BASIS WASHINGTON, D.C. SENIOR PROJECTS 2021–2022



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

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

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

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

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

Carolyn McGarvey Chief Executive Officer

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BASIS.ed AZ+

Peter Bezanson Chief Executive Officer

BASIS.ed Texas



TUBA B.

HARNESSING FUSION ENERGY THROUGH PLASMA CONTAINED BY HIGH TEMPERATURE SUPERCONDUCTING MAGNETIC TOKAMAKS



ABSTRACT: Fusion is the process of "light" elements, such as hydrogen, combining to form "heavier" ones, such as helium. This process already naturally occurs in the universe, even in our solar system - the sun. As these elements fuse, large amounts of energy are released. Fusion energy provides a new avenue of technology that is virtually unlimited and carbon-free and has a very light footprint. In my research I intended to answer the question of how the plasma that produces this energy would be stabilized in the SPARC device, a high temperature superconducting magnetic tokamak, and how this energy will be efficiently integrated into the power grid. I explored this developing technology at the MIT Plasma Science and Fusion Energy Center, where I created a "how to guide" to understanding fusion for the general public. By studying the physics and engineering behind the SPARC device, I wrote a paper detailing the current problems and possible solutions being explored. In addition, I developed a visualization model for potential materials to be used in the SPARC device structure in order to gauge their effectiveness in containing the plasma.

- BASIS ADVISOR: Sidi Maiga ON-SITE MENTOR: Dennis Whyte
- LOCATION: MIT Plasma Science and Fusion Center

AYA H.

THE ETHICS BEHIND LOBOTOMIES IN EARLY MEDICINE



ABSTRACT: Between the 1940's and 60's, mental asylums took in patients with issues varying from simple temper tantrums to those with seriously detrimental mental illnesses. Despite the varying levels of mental illness, treatment of patients was relatively similar. The methods of treatment bordered on torture, and medical professionals were more concerned with keeping patients sedated and manageable than treating and rehabilitating them. Throughout my project, I wondered how procedures and treatments with such a low success rates were allowed to continue in practice for over a century. By using both fact-based fiction and firsthand accounts of people who experienced mental asylums of the time, I questioned the motives of the nurses and doctors employed at these hospitals and how the government was able to turn a blind eye on procedures that ignored patient autonomy. During my internship, I aided a subcommittee of the Ways & Means Committee to further research Medicare's role in addressing the mental health crisis exacerbated by the ongoing COVID-19 pandemic and helped develop legislation to increase access to mental health care. Through the comparison of how modern health care legislation develops and research on procedures of the past, I was able to evaluate how treatments without a clear success rate were allowed to continue in practice for such a long period of time without government interference.

• BASIS ADVISOR: Laura Webster • ON-SITE MENTOR: Amy Hall • LOCATION: House of Representatives

JONAS H.

LATIN LANGUAGE EVOLUTION OVER TIME



ABSTRACT: As a longtime student of Latin, I was fascinated with the mechanics of etymology, particularly how English words were derived from their original Latin roots. As such, the primary goal of my project was to explore the evolution of language through the transformation of various Latin dialects into the Romance languages. Specifically, I examined various texts written in Classical Latin, Late Latin, and the earliest forms of the Romance languages to determine what regional factors characterized the differentiation of Latin across geographical lines. I also explored the pertinence of Vulgar Latin in the development of the Romance languages as well as contemporary and modern perceptions of what constitutes this type of Latin. Finally, by contributing to Haverford Professor Bret Mulligan's online lemmatization resource, the Bridge, I honed my proficiency in identifying the etymological root of Latin words to better analyze the etymology of unfamiliar Late Latin/Early Romance words.

• BASIS ADVISOR: Maureen Beabout • ON-SITE MENTOR: Bret Mulligan • LOCATION: Haverford College

CADEN K.

