2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Polar Geography

SPECIFIC TITLE OF RESEARCH PROJECT

Production and Routing of Surface Meltwater on the Greenland Ice Sheet Ablation Zone

FACULTY SUPERVISING RESEARCH

Name: Nathanael Amador

Department: Geology and Geography

Campus phone: 740-368-3619

Email user name: nsamador@owu.edu

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: _08 May 2017__ one ____

Ending: _14 July 2017_____ two _X_

IF REQUESTING TWO STUDENTS: (Please indicate 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: Experience with ArcGIS software (e.g., Geography 222, 353, 355, 300.6, 369, or self-taught)
Preferred: Working with remotely sensed imagery (raster data sets)

Expected: Self-motivated student who is eager to accomplish tasks and is excited to learn about the world around them.

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

Appended

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*"

Production and Routing of Surface Meltwater on the Greenland Ice Sheet Ablation Zone

The Greenland Ice Sheet (GrIS) is the second-largest reservoir of freshwater on the planet – having the potential to raise sea level by 7 m if completely melted (Fettweis, 2007). Lower elevations of the ice sheet are constrained to the periphery of the ice mass and are often subjugated to temperatures that exceed the melting point (0°C) during the summer months – this is known as the ablation season. These low-lying areas, where wintertime accumulated snow is overcome by summertime melt, is known as the ablation zone. When meltwater is produced in the ablation zone, it gets routed through supraglacial channelization and collects in topographic depressions, forming supraglacial melt lakes (SGL). Along the margins of the ice sheet, in the ablation zone, these SGL have been observed (e.g., Lüthje et al., 2006) to occur in the same locations inter-annually. The significance of SGL is that they have been observed to drain large volumes of meltwater (~44 x $10^6 m^3$) in less than 24 hours (Das et al., 2008). The water is injected to the englacial system, where water being warmer than the underlying ice, melts the nearby ice, essentially drilling a channel to the ice-bedrock interface. These channels, known as moulins, when open, easily transfer this water to the bedrock, of depths greater than 1000 m (Zwally et al., 2002). When surface meltwater reaches the base, the overlying ice, usually frozen to the bedrock, is decoupled from the bedrock, decreasing basal friction and impacts ice flow. This work aims to connect the driving force for melt, atmospheric conditions, to the production of meltwater to fill in SGL basins during the summer months. This work is broken down into two primary tasks:

1) **Collection and processing of atmospheric data**: This student will collect and use local atmospheric data from the Greenland Climate Network (GC-Net) and large-scale synoptic data from the National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) to estimate water production on the ice sheet due to melting. This work would include data for the 2000 – 2016 summer melt seasons.
2) **Routing of surface meltwater**: Surface meltwater gets routed to lower elevations, many times to internal drainage systems, filling them and forming supraglacial lakes. This student will use a combination of satellite imagery to delineate SGL perimeters. The resulting lake boundary will then be overlaid to high-resolution digital elevation model (DEM) data to calculate the volume of water stored in the lake at various times throughout the melt seasons.

Das, S., I. Joughin, M. Behn, I. Howat, M. King, D. Lizarralde, and M. Bhatia. 2008. Fracture propagation to the base of the Greenland Ice Sheet during supraglacial lake drainage, *Science, 320(5877),* 778–781 doi:10.1126/science.1153360.

Fettweis, X. 2007. Reconstruction of the 1979–2006 Greenland ice sheet surface mass balance using the regional climate model MAR, *The Cryosphere, 1,* 21–40 doi:10.1007/s00382-010-0772-8.

Lüthje, M., L.T. Pederson, N. Reeh, and W. Greuell. 2006. Modelling the evolution of supraglacial lakes on the West Greenland ice-sheet margin, *J. Glaciol., 52(179),* 608–618, doi.10.3189/172756506781828386.

Zwally, H. J., W. Abdalati, T. Herring, K. Larson, J. Saba, and K. Steffen. 2002. Surface melt-induced acceleration of Greenland ice-sheet flow, *Science*, 297, 218–222.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Genetics & Molecular Neuroscience

SPECIFIC TITLE OF RESEARCH PROJECT

MicroRNA modifiers of neuronal differentiation and neurodegeneration.

FACULTY SUPERVISING RESEARCH

Name: **Suren Ambegaokar**

Department: **Botany & Microbiology**

Campus phone: **x3915**

Email user name: **ssambega@owu.edu**

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: Monday, May 15 one **_X_**

Ending: Friday, July 21 two ___

IF REQUESTING TWO STUDENTS: (Please indicate 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)

Minimum qualifications:

Experience with micropipettors, strong organizational skills, and detailed notetaker.

Preferred qualifications:

Knowledge of sterile and/or aseptic technique.
Completed courses in BIOL 120 (and/or BOMI 125) and CHEM 111 by the end of the Spring 2017 semester.

