SYNAPSE

2023 | BYU NEUROSCIENCE

LETTER OF BELONGING

Dear Neuroscience ungraduated and graduate students,

As always, it is a great opportunity we have to learn and grow together at this great institution. I hope you make friends and associates during your time here that will last a lifetime, and that you feel integrated into the Neuroscience community on campus. Branch out and try new things including volunteering to help others, research in a lab, TA, or any of the many opportunities that you have available at BYU such as attending the Neuroscience seminars.

I wanted to share a thought with you all. At our fall university conference, we heard from Elder Christofferson from the quorum of the twelve. He encouraged us to cultivate love of God and our fellow beings. He also highlighted a quote from President Russell M Nelson regarding labels:

“Labels can be fun and indicate your support for any number of positive things. But if any label replaces your most important identifiers, the results can be spiritually suffocating. I believe that if the Lord were speaking to you directly, the first thing He would make sure you understand is your true identity. My dear friends, you are literally spirit children of God.

No identifier should displace, replace, or take priority over these three enduring designations:
- Child of God
- Child of the covenant
- Disciple of Jesus Christ

Any identifier that is not compatible with those three basic designations will ultimately let you down. Make no mistake about it: Your potential is divine. With your diligent seeking, God will give you glimpses of who you may become.”

Our office of belonging at BYU also focuses on labels such as ‘Children of God’. While these designations may seem basic at first, there is a profound thought here that as we prioritize our label as ‘Children of God’, this will allow us to rise to our potential more than any other label we or others try to put on us.

We wish you the best of luck in all your academic endeavors! I think you have all chosen one of the best majors on campus...probably the best, but that is my bias. Know that the faculty are here to help you along and are cheering you on. Good luck!

All the best,

Jeff Edwards
Neuroscience Director

2023

SYNAPSE

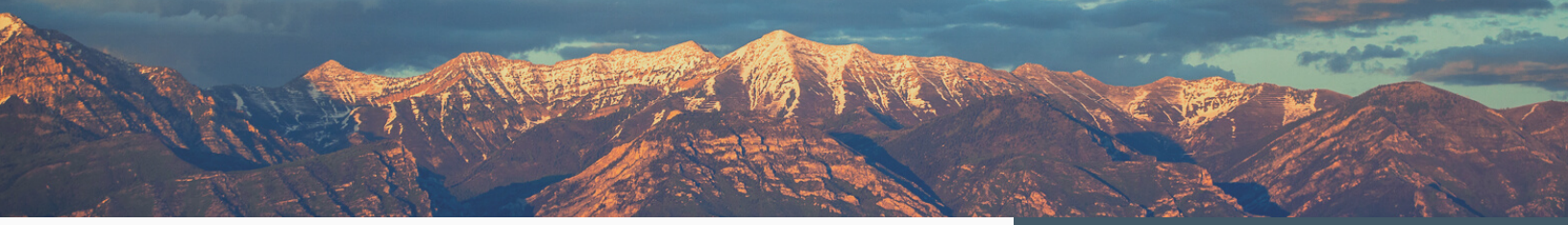
BYU Neuroscience

This issue:

Spiritual Moments in the Classroom

KEATON HELQUIST

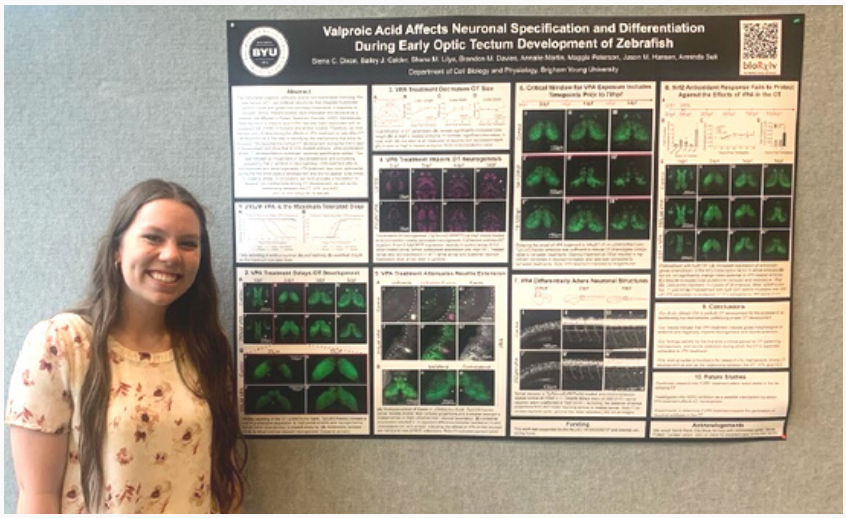
I took Biochemistry as a Neuroscience program elective to help me prepare to apply for medical school. I didn't enter the classroom with any expectations rather than simply checking a box-- one more step on a path. One class, we were doing a case study on hemoglobin, the oxygen-carrying mechanism of the human body. Dr. Price showed us a binding curve of infant hemoglobin compared to adult hemoglobin, and taught us how the mechanism of infant hemoglobin has been modified to allow the infant to maximize its oxygen level, despite modifications the mother's body makes according to heat, pH, CO2 levels and more! Babies receive adequate oxygen because of a small but intentional modification to hemoglobin. To me, it was a reaffirmation of the reality of a detail-oriented and intentional Creator. Alma says the earth and planets moving in their form witness a Supreme Creator (Alma 30:44). Whether it's the tallest mountain, or a sub-microscopic oxygen carrying protein, evidence of God's loving hand is all around.



