# 2026 OWU Summer Scholarship & Research Program

# Faculty Mentor Research Proposal

## General Area of Research

Data Analytics

## Project Title

Data-Driven Benchmarking of Classical and Quantum Machine Learning Algorithms

## Faculty Mentor

**Name:** Mehwish Abbasi
**Department:** Mathematics and Computer Science
**Email:** mabbasi@owu.edu

## Anticipated Research Dates (10 weeks):

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

## Requested Number of Students

One

## Minimum qualifications of student researcher (be as specific as possible)

1. Enrollment as an undergraduate major in Data Analytics, Computer Science, Mathematics, or Physics.
2. Completion of at least one programming course (e.g., Python, Java, or C++).
3. Successful completion of CS 300: Data Mining and Machine Learning, or equivalent coursework or experience.
4. Experience with Python-based data science libraries (e.g., NumPy, pandas, scikit-learn), or demonstrated willingness and ability to learn them quickly.
5. Ability to work independently, manage time effectively, and clearly document research methods and results.

## Description of Research Project

This research project explores how quantum computing can be used as an alternative

computational paradigm for machine learning tasks and how its performance compares to classical approaches. As machine learning models continue to grow in complexity and computational cost, there is increasing interest in whether emerging technologies such as quantum computing may offer advantages in efficiency or scalability. This project focuses on an empirical, data-driven comparison rather than claims of immediate quantum advantage.

The student researcher will implement a small, well-defined supervised learning task using a standard benchmark dataset commonly used in data analytics education and research. A classical baseline model, such as a shallow neural network, will be developed using established Python-based machine learning frameworks. The model's performance will be evaluated using standard metrics including accuracy, training time, and inference time.

In parallel, the student will implement a quantum or hybrid quantum-classical model designed to address the same learning task. Rather than attempting to replicate a classical neural network exactly, the quantum approach will use a variational quantum circuit or quantum classifier, which is widely studied in current quantum machine learning research. The quantum model will be implemented using a publicly available quantum computing framework and executed primarily on a quantum simulator, with optional runs on real quantum hardware if access permits.

The core of the project involves systematic benchmarking and comparison. The student will design controlled experiments to compare classical and quantum models in terms of computational runtime, model complexity (e.g., number of parameters or qubits), and learning behavior. Experimental results will be collected, analyzed, and visualized using standard data analytics techniques to ensure reproducibility and clarity.

This project is exploratory in nature and is not intended to demonstrate definitive performance superiority of quantum computing. Instead, it aims to provide hands-on experience with emerging quantum machine learning tools while developing critical skills in experimental design, data analysis, and technical communication. The results will offer insight into the practical strengths and limitations of quantum machine learning models and inform future research at the intersection of data science and quantum computing.

# 2026 OWU Summer Scholarship & Research Program

# Faculty Mentor Research Proposal

## General Area of Research

Plant ecology

## Project Title

Studies of temperate forest change and pollinator habitat in central Ohio and southern Canada

## Faculty Mentor

**Name:** Laurie Anderson
**Department:** Biological Sciences, Environment & Sustainability
**Email:** ljanders@owu.edu

## Anticipated Research Dates (10 weeks):

**Beginning:** 5/26/2026
**Ending:** 7/31/2026

## Requested Number of Students

Three

## Minimum qualifications of student researcher (be as specific as possible)

Willingness to work outdoors for several hours per day and deal with heat and insects. Work will involve walking off-trail through forest habitats and working with plants at ground level. Enthusiasm for learning field ecology is required. Students with severe allergies to poison ivy are advised to avoid this project. The lab group will travel by car to southern Canada for one week in July to set up permanent forest monitoring plots and will stay in a rustic cabin with basic amenities. A driver's license is helpful.

## Description of Research Project

Ohio's temperate deciduous forests are experiencing significant stresses from climate change and introduced species. These habitats are critical for capturing carbon dioxide from the atmosphere, maintaining biodiversity, providing timber, supporting recreational industries, and providing resources for pollinating insects. Many

populations of crucial pollinators are showing declines, with serious implications for agriculture and native plants. Projects in Dr. Anderson's lab will tap into these themes from a range of perspectives. In summer 2026, student researchers will:

1. Complete a long-term survey of understory plant population dynamics in plots invaded by garlic mustard (Alliaria petiolata), an herbaceous biennial plant introduced from Europe. This study tests the hypothesis that native understory plants are suppressed by garlic mustard presence in Ohio Wesleyan's nature preserves.
2. Maintain a series of long-term permanent forest monitoring plots in Ohio Wesleyan nature preserves by checking tags, refreshing diameter markers, and preparing data for upload to a shared database. These plots are designed to track forest health over time to document changes as Ohio's climate shifts.
3. Travel to Canada with Dr. Anderson by car for one week in July to set up long-term forest monitoring plots near a lake enclave of Ohio Wesleyan alumni. This will initiate a long-term study to see how this transitional temperate-boreal forest changes over time, particularly with the stresses of climate change.
4. Survey pollinator habitat in the Delaware, Ohio area and maintain pollinator-friendly plantings on Ohio Wesleyan's campus. The goal is to document habitat quality for pollinators in our area and contribute to ongoing plans to improve this habitat, in collaboration with local community partners.

Students should enjoy working outdoors and be willing to deal with heat and biting insects. A driver's license is helpful. Students who are dangerously allergic to poison ivy should avoid this project, as poison ivy is common in the Ohio Wesleyan nature preserves. Enthusiasm for learning plant ecology is necessary. Students will gain skills in plant identification, field sampling techniques, caring for native plant gardens, invasive plant issues, data management, and data analysis. Students must have a valid passport to cross the U.S./Canada border. In Canada, we will stay in a cabin without electricity owned by an OWU alum. The cabin has indoor plumbing, beds, and propane fuel for cooking and refrigeration. There is access to swimming and boating on the lake.

# 2026 OWU Summer Scholarship & Research Program

# Faculty Mentor Research Proposal

**General Area of Research**

Neuroscience, psychology

**Project Title**

Examining Effects of Video Games on Cognition & Brain Function

**Faculty Mentor**

**Name:** Kira Bailey
**Department:** Psychology & Neuroscience
**Email:** kmbailey@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/18/2026
**Ending:** 7/24/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

For this project, students should have an interest in understanding human cognition and/or brain function. A motivation to study video games and their effects on players is also encouraged. Prior coursework or experience with the coding and/or electroencephalography (measurement of human brain waves) is preferred, but students willing to learn these skills are encouraged to apply. Students must be comfortable learning new computer software and interacting with human research participants.

Completion of any of the following courses is strongly recommended, but not necessarily required: Introduction to Neuroscience (NEUR 110 or 250), Cognitive Psychology (PSYC 266 or 364), Cognitive Neuroscience (PSYC/NEUR 342). Experience in CS and/or Data Analytics courses may also be useful.

