
Natural Sciences

Position #1; Brian Ackley

Mentor name: Brian Ackley, Molecular Biosciences

Job/project title: Genetic risk factors for tauopathies

Project description:

The Ackley lab is interested in understanding how mutations in genes in different individuals might alter their risk for developing neurological disorders later in life. To do this we are using a genetically tractable system, *C. elegans*. By expressing disease-associated variants of the human gene tau we can induce progressive synaptic loss. We can accelerate that degeneration when we introduce mutations in a *C. elegans* gene that is similar to a human risk factor for Alzheimer's Disease. There are more than 20 known genetic risk factors for AD, and most of those genes have orthologs in *C. elegans*. We are currently working to combine the *C. elegans* with mutations in those genes with our lines expressing the tau variants. Students will contribute to the generation of these new strains of *C. elegans*.

Potential student tasks and responsibilities: Tasks and responsibilities will include preparation of media for nematode growth and conducting genetic crosses to establish the new lines of *C. elegans* for our tauopathy model. *C. elegans* are simple to maintain and have a short generation time, and therefore, this work is well within the capabilities of a student who has never done genetic work before. Over the long term, the project may expand to learning how to do confocal microscopy and synapse analysis in the newly created strains.

Student qualifications and characteristics: Students should be well organized and attentive to detail. No previous experience with *C. elegans* is required. Curiosity about neural development and neurological disorders or a professional interest in biomedical research is preferred. The lab work is done using shared resources in the lab, and therefore students should be thoughtful and willing to maintain workspaces as they find them.

Position #2; James Blakemore

Mentor name: James Blakemore, Chemistry

Job/project title: Technician in Chemistry for Clean Energy and Sustainability

Project description:

Our laboratory focuses on addressing challenges in development of clean energy sources. We use the tools of contemporary inorganic chemistry and surface science to carry out our projects. Broadly speaking, a student that joins our group will prepare inorganic compounds and materials that are pure--purity is important because we must understand what happens to our compounds during experiments. Tools to accomplish this work include a solvent purification system, sublimators, and chromatography.

Potential student tasks and responsibilities: Potential student tasks include drying common solvents, preparing and purifying organic and inorganic compounds, preparing custom glassware for experimentation, and use of inert-atmosphere gloveboxes. Prior to beginning work, the student will undergo a thorough safety training and introduction to the work in our laboratory.

Student qualifications and characteristics: A student will be qualified for this position if they are interested in experimental chemistry research and working in a chemical laboratory. Our group values safety in the laboratory and therefore the student should be prepared to understand and follow all safety regulations--these include university, chemistry department, Blakemore laboratory, and project-specific procedures. In order to carry out the research tasks, the student should be ready to learn about new apparatus on a weekly-to-monthly basis and be detail oriented. Much of our equipment is custom-built and rather specialized, so care is needed when carrying out specific tasks. Presentations at our weekly group meetings are generally a requirement of every member of our group, although this may be optional depending on schedule and student preference.

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 #4; Josephine Chandler

Mentor name: Josephine Chandler, Molecular Biosciences

Job/project title: Laboratory Research Assistant

Project description:

The Chandler lab seeks to understand how complex behaviors like communication and cooperation evolve in bacteria. Such behaviors are considered social and studying these behaviors is part of an emerging field called 'sociomicrobiology.' Many bacteria communicate with dedicated chemical or peptide signaling molecules. These communications systems are widespread and found not only in bacteria but in animals, plants and even insects. Our lab is particularly interested in a type of communication called quorum sensing. These systems enable cell density-dependent changes in behavior (hence the term 'quorum sensing'). We study quorum sensing and how it benefits bacteria in different environments such as soil, interspecies competition, and infections. We also study how quorum sensing systems evolve in these environments.

The position is for a student to assist with general lab duties and research-related activities in the Chandler laboratory. This position will begin broadly so that the student can learn basic skills applicable to all projects from routine lab maintenance (e.g. washing dishes) to microbiological and molecular biological skills (e.g. growing bacteria, working with DNA). It is expected that, over time, the student will master these basic skills and be able to take on more responsibility and independence. It is also expected that the student will engage in the research going on in the lab and eventually transition to a more research-focused role in the lab that will be determined based on interests of the student and project availability.