Sierra Dixon

SHIN SCHOLARSHIP RECIPIENT

The Shin scholarship has helped me accomplish my research goals in so many ways. I work as a Research Assistant in the Suli Lab. We study neurodevelopment by using the zebrafish as a model organism. We use an anticonvulsant drug called Valproic Acid (VPA) to induce Autism Spectrum Disorder (ASD) phenotypes in the brain, both structurally and behaviorally. The purpose of our research is to further understand ASD mechanisms by imaging and analyzing the development of the Optic Tectum, an integration center in the midbrain homologous to the superior colliculus. Thanks in part to this scholarship, we have been able to advance and finish our research, which just got accepted for publication in the journal Biology Open.



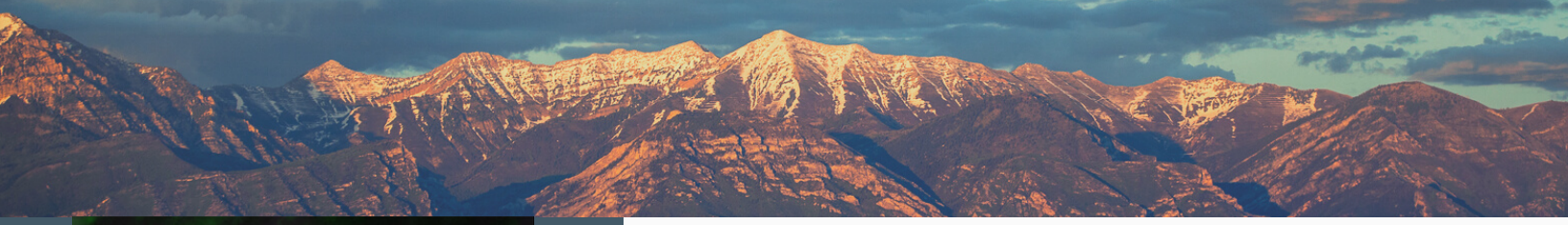
The scholarship has allowed me to continue my work in this incredible lab as well as present our findings at multiple research conferences. My team and I went to Montreal for the International Zebrafish Society Conference, as well as the Snowbird Neuroscience Conference, where I was able to present posters of our results. This was an amazing opportunity. The Shin scholarship kick-started my research career, which eventually led to these incredible conferences and a publication as primary author.

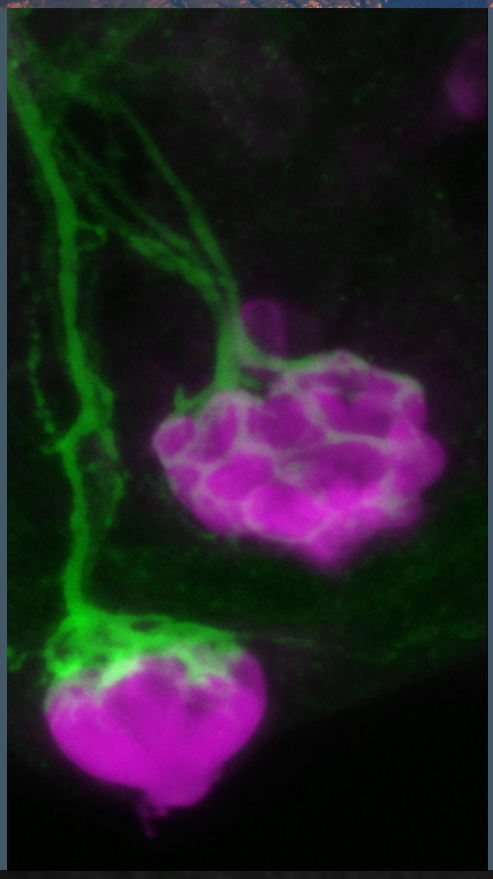
Because of these many opportunities afforded me by this scholarship, I have gained so much experience in the research world which will help me in my future career after graduation. I learned to think scientifically, critically, and out of the box. I also learned to work hard and be determined despite roadblocks that often occur in animal research. I am so grateful for these skills which will help me when I go on to PA school and enter the medical realm.

The Shin Scholarship opened many doors for me in the research world, and because of that I fell even more in love with science and searching for knowledge. I have also gained a greater appreciation for the beauty of nature and the complexity of the brain. This scholarship showed me the value of research and the way neuroscience can change the world!

"The Shin scholarship kick-started my research career, which eventually led to these incredible conferences and a publication as primary author."

