
*Natural
Sciences*

Position #3; Amy Burgin

Mentor name: Amy Burgin, Kansas Biological Survey, Environmental Studies and Ecology and Evolutionary Biology

Job/project title: Environmental Science Field and Lab Technician

Project description:

The Burgin Lab focuses on understanding current environmental issues affecting aquatic ecosystems, including nutrient pollution and associated algal blooms (water quality), carbon storage and global warming in wetlands and how microbes drive ecosystem processes. Students working in the lab gain exposure to a wide variety of projects, while focusing their skills on a particular area of interest. More information can be found at: <https://burginlab.wordpress.com/>

Project Overview: We seek assistance from a student in developing a project to measure greenhouse gases and water quality in soils and wetlands. We rely on field sample collection and lab analysis, but also emphasize technologically advanced monitoring options, including sensors (to measure temperature or water quality) and unmanned aerial vehicles (drones) to collect water. We use these methods to understand how water and soil chemistry vary in space and time.

Potential student tasks and responsibilities:

Tasks and Responsibilities: The student will partly work at the KU Field Station collecting water samples from Cross Reservoir for chemical analysis. The student will also assist with analyzing soils from restored wetlands (in KS and OH). Students will also assist with deploying and managing environmental sensors for recording water quality. The student will assist in developing protocols and training materials for analyses.

Student qualifications and characteristics:

Qualifications and Characteristics: Curiosity in the environment and interest in learning cutting-edge analytical skills. Ability to communicate clearly and follow instructions; attention to detail, particularly for keeping lab and field notes. Interest in spending time outdoors and collecting water and soil samples. Students interested in combining scientific training with video and website production are particularly encouraged to apply. While not required for working in the lab, please

highlight any skills you have pertaining to lifeguarding, boating or outdoor recreation. Please also note any skills related to technology, including video or audio production, website development or computer programming. Must be available for at least a 3 hour block within the 8-5 window.

Additional comments: Dr. Burgin is a first-generation college graduate who entered environmental science from an undergraduate research experience.

Position #5; Bruce Frederick

Mentor name: Bruce Frederick, Geology

Job/project title: Geoscience Lab Technician

Project description:

The Blum Lab focuses on improving our quantitative understanding of earth surface processes and their reflection in the sedimentary rock record. With particular focus on fluvial and coastal sedimentary processes, our students leverage a variety of geological, geographical and geophysical techniques to more accurately detail each stage of source-to-sink (S2S) clastic sediment transport from the world's mountain ranges to the sedimentary basins. In doing so, we set out to better characterize the geological response to both global climate and sea-level change.

Project Overview: Dr. Mike Blum and I are seeking assistance from a scientifically inquisitive student to develop internal lab protocol for the mining, storage, and illustration of pertinent S2S-related geological and geophysical data from a variety of publically-available internet databases. Our sedimentary geology lab relies heavily on well data acquisition and analysis to better comprehend the regional subsurface stratigraphy and geochronology, and would substantively benefit from an energetic, detail-oriented, quantitative scientific mind who might assist our team. Our geoscience research project field areas extend from Alberta to the Maritime Provinces of Canada, and from the Rocky Mountains to the Gulf Coast of the US.

Potential student tasks and responsibilities:

Task and Responsibilities: The student will primarily work at our lab at 323 Lindley Hall on KU Main Campus. The student will be responsible for collection, maintenance, and illustration of geological/geophysical well data from various US state and Canadian geological surveys. The student may also assist with the upgrade and maintenance of our current ArcGIS database and assist in the production of regional geologic cross sections, geospatial maps, and scientific figures for publication/presentation. Opportunities for field research trips may be made available depending upon amenable schedules.

