Life in Extreme Conditions Research

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Environmental Biology Research

Dr. Allen G. Gibbs
Professor
School of Life Sciences
Phone: 702-895-3203
Email: allen.gibbs@unlv.edu

Expertise

- Environmental physiology
- Insect physiology
- Experimental evolution

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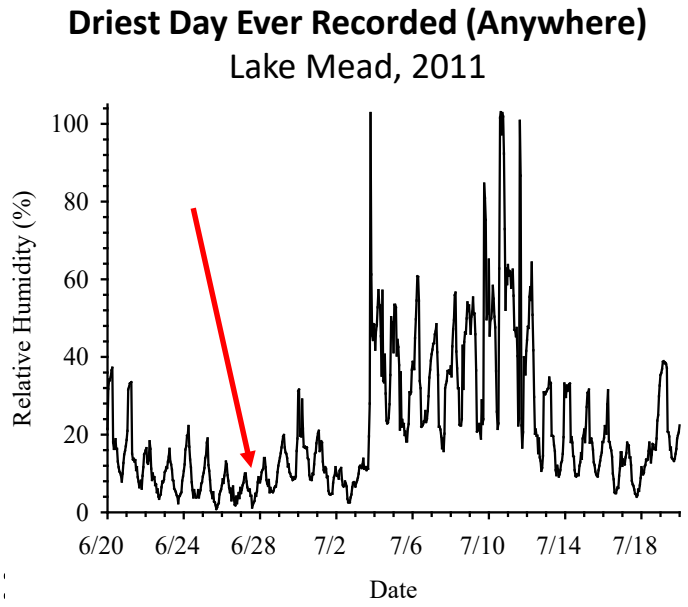
Environmental Physiology of Desert Invertebrates

Adaption to water stress:

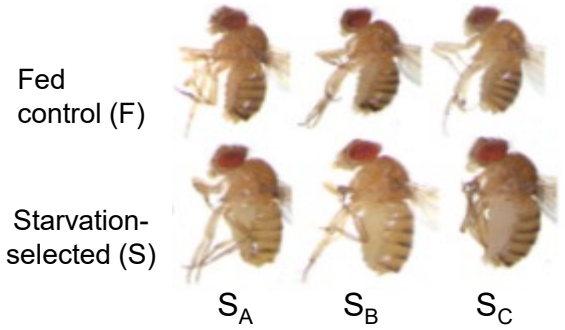


Adaptation to high temperatures:

Experimental Evolution Research Using Fruit Flies

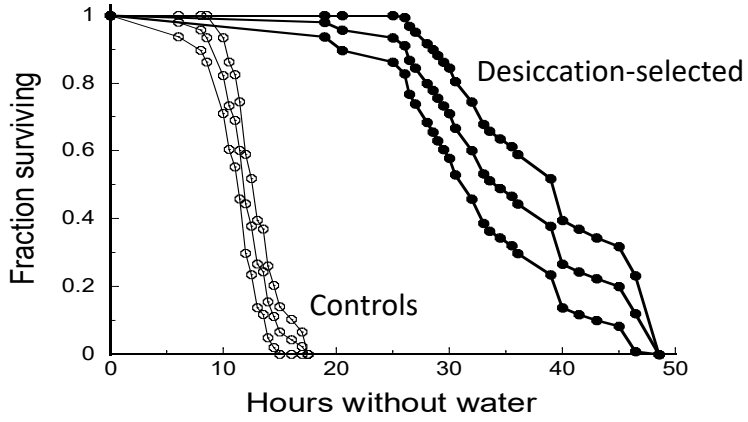
Starvation resistance:

- a fly model for obesity



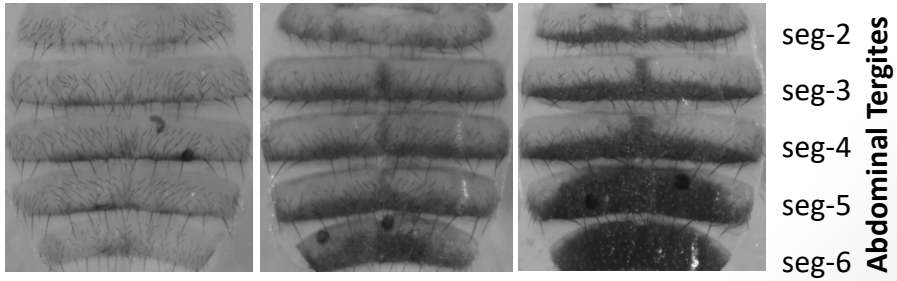
Desiccation resistance:

- understanding responses to desertification



Pigmentation:

- phenotypic correlations of melanization



Aqueous Geochemistry and Astrobiology

- **Dr. Elisabeth (Libby) Hausrath**
- Professor
- Department of Geoscience
- Email: Elisabeth.Hausrath@unlv.edu
- Website: https://hausrath.faculty.unlv.edu/

Expertise

- Using laboratory experiments, field work, and modeling to interpret water-rock interactions and soil-forming processes on Earth and Mars
- Interpreting the signatures of past aqueous and biological impacts on minerals
- Participating Scientist on the Mars Science Laboratory Curiosity and the Mars2020 rover Perseverance and member of the Network for Life Detection (NFOLD) Steering Committee..

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Holes made by sampling soil on Mars

