to the reader. However, current public sources—articles and websites—are not providing this crucial detail, making the writer’s job even more tedious. Through this research project, I worked to uncover and compile my discoveries of critical worldbuilding element trends into a simplified electronic guide on middle-grade urban fantasy worldbuilding for aspiring writers. To create this online worldbuilding guide, I conducted an in-depth analysis of worldbuilding by searching for its trends in the first books of middle-grade urban fantasy bestseller series like Percy Jackson, Keeper of the Lost Cities, Artemis Fowl, and many more. Additionally, I interned under the book coaching company Truant Pen, where I developed an urban fantasy world, an engaging plot, and fleshed-out characters to build the plot outline for my own urban fantasy story.

• **BASIS ADVISOR:** Luke Morris • **ON-SITE MENTOR:** Samantha Cameron • **LOCATION:** Truant Pen, LLC

ETHAN K.



BENEFITS AND METHODS OF STEM LEARNING IN EARLY CHILDCARE EDUCATION

SUMMARY: This research project investigated the methods and benefits of STEM (Science, Technology, Engineering, and Mathematics) education in early childcare education. The project took place in the Pre-K (4-5 year-old) section of the Early Childcare Center of the Valley of the Sun Jewish Community Center, with students of diverse cultures, backgrounds, and personalities. This research project examined various educational approaches and disciplines to teach STEM subjects, including basic aspects of physics, chemistry, geometry, arithmetic, and engineering, to young children. Then, it assessed the impacts these educational approaches had on students' ability to retain information, focus during lessons, and solve problems. Lessons consisted of engaging demonstrations, hands-on activities, and basic Socratic-style discussions (e.g. baking soda and vinegar volcano or completing mock electrical circuits). Student enjoyment was emphasized to maximize their attention spans and increase the accuracy of the results. Data was gathered through rudimentary, age-appropriate surveys of students, as well as objective observations of the school environment and student behavior before, during, and after the project. The findings of the project contributed to a better understanding of the role of STEM education in the early years and the benefits it brings to young children's cognitive, social, and emotional development. Data from trials of different disciplines could inform the early childhood education community of which specific strategies may function best in their unique classroom. Overall, these results could inform and improve STEM educational programs and policies and provide a foundation for future research and implementation.

• **BASIS ADVISOR:** Johnson Trong • **ON-SITE MENTOR:** Amanda Watsky
• **LOCATION:** Valley of the Sun Jewish Community Center Preschool

HOLLYN K.



THE PREDISPOSITIONS AND THE RISK OF INJURY IN RELATION TO PEOPLE'S ANATOMICAL DIFFERENCES: WHEN INJURIES OCCUR IN FEMALES IN RELATION TO THEIR MENSTRUAL CYCLE

SUMMARY: The purpose of this senior research project was to explore the correlation between a woman's menstrual cycle and her susceptibility to athletic injury. Through a review of existing literature and data analysis, the study aimed to determine if a connection exists between the hormonal changes experienced during a menstrual cycle and an increased risk of injury through ligament tears, fractures, sprains, etc. in female athletes. The study employed a mixed-methods approach, utilizing both a survey of college athletes from a variety of sports and deeper research through past examinations. Through the comprehensive survey, the study gathered information on the personal experiences and perspectives of female athletes regarding the relationship between their menstrual cycle and athletic performance, including any changes in physical ability or injury risk. The research also gathered data from athletic trainers to determine their observations and understanding of the potential impact of the menstrual cycle on athletic injury risk. This research provides valuable insights into the experiences of female athletes and the understanding of the athletic training community on this important topic. Additionally, this research contributes to a growing body of knowledge that will help address any misunderstandings or misperceptions about the menstrual cycle and athletic performance, thereby promoting a better understanding of this complex relationship. Overall, this study has important implications for training and injury prevention, and has valuable information for not only female athletes, but athletic trainers and healthcare professionals working with female athletes as well.

- **BASIS ADVISOR:** Dylan Crane • **ON-SITE MENTOR:** Robert Dyson
- **LOCATION:** Paradise Valley Community College Athletic Training Center

NEHA K.



