

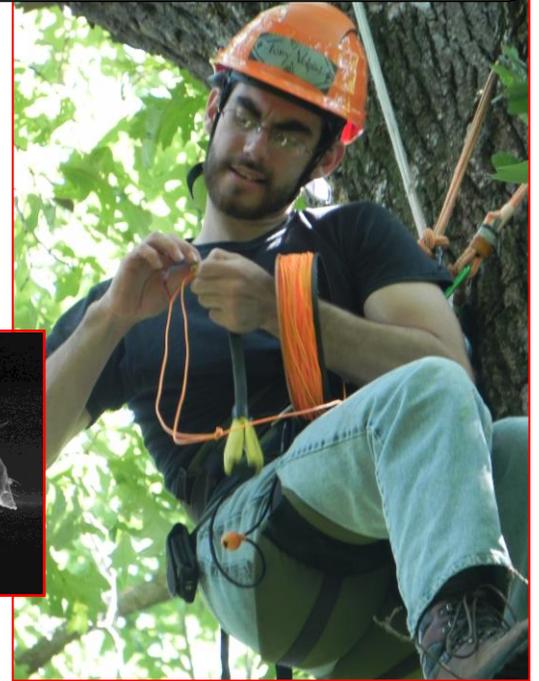
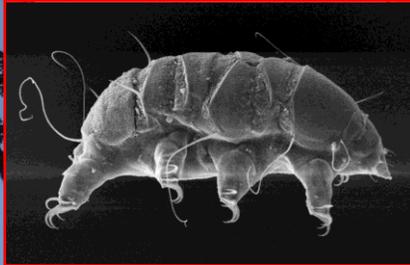
2016: REU: ANNOUNCEMENT

# In the Canopy with Wheelchairs and Tardigrades



Research Experience  
for Undergraduates  
DBI: 1461005

W.R. Miller,  
M. D. Lowman



**Want A Different  
Research  
Experience?**

Want new skills, new challenges, a research publication opportunity, a bit of adventure, and to be part of the future of the planet?

## An NSF: REU Research Opportunity

This is a three dimensional research project to define the taxonomy and distribution of Tardigrades (Water Bears) in the Canopy and the herbivory of insects on a North American deciduous forest. This project is a fast paced, tree climbing, data collecting, rapid analysis, and results oriented internship. It's not for the timid.

Students will be professionally trained to ascend into the canopy. There they will measure the impact of micro and macro invertebrates on the habitat and establish a baseline from which change can be measured. This is the cutting edge of ecological analysis in a world impacted by climate change. Students will learn to use remote sensing, GIS, and a Scanning Electron Microscope to document the micro environment.

Students will be employed for the summer. They will collaborate with the PIs to prepare their data for presentation and publication. They will also meet and network with the scientists and graduate students at the California Academy of Sciences, KU Microscopy & Analytical Imaging Lab, KSU LTER, and the Harvard Forest. Students may attend a regional or national meeting and present their results.

**June 1- Aug 9, 2016**

**Application Deadline: Sunday, March 13, 2016**

Dr. William Miller

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## The Project

This canopy based REU project offers students of all abilities equal opportunity to explore and learn. They may discover new species, define new ecologies, explore new limits, and reach new heights.

Based at the new Boyd Center, Baker University the project will explore the canopy of the Transition Zone between the eastern deciduous forest and the tall grass prairie biomes. By collecting in both environments we will measure the impact on species diversity, density and distribution by changes in habitat, substrate, height, chemistry and competition.

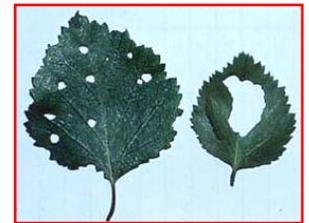


## Tardigrades or Water Bears

Tardigrades are microscopic animals that are known for being the first animal to have survived space travel. But on earth they are little known, little studied, and easy to work with. Water bears provide the opportunity for students to quickly get to the edge of knowledge and embark on true taxonomic and ecologic exploration and discovery.

## Herbivory

This measure of insect usage in temperate deciduous forests is totally under documented and offers the opportunity to put students on the cutting edge of discovery.