THE EFFECTS OF EARLY STEM EXPOSURE ON CAREER INTEREST



ABSTRACT: As technology imposes an ever-stronger influence on our daily lives, the STEM workforce will need a new generation of competent, curious, and passionate individuals. Colleges are perfectly capable of offering students a comprehensive education with respect to robotics, computer science, and engineering that will be needed to advance the STEM field in the future. However, individuals who may have incredible potential in this field may never have exposure to the fundamental building blocks during their primary education. Notably, underrepresented students and poorer communities often don't have access to robotics and computer science courses that have pricey expenses associated with them. As a result, the workforce is extremely homogenous which stagnates innovation and equity in goods and services. I researched how placing these minority students in a STEM environment can influence their career aspirations as well as build essential communication and teamwork skills. For the internship portion of my project, I worked for Capital City Robotics as a program mentor, which gave me first-hand experience engaging with the students on whom my project was focused. Each week, I developed a "lesson plan" of sorts and led a group of young children in a robotics course that gave them fundamental exposure to core concepts in STEM. Throughout my internship, I performed a qualitative longitudinal study to derive quantitative data points that gauged the impacts of STEM exposure at a young age on future career interest and the effects of cooperative educational programs on self-efficacy. In my final research paper, I discussed the results of my study, going into detail on the ways in which the robotics course shifted the career aspirations of the children. Additionally, I explored how the collaborative environment of STEM programs could build "soft skills" like teamwork and leadership, using my experience as a mentor to observe these developments first-hand throughout the course. Finally, I examined significant causes behind the inherent lack of equity in access to STEM programs and potential courses of action to improve said equitability.

• BASIS ADVISOR: Nathaniel Green • ON-SITE MENTOR: Ryan Daza • LOCATION: Capital City Robotics

TAYLOR K.

QUANTUM PHYSICS AND THE BRAIN



ABSTRACT: Physics and mental health advocacy have always fascinated me, so I found a way to combine the two. My goal was to understand how physics and mental health were related and how we can use the information on physics and the brain to develop better treatment and advocacy strategies. I read several academic articles to gain a greater understanding of the use of mathematical models behind quantum physics to map out the brain. Understanding these relationships allows us to better predict decisions and even mental illnesses. I dove deeper into which mental illnesses can be predicted as well as how quantum physics can be used to explain anosognosia. Through my internship, I developed an understanding of how we can use this information to actually help those struggling with mental illnesses. I worked on weekly blogs with a younger target audience to educate on early signs of mental illnesses as well as the importance of having open and healthy conversations to try and eliminate the stigma. I created fact sheets and other resources to continue the education about serious mental illnesses for younger people.

- BASIS ADVISOR: Laura Webster ON-SITE MENTOR: Lisa Dailey and Elizabeth Hana
- LOCATION: Treatment Advocacy Center

NATHANIEL L.

THE INFORMATION CRISIS: SHOULD JOURNALISM BE REGULATED?



ABSTRACT: The intersection between press and politics has always fascinated me, and my internship with the National Press Club Journalism Institute allowed me to explore this further. The goal of my project was to research the role of journalism in democracy, examining the positive and negative effects absolute freedom of information can have in maintaining a stable society. Since there are many mediums of journalism, I focused my attention on photojournalism as a singular vessel of the dissemination of information. I examined what can be defined as journalism and how journalism has changed in the internet age, as well as the implications of this change on the regulation of information and journalism. In doing so, I explored the idea of regulating the dissemination of information while preserving the intent of the First Amendment and its international counterparts. I endeavored to define journalism in a world where modern technology has blurred the line between opinions and facts and between journalists and citizens. At the National Press Club Journalism Institute, I assisted in planning programs, including panels and speakers, as well as documenting their work through photography and other media. I conducted interviews which ultimately took the form of published Q&As and tip sheets on the Institute website and newsletter. Ultimately, my work there had the goal of advancing press freedom.

• BASIS ADVISOR: Nicole Felmus • ON-SITE MENTOR: Julie Moos • LOCATION: National Press Club Institute

CHAPIN M.

HOW ANIMALS HEAL FROM TRAUMATIC INJURIES



ABSTRACT: Axolotls are a type of amphibian that have incredible regenerative properties. These animals are able to regrow all of their limbs, some organs, and even parts of their brains. While humans have some regenerative properties, such as regrowing skin after a cut or scrape, the regrowth of limbs and organs is, currently, impossible. Biomedical engineers have tried to combat humans' poor regenerative properties with prostheses. However, by researching the way that axolotls and other amphibians are able to regrow so much of their bodies, scientists and biomedical engineers have been able to use that information to advance the prosthetics field. The continuous research of animals with extreme regenerative properties may even lead to the ability of humans to regrow limbs or organs one day. This ability would be incredible for those who have been seriously injured, or those born without a certain part of the body. During my senior project, I focused on this research in order to further understand the way that animals regenerate. I was also able to work with the District Veterinary Hospital where I observed how animals heal first-hand. Using all of the knowledge I have gained over these past two months, I have created a presentation that helped to further explain how animals are able to regenerate so much better than humans, restated some of the research I have been reading in layman's terms, and addressed the current ideas that scientists have about regenerative medicine and how those ideas can be advanced using the knowledge we have of axolotls.

• BASIS ADVISOR: Elana Horowitz • ON-SITE MENTOR: Erika Martin • LOCATION: District Veterinary Hospital

CRISTIAN M.