Potential student tasks and responsibilities: The position would help support general lab activities by assisting with routine lab maintenance, such as washing dishes (automated dishwasher is available), making buffers, media and other lab reagents, autoclaving and disposing of lab waste, and general lab cleanup. As the position transitions to a more research-focused position, it would also involve learning and applying basic microbiological methods (growing bacterial cultures using aseptic technique), molecular methods (isolating and manipulating DNA), and other techniques specific to the particular research project.

Student qualifications and characteristics: We seek students that are interested and engaged in learning and the scientific process

1. is interested in molecular biology/microbiology
2. is available for ~2 hrs blocks several times a week (can be flexible), and available to stop by at other times briefly too.
3. will be committed and reliable with the agreed-upon schedule, and communicate changes as needed
4. is careful and detail oriented
5. is engaged and excited to learn, and comfortable asking for help
6. Is a good communicator and team player

Position #5; Dan Dixon

Mentor name: Dan Dixon, Molecular Biosciences

Job/project title: Laboratory Research Assistant

Project description:

The Dixon Laboratory (<https://molecularbiosciences.ku.edu/dan-dixon>) investigates gene regulation in cancer. Commonly observed in tumors is overexpression of many oncogenic and inflammation-associated genes, that allow the tumor cell to proliferate, promote angiogenesis, escape apoptosis, and metastasize.. Our work focuses on understanding why these genes are overexpressed and finding new approaches to target their expression. The Dixon Lab incorporated aspects of Molecular, Cell, and Tumor Biology to gain a better understanding of this important process in Cancer Biology. The position is for a student to assist with general lab duties and activities in the Dixon Laboratory. Students will develop essential skills that will allow them to perform independent research and learn the fundamentals of Cancer Biology.

Potential student tasks and responsibilities: The position would help support general lab activities involving:

1. Laboratory maintenance and reagent preparation.
2. Animal genotyping by PCR.
3. Mammalian cell culture.
4. Assisting with experimental assays.

Students work closely with lab personnel, keep good records and participate in lab group meetings.

Student qualifications and characteristics: 1. Great work ethic and communication skills; ability to work in a team/group setting.

2. Desire to learn research techniques and activities.
3. Interest in cancer research and/or molecular biology.

Position #6; Hume Feldman

Mentor name: Hume Feldman, Physics & Astronomy

Job/project title: Research Assistant

Project description:

Study the distribution, dynamics and morphologies of galaxies in cosmological simulations

Potential student tasks and responsibilities: The job entails programming (mainly in python). The student will learn how to find cosmological simulations of the universe online, download the data and use the results of the simulations to study the large-scale-structure of the universe. Students will learn how to use the python programming language to create mock surveys from the simulations and develop statistical and analyses skills to study cosmological models and compare them to real data from astronomical surveys.

Student qualifications and characteristics: Students should be self motivated and willing to work hard to learn programming as well as new concepts in astrophysics and cosmology. There is no need to have advanced computing skills, some background in computing or at least a willingness to learn how to program is necessary.

Position #7; 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 that affect male and female reproductive success. 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.

This project does not require any field specific knowledge or experience. All that is needed is a willingness to try, the ability to communicate with others, and the ability to plan weeks in advance.

Position #8; *Richard Glor*

Mentor name: Richard Glor, Ecology and Evolutionary Biology/Biodiversity Institute

Job/project title: Research Assistant

Project description:

The University of Kansas is an internationally recognized leader in research on reptiles and amphibians. The KU Herpetology Division is home to the 4th largest collection of reptile and amphibian specimens in the United States and a diverse group of more than a dozen active researchers. KU Herpetology conducts research on global reptile and amphibian diversity through a combination of field work and specimen-based research on the KU campus. Numerous distinct projects related to systematics, evolution, biogeography, genetics, morphology, conservation, ecology, or behavior of reptiles and amphibians will be available to undergraduate researchers. The work required for these projects could range from cataloging biodiversity specimens to acquisition and analysis of genomic sequence data. The student and their potential mentor will work together to choose a project that is most appropriate given the students interests and prior experience.

Potential student tasks and responsibilities: Entry level students will generally be expected to assist with inventory, cataloging and maintenance of biodiversity specimens and associated databases. Students who are successfully trained in these areas will move on to receive training in advanced morphological methods, molecular genetics and related areas.

