Wen Zhang
Dr. Wen Zhang's research focuses on using microbiological processes to improve water quality. One project examines the impact of glycerol addition in nutrient removal at Rogers Wastewater Treatment Plant. Microbial community shift from activated sludge will be analyzed in addition to nutrient removal efficiency. The other project focuses on developing the genotoxicity assay using mammalian cells.

Cammy Willett
Plant response to stress, such as exposure to herbicides, is affected by environmental factors including light, water, and nutrient availability. One measurement of plant stress response is through changes in metabolism. The goal of the research project is to determine biochemical differences in metabolites of dicamba, an agriculturally important herbicide, in plants that are well-watered compared to plants that were water-stressed. Plants will be dried, ground, and extracted with solvents to isolate the dicamba metabolites. Samples will then be analyzed with UPLC-MS to quantify relative abundances of each metabolites. Metabolite abundances will be compared between the well-watered and water-stressed plants. The student will be involved with processing plants for analysis and will gain understanding of the use of UPLC-MS for detection of metabolites in plant tissue extracts.

Dicamba herbicide is an important tool for farmers to control trouble-some weeds. New soybean seeds are available that allow a farmer to use dicamba on the soybeans to kill weeds without killing the soybeans. However, if farmers plant soybeans without the new dicamba-resistant technology, dicamba can cause damage to the soybean even at very low concentrations. The amount of damage caused by the dicamba exposure (called drift) may be influenced by the moisture content in the soil. This research will help quantify the plant response differences following dicamba drift under different environmental conditions.

Plant extractions and UPLC-MS are methods used to address a wide range of research issues spanning biology, chemistry, biochemistry, medical science, pharmacology, crop and plant science, environmental science, food science, forensic science, and beyond. The REU student will gain valuable experience using methods relevant to a wide range of research problems, cultivating possibilities for future research in many fields of study.

Kent Kovacs
The options for large scale afforestation of private land are limited because of strong competition with other land uses, particularly agriculture. One way to encourage afforestation is for the government to pay agricultural landowners for easements on their marginal land and plant fast growing trees that may be harvested in the future. Currently, the Conservation Reserve Program (CRP), administered by USDA, is used to convert environmentally sensitive agricultural land into natural vegetative cover. The contracts on CRP typically last for 10 to 15 years, landowners receive rental payments based on soil productivity, and the USDA will pay up to 50 percent of the eligible cost of establishing a CRP practice. One potential practice that is beneficial for C sequestration in the Mississippi Delta is forest establishment. Trees not only sequester carbon during the contract period but also can be harvested for wood products like lumber that store C for longer periods or for fuel that replaces fossil-fuel C emissions. The REU student will identify the growth rates of different forest types managed for permanent natural cover and also for wood products.

Lauren Greenlee

Project 1.

Membrane Filtration for Water Treatment

In our research group, we develop novel membrane materials for water filtration. One of the first tasks once a new membrane is developed is to evaluate the performance of the membrane for filtering water. This project will focus on finalizing the setup of a lab filtration system, testing the system with commercially available membranes, and then comparing the results from the commercial membranes with a set of novel membranes made of chitosan and graphene oxide. We are developing these novel nanocomposite membranes made of a polymer, such as chitosan, and the nanomaterial graphene oxide to enable improved flux performance and removal of target water contaminants. If the student is successful in initial tests with pure water, there will be the opportunity to move on to testing a model water contaminant in filtration tests.

Project 2.

Nanoparticle Synthesis in a Continuous Flow Process

Part of our research is developing bimetallic catalytic nanoparticles for degradation of water contaminants during water treatment. Our research for this project is focused on transitioning our nanoparticle synthesis process from a small scale batch process to a bench scale continuous flow process. Our continuous flow system has been designed and the next step is to start making nanoparticles with this process and determine if we are able to produce the same nanoparticles with the continuous flow process. The project will focus on synthesis and then testing of the nanoparticles with a test catalytic reaction to see if the nanoparticles perform the same as those synthesized in the batch method. The target catalytic reaction will be either degradation of a model water contaminant or electrochemical water splitting for hydrogen production.

Project 3.

Conversion of Biofuels: Evaluation of Oxide Surfaces for Selective Sugar Attachment

This is a new research project where we are working with a collaborator at Georgia Tech to understand how sugars attach to catalyst surfaces that the Georgia Tech team is developing for sugar conversion during biofuel production. They are able to understand the total amount of sugar adsorbed but are interested in understanding the real time kinetics of how the sugars adsorb. In our lab, we have a unique instrument called a quartz crystal microbalance that can be used to measure molecule adsorption and desorption from surfaces in real time. Our goal with this project is to understand sugar adsorption to target catalyst surfaces such as zirconium oxide to help our collaborators design better, more efficient catalysts.

Brian Haggard

The REU student will integrate into existing projects related to water quality managed by PhD student, Abbie Lasater. Projects would potentially focus on streamflow and water quality monitoring, influence of nutrients on algal growth, and nutrient cycling between sediments and stream water. The student will have the opportunity to gain field, lab and data management experience in water research.