THE IMPACT OF COVID-19 ON SMALL BUSINESS



ABSTRACT: My parents started their small renovation business in 2001 and I realized immediately that small businesses establish a closer relationship with the community because they adapt to the needs and wants of their location. However, there was a larger gap forming between small businesses and large businesses, so I believed it was important to understand its effect on the local economy. My senior project helped me answer the questions of how environmental factors play a role, what financial issues have to be considered, and the legal issues involved in running a small business. I had previous experience working with my parent's business in the office, but the majority of my research was academic research as well as observations of the operation of the small business at which I interned. My internship allowed me to get first-hand experience with clientele as well as the problems they face on a day-to-day basis. I consulted employers and asked questions regarding competition and keeping up with larger companies who have more resources. I discussed what their relationship was with banks and loans. My research indicated that the environment in which a business operates plays a significant role.

• BASIS ADVISOR: Joey Zara • ON-SITE MENTOR: Vanessa Miranda • LOCATION: Miranda & JSC Renovations

HANNAH M.

CLIMATE CHANGE VS PHOTOSYNTHESIS: THE RACE OF PLANT ADAPTABILITY IN AN INCREASINGLY INHABITABLE PLANET



ABSTRACT: Climate change continues to be the single biggest health threat facing humanity, according to the WHO. The associated severe weather, changes in precipitation patterns, increasing levels of carbon dioxide, and reduction of water availability could have catastrophic effects on food availability and result in significantly reduced agricultural productivity. In trying to understand what solutions can be implemented to mitigate the impact of climate change, I studied how Microalgae's ability to photosynthesize is adapting to climate change. Photosynthesis serves as the main source of oxygen in the atmosphere, ensuring that oxygen-requiring life can survive and carbon-cycling can occur. Additionally, photosynthesis is the main source of biological CO2 fixation (conversion of inorganic compounds to organic compounds) and is responsible for fixing 20 times more CO2 than what humans are rejecting. As our planet increasingly experiences various environmental fluctuations, including those of light, CO2 availability, temperature, and drought, photosynthesis is forced to adapt to these changes. By leveraging tools like CRISPR (used for genome editing), we can make mutations on genes thought to be important, in turn understanding which proteins are advantageous for photosynthetic organisms, like algae, to survive in future harsh/stressful environments. From this, we can evaluate how photosynthesis can be enhanced in the future.

- BASIS ADVISOR: Nathaniel Green ON-SITE MENTOR: Adrien Burlacot
- LOCATION: Carnegie Institution for Science

ALEXANDER O.

AFRICAN-AMERICAN PLAYERS IN BASEBALL



ABSTRACT: Baseball has been my favorite sport since I was six years old, but my continued fandom and participation in the game hasn't always felt particularly welcome or common, and, unfortunately, my experience is shared among many African-American children and teenagers throughout this country. In 1981, the percentage of African-American players in baseball was 18.7%. Forty years later, the percentage is 7.7%. The reasons behind this precipitous decline have long mystified me, and, because of my senior project, I was able to research the topic and identify the primary causes and potential solutions. I conducted interviews with a baseball journalist, historian, and professional player who have reported on, studied, and experienced the issue first-hand. In my internship, I worked with the National Press Club Journalism Institute. During my eight weeks, I combined my interest in furthering my journalistic skills with my desire to research an issue I had long wished to study. I developed educational programs for journalists to attend, and I participated in similar programs that informed some of the skills I used to conduct my research and interviews. I produced content for the Institute's newsletter and wrote online articles for the website which demonstrated my intersectional passion for sports, identity, and journalism. My research found that, in order to make Major League Baseball a more reflective representation of our nation's demographics, the MLB must finally correct its century's worth of exclusionary and racist policies and culture and make a serious effort towards combating the underlying socioeconomic disparities plaguing youth participation in the game today.

• BASIS ADVISOR: Nicole Felmus • ON-SITE MENTOR: Julie Moos • LOCATION: National Press Club Journalism Institute

KALEB P.

IS AVIATION GOOD FOR THIS WORLD?



ABSTRACT: I have loved aviation since I was a child. Airplanes, helicopters, basically anything flying fascinated me. To further root me into the aviation community, I began taking flying lessons in 2019 and have, so far, attained my private pilot's license. Taking flight lessons led me to pose the question: Do the benefits of aviation outweigh its harms? While it has increased the interconnectedness of and revolutionized the world, it has also been a primary contributor to global warming. To help answer this question, I worked under Professor Lance Sherry with PhD Student Jomana Bashatah at George Mason University's Center for Air Transportation Systems Research. I helped her collect and analyze data to build a human performance database. This internship gave me insight into collegiate undergraduate research and taught me how to analyze data. Additionally, I learned about some other projects such as those on global warming this center was researching. Through independent research and my internship, I was able to analyze the double-edged sword that is the aviation industry and determine future steps humans can take to reduce the harmful effects of aviation.