RELATIONSHIP BETWEEN ORAL HEALTH LITERACY AND DENTAL ANXIETY AMONG ADOLESCENTS

SUMMARY: Around 36% of people in the U.S. fear dental treatment, with 12% having extreme apprehension. Furthermore, about 3% of adults have dentophobia, which involves complete avoidance of visiting a dentist. With these staggering rates in mind, it's beneficial to comprehend the causes, correlations, and preventative measures for dental anxiety. The goal of this research was to examine if a correlation exists between oral health literacy and dental anxiety among adolescents in local schools and dental clinics. Dental anxiety and oral health literacy are significant topics to research because of their impact on everyday hygiene practices and healthy oral care. Dental anxiety can prevent individuals from seeking necessary dental care, leading to untreated oral diseases and potentially more severe problems in the future. Longer intervals between dental visits for dentally anxious people can lead to high hospitalization rates and higher mortality. Furthermore, low oral health literacy can also lead to inadequate understanding of how to properly care for one's teeth and gums, resulting in poor oral health. Understanding these issues and developing strategies to address them can help improve overall oral health and prevent future problems. This research project took place at Norterra Family Dentistry under the guidance of Dr. Matti. Through shadowing and understanding oral hygiene practices, I created an oral hygiene questionnaire to survey adolescents' current knowledge about oral health and their dental anxiety. Later, I conducted an educational session about the importance of maintaining good oral practices, discussing their dental fears, reasons for these fears, and tips for preventing them.

- **BASIS ADVISOR:** AJ Feffer • **ON-SITE MENTOR:** Dr. Rafed Matti • **LOCATION:** Norterra Family Dentistry

SAKSHI K.



NASA LUNAR GPS SERVERLESS APPLICATION

SUMMARY: Artemis I, the first lunar mission to the moon in half a century, was launched on September 3, 2022, marking the beginning of humanity's return to the moon since the Apollo missions. For my Senior Project, I contributed the Lunar Global Positioning System (GPS) to the effort for lunar exploration. This software will aid in lunar exploration once humans settle on the moon. Astronauts could use this application to help collect samples from research sites and control rovers to travel to more accurate locations. A notable feature of this application is that it is serverless. A server refers to an on-site machine that handles the back-end processes required by the front end. Front-end refers to the user interface and application design, while the back-end is the logic that powers the application behind the scene. In an application, multiple servers are often needed. To avoid the additional cost, complexity, and burden of maintenance, a serverless application was the optimal choice for this project. To create a serverless application, I used Amazon Web Services (AWS). For the overall program itself, the Lunar GPS functions similarly to well-known systems such as Google Maps, Apple Maps, etc. Functions of a GPS application include mapping, search, turn-by-turn navigation, and off-road navigation features. A GPS program calculates distance, the approximate time to get to a set location, and displays a map with directions. This Lunar GPS functioned similarly, except for limitations from technology due to the lack of satellites circling over the moon.

- **BASIS ADVISOR:** Duane Oakes • **ON-SITE MENTOR:** Heather Thomas
- **LOCATION:** Virtual with Johnson Space Center

RAVI M.



A NARRATIVE REVIEW ON INTERLEUKIN-1 INHIBITORS IN TREATMENT OF PEDIATRIC SEPSIS WITH ASSOCIATED HYPERFERRITINEMIA

SUMMARY: Sepsis is the leading cause of death in hospitals and the main cause of readmission into hospitals worldwide. With the World Health Organization reporting a contribution of one out of every five deaths each year, sepsis has made its mark in the medical literature. Sepsis is a severe condition of the immune system, caused by an unregulated host response to an infection, which leads to systemic inflammation followed by multiple organ dysfunction. Severe sepsis, also known as septic shock, is often fatal. First recorded in Ancient Greek writings, sepsis has long puzzled early physicians and scientists. Since the development of Germ Theory in the mid-19th century by Louis Pasteur, physicians have continued to develop new treatments. However, the treatment of sepsis has been the same for the past 40 years, with currently-used therapies of antibiotics, infection source control, fluid resuscitation, and vasopressors recommended in the literature dating as far back as 1970. With children being one of the more susceptible groups, sepsis is being carefully studied in pediatric clinical settings in hopes of finding key data in clinical and translational research. My Senior Project compiled findings in the medical literature into a systematic review of current research on using interleukin-1 receptor antagonists (namely Anakinra and Canakinumab) in treating sepsis in the pediatric ICU setting. My findings will potentially help many children diagnosed with sepsis and guide physicians on targeted anti-inflammatory therapies in treating severe sepsis.

