Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

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

Data Analytics; International Relations (Interdisciplinary)

Specific title of research project

Public Opinion in International Disputes: A Survey Experiment

Faculty mentor supervising research

Name: Nick Dietrich

Department: Data Analytics (in Math/CS)

Campus phone: 740-368-3662

Email address: nmdietrich@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 9, 2022

Ending: July 15, 2022

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 analysis software, especially R
- Understanding of research design and experiments
- An interest in social science research, survey data, public opinion, or international politics, broadly defined
- Familiarity with basic statistical concepts such as means/medians and linear regression

Description of the research project (one page maximum)

See attached sheet.

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*”

Public Opinion in International Disputes: A Survey Experiment

2022 Summer Science Research Project Proposal

Nick Dietrich

This research project will design and implement a survey experiment to assess how people decide to support or oppose hostile international action. What drives public opinion about escalating situations like trade disputes, military standoffs, and hostile rhetoric? Do people base their support/opposition on the potential costs, their pre-conceived opinions of the target country, or something else? This is a consequential question because leaders often consider public opinion when deciding whether to pursue policies that would escalate international disputes.

The student researcher and faculty mentor will work together to review relevant literature, decide which determinants of public opinion to test, design an original survey experiment to test those determinants, and field the experiment. We will then use statistical software to analyze the results of the experiment and create visualizations of our findings. The student researcher will get hands-on experience conducting a research project from start to finish, including designing the experiment to answer relevant questions and presenting analysis in a style suitable for publication in a scientific journal.

We will field the survey experiment on Amazon's Mechanical Turk or a similar online platform. We will use the funds budgeted for research supplies to recruit participants. Conditional on acceptable performance, the student researcher will be listed as an author when submitting the manuscript for publication. The student researcher should have some prior experience working with data, preferably in R or a similar software, and an interest in social science research (broadly defined).

Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)
Submission Deadline: 13 January 2022

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

ecology, freshwater biology, environmental science

Specific title of research project

Variation in tolerance to chloride (NaCl) in a freshwater invertebrate, *Daphnia pulex*

Faculty mentor supervising research

Name: ___Amy Downing_____

Department: ___Biology_____

Campus phone: __3890_____

Email address: __aldownin@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: __5/9___

Ending: ____7/19_____

Requested number of students

one _x__

two _x__

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

Willingness to work both in the lab which will be majority of the time but also in the field collecting water samples from local freshwater ecosystems.

Attention to detail.

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

Description of the research project (one page maximum) **Background:**

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 and Arnott et al. In press.)

One well-studied freshwater invertebrate species that is known to be sensitive to chloride is *Daphnia pulex. Daphnia* are important members of freshwater zooplankton (i.e. microscopic invertebrates) because they are herbivores that provide an important link between algae/phytoplankton and the rest of the food web. *Daphnia* are often used as test organisms in ecotoxicology tests because they can be maintained in lab cultures and serve as indicators for how other species of zooplankton might respond to a toxin. While biologists know *Daphnia* are sensitive to chloride, biologists have very little understanding of how much variation in chloride tolerance exists between different populations of *Daphnia*. It is believed that natural populations of zooplankton may be able to genetically adapt to tolerate increasing salinity and that variation in Cl^- sensitivity may vary with environmental context such as food quality and quantity or ion composition of freshwater ecosystems. However, very few studies have looked systematically at the degree and causes of intraspecific variation in chloride tolerance within single species of zooplankton.

