Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)
Neuroscience, psychology

Specific title of research project
Examining Cognitive and Brain Function through Video Games

Faculty mentor supervising research

Name: ___Kira Bailey_____

Department: _____Neuroscience/Psychology_____

Campus phone: ___3808_____

Email address: ____kmbailey@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: _____5/22/2023_____

Ending: _____7/28/2023_____

Requested number of students

one _____

two __X___

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

For this project, the student should have an interest in understanding human cognition through video games. Prior coursework or experience with the coding and/or electroencephalography (measurement of human brain waves) is strongly preferred, but students willing to learn these skills are encouraged to apply. The student should be comfortable learning new computer software. Completion of any of the following courses is strongly recommended, but not necessarily required: Introduction to Neuroscience (NEUR 250), Cognitive Neuroscience (PSYC 342). Students who have taken CS courses or have prior experience with programming in any language are encouraged to apply.

Description of the research project (one page maximum)

A growing body of 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 (Boot, Blakely, & Simons, 2011; Green & Bavelier, 2003), 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). These recommendations may be premature, however; there are several methodological criticisms of the past research (Boot, Blakely, & Simons, 2011; Bisoglio et al., 2014). One criticism is that the use of readily available commercial video games does not allow for strong experimental control over the numerous variables that could influence cognitive skills. At this point it is nearly impossible to know what features of a given video game are training which cognitive skills.

The proposed project is designed to address this criticism by developing new video games specifically designed to train cognitive skills and modifying existing commercial games for that purpose. In addition to allowing the researchers greater control over important variables, this approach allows for simultaneous recording of brain activity during game play, which only a few studies have achieved (e.g., Mondejar et al., 2018). We can examine changes in brain activity during, as well as after, video game training, which may provide information about the mechanisms of video game effects that could be used to develop future training protocols.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line “Proposal for *faculty name*”

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Psychology, Developmental Science

Specific title of research project

Development in the Context of LGBTQ+ Families

Faculty mentor supervising research

Name: Krystal Cashen

Department: Psychology

Campus phone: 740-368-3810

Email address: kkcashen@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 15, 2023

Ending: July 21, 2023

Requested number of students

one __X___

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Required:
Successful completion of PSYC 110
Interpersonal skills necessary for interacting with potential human participants
Sensitivity to LGBTQ+ identities and openness to continued learning in this area
Detail-oriented and reliable
Preferred:
Successful completion of either PSYC 233, 282, 285, or 333
Familiarity with statistical and survey software

Description of the research project (one page maximum)

The student would have the opportunity to contribute to two projects examining impacts on

developmental outcomes within LGBTQ+ families. In both projects, the student would have the ability to assist in various phases of the research process including data collection, data cleaning/preparation, and data analysis. The student would be able to use data from either project to examine a research question of interest to them.

Impact of Political Context on Family Formation Decision Making among LGBTQ+ Individuals

In recent decades, scientific advances in assisted reproduction technologies (ART) and changes in legal access to adoption have resulted in greater access to multiple pathways to family formation for LGBTQ+ individuals. However, each family formation pathway carries unique benefits, risks, and considerations for family functioning and child development (Goldberg, 2023). Previous research has shown that LGBTQ+ individuals often report distinct reasons for choosing a specific family formation pathway in comparison to cisgender heterosexual individuals. However, recent changes in the political and legal landscape within the United States (e.g., discussions about the impact of the overturning of Roe v. Wade on the future of in-vitro fertilization, increasing anti-LGBTQ+ legislation) may shift how LGBTQ+ individuals make decisions about family planning. For example, a recent study of current LGBTQ+ parents in Florida found that many parents had considered or were actively undertaking changes to their own behavior (e.g., not disclosing their LGBTQ+ identity) and/or changes to their family context (e.g., changing their child's school, moving out the state) to cope with growing concerns about the safety of their families following the passage of HB 1557 (Goldberg, 2022).

Using a survey design, this study will build on previous research by examining whether LGBTQ+ individuals are similarly making adjustments to their plans for future parenthood (e.g., whether to become a parent, choice of family formation pathway, parenting contexts). We will also collect data from participants on personal (e.g., identity, religiosity, social support) and contextual (e.g., state of residence, urbanicity) characteristics to examine how these may be related to individuals' plans for future parenthood.

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 acceptances to their upbringings (Burand et al., accepted). 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 will examine how LGBTQ+ family socialization is associated with outcomes such as identity development, community connections, and queer political consciousness in emerging adults with LGBTQ+ parents.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Data Analytics; Political Science / International Studies

Specific title of research project

Text Analysis of Human Rights Documents

Faculty mentor supervising research

Name: Nick Dietrich

Department: Math/Computer Science (Data Analytics Program)

Campus phone: 740-368-3662

Email address: nmdietrich@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 15, 2023

Ending: July 25, 2023

Requested number of students

one __X__

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

- Experience with data collection and data analysis techniques
- Experience using software to manipulate, collect, and analyze data, especially R, Python, or an equivalent software package
- An interest in social science research, human rights, or international politics, broadly defined
- An interest in text analytics
- Familiarity with basic statistical concepts such as means/medians and linear regression

Description of the research project (one page maximum)

Text Analysis of Human Rights Documents
2023 Summer Science Research Program Project Proposal
Professor Nick Dietrich (Math/CS, Data Analytics)

This research project aims to convert reports on the human rights practices of governments into a source of data for comparing and analyzing global human rights practices. Organizations including Amnesty International, Human Rights Watch, and the United States Department of State produce yearly reports on the human rights practices of countries around the world. These documents contain rich qualitative detail about the extent to which governments respect or abuse human rights and the means by which those rights are violated. These reports are issued in a country-year format such that a particular report covers the practices of a single country in a single year; reports might describe abuses by the government including torture or mistreatment of prisoners, political imprisonment, or discrimination against a minority group within the country.

