Research and Economic Development Committee Agenda
May 11, 2022
1:00 – 3:00 pm
Gateway Center, Salon C

1. Joint meeting of Research and Economic Development (RED) Subcommittee Meeting with Academic and Student Affairs Committee (30 min)
    a. RED Subcommittee members:
        i. Dave Fall, Chair
        ii. Brad Bonner
        iii. Elizabeth Greenwood
        iv. Brad LaCroix
    b. Academic and Student Affairs Subcommittee members:
        i. Michelle Sullivan (Chair)
        ii. Brad Bonner
        iii. Macey Moore
        iv. Laura Schmid-Pizzato
    c. RED Subcommittee Presentation – Wyoming Innovation Partnership (WIP)
        i. Steve Farkas, Assoc Vice President for Economic Development
        ii. Bryan Shader, Special Assistant to the President, Professor of Mathematics
        iii. Dan McCoy, Degree Coordinator & Associate Lecturer, Outdoor Recreation and Tourism Management
        iv. Penelope Shihab, Director, Center for Entrepreneurship and Innovation
2. RED Meeting
    a. Science Initiative Wyoming Research Scholars Program – Jamie Crait, Program Director and student presentations (30 min)
    The Wyoming Research Scholars Program is a university-wide UW Science Initiative program that pairs undergraduate students with faculty mentors to participate in cutting-edge research starting as early as their freshman year.
    b. Wyoming IDeA Networks for Biomedical Research Excellence (INBRE) Student Programs – Annie Bergman, Director and student presentations (30 min)
    Each Fall, Spring, and Summer semester, the Wyoming INBRE program funds about 10 UW undergraduates wishing to engage in biomedical research. INBRE also funds competitive awards for outstanding community college life science students who are transferring to the University of Wyoming to pursue careers in the biomedical sciences. The program will provide financial support for selected students to attend UW for up to 2 years and engage in INBRE-supported research activities in addition to their degree coursework.
3. Science Initiative Update – Greg Brown, SI Executive Operations Director, Mark Lyford, SI Programs Director and Diana Hulme (15 minutes)
4. Electronic Research Administration System Update – Farrell Rapp, Research Services Director (5 minutes)
5. Other business (5 minutes)
6. Adjourn

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Wyoming Outdoor Recreation, Tourism & Hospitality (WORTH) Initiative

UNIVERSITY OF WYOMING

Dr. Dan McCoy

- Began at UW in 1999
- Ran the UW Outdoor Program for 19 years
- 2017, helped develop and coordinate the Outdoor Recreation and Tourism Management Degree
- Director, WORTH Initiative (since March)

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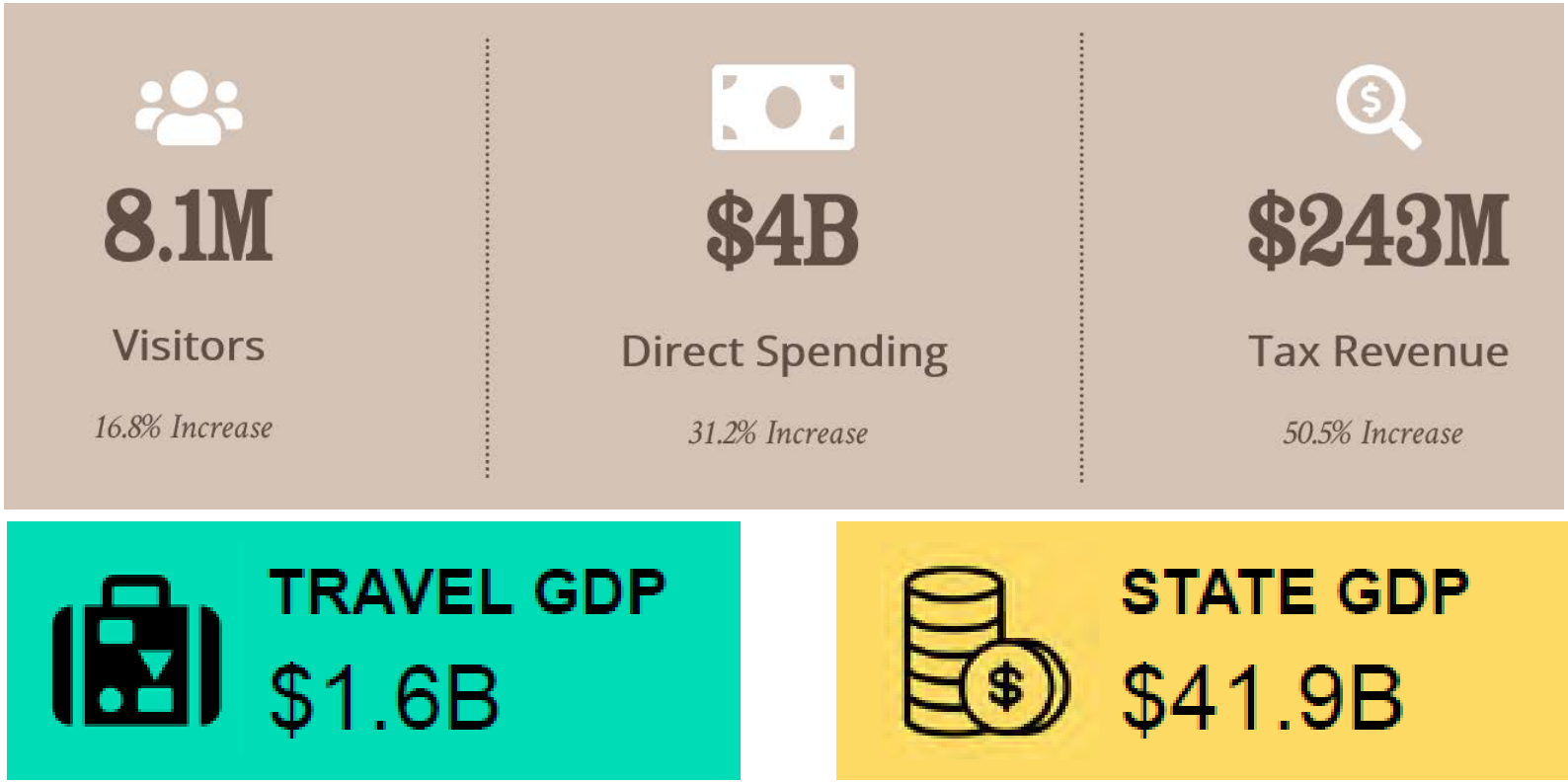
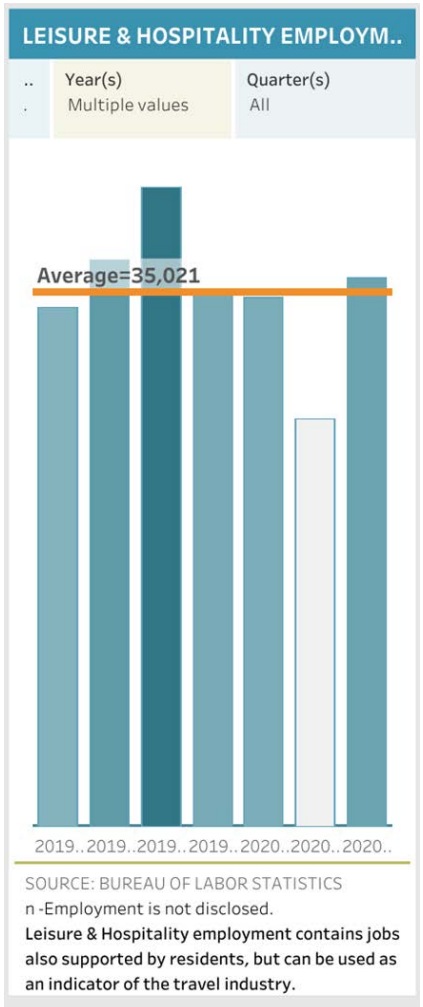
Why the WORTH Initiative? Supporting our #2 Economic Driver in 2021



Sources: Dean Runyan Associates, Bureau of Economic Analysis

Largest employment sector in Wyoming



Recovery & resilience

2020

6.9M	$3.1B	$159.8M
Visitors	**Direct Spending**	**Tax Revenue**
25.6% Decrease	22.9% Decrease	21.4% Decrease

Source: Dean Runyan Associates, The Economic Impact of Travel Report, April 2021 Click here for the report.

2021

8.1M	$4B	$243M
Visitors	Direct Spending	Tax Revenue
16.8% Increase	*31.2% Increase*	*50.5% Increase*

Source: Dean Runyan Associates, The Economic Impact of Travel Report (Preliminary), February 2022.
These preliminary estimates for Wyoming are subject to revision as more complete source data becomes available.

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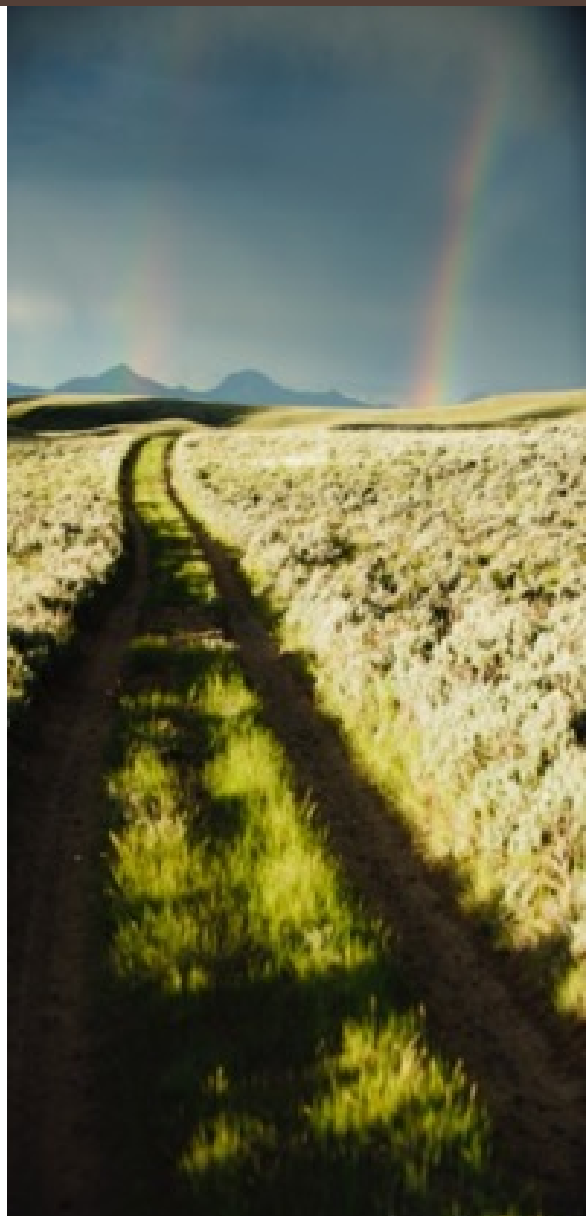
Vision

- An expanded, diversified and more resilient Wyoming economy
- WORTH industries thriving and growing
- Leaders and innovators nationally in applied research, professional development, and outreach



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The WORTH Initiative

PROFESSIONAL DEVELOPMENT

- ✓ BS in Hospitality Management
- ✓ Certificates & continuing ed.
- ✓ On-line/distance learning
- ✓ Student experiences

OUTREACH & EXTENSION

- ✓ Extension agents
- ✓ Assistance for state
- ✓ Economic analyses

APPLIED RESEARCH

- ✓ Surveys, intercept studies
- ✓ Data-informed decisions
- ✓ Graduate student research
- ✓ Student internships

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UW Students and WORTH

- Capstone projects for Outdoor Recreation and Tourism Management degree
- New BS in Hospitality Management
- Emergent research support (research assistants)
- Educational products (trainings and certifications)
- Internships

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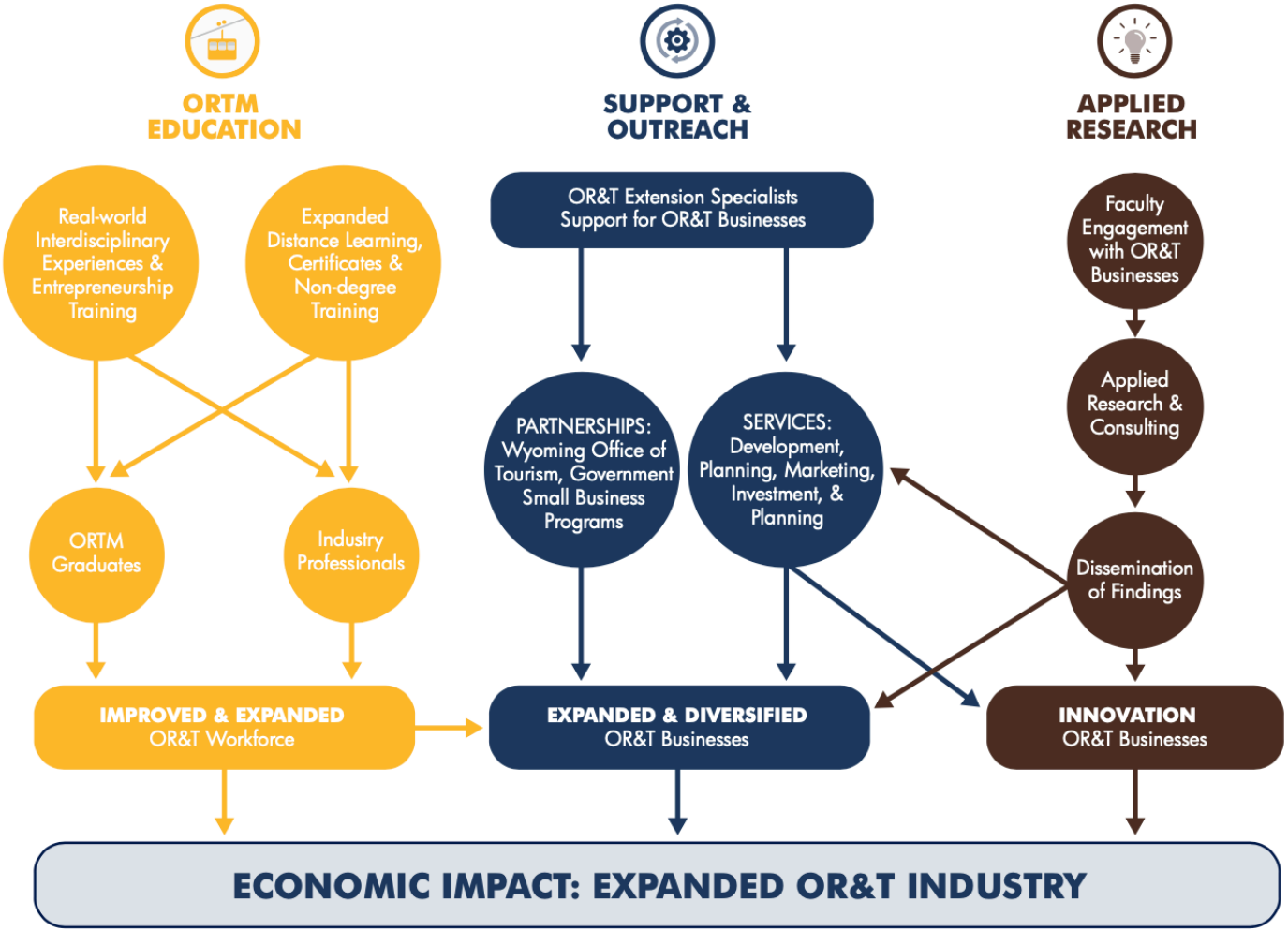
Framework



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Questions?

Science Initiative Undergraduate Research Programs

University of Wyoming Board of Trustees

Research & Economic Development Committee

May 11, 2022

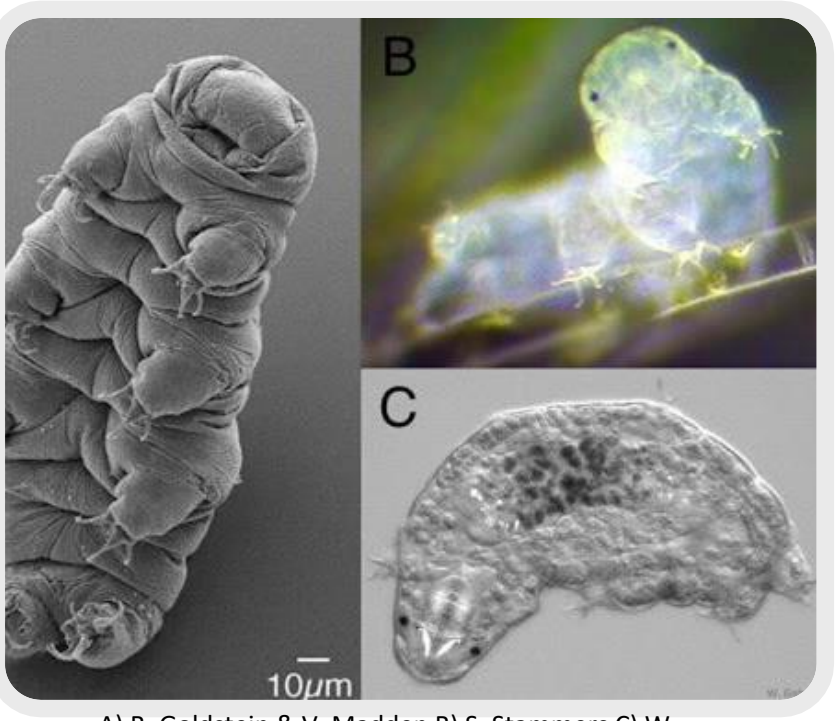
WYOMING RESEARCH SCHOLARS PROGRAM

Pairs undergraduate students with faculty mentors to conduct their own, cutting-edge research.

Protection of Biologics Using Sugars and Intrinsically Disordered Proteins

Maxwell Packebush
Boothby Laboratory
University of Wyoming

Anhydrobiotic Organisms and Protection of Biologics

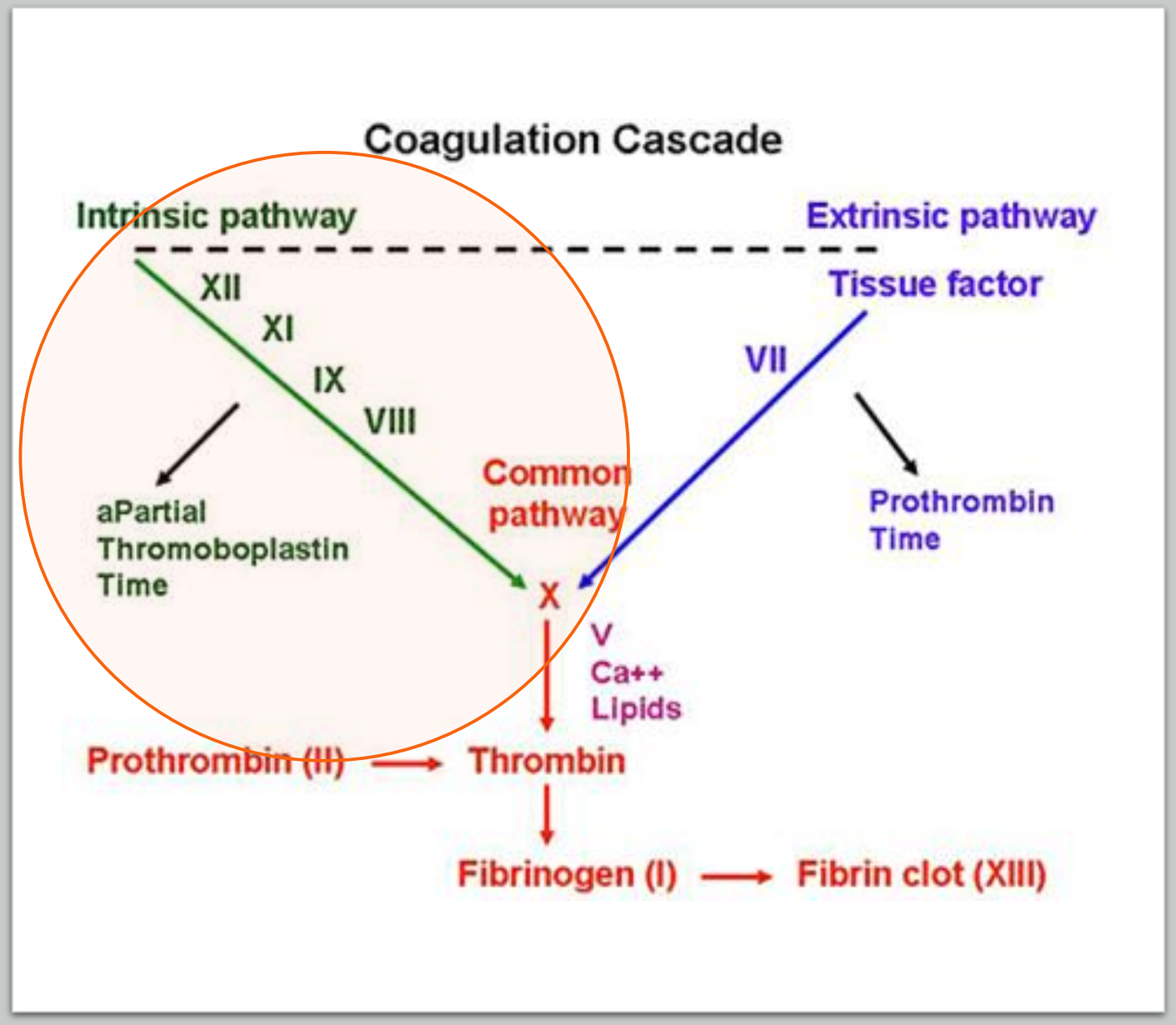


A) B. Goldstein & V. Madden B) S. Stammers C) W. Gabriel

- Tardigrades are an anhydrobiotic extremotolerant microorganism
- Tardigrades use sugar substrates and intrinsically disordered proteins (IDPs) to protect themselves
- Sugars and IDPs can be used to prevent aggregation and preserve protein function