Methods:

For this project we will be collaborating with a broader research group of freshwater biologists from the USA, Canada and Europe to conduct coordinated experiments on intraspecific variation in chloride tolerance in *Daphnia* (Hintz and Arnott et al. In press). Individual research groups, including our group at OWU, will conduct the same experiments using standardized protocols across. This will allow us to collectively sample of *Daphnia* populations across a broad geographic range that have been exposed to different environmental backgrounds and historical and current concentrations of chloride. Each research group will collect local populations of *Daphnia* from local freshwater ecosystems and create cultures of these species to be maintained under laboratory conditions. Because *Daphnia* can reproduce asexually in the lab, cultures of genetically identical individuals can be raised in the lab to be used to conduct LC50 experiments (**L**east **C**oncentration of chloride to cause **50**% mortality of Daphnia) in the lab. Our research group at OWU will identify local populations of *Daphnia* and create and maintain *Daphnia* cultures in the lab. Once we have established lab cultures we will run LC50 experiments at different concentrations of chloride on different local Daphnia populations to determine the concentration resulting in 50% mortality (LC50). Results will be pooled across research groups to explore the role of genetic variability, genetic adaptation, phenotypic plasticity and environmental context in determining *Daphnia* variation in tolerance to chloride.

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) Hintz, W. D.†, S. E. Arnott†, C. C. Symons, D. A. Greco, A. McClymont, J. A. Brentrup, M. Cañedo-Argüelles, A. M. Derry, **A. L. Downing,** D. K. Gray, S. J. Melles, R. A. Relyea, J. A. Rusak, C. L. Searle, L. Astorg, H. K. Baker, B. E. Beisner, K. L. Cottingham, Z. Ersoy, C. Espinosa, J. Franceschini, A. T. Giorgio, N. Göbeler, E. Hassal, M-P. Hébert, M. Huynh, S. Hylander, K. L. Jonasen, A. E. Kirkwood, S. Langenheder, O. Langvall, H. Laudon, L. Lind, M. Lundgren, L. Proia, M. S. Schuler, J. B. Shurin, C. F. Steiner, M. Striebel, S. Thibodeau, P. UrrutiaCordero, L. Vendrell-Puigmitja[2], G. A. Weyhenmeyer. In press. Current water quality guidelines across North America and Europe do not protect lakes from salinization. PNAS, Co-led†.

Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

General area of research (broad overall area such as genetics, biochemistry, environmental science, etc.)
Biology (Physiology and Thermal Biology of Ectotherms)

Specific title of research project
Understanding species response to climate change: A case study with lizards in the Pyrenees

Faculty mentor supervising research

Name: __Eric Gangloff_____

Department: __Biological Sciences_____

Campus phone: _740-368-3892_____

Email address: _ejgangloff@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: _1 June 2022_____

Ending: _5 August 2022_____

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;
(2) Comfort with traveling abroad in a place where English is not the primary language (some knowledge of French is helpful but not necessary);
(3) Experience with meticulous record keeping and/or data collection;
(4) Interest in spending long hours outdoors, including hiking in mountainous terrain;
(5) Students with interest in evolutionary biology and/or physiology preferred.

Description of the research project (one page maximum)

As a result of recent climate warming, the common wall lizard (*Podarcis muralis*), has expanded its range upward in elevation, notably in the Pyrenees Mountains of France. We don't yet know the mechanisms that allow (or prevent) this range expansion in most animals. This upward colonization might be good for this species, but it can create problems for other species through competition for shared resources.

In my previous work, we conducted experiments in controlled settings with wild-caught animals brought into captivity to understand how *P. muralis* might respond to living at high elevation. While the data from these lab experiments are important, without knowing how the animals behave in their natural environments it is difficult to predict their responses to future climates. Students on this project will work with me and a team of French collaborators (including Constant Perry, PhD student at the University of Toulouse) to conduct an important set of field observations to understand how these lizards respond to temperature variation in natural habitat across an elevational gradient and how they interact with the high-elevation specialist lizard *Iberolacerta bonnali*.

We will conduct intensive field sampling and observation of lizard populations at low, medium, and high elevation sites. We have identified these sites in our previous work and have the required equipment and resources to complete the observations. We will address the following biological questions:

- What are the minimum, maximum, and average activity temperatures of *P. muralis* in natural habitats?
- How do ambient temperature and humidity affect thermoregulatory behaviors (i.e., how precisely do they thermoregulate)?
- How are these behaviors affected by age class, sex, and reproductive status?
- How do these behaviors vary among lizards across an elevational gradient?
- How do interactions between *P. muralis* and *I. bonnali* affect the thermoregulation of each species?