• BASIS ADVISOR: Terry Villarreal • ON-SITE MENTOR: Lance Sherry • LOCATION: George Mason University

MATTHEW S.

ASSISTY- A PROGRAM MEANT TO ASSIST SENIORS AND INDIVIDUALS WHO HAVE DIFFICULTY USING COMPUTERS



ABSTRACT: I have been fascinated with computers and programs and have been exploring the topic ever since I was in eighth grade. Being the family IT man, I realized how much elderly people and people inexperienced with computers struggle when using a computer as well as being severely hindered in its usage. In an era of computers and virtual meetings, virtual jobs, and once-in person jobs in buildings with IT people now being at home, many people who are inexperienced in computer usage have had a challenging time working on their computers and, as a result, have a challenging time learning/working. Some people with tasks such as an online psychiatrist visits or time sensitive tasks cannot afford to have to troubleshoot, look up solutions, and contact IT support when they have some sort of problem. Therefore, I created a virtual assistant-like program that helps primarily elderly but really all people who have trouble using computers. The purpose of this program is to eliminate a significant amount of computer problems to allow people and students to be more productive and minimize disruptions. IN addition to my academic research, I worked alongside Mr. Rea, BASIS DC's IT expert, to learn as much as I could about computers, the problems they cause, and the solutions to those problems.

• BASIS ADVISOR: Dame Callender • ON-SITE MENTOR: James Rea • LOCATION: BASIS DC

NICOLAS S.

PATHOGENESIS OF PD: DEVELOPMENT OF LEWY BODIES



ABSTRACT: I chose to research neurodegenerative diseases out of a case of personal connection. My paternal grandmother, who lives in Sibiu, Romania, is affected by an essential tremor and by mild dementia. As I have spent time in Romania caring for her, I have developed a visceral connection to the topic. Lewy bodies are found in about ten percent of brains from normal elderly individuals over age sixty-five. They are considered one of the main factors of neurodegenerative diseases, and their prevalence raises concern. Moreover, as the global population ages, age-related diseases, particularly neurodegenerative ones, are of rising concern. The main goal of the project was to determine the pathological effects of alpha-synuclein and its development in the brain, specifically in the locus coeruleus and substantia nigra. I had three main objectives in order to accomplish my goal. First, I explored the epigenetic factors that stimulate the pathological expression of the SNCA gene. Second, I investigated the accumulation of alpha synuclein, with specific focus to the locus coeruleus and substantia nigra. Finally, I examined the pathogenic effects of alpha-synuclein and how its presence contributes to the pathogenesis of neurodegenerative diseases. I hope my research will help my grandmother and others like her.

- BASIS ADVISOR: Joey Zara ON-SITE MENTOR: Xiaobo Mao
- LOCATION: Johns Hopkins University School of Medicine

KAYLA T.

STEM AND THE ARTS: A DIGITAL REVOLUTION



ABSTRACT: Over time, technology has significantly increased its presence in the art world. From the earliest implementation of basic mechanical devices in artworks to strictly computer-based art, artists have gained a wide variety of new mediums and avenues of exploration. The invention of tools like computers and the internet have impacted the art world by providing increased artist visibility to audiences, but also by becoming a new source of inspiration for many. In what ways can art and technology intertwine? What new forms of art or technology have developed as a result of this work? How do these innovative creations break down or maintain traditional standards of art and its presentation? Through my time at the Innovation Center at George Washington University and Nova Labs, a local makerspace, I have answered these questions by researching this intersection and learning about the technology of the future. Being able to dive more deeply into a range of technologies from 3D printing to creative coding, I have even been able to create a piece of my own, utilizing the knowledge that I have gained. Since these new art forms are ever changing, this project served as not only an effort to understand the art world today, but also its promising future.

- BASIS ADVISOR: Holly Draper ON-SITE MENTOR: Erica Wortham and Fabiana Cesa
- LOCATION: George Washington University and Nova Labs

MIA T.