**Description of Research Project**

Evidence suggests that action video game (AVG) experience is associated with improvements in visual/spatial attention and executive functioning (Feng, Spence, & Pratt, 2007; Green & Bavelier, 2003, 2006, 2007; Green, Pouget, & Bavelier, 2010; West, Stevens, Pun, & Pratt, 2008) and changes in brain function (Knols et al., 2017). The significance of this finding lies in the implication that the skills acquired in an AVG might be transferred to other contexts (Green & Bavelier, 2003; Boot, Blakely, & Simons, 2011), which contrasts with findings from a wealth of training paradigms wherein improvements in performance transfer very narrowly (to highly similar tasks) or not at all (Ball et al., 2002; Hertzog et al., 2009; Owen et al., 2010).

The seemingly broad transfer of skills from AVGs after little to moderate amounts of training (10 to 50 hours) has led some researchers (Bavelier et al., 2012; Green & Bavelier, 2008) to recommend the use of AVGs in training protocols among populations that would benefit from enhanced visual attention and cognition (e.g., older adults, pilots, military personnel, surgeons). These recommendations may be premature, however, as there are important methodological limitations of the past research (Bisoglio et al., 2014; Boot, Blakely, & Simons, 2011) as well as negative effects of AVGs on some forms of attention and cognition (Bailey et al., 2010; Cudo et al., 2024; Rice et al., 2021).

Several ongoing studies in my lab are designed to address these limitations and students will have the option of working on one or more of these projects. Potential research activities include: developing new video games and research protocols for testing the causal impact of games on cognition, collecting and analyzing brain and behavioral data to assess commercial video game effects in the lab, and conducting survey research to examine existing patterns of player behavior and cognition in the real world. Students will have the opportunity to engage with projects at various stages of the research process from conception and experimental design to manuscript preparation.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Water resources management

**Project Title**

1. Salinization trends in the Delaware Run and Olentangy River along Delaware, OH
2. Water quality trends in the Old Woman Creek

**Faculty Mentor**

**Name:** Carolina Barbosa

**Department:** Environment and Sustainability

**Email:** ccbarbosa@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/18/2026

**Ending:** 7/24/2026

**Requested Number of Students**

3 total (2 for project 1 and 1 for Project 2)

**Minimum qualifications of student researcher (be as specific as possible)**

1. Environmental Sciences, Environmental Studies or Geography major or minor (both projects)
2. Basic understanding of environmental and water quality concepts (both projects)
3. Willingness to work outdoors in various weather conditions and carry field equipment (project 1)
4. Experience conducting field work is desired (project 1)
5. Willingness to learn data analysis using R and GIS (both projects)

**Description of Research Project**

Students interested in these projects should indicate whether they are interested in

one or both of the projects listed.

*Project 1. (Two Students)*

Freshwater salinization is the process by which salts and minerals accumulate in rivers, streams, and other freshwater systems, often as a result of human activities. As these salts enter waterways, they can alter water quality, impact aquatic ecosystems and disrupt ecosystem services. This process is closely linked to both road salt application and agricultural practices, which are major contributors to the increasing salt levels in urban and rural streams. In urban areas, road salts—primarily sodium chloride—are heavily applied during winter months to melt ice and ensure road safety. However, much of this salt is washed into nearby streams and rivers through stormwater runoff, especially in areas with extensive pavement and limited natural filtration. In agricultural areas, the use of fertilizers and irrigation can introduce salts like potassium, calcium, and magnesium into the soil, which eventually leach into surface waters or groundwater. The cumulative impacts create long-term challenges for ecosystem health and water management. Delaware run is a tributary of the Olentangy river which originates 40 miles north of Delaware, OH, and flows into the Scioto River in downtown Columbus, Ohio. In this project we will investigate both systems because they each have unique features that make them good exemplary systems to investigate salinization trends.

*Project 2. (One Student)*

For this project, a student will analyze a long-term water quality data from Old Woman creek to evaluate how stream conditions have changed over time and across space. The purpose is to study a real environmental dataset and interpret what the trends reveal about the creek conditions and watershed health and to explain possible environmental drivers of those trends.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Developmental Psychology

**Project Title**

Development in the Context of Adoptive and LGBTQ+ Families

**Faculty Mentor**

**Name:** Krystal Cashen
**Department:** Psychology
**Email:** kkcashen@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

One

**Minimum qualifications of student researcher (be as specific as possible)**

*Required:*

1. Successful completion of PSYC 110 and PSYC 210
2. Willingness to engage in reflexivity
3. Detail-oriented and reliable

*Preferred:*

1. Successful completion of PSYC 310
2. Successful completion of either a Group C: Psychology Across the Lifespan Course or PSYC 285
3. Familiarity with statistical and survey software

**Description of Research Project**

The SSRP student will contribute to ongoing efforts in the lab related to the two

projects described below. The student will also develop an independent research project using one of the available data sets in the lab. Interested students are encouraged.

### LGBTQ+ Family Socialization and Developmental Outcomes in Emerging Adulthood

My previous work has shown that people with LGBTQ+ parents develop unique community connections and identities (Cashen, 2022) and attribute increased feelings of openness and acceptance to their upbringings (Burand et al., 2023). However, we still do not understand which specific processes contribute to these developmental outcomes. One potential parenting practice that may contribute to these outcomes is LGBTQ+ family socialization or the ways in which LGBTQ+ parents talk to their children about what it means to be an LGBTQ+ family (Oakley et al., 2017). This survey study examines how LGBTQ+ family socialization is associated with important developmental outcomes (e.g., identity, mental and physical health, family planning, etc.) in emerging adults with LGBTQ+ parents. Data for this study was collected in the fall of 2025. The SSRP student will contribute to data cleaning, coding, and data analysis for this project.

### Longitudinal Study of Openness in Adoption

In collaboration with colleagues at the University of Kentucky, we are in the initial stages of planning a new wave of data collection for a longitudinal study examining how openness in private domestic adoption in the United States is related to adjustment across the adoption kinship network (Grotevant et al., 2013). This new wave of data collection would include a focus on adult development and experiences of parenting among adoptees. The SSRP student will have the opportunity to contribute to planning efforts through helping with literature review, identification of potential measures, etc.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Physics

**Project Title**

Boost-Dependent Lorentz Violation in Storage-Ring Experiments

**Faculty Mentor**

**Name:** Yunhua Ding
**Department:** Physics and Astronomy
**Email:** yding@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/6/2026
**Ending:** 7/15/2026

**Requested Number of Students**

One

**Minimum qualifications of student researcher (be as specific as possible)**

Successful completion of PHYS 280 Contemporary Physics. Some knowledge of Mathematica coding is preferred, but not required.

**Description of Research Project**

Lorentz invariance is a fundamental symmetry in physics. It states that the laws of nature are the same for all observers regardless of their orientation or uniform motion. This symmetry is built into both the Standard Model of particle physics and Einstein's theory of general relativity. This symmetry is a cornerstone of both the Standard Model of particle physics and Einstein's theory of general relativity. However, tiny violations of Lorentz invariance may arise in more fundamental theories that seek to unify gravity with quantum physics, such as string theory.

One approach to testing Lorentz invariance is to search for observables that depend on the orientation or velocity of an experimental system relative to a preferred inertial

reference frame. Tests sensitive to orientation are known as rotation tests, while those sensitive to changes in linear motion are referred to as boost tests. Boost tests are particularly compelling because they can reveal new types of Lorentz-violating effects associated with velocity-dependent modifications of physical observables. Among the prime examples is the annual variation of a measured quantity induced by the Earth's orbital motion around the Sun in the presence of Lorentz violation.