We will conduct standardized surveys at established sites along an elevational gradient throughout the summer. We will hand capture each lizard (using the well-established and safe lasso method), collect morphometric data (body length, head dimensions, leg length, mass), and mark lizards with a permanent mark. We will collect data using a thermal imaging camera and remote data loggers. Simultaneously, we will record temperatures and humidity at each site using data loggers for the duration of the sampling period, thus allowing us to place the data on lizard activity and body temperature in the specific context of their experienced environmental temperature.

The combination of field observation and experimentation make the data obtained from this work unique in the field of thermal biology and highly informative for predicting species distributions under future climate scenarios. It thus represents a major and important contribution to these fields of biological research.

Students will spend the first week of the SSRP program in Delaware, conducting preliminary measures and preparing for the trip. We will then work in France from approximately 6 June to 2 August. Students will then return to complete the SSRP program, organize equipment, enter data, etc.

Students will NOT be expected to pay for transportation (i.e., flights) or lodging. We will work together to seek funding support for meals and other incidental expenses, but I cannot guarantee these costs will be covered.

This research project for students complements the research I will be conducting this summer with support from a TEW Grant and the Le Laboratoire d'Excellence (LabEx) TULIP in France.

Submit the research proposal

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Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

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 (10 weeks):

Beginning: May 9

Ending: July 15

Requested number of students

one _____

two __X___

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 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 B, 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 2014-2021.

Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

General area of research Computer Science

Specific title of research project

Artificial Intelligence of Modern Board Games

Faculty mentor supervising research

Name: Sean McCilloch

Department: Mathematics and Computer Science

Campus phone: 3663

Email address: stmccull@owu.edu

Anticipated research dates (10 weeks):

Beginning: May 16

Ending: July 22

Requested number of students

one XX

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)

Successful completion of CS210. Success in more advanced classes would also be desirable.

Description of the research project (one page maximum)

Much work has been done in the past on designing Artificial Intelligence (AI) programs to play "classic" board games, such as Chess, Checkers, Othello, and Go. Many of these games have programs that are sufficiently advanced that they beat the best human players (see, for example, Refs. [1-3]). In the last ten to twenty years, however, there has been a rise in "abstract" or "European-style" board games. These differ from the board games many of us have played as children (such as Monopoly or Life) in several areas: (1) the games are typically short, many finishing in 90 minutes or less; (2) the games usually emphasize player interaction in some way (components such as bidding, competing for scarce resources, or trading/negotiation are commonly seen); and (3) the games often are based around hidden information, so that nobody can know the whole state of the game. These factors, especially the last two, make designing an AI for these games a challenge, and so much less has been done analyzing these games, and what has been done has much room for improvement (some examples include Refs. [4, 5], while other game companies have been developing AI programs for sale, usually as mobile apps). I have personally created a game-theoretic agent to play the game Football Strategy [6], and past summer students have created an agent for the game Battle Line that is based on probability [7].

Previous summer students have also begun work on agents for the games Modern Art (a multiplayer auction game), Euro Rails (a game where players create rail lines and deliver goods), and Pandemic (a cooperative game where players work together to cure diseases before it outbreaks across the world). This summer's SSRP student can either extend the work in these programs, refine the Football Strategy or Battle Line programs, or begin work on an entirely new game.

References

[1] M. Campbell, A.J. Hoane Jr., F. Hsu, Artificial Intelligence **134**, 57 (2002).

[2] J. Schaffer, J. Culberson, N. Treleoar, B. Knight, P. Lu, D. Szafron, Artificial Intelligence **53**, 273 (1992).

[3] M. Buro, Artificial Intelligence **134**, 85 (2002).

[4] C. Heyden, Master's Thesis, 2009. [http://www.personnel.unimaas.nl/uiterwijk/Theses/MSc/Heyden_thesis.pdf].

[5] F. Schadd, Master's Thesis, 2009. [http://www.unimaas.nl/games/files/msc/fschadd_thesis.pdf].