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*"

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

This project focuses on how certain genes may regulate aspects of both neuronal growth and neuronal health. In particular, the role of microRNA-7 (*miR-7*) will be studied in human neural progenitor cell lines (SH-SY5Y). This cell line is derived from a human glioblastoma, and *miR-7* expression is also related to cancer in many other non-neuronal cell types. Previous research has found changes in *miR-7* expression during brain development, and in some neurobehavioral disorders such as schizophrenia, Alzheimer disease, and Parkinson disease. Students will continue previous work from my lab on measuring the expression of *miR-7* before, during, and after neuronal differentiation. This project will also transfect SH-SY5Y cells to alter the expression of *miR-7* to examine the effects on neuronal differentiation. Reduced expression of *miR-7* also reduces neurotoxicity due to the protein Tau, which is highly related to Alzheimer disease and other neurodegenerative disorders. Students will have the ability to continue research on the molecular interaction between *miR-7* and Tau. This project will allow training in a variety of molecular and cellular techniques, namely maintaining mammalian cells in culture, RNA and miRNA purification, and quantification of RNA via quantitative PCR (qPCR).

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)
Neuroscience/Psychology

SPECIFIC TITLE OF RESEARCH PROJECT

Video Games and the Neural Correlates of Cognitive Control

FACULTY SUPERVISING RESEARCH

Name: _____Kira Bailey, PhD_____

Department: _Neuroscience and Psychology_____

Campus phone: ___x 3808_____

Email user name: _____kmbailey_____

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: ___May 15th, 2016_____ one _x__

Ending: __July 20th, 2016_____ two ____

IF REQUESTING TWO STUDENTS: (Please indicate 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 student must be willing to collect and analyze electrophysiological data (i.e., electroencephalogram and event-related potentials) from human participants. They needn't have prior experience with the procedures, only be willing to learn them. The student should be comfortable interacting with human participants and learning new computer software. Completion of any of the following courses is strongly recommended, but not necessarily required: Introduction to Neuroscience (NEUR 300.1), Cognitive Neuroscience (PSYC 300.15), Affective Neuroscience (PSYC 300.16).

DESCRIPTION OF RESEARCH PROJECT (attach statement; 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). 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 is in contrast to 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; other evidence indicates that AVGs are associated with diminished cognitive control (Bailey, West, & Anderson, 2010; Kronenberger et al., 2005; Mathews et al., 2005), increased aggressive behavior (Anderson et al., 2010), disruptions in affective processing (Bailey, West, & Anderson, 2011; Bartholow, Bushman, & Sestir, 2006; Kirsh & Mounts, 2007), and greater risk-taking (Bailey, 2012; Pawlikowski & Brand, 2011).

The proposed research seeks to examine the relationship between individual differences in video game experience and inhibition, an aspect of cognitive control that involves the ability to ignore irrelevant information in the environment. AVGs and real-time strategy video games will be examined. The student will learn how to collect, analyze, and interpret electrophysiological and behavioral data.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Computational Neuroscience

SPECIFIC TITLE OF RESEARCH PROJECT

FACULTY SUPERVISING RESEARCH

Name: ____Christian Fink_____

Department: __Physics_____

Campus phone: _3770_____

Email user name: _tcfink_____

ANTICIPATED RESEARCH DATES, (ten weeks):

Beginning: _____May 22_____

Ending: _____July 28_____

Requested Number of Students:

one _X___

two ____

IF REQUESTING TWO STUDENTS: (Please indicate 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)

The student needs to have taken a course in computer programming, or demonstrate sufficient programming aptitude to be able to run numerical simulations. They also need to have taken a course in differential equations.

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

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*"

Characterizing High-Frequency Oscillations in Epileptic Brain Tissue: Christian G. Fink

Epilepsy affects roughly 1% of the world's population [1], with approximately 25% of all people with epilepsy suffering from an intractable form of the disease, untreatable either by medication or surgery. The primary reason for this unfortunate fact is our incomplete understanding of how epileptic seizures are generated, for there are many ways in which electrical activity in the brain may go awry. One important clinical tool for investigating the causes of focal epilepsy is recording electrical activity (known as the local field potential, or LFP) near the part of the brain where seizures are generated (the epileptogenic zone, or EZ). If a patient is resistant to medication, identification of the EZ through analysis of LFP recordings is essential to surgically treating the patient by removing the EZ.

In the last 15 years, a promising new biomarker has emerged that may improve surgical outcomes and shed light on how focal seizures are generated. High-frequency oscillations (HFOs) are oscillations observed in LFP recordings of 100 Hz or more, and oftentimes HFOs occur much more frequently in the EZ than in other regions of the brain [2]. HFOs are typically lumped into two categories based upon their dominant frequency: ripples (100-250 Hz) and fast ripples (>250 Hz). Fast ripples tend to be a more reliable indicator of pathology than ripples, but neither is a perfect epilepsy biomarker, for both ripples and fast ripples have been shown to also occur in normal brain tissue [3, 4]. One of the most pressing questions in the quest to better understand the causes of epilepsy is, "What distinguishes normal HFOs from pathological HFOs?"