Student qualifications and characteristics: Students must be available for at least two significant (3+ hour) blocks of time during business hours each week. This position will involve work in a laboratory environment, and therefore requires attention to detail and the ability to learn and follow laboratory safety protocols. Students should also have a strong interest in biology or biodiversity science with an interest in potentially pursuing a career in these fields.

Position #9; Victor Gonzalez

Mentor name: Victor Gonzalez, Undergraduate Biology Program

Job/project title: Biology and diversity of native pollinators

Project description:

Insects are the most common group of animals on the planet and some are beneficial to our health and economy. For example, we have about 4000 species of native bees in North America (four times the number of bird species!), and they not only make honey, but also increase the yield of our crops via pollination. Despite the importance of bees, the biology of most of them is unknown and many species are rapidly disappearing due to pesticides and other environmental factors. Thus, this project investigates several aspects of the anatomy, behavior, and biology of our native bees.

Potential student tasks and responsibilities: You will have the opportunity to:

- Learn how to recognize native bees
- Learn how to record, organize, and analyze scientific data
- Learn how to use statistical software
- Learn how to use online research platforms
- Learn how to use state-of-the-art imaging systems and digital editing software
- Develop communication skills throughout professional writing and illustration

Student qualifications and characteristics: Interest in learning as well as in developing curiosity and creativity

Position #10; Lynn Hancock

Mentor name: Lynn Hancock, Molecular Biosciences

Job/project title: Laboratory Research Assistant

Project description:

The Hancock Laboratory studies the opportunistic pathogen *Enterococcus faecalis*. Nearly all land animals, including humans, harbor enterococci in their digestive tract. In healthcare settings, particularly intensive care units, enterococci are able to transition to a pathogenic state when introduced into extraintestinal sites. They are leading causes of catheter-associated urinary tract infections, bloodstream infections, and surgical site infections. The growing emergence of antibiotic-resistance exacerbates the challenge of treating patients with an enterococcal infection. The laboratory investigates how enterococci establish infection and we study cell-cell communication in the context of biofilm formation. We are also interested in identifying bacterial factors that assist in nutrient acquisition during infection.

Potential student tasks and responsibilities: We are looking for a student with an interest in Microbiology, Molecular Biology or Biochemistry. As the scholar joins our research team they will initially assist with general lab duties and maintenance, including preparing growth media for growing bacteria in the laboratory, making chemicals used by laboratory scientists and assisting with a variety of ongoing projects in the lab. Lab maintenance involves washing glassware (loading and unloading dishwasher), restocking disposable consumables, handling lab waste disposal by autoclaving and assisting senior laboratory personnel in day to day operations. As the scholar develops proficiency in performing routine laboratory duties, they will transition to an independent research project.

Student qualifications and characteristics: 1) Desire to learn about the scientific enterprise; 2) Highly dependable and willingness to commit to a consistent work schedule (ideally we are looking for a student that can commit to a minimum of 2 hour blocks on work days); 3) Ability to receive and follow instructions from senior laboratory members; 4) Be a contributing member of an interactive team of laboratory scientists.

Position #11; Ted Harris

Mentor name: Ted Harris, Kansas Biological Survey

Job/project title: Lake and Reservoir Research Technician

Project description:

The Harris lab is seeking a student to assist with bathymetric surveys and the aggregation of historical Harmful Algal Bloom (HAB) data from reservoirs in Kansas. Bathymetry – the mapping of lake bottom contours - determines reservoir water storage capacity, how much water capacity has been lost due to accumulated sediment since reservoir impoundment, and how quickly a reservoir is infilling with sediment. Thus, bathymetric maps allow researchers to determine the quantity of water a reservoir could hold during droughts and floods.

Harmful Algal Blooms (HABs) degrade the water quality of reservoirs in Kansas. HABs pose a serious threat to human and animal health due to the production of potent toxins. Additionally, HABs produce taste-and-odor compounds that are difficult to remove in drinking water treatment, and ultimately increase drinking water costs. Collected bathymetric and HAB data and will ultimately be used to help determine water supply storage and mitigation strategies for harmful “blue-green” algal blooms in Kansas.

