Stonehill Undergraduate Research Experience (SURE) Summer 2018 Awards

Forty-nine Stonehill College students will work with twenty-three faculty members on a variety of research projects during the summer of 2018. The Stonehill Undergraduate Research Experience (SURE) program 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.

Sydney Martin '19 and **Samantha Mauro '19** will work with **Leyda Almodovar**, Assistant Professor of Mathematics, and **Heiko Todt**, Associate Professor of Mathematics, on *Design of Self Assembling DNA Complexes*. Recent advancements in nanotechnology and new laboratory techniques involving DNA strands have highlighted the usefulness of formal graph theory. In this project, the students will first collaboratively study introductory material to obtain basic knowledge and skills in graph theory. Using this knowledge, the students will then explore several ways of constructing lattice-based DNA complexes. Martin and Mauro, both mathematics majors, will choose a problem to solve during the summer. If solved, they will write a mathematical paper and share it in a peer-reviewed journal. They also hope to present their findings at a national or regional conference.

Abigail Bosse '19 and **Lauren Wallace '19** will work with **Rebecca Babcock Fenerci**, Assistant Professor of Psychology, on *Maternal Attachment Coping & Health (MATCH)*. This project hopes to build on prior research done by Babcock Fenerci by examining how thoughts related to a mothers' own experience of maltreatment may affect their own parenting behavior as well as child attachment, emotional regulation, and mental illness. The students will recruit and collect multi-method data with mothers and children from the community and prepare for the continuation of the project during the 2018-2019 academic year. Bosse, a psychology major, will conduct analyses to examine whether children's attachment styles may be influenced by mothers' maltreatment-related cognitions. Wallace, a psychology and sociology double major, will analyze the data to see if mothers who have witnessed domestic violence in their own childhoods endorse certain maltreatment-related appraisals. The students will write a manuscript for submission to a peer-reviewed journal and perhaps present their findings at a national or regional conference.

Caroline Colbert '19 will work with **Bronwyn Heather Bleakley,** Associate Professor of Biology, **and Brian Haney**, Teaching and Research Fellow, on *Effects of Light Pollution on Reproductive Success of Burying Beetles*. To better understand the ecological challenges facing the critically endangered American burying beetle, this project proposes to investigate the effects of light pollution on the reproductive and parental care behavior of their closest relative, which is abundant on the Stonehill campus. The research team will set up "light traps" and observe if the beetles are attracted to the artificial light source of various colors and collect data on the beetles. They will then compare that data to the data collected on a population of beetles in an unlit area. Colbert, a biology major, will be responsible for the husbandry of the beetles, behavioral observations, the trapping and census of the beetles, record keeping and data organization, and statistical analysis of the data. She will submit these results to a refereed journal for publication.

Nicholas Perry '19 will work with **Nicholas Block**, Assistant Professor of Biology, on *A Genomic Investigation of Despeciation in a Passerine Bird*. Despeciation is the merger of formerly isolated genetic lineages. This merger is suspected to occur in vertebrates when humans alter habitat or introduce non-native species to an area. The team will analyze genome-level data from 48 samples of *Xanthomixis zosterops*, a Malagasy passerine bird that appears to be undergoing despeciation. Perry, a biology major and data science minor, will be responsible for many tasks, including preparation of the DNA samples for sequencing, learning and implementing a number of Python coding scripts, and processing and analyzing the genomic data to estimate levels of gene flow. The ultimate goal of this project is a science research journal publication.

Nicolette Kolgraf '19 and **Siobhan McKenna '19** will work with **Linzy Brekke-Aloise,** Associate Professor of History, on *The Revolutionary History behind Hamilton: An American Musical*. Through the group's examination of the primary source documents of Alexander Hamilton, Aaron Burr, George Washington, Thomas Jefferson, and Abigail and John Adams, Brekke-Aloise will author a book that provides a concise, readable narrative analyzing the tumultuous 18th century history behind the musical "Hamilton". They will also transcribe, edit, and annotate select primary source documents for inclusion in the appendix, for use in high school and college classrooms. Kolgraf, an English major with a background in musical theater, will be responsible for the English editorial work, summarizing, and writing introductions to help students interpret the musical. McKenna, a history major, will analyze the documents to determine which are appropriate for wide audiences and for inclusion in the finished book.