[6] S. McCulloch, *A Game-Theoretic Intelligent Agent for the Board Game Football Strategy*, MAICS 2015, p. 121-125.

[7] S. McCulloch, D. Bladow, T. Dobrow, H. Wright. *Deep Barca: A Probabilistic Agent to Play the Game Battle Line*, MAICS 2017, pp, 145-150

Submit the research proposal

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Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

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

Organic, Inorganic and Organometallic Chemistry

Specific title of research project

Investigation of Dipyrrin Complexes for Small Molecule Activation

Faculty mentor supervising research

Name: _____Allen Pistner_____

Department: _____Chemistry_____

Campus phone: _____x3519_____

Email address: _____

Anticipated research dates (10 weeks):

Beginning: _____5/9/22_____

Ending: _____7/15/22_____

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.

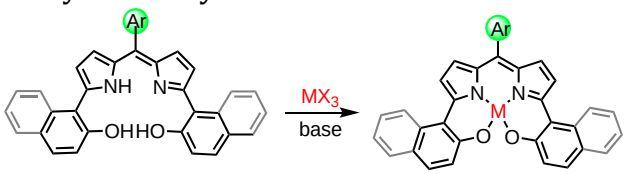
Minimum qualifications of student researcher (be as specific as possible)

CHEM 110, 111, 260, and 261 (or currently enrolled in CHEM 261 Spring 2021)

Description of the research project (one page maximum)

Ligand scaffolds that possess the ability to participate in redox activity have recently been an active area of research. The intriguing ability of these systems to act as an electron reservoir allows for the development of new catalysts even when coordinating to redox-inactive metals.[i-iii] This has led to the increase in design of complexes containing earth-abundant metals capable of performing transitions that were previously reserved for expensive rare-earth metals.[iv-vi]

This project will continue to build on the development of a bis(phenolate)dipyrrin ligand scaffolds. This will allow for the redox activity to be tuned, affording the ability to influence the reactivity. These redox active complexes will be synthesized using the following route (Scheme 1),[vii] while varying the electronic character of the aryl substituents. Students working over the summer will focus on synthesizing metal complexes and characterizing them through NMR, uv-vis spectroscopy, electrochemistry, etc. along with evaluating their catalytic activity.



Scheme 1. Synthesis of dipyrrin complexes.

The multi-electron redox activity of the dipyrrin ligand scaffold provides the opportunity for catalysis for transformations requires more than two electrons typically provided by the change in the oxidation state of the central metal. The ability of the ligand scaffold to act an as electron reservoir provides the opportunity to pursue challenging transformations such as the reduction of dioxygen into water. The redox activity engendered by the dipyrrin ligand scaffold make these promising candidates to serve as electrocatalysts for the reduction of O_2 to 2 H_2O. This electrocatalytic activation of oxygen has potential applications in the construction of fuel cells.[viii]

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[i] Blackmore, K. J.; Ziller, J. W.; Heyduk, A. F. *Inorg. Chem.*, **2005**, *44*, 5559.
[ii] Haneline, M. R.; Heyduk, A. F. *J. Am. Chem. Soc.*, **2006**, *128*, 8410.
[iii] Zarkesh, R. A.; Ziller, J. W.; Heyduk, A. F. *Angew. Chem. Int. Ed.*, **2008**, *47*, 4715.
[iv] Lyaskovskyy, V.; de Bruin, B. *ACS Catalysis*, **2012**, *2*, 270.
[v] Praneeth, V. K. K.; Ringenberg, M. R.; Ward, T. R. *Angew. Chem. Int. Ed.*, **2012**, *51*, 10228.
[vi] Luca, O. R.; Crabtree, R. H. *Chem. Soc. Rev.*, **2013**, *42*, 1440.
[vii] Nakano, K.; Kobayashi, K.; Nozaki, K. *J. Am. Chem. Soc.*, **2011**, *133*, 10720.
[viii] Zhang, W.; Lai, W.; Cao, R. *Chem. Rev.*, **2017**, *117*, 3717.

