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Stonehill Undergraduate Research Experience (SURE) Summer 2023 Projects

Twenty-three Stonehill College students will work with eleven faculty members on a variety of research projects during the summer of 2023, the twenty-seventh 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.

Emma Gallagher '25, **Elizabeth Hanna '24**, **Jace Hollenbach '25**, and **Jacob Jackson '24**, will work with **Hsin-hao Su**, Professor of Mathematics, and **Heiko Todt**, Associate Professor of Mathematics, on *Graph Labeling Problems*. The study allows undergraduate students to experience what they will encounter during a graduate program in mathematics. Emma, Elizabeth and Jace, all mathematics majors, and Jacob, an actuarial mathematics major, will collaboratively study introductory material on graph labeling and then will attempt to solve one of three problems of their choosing. If they find a solution for the previously unsolved problem, they will collaborate to write a paper to be published and presented at a national or regional conference, as well as within a peer-reviewed journal.

Anthony Ferrara, '24 will work with **John McCoy**, Professor of Neuroscience & Psychology, on a project entitled *Neural Circuits, Attention and Cognition*. The project will focus on the role of parvalbumin-containing neurons in the basal forebrain (BF). The BF represents a critical component of the default mode network, a multi-region brain circuit that is active during periods of quiet wakefulness and is silent during engagement with stimuli in the external world. Anthony's project will combine state-of-the-art optogenetic techniques with measures of electrical activity from the cortex and behavioral tests of attention and cognition. We hope to present the findings at a Northeast Undergraduate/Graduate Research Organization for Neuroscience (NEURON) conference next year.

Leah Tabor, 25' and **Brian Traves, 25**', will work with **Anwar Mhajne**, Professor of Political Science, on a project entitled *Digital Embodiments of the Women's Protest in Iran*. We will compile a database of social media posts relating to the recent protests in Iran and responses to these posts. We will analyze this data looking for how the veil, considered an important marker of Islam in all Muslim countries, was discussed on social media in response to the feminist protest in Iran. The responses to the digital artwork and data being disseminated through social media offer great insight into how religious debates, especially about feminist

issues, are framed and conducted. Social media can be a double-edged sword helping promote the protest and creating a space for censorship and backlash. We will present the project at the September American Political Science Annual Conference in LA. We received the acceptance in March.

Ryan Coutu, '24 will work with **Oltiana Muharremi**, Associate Professor of Accounting on a project entitled *Statistical Manipulation: An Analysis of Potential Economic Data Tampering in Eurasia.* Economic data is important in understanding the state of a country. It impacts foreign investment, international relations, tourism, and global perceptions of the country. However, many countries, especially those under an autocratic regime, may restrict or influence this data to exaggerate economic success. Manipulation of economic data is done mainly to improve the appearance of the country's economic state. For this project, we will analyze if and to what extent countries in both Europe and Asia manipulate data by comparing reported economic data to non-manipulatable statistics. These statistics will serve as a proxy for economic growth, and once compared to supplied economic information, we should be able to determine if countries manipulate the publicized economic data. We plan to evaluate visible-nighttime light growth, energy consumption, and motorway data as our main comparison in the analysis. The outcome of the project is to determine which countries have a history of manipulating economic data for their own interests. Our goal is to write a comprehensive research paper and present our findings at an Economic Conference in 2024.