- **BASIS ADVISOR:** Amy Anderson • **ON-SITE MENTOR:** Dr. Keith Sacco • **LOCATION:** Phoenix Children's Hospital

VEDHA N.



BIPARTISAN SOLUTIONS TO COMMUNITY VIOLENCE

SUMMARY: In 2022, there were 647 mass shootings in the United States. The number of innocent victims who succumb to mass shootings continues to grow not yearly, not weekly, but daily. There are various methods to prevent community violence, including educating the public on how to prevent community violence and protect themselves during an act of violence and changing the legislation regarding guns itself. With the increasing amount of mass shootings across the country, most notably the recent Uvalde shooting, protecting the innocent public should be of utmost importance to our lawmakers. Unfortunately, due to the wide ideological divide in legislatures, both local and national, throughout our country, no progress is being made towards building legislation regarding gun control. My goal with this project was to provide some assistance to our legislators so that a compromise can be made and communities can be kept safe. By researching local policies, I came up with a feasible solution to keep people safe and keep guns out of the hands of dangerous criminals on a state and local level. Nationally, it was quite difficult to come up with a bipartisan solution to gun violence specifically, so I proposed bipartisan legislation that focused on preventing community violence in general. This portion of my research project focused on measures to prevent violence within communities, such as raising awareness about bullying in schools to stop the possibility of violence at its root cause. Additionally, gun violence and mental health are interconnected, as many mentally ill individuals who are left untreated are responsible for many acts of mass violence. By focusing on the legislation behind preventing community violence on a national level and gun violence on a local level, I hope to protect lives.

- **BASIS ADVISOR:** Clifton Chandler • **ON-SITE MENTOR:** Jerald Monaham
- **LOCATION:** Yavapai College Justice Institute

KARISHMA S.



THE INFLUENCE OF GEOCHEMISTRY ON THE ABUNDANCE OF ANTIBIOTIC RESISTANCE GENES FOUND WITHIN MICROBIAL COMMUNITIES IN PEATLANDS OF THE AMAZON BASIN

SUMMARY: Tropical peatlands are globally important carbon reserves. They are ecosystems where primary plant productivity exceeds organic matter decomposition, resulting in the accumulation of soil organic matter. The Pastaza-Marañón Foreland Basin (PMFB) in Peru is home to a large expanse of tropical peatlands in the Amazon basin and represents 8.3% of the stored organic carbon (SOC) in global tropical peatlands. The PMFB peatlands, however, are expected to shift from being a carbon reserve to a carbon source in response to the warming climate. Microorganisms in these soils are responsible for breaking plant biomass down into greenhouse gasses (CH_4 and CO_2). Warmer climates will result in dryer environmental conditions and expand the dry season when microorganisms are most active, increasing the peatlands' release of SOC. In their fight for survival, these microbes produce antibiotics to disrupt the physiology of their competitors, ultimately determining which microorganisms survive and comprise the PMFB's microbial communities. This project identified and quantified antibiotic resistance genes (ARGs) from 24 metagenomes (DNA of all microbes) of 3 geochemically distinct peatlands in the PMFB. Novel bioinformatic techniques were employed to assess the influence of geochemistry on ARG diversity and frequency. They revealed that ARG classifications antibiotic inactivation, methyltransferase, and nucleotidyltransferase are strongly impacted by geochemistry. In addition, potential interactions and associations among the PMFB microbes and ARGs were examined to discern how antibiotic resistance influences the microbial community. Understanding the factors that regulate community member abundance will assist in predicting how the PMFB ecosystem will respond to climate change.