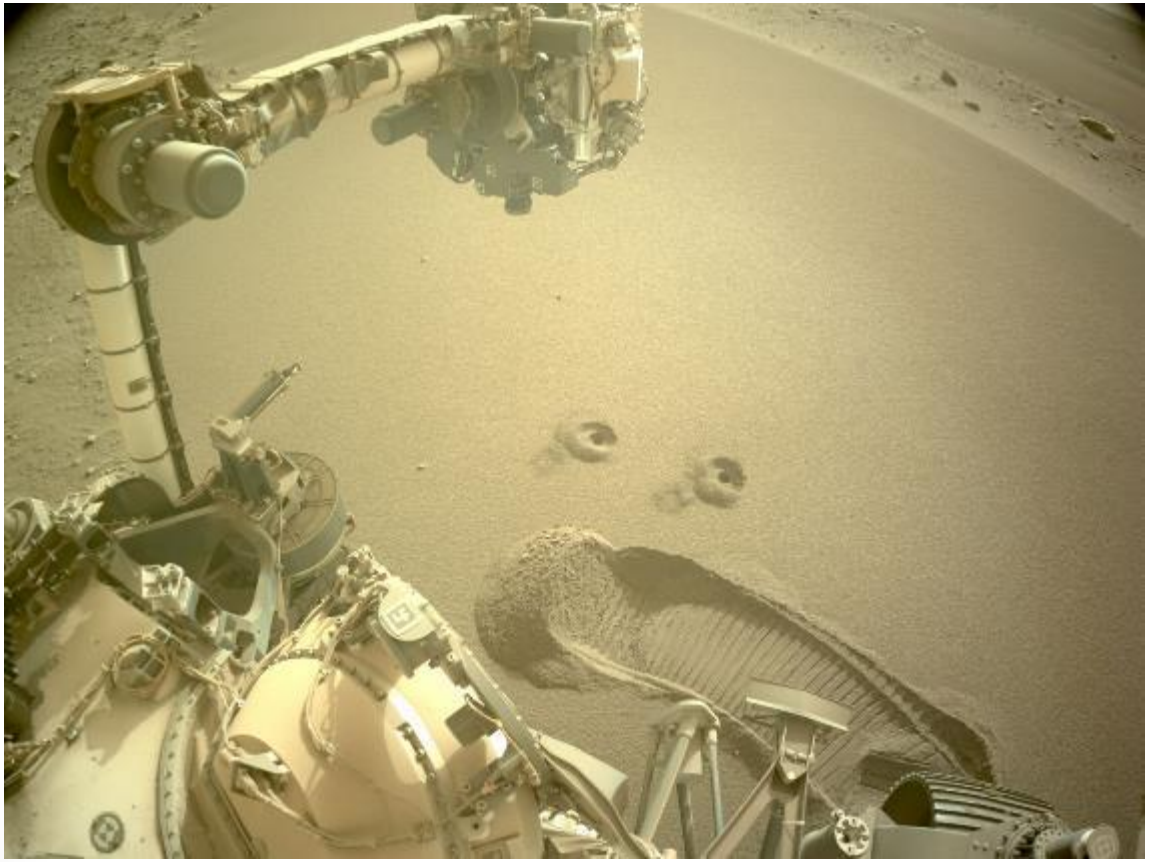

Image credit: NASA/JPL-Caltech

https://mars.nasa.gov/news/9311/nasas-perseverance-rover-gets-the-dirt-on-mars/#:~:text=The%20mission's%20first%20two%20samples,prepare%20for%20future%20missions%20there.

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Integrative Physiology

Dr. Allyson Hindle

Assistant Professor

School of Life Sciences

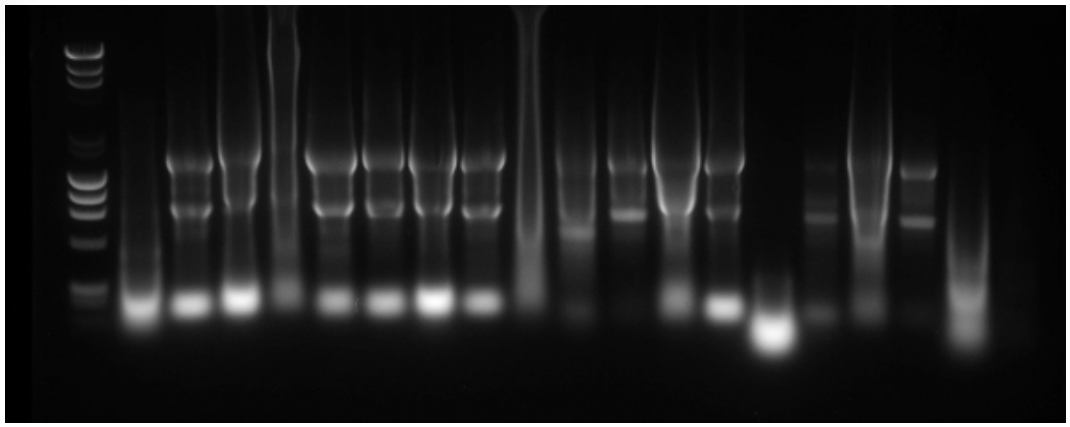
Phone: 702-895-4521

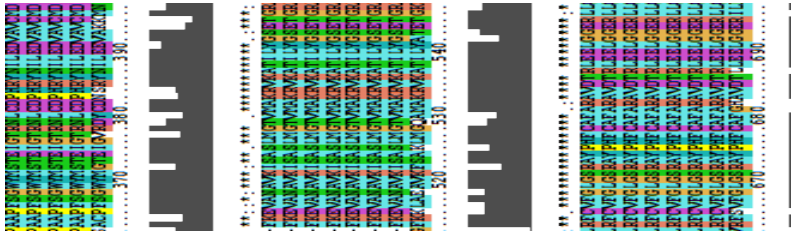
Email: allyson.hindle@unlv.edu

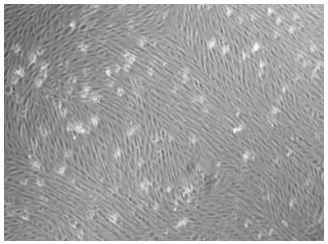
Expertise

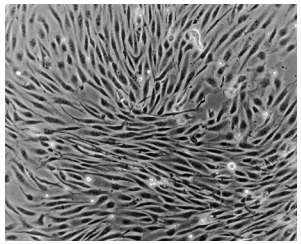
- molecular mechanisms of hypoxia tolerance in hibernating and diving mammals
- cardiovascular and blood pressure regulation
- comparative genomics, biomarker discovery and bioinformatics
- cell line resource development for non-model systems

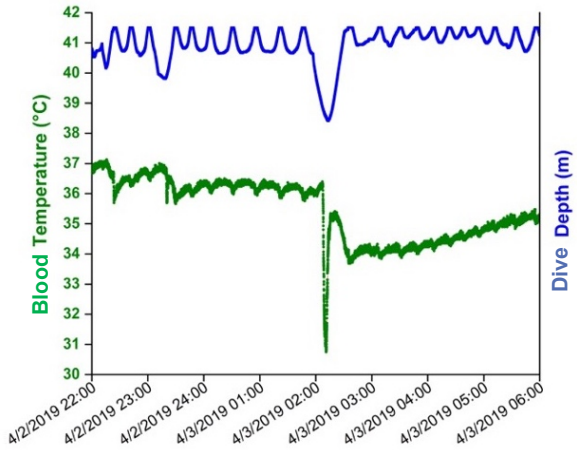
Cardiovascular protection of deep divers

