FALL UNDERGRADUATE **RESEARCH FAIR**

Information Booklet

Thursday, October 26, 2023
Jordan Hall of Science
University of Notre Dame

UNIVERSITY OF NOTRE DAME | SCIENCE

College of Science – Fall Undergraduate Research Fair 2023

Welcome!

The purpose of this event is to provide science students with an opportunity to get many of their questions answered about undergraduate research. Not only about how to get more involved in research, but also how to get more out of the research experience itself.

Throughout and beyond the College of Science, there are many different ways in which students can get involved in research. Often it's just a question of looking in the right places and being persistent in the hunt for the right opportunity. However, getting the right opportunity is also about getting as much information as possible from a diversity of sources. This could be as simple as a fellow student but there are many organizations, institutes, and centers on campus that are also more than willing to help a student find and support their research endeavors. Furthermore, there are many ways for students to get even more out of their research experience, through publishing and presenting their research to their peers.

Through a combination of listening to speakers, poster presenters, and representatives from various institutions, students should be able to get some ideas about how best to get started looking for research opportunities. Also, students should be able to see how they can add value to their research experience by participating in other related activities. The sooner a student begins the search, the sooner they will be able to start participating in undergraduate research and getting the most from that experience!

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Thursday Oct 26th, 2023 | Jordan Hall of Science

6 – 7 pm: Undergraduate Research Opportunities in Chemistry (UROC), **101 Jordan**

7 – 8 pm: Information tables and research posters, **Galleria**

8 – 9 pm: Undergraduate Research Internship Information Night (UGRIIN), **101 Jordan**

Oral Presenter Information

UROC

Steven Wietstock, Ph.D., Teaching Professor, Department of Chemistry & Biochemistry

UGRIIN

T. Mark Olsen, Ph.D. Associate Teaching Professor, Department of Biological Sciences

Ashley Zolfaghari, azolfagh@nd.edu (Plenary speaker)

Ashley, a Senior Biology major with a minor in Digital Marketing, will talk about types of research opportunities, internship strategy (searching, applying, etc.) as well as her internship experiences (ND's Vaughan lab researching Niemann-Pick Type C Disease, Andersen lab at the Scripps Research Translational Institute in San Diego studying the Zika and SARS-Cov-2 viruses)--work that has culminated in authorship in a peer-reviewed journal. Ashley plans on earning her PhD in microbiology/virology, then working for a biotechnology or pharmaceutical company.

Maeve Murdock, mmurdoc4@nd.edu

Maeve, a Senior Biology major with minors in STV and Entrepreneurship, has conducted research in ND's Hyde Lab (role of the human epidermal growth factor receptors HER4 and HER9 in retinal regeneration) and an internship in epigenetic oncology in the Shilatifard Laboratory at the Department of Biochemistry and Molecular Genetics at Northwestern Feinberg School of Medicine. Maeve, Founder & President of ND's Biotech Club and Technical Market Analyst at the IDEACenter, looks to work in biotech strategy consulting after graduation.

Clayton Glasgow, cglasgow@nd.edu

Clayton, a Senior Environmental Sciences major with minors in Sustainability and Latino Studies, looks to pursue a graduate degree in ecology/conservation biology after graduating from ND. Clayton has had a variety of research experiences including a National Oceanic and Atmospheric Administration (NOAA) Hollings Scholarship Program where he contributed to an ongoing NOAA project by developing and implementing a study of drone efficacy in monitoring oyster reefs. At the conclusion of the summer internship, he and other NOAA undergraduate interns presented their work to peers and NOAA scientists in Washington D.C. Clayton has also conducted research in two ND labs: the McLachlan Lab studying coastal salt marshes and the Torres-Dowdall lab studying phenotypic plasticity in fishes.

Information Tables – Jordan Galleria

Berthiaume Institute for Precision Health | precisionhealth.nd.edu

Berthiaume Institute for Precision Health is a community of affiliated researchers who tackle a wide range of biomedical and environmental health through innovation, invention, and real-world applications.

IPH awards up to four undergraduate Feinstein Institute for Medical Research (FIMR) – Precision Medicine Research Fellowships. These fellowships are competitive awards given to highly qualified undergraduate and graduate students from Notre Dame that enable them to spend eight weeks in summer residence conducting laboratory and clinical research at the Feinstein Institute in Manhasset, New York. The fellowships are concurrent with FIMR's existing visiting scholars program, which takes place from approximately June 1 to July 31 each year. Each student receives a stipend to cover daily living expenses. The cost of transportation to and from FIMR and their home or campus is covered (within reason and subject to approval). The Feinstein Institute provides apartment housing on the institute's campus, which is a 30-minute train ride from New York City, at no cost to the fellows. These fellowships afford Notre Dame Students an opportunity to experience hands-on research in a world-class setting.

Contact: Corrine Hornbeck chornbec@nd.edu, Administrative Assistant

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Eck Institute for Global Health | globalhealth.nd.edu

The Eck Institute for Global Health (EIGH) is a university-wide enterprise that recognizes health as a fundamental human right and endeavors to promote research, training, and service to advance health standards for all people, especially people in low and middle-income countries, who are disproportionately impacted by preventable diseases. The EIGH is a cross-disciplinary group of faculty whose research and teaching are dedicated toward finding and implementing solutions to global health challenges. Over 85 faculty affiliates serve the Institute's global mission to promote research, training and service. Education and training opportunities within the EIGH include the Global Health Case Competition, the Global Health Minor, the Master of Science in Global Health program, and the Global Health Research Associate program. The EIGH also offers funding for research and travel for faculty and students including graduate student fellowships, Travel Grants for Research, and the Undergraduate Research Support Program.

Contact: Katharyn Hutson eigh@nd.edu, Institute Coordinator

Flatley Center for Undergraduate Scholarly Engagement (CUSE) | cuse.nd.edu

The Flatley Center for Undergraduate Scholarly Engagement, or CUSE, guides Notre Dame undergraduates in the process of scholarly discernment and advises them on how best to identify or create opportunities for experiential learning, especially research; secure University and external funding to support such opportunities; and prepare competitive applications for national fellowships, all with the aim of transforming themselves and their communities in the pursuit of human flourishing and the common good.

Contact: Kathleen Schuler cuse@nd.edu, Associate Director for Student Engagement

Harper Cancer Research Institute | HarperCancer.nd.edu

Investigators in the Harper Cancer Research Institute (HCRI) are dedicated to conducting innovative and integrative basic cancer research that confronts the complex challenges of cancer. HCRI utilizes an interdisciplinary approach to cancer research. Students in our labs work across scientific fields on project collaborations. Over sixty HCRI faculty members bridge the College of Science, College of Engineering, College of Arts and Letters, and the Indiana University School of Medicine-South Bend. Some of the research projects currently taking place on campus involve using nanotechnology to better target chemotherapeutics, searching for new cancer markers and targets, reducing side effects of chemotherapy, and developing less expensive and more accurate diagnostics. Research cures cancer.

Contact: Angela Cavalieri cavalieri.2@nd.edu, External Relations and Special Events Program Coordinator.

Hillebrand Center for Compassionate Care | compassionatecare.nd.edu

The Hillebrand Center at Notre Dame works to restore the spirit of compassion in healthcare by advancing the application of the science of compassion at every level of medical training and practice to transform clinician well-being and patient care.

Contact: Rose Carroll rcarrol4@nd.edu, Operations and Strategic Coordinator

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Indiana University School of Medicine – South Bend | medicine.iu.edu/southbend

Indiana University School of Medicine – South Bend (IUSM-SB) is a regional campus of the Indiana University School of Medicine. This four-year regional campus is located on the corner of Angela Blvd. and Notre Dame Avenue across from the main entrance to the University of Notre Dame (UND) campus. Our campus offers research opportunities for undergraduates in the basic sciences, Biology, Chemistry, and Biochemistry with an emphasis on medically related research projects in cancer, infectious disease, and neurosciences. The research programs are led by IUSM-SB faculty members who have adjunct ND Faculty positions and consist of ND undergraduates, ND graduate students, and IUSM-SB post-doctoral fellows and technical staff. Information on research opportunities and the various laboratories can be found at medicine.iu.edu/southbend/research/research-faculty.

Contact: Jenifer Prosperi jprosper@nd.edu or jrprospe@iupui.edu, Associate Professor

Institute for Scholarship in the Liberal Arts (ISLA)

The Institute for Scholarship in Liberal Arts provides grants to students who wish to pursue independent research or creative projects. Together with the College of Science, ISLA also offers the DaVinci Multidisciplinary Summer Grants for those students who wish to engage in research or creative projects that cross the traditional boundaries between the sciences and the liberal arts. These grants are open to College of Science/Arts and Letters double majors as well as those students who have a minor in the College of Arts and Letters.

Contact: Sevda Arslan sarslan@nd.edu, Program Manager

Kellogg Institute for International Studies

The Kellogg Institute for International Studies engages an interdisciplinary community of scholars in research and education on the critical challenges of democracy and human development around the globe. Kellogg Institute student programs allow exceptional undergraduates to focus and develop their international interests and scholarly abilities. Research grants and fellowships complement the Kellogg International Scholars Program, which matches students with faculty in a unique research perspective. The new Kellogg Developing Researchers Program offers students the opportunity to develop their research skills through training and working on short-term projects with faculty. Fellowships provide undergraduates with hands-on experiences in the developing world that can be transformative. Such encounters prepare students for the International Development Studies minor and for independent field research. Students can present their research at the annual Human Development Conference in the spring. More information about the Institute can be found at kellogg.nd.edu

Contact: Holly Rivers hrivers@nd.edu, Associate Director

Rachel Thiel rthiel@nd.edu, Program Manager

Meruelo Family Center for Career Development | undergradcareers.nd.edu

The Meruelo Family Center for Career Development prepares students for lifelong career readiness by guiding them to discern, pursue, and achieve career goals that align with their values, interests, and skills. We encourage students to take ownership of their career direction, and are here to support them to conduct a successful search for jobs, internships, fellowships, and/or other postbac opportunities. For more information, please visit our website, undergradcareers.nd.edu, or contact us at careerdevelopment@nd.edu.

Contact: Karen Manier kmanier@nd.edu, Career Counselor and Assistant Director

Museum of Biodiversity | biodiversity.nd.edu

The Museum of Biodiversity, located near the northern end of Jordan Hall, showcases the Department of Biological Sciences' extensive collection of fossils, amphibians, fishes, birds, mammals, and insects that have been collected over the last 150 years. As part of the museum, the herbarium preserves the scientifically important collection of dried and pressed plants of the Greene-Nieuwland Herbarium. There are many opportunities for undergraduate research projects including identification and organization of specimens contained in museum collections, development of databases of plants and animals and their distributions, identification of rare, endangered, or invasive species, and development of thematic displays. Projects can be supported by the Robert E. Gordon Museum of Biodiversity Undergraduate Research Support Fund.

Contact: Barbara Hellenthal bhellent@nd.edu, Curator Ron Hellenthal

Ronald.A.Hellenthal.1@nd.edu, Director and Emeritus Professor

Joanna Larson jlarson7@nd.edu, Assistant Curator

Nanovic Institute for European Studies | nanovic.nd.edu

The Nanovic Institute for European Studies is committed to enriching the intellectual culture of Notre Dame by creating an integrated, interdisciplinary home for students and faculty to explore the evolving ideas, cultures, beliefs, and institutions that shape Europe today. We help students from the College of Science plan and conduct focused, original scientific research in Europe. We support high-quality European internships in laboratories and other scientific settings and make it possible for you to immerse yourself in local languages, to live among Europeans, and to see the world from a different perspective. Our students return to Notre Dame transformed with a new sense of confidence, awareness, and maturity that helps them to succeed. Note that science internships should have some European policy, culture, or other aspects to be most competitive for Nanovic funding. Students are welcome to visit for advice on applications and opportunities. For more information on the Nanovic Institute and our undergraduate grant programs, please go to nanovic.nd.edu.

Contact: Abigail Lewis alewis26@nd.edu, Director of Undergraduate Studies

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ND Energy | Center for Sustainable Energy at Notre Dame | energy.nd.edu

ND Energy's mission is to build a better world by creating new energy technologies and systems and educating individuals to help solve the most critical energy challenges facing our world today. ND Energy engages undergraduate students in energy-related research and education programs, including the Vincent P. Slatt Fellowship for Undergraduate Research in Energy Systems and Processes, the Energy Studies Minor, and the Student Energy Board. These programs prepare students to become successful leaders who understand the complexities of society's energy challenges and the global energy economy. Learn more at energy.nd.edu.

Contact: Anne Berges Pillai apillai@nd.edu, Education and Outreach Associate Program Director

Barbara Villarosa bvillaro@nd.edu, Business and Communications Program Director

Notre Dame Nanoscience and Technology | nano.nd.edu

Notre Dame Nanoscience and Technology (NDnano) promotes collaborative research in science and engineering. The Center's 80+ affiliated faculty members work to address unsolved scientific and technical questions with an aim to promote the greater good.

Each year, NDnano awards several paid fellowships to undergraduate students who will spend 10 weeks of their summer engaged in an on-campus research project mentored by one of the Center's faculty. To date, nearly 300 students from Notre Dame and several other universities in the U.S. and abroad have participated in the program, gaining valuable research skills and experience.

Contact: Heidi Deethardt deethardt.1@nd.edu, NDnano Center Coordinator

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Notre Dame Integrated Imaging Facility (NDIIF)

The Notre Dame Integrated Imaging Facility (NDIIF) is a state-of-the-art research core facility within Notre Dame Research that consolidates the University's imaging capacity and augments it with powerful new imaging modalities. The NDIIF creates an interactive network of research groups who are connected by their interest in imaging technology and allows them to cross-fertilize ideas and form interdisciplinary collaborations. The Imaging Facility makes available to the Notre Dame science and engineering community an integrated suite of sophisticated microscopes and imaging stations that enable expert users to attack the most complex modern research problems and, equally important, resident professional staff (technicians and research specialists) to guide the non-expert users and allow them to conduct experiments that were previously beyond their limits. The NDIIF brings together two conceptually different groups of science and engineering researchers, the inventors who design new materials and techniques and seek research problems that will test their inventions, and the discoverers who are always looking for improved technologies that can better test their hypotheses of how things work. Learn more at imaging.nd.edu/

Contact: Sarah Chapman VanHouten Sarah.Chapman@nd.edu, Associate Director

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Reilly Center

The John J. Reilly Center at the University of Notre Dame offers graduate and undergraduate programs and fosters scholarly conversation at the intersections between the humanities and social sciences, and the sciences and medicine. Both group and individual research opportunities are available through these programs.

Contact: Anna Geltzer ageltzer@nd.edu, Associate Director

Scientia | scientia.nd.edu

Scientia, ND's own student-run Undergraduate Journal of Scientific Research, is looking for student reviewers and news writers for this year's publication. Reviewers should have some research experience and be interested in reading, critiquing, and commenting on student research writing. News writers can be from any discipline and must simply want to write about some of the important and interesting things happening in the College of Science.

Contact: Kayla Nguyen knguyen9@nd.edu, Stephanie Swegle sswegle@nd.edu

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University of Notre Dame Environmental Research Center (UNDERC) | underc.nd.edu

Celebrating over forty years of environmental education and research, UNDERC provides students with a unique opportunity to not only take part in hands-on field courses in environmental biology, but also the chance to gain invaluable experience in field research. UNDERC provides two opportunities to promote understanding of field biology and how field research is conducted through 10 weeks in the wilds. Our Track 1 opportunity is designed for students wanting to gain initial experience in field biology where they can gain an introduction to the concepts and methodology while conducting a collaborative research project with other students in the program. Our Track 2 opportunity is designed for undergraduates with prior research experience at UNDERC (including Track 1) or elsewhere that would like to conduct an independent research project under the mentorship of UNDERC scientists. Each Track would include housing, travel between the Notre Dame campus and UNDERC, and a stipend.

Contact: Michael Cramer mcramer@nd.edu, Assistant Director

Poster Abstracts

Linking Angiogenic Cellular Motility to Metabolic Energy

Evan Arsenault, Andrew Kim, Mackenzie Schaff, Mary Musselman, Nadim Khouzam, Grace Hsu, Amir Khouzam, Michael Van Etten, Dushani Ranasinghe, Margaret Schwarz
University of Notre Dame, Department of Chemistry and Biochemistry
Indiana University School of Medicine

Angiogenesis has been shown to be mediated by growth factors, glucose availability, and metabolic stability *in vitro*. While there has been a correlation between endothelial cellular motility and metabolic energy, it is technically challenging to link the process of glycolysis to angiogenic movement of endothelial colony forming cells (ECFC). The purpose of this study is to further explore the metabolic pathways involved in angiogenesis in order to lessen the detriments of chronic lung disease, Bronchopulmonary Dysplasia (BPD). This disease occurs in infants born with underdeveloped lungs that cannot handle normoxic conditions. Increasing the understanding of the metabolic needs of ECFC will further clarify the linkage of metabolics to angiogenesis. In addition, experimentation has shown that nicotimamide adenine dinucleotide (NAD^+), generated from vitamin B_3 "Nicotinamide" (NAM), is significantly reduced in a hyperoxic cellular model of BPD. Lastly, this study shows that hyperoxia suppresses ECFC angiogenesis, while NAM supplementation significantly rescued vascular networks, branched nodes, and branch points ($p<0.001$).

What inspired you to participate in undergraduate research?
I have been surrounded by pulmonology my entire life. In 2007, my grandfather was diagnosed with stage two lung cancer. After two hard fought years against cancer, he sadly passed away. In addition, my step-brother, Gus, suffers from Cystic Fibrosis (CF). Being exposed to lung pathophysiology from a young age, I have always been inspired to take a stand in the relentless pursuit of healing and wanted to make an impact in the field of pulmonology. My research specifically targets lung disease in infants in order to make an impact that will significantly improve their lives. I continue to do my research in the hope of one day making a difference in the world that will give people to take deep breaths.

How did you get your research position, and what preparation did you undertake for it?
In August of 2023, I was fortunate enough to receive the opportunity to research under Dr. Margaret Schwarz. I met with Dr. Schwarz to discuss my position as an undergraduate researcher. I expressed significant interest in her lab, and explained my motivation for wanting to work on lung development specifically. I prepared for my talk with Dr. Schwarz by reviewing metabolic pathways and lung physiology.

Where was your research experience located?
I conduct my research in Harper Hall at Indiana University School of Medicine, South Bend.

What did you get out of your research experience?
I have gained a significant amount of biological knowledge, mental fortitude, and character from my research experience. Over the past year, I have spent over 500 hours in a laboratory setting. With this significant amount of time spent in lab, there have been a variety of different challenges. I am now proud to say that I am independent in conducting immunofluorescence, genotyping, Western Blotting, and a plethora of other biological experimentation methods. Research has taught me that things do not always go your way. These failures are the key to success and asking new questions when figuring out solutions to things as complex as Bronchopulmonary Dysplasia. I am unbelievably blessed to have the skills that I have now, and could not be more thankful for the research opportunities that I have had over the past year.

