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2024 Stonehill Undergraduate Research Experience (SURE) Summer Projects

Thirty-five Stonehill College students will work with 20 faculty mentors on a variety of research projects during the summer of 2024, the 28th year of the Stonehill Undergraduate Research Experience (SURE) program. SURE provides students with an opportunity to perform significant, publishable research under the guidance of an experienced faculty researcher. The research experience gives students a competitive advantage in graduate and professional school applications and in post-college employment opportunities, as well as to offer assistance to faculty in research activities.

Mario Evora Fonseca '26 and **Christopher Purcell '26** will work with **Shahrokh Sani**, Associate Professor of Engineering, on a project entitled "Design and Manufacturing of Cost-Effective Automated Bottle Filling and Capping Machine." The research project aims to design optimal Automated Bottle Filling and Capping Machine to reduce its cost. The designed machine will be manufactured by using a Programable Logic Controller (PLC) to automate the bottle filling and capping process. In the beginning of the process the empty plastic bottle moves on the conveyer, and it passes the bottle to the filling point. Bottle stops in the filling point (by using the proximity sensor) and fills to desired level (by using a pump). While the bottle is moving to capping station, the cap is placed on top of the bottle by using a simple mechanical mechanism. A stepper motor rotates a cylinder to pass the bottle from conveyer to capping station. In the caping station, pneumatically actuated piston and a DC motor are used to tight the cap. A second conveyer is used to transfer the capped bottle from capping station to the bottle box.

Justina Botros '26 and **Amanda Brown' 25** will work with **Nicole Cyr**, Associate Professor of Biology, to continue previous research aimed at better understanding how obesity alters brain and liver function. For her project titled "*Obesity alters Brain Metabolism,*" Biology major Justina Botros will investigate the effect of obesity on physiologically relevant biochemical signaling pathways such a mTOR and SIRT1. Furthermore, her studies will explore how changes in these pathways impair brain metabolism and lead to disease. Amanda Brown, Biology major, will investigate how stress alters liver function to increase the risk of obesity and thus Type 2 Diabetes for her project titled "*Excess stress hormones and liver disease*." Results of these studies will be presented at the Northeast Undergraduate/Graduate Research Organization for Neuroscience (NEURON) conference next year.

Bronwyn Bacon, '26 will work with **Cheryl Schnitzer**, Professor of Chemistry, on a project entitled *Pump-Probe Laser Experiments*. The purpose of our work is to examine transient oscillations in lithium niobate ($LiNbO_3$) and gallium arsenide (GaAs) crystals with a pump-probe

laser experiment. Applications of our findings are important and timely for understanding optical devices which are important for semiconductor technology. We will submit our methodology and results for publication, and present at the National American Chemical Society (ACS) meeting in San Diego, spring 2025.

Alexandra Trantos, '25 will work with **Anwar Mhajne,** Assistant Professor of Political Science and International Studies, on a project entitled *Disinformation in the Israel-Hamas War.* This paper aims to understand how the diffusion of mis- and disinformation concerning the Israel-Hamas conflict has been used as a strategy of war. To examine the spread of false information, this research will utilize qualitative data to assemble a sample of content from social media, online platforms, news articles, as well as official statements by political actors in order to uncover the hidden, symbolic, and often threatening implications of unverified information. We already have a publication on the topic together and we plan on publishing more on the topic.

Alyssa Tyler, '26 will work with **John McCoy,** Professor of Neuroscience & Psychology, on a project entitled *Control of Sleep-Wake State by the Basal Forebrain*. The neurons in the basal forebrain (BF) region are known to regulate cortical activity and sleep-wake behavior. Alyssa's project will employ interdisciplinary approaches to investigate the roles of different populations of BF neurons in the control of sleep and wakefulness. Alyssa will be part of a collaborative team of investigators who will utilize genetic, neuroanatomical and immunohistochemical techniques to identify the developmental origin of known cell-types in the BF and identify previously unrecognized BF cell-types using developmental markers. This research could allow for the development of targeted therapies aimed at the restoration of normal sleep in disorders such as insomnia or medical conditions that have sleep disruption as a symptom. It is anticipated that Alyssa will prepare and present a poster based on her research findings at the Northeast Undergraduate/Graduate Organization for Neuroscience (NEURON) next year.