The student researcher and the principal investigator will use text analytic techniques to analyze patterns within and between human rights documents. In particular, this includes some or all of the following tasks:

- Gathering a corpus of human rights reports by compiling existing sources or using automated data collection techniques;
- Reformatting human rights texts to manipulate and analyze them using data software;
- Calculating sentiment scores of human rights documents;
- Comparing the sentiment scores of human rights documents;
- Developing automated techniques for identifying the occurrence or severity of particular human rights violations within a document;
- Analyzing the convergent validity of automated techniques with manually coded measures of human rights;
- Validating automated coding of human rights documents using crowdsourcing;
- Visualizing word frequency, word distinctiveness, and other quantities of interest across the corpus of human rights documents;
- Analyzing how content of human rights documents varies across time, across space, and with the occurrence of international events.

Using the data gathered from these reports, the student researcher and the principal investigator will investigate substantive questions about international human rights. Are human rights violations becoming more or less prevalent over time? Are particular kinds of rights violations more common today than in the past? Has the language in the source documents changed to reflect shifting societal norms? The student researcher may have interests that inform the substantive questions we address using data derived from the human rights texts.

During this project, the student researcher will develop their ability to apply text analytic techniques, formulate and conduct empirical research, and communicate about their findings through presentations and written documents. The student researcher should have familiarity with techniques for collecting and analyzing data, prior experience using software to manipulate data, and an interest in using data analytic techniques to address questions involving social behavior.

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Physics

Specific title of research project

Testing Spacetime Symmetries with Neutron Electric Dipole Moments

Faculty mentor supervising research

Name: Yunhua Ding

Department: Physics and Astronomy

Campus phone: 3774

Email address: yding@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 15

Ending: July 21

Requested number of students

one __X__

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Completion of General Physics (PHYS 110 and 111). Familiarity of Quantum Mechanics (PHYS 380) is preferred, but not required.

Description of the research project (one page maximum)

General Relativity (GR) and the Standard Model (SM) of the particle physics are the two most successful theories describing our nature so far. Among the important foundations of both theories, Lorentz and CPT symmetries play a crucial role. The former states that physical laws are unchanged when transforming between two inertial frames, while the latter is the symmetry of physical laws under the simultaneous transformations of charge conjugation (C), parity inversion (P), and time-reversal (T).

Although many of the predictions from GR and the SM have been testified by experiments, these two theories are not unified, and they are believed as low-energy limits of a more fundamental theory. Recent analysis indicates that tiny violations of Lorentz and CPT symmetries could appear theoretically as natural features of models unifying gravity with quantum physics. Such tiny deviations from these symmetries could produce interesting observable effects in precision experiments, such as the experiments searching for a nonzero Electric Dipole Moment (EDM) of a neutron.

This theoretical project is aimed to study interesting signals arising from Lorentz and CPT violation in experiments searching for nonzero neutron EDMs. By exploring both theoretical and experimental prospects for Lorentz and CPT violation related to the spin motion of neutrons, we aim to derive Lorentz- and CPT-violating contributions to the spin motion to provide additional insights to the fundamental theory unifying gravity with quantum physics.

In this project, the student will

1. Learn the general framework, which is called the Standard-Model Extension, of studying Lorentz and CPT violation and use it to derive corrections to energy levels of an ultracold neutron.
2. Derive the Lorentz- and CPT-violating contributions to the neutron spin precession frequency.
3. Review the relationship between the spin precession frequency and the EDM of a neutron in the absence of Lorentz and CPT violation.
4. Apply published results for the neutron EDM measurements to constrain the size of Lorentz- and CPT-violating effects.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line “Proposal for *faculty name*”

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)
ecology, freshwater biology, environmental science

Specific title of research project

The effects of salinization from road salt on freshwater communities

Faculty mentor supervising research

Name: __Amy Downing

Department: _Biology

Campus phone: __3890

Email address: __aldownin@owu.edu

Anticipated research dates (10 weeks):

Beginning: _May 15

Ending: __July 21

Requested number of students

one _____

two __X

Minimum qualifications of student researcher (be as specific as possible)
Willingness to work both in the lab and in the field. The outdoor field experiment will require that students are comfortable and willing to work outside in all weather and to be able to participate in some physical labor such as lifting and pouring buckets of water and collecting water samples from local freshwater ecosystems.

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

Introductory biology courses strongly preferred (BIOL 120/122).

Description of the research project (one page maximum)

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 been shown to have severe impacts on aquatic communities and food webs (Cañedo-Argüelles 2019). Specifically, higher chloride concentrations in freshwater ecosystems reduces the abundance and diversity of many freshwater invertebrates which disrupts food webs and leads to cascading effects within freshwater ecosystems (Hintz et al. 2022). Freshwater zooplankton are one particularly important group in freshwater food webs. Zooplankton are small, microscopic herbivores that feed on algae (phytoplankton) and are therefore important members of the food web that transfer nutrients and energy from lower to higher trophic levels.