Motivated by these ideas, this project investigates potential Lorentz-violating signals arising from boost effects in experiments involving charged particles confined in a storage ring. The project begins with a review of the theoretical framework describing spin dynamics in electromagnetic fields, and how Lorentz-violating operators can modify the spin precession frequency of circulating particles. Particular emphasis is placed on identifying the relevant coefficients for Lorentz violation that contribute to these frequency shifts. The project then introduces the standard inertial reference frame commonly used in Lorentz-violation studies, known as the Sun-centered frame. Using this frame, students will develop computational tools in Mathematica to transform the coefficients for Lorentz violation from the laboratory frame into the standard frame and isolate leading-order contributions associated with the Earth's orbital boost. Finally, results from existing and near-future storage-ring experiments will be used to place new constraints on coefficients for Lorentz violation that are currently weakly bounded or unconstrained.

This project is well-suited for students interested in using computational software (Mathematica) to analyze effects arising from unconventional physics. Students will use Mathematica to handle tensor transformations, organize complex expressions, and analyze their physical structure. Along the way, they will gain experience in modeling physical systems, performing tensor calculations, and strengthening both analytical and computational skills.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Social psychology

**Project Title**

Analyzing the effects of pro-environmental messages

**Faculty Mentor**

**Name:** Benjamin Douglas
**Department:** Psychology
**Email:** bddouglas@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

One

**Minimum qualifications of student researcher (be as specific as possible)**

For this project, students must be interested in learning advanced data-analytic techniques and the social psychological processes that underlie persuasion.

It is highly recommended that students have completed the following courses: Psych 210 with a grade of 90 or higher, research methods or conducted psychological research under the supervision of a university instructor, and a social psychology course (or similar) that discusses the effects of persuasive messages. Familiarity with R and R Studio is strongly encouraged. Students must be comfortable learning new programming and data analytic skills.

**Description of Research Project**

Persuasive messages are a frequently used tool to change human behavior (e.g., Cialdini et al., 1990) and have received particular attention as a tool to encourage

pro-environmental behavior (e.g., Sparkman et al., 2021). To test the effectiveness of these messages, researchers examine how the inclusion of different components of the text or images affect real-world behaviors. While numerous studies have tested the effects of persuasive messages, most rely on small convenience samples or are situated in contexts unrelated to pro-environmental behavior. To correct the challenge of reaching a large, nationally representative sample of participants, the present project partners with the National Wildlife Federation, a pro-environmental non-profit organization, to analyze the effectiveness of persuasive messages used to encourage pro-environmental actions.

The proposed research will occur in two steps. In the first step of the project, we will conduct a content analysis of the messages used by NWF from 2020 – 2026. We will examine each message to assess whether it includes communications about social norms, moral values, appeals to group goals, external rewards, positive versus negative framings, or justification language, all of which have been identified as key components to persuasive messages (Douglas & Brauer, in prep.). The research team will further analyze the included iconography to determine common characteristics of the images accompanying each message.

In the second step of the project, we will use secondary data provided by NWF to determine which messages were most effective at changing behavior. Behavior will include donations to NWF, clicks to NWF's website, and additional online actions among individuals contacted by NWF. Students involved in this project will learn advanced data-analytic strategies including multiple regression, linear mixed effects models, and generalized linear mixed effects models.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Freshwater ecology

**Project Title**

The effects of road salt on local freshwater ecosystems

**Faculty Mentor**

**Name:** Amy Downing
**Department:** Biological Sciences
**Email:** aldownin@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

Willingness to work both in the lab and in the field. We will be sampling local ponds. This will require that students are comfortable and willing to work outside in all weather and to be able to participate in some physical labor including walking to field sites and collecting samples from local freshwater ecosystems.

Students will also substantial spend time in the lab working to identify and count small zooplankton under a microscope.

Introductory biology courses strongly preferred, especially BIOL 122. Working knowledge of GIS would be a plus but is not required.

**Description of Research Project**

Freshwater ecosystems have become 'saltier' over time due to run-off in regions where road salt is regularly applied to impervious surfaces (Dugan et al. 2017; Hintz

and Relyea 2019). Freshwater salinization has strong and negative impacts on freshwater communities and food webs (Cañedo-Argüelles 2019). Specifically, high salinity reduces the abundance and diversity of many freshwater invertebrates. Among the most sensitive members of freshwater food webs are zooplankton, small herbivores that feed on algae/phytoplankton. Zooplankton transfer nutrients and energy from lower to higher trophic levels, therefore the loss of zooplankton is disruptive to freshwater food webs (Hintz et al. 2022). The response of zooplankton to salinization has been studied primarily through laboratory toxicity studies of individual species and controlled field experiments using specific freshwater communities. These studies show that freshwater zooplankton communities are negatively affected by salinity but also have identified substantial variation in how zooplankton communities and species respond (Arnott et al. 2023, Hebert et al. 2023, Hintz et al. 2022).

For this research project, we will survey small freshwater ecosystems including rural and urban ponds that vary in salt exposure to quantify the degree of freshwater salinization occurring in local landscapes. Specifically, we will travel to local pond habitats and measure chloride (a measure of salinity) and collect water samples and phytoplankton and zooplankton samples. We will use microscopy to identify zooplankton species to quantify how zooplankton communities are responding to actual salinity gradients across space. The survey data can also be used to identify land-use variables such as degree of impervious surface area that may predict which habitats are most vulnerable to freshwater salinization.


1. Cañedo-Argüelles et al. 2019. Phil. Trans. R. Soc. B 374. doi.org/10.1098/rstb.2018.0002
2. Dugan HA, et al. 2017. PNAS. Sci USA 114: 4453–58. doi.org/10.1021/acs.est.9b07718
3. Hintz WD and Relyea RA. 2019. Freshwater Biol 64: 1081–97. doi.org/10.1073/pnas.2115033119
4. Arnott, S. E. et al. 2022. Limnology and Oceanography Letters. doi: 10.1002/lol2.10277.
5. Hintz, W. D. et al. 2022. PNAS. 119 (9). doi: 10.1073/pnas.2115033119.
6. Hebert, M. P et al. 2022. Limnology and Oceanography Letters. doi: 10.1002/lol2.10239.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Religion

**Project Title**

Islamic Education and Training in Britain

**Faculty Mentor**

**Name:** Susan Gunasti
**Department:** Philosophy & Religion
**Email:** sgunasti@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

Successful completion of at least one upper-level, college course in religion, preferably on Islam. The student researcher must have the ability to read, analyze, and discuss one academic monograph a week; have the unaided ability to write at college level; have the basic ability to gather and analyze data; and have the willingness and ability to reach out and communicate with Muslim communities in Britain.

**Description of Research Project**

This research group will research Islamic educational outreach and chaplaincy training programs in Britain at the higher education level and beyond. Britain has had long and close contact with Islam and the Muslim world, and as a result of its colonial legacy has a sizable Muslim population living in its borders. Within Europe, Britain stands out for its historic avoidance of assimilationist policies that has largely left its Muslim community to meets its religious, educational, social, and cultural needs on its

own without state intervention. This research group will research the ways in which British Muslims have created processes, trainings, and programs to meet their needs in the realm of education and the ways in which these programs have engendered religious authority among their respective communities.