Cannabinoid Signaling is Essential for Zebrafish Kidney Development

Sophia Baker, Thanh Khoa Nguyen, Liana Arceri, Shannon Gibson, and Rebecca Wingert
University of Notre Dame, Department of Biological Sciences

Cannabinoid receptors are located throughout the body and are part of the endocannabinoid system. Endocannabinoids bind to G protein-coupled receptors in the central nervous system (CNS), as well as the peripheral nervous system, which includes the kidneys. However, there is still very little known about the role of cannabinoid receptors, and their role within the kidneys. Our goal is to observe the role of cannabinoid receptors, specifically CB1, in multiciliated cells (MCCs) within zebrafish kidneys. We found that CB1 agonism using methanamide and anandamide results in a decrease of MCC numbers with mature MCC markers at 28 somite-stage (ss), but not with MCC progenitor cell markers at 24 ss. Additionally, live imaging of agonist-treated zebrafish embryos at 24-72 hour-post-fertilization (hpf) revealed that MCC deficiency produced morphological changes such as pericardial edema and body curvature. Next, live imaging revealed a unique phenotype with a darkened tail in the agonist-treated embryos, which we hypothesized to be cell death. We further investigated this phenomenon with an acridine orange assay during 48-72 hpf, which revealed a greater cell death area in the tail region of agonist-treated embryos compared to WT embryos.. Using a splice-targeting morpholino of the *cnr1* gene, we found that our embryos also exhibited a decrease in MCC number. Interestingly, our treatment with CB1 antagonists showed a significant decrease in the number of MCCs with AM-251, but not with AM-281. The morphological changes that were associated with agonist treatment were also seen with antagonists. Our results are consistent with our hypothesis that CB1 receptors play a role in MCC development. Future studies include the characterization of CB1 receptor by *crn1* genetic loss of function with the use of CRISPR-Cas9 to create a stable mutant line.

What inspired you to participate in undergraduate research?
I was always curious about research in a biological context, and I knew that I wanted to participate in some capacity once I got to college.
How did you get your research position, and what preparation did you undertake for it?
I took Dr. Wingert's physiology class the Fall of my sophomore year and her passion for the subject really inspired me to look into her research. She graciously saved me a spot in her lab for the Spring semester and I was able to join the lab and work under her direction to learn the techniques and procedures and then immediately followed with a summer fellowship two years in a row while continuing the work on my project during the school year.
Where was your research experience located?
Galvin Life Science Center
What did you get out of your research experience?
I was able to learn the lab experimental techniques and skills, in addition to honing my scientific reasoning skills. My research experience has been one of the most impactful parts of my undergraduate career, and I have learned so much going beyond the bench work.

Validation of Measles-Derived iPSC through Differentiation into Pancreatic and Hematopoietic Progenitors

Katherine Beckman, Sarriana Hoffer, Brenna Sharp, Tiana Salomon, Carter Caya, Patricia Devaux, PhD
Virology and Gene Therapy Track, Department of Molecular Medicine, Mayo Clinic Graduate School of Biomedical Sciences

The production and application of stem cells play an essential role in many fields of medicine, including cell therapy, gene therapy, and personalized regenerative medicine. In this study, a measles vector was used to deliver four transcription factors into adult human fibroblasts to reprogram them into iPSCs. To validate the quality of these iPSCs, they were differentiated into pancreatic and hematopoietic progenitors through a two-week long process of changing media with additional supplements. This allowed for the extracellular signals to be altered to guide the cell's fate. Using flow cytometry, differentiation efficiency was quantified to be 70.4% and 97.9% for the pancreatic and hematopoietic progenitors, respectively. To assess the hematopoietic progenitors, CFU assays were used to determine their ability to further differentiate into erythroid and granulocyte-macrophage progenitors. To assess the pancreatic progenitors, immunofluorescence was used to confirm the expression of PDX1, SOX9, and NKX6.1. In conclusion, the results reveal successful pancreatic and hematopoietic differentiations, thereby validating the quality of iPSCs produced by our measles reprogramming vector.

What inspired you to participate in undergraduate research?
I was inspired to participate in undergraduate research to decipher whether research was something I was truly passionate about and wanted to pursue as a career. Being involved in research over the summer allowed me to be fully integrated into a lab and have my own project to work on. I was able to focus all my attention and time towards research, which is something that I am unable to do during the school year.
How did you get your research position, and what preparation did you undertake for it?
I got my research position by applying to the Mayo Clinic Summer Undergraduate Research Fellowship (SURF). My preparation included updating my resume, asking professors for letters of recommendation, and preparing essay responses. In general, I prepared for this position by taking a research position at the Ferdig Lab on campus and being a teaching assistant for the biology investigations lab.
Where was your research experience located?
My research experience was located at Mayo Clinic in Rochester, Minnesota.
What did you get out of your research experience?
Out of my research experience, I gained valuable lab skills, including techniques, methods, and time-management. I learned a wider breadth of research questions, topics, and projects from the seminar series that was offered to SURFs to attend throughout the summer and was better able to understand and analyze others' research projects. I also gained a lot of knowledge about virology, which is a subject that I had never taken a course in before. Lastly, I got the first-hand experience of being fully integrated into a lab environment, including all of the collaboration and communication involved.

Estimating functional connectivity in the visual cortex via probabilistic graphical models

Lauren M. Beede
University of Notre Dame, Department of Applied and Computational Mathematics and Statistics

Researchers continue exploring neurons' intricate patterns of activity in the cerebral visual cortex in response to visual stimuli. The way neurons communicate and optimize their interactions with each other under different experimental conditions remains a topic of active investigation. Probabilistic Graphical Models are invaluable tools in neuroscience research, as they illustrate the functional connections, or conditional statistical dependencies, between neurons. Graphical models represent these connections as a graph, where nodes signify neurons and edges indicate the presence of functional connections between them. In this study, we utilize two-photon calcium microscopy imaging data from approximately 10,000 neurons in a 1mm cubic section of a mouse's visual cortex. This data was collected in response to visual stimuli of 2,800 natural images. Given the high-dimensionality of the problem, we employed advanced statistical methods, such as the graphical lasso, for regularized estimation to derive meaningful functional connectivity graphs. We discuss the statistical challenge associated with selecting appropriate graphical models when analyzing vast amounts of high-dimensional neuronal data, and with exploring how functional connectivity changes across various stimuli and conditions.

What inspired you to participate in undergraduate research?
Fascinated by computational neuroscience, I pursued undergraduate research to gain firsthand experience in the intersection of neuroscience and statistics. However, my uncertainty about my post-undergraduate path and curiosity of research guided me towards this position.
How did you get your research position, and what preparation did you undertake for it?
After my first semester at Notre Dame, I reached out to Dr. Giuseppe Vinci in the ACMS Department. Although I initially lacked familiarity with the mathematical applications he employed, I extensively researched graphical models to understand their uses before starting our project together. Dr. Vinci and I spent the majority of my first few months ensuring I understood graphical models and probability comprehensively.
Where was your research experience located?
Notre Dame, IN
What did you get out of your research experience?
Over the past two years, I significantly improved my coding skills, enhancing my proficiency in various languages. This research experience not only sharpened my technical abilities but also provided valuable insights into professional applications. Furthermore, it honed my time management skills, especially as this project was primarily independent. Since starting with Dr. Vinci, I have also begun another research position at Notre Dame with Dr. Robert Rosenbaum using a statistical approach to uncover hidden patterns in EEG signals in his Neural Dynamics and Computing Lab. I also undertook a researcher position at Trinity College, Dublin with Vinny Cahill using reinforcement learning to optimize journey time in motorway traffic through the Naughton Fellowship Research Experience for Undergraduates in summer 2023. My experience with Dr. Vinci ultimately guided me to seek new experiences which expand my breadth of knowledge in academia.

Establishing an Organoid Model for Renal Cell Carcinoma

Bhakta, Meera; Carter, Phoebe; Carroll, Tom, Ph.D.
UT Southwestern Medical Center, Department of Internal Medicine, Division of Nephrology

Mutations in the Hippo/Warts pathway are common in renal cell carcinoma (RCC). We found that ablation of the Hippo/Warts pathway kinases Lats1/2 from adult mouse kidney epithelia resulted in metastatic sarcomatoid RCC. The molecular and cellular processes affected by Lats are still not clear.

Tissue-specific organoids allow high throughput, ex vivo examination of heterogeneous, 3D tissues. Such tumor organoids show potential for developing novel cancer treatments and studying cancer cell behavior. This study establishes an organoid model for RCC by modifying an existing organoid protocol for metastatic breast cancer.

Kidney tumor tissue was harvested from Lats mutant mice, digested into small organoid clusters, and placed on low attachment plates. Lats organoids continued proliferating in the low attachment plates for weeks after isolation. The organoids were subsequently seeded in both matrigel and collagen substrates, then cultured, fixed, and stained at different time points between one and ten days to observe and compare tumor cell behavior in the different conditions. As expected from previously published work, collagen stimulated more tumor cell outgrowth and migration than matrigel. Immunostaining showed that the organoids maintained the sarcomatoid RCC phenotype observed in vivo.

This organoid model has many prospective applications for novel RCC studies including high throughput drug screening and immuno-oncology to study the interactions between tumor organoids and co-cultured immune cells. These models may yield results more rapidly than our mouse model while allowing us to maintain the 3D conformation and cellular heterogeneity of an in situ tumor.

What inspired you to participate in undergraduate research?

My interest in research peaked in high school and my deep rooted fascination with oncology. I feel that what differentiates research from other forms of learning is that a researcher is forced to truly understand all the complexities of their subject while forging novel methods to answer questions that no one has the answers to, and my yearning to learn in such a way was thoroughly satisfied by this research experience.

How did you get your research position, and what preparation did you undertake for it?

After being accepted to a summer research fellowship through the NIH, my coordinating center (University of Alabama at Birmingham) connected me with potential mentors. I reached out to Dr. Carroll, who runs the Summer Undergraduate Research Institute for the Study of Kidney Disease (SURISKD) at UT Southwestern, to see if there were any oncology labs he could connect me with. After interviewing me, he offered me a spot in his own lab where I worked with my mentor on a project in onconephrology.

Where was your research experience located?

UT Southwestern Medical Center

What did you get out of your research experience?

I was fortunate to present at the NIH, University of Wisconsin-Madison, and UT Southwestern. I was also invited to Kidney Week by the American Society of Nephrology (ASN) as part of the ASN STARS program. The ability to travel and present my work has allowed me to meet so many students and professors across the country, and I can not express how rewarding these presentations were. I was fortunate to have daily programming in professional development, research ethics, nephrology, and science research throughout my ten weeks at UT Southwestern (including presentations by Nobel Laureates). Such lectures, paired with my research, expanded my understanding of complex scientific fields while fueling my interest in nephrology. I gained fantastic mentors (Mrs. Phoebe Carter and Dr. Tom Carroll) during my time in the Carroll lab and was able to conduct a research project that helped me grow as a scientist and person. I forged incredible friendships with the other undergraduate kidney researchers and I can't express how grateful I am to have been in this program.

Transcutaneous Vagal Nerve Stimulation Effects on Adolescent Non-Suicidal Self Injury and Emotional Regulation

Ethan Boyle
University of Notre Dame, Department of Psychology

Adolescent non-suicidal self-injury (NSSI) and suicidal ideation can signify relationship dysfunction, depression, suicidality, and other impairments in adulthood. A steady rise in adolescent NSSI and suicidal ideation have been recorded in the past 15 years despite national investment in prevention. Clinical and psychosocial interventions are often expensive and call for trained clinicians to treat adolescents engaging in NSSI and suicidal ideation. Consequently, this treatment is often unavailable to adolescents who live in rural areas and those with low socioeconomic status. Therefore, cheaper yet effective alternatives are necessary for vulnerable adolescents to regulate their emotions and reduce their NSSI and suicidal ideation tendencies. This pilot study investigated the effects of transcutaneous vagal nerve stimulation (tVNS) on adolescent suicidal ideation, emotional regulation, and frequency and severity of NSSI in order to support funding for a larger study. Adolescent participants were split into control (n = 13) and tVNS (n= 13) groups and attended 3 visits over the course of 3 months. Each visit included online and in-person assessments that measured adolescent emotional regulation, suicidal ideation, and NSSI history. Preliminary results indicate females are more likely to participate in studies with NSSI inclusionary criteria, and the levels of stress for adolescent participants decrease after a visit. Additional statistical analysis should be conducted to determine any significant effects of tVNS on adolescent non-suicidal self-injury and emotional regulation.

What inspired you to participate in undergraduate research?
I wanted to conduct undergraduate research in the field of psychology because I wanted to interact with other people in my research. I values and previous experiences directly align with the Notre Dame Suicide Prevention Initiative, and I decided to join a research lab dedicated to reducing the stigma of mental illness and empowering those who struggle with mental health.

How did you get your research position, and what preparation did you undertake for it?
The preparation for my undergraduate research included taking lab classes at the University of Notre Dame in order to develop my understanding of the scientific method and relevant statistical analyses. I join my lab by reaching out Dr. Ted Beauchaine and describing my interests in suicidal ideation and passion for mental health awareness.

Where was your research experience located?
My research experience is focused on the effects of transcutaneous vagal nerve stimulation on adolescent suicidal ideation and emotional regulation. I am able to take on a significant role is this field by being able to write a thesis on my research through the Honors in Neurosciences and Behavior Program in the College of Science.

What did you get out of your research experience?
From my research experience, I have been able to have a direct impact on teens who struggle with mental illness. My role as a teen assessor allows me to measure a teen's levels of suicidal ideation and history of self-harm, and I am grateful to listen to these teens share with me their motivations to cut themselves and reasons for wanting to end their lives. I hope to have a future career in clinical research, and I believe my experience in undergraduate research will prepare me for research in higher education.

Stem cell-derived neurons and directly reprogrammed neurons capture pre-clinical and clinical phases of tauopathies

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Washington University School of Medicine, Department of Psychiatry

Tauopathies are a group of neurodegenerative diseases characterized by the deposition of abnormal tau protein in the brain. Human induced pluripotent stem cell (iPSC)-derived neurons and micro-RNA induced neurons (miNs) are both powerful cellular systems to model the pathological events in the human genome. We compared the transcriptomic profiles of iPSC-neurons carrying MAPT IVS10+16 and isogenic controls, and miNs carrying MAPT IVS10+16 and healthy controls without the mutation, as well as human brains carrying the mutation and controls obtained from healthy donors. Our goals were: (i) to determine the impact of aging on molecular signals of disease using these two technologies, and (ii) to compare this transcriptomic signal with the gene expression in human brains with primary tauopathy (e.g., MAPT mutation carriers and progressive supranuclear palsy (PSP)) and secondary tauopathy (e.g., Alzheimer's disease (AD)), and FTLD caused by rare mutation within TDP-43, GRN and C9ORF72. Common pathways altered in miNs carrying MAPT IVS10+16 mutation and in related tauopathies included a reduction of synaptic vesicle acidification and an increase in the inhibition of intracellular signal cascades. Common pathways altered in iPSC-neurons carrying the IVS10+16 mutation and in related tauopathies included increases in neuronal survival and neuronal projection. We concluded that iPSC-neurons and miNs can be used complementarity for the investigation of genetic processes of the MAPT IVS10+16 mutation. Both cell models capture the phenotypes associated with different stages of disease pathophysiology.

What inspired you to participate in undergraduate research?
I have always been curious about scientific research, but I had never had the opportunity to participate in what felt like real, discovery-making research. I enjoyed the biology and chemistry labs I took here at Notre Dame, but they always felt somewhat superficial: I always knew what the outcome was supposed to be, and I never felt like I was truly contributing to science at large. Working at the Karch Lab gave me the opportunity to make these real discoveries that I craved. Participating in undergraduate research allowed me to see what real scientists do outside of the classroom.

How did you get your research position, and what preparation did you undertake for it?
My research position was part of a summer experience through the Institute for Public Health at Wash U focused on aging and what healthy aging looks like, as opposed to diseased aging. I attended twice-weekly seminars given by Wash U-affiliated faculty from a variety of fields discussing various aspects of aging, from the biological/neuroscientific aspects to the cultural/policy-making aspects. Through the program, I was given several choices of labs that I could work for, and being neuroscientific-minded, I chose the Karch Lab, where they specialize in molecular models of neurodegeneration. In terms of preparation, I made sure to familiarize myself with the methods of the lab by reading their published research, especially that of my mentor, Miguel Minaya. I made sure that I had at least surface knowledge of the topics discussed in these papers, such as iPSC and micro-RNA induced neurons, as well as the methods that other labs had used to make similar findings.

Where was your research experience located?
Washington University School of Medicine in St. Louis, MO.

What did you get out of your research experience?
Aside from the technical lab skills I was able to develop through daily practice, I gained invaluable experience through working with a mentor and larger team towards a common goal. I can't say how enjoyable it was to meet my fellow lab members and get to know them not only as coworkers, but as friends too, who truly do want to see you succeed. They were in the exact position as I am at some point in their lives, and the joy they get from helping me on my journey was tangible. I discovered in myself a love of research, and a desire to want to continue working on the project I worked on all summer.

Preliminary Study on gene x environment interaction between the ADHD risk gene latrophilin-3 and permethrin in Sprague Dawley rats

Cara Cavanaugh

Attention-deficit/hyperactivity disorder (ADHD) is the most prevalent mental health disorder for U.S. children and has greater diagnosis rates in children living below the federal poverty level.[1] While the causes of ADHD are largely unknown, a combination of genetic and environmental factors are suggested to be responsible for the disorder. The *Latrophilin-3* gene (LPHN-3), which codes for an adhesion G protein coupled receptor, is one genetic factor that has been linked to ADHD.[2] LPHN-3 global knockout rats show hyperactivity, impaired learning and memory, and reduced levels of dopamine receptors, all of which are common signs of ADHD in humans.[3]

Pyrethroids are a class of chemicals used as insecticides. They are an environmental factor that has been linked to increased ADHD occurrences.[4] Permethrin (PRM) is a common pyrethroid insecticide that is used particularly in impoverished areas.

This study investigates the possible connection between LPHN-3 gene deletion and permethrin exposure during development in a rat model. Sprague Dawley rats were used and were bred to be wildtype (WT) for LPHN-3 (+/+) or heterozygous (Het) for LPHN-3 (+/-). The rats were dosed with 1.0 mg/kg of either a control solution of corn oil (CO) or PRM from 6-20 days postnatal (P). This study has four groups: WT+CO, WT+PRM, Het+CO, and Het+PRM. It is hypothesized that LPHN-3 deletion combined with developmental PRM exposure will worsen the effects of either factor individually.