Taylor Auletto '19 will work with **Nicole Cyr,** Assistant Professor of Biology and Neuroscience, on *Role of Cellular Stress in Obesity*. Neuropeptides produced in the brain are known to regulate appetite. This project will investigate how the appetite-suppressing neuropeptide alpha-MSH is altered in obesity. Auletto, a biology major, will determine if endoplasmic reticulum (ER) stress, caused by obesity, impairs the production of alpha-MSH in neurons; and whether drugs that alleviate ER stress can reverse those changes. Auletto will be responsible for conducting techniques and assays such as sterile technique, tissue culture, cDNA transfections, ShRNA knockdown, Western Blots, and Immunofluorescence.

Catie Cutia '19 will work with **Nicole Cyr,** Assistant Professor of Biology and Neuroscience, on *Effects of mTOR on Hypothalamic Synapses.* Leptin is a hormone that acts in the hypothalamus (brain) to suppress appetite. However, during obesity, leptin resistance occurs such that the hypothalamus no longer responds to leptin. This project will focus on how mTOR (an energy sensor) impairs leptin's actions on synapses in the hypothalamus to worsen the obese condition. Cutia, a neuroscience major, will continue her research from SURE 2017, running all the assays, analyzing her data, and will report her results in a formal paper. She will also be responsible for helping the new members of the lab, thus learning leadership and mentoring skills.

Monica Kashi '19 will work with **Nicole Cyr,** Assistant Professor of Biology and Neuroscience, on *Role of Prohormone Convertase 2 in Obesity.* This project will research cellular changes in the hypothalamus of the brain that can alter POMC processing. Processing of POMC is known to be essential to maintain typical body weight. This study aims to understand how the obese condition alters the POMC processing enzyme PC2. The experiments conducted hope to target specific chemicals as prospective drugs to reverse or prevent obesity. Kashi, a neuroscience major, will learn how to design and conduct an experiment and to analyze data properly.

Zarir Sidhwa '19 will work with **Nicole Cyr,** Assistant Professor of Biology and Neuroscience, on *The Role of POMC Processing in Obesity*. In this project, the researchers hope to better understand the changes that occur in POMC neurons when exposed to high levels of long-chain saturated fatty acids and their relationship to obesity. POMC is a protein that regulates body weight, and obesity can cause these POMC neurons to die. Sidhwa, a biology major, will conduct experiments to determine if the presence of fatty acids, such as those found in palm oil, butter, cheese, milk, and meats, cause the neurons that produce POMC proteins to die off.

Elizabeth Ventura '20 will work with **Nicole Cyr,** Assistant Professor of Biology and Neuroscience, on *The Role of Two Major Biochemical Pathways in Obesity*. The team has hypothesized that the increase in hypothalamic Sirtuin (an energy sensor) during obesity blocks the action of the mTOR pathway and causes weight gain. This will be the first study to measure the effect of Sirtuin1 on mTOR in the hypothalamus during obesity. Ventura, a neuroscience major, will be responsible for conducting techniques and assays such as sterile technique, tissue culture, cDNA transfections, ShRNA knockdown, Western Blots, and Immunofluorescence.

The results of the research of Auletto, Cutia, Kashi, Sidhwha, and Ventura project will hopefully be presented at the NEURON conference next year.

Hannah Baxter '19 and **Molly Jones '19** will work with **John Duggan,** Assistant Professor of Business Law, on *Massachusetts Benefit Corporations- An Analysis of Social Benefit*. This project will analyze the current legal research and commentary on Benefit Corporations and determine whether the designation is accomplishing its promise. A Benefit Corporation is a domestic for-profit corporation, which strives to achieve a social benefit in addition to profit. This project will locate corporate findings, evaluate a corporation's compliance with the Massachusetts Benefit Corporation Act, and assess the impact of the Benefit Corporation status on consumers. Baxter, an accounting major, and Jones, a management major, will be responsible for individual research and analysis that will then be further discussed with the whole team. They hope to publish their findings in the Business Law Review, American Business Law Journal or other regional law review and may also be presented at the annual NARBLA conference.

