

# Senior Projects

2023–2024



**BASIS** PRESCOTT



# SENIOR 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 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 each student's 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 students' 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. 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. 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, DC, LA



David Hubalik  
Chief Executive Officer  
BASIS Ed Texas



# Prescott SENIOR PROJECTS

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## EDWARD A.



### HOW IS ASTRONOMICAL RESEARCH CONDUCTED FROM EARTH?

**SUMMARY:** Space is all around us. We can look up at the night sky and see it all around us. Containing planets, nebulas, and stars, there is so much we do and do not know within our solar system and beyond. As humans, we even dream of venturing into the cosmos and exploring this uncharted realm for ourselves. In our time, however, we're nowhere near leaving the borders of our solar system and the celestial objects around us are thousands of kilometers if not lightyears away from us. Despite this, we have managed to learn so much about these space and celestial bodies. In this project, I got a first-hand view of how this research occurs. I spent project term at Embry Riddle Aeronautical University working with astronomy professor, Doctor Noel Richardson and some of his students. I learned how data is collected using instruments on campus, how to analyze the data collected from the instruments and public data from NASA, and how to process the data via Python. I learned to use these high-tech telescopes and spend most of our time interpreting and processing the data.

- **BASIS ADVISOR:** Sheri Nelson • **ON-SITE MENTOR:** Dr. Noel Richardson
- **LOCATION:** Embry Riddle Aeronautical University

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## PAYTON B.



### LUMINOUS BLUE VARIABLES: WHY DO THEY VARY?

**SUMMARY:** Have you ever wondered about the universe, how it works, what happens throughout it, or maybe even its beginning? For years, I have asked myself these same questions and many more about the universe and all that happens in it. There is a very rare kind of star known as a Luminous Blue Variable (LBV) that can teach us a lot about the universe and its history. These large blue stars are approaching the end of their lives and will likely supernova when they die. The problem is that these stars often change brightness, color, and even size which makes it difficult to gather data and understand that gathered data. I worked with Dr. Noel Richardson, a professor at Embry-Riddle Aeronautical University, and one of his students to help gather and understand data about LBVs. I got the opportunity to occasionally observe these stars using various equipment at ERAU. We also analyzed data gathered from the Transiting Exoplanet Survey Satellite (TESS). Finally, we worked a lot with computer coding to help process this data. This research will give us to better understand LBVs, how they vary, how often these variations occur, what these variations mean, and maybe even help us understand the history of the universe.

- **BASIS ADVISOR:** Sheri Nelson • **ON-SITE MENTOR:** Dr. Noel Richardson
- **LOCATION:** Embry Riddle Aeronautical University

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## ZOEY C.



### EXPLORING THE WORLD OF SMALL BUSINESS MANAGEMENT

**SUMMARY:** 20% of small businesses fail in their first year, with the rate increasing to 70% in the tenth year. When a business is starting, it is typical to have struggles in learning what works for the business and keeping it from going under. Business management is essential to outlive the statistics for these businesses. Businesses have to find what techniques work best for their company. A tactic for one business may not work as well for a separate business, depending on what service they are giving. Throughout my project, I studied the successful management tactics implemented in a small business, specifically a small service business. My mentor, an optometrist named Dr. Willer owns his own business called Willer Optometry, located within Costco. He has been located in Prescott for some time, and has many connections to other business owners. Throughout the time of my project, I connected with these local small businesses and interviewed them on what techniques they prioritized within the business. I had the opportunity to talk to small business owners on what tactics have helped them to be successful, and I have used these tactics to form a business plan on how I would manage a small business of my own. During this project, I have learned from successful business owners and heard stories of what not to do for my very own soda shop business plan!

• **BASIS ADVISOR:** Matthew Corradi • **ON-SITE MENTOR:** Dr. Patrick Willer • **LOCATION:** Willer Optometry

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## TOBY C.