The Last of Fung-Us: Evaluating the Antifungal Activity of a Synthetic Enterocin Peptide Library

Dorrian G. Cohen
University of Notre Dame, Department of Biological Sciences

The antimicrobial peptide (AMP) circularized bacteriocin enterocin AS-48 produced by *Enterococcus* sp. exhibits broad-spectrum antibacterial activity via dimer insertion into the plasma membrane that forms pore structures. A specific alpha-helical region of enterocin AS-48 is responsible for the membrane-penetrating activity of the peptide. The canon syn-enterocin peptide library previously generated by the Lee Lab using rational design techniques to have ninety-five synthetic peptide variants from the truncated, linearized enterocin AS-48 was screened against three clinically relevant fungal strains: *Cryptococcus neoformans*, *Candida albicans*, and *Candida auris*. In screening, twelve peptides exhibited activity against *C. neoformans,* and two peptides exhibited activity against *C. albicans*. None of these fourteen peptides showed cytotoxicity to an immortalized human keratinocyte cell line (HaCats). Four peptides were identified with minimum inhibitory concentrations (MICs) below 8 μM against *C. neoformans*. One of these four peptides, peptide 24, has previously been shown to be effective against gram-negative and gram-positive bacteria and another one of these peptides, peptide 19, has previously been shown to be effective against the protozoan parasite *Leishmania donovani*. Early fungistatic/fungicidal tests show that three of the four peptides, 24, 32, and 40, are fungicidal. In 36-hour cell growth tests with these fungicidal peptides, peptide 32 exhibited *C. neoformans* cell counts slightly below those of the antifungal medication fluconazole and peptides 24 and 40 exhibited *C. neoformans* cell counts below those of vehicle control. These findings demonstrate that naturally derived AMPs produced by bacteria can be engineered and modified to exhibit potent antifungal activity. Our results will contribute to the development of new treatment alternatives to fungal infections and lend themselves to direct implications for possible treatment options for *C. neoformans* infections.

What inspired you to participate in undergraduate research?
My interest in research as it relates to medicine.
How did you get your research position, and what preparation did you undertake for it?
I emailed Dr. Shaun Lee, a professor of mine. I did online and in-person training.
Where was your research experience located?
University of Notre Dame, Notre Dame, Indiana, 46556
What did you get out of your research experience?
I learned that I have a passion for research, which I am pursuing after graduation.

Measurement and Analysis of the 17F(p,p') Reaction

Sydney Coil, Daniel Bardayan, Chevelle Boomershine, Scott Carmichael, Cade Dembski, Patrick O'Malley, Will von Seeger
University of Notre Dame, Department of Physics

X-ray bursts are one of the most frequent transient events observed in the universe. They repeat irregularly with periods from a few hours to months and lead to the synthesis of numerous heavy elements in the *rp*-process. This process is poorly understood due to the numerous reactions on exotic nuclei. The *rp*-process is thought to be triggered by the $^{14}O(\alpha,p)^{17}F$ reaction, and understanding the rate of this reaction will aid in interpreting x-ray burst light curves. Because of the difficulty of studying the forward reaction, recent attempts have been made to study the time reversed reaction, $^{17}F(p,\alpha)^{14}O$. Since these studies only probe astrophysical branches to the ground state of ^{17}F, the $^{17}F(p,p')$ reaction was studied at the Nuclear Science Laboratory at the University of Notre Dame to look for the population of excited states. The data will be presented and preliminary results discussed.
Research supported by the National Science Foundation grant NSF PHY-2011890 and the University of Notre Dame.

What inspired you to participate in undergraduate research?
I participate in research because I am interested in
How did you get your research position, and what preparation did you undertake for it?
I emailed the faculty in the physics department and asked their groups until one PI said yes. I did not have to prepare anything to take this research position.
Where was your research experience located?
I conduct my research in the Nuclear Science Laboratory at the University of Notre Dame.
What did you get out of your research experience?
My research gives me the opportunity to collaborate with brilliant scientists and contribute to the wider scientific community in a subfield that I am passionate about. It gives me the chance to have an area that I alone am the expert in while acquiring a wide skill set that can be applicable to many different fields.

Effects of Essential Amino Acids on the Hemolytic Activity of *M. marinum*

Isalina L.E. Colsman, Dr. Camille Syska, Dr. Patricia Champion
University of Notre Dame, Department of Biological Sciences

Mycobacterial pathogens cause acute and chronic disease in humans and animals, and one of them, *M. tuberculosis*, is the causative agent of tuberculosis. Both *M. tuberculosis* and *M. marinum*, a non-tuberculous bacteria that causes tuberculosis-like infections in ectotherms, require the ESX-1 secretion system to transport protein virulence factors across membranes to trigger host phagosomal membrane lysis that promotes survival. *M. marinum* lyses red blood cells in a contact dependent, ESX-1 dependent manner. We found that the hemolytic activity of *M. marinum* had an inverse relationship with bacterial growth and hypothesized that the metabolism of the *M. marinum* cultures was impacting hemolytic activity. To test this hypothesis, we sought to understand the impact of metabolism on ESX-1 mediated hemolytic activity. We investigated the effect of the twenty essential amino acids on hemolytic activity by supplementing *M. marinum* cultures with each amino acid. We discovered that the addition of some amino acids, most notably arginine and lysine, increase the hemolytic activity of the WT strains during growth. There are also amino acids that inhibit hemolysis compared to WT, most drastically methionine. We also determined whether certain amino acids may be able to rescue hemolysis in three strains, each lacking an acetyltransferase involved in the metabolism of *M. marinum*. These strains were developed by single deletion of the putative NAT genes *MMAR_1123*, *MMAR_4496*, and *MMAR_3205*. Arginine rescued hemolysis for all strains except for *MMAR_3205*. Since the *MMAR_3205* strain was signal blind to arginine, we hypothesize that the MMAR_3205 may participate in arginine sensing to restore hemolysis. Furthermore, we found that *MMAR_4496* was signal blind to methionine and showed no reduction in WT hemolytic activity in the presence and absence of methionine. We therefore propose that *MMAR_4496* might mediate the sensing of methionine to inhibit hemolysis. These findings provide the first mechanistic insight into metabolic regulation of hemolysis and the ESX-1 secretion system in *M. marinum*. Further research could elucidate the connection between amino acids arginine and methionine and substrates of the ESX-1 system.

What inspired you to participate in undergraduate research?
My interest in infectious disease began upon reading *Mountains Beyond Mountains*. The story of Dr. Farmer's efforts to cure ID while tackling global health issues exposed me to the health disparities between low-middle-income and high-income countries. I have pursued opportunities to learn more about ID and how to reduce its global burden.I joined the Champion lab at Notre Dame, where my research provides the first mechanistic insight into metabolic regulation of hemolysis in mycobacterial pathogens. This research could have a wide range of implications, such as the development of a new vaccine for tuberculosis. My experience at the Champion lab has given me an appreciation for laboratory research in the fight against health disparities that I plan to continue nurturing.
How did you get your research position, and what preparation did you undertake for it?
I joined Dr. Champion's lab in fall 2022. To prepare for my research position, I read many of the research articles the Champion lab had produced in recent years. I also reviewed work from the Intro to Biology lab, because the module I had chosen focused on research in the Champion lab. After deciding to use my research in the Champion lab for my senior thesis, I worked toward applying to COS-SURF in order to continue doing research at Notre Dame over the summer. I developed a project with my mentor, Dr. Camille Syska. We outlined a rough schedule for my work and began gathering materials and methods for the research.
Where was your research experience located?
My summer research experience was at the University of Notre Dame in the Champion Laboratory.
What did you get out of your research experience?
I learned how to do experiments on my own and gained greater critical scientific thinking skills by analyzing my data and proposing new experiments based off results. The data I gathered is the first mechanistic insight into metabolic regulation of mycobacterial pathogens. I am currently working on submitting a proposal for it to be in a journal paper.

Developing Tetra-Meta Substituted Porphyrins for Use in Photodynamic Therapy

Declan Creaney, Grant Strachan, Mathias Senge
Trinity College Dublin, Department of Chemistry

Photodynamic therapy (PDT) is an exciting route to explore for cancer therapy and treatment. Unfortunately, current drugs and medicines cause adverse side reactions in the body, such as painful skin burns that make PDT an often undesirable cancer treatment method. This research aimed to develop a tetra-meta substituted porphyrin molecule capable of delivering an effective dose of cancer treatment while minimizing adverse side effects. To do this, we synthesized the porphyrin 5,10,15,20‑Tetrakis(3‑hydroxyphenyl)porphyrin (mTHPP). We performed a double diels-alder reaction with pentacene to increase transient triple oxygen species formation to reduce the necessity of prolonged UV exposure, thus eliminating burns. Various products and side products were formed throughout the experiment, each with heavily varied yield and consistency. Characterization of the final product in our experiments indicated that we had successfully created a tetra-meta substituted porphyrin molecule attached to pentacene to serve as a potential future route of photodynamic therapy treatment.

What inspired you to participate in undergraduate research?
I've always been fascinated by organic chemistry since I took my first course in high school. Likewise, I've felt very connected to my Irish heritage throughout my life and knew that combining my interest in organic chemistry with an experience in Dublin, Ireland, through the Naughton Fellowship would give me the perfect opportunity to explore a potential career option.

How did you get your research position, and what preparation did you undertake for it?
I applied and was accepted into the Naughton Fellowship, a program that agrees with a select few students each year to do research in the hard sciences in Dublin, Ireland. To prepare, I've taken on many research projects over the year, excelled in my chemistry and organic chemistry classes over the past few years, and read countless research papers and journals to get acclimated to the work I would be performing.

Where was your research experience located?
My research was located in the Trinity Biomedical Sciences Building, Chemistry Department in Dublin, Ireland, at Trinity College Dublin. My research lab was under the guidance of Professor Mathias Senge.

What did you get out of your research experience?
In previous years, I've done research in biology as well as engineering. This experience was my first in chemistry, something I've found a love for in classes but never explicitly in a lab setting. This experience allowed me to combine my interests in research and chemistry, and it came with many challenging obstacles to overcome, as well as great satisfaction upon figuring out problems. I feel much more competent in the lab environment, and I've since decided to become a chemistry lab TA here at Notre Dame to spread my newfound passion for chemistry lab work with other students. Aside from the lab, being in Ireland and exploring a new country taught me a lot about living independently, becoming the person I want to be, and valuing my time much more than I typically would.

Perception of Religious Art as a Function of Attribution: A Comparison of Human- and Artificial Intelligence

Caitlin Cunningham, Dr. James Brockmole
University of Notre Dame, Department of Psychology

Artificial Intelligence (AI) has the capability to create visual images with minimal human input, a technology that is being applied to many areas of daily life. However, the products of AI are consistently judged as worse than human-created art, even when comparable in quality. The purpose of this study [1] is to determine whether cognitive bias against AI is related to low-level perceptual mechanisms active while viewing art. To do this, participants' eye movements were recorded while viewing religious art, a notably human domain meant to maximize potential bias against AI. Participants (n = 62) viewed 24 pieces of Biblically-inspired religious art, created by the AI tool DALL-E, while in an eye tracker. Participants in the control group were told prior to viewing that the pieces were created by Notre Dame art students, while participants in the experimental group were told the pieces were created by AI. Participants were surveyed after viewing to ascertain their opinions on the quality and artistic merit of the pieces. Participants' gaze patterns did not differ based on who they believed created the pieces, but their subjective opinions of the pieces were significantly more positive when they believed pieces were created by humans as opposed to AI.

What inspired you to participate in undergraduate research?
I have been doing science experiments since childhood, which inspired me to perform my own research studies in high school. I fell in love with the research process, inspiring me to pursue research as a career. In college, I was fascinated by my classes in areas related to sensation and perception, which is what inspired me to join the Visual Cognition Lab, and my interest in art helped me develop my research question for this project in an area of close personal interest to me.
How did you get your research position, and what preparation did you undertake for it?
I have been working in research related to visual cognition of art since January 2023, when I joined the Visual Cognition Lab at Notre Dame. Due to my completion of relevant coursework, previous research experience in the Memory, Aging, and Cognition Lab at Notre Dame, and experience in independent research through summer and high school experiences, I was determined to be a good fit for the lab. Regarding this specific research, as a member of the Neuroscience & Behavior Honors Program, I have been working on this project for almost a year. Last spring, I developed my experimental design and prepared a research proposal, and over the summer through CoS-SURF, I read literature, created stimuli, developed surveys, programmed the experiment, and prepared consent forms and other aspects of the study.
Where was your research experience located?
My research is being performed through the Visual Cognition Lab in the Notre Dame Department of Psychology, Notre Dame, Indiana.
What did you get out of your research experience?
Through my research experience thus far, I have developed confidence in running an experiment from start to finish. I have had the opportunity to bring a personal research question to life, giving me experience with reviewing literature, making experimental design choices, recruiting participants, and numerous other key aspects of the research process. I have also learned new skills, such as using an eye tracker, programming an experiment, and analyzing data. Overall, this research has prepared me very well for graduate school and a future in research.

Exploring the potency of amphiphilic 1,4-diaryl-pyrazolo-pyridinone loaded gold nanoparticles against *Leishmania donovani*

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[2]University of Notre Dame, Department of Aerospace and Mechanical Engineering

Leishmania donovani infections result in the onset of visceral leishmaniasis, which has symptoms including swelling of the liver and spleen. If left untreated, visceral leishmaniasis has a 95% mortality rate. Currently approved treatments are limited by host cytotoxicity, drug resistance, and high costs, leading to an emphasis for the identification of novel antileishmanial compounds. Previously, our lab identified 1,4-diaryl-pyrazolo-pyridinone (1,4-DAPP), a compound with antileishmanial properties, but limited stability resulting in its rapid in vivo clearance. The use of amphiphilic gold nanoparticles (AuNPs) as a drug delivery system to enhance 1,4-DAPP stability and increase its availability was explored. Toxicity of 1,4-DAPP AuNPs against THP-1 host cells was measured, with preliminary data suggesting minimal toxicity compared to drug alone and the currently approved antileishmanial drug, miltefosine. The killing potency of 1,4-DAPP AuNPs against *L. donovani* axenic amastigotes was determined, and preliminary data shows less killing potency than drug alone or miltefosine. The lower killing potency was further explored in two drug release studies, with results suggesting incomplete release of 1,4-DAPP from the drug loaded nanoparticles and the occurrence of passive diffusion of 1,4-DAPP from the 1,4-DAPP AuNPs with the currently used storage method. Based upon this preliminary data, it was determined that investigations into alternative nanoparticle drug delivery systems are needed.

What inspired you to participate in undergraduate research?
I love science and wanted to do more with the subject than just learn about it. I find science pertaining to infectious diseases and drug development especially interesting and was very excited to join a lab where I could do research in both subjects!
How did you get your research position, and what preparation did you undertake for it?
I reached out to Dr. McDowell Spring of 2023, expressing my interest in joining her lab. To prepare, I read many papers about leishmaniasis and the use of nanoparticles for drug delivery.
Where was your research experience located?
University of Notre Dame
What did you get out of your research experience?
I learned so much and had a lot of fun doing so! Most importantly, I learned how to approach problems and think like a scientific researcher and developed scientific communication skills.

Exploring the Effects of Plasma Radiation on the pH of Solutions for Potential Medical Applications

Beatriz de Campos Silva
University of Notre Dame, Radiation Laboratory

Despite cancer being the second leading cause of mortality worldwide, current treatments still have limitations, such as drug resistance, cytotoxicity to healthy tissues, and high recurrence rates. Plasma medicine, specifically low-temperature plasma (LTP), has provided effective cancer therapies in recent years, with potent effects on cancer cells and minimal side effects on healthy tissues4,5. This study investigates how LTP irradiation affects pH in solutions, which is relevant to understanding cancer cell behavior, growth, and spread. Further experiments with one amino acid are also conducted to assess how the process is altered in the presence of a biomolecule. Specifically, we conducted experiments with glycine, an amino acid relevant to cancer pathways and essential for cancer cell metabolism. Our findings indicate that a combination of high voltage, high frequency, and long irradiation times leads to greater acidification of pure water solutions. Additionally, when each irradiation time is analyzed separately, an increase in voltage seems to play a more significant role in lowering the pH of water solutions. Experiments with glycine showed that higher amino acid concentrations enhance pH stability, while lower concentrations cause similar pH variations as observed in pure solutions. These results offer insights into body pH stability during LTP treatments, which can inform effective cancer therapies targeting cancer cells without affecting healthy tissues.

What inspired you to participate in undergraduate research?
Firstly, my desire to develop tools that allow me to see the world in different ways. Additionally, what motivated me to participate in undergraduate research was the opportunity to work and learn from graduate students and experienced faculty members in the area I'm interested in continuing to explore after graduation.

How did you get your research position, and what preparation did you undertake for it?
I looked at a few departments' websites and found a professor who had research projects that interested me. After that, I sent her an email asking about joining her research lab, and after a fantastic meeting, I officially joined it! The preparation consisted of a few safety training sessions and a lot of readings about plasma physics and plasma medicine.

Where was your research experience located?
Radiation Research Building at the University of Notre Dame

What did you get out of your research experience?
My research experiences have shown me the importance of working with people from different academic backgrounds and having a multidisciplinary mindset when approaching research. Moreover, they allowed me to realize the potential of positively impacting people's lives and exploring more effective ways of addressing several diseases and current treatments in the medical field through science laboratories. Digging deeper into nuclear and plasma medicine fields allows for developing more efficient and less invasive treatment and diagnosis options for patients. I am grateful for the opportunity to approach similar issues in medicine from different perspectives in each laboratory and develop reliable options for diseases worldwide. The potential to improve patients' quality of life and create a positive impact is what drives my passion for pursuing a career in science.

The Role of *amt* in Embryonic Development and Nephrogenesis

Noelle M. Dorvault, Allison Healy, Nicole E. Weaver & Rebecca Wingert
University of Notre Dame, Department of Biological Sciences

Nonketotic hyperglycinemia (NKH) is a rare metabolic disorder resulting from a mutation in the glycine cleavage system (GCS), which catalyzes the breakdown of glycine. The GCS employs four major proteins to convert glycine into one-carbon subunits. One of these proteins is *aminomethyltransferase* (AMT) which functions to transfer carbon-2 of glycine to tetrahydrofolate. Mutations in AMT are seen in ~20% of NKH cases, but the extent to which AMT is involved in development remains unclear. Only one mouse model of *Amt* deficiency has been examined to date, and the analysis focused on neural tube defects. Though current NKH models are also primarily focused on central nervous system (CNS) ontogeny and function, there is evidence that AMT is crucial in organogenesis elsewhere, such as the kidney. AMT is highly expressed in nephron progenitors and tubule precursors in the human embryonic kidney. Here, we developed an *amt* loss of function model in the zebrafish, which led to morphological phenotypes including elevated cell death, hydrocephalus, pericardial edema, cloacal cysts, seizures, and kinked tails. *amt* deficient zebrafish also exhibited decreased survivability compared to wild-type controls. Based on these preliminary observations, we hypothesized that *amt* deficient zebrafish would display abnormal CNS and renal development. To investigate this further, we used techniques such as whole mount *in situ* hybridization, and observed differential patterning in both the brain and embryonic kidney. Within the kidney, the nephron functional units in *amt* morphants displayed a normal length but possessed segmentation defects including longer proximal convoluted tubule lengths, longer distal early tubule length, shorter distal late tubule length, less distance or fused podocytes, and enlarged cloaca. These findings may provide insight into why NKH patients can experience kidney dysfunction. Due to high levels of conservation from zebrafish to humans, zebrafish will continue to provide an amenable model for investigations into the molecular and developmental basis of NKH, building a knowledge base for future therapeutic development.