Summer Science Research Program
Ohio Wesleyan University

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

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

Animal Behavior, Evolution, Endocrinology

Specific title of research project

Behavior, physiology, and reproductive success in two species of North American wrens

Faculty mentor supervising research

Name: _____Dustin Reichard_____

Department: _____Zoology_____

Campus phone: ____x2890_____

Email address: ____dgreicha@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: ____May 2_____

Ending: _____July 29_____

Requested number of students

one _____

two __X___

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)

- **Must be able to *wake up early*** (pre-dawn) and hike on uneven terrain in hot, humid conditions in the presence of biting insects such as ticks, mosquitos, and flies.
- Must be willing to handle live birds (adults and nestlings) and collect blood samples (no previous experience necessary, training will be provided!)
- Completed BIOL 122 (preferred) or BIOL 120

Description of the research project (one page maximum)

Research in my lab focuses broadly on the evolution of animal communication and the physiological mechanisms of behavior, specifically how circulating hormone levels both affect and are affected by different behaviors. We investigate these topics in a variety of free-living (wild) songbird species, but our primary focus is two closely related species of wrens that nest in bird boxes. House and Carolina Wrens differ in a variety of life history characteristics, which makes them a compelling comparative study system. House wrens are migratory, experience a shorter breeding season, and coexist at much higher densities than Carolina Wrens, which are sedentary and found in central Ohio year-round. My lab studies both species using a collection of 200 nest boxes in the Delaware area. Students that work in the lab gain skills in handling and extracting birds from mist nets, bird banding, blood sampling and processing, behavioral observation, audio recording, and field data collection and management. In the summer of 2022, we will not be continuing an existing project, which is different from recent years, but that means that students have more options to pursue their interests. Below are some examples of potential projects that students could choose depending on their interests.

1. **Antipredator behavior in House Wrens**

   Songbirds produce altricial young that are wholly dependent on their parents for food, warmth, and protection from predators for the first few weeks of life. The guild of predators that targets young songbirds is diverse and includes mammals, snakes, and birds of prey. Over the past two years, SSRP students have found that female House Wrens respond differently to different types of predators at their nest. More specifically, parents do not respond as aggressively to a predator that poses a higher risk of death or injury to them. Future projects could continue this line of inquiry. For example, how do parents assess risk and vary their antipredator behavior? Alternatively, how do different types of predators affect the parental stress response, which can be measured through circulating hormone levels?

2. **Song repertoire size, sharing, and fitness in House and Carolina Wrens**

   Animals use a variety of signals to attract mates and defend territories, and among songbirds, vocalizations are one of the most prominent forms of communication. The total number of unique songs that an individual produces is referred to as his/her repertoire, and the repertoires of different individuals can have both shared and unshared song types. Previous research investigating the adaptive role of song repertoires has yielded largely mixed results, and it remains unclear why repertoire sizes range from one to thousands of songs across different species. We can study this phenomenon by collecting song recordings actively with handheld parabolic microphones as well as passively with automated recordings units that can be placed on the territory of individual males to record continuously for weeks at a time. Students will learn how to visualize and collect measurements from these recordings using bioacoustics software.

3. **Courtship interactions and circulating hormone levels in House and Carolina Wrens**

   Courtship behavior can be studied in the wild by observing natural interactions, which are difficult to predict in time and space, or they can be simulated by presenting wild birds with a potential mate and observing how they respond. Courtship behavior in House and Carolina Wrens has never been studied in the wild, and we now have a taxidermied female of both species posed in a copulation solicitation display. Students can work to optimize this technique in these species and investigate questions related to differences in courtship behavior between species and whether engaging in a courtship affects circulating hormone levels.

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

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

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

Biochemistry, Protein Structure

Specific title of research project

Investigating and Characterizing the Interactions between the Membrane and the Intracellular M3-M4 loop of the Glycine Receptor

Faculty mentor supervising research

Name: _____Kayce Alexandra Tomcho_____

Department: _____Chemistry and Biological Sciences_____

Campus phone: ____740-368-3523_____

Email address: _____katomcho@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: ____May 9, 2022_____

Ending: _____July 15, 2022_____

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)

It is ideal that the student researcher has taken CHEM 110, 111, and any Biological Science class that has given the student minimum hands-on aseptic technique experience. CHEM 260, 261 and 340 are not necessary, but would be helpful.