The effects of freshwater salinization has been explored at many different scales ranging from single-species studies conducted in laboratory settings, to single-lake studies, to larger coordinated research experiments across multiple sites and countries. The results from these various experiments have revealed some interesting patterns. First, freshwater zooplankton communities can vary substantially in their response to freshwater salinization with some communities losing individuals and species at much lower concentrations of salt than others (Hintz et al. 2022). Second, some specific species or groups of zooplankton appear more resistant than others (Arnott et al. 2022, Hebert et al. 2022). For example, rotifers are more resistant to the effects of salt than cladocerans. Third, even within a single species, such as *Daphnia pulex*, substantial variation in salt concentration appears to exist between genotypes and between site (Hebert et al. 2022). These results have led scientists to try to identify and quantify the variation in the salt resistance in freshwater communities and to try to identify factors that explain why some zooplankton communities and species are more resistant than others.

In this particular study, we will focus on one factor that could contribute to the variation in resistance to salt among zooplankton communities: past salt exposure. Specifically, this study will test the hypothesis that prior exposure to higher concentrations of salt will increase the resistance to salt. The prediction is that communities that do have a history of high salt exposure will be more sensitive to loss of zooplankton diversity and abundance with increased salt exposure. We will test this hypothesis by conducting field experiments and continuing an ongoing survey of local freshwater ecosystems.

Survey: We will explore the differences in zooplankton communities (e.g. diversity, abundance, composition) between local freshwater communities that have different histories of salt exposures by continuing our survey work of local ponds.

Field experiment: We will use plankton communities identified from the pond survey that span a gradient of winter/peak salt concentrations that vary from almost no salt to medium and high levels of salt. We will maintain the plankton communities in experimental tanks at the Kraus Nature Preserve and expose them to the same salt gradient. We will quantify the response of each community to increased concentrations of salt.

1) Cañedo-Argüelles M, Kefford B, Shäfer R. 2019 Salt in freshwater; causes, effects and prospects - introduction to the theme issue. Phil. Trans. R. Soc. B 374: 20180002
2) Dugan HA, Bartlett SL, Burke SM, et al. 2017. Salting our freshwater lakes. P Natl Acad Sci USA 114: 4453–58.
3) Hintz WD and Relyea RA. 2019. A review of the species, community, and ecosystem impacts of road salt salinisation in fresh waters. Freshwater Biol 64: 1081–97.
4) Arnott, S. E.; Fugere, V.; Symons, C. C.; Melles, S. J.; Beisner, B. E.; Canedo-Arguelles, M.; Hebert, M. P.; Brentrup, J. A.; Downing, A. L.; Gray, D. K.; et al. 2022. Widespread variation in salt tolerance within freshwater zooplankton species reduces the predictability of community-level salt tolerance. *Limnology and Oceanography Letters*. DOI: 10.1002/lol2.10277.
5) Hintz, W. D.; Arnott, S. E.; Symons, C. C.; Greco, D. A.; McClymont, A.; Brentrup, J. A.; Canedo-Arguelles, M.; Derry, A. M.; Downing, A. L.; Gray, D. K.; et al. 2022. Current water quality guidelines across North America and Europe do not protect lakes from salinization. *Proceedings of the National Academy of Sciences of the United States of America*, *119* (9). DOI: 10.1073/pnas.2115033119.
6) Hebert, M. P.; Symons, C. C.; Canedo-Arguelles, M.; Arnott, S. E.; Derry, A. M.; Fugere, V.; Hintz, W. D.; Melles, S. J.; Astorg, L.; Baker, H. K.; J.A. Brentrup, J.A.; Downing, A.L., et al. 2022. Lake salinization drives consistent losses of zooplankton abundance and diversity across coordinated mesocosm experiments. *Limnology and Oceanography Letters*. DOI: 10.1002/lol2.10239.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)
Organismal Biology (physiology, behavior, ecology)

Specific title of research project
Invasion Biology and Urban Ecology of Wall Lizards in Ohio

Faculty mentor supervising research

Name: _Eric Gangloff_____

Department: __Biological Sciences_____

Campus phone: __740-368-9892_____

Email address: ____ejgangloff@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: ___15 May_____

Ending: _____14 July_____

Requested number of students

one __X___

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.
N/A

Minimum qualifications of student researcher (be as specific as possible)
Students should have the following qualifications:

(1) Experience with handling live animals (or willingness to learn);
(2) Experience with meticulous record keeping and/or data collection;
(3) Students with interest in evolutionary biology and/or physiology preferred;
(4) Ability to work flexible hours under sometimes uncomfortable conditions (long field days);
(5) Comfort traveling for 2-3 days at a time to Cincinnati

Description of the research project (one page maximum)

This student researcher will be part of a team (3-4 students) working on the National Science Foundation funded project "BRC-BIO: Success in the Anthropocene: Evolutionary Ecology of the Common Wall Lizard in Ohio". Here is a summary of the project:

Human-induced changes to our planet's climates and ecosystems have presented challenges to many organisms, yet some species are apparently thriving in these new environments. One example is the Common Wall Lizard, a small, active lizard species native to Europe but recently established in the United Kingdom, Canada, and the US. This research program seeks to identify the reasons that this species has flourished in Cincinnati, Ohio, since the introduction of just ten animals in the 1950s. These lizards present a unique opportunity to uncover how a species can thrive in novel urban environments on a new continent after an introduction of so few animals. Specifically, this research will leverage **field observations** and **lab experiments** to describe responses to new climates and changes to the physical habitat structure, including measures of **behavior**, **physiology**, and **body dimensions**. Additionally, the research will employ new advances to identify genes related to these specific traits and how these traits have helped lizards expand across the landscape since their introduction. This information can then be leveraged in management efforts to prevent the spread of potentially harmful invasive species or to understand how organisms we want to protect may respond to changes in their environment.