Lena Ottati '19 and **Emma Patten '19** will work with **Jungyun Gill**, Assistant Professor of Sociology, on *Feminism in the Era of Trump.* This project will focus on the motivations of college students who participated in the Women's March on January 21, 2017, the effects it had on them, and any activism they have participated in since the march. Ottati and Patten, both Sociology majors and Gender and Sexuality Studies minors, will be responsible for researching literature about the history of activism on college campuses and feminist movements. They will also be responsible for conducting approximately fifty in-depth interviews with students of colleges and universities in the New England and New York areas. The team hopes to present their research at the 2019 Eastern Sociological Society meeting and to co-author a paper to be submitted to an academic journal such as *Feminist Studies* or *Mobilization*.

Elijah Morris '19 and **Joseph Varney '19** will work with **Martha Hauff**, Assistant Professor of Biology, on *Little Fish with a Big Impact: Early Life Dynamics of Sand Lance in the Gulf of Maine.* The sand lance, a key forage fish species in the Northeast Atlantic shelf ecosystem, is a critical food source for some of our most iconic local marine fauna (humpback whales, bluefin tuna, seabirds, and cod). This project will look at the influence of habitat characteristics and seasonality on larval and juvenile sand lance growth and survival, allowing for an in-depth examination of sand lance population dynamics and variability. Morris and Varney, both biology majors, will have the opportunity to carry out field collections on oceanographic expeditions on the research vessel, R/V Tioga. They will conduct taxonomic and growth analyses of their collected samples back in the labs at Stonehill and Woods Hole Oceanographic Institution (WHOI). Their findings will be presented at a biological research symposium at WHOI and will contribute to peer-reviewed publications written in collaboration with colleagues at WHOI and the University of Connecticut.

Kalyani Twyman '20 will work with **Martha Hauff,** Assistant Professor of Biology**,** on *Coral Chorus: The Role of the Soundscape in Coral Reef Larval Recruitment and Diversity*. This project will examine the variation in biologically mediated reef noises among different reef habitats and will investigate the role those noises play in attracting new larvae and sustaining the reef ecosystems. This research should help to elucidate our understanding of reef community dynamics over time and facilitate management measures needed to protect or replenish these imperiled habitats. Twyman, a biology major, will be responsible for lab work at both Stonehill and WHOI, and their findings will be presented at a biological research symposium at WHOI and will contribute to a peer-reviewed publication prepared with WHOI collaborators.

Marissa Beachell '19 and **Claire Shamber '20** will work with **Rachel Hirst,** Associate Professor of Biology, on *Comparative Genomic Analysis of Methylobacterium Species Associated with Mycorrhizal, Saprophytic and Parasitic Fungi Found in Southeastern Massachusetts.* Over the years, the Hirst lab and the Magdalena James Pederson SURE labs have identified a strain of Methylobacterium (a pink bacteria) that lives in association with numerous genera of fungi. The fungi have been sorted into three categories; mycorrhizal (associated with plant roots), saprophytic (feed on decaying matter), and parasitic fungi (feed on live plant host). This project hopes to determine if there are different metabolic capabilities between Methylobacterium species that associate with mycorrhizal fungi versus the species that associate with saprophytic and parasitic fungi. To answer this question the researchers will use a technique called comparative genomics, which allows scientists to analyze and compare genetic information to determine the similarities and differences between organisms. They will also use Pathosystems Resource Integration Center (PATRIC), a genomics database designed to assist scientists in comparing bacterial genomes. Beachell and Shamber, both biology majors, will become proficient in laboratory procedures and techniques, maintain an organized lab notebook, design and carry out experiments, and participate in data analysis and interpretation. The findings of this research will be presented at the 2018 SURE poster session as well as the 2019 Eastern New England Biology Conference.