Daniel Scanlon '25 will collaborate with **Francesca Fornasini**, Assistant Professor of Physics & Astronomy, on *Investigating Galaxies with Bright X-ray Binary Populations*. X-ray binaries consist of a black hole or neutron star stealing material from a normal stellar companion. As astronomers are starting to peer into the very early Universe and piecing together our cosmic history, an important piece of the puzzle is how the bulk of the gas in the Universe transitioned from being neutral to almost fully ionized. The first generations of X-ray binaries may have played an important role in that ionization process. In this project, we will be investigating the properties of some of the most luminous X-ray binary populations, which can help shed light on their impact in the early Universe. We plan to present results from this study at the Meeting of the American Astronomical Society in January 2025. We plan to present results from this study at the Meeting of the American Astronomical Society in January 2025.

Charlotte Perry '26 will work with **Francesca Fornasini**, Assistant Professor of Physics & Astronomy, on *Investigating the Relationship between Planet Size and Stellar Properties*. Over the past decade, there has been a boom of planets discovered around other stars. With more than 5,000 exoplanets discovered to date, it is now possible to statistically study exoplanet demographics. In this project, we will use the most up to date catalogs of confirmed exoplanets

to study the relationship between planet sizes and stellar properties including chemical composition and stellar mass. Correlations between planet and host star properties can contribute to our understanding of planetary formation processes. We intend to present results from this study at the Meeting of the American Astronomical Society in January 2025.

Kelsey DelPrete '26 and **Emily Green '26** will work with **Leyda Almodóvar Velázquez**, Associate Professor of Mathematics, on *Mathematical Modeling of DNA Self-Assembly.* Several techniques have been applied to create self-assembled DNA molecules in specific shapes. Since modeling this self-assembling process requires designing the component molecular building blocks, which often are modeled as graph-like structures, construction methods developed with concepts from graph theory have resulted in significantly increased efficiency. Over the summer, students will explore the underlying graph-theoretical structure of self-assembling DNA complexes and related design strategy problems. Students will work collaboratively to find the optimal strategy to construct DNA molecules shaped like a given family of graphs. Students will present their results at the MAA Northeastern Section Fall Meeting in November 2024.

Leah Goldman '26 will work with **Kevin Carriere,** Assistant Professor of Psychology, on *Not In My Breakroom: Measuring union support through interactive storytelling.* Current research has consistently shown a broad endorsement of unionization across various demographics. This summer project aims to investigate whether we can observe drops in support for unions if it impacts one's workplace directly. Participants will be immersed in a factory setting, portrayed through a choose-your-own-adventure narrative, where they will navigate scenarios of workplace strife or success. We will develop, run, and analyze the experiment throughout the summer. We intend to present results from this study at the Society for the Psychological Study of Social Issues Conference in June 2025, and publish the work.

Kylie Lindo, '26 will work with **Rachel Monyak**, Assistant Professor of Neuroscience and Biology, on a project entitled *Examining genes involved in aggression in the fruit fly.* This project will assess how mutations in the *rbfox1* gene affect aggression. *Rbfox1* mutations have been implicated in aggression in mice, dogs and humans and some preliminary evidence suggests aggression in male fruit flies may also be affected. Kylie will examine aggression in both male and female flies to determine if *rbfox1* mutations affect aggression in *Drosophila*, and to determine if there is a difference in how male and female aggression is altered. If we are able to identify *rbfox1* as being involved in aggression, further work will focus on using the powerful genetic techniques available in flies to identify where in the brain *rbfox1* acts.

Jamie Baker '25 will collaborate with **Bronwyn Bleakley**, Professor Biology, on the *Role of UV reflectance in Coordinating Cooperation in Trinidadian Guppies*. Trinidadian guppies cooperate in pairs to perform a suite of behaviors in response to predatory threats. How an individual behaves within a cooperative interaction will reflect the interaction between the fish, which is at least partially coordinated by visual signals. Guppies see both the full spectrum of visible colors and UV wavelengths, and female guppies use UV information to make social decisions. Male guppies display colorful patterns that have been well-documented to affect female mate choice and affect survival in the presence of predators. Both male and female guppies display

patches of UV reflectivity that may provide information about how likely they are to cooperate to respond to predatory threats. However, UV reflectivity and some color patterns may trade-off for space on males. Baker will be investigating 1) how variation in UV reflectance patterns influences cooperation among females, 2) whether color and UV trade-off in males, and 3) how male color and UV reflectance influences cooperation among males. Baker has applied to present results from this experiment at the Evolution Meeting in 2024.