The work we will conduct looks like this: We will conduct standardized surveys at established sites in multiple visits to Cincinnati throughout the summer. We will hand capture each lizard (using the well-established and safe lasso method), collect a variety of data in the field (body temperature, body dimensions, etc.), and mark lizards with a permanent mark. We will collect small blood samples and process them in the field. Additionally, we will collect data using a thermal imaging camera and remote data loggers. Depending on student interest, lizards will be returned to lab to conduct experiments related to thermal biology, physiology, reproduction, and performance (sprinting, climbing). While the general infrastructure and framework is established for these studies, the specifics of the work will be determined by student interest. Students will also assist with care of captive animals.

Please see more about the lab's research here:
https://glare-owu.wixsite.com/glare

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)
Math, Physics, and possibly a little bit of Psychology

Specific title of research project
Traffic modeling: how individual driving decisions affect the overall traffic flow

Faculty mentor supervising research

Name: __Han Guo_____

Department: _____Math and CS_____

Campus phone: ___3664_____

Email address: ____hguo@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: ____May 15, 2023_____

Ending: _____July 21, 2023_____

Requested number of students

one __X___

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.
N/A

Minimum qualifications of student researcher (be as specific as possible)
The successful candidate should

1. have taken Math 111 (calc II) and possess equivalent knowledge of CS110 (basic knowledge for programming);
2. not be afraid of programming;
3. be curious about the traffic jams;
4. be hardworking and embrace challenges.

Description of the research project (one page maximum)

People drive. People drive to save time. People make poor decisions while driving thinking they can save time. However, too many people driving and/or making poor decisions causes traffic jams and everyone lose time as a result. Besides the unfavorable time consumption, traffic jams also lead to many car accidents and sever air pollution that impose danger to human health and safety.

The traffic jam problem is a complex system problem in which everyone's driving decisions affect the overall traffic flow. In this project, we aim to explore the connections between individual's driving decisions and the overall traffic flow rate. It is our hope that by understanding the connections, the drivers would make informed decisions for their own and the public's benefit.

We will model the traffic flow mathematically and write computer programs to run simulations. We will simulate each car and study how individual driver's behaviors affect the overall traffic flows. Some intuitive factors to consider are car-to-car distance, reaction time for both the driver and car, as well as acceleration. We will start from single-lane dynamics and then expand to multi-lane dynamics, in which case the intriguing lane-changing decisions become a huge factor.

We may be able to access empirical data from online database to test/improve our model. We may also use online polls to garner public's driving habits.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Cellular and developmental genetics

Specific title of research project

Characterization *C. elegans* spindle mutants and novel nematodes

Faculty mentor supervising research

Name: _____Danielle Hamill_____

Department: ____Biological Sciences_____

Campus phone: _____x3888_____

Email address: ____drhamill@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: _____May 16_____

Ending: _____July 21_____

Requested number of students

one __X__

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Students should have completed at least one upper-level BIOL course with preference given to students who have taken genetics, developmental biology, or another molecular-focused course with a lab. Students must be comfortable looking in microscopes.

Description of the research project (one page maximum)

The Hamill lab uses nematodes to study questions related to cell and developmental biology. A student in the lab this summer will contribute to one or both of the following projects.

Project 1: Characterization of *sas-7* null mutants in *C. elegans*. Recently we described the isolation, identification, and characterization of a temperature-sensitive *sas-7* mutation in *C. elegans*. Briefly, homozygous mutant worms shifted to the restrictive temperature as larvae produce embryos, but they fail to form bipolar mitotic spindles leading to embryonic lethality. While the embryonic phenotype was interesting, it does not represent the complete loss-of-function phenotype for *sas-7*. To get at this, we used CRISPR to generate putative null alleles. Our preliminary results show that these worms are sub-fertile and have structural differences in the adults of both sexes. Students will use microscopy and genetic crosses to further characterize the null mutant phenotype.