In order to answer this question, we will construct a computational model of a brain network and modify various processes and parameters in ways that are known to be either normal or pathological. We will then observe differences in the LFP that result from these modifications, and combine these observations with "Big Data" techniques to determine features of real-world recordings which distinguish normal from pathological HFOs. Real-world comparisons will be made in collaboration with William Stacey, an epileptologist at the University of Michigan. Successful discrimination between normal and pathological activity in real-world human recordings will suggest underlying biophysical mechanisms, based on the computational model, and such knowledge will likely provide insight into the mechanisms underpinning the initiation of epileptic seizures.

REFERENCES

[1] Thurman et. al. "Standards for epidemiologic students and surveillance of epilepsy," *Epilepsia*, 2011.
[2] Brain et. al. "High-frequency oscillations in human brain," *Hippocampus*, 1999.
[3] Ylinen et. al. "Sharp wave-associated high-frequency oscillations (200 Hz) in the intact hippocampus: network and intracellular mechanisms," *J. Neuroscience*, 1995.
[4] Jones et. al. "Intracellular correlates of fast (>200 Hz) electrical oscillations in rat somatosensory cortex," *J. Neurophysiology*, 2000.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Cognitive Psychology

SPECIFIC TITLE OF RESEARCH PROJECT

Maintenance of Knowledge

FACULTY SUPERVISING RESEARCH

Name: __Lynda Hall_____

Department: __Psychology_____

Campus phone: ___x3810_____

Email user name: __lkhall@owu.edu_____

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: ___May 15, 2017_____ one ____

Ending: ___July 21, 2017_____ two _X___

IF REQUESTING TWO STUDENTS: (Please indicate 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 must have completed Introduction to Psychology and one other Psychology course. Preference will be given to those who have completed one or more of the following courses: Quantitative Methods, Research Methods, or Cognitive Psychology.

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*"

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

Very few research investigations have explored long term retention of information acquired in the classroom, and several of the best known studies were conducted at Ohio Wesleyan. For example, Bahrick (1984) investigated memory for Spanish learned in school in 773 participants who had completed their studies up to fifty years prior to completing the memory test. He found that the proportion of material retained from introductory courses was strongly related to how much the students used the material in subsequent courses. Bahrick and Hall (1991) drew similar conclusions from a study of memory for algebra and geometry learned in high school with 1726 participants.

For more than twenty years, I have retained the final exams from students who completed my course in Quantitative Methods, and I'm preparing to conduct an investigation of very long term memory in this pool of participants. Compared to the past studies, I'll have much more detailed information on the student's performance when they acquired the knowledge to be tested. I also want to expand on past investigations by exploring gist memory in addition to rote memory. Reyna and her colleagues (e.g., Blalock & Reyna, 2016; Reyna & Wilhelms, 2016) have shown that gist memory often predicts decision making behavior better than rote memory. I'd like to explore the acquisition variables that predict gist memory and compare those relationships to the associations between acquisition variables and rote memory. I'd also like to measure the relationships between gist memory for statistical concepts and between gist memory and quantitative reasoning performance.

This summer, I'll begin work on the project by creating a database of questions from final exams from the last twenty years, conducting a detailed item analysis on those questions, and constructing memory tests for the planned investigation.

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*"

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Cellular and developmental genetics

SPECIFIC TITLE OF RESEARCH PROJECT

Analysis of Cell Division and Development in *C. elegans* and other Nematodes

FACULTY SUPERVISING RESEARCH

Name: __Danielle Hamill_____

Department: ____Zoology_____

Campus phone: _____3888_____

Email user name: ___drhamill@owu.edu_____

ANTICIPATED RESEARCH DATES, (ten weeks):

Beginning: ____~May 16_____

Ending: ___~July 21_____

Requested Number of Students:

one _X_

two ___

IF REQUESTING TWO STUDENTS: (Please indicate 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)

Before the summer students should have completed a minimum of one upper-level biology course with lab – preferably with a molecular focus such as genetics, developmental biology, cell and molecular biology or similar.

Students should also be eager to do independent lab work, should have an interest in cells and developing embryos and should be willing and able to spend considerable time peering through microscopes.

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*"

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

The Hamill lab focuses primarily on cell division and early development. For many of our studies, we use the model organism *C. elegans*, which is a small free-living soil nematode. More recently the Hamill lab has begun studying cell division and development in other nematodes.

The patterns of development in *C. elegans* are well characterized. We recently isolated several other free-living nematodes from Delaware County and from Southern Florida. Based on preliminary DNA sequence analysis, we believe at least some of the worms we isolated are species that haven't yet been described. Our lab is now characterizing these worms and their embryos, comparing them to each other and to *C. elegans*, and working on species descriptions.

We have noted similarities, but also some intriguing differences between *C. elegans* and these other worms. For example, we have seen that aspects of mitotic spindle positioning and timing as well as other indicators of embryonic polarity appear to differ in these species. Embryonic asymmetries that are critical for *C. elegans* embryo viability are often not present in embryos of these other species. We will continue to characterize these differences. Some of the projects to be done this summer include addressing questions about these worms such as: How big are they? How long do they live? How many embryos do they make? etc. We will also do a careful analysis of cell division patterns in early embryos. To aid in their identification we will also extract DNA from the worms and sequence conserved genes. We will also begin to explore the feasibility of using CRISPR to knock down or knock in genes.