Potential student tasks and responsibilities: The student will learn how to (1) calibrate and operate bathymetric hydro-acoustic equipment, (2) analyze bathymetric data using Biosonics software, and (3) aggregate historical Harmful Algal Bloom and associated water quality data from multiple state and federal agencies. The student may also learn how to aggregate harmful algal bloom data into the Global Microcystin Aggregation project through the Global Lakes Ecological Observatory Network (see <http://gleon.org/research/projects/global-microcystin-aggregation-gma>). Skills learned within the position are applicable to skills needed for academic, government, or private consulting employment opportunities.

Student qualifications and characteristics: An interest in learning applied environmental research skills, the basics of the computer language R, and being outdoors. Applicants are required to have the following skills: clear communication, superb time-management and work ethic, and the ability to follow instructions. Although not required, please note any lifeguarding, boating, or computer programming skills.

Position #12; Scott Hefty

Mentor name: Scott Hefty, Molecular Biosciences

Job/project title: Laboratory Research Assistant

Project description:

The Hefty Laboratory (<http://hefty.faculty.ku.edu/>) investigates the obligate intracellular bacteria, *Chlamydia trachomatis*. Infections by these bacteria inflict an immense impact on public health as the most common cause of preventable blindness worldwide and sexually transmitted bacterial infections. Despite this immense public health impact, there is much about the basic biology and pathogenesis that is poorly understood. The Hefty Lab incorporates aspects of Microbiology, Biochemistry, and Cell Biology to gain a better understanding of this unique and critical bacteria.

The position is for a student to assist with general lab duties and activities in the Hefty laboratory. In learning and assisting in these activities, it is expected the student will develop essential skill sets that will enable their future desire to perform independent research. Additionally, it is expected that they will also learn about the scientific projects that are ongoing in the Hefty laboratory so that the student transitions into performing research on a project of interest.

Potential student tasks and responsibilities: The position would help support general lab activities

- 1) Glassware – Clean appropriately (automated dishwasher for most items) and place back on shelves.
- 2) Buffers – Replenish when necessary.
- 3) Waste – Autoclave biohazard, place in black garbage bags, take to outside dumpster.
- 4) Reagent area – Clean as needed (wipe off balances, replace bench paper, etc).
- 5) Pipette tips – Refill boxes, autoclave, and stack on shelves.
- 6) Packing material removal - Breakdown cardboard boxes and take to recycling and remove insulation boxes (Biostore will take most).
- 7) General autoclaving – autoclave glassware and/or reagents as needed (usually placed in tubs on the cart near the front lab door).
- 8) Bacterial media/plates – as needed, make LB broth and agar plates.

9) Electrophoresis gels – as needed, make agarose and acrylamide gels.

Student qualifications and characteristics: 1) Great work ethic, 2) desire to learn research techniques and activities, 3) interest in molecular biology and/or microbiology, and 4) considerate and constructive interactions within a team/group setting.

Position #13; 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 #14; Julien Kimmig

Mentor name: Julien Kimmig, Biodiversity Institute

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 antipredator

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 #39; Sarah LeGresley Rush

Mentor name: Sarah LeGresley Rush, Physics and Astronomy

Job/project title: Redesigning physics courses: how do we improve student learning?

Project description:

Recently there has been a push to redesign courses and the focus has primarily been on the delivery of the curriculum (course content). Students are increasingly being required to take a more active role in their learning. For example, in our introductory physics courses, instead of sitting and watching (or in many cases not watching) a lecture during class, students are required to read or watch videos before class. This allows the class time to be focused on solving problems (typically in a group environment) which is where students tend to struggle the most. Having already redesigned the delivery in many of our introductory courses, this project will focus on how redesigning the curriculum (specifically the reordering of the topics covered in courses) will impact student learning.

Potential student tasks and responsibilities:

- a. reading relevant articles related to the research (some articles will be provided and additional articles of interest can be chosen by the scholar)
- b. after reading the articles, try and determine what changes have been applied to the ordering of the physics topics
- c. determine if the changes have improved the grades, and/or attitudes and if so how was that measured (pre and post tests, student surveys, grades in courses, etc.)
- d. look at and analyze the data that we are collecting and work to find ways to present the data (presentation style might be similar to that found in the research articles)

Student qualifications and characteristics: Most important qualifications and characteristics are a willingness to work and a desire to learn! You don't necessarily need to be good in physics or interested in education. That would likely make the job more interesting and fun but is not required and training of the skills required will be provided. There will be a mandatory 1 hour meeting each week.