## Hypothesis

The hypothesis is that unlike the tropics there are no differences in the tardigrades, the herbivory or the chemistry at different levels in the deciduous trees of the Transition Zone of temperate forests.

## The Research

To test this hypothesis the team will conduct vertical transects at various sites on multiple species of trees. Field collections will be the moss, lichen, bark and leaves at each 3 meters up the trunk and out onto the branches of the study trees. Soil samples will also be taken from adjacent prairie and under the trees to build a clear picture of the complexity of the micro invertebrate life in the Transition zone.



In the lab students will extract, identify, and quantize the animals (water bears) found in each sample. Students will analyze the chemistry of the habitat (moss/lichen) for its influence on the interstitial aquatic environment in which the animals live. The leaves of the trees will be analyzed for insect herbivory. Data from remote sensors and metadata associated with the latitude and longitude of the site such as weather, geology, vegetation types, aspect, slope, will be layered for analysis.

Statistical analysis for diversity, density, association, and clustering, and patterns of distribution will be used and the data will be mapped with GIS to predict other places where similar populations might exist. The data will establish a base line from which change due to global warming can be measured in the future.

## Presentation

Students will use PowerPoint to present their findings to the scientists and public at the California Academy of Sciences and regional meetings. They will also have the opportunity to produce manuscripts for publication.

**Results: 2013 - 7 Publications, 2014 – 3 Publications, 2015 – 4 Manuscripts (so far)**

2013: Climbed 117 trees, took 543 samples, 4,256 Tardigrades: 16 species, 4 new to science, and 2,945 leaves  
2014: Climbed 135 trees, took 852 samples, 8,065 Tardigrades, 20 species, 4 new to science, and 7,000 leaves  
2015: Climbed 126 trees, took 764 samples, 8,307 Tardigrades, 17 species, 3 new to science

# We are recruiting students with ambulatory disabilities

Designed for 8 students, up to 4 with ambulatory disabilities, this project is based on the idea that wheelchair dependency is not a limit to good field biology or canopy access. To explore the canopy we climb ropes not trees, and in the lab we use microscopes, computers, and minds that have no boundaries.



Accommodation for wheelchairs is provided in living, transportation, and service arrangements but not in the scientific rigor of the experimental design. All students are expected to carry their own weight in the collection of samples from the canopy, environmental measurements, laboratory processing, data management, presentations and manuscript preparation.

## Citizen Science: Water Bears Hunts

Outreach or informing the public, especially students who may one day elect to become scientists, is a critical part of the learning process for our students. Our water bear hunts will blend the charisma of tardigrades and the adventure of canopy exploration into a public presentation.



We will set up a booth in the visitor's center with our microscopes and live water bears for the public. Flanked by SEM images, posters, and signage we will attract the patrons of the museum or arboretum to ask questions and learn about our animals and this NSF project.

We know from experience that both students and parents want to learn more about the animal that has recently survived exposure to true outer space. This element alone raises many questions about extreme survival, global warming, evolution, and the fragility of life on earth.

Tardigrade Hunt, California Academy of Sciences, 2014.

Under the professional supervision of Tin Kovar, we will take the public outside and teach them to ascend the ropes we use to actually collect tardigrades.

In 2014, we took more than 200 people into the High Frontier of the canopy.



We are looking for a few students who have the confidence to climb into the tops of trees and explore. Students who can ask questions that do not yet have answers. Students who want to learn from the unknown.

## The Study Environments

### **Baker Wetlands** ([bakeru.edu/wetlands](http://bakeru.edu/wetlands))

The Baker Wetlands is located 10 miles north of Baker on the south edge of Lawrence; the Wetlands comprise more than 800 acres of restored habitat, including a mature rapraian zone with walnut and elm along the Wakarusa River.



### **University of Kansas Field Station, NEON site** ([kufs.ku.edu](http://kufs.ku.edu))

The 3,400 acre KU Field Station is only 15 miles from Baker and offers diverse mature native Oak-Hickory forest adjacent to tall grass prairie. With a maintained trail system there is access to many examples of the proposed research trees. The station facilities with will allow us to use remote sensing.