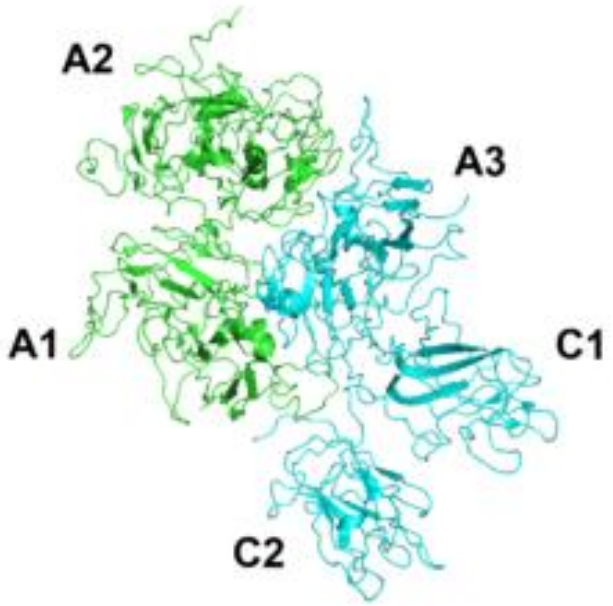
What are Blood Clotting Factors

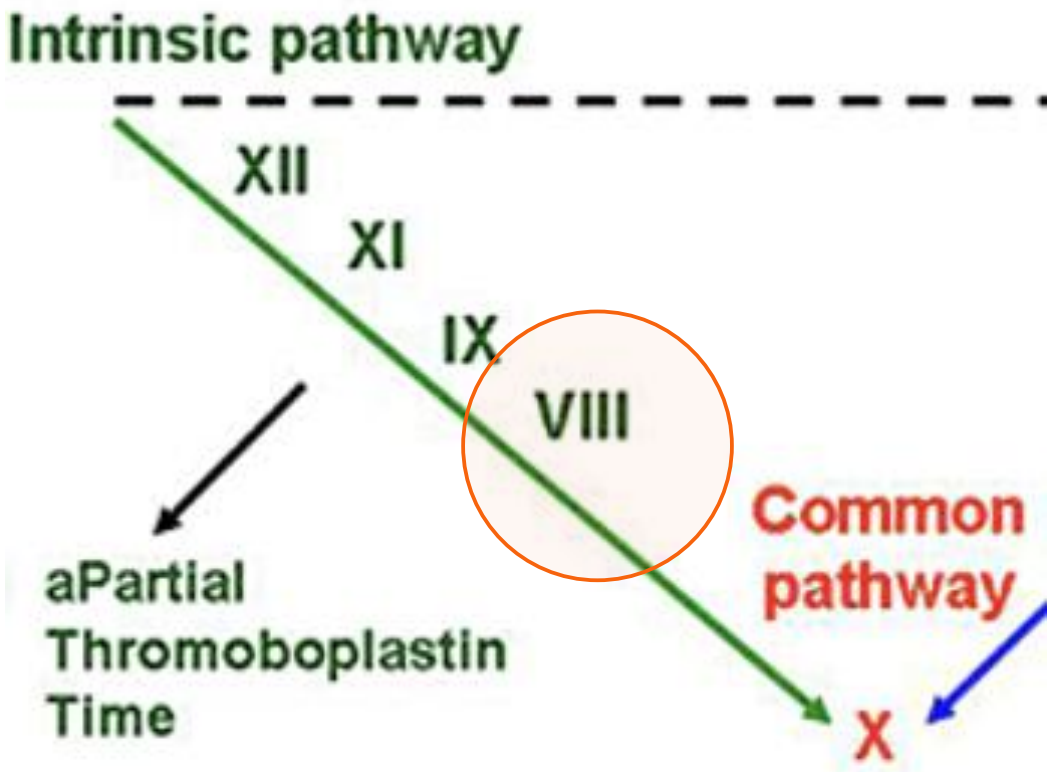
- Proteins made in the liver that inhibit blood loss by coagulating liquid blood at the site of injury
- The clotting factor cascade is important for regulation of blood clotting



Instability of Blood Clotting Factors

- Clotting Factors must be stored at -20°C
- Storage of clotting factors at 4°C for 21 days results in 50% degradation
- Clotting ability decreases by 15% in just 10 hrs at room temperature

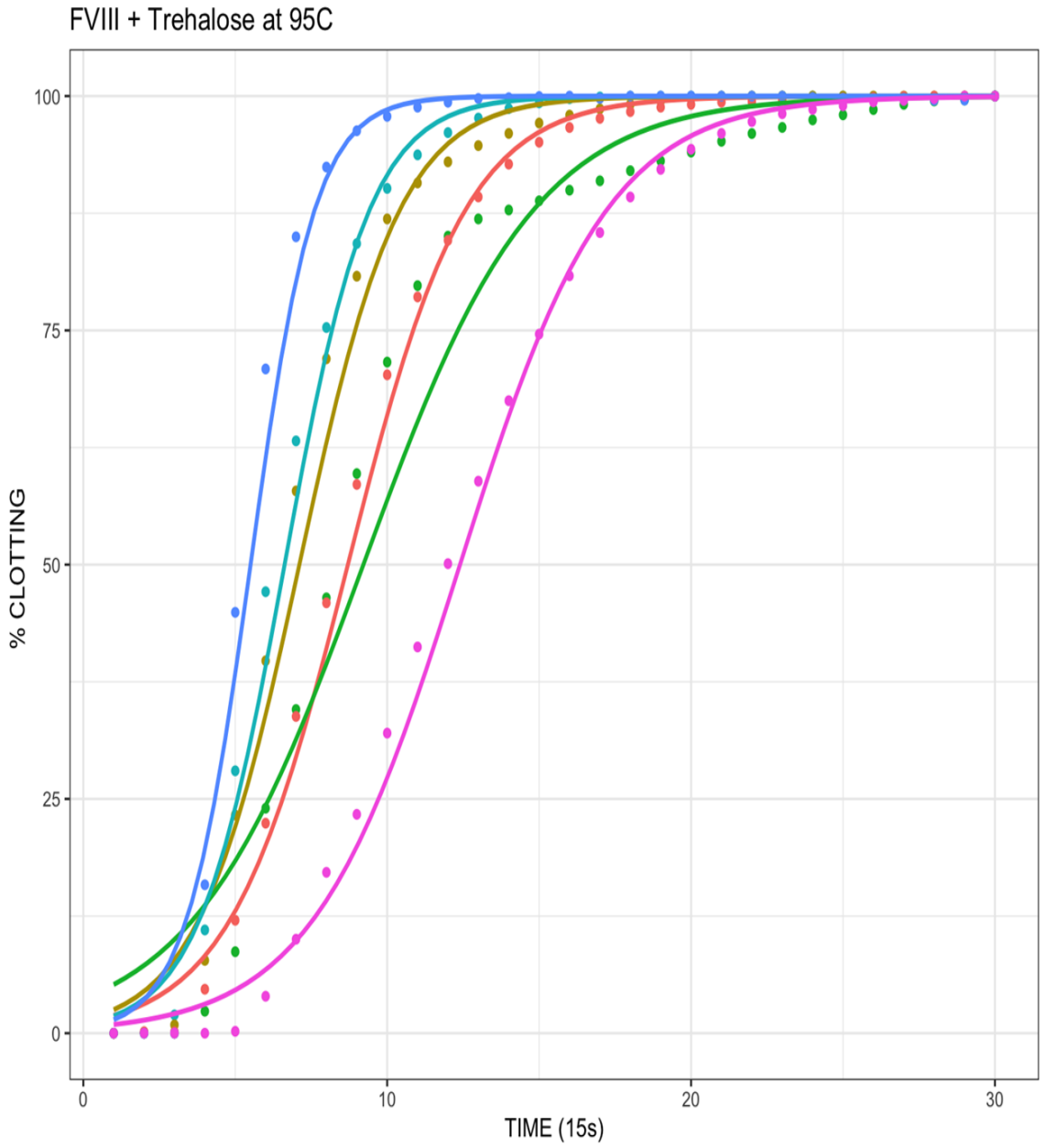


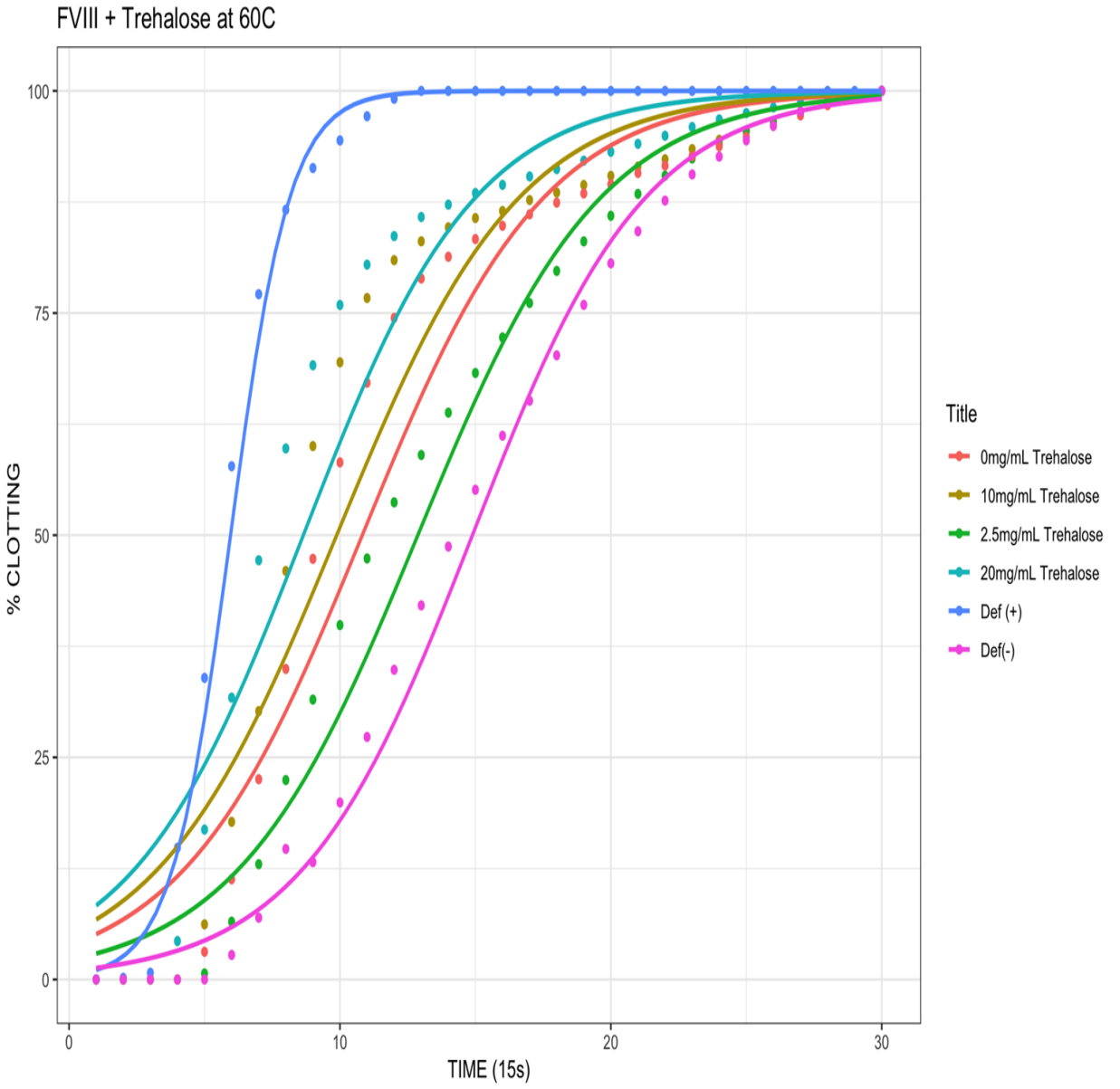


Can Substrates/Peptides Protect Blood Clotting Factors from Degradation?

- Sugar substrates and peptides such as Sucrose/ Trehalose and Intrinsically IDPs have been observed to protect client proteins in under desiccation and heat stresses
- Can these sugar substrates and IDPs be used to protect clotting factors/ biologics under stressful conditions without impeding proper clotting function?

Trehalose Protects FVIII at Multiple Temperatures





Next Steps

- Test IDPs as a protectant for FVIII under heating and desiccation stresses
    - Optimize concentrations of protectants
- Use IDPs as a protectant for *other* blood clotting factors
- Use IDPs and sugar substrates as a protectant for other biologics

Stratigraphic relationships surrounding the Cretaceous-Paleogene (K-Pg) Boundary within the northern Great Plains, USA

By: Gracen Wallen

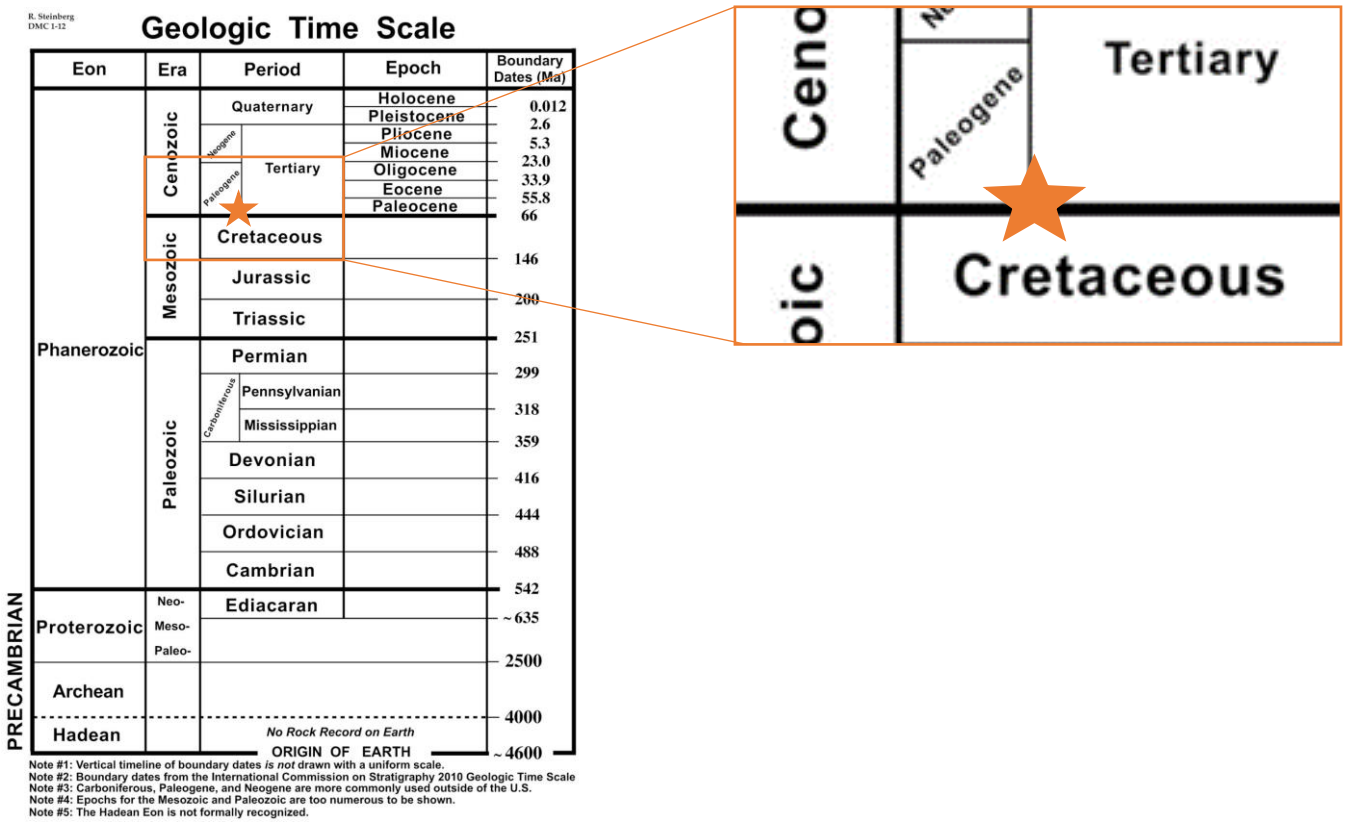
Photo taken by G. Wallen

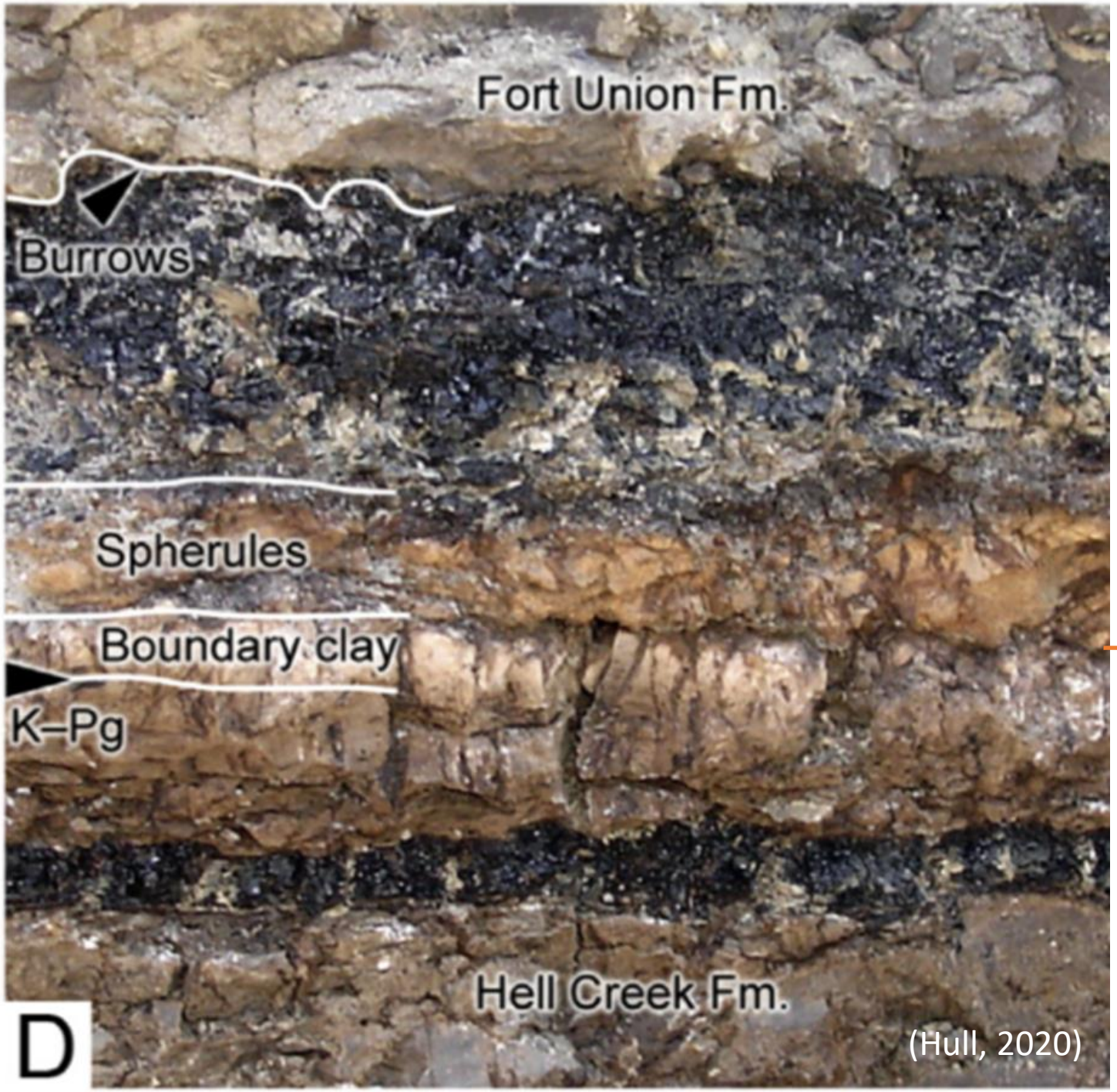
Introduction

- K-Pg boundary was deposited globally, approximately 66 million years ago
- Distinct layer of clay
- Associated with mass extinction event and large positive iridium anomaly
- Abrupt end to the age of the dinosaurs

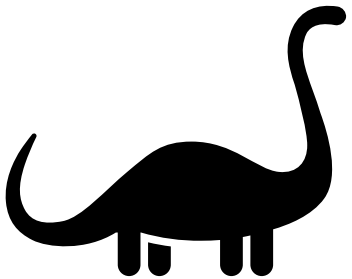
(Bercovici and Fastovsky, 2015)

https://serc.carleton.edu/NAGTWorkshops/time/visualizations_teachtips/60786.html





K-Pg boundary



Research Question

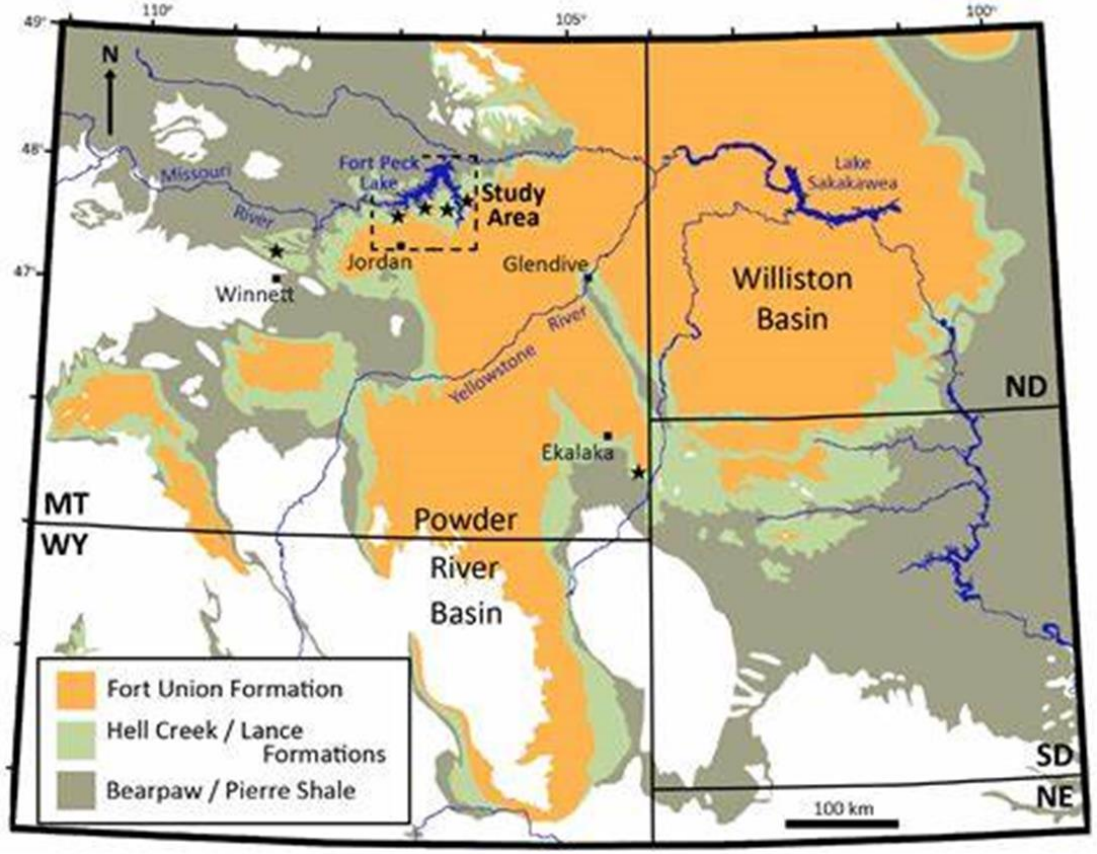
How do stratigraphic relationships vary surrounding the Cretaceous-Paleogene (K-Pg) boundary within surface exposures across the northern Great Plains of the United States?