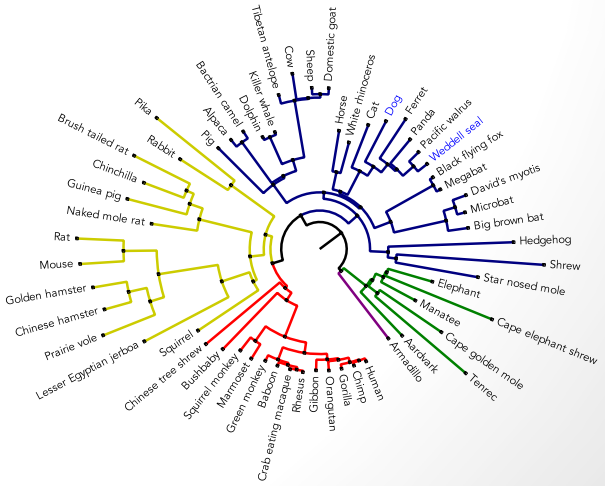




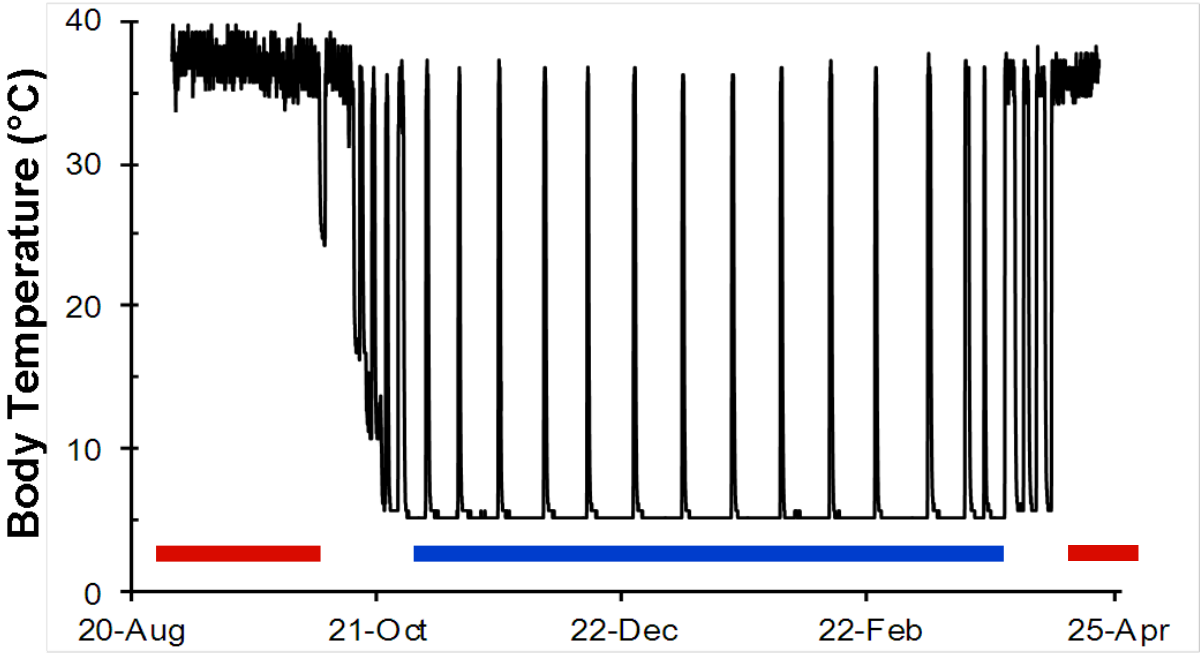






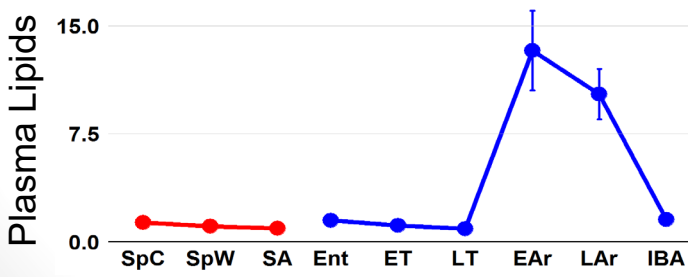


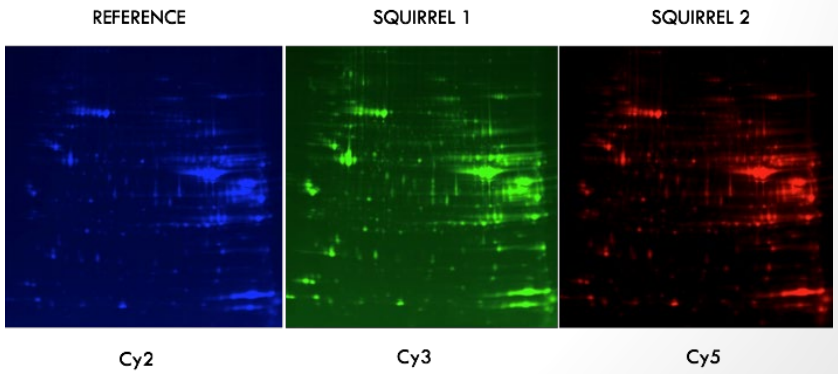
Metabolic control of small hibernators



SUMMER

WINTER





Meiselman Lab: Vectors and Dormancy

- **Dr. Matthew R. Meiselman**
- Assistant Professor of Neurophysiology
- School of Life Sciences
- Email: matthew.Meiselman@unlv.edu
- Website: meiselmanlab.com

Expertise

- Dr. Meiselman completed his PhD. In Cell, Molecular, and Developmental Biology at University of California-Riverside before studying neurobiology during his Postdoctoral work at Cornell University
- Dr. Meiselman focuses on the molecular and neural components which comprise dormancy (an extended depression of metabolism and behavior).
- Mosquitoes, ticks, and other medically-relevant arthropods depend on this state change for survival during winter or dry seasons
- We use the genetically tractable fruit fly as an “engine for discovery” to learn about this state, with the goal of applying this knowledge to other species to curtail the contraction of vector-borne disease