A student working on these projects will use a variety of skills and techniques including light and fluorescence microscopy and molecular techniques including PCR, DNA sequencing, and cloning. In addition to working with worms, students will also perform standard lab techniques and skills such as making solutions and plates, growing bacterial cultures, and reading and discussing scientific papers.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Zoology

SPECIFIC TITLE OF RESEARCH PROJECT

Paternity and mating behaviors in the sailfin molly, *Poecila latipinna*

FACULTY SUPERVISING RESEARCH

Name: __Shala Hankison_____

Department: ___Zoology_____

Campus phone: ___368-3869_____

Email user name: ____sjhankis@owu.edu_____

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: __11 May 2015 _____ one _X_

Ending: ___24 July 2015 _____ two ___

IF REQUESTING TWO STUDENTS: (Please indicate 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 is preferred, but not required. Strong interest in working with animals, specifically fish, is a must, including ability to be very involved in animal care (cleaning, feeding, etc), including some weekend work.

As animal care is required, reliability is critical.

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

An ongoing question related to mating strategies and mating behaviors is how these relate to actual reproductive success. In the sailfin molly, *Poecilia latipinna*, males exhibit a wide range of mating behaviors (Ptacek & Travis 1996, Ptacek & Travis 1997), from performing elaborate courtship to elicit female cooperation, to sneaky copulation attempts, which females often try to avoid, along with post-copulatory sperm competition (Schlupp and Plath 2005, Aspbury and Gabor 2004). Females, too, have a range of responses (Farr et al 1986). They may actively solicit male courtship and cooperate during sperm transfer, or may avoid certain males that lack preferred characteristics. There may also be crypic choice, in which females may preferentially use some sperm over other sperm (Pilastro et al 2004). Finally, use of stored sperm, mating order, timing of mating relative to the female's reproductive cycle, and other factors may all influence which male(s) actually fertilize the eggs.

This project seeks to combine behavioral observations of male and female *P. latipinna* courtship behaviors with paternity testing of offspring to determine whether certain behaviors correlate with mating success. Previous work has suggested that at least half of all brood are sired multiply (Travis et al 1990). We will use the event recorder program, The Observer, to record mating behaviors of known females and males. We will also collect DNA samples from fish and characterize the DNA using a suite of microsatellites, short pieces of repeated DNA. Microsatellites have already been developed for *P. latipinna* for use in paternity testing (Girndt et al 2012), and are being piloted for use in my lab during the spring semester.

Once we have offspring from the matings of known females with sets of males, we will determine paternity and look for patterns relating paternity to observed mating behaviors. While paternity can be influenced by the suite of circumstances detailed above, patterns that we observe may allow us to better understand the outcome of specific mating behaviors on fitness.

Aspbury AS, Gabor CR (2004) Discriminating males alter sperm production between species. PNAS 101: 15970-15973.

Farr JA, Travis J, Trexler JC (1986) Behavioural allometry and interdemic variation in sexual behaviour of the sailfin molly, *Poecilia latipinna* (Pisces: Poeciliidae). Animal Behaviour 34:497-509

Girndt A, Riesch R, Schröder C, Schlupp I, Plath M, Tiedemann R (2012) Multiple paternity in different populations of the sailfin molly, *Poecilia latipinna*. Animal Biology 62: 245-262.

Pilastro A, Simonato M, Bisazza, Evans JP (2004) Cryptic female preference for colorful males in guppies. Evolution 58: 665-669.

Ptacek, MB, Travis, J (1996) Inter-population variation in male mating behaviours in the sailfin molly, *Poecilia latipinna*. Animal Behaviour 52: 59-71.

Ptacek MB, Travis J (1997) Mate choice in the sailfin molly, *Poecilia latipinna*. Evolution 51:1217-1231.

Schlupp I, Plath M (2005) Male mate choice and sperm allocation in a sexual/asexual mating complex of *Poecilia* (Poeciliidae, Teleostei). Biology Letters 11: 169-171.

Travis, J, Trexler JC, Mulvey, M (1990) Multiple paternity and its correlates in female *Poecilia latipinna* (Poeciliidae). Copeia, 722-729.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Experimental Nuclear Physics

SPECIFIC TITLE OF RESEARCH PROJECT

Parity Measurements in the Gallium–70 Nucleus

FACULTY SUPERVISING RESEARCH

Name: Bob Haring-Kaye

Department: Physics and Astronomy

Campus phone: x3774

Email user name: rakaye

ANTICIPATED RESEARCH DATES, (ten weeks):

Beginning: May 22

Ending: July 28

Requested Number of Students:

one X

two ___

IF REQUESTING TWO STUDENTS: (Please indicate 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 PHYS 280C and 280L (Contemporary Physics class and lab) with a "C" or better

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

Please see the following page.