Student qualifications and characteristics:

Qualification and Characteristics: Curiosity in the environment and the interdisciplinary study of the sedimentary rock record with a desire to gain experience on cutting-edge industry software. Ability to communicate effectively, follow instructions, and problem solve independently. Attention to

detail, with respect to maintaining accurate lab notes and database structure, is required. A genuine interest in nature, earth history, and scientific curiosity is critical. Students who work well with others, are interested in integrating with an energetic team of graduate students, and desire opportunities for field experience are also encouraged to apply. Hours are flexible M-F between 9am – 6pm, however 2-3 hour blocks of scheduled time are preferred. Prior experience with the MS Office suite, ArcGIS, Adobe Illustrator, and Petra is beneficial but not required.

Position #6; Jennifer Gleason

Mentor name: Jennifer Gleason, Ecology and Evolutionary Biology

Job/project title: Reproductive Biology of an Invasive Species

Project description:

Zaprionus indianus, a fruit fly native to India and Africa, has invaded the United States, first arriving in Kansas in 2012. The species is a pest of figs, causing economic losses. Very little is known about its reproductive biology, but our preliminary data indicate that the species has unusual courtship behaviors and egg laying patterns, at least in comparison to its closely related *Drosophila* species. In this project, we will investigate the courtship behaviors and determine the factors that affect male and female fecundity. The results will have implications for both the evolution of the species and control of the pest.

Potential student tasks and responsibilities:

To investigate the behavioral biology and the reproductive output of the flies, the student will maintain cultures of the flies, sort flies for experiments, and perform experiments. All experiments will involve manipulation of the flies or environmental variables. The student will be completely trained in the lab by lab personnel that have extensive experience raising the flies, thus no prior experience is needed. As the student becomes familiar with the flies and how they behave, there will be opportunities for the student to develop new hypotheses and then design and execute the experiments to test the hypotheses. In addition to specific experiments, the student will be expected to contribute to basic lab maintenance (such as making fly food) as all lab members are required to do.

Student qualifications and characteristics:

The ideal student for this project is excited to learn about evolutionary biology and animal behavior. The student will need to have a set schedule each week, though the exact schedule is flexible. The student must be available during regular working hours for at least three two-hour blocks a week, but fewer, longer blocks are good as well. The student must have attention to detail, be organized and be willing to ask questions. The student will need to do some problem solving and troubleshooting because the experiments to be done have never done before. The experiments are not technically difficult, but may require some thought, as well as trial and error, to be executed properly. The student will need to be persistent and not easily discouraged. The student will need to

communicate when roadblocks are encountered with all members of the lab so that the group can help troubleshoot experimental issues.

Additional comments: This project does not require any field specific knowledge or experience. All that is needed is a willingness to try and the ability to communicate with others.

Position #9; *Lena Hileman*

Mentor name: Lena Hileman, Ecology and Evolutionary Biology

Job/project title: Genetic studies of flower diversity

Project description:

Flowers that are adapted to specific types of pollinators (bees, birds, moths, wind) exhibit pollinator specific floral traits. For example, flowers adapted to hummingbird pollination tend to have long, tubular, red/orange flowers producing a large nectar reward, whereas flowers adapted to bee pollination often have short, tubular, blue/purple flowers producing a small nectar reward.

In the Hileman lab, we are studying closely related pairs of species where one species in the pair is adapted to bee pollination while the other species in the pair is adapted to hummingbird pollination. We are using genetic studies in these species pairs to understand how adaptation to hummingbird pollination evolves. For example, what types of genetic changes are important for flowers to adapt to hummingbirds as a pollinator? Do many genes have to change in function? Do some single genes that change function have a corresponding effect on multiple floral traits? As we gain insight into the answers to these questions, we will have a deeper understanding of how and why some evolutionary changes in nature happen so frequently and apparently so easily - for example, evolutionary transitions from bee to hummingbird pollinated flowers.

The open position is for an undergraduate to work on a large, ongoing project with a postdoctoral researcher and graduate student in the Hileman lab. The project is focused on a very large number (100s) of plants that are the offspring of crosses between bee adapted and hummingbird adapted parental species. The undergraduate will contribute to both general plant care and to characterizing specific floral traits found in this hybrid population. This characterization includes taking careful measurements of specific floral organs, and harvesting tissues for later genetic and developmental analyses. The student will work closely with the postdoctoral researcher and graduate student on these tasks, but will be able to gain independence. This independence will be in the tasks described above, as well as in opportunities for more independent research on flower development and plant genetics depending on the student's level of interest and motivation.