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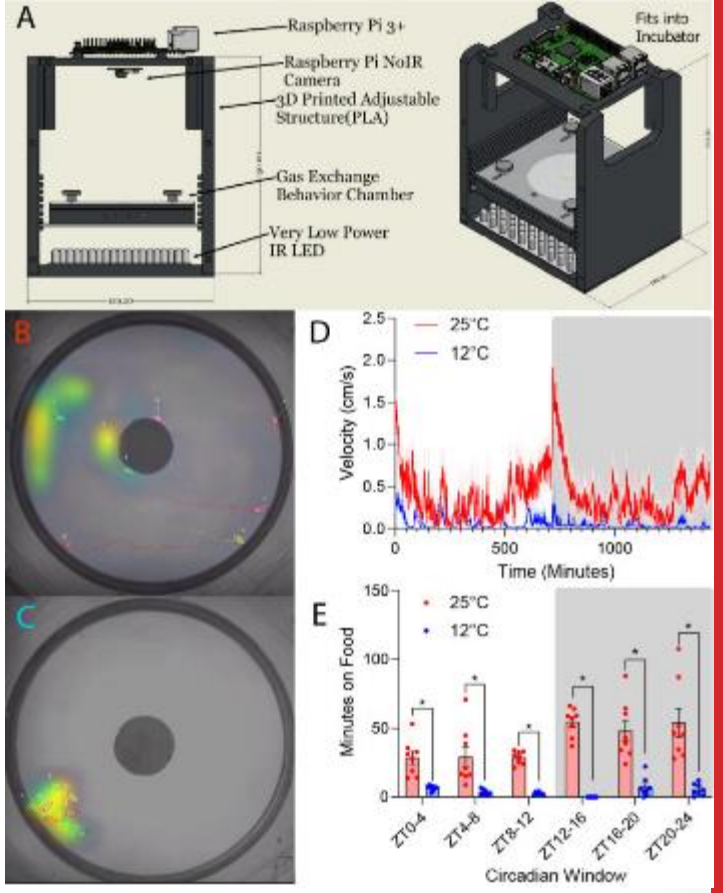
Our lab currently has two main projects:

1. We are searching for neurons that control dormancy in *Drosophila melanogaster*. By using transgenic activators and inhibitors of neural activity, we are attempting to induce dormancy (normally a response to cold) in warm conditions, and to prevent induction of dormancy in cold conditions. We are also searching for **ethological signatures of dormancy,** such as changes in circadian rhythmicity, sleep or photopreference, which can complement our metabolism-oriented definition.



2. We are attempting to understand the drivers of tick questing (hunting) behavior. We are using custom-built apparati and high-resolution video analysis to determine how tick circadian rhythm or activity levels respond to ambient temperature, humidity and lighting conditions. This may lead to better information linking climatic conditions to tick bite risk.

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Geomicrobiology

Dr. Aude Picard

Assistant Research Professor

School of Life Sciences

audeamelie.picard@unlv.edu

Expertise

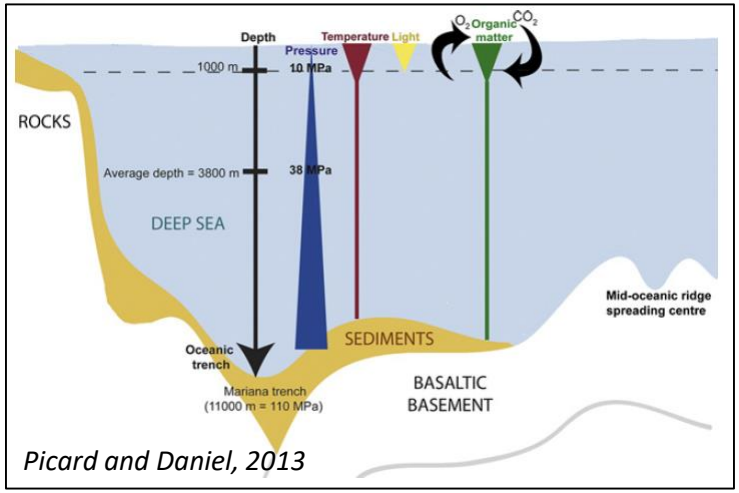
- Anaerobic microbiology
- Microbial physiology
- Biomineralization
- Astrobiology and biosignatures
- Microscopy & spectroscopy

Microbial life in extreme conditions

1 Microbial life under high pressure

◦ What are the pressure limits for microbial life?

High-pressure environments represent the largest habitat for microbial life on Earth



Picard and Daniel, 2013

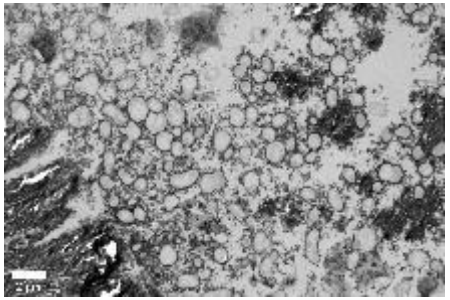
Oceans on icy moons (e.g. Europa) are potential habitats for microbial life in the outer Solar System

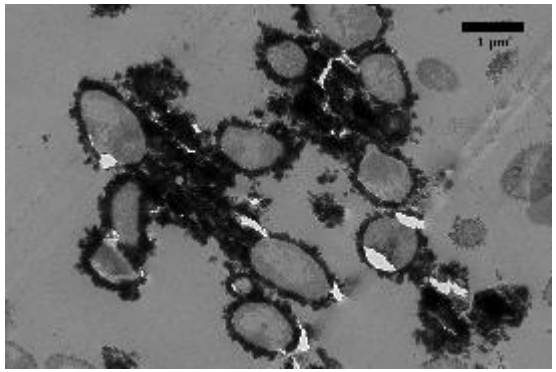
Europa (image credits: NASA)

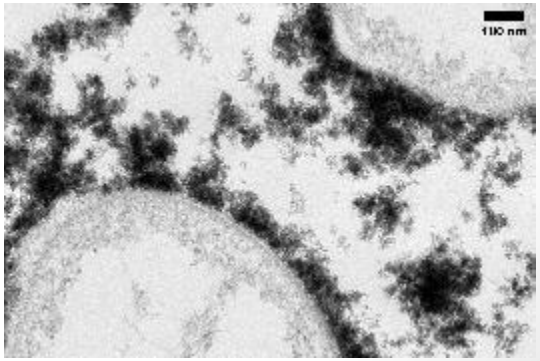
2 Microbe-mineral interactions

◦ How do bacteria cope with mineral encrustation?
◦ Do minerals play a role in long-term survival of bacteria?