Our research is concerned with the ways in which figures holding religious authority emerge in British communities through educational programs. Our focus will be on training programs for religious leaders and the institutions in which they exert their religious authority and influence. We will begin with an examination of Muslim student organizations at the higher education level. In particular, we will focus on training programs to create Muslim student religious leaders that work with Muslim college students. This program is internal facing as it is designed by Muslims for Muslims and serves as an important site to understand religious authority among young Muslims. The research group will also identify Muslim organizations and explore the ways in which they enjoy religious authority and influence among the British Muslim communities they represent. The American context is better documented than the British one, and we will use the American case as a springboard to begin our exploration of these issues. Our research will address several questions: How is religious authority constituted outside of Muslim-majority settings? How have Muslims created institutions to serve their needs without state assistance or intervention? How is religious authority expressed in various British Islamic settings? How is leadership of British Muslims institutions related to traditional forms of leadership, such as at mosques? How do the British and American cases compare, and what do differences say about Islam in the West?

In a given week, student researchers will work independently and collectively. Students will have individual research tasks, and the group will meet together most days for regular discussion and feedback. Students' research skills development and intellectual growth are key goals of this group.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Math, Physics

**Project Title**

Swimming at micron scale

**Faculty Mentor**

**Name:** Han Guo
**Department:** Math/CS
**Email:** hguo@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

One

**Minimum qualifications of student researcher (be as specific as possible)**

*Student who wants to work on the numerical side should*

1. have taken at least MATH 210, 280, CS 110 by the end of the Spring semester;
2. have basic knowledge of matrix algebra;
3. enjoy programming.

*Student who wants to work on the experimental side should*

1. have taken at least MATH 280 and PHYS 111(C+L) by the end of the Spring semester;
2. have basic knowledge of matrix algebra;
3. have strong Lab work experience.

## Description of Research Project

When we think about better swimming, we usually think about three things: increasing thrust, reducing drag (or viscous force), and making use of inertia. While the thrust is generated when the swimmer pushes water, the latter two are important at all stages of swimming. We want to reduce drag to limit the “friction” working against our motion, and make use of inertia to “coast” after each stroke (this is especially true for long-distance swimmers).

The ratio between the inertial forces and the viscous forces, Reynolds number, is arguably the most important dimensionless quantity in the field of fluid dynamics, which was named after Osborne Reynolds more than 100 years ago. Mathematically, the Reynolds number is computed as velocity times length divided by the fluid viscosity. For a human swimming in water with a reasonable speed, the Reynolds number is typically in the order of 10,000 ~100,000. The Reynolds number decreases fast as we turn our eyes to smaller animals. For example, the Reynolds number of E. coli swimming could be as low as 0.00001 ~ 0.0001. That is to say, microswimmers like E. coli live in an environment which is dominated by viscosity and inertia becomes irrelevant. Strokes useful for humans are very ineffective for microswimmers.

In this project, we are going to dive into the counter-intuitive world of microswimmers. We will model different types of cilia/flagella driven microswimmers using various reduced order models, and conduct either numerical or experimental studies depending on student's interest. Successful completion of the project will likely lead to presentation(s) at Fluid Dynamics/Applied Math conference(s).

# 2026 OWU Summer Scholarship & Research Program

# Faculty Mentor Research Proposal

**General Area of Research**

Astrophysics

**Project Title**

Determining How Stellar Magnetic Activity Depends on Stellar Parameters using Data from the Kepler Space Telescope

**Faculty Mentor**

**Name:** Robert Harmon
**Department:** Physics and Astronomy
**Email:** roharmon@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** May 11
**Ending:** July 17

**Requested Number of Students**

2

**Minimum qualifications of student researcher (be as specific as possible)**

PHYS 111 or CS 110

**Description of Research Project**

Students selected for this project will participate in a collaborative project of Dr. Harmon and OWU alum Dr. Rachael Roettenbacher, a research scientist at the University of Michigan. We are conducting the the largest-scale systematic study to date of how the magnetic activity of stars depends on stellar parameters such as the star's mass, surface temperature, and rotation rate.

The Kepler space telescope was launched in 2009 as NASA's first mission to study exoplanets, which are planets orbiting other stars, and remained operational in this

mode until 2013. Kepler was designed to discover exoplanets via the transit method: When a planet passes in front of its star as seen from our perspective, it blocks some of the star's light from reaching us, resulting in a temporary dip in brightness. Kepler took repeated digital images of more that half a million stars, allowing how their brightness changed over time to very high precision, ultimately detecting almost 2800 confirmed exoplanets.

As a side effect of searching for exoplanets, Kepler detected starspots on more than 40,000 stars. Starspots, like sunspots on our own Sun, are regions on a star's surface where strong vertical magnetic fields suppress the transport of heat towards the surface, causing the spots to be cooler and thus darker than the rest of the star's surface. The star's brightness varies as the dark spots are carried into and out of view by the star's rotation, so that monitoring stars for brightness changes due to exoplanets naturally also detects starspots as well.

Because they are associated with concentrations of a star's magnetic field, studies of spots provide important insights into the physics of stellar magnetic fields and how they are generated. This in turn provides insight into magnetic processes on the Sun, which are important to understand because the Sun's magnetic field is the driver of solar storms and coronal mass ejections that can have profound consequences for electrical grids, satellites, and more.

Dr. Harmon developed a computer program that takes measured brightness variations as input and generates a map of the distribution of starspots on the star's surface. Students working on the project will assist in analyzing how the starspot distribution and the way it changes over time depends on other stellar characteristics. There is also the potential for student involvement in the further development of machine learning algorithms to assist in the selection and analysis of the large number of models generated, or using machine learning to develop an alternate and possibly faster approach to mapping the starspots based on the light curves.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Mathematics, Computing, Engineering, Art

**Project Title**

New Mechanisms for Generative Textiles

**Faculty Mentor**

**Name:** Craig Jackson
**Department:** Mathematics and Computer Science
**Email:** chjackso@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/18/2026
**Ending:** 7/24/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

(MATH 110 OR CS 110) AND (some experience with art production, textiles preferred)

**Description of Research Project**

The broad goals of our studio are (1) the construction of innovative digital-mechanical machines (looms) that facilitate generative design in textile production and (2) the production of high quality, generatively designed textiles. “Generative designs” are those in which the designer relinquishes some significant aspect of control over the final piece to an external agent. Often, this external agent is machine randomness (RNG).

The goals of this specific project are:

1. The development of generative algorithms for textile design. For example, designs could make use of cellular automata, reaction-diffusion equations, or other

mathematical models in which stochastic and deterministic processes interact in interesting ways. It is important to note that textile designs must be heavily constrained by the material reality of the underlying woven medium since designs that look good on paper can easily result in poorly woven pieces.