Additional comments: Here's your chance to get paid to think about how people learn and what approaches work best.

Position #15; Erik Lundquist

Mentor name: Erik Lundquist, Molecular Biosciences

Job/project title: Molecular Genetics Laboratory Work

Project description:

The goal is to teach the student the techniques and responsibilities involved in maintaining an active research lab in molecular genetics.

Potential student tasks and responsibilities: Learning to make solutions of various molar concentrations and pH.

Learning to make nematode growth medium plates for *C. elegans* genetics.

Learning sterile technique.

General lab tasks such as autoclaving, glassware cleaning and sterilization, and lab organization.

Student qualifications and characteristics: Dependability and reliability are a must.

Ability to work on and follow schedule.

Promptness and attentiveness to detail.

Position #16; Joanna Slusky

Mentor name: Joanna Slusky, Molecular Biosciences

Job/project title: help with scientific research to combat superbugs

Project description:

Bacterial resistance is an increasingly dire global health challenge. Efflux pump inhibition would stop bacteria from being able to shuttle out existing antibiotics, thereby preventing a return of the pre-antibiotic era. Our lab designs outer membrane proteins to disable efflux pumps and potentiate antibiotics. Students are needed to assist with our research enterprise.

Potential student tasks and responsibilities: Students will start with reagent preparation, molecular cloning, and assisting with keeping the laboratory clean and well stocked. The student will learn to use sterile technique. As the student develops mastery of tasks they are given they will be given more independence with the ultimate goal of having the student conduct original scientific experimentation.

Student qualifications and characteristics: A strong interest in biochemical scientific research is essential.

Curiosity, detail-oriented task management, and willingness to work with others are also important.

Student must be available to complete their work during normal business hours.

Position #17; *Lisa Timmons*

Mentor name: Lisa Timmons, Molecular Biosciences

Job/project title: Genetic and molecular analysis of RNA silencing mechanisms

Project description:

How genes are expressed and how DNA and chromosomes are protected from environmental assault are ongoing research interests of the lab. The laboratory utilizes the genetically tractable organism *Caenorhabditis elegans* as a vehicle of discovery to identify and analyze cellular components that are involved in RNA-directed gene silencing mechanisms. Students may assist in a number of ongoing projects, some examples include: genetic analysis of RNAi mechanisms, protein over-expression and biochemical assay development, or cell biological analysis of protein localization and function, for example.

Potential student tasks and responsibilities: The level of responsibility and involvement will depend on the interests/goals of the student, from roles as a research assistant all the way up to performing experiments independently and testing hypotheses as part of a research project that could lead to Honors in Biology. Short, introductory training sessions will focus on media preparation, sterile technique, and preparation of laboratory supplies and reagents. Students should progress and master tasks and scientific techniques of increasing complexity, such as PCR, plasmid cloning and molecular biology techniques, DNA sequence analysis and related techniques associated with DNA and RNA analysis, genetics and genotyping, microscopy, protein expression and analysis, transgenesis, and/or immunofluorescence techniques.

Student qualifications and characteristics: Previous experience is not required as students will receive extensive on-the-job training. We can accommodate students who lack advanced courses in biology and may not be able to comprehend our research goals at the outset. A successful student will be responsible, careful, dependable, communicative, will learn quickly, and will get along well with the rest of the group. The work schedule can be flexible; however, at the outset, the student will not be allowed to work alone; work hours must coincide with those of other lab members.

Additional comments: We have mentored freshmen and work study students, including non-biologists, and can mentor students with programming expertise.

Position #18; 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 injection of wastewater in deep wells 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 Kansans.

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 Slawson Hall, in the new Earth Energy and Environment center.

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.