Transmission electron microscopy images of bacteria encrusted in iron sulfide minerals







Dryland microbes and soil ecology

Dr. Nicole Pietrasiak

- Associate Professor of Sustainability in Arid Lands
- School of Life Sciences
- Email: nicole.pietrasiak@unlv.edu

Expertise

- Soil Microbiology and Ecology
- Biological Soil Crusts
- Phycology and Cyanobacteria/Algae Culture Collection
- Soil Science
- Dryland Ecology
- Biogeomorphology

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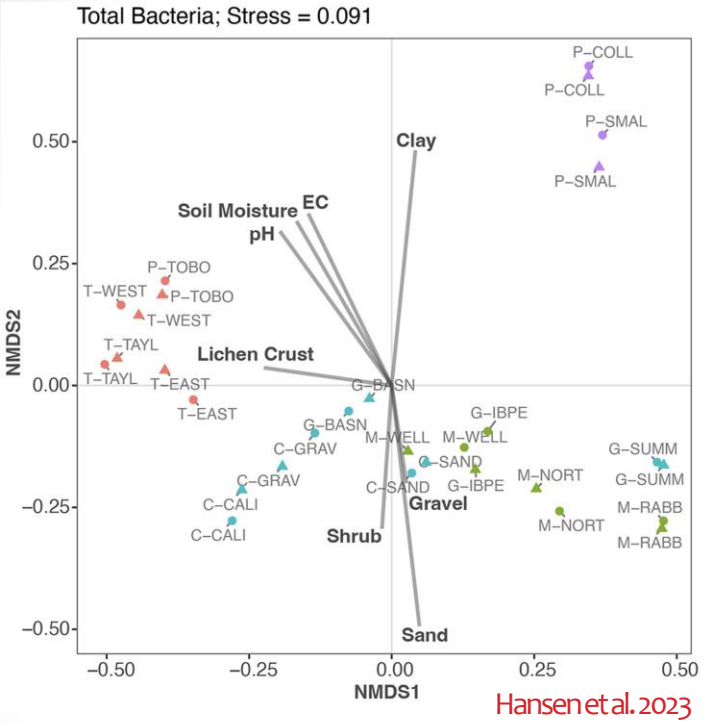
In our lab we investigate what shapes the diversity, abundance, and distribution of desert microbes



Hansen et al. 2023

Landscape and soil properties select for unique microbiomes

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DOI: 10.1111/jpy.12887

WHEN IS A LINEAGE A SPECIES? A CASE STUDY IN *MYXACORYS* GEN. NOV. (SYNECHOCOCCALES: CYANOBACTERIA) WITH THE DESCRIPTION OF TWO NEW SPECIES FROM THE AMERICAS[1]

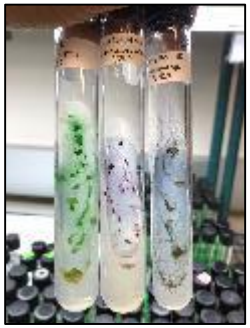
Nicole Pietrasiak[2]
Plant and Environmental Sciences Department, New Mexico State University, 945 College Drive., Las Cruces, New Mexico 88003, USA

Karina Osorio-Santos
Department of Comparative Biology, Faculty of Science, Universidad Nacional Autonóma de México, Coyoacán, Distrito Federal 04510, México

Sergei Shalygin
Plant and Environmental Sciences Department, New Mexico State University, 945 College Drive., Las Cruces, New Mexico 88003, USA

Michael P. Martin
Department of Biology, John Carroll University, University Heights, Ohio 44118, USA

and Jeffrey R. Johansen
Department of Biology, John Carroll University, University Heights, Ohio 44118, USA
Department of Botany, Faculty of Sciences, University of South Bohemia, Branišovská 31, České Budějovice 370 05, Czech Republic



We also describe species and genera new to science and society.

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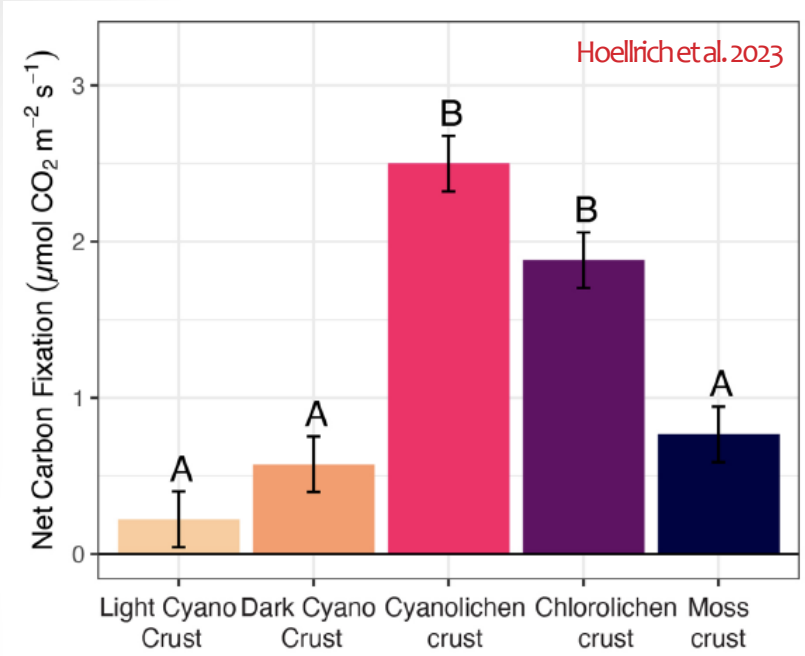
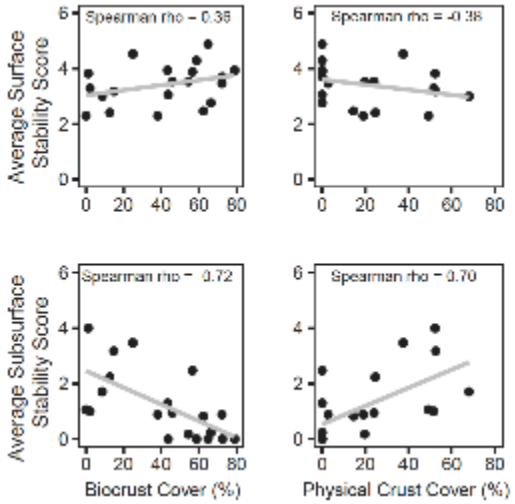
And we identify and quantify the roles microbes play in dryland ecosystem functioning and soil health



Dryland microbes are crucial for maintaining sustainable arid lands.



Stovall et al. 2023

Microbes are part of our dryland biodiversity. They prevent soil loss, increase soil fertility, control nutrient cycling, and contribute to carbon sequestration.