What inspired you to participate in undergraduate research?
I was inspired by attending the Rare Disease Patient Advocacy Summit and by my minor in Science and Patient Advocacy to get involved with research surrounding rare disease.
How did you get your research position, and what preparation did you undertake for it?
I emailed various professors involved with rare disease research on campus, and I was lucky enough to hear back about an opening in Dr. Wingert's Lab. I applied for summer research funding through COS-SURF and prepared to take on a summer of research by working in the lab for one credit during the prior spring semester.
Where was your research experience located?
Galvin Life Science Center
What did you get out of your research experience?
I have gained so many important biological research skills that required venturing out of the classroom and into an active lab. I was able to present my research at the Summer Undergraduate Research Symposium and will present again in the Fall Undergraduate Research Fair (FURF). Eventually, the research I performed this summer will be incorporated into my thesis during my senior year. Gaining a greater understanding of biomedical research has inspired me to apply to Notre Dame's biology honors program, to continue working in this lab for the rest of my undergraduate career, and to pursue research opportunities during medical school following my graduation.

Site-Specific Analysis of Erythropoietin Glycosylation After Rapid Digestion

Kayleigh Doyle
Major: Science-Business
Advisor: Merlin Bruening, Ph.D., Department of Chemical and Biomolecular Engineering,
University of Notre Dame
Co-author: Weikai Cao

Glycosylation is an important post-translational modification that affects the pharmacokinetics of therapeutic proteins such as erythropoietin, a hormone used to treat anemia. As an example, the sialic acid content, the number of antennary structures, and the extent of O-acetylation(Ac) of sialic acids all affect its pharmacokinetic stability in human serum. Liquid chromatography with tandem mass spectroscopy (LC-MS/MS) allows identification of protein glycans with site specificity. However, traditional methods include overnight proteolysis prior to LC-MS/MS analysis, which leads to high turn-around times for site-specific glycosylation analyses. Our research seeks to develop an alternative digestion method that reduces the time required for glycosylation analysis via LC-MS/MS, while maintaining the accuracy of glycan identification and quantitation compared to conventional methods. With this aim, we examined digestion of erythropoietin in minutes using a new trypsin-containing membrane in a spin column. Comparison of overnight in-solution digestion of erythropoietin versus rapid in-membrane digestion of erythropoietin reveals no significant differences in site-specific glycan identification and relative quantitation. These results suggest that the trypsin-containing membranes will allow for quicker sample-preparation time for glycosylation analysis of therapeutic proteins.

What inspired you to participate in undergraduate research?
I discovered my love of research during an internship as a laboratory assistant in a protein purification lab. I wanted to continue working in a related field, so found a lab on campus that would allow me to deepen my understanding of proteins and learn more about the research process.

How did you get your research position, and what preparation did you undertake for it?
I reached out to Dr. Bruening after my sophomore year and I have remained in his lab since. There was a lot of reading and many conversations with the graduate student I work with in order to provide me with the basic knowledge needed to work in the lab.

Where was your research experience located?
Department of Chemical and Biomolecular Engineering, University of Notre Dame

What did you get out of your research experience?
My experience has uncovered a passion for the research process that has led me to pursue a Ph.D. with the intention of entering a career in applied physiology and kinesiology research.

Empirical Measurement Comparison Between CT Scan Imaging and 3D Angio Imaging Technology.

Vivienne Dragun
Major: Biochemistry
Advisor: Dr. Fernando Boccalandro, Dept. of Cardiology, Odessa Regional Medical Center
Coauthors: none

In the past, most non-invasive heart imaging has been done using CT scans. However, these scans are less detailed than desired, and compared to newer 3D angiography technology, the CT images are bulkier to work with because they cannot capture all angles at the same time. Also, the 3D angiography imaging can be manipulated better after patient imaging has occurred, allowing the doctor to view and understand the affected veins or arteries better than with a traditional CT scan. However, to date, the CT scan is known to be the most empirically accurate type of imaging for cardiovascular studies, and the measurements that are gathered from CT scans are widely acknowledged as correct. This project studied the variation in measurements found between 3D angiography images and the CT scan images of the same patient. The Results showed that although the measurements given by each imaging technique were significantly similar ($r^2 > 0.97$) in most of the angles, however the measurements of the ICA, or invasive coronary angiography, were not significantly similar ($r^2< 9.7$). Thus, it was concluded that the 3D imaging is close to being as accurate in measurement as the CT scans, but the technology is still not quite as consistent, and thus the CT scans are still necessary for accurate measurements.

What inspired you to participate in undergraduate research?
I wanted to learn more about how translational research within a hospital takes place and wanted to explore this environment further.

How did you get your research position, and what preparation did you undertake for it?
I got in contact with my advisor, Dr. Fernando Boccalandro, during the spring semester of my sophomore year, as I knew that he conducted interesting research near my hometown. When I asked him if I could participate in research with him over the summer, he agreed.

Where was your research experience located?
Odessa Regional Medical Center in Odessa, Texas
What did you get out of your research experience?
I gained a deeper understanding of what it looks like to do research while simultaneously working as a medical doctor, which was very exposure and experience. I am looking into working in a similar medical field in my future, so experiencing it firsthand was very eye opening!

Evaluating regulation and expression of human endogenous retrovirus K (HERV-K) in ovarian cancer

Julia Florek Carlson, Jing Yang, Sharon Stack
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HERV-K is the youngest member of the human endogenous retroviruses (HERVs), which are ancient external viruses that have become integrated into the human genome. HERV-K has been extensively studied in breast and prostate cancer, and upregulation of its mRNA and proteins has been observed in several tumor types. It has been postulated that HERV-K may contribute to tumor growth and metastasis, though the molecular mechanism of its function has not yet been thoroughly investigated. Associations have been observed between HERV-K and inducible nitric oxide synthase (iNOS) in breast and prostate cancer, suggesting a possible link between iNOS signaling and HERV-K expression. Transcriptional activity of HERV-K has also been observed in ovarian cancer, but the body of knowledge surrounding its role in ovarian cancer is limited. This research aims to evaluate the expression of HERV-K across multiple ovarian cancer cell lines and to investigate the mechanism of HERV-K regulation in ovarian cancer and its relationship to iNOS. We have observed the expression of the HERV-K Envelope gene and protein in three ovarian cancer cell lines, Caov3, Ovcar5, and Ovcar8, through qRT-PCR and Western Blot analysis. Study of the regulation by the iNOS signaling pathway is ongoing. It is of critical importance to develop new methods of identifying and treating ovarian cancer because it is most often diagnosed at a late stage and is considered to be the deadliest gynecologic cancer.

What inspired you to participate in undergraduate research?
I was initially motivated to participate in undergraduate research by my interest in a research-related career and the robust research offerings within the Department of Chemistry and Biochemistry, my real first exposure to which was at the ND Chem/Biochem Club Research Night my freshman year. I was inspired by stories from my upperclassmen peers who were already involved in research and had talked about how interesting and rewarding of an experience it was for them. Having been involved for over two years now, I would agree with their assessment!
How did you get your research position, and what preparation did you undertake for it?
I joined the Stack Lab at the beginning of my sophomore year, and obtained research funding for Summer 2023 through the College of Science Summer Undergraduate Research Fellowship (COS-SURF). I prepared for my summer research during the preceding semester, which involved ordering primers and antibodies as well as reading literature, so that I could hit the ground running right at the start of the summer.
Where was your research experience located?
Notre Dame, Harper Cancer Research Institute
What did you get out of your research experience?
Through my summer research, I was able to make substantial progress towards my senior thesis, gain considerable independence as a researcher, and hone experimental design skills and lab techniques. This experience also solidified my interest in a career involving research, and I plan to pursue an MD-PhD in the future.

Tandem Repeat Expansions in Intellectual Disability

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Intellectual disability (ID) is a broad term used to describe global cognitive deficits in individuals from a variety of causes. Recent research shows that a large fraction of ID cases are caused by deleterious genetic mutations. To date, most genetic mutations examined are single nucleotide variants (SNVs), which represent mutations causing a change in a single nucleotide (ex: C to G). However, another type of genetic mutation are tandem repeat expansions (TREs), which occur when a region of tandemly repeated motifs undergoes expansion in copy number (ex: CAG to CAG-CAG-CAG-CAG). TREs are systematically understudied in the field of genetics, and although a few examples are known (e.g., a CGG expansion in *FMR1* is a common cause of ID and autism), their wider pathological role in intellectual disability is unknown. We hypothesized that TREs occurring in genes that are known to be linked with ID would result in reduced cognitive ability. We utilized data from 168,494 unrelated individuals of European ancestry recruited as part of the UK Biobank. We analyzed genome sequencing data to identify TREs in each individual that occurred in autosomal ID genes (n = 3,277) and compared these with educational attainment data and multiple measures of cognitive function based on three cognitive assessments. Logistic and linear regression was performed using R and Bash, and multiple testing correction was performed. Results showed that TREs in the genes *AFF3* (q<.001, β = -1.21), *C9ORF72* (q<.001, β = -.65), *GATA6* (q<.01, β = -1.81), *ZEB2* (q<.01, β = -1.20), *FLNB* (q<.05, β = -.22), and *PRKACB* (q<.05, β = -.82) significantly predicted lower cognitive ability. Understanding how TREs influence intellectual disability is critical for creating new treatment options for affected individuals.

What inspired you to participate in undergraduate research? I desire to create new scientific knowledge at the intersection of neuroscience and genetics and use this to inform novel treatments for neurological diseases like Alzheimer's. Thus, I believe pursuing research is the most meaningful career path for me.
How did you get your research position, and what preparation did you undertake for it? To prepare for my summer applications, I networked with previous summer interns and gathered feedback on my essays. I applied for this program during the winter of my junior year and was accepted in mid-February.
Where was your research experience located? I participated in the Summer Undergraduate Research Program for Underrepresented Scholars (SURP4US) at the Icahn School of Medicine at Mount Sinai this summer. Mount Sinai is located in the Upper East Side in New York City.
What did you get out of your research experience? I am applying for PhD programs in neuroscience this cycle and I wanted to gain more computational experience in genetics, so I joined Dr. Sharp's lab. This experience confirmed my passion for computational work and strengthened my confidence that I will be a successful scientific researcher.

Grasshoppers and Parasitoids and Mites, oh my! The Effect of Grasshopper Developmental Stage, Sex, Family, Size, and Parasitoid Presence on Mite Abundance

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Grasshoppers play an important role in influencing the distribution and composition of plants in ecosystems, and are often agricultural pests for man made landscapes, particularly crops. The grasshopper mite acts as a biological control that parasitizes grasshoppers and feeds on them. We investigated how these mites select grasshoppers, a topic not well researched, and focused on life stage, sex, family, size, location on body, and parasitoid presence. To conduct this, we collected grasshoppers of two families (spur-throated and band-winged) from four sites at the University of Notre Dame Environmental Research Center. We observed their physical characteristics, counted the total number of mites on each region of the body, and dissected adults for parasitoids. The results yielded significant findings, indicating that mites prefer adult female band-winged grasshoppers with no parasitoid presence and favor attachment at the hindwing over other locations. No correlation was found between grasshopper size and number of mites. This study offered novel insight into the relationship between grasshoppers and mites and it encourages further investigation.

What inspired you to participate in undergraduate research?
We both have an interest in environmental science, and at the UNDERC program we became interested in the grasshopper research that could be done around the property.
How did you get your research position, and what preparation did you undertake for it?
We received our research position through applying to the UNDERC Track 1 Program. We were prepared for it through one credit course offered in the spring semester prior to the program.
Where was your research experience located?
The University of Notre Dame Environmental Research Center in Land O' Lakes, Wisconsin.
What did you get out of your research experience?
We gained ecological research skills that combined both lab and field components, along with technical writing skills.

Investigating the role of METTL16 in Miller-Dieker Syndrome

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Miller-Dieker Syndrome (MDS) is a rare neurological disorder due to heterozygous gene deletion on chromosome 17. Often MDS patients die *in utero*, but children who are born display lissencephaly, neurological disorders, epilepsy etc. Life expectancy of MDS patients is related to the severity of the gene deletion. Our proteomics study revealed that methyltransferase-like protein 16 (METTL16) is downregulated and translational pathways are misregulated in MDS cells. Since *METTL16* is located within the MDS locus on chromosome 17 and is involved in methylation-independent functions such as controlling protein translation, we investigated global translational differences in non-MDS and MDS cells. We utilized an *in vitro* approach using BJ (non-MDS cells) as our control from a healthy person and GM06097 (MDS cells) as a disease model from an MDS patient. Western blot validation of METTL16 levels showed ~50% decrease in MDS cells. Further, we studied the global protein translation levels in non-MDS and MDS cells using surface sensing of translation (SUnSET) assay, a method that quantifies global protein synthesis via the incorporation of puromycin into the neosynthesized peptides. Western blot quantification of proteins after puromycin treatment showed a 10-fold decrease of newly synthesized proteins in MDS cells, while MDS cells overexpressing METTL16 rescued the translation defects observed. Next, we will be studying the specific binding partners of METTL16 that could be regulating protein translation (translation initiation factors: eIF4A1 and eIF4A2) as well as splicing (splicing factors: eIF4A3, SRSF1, and SRSF6). Hence, this study will pave the way for identifying therapeutic targets to treat MDS.

What inspired you to participate in undergraduate research?

I wanted to participate in undergraduate research to better prepare me for my future after my undergraduate degree completion. I am still in the middle of discerning whether I would like to attend graduate school or apply for medical school, and getting involved with research helped me to have an experience like that of graduate school. Additionally, I wanted to explore my interests in the field of science, and more specifically, biochemistry. I wanted to be able to learn more about a topic of interest via a hands-on method.

How did you get your research position and what preparation did you undertake for it?

I got my research position as an undergraduate researcher in the Jessica Brown Lab at the beginning of the Fall 2023 semester following an application process in the spring semester prior. As a member of her lab, I applied for the College of Science Summer Undergraduate Research Fellowship. In applying for this Fellowship, I met with my research professor to determine what type of project would be suitable to pursue for the summer, based on complexity and expected duration of the project. Following the drafting of a research proposal for the application, I was accepted for the summer fellowship to conduct the proposed project throughout the summer weeks.

Where was your research experience located?

My research experience was located at the University of Notre Dame in Stepan Hall, which is the location of the Jessica Brown Lab.

What did you get out of your research experience?

From my research experience, I was able to get the full graduate life experience. I knew prior to going into the summer, that graduate students have the primary role of working in the research lab full time. Over the summer, through this experience, I was able to be in the lab for 40 hours a week and go through the workday without the added commitment of schoolwork. I found out that I mostly enjoyed the aspect of doing research, troubleshooting problems with experiments, interpreting data, and forming conclusions. However, I also learned that I don't think that I would want to spend every week of my working life in a lab, based on the repeated failure of experiments as opposed to the more noteworthy, but also more rare, significant results. Overall, this research experience helped my to refine my interests in a laboratory setting and further discern my future career path.

Childhood socioeconomic status as a predictor of elevated inflammation and reduced executive functions in adulthood

Anna M. Kierski & Miguel Blacutt

Keywords: Socioeconomic status, inflammation, working memory, processing speed, inhibitory control

Individuals with lower early socioeconomic status (SES) are often exposed to higher levels of chronic stress (Reiss 2019) which may lead to hypothalamic-pituitary-adrenal axis hyperactivation and heightened inflammation (Zhou 1993). Low SES during childhood may have a negative impact on cognitive development and executive functions such as working memory (Hackman & Farah 2009) and inhibitory control (St. John 2019). This investigation aimed to examine the effects of childhood SES on inflammation, working memory, and inhibitory control. Participants (n = 3921, 46.9±12.1 years old, 53.8% female) were recruited as part of the Midlife in the United States (MIDUS) Study. Childhood SES was collected at a baseline visit and was calculated as the sum of three indicators: father (or mother) highest level of education, welfare status during childhood, and financial status growing up. IL-6, Stop and Go Switch Task (SGST), and category fluency were measured nine years later, and used as markers of inflammation, inhibitory control, and working memory, respectively. SGST performance was assessed by local task switch cost and post-switch reaction time. Category fluency was assessed by the number of unique items recalled in two categories. Linear regression was used to examine the relationship between childhood SES and later IL-6, SGST metrics, and category fluency. We found that childhood SES was inversely associated with IL-6 (β = -0.14, p = .034). Furthermore, childhood SES was associated with better performance on categorical fluency (β =0.95, p < .001) and had an inverse reaction with SGST local switch cost (β = -0.015, p < .001) and reaction time (β = -0.033, p < .001). We found that lower childhood SES is associated with heightened inflammation and lower performance on tests of working memory and inhibitory control. Future research should examine the interplay between SES, inflammation, and executive function throughout the lifespan.

What inspired you to participate in undergraduate research?
I knew I wanted to participate in research right when I got to Notre Dame. I originally came in as a biology major and wanted to study virology, but soon realized that I enjoyed studying the human mind more, which is when I switched into neuroscience. I quickly became passionate about mental health and knew I wanted to work in clinical psychology research, which is why I am now in the SPIRIT lab.

How did you get your research position, and what preparation did you undertake for it?
I emailed professors! It really helps if you have taken a class from them too. For instance, I was in Psychology of Addiction, which the professor whose research I was interested in taught.

Where was your research experience located?
University of Notre Dame

What did you get out of your research experience?
How to analyze data. It is a very important skill to know and research is 99% collecting/ analyzing your data before you can do something cool with it :)

The ESX-1 Transcriptional Network and Mycobacterial Pathogenesis

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Pathogenic mycobacteria, including Mycobacterium tuberculosis, the causative agent of human tuberculosis infections, use the ESX-1 protein secretion system to evade the macrophage immune response by lysing the phagolysosomal membrane. We have recently defined the transcriptional network regulating the ESX-1 system both in the laboratory and during infection. We are interested in understanding the relationship between transcription factors EspM and EspN, which work in opposition to control ESX-1 secretion. There is an undefined, infection-dependent signal regulating the switch between ESX-1 repressor EspM and activator EspN on the ESX-1 activator WhiB6, ESX-1 protein machinery components EccA-EccCb1, and ESX-1 secreted substrates. The mechanisms behind the competitive regulation by these two proteins remain undefined. Recent work has suggested that EspM negatively regulates EspN post-transcriptionally. We used a bacterial two-hybrid system to further understand this and other protein-protein interactions of the transcriptional network. In addition, the DNA binding ability of EspN has not been characterized in vitro. Electrophoretic mobility shift assays (EMSAs) presented here using newly purified EspN and the *whiB6* promoter probe confirm the specific DNA binding ability of EspN. This work is foundational for future experiments aimed at testing the potential effects of EspM on the DNA binding ability of EspN, thus defining the mechanism of ESX-1 regulation. Defining the transcriptional network regulating the ESX-1 system will help answer important questions about the signaling events initiating virulent mycobacterium defense mechanisms. Understanding these regulatory mechanisms can lead to potential future therapies aimed at disrupting host signals contributing to ESX-1 regulation.