Methods

1. Identify late Cretaceous and early Paleogene exposures across the northern Great Plains of the United States.
2. Measure and describe stratigraphic sections containing the K-Pg boundary from each exposures across Wyoming and Montana. These sections will include the K-Pg boundary and a minimum of five meters of underlying and overlying sediments.
3. Collect samples of the K-Pg boundary and every distinct layer of sediment measured, where permitted.
4. Create stratigraphic column based on each section measured.

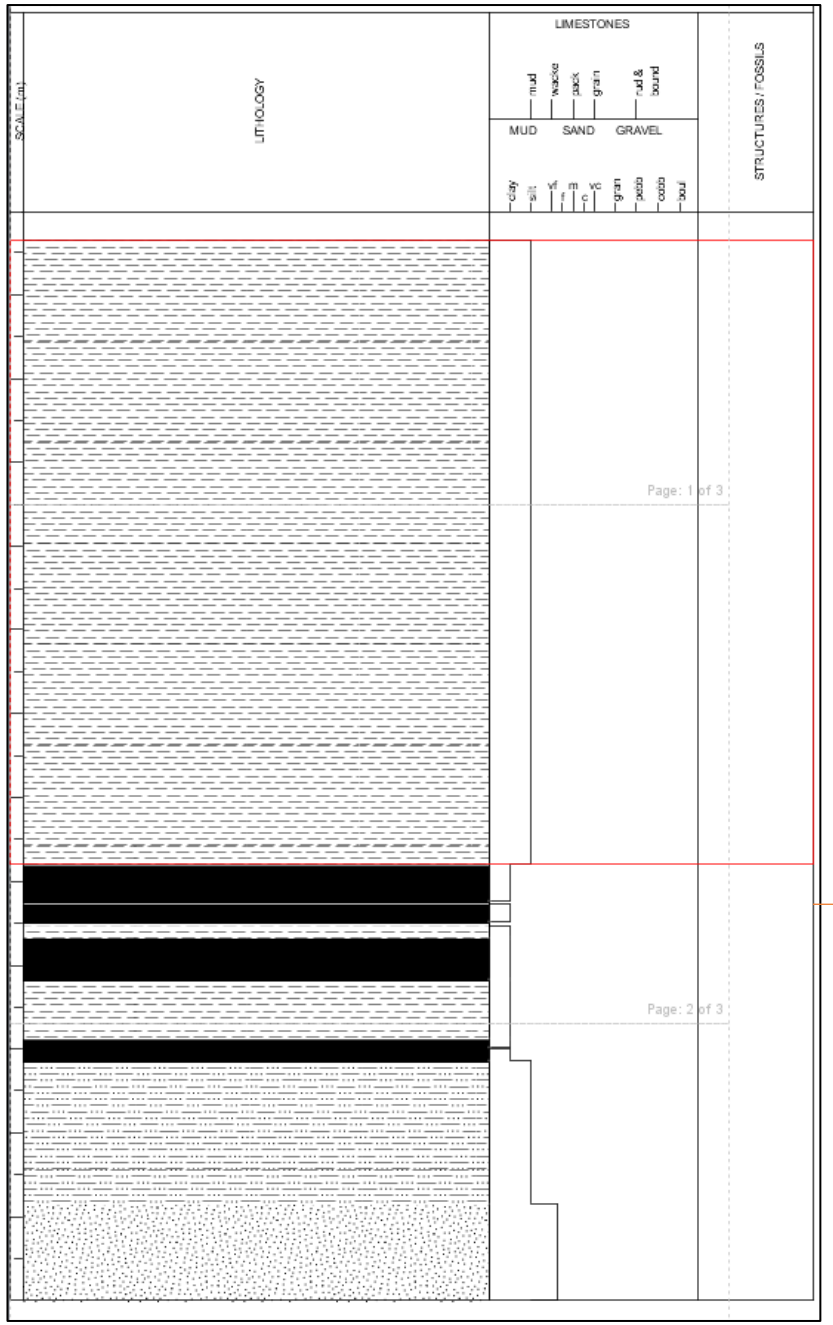
Study Area

- Extensive surface exposures across the states of Wyoming and Montana.
- Two stratigraphic sections measured and described in Garfield County, MT.



(Fowler)

Stratigraphic relationships surrounding the K-Pg boundary in Garfield County, MT. Study Site #1.



Fort Union Formation

K-Pg

Hell Creek Formation

Findings

- K-Pg boundary believed to be preserved in both locations within the “z” coal layer
- For both sites:
  - Uppermost section of Hell Creek Formation consists of interbedded sandstones and siltstones, with intermittent layers of coal
  - Abundance of flora and fauna found within Hell Creek Formation, little to none found in the overlying Tullock member of the Fort Union Formation
- Variations in thickness and composition of stratigraphic layers between the two study sites
- More extensive lignite exposures in study site #1 compared to study site #2

Future Directions

- Create thin sections of sediments collected and then examine them under a microscope, notating any observable variations
- Analyze samples of K-Pg boundary for an iridium anomaly and examine variations in iridium concentration between the different study sites

Acknowledgements

- Dr. John Kaszuba, Department of Geology and Geophysics, University of Wyoming.
- Department of Geology and Geophysics, University of Wyoming.
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- Dr. Mark Clementz, Department of Geology and Geophysics, University of Wyoming.
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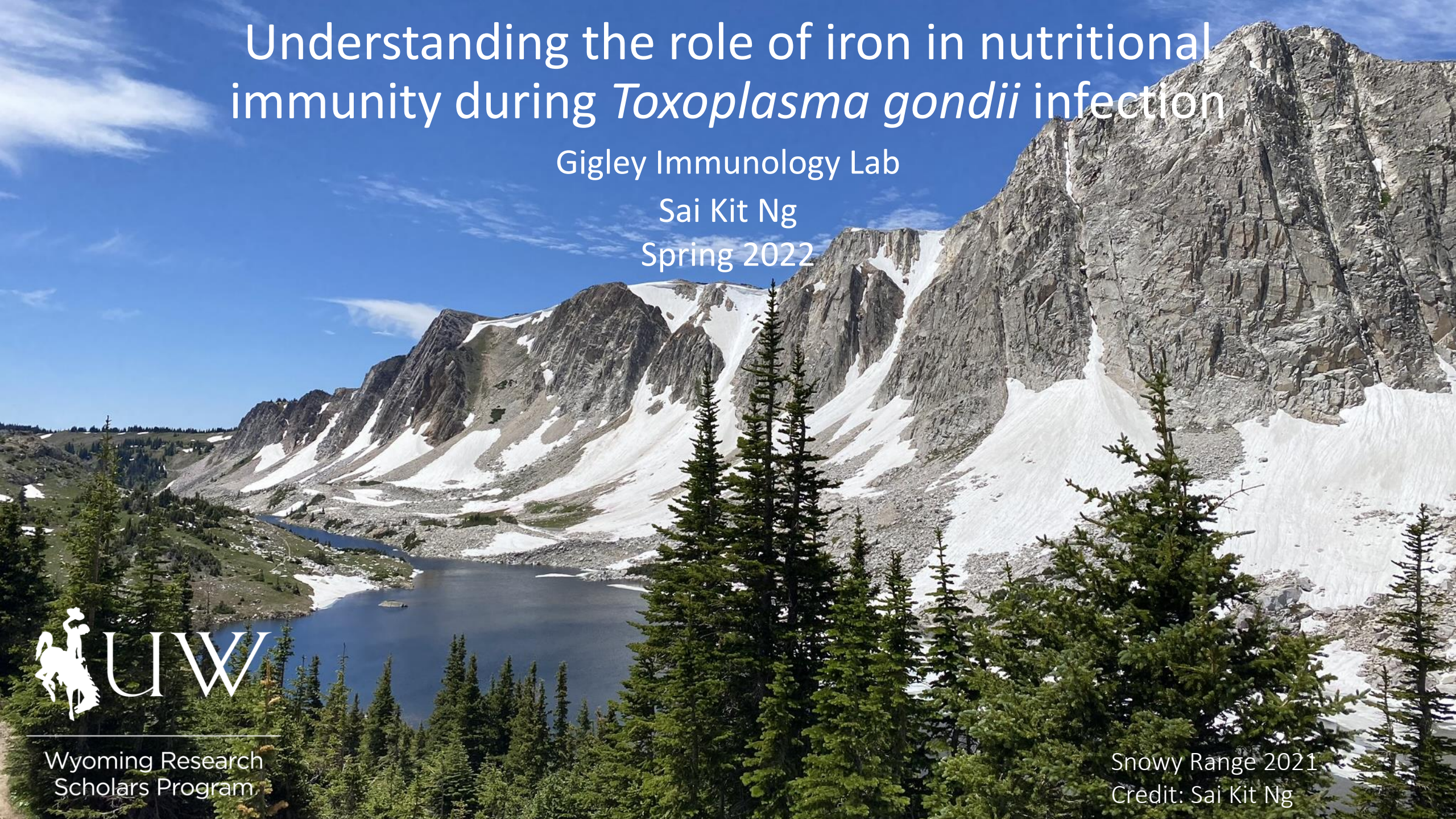
- Susannah Wright, University of Wyoming.
- Matthew Mers, Emporia State University.

References

1. Bercovici, A. and Fastovsky, D. (2015). The Hell Creek Formation and its Contribution to the Cretaceous-Paleogene Extinction: A Short Primer. *Cretaceous Research 57,* 368-390. https://doi.org/10.1016/j.cretres.2015.07.007
2. Connor, C. (1992). The Lance Formation; Petrography and Stratigraphy, Powder River Basin and Nearby Basins, Wyoming and Montana. *United States Geological Survey.* Retrieved April 23, 2021. The Lance Formation; petrography and stratigraphy, Powder River basin and nearby basins, Wyoming and Montana (usgs.gov).
3. Fowler D. The Hell Creek Formation, Montana: A Stratigraphic Review and Revision Based on a Sequence Stratigraphic Approach. *Geosciences*. 2020; 10(11):435. https://doi.org/10.3390/geosciences10110435.
4. Pincilli M. Hull, A. Bornemann, D. E. Penman, M. J. Henehan, R. D. Norris, P. A. Wilson, P. Blum, L. Alegret, S. J. Batenburg, P. R. Bown, T. J. Bralower, C. Cournede, A. Deutsch, B. Donner, O. Friedrich, S. Jehle, H. Kim, D. Kroon, P. C. Lippert, D. Loroch, I. Moebius, K. Moriya, D. J. Peppe, G. E. Ravizza, U. Rohl, J. D. Schueth, J. Sepulveda, P. F. Sexton, E. C. Silbert, K. K. Sliwinska, R. E. Summons, E. Thomas, T. Westerhold, J. H. Whiteside, T. Yamaguchi, J. C. Zachos. 2020. On Impact and Volcanism Across the Cretaceous-Paleogene Boundary. *In* Science 367:266-272.

Understanding the role of iron in nutritional immunity during *Toxoplasma gondii* infection

Gigley Immunology Lab
Sai Kit Ng
Spring 2022

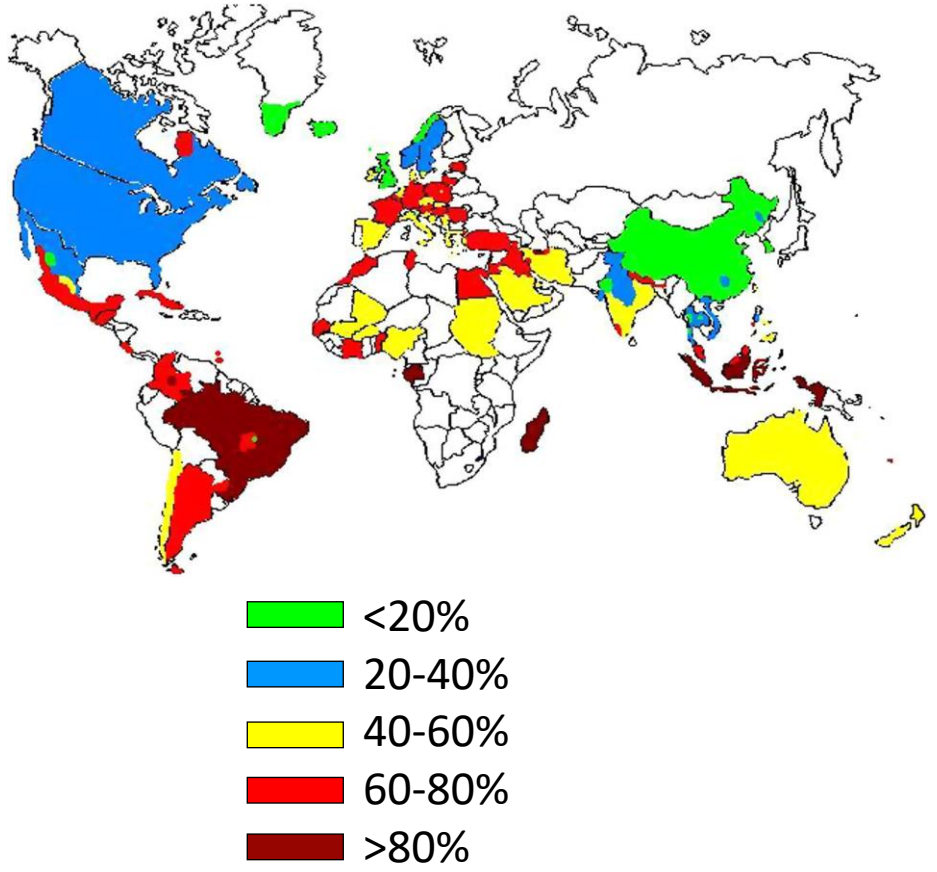


UW
Wyoming Research Scholars Program

Snowy Range 2021
Credit: Sai Kit Ng

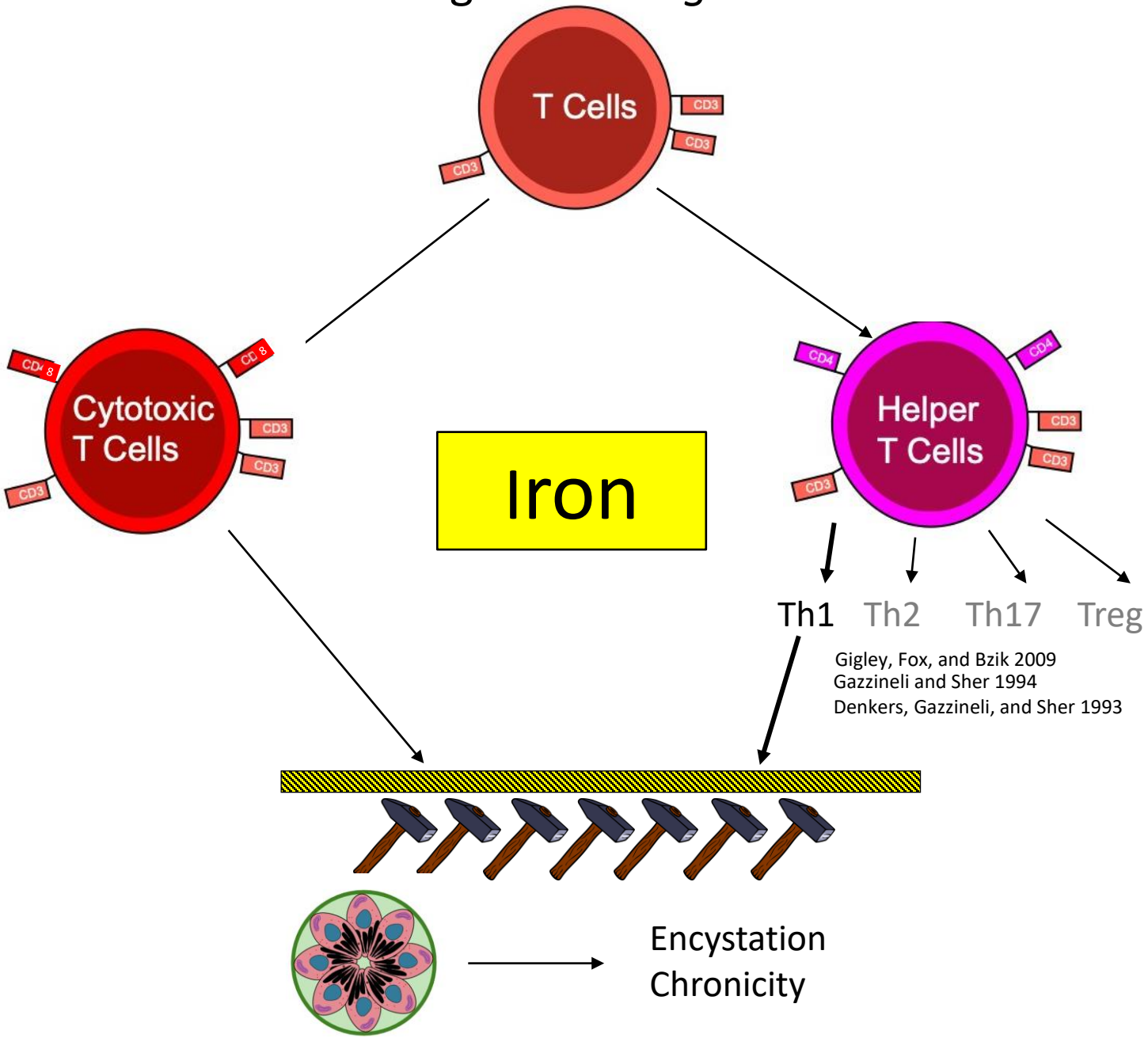
Three P's of *Toxoplasma gondii* (*T. gondii*, "Toxo")

1. Prevalence
   - Tropism: Nucleated animal cells
   - 2 billion + humans are infected (~1 in 3)
2. Persistence
   - No curative therapy exists
   - Infections are lifelong
3. Prognosis
   - 4th highest cause of foodborne hospitalizations in US
   - Can be lethal when Toxoplasmic encephalitis develops



Tenter et al., 2000, *Int J Parasitol*

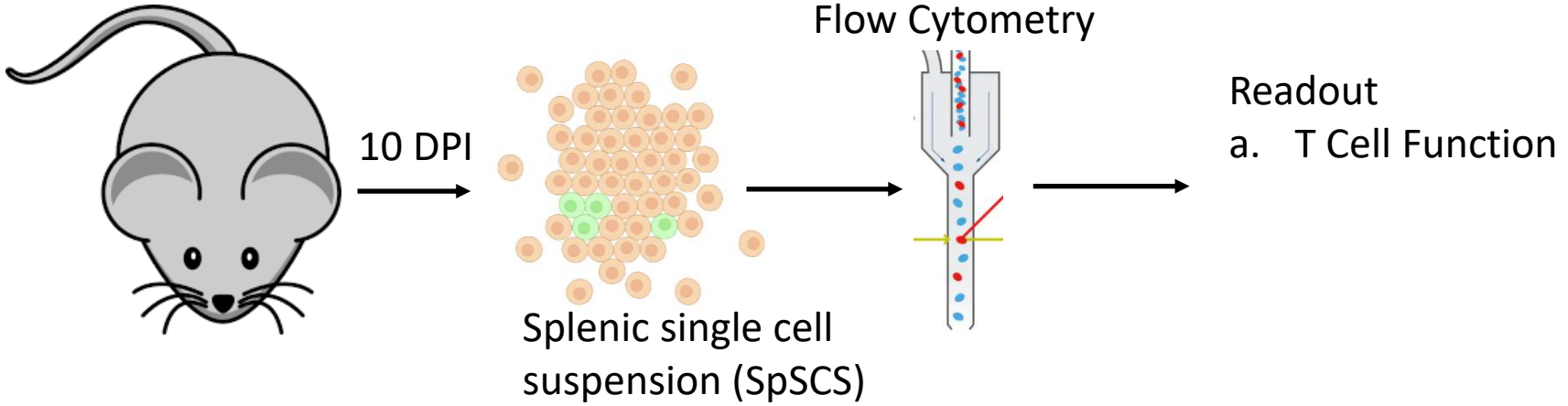
Immune Cell Delegation in *T. gondii* infection