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Extremophiles

Dr. James Raymond
Adjunct Research Professor
School of Life Sciences
Phone: 702-895-3268
Email: raymond@unlv.nevada.edu

Expertise

Adaptations to cold environments
Snow algae
Ice-binding proteins
Horizontal gene transfer

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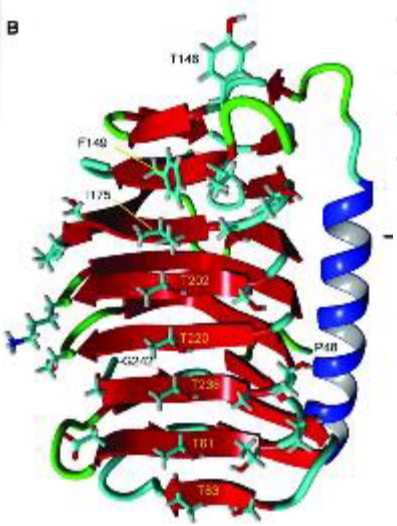
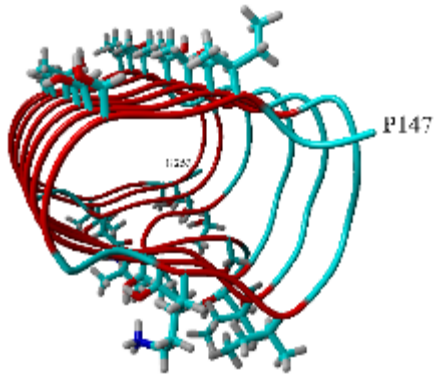
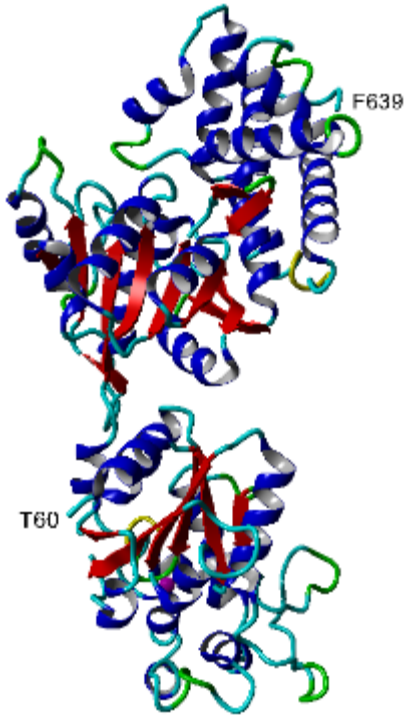
Much of the Earth's surface is exposed to extreme conditions such as freezing, high temperature and hypersalinity.

Organisms living in these regions have developed some remarkable adaptations that not only reveal the beauty of Nature, but also may have commercial applications (e.g., low-calorie ice cream) as well as provide clues to the presence of life in other worlds.

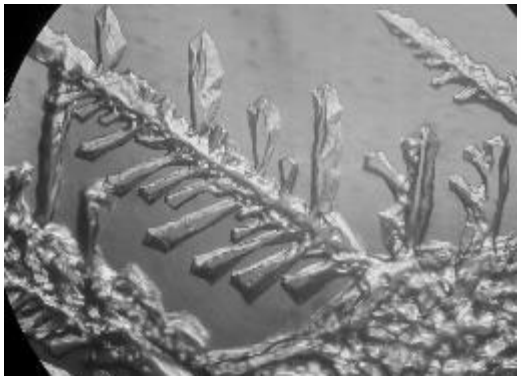


Ice-binding proteins. Above, from a snow alga from the Austrian Alps.[1] Below, from a grass growing on the coast of the Arctic Ocean.[2]





An unusual enzyme found only in a few species of algae. This one is from an alga that lives in a saline lake in Antarctica. The alga uses the enzyme to make glycerol so that it can remain in osmotic equilibrium with the lake water.[3]



Demonstration of how many proteins produced by microorganisms affect the growth of ice by binding to its surface. Here, proteins from a polar cyanobacterium distort the growth of a growing ice crystal.

References
1. Raymond and Remias (2019)
2. Sformo and Raymond (2020) (Submitted)
3. Raymond, Morgan-Kiss and Stahl (2020) (Submitted)

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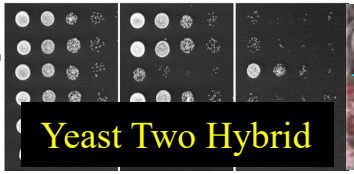
Dr. Jeffery Shen
Professor,
School of Life Sciences
Phone: 702-895-4704
Email: jeffery.shen@unlv.edu

Expertise

- Big Data Analysis to Study Biology, Agriculture and Medicine
- Molecular Mechanisms Controlling Plant Responses to Drought Heat, and Salinity
- Seed Germination, Tissue Culture and Plant Transformation
- Molecular Basis of Leukemia (in collaboration with Dr. J. Cheng at the University of Chicago Medical School)
- Nutrition of Cereal Crops (in collaboration with Dr. Christine Bergman, Ph.D. and R.D. at UNLV)

Molecular Basis of Drought Stress Responses and Seed Germination



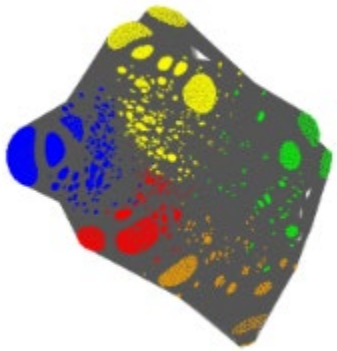
BMC Genomics, 2016, 17:102
Plant Science, 2015, 236:214-222
Front. Plant Science,2015; 6: 1145
Trends in Plant Sci, 2010, 15: 247

Short Read Assembly Algorithm

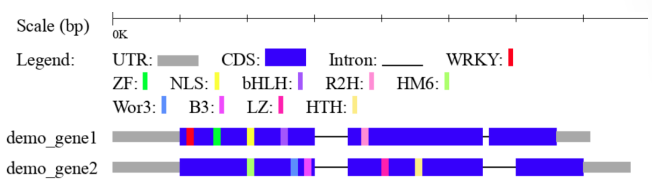
for Genome and Transcriptome Analysis

http://shenlab.sols.unlv.edu/shenlab/software/Tiling_Assembly/tiling_assembly.html

DNA Research, 2015, 22: 319-329
Genomics, 2014, 103:122-134



Signaling network Analysis



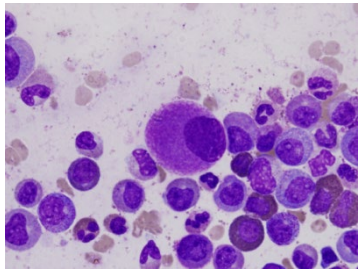
Promoter and Coding Region Structures

http://shenlab.sols.unlv.edu/shenlab/software/TSD/transcript_display.html

Bioinformatics, 2016, 32:2024-2025
Plant Cell Environ. 2017, 40:2004-2016

Molecular Basis of Leukemia

(in collaboration with Medical School, University of Chicago)