2. The design and construction of production-capable looms (or prototypes) that are suitable for generative textile production. Implementing complex generative designs on traditional looms requires time consuming manual intervention by the artist. As a remedy for this, we have designed and built several digitally-controlled looms that enlarge the pattern space available to the weaver and make the production of generatively designed textiles much more efficient. More opportunities exist to design and construct looms with even more advanced features, some of which have (to our knowledge) never been built. This would involve: computer aided design, 3D printing, fabrication, and microcontroller circuit design.
3. Validation of the work done in (1) and (2) by producing full-sized woven pieces. Our studio is premised on using math and computing in the production of art/craft that is both aesthetically pleasing and fit for purpose. Hence, to be successful, it is important that the theoretical work done in the service of this goal is tested by producing representative artifacts. It can take many hours to produce a finished piece. Hence, students who apply must be willing and able to spend significant time at the loom.

For more information, please consult the following papers:

https://generativeart.com/GA2023/papersDOC/OK/44_CRAIG_Jackson_Nilan3.pdf

https://generativeart.com/XXVIIIGenerativeArt.pdf#page=284

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Education

**Project Title**

Mixed-Methods Analysis of Library of Congress Grant Teaching and Learning Artifacts

**Faculty Mentor**

**Name:** Sarah Kaka
**Department:** Education
**Email:** sjkaka@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

1. Interest in educational and/or social science research, supported by strong attention to detail and reliability with research tasks.
2. Willingness to learn and apply basic quantitative and qualitative methods, including spreadsheet-based statistics (Excel/Google Sheets) and qualitative coding.
3. Strong academic writing skills, including the ability to produce clear analytic memos, literature notes, and concise research summaries.
4. Successful completion (B- or higher) of a humanities or social science course requiring analysis of texts, evidence, and/or human behavior in context (e.g., history, sociology, anthropology, political science, psychology).
5. Has an established relationship with the faculty mentor through prior coursework, advising, co-curricular collaboration, research assistance, or other direct

mentorship/contact.

6. Successful completion (B- or higher) of a research methods course (e.g., PSYC 310 or an equivalent methods course) preferred, or demonstrated readiness through prior research experience and a strong faculty recommendation.

## Description of Research Project

Students will learn core methods of educational research by analyzing a multi-source dataset generated through a Teaching with Primary Sources (TPS) Library of Congress grant awarded to Dr. Kaka. Data sources include pre-surveys, online module assignments, workshop artifacts (e.g., reflections, planning tools, lesson drafts), lesson-design think-aloud transcripts, and additional evidence collected through grant activities. The project is intentionally methods-focused: students will be mentored through the full research cycle using authentic data from an active education initiative.

The investigation will be guided by broad, methods-appropriate questions such as:

1. What patterns appear in participants' beliefs, confidence, and reported practices across survey measures?
2. What kinds of reasoning and decision-making are visible in written artifacts and think-aloud protocols?
3. How can qualitative evidence help explain quantitative patterns (and vice versa)?

**First phase: Literature review and research design training.**

The students will review foundational scholarship on educational research methods, including survey research, qualitative coding of instructional artifacts, and mixed-methods integration. This phase will also introduce research ethics and data protection practices, support the development of a concise conceptual frame for the study, and refine the project's guiding questions. The students will learn how to locate and organize research literature using library databases and will produce an annotated bibliography and working definitions for key constructs that appear in the dataset, and write a literature review.

**Second phase: Data preparation and analysis planning.**

The mentee will create a structured data system for the TPS dataset (file naming conventions, documentation, and data dictionaries). They will clean and organize survey data (variable labels, missingness checks, basic descriptives) and develop a qualitative codebook for module assignments, workshop artifacts, and think-aloud transcripts. During this phase, the mentee will pilot-code a sample of artifacts and transcript excerpts, revise the codebook, and practice reliability/calibration procedures to ensure consistent application of codes.

**Final phase: Mixed-methods analysis, synthesis, and dissemination.**

The mentee will complete qualitative coding and finalize quantitative summaries/analyses appropriate to the dataset (e.g., descriptive statistics and comparisons/correlations when warranted). They will then integrate findings using mixed-methods strategies such as “joint displays” that connect survey patterns to explanatory evidence in artifacts and think-alouds. Findings will lead to practical implications for improving educational programming and supports within the TPS initiative, as well as a research narrative suitable for broader dissemination.

Mentorship will be structured and collaborative, with regular research meetings, weekly “methods workshops” (quantitative analysis, qualitative coding, and research writing), and iterative feedback on analytic memos and visuals. Deliverables will include a curated analytic dataset and codebook, summary tables/figures and thematic findings, and a poster presentation for the SSRP Symposium during the fall Connection Conference, with the hope of publishing a journal article.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Education

**Project Title**

Patterns of Preservice Teachers' Evidence-Based Claims of Students' Mathematical Thinking

**Faculty Mentor**

**Name:** Bona Kang
**Department:** Education
**Email:** bkang@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/26/2026
**Ending:** 7/31/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

1. A productive (positive) disposition towards mathematics.
2. Comfortable with using technology and access to a computer/laptop with internet connection.
3. Ability to do mental math with whole numbers and decimals, operations (adding, subtracting, multiplying, dividing) with fractions, and solving word problems (story problems).
4. A willingness (and eagerness) to learn how to visually represent and verbally explain the 'why' behind common algorithms for operations.
5. Critical thinking, reading, and writing skills.
6. Successful completion (B- or higher) of a research methods course (e.g., PSYC 310) OR experience reading, annotating, and understanding academic research

papers (through coursework, internships, etc.)

7. Two positive faculty recommendations for a productive disposition towards in-person and online communication, collaboration, mentorship, and independent learning (emailed to Dr. Kang).
8. Successful interview with faculty mentor (Dr. Kang) to demonstrate interest, initiative, and skills for the project.

## Description of Research Project

This mentored independent project will introduce OWU students to scholarship of teaching and learning and research methods for examining preservice teacher learning within mathematics education courses.

For this project, OWU mentees will learn about frameworks related to teacher noticing (of student mathematical thinking; Jacobs et al., 2010), mathematical knowledge for teaching (Ball et al., 2008; Hill et al., 2004), and practice-based teacher education (e.g. Grossman et al. 2009) to help revise an existing codebook (from a previous project; Corven et al., 2025), and then code de-identified preservice teachers' child math interview assignments from the mentor's course from previous years. Through this experience, mentees will learn how to analyze the quality of claims that preservice teachers made with evidence from their child interview assignments. (i.e., What is the level of evidence that preservice teachers use to identify mathematical knowledge of their interviewees?) The final goal is to generate practical recommendations and consider implications for the course that assigns this assignment: What kinds of experiences do preservice teachers need to shift from making general claims without evidence to making specific claims about student thinking from detailed evidence? How might the assignment be improved to better support this goal? The results and discussion of this project will help inform the instructor's next iteration of the course with regards to supporting preservice teachers to notice details of students' mathematical thinking and be able to use that evidence to make quality claims about their thinking.

The data for this study is already IRB-approved (protocols 2311.028 and 2412.016), so an amendment will be submitted for adding student researchers to the project (who will complete the required training for IRB approval).