Potential student tasks and responsibilities:

General plant care will include transplanting, watering, fertilizing, pruning, monitoring for insect herbivores, and herbivore remediation as necessary.

Characterization of floral traits across 100s of plants derived from a cross between bee adapted and hummingbird adapted species. This will include harvesting flowers on the day they open, dissecting

flowers to photograph (with calibration) specific floral organs, measuring nectar volume, and placing correct tissues into correct solutions or freezing for later genetic and cellular analyses. We have a very specific protocol to follow for data collection.

Depending on student interest and level of commitment, characterization of floral traits may also include using morphometric software to collect measurement data from photo-documented flower traits, mounting floral tissue onto microscopy slides, and using a different set of morphometric software, coupled with microscopy, collect measurement data on individual cell size across floral tissues.

Student qualifications and characteristics:

The ideal student for this position:

1. is interested in plant genetics and/or flower diversification
2. is available multiple (2-3) mornings each week (1-2 hours between 9am-noon) for plant care and floral measurements/documentation; additional microscopy and/or computer-based data collection can be done other times during the day.
3. will be committed and reliable with the agreed-upon schedule
4. is careful and detail oriented
5. is eager to learn, comfortable asking for help/clarification, and generally enthusiastic about asking technical and/or scientific questions whenever clarification or curiosity requires

Position #11; Elizabeth Koziol

Mentor name: Elizabeth Koziol, Kansas Biological Survey and the Land Institute

Job/project title: Mycorrhizal fungi of the Tallgrass prairie

Project description:

The student will assist with research projects that investigate prairie plants and their associated belowground mycorrhizal fungi. Generally, we are interested in plant-soil mutualisms and how microbes maintain plant community diversity and productivity. Our lab cultures fungi from old-growth prairie soils to include in novel prairie restoration experiments and in manipulative greenhouse experiments. Several of our lab members are also partnering with the Land Institute, where we are investigating the role of the soil microbiomes within perennial agriculture systems. Working on this project, a student would aid in assessing whether plant dependence on mycorrhizal fungi is changing with plant domestication.

Our lab recently relocated to KU from Indiana and our lab website has not transitioned to KU yet. However, our old Indiana webpage represents our research well.

<http://www.indiana.edu/~beverlab/research.html>

Potential student tasks and responsibilities:

The position will involve mainly laboratory work that will include isolating, identifying and quantifying fungal structures in the microscope, isolating root fragments for DNA amplification. The position will involve greenhouse work including experimental set up, monitoring, and plant and fungal harvesting. We also conduct field experiments that would involve monitoring plant community composition, weighing plant biomass, assessing soil properties, and the spread of fungal isolates.

Students will gain experience with the scientific method and lab techniques including plant propagation, fungal isolation, sterile technique, and many others. Many of our past undergraduate students have used their research experiences in our lab to conduct independent research projects and honors thesis projects in addition to going on to graduate school or medical school, to careers in industry as lab managers and quality control technicians, and other diverse fields.

Student qualifications and characteristics:

The ideal candidate would be comfortable across a range of working environments, such as in field, dirt lab, greenhouse, and molecular laboratory settings. Our work is varied and the ideal candidate would work well across these varied environments. Knowledge of prairie species or mycorrhizal fungi is not necessary.

Our lab currently has two professors (Drs. James Bever and Peggy Schultz), four post-doctoral scholars, three graduate students, four undergraduate student helpers and a full time lab technician. Thus, the ideal candidate would work well with others. Additionally, we have a number of different research project interests that the candidate could participate on.

Previous lab experience is not required. We can start off students with basic tasks, such as weighing plant biomass, and gradually progress to more complicated tasks as a new student is able. However a willingness to learn new techniques and to operate in a sterile environment, such as a molecular space, is required.

We are primarily interested in students with blocks of time of 3 hours or more 2-4 days a week any time between 9-5 M-F.