Mallory Crispens '25 and **Colton Burkhart '26** will collaborate with **Bronwyn Bleakley**, Professor Biology, on *Multimodal Coordination of Social Learning in Trinidadian Guppies*. Trinidadian guppies acquire information from social partners, including the location and quality of food, through the process of social learning. Different genetic strains of guppies vary in their ability to socially learn and vary in a range of physiological and behavioral traits. Guppies use visual, olfactory, and mechanosensory signals to communicate with their social partners, but it is not clear how these signals are integrated to yield different social learning outcomes. Crispens and Burkhart, both Biology majors, will measure the correlations between visual, chemical, and mechanosensory sensitivity and social learning ability to better understand how these signals are integrated and influence behavior. We plan to present results from this experiment at the Evolution Meeting in 2025.

Anna Varholak '26 will collaborate with **Brittany Cavazos**, Assistant Professor of Biology, on *Pollinator-mediated plasticity in floral traits*. Most flowering plants are animal-pollinated, relying on visitation by animal pollinators to successfully reproduce. Pollinator-mediated plasticity is a type of response in which flowers will respond to specific pollinator cues by altering their traits. Induced responses, or phenotypic plasticity is common in antagonistic interactions, such as herbivory or abiotic stress, but plasticity in response to mutualistic interactions is not well documented. Further, it is unknown whether pollinator visitation, type of pollinator visitation, or pollinator timing will influence subsequent floral traits produced by the same plant. Varholak will use a field and greenhouse set up to test pollinator-mediated plasticity in floral abundance, size, and ovule count by using wild tomato, *Solanum pimpinellifoium* that is pollinated by bumblebees. By choosing a species that can self-pollinate under certain conditions, Varholak and Cavazos will better understand how plants-pollinator interactions can affect total reproductive output over a flowering season, and further, test how pollination impacts subsequent fruit traits. We plan to present the results from this experiment at SACNAS in 2025.

Jasmine Anderson '25 and **Lauren Printz '26** will collaborate with **Marilena Hall**, Professor of Chemistry, on the *Replacement of S-peptide in RNase S using Phage Display*. For nearly a century, the enzyme ribonuclease A (RNase A) has served as perhaps the most important model system in protein biochemistry. Even when the RNase A backbone is cleaved into two fragments, S-protein and S-peptide, the two separate pieces bind to each other to recreate the functional enzyme, dubbed RNase S. Panning a phage display library against just the S-protein could identify peptides that effectively replace the S-peptide to recreate the enzyme in an unprecedented configuration. Information gleaned from this study may shed light on receptor/hormone and other cellular binding interactions implicated in disease states, leading

to the development of pharmacologically relevant therapeutics. Anderson and Printz, both biochemistry majors, will apply the findings to their senior capstone theses and/or posters at the American Chemical Society national meeting next spring.

Olivia Pham '26 and **Julia Helms '26** will collaborate with **Marilena Hall**, Professor of Chemistry, on the *Identification and Characterization of Glycated Peptides that Bind to the RAGE Receptor*. The receptor for advanced glycation endproducts (RAGE) is a protein embedded in the cell membranes of the lungs and other tissues. In the normal aging process, proteins in our cells react with sugars ("glyc") to form advanced glycation endproducts (AGEs), which bind to RAGE and trigger biological pathways inside the cell. AGE-RAGE binding is also associated with diseases such as diabetes, atherosclerosis, Alzheimer's and more. Consequently, studies of how AGEs bind to RAGE can lead to a greater understanding of these diseases. Phage display can be used to identify glycated peptides that bind to RAGE, and once fully characterized by chemical methods, these AGE mimics could serve as drugs that block the natural AGEs from binding to RAGE, thereby preventing the disease states. Pham (a chemistry major) and Printz (a biochemistry major), will apply the findings to their senior capstone theses and/or posters at the American Chemical Society national meeting next spring.