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*"

Fundamental symmetries play an important role in understanding physical properties. Usually, these symmetries greatly simplify a measurement or a calculation of observable quantities. For example, an object having spherical symmetry (e.g., a sphere) has a particularly simple way of calculating its volume. Symmetries are also extremely useful in the world of the very small, governed by the theory of quantum mechanics, where many calculations would be intractable without them. For instance, it is straightforward to calculate the probability of finding the electron in a hydrogen atom at any radial distance from the proton, in any one of its discrete (quantized) energy states, because the potential energy of the electron-proton system has spherical symmetry.

Atomic nuclei also possess fundamental symmetries that help to understand their basic properties. One of the most important of these is the parity, or "mirror," symmetry that applies to each of its intrinsic discrete energy states. Since nuclei follow the rules of quantum mechanics, these energy states are characterized by a wave function that describes the wave-like properties of the nucleus. If one were to plot the wave function on a graph, the parity of the wave function describes what you would see on the other side of the "mirror" formed by the vertical *y*-axis. If the graph looked inverted (non-inverted), then the parity is odd, or negative (even, or positive). (Perhaps the simplest example of an odd (even) wave function would be an ordinary sine (cosine) function.) The parity of the discrete energy states of a nucleus has important consequences, including what transitions are possible (through gamma-ray emission) between these states, and what single-particle energy orbitals must be occupied by the individual protons and neutrons in order to generate these energy states.

This proposed research aims to strengthen the knowledge of the Gallium–70 (^{70}Ga) nucleus by measuring the parities of as many of its excited energy states as possible. This nucleus is particularly interesting since it lies in a region of the nuclear chart that is predicted to demonstrate a variety of exotic shape characteristics, and since very little is known about its properties from previous studies. Although significant enhancements have been made to the ^{70}Ga decay scheme by my 2015 SSRP student, including the discovery of a new sequence of states that may be associated with an underlying deformed shape, many of the excited-state parities remain uncertain. Even the lowest-energy states have only tentative parity assignments based on indirect evidence or systematic comparisons with other nuclei. A direct measurement of the parity of these states would serve as a definitive test of the proposed enhancements to the ^{70}Ga decay scheme and would allow for a more direct comparison between ^{70}Ga and neighboring isotopes that show similar decay structures, as well as the predictions of contemporary theoretical models.

The necessary experimental data have already been collected as part of a recent experiment performed at the Florida State University (FSU) particle accelerator lab. The student will use a Linux PC workstation running specialized software in order to perform the data analysis. No previous experience with Linux or the data analysis tools is necessary; I will teach the student all of the needed system commands and how to use the analysis software. Since the data analysis requires a basic understanding of the techniques of gamma-ray spectroscopy and Compton scattering of photons in gamma-ray detectors, I will train the student on the relevant experimental techniques using my on-campus research laboratory, which utilizes the same gamma-ray detection technology that was used in the actual experiment at FSU. I am also planning on taking the student to Michigan State University to collaborate on a new experiment (unrelated to ^{70}Ga), so there is an opportunity to gain experience with the setup, implementation, and operation of a large-scale nuclear physics experiment.

The student will also have the opportunity to present a poster of the summer research results at the annual Fall Meeting of the Nuclear Physics Division of the American Physical Society in Pittsburgh this October through the Conference Experience for Undergraduates program funded by the National Science Foundation. I expect the final results of this research to eventually be published in an internationally recognized journal such as *Physical Review C*, with the student as a co-author.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Astrophysics

SPECIFIC TITLE OF RESEARCH PROJECT

Starspots on LO Pegasi

FACULTY SUPERVISING RESEARCH

Name: Robert Harmon

Department: Physics and Astronomy

Campus phone: 3778

Email user name: roharmon

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: May 22 one

Ending: July 28

IF REQUESTING TWO STUDENTS: (Please indicate 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 PHYS 111 Lab

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*"

DESCRIPTION OF RESEARCH PROJECT (attach statement; 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 which best replicates the observed light curve will produce a surface peppered with spurious bright and dark spots which 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 who works 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 the target star 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 2006-2016.

It is anticipated that the results will be presented by the student at the national meeting of the American Astronomical Society near Washington, DC in January 2018.

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Comparative morphology, evolution, molecular biology, genetics

SPECIFIC TITLE OF RESEARCH PROJECT

A comparative study of the structure and function of placental tissues in the teleost fish *Poeciliopsis* (Poeciliidae)

FACULTY SUPERVISING RESEARCH

Name: Tami Panhuis

Department: ZOOLOGY

Campus phone: x3859

Email user name: _tmpanhui@owu.edu

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: Prefer, prior to me leaving on TL course – May 12 (I could easily get them started on the literature and microscopy work before I leave for TL course. But if need be, we could start after I return from TL – May 31)

one ____

Ending: If they started May 12, then week July 17
If they started May 31, then week July 24 **two X**

IF REQUESTING TWO STUDENTS:

MINIMUM QUALIFICATIONS OF STUDENT RESEARCHER (be as specific as possible)
Strongly prefer students who have had BIOL 120, 122, Chem 110, 111, and at least one upper level ZOOL lab course. The students should be comfortable working at a microscope for several hours a day, they should have good dexterity and patience, good note taking skills, and be willing to sacrifice and work with fish and fish embryos (following approved IACUC protocols).