Rachel Henshaw '19 will work with **Rachel Hirst,** Associate Professor of Biology, on *Metagenomics Analysis of Microbial Communities Associated with Mycorrhizal and Saprophytic Fungi.* This project will research the overall structure of microbial communities found associated with mushroom-forming fungi and determine if the composition differs between mycorrhizal, saprophytic, and parasitic fungi. The researchers will use a sequencing technique known as metagenomic analysis to study the genetic material recovered directly from the environmental samples of mushrooms. Henshaw, a biology major, will be responsible for taking an active role in designing and carrying out experiments, as well as data analysis. She will also be responsible for attending biweekly meetings with all members of the lab and give a short presentation on her results. Their research will be a part of Henshaw's thesis, presented at the Eastern New England Biology Conference, and eventually published in a journal such as *Applied and Environmental Microbiology*.

Nicolas Cannavo Berrazueta '20 and **Jaisil Chacko '20** will work with **Jane Hyo Jin Lee,** Assistant Professor of Mathematics on *Molecular Dynamics Simulation of Water.* This project will study the dynamics of water molecules in the process of water's state change from ice (solid), to liquid, and then to steam (gas). They will use Molecular Dynamics (MD) a computer simulation method to study the movement of the atoms and molecules. Berrazueta, a computer science major, and Chacko, a computer engineering major will be responsible for designing the simulation, running the program, and collecting and analyzing data. The research findings will be presented at a American Chemical Society meeting or at a regional mathematics conference in Spring 2019.

Stephanie Bryson '20, **Katie Bucking '20, Jessica Massey '19, Meredith Pomfret '19** and **Brian Purisky '20** will work with **Professor Louis Liotta,** Professor of Chemistry on various synthesis projects. Over a period of several years, Liotta's research groups have developed ways in which to convert commercially-available sugars into pharmacologically interesting iminosugars. During this summer, his group hopes to expand synthetic methodologies to include more highly hydroxylated polyhydroxylated indolizidines. Bryson and Pomfret biochemistry majors, Bucking, a chemical engineering major and Massey, a chemistry major, will all be responsible for synthesizing, purifying and characterizing different but related tetrahydroxylated indolizidines from different starting sugars. Purisky, a chemical engineering major, will learn how to use the recently acquired Quadrupole Time of Flight Mass Spectrometer, becoming the resident expert on using the instrument. He will then run samples from Liotta's group research. The group's findings will hopefully be published in the Journal of Organic Chemistry and/or presented at an upcoming ACS conference.

Will Gilmore '20, will work with **Pamela Lombardi**, Assistant Professor of Chemistry, on *Synthesis of a New of Chiral N-Heterocyclic Carbene Ligand for Catalysis.* Molecules are said to be chiral if they have a non-superimposable image. Reactions to produce these molecules often result in two mirror images, or enantiomers, which can be problematic if the biological activity of one is different from the other. Therefore, producing one enantiomer is the preferred objective. N-Heterocyclic Carbenes (NHCs) are often used as ligands in metal-catalyzed reactions. Gilmore, a chemistry major, will continue synthesis work completed during previous SURE research. He will attempt to synthesize a triamine, but beginning with diphenylethylenediamine, which is new to the process and compare the results to earlier reactions. He will then test the new NHC in a benzoin condensation reaction to test reactivity. Gilmore would like to present his findings at an ACS conference.

Leslie Clapp '20 will work with **John McCoy**, Professor of Psychology, on *Role of Sleep Spindles in Memory Consolidation (Part 2)*. This project will build upon research conducted previously regarding the effect that sleep spindles have on memory consolidation with a specific focus on a site in the brain called the thalamic reticular nucleus (TRN). The project will utilize a technique called optogenetic stimulation to determine if the facilitation of spindle activity in the TRN neurons at specific times during sleep might improve attention and memory. Clapp, a neuroscience major, will learn both the optogenetic techniques, as well as behavioral methods to assess attention and memory.