### PATHWAYS TO POLITICAL OFFICE

**SUMMARY:** Running for political office is an effective way to advocate for policy issues, but it is also a form of civic engagement that is foreign to most of the American public. Not only is it a great financial and time commitment, but most are unfamiliar with where to start the process. In order to have a functioning democracy, public office should be accessible to all—this project seeks to explore how it can be made so. Because the outcome of an election is dependent on such a wide variety of factors, my internship was not limited to one site, but rather multiple internships with candidates, campaigns, and party officials. This allowed for a more well-rounded experience and a bird's-eye view of what goes into a successful campaign. Interviews with those with campaign experience helped provide a baseline for developing a publicly available resource that lays out what the election season looks like from the candidate's side. What differences are there in a rural area versus an urban area? How many successful candidates would consider themselves introverts? Do campaign managers use specific software to stay on track? By exploring these questions, I sought to demystify the political office and encourage the average citizen to run for office, representing the issues they're passionate about.

• **BASIS ADVISOR:** Brent Weaver • **ON-SITE MENTOR:** Dr. Luke Perez • **LOCATION:** Arizona State University

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## GIANNA F.



### HOW TO RUN A BUSINESS\$: TACKLING TAXES IN THE U.S. ECONOMY

**SUMMARY:** Taxes, ideally, foster economic growth and provide sustainable sources for funding social programs and public investments. However, to many, this idea is not necessarily the reality of the system. Higher tax rates do not directly result in good public service due to the delicate nature of the tax system (The World Bank). I was able to better understand the ebbs and flows of our nation's tax system through developing a public podcast in which I interviewed various business owners and accountants at different corporate levels. In hearing the start-up stories, the struggles, and the successes of businesses, I was able to isolate how an effective business manages the complexities of taxes/financial burdens. Additionally, I was able to better understand the role a Certified Public Accountant has in mitigating the hurdles that taxes impose, I interned with a local CPA at SC Audit & Accounting Solutions. In the end, from Sunday morning cafes to independent neurosurgery clinics, navigating taxes is a major constraint amongst most corporations, making it vital to understand the balance between these firms and the tax system, so our economy can truly receive all the benefits offered by taxes.

- **BASIS ADVISOR:** Christine Bradford • **ON-SITE MENTOR:** Stephen Crandal, CPA
- **LOCATION:** SC Audit & Accounting

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## YAJAIRA G.R.



### BEHIND THE DOORS AT A MEDICAL EXAMINER'S OFFICE

**SUMMARY:** What happens in a medical examiner's office? How are post-mortem exams performed? How do they determine the cause of death? The medical examiner's office is an important place to know about since they work in close association with the community in many avenues. Plenty of people do not know what happens at the facility. Knowing what happens behind the doors at a medical examiner's office will help with understanding how to be safer in some aspects and combat any misconceptions that society has about them. To gain these valuable insights, I shadowed in multiple areas at the Pinal County Medical Examiner's Office. Shadowing helped me better understand what happens within and has allowed me to spread awareness about the field, especially with the worldwide shortage of medical examiners. By observing in-person, we got a better understanding of how each field works together to come up with a prognosis. Personally, I chose this opportunity because I am interested in pursuing a potential career path in a medical examiner's office and I desired to learn more. I am highly looking forward to clearing misconceptions moving forward from the valuable insights I gained from my internship in the field of forensic pathology.

- **BASIS ADVISOR:** Miles Hansen • **ON-SITE MENTOR:** Andre Davis • **LOCATION:** Pinal County Medical Examiner

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**EDIE L.**



## **DEVELOPING A LAB FOR FOURIER-TRANSFORM INFRARED (FTIR) SPECTROSCOPY**

**SUMMARY:** In school and in colleges, we are surrounded by courses laid out for us by someone who has developed the course. In a science class, students perform labs to do a deeper study into a certain topic, but how can a school perform those labs when they might not have the same materials required? How does someone develop a course that is tailored to the school? For my project, I created several experimental labs for a college class whose purpose was to be a bridge from general chemistry to organic chemistry at Embry Riddle Aeronautical University. The purpose of this lab was to help identify organic, polymeric, and inorganic materials in compounds. I developed a step-by-step lab procedure on Fourier-Transform Infrared (FTIR) Spectroscopy to find out what is in a sample and how it is measured. I participated in multiple labs to see if I could integrate one of them into the course. After completing my first lab, I moved onto a different lab that focused on pipetting different concentrations of solutions to determine the amount of protein in a compound. The courses I develop will be used by Embry Riddle Aeronautical University for a second semester laboratory. I hope that this internship will provide insight to my readers on the techniques used by certain schools to develop a lab procedure for their students.