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

Teleost fish in the genus *Poeciliopsis* (Poeciliidae) give live birth and successful gestation of the embryos depends on maternal provisioning of nutrients to the developing embryo. For some species in the genus these maternal nutrients are provided as large amounts of yolk that sustain the embryo during gestation. In other species, the mother produces little amounts of yolk and thus must continually transfer nutrients to the embryo throughout development. In these matrotrophic species, a placental tissue has evolved that facilitates the exchange of substances between the mother and the embryo (Figure 1). In my lab we are interested in understanding the function and structure of this placental tissue. One way, of several, that we do this is by studying the morphological specializations of the placenta – both maternal and embryonic features involved in maternal-fetal nutrient exchange.

Missing from the *Poeciliopsis* placenta literature are functional studies revealing specific embryonic surface regions involved in external nutrient absorption. This summer students in my lab will be the first to contribute to this missing literature by performing two experiments. One experiment will focus on the analysis of prepared histological slides of five *Poeciliopsis* species that vary in their degree of placentation. These slides were made from the gestating ovary of females and should reveal the specific maternal and embryonic placenta features. By comparing maternal and embryonic morphological features across five closely related species that differ in their degree of maternalnutrient transfer, we will learn how these specializations evolved. The second project is a functional analysis of the embryonic surface regions involved in nutrient transfer. Here students will use molecular biology techniques (e.g. fluorescent markers) and microscopy work to isolate the specific surface areas of embryos that are directly involved in nutrient absorption.

Both of these projects will provide students an opportunity to learn several lab techniques, such as compound and dissecting microscopy, fish dissection, retro-orbital injection, fish husbandry, fluorescence labeling, fluorescence microscopy, micropipetting, buffer preparation, histology, scientific literature analysis, scientific note taking, and digital microscopy software and analysis. Students will also be exposed to several key topics in biology, including molecular biology, phylogeny, comparative evolution, comparative morphology, and genetics.

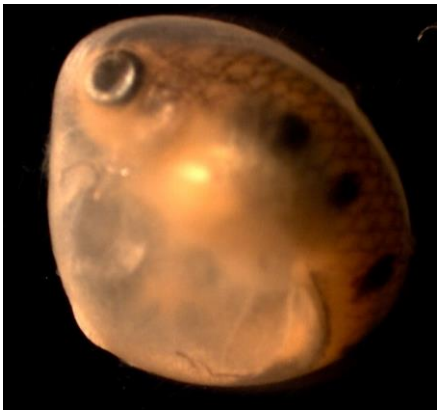


Figure 1. *Poeciliopsis turneri* late stage embryo surrounded by the maternal follicle. Together the maternal follicle and the embryonic pericardial sac comprise the placenta tissues.
Image by T. Panhuis and L. Kwan

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)
Organic, Organometallic Chemistry

SPECIFIC TITLE OF RESEARCH PROJECT
Redox-active Ligand Scaffold for the Activation of Lactide

FACULTY SUPERVISING RESEARCH

Name: ____Allen J. Pistner_____

Department: __Chemistry_____

Campus phone: __368-3519_____

Email user name: ___ajpistne@owu.edu_____

ANTICIPATED RESEARCH DATES, (ten weeks):

Beginning: _____5/22/17_____

Ending: _____7/28/17_____

Requested Number of Students:

one ___

two __X__

IF REQUESTING TWO STUDENTS:

MINIMUM QUALIFICATIONS OF STUDENT RESEARCHER (be as specific as possible)

CHEM 110, 111, 260, and 261 (or currently enrolled in CHEM 261 Spring 2017)

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

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*"

Description of Research Project

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.[1-3] 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.[4-6]

One application for the use of redox active ligands has been the ring-opening polymerization of lactide, as shown in Figure 1. Polylactides (PLAs) have garnered much attention due to several favorable properties with monomers obtained from renewable resources, are biodegradable and have been used in applications in biomedical, pharmaceutical and agricultural processes.[7-10]