Sarah Jacobson '20 will conduct research with **John McCoy,** Professor of Psychology, on *Sleep Spindle Dysfunction in Schizophrenia and Bipolar Disorder*. Disturbances in sleep are seen in illnesses such as schizophrenia and bipolar disorder. Perineuronal nets (PNNs), which surround and protect TRN neurons, have been found to be decreased in the brain tissues of patients diagnosed with either schizophrenia or bipolar disorder. Jacobson, a neuroscience major, will conduct research to determine if these PNNs, play a crucial role in sleep spindle formation. This will be done by injecting enzyme known to alter the composition of PNNs, and then measuring how this alteration affects sleep/wake states, as measured by EEG/EMG recordings.

Alana Johnston '20 will work with **John McCoy,** Professor of Psychology, on the Role of Interleukin -18 in Sleep Homeostasis. Sleep loss alters the immune system in potentially deleterious ways. One response to sleep loss is the enhancement of certain brain inflammatory molecules. However, the exact mechanisms which regulate this process are unknown. This project will investigate the role of the nucleotide-leucine rich protein 3 (or NLRP3) inflammasome and the molecule interleukin-18 in sleep homeostasis. The sleep patterns of mice that lack the NLRP3 inflammasome and interleukin-18 will be studied. Johnson, a neuroscience major, will utilize molecular techniques such as polymerase chain reaction, immunohistochemistry, and fluorescent cell sorting in this project.

The research of Clapp, Jacobson, Johnston, and McCoy will be conducted at the Neuroscience Laboratory at the West Roxbury VA Medical Center. The outcomes of these studies will be presented in posters at a NEURON conference. Data will also be used in presentations at national conferences, for scientific journal articles and grant submissions.

Tim DeLouchrey '19, Paige Ferreira '19, and **Chase LeMay '19** will work with **Anna Ohanyan**, Associate Professor of Political Science, on *Empire Strikes Back: The Imperial Roots of Regional Fracture.* This project will build upon prior work done by Professor Ohanyan in 2015 to examine the dynamics of regionalism in areas of armed conflicts, either active or "frozen". The researchers will conduct a comparative analysis of conflict regions to understand the conditions under which some of such regions overcame political cleavages and develop region-wide ties, while others struggle to do so. DeLouchrey, a political science major, will focus on the Ottoman Empire, the Russian Empire, and the Soviet Union. LeMay, a political science and criminology double major, will concentrate on armed conflicts in Turkey and in Russia's neighborhoods. Ferreira, a political science and French double major, will examine the literature on the imperial legacies of contemporary ethnic conflicts in general. The outcomes of this research will be presented at the International Studies Association Conference in 2019, regional conferences around New England, Professor Ohanyan's forthcoming edited volume, *Russia Abroad: Driving Regional Fracture in Post-Communism Eurasia and Beyond,* as well as in some of her articles currently in progress.

Emily Langmeyer '20 will work with **Irvin Pan**, Assistant Professor of Biology, on *Examination of Leaf Development Genes and Convergent Evolution in Carnivorous Pitcher Plants.* This project seeks to continue work begun last summer examining the evolution of modified leaves in carnivorous plants. The research will be conducted in the on-campus greenhouse and in the laboratory. Langmeyer, a biology major, will be responsible for many tasks including, growing and caring for plants in the greenhouse, collecting tissue, extracting DNA and RNA, and analyzing expression of various leaf development genes.

Meghan Curran '20, Claire Farnan '19, **Peter Giannini '20**, **Kyle Paquette '19** and **Anna Pinckney '19** will work with **Dan Rogers**, Assistant Professor of Chemistry, on *Evaluating Three Different Oyster Aquaculture Methods for N-Remediation.* Using information gathered from previous year's SURE projects, the team will install three oyster culture systems (floating bags, rack-mount systems, and bottom cages) in Waquoit Bay. The systems will be evaluated to determine their ability to remediate nitrogen levels in their surrounding waters and sediments. Giannini, a chemical engineering major will build flux chambers and run isotope pairing analyses. Curran and Farnan, both chemistry majors, will be responsible for collecting sediment and water samples and testing their carbon, nitrogen and isotopic levels. Pinckney, an environmental science major will measure water column parameters and collect samples for DNA and RNA analysis. Paquette, a chemistry major, will determine water column and pool water dissolved inorganic carbon and take oyster tissue samples for analysis. During the summer, the team will work closely with collaborators from the Woods Hole Oceanographic Institute and the Town of Falmouth. Students will have the opportunity to present their findings in scientific and public settings.