2. Does iron homeostasis impact T cell response to *T. gondii*?

Experimental Setup

HFE-
C57BL/6 Background
Jax # 017784
Null Allele

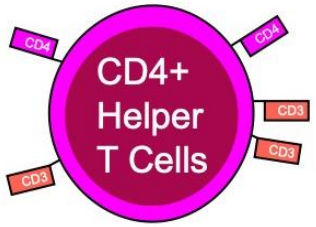


Mice Groups (N=3)

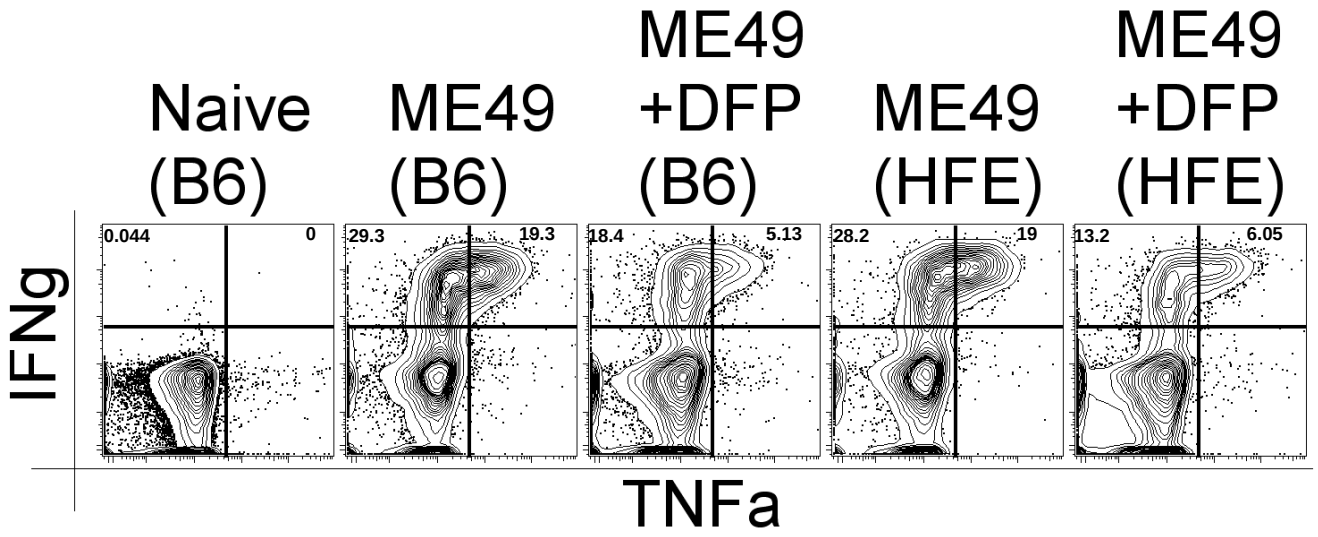
a. Naïve, No Treatment **(Normal Iron Condition)**
b. ME49, No Treatment **(Normal Iron Condition)**
c. ME49, 10mg/mL DFP **(Reduced Iron Condition)**
d. HFE, No Treatment **(Elevated Iron Condition)**
e. HFE, 10mg/mL DFP **(Rescued Iron Condition)**

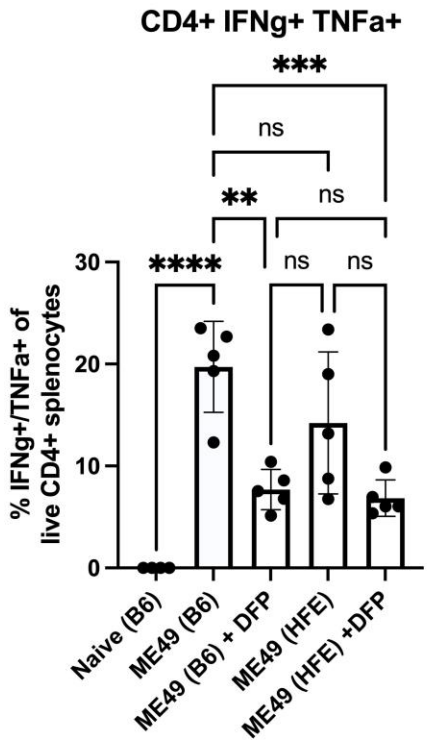
10 mg/mL DFP treatments at t=-1 day, then subsequent treatments every other day

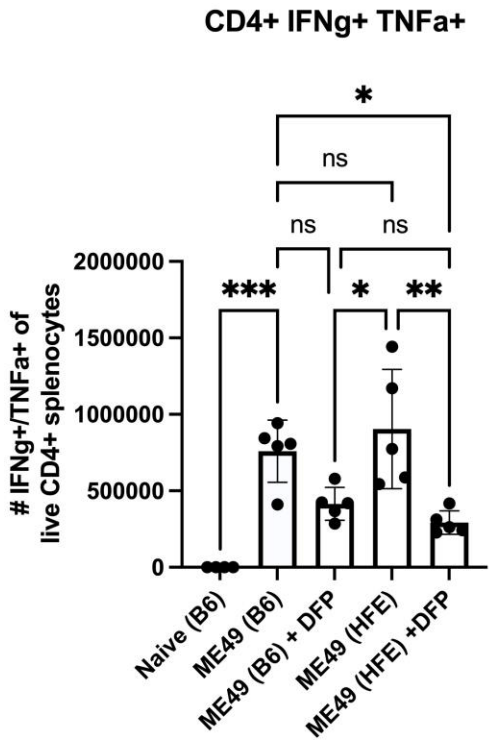
2. Does iron homeostasis impact T cell response to *T. gondii*?



Function







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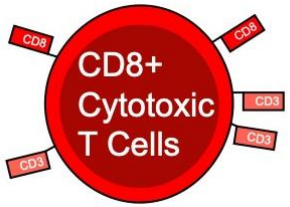
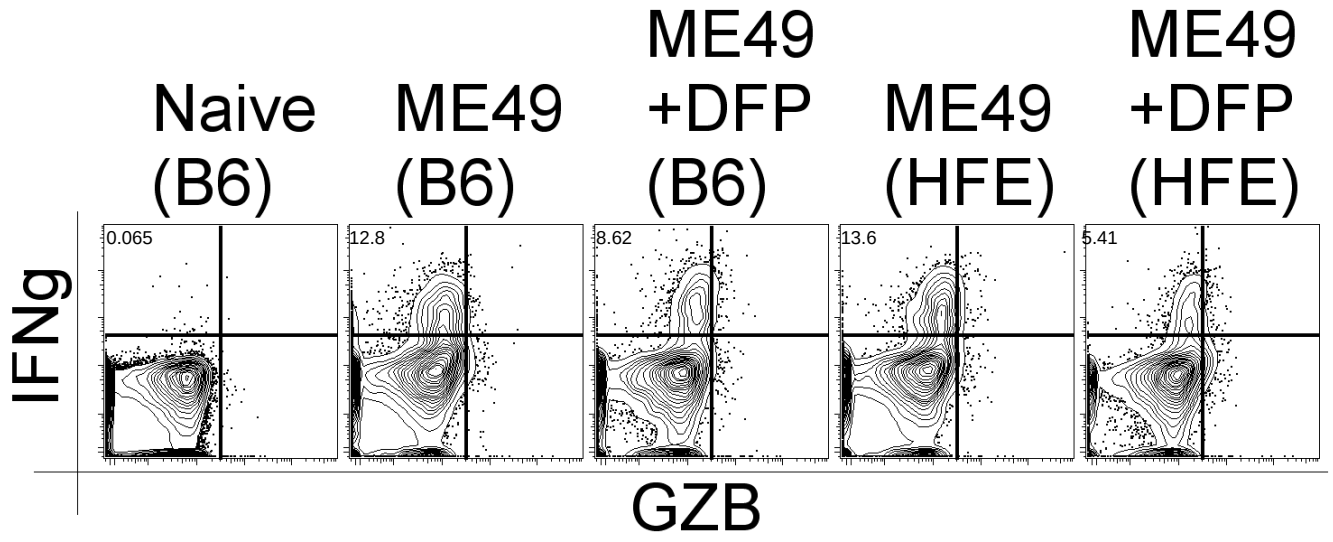
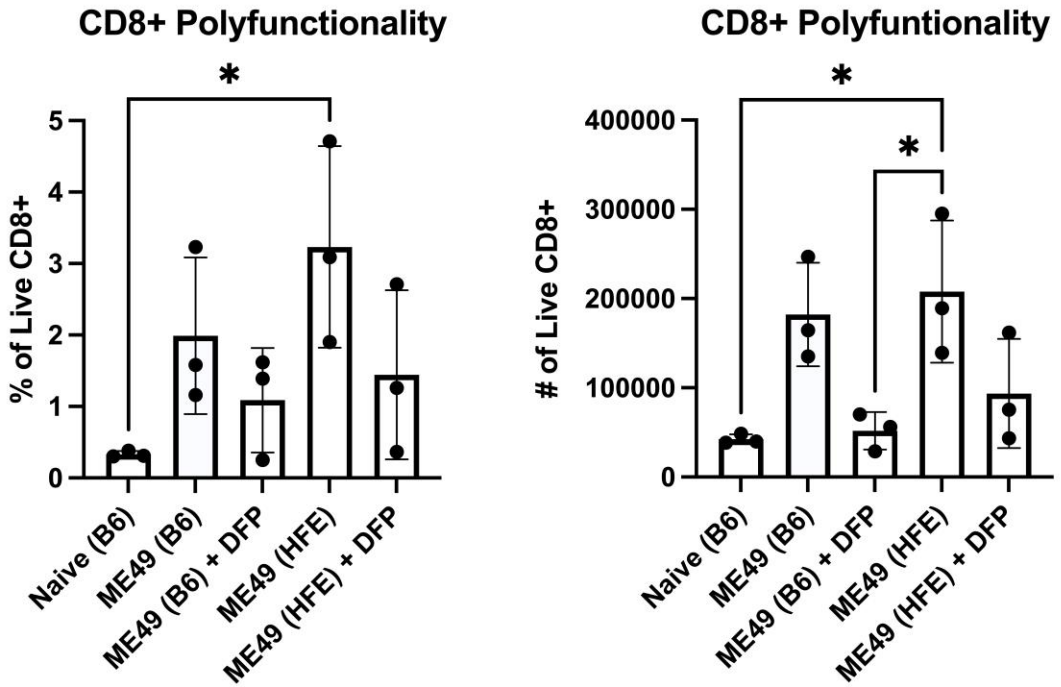


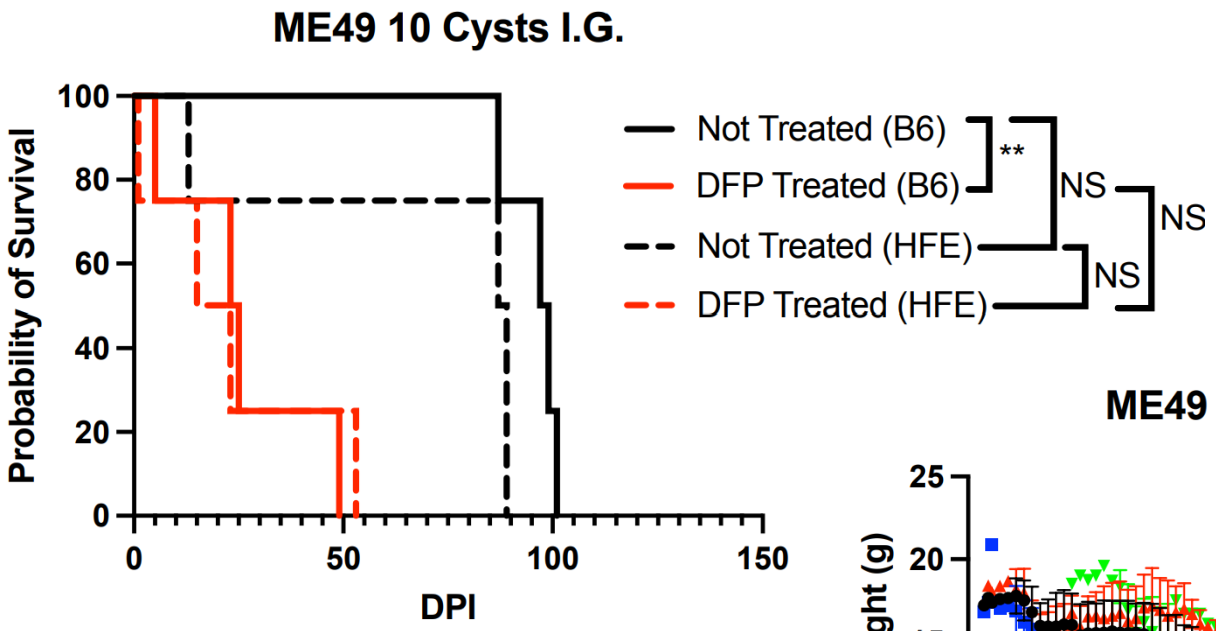
Function

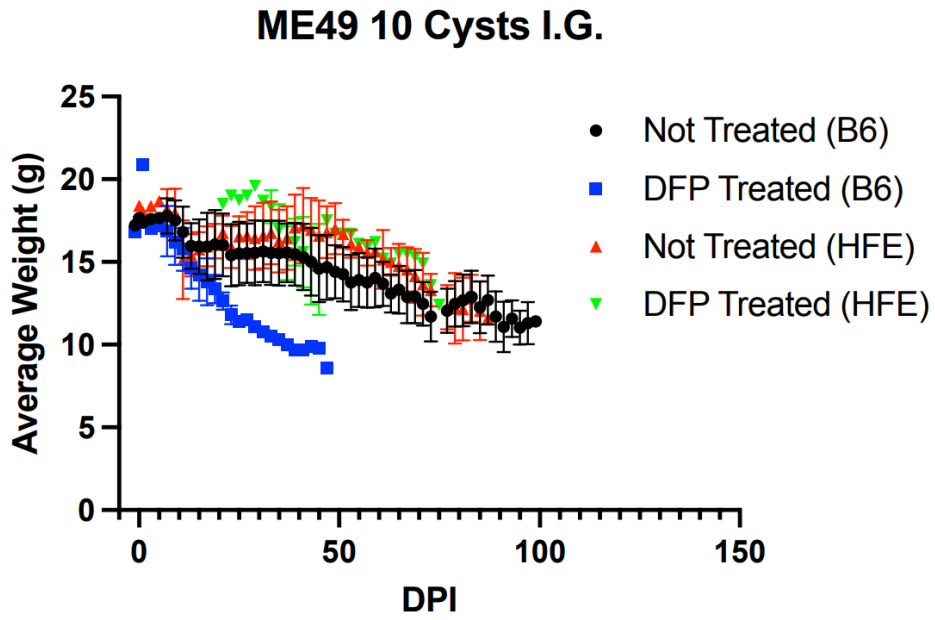




Do changes in iron homeostasis affect *T. gondii* pathogenesis?

Survival and Survival Weights (avg.)





Future Directions

- What role does iron homeostasis play on intrinsic T-cell biology?
- What role does iron homeostasis play on the myeloid and NK cell population during infection?
- What is the role of iron in nutritional immunity in long-term memory populations?

Acknowledgements

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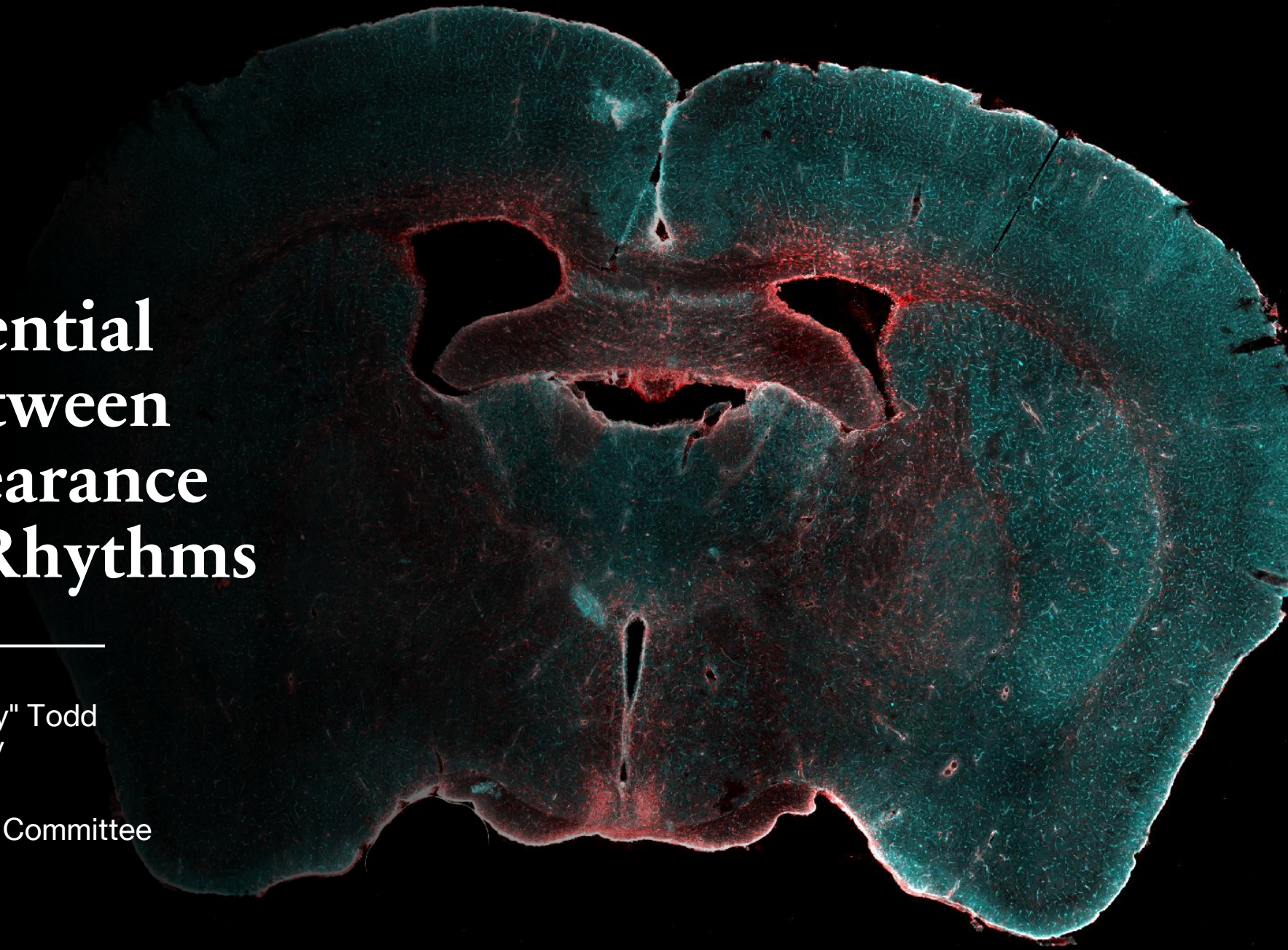
IDeA Networks for Biomedical Research Excellence
NIH
USDA
American Heart Association®
University of Wyoming
Wyoming Research Scholars Program

Assessing a Potential Intersection Between Glymphatic Clearance and Circadian Rhythms