Cytogenetically normal refractory cytopenia with multilineage dysplasia (CN-RCMD)

Nature Communications, 2018, 9:1163
Leukemia, 2013, 27: 1291-1300

STEM Education Research

Dr. Jenifer C. Utz

Associate Professor in Residence

School of Life Sciences

Phone: 702-895-3386

Email: jenifer.utz@unlv.edu

Expertise

- Undergraduate STEM education
- Digital learning resources
- Mammalian hibernation

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Facilitating academic achievement for a diverse undergraduate population

- Effects of self-testing:

Voluntary Web-Based Self-Assessment Quiz Use is Associated With Improved Exam Performance, Especially for Learners with Low Prior Knowledge

Jenifer C. Utz, PhD[1] and Matthew L. Bernacki, PhD[2]
[1]School of Life Sciences, College of Sciences, University of Nevada Las Vegas, 4505 S. Maryland Parkway, Las Vegas, NV 89154
[2]Learning Analytics Initiative, College of Education, University of Nevada Las Vegas, 4505 S. Maryland Parkway, Las Vegas, NV 89154
jenifer.utz@unlv.edu, matt.bernacki@unlv.edu

Abstract
This study examined students' voluntary use of digital self-assessment quizzes as a resource for learning in a large anatomy and physiology lecture course. Students (n = 238) could use 16 chapter quizzes and four analogous unit quizzes to rehearse and self-assess knowledge. Most students (75%) engaged in occasional use of self-assessment quiz items; repeated use was uncommon (12%), as was lack of use (13%). Exam performance differed between quiz use groups. Quiz use improved exam performance more among students who entered the course with low prior knowledge of concepts from the prerequisite course. Cumulatively for all students and all exams, repeated self-assessment quiz users significantly outperformed occasional users (+7.5%) and non-users (+11.9%) on course exams. Incorporation of optional learning resources can enhance the learning success of students.

- Effects of skill training:

Journal of Educational Psychology

Can a Brief, Digital Skill Training Intervention Help Undergraduates "Learn to Learn" and Improve Their STEM Achievement?

Matthew L. Bernacki
University of North Carolina, Chapel Hill

Lucie Vosicka and Jenifer C. Utz
University of Nevada, Las Vegas

Students who drop out of their science, technology, engineering, and math (STEM) majors commonly report that they lack skills critical to STEM learning and career pursuits. Many training programs exist to develop students' learning skills and they typically achieve small to medium effects on behaviors and performance. However, these programs require large investments of students' and instructors' time and effort, which limits their applicability to large lecture course formats commonly employed in early undergraduate STEM coursework. This study examined whether brief, digital training modules designed to help students apply learning strategies and self-regulated learning principles effectively in their STEM courses can impact students' behaviors and performance in a large biology lecture course. Results indicate that a 2-hr *Science of Learning* to Learn training had significant effects on students' use of

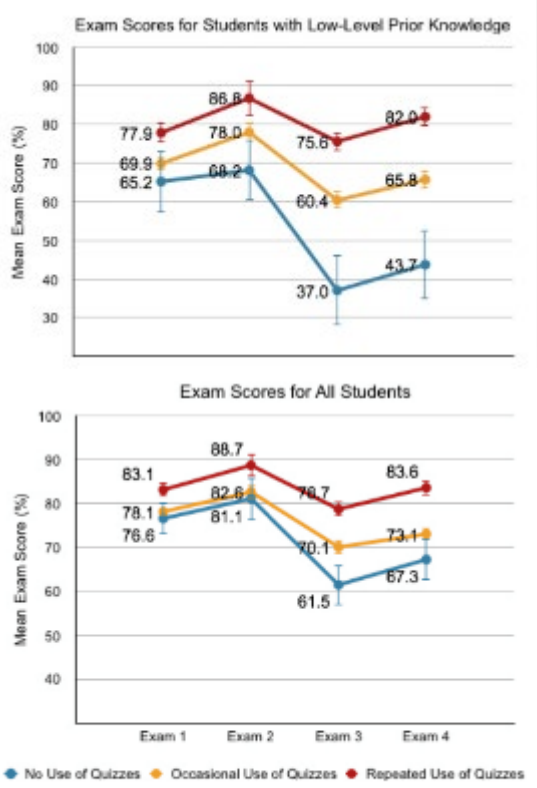

Figure 3. Effect of Self-Assessment Quiz Use on Exam Performance Symbols represent means ± standard error of the mean.

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Developing the Skill and Will to Succeed in STEM Scholarship Program

A primary goal of this scholarship program is to diversify and increase the number of students entering STEM professions

- The School of Life Sciences welcomed the first cohort of 17 Succeed in STEM Scholarship recipients in 2019
- Over $420,000 of scholarship support will be distributed across the lifetime of this 5-year program

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Hibernation physiology

- Rewarming from torpor:

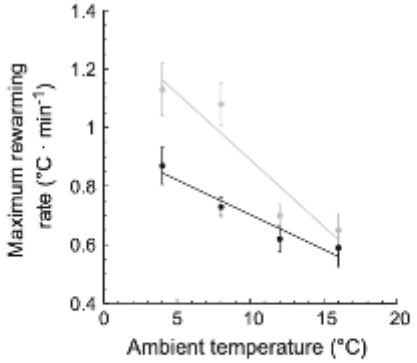


Fig. 3. Effect of ambient temperature on maximum rate of rewarming for natural and prematurely induced arousal from torpor. Symbols represent means ± SE for natural (black) and induced (gray) arousal; $n = 5$. There is a significant effect of T_a on the maximum rate of rewarming for both natural and induced arousals, $p < 0.05$, $r^2 = 0.93$, $r^2 = 0.88$ respectively. There is a significant effect of arousal type on the maximum rate of rewarming, $p < 0.05$.