Michaela Sullivan '19 will work with **Cheryl Schnitzer**, Associate Professor of Chemistry on *Measuring Ultrafast Phenomena.* The team has set forth three goals for the project. First, they hope to determine the pulse length accurately of the laser system located in the Shields Science Building by building a device called GRENOUILLE. Next, they will continue work from previous summers using Second Harmonic Generation (SHG) to ensure the overlap of the pump and probe beams in space and time. Finally, working with Ruby Gu (Physics Department, Stonehill College) and Xuejun Lu (Electrical and Computer Engineering, UMass Lowell) they will use Stonehill's femtosecond laser system as a test system for UMass's detector prototype. Sullivan, a chemistry major, will also be responsible for operating the laser system and will serve as an expert on the SHG experiment. The team will present their findings at the American Chemical Society meeting and hope to publish their work.

Madalyn Fernbach '19 will work with **Jennifer Segawa**, Assistant Professor of Neuroscience and Biology, on *EEG Measures of Speech Motor Control in Stroke Recovery.* In stroke survivors, the loss of speech motor control - the physical ability to communicate with others - strongly correlates with a lower quality of life. It has been proposed that when a stroke impairs the left hemisphere of the brain (where speech and language skills are controlled), patients recover more quickly when the right hemisphere takes over language. Others believe that language moves to the frontal region of the left hemisphere. This project aims to understand how these compensation patterns affect speech motor control recovery and its relationship to a patient's higher-level language skills and non-speech motor control. They will measure the patient's brain function using electroencephalography, or EEG. Fernbach, a neuroscience major, will be responsible for learning ethics of using human subjects, conducting EEG research, and collaborating with Segawa to create the study design.

Samuel Perreault '19 will work with **Leon Tilley,** Professor of Chemistry, on *Synthesis of Diflourobicyclobutane.* Many pharmaceuticals contain fluorinated moieties, as fluorine can favorably alter the properties of drugs to increase lipophilicity, provide novel biosteres, and increase metabolic stability. This project plans to test the viability of electron withdrawing CF2H group to prepare difluorobicyclobutane. Perreault, a biochemistry major, will continue his research by adding an appropriate leaving group to the precursor alcohol and solvolyzing. This research will be presented at the ACS National Meeting in March 2019.

Victoria Rapela '20 will work with **Leon Tilley**, Professor of Chemistry, on *Synthesis of Electron-Withdrawing Oxammonium Salts.* 4- Acetylamino -2,2,6,6-tetremethylpiperidine-1-oxoammonium tetrafluoroborate, also known as "Bobbitt's Salt" is recently emerging as an important green oxidant. It can be used for the oxidation of alcohols, amines, and a variety of other transformations. This project proposes to synthesize some novel derivatives of Bobbitt's salt which would be sufficiently strong to oxidize alkyl trifluoromethyl alcohols. Rapela, a biochemistry major, will be responsible for designing and conducting synthetic organic reactions, monitoring the reactions, and for purifying and characterizing her products. This research will be presented at the ACS National Meeting in March 2019 and will ultimately be published in a peer-reviewed journal.

Robert Giannelli '20 and **Rebecca Merkel '19** will work with Anamika Twyman-Ghoshal, Associate Professor of Sociology and Criminology on *Contemporary Maritime Piracy—Understanding Highest Piracy Incidence Countries*. Maritime piracy has evolved over time and still remains a challenge, occurring in over 90 countries in the past two decades. Twyman-Ghoshal has researched piracy trends around the world, created the Contemporary Maritime Piracy Database, and developed a list of highest piracy incidence countries (HPICs). This research project hopes to further understand contemporary piracy by exploring these HPICs. Giannelli, a psychology major, will focus on Indonesia, India, and Bangladesh, while Merkel, a criminology and foreign languages double major, will focus on China, Guatemala and Nigeria. The research team will compile information on the nature of piracy using existing data sets and qualitative data. They will write papers on the HPICs researched and will hopefully present their findings at a regional criminal justice conference.