What inspired you to participate in undergraduate research?
Coming into college, I knew I wanted to go to grad school and get my PhD in biology, so I got involved in research as soon as I could to discern if research was really the right path for me. I was inspired by the work going on in the different labs and by upperclassmen who were leading their own projects and finding answers to their own questions.
How did you get your research position, and what preparation did you undertake for it?
I emailed professors whose work I found interesting and asked to meet to discuss research opportunities. I prepared by reading papers and talking to upperclassmen and people familiar with the lab.
Where was your research experience located?
I worked in Patricia Champion's lab here on campus over the summer. I have been part of the lab since fall of my sophomore year.
What did you get out of your research experience?
I gained lots of new lab skills and techniques, as well as the ability to plan and execute experiments fairly independently. From working with the graduate students in my lab I got a better idea of what life might look like as a PhD student, which was really helpful for my own career discernment.

Elucidating the Role of *Iroquois Transcription Factor 4a* in Kidney Development

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Chronic kidney disease is a very prominent problem in the US, impacting millions of Americans a year. In order to better address this issue, more advanced knowledge of kidney function and development is critical. The kidney is a vital organ responsible for both filtering waste from the blood, and balancing ion concentrations in the blood. These roles are carried out by the nephron, the functional unit of the kidney. The nephron consists of a glomerular blood filter attached to a segmented epithelial tubule, which is organized into functionally distinct domains. Although nephron development is vital to renal function, there has been limited research into the genetic mechanisms that regulate their formation. There are many genetic pathways that play crucial roles in the various components of kidney formation, one of which is the Iroquois (Irx) gene family of transcription factors. Of these, *Iroquois transcription factor 4a* (*irx4a*), is previously unstudied in regards to its role in nephrogenesis. The zebrafish is a useful model to study nephron development due to the high conservation in nephron composition with humans. Here, using whole mount *in situ* hybridization to assess spatiotemporal expression, we found that *irx4a* was expressed in the proximal straight tubule (PST) and distal early (DE) regions of the embryonic nephron. Interestingly, *irx4a* transcripts were first expressed at around the 12 somite stage (ss) in the renal progenitors which found these segment regions. Further *irx4a*+ cells exhibited a speckled expression pattern within the nephron, which suggests that it is likely a marker of either multiciliated cells (MCCs) or transporter cells. In the zebrafish kidney, MCCs are responsible for driving fluid flow through the kidney. We hypothesize that *irx4a* acts redundantly with *irx2a*, another member of the Iroquois gene family, because the two genes have very similar expression patterns. *irx2a* is expressed in MCCs, so it is believed that *irx4a* is expressed in MCCs as well. To examine whether *irx4a* is required for nephrogenesis, *irx4a* deficient embryos were created through the microinjection of a splice blocking morpholino. *irx4a* knockdown caused a significant decrease in the number of MCCs present in the nephron. This implies that *irx4a* plays a vital role in proper MCC formation. Future studies will examine the consequence of dual *irx4a/2a* deficiency on MCC ontogeny. Gaining insight into the function of genes such as *irx4a* will allow for greater understanding of how kidneys develop. This knowledge could provide critical insight into better understanding and eventually treating congenital and chronic kidney diseases.

What inspired you to participate in undergraduate research?
Ever since middle school science class, I've been interested in the concept of discovery. It amazed me that through their research, scientists have the ability to discover things that no one else on the planet has ever known. I wanted to carry out my own research and be the first to learn something that could advance humanity. I was also fascinated by genetics. How a simple string of nucleotides could encode our entire body plan. Thus, when I got to Notre Dame, I reached out to Dr. Wingert about joining her lab as an undergraduate researcher so that I could carry out my own research and work towards my goal of discovering something that no one else ever has.

How did you get your research position, and what preparation did you undertake for it?
I started out by researching different labs at Notre Dame, and was really interested in Dr. Wingert's lab. I reached out to her, and we had a meeting about me joining the lab. Shortly after, I started working in the lab. In order to prepare I read several papers both from the lab and from other researchers on similar topics.

Where was your research experience located?
Galvin Life Science Center at the University of Notre Dame

What did you get out of your research experience?
I'm currently in the process of applying to graduate schools, so carrying out an extended research project taught me what it's like to formulate, plan, and carry out an original research project, similarly to what I would be doing in grad school, just on a smaller scale. This opportunity confirmed my interest in graduate school and taught me valuable skills for my future plans.

Epigenetic Targeting Improves Glioblastoma Cell Sensitivity to Chemotherapy

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Histone deacetylase inhibitors (HDACi) have emerged as a new class of anti-tumor agents for various types of cancers, including glioblastoma (GBM). Recent studies have shown that modifying the GBM epigenome can enhance the effects of standard clinical therapies. Here, we utilized the human U87-GBM cell line to evaluate the cytotoxic properties of three blood-brain-barrier-penetrating HDACi—suberoylanilide hydroxamic acid (SAHA, or Vorinostat), valproic acid (VPA), and CAY10603—both as monotherapies and in combination with the chemotherapeutic agent temozolomide (TMZ). Human normal astrocytes (HNAs, SV40T) were used as cytotoxic controls.
We found that HDACi significantly reduced cell viability and increased cell death of human GBM cells, but not HNAs. Combination therapy of HDACi with TMZ generated increased cytotoxic activity in comparison to TMZ monotherapy, with the combination of VPA and TMZ having the strongest effect (30% viability following VPA/TMZ treatment). In contrast, when evaluating epi-drugs as monotherapies, at intermediate concentrations, 1.9 μM CAY10603 was most effective in decreasing U87-GBM cell viability (27%) particularly at micromolar concentrations, compared to 3.7 μM SAHA (36%) and 1.5 mM VPA (51%). In HNAs, CAY10603, SAHA, and VPA decreased cell viability to 80%, 87%, and 90%, respectively.
These findings suggest that HDACi synergize with TMZ to enhance its cytotoxicity. The promising anti-tumor effects of HDACi warrant preclinical studies.

What inspired you to participate in undergraduate research?
I didn't know much about undergraduate research as a freshman, until I participated in a vertical mentoring program within the biology major. My mentor talked to me about her own work and suggested research as 1) a great way to prepare for medical school and 2) an excellent way to engage my love of science and learning. Research has since come to define my undergraduate experience, and I recommend it for all those who enjoy intensive, collaborative problem-solving.

How did you get your research position, and what preparation did you undertake for it?
I originally got into research at Notre Dame by establishing a professional relationship with my biology lab professor and entering her research lab, but I found my current research lab by emailing professors who were leading projects that I found interesting. Freshman biology and chemistry labs helped prepare me for research to an extent, as did extensively reading previous research in my field of study. As a member of the Biology Senior Leadership Committee's Skills Workshop Committee, I highly recommend participating in the spring Skills Workshop Series to develop your skills in presentation, basic data analysis, and bench work before applying to a research lab!

Where was your research experience located?
This research project is ongoing at the University of Notre Dame, in conjunction with the Department of Aerospace and Mechanical Engineering.

What did you get out of your research experience?
As a biological sciences major working in a chemical engineering lab, I have learned a great deal about the benefits of multidisciplinary research and the skills required to be a part of it. This prepared me incredibly well for a career in academic medicine, where I'll need the communication skills to work within a multidisciplinary care team. I have also been with this project since it began, and thus have had the very unique opportunity to follow a research project through from inception to publication. Most importantly, I've improved my understanding of epigenetics and cancer cell biology, areas of academic interest that I hope to continue studying after graduation.

Analysis of Thoracic Aortic Function with Hemodynamic models and Correlation Graphs

Lauren Latimer
Advisor: Dr. Daniele Schiavazzi, Department of Applied and Computational Mathematics and Statistics, University of Notre Dame

Cardiovascular disease has been named the leading cause of death in the United States for several decades, highlighting the demand for thorough comprehension of the cardiovascular system's inner workings. This study utilizes computational models for their ability to capture patient-specific time histories of pressure and blood flow from medical image data. Specifically, this research focuses on tracking these hemodynamic outputs within the aorta and identifying potential changes due to aortic disease. The two-element Windkessel model was first used to gather a preliminary analysis on the aorta, followed by the use of zero-dimensional modeling to gain insights on two 11-year-old patients: one healthy and one diagnosed with coarctation of the aorta. Correlation matrices for both patients were constructed to observe the relationship between blood flow values at all main branches in the thoracic aorta. Statistical analysis of these matrices revealed that on average, the diseased patient presented limited correlations between branch flows, leading to graphs with fewer connectivities than the healthy patient. This approach can be implemented in additional models from public repositories to identify if significant trends in hemodynamic outputs exist according to disease, which may allow these computational methods to serve as a marker for cardiovascular disease.

What inspired you to participate in undergraduate research?
As an ACMS major with a concentration in biology, my main goal was to discover how my niche for mathematics and analytical thinking could be applied towards my interest in the life sciences. Participating in undergraduate research was the ideal opportunity for me to see the work done at the intersection of these two fields, and doing so has further inspired me to continue undergraduate research.
How did you get your research position, and what preparation did you undertake for it?
I received my position by applying to a summer research program organized by the ACMS department, in which they paired me with a project I expressed interest in. From there, I was offered to continue doing research during the semester.
Where was your research experience located?
Both virtually and at Notre Dame.
What did you get out of your research experience?
Participating in this research not only strengthened my technical skills and coding abilities, but it has also sharpened my problem solving skills, as it consistently requires me to rethink, revise, or hypothesize new approaches when I run into errors.

An Eccentric Planet Orbiting the Polar V808 Aurigae

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Changes in eclipse timings of cataclysmic variables (CVs) are excellent at discovering planets and other stellar components. This can be due to the light-travel time effect, where an external massive object, such as a third body, shifts the center of mass of the binary, and is seen in observed minus calculated eclipse timing (O - C) plots. Polars are a specific type of CV where the magnetic field from the white dwarf disrupts the formation of an accretion disk and creates extremely bright emission regions at the poles. This lets us measure eclipse timings to a precision of a few tenths of a second. In this study, we analyze the eclipse timings of the polar V808 Aurigae spanning 15 years. We find a 50 second jump in the O - C values over just three years, which suggests a third body orbiting the binary with a highly eccentric orbit. Calculating the orbital parameters of the third body estimates its mass to be about 7 Jupiter masses with an orbit period of 11.3 years. However, one must proceed with caution, as HU Aqr, a similar polar to V808 Aur, was also thought to have many bodies until Schwope and Thinius (2018) concluded that HU Aqr's variations in eclipse timings were due to the Applegate mechanism and many bodies. While this is the case for HU Aqr, the shift in V808 Aur is well modeled by the light-travel time effect.

What inspired you to participate in undergraduate research?
I had always been fascinated by discovering new things and learning how things worked in the universe. I knew that I could get a head start on following this passion by participating in undergraduate research, where I could learn at my own pace and dive head-first into deep topics in astronomy.
How did you get your research position, and what preparation did you undertake for it?
I started doing research with Professor Garnavich the summer after my freshman year. I read a lot of background papers on cataclysmic variable stars and took a couple coding classes to analyze my data. As the years progressed, I became more experienced in Python, which is what I used 90% of the time in my research.
Where was your research experience located?
For this project, I could do my research anywhere on campus. Most of my work was coding in Python so I just needed my computer to get it done. But I also used the Krizmanich telescope on top of Jordan Hall to take my own data, so I spent a couple nights there analyzing V808 Aur data.
What did you get out of your research experience?
This research experience taught me a lot about observational and computational astrophysics. I learned to take, clean, analyze, and present my own data, as well as practice my presentation skills—essential for future research projects, proposals, and conferences.

CYTOKINE BIOMARKERS ASSOCIATED WITH THE INFLAMMATORY RESPONSE AND CLINICAL DATA MAY SERVE TO PREDICT THE DEVELOPMENT OF HETEROTOPIC OSSIFICATION IN COMBAT-RELATED EXTREMITY TRAUMA

Peter Lukish [2,6], Felipe A. Lisboa, MD[1,2,5,6], Benjamin K. Potter, MD[1,2,6], Matthew J. Bradley, MD[1,2,6], Seth A. Schobel, PhD[2,5,6], Simon Tallowin, BMBS MSc[2,6], Renhua Li PhD[2,5,6] Henry T. Robertson, PhD[1,2,5,6], Christopher J. Dente MD[3,6], Timothy G. Buchman, PhD MD[3,6], Allan D. Kirk, MD PhD[4,6], and Eric A. Elster, MD[1,2,6]

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Heterotopic ossification (HO), an ectopic bone formation, is a frequent treatment complication of combat-related extremity trauma. Estimating the risk of HO may help identify patients who should benefit most from early methods of prophylaxis such as the use of nonsteroidal anti-inflammatory drugs (NSAIDs). Therefore, we examined the records of 73 patients treated at the WRNMMC with 116 combat-related extremity wounds (IRB Protocol 352334). By 24h of hospital admission, wounds were photographed for injured area calculation and samples of blood and wound effluent were collected for cytokine testing. The Boruta algorithm was used for variable selection followed by random forest (RF) model training to predict HO development. Model performance and 95% CI was evaluated by the area under the receiver operating characteristic curve (AUC), sensitivity, and specificity. Selected serum biomarkers (IL2R, IL8, IL15, MIP-1B, IL12, and IL7) were used to train Model 1, selected effluent biomarkers (IL17 and GMCSF) and wound surface area for Model 2, and selected clinical data (blood glucose, RBC, FFP, and the number of blood products received in the first 24h post injury and 24h post hospital admission at WRNMMC) for Model 3. Model 1 showed the best AUC of 0.84 (0.82 to 0.85), followed by Model 2, AUC of 0.80 (0.77 to 0.83). Model 3 had a lower AUC of 0.77 (0.74 to 0.79) if compared to Model 1. All models had relatively similar sensitivity (0.79 to 0.84) and specificity (0.61 to 0.64). Addition of standard of care clinical variables in model training did not improve performance. In conclusion, the development of a clinical decision support tool based on selected serum biomarkers, after external validation, may offer surgeons an additional option of considering the use of prophylactic methods such as NSAIDS in patients with higher risk of development of HO by hospital admission.

What inspired you to participate in undergraduate research?
I was inspired by the exploration of what is unknown and can thus be found out about the world.
How did you get your research position, and what preparation did you undertake for it?
I applied for it through ORISE application, and I completed regulatory protocols and R training for it.
Where was your research experience located?
It was located at the Uniformed Services University of Health Sciences in Bethesda, Maryland.
What did you get out of your research experience?
I got out the capacity to work as highly functional part of a research team, and I had fun doing it!

Examining the preferential chelation of metals by APDC in complex mixtures: a colorimetric and quantitative approach.

Quinn Mackay[1,2], Gabriella Morales[3,4], David Reed[3,4], and Yoshiko Fujita[3,4]
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Tellurium is a metal critical to CdTe solar cells, and is exceedingly rare, averaging at ~1ppb in Earth's crust. However, Te is found at higher concentrations in some copper and gold mine tailings. Tellurium can be bioleached from these mine tailings, ending up in the aqueous solution as either Te(IV) or Te(VI). In order to design the most effective recovery approach, it is useful to know Te's speciation in solution. Ammonium pyrrolidine dithiocarbamate (APDC) is an organic compound that can chelate Te(IV), but not Te(VI), to form a metal:APDC complex that can be separated from Te(VI) via solid phase extraction (SPE) onto an organic resin. By measuring the total Te(IV+VI) prior to addition of APDC and the concentration of Te in the solution that passes through the resin, the concentration of Te(IV) can be determined by difference. However, our previous experimentation has shown that while this method works well in synthetic solutions, the method is less effective in complex solutions that contain high concentrations of other metals. To determine if metal competition could be hindering determination of the Te speciation, the effectiveness of APDC metal chelation in a synthetic complex solution containing Te, Fe, Cu, and Zn was tested. Each metal chelate has a unique color. Mixtures of APDC and metals at varying concentrations were prepared and colors of the mixtures were noted. The concentrations of the metals in the post-SPE solutions were also measured with inductively coupled plasma mass spectrometry for quantitative analysis of metal chelation. The authors found that APDC does react preferentially with metals, chelating with some metals more strongly than others. This was supported by absorption spectra measurements and visual color observations. In our analysis, binding is preferential in the order Cu(II) > Te(IV) > Fe(II)/Zn(II). These results could have an impact on future efforts to examine Te speciation in complex metal solutions, such as mine tailings leachates.

What inspired you to participate in undergraduate research?
I decided to pursue undergraduate research due to my desire to apply classroom learning to the real world, especially regarding environmental and earth science. I wanted to do my part to solve global environmental change. Thus far, I have found love in research in oceanography and geochemistry, and want to pursue chemical oceanography for my Ph.D.

How did you get your research position, and what preparation did you undertake for it?
I got this research position from applying for the Department of Energy Summer Undergraduate Laboratory Research Internship (DOE SULI) program, which places an individual with a lab within the wider DOE National Lab complex. I prepared by having a few years of geochemistry and other research experiences prior.

Where was your research experience located?
Eastern Idaho, in Idaho Falls, ID. Right near the Grand Tetons!

What did you get out of your research experience?
From this experience, I was able to experience what research looks like outside of the academia sphere. I am significantly more interested now in looking at industry / government research post-Ph.D. I was also able to learn a lot more about the inner workings of the Department of Energy, and the massive scale of operations.

Multiple Test Correction for Genomic Studies

Erin A. McNally
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Multiple test correction is necessary for avoidance of false rejections of null hypotheses in studies that analyze numerous tests simultaneously. Studies of heredity utilize genome wide association studies (GWAS) that contain hundreds of thousands to millions of single nucleotide polymorphisms (SNPs). While the permutation test appears to be the ideal correction method, the amount of tests in genomic datasets makes this computationally prohibitive. To this end, I compared alternative methods that could provide corrections similar to the permutation test. Specifically, the Bonferroni method, simpleM method, and false discovery rate (FDR) were investigated. The Bonferroni method assumes tests are independent, which does not hold for genomic datasets due to linkage disequilibrium, making this method overly conservative. FDR is not preferred for genomic datasets because most tests truly fall under the null hypothesis. The simpleM method appears to currently be the most accurate alternative to the permutation test. I am developing code to implement these correction methods and visualize the results.

What inspired you to participate in undergraduate research?
I have really enjoyed the majority of my ACMS courses, but I did not have a great understanding of application beyond classes. I realized that engaging in research would expand upon my in-class learning.
How did you get your research position, and what preparation did you undertake for it?
The ACMS administrative assistant sent an email to all undergraduates in the major with the opportunity to apply for different research positions. I applied and over the summer communicated with Dr. Giuseppe Vinci about conducting research together on genomics. At the start of the fall semester we planned out specific research into multiple test corrections for genomic datasets.
Where was your research experience located?
My research is conducted mostly online, with weekly meetings in Crowley Hall.
What did you get out of your research experience?
I gained experience with an independent work schedule and freedom in what topics I wanted to explore. From this research I have learned a lot about coding and statistical analysis beyond what I covered in my courses. This research specifically combines my interest in biology with my ACMS major. I plan to attend medical school after graduation, and this experience allowed me to study genomics preparing me for my future career. I also learned about specific genes that are correlated with opioid addiction and as I continue my research I will hopefully find further information about the heredity of addiction.