- **BASIS ADVISOR:** Brittany Holtzman • **ON-SITE MENTOR:** Michael Pavia
- **LOCATION:** Cadillo Lab, School of Life Sciences, Arizona State University

SRIYA S.

RETROSPECTIVE STUDY OF DRUG INDUCED INTERSTITIAL LUNG DISEASE IN BREAST CANCER PATIENTS AT MAYO CLINIC FROM 2018–2023



SUMMARY: Breast cancer is one of the most common cancers globally. In the United States, there is a one-in-eight chance that a woman will develop breast cancer in her lifetime. In recent years, many targeted therapies including trastuzumab have been developed, significantly improving treatment outcomes. These new treatments, however, come with risks and they must be monitored to prevent fatal consequences. One example is the increased risk of developing treatment-related interstitial lung disease (ILD) in breast cancer patients. ILD describes a large group of disorders that progressively scar lung tissue. Characterized by dry coughs and shortness of breath along with other non-specific symptoms, ILD is tough to discriminate among different respiratory issues. It may be life-threatening for some patients and result in suspending treatment. The goal of this study was to determine the incidence of drug-induced ILD (DIILD) in patients who have received treatment for breast cancer at Mayo Clinic. We used this information to ascertain the time it took for patients to develop DIILD and their most recent line of treatment that could have caused it. I worked with Dr. Fanous and Dr. Zamora-Martínez, pulmonary doctors at Mayo Clinic, to collect data from breast cancer patients diagnosed with ILD or pneumonitis. Analyzing the data helped us identify correlations between the usage of certain drugs and the incidences of DIILD as well as factors that predicted its occurrence.

• **BASIS ADVISOR:** Wendy Sandor • **ON-SITE MENTOR:** Dr. Zamora-Martínez • **LOCATION:** Mayo Clinic

ANNA T.

THE ORIGINS OF SKIN IRRITATION AND IDENTIFYING KEY INGREDIENTS AS A GUIDE TO CHOOSE THE BEST MOISTURIZER FOR YOUR SKIN



SUMMARY: Skin irritants and allergies have become a growing concern in recent times, with a significant increase in individuals experiencing symptoms such as redness, itching, and rashes. The origin of these irritants can stem from environmental factors, genetic predisposition, and exposure to certain chemicals. For this project, I identified skin irritants and researched how an individual becomes sensitive to ingredients over time. Research has shown that sensitivity to certain ingredients can develop over time through repeated exposure to allergens, resulting in a heightened immune response. The rising issue is that many moisturizers are labeled “for sensitive skin,” but still irritate sensitive skin. To address this growing concern, there is a need for the development of skincare moisturizers that are gentle and safe for sensitive skin. This requires a thorough understanding of the skin’s physiology and the role that various ingredients play in triggering skin irritation. The development of hypoallergenic and all-natural skincare products is crucial in reducing the incidence of skin irritation and allergies. This was a self-motivated project because I struggle with finding a moisturizer suitable for my skin. Within my research, I surveyed clinical patients to investigate how many people struggle with finding the right skincare product. In conclusion, the research project was designed to shed light on the origins of skin irritants and their impact on individuals. Individuals with sensitive skin can benefit from improved quality of life through skin sensitization and effective skincare products.

• **BASIS ADVISOR:** Jen Smetanick • **ON-SITE MENTOR:** Dr. Linda Som and Dr. Andy Le
• **LOCATION:** Arizona Medical Clinic

HARINI T.



TARGETING NUCLEOTIDE EXCHANGE TO INHIBIT CONSTITUTIVELY ACTIVE G PROTEIN ALPHA-SUBUNITS IN CANCER

SUMMARY: A few decades ago, cancer was incurable. It was a death sentence. Then came chemotherapy, surgery and many more. After they became insufficient, targeted-combination therapy came into play but the cancer cells currently are building resistance against the drugs administered. Hence, this project focused on finding a compound that targets nucleotides such as ATP and GTP, a key part of metabolic pathways in cancer cells. The highlight was on the function of the nucleotides in the G-protein pathway, as mutations in the Gα subunits cause the proliferation of multiple types of neoplastic cancers. A series of assays were conducted to test the effectiveness of possible compounds that halt the regeneration of these nucleotides from their inactive state, ADP and GDP, respectively. Another component looked for was that the compound affects the G-protein pathway cascade in cancer cells but not the wild-type. After extensive screening, a drug was found effective. This was an antipsychotic drug that could be reused, so further validation was required to confirm a direct impact of the drug to the G-protein pathway. Several western blots and other experiments were conducted to form a direct correlation between the drug, the G-protein pathway, and tumor necrosis. This research was conducted at TGen with the compounds of their libraries to advance the process of finding a long-lasting therapy for cancer.