Avery Holzworth '25 will work with **Kirk Buckman**, Assistant Professor of Political Science & International Studies, on the *End or New Beginning of the "Miracle of Chile"?* This project explores quantitative and qualitative resources to develop a historical-institutional analysis of how weak middle-class development contributed to the contemporary constitutional predicament. Between October 2019 and December 2023, one of the most successful democracies in Latin America seemed poised to unravel as the country attempted to write and adopt a new constitution. Twice these efforts failed, leaving in place Pinochet's constitution and an enormous political question about the future of Chile's democracy.

Michelle Heredia '25 will work with **Kirk Buckman**, Assistant Professor of Political Science & International Studies, on the *"Ecuador's Democracy and Political Economy."* This project explores developments around Ecuador's recent turn to the right with the October 2023 election of President Daniel Noboa Azín. We rely on quantitative and qualitative resources to develop a historical-institutional analysis of how macroeconomic conditions may have been weakened by the social democratic policies implemented by President Rafael Correa and his successor, and to estimate a model of the emerging party system. As a result of economic instability, the country forced the resignation of President Guillermo Lasso, triggering a political crisis for the future of this democracy.

Adam Wainwright '25 will work with **Kirk Buckman**, Assistant Professor of Political Science & International Studies, on *Democracy and Middle Class in Latin America*. This project applies the ordinary least square (OLS) regression model to estimate effects of macroeconomic trends over a thirty-year period 1991-2020 on the percentage of income held by the middle quintile, and economic confidence in the future in the nine largest Latin American countries by population. The econometric model will explore the correlation of nine independent variables—unemployment, inflation, economic growth of gross domestic product (GDP), population

growth, national savings, debt to GDP ratio and total educational expenditure (% GDP), corruption levels, and levels of confidence in the political system—to the percentage of income earned by the middle quintile, the dependent variable. We will run this same model gain, but with "economic confidence in the future" as the dependent variable. The project addresses debates over wealth and income inequality as they relate to democratic performance in Latin America. The econometric model explores the relationship between economic performance and the consolidation of democratic political systems in nine countries, most of which are part of the so-called "Third Wave" of democracy.

Stella Henderson '26 and **Isabella Melo '26** will collaborate with **Robert Rodgers**, Assistant Professor of Political Science & International Studies, on a project entitled *Partisan Advantage in the American Political System*. This project will delineate three types of partisan advantage – situational, institutional, and manufactured – and then measure the magnitude of each type of advantage enjoyed by either the Democratic or Republican Party in recent American history. Based upon this research, three papers -- one for each type of advantage – will be submitted for presentation at the New England Political Science Association annual conference.

Caroline Green '25 will work with **Margaret Pierce**, Associate Professor of Education Studies, and **Ken Branco**, Professor of Sociology, on a project entitled *Co-occurring Disabilities Among Autistic Adolescents*. Using a national probability sample, this project will explore the prevalence of co-occurring Attention Deficit and Learning Disorders among Autistic adolescents without intellectual disability. We will further explore the incidence of a range of functional problems among adolescents with and without co-morbid disabilities, with implications for effective diagnosis and intervention. Green, a special education and sociology double major, will conduct a systematic review of the literature on co-occurring disorders with autism, and she will take the lead in preparing and analyzing the dataset from National Survey of Children's Health. We will be presenting our findings at the 46th Annual Meeting of the International Academy of Research in Learning Disabilities in Kielce, Poland this summer.

Giovana Vieira '25 will collaborate with **Tracy Rosebrock**, Assistant Professor of Health Science, on *Hunting for human proteins that regulate Human Cytomegalovirus gene expression*. Human Cytomegalovirus (HCMV), is one of the rare microbes that can pass from a pregnant person to a fetus by moving through the placenta, increasing the risk of birth defects. Once a person is infected, the virus becomes dormant and 'hides' within cells for a lifetime, however it may 'reactive' in times of stress or reduced immune efficiency, such as pregnancy. Many HCMV genes have been shown to be important for the virus to establish dormancy (silent infection) or reactivate (active infection) in human cells. However, *how* these genes are regulated (turned on or off) is not known. Giovana, and other Stonehill students, have located an 'off' switch and a larger genetic region that contains one or more 'on' switches. Giovana will design and execute experiments to identify the human proteins that bind and control these DNA regulatory switches. Identifying these proteins is an important step to explain the environmental stimuli that control the dormancy-reactivation switch.