Project 2: Characterization of novel nematodes. *C. elegans* is a model organism that is widely studied, but we are also interested in comparative studies between related nematode species. We have been studying strains we isolated that we believe have not been previously described. This project will continue this analysis. Specifically, we will do marked mating experiments to see if males of one type can fertilize and produce fertile offspring when mated with hermaphrodites of another type. We will also use time-lapse video microscopy to characterize the rate and patterns of early development. In addition, we will be collecting information on brood sizes and lifespan. We also will measure adult worms for comparison to each other and to published species. For molecular comparisons, we will extract DNA and amplify and sequence conserved genes. The suitability of using CRISPR genome editing in these worms will also be explored. The ultimate goals of this work will be to establish if any of these are new species and to describe the ways they are both similar to and different from each other and from *C. elegans.*

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line “Proposal for *faculty name*”

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Behavioral Ecology

Specific title of research project

Male mating preferences for familiar and unfamiliar females in the sailfin molly fish, *Poecilia latipinna*

Faculty mentor supervising research

Name: Shala Hankison

Department: Biological Sciencs

Campus phone: x3869

Email address: sjhankis@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 15

Ending: July 21

Requested number of students

one X

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Ability to work independently is a must. Completion of Animal Behavior (BIOL 347) is preferred, but not required. Project includes both behavioral observations and some bench work, so a student interest in both areas is critical. Student will also be involved in animal care (cleaning, feeding, etc), including some weekend work. As animal care is required, reliability is critical.

Description of the research project (one page maximum)

Most studies of mating preferences focus on females, as they are often under selection to be the choosier sex. Male mating preferences may also be an important target of selection, however, as males should still make mating choices that maximize their lifetime fitness (Edward & Chapman 2011). In the sailfin molly, *Poecilia latipinna*, males have shown mating preferences (Witte & Ryan 2002) and also differences in sperm priming and availability (Aspbury & Gabor 2004).

This project seeks to further understand male mating behaviors in *P. latipinna* as part of a larger understanding of how mating behaviors have shaped evolution in the mollies. Specially, I am interested here in the strength of male mating preferences and whether and how this impacts mating success.

In this project, I propose to continue studies that have begun in my lab on male preferences for familiar and unfamiliar females in *P. latipinna* and to investigate sperm priming and availability relative to female familiarity. This work will involve behavioral observations of male mating preferences through mate-preference tests and learning to extract and count sperm, a new technique for my lab.

Aspbury, A. S., & Gabor, C. R. (2004). Differential sperm priming by male sailfin mollies (Poecilia latipinna): effects of female and male size. *Ethology*, *110*(3), 193-202.

Edward, D. A., & Chapman, T. (2011). The evolution and significance of male mate choice. *Trends in Ecology & Evolution*, *26*(12), 647-654.

Witte, K., & Ryan, M. J. (2002). Mate choice copying in the sailfin molly, Poecilia latipinna, in the wild. *Animal Behaviour*, *63*(5), 943-949.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line “Proposal for *faculty name*”

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Astrophysics

Specific title of research project

Imaging Starspots via Light-curve Inversion

Faculty mentor supervising research

Name: Robert Harmon

Department: Physics and Astronomy

Campus phone: 3778

Email address: roharmon@owu.edu

Anticipated research dates (8 weeks):

Beginning: May 29

Ending: July 21

Requested number of students

one _____

two __X__

Because I will be leading a Travel-Learning course after Commencement, my project will start on May 29 and last 8 weeks. This will suffice to accomplish the project goals.

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

Completion of PHYS 111 L.

Description of the research project (one page maximum)

Even as imaged by the Hubble Space Telescope, stars appear to be featureless pinpoints. As a result, it is necessary to use indirect techniques in order to obtain information about their surface features. This project uses a particular technique for doing that called Light-curve Inversion (LI).

Of particular interest are “starspots,” which are analogous to sunspots on the Sun, and are known to be present on certain classes of stars. Like sunspots, starspots are believed to be manifestations of stellar magnetic fields. The study of starspots can thus provide valuable insights into the physics of the magnetic dynamos operating in the Sun and other stars.

If there is a dark spot on the surface, then every time the star’s rotation carries the spot into view from Earth, there will be a dip in the star’s brightness. If we knew in detail the appearance of the star’s surface, a relatively straightforward calculation would allow us to predict the star’s brightness as a function of time, i.e., its light curve. With LI we attempt to go in the other direction: knowing the light curve, determine the appearance of the star’s surface. This is not a simple matter, because the problem is ill-posed, in that very different surfaces can give rise to nearly identical light curves. This arises because the effects of a large number of small bright and dark patches on the surface would nearly but not completely cancel, such that their presence would impart a low-amplitude, high-frequency “ripple” on the light curve as the star rotates. This ripple would look very similar to random noise, with the result that a straightforward attempt to find the surface that best replicates the observed light curve will produce a surface peppered with spurious bright and dark spots that are merely noise artifacts. LI circumvents this problem by constraining the solution so as to favor surfaces which are “smooth” and thus free of noise artifacts in a well-defined sense.

The student or students who work on this project will most likely apply LI to a particular star, LO Pegasi, that is particularly well-suited for a summer research project: It is well-placed for observation in June and July, and it has a short 10.153-hour rotation period, making it relatively easy to gather enough data for analysis of its starspots. Images of a star field surrounding LO Pegasi will be obtained using a QSI
632 CCD camera and V, R and I photometric filters at OWU’s Perkins Observatory. Standard reductions (dark subtraction and flat fielding) will be performed on the images in order to reduce random noise and systematic errors. Then differential aperture photometry will be used to obtain the light curve (plot of intensity vs. time) of LO Pegasi as seen through each filter. Using multiple filters significantly improves the latitude resolution of the technique by taking advantage of the wavelength dependence of the limb darkening (center-to-edge dimming) of the stellar surface. The light curve data will then be analyzed via LI to produce maps of the stellar surface. This summer’s data will also be compared to data obtained from 2014-2022.