### **Overland Park Arboretum** ([www.opkansas.org/overland-park-arboretum](http://www.opkansas.org/overland-park-arboretum))

The 300-acre Overland Park Arboretum & Botanical Gardens was founded to keep the city at the forefront of environmental and ecological issues. The team will conduct both basic research in the tall trees and hold a Water Bear Hunt for the patrons of the arboretum.



### **KSU, KANZA Prairie, LTER & NEON site** ([kanza.ksu.edu](http://kanza.ksu.edu))

The Kanza Prairie is 8,613 acres of native tall grass prairie with islands of tall trees near water and along streams. These isolated habitats may house unique species of tardigrades. The LTER has the history of remote sensing data available to be correlated with current collections.

### **Harvard Forest Biological Station a NEON site** ([harvardforest.fas.harvard.edu](http://harvardforest.fas.harvard.edu))

The team will travel to of Petersham, Massachusetts and the Harvard Forest to explore the canopy of oak-pine-hemlock forest typical of southern New England. The Station comprises over 3,700 acres, it is a NEON site and will provide great contrast of forest type.



### **California Academy of Sciences** ([www.calacademy.org](http://www.calacademy.org))



The CAS offers both interactions with the public and professional research into the biodiversity of the planet. Based on their collections and exhibits, the academy reaches out to people from all walks of life to educate and inform.

The REU team will climb and collect in a Douglas-fir forest for a third major type and visit the giant redwoods. Meanwhile, they will they will learn to use a Scanning Electron Microscope (SEM)

to produce images and data for analysis and their presentations & publications.

We will conduct climbing class and take the public high into the canopy while we hold an interactive Water Bear Hunt in the main hall, showing a thousand people a tardigrade up close.

The students will also present the results of their research at the Bay Area REU Symposium, to both the science staff and the public



### **Tree Climbing Kansas City** ([TreeClimbingKansasCity.com](http://TreeClimbingKansasCity.com))

The KC Tree Climbers are professional tree climbers with more than 50 years of tree climbing and teaching experience. They will train the students in SRT & DRT climbing techniques. KCTC will train and qualify our students to climb safely and make good decisions as part of the program.

## The REU Internship

This research program is a 10 week internship, from 31 May to 9 Aug, 2015. The project is a fast paced, tree climbing, data collecting, rapid analysis, and results oriented internship. It is not for the timid. The plan is to climb & collect one day and spend the day and evening processing specimens in the labs. Weekends include visits to local cultural sites and Water Bear hunts.

Interns will receive a stipend of \$525.00/week for the 10 week project, paid bi-weekly.

Students will be provided a shared apartment in university housing with Individual bedrooms, two bathrooms, a kitchen (refrigerator, stove, & dishwasher) , laundry, air conditioning & ceiling fans, wireless internet, ADA compatible, cable available. Close parking. One block from the research labs in the new Mulvane Science Hall.



Travel costs (to and from home or school) are included.

### Baker University ([bakeru.edu](http://bakeru.edu))

Baker University is the oldest university in Kansas with about 900 students on the Baldwin campus, 3,000 enrolled in the Professional Develop programs, 300 in the nursing school, and 200 in the School of Education.



### Mulvane Science Hall

Completely renovated and expanded with new labs, classrooms and offices in 2012, the Mulvane Science Hall houses the Ivan Boyd Center for Collaborative Science Education with a dedicated Tardigrade Research lab in addition to new Ecology and Chemistry labs to be used by the project. ADA accessible, the building is a show case of practical and usable science teaching and research spaces. Our REU was the first summer program to use the new facilities.

### Baldwin City, Kansas ([Baldwincity.org](http://Baldwincity.org))

Baldwin City is a small (pop. 4,500) mid-western town with tree lined streets about 15 miles south of Lawrence, KS. Built astride the Santa Fe Trail the services of the town are totally accessible. Just 3 miles from the Battle of Black Jack where the Civil War started, downtown is on one side of the Baker University campus and convenience stores, a market, banks, and takeout only two blocks the other direction. Emergency services are provided by the Baldwin City Fire Department, and the Lawrence Regional Hospital is only 15 miles away. Field trips to the Nelson-Atkins Museum, historic sites, the KU Natural History Museum, are planned. Some local businesses have promised a barbeque and even a fishing derby. Shopping trips to Lawrence are scheduled.