This project is relevant to the Ohio Wesleyan community because it will provide insights to OWU Education faculty who train preservice teachers to teach mathematics to students, and support preservice teachers in developing skills to notice and interpret students' mathematical thinking. The findings will be presented at the SSRP Symposium, OWU Connection Conference, other related campus opportunities, and potentially at practitioner-oriented conferences (e.g., AMTE).

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

English; Interdisciplinary Studies

**Project Title**

Chiasmus Across the Disciplines

**Faculty Mentor**

**Name:** Zack Long
**Department:** English
**Email:** zclong@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

3

**Minimum qualifications of student researcher (be as specific as possible)**

1. Successful completion of, or exemption from, ENG 105: College Writing Seminar
2. Basic familiarity with library research tools (additional training will be provided)
3. Organizational and time management skills
4. Ability to work both independently and collaboratively
5. Willingness to present and discuss findings
6. Completion of a disciplinary methods course helpful but not required

**Description of Research Project**

In literary studies, chiasmus is typically defined as the rhetorical figure in which "the order of words in one of two parallel clauses is inverted in the other" (Oxford English Dictionary): in its simplest form, ABBA ("Ask not what your country can do for you; ask what you can do for your country"). Described in this way, chiasmus seems like a

clever but cosmetic bit of linguistic artifice–a way to dress up words to make them memorable but nothing more. However, scholars across a range of disciplines–from literary studies, art history, philosophy, and religion to architecture, anthropology, biology, and even genetics–have observed chiastic organization in both natural and created objects, from literary works, scriptures, paintings, buildings, gardens, and rituals to anatomical structures, developmental diagrams, DNA sequences, stratigraphic columns, and phylogenetic trees. For reasons both murky and obvious, the human mind seems to delight in arranging–or perceiving–reality into complementary and contrasting pairs characterized by inversion or reversal.

This research program will investigate the history and theory of chiasmus across the disciplines. The immediate context for this investigation will be my own scholarship on Hamlet, a play that exhibits an unusual variety and density of chiastic arrangement within the Shakespearean canon. While I already have some theories about why this is the case, I strongly suspect that the significance of these patterns runs deeper, calling for a broader, more interdisciplinary analysis. Participants in this program will therefore not only become partners in my research, but will help probe the broader significance of chiastic organization beyond literary studies.

Participants will be selected for this program on the basis of disciplinary range, with the aim of assembling a genuinely interdisciplinary cohort. After an introduction to chiasmus and my work on Hamlet, each student will be given responsibility for researching chiasmus within a specific context. Depending on disciplinary affiliation, students will work with primary texts, secondary texts, images, diagrams, or datasets, and develop close analytical descriptions, visual maps, and comparative frameworks to test whether and how chiastic organization operates across domains. Team members will share and discuss their findings in weekly meetings; the group will look for patterns amongst these findings; and these interdisciplinary conversations will refine subsequent rounds of research. In the last stretch of the program, students will develop their own analysis of a specific object that exhibits chiastic organization and synthesize their findings in a poster presented at the SSRP Symposium.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Political Science

**Project Title**

The Politics of Food Allergy

**Faculty Mentor**

**Name:** Franchesca Nestor
**Department:** Politics and Government
**Email:** fvnestor@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

Strong applicants will have taken at least one OWU PG class in American politics and at least one social science methods course. Having taken Food Politics and Policy at OWU, or having experience with food allergy or intolerance or chronic illness, either directly or indirectly, is not required but is a plus.

**Description of Research Project**

This project entails collaborative research assistance work alongside PG professor Franchesca Nestor on multiple related research questions which consider the impact of food allergy in politics. The research questions build on Dr. Nestor's existing research agenda and courses and include:

1. An investigation of the level of partisan sorting around food allergy—are there clear differences in preferences when it comes to Republicans and Democrats on this issue?

2. A focus on a critical new element in food politics and public health—Do views on MAHA (Make America Healthy Again) and state legislative actions related to MAHA relate to opinions on the issue of food allergy?
3. An exploration of the public's perception of food allergy as it relates to individuals in government—would they be hesitant to elect an individual with chronic health issues like food allergy? What factors might relate to any hesitance?
4. A study of the willingness (or lack of willingness) of elected representatives to share food allergy or other health diagnoses—if they were diagnosed, would they share this information with their constituents? Why or why not?

This project fits within the larger political science literature on representation, the politics of disability, legislative politics, and state politics.

Student researchers will have the opportunity to contribute collaboratively to multiple ongoing and possible future papers in development from a variety of angles, from literature review, including searching for relevant sources and literature review writing; to survey design, from question development to sampling approach considerations to survey experiment set up; to data analysis. They will work closely alongside the faculty mentor and other student researchers, developing research skills and writing skills, designing mock media news stories, building and running a survey using survey software, and analyzing data. The project includes both quantitative and qualitative elements in the research designs, so participants will gain a background in both empirical approaches. The mentorship approach will be team-based and collaborative, providing guidance alongside independent work, but with all team members contributing to and building capabilities in all project elements. The group will meet together multiple days a week, with regular time for independent work and follow-up feedback to ensure continual individual growth on research skills.

Progress on all projects in development is the goal for the summer, with possible manuscript submission on existing projects during the summer, and longer term goals on new projects including presenting at the Student Symposium, co-authorship on manuscripts, and, potentially, conference attendance.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Nutrition, food, gender

**Project Title**

Gender Roles in the kitchen: Narratives from "the Manosphere"

**Faculty Mentor**

**Name:** Liz Nix
**Department:** Health and Human Kinetics
**Email:** eanix@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/20/2026
**Ending:** 7/29/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

Students do not need to come in with prior experience.

**Description of Research Project**

This research project builds off a bigger research question regarding industrialized food and gender roles around food acquisition and preparation specifically, but also gender roles more broadly. After world war 2, many women moved into the workforce. However, there was no migration of men moving into the role of home maker. This led to, in many cases, the "double shift" for working mothers; working their job during the day, and also taking care of household necessities at home, including childcare, food preparation, and cleaning. In recent years, many men have taken on the role of approaching issues that affect men, through podcasts and social media. While some of these issues focus on healthy behaviors specific to men that may help to reduce stress and risk of suicide, a major public health concern among men. However, others

may focus on the reassertion of historic gender roles, particularly as it relates to women. For this project, we will use thematic analysis of several podcasts and social media influencers in the "manosphere" to answer 3 important questions, 1) What gender roles are being promoted as particularly "male" roles, 2) What gender roles are being promoted as particularly "female" roles, and 3) what, if any, evidence is provided as justification for distinct gender roles.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Education

**Project Title**

Exploring Resilience in Perservice and Early Career Teachers

**Faculty Mentor**

**Name:** Michele Nobel
**Department:** Education
**Email:** mmnobel@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

One

**Minimum qualifications of student researcher (be as specific as possible)**

This project seeks a student researcher with a major or minor in Education, Psychology, Sociology, Human Development, or a related field, along with basic familiarity with—or a willingness to learn—surveys and interview protocols and human subjects research (including completion of IRB/CITI training, if needed). The student researcher should demonstrate strong written communication skills for transcription, memos, and coding; an interest in teacher preparation, resilience, stress, or well-being; and well-developed active listening skills. A strong sense of confidentiality and research ethics, careful attention to detail and accuracy (particularly in transcription and data handling), and effective time management skills are also required.