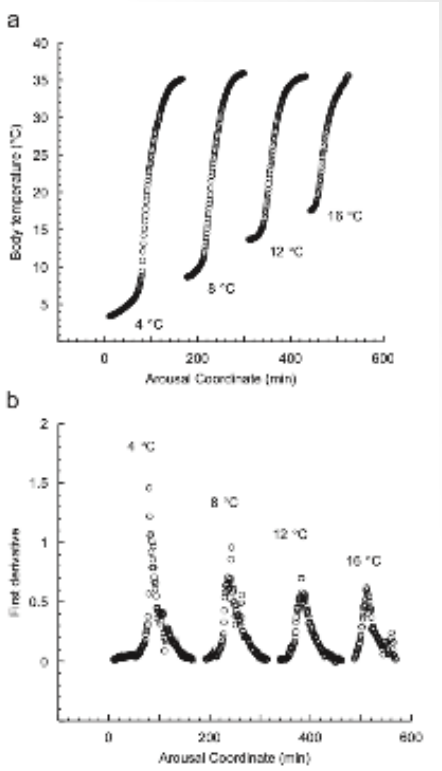
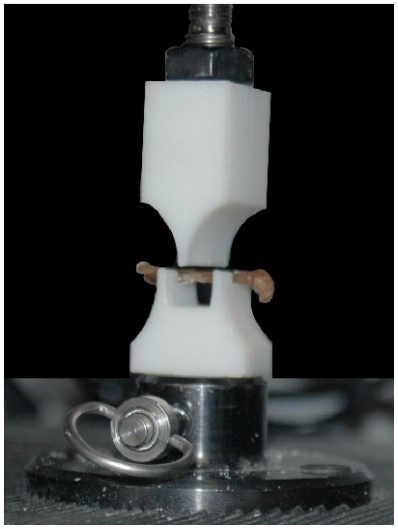
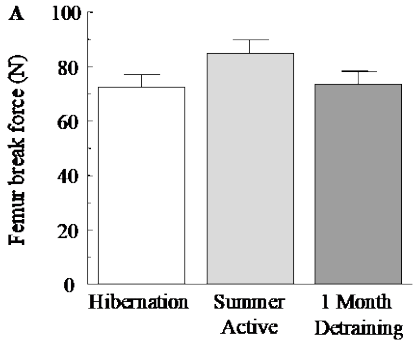
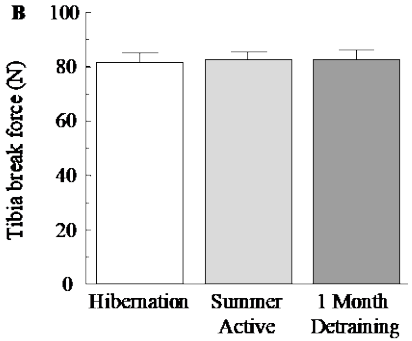


Fig. 2. Body temperature as a function of time during arousals from one individual. (A) Body temperature was measured every minute for a squirrel housed at 4, 8, 12, and 16 °C. (B) Instantaneous rate changes as demonstrated by plotting the first derivative as a function of time across the same range of ambient temperatures.

- Resistance to bone disuse atrophy:







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School of Life Sciences

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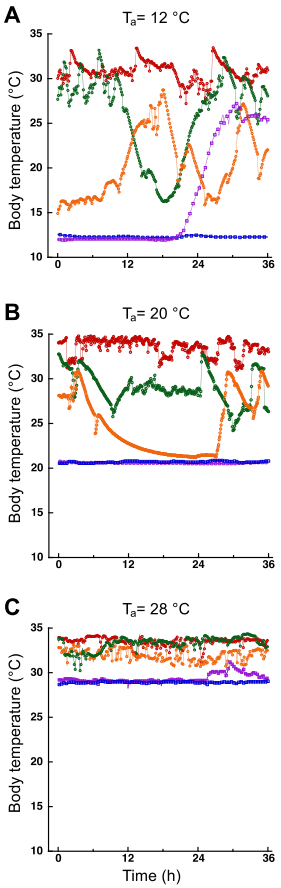
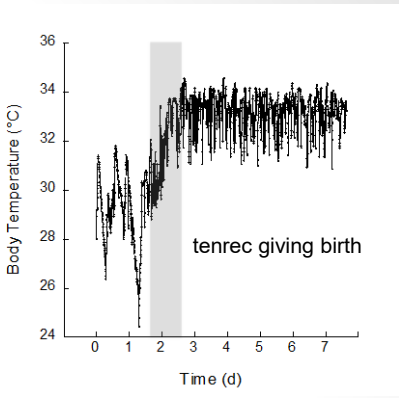
Expertise

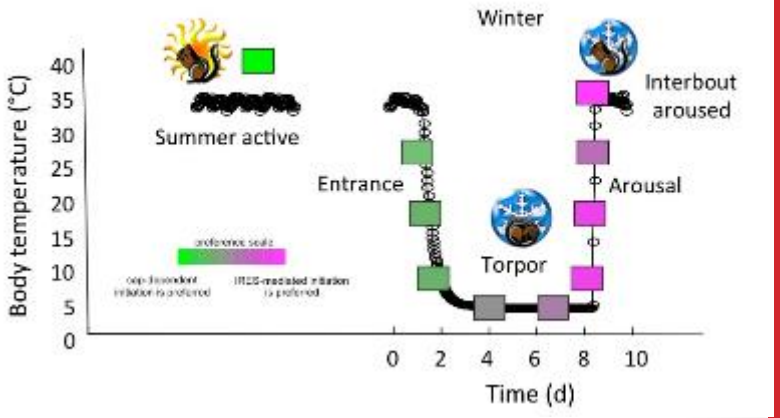
- Metabolic depressions like mammalian hibernation
- Life in extreme environments

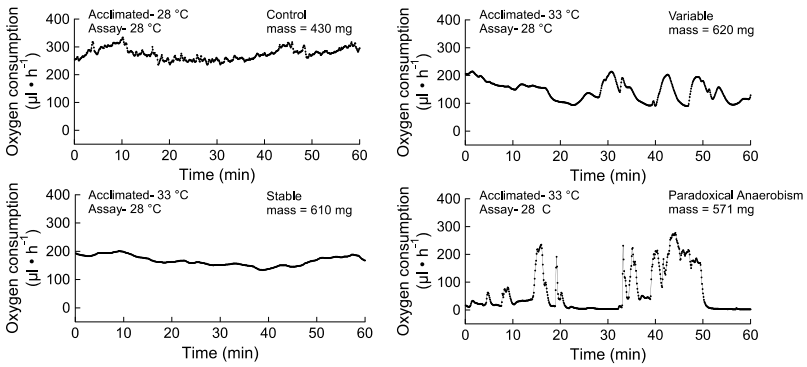
Areas of research

- Hibernation in tenrecs and ground squirrels
- Paradoxical anaerobism in pupfish
- We use a variety of approaches from whole animal physiology to biochemistry to understand how animals live in extreme environments









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