- **BASIS ADVISOR:** Amy Anderson • **ON-SITE MENTOR:** Sydney Adamson and Shelby Rheinschmidt
- **LOCATION:** Translational Genomics Research Institute (TGEN)

VARUN V.



DETECTION AND ANALYSIS OF GRAVITATIONAL WAVES

SUMMARY: Over a century ago, Albert Einstein postulated a model of the universe in which spacetime was analogous to a flexible fabric capable of distortion. Vibrations in this fabric were what he termed gravitational waves, caused by massive celestial objects that were involved in decaying orbits or collisions. However, detecting these disturbances turned out to be difficult, and he would pass away in 1955, doubting the validity of his own theory. After decades of attempting to prove Einstein correct and detect these elusive waves, physicists unveiled the Laser Interferometer Gravitational-Wave Observatory (LIGO), which consists of a sensitive array of lasers and mirrors to pick up the tiniest spacetime disturbances. Accompanying this hardware is a plethora of measures to eliminate all other disruptive factors, leaving gravitational waves as the only possible trigger to set off the detector. Which is exactly what LIGO scientists would experience one September morning in 2015, discovering the cosmic message-in-a-bottle humanity was waiting for, one that Einstein saw coming before anyone else. Over a billion lightyears away, two black holes collided in the most powerful explosion ever witnessed, second only to the leftover radiation of the Big Bang. Acknowledging this initial victory, this project involved collaboration with the Texas Tech University Department of Physics and Astronomy to review multi-messenger sources, investigate the methods through which genuine gravitational wave detections are separated from unrelated stimuli, and study how the resulting observations can be interpreted to draw conclusions on the source of the signal.

- **BASIS ADVISOR:** Ahmad Khayyat Jafari • **ON-SITE MENTOR:** Corey Bradshaw
- **LOCATION:** Department of Physics and Astronomy at Texas Tech University



Phoenix SENIOR RESEARCH PROJECTS

SHANKAR C.



ANALYZING THE SENTIMENT OF TWEETS REGARDING SUSTAINABILITY PRACTICES TO PREDICT STOCK PERFORMANCE

SUMMARY: In recent years, sustainability has entered the mainstream consciousness of citizens, policy makers, and companies across the globe. A key factor of sustainability in the investing world is ESG (environmental, social, governance) scores that demonstrate how sustainable the actions and decisions of a company are for employees, shareholders, and the ecosystem. In the United States, there has been a political divide in ESG values as investors seek to balance their drive to maximize shareholder value and also promote positive change in society for all stakeholders. One platform this debate has occurred on is Twitter, where users express their opinions on various companies. I analyzed the sentiment of users' tweets on companies that have been regarded as sustainability leaders and companies that are laggards in this area. My analysis was completed through the Python coding language, a programming language designed for statistical computing and graphics. The sentiment data was then compared with the stock performance trends of these respective companies during specific time frames of high Twitter activity to determine if there was a correlation. Ultimately, I sought to determine whether social media has a significant influence on the stock market and whether that will play a large part in driving sustainable change, which will improve the environmental and social consciousness in the United States. Future research can identify what specific ideas or principles regarding sustainability are most widely discussed on Twitter and how this in turn relates to the decisions that companies make on key public policy issues.

- **BASIS ADVISOR:** Amy Anderson and Bryce White • **ON-SITE MENTOR:** Dr. John Almasan
- **LOCATION:** TIAA Financial Services

TARANNUM F.