**Description of Research Project**

The topic of resilience and self-care is well documented in the literature as critical for helping individuals persevere during challenging times (Beck et al., 2020). Researchers

have consistently called for improvements in working conditions as essential for retaining teachers (Carver-Thomas & Darling-Hammond, 2017; Sutcher et al., 2016; Walker, 2025; Zhang & Zeller, 2016). Those responsible for preparing future educators likewise recognize the importance of ensuring teachers enter the profession equipped to meet these challenges and remain in the field (Ingersoll et al., 2016; Sutcher et al., 2016; Walker, 2025).

Research identifies several key factors that influence teacher persistence, including the development of professional identity (Cochran-Smith, 2003; Hochstetler, 2011), high self-efficacy (Elliott et al., 2010), resilience (Doney, 2013), and advocacy (Walker, 2025).

Fostering resilience and self-care is particularly important given that teachers who leave the profession frequently cite stress and anxiety as contributing factors (Diliberti et al., 2021). Emphasizing self-care allows educators to intentionally develop routines and strategies that support resilience. Research underscores the need for targeted support during educator preparation (Doney, 2013; Wang, 2021) and throughout teachers' careers (Lesh, 2020). In addition, scholars highlight the importance of advocacy aimed at improving the working conditions teachers face (Juárez & Becton, 2024; Stewart-Ginsburg et al., 2024; Walker, 2025). Providing opportunities for teachers to engage in self-care and advocacy may contribute to increased retention of highly qualified educators.

Contingent on IRB approvals, the SSRP student researcher will assist with recruitment and data collection, conduct case study interviews, and analyze data from previously completed surveys and interviews. The survey component will collect quantitative data from preservice teachers and teachers within their first five years of practice, focusing on perceptions of resilience, stressors, coping strategies, sources of support, and self-efficacy. The qualitative component will include semi-structured interviews, with case studies highlighting individual pathways to resilience. Data will be analyzed using descriptive and inferential statistics and thematic analysis.

Findings from this study aim to inform teacher education, mentoring, and professional development by identifying factors that promote resilience during the early stages of teaching and support teacher retention and well-being.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Astronomy

**Project Title**

Expanding Observational Capabilities at Perkins Observatory

**Faculty Mentor**

**Name:** Kyle Pellegrin
**Department:** Physics & Astronomy
**Email:** kspellegrin@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

Completion of PHYS 111L

**Description of Research Project**

Perkins Observatory at Ohio Wesleyan University is a unique facility to undertake astronomical observations. Notably, Dr. Robert Harmon has used the facility to undertake a long-term study of the starspots on the star LO Pegasi utilizing photometric techniques. This project seeks to not only continue the data acquisition on LO Pegasi, but to also expand the capabilities of the observatory by developing the tools and techniques needed to successfully obtain astronomical spectra, allowing for new capabilities in studying a variety of astronomical objects. LO Pegasi is a young, rapidly rotating star that exhibits dark patches, called starspots, on its surface. To detect the presence of these spots, repeated measurements of the star's brightness are made over a period of time as the star will appear to dim when the dark spots

move into our field of view. To visualize the possible distribution of starspots on the stellar surface Dr. Harmon utilizes his technique of Light-curve Inversion (LI), taking these observations of the changing brightness of LO Pegasi and working backwards to suggest what the stellar surface may look like.

While photometric techniques can provide a wealth of information about a variety of objects of interest, spectroscopy goes one step farther by studying the individual wavelengths present in the star's light, allowing for the determination of properties such as chemical abundances, radial velocities, doppler shifts, and more which are unachievable via photometric techniques.

The chosen students for this project will support the ongoing efforts to study LO Pegasi by collecting photometric data and applying the LI technique to study the starspots in collaboration with Dr. Harmon. Additionally, the students will also construct a 3D printed spectrograph; the well-known Star'ex spectrograph designed by Christian Buil. Once constructed, the device will be fine-tuned to optimize its performance while undertaking spectroscopic observations of a wide variety of targets, such as stars (including LO Pegasi), galaxies, etc., in order to determine the sensitivity of the instrument and the limits of using the spectrograph in Delaware, OH. Once high-quality spectra have been acquired, data collected by the student(s) will be submitted to the American Association of Variable Star Observer's spectroscopy database, AVSpec, for use by amateur and professional astronomers around the world.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Orthopaedics (Exercise Science)

**Project Title**

Orthopedic Surgeon Surgical Technique Preferences

**Faculty Mentor**

**Name:** Liz Starns
**Department:** Health and Human Kinetics
**Email:** eastarns@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/18/2026
**Ending:** 7/27/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

1. Organized
2. Experience using Microsoft and Google products
3. Experience searching for and finding relevant scientific articles and information
4. Knowledgeable of the scientific research process
5. Able to write clearly, concisely, and professionally
6. Have an interest in medicine (Orthopedics and Sports Medicine preferred)

**Description of Research Project**

The research will, broadly stated, evaluate orthopedic surgeon preference of surgical techniques. Specifically, a review of literature and thorough understanding of surgical techniques will be performed on a given injury. A short survey will be created asking about surgeon preference of the researched surgical technique. Then a list of

orthopedic surgeons will be compiled and a survey sent to them. After data collection, data will be organized and analyzed for eventual dissemination and publication.

Secondarily, a thorough review of surgical technique choices will be performed from other countries, such as Europe and Australia. This information will be organized, synthesized, and scientifically written about for publication/presentation.

Tertiarily, a qualitative study on orthopedic surgeon surgical technique preference that spans orthopedic surgeon career stage within a specific hospital system in Ohio will be designed and the IRB proposal created. This study will not be performed over the summer, but if the student(s) wish to see it through they may take a directed reading or independent study course in the Fall, 2026 and/or Spring, 2027 to see the research project through.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Biochemistry

**Project Title**

Interactions between monolayer membrane mimics and cell-penetrating peptides

**Faculty Mentor**

**Name:** Kayce Tomcho
**Department:** Chemistry
**Email:** katomcho@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Three

**Minimum qualifications of student researcher (be as specific as possible)**

The student should have successfully completed the organic chemistry sequence. Ideal candidates have proficiency in basic laboratory skills such as solution preparation. This project will also involve data analysis using graphing software and a large amount of literature review.

**Description of Research Project**

Biological membranes are significant contributors to transmembrane protein function and localization. Additionally, membrane fluidity and dynamics is influenced directly by its composition. In this project, students will study Langmuir monolayers of sphingolipids, phospholipids and cholesterol as simple model systems representing human biological membranes. Two-dimensional Langmuir monolayers have long been used as simplified model systems to study the interactions that occur within cell membranes (bilayers). Using simple Langmuir model systems allows us to obtain

molecular-level information on the interactions between these lipids and various small molecules (i.e. drugs, hormones, peptides, etc.) which can be correlated to their physiological activity. The glycine receptor (GlyR), a pentameric ligand gated ion channel (pLGIC) protein, is responsible for inhibitory neurotransmission by facilitating the influx of chloride ions. GlyR is a therapeutic target as it is linked to chronic pain and hereditary hyperekplexia. A large intracellular loop within GlyR, the M3-M4 loop, is not well characterized structurally, though it is known that receptors that have truncated or missing loops do not function. Crosslinking-mass spectrometry (CXMS) studies have shown that attaching a crosslinker to mutated Cys residues in the extracellular domain of GlyR can crosslink to residues in the M3-M4 loop region, though these residues are located beyond the reach of the crosslinker. One explanation of the results could be due to poly-Arg/Lys regions, located in the M3-M4 loop. Studies have shown that peptides containing Arg and Lys residues have the ability to penetrate the membrane and act as cell-penetrating peptides (CPPs). By studying the effects CPPs have on the structural organization of various Langmuir monolayers, the M3-M4 loop can be better understood. Through this project, students will get a unique opportunity to use specialized surface-science instrumentation. Students will utilize a Langmuir trough to collect surface pressure-area isotherms and Brewster angle microscopy to image the aqueous interfaces of interest.