Position #12; Bruce Lieberman

Mentor name: Bruce Lieberman, Biodiversity Institute and EEB

Job/project title: Examination of the Diversity and Function of Early Animal Fossils

Project description:

Cambrian (~520 – 500 million years old) arthropods represent some of the earliest representatives of modern animals and comprise an extraordinary range of types and forms. In fact, several early arthropod groups hit the acme of their diversity in the Cambrian, relatively soon after they evolved. This project will focus on bivalved arthropod fossils from the Cambrian of Utah; these are enigmatic organisms that seem to represent early branching forms in arthropod evolution. Thus, enhancing understanding of these may provide key insights into the early evolution of the most diverse group of marine organisms alive today. Actual fossil specimens will be examined, and these are housed in the Division of Invertebrate Paleontology in the University of Kansas Biodiversity Institute (KUMIP), which happens to possess one of the largest collections of these fossils in the world.

In some cases, the two valves (which in overall shape somewhat resemble clam shells, although their structure and function was very different from these) are found associated with and surrounding the soft tissues of arthropods, such that their functions can be better interpreted. However, in many cases distinct valves are preserved without the arthropod that bore them. This complicates interpretation of function. It has been suggested that in some species these valves could be closed, and also allowed for swimming. Similar behaviors are seen in some modern crustacean groups. As of yet, however, this has not been tested in any detail.

The work proposed here aims to remedy that and expand our understanding of the life habits and behavior of these enigmatic bivalved organisms that lived during a key time period in the history of animal life. A student will be employed to measure the geometries of the Cambrian fossil valves, and thereby perform analyses to compare these with modern valves. Then in turn the student can ascertain in which species valves remained open in life position and also in which species could they be fully closed. Further, they can determine whether the valves could have functioned as anti-predator devices, and also the extent to which they show geometries compatible with what we see in modern bivalved crustaceans that swim.

Valves will be photographed and then a series of statistical analyses can be employed on the resulting valve outlines. Valves of modern crustacea will also be photographed for the purposes of statistical analysis and comparison. This work could result in a publication. The student will also assign longitude, latitude and error radius to the collection localities from where the bivalve fossils come from, in order to potentially identify patterns in their geographic distribution.

The results of this project will extend knowledge of the distribution and lifestyle of these distinctive Cambrian bivalved arthropods. Further, depending on the student interest, there is the possibility to extend the research such that specimens from other institutions beyond the KUMIP will be considered. Depending on progress and results, the student might be able to give a presentation at the KU Undergraduate Research Symposium and possibly the Geological Society of America Annual Meeting.

Potential student tasks and responsibilities:

- Taking high quality photographs of specimens that can be used for statistical analysis and publication
- Use various photo editing tools such as Adobe Photoshop and Illustrator
- Georeferencing fossil locations
- Possible taxonomic identification of Cambrian arthropod fossils
- Data entry
- Library research

Student qualifications and characteristics:

- Interest in Paleontology, Biology, or Geology
- Keen eye for details
- Self-motivated
- Interest in working in museum collections

Position #13; Terry Loecke

Mentor name: Terry Loecke, Kansas Biological Survey and Environmental Studies

Job/project title: Field and Lab Technician

Project description:

The Loecke Lab focuses on understanding how current environmental issues affect soil, air and water quality. Students working in the lab gain exposure to a wide variety of projects, while focusing their skills on a particular area of interest. More information can be found at:

<https://loeckelab.wordpress.com/>

Project Overview: We seek assistance from a student in developing a project to measure greenhouse gases and water quality in soils and wetlands. We rely on field sample collection and lab analysis, but also emphasize technologically advanced monitoring options, including sensors (to measure soil oxygen and temperature or water quality), micro-computers and remote sensing. We use these methods to understand how water and soil chemistry vary in space and time.

Potential student tasks and responsibilities:

Tasks and Responsibilities: The student will partly work at a nearby field site collecting air, water, and soil samples for chemical analysis. The student will also assist with analyzing soils from restored wetlands (in KS and OH). The student will assist in developing protocols and training materials for analyses.