Description of the research project (one page maximum)

Protein function is intimately linked to protein structure; the more information that is known about the structure of a protein, the better able a researcher is able to modulate its function, which is especially important in terms of designing targeted therapeutics for diseases linked to a particular protein. Crystallographic methods (X-ray crystallography, cryo-electron microscopy) are often considered the gold-standard in terms of accessing protein structure. And though crystallographic methods do provide high-resolution structural images of proteins of various sizes and environments (soluble, membrane-bound) the resulting images are static and do not accurately depict protein dynamics. Furthermore, until recently, it has been difficult to obtain structural information on membrane proteins due to their complex purification processes and the need to use detergents, which are not a protein's native environment, to stabilize protein structure. Therefore, the structural information on membrane proteins is lagging behind their soluble counterparts.

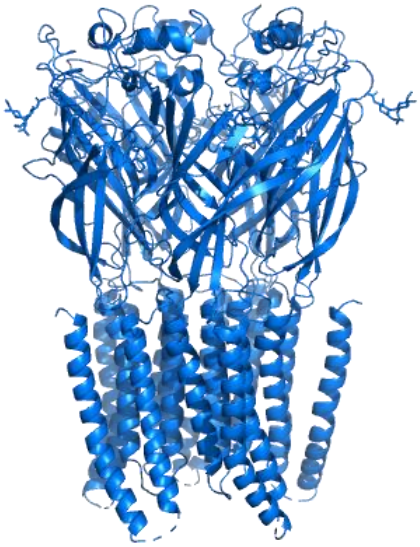

Figure 1. Cryo-EM Structure of GlyR. The desensitized state of GlyR is visualized above. It was crystallized in 2015 by Du et al. PDB: 3jad

The glycine receptor (GlyR), a pentameric ligand gated ion channel (pLGIC) protein, is responsible for inhibitory neurotransmission by facilitating the influx of chloride ions (Popot et al., 2011). GlyR is a therapeutic target as mutations to it can cause hereditary hyperekplexia (Bode and Lynch, 2014). Studies have linked GlyR to chronic pain as well, as an analgesic effect results via potentiation by cannabinoid-containing compounds (Lu et al., 2018). Current structural models of GlyR (Figure 1), not only are lacking in dynamic information as the protein shifts allosterically through tis three states: resting, open and desensitized, but also lack a large intracellular loop, the M3-M4 loop. This intracellular loop has many different functions and modulations, including mediating specific interactions with intracellular binding partners,(Langlhofer & Villmann, 2016) post-translational modifications, (Langlhofer & Villmann, 2016; Schaefer et al., 2018) channel structural integrity, (Baptista-Hon et al., 2013) gating, (Choii & Ko, 2015) desensitization, (Breitinger et al., 2009; Meiselbach et al., 2014; Milani et al., 1998) modulation by positive allosteric ligands (Lara et al., 2019) and receptor surface expression.(Schaefer et al., 2018) Studies of pLGICs have shown that if the loop is severely truncated, or if the receptor is lacking the loop entirely, this leads to non-functional receptors.(Haeger et al., 2010; Langlhofer & Villmann, 2016; Schaefer et al., 2015; Unterer et al., 2012).

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 (Tomcho KA et al. *In progress*), though these residues are located beyond the reach of the crosslinker. One explanation of the results could be due to poly-R/K regions, located in the M3-M4 loop. Studies have shown that peptides containing Arg and Lys residues have the ability to penetrate the membrane (Deshayes et al., 2005; Guidotti et al., 2017; Koren & Torchilin, 2012; Milletti, 2012; Vives et al., 2005; Zorko & Langel, 2005).

This project will focus on the interactions between the M3-M4 loop and model membranes. Because the membrane is a significant contributor to transmembrane protein function and localization, studying the interactions between membranes with varying lipid concentrations and the M3-M4 loop will give structural insight into the roles the loop has been linked to.