Better Safe Than Sorry? Tracking the Association Between Safety Behaviors and Anxious Symptoms During the COVID-19 Pandemic

Matt Hawkins, Joshua Moeller, Rebecca Wingert
University of Notre Dame, Department of Biological Sciences

Fetal alcohol spectrum disorders (FASD) encompass a broad range of effects caused by prenatal alcohol exposure. In the United States, conservative estimates place the incidence of FASD at a rate of 5 in 100 births. Children afflicted with FASD can have symptoms ranging from congenital defects of the heart, eyes, and kidneys, as well as poor development of facial structures such as the nose and mouth. Invisible complications such as learning disabilities, socio-developmental delays and emotional disorders are also highly prevalent. There is no known cure for FASD and in utero detection methods are not available. In terms of urinary tract defects, kidney and renal related maladies remain an underreported and rather uncommon diagnosis within patients with FASD. In order to better understand the renal phenotypes associated with prenatal alcohol exposure, we employed the zebrafish, *Danio rerio*, a vertebrate species well suited for developmental nephrology and teratological work that has been used extensively to model FASD. We treated zebrafish embryos with ethanol to examine its effects on the formation of renal cell populations. Using whole mount in situ hybridization for renal cell markers, we determined that both tubule and non-tubule populations are greatly perturbed by alcohol exposure. Further, we found that retinoid acid, a vitamin A derived chemical associated with mitigating the effects of ethanol exposure in zebrafish and other animals, was sufficient to partially rescue several renal alterations caused by early ethanol exposure. These studies have revealed several consequences of ethanol exposure, as well as interactions with retinoic acid, that lead to the deregulation of kidney development, thereby contributing novel insights relevant to the broader field of FASD research.

What inspired you to participate in undergraduate research? I have been obsessed with Biology for a very long time. I hope to go on to get a Ph.D. and pursue research as a career, so it was important for me to gain experience as soon as possible.
How did you get your research position, and what preparation did you undertake for it? I found my position in a pretty typical way. I looked at all the labs listed on the department website, filtered out the ones that seemed most interesting and emailed their faculty until they responded. Most of the skills you need to work in your laboratory are learned on the job, however I did learn some coding in my free time for use in the lab.
Where was your research experience located? The Wingert Laboratory, University of Notre Dame, BioREU.
What did you get out of your research experience? This was my first time experiencing research full-time. I had some doubts about my career choice prior to this summer, but I enjoyed experiencing what it was like to be a full-time researcher and am more confident than ever that I want to go to graduate school.

Carbon Dating for Interdisciplinary Research and Teaching: Developing 14C AMS at Notre Dame

Griffin Mulcahy, Thomas Bailey, Chloe Jones, David Lund, William Peeler, Liam Wood, Philippe Collon
University of Notre Dame, Department of Physics

The purpose of developing 14C Accelerator Mass Spectrometry (AMS) at Notre Dame is to provide carbon dating capabilities to researchers internally and to develop a program to introduce AMS techniques to graduate and undergraduate students.
The AMS Group at Notre Dame's Nuclear Science Laboratory uses an NEC MC-SNICS ion source (SNICS), FN Tandem Accelerator, and various detector systems to determine the concentration of isotopes of interest in samples. A retractable compact-IC and offset FCs were used to measure 14C counts and 12C & 13C beam currents in tandem. Thus far, the maximum 12C current reached on the post-SNICS FC is ~4.3 microamps, the maximum transmission of 12C through the system is ~3.16%, and the average background ratio of 14C/12C is ~2.4x10^-14. Short-term objectives of the 14C project include achieving: 8 microamps of 12C beam current on the post-SNICS FC, a consistent transmission rate of 5%, and a reduction of 14C/12C background to ~5x1o^-15.
For a discussion of preliminary results from these experiments see William Peeler's FURF abstract. The first results of these experiments and any further developments will be presented at the FURF poster session.

What inspired you to participate in undergraduate research?
I have always been interested in investigating scientific questions and have been eager to research since I started high school. I began doing research my first semester and began my current research project in January of 2023.
How did you get your research position, and what preparation did you undertake for it?
I approached my current research advisor Professor Philippe Collon in December of 2022 about beginning research in his group. I was interested in working with Professor Collon because we had developed a strong working relationship while he was my Physics A and B professor and I was interested in working in the Nuclear Science Lab because I wanted to gain hands-on experience on experimental equipment which was not available to me when I was doing research in high energy physics. I have read dozens of articles and many textbook chapters on nuclear physics in general, developments in nuclear physics, the operation of particle accelerators, novel as well as widely used methods for AMS experimental techniques and sample preparation, and techniques of data analysis using programs such as ROOT, Python, and Excel both in direct application to nuclear physics as well as in general.
Where was your research experience located?
I was on campus over the summer on a COS-SURF grant conducting research at the Nuclear Science Lab at the University of Notre Dame. I have been conducting and assisting with nuclear physics experiments and accelerator maintenance regularly at the Nuclear Science Lab since the beginning of the 2023 Spring Semester.
What did you get out of your research experience?
I have developed as a leader and manager from being the lead on my research project. I have also become better at learning independently, better at time management, and better at delegating tasks to be able to balance all of the demands on my time.
I have gained a lot of knowledge about how to run experiments well through my research and how to think through the physics of real-life situations, ie to apply my quantitative skills gained in solving textbook problems to real-world situations.
My grad student mentor Thomas Bailey often challenges me to diagnose issues with experiments and determine the function of different components that I am unfamiliar with to help me expand my knowledge which I find helpful and encouraging.

Sulfur Biology: Deciphering Reactions of Hydrogen Sulfide and Polysulfides with Naphthoquinones as Catalysts

Ella R. Pfaff, Kenneth R. Olson, Yan Gao
University of Notre Dame, Department of Biology

Hydrogen sulfide (H2S) is an important gasotransmitter and cellular signaling molecule. By combining with itself in intermolecular reactions it can form hydrogen disulfide (H2S2) and other polysulfides (H2Sn, n = 2-4). However, possibly more important is the ability of these small molecules to attach to other biologically relevant compounds such as the cysteine residues of proteins, affecting their functions in cells. It is a broader goal to investigate and understand the effects of a class of molecules called naphthoquinones (NQs) on hydrogen sulfide and resulting sulfur chemistry, as well as its biological relevance. The purpose of this study was to compare the reactions of NQs with H2S and H2Sn. This was done mainly through monitoring oxygen levels of a reaction solution, as well as through fluorescent probes used to detect hydrogen- and poly-sulfides. It was found that NQs react catalytically to produce polysulfides from H2S, and this reaction is dependent on oxygen. Additionally, NQs react differently when exposed to molecules containing concatenated sulfur atoms. This work helps to elucidate the chemistry of small sulfur signaling molecules as it is relevant to the biology of a human cell.

What inspired you to participate in undergraduate research?
I am hoping to have a career in research, so I wanted to become part of a research lab as soon as possible to gain that experience and see what it would be like in order to better direct my future.

How did you get your research position, and what preparation did you undertake for it?
To get my research position, I looked at professors' research on the ND website and cold emailed a lot of professors asking to be part of their labs. Ultimately I chose one that I liked, and for preparation read as many papers as I could on the topics that the lab was investigating.

Where was your research experience located?
Indiana University School of Medicine - South Bend

What did you get out of your research experience?
Experience! I didn't know what it was like to work in a research lab, to think creatively and try to answer open questions, to learn and implement new techniques, and to participate in such an exploding field of biology. I also am an author on multiple papers as a consequence of my work.

Phenotypic plasticity in wood frog tadpole (Rana sylvatica) development when exposed to road salt

Elysa Ng
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Road deicing salts are frequently used during winter and runoff can raise the salinity levels in nearby freshwater habitats. Aquatic organisms in these environments are continuously exposed to these contaminants, including amphibians whose highly permeable skin can cause them to be sensitive to ions in the water. Understanding the impacts of NaCl as an environmental stressor to amphibians can provide a more comprehensive picture on the factors affecting amphibian decline. In this study, the effects of salinity on the morphology, behavior, and escape performance of the wood frog (*Rana sylvatica*) were investigated. The interactive effects between road salt and biotic stressors were also tested, namely in the presence of a predator. During the summer of 2023, 24 experimental tank units, each with 35 *R. sylvatica* tadpoles, were randomly assigned to one of six experimental conditions with two main factors: three salt treatments (no salt, low salt (1,600 mg/L), high salt (3,200 mg/L)) and the presence/absence of a predator (*Dytiscus* spp.) This experiment revealed that salinity had a significant effect on tadpole behavior, with tadpoles being less active in the higher salt treatments than the control treatment with predators, likely due to osmoregulatory stress. There was also an overall trend towards slower escape swim speeds in tadpoles that were exposed to salt, which could also be attributed to the higher costs of osmoregulation. A significant difference in the escape behavior of tadpoles in the high salt without a predator treatment as compared to the control with a predator treatment was detected. This study found no significant effect of salt or predator exposure on mortality or morphology. In conclusion, this study suggests that chronic exposure of mid-stage *R. sylvatica* larvae to increased salinity levels can result in negative impacts that might affect their future populations.

What inspired you to participate in undergraduate research?
I always believe that to make the most of my Notre Dame experience, I should try out different areas of research to find out what I like or don't like. At the end of the day, my desire to do research comes from wanting to play a bigger role in the scientific community and find a discovery that will have a positive impact to the world. My dream is to eventually go into graduate school and study development and regeneration, hopefully with axolotls.
This undergraduate research project was inspired by my desire to conduct an independent research project.. When I got accepted into UNDERC Track 2, it was the perfect time for me to execute this. I decided to do a topic on something that I was passionate about, and had a lot of fun learning how to run a project.
How did you get your research position, and what preparation did you undertake for it?
I am now currently working an undergraduate research position in the Wingert Lab. I got this position because of my interest in development and regeneration, and I wanted more hands on experience to explore that field. This is a huge change for me, as my background was in ecology and evolution. I have previously worked on projects in both the Archie Lab and the Rohr lab involving animal behavior, so I have experience with research as a whole.
Where was your research experience located?
The Environmental Research Center (UNDERC), Department of Biological Sciences, is located in the Northwoods. The property is right by the Wisconsin-Michigan border.
What did you get out of your research experience?
If I had to describe this project, it was hard. There were many sleepless and anxiety filled nights of me wondering if my project was going to turn out well. However, I felt really proud because this was an experiment of my own, and my results were a consequence of my hard work and effort. Throughout this project, I have learnt to work independently, creating daily manageable goals and consistently meeting them everyday. I also honed important skills such brainstorming research ideas, collecting data and analyzing data in R Studio.

Effect of Optimism on Visual Attention and Memory for Negative and Neutral Scenes

Nadia Nosek, Dr. Kristin Sanders, Dr. Jessica Payne
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Optimism, or expecting good things to happen in the future, is correlated with long-term benefits including higher reported happiness and higher chance of recovering from cancer. However, the mechanisms linking optimism to improved quality of life remain unknown. Previous research suggests that pessimists may visually attend to negative information more than optimists. In addition, other research suggests that increased visual attention leads to better later memory of that information, but this finding has not been connected to the optimism field. Here, we will examine the relationship between participants' trait optimism, attention to negative information, and later memory for the negative information at the expense of the neutral information.
Participants aged 18-59 viewed a series of negative and neutral scenes, consisting of a negative or neutral object placed on a neutral background, while eye movements were recorded using an eye tracker. After a period of 12 hours, participants viewed objects and backgrounds separately and judged whether they had seen each item in the previous session. Optimism scores were recorded using the Life Orientation Test-Revised prior to the first session.
As predicted, participants remembered the objects better than the backgrounds of negative scenes, but this trade-off was not present for neutral scenes. We found the same relationships for eye gaze duration, where participants looked at the negative objects longer than their backgrounds, showing an attentional bias for the negative objects at the cost of their backgrounds which is not present for neutral scenes. The total time a participant spent looking at the object of any scene was significantly correlated with their memory for that object, suggesting visual attention's contribution to memory. Optimism scores did not significantly predict either participants' attention to or memory for negative information. This research has implications for the mechanism behind optimism's connection to cognition and life quality.

What inspired you to participate in undergraduate research?
I knew that I was not interested in becoming a medical doctor, and I have always been passionate about academics. I found that becoming involved in research is the way I can use my skills and creativity to make an impact in the neuroscience field. I hope to continue to be a part of research, and to do so I am now pursuing graduate school.

How did you get your research position, and what preparation did you undertake for it?
I joined the Sleep Stress and Memory Lab in Spring 2021. To join the lab, I looked at all the neuroscience affiliate faculty of ND and found this lab, which was the one that was most interesting to me. Through my work throughout the years, I fully got involved in the lab's research questions and developed a relationship that allowed me to start taking my own steps to my own project within the lab.

Where was your research experience located?
My experience was located on Notre Dame Campus, so I stayed in South Bend over the summer.

What did you get out of your research experience?
This summer project that I began was vital in starting the work for my honors thesis. Beginning data collection and creating code for data analysis was a lot of work, but having the time and resources to dedicate myself throughout the summer, with the support of my mentors in the lab, set me up to finish a lot of necessary steps before the academic year even began.

The Effects of Paternal Substance Abuse and Paternal Support on Adolescent Alcohol and Marijuana Use

Julia Norton
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While previous work has explored areas such as psychological and physical effects of caregiver substance abuse on youth, further research is needed to identify potential associations between parental and adolescent substance use, and the role of paternal support. The purpose of this study was to examine the potential relationships between aspects of male caregiver and adolescent alcohol and marijuana use at age 18. Factors of interest included history of parental substance use, paternal support of children, and child maltreatment history. Data were drawn from the LONGSCAN study, which was created to investigate causes and effects of children at risk for maltreatment across the United States (Runyan et. al, 2014). The study also aimed to investigate child risk behaviors while recording family characteristics and environmental factors. Children (n=819) from five different sites completed surveys; we performed logistic regression for dichotomous variables and multiple linear regression for continuous variables. Results show that maltreatment correlates with the age adolescents begin to drink alcohol. Additionally, results show that caregiver alcohol use correlates with child marijuana use. However, father involvement shows no significant correlation with adolescent alcohol use.

What inspired you to participate in undergraduate research?
I wanted to apply what I had been learning in a way that could positively impact people. Additionally, I strived to challenge myself academically and try something new. After learning about the Building Resilience After Violence Exposure (BRAVE) Lab, I knew that this research was incredibly meaningful and that I wanted to be involved.

How did you get your research position, and what preparation did you undertake for it?
I found my lab professor Dr. Miller-Graff through the Kellogg faculty fellows. Her research is incredibly powerful, and I was instantly inspired. I reached out to Dr. Miller-Graff and had a meeting to discuss what the research position would entail. I prepared by working hard in my courses and reading a lot of research papers. Before beginning this project, I had a year of experience working in her lab, which prepared me to take on my own research.

Where was your research experience located?
My research experience was located on campus in Corbett Family Hall. Most of my research was conducted online.

What did you get out of your research experience?
This experience has given me a lot of confidence and knowledge. I loved working with my lab professor and being able to learn so much from her. I have developed a more well-rounded understanding of the scientific process, which has given me a deeper appreciation for research and science overall. I have also gotten more comfortable working with and analyzing data.

Attacks on the NTRU Cryptosystem

Jack O'Sullivan
University of Notre Dame, Department of Applied and Computational Mathematics and Statistics

With the rise of quantum computing, the NTRU cryptosystem of Hoffstein, Pipher, and Silverman has emerged as a promising public-key encryption algorithm, offering fast key generation and efficient cryptographic operations. As a lattice-based scheme, NTRU's resistance against classical and quantum attacks has sparked considerable interest. In this study, I will first present an overview of the NTRU cryptosystem, focusing on parameter selection, key generation, encryption, and decryption processes. Additionally, I will explore potential attacks that may compromise the security of NTRU, including lattice reduction algorithms and chosen-ciphertext attacks. Finally, I will draw conclusions about the overall security of NTRU, considering its strengths, weaknesses, and potential for further development in an era of advancing computational capabilities.

What inspired you to participate in undergraduate research?
In the Spring 2023 semester, I took a new ACMS elective course called Mathematical Cryptography with Python and really enjoyed it. Learning about the real-world applications of Lattice-Based Cryptography and the mathematical processes behind it really fascinated me. When I found out that Dr. Catie Acitelli, who taught the elective course, would be a mentor for a Cryptography research project, I jumped at the opportunity to dive deeper into the material.
How did you get your research position, and what preparation did you undertake for it?
I got my research position by filling out an application form for the 2023 ACMS Undergraduate Summer Research Program. I had to fill out the form, list a recommender, and explain why I wanted the position.
Where was your research experience located?
My research was mainly located on-campus over the summer through in-person weekly meetings with Dr. Acitelli to discuss my progress. Occasionally, if Dr. Acitelli or I were not on campus, we would meet via Zoom.
What did you get out of your research experience?
Overall, my main takeaways from this research were a deeper understanding of cryptographic systems and the attacks against their security, more experience with reading complex mathematical papers, and further development of my programming skills in Python.

Probabilistic Graphical Models in Scientific Applications

David P. Oppenlander
Major: Statistics and Music Theory/History
Advisor: Giuseppe Vinci
Dept. of Applied and Computational Mathematics and Statistics, University of Notre Dame

Probabilistic Graphical Models (PGMs) are powerful tools for the description of data generating processes and dependence structures of large numbers of variables, which can be seen as nodes of a vast network. These models have a wide range of applications, including genomics, biology, neuroscience, psychology, physics, and astronomy. There exist two main types of PGMs: Undirected Graphs (UGs) and Directed Acyclic Graphs (DAGs). I am currently focusing on the efficient implementation of DAG estimation in both R and Python. I am exploring the application of DAGs to the study of dependencies between large numbers of variables in real multivariate scientific data.

What inspired you to participate in undergraduate research?
I was uncertain of whether or not I wanted to go into industry or academia after graduation, so I decided to explore what student research was like to better understand where I think I should go.
How did you get your research position, and what preparation did you undertake for it?
I participated in the ACMS Undergraduate Research Program in Summer 2023 with Dr. Giuseppe Vinci. My time leading up to my research was spent performing an extensive literature review of PGMs and their varied applications in science to get acquainted with the material I would be working with.
Where was your research experience located?
I decided to stay on campus over the summer during my program. I was given an office in the ACMS Department, Crowley Hall. Moreover, I had the incredible opportunity to work in many of the commonly busy areas of Notre Dame without the stress of schoolwork and the high traffic those spots get during the semester.
What did you get out of your research experience?
Not only did I get to interact with statistical material at a much deeper level, I also got to utilize R and Python extensively during my research, both of which I've been looking for more opportunities to work with while studying at Notre Dame.