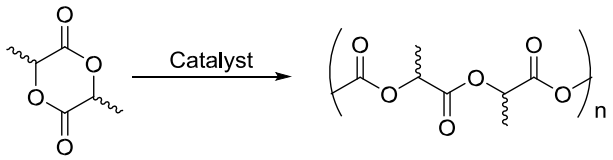
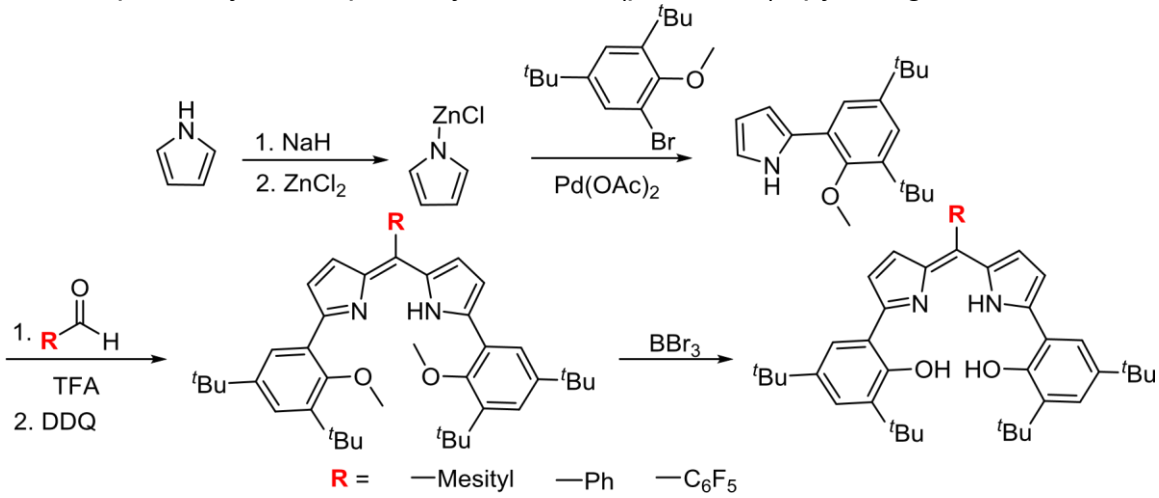


Figure 1. Ring-opening polymerization of lactide.

Abundant metals such as Zn, Al and Mg have shown the ability to polymerize lactide, however many of the ligand systems lack the ability to control the electronic environment of the ligand system.[11,12]

This project will focus on the development of a bis(phenolate)dipyrrin ligand scaffold that will allow for the redox activity to be tuned, affording the ability to influence the reactivity. This redox active ligand system will be synthesized using the following route (Scheme 1),[13] while varying the electronic character of the R substituent. This will provide an opportunity to optimize the reactivity in a systematic fashion to create an efficient catalyst for the polymerization of lactide.

Scheme 1. Proposed synthetic pathway for the bis(phenolate)dipyrrin ligand scaffold.



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[2] Haneline, M. R.; Heyduk, A. F. *J. Am. Chem. Soc.*, **2006**, *128*, 8410.
[3] Zarkesh, R. A.; Ziller, J. W.; Heyduk, A. F. *Angew. Chem. Int. Ed.*, **2008**, *47*, 4715.
[4] Lyaskovskyy, V.; de Bruin, B. *ACS Catalysis*, **2012**, *2*, 270.
[5] Praneeth, V. K. K.; Ringenberg, M. R.; Ward, T. R. *Angew. Chem. Int. Ed.*, **2012**, *51*, 10228.
[6] Luca, O. R.; Crabtree, R. H. *Chem. Soc. Rev.*, **2013**, *42*, 1440.

[7] Williams, C.; Hillmyer, M. *Polym. Rev*., **2008**, *48*, 1.
[8] Drumright, R. E.; Gruber, P. R.; Henton, D. E. *Adv. Mater*., **2000**, *12*, 1841.
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[12] Wheaton, C. A.; Hayes, P. G.; Ireland, B. J. *Dalton Trans.*, **2009**, 4832.
[13] Nakano, K.; Kobayashi, K.; Nozaki, K. *J. Am. Chem. Soc.*, **2011**, *133*, 10720.

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2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Applied mathematics

SPECIFIC TITLE OF RESEARCH PROJECT

Modeling the Spread of and Vaccination Against a Disease Through a Network

FACULTY SUPERVISING RESEARCH

Name: Pamela Pyzza

Department: Mathematics and Computer Science & Neuroscience Program

Campus phone: 740-203-4908

Email user name: pbpyzza

ANTICIPATED RESEARCH DATES, (ten weeks):

Beginning: May 22. 2017

Ending: July 28, 2017

Requested Number of Students:

one X

two ___

IF REQUESTING TWO STUDENTS: (Please indicate 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)

Student should have experience working with multivariable calculus and/or differential equations and experience programming in Matlab or C++. Course prerequisites include (MATH 110/111 – Calculus 1 &2, MATH 210-Multivariable Calculus, CS 110-Introduction to Computer Science and Programming). Additional knowledge of disease dynamics or network modeling is helpful but not necessary.

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DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

Diseases such as HIV, HPV, TB, and influenza, are all spread from one individual to another and can cause an epidemic if not properly contained and vaccinated against. The key to the spread of these diseases is human contact, as viruses like HIV and HPV are transmitted primarily through sexual contact [1,2], while TB and the flu are transmitted to people nearby through the air [3].

One approach to mathematically modeling the spread of and vaccination against such diseases uses agent-based modeling and focuses on basic social network structures [4]. Agent-based modeling allows us to model individual people and connect them in various network structures to form a community [5]. The individuals or agents in the model have various traits that make them unique. They are connected by edges or links, across which the disease may transmit. According to an established set of rules, stochastic random processes determine which edges are active at a particular time.