- **BASIS ADVISOR:** Christine Bradford • **ON-SITE MENTOR:** Dr. Teresa Eaton
- **LOCATION:** Embry Riddle Aeronautical University

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**TAYLOR P.**



## **FROM AN IDEA TO A SHELF: THE PROCESS OF BOOK PUBLICATION**

**SUMMARY:** When first cracking open a book, readers skip the most important page: the copyright page, otherwise coined the "publication information page." That single page tells its own story, starting from an idea and ending on a shelf. The process of book publication is a complex, convoluted undertaking the average consumer takes for granted when reading. So, through my senior project, I studied in-depth the process of book publication and what it takes to successfully publish, market, and sell a book. I researched the three main categories: traditional, self, and hybrid whilst analyzing their pros and cons; I worked with Writers Publishing House to analyze the way a publishing company runs and what it takes to make professional books; and I interviewed six different authors about their unique processes of publication to further analyze their successful strategies and past mistakes. Through all of this research, I decided to publish my first book through Writers Publishing House; however, I ensured I put my research into practice. I was able to write, edit, design, format, and ultimately publish my book utilizing everything I learned. After my project, I decided that my intention with my research is split into three parts: one, to guide new authors through the book publishing process; two, to publish my work and establish my place in the literary world; and, three, to change the minds of average consumers. Books are a fragment of a writer's soul that they so bravely share, and I wanted to help the world learn to see that beauty.

- **BASIS ADVISOR:** Danielle Longworth • **ON-SITE MENTOR:** Lizzy McNett • **LOCATION:** Writers Publishing House



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## SOFIA R.



### EXPLORATION OF EMERGENCY MEDICINE: HOW IT WORKS

**SUMMARY:** What happens when you call 911? How does a patient get proper care and transportation when needed? In my project, I looked at how on-scene emergency medicine works, what different positions do, and how different first-responding groups work together to give the best care possible to patients in need. Every day, people call for help, which causes lots of anxiety and stress. I highlighted what first responders did to help patients, and created a guide to educate individuals on how this system works. Hopefully, by knowing what happens when this number is called, people will know what to expect and decrease their anxiety. I conducted my project with the Prescott Fire Department. I talked to medical professionals, did ride-a-longs to calls, and learned about the equipment they use. By interacting with this agency, I developed a vast sense of knowledge of how EMTs and paramedics assess and treat patients. Hopefully, my project can educate the public on how this system works and create a broader sense of peace for patients and families calling 911.

- **BASIS ADVISOR:** Christine Bradford • **ON-SITE MENTOR:** Battalion Chief Dave Haskell
- **LOCATION:** Prescott Fire Department

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## SELENE R.



### THE TRIPLE BOTTOM LINE CONCEPT APPLIED TO SUSTAINABLE ARCHITECTURE

**SUMMARY:** The environmental state of the world is a crisis we continue to endure daily. In general, multiple efforts are being made to find ways to coexist with nature. When speaking on sustainability, all heads turn to companies and businesses. One of the many ways businesses have been trying to achieve sustainability is through the architectural structure of their buildings. Ideally making a business building sustainable would tremendously aid the environment; however, not all can incorporate sustainability. Why is that? The word “sustainability” is often stigmatized as focusing solely on the planet. This mindset is often carried by many business owners when attempting to turn their companies “sustainable”. Most businesses will prioritize profit over all else which often leaves sustainability neglected. My research is based on the measures that should be taken in architectural design to equally guarantee profit, human comfort, and planet needs. A concept that defines sustainability as more than the environmental factor and ensures a holistic perspective for each business’s sustainable needs is the Triple Bottom Line Concept. By providing a definition of sustainability that focuses on the “Planet”, the “Profit” and the “People”, it allows accountability to be easily taken regarding the environment without having to sacrifice profit. Alongside researching Sustainable Architecture, I have been able to explore a career in Architecture, and learned about the software, history, and what my first year of college will look like studying Architecture!

- **BASIS ADVISOR:** Miles Hansen • **ON-SITE MENTOR:** Dr. Sandra Bernal Cordova • **LOCATION:** University of Arizona

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## MADELINE S.