Moussa Abboud '24 and **Guilherme Vaz '25, will** collaborate with **Magda James-Pederson**, Associate Professor of Biochemistry, on *Comparative Analysis of AFP Gene Locus in Healthy vs Hep 1-6 Mouse Cells*. Alpha-fetoprotein (AFP) is a specialized protein that plays an important role in stimulating cell growth during the early stages of mammalian development but has no function in healthy adult tissue. The AFP gene is actively expressed in fetal tissue, but it becomes inactive soon after birth. Interestingly, the AFP gene is reactivated in various types of liver cancer (hepatomas) and the cellular mechanisms by which this reactivation occurs in somatic cells are poorly understood. Abboud and Vaz, both biology majors, will expand upon the SURE research from last year to characterize the structure of the AFP locus from a mouse hepatoma cell line (Hep 1-6 cells) and compare it to the locus from healthy cells. The goal is to analyze both the primary DNA sequence, the epigenetic markers, and the transposable elements around the regulatory region of the AFP locus to determine if there are changes that can account for the observed differences in gene expression. Studying the structural differences associated with AFP gene reactivation might provide new insights into the mechanisms of tumorigenesis in mammalian hepatomas. The research team hopes to present the findings at the annual Eastern New England Biological Conference.

Kaiyun Yao '24, Jamie Baker '25, and **Tyler Deslouches '24** will collaborate with **Bronwyn Bleakley**, Professor Biology, on *Ecophysiology of 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 influence of the social partner's behavior and how responsive the focal fish is to that partner. We do not know which aspects of a fish's physiology (hormone levels and/or sensitivity to visual, chemical, or mechanosensory cues) combine to make a fish cooperative. Yao and Baker, both Biology majors, and Deslouches, a Health Science major, will quantify the correlations between visual and mechanosensory sensitivity, hormone levels, and cooperative antipredator behaviour in families of fish from different populations. We plan to present results from this experiment at the Evolution Meeting in 2024.

Caitlin Swanson '24 and **Cedric Henry** '24 will collaborate with **Bronwyn Bleakley**, Professor of Biology, on *Influence of Light Pollution on Burying Beetle Parental Care and Physiology*. American Burying Beetles (*Nicrophorus americanus*) are an IUCN and US Fish and Wildlife-listed endangered species. The factors precipitating their decline remain mysterious, although climate change, pollution, and habitat alteration, including light pollution, all likely play a role. Swanson and Henry, both Biology majors, will investigate the effects of light pollution on the distribution of *Nicrophorus orbicollis*, the closest relative of *N. americanus,* using mark/recapture studies in the field. Additionally, they will use darkling beetles (*Zophobas morio*) that are commercially available, nocturnal, and developmentally similar to *Nicrophorus* to investigate the immunological effects of light exposure during pupation. We plan to present results from this experiment at the Evolution Meeting in 2024.

Christian F Leonard '25 and **Charles Dwyer '25** will collaborate with **Guiru Gu**, Associate Professor of Physics, on *Artificial Intelligence (AI) Based Object Detection Using Edge Computing.* Edge computing technology with compact computers provides new enabling capabilities for drones in numerous applications such as farming, infrastructures sensing, monitoring, and assessment during emergencies or disasters, etc. This project aims to develop integrated AI-object detection capabilities using the edge computing platforms such as Jetson Nano and Raspberry Pi. In this project, we will develop AI-object detection programs using edge computing platforms such as Jetson Nano and Raspberry Pi. All the related experiment test will be performed in the photonics lab LEAP with the new state-of-the-art Photonics equipment.

Rebecca Gracia '24, will work with **Leon Tilley**, Professor of Chemistry on *Asymmetric Nucleophilic Di- and Trifluoromethylation Reactions Using Chiral Alkoxide Initiators*. Trifluoromethyl alcohols and their derivatives represent an important sector of pharmaceuticals as they can exhibit anti-inflammatory, anti-diabetic, and anti-HIV activity. The chirality, or handedness of molecules is a property that is of vital importance in the way they interact in biological systems. Because the efficacy of a drug can be (and usually is) highly dependent on chirality it is desirable to develop methods for stereospecific addition of CF_3 groups to synthesize the corresponding alcohols with a high enantiomeric excess (ee) of the desired stereoisomer. Gracia, a chemistry major, will investigate the stereoselective ability of a series of chiral alkoxides on a variety of substrates for their potential to initiate di- and

trifluoromethylation reactions of carbonyl compounds to produce the corresponding chiral alcohols. She will present her results at an upcoming American Chemical Society national meeting and/or publish in a peer-reviewed journal.