A Study Examining Demographic and Clinical Factors Affecting Receipt of Guideline Concordant Care for Stage III Inflammatory Breast Cancer Patients

Keo Pangan
Major: Applied & Computational Mathematics & Statistics (ACMS), Harp Performance
Advisor: Varadan Sevilimedu, Memorial Sloan-Kettering Cancer Center, Dept. of Biostatistics & Epidemiology

Inflammatory Breast Cancer (IBC) is an aggressive form of breast cancer with a comparatively lower five-year survival rate. Guideline Concordant Care (GCC) is the receipt of trimodality therapy in sequence (preoperative chemotherapy, a modified radical mastectomy (MRM) with axillary dissection, and postoperative radiotherapy) and the timeliness to intervention. This study examines the factors at the patient and facility levels that are associated with IBC patients' receipt of GCC. The dataset comes from the NCDB, consisting of 6,945 stage III IBC patients diagnosed between 2010-2018. Generalized Linear Mixed Effects Models (GLMM) were used but Generalized Estimating Equations (GEE) will help to compare findings. The four outcomes that will be tested included the receipt of GCC and its three components – chemotherapy within 60 days of diagnosis, an MRM without reconstruction and an axillary dissection, and radiation in sequence. The covariates that were tested included age, race, ethnicity, insurance status, distance to provider, rurality, tumor grade, histology, pathological complete response, year, and clinical nodal stage. In the study population, 25% had received GCC. There is also some variation of receipt of GCC between different racial and ethnic groups and a notable decrease in receipt of GCC is observed for patients over 70 years old. The GLMM's for the receipt of GCC revealed four significant variables: clinical nodal stage, age, year, and histology. There were decreased odds of receiving GCC for patients diagnosed between 2014-2018 in comparison to 2010-2013 and increased odds of receiving GCC for cN1 and cN2 patients in comparison to cN0. Patients that are 60-69 years old, and patients with IDC, ILC, inflammatory carcinoma, or mixed histologies were more likely to receive GCC. The GLMM is preferable to the GEE since there are facility-level random effects present and the data are missing at random, thus offering robustness to the estimates. The receipt of GCC is affected by patient and facility-level factors: clinical nodal stage, age, year, and histology. Differing factors played a role in the component factors of GCC. Further study is needed to determine how likely specific population subsets receive GCC and to validate the results presented in this study.

What inspired you to participate in undergraduate research?
I am curious about solving real-world problems that rely on ideas and concepts that we learn in the classroom. Research allows me to think critically about problems that impact our communities, especially those related to the health and well-being of the population.

How did you get your research position, and what preparation did you undertake for it?
After enjoying doing biostatistics research with the Children's Environmental Health Initiative under Dr. Marie Lynn Miranda, I looked for research opportunities within biostatistics to expand my knowledge of the field and gain more experience with individual research projects related to my interests at the intersection of biostatistics methods and public health.

Where was your research experience located?
Memorial Sloan-Kettering Cancer Center, New York City, NY

What did you get out of your research experience?
From this research experience, I had the opportunity to conduct an individual research project, under the mentorship of my PI. This summer, I was able to further develop my skills in data analysis and R programming, as well as technical writing, team collaboration, and scientific communication skills. I also learned more about the field of biostatistics and its applications within and outside public health.

Environmental Drivers of Seedling Distribution in a Northwoods Forest Landscape

Michael Parent, Subash Sapkota, Alan Huff, Dr. Nathan Swenson
University of Notre Dame Environmental Research Center

Seedling distribution dictates the composition of a future forest, and there are many ways in which abiotic factors around the seedlings can influence this process of assembly. Our study aimed to determine the best environmental predictor of seedling distribution and understand how certain environmental gradients impact the composition of seedlings present in a given area. We censused 90 1x1 m plots inside of the Forest Dynamics Plot at the University of Notre Dame Environmental Research Center (UNDERC) by identifying each species, measuring heights, and counting leaves. We took hemispherical photos of the canopy to measure canopy openness and accessed NEON's AOP data for elevation and slope measurements. Based on the plots we were able to census and analyze during the summer, elevation is the best predictor of seedling distribution in this Northwoods forest landscape. We came to this conclusion because increasing elevation was shown to increase diversity and abundance, while the other environmental drivers did not explain as much of the distribution and composition found in the field.

What inspired you to participate in undergraduate research?
I have always found the natural world extraordinarily interesting. This interest lends itself to curiosity about how the natural world works, and research is one of the best ways for me to understand the processes of nature. Having the opportunity to go to UNDERC and spend an entire summer outside only further fueled my interest in ecological research in pursuit of understanding nature's inner workings.
How did you get your research position, and what preparation did you undertake for it?
I applied to Track 1 at UNDERC and was accepted into the program to gain exposure to ecology and conduct research. To prepare for research, I worked in Dr. Swenson's lab during the Spring 2023 semester and gained a better understanding of tree communities at UNDERC from aerial imagery. Once I was on the property, I could go out into the forest to observe the topography and distribution of trees allowing me to ask relevant questions and hypotheses.
Where was your research experience located?
My research took place at the University of Notre Dame Environmental Research Center in Land O' Lakes, WI. On the UNDERC property, Dr. Swenson has a larger Forest Dynamics Plot where our research plots were located and censusing occurred.
What did you get out of your research experience?
The opportunity to spend most of my day outside brought so many benefits, but in particular, I gained a much deeper understanding of how nature is structured. I also learned how to brainstorm, set up, and execute a scientific experiment from beginning to end. While working towards this, I gained skills that will be immensely useful in the future from orienteering and tree ID to coding statistical analysis in R.

Preliminary Results in 14C Dating at the University of Notre Dame's Nuclear Science Laboratory

Willaim Peeler, Griffin Mulcahy, Philippe Collon, Thomas Bailey
University of Notre Dame, Nuclear Science Laboratory

Accelerator Mass Spectrometry (AMS) has proven the most sensitive method of measuring the amount of 14C present in a material for the purpose of radiocarbon dating. The AMS group at the University of Notre Dame's Nuclear Science Laboratory has graphitized and dated both a sample believed to be sourced from the shipwreck of Le Griffon and an insect living in the depletion zone of the Alaskan glaciers provided by collaboration with the University of Notre Dame Department of Biology. Preliminary results of the former show a radiocarbon age of 1105±641 years, while preliminary results from the latter show a radiocarbon age of 6738±1290 years. As Le Griffon sank in the year 1679, it is unlikely that the sample actually came from the wreckage.

To achieve these results, each sample was measured in sets of four consecutive fifteen-minute trials along with 14C standards and blanks to calibrate the resultant counts. OxCal software was used to determine the age range of the sample from the calculated 14C/12C ratio.

The wide error margins are due to inconsistent count rates of 14C between trials. For a discussion of developments in measurement precision and capability, see Griffin Mulcahy's CEU abstract, Carbon Dating for Interdisciplinary Research and Teaching: Developing 14C AMS at Notre Dame. The first results of these experiments will be presented at the CEU poster session and will include recent developments.

What inspired you to participate in undergraduate research?

I have always wanted to participate in research: it is the entire reason I became a physics major. To me, there is nothing more important than furthering knowledge and nothing more enjoyable than having the chance to figure something out.

How did you get your research position, and what preparation did you undertake for it?

I got my research position by asking to join Professor Collon's group, as he had already been my professor for two semesters by that point. In order to prepare for this position I did a lot of independent research on accelerator mass spectrometry and how carbon 14 dating works in order to work on the project myself.

Where was your research experience located?

At Notre Dame's Nuclear Science Laboratory.

What did you get out of your research experience?

I have submitted my abstract and been accepted to present at the DNP later this fall which is a huge opportunity. More than that, I have learned a lot about how to independently lead my own projects and learning: it was very different to be the head of my own push within a group, as I have never worked without someone else creating due dates before. This helped me figure out how to motivate myself in a research setting and also grew my passion for research.

Saturation Genome Editing to Identify Pharmacologically Relevant Variants in *DPYD*

Emma Powers
Coauthors: Kelly J. Bouchonville, Joe Laubach, Huixing Huang, Brianna Bembenek
Advisor: Dr. Steven M. Offer, Department of Molecular Pharmacology and Experimental Therapeutics, Mayo Clinic Graduate School of Biomedical Sciences

5-Fluorouracil (5-FU) is a commonly used chemotherapy drug, especially in colorectal cancer. However, approximately 30% of patients experience severe toxicity (clinical grade ≥ 3), and ~1% of patients die during treatment with 5-FU. This toxicity is linked to dihydropyrimidine dehydrogenase (DPD, DPYD gene) deficiency because DPD is believed to be the rate-defining step in 5-FU catabolism. Currently, only 1000 missense variants have been identified in DPYD, but only 4 of these have been studied clinically. To determine the rest of the deleterious variants of DPYD, this proposed method of analysis uses saturation genome editing to generate functional data for all of the variants across DPYD, with the intention of identifying which variants increase toxicity risk. To determine the feasibility of this project, saturation genome editing was applied to exon 13 of DPYD which contains previously known harmful and benign variants. This was done by creating the oligo library for exon 13 and optimizing the DNA assembly procedure. These studies suggest that this method of analysis is feasible for DPYD, but further optimization of the later protocols is necessary to provide certainty of this method. Future work will include finalizing the DNA assembly protocol for the mutated oligo library, determining the differences in oligo recovery between 5-FU treated and non-treated cells, and extending the study to include the other 22 exons to generate a comprehensive database of variant impact on function.

What inspired you to participate in undergraduate research?
I wanted to become involved in undergraduate research because I want to pursue a career in pharmaceutical development following my time at Notre Dame. Undergraduate research was a way for me to explore this career path to further determine if this is what I want to do, and it helped me see what opportunities there are.
How did you get your research position, and what preparation did you undertake for it?
I applied for the Mayo Clinic SURF program during the winter of my sophomore year of college, and I reached out to professors of interest to see if they would be willing to mentor me. As for preparation, I read up on the various research the lab was performing to get accustomed to their methods.
Where was your research experience located?
It was located in Rochester, MN at Mayo Clinic's flagship location.
What did you get out of your research experience?
It showed me how academic research can interact directly with a top hospital. It was an incredible opportunity to see how they all work together to make patient's lives better. Additionally, I got to meet some incredible scientists and doctors who are some of the best in the world, and it was really insightful to discuss their pathways and ideas in biomedical research.

Testing Low-Cost Particle Meters for Monitoring Particle Counts in Cleanroom Settings

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Particle meters are relied upon to monitor the counts of airborne particulate matter. The particulate matter is grouped and analyzed based on the size of the particles. Low-cost particle meters are typically used for environmental monitoring. High-end, calibrated sensors are relied upon for use in cleanroom settings to ensure precise measurements in an environment with highly filtered air and low particle counts. This study focuses on comparing two low-cost particle meters to a high-end particle meter, with a specific interest on compatibility in a Class 100 cleanroom. Measurements were taken in both open-air environments as well as a controlled environment with the flow of nitrogen gas to purge the particulate matter. The data from the three meters are displayed together on line graphs to demonstrate the closeness of their measurements in each testing scenario. The conclusion of whether or not the low-cost particle meters are fit to monitor particle counts in a Class 100 cleanroom will depend on their ability to detect and accurately count the 0.5-micron particles within the classified range for a Class 100 cleanroom.

Effect of Physical and Conceptual Event Boundaries on Recognition-Based Memory

Camille Scandurro, Dani Parra, G.A. Radvansky
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To relate the many different qualities and characteristics of an event, humans create event models, which are mental representations of the described circumstances. They divide continual activity into events, each marked by an event boundary that typically occur during times of transition, either physical perceptual changes such as a change in spatial location or conceptual change in content such as a shift to a new topic of discussion. Research has shown that event boundaries significantly impair semantic memory in some cases, and also that event boundaries can enhance memory in other cases. The purpose of this study is to investigate how event structure influences memory for newly acquired knowledge. Notre Dame student participants (n=80) were recruited via the Sona system. This study consists of two parts: a reading portion and a test portion. Participants read one of three articles: a two-page article about the rock cycle, a two-page article about Shrovetide, or a two-page article containing half the information from each of the previous. They either read both pages in one room, or after the first page were directed to another room to read the second page. Participants took a memory test coded through PsychoPy assessing the three levels of memory according to Schmalhofer and Glavanov's theory: surface form, textbase, and mental model. We used signal detection theory to analyze the data. To measure how accurately participants could discriminate hits from false alarms, we calculated *d'*, where larger *d*' values indicate that participants were more accurate. The study is ongoing, so no final conclusions have been made.

What inspired you to participate in undergraduate research?
I have thoroughly enjoyed my experience in the Memory Lab the past three years, and wanted to conduct my thesis through the Neuroscience Honors Program. I love learning about new theories and methods, as well as interacting with student participants.

How did you get your research position, and what preparation did you undertake for it?
I was accepted into the Neuroscience Honors Program, and subsequently received the College of Science Summer Undergraduate Research Fellowship. This past summer, I was on campus designing my study and writing my thesis drafts.

Where was your research experience located?
The Memory Lab is in E374 Corbett Hall on the University of Notre Dame's campus.

What did you get out of your research experience?
I have an immense appreciation for the meticulous process of exploring novel ideas and creating protocols to investigate them. I submitted an IRB proposal, and worked through all possible confounds and randomizations in designing my study. Remaining resilient and making sure I covered all bases has prepared me well for my future medical career, where I plan on conducting population-based public health research.

Does the Methylome of METTL16 include DNA?

Ian P. Schowe, Jessica A. Brown
University of Notre Dame, Department of Chemistry and Biochemistry

A common nucleic acid modification is the N6-methyladenosine (m6A). This installation has been most notably studied with the methyltransferase protein complex of METTL3/METTL14, which methylates DNA and RNA. A lesser understood methyltransferase protein, METTL16, has gained greater prominence as it regulates SAM, a metabolite that controls nearly all methylation reactions in a cell. METTL16 recognizes and methylates a nonamer sequence UACAGAGAA (underlined A is methylated) in pre-mRNA and ncRNAs; its most noticeable methylation partners are MAT2A mRNA and U6 snRNA. However, no DNA targets have been verified. Here, we explore whether METTL16 can methylate and/or bind to DNA using U6 as a model system. We designed U6 as a two-piece system; one piece had the nonamer motif and another was its complement strand to give it structure. These two pieces were either both RNA, a hybrid of RNA and DNA, or both DNA. We tested these substrates along with a positive control of wildtype RNA U6 by in vitro MTase assays followed by mass spectrometry to test for m6A marks and electrophoretic mobility shift assays to test for binding. Despite sequence and structural similarities, only the two-piece U6 and positive controls showed m6A. However, the binding assays demonstrated some binding. The binding of these substrates needs to be further tested and characterized due to possibility of strand annealing/displacement. Overall, this study provides insights into the substrate specificity of METTL16 and seeks to understand its function more.

What inspired you to participate in undergraduate research?
I participated in a week-long research program at Indiana University Bloomington when I was in high school; this experience made research a top priority when I was in my college discernment process. Furthermore, I joined undergraduate research because I enjoyed being able to apply the material from class to real-world research that was shared with a greater community.

How did you get your research position, and what preparation did you undertake for it?
I emailed multiple professors in the Department of Chemistry and Biochemistry. After I got replies, I went in for informal interviews to meet with the professors, and I accepted the laboratory that had similar interests to me. To prepare, I first used the University of Notre Dame's faculty page to get a brief insight into each professor's research work. Then, I read multiple papers that were published by the lab groups or from the professor's previous work to get scope of the lab and to demonstrate to the professor's my interest in the lab group.

Where was your research experience located?
My research experience was at the University of Notre Dame in Notre Dame, Indiana. It took place in Dr. Jessica Brown's laboratory in Stepan Chemistry Hall.

What did you get out of your research experience?
The biggest thing I gained was being able to quasi-experience being a graduate student in biochemistry. I gained independence and reasoning skills as I worked on my research project alone, as the graduate student I was working with graduated in May. Moreover, I gained valuable skills in troubleshooting wet-lab experiments; this is valuable since many projects do not go as planned. Furthermore, I gained valuable experience in editing and finalizing a manuscript that was submitted for peer-review in September.

Use of ATR-PARP inhibitor combination therapy to treat and generate an immune response in PARP inhibitor resistant breast cancer is questioned

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The University of Texas MD Anderson Cancer Center, Department of Clinical Cancer Prevention

To treat breast cancer tumors independent of BRCAness, PARP inhibitors (PARPi), such as Olaparib, are used as first-line maintenance therapies. However, novel combination therapies, such as PARPi and ATR inhibitor (ATRi) combinations, are being developed in clinical trials due to inevitable tumor PARPi resistance. Although PARPi-ATRi is too cytotoxic for first-line maintenance therapy, this study further elucidates this combination's efficacy in re-sensitizing PARPi-resistant recurrent tumors. Furthermore, in addition to causing unresolved genomic lesions, ATRi/PARPi-ATRi treatments are potentiated in the context of immunotherapy. Hence, this study also assesses whether cytosolic DNA fragments created by ATRi/PARPi-ATRi can trigger the cGAS-STING pathway for a Type I Interferon (IFN) response, such as the production of CCL5 and CXCL10 chemokines, promoting T-cell chemotaxis and antitumor effects. From the study, an unexpected result was obtained: cell death and immune response appears separate. We speculate the generation of DNA fragments from the damaged genome in the ATRi-PARPi treatment or in the resistant line is not as efficient as the ATRi alone or in WT cells, leading to differential effects in Type 1 IFN induction. To gain mechanistic understanding, the effect of ATRi and ATRi-PARPi on DNA damage signaling and cytosolic DNA accumulation should be examined using Western blot and Picogreen. Alternative signaling pathways such as ATM, DNA-PK or AKT should be analyzed to explain p-CHK1 and p-RPA32 in the presence of ATRi or ATRi-PARPi. Observations need to be confirmed in additional cell lines, cancer types, and replicates. Further testing in pre-clinical animal models will potentially guide the choice of ATRi in PARPi resistant tumors.

What inspired you to participate in undergraduate research?
I have been interested in tumor cell biology since taking Professor Zachary Schafer's module in my Introduction to Biology class. This interest was rekindled after spending a summer at the Henry Ford Cancer Institute. I decided to participate in research at MD Anderson to further understand what a career in cancer treatment and prevention entails. By the end of this research experience, I was certain of my desire to become an oncologist and play a bigger role in shaping cancer treatment and therapy.
How did you get your research position, and what preparation did you undertake for it?
I applied through the University of Notre Dame Summer Undergraduate Research Program at MD Anderson. I had little understanding of lab techniques before arriving in Houston but a combination of hard work and not being afraid to ask other lab members for help allows you to acclimate quickly!
Where was your research experience located?
The University of Texas MD Anderson Cancer Center in Houston, Texas.
What did you get out of your research experience?
I feel confident in most basic lab techniques, allowing me to easily transition into my role as a lab member of the Dahl Lab (affiliation with The University of Notre Dame Harper Cancer Research Institute). I am also more certain of wanting to pursue a career in oncology.