Student qualifications and characteristics:

Qualifications and Characteristics: Curiosity in the environment and interest in learning cutting-edge analytical skills. Ability to communicate clearly and follow instructions; attention to detail, particularly for keeping lab and field notes. Interest in spending time outdoors and collecting water and soil samples. Students interested in combining scientific training with video and website production are particularly encouraged to express interest in this position. Any skills related to technology, including website development or computer programming, would also be useful in this position. Must be available for at least a 3 hour block within the 8-5 window.

Position #15; Minae Mure

Mentor name: Minae Mure, Chemistry

Job/project title: research assistant

Project description:

To make a recombinant electron-transfer flavoprotein (ETF) from a soil bacteria, *N. simplex*. The student will learn basic techniques in molecular cell biology and biochemistry such as culturing bacteria, isolating genomic DNA, cloning a gene coding for ETF, expression of recombinant ETF using *E.coli*, and protein purification. The ultimate goal of this project is to develop an enzyme-based histamine sensor. Such as sensor can be used to examine the freshness of seafood and its product.

Potential student tasks and responsibilities:

To work closely with postdoctoral researchers in the Mure lab, keep good records and participate in lab group meetings.

Student qualifications and characteristics:

- 1) student is required to work at least three hours per day, two days per week.
- 2) student needs to communicate well with postdoctoral researchers and the PI. Good record keeping, organizing and time-management skills.
- 3) interests in cancer research and eager to learn new techniques and skills

Position #18; *Raymond Pierotti*

Mentor name: Raymond Pierotti, Ecology and Evolutionary Biology

Job/project title: Ecological Knowledge in Different Cultural Traditions

Project description:

Upon my arrival at KU in 1992 I worked with Haskell Indian Nations University where I developed a program and a set of courses that are now incorporated in an NSF sponsored native American Science Curriculum (this can be viewed at www.nativeamericanscience.org). My goal was to examine and establish the scientific credibility of knowledge traditions from a range of Indigenous cultures. I am now interested in expanding this work into other cultures, specifically African or Latin American cultures. This work will involve texts and traditional stories and knowledge from Africa and Latin America. I expect that students will work with me and that we will work to prepare research that could be publishable.

Potential student tasks and responsibilities:

Students will meet with me on weekly basis as we work with the various museum and library resources. Students will be trained on reading and reviewing materials so that they dig beneath the surface of accounts and stories to find materials that present insights into cultural traditions. We will work with librarians to support our literature searches.

Student qualifications and characteristics:

Students working on this project should have an interest in learning and examining language and culture from Africa or Latin America.

Position #19; Jennifer Raff

Mentor name: Jennifer Raff, Anthropology

Job/project title: Research assistant in the Laboratory of Biological Anthropology

Project description:

The genetics collections of the Laboratory of Biological Anthropology (LBA) represent an important research resource for the University of Kansas and collaborating institutions. The collections consist of hundreds of DNA samples from populations worldwide, collected over decades of fieldwork. To continue research with these collections into the future, they need to be assessed for DNA quality and their associated records digitized and incorporated into a database.

Potential student tasks and responsibilities:

During the first semester, students will work primarily on digitizing records associated with collections and entering information into a database. This will comprise approximately 4 hours/week. The remaining 3 hours/week will be spent undergoing laboratory methods instruction from a graduate student.

During the second semester, students will additionally begin working with the collections in the laboratory using a combination of techniques including: DNA quantification with qubit and nanodrop instruments, PCR amplifications of samples, gel electrophoresis, DNA sequencing and sequence analysis. These will provide preliminary results for larger projects for undergraduate independent research into multiple questions, including population history, health and demography.

Student qualifications and characteristics:

No specific prior background is needed, as we will provide training in laboratory methods during the first semester. Ideally, students interested in this position will be curious, have patience and an eye for detail, and be interested in questions about human history and genetics. The Raff lab is committed to fostering undergraduate research experience, so students who succeed in the Emerging Scholars Program may be welcome to continue pursuing research throughout the duration of their undergraduate experience at KU. This project would be ideal for a student intending a career in medicine or life sciences research.