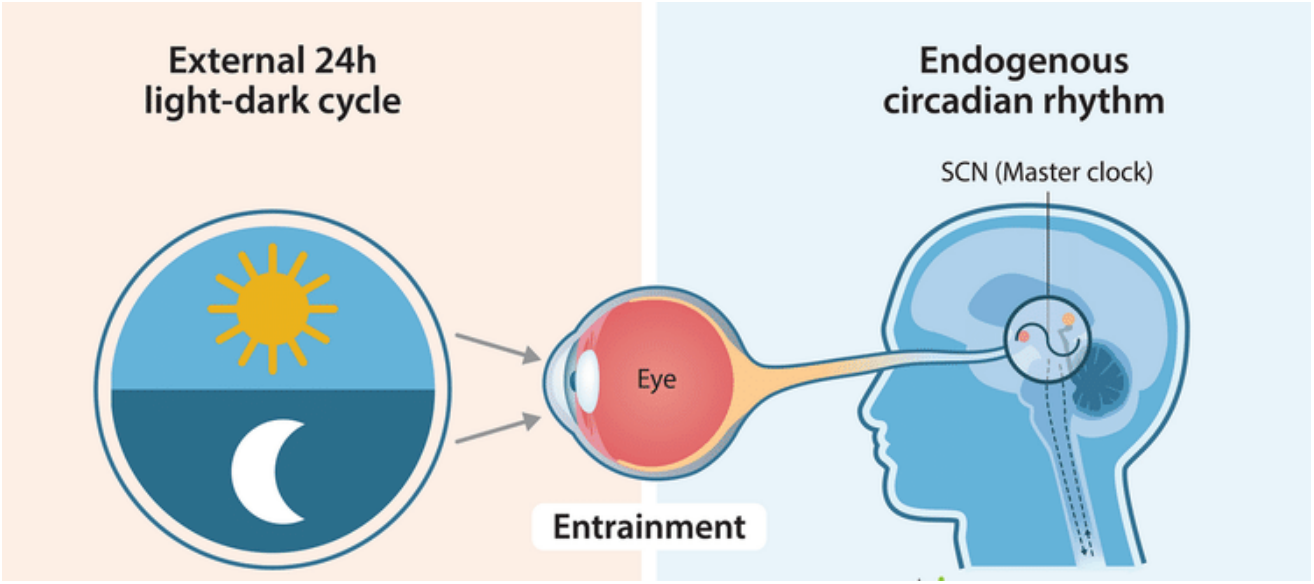


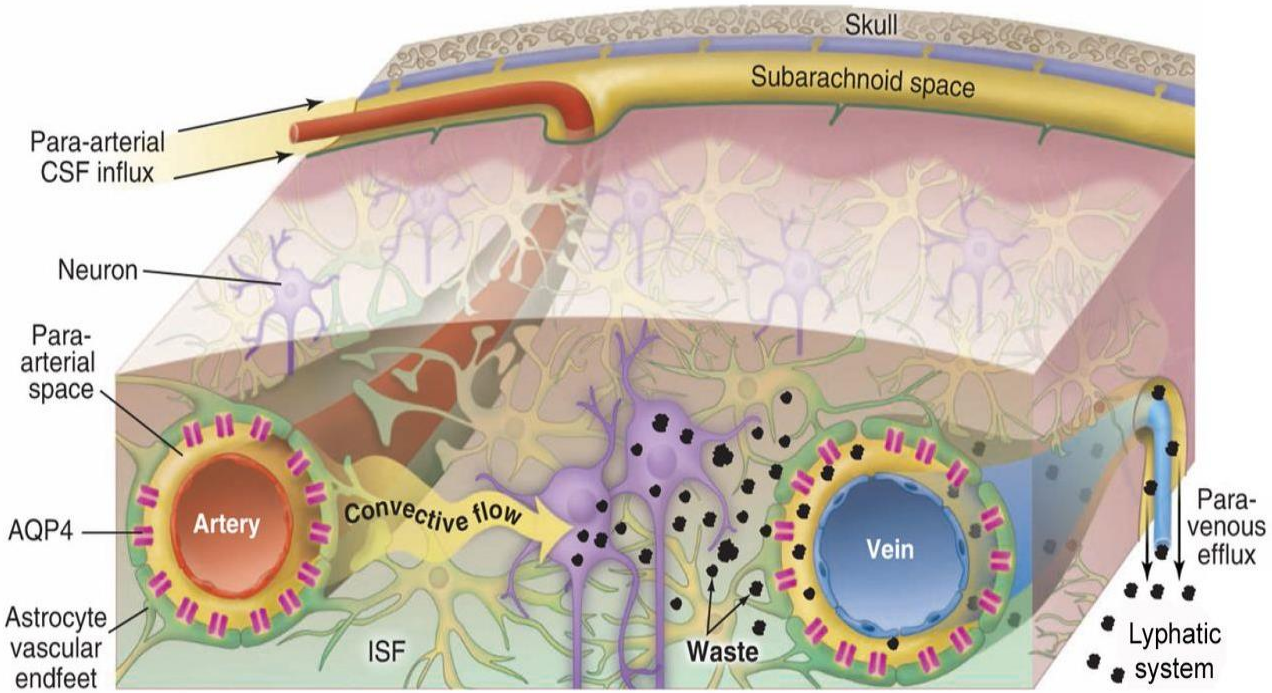
Hannah W. Rhymes, Dr. William "Trey" Todd
Department of Zoology & Physiology

Research & Economic Development Committee
University of Wyoming
May 11th, 2022

Circadian Rhythms

- Patterns of physiological and behavioral activity aligning with 24hr light/dark cycle
- SCN (located in hypothalamus) uses light input from the eyes to synchronize internal rhythms with external stimuli





Glymphatic Clearance

- Brain lacks lymph vessels to clear waste
- Cerebrospinal fluid flows through spaces around vessels to flush out waste products
- Relies on AQP4 water channel proteins to exit this space and wash through the tissue

Circadian Rhythms

Maintains steady sleep cycle, but can be disrupted by external stimuli

Circadian disruption occurs very early on in AD, and is prevalent in patients with mature AD

Evidence that strength of circadian rhythmicity grows weaker with age

OVERLAP

Interactions with sleep/wake cycle

Strong association with Alzheimer's Disease (AD)

Aging is a risk factor for diminished function

Glymphatic Clearance

Circadian pattern of AQP4 expression; primarily active during sleep

Responsible for clearing amyloid-Beta proteins, a pathology hallmark for AD, from interstitial space

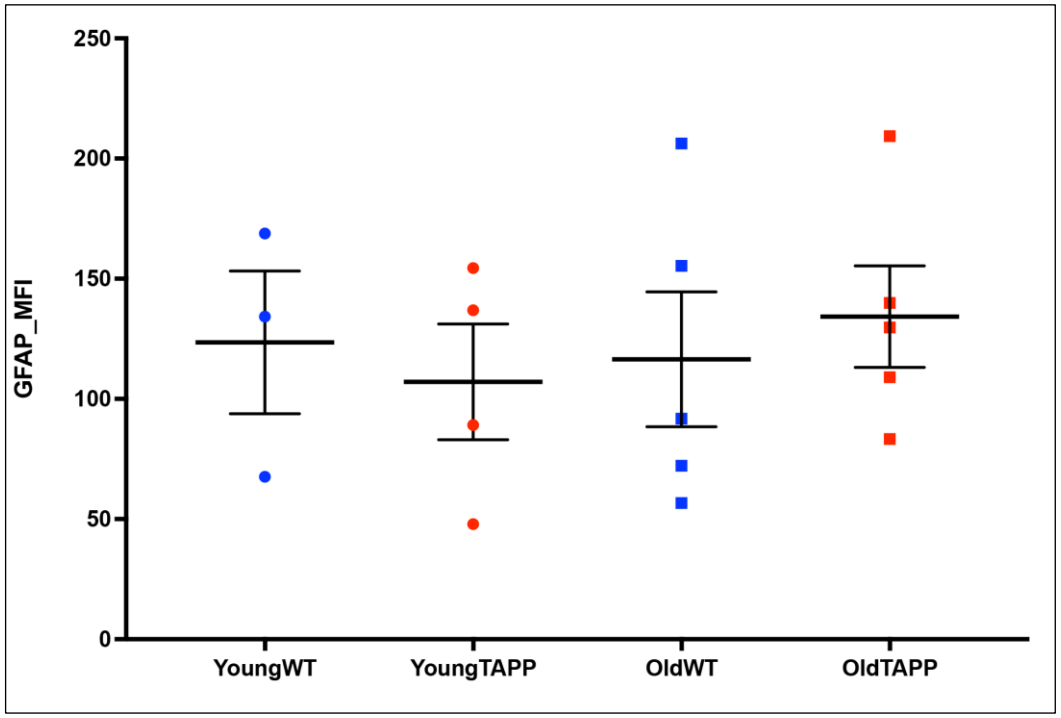
Capacity for CSF flux and solute clearance reduced dramatically with age

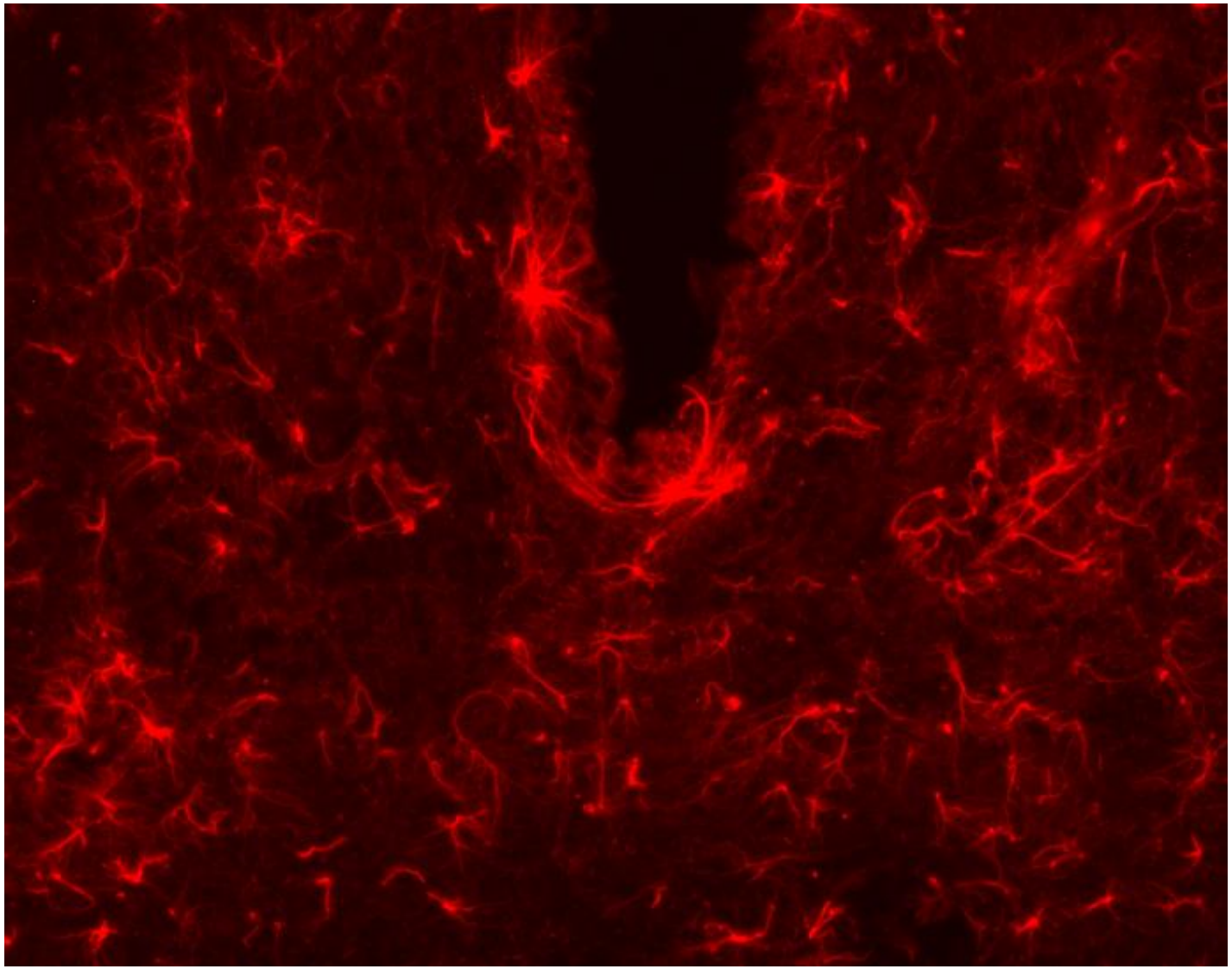
Healthy mice and mice with AD pathology will differ in their expression of AQP4 channels and astrocytes in brain regions associated with circadian rhythm regulation.

Hypothesis

Methodology

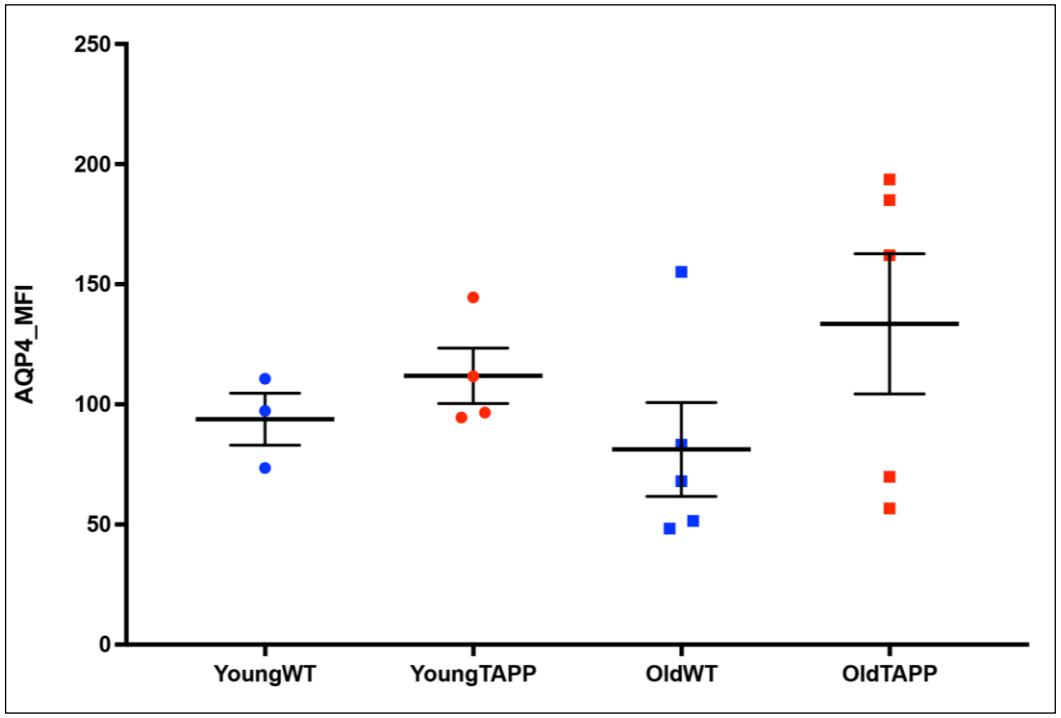
- Mutant group = Transgenic mice w/ AD pathology
- All subjects tested for signs of circadian disruption
  - "Young" = tested at 3-5 months
  - "Old" = tested at 7-9 months
- Suprachiasmatic Nucleus
  - Main location of interest
- Fluorescent staining (IHC)
- Objective: acquire preliminary data, assess the potential of this research direction

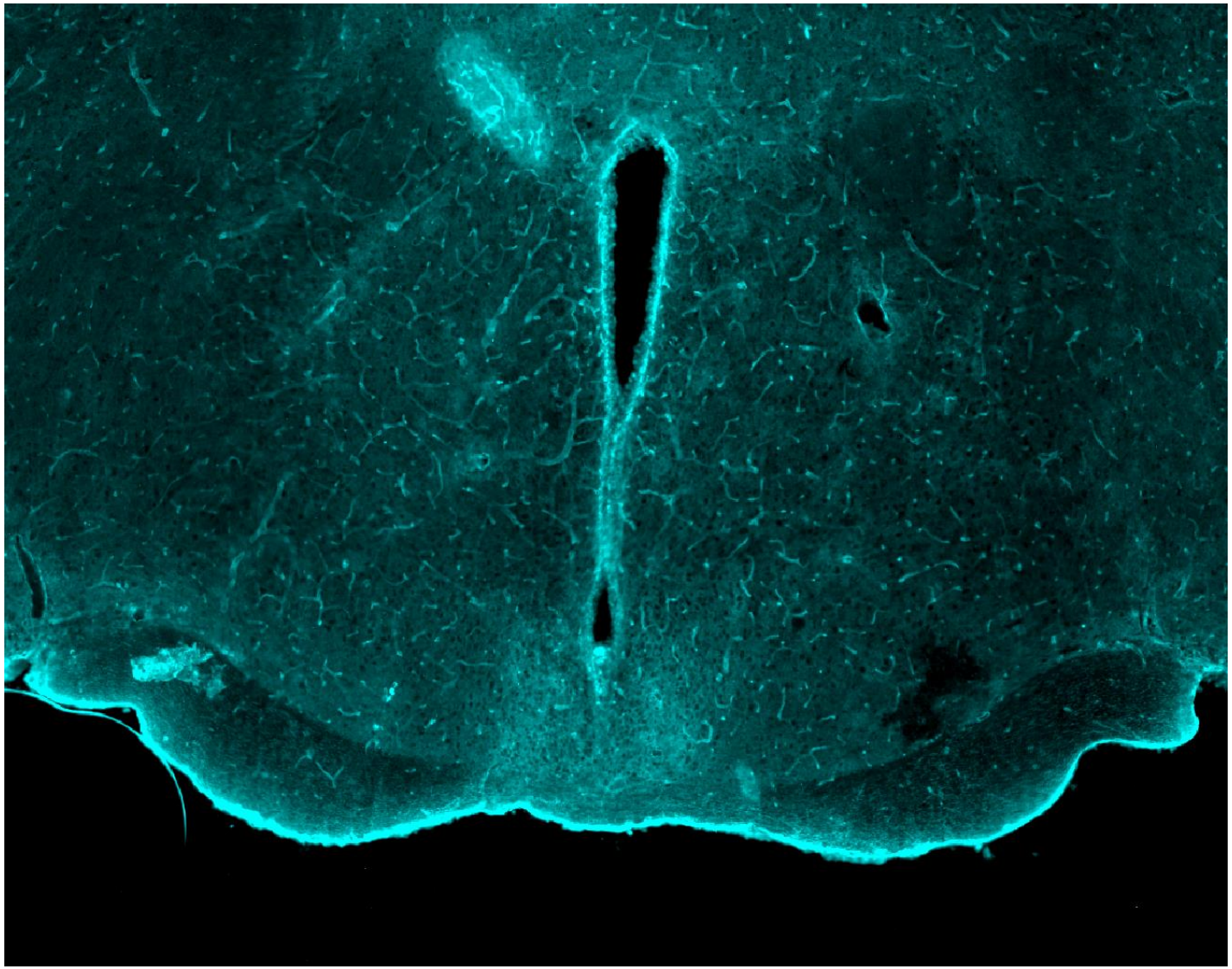




Results: Astrocyte staining

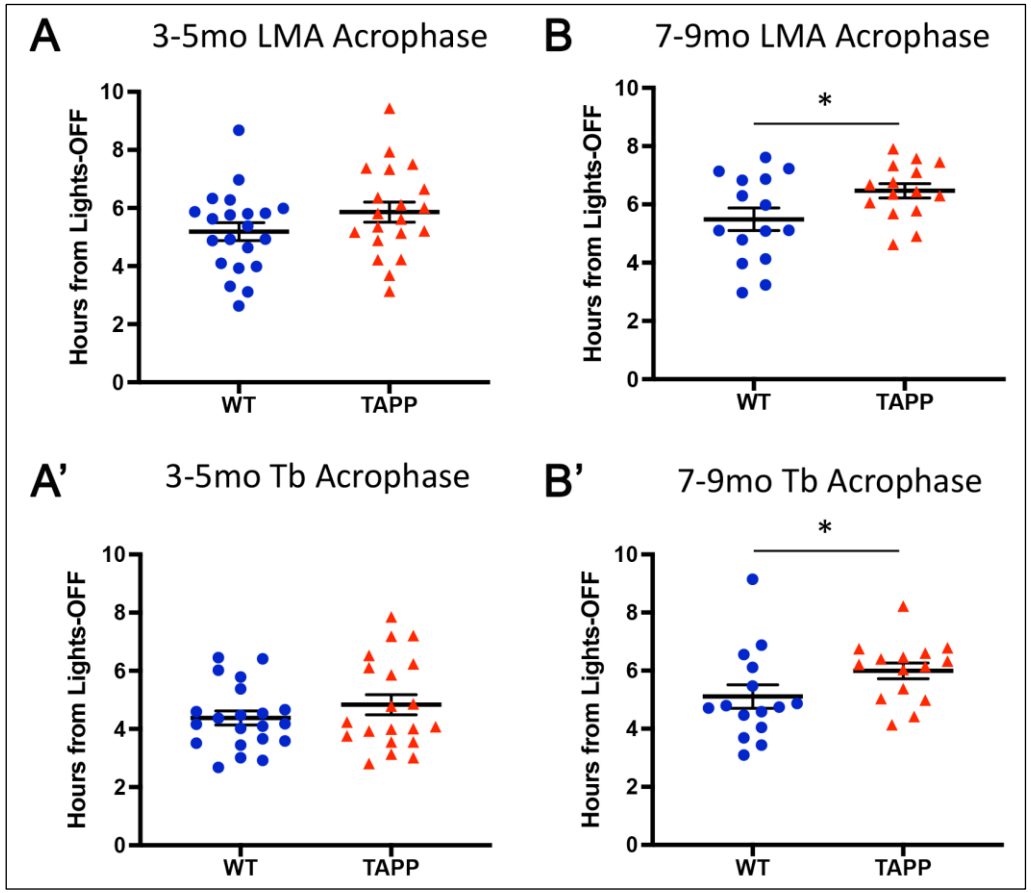
- No readily identifiable differences

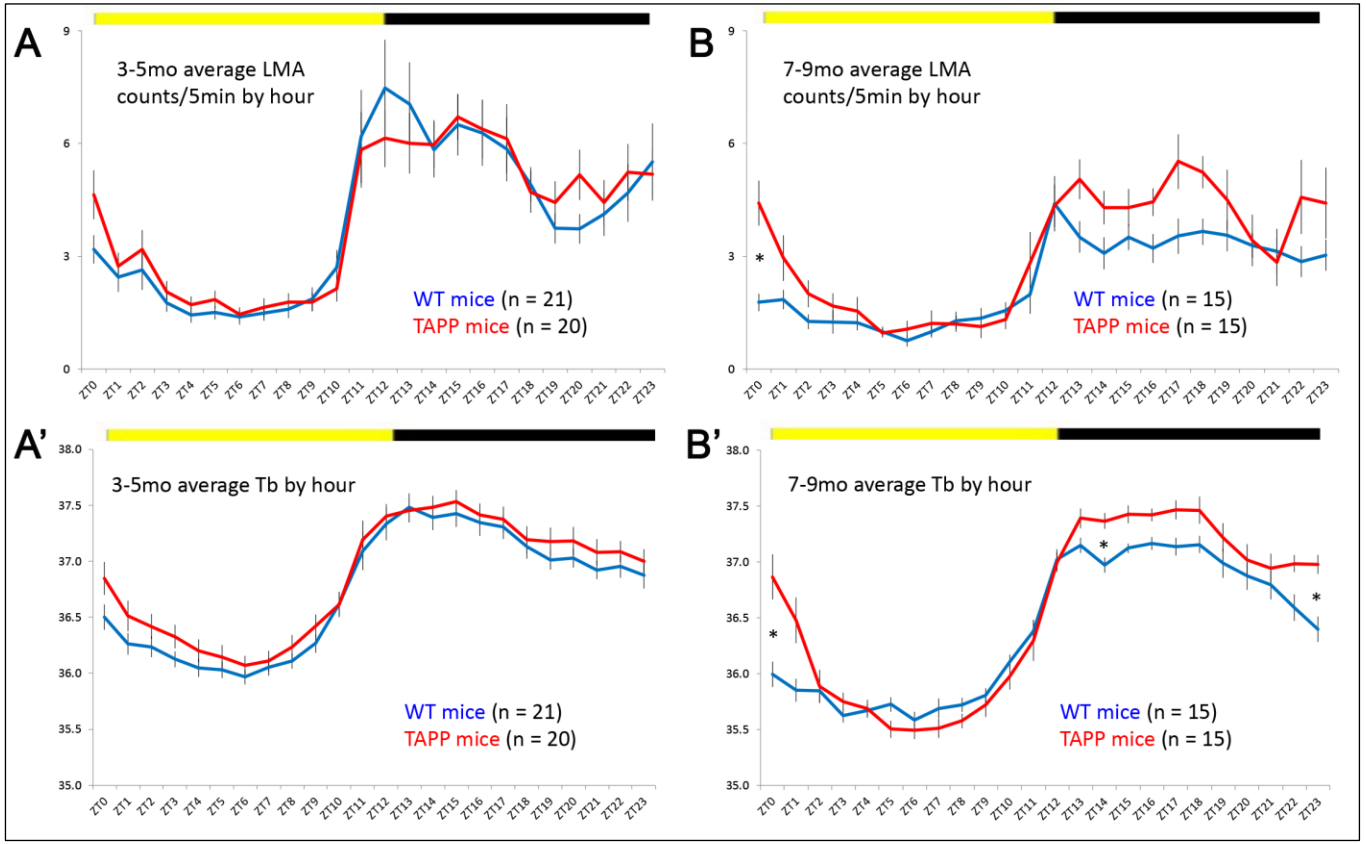




Results: AQP4 staining

- Reduced variability in both young groups
- High variability in both old groups
- Highest expression of AQP4 found in majority of old group mutants