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

2022 Research Project Information Sheet

(Faculty information sheet)

Submission Deadline: 13 January 2022

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

Neuroscience, Psychology, Animal Behavior

Specific title of research project

Using a mouse model to investigate the roles of stress and circadian rhythm disruption in behaviors relevant to psychiatric disorders

Faculty mentor supervising research

Name: __Chelsea Vadnie_____

Department: _Neuroscience/Psychology_____

Campus phone: __3811_____

Email address: __cavadnie@owu.edu_____

Anticipated research dates (10 weeks):

Beginning: _05/09/22_____

Ending: ___07/15/22_____

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)

- Interest in neuroscience research using animal models
- Ideally experience handling mice, but at a minimum willingness to handle rodents (training will be provided)
- Ability to work flexible hours that includes time on weekends since the project involves daily monitoring of the animals and some weekend testing
- Detail-oriented and reliable
- Strongly recommended to have completed Introduction to Neuroscience (NEUR 250) and Behavioral Neuroscience lecture and lab (PSYC 343 and PSYC 343L)

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 circadian rhythm disturbances, such as flattened and altered timing of bodily rhythms, are commonly observed in individuals with mood and/or anxiety disorders. But do circadian rhythm disruptions play a key role in the development of psychiatric disorders or are they simply a co-occurring symptom? Clinical research suggests that circadian rhythm disruption plays a causal role in at least some individuals. The Vadnie lab is centered on further investigating the role of circadian rhythm disruptions in behaviors relevant to psychiatric disorders by using mouse models.

The student may have the opportunity to work on one of two projects:

Project 1. Role of stress and circadian rhythms in the development of depressive and anxiety-like behavior

Chronic unpredictable mild stress is a well-established paradigm to produce depressive and anxiety-like behavior in adult mice. This model has construct and predictive validity. Stress is a risk factor for mood and anxiety disorders, and current treatments have therapeutic-like effects in this model. Interestingly, like in humans, rhythms were disrupted in these chronically stressed mice and the degree of disruption correlated with depressive and anxiety-like behavior (Logan et al. 2015). Chronic administration of melatonin, a hormone released by neurons that regulates circadian rhythms, reduced the effects of chronic stress (Haridas et al. 2013). Prenatal stress is also known to affect circadian rhythms and psychiatric-related behaviors in mice. So far there is evidence to support that circadian rhythm disruption plays a key role in the effects of stress on anxiety and depressive-like behavior in mice, but a major piece of the picture is missing. How does stress during childhood and adolescence (when psychiatric disorders develop) affect biological rhythms and behavior in adults?

The student would have the opportunity to build upon a pilot project that was started by a group of students in the fall of 2021 at OWU. The project involves determining the effects of an abbreviated early adolescent stress paradigm on behaviors relevant to psychiatric disorders, homecage activity rhythms, and neurogenesis in the hippocampus of adult mice. The student would learn how to design, carry out, and analyze behavioral neuroscience experiments. If successful, in the future, we will further explore circadian disruptions in this mouse model and whether manipulations that enhance rhythms have therapeutic-like effects.

Project 2. Role of the central pacemaker, the suprachiasmatic nucleus (SCN), in regulating anxiety-like behavior

Previously, we found that chronic disruption of the neural firing of the SCN by repeated optogenetic stimulation, resulted in flattened homecage activity rhythms that were associated with increased anxiety-like behavior in mice (Vadnie, et al. 2022). Interestingly, acute stimulation of the SCN during open field testing had a similar anxiogenic effect in mice. Thus, our work supports that the SCN plays a key role in regulating anxiety-like behavior. This work also raises many additional unanswered questions. It is unknown whether acute stimulation of the SCN at different times of day would have the same effect, what other related behaviors may be altered, and how long the effect lasts. If funding and space allow, the student could be involved in learning how to carry out optogenetic stimulation of the central pacemaker in the brains of mice to address some of these major unanswered questions.

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*”