Position #19; Robert Ward

Mentor name: Robert Ward, Molecular Biosciences

Job/project title: Research Assistant

Project description:

In most animals, organs and tissues grow at different rates relative to each other (think for example of how the size of the head compared to the body changes in a human from infancy to adulthood), which suggest that there must be tissue-specific mechanisms to control their differential growth. Surprisingly, we know little about these mechanisms. One way to understand these mechanisms is through the characterization of mutations that specifically alter growth in a single organ in a genetically tractable model system. We have been studying these mechanisms using the larval trachea of *Drosophila melanogaster*. The larval trachea is an excellent model system for studying tissue-specific growth. Not only is the larval trachea a well-studied tubular organ that expands in size and complexity in response to the increasing oxygen demands of a developing animal, it also can be easily visualized and measured in living animals. In a genetic screen we identified mutations in eight genes that show altered growth specifically in the larval trachea. The detailed characterization of these mutations provides a unique opportunity to uncover the genetic mechanisms of larval tracheal-specific growth regulation, and are likely to shed light on similar growth pathways in other organs and tissues in a wide range of organisms. The main focus of this project is to identify the genes that are affected by these mutations and characterize their role in growth regulation. This will be accomplished by a combination of genetic and cell biological analyses including antibody staining and microscopy.

Potential student tasks and responsibilities: The student will be trained in fly husbandry, immunohistochemistry and microscopy. The student will maintain a collection of fly stocks, complete complementation analyses with mutations in candidate genes, conduct RNA interference experiments to test candidate genes, isolate and sequence genomic DNA from mutant flies, and perform antibody stains to examine the expression and localization of critical proteins in wild type and mutant tissues.

Student qualifications and characteristics: The student does not need any experience with genetics or fruit flies, as we will provide all the training necessary. The genetic analysis requires morning hours (sometime between 9-11) two to three days a week. The ideal student will have good record keeping and organization skills, and a good eye for detail.

Position #20; Malgorzata (Maggie) Witek

Mentor name: Malgorzata (Maggie) Witek, Chemistry

Job/project title: Biological Cells Immuno-phenotyping and Analysis in Cancer Diagnostics.

Project description:

Our laboratory is evaluating the process of rare biological cell isolation using microfluidic devices and the identification of cancer cells via immunostaining. The work aims at the development of assays for detecting cancer cells in blood for disease diagnostics. The work will involve the characterization of the process of transferring released cells from a microfluidic chip to a glass slide, utilizing different architecture transfer devices.

Potential student tasks and responsibilities: The candidate will learn how to (i) grow mammalian cell cultures in the lab, (ii) isolate cancer cells in microfluidics, (iii) stain and (iv) count biological cells using tools frequently used in biology, pathology, and bioengineering laboratories. These tools will include manual and automated staining systems and fluorescence microscopy. The student is encouraged (if time permits) to attend research group meetings and help analyze and interpret the results. Successful completion of the project may result in publication.

Student qualifications and characteristics: Experience is welcomed but not necessary; however, this position requires attention to detail, good organization, and the ability to follow instructions with great care. This position will involve work in a laboratory environment and requires ability to learn and follow laboratory safety protocols. The student must be available for at least a 3-4 hour block once per week (preferentially twice a week) within the 8 am-6 pm window.

Position #21; Chi Zhang

Mentor name: Chi Zhang, Geology

Job/project title: Geoscience lab assistant

Project description:

This student will work in the research laboratory of Dr. Chi Zhang at the KU Lawrence campus. Dr. Zhang's research program involves the development of innovative geophysical monitoring approaches sensitive to alterations of physicochemical properties in different porous media. The student's duties will include but are not limited to: assisting in bench-scale and pilot-scale geophysical experiments using nuclear magnetic resonance and geoelectrics, reviewing the pertinent literature, designing and conducting experiments involving rock and fluid characterization using geophysical methods, analyzing acquired experimental data, performing necessary chemical and image analysis, maintaining excellent written and electronic data records, preparing and present routine summaries and presentations (oral and written), and helping prepare scientific manuscript for publication.

Potential student tasks and responsibilities: This position will entail lab work associated with the near-surface geophysics lab to perform geophysical measurements and analyses of porous media. The location is in Ritchie Hall G264A. The student will be responsible for collection, analysis, and demonstration of geophysical data. The student may also assist with the development of Matlab GUI that has a simple user interface for geoelectric measurements. Opportunities for field research trips may be made available depending upon amenable schedules.

Student qualifications and characteristics: The qualified student will need to demonstrate the 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. The student will need to have a set schedule each week, though the exact schedule is flexible. Data processing skills using Excel or Matlab experience is required.