FUTURE ADVANCEMENTS IN NANO-TECHNOLOGY



ABSTRACT: Even though Nano-oncology is in its nascent stages of science and treatment, Nanoparticle-based drug delivery systems will exist as the main cancer treatment in the future. Hopeful results like these beg the question: can nanoparticles serve as a solution to some of the world's most hard-hitting diseases? Over the span of years, researchers and bioengineers have been trying to determine the number of problems that could have potential resolutions thanks to nano-technology. But what more is there left to explore? For my internship, I worked alongside Dr. Wei Li in the Center for Genetic Medicine Research at Children's National Hospital. There, I worked virtually by learning how to code and analyze genetic data towards the improvement of genetic mechanisms in conjunction with nano-technology. I was able to receive hands-on data from a lab to copy and examine intricate details that would piece together what type of nano-material would best fit the specific code. I also researched and read scientific papers about nanoparticles and their involvement in other areas of medical specialties such as oncology and infectious diseases. As a result of this extensive work, I look forward to sharing my promising proposals on the future advancement of nano-technological treatment across multiple branches of medicine to the BASIS DC community.

- BASIS ADVISOR: Nathaniel Green ON-SITE MENTOR: Wei Li
- LOCATION: Center for Genetic Medicine Research, Children's National Hospital

LUCILLE W.

LIMITING THE LONG-TERM EFFECTS OF COVID 19: A PHYSICAL THERAPY APPROACH



ABSTRACT: Physical therapy is the key to helping one not just feel better, but return to feeling normal, as well. As COVID-19 has emerged, we must understand the full extent to which the human body is affected. By not only comprehending how viruses are transferred but exploring their severity and their impact, we have been able to expand our initial response treatments. In the past, illnesses such as Chicken Pox, which was most commonly found in children and easily cured, later led to Small Pox in adulthood. By minimizing side- and long-term effects as we did with Chicken Pox, we can decrease the potential for a mutated or new COVID-related virus in the future. The intent of my project was to determine whether or not physical therapy could aid current and post COVID-19 patients and prevent long term effects from happening. Through research, I have determined the primary short-term side effects to be cardiovascular and the most impactful long-term effect to be cognitive. While interning at Pivot Physical Therapy, I worked with Dr. Dan Soler to analyze physical therapy exercises and developed a proposed treatment guide that can be used by patients currently suffering and those who recently recovered from COVID-19.

• BASIS ADVISOR: Elana Horowitz • ON-SITE MENTOR: Daniel Soler • LOCATION: Pivot Physical Therapy

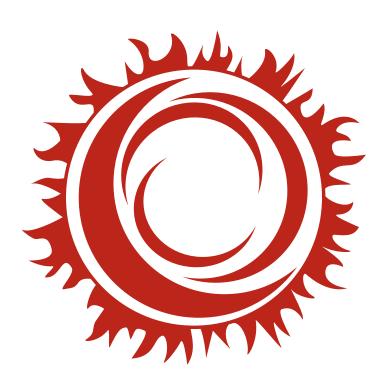
STUART W.

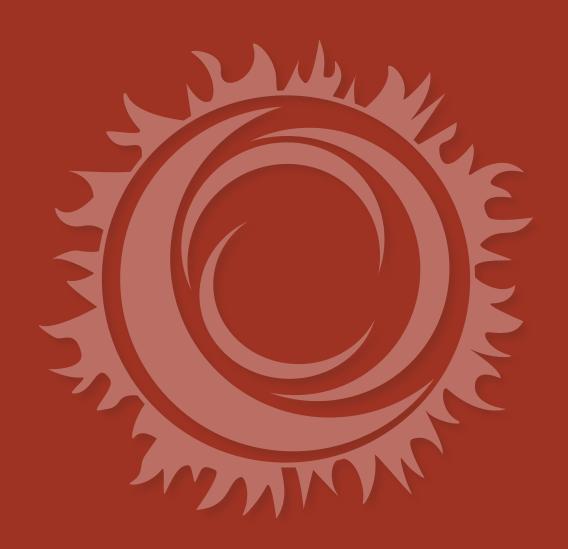




ABSTRACT: My interest in statistics started with my passion for college football. I have loved every aspect of college football since the day I began learning about it, except for one extremely frustrating facet of the game: the way teams were ranked. There is no defined criteria or set logic when the Associated Press creates its weekly list of the twenty-five best teams which creates massive inconsistencies and inaccuracies. The BCS system was the answer to this problem - a computer that anylazied mounds of data and produced a totally objective list of the twenty-five best teams. In 2014, the system ended in controversy, but during its sixteen-year use the question was raised: could a computer based ranking system be the future of all sports leagues? And should the traditional win-loss-tie table be replaced by computers? Through my research and internship, I analyzed data both in academic papers and that supplied by DC United during my internship there to determine the best system to adequately and accurately rank sports teams.

• BASIS ADVISOR: Elana Horowitz • ON-SITE MENTOR: Sam Marich • LOCATION: DC United





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



410 8th Street NW | Washington, DC 20004