Michelle Evans-White

Ion concentration and identity effects on freshwater algae and herbivores: Gradual low-level, sub-lethal increases in ion concentrations such as sodium (Na), chloride (Cl), and bicarbonate (HCO_3) are common in US freshwaters, but their impacts on stream organisms and processes are not well understood. These ions may impact freshwater herbivore-algae interactions by 1) directly altering algal community composition, salt and nutrient content, and production, 2) directly altering herbivore consumption,

respiration, and growth via altered osmoregulation, and 3) indirectly altering algal food quality for herbivores. Students will design a greenhouse recirculating stream experiment to test the relevance of some of these mechanisms.

Dan Magoulick
Project 1.
Title: Influence of hydrologic alteration on fish species morphology and body condition

Project Summary: We will examine the relationship between a select group of fish species and hydrologic alteration. The fish species selected will be those shown to be important indicators of hydrologic alteration from our previous research. We will identify streams that have experienced varying levels of hydrologic alteration and collect fish from each stream and record abundance, morphology, and body condition. We will determine whether there is a relationship between these response variables and degree of hydrologic alteration, along with land use, climate, topography, geology and soils.

Project 2.
Title: Influence of flow regime on smallmouth bass and spotted bass growth and recruitment at the southern range extent

Project Summary: Climate change is expected to lead to increased extremes of precipitation and increased air temperatures over the next 50 years in the Ozark-Ouachita Interior Highlands. These changes along with altered land use are likely to affect flow regimes in this region. The Ozark-Ouachita Interior Highlands are at the natural southern range extent of smallmouth bass, and therefore climate change and flow regimes are likely to affect distributions and biotic interactions of smallmouth bass. Smallmouth bass are an important fish species in the Interior Highlands both ecologically and economically. We will examine the influence of flow regime on smallmouth bass and spotted bass spawning timing, body condition and recruitment in the Interior Higlands.

Project 3.
Title: Examining the effects of common ecological stressors on Ozark stream communities.

Project summary: Anthropogenic degradation of freshwater ecosystems represents a severe threat to global aquatic biodiversity. Three of the most detrimental ecological disturbances to stream systems—hydrological alteration, nutrient pollution, and invasive species—have profound and diverse impacts on aquatic communities and are often some of the most pervasive threats to biodiversity in developed countries. Because aquatic ecosystems often experience multifaceted anthropogenic degradation, exploration of the ecology of severely degraded streams represents an increasingly necessary and logical area of expansion to our understanding of disturbance mechanisms. This research will attempt to explore the dynamics of impacted ecosystems using a multifaceted approach involving experimentation and theoretical modeling. First, we will perform a manipulative study that assesses the potential ecological impacts of drought and nutrient pollution on a cross section of an Ozark stream community. Second, we will construct a model that explores the population dynamics of Ozark fauna under various disturbance scenarios.

What the REU student would get out of these projects:
1. Opportunity to develop and conduct a research project

2. Experience with different sampling, experimental and statistical techniques
3. Outdoor experience in the Ozarks
4. Authorship on a manuscript

Qiuqiong Huang
The project examines the factors that deter the adoption of irrigation scheduling techniques by Arkansas producers. The project also examines the effects of the mix of best water management practices on water use and irrigated acres and answers the question why some combinations of BMPs seem to lead to the unexpected rise in water use while other combinations do not.

Kusum Naithani
Project 1: Testing nanomaterial antenna to measure leaf gas exchange. This project will be done in collaboration with Dr. Roper in Chemical Engineering.

Project 2: High throughput phenotyping of rice genotypes to screen for drought and high nighttime temperature tolerance. This project will be done in collaboration with Dr. Pereira from Crop, Soil and Environmental Sciences.

Julian Fairey
Project 1. One EcoREU student is requested to assist with a project aimed at developing a fluorescence sensor system to detect early nitrification detection in chloraminated drinking water distribution systems. This project is supported by the Water Research Foundation, Dallas Water Utilities, and the City of Houston. Specifically, the EcoREU student will assist a graduate student in operating lab-scale biofilm annular reactor experiments and characterize the resultant waters, including measurement of fluorescence excitation-emission matrices, inorganic nitrogen and carbon, and monochloramine.

Project 2. One EcoREU student is requested to assist with a project aimed at elucidating the reaction pathway for N-nitrosodimethylamine (NDMA) in chloraminated drinking water distribution systems. This project is supported by the National Science Foundation. Specifically, the EcoREU student will assist a graduate student with batch kinetic tests and characterize the resultant waters, including measurement of NDMA by GC-MS and chloramine species.

Project 3. One EcoREU student is requested to assist with a project aimed at assessing carbon nanotube supraparticles (CNT-SPs) for removal of disinfection byproduct precursors. This project is supported by the National Science Foundation in collaboration with the University of Cambridge (UK). Specifically, the EcoREU student will perform microfluidic-based experiments to assess the sorption capacity of CNT-SPs and characterize the resultant waters by UV-Vis spectroscopy.

Jamie Hestekin
Project 1. Algae can grow on carbon dioxide, but bicarbonate is desirable in some cases. A detailed study of introducing bicarbonate to algae has not been done. We will do this with addition and with a separation process call EDI. The student involved in this will learn biological engineering skills as well as separation skills.

Project 2. Membranes can be used for a variety of applications. To do environmental experiments, the membrane must have incredibly low fouling capabilities. We are developing low fouling membranes due to functionalization. The student working on this project will do low fouling expeirments and test with different waters.