DETERMINING SPATIAL ABILITY IN HEARING SIGNERS

SUMMARY: There exists research in which deaf signing children have been proven to experience enhanced spatial cognition compared to hearing children who don't sign. This phenomena occurs due to the spatial nature of sign language, which is a visual-gestural language. Some hearing individuals learn sign language, such as American Sign Language interpreters and parents of deaf children. My research sought to determine whether hearing adult signers who did not learn sign language as their first language (non-native signers) could exhibit enhancement to their spatial cognition through a spatial reasoning test. Future research may delve into participants who produced results that demonstrate enhanced spatial cognition compared to hearing individuals. Learning sign language can be used as a means to improve spatial cognition among individuals whose spatial cognition is deteriorating (e.g. individuals with ASD, Asperger's, cerebral palsy, etc.).

- **BASIS ADVISOR:** Amy Anderson • **ON-SITE MENTOR:** Ashley Martin • **LOCATION:** Harmony Project Phoenix

SIDDARTH VENKAT J.



ANALYZING QUASI-SEGREGATION IN THE HOUSING SECTOR VIA RESTRICTIVE COVENANTS AND ZONING

SUMMARY: Racial discrimination is one of the most prevalent problems in society today. Minority populations, especially African Americans, have experienced different treatment in several sectors of society, including access to healthcare, employment, politics, and more. A commonly overlooked sector where discrimination is highly prevalent is the housing sector. The private housing sector creates an industry laden with loopholes and regulations that allow for discriminatory practices to continue even with legal pushback. These kinds of practices result in cities where pockets of minority communities form, often with severe pollution, poor schooling, and limited access to services—termed “quasi-segregation.” Current research attributes the growth of quasi-segregation primarily to income disparities, different job locations, and predatory practices. This research looks to explore a different cause of quasi-segregation: restrictive covenants backed by zoning ordinances. Restrictive covenants originated in the early 1900s to preserve the value of land and the area around it. In practice, however, they’re often employed to prevent certain races or ethnicities from living in certain areas to preserve land value. Zoning codes and ordinances were implemented on a broader scale to define how property in specific geographic zones can be used. Similar to restrictive covenants, zoning codes often found ways to restrict by race, but minimal research exists on how local restrictive covenants may impact a city’s zoning. This research focused on the correlation between the restrictive covenants and zoning codes in the Davis Estates community, a subdivision of Worthington, Ohio, and explored ways to address the problem both locally and nationally.

- **BASIS ADVISOR:** Amy Anderson • **ON-SITE MENTOR:** Glennon M. Sweeney
- **LOCATION:** The Kirwan Institute for the Study of Race and Ethnicity at Ohio State University

ASHMIN O.



HOW CAN THE TURBOJET ENGINE MODEL BE MANIPULATED TO ACHIEVE FLIGHT ON VARIOUS PLANETARY SYSTEMS WITH DIFFERENT ATMOSPHERIC CONDITIONS COMPARED TO EARTH?

SUMMARY: In the past decade, space exploration was heavily focused on surface exploration through rovers and other land-based vehicles. However, recently NASA has been pushing towards more aerial exploration on different planetary systems. This is a huge challenge because of the varying atmospheric conditions and chemical compositions of different planets. The Ingenuity Drone on the Perseverance rover took flight on Mars in 2020, becoming the first power drone to fly on a different planet. While this drone marked the first step towards advancing space expeditions with aerodynamics and the idea of flight on other planets, this was certainly a challenging project. In addition to making improvements to the current model, there are many other planets that could be used to test for planetary flight. This is an important gap because even though the idea is present, there are many planets with different atmospheres still left unexplored. This research focused on modifying the existing turbojet engine model in regard to different atmospheric conditions such as pressure, temperature, etc., with a goal of creating a new model that could be capable of flying on other planetary systems. This was completed through coding in MATLAB, which is a reliable programming language used in the aerospace engineering field. The findings of this research provide insight into the possibility of exploring many other planets, allowing for further space exploration.

- **BASIS ADVISOR:** Amy Anderson • **ON-SITE MENTOR:** Akash Joseph
- **LOCATION:** BASIS Phoenix and Virtual Embry Riddle Connection



Phoenix

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