Targeted Restoration of NF1 Haploinsufficiency for the Treatment of NF1-associated Neurocognitive Deficits

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Neurofibromatosis type 1 (NF1) is an autosomal dominant genetic disorder affecting 1 in 3,000 individuals worldwide. The *NF1* gene encodes neurofibromin, a tumor suppressor that inhibits the RAS-MAPK pathway. While tumorigenesis is associated with biallelic loss of NF1 function, cognitive deficits such as learning, behavioral, and memory issues affect 70% of NF1 patients and are associated with NF1 haploinsufficiency. Restoring neurofibromin levels by inhibiting its ubiquitin-mediated degradation is a potential therapeutic strategy to rescue haploinsufficiency. Prior studies have identified the specific E3 ligase and candidate kinases involved in NF1 degradation. Here, a mouse neuroblastoma cell line, Neuro-2a (N2a), was used to model NF1 haploinsufficiency. N2a wild type ($Nf1^{+/+}$) and heterozygous ($Nf1^{+/-}$) cells were used to model neuronal differentiation. We hypothesized that neurofibromin haploinsufficiency would affect retinoic acid (RA)-induced differentiation of N2a cells. RNA sequencing of $Nf1^{+/+}$ and $Nf1^{+/-}$ cells revealed significant changes in RA response, particularly the expression of Phox2b, a transcription factor involved in neuronal development. Western blotting confirmed that Phox2b expression was reduced in $Nf1^{+/-}$ cells compared to wild type when exposed to RA. We utilized a candidate kinase-targeted proteolysis targeting chimera (PROTAC) to restore neurofibromin and investigated whether Phox2b levels were rescued. In these studies, we have validated a neuronal model of neurofibromin haploinsufficiency and initiated targeted therapeutic studies to restore neurofibromin levels. Future work will involve RNA sequencing and more comprehensive molecular characterization of the RA response with neurofibromin restoration.

What inspired you to participate in undergraduate research?
I have always been fascinated by medical research because I think it is an amazing way to help people. I originally wanted to participate in undergraduate research to see if it was a life path I was interested in pursuing.
How did you get your research position, and what preparation did you undertake for it?
I applied for a summer research program at the Indiana University School of Medicine. I prepared by reading the lab's most recent publications in order to better understand what the goals of the lab were and what kind of work was being done.
Where was your research experience located?
I worked on campus at the Indiana University School of Medicine in Indianapolis, Indiana.
What did you get out of your research experience?
I gained a lot of technical skills, knowledge about the focus of the lab, and an understanding of how labs in general operate. More importantly, I further confirmed that I love research, and I now confidently know that I want to attend graduate school.

Viral Variety: Bacteriophage Host Range in the Gut Microbiome

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The Sonnenburg Lab at Stanford University, Department of Microbiology and Immunology

The gut microbiome has been found to impact many aspects of health: the immune system, mental health, the liver, and risk for many diseases. Recent research has shown that not only the dynamics of microbes, but also the dynamics of bacteriophages are important to study in terms of how gut health impacts overall health and longevity (Johansen, 2022). The purpose of this study was to try to expand the knowledge of bacteriophages within the gut microbiome. For this study, I used previously collected longitudinal metagenomic data collected from fecal samples (n=36) from the paper "Gut-microbiota-targeted diets modulate human immune status" Wastyk, Hannah C. et al. With this data, I ran blast on the viral contigs and the bacterial host contigs to find recent examples of viruses infecting bacterial hosts. Using bioinformatics, I was able to determine the host range of viruses in our data, meaning how many viruses have two or more bacterial hosts spanning different levels of taxonomy. I also found that on average, viruses in this dataset have 2-5 bacterial hosts, which is much broader than past studies have found (Nayfach, 2021). I was also able to analyze potential examples of times when a virus was switching bacterial hosts within a single person between a six week period in the study. Finding host switches within a single person is exciting because this virus switching could lead to horizontal gene transfer in gut bacteria, accelerating evolution in the gut. In this study, I found that viruses have a much broader and larger host range than past studies have found, and I found very interesting potential examples of viruses switching bacterial hosts within a single person.

What inspired you to participate in undergraduate research?
When I was a junior in high school, I attended a talk at the Institute for Systems Biology about fecal transplants. Hearing about fecal transplants as a potentially life saving tool and the emerging field of microbiome research fascinated me. When I got to Notre Dame, I knew I wanted to be involved in research about the microbiome and its impacts on human health. I am also fascinated by the gut-brain connection and all of the research surrounding this connection and mental health.

How did you get your research position, and what preparation did you undertake for it?
Throughout my career in microbiome research, I have read many papers from the Sonnenburg Lab that have fascinated me. Two summers ago, I conducted an REU in the Gibbons Lab at the Institute for Systems Biology where I worked with some data from the Sonnenburg Lab. Since I am in the Sorin Scholars Honors Program at Notre Dame, I am able to come to research opportunities with my own funding. When I was planning my summer, I reached out to Professor Justin Sonnenburg and told him about my past experiences with microbiome research, my experience with using data from his lab, and that I would love to work in his lab this summer if he had a spot. I interviewed with a post doctoral researcher in his lab and then I interviewed with Professor Sonnenburg, and was offered a position as a summer undergraduate research intern. Before beginning this internship, I practiced my Python and R skills because I knew I would be coding in those languages a lot. My previous research experience in the Archie Lab at Notre Dame and the Gibbons Lab at the Institute for Systems Biology prepared me well for the research I conducted in the Sonnenburg Lab.

Where was your research experience located?
My research experience was located in the Sonnenburg Lab at Stanford University in Palo Alto, California.

What did you get out of your research experience?
Through my research experience, I gained valuable bioinformatics experience using Python, R and Shell. I also was able to greatly expand my network of researchers in the microbiome field through meeting with and shadowing members of the Sonnenburg Lab. I also gained more experience presenting my research to a group of scientists through a final presentation at the end of the internship. This experience also gave me a great chance to have my own research project and explore avenues of the project that I found to be interesting and exciting. I thought this was a very valuable experience because it prepared me well for my senior thesis and the future work that I will do in graduate school.

Efficacy of Mammalian Aquaporin Inhibitors in Treating Breast Cancer Metastasis

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Breast cancer is the most diagnosed cancer among women and the second leading cause of cancer related deaths in the U.S. Aquaporins (AQPs) have been identified as having roles in breast cancer progression and metastasis. Aquaporin-7 (AQP7) is a channel protein belonging to the family of aquaglyceroporins. AQP7 facilitates the permeation of water and glycerol in addition to other small uncharged molecules. AQP7 as well as other AQPs are essential for water homeostasis, fat metabolism, and proliferation. While AQP7 expression has been detected in the breast, the physiological role of AQP7 remains largely unknown. Previously, we established that abnormally high AQP7 expression is associated with the progression and metastasis of breast cancer. We demonstrated genetically, both *in vitro* and *in vivo*, that AQP7 is necessary for proliferation, primary tumor progression, and metastasis. AQP7 knockdown significantly reprogrammed cell metabolism and changed oxidative stress tolerance. We reasoned that AQP7 is a targetable vulnerability that can overcome breast cancer metastasis and increase treatment efficacy. Utilizing AQP inhibitors in this study, we investigated whether therapeutic inhibition of AQP7 can reduce tumor progression and increase the therapeutic efficacy of endocrine therapy in breast cancer. To do this, we evaluated the consequences of the aquaporin inhibitors Auphen, a pan-AQP inhibitor, and Z433927330, an AQP7 selective inhibitor. Interestingly, the aquaporin inhibitor Auphen cooperates with endocrine therapy Tamoxifen to reduce the viability of breast cancer cells in culture and tumor *in vivo*, which suggests that Auphen treatment makes the cells more responsive and susceptible to Tamoxifen. Together, this study highlights that AQPs, such as AQP7, are a potential cancer-specific therapeutic vulnerability, and AQP inhibition can be exploited for therapeutic benefit in overcoming endocrine therapy resistance. Also, further development of novel aquaporin inhibitors and developing a better mechanistic understanding of the physiological role of aquaporins remains needed to advance treatments for breast cancer.

Effects of Submerged Breakwater Structures on Connecticut Salt Marsh Recovery

Katiebelle Thompson, Dr. Jamie Vaudrey
National Science Foundation Research Experience for Undergraduates (REU), University of Connecticut and Mystic Aquarium

Salt marshes provide ecological and economic benefits, and must be preserved. In some places, Reef Balls (submerged breakwater structures) are currently used to trap sediment and encourage marsh grass survival. This experiment aimed to determine if Reef Balls effectively assist marsh ecosystem recovery, and, if so, how long marshes take to regain fish biodiversity. To accomplish this, GoPro cameras were placed underwater in two marshes (pristine and recovering) and an adjacent artificial reef. Analysts recorded fish species and on-screen time. Site diversity was examined using the Shannon Index, Simpson's Inverse Dominance Index, and Sequential Comparison Index (these methods were used by Vaudrey et al. in 2018). No sites have significantly increased in biodiversity since 2018. The pristine marsh's biodiversity varied between sites, while the recovering marsh's metrics were between the pristine marsh's values. The reef habitat's biodiversity values were the lowest of the three. These findings suggest that the recovering marsh is able to support a similar assemblage of species as a pristine marsh. The presence of reef-associated and marsh-associated fishes in the artificial reef's footage suggests that while submerged structures do assist marsh recovery, they may also be supporting a distinct, hybrid ecosystem.

What inspired you to participate in undergraduate research?
I want to be an ecologist, and work in the research field. Undertaking undergraduate research is my way of entering the field, gaining experience, and discerning whether this career is right for me.
How did you get your research position, and what preparation did you undertake for it?
I applied to the REU online through Mystic Aquarium's website (now, it is done through NSF ETAP). I submitted demographic questions, a cover letter, essays, my unofficial transcript and my resume. The REU program prepares you during the first two weeks of the program, so before attending, I mainly organized logistics and personal gear.
Where was your research experience located?
My experience was located in Mystic, Connecticut, though I lived in the neighboring town of New London.
What did you get out of your research experience?
I gained real-world experience working in the field of marine science, conservation, and outreach. I truly was able to experience a myriad of conservation-oriented jobs, from shadowing veterinarians at Mystic Aquarium, to working with faculty at Connecticut National Estuarine Research Reserve and UConn, and educators from both organizations. Marine science has so many niches to be a part of, and I was excited to explore every one that I could. I loved being able to see the variety of jobs in my career path– it truly broadened my horizons and taught me more about myself and my goals.

cyfip2 Plays a Role in the Dorsal Root Ganglion's Axonal Navigation Process

Grace S. Waddell, Cody J. Smith
University of Notre Dame, Department of Biological Sciences

Rare diseases afflict up to 30 million Americans, approximately 80% of which have a genetic origin, and 50% of which affect children[1]. Many of these rare diseases impact the nervous system, which is responsible for a person's ability to interpret her environment, move, and learn, among other things. Many of these diseases have genetic bases and relatively little is known about the genetic abnormalities that can cause neural dysfunction in many of them, so further research into these genetic factors is critical. This project investigates one such gene, *cyfip2*, which significantly affects the ability of the dorsal root ganglion (DRG), somatosensory neurons that transmit external sensory information to the spinal cord, to connect with the spinal cord in zebrafish (*Danio rerio*). It is known that during development the DRG neurons extend projections known as axons through the spinal cord boundary at a region known as the DREZ. This initial research demonstrates that cyfip2 RNA and protein are both localized to the DRG at established time points of axonal navigation towards the DREZ and entry into the spinal cord. Further research demonstrates that when *cyfip2* is perturbed, via either a CRISPR knock-down or the established *triggerhappy*^{p400} genetic mutant line[2], the DRGs are still able to form, but they have a decreased ability to successfully connect with the spinal cord, suggesting that *cyfip2* plays a critical role in the DRG axonal navigation process.

What inspired you to participate in undergraduate research?
Since I enrolled as an undergraduate at the University of Notre Dame, I have aspired to complete a Ph.D. in computational neuroscience, specifically working with developmental models. I remember attending the Fall Undergraduate Research Fair during my freshman fall, and I was incredibly excited to see all of the research that was being conducted by undergraduates at Notre Dame. I found the research process fascinating, and after meeting with students in Dr. Cody Smith's lab, I knew that I wanted to conduct research as soon as possible.

How did you get your research position, and what preparation did you undertake for it?
I got my research position in March 2022, and I think that there were several factors that helped me to get this position. I reached out to Dr. Smith and conveyed my interest in the research that his lab was conducting. When I was told that the lab was full, I responded by stating that I would still be interested in pursuing research in his lab in the future, even if it would not be possible to start at that time. Before I had reached out to Dr. Smith, I was in a program called STEMentorship, run through AWIS (the Association of Women in Science). My graduate student mentor, Amandhi Mathews, was a first-year graduate student in the Department of Biological Sciences and was rotating in the neuroscience labs while she served as my mentor. When I would ask her questions about the labs in which she was rotating, she always had great things to say about the Smith lab, and she ended up joining the Smith lab a few weeks before I did. Additionally, I knew two more senior undergraduates who worked in the Smith lab when I was joining , and I had spoken with both of them about their research before I reached out to Dr. Smith. I think that learning about the Smith lab from students in the lab was a critical part of my preparation for beginning my research and ensuring that this lab would be a good fit for me.

Where was your research experience located?
My research experience was located in the Galvin Life Sciences Center at the University of Notre Dame.

What did you get out of your research experience?
I cannot say enough about how much my research experience has taught me. I have been conducting research in Dr. Smith's lab for about 1.5 years, and I have loved the research that I have done. Not only have I learned several basic laboratory skills and how to follow protocols, but I am the most proud of how I have developed intellectually. With Dr. Smith's mentorship, I have learned how to think critically and to refine the scientific questions that I ask, which are abilities that will serve me for the rest of my life. Additionally, many of my closest friends are in the Smith lab, and the graduate students and postdoctoral fellows in the lab have served as mentors to me, both in science and in life. Thus far, this experience has confirmed that I want to conduct developmental neuroscience research throughout my future career in academia.

Community Paramedicine as an Alternative to Traditional Acute Care Utilization for patients with intellectual and developmental disabilities

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Icahn School of Medicine at Mount Sinai, Department of Emergency Medicine

Individuals with intellectual and developmental disabilities (IDD) utilize acute and inpatient care services at a higher rate than the general population and exhibit an increased risk of emergency department (ED) visits and hospital admissions. Our goal was to assess if this population could benefit from targeted community paramedicine (CP) services to reduce healthcare-associated costs and improve patient outcomes. We conducted a retrospective review of Mount Sinai Community Paramedicine encounters at IDD facilities between January 1-December 31 2022. Both physician Electronic Medical Records (EMR) and paramedic Electronic Patient Care Reports (ePCR) were reviewed. Encounters with incomplete EMRs were excluded. There were a total of 232 encounters with 136 patients from January 1-December 31 2022. 183 encounters (78.88%) resulted in patients not being transported to the hospital, while 49 encounters resulted in transport (21.12%). 34 encounters (69.39%) had confirmed dispositions (discharge or admission) and 16 of these encounters (47.05%) were admitted. 19 encounters (8.19%) received a paramedic-administered intervention and 78 encounters (33.62%) received a prescription. This review shows that a CP program for adults with IDD prevented over 180 separate ED visits. Furthermore, nearly half of those transported to the ED were ultimately admitted to the hospital.

What inspired you to participate in undergraduate research?
I became an EMT in high school as a way to get involved in medicine and fell in love with emergency medicine. After experiencing basic laboratory research here on campus last year, I wanted the opportunity to explore clinical research in an area that I was passionate about.
How did you get your research position, and what preparation did you undertake for it?
I found my research position by searching for undergraduate emergency medicine research opportunities online and was able to find one close to home. I was fortunate to have knowledge of prehospital care prior to beginning my research experience but also prepared with some readings from my preceptor (Dr. Nicholas Gavin).
Where was your research experience located?
Icahn School of Medicine at Mount Sinai, Department of Emergency Medicine
What did you get out of your research experience?
I gained exposure to the clinical research process and academic medicine. More specifically, I learned how to navigate EPIC's electronic medical record, perform data analysis, and develop scientific communication skills. This opportunity further helped solidify my desire to pursue a career in clinical medicine.

Evaluating the Relationship Between Anxiety, Sleep, and Emotional Memory

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Previous literature has found an existing relationship between anxiety, sleep, and emotional memory, but the existing findings on the ways in which these affect each other are inconsistent. Higher levels of both anxiety and REM sleep have been tied to an enhancement of emotional memory consolidation. Anxiety has also been found to have a bidirectional relationship with sleep quality and architecture. This research explores the intricate relationship between anxiety, sleep, and emotional memory, investigating how they mutually impact each other. Participants (n = 24) ages 18-59 were recruited from the South Bend community. They completed the State-Trait Anxiety Inventory (STAI-T) to assess trait anxiety, engaged in an encoding task featuring negative and neutral objects, underwent overnight EEG-monitored sleep, and took a memory test. Participants were categorized as low or high anxiety based on STAI-T scores. The results showed that memory was significantly better for negative objects at the expense of their accompanying backgrounds (something known as the emotional memory trade-off). High-anxiety participants exhibited superior memory for backgrounds linked to negative objects, whereas low-anxiety participants were better at recalling the negative objects themselves. Surprisingly, no significant differences in sleep onset latency (SOL) were found between the anxiety groups. However, a negative SOL-memory correlation was found, suggesting that prolonged SOL may impair memory. Furthermore, lower anxiety participants experienced more slow-wave sleep (SWS), positively correlated with memory in both groups. While the small sample size limits statistical significance, this research offers insights into the interconnections between these three components.

What inspired you to participate in undergraduate research?
Ever since I got to Notre Dame, I knew I wanted to get involved in research eventually. I have always thought of myself as a very curious person, and I love learning and exploring new things in the realm of science. I thought research was the perfect way of merging my learning with an opportunity to expand our knowledge of the brain and behavior.

How did you get your research position, and what preparation did you undertake for it?
During my sophomore year, I was interested in getting into research but was unsure of where to start. I participated in many psychology studies for class credit, including several for SAMLab, and this was when the lab caught my eye. I thought the research was very interesting and I liked the lab's environment. I looked up the lab and professor, read some of the lab's publications, and reached out to Dr. Payne to express my interest. She put me in contact with the lab manager, who sent me a link to an online application and set up an interview with me. I heard back from her a few weeks later, and she offered me a position as a research assistant in the lab!

Where was your research experience located?
Sleep, Stress and Memory Lab – University of Notre Dame

What did you get out of your research experience?
My summer research fellowship was an incredibly enriching learning experience. I learned a lot of technical skills that are important for neuroscience research, such as EEG setup and analysis, coding in R, setting up eye tracking/skin conductance/heart rate measurements, and more. I improved my skills at finding, reading, and understanding scientific journals as well, a skill that is incredibly important for the science world. I also learned how to interact professionally with a wide array of participants. I strengthened my collaboration skills, as I worked alongside other research assistants throughout the whole summer. As I continue my work at the lab this semester, I look forward to learning and growing even more as a scientist!