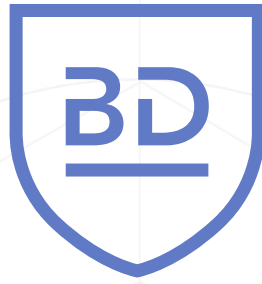


Senior Projects

2022–2023

BASIS TUCSON NORTH



SENIOR PROJECTS & SENIOR RESEARCH PROJECTS

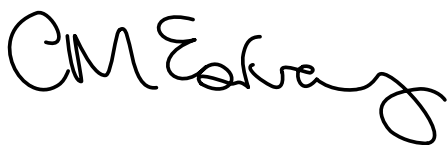
At this point in their senior year, BASIS Charter School students have completed a set of four BASIS Capstone classes to earn their BASIS Honors Diploma. In addition, many students are in the process of completing the prestigious College Board's AP Capstone Diploma™, a challenging, two-year sequence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



Tucson North SENIOR PROJECTS

ISABELLA D.

WHEN HEROES NEED SAVING



SUMMARY: A firefighter once told me an unfortunate, common saying in the industry: "You aren't a true firefighter until you've had your first divorce." The fact is, first responders are exposed to many unique and different challenges in their field that can impact their life. These experiences include very long shifts, back-to-back shifts, financial stress, being late to family events, and a significant amount of stress caused by handling cases of extreme trauma such as a dead person or a mutilated body. All of these can have a negative impact on a first responder's personal life. Even though handling these events is part of their job, first responders suffer from a significant amount of psychological effects. Research has shown there is an 85% chance that first responders will experience psychological effects (such as depression, anxiety, or PTSD) due to the extreme cases they handle. Unfortunately, these psychological problems are affecting first responders' lives, causing an increase in divorce rates (ranging from 60–75%), and a five-fold increase in suicide or suicide attempts. During this project, I analyzed the types of calls that first responders receive and how they handle these calls. Additionally, I surveyed first responders ranging from firefighters, EMTs, and paramedics, to understand some of the challenges they face on the job and to obtain statistics of how they cope with traumatic calls. I compared the staggering statistics of psychological effects observed nationwide to the statistics of first responders in Tucson. Finally, I documented support mechanisms in the Tucson area to help first responders overcome the psychological problems they face due to the nature of their work.

• **BASIS ADVISOR:** Kristen Sanders • **ON-SITE MENTOR:** Stuart Sherman • **LOCATION:** Tucson Fire Department

GERARDO Q.

APPLYING ADORNO: COMPARING SELF-ORIENTED AND AUDIENCE-ORIENTED CREATIVE PROCESSES IN SCULPTURE



SUMMARY: Theodor Adorno's study "Philosophy of New Music" discusses what is good music and bad music through a spectrum between pure and material music. While he specifically talks about music, this idea can be used for any form of art. His analysis summed up is that there are two extremes in art: pure art and material art. Pure art is described as being made purely for art's sake, without regard for what the mass media considers good or bad. This relates to atonal music or music without a consistent tone or rhythm, but this is the same for much of abstract art or modern and color field art. Materialistic art is art that's made for the express purpose of appealing to the masses for material gain. This falls with following trends in population to make something perfected to appeal to the most amount of people through algorithms or just simply getting feedback from people. While Adorno actively rejects everything that falls into materialistic art, partially through a level of pretentiousness, and labels pure art as better, there's no real better or worse type of music. He also specifically calls out that pure art is the art that most people don't like, and that material art is the preferred form in popular media. In my research, I applied this idea to a real and new population. With the current environment of art pushing toward independence and uniqueness, there have been shifts in what people prefer since when Adorno wrote his paper. This research collected data regarding people's preferences by taking samples of sculpture artists who do art with feedback or trends and those who make art through their own interests. A survey was given out primarily to people in the high school age range (16–18), spreading to older and younger ages. This survey can help willing artists determine the preferences of those surveyed and graphed.

• **BASIS ADVISOR:** Dr. John Rosinbum • **ON-SITE MENTOR:** Robin McArdle • **LOCATION:** Sculpture Tucson

WENLI X.