Scheduling requirements: Students must be available for weekly training on Wednesdays from 10:00 am-12:30.

Position #22; Benjamin Sikes

Mentor name: Benjamin Sikes, EEB

Job/project title: Soil microbes and land use

Project description:

Our lab (<https://bensikes.wixsite.com/sikesmicrolab>) researches the ecology of soil microbes such as fungi and bacteria. Soil microbes are largely unknown (i.e. we have identified about 2% of the estimated soil fungi), but are critical in nature, agricultural, and even in their effect on our health. In natural and managed ecosystem these microbes recycle nutrients in the soil, form partnerships with plants that help the plants access these nutrients, and cause important plant diseases that reduce food security worldwide. The function and effect of these soil microbes often depends on the diversity and makeup of their communities. Several factors influence microbial community composition including: soil factors (i.e. water content or fertilizer in the soil), the intensity and frequency of disturbance such as tillage or fires, and the identity of the plant hosts they partner with or attack. Our research explores how these factors shape soil microbial communities and how these changes affect both plant hosts and ecosystems, both of which are critical to restore natural systems and increase crop production in agricultural systems.

Potential student tasks and responsibilities:

There are currently a number of projects underway in the lab: Prairie monoliths for restoration: we are moving large chunks of native prairie (intact with soil) to disturbed sites in an attempt to improve prairie restoration success. Fire – fungal feedbacks: in fire-dependent ecosystems (i.e. prairies) we are collecting soils before and after prescribed burns to understand how fire effects soil microbes and how these changes might alter fuels for the next fire. Soil microbial accumulation on perennial crops: We are exploring how perennial crops may harbor different soil microbes than normal annual crops and whether shifted microbes will affect the yield of these cutting-edge agricultural systems. Students will be exposed to multiple projects and have the opportunity to gain experience in the field, greenhouse, and lab. Duties may include but are not limited to: assisting with collecting data and specimens in the field, greenhouse experimental setup and plant growth assessment, collecting and washing root samples, lab isolation and culturing of fungi, and DNA isolation from both environmental and/or pure cultures.

Student qualifications and characteristics:

We are seeking individuals with an interest in plant and soil biology to help with setting up experiments and data collection. Both data collection and technical work requires the ability to follow instructions, pay attention to detail, and communicate clearly. We ask that interested individuals be available for three hour blocks of time between 8 am and 5 pm Monday through Friday.

Position #23; George Tsoflias

Mentor name: George Tsoflias, Geology

Job/project title: Kansas Earthquakes

Project description:

When we think of earthquakes we think of California. However, in the last five years we have seen a large increase in the number of earthquakes occurring in Kansas and Oklahoma. We believe that wastewater produced in oilfields that is subsequently injected underground can cause earthquakes. In this project we use a network of seismic sensors installed at Wellington (south central Kansas) to detect earthquakes, pinpoint their location and measure their magnitude.

Understanding better how those earthquakes occur can help us manage the potential for damages caused to property and danger to human life.

Potential student tasks and responsibilities:

No prior knowledge in earthquake research is needed. The student will work in a team with undergraduate and graduate students (2 or 3) and will learn the methods we use to analyze data for detection of earthquakes. The data is in digital form and it is handled by computer. Typical tasks involve downloading data from the network, reformatting data and reading it into the software for analysis, visual observation of the data, identification of earthquakes, analysis of earthquakes for determination of location and magnitude. In addition, we conduct monthly visits to the network at Wellington KS for routine maintenance. The student applicant will be involved in all aspects of the research as the other team members. Students spend most of their time at Moore Hall, Kansas Geological Survey, on West Campus.

Student qualifications and characteristics:

Interest in physical sciences and curiosity on how natural processes work and affect our lives. Detail oriented and organized. Ability to work well with others. This is a team project and our work depends on the work of others. Reliable, responsible and able to complete tasks within the timeframe agreed. Work hours are flexible, but overlap with other students is essential for communication and training.