Madison Warren '25 will collaborate with **Tracy Rosebrock**, Assistant Professor of Health Science, on *Characterizing Human Cytomegalovirus gene regulation at the decision point of viral latency or reactivation*. Human Cytomegalovirus (HCMV) is a ubiquitous virus that infects nearly 80% of the population. Once a person is infected, the virus becomes dormant within bone marrow cells where it may 'reactive' in times of stress or reduced immune efficiency, such as pregnancy, HIV infection, or organ transplant. HCMV genes in the UL/b' locus have been shown to be important for HCMV to establish dormancy (silent infection) or reactivate (active infection). However, *how* these genes are regulated (turned on or off) is not known. The Rosebrock lab has identified large regions within the UL/b' locus that regulate gene expression by either promoting or repressing transcription. Madison will design and execute experiments to create a fine resolution map of the minimal HCMV genetic sequences necessary to regulate gene expression. This work is an important step forward in helping to identify the transcriptional regulators that bind these sequences and direct the dormancy-reactivation switch.

Kelly McClymer (2025) and **James Dewar** (2025) will work with **Edward McGushin**, Professor of Philosophy, on a project that examines twentieth century French philosopher Michel Foucault's long fascination with Greek tragedy and his contribution to our understanding it's philosophical significance. Our main focus will be on his reading of Sophocles' *Oedipus Tyrannus*, which he articulates in a lecture he gave again and again over the years (1971, '72, '73, and '80), each time with subtle variations, new insights, and shifting emphases. We will present an early version of our reading of Foucault and Derrida on tragedy for the July 2024 meeting of the Society for Philosophy in the Contemporary World, which will be held at Worcester Polytechnic Institute.

Liam Barry (2026) will work with **Samuel Goree**, Assistant Professor of Computer Science, on a study of qualitative evaluation of computer vision models for subjective visual perception problems, such as image aesthetic quality assessment. Such models are typically evaluated through accuracy on large-scale performance benchmarks, which lose the nuance of individual human perspectives, and qualitative evaluations have the potential to provide a much-needed counterweight to bold claims about AI model performance. To solicit qualitative evaluations, we will be developing an android smartphone application that efficiently applies models to the image in front of the smartphone camera so that users without machine learning experience can see the difference between models in real-time. We believe such methods may help democratize evaluation of artificial intelligence technologies in the future.

Emersyn Kelter '25 and **Marissa Such '25**, will collaborate with **Magda James-Pederson**, Associate Professor of Biochemistry, on characterizing *Differences in AFP Gene Expression in Mouse Hep 1-6 Cells vs Normal Cells*. Alpha-fetoprotein (AFP) is a specialized protein that plays a key role in stimulating cell growth during the initial stages of mammalian development but has no function in healthy adult tissue. Normally, the AFP gene is actively expressed in healthy fetal tissue only. However, in several types of liver cancer (hepatomas) the gene is reactivated and the cellular mechanisms by which this reactivation occurs in somatic cells are poorly understood. Kelter and Such, both biochemistry majors, will expand upon the SURE research

from last year to continue characterizing the structure of the AFP locus from a mouse hepatoma cell line (Hep 1-6 cells) and compare it to the gene locus in healthy cells. One goal of the project is to analyse both the DNA sequence and the epigenetic markers around the regulatory region of the AFP locus to find changes that can account for the observed differences in gene expression. A second goal is to investigate the potential role of a novel and shorter AFP-derived mRNA product that was discovered in Hep 1-6 cells last summer but not in healthy mouse cells. Studying the structural and gene expression differences associated with the AFP gene in two distinct cell types might provide new insights into the mechanisms of tumorigenesis in mammalian hepatomas.

Hayden Kane ’25 will collaborate with **Suzanne Edinger**, Associate Professor of Management, to continue their work on a project entitled *The Relationship Between Social Support and Post-Pandemic College Student Success*. This study aims to investigate three interrelated research questions within a post-pandemic lens: how students are defining student success, if students are successfully forming relationships with faculty, staff, and fellow students, and how students are finding and facilitating these connections. The goal of the study is to determine how students can be better supported in creating and maintaining their relationships on-campus, as well as analyzing any post-COVID changes in these techniques. Findings from this study will be presented at a relevant academic conference and submitted to a peer-reviewed academic journal in higher-education.