Circadian Disruption

- Older mutants exhibit later peaks of body temperature (Tb) and locomotor activity (LMA)
- Taking longer to enter resting phase = indicator of circadian disruption
- Not seen in younger mutants

Discussion, Relevance, and Next Steps

Astrocytic expression in SCN

- No observable differences for now

AQP4 expression in SCN

- Increased expression of AQP4 in hypothalamic regions for older mutants
  - Aligns with results from prior studies that focused on cortical regions
- If AD pathology affecting the SCN, then AQP4 may be "working harder" (increased expression) to clear waste

Continuing work

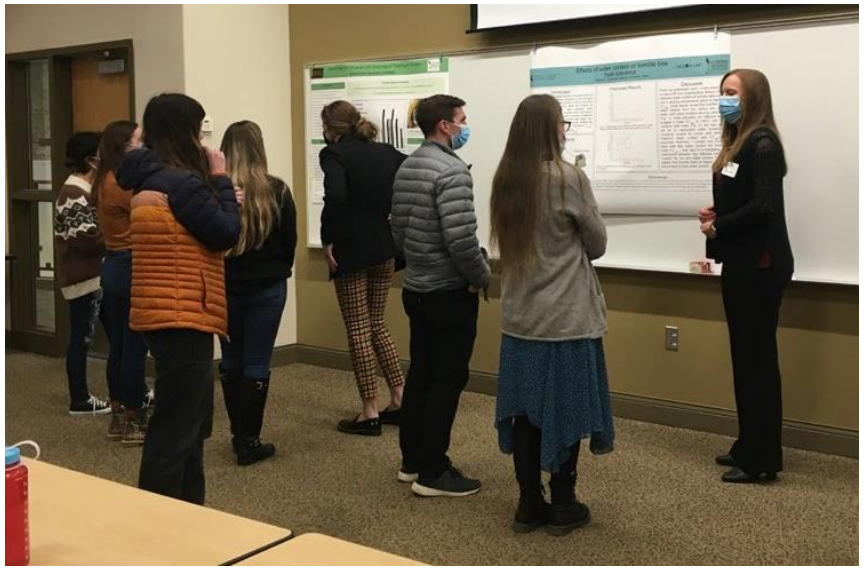
- Assess differences in AQP4 and astrocytic expression in relation to AD markers
  - Tau and Amyloid-Beta
- Investigate cell overlap between AQP4 and astrocytic expression for more specific insight
- Assess expression in two other regions:
  - **Subparaventricular zone (SPZ)**, which is known to *receive inputs* from the SCN
  - **Lateral parabrachial nucleus (LPB)**, which is known to *project outputs* to the SCN

New Undergraduate Research Program

- The Wyoming Research Scholars Program has been quite successful, and we aim to continue growing it to the original goal of ~100 students/year

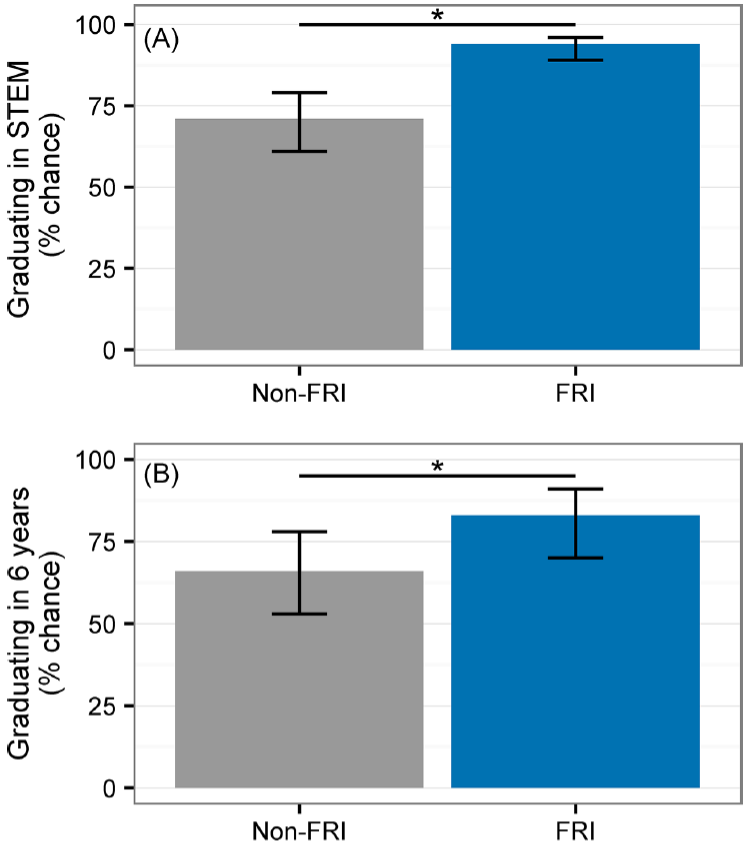
- We recently adopted a method to reach even more students, particularly in their freshman year
  - **Course-based Undergraduate Research Experiences (CUREs)**

- Many institutions have some form of CURE - notable ones include UT Austin, U Maryland, SUNY Binghamton, etc.



Course-based Undergraduate Research Experiences (CUREs)

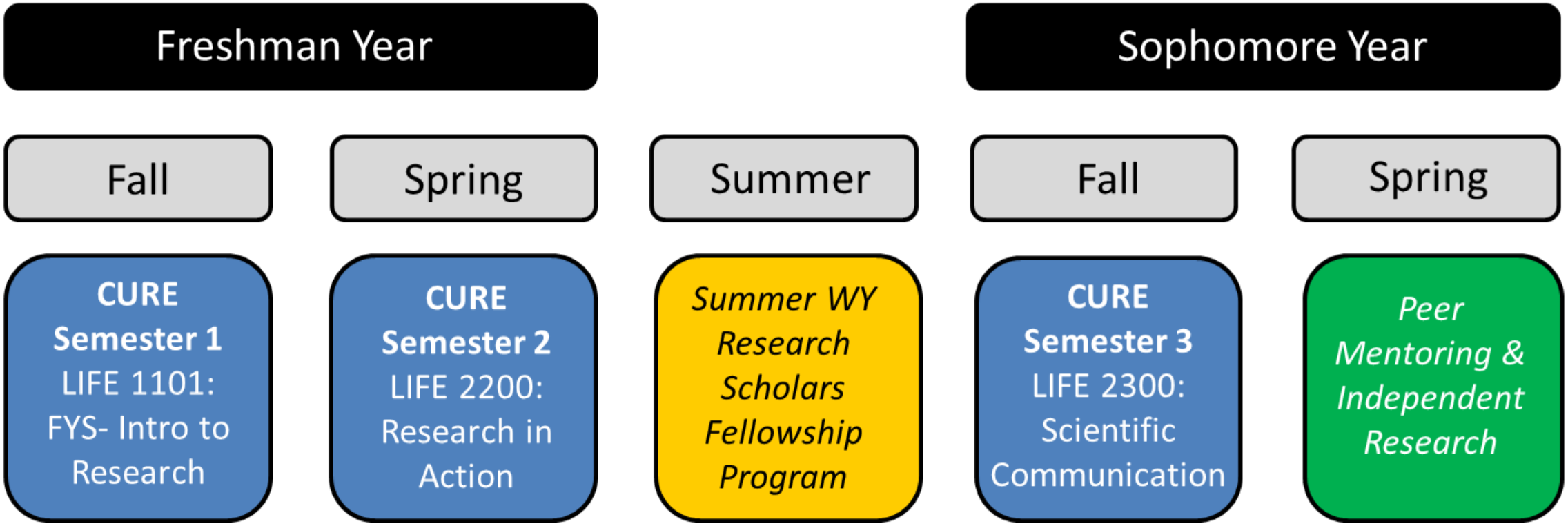
- Accommodate many more students than traditional research internships
- Help reach underrepresented students
- Example: University of Texas-Austin Freshman Research Initiative (FRI)
  - 3-course CURE has involved thousands of students since 2005 (~900/yr)
  - CUREs are <u>most effective</u> over *multiple semesters* early in a student's education



Students who complete UT CURE show significant improvements in (A) probability of graduating in STEM major and (B) graduating in 6 years. (Rodenbusch et al. 2016)

Recent CURE Implementation at the University of Wyoming

CURE Program Curriculum



Adapted from University of Maryland FIRE Program

LIFE 1101: Introduction to Ecological Research

Began developing CURE sequence in 2019

Fall 2019: "*Beaver pond ecosystems***"**
Taught as a Special Topics course (½ semester, 4 hrs/week)

Fall 2020: "*Freshwater ecology*"
Under First-Year Seminar (FYS) designation
Worked in the nearby Laramie River and remote locations

Fall 2021: "*Beaver pond ecosystems***"**
Under First-Year Seminar (FYS) designation
Happy Jack area of Medicine Bow National Forest

The Effects of Beaver Dam Habitats on Water Quality

Conducted by [Students]

Background and Significance

Beavers are known ecological engineers that construct dams and affect the flow of water. This in turn changes the surrounding ecosystem. With the data we gathered we can use it to look at a multitude of ecosystem advantages

- Use of the water for agricultural irrigation
  - Allows for irrigation later in the season
- Increase in vegetation
  - Plants preferred pH is more acidic(pH<7)
- Density of aquatic life
  - Fish preferred

Hy

- We hypothesize that th
  will differ from that of
  the of the stationary w

Locati

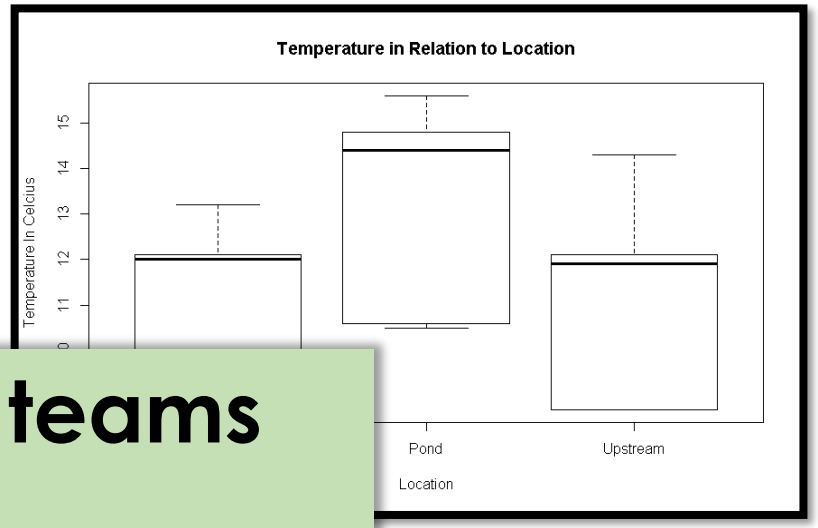
- Pole Mountain of the M
  outside of Laramie, WY
- September 18, September 25 and October 2 from 2-4pm

Methods and Equipment

- Data was collected using the following equipment on three separate occasions
  - YSI Pro Plus – used to obtain field levels of dissolved oxygen, pH, temperature and atmospheric pressure.
  - Ion Chromatography – used in the lab to obtain concentration levels of cations and anions in mg/mL

Other 2019 teams studied:

- **Bird Diversity**
- **Willow Disease**



gnificantly higher in the beaver
d down stream

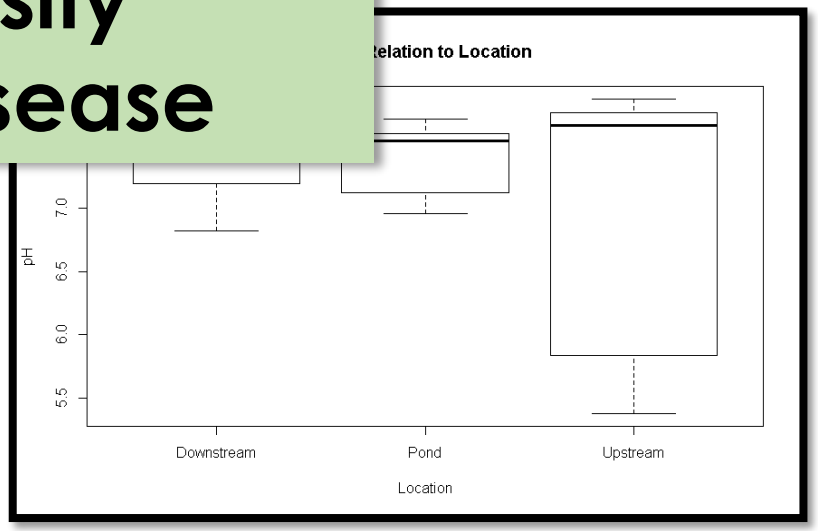


Figure B: pH median decreases as it goes from up-stream to down-stream, with upstream having some outliners.

Results Explained

- The temperature of the pond compared to upstream and downstream was significantly different ($p<0.001$, Figure A)
- On days, the water was tested, there was always a significant pH difference between the upstream and downstream water ($p<0.01$, Figure B)
- Ion levels in all samples were insignificantly different

Conclusion

- We can conclude with this data, that there is a relation between the water quality of the pond compared to the free-flowing up-stream and down-stream water

Figure C: Collecting water samples for the experiment and gathering data (Photo Cred: Dr. C. North)

References

- Endut. A., et al. 2009. Effect of flow rate on water quality parameters and plant growth of water spinach (Ipomoea aquatica) in an aquaponic recirculating system. Desalination and Water Treatment. 5:1-3, 19-28, DOI: 10.5004/dwt.2009.559
- Schofield. L.C.. 1976. Acid Precipitation: Effects on Fish. Royal Swedish Academy of Sciences. Vol. 5, No. 5/6, pp. 228-230
- McCall. W.W.. 1914. The pH Prefrence of Plants. The Hawaii Cooperative Extension Service. No.18

Human Presence on Wildlife Diversity

[Wildlife Team]

Fox (*Vulpes vulpes*)

Introduction

- Wildlife diversity can be imp
  human presence, and it can b
  to learn more about those affe
- Camera traps have become th
  efficient way of monitoring a
  populations.
- Using these traps, our team w
  watch riparian zones without
  the variable of human activity.

Objective & Hypothesis

- To determine whether human foot traffic has an effect on wildlife diversity and abundance.
- We hypothesised that wildlife diversity and abundance will decrease when human activity is increased.

Figure 1. The number of each individual animal from species grouping spotted on camera traps at different sites.

Rabbit (*Oryctolagus cuniculus*)

Other 2020 teams studied:

- **Cattle Grazing**
- **Macroinvertebrates, Algae, and Velocity**
- **Water Quality and Macroinvertebrate Richness**

Methods

- We collected data at three separate locations along the Laramie River in Wyoming.
- The sites varied in human foot traffic levels with low, medium, and high foot traffic.
- Camera traps were placed at the medium(n=3), high(n=3), and low(n=4) foot traffic sites.
- We checked cameras one to two times per
  ed out the SD cards, and recorded
  ls were caught by the camera trap.

iversity level, the high area had an
.89, the medium area had 1.68, and
had 1.71 (Figure 1).
human foot traffic did not
affect wildlife diversity.
ed richness value was 9 in the high
activity areas, and 7 in the low
(Figure 1).

Discussion

- Human activity appears to only affect types of animals spotted in the area.
- A larger number of individual animals were spotted closer to the high human activity area (Figure 1).
- Further research should focus on a limited number of species when determining diversity to get more accurate data.

The Effect of Beaver Ponds on Water Quality Using the EPT Index

Conducted by [Students]

Introduction

- Unlike other herbivores, beavers greatly impact ecosystems with a range that exceeds their presence.
- Water quality can be determined through the EPT index.
- EPT (Ephemeroptera, Plecoptera, Tricoptera) are intolerable to pollutants, making them crucial indicators in water quality .
- Equation used to determine EPT index : $\frac{Total\ EPT\ Taxa}{Total\ Taxa\ Found} * 100.$

Question and Hypothesis

Will beaver ponds affect the EPT index, and ultimately the water quality?

We hypothesized that the EPT index would be higher in beaver ponds than that of upstream.

Methods

- Using a YSI probe, we measured the dissolved oxygen (mg/L), pH, and temperature (ºC)
- Using an Oakton PCTSTestr 50 probe, we measured the salinity (ppt.)
- Obtained samples using a D-Net.
- Calculated EPT index

Other 2021 teams studied:

- **Mammal Diversity**
- **Water Flow and Aquatic Insect Diversity**
- **Soil Nutrients**

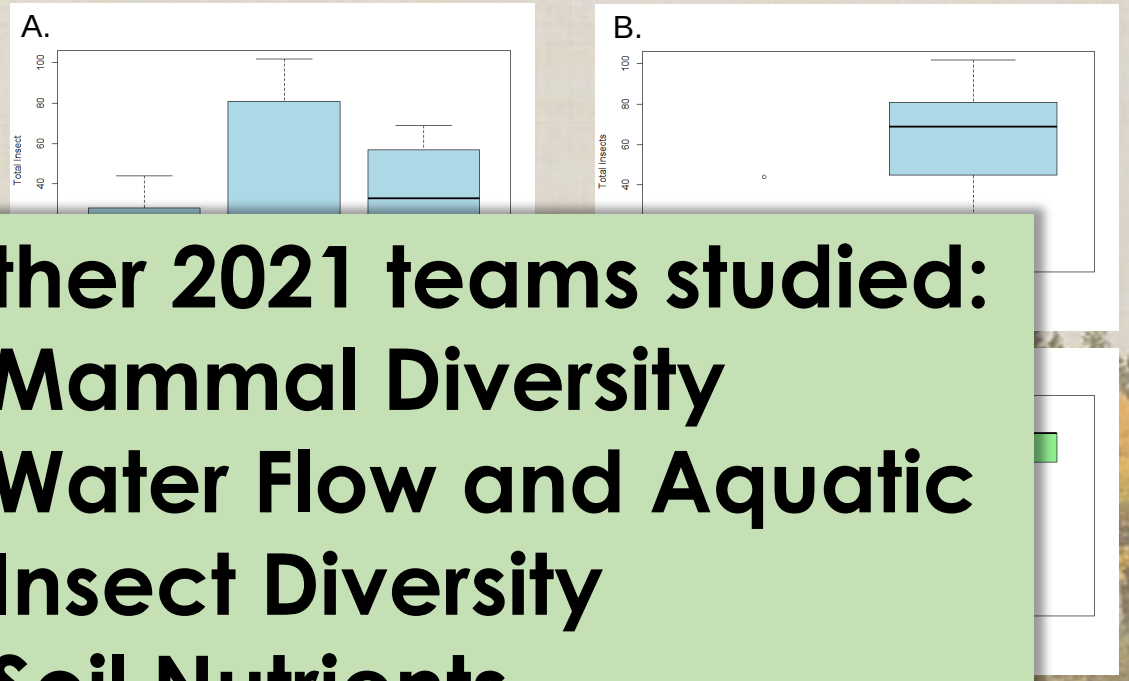


Fig. 3. Mayflies (E), Stoneflies (P), and Caddisflies (T)

there was a significant difference in the total number of insects and taxa richness among ponds (B, D; $p < 0.05$).

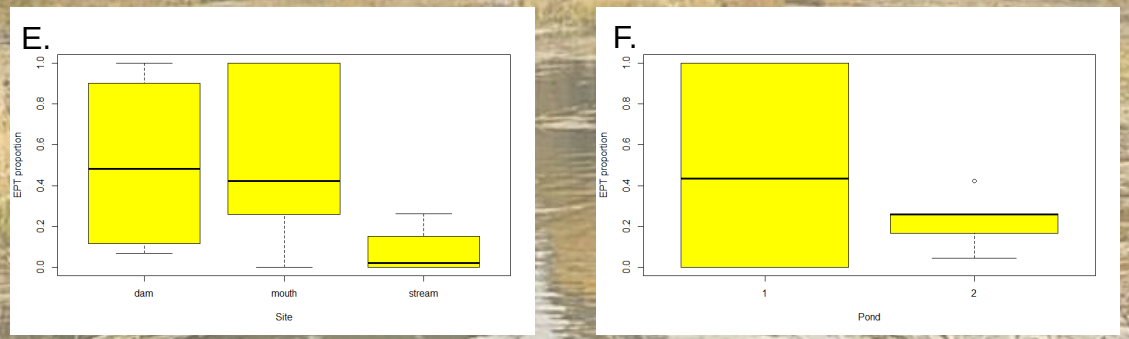


Fig. 2. Total EPT proportion among sites (E) and ponds (F). There was no significant difference in the total EPT proportion among sites and ponds (E, F; $p > 0.05$).