There is also the possibility that we will apply LI to archival data acquired at other facilities.

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Evolution--data analytics

Specific title of research project

Analysis of nuclear genome data from tropical forest trees

Faculty mentor supervising research

Name: David Johnson

Department: Biological Sciences

Campus phone: 740-368-3505

Email address: dmjohnso@owu.edu

Anticipated research dates (10 weeks):

Beginning: 22 May 2023

Ending: 4 August 2023

Requested number of students

one __X__

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Minimum: One semester of introductory biology
One semester of computer science, experience with R
Handling/processing herbarium specimens

Preferred: BIOL 271, coursework in calculus

Description of the research project (one page maximum)

Using the plant family Annonaceae as a model system, we are studying the origin and evolution of tropical forests to interpret current diversity patterns and aid forest conservation efforts. Our lab has been working with an international consortium* of scientists. A team member came to campus in August of 2022 to collect samples for nuclear genome sequencing at the laboratory center for the project in Montpellier, France. Sequencing will be complete in March and we will analyze these data to reconstuct the evolutionary history of our pantropical study group, including the time frame of dispersal from the African to the American and Asian tropics.

The student researcher will consult with the Montpellier team via Zoom for training and as needed to learn the protocols for analyzing the dataset using several software packages--IQtree http://www.iqtree.org/, RAxML https://academic.oup.com/bioinformatics/article/30/9/1312/238053, and Astral, https://academic.oup.com/bioinformatics/article/30/17/i541/200803. A former student, Dr. Greg Stull, has also offered to assist with the analysis.

A previous project, based on a smaller dataset and older methods, led to a peer-reviewed publication with three OWU students, doi 10.1600/036364417X695484. The proposed project will address questions raised by the results of that project as well as contribute to the larger questions of tropical forest diversity addressed by the consortium.

*European Research Council (ERC) Global project:
"Tropical rain forests (TRF) are the most species rich yet highly threatened ecosystems on Earth. They play pivotal roles as global climate regulators and for human wellbeing. Their long term conservation is central for global climate mitigation and biodiversity conservation. Elucidating the evolutionary processes that underpin this immense diversity is critical for improved conservation actions. What evolutionary processes determine TRF diversity? How will human-induced species losses impact the evolutionary history of TRF? Time calibrated phylogenies retain the fingerprint of these patterns and are fundamental prerequisites to maximize the conservation of evolutionary history. These data will then be integrated using innovative statistical macroevolutionary comparative approaches to answer the above questions at never achieved levels of precision. GLOBAL will provide improved predictions of TRF evolution informing conservation policies, and set the new standard for next generation evolutionary studies of TRF evolution applicable to other key tropical groups."
(http://www.couvreurlab.org/erc-global.html)

Submit the research proposal
Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line “Proposal for *faculty name*”

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research: *Applied and computational math*

Specific title of research project: *Investigating thermal convection in an enclosed porous medium*

Faculty mentor supervising research

Name: *Matthew McCurdy*

Department: *Math & Computer Science*

Campus phone: *740-368-3657 (but I have never used the phone in my office...)*

Email address: *mtmccurdy@owu.edu*

Anticipated research dates (10 weeks):

Beginning: *Flexible (would like to discuss with student)*

Ending: *Flexible (would like to discuss with student)*

Requested number of students

one _____

two ☑

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

Successfully have completed MATH 280, have some experience coding (preferably with one or more CSC courses).

Description of the research project (one page maximum)

The phenomenon of convection is found in a wide variety of settings on different scales—from applications in cooling technology of laptops to heating water on a stove, and from the movement of ocean currents to describing astrophysical events with the convective zones of stars. Given its importance in these diverse areas, the process of convection has been the focus of many research students over the past two centuries. However, much less research has been conducted on how the presence of an obstruction in the flow can impact convection. My work with previous students investigated convection in a fluid, and in this project, we will follow similar arguments to investigate convection in a (fluid-saturated) porous medium and explore how introducing an obstruction impacts heat transfer.

Throughout this 10-week research project, students will explore how fluids and heat interact from an analytical perspective (setting up and solving equations) as well as from a computational perspective (conducting numerical simulations). They will begin with setting up a system of equations to describe fluid flow along with another set of equations governing heat transfer. After solving these analytically under simplified assumptions, we will move to developing numerical methods to computationally simulate heat transfer in fluid flow. Both of these tasks are relatively advanced for undergraduates and, as such, students will (hopefully) be teaming up with another student to tackle this project. Students should have experience with higher-level mathematics and some sort of computer science coursework. Towards the end of the summer, we will work on technical writing and presentation skills so that students can present their work in the next school year with a conference talk and/or an undergraduate journal article.

While students should have a good base of knowledge for this project, they will inevitably further those skills while developing new ones. After this project, students should be able to: collect/analyze large sets of data, visualize and effectively convey what those results are, and have a better understanding of advanced topics in mathematics. Other academic/technical skills that should benefit from this experience are related to coding and using ideas from coursework to address real-world applications. This research project will provide a valuable experience with giving students an idea of what math research is, allowing them to see what graduate school for mathematics can look like, and help students decide if this is a path they wish to pursue in their future. If they do choose to pursue graduate school, having undergraduate research experience will bolster their (already great!) application and should allow them to have their choice of programs.