DEVELOPING ANTIBIOTICS TARGETTING GROEL



SUMMARY: The discovery of antibiotics is arguably one of the most significant milestones in medicine, saving countless lives from infectious disease. As bacteria perpetually evolve and develop resistance to existing drugs, humans continue creating new drugs to protect themselves from deadly diseases. In my project, I worked in a lab at the Skaggs Pharmaceutical Sciences Center at the University of Arizona College of Pharmacy to develop new antibiotics that target GroEL, a protein found in bacteria belonging to a family of heat shock proteins called chaperonins that engage in protein folding. GroEL/GroES has been the only chaperone system found essential to the growth of bacteria under all conditions, and therefore may work as an effective antibiotic target. We targeted *Mycobacterium tuberculosis*, which has two GroELs: GroEL 1 and GroEL 2. To do this, we used *E. Coli* strains and replaced its GroEL with GroES, another cofactor in the protein folding in bacteria. At my site placement, I learned essential skills for working in a lab and furthered the research on this topic.

- **BASIS ADVISOR:** Robert Lee • **ON-SITE MENTOR:** Dr. Eli Chapman
- **LOCATION:** University of Arizona College of Pharmacy



Tucson North SENIOR RESEARCH PROJECTS

GREGORY A.

MODELING FRAILITY

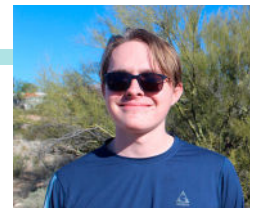


SUMMARY: Frailty is defined as a clinical syndrome in which three or more of the following criteria are present: unintentional weight loss of 10 lbs or more in the last year, weakness, slowness, self-reported exhaustion, and low physical activity. In this paper, I studied frailty assessment outside a clinical setting through a smartwatch device. Using heart rate data during intervals of rest and movement from a Fitbit, MATLAB, and the HRV program, I calculated entropy values that show heart rate complexity and determine frailty.

• **BASIS ADVISOR:** Dr. John Rosinbum • **ON-SITE MENTOR:** Dr. Toosizadeh
• **LOCATION:** University of Arizona College of Medicine

SPENCER A.

DEFAULT OR DEEP THINKING IN CHESS PROBLEM SOLVING



SUMMARY: Chess players can't gain experience just by playing games. Instead, they resort to multiple resources to improve their game, such as the analysis of chess games, study with more skillful players, and gathering of preparation for future opponents. One of the more important resources, however, is the solving of chess puzzles, as these can emulate a potential position in a chess game and challenge the player to think out of the box to find a solution. In a particularly challenging puzzle or game, a player is usually advised to unfocus their attention on the game, wandering across a tournament room before sitting back down to play, taking a bathroom break, or even "sleeping on it" if possible. Why is this beneficial? Is it because the player resets their emotions and clears their mind, or is it because of something deeper? As multiple academic papers have brought up the idea of "unconscious thought," my research project focuses on seeing if chess players can improve their quality of solving ability by this mode of thought, and if the type of problem, intuitive or non-intuitive, affects the advantages of one mode of thought over the other.

• **BASIS ADVISOR:** Dr. John Rosinbum

PRANAV B.

THE MUSK EFFECT: EVALUATING HOW A TWEEN CAN SHAPE MARKETS



SUMMARY: As the use and impact of social media increases throughout society, specific people have huge amounts of influence on different areas. In my research project, I analyzed how a large public figure, Elon Musk, has influenced the actual stock prices of corporations with his opinionated posts on Twitter, and whether these effects on prices are long-lasting or temporary.

• **BASIS ADVISOR:** Dr. John Rosinbum

ALEXANDER B.



"IT BELONGS IN A MUSEUM!": AN ANALYSIS OF ARCHAEOLOGY IN THE INDIANA JONES FILM SAGA

SUMMARY: "We do not follow maps to buried treasure, and X never, ever marks the spot," says Indiana Jones in his third film. Indiana Jones, 40 years after his debut, remains the most famous fictional archaeologist of all. The movie franchise, consisting of just four movies, made almost two billion dollars at the box office. Merchandise, spinoffs, and even a ride at Disneyland only made Indiana Jones more popular. These films, though they may be classified as adventure movies, focus on one thing—archaeology. Archaeology, however, is not a Catholic discipline. By the 1980s, a divide between fundamentally different approaches to the subject had formed. This divide was between the Classical Archaeologists and the Processual Archaeologists. Classical Archaeology was noted for its strict adherence to convention. Processual Archaeology, which spawned in the universities of the Americas that European academics so often ignored, was much freer—it was much less focused on written histories (as relatively few existed for the Americas) and more focused on extracting general theories and ideas about society. Thus, my project focused on analyzing which of these archaeology styles show up in the Indiana Jones saga. My work focused on analysis of these movies coupled with work at a local archaeology company, Old Pueblo Archaeology. There, I wrote a report on the Sabino Canyon Dam excavations of the early 2000s and familiarized myself more with the discipline. The research that I completed will enter the scholarly discussion and present a new lens of examination for the Indiana Jones movies—one that focuses on the effects they have on the discipline itself.