The necessary details about people and their interactions are specific to the particular disease being studied. For example, when modeling the spread of HPV, an individual's age and gender are important [6], while contracting the flu is more dependent on where an individual spends most of their time.
Students will conduct literature searches to obtain current details about the disease, its means of transmission, and any possible vaccination methods that may exist. They will implement an agent-based model for the spread of a disease using MATLAB or C++, comparing their results with data from the Centers for Disease Control and Prevention and other health databases. They can use their models to begin to ask and answer questions which are otherwise not feasible, unethical, or too expensive to test on humans. Given a model describing the spread of a disease, additional stochastic processes can be incorporated to model the vaccination of individuals against the disease [6–8]. Students can develop various vaccination policies for eradicating the disease and use their model to test the efficacy of each methods.

References

[1] Center for Disease Control and Prevention, *Sexually Transmitted Disease Surveillance 2013*. Atlanta: U.S. Department of Health and Human Services, Dec. 2014.
[2] M.-C. Boily, G. Godin, M. Hogben, L. Sherr, and F. I. Bastos, "The impact of the transmission dynamics of the hiv/aids epidemic on sexual behaviour: a new hypothesis to explain recent increases in risk taking-behaviour among men who have sex with men," Med. Hypotheses **65**, pp. 215–226 (2005).
[3] Y.-H. Cheng, C.-H. Wang, S.-H. You, N.-H. Hsieh, W.-Y. Chen, C.-P. Chio, and C.-M. Liao, "Assessing coughing-induced influenza droplet transmission and implications for infection risk control," Epidemiol. Infect., pp. 1–13 (2015).
[4] L. Perez and S. Dragicevic, "An agent-based approach for modeling dynamics of conta-gious disease spread," Int. J. Health. Geogr. **8**, p. 50 (2009).
[5] X. Fu, M. Small, D. M. Walker, and H. Zhang, "Epidemic dynamics on scale-free networks with piecewise linear infectivity and immunization," Phys. Rev. E **77**, 036113 (2008).
[6] Center for Disease Control and Prevention, "Genital hpv infection -fact sheet." [http://www.cdc.gov/STD/HPV/STDFact-HPV.htm].
[7] E. Herweijer, A. L. Feldman, A. Ploner, L. Arnheim-Dahlstrom, I. Uhnoo, E. Netterlid, J. Dillner, P. Sparen, and K. Sundstrom, "The participation of hpv-vaccinated women in a national cervical screening program: Population-based cohort study," PLoS One **10**, p. e0134185 (2015).
[8] A. L. Greer, "Early vaccine availability represents an important public health advance for the control of pandemic influenza," BMC Res. Notes **8**, p. 191 (2015).

2017 OWU SUMMER SCIENCE RESEARCH PROGRAM

RESEARCH PROJECT INFORMATION SHEET

(Faculty information sheet)

Submission Deadline: 19 January 2017

GENERAL AREA OF RESEARCH (broad overall area such as genetics, biochemistry, environmental science, etc.)

Animal Behavior and Evolutionary Biology

SPECIFIC TITLE OF RESEARCH PROJECT

Songs, stress, and reproductive success in a central Ohio songbird

FACULTY SUPERVISING RESEARCH

Name: ____Dustin Reichard_____

Department: __Zoology_____

Campus phone: ___x2890_____

Email user name: ___dgreicha@owu.edu_____

ANTICIPATED RESEARCH DATES, (ten weeks): **Requested Number of Students:**

Beginning: __May 10, 2017_____ one __X__

Ending: ___July 19, 2017_____ two ___

IF REQUESTING TWO STUDENTS: (Please indicate 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)

Completed BIOL 122 (preferred) or BIOL 120
Must be able to wake up early (pre-dawn) and hike on uneven terrain in hot, humid conditions in the presence of insects (some of which may bite)

DESCRIPTION OF RESEARCH PROJECT (attach statement; one page maximum)

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*"

My research focuses broadly on the evolution of animal communication with a particular emphasis on songbirds. During the breeding season, many songbirds produce a diverse repertoire of songs and calls that serve a variety of social functions such as repelling rivals, attracting mates, avoiding predators, and maintaining contact with conspecifics. How effectively each individual produces these different sounds in various social contexts has a direct effect on its fitness and survival. Historically, I have focused predominantly on dark-eyed juncos, a species of sparrow that does not breed in central Ohio. A major goal for this summer is to develop a new study system with a species of songbird that breeds locally. My SSRP student will work collaboratively with me to assess the feasibility of field research involving either a common nest box species (e.g., Eastern Bluebird, House Wren, etc) or a common ground nesting species (e.g., Turdid thrushes, Emberizid sparrows). We will capture and band mated pairs, collect small blood samples to assess individual stress responses, record and analyze songs and calls, and track the survival and reproductive success of all marked individuals. The student will also work with me to develop an independent research project focused on a topic matching their interests, which will ideally involve some aspect of vocal communication.