There is also the *potential* for students to travel to Amherst College or the University of Chicago with me over the summer to serve as a TA in a seven-week math class for Thrive Scholar's Summer Academy. Thrive Scholars is a non-profit aimed at helping high-achieving, low-income underrepresented students get into and graduate from top colleges to achieve their full career potential. Food, lodging, and an additional stipend would be provided. (Traditionally, travel costs have been reimbursed as well, but is not guaranteed.)

LINKS:
*Previous work with students:
https://www.siam.org/Portals/0/Publications/SIURO/Vol15/S145453.pdf?ver=2022-03-30-111034-623

*Thrive Scholars:
https://www.thrivescholars.org/

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Environmental Science

Specific title of research project

Using multispectral remote sensing for high-resolution environmental mapping in costal Costa Rica.

Faculty mentor supervising research

Name: Nathan Rowley

Department: Environment and Sustainability

Campus phone: 740-368-3619

Email address: nrowley@owu.edu

Anticipated research dates (10 weeks):

Beginning: 05 JUNE_____

Ending: 11 AUGUST_____

Requested number of students

one _X____

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Understanding and comfort with flying unoccupied aerial vehicles (UAVs, or drones)
Experience with GIS – typically through GEOG 112, GEOG 191/192, or GEOG 369

Description of the research project (one page maximum)

Since the beginning of the 21st Century, there has been rapid, and significant change in the remote sensing of the global environment. Remote Sensing is the ability to understand a surface (e.g., water, forest, urban area, different planetary bodies) without direct contact; unlike weather stations that provide data about our atmosphere while being ***in*** the atmosphere. The sensors associate with remotely sensed data mainly rely on freely-available satellite imagery and, more recently, the professional use of UAVs, or unoccupied aerial vehicles.

To date, this research project has captured and analyzed data in the visible portion of the electromagnetic (EM) spectrum, that is, in red (0.70 μm), green (0.55 μm), and blue (0.48 μm) wavelengths. This has allowed us to generate two-dimensional orthomosaics and high-resolution digital surface models (DSMs). In the past year, the Remote Sensing Lab, has acquired two additional sensors that will allow us to expand on this work, through the Micasense Dual RedEdge cameras and the Zenmuse L1 LiDAR sensor.

The Dual RedEdge camera has a total of 10 bands in which it captures data and has been designed to distinguish between various plant species. The Zenmuse L1 LiDAR sensor will allow us to generate a 3-D view of a forest, and with this information, generate an estimate of carbon being stored.

We will work to develop a methodology in the Delaware, OH region and refine this work to collect the environmental data in Bahia Ballena, a small, costal Costa Rica town. Specifically, we will map the land portions of the Marino Ballena National Park (with permission) and its adjacent areas of interest.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)
Physics

Specific title of research project
Coupled Nonlinear Systems: The Physics of Josephson Junction Arrays

Faculty mentor supervising research

Name: Brad Trees

Department: Physics and Astronomy

Campus phone: 3779

Email address: brtrees@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 22, 2023

Ending: July 28, 2023

Requested number of students

one X

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

Two years of physics and math: Physics courses: 110, 111, 280. Math courses: 110, 111, 210, 280.
One upper-level physics theory course preferred.

Description of the research project (one page maximum)

This project studies the effect of coupling two or more current-biased Josephson junctions (JJs), which are superconducting tunnel junctions, by means of linear or nonlinear circuit elements, *e.g.* a nanomechanical oscillator or another JJ, respectively. The focus is on two particular aspects of this coupling: the effect on synchronization of the voltage across the JJs, and the effect on tunneling and decoherence rates of each JJ when biased so as to operate as so-called phase qubits. *Classical and Quantum Synchronization:* Systems of limit-cycle oscillators show a wealth of interesting behaviors. For example, synchronization due to coupling of the oscillators has been experimentally observed in many systems in many scientific disciplines such as physics, chemistry, and biology. On theoretical grounds, the Kuramoto model, describing the dynamics of N globally-coupled oscillators of phase ϕ_i, angular velocity ω_i, and coupling strength K, $d\phi_i / dt = \omega_i + (K/N)\sum_{j=1}^{N}\sin(\phi_j - \phi_i)$, has provided important insight into the nature of a synchronization transition itself. JJ arrays, which have been theoretically linked to the Kuramoto model in certain geometries, are perhaps the quintessential nonlinear system for studying the causes and stability of synchronous behavior. Well-controlled, modern fabrication techniques allow the design of JJ arrays with precise geometries and junction parameters. The result is an exquisitely controlled "test bed" for the study of complex dynamical systems. This computational project involves the simulation of JJs coupled both to each other as well as to external loads that could result in synchronous time-dependent behavior of the junction voltages. For example, one goal is to determine if coupling a nanomechanical oscillator to a JJ array can result in stable synchronization of the junctions in the array. Such coupled nanomechanical-oscillator and JJ systems are currently of interest because of their potential use as quantum bits and because of the expanding expertise in fabricating high-Q mechanical oscillators on the microscopic scale. This project is highly suitable to undergraduates because the model for a current-biased JJ is analogous to that of a damped, driven, nonlinear pendulum, and the JJ can be treated in either a classical or quantum limit, depending on its size and other physical characteristics. For junctions in the classical limit, the pendulum analogy allows students to build up physical intuition about the behavior of single junctions. They can then focus on learning new physics based on how multiple junctions behave when coupled. Students with a stronger physics and mathematics background can study the synchronization of JJs in the quantum limit by learning about numerical techniques for solving the Schrödinger equation for an open system. Such a more challenging project is of considerable interest, since the phenomenon of quantum synchronization is still not well understood. The project involves a combination of analytical work and computation (Mathematica and Python, or Fortran).