• **BASIS ADVISOR:** Dr. John Rosinbum • **ON-SITE MENTOR:** Allen Dart
• **LOCATION:** Old Pueblo Archaeology Center

JAKE F.



WHY DO WE FIGHT AND DIE? COMPARING MOTIVES ACROSS THE LORD OF THE RINGS AND THE WITCHER

SUMMARY: It is difficult to dispute that literature of all types is influential to our perception of the world. Often we read specifically to learn more about our surroundings, or simply as escapism. It would also be almost impossible for any author to write a novel or poem without any of their own worldview or opinions bleeding into their art. Thus, literature has a capacity to influence its readers of certain opinions held by its authors. An interesting case of this appears in fantasy literature, specifically medievalist fantasy, due to its escapist features. A genre championed by Tolkien with his legendary Lord of the Rings saga, this type of fantasy is characterized by medieval settings, magical creatures, and larger than life conflicts. As stated in "What's Wrong with Medievalism? Tolkien, the Strugatsky Brothers, and the Question of the Ideology of Fantasy" by Irina Malone, by attempting to imitate the characteristics of a medieval world, medievalist fantasy must also take on the medieval period's intimate relationship with violence and war. The story of Lord of the Rings centers around a massive conflict, which calls into question what is meant to be said about the nature of war and its consequences through the novels. Therefore, in this study, my goal was to identify the most common consequences of war as portrayed in the Lord of the Rings saga, and also to compare it to a more recent medievalist fantasy series, Andrzej Sapkowski's The Witcher series. Thus, my research aimed to answer the question: What are the most common short-term consequences of war with respect to people's lives, the environment, and its effects on the mental state of people, as presented in J. R. R. Tolkien's Lord of the Rings saga and Andrzej Sapkowski's The Witcher series, and how do they compare with one another?

• **BASIS ADVISOR:** Dr. John Rosinbum • **ON-SITE MENTOR:** Dr. Dennis Wilson Wise
• **LOCATION:** University of Arizona

JONATHAN H.

YOU MADE IT! BUT HOW? EXPLORING FACTORS THAT MAKE A ONE-HIT WONDER



SUMMARY: There tends to be a variety of factors that are involved in what exactly constitutes a musical piece as “popular.” For example, popularity of a song is often determined by external variables that do not relate to the song itself, such as the level of advertisement that the song receives, or certain situations that the artist gets themselves into that can act as advertisement. However, it can’t be said that those external variables are the entire influence of how a song gets popular, because a song requires some level of internal variables such as the musical instruments utilized in order to be enjoyed to begin with. Now, there’s a very specific phenomenon that seems to arise within the musical industry in which an artist or band rises to a level of significant fame that they never seem to reach again. This phenomenon is called the One-Hit Wonder phenomenon, and while some seem to root the causes of this phenomenon to external variables that relate to the artist themselves, this senior research project aims to find how stylistic choices in a musical piece can influence the popularity of a song. I analyzed the role of those internal variables within the context of this phenomenon to understand how the concept of popularity operates under a statistical framework, and to develop some analysis on why the anomalous One-Hit Wonder phenomenon is present within the music industry.

• **BASIS ADVISOR:** Robert Lee • **ON-SITE MENTOR:** Dr. Gulgas • **LOCATION:** University of Arizona

BELLA L.

K-POP’S INFLUENCE ON CULTURAL AWARENESS



SUMMARY: Growing up as a Korean-American, I’ve always searched for ways to connect to both sides of my identity. As I moved from America to Korea, then back to America once again, I struggled to coexist as both. I grew up choosing one or the other, which, after years of living in America, caused me to become estranged from the Korean part of my identity—I forgot the language and culture I’d lived during my elementary years. However, I was introduced to a novel genre of music by my sister in eighth grade: K-Pop. It was a complete turn from the American music industry’s lack of mainstream Asian representation, with a mix of various East Asian languages with English, internationally-based artists, and diverse genres, and I was instantly drawn in. Listening to K-Pop helped me realize that I wanted to know and use the Korean language better, and I restarted learning Korean. Most of my studies were informal. I wrote analyses of song lyrics, translated excerpts from my favorite books, and interacted with other Koreans on social media. During the pandemic, however, I took the chance to formally test my Korean, and earned an Advanced proficiency level (the highest level) in conversational Korean with the STAndards-based Measurement of Proficiency (STAMP) Exam.