Discussion and Conclusion

- Unlike previous studies, there was no significant difference in the total EPT proportion among sites and ponds (Fig. 2) suggesting our sample size was too small.
- The difference between EPT proportion and sites was insignificant ($p > 0.05$) but there was a visually noticeable difference between the pond sites (dam, mouth) and the stream site.
- There was no significant difference in total number of insects, and taxa richness among sites (Fig. 1).
- There was a significant difference in the total number of insects and taxa richness among ponds (Fig. 1) suggesting that collecting samples from more ponds may strengthen results.

References

[1] Arndt, E., & Domdei, J. 2011. *Polish Journal of Ecology 2011*. [2] Butler, D., & Malanson, G. 1995. *Geomorphology*. [3] Hamid, S., & Rawi, C. 2017. *Tropical life sciences research 2017*. [4]Strzelec et al. 2018. *Biologia 2018*. [5]Griffith et al. 2001. *Ecological Applications 2001*. [6] Washko S, Roper B, & Atwood T. 2019. *John Wiley & Sons Ltd.*

Assessment – Fall 2020 FYS CURE survey

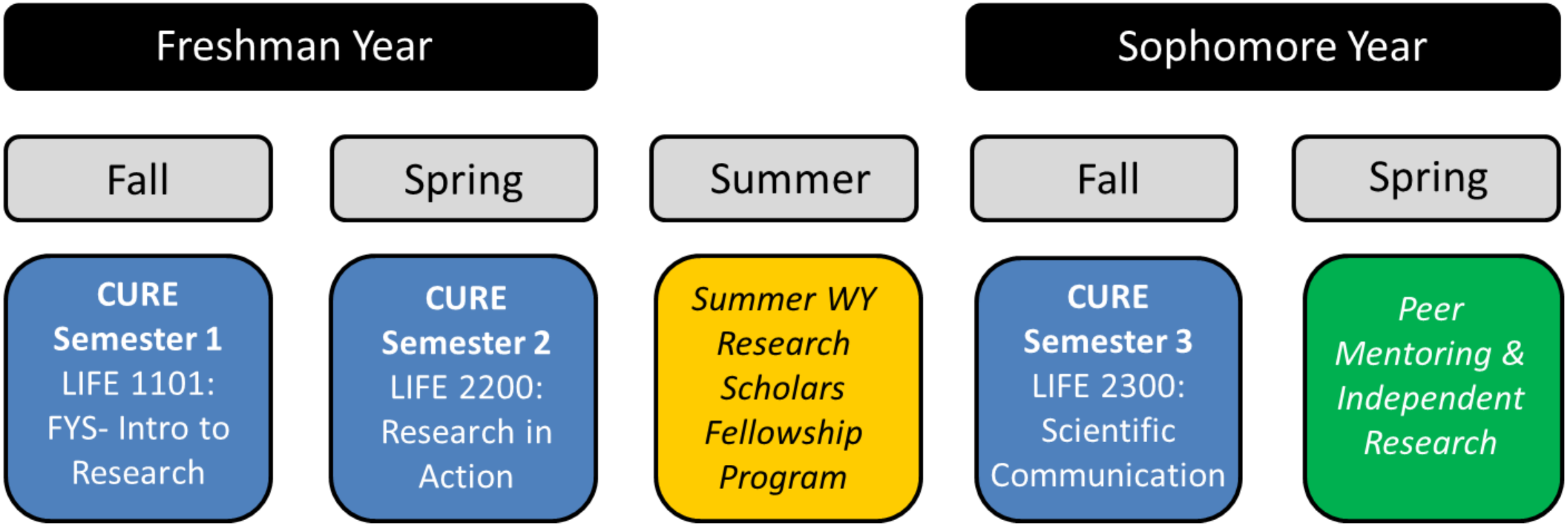
Level of experience with	Average student estimate (±SD)
Projects where only the instructor knows outcome	Some (3.2 ± 1.0)
Projects where no one knows the outcome	**Some (2.6 ± 0.6) to Much (4.2 ± 0.7) (p < 0.001)**
Projects entirely of student design	**Some (2.9 ± 1.1) to Extensive (4.6 ± 0.5) (p < 0.001)**
Reading primary scientific literature	**Some (3.1 ± 1.0) to Much (4.4 ± 0.9) (p = 0.020)**
Writing a research proposal	**Little (2.4 ± 1.0) to Extensive (4.6 ± 0.5) (p < 0.001)**
Science attitude statement	**Likert scale response (±SD)**
Even if I forget the facts, I'll still be able to use the thinking skills I learn in science	**Agree (4.0 ± 0.6) to Strongly Agree (4.7 ± 0.5) (p = 0.021)**
I can do well in science courses	Agree (4.3 ± 0.7)

(from North and Crait 2021)

- Modified version of CURE survey developed by Lopatto et al. (https://www.grinnell.edu/academics/resources/ctla/assessment/cure-survey)
- Estimates of experience: None = 1 (1.0-1.5); Little = 2 (1.6-2.5); Some = 3 (2.6-3.5); Much = 4 (3.6-4.5); Extensive = 5 (4.6-5)
- Rows in **bold** indicate significant changes in reported experience level pre vs. post (adjusted p-values < 0.05; paired *t*-test)
- For rows in which no significant change was detected, reported means and SD represent average values of pre and post survey results

Course-based Undergraduate Research Experiences (CUREs)

CURE Program Curriculum



Adapted from University of Maryland FIRE Program

Course-based Undergraduate Research Experiences (CUREs)

- Proposed Plan moving forward
  - Develop multiple research-based FYS courses across STEM disciplines, culminating with students and faculty designing a small research project

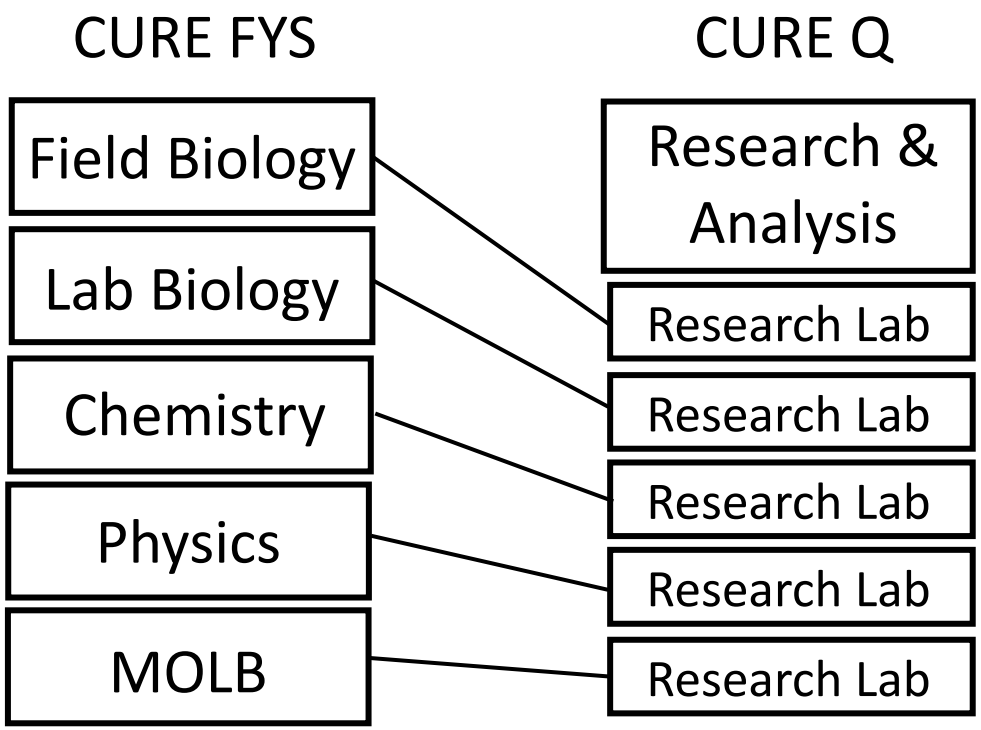
CURE FYS

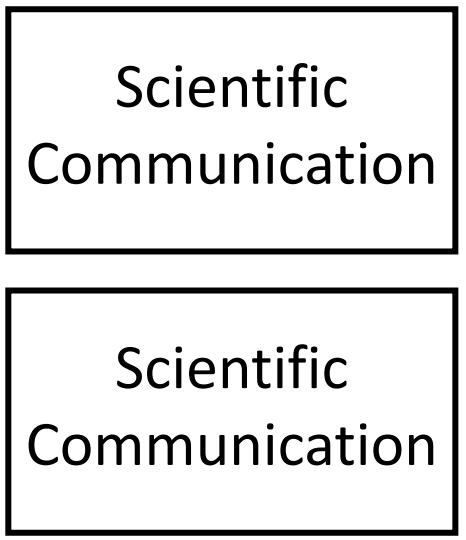
- Field Biology
- Lab Biology
- Chemistry
- Physics
- MOLB

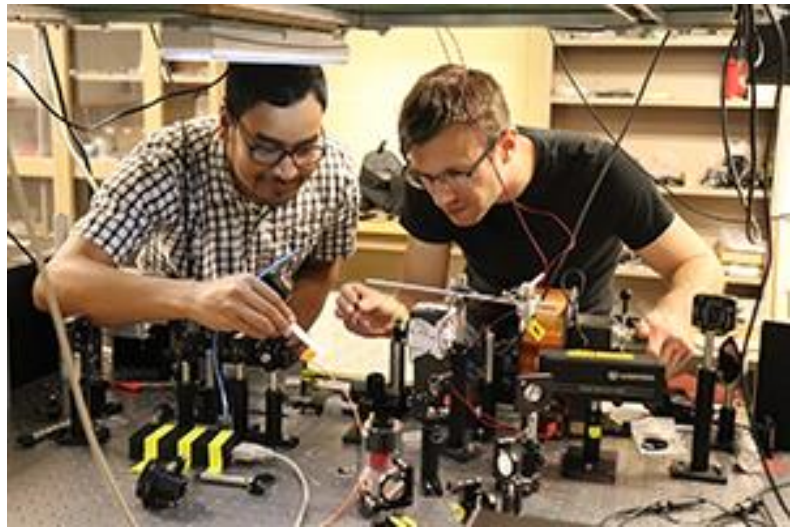
Etc.

Course-based Undergraduate Research Experiences (CUREs)

- Proposed Plan moving forward
  - Second semester Quantitative Reasoning (Q) course with lab sections. Students analyze data in Q course (LIFE 2200 may be good model or match for lecture side)
  - Add section of COM2 – Scientific Communication

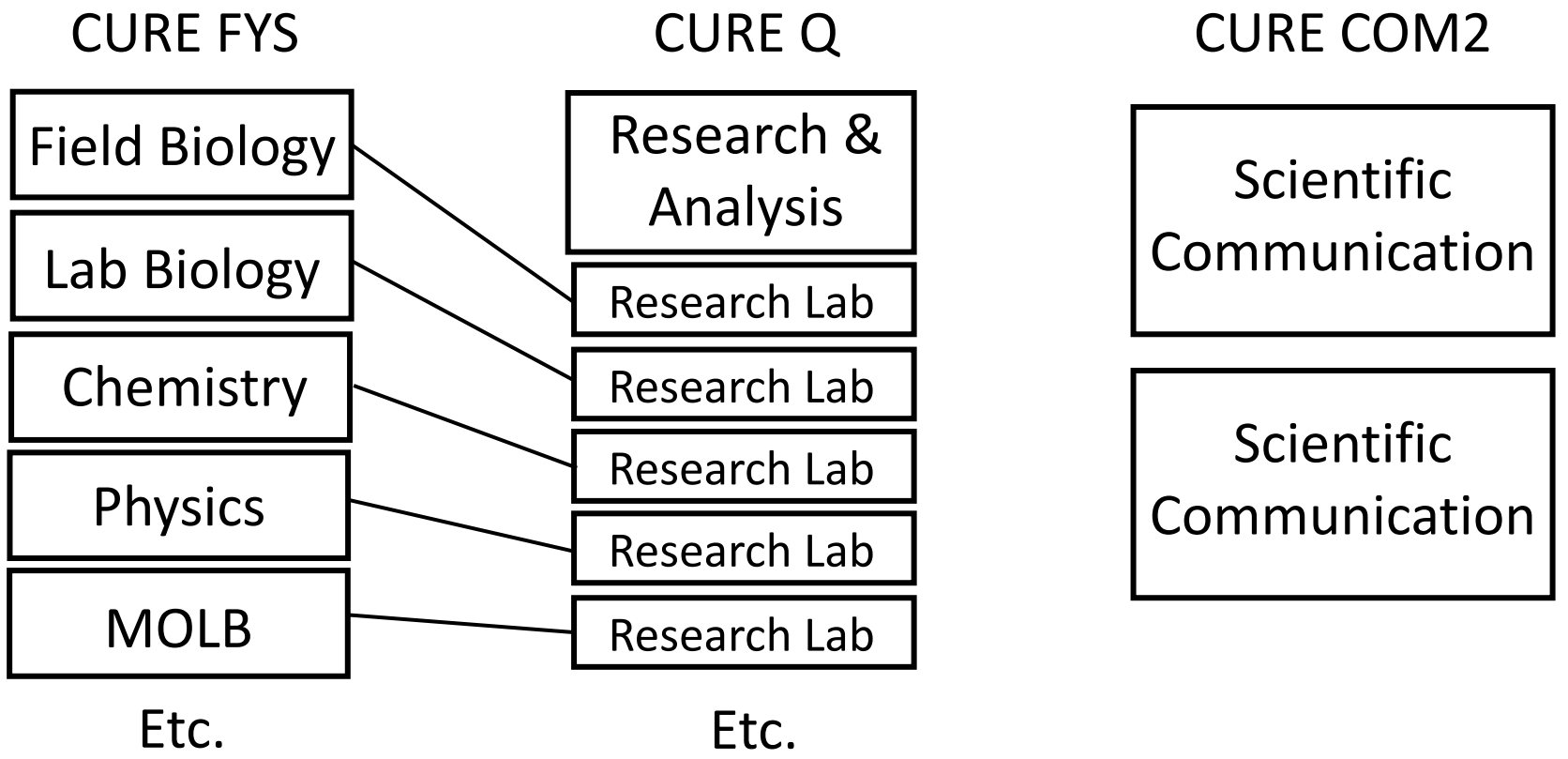






Course-based Undergraduate Research Experiences (CUREs)

- Proposed Plan moving forward
  - Students completing sequence could receive Certificate (perhaps with other requirements like K-12 Outreach, presentation at UG Research Day) & would be well positioned to move into mentored research



CUREs Looking Forward

Challenges

- Curriculum integration
- Resources & logistics

Opportunities

- Recognized value
- Model for new courses
- Unique research opportunities in WY
  - UW-NPS Research Station
- Freshman CURE bootcamps

Questions?

WY INBRE
Student Programs

Annie Bergman, Ph.D.
Director, INBRE Student Programs
Director, UW STEAM Camps

UW INBRE Internships

- Academic Year internships: (~10 hours/wk in lab)
- Fall/Spring 2021 (10) – 160 hours
- Fall only option - 80 hours
- Spring only (10)– 80 hours

- Summer Internship – 10 weeks; full-time $6000

  culminating in INBRE Summer Research Symposium
  - 2021 (17) 2022 (17)

Transition Student Program

WY Community Colleges provide experience in:

- INBRE Research Labs
- INBRE Research Course
- UW-INBRE Collaborative Grants

Transition Student Awards

- Students apply in spring of their second year
- Accepted students receive funding at UW for their junior and senior years $5000/yr
- Two lab rotations followed by ‘home lab’ selection

  Independent, mentored research

RAIN: Regional Alliance of INBRE Networks

- Summer Internships: applications from our 7 western INBRE states
  - 2021: Dipesh Pokharel (pre-med in the Bobadilla Lab)
- Research awards in regional INBRE labs in ID, MT, NM, NV, AK, HI
  - National labs, INBRE labs, Data Science virtual and in-person workshops

BEyond the ‘Bench’ support

- Becoming a Resilient Scientist training
  - Resilience/Wellness skills and resources
- Professional Development skills – writing/presentations/etiquette
- Community service opportunities
  - STEAM outreach and inreach with K12 during the school year
  - UW STEAM Camps – outdoor, place-based for elementary & MS youth
  - WSSF judging and Enrichment Day
  - Afterschool STEAM/Youth Tennis
- Women in Math, Science & Engineering events
- Women in STEM events: Own It! and MS/HS student activities

Skylar Hodgins - *Dr. Ana Clara Bobadilla*

Brett Ralston – *Dr. Amy Navratil*

Caleb Price – *Dr. Mark Gomelsky*

Taylor Hatcher – *Dr. Michael Dillon*

Gareth Flowers – *Dr. John Oakey*

Structural Plasticity of Dendritic Spines Within Cocaine-Seeking Neuronal Ensembles

Skylar Hodgins, Levi Flom, Lucio Vaccaro, Kathryn Sandum, Ana-Clara Bobadilla
Department of Pharmaceutical Sciences, University of Wyoming, Laramie, WY 82070

INTRODUCTION

Substance Use Disorder (SUD)

- Uncontrollable use of drugs resulting in life impairment[1]
- SUD problem: relapse 40 – 60%[2]

Brain Region of Interest: Nucleus Accumbens (NAc)

- Center of motivation, learning, and reward pathways
- Coactivated brain cells = neuronal ensembles

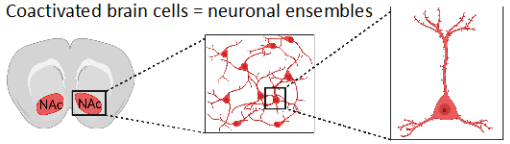


Fig. 1: Dendritic spines are located on medium spiny neurons (MSNs) within NAc neuronal ensembles.

Mouse Model

- Human and mouse brains process cocaine similarly[3]
- Transgenic mice allow for specific tagging of cocaine-seeking ensembles (Tom+)[4]
- Green fluorescent protein (GFP+) used to tag non-seeking ensembles

Synaptic Potentiation

- Increased coactivation during seeking strengthens pathway and action potential for negatively reinforced behavior[5]

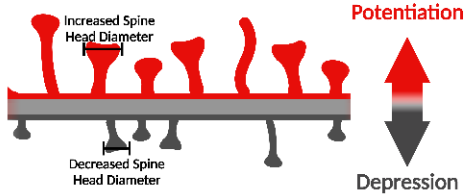


Fig. 2: Dendritic spine synaptic potentiation and depression.

Spine Analysis

- Imaris widely used, $8,000.00 contract fee
- SpineJ – FIJI plugin, open source[6]

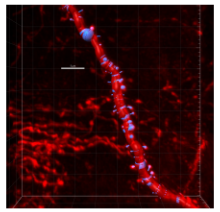


Fig. 3: Imaris segment.

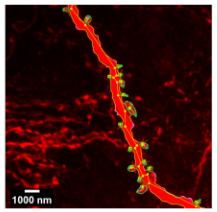


Fig. 4: SpineJ segment.

SPECIFIC AIMS

1) Compare dendritic spine analysis in Imaris and SpineJ.
2) Evaluate cocaine-seeking spine plasticity in NAc.

SIGNIFICANCE: Understanding the neurophysiology of SUD could lead to potential improvements in treatment.

METHODS

Fig. 5: Self-Administration (SA) Timeline

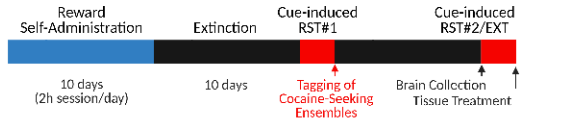


Fig. 6: SA mouse model chamber.

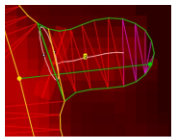


Fig. 7: Spine triangulation in SpineJ.

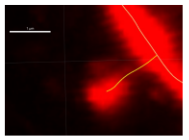
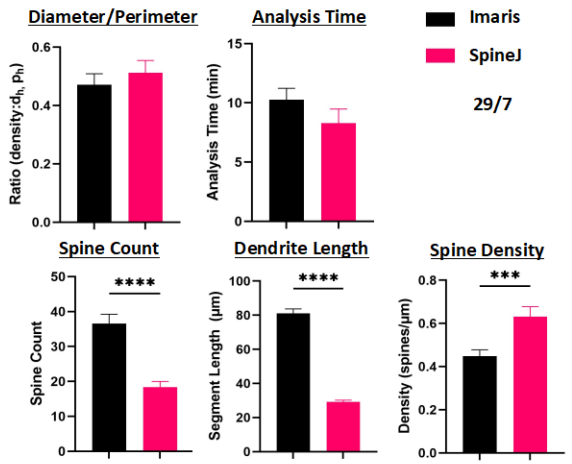
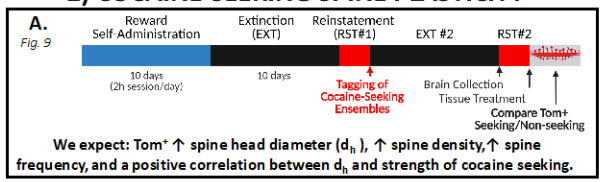


Fig. 8: Spine quantification in Imaris.

1) IMARIS VS. SPINEJ



2) COCAINE-SEEKING SPINE PLASTICITY



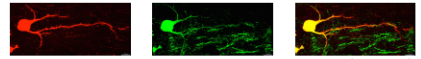


Fig. 11: Microscopy images of AT-194 N1-63x in Imaris comparing Tom+ and GFP+ expression.

CONCLUSIONS

IMARIS VS. SPINEJ

- Imaris resulted in significantly different spine morphology.
- SpineJ is suited for 2D analysis of shorter dendritic segments.
- Imaris will be the primary software for spine analysis in future Bobadilla Lab research.