Isabella Rossetti '24 will work with **Leon Tilley**, Professor of Chemistry, on *Development of Antidihydroxylation Methods for Polyhydroxylated Indolizidines* from the sugars *D-Allopyranoside* which will be prepared from the commercially available sugar D-Glucopyranoside. Over a period of several years, the research group of Louis Liotta, retired Professor of Chemistry, has developed ways in which to convert sugars into medicinally interesting sugar analogs known as iminosugars. Polyhydroxylated indolizidines are one class of iminosugars involving a six-atom ring structure fused to a five-atom ring structure with multiple hydroxyl groups (O-H groups) attached. Previous research has resulted in the ability to attach two of the O-H groups from the same side of the structure (called syn addition). This research hopes to expand upon this previous work by developing a means to add two O-H groups from opposite sides of the structure (called anti addition). Rossetti, a chemistry major, will be responsible for synthesizing, purifying and characterizing all intermediates as well as the final target iminosugars. The she hopes to publish her findings in the Journal of Organic Chemistry and/or present at an upcoming American Chemical Society (ACS) conference.

Ana Paula Sudario '25 will work with **Leon Tilley**, Professor of Chemistry, on *Synthesis and Study of Electron-withdrawing Group Substituted Nitroxyl Radicals and Oxoammonium Salts*. Nitroxyl radicals and oxoammonium salts are emerging as important compounds with uses ranging from green oxidants to spin labels for tracing biological activity in vivo, and even dopants for solar cells. 2 4-Acetylamino-2, 2, 6, 6-tetramethylpiperidine-1-oxoammonium tetrafluoroborate, also known as "Bobbitt's salt, can be utilized for a variety of purposes including oxidation of alcohols (to aldehydes, ketones, and carboxylic acids. Unfortunately, it will not oxidize trifluoromethyl alcohols to the corresponding trifluoromethyl ketones (TFMKs) unless it is used in large excess, and then only with some difficulty. Recent literature has indicated that electron-withdrawing groups (EWGs) can enhance the oxidizing ability of nitroxyl radicals and oxoammonium salts. Consequently, Sudario, a biochemistry major will be continuing syntheses initiated by previous research students to prepare some novel difluoro- and trifluoromethyl substituted nitroxyl radicals and oxoammonium salts. The oxidizing capability of these compounds will then be examined. She will present her findings at an ACS national meeting and ultimately hopes to publish them in a peer-reviewed journal.

James Doherty '24 will work with **John Duggan**, Associate Professor of Business Law on a project entitled *Privacy in Non-profits: An Analysis of Residential Address Disclosure in the Formation of Non-Profit Entities in Massachusetts.* This project seeks to understand the governmental interest of state regulatory and compliance bodies in requiring incorporators of non-profit organizations to publicly disclose the residential address of each incorporator in their articles of incorporation. Specifically, we will look at the effects of this requirement, and those

like it in other states, in light of the recent United States Supreme Court opinion in *Ams. for Prosperity Found. v. Bonta*, 141 S. Ct. 2373 (2021). This requirement may be ripe for reconsideration by state legislators, or court challenge by impacted parties, as the Commonwealth implies in its public guidance that there may not be a compelling governmental interest in collecting this data.

Julia Bennett '25 and **Margaret Gallagher '25** will collaborate with **Nicholas Block**, Associate Professor of Biology, on a project entitled *Assessment of Crescent Butterfly Species Limits in New England*. They will examine the extent of gene flow in New England between the Pearl Crescent and Northern Crescent, two small, orange-and-black butterfly species found across much of the United States and Canada. The project will involve learning research skills related to field work, lab work, and bioinformatics, as the students will collect specimens from throughout New England, extract and sequence DNA, and analyze the resulting genetic data.