• **BASIS ADVISOR:** Dr. John Rosinbum

RENEE L.



THERE'S WATER IN YOUR EYES, AND I'M USING SUPERCOMPUTERS TO LOOK AT IT: INVESTIGATING RHODOPSIN HYDRATION USING MUTANT STUDIES AND MOLECULAR DYNAMICS METHODS

SUMMARY: G-protein coupled receptors (GPCRs) are a class of transmembrane proteins that play an essential role in cell signaling, and are of great interest due to their prevalence in the human body and implications in a wide variety of diseases. Rhodopsin is an archetypal, frequently-studied GPCR located in the eye, and is involved in mediating dim-light vision. Both experimental and computational simulation methods alike have suggested that rhodopsin becomes more hydrated upon activation, with a difference of about 80 water molecules between the dark inactive state and the Metarhodopsin II activated state. However, it is unknown if hydration is required to initiate or mediate activation, or if it is solely a byproduct of activation. My project involved using computational simulations, specifically molecular dynamics (MD) methods, to compare the hydration of two constitutively-active mutants (CAMs) of rhodopsin to normal rhodopsin. Since CAMs are locked in the active state even in the presence of no stimulus, determining if there is any significant difference in water count between CAMs and normal rhodopsin can provide insight into the necessity of hydration in rhodopsin activation. Using MD and other computational simulation methods in this regard is advantageous to studying small, complex systems in depth, as well as to compare to experimental data and predict future experimental outcomes. The CAMs involved in this study cause diseases of vision such as congenital stationary night blindness (CSNB) and retinitis pigmentosa. Thus, studying them may aid in advancing treatment for these diseases. Additionally, the prevalence of GPCRs makes them important in the pharmaceutical industry, and they are the targets of 34% of all FDA-approved drugs. As such, studying rhodopsin, a model GPCR, allows for more understanding of GPCRs in general, contributing to the development of more specific, targeted pharmaceuticals.

- **BASIS ADVISOR:** Dr. John Rosinbum • **ON-SITE MENTOR:** Andrew Erly
- **LOCATION:** University of Arizona Brown Lab

DANIEL O.



CREATING A LOGICAL LANGUAGE

SUMMARY: Constructed languages (conlangs) are speakable languages artificially created to achieve an artistic, philosophical, or scientific goal. One motivation in the philosophical and scientific context is testing of the Sapir-Whorf Hypothesis of linguistic relativity, which states that the languages a person speaks influences the way they think because it informs the organizational structure behind complex thought and interpersonal communication. One type of conlang made in part to test this is loglangs, or logical languages. They are made to be completely syntactically unambiguous, in that the grammatical rules are specific enough that any grammatically correct sentence can be logically parsed into the underlying organizational structure with complete certainty. The syntax of loglangs is designed to allow a guarantee of greater specificity of the connection between elements in a sentence than is normally possible in natural languages, or even other types of conlangs. Most loglangs use an analytic grammatical structure, which primarily uses the order of words to convey the relationship between words and the assignment of grammatical roles. These languages use analytic syntax informed by predicate logic to achieve syntactic unambiguity. Because of the harsh restrictions on syntactic freedom and the reliance on word order, the number and order of arguments taken by words that express defined relationships between other words, like verbs, is completely unique to each word, with little correlation between each other. This means that learning new words necessitates learning new minor grammatical features, decreasing the overall efficiency of the language. Each different word's definition must be unique, otherwise they wouldn't be different words, but that doesn't necessitate them all behaving differently in a grammatical context. My project aimed to eliminate this type of problem by using instead a synthetic syntax, which relies on structures other than word order, such as word endings and particles. This allowed me to create a widely applicable base grammatical system that each verb's definition could adapt to, rather than the grammar having to adapt to each different word. The results of this experiment can inform further use of loglangs in testing the implications of their different aspects in the context of linguistic relativity.

• **BASIS ADVISOR:** Dr. John Rosinbum



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