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"

Summer Science Research Program
Ohio Wesleyan University

2023 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 26 January 2023

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)

Neuroscience, Psychology

Specific title of research project

Determining the effects of juvenile stress on adult mice

Faculty mentor supervising research

Name: _Chelsea Vadnie_____

Department: _Psychology/Neuroscience Program_____

Campus phone: ___3811_____

Email address: __cavadnie@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: ___05/15/2023_____

Ending: _____07/21/2023_____

Requested number of students

one __X___

two _____

If requesting two students: Please indicate the rationale for requesting two students, including willingness to work with just one student if that is all that can be placed in your project.

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

- Interest in neuroscience research using animal models
- Experience using a pipette
- Detail-oriented and reliable
- Strongly recommended to have completed Introduction to Neuroscience (NEUR 250) and preferably Genetics (BIOL 271)

Description of the research project (one page maximum)

Mood and anxiety disorders are highly prevalent, especially amongst young adults, and are a leading cause of disability. It is well established that stress and circadian rhythm disturbances are risk factors for mood and/or anxiety disorders. There is evidence from animal models to support that both stress and circadian rhythm disruptions can cause behaviors relevant to psychiatric disorders. However, there are many remaining questions about the underlying neurobiological mechanisms. It is our hope that elucidating these mechanisms through studying animal models will lead to effective preventions and better treatments for psychiatric disorders. The Vadnie lab is centered on further investigating the role of stress and circadian rhythm disruptions in behaviors relevant to psychiatric disorders by using mouse models.

The project this summer will be focused on continuing a study that is centered on determining the effects of juvenile stress on adult mice. In humans, childhood trauma is known to increase risk for later mental illness (McKay et al. 2021; Heim & Nemeroff, 2001). Similarly in rodents, juvenile stress has been shown to alter behaviors relevant to psychiatric disorders, such as producing more avoidance or anxiety-like behavior (Albrecht et al. 2017). Rat juvenile stress models have been more prevalent despite the abundance of neuroscience tools available for mouse models (Brydges et al. 2012; Jacobson-Pick & Richter-Levin, 2010). The types of stressors and age ranges over which the stressors were applied in rodents have varied. Thus, we sought to replicate previous behavioral findings on the effects of juvenile stress in the most commonly used inbred mouse line, C57BL/6J mice. Mice experienced 3 days of stressors early in life (postnatal days 25-27) or were left undisturbed. Behavior testing was carried out when mice reached adulthood at postnatal day 60. Our results, thus far, indicate that juvenile stress increases anxiety-like behavior of mice in the open field when they are tested in adulthood. The next step with this project is to investigate the effects of 3 days of juvenile stress on the brain to begin to understand why this paradigm has long-lasting effects on anxiety-like behavior.

The student selected for the SSRP position would work on determining the effects of juvenile stress on gene expression in brain regions that have been implicated in anxiety disorders and the effects of stress. The student would isolate specific brain regions in adult mice from previously acquired tissue and would extract RNA. The RNA would be used for quantitative real-time PCR. Previous work suggests that juvenile stress may result in changes in the expression of GABAergic genes in limbic areas (Albrecht et al. 2017). We will focus on investigating how our juvenile stress model may affect the inhibitory/excitatory balance of the adult mouse brain through altering the expression of GABAergic and other genes.

References

Albrecht, A., Müller, I., Ardi, Z., Çalışkan, G., Gruber, D., Ivens, S., Segal, M., Behr, J., Heinemann, U., Stork, O. & Richter-Levin, G. (2017). Neurobiological consequences of juvenile stress: a GABAergic perspective on risk and resilience. *Neuroscience & Biobehavioral Reviews*, *74*, 21-43.

Brydges, N.M., Hall, L., Nicolson, R., Holmes, M.C., & Hall, J. (2012) The effects of juvenile stress on anxiety, cognitive bias and decision making in adulthood: a rat model. *PLoS One 7*, e48143.

Heim, C., & Nemeroff, C. B. (2001). The role of childhood trauma in the neurobiology of mood and anxiety disorders: preclinical and clinical studies. *Biological psychiatry*, *49*(12), 1023-1039.

Jacobson-Pick, S., Richter-Levin, G. (2010). Differential impact of juvenile stress and corticosterone in juvenility and in adulthood in male and female rats. *Behav. Brain. Res. 214*, 268-276.

McKay, M. T., Cannon, M., Chambers, D., Conroy, R. M., Coughlan, H., Dodd, P., Healy, C., O'Donnell, L., & Clarke, M. C. (2021). Childhood trauma and adult mental disorder: A systematic review and meta-analysis of longitudinal cohort studies. *Acta Psychiatrica Scandinavica*, *143*(3), 189-205.

Submit the research proposal

Please save as a **pdf** and email completed form to ssrp@owu.edu as an attachment (pdf file) with the subject line "Proposal for *faculty name*"