COCAINE-SEEKING SPINE PLASTICITY

- Optimize GFP tagging of animals not actively seeking cocaine.
- Characterize spine remodeling in polysubstance models of SUD.

REFERENCES

1. American Psychiatric Association, 2020, "American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders", VA: American Psychiatric Association.
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6. Levet et al., 2019, "SpineI: A software tool for quantitative analysis of nanoscale spine morphology" Methods, 1;174:49–55.

ACKNOWLEDGEMENTS

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Citrullination of Histone H3 Regulates miRNA Processing of PTTG1 Targeting miRNAs, A Prominently Overexpressed Protein in Pituitary Adenomas

Brett Ralston, Stanley Devore, Paul Thompson, and Brian Cherrington
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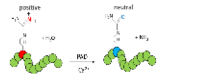
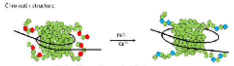
Background

What is Citrullination?



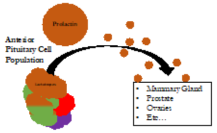
Peptidyl Arginine Deiminase Enzymes A.K.A PADs

What Can it Affect?



DNA Wrapped around a Nucleosome

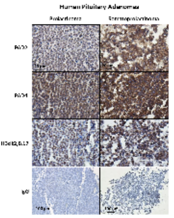
What are Prolactinomas and Somatoprolactinomas?



Over-proliferation of Lactotropes or Somatolactotropes that secrete their hormones (Prolactin or Growth Hormone)

- Irregular Menstrual Periods
- Milky Discharge from Breasts
- Tumor Pressure
- Infertility

Are Pads Expressed in Prolactinomas and Somatoprolactinomas?



Immunohistochemistry Stain of PADs 2 and 4 in Prolactinomas and Somatoprolactinomas

What Genes Does PAD Catalyzed Citrullination Regulate?

DMSO vs. 14hr 1.25 µM BB-ClA: Upregulated

SYMBOL	GENE NAME	FOLD CHANGE	P_{adj}
Hmox1	heme-oxygenase-1	5.985	1.56E-66
Mirlet7c-2	[illegible]	4.500	2.75E-34
[illegible]	aminopeptidase-O	3.001	[illegible]
Dgcr8	DGCR8-microprocessor-complex-subunit	2.532	1.57E-82
Mir27b	microRNA-27b	2.392	[illegible]
Mir3556b	microRNA-3556b	2.195	2.51E-10
Mir3074	microRNA-3074	2.075	5.77E-10
Mir1306	microRNA-1306	2.070	2.24E-05
Mir23b	microRNA-23b	1.981	2.99E-13
Mir29c	microRNA-29c	1.966	4.20E-06
Tk	TTK-transcript-20-KRT-regulator	1.826	4.35E-06
Lamp2	lysosomal-associated-membrane protein 2	1.709	1.08E-04

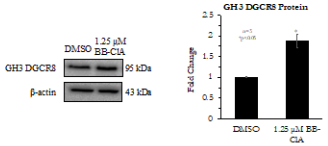
Top Ten Upregulated Genes From RNA Sequencing of Somatolactotrope Cell Line (GH3s) Treated with PAD Inhibitor

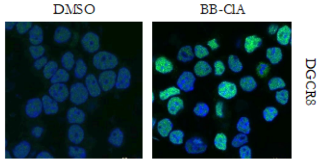
What is DGCR8?

Critical for miRNA Creation & Stabilization of Its Binding Partner DROSHA for the Maturation of miRNAs

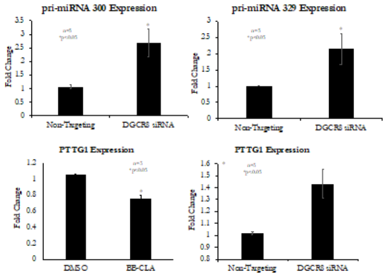
Results

PAD Inhibition Upregulates DGCR8 Expression

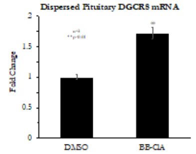




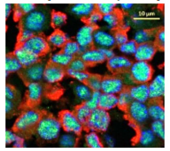
miRNAs and PTTG1 Change with DGCR8 Knockdown



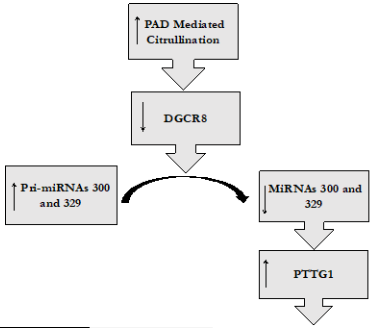
Ex Vivo and In Vivo Data Suggests Similar Trends to in Vitro Data

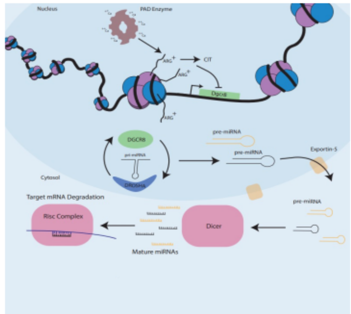


DGCR8 Expressed in Primary Lactotropes

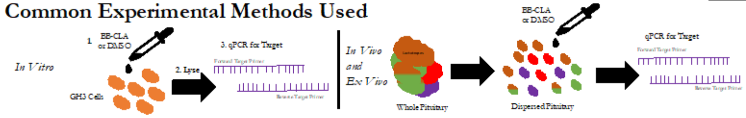


Data Supported Model for PAD Mediated DGCR8 Regulation Leading to Changes in miRNAs and Target Proteins





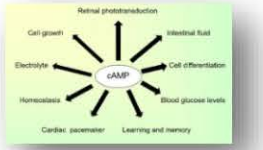
Common Experimental Methods Used



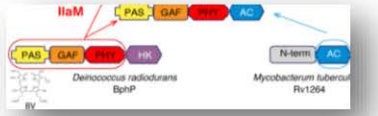
Bioengineering of Light Controlled Proteins

PRESENTER:
Caleb Price

BACKGROUND: cAMP is the most important signal relay in the body, responsible for all the processes below.

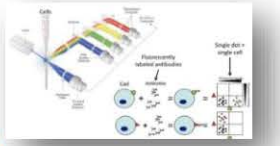


A special construct is needed to achieve this control using a bacteriophytochrome (**part that gets turned on by light**) and an adenylate cyclase (**makes cAMP**).

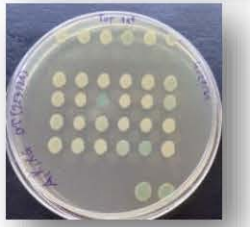


METHODS

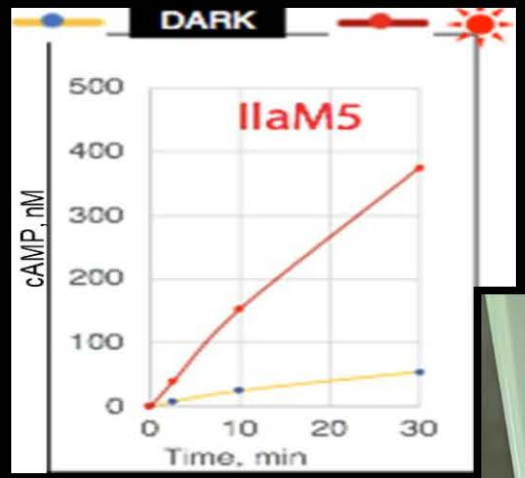
1. Mutate the I5BO-mSc plasmid to make changes that might improve construct
2. Put the I5BO-mSc plasmid into *E. Coli* cells.
3. Grow cells in light and in dark.
4. Sort cells based on fluorescence
5. Verify ideal cells

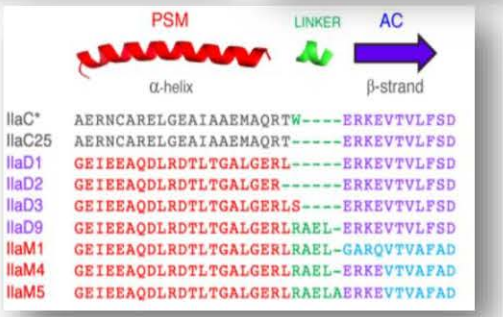


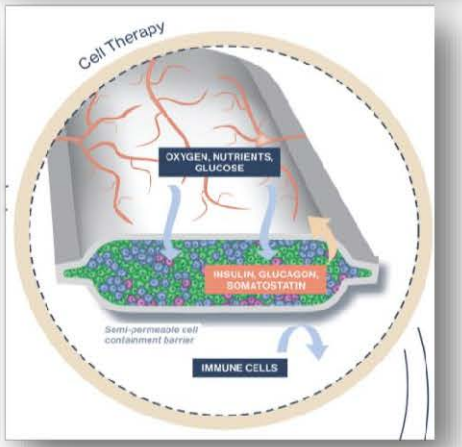
RESULTS



Your Body Can Be Controlled with Light







Caleb Price, Oliver Trunschke, Mark Gomelsky

UNIVERSITY OF WYOMING

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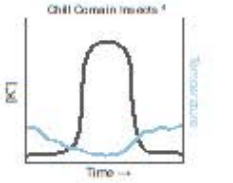
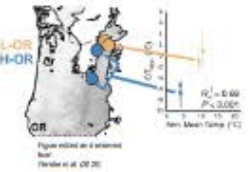
Shal does not determine cold-induced onset of spreading depolarization

Taylor Hatcher, Megan K. Dillon, Michael E. Dillon

Background:

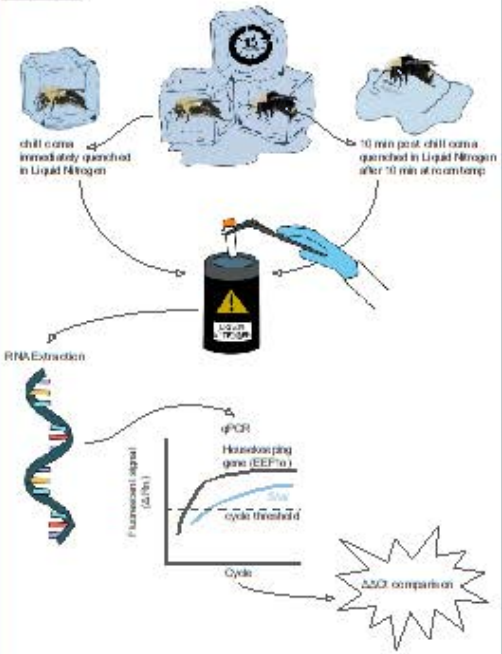
Spreading depolarization (SD) has been described in both human and insect nervous systems as a loss of ion homeostasis that eventually results in a pronounced increase in extracellular potassium. SD in humans has serious implications due to its role as a mechanism of secondary brain injury.[1] Due to bumble bees having the ability to go into this reversible state where they are experiencing a SD response with exposure to their cold tolerance minimum (CT^{min}), they make a great model organism for studying the mechanism of SD. Recent work has revealed striking differences in cold tolerance (CT^{min}) among bumble bee populations.[2] In parallel, transcriptomics has revealed differences in expression of the voltage-gated potassium channel, *Shal*, between low and high elevation bees exposed to cold, making *Shal* an attractive candidate to study chill coma and the mechanisms underlying resistance to SD.[3]





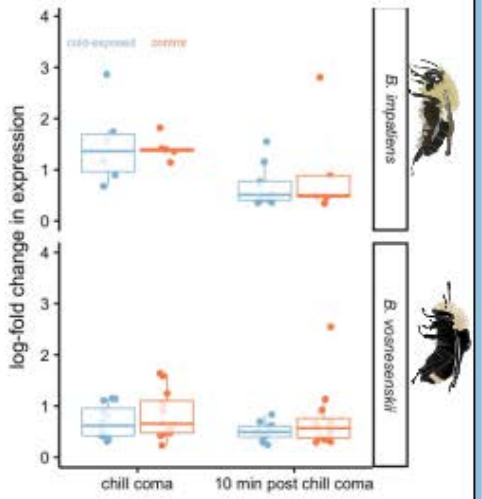
Do more cold-tolerant bumble bees maintain reduced *Shal* expression when exposed to cold?

Methods:



Shal expression did not change with time or differ between control and cold-exposed bees for either species.

Results:



Discussion:

Shal expression did not change with cold exposure for either *B. impatiens* or *B. vosnesenskii*. For *B. impatiens*, *Shal* expression was higher at chill coma and then fell with time for both cold-exposed and control bees, possibly due to stress from containment in vials. *B. vosnesenskii* maintained lower expression levels throughout the experiment, which suggests a resistance to general stressors which may contribute to the lower CT^{min} in this species. As a first look at variation in *Shal* expression in *Bombus*, the targeted sequence was in the conserved region and therefore captured all *Shal* expression. However, there are seven predicted *Shal* splice variants, and particular variants may prove more advantageous in warmer or cooler climates. Future work will assess differences in the expression of *Shal* variants in response to cold exposure for populations of bumble bees differing in cold tolerance.

References & Acknowledgements:

[1]Hertelendy et al. *Neurochemistry International*. 2019, 127, 125-136.
[2]Pimsler et al. *Scientific Reports*. 2020, 10(1), 17063.
[3]Jackson et al. *Molecular Ecology*. 2020, 29(5), 920-939.
[4]Robertson et al. *Scientific Reports*. 2017, 7(1), 10297.

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Laminated Plastic Microfluidic Systems for Continuous Nanoparticle Precipitation and Rapid Immunoassays

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College of Engineering and Applied Science
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Abstract:

Microfluidic devices have become widely used across research disciplines. The most common fabrication method for microfluidic devices is replica molding in polydimethylsiloxane (PDMS). This is quick and convenient for laboratory researchers and has enabled applications in droplet generation, cell encapsulation, immunoassays, and particle precipitation. Nevertheless, PDMS-based devices are not scalable, and are often limited by their inability to withstand common solvents, such as ethanol, acetone, and acetonitrile. Here, two new manufacturing methods are explored for the sake of particle precipitation and lateral flow immunoassay microfluidic devices. Particle precipitation is a technique used for the formation of polymeric nanoparticles used as drug delivery systems. Lateral flow immunoassays can be used for rapid and highly accurate detection of viral infections such as COVID-19. By using polyethylene terephthalate (PET) layered with a 3M adhesive or thermal laminating sheets, assembled layer-by-layer, new microfluidic devices can be developed, providing robust, scalable and potentially modular systems. Thermal lamination provides an even more robust system and more facile device production, by the elimination of the adhesive needed to bind the PET layers. While the PET system can withstand acetonitrile, the adhesive dissolves slightly in the solvent, making this method non-ideal for particle precipitation. Because both of these methods employ layer-by-layer assembly, they introduce the option of modular fabrication, not possible in PDMS. By rearranging, adding or subtracting layers upon a standard manifold footprint, a wide variety of devices with different applications could be created in a "Lego-like" fashion.

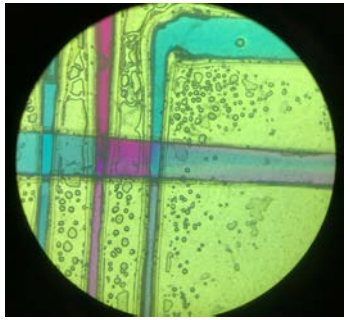

Figure 1: Laser cut Nanoprecipitation device mixing area.

Purpose:

- Mitigate Solvent Dissolution
- Streamline Fabrication
- Increase Resolution
- Decrease Imperfections

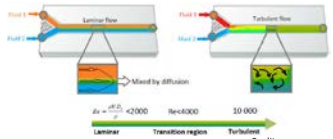

Figure 2: Laminar vs. Turbulent mixing

Credit: Researchgate.com

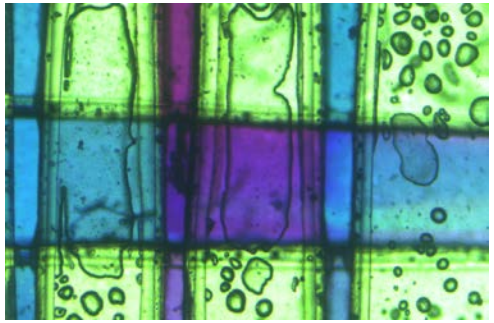

Figure 3: Close of mixing area in laser cut Nanoprecipitation device.

Methods and Materials:

- **Laser Cutter:**
  - Epilog Fusion Pro Laser Cutter
  - 3M PET Transparency Film (PP2500)
  - 3M 467MP Double-Sided Adhesive
  - In-house 3D printed manifold
- **Vinyl Cutter:**
  - Silhouette Cameo 4 Vinyl Cutter
  - Scotch Thermal Laminator
  - 3M Thermal Laminating Pouch 3mil
  - 3M 467MP Double-Sided Adhesive
  - In-house 3D printed manifold

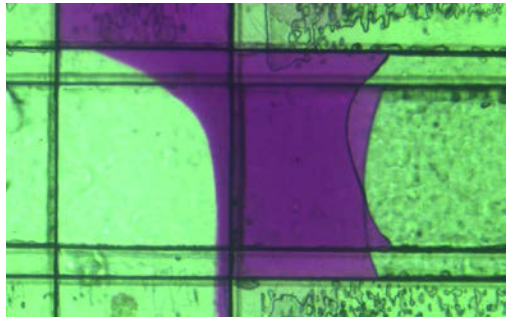

Figure 4: Laminated Nanoprecipitation device.

Conclusion:

- Fabrication Streamlined
- Swelling Less of an Issue
- More Uniform Flow Profile
- More Photogenic
- Imperfections Still Present

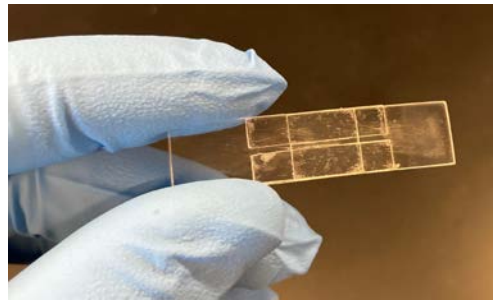

Figure 5: PET Lateral flow immunoassay prototype.

Future Work:

- Characterization of Swelling
- Exploration of Different Adhesives
- Create Uniform Flow Profile
- Decrease Imperfections Further

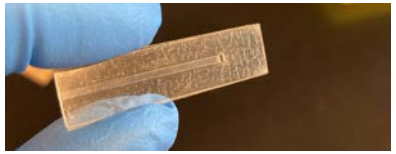

Figure 6: Later rendition of PET lateral flow immunoassay device.

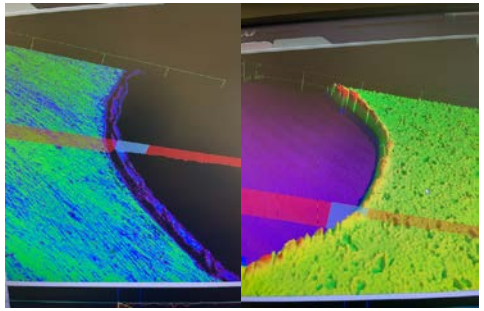

Figure 7: Imperfection (lip) produced by fabrication processes.

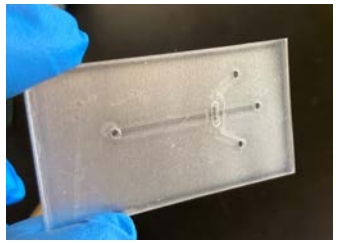

Figure 11: Assembled Nanoprecipitation device.

Acknowledgements:

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Thank you!

- WY INBRE
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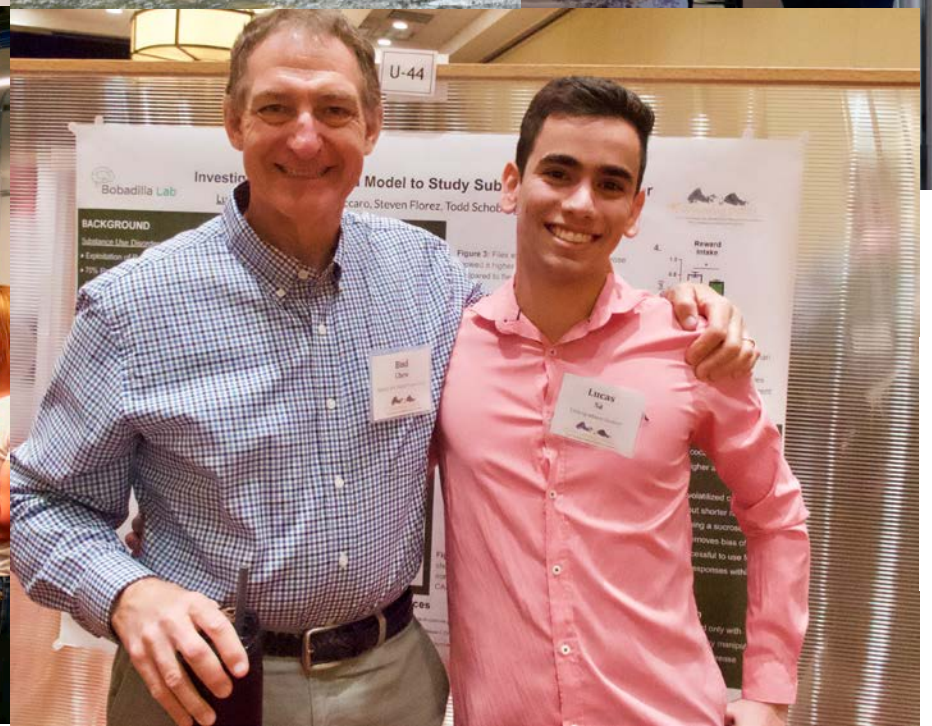
  Diana Hulme
- Science Initiative/WY Research Scholars Program
- NASA Space Grant Consortium/Science Kitchen
- Our network of UW and Community College faculty and students!



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