### A NEW TYPE OF REVOLUTION: HOW QUANTUM COMPUTERS ARE SHAPING THE WORLD OF CRYPTOGRAPHY

**SUMMARY:** From ordering groceries online to booking airline flights to purchasing birthday gifts, digital transactions are a common occurrence in the contemporary world. Each time we enter our information into a new website or use our credit cards to make a purchase, we trust that our information is secure. What we don't consider is the mathematics that encrypts our data behind the scenes and how the rise of quantum computers presents a threat to our online safety. The advanced computing power of the quantum revolution is a danger to modern cryptography that mathematicians and physicists must tackle to uphold a safe digital economy. Under the guidance of Dr. Lara Ismert, a mathematics professor at Embry-Riddle Aeronautical University, I researched encryption methods such as RSA encryption, elliptic curve encryption, and the advanced encryption standard (AES) to assess their strengths and weaknesses from a mathematical perspective. Additionally, I delved into the developing realm of quantum-safe cryptography and studied the BB84 protocol specifically to identify to what extent quantum computing is revolutionizing digital cryptography. While studying the nuanced mathematics that protects our daily transactions, alongside the history of encryption and a future of cryptography that exists in a world of quantum supremacy, I used visual descriptions and analogies to unveil the complexities behind the click of a cursor to the public eye. Although mathematicians may be on the frontlines of this revolution, it should not be left unseen by anyone as it affects consumers around the globe. Throughout my project, I explored a journey through the evolution of encryption while also developing methods to effectively share this journey with the public.

• **BASIS ADVISOR:** Josh Smith • **ON-SITE MENTOR:** Dr. Lara Ismert • **LOCATION:** Embry Riddle Aeronautical University

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## NATHAN S.



### WHAT GOES INTO ENGINEERING A PRODUCT

**SUMMARY:** The cost of manufacturing a product is one of the largest limiting factors when it comes to product design. Because of this, product design can greatly benefit from understanding the manufacturing process and considering it from the start of development. This can improve products in all fields. To better understand designing for cost, I interned at Bent River Machine, where they are capable of completing products in-house, from design and engineering to manufacturing and assembly. At Bent River, I am following a part of a larger project through the whole process, starting with computer-assisted designing of a part, then converting that design into blueprints to be read and machined, and then machining the part. While my part does not need electronics, I shadowed both the electrical and controls engineers to understand other processes that a part might need to go through. By following one part along the entire path, I fostered an understanding of manufacturing and how to design parts of a project from start to finish with that in mind. What are the most important considerations to take into account when designing a product? What limitations might the manufacturing process have on designing? How can one effectively bridge the gap between the most effective design and the most practical piece to manufacture? I believe I have a better understanding of these questions and so many more.

• **BASIS ADVISOR:** Miles Hansen • **ON-SITE MENTOR:** Jessica Eckman • **LOCATION:** Bent River Machine

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**LENA T.**



**PATTERNS THAT LEAD TO THE DEVELOPMENT OF OSTEOPOROSIS**

**SUMMARY:** 80% of patients, who have Osteoporosis, do not know they have the condition until a fracture sneaks up on them. It is important to catch it early on before a fracture occurs because once that fracture happens it leads to more future fractures, possible long-term disability, loss of independence, and even death. How can elderly Osteoporosis patients avoid future fractures? What exactly are the factors that leave patients with brittle bones that snap with a sneeze? Why is treatment important? What does the surgery look like to piece one's vertebrae back together? As an intern at AZ Neurosurgery and Spine since June of 2023, I have been in charge of sending referrals for Osteoporosis patients to receive treatments. I was able to observe firsthand what the treatment process is like through the lens of both patients and providers. Through the Osteoporosis Research Survey, I was able to reach out to both patients with and without the condition to investigate what increases the risk of the "silent disease." My senior project would look at the patterns that emerge in the progression of Osteoporosis in the local Northern Arizona area, explore a disease that has been under-represented in public health, and hopefully elucidate the uncertainty surrounding what lifestyle factors can affect it.

- **BASIS ADVISOR:** Christine Bradford • **ON-SITE MENTOR:** Donna Galati
- **LOCATION:** Arizona Neurosurgery and Spine





# Prescott

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