This is an ongoing continuation of a project started in 2024. Two students will work on the following parallel projects:

1. Interaction of Sphingomyelin-dipalmitoylphosphatidylcholine-cholesterol monolayers with the following potential CPPs in the M3-M4 loop: 378KLFIQRAK385
2. Interaction of Sphingomyelin-dipalmitoylphosphatidylcholine-cholesterol monolayers with the following potential CPPs in the M3-M4 loop: 372SPEEMR377
3. Analysis of the following peptides: LLLLLR and LLLLSR to gain understanding of the influence of hydrophobic amino acids versus polar amino acids next to a terminal arginine residue

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Neuroscience

**Project Title**

Determining the effects of adolescent stress or circadian disruption on the brain or behavior of adult mice

**Faculty Mentor**

**Name:** Chelsea Vadnie
**Department:** Psychology Department and Neuroscience Program
**Email:** cavadnie@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Two

**Minimum qualifications of student researcher (be as specific as possible)**

The student researchers must be accepting of behavioral neuroscience research using animal models. The students will ideally have some experience handling mice, but should at a minimum be willing to learn to handle rodents (training will be provided). The ability to work flexible hours, including some weekend work, is needed since the projects may involve daily monitoring of animals and some weekend testing. The students will need to be detail-oriented and reliable. Preference will be given for students who have completed Behavioral Neuroscience lecture and lab (NEUR 343).

## Description of Research Project

Mood and anxiety disorders are highly prevalent and often develop during late adolescence or early adulthood. Stress and circadian rhythm disturbances are risk factors for mood and/or anxiety disorders. Rodent research has shown that stress and circadian rhythm disruptions can cause behaviors relevant to psychiatric disorders. However, there are remaining questions about the factors that affect vulnerability to these effects and the possible underlying neurobiological mechanisms.

This summer we will expand upon our study centered on determining the effects of adolescent stress on brain function in adult mice. In both humans and rodents, there is a heightened response to stress during adolescence. It's challenging to study the effects of stress during only adolescence in humans. Thus, rodent models are especially valuable for this work. Studies indicate that rodent adolescent stress can regulate behaviors relevant to psychiatric disorders, such as anxiety-like behavior (Albrecht et al., 2017). Similarly, we found that just six days of stress during early adolescence in C57BL/6J mice increased multiple measures of anxiety-like behavior in adulthood. We next looked at the brains of these animals to understand why this paradigm had a long-lasting effect on behavior. Previous work suggested that adolescent stress changes the expression of GABAergic genes in specific brain regions (Albrecht et al., 2017). Through quantitative real-time PCR, we measured the relative expression of GABAA receptor subunits in the prefrontal cortex (PFC), hippocampus, and nucleus accumbens. We found that adolescent stress decreased the expression of the GABAA α3 subunit in the PFC, as also found by Jacobson-Pick et al. (2012). We are now using immunohistochemistry to look at the effects of adolescent stress on the GABAA α3 protein levels in the PFC. The selected student would continue this work by imaging slides, analyzing images, or possibly generating a new tissue bank for further analysis.

This summer we will also start a project to build upon our findings that adolescent circadian disruption affects adult reward and risk-taking behavior (DePoy, Vadnie et al., 2024). We would start by setting up and testing homecage activity monitoring equipment. We would work together to design the light cycle paradigm and the battery of translationally relevant behavior tests. Since this project is in the initial stages, there is a strong interest in someone who would consider continuing the work during the academic year. The selected student should expect to work with me and the other student daily this summer.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Organic Chemistry

**Project Title**

The synthesis of drazepinone and derivatives for protein tyrosine phosphatase inhibition

**Faculty Mentor**

**Name:** Grant Walby
**Department:** Chemistry
**Email:** gdwalby@owu.edu

**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

2

**Minimum qualifications of student researcher (be as specific as possible)**

Ideally, the student will have completed Organic Chemistry 1 and 2. I would be willing to take a singular student who has only completed General Chemistry if they have a strong letter of recommendation from both their General Chemistry lecture AND laboratory professor

**Description of Research Project**

PTPs are important enzymes involved in the dephosphorylation of key proteins in the insulin recognition signal transduction pathways, and many have ties to diabetic diseases and cancer. However, there exist difficulties in selectively binding a singular PTP over another, due to the homologous nature of the binding pockets. Two PTPs in particular, PTP-1B and T-Cell PTP (TCPTP), are common PTP targets that experience this issue of selective binding. Despite there being examples of selective binding to

these PTPs, they remain compelling targets for drug design.

(-) – Drazepinone is a natural product that recently had its structure revised, and in that publication was shown to have unique selectivity for PTP-1B and TCPTP over other PTPs. However, the selectivity between PTP-1B and TCPTP was minor by medicinal chemistry standards. Computational modeling done indicated certain regions that are important for binding and thus are areas of focus.

The goals of this project are to work towards the synthesis (-) – drazepinone, as there are no reported syntheses, and to design derivatives of drazepinone so as to perform structure-affinity relationship (SAR) studies to improve on the affinity and selectivity.

# 2026 OWU Summer Scholarship & Research Program

## Faculty Mentor Research Proposal

**General Area of Research**

Genetics

**Project Title**

Finding New Genes in Gravity Responses in Plants

**Faculty Mentor**

**Name:** Chris Wolverton
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**Anticipated Research Dates (10 weeks):**

**Beginning:** 5/11/2026
**Ending:** 7/17/2026

**Requested Number of Students**

Three

**Minimum qualifications of student researcher (be as specific as possible)**

Completion of BIOL 120 or equivalent; Competence with basic wet lab skills (pipetting, making dilutions, calculating concentrations); Willing to learn and adhere to laboratory safety practices; Enjoys giving attention to small details, making careful observations and keeping detailed records in a lab notebook.

**Description of Research Project**

Plants are sensitive to numerous cues in their environment, many of which influence growth direction and overall shape of the plant body. Despite numerous mutant studies, only a small handful of regulatory genes have been characterized in the gravity response pathway. Recently, my lab has used RNA-seq and comparative gene expression analyses to identify new candidate genes involved in gravity responses. This summer, students will follow up on previous work by analyzing double mutant combinations and mutants expressing a semi-quantitative fluorescent protein-based

auxin reporter to assess the contribution of new candidate genes to the gravity sensing and response pathways.