### Schedule

<b>Week 1</b>	<b>June 01-07</b>	Training: Climbing, Research, Herbivory, Tardigrades, GIS
<b>Week 2</b>	<b>June 08-14</b>	Baker Prairie & Blackjack Battle Field
<b>Week 3</b>	<b>June 15-21</b>	KU Field Station: NEON Site
<b>Week 4</b>	<b>June 22-29</b>	<b>Petersham MA, Harvard Forest a NEON site</b>
<b>Week 5</b>	<b>July 30-05</b>	KU Field Station: Rice Woods
<b>Week 6</b>	<b>July 06-12</b>	KSU-Konza LTER/NEON & Forest
<b>Week 7</b>	<b>July 13-19</b>	Water Bear Hunt at Overland Park Arboretum
<b>Week 8</b>	<b>July 20-26</b>	Specimen Processing
<b>Week 9</b>	<b>Aug 27-02</b>	Presentation Prep & Data Finalization
<b>Week 10</b>	<b>Aug 03-09</b>	California Academy of Sciences: SEM Imaging, Presentations, Climb Douglas Fir Forest, Water Bear Hunt and Climbing for Public Outreach



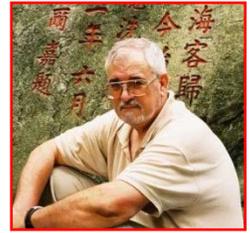
## Principle Investigators

### William R. Miller, Ph.D.

Baker University

Tardigrade Taxonomist & Ecologist

Director of Student Research at Baker, Miller has been the Principle Investigator on three major NSF grants about Tardigrades, he has published more than 70 popular & scientific papers and described more than a dozen new species. He has more than a dozen years of Canopy experience and presented data at the 2<sup>nd</sup>, 3<sup>rd</sup>, and 5<sup>th</sup> International Canopy Conferences.



### Meg D. Lowman, Ph.D.

California Academy of Sciences

Canopy Pioneer, Conservationist & Author

Chief of Science and Sustainability at the California Academy of Sciences and called the "Einstein of the treetops" by Wall Street Journal, Lowman has published over 120 popular books & scientific canopy articles. She can be seen in National Geographic's "Hero's of the High Frontier" video, was a leader in the Canopy segment of the Jason Project and is an advocate for conservation. Dr Lowman's research interest is herbivory, the use of canopy vegetation by insects. She has been instrumental in the design and construction of several canopy walkways which include ADA accessibility in the design.



#### Text Books

*Methods in Forest Canopy Research*, 2012. ed. M. Lowman, T.

Schowalter, and J. Franklin. Univ. California Press

*The Biology of Tardigrades*. 1994. Ian M. Kinchin

*Science, Ethics & Technological Assessment*. 2011. Donald Hatcher

**Qualifications:** US Citizen, undergraduate before & after program.

**Application:** on-line form, transcript, 2 reference letters, & why letter

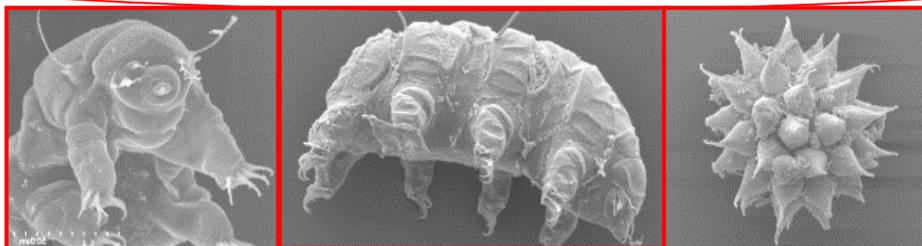
**Limited Positions:** **Apply Early**

**Application:** Apply on-line at [www.bakeru.edu/canopy](http://www.bakeru.edu/canopy)

Or submit by e-mail to [reu-canopy@BakerU.edu](mailto:reu-canopy@BakerU.edu)

**Deadline:**

**Sunday, March 13, 2016**



Questions?

<http://www.BakerU.edu/Canopy> or email [reu-canopy@bakeru.edu](mailto:reu-canopy@bakeru.edu)

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