SIERRA DIXON



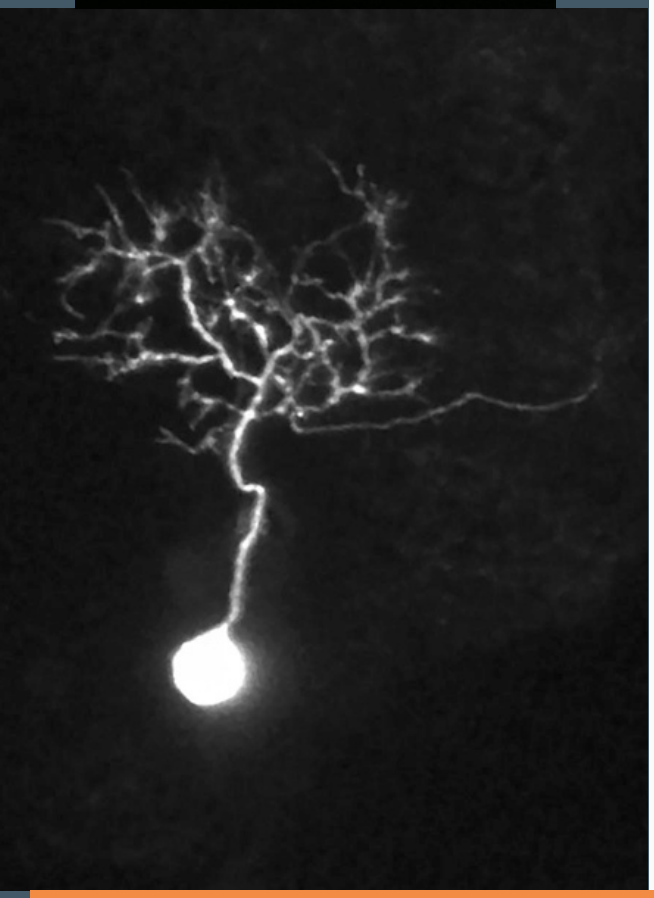


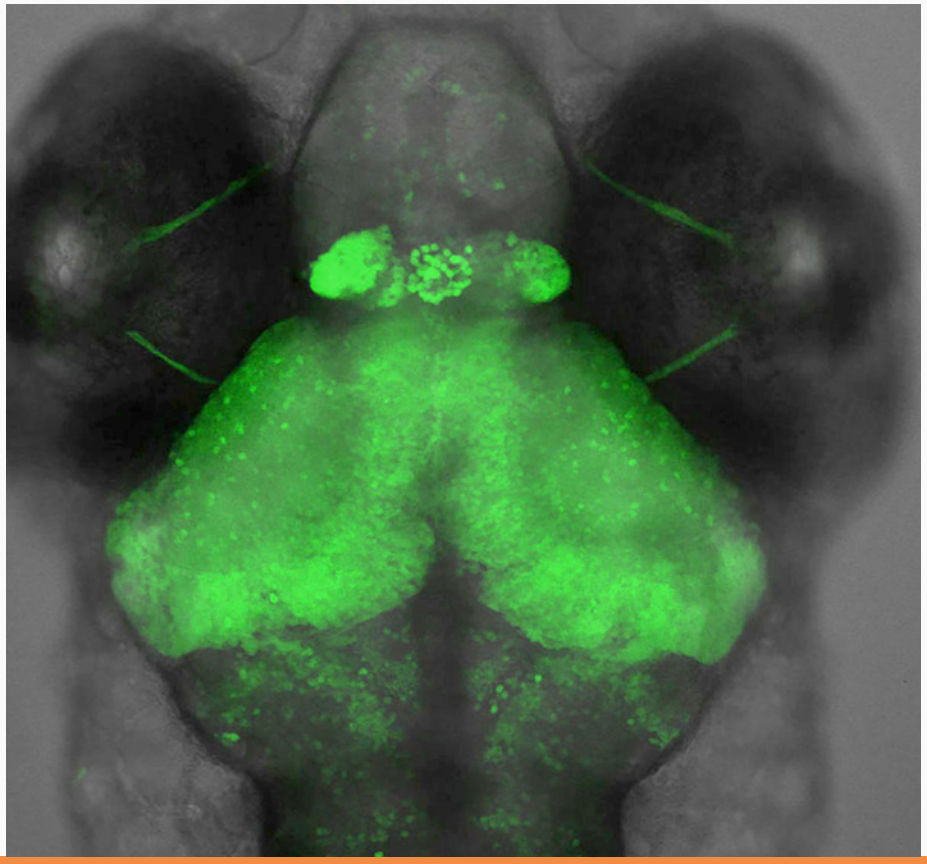
Valproic acid affects neurogenesis during early optic tectum development in zebrafish

SIERRA C. DIXON, BAILEY J. CALDER, SHANE M. LILYA, BRANDON M. DAVIES, ANNALIE MARTIN, MAGGIE PETERSON, JASON M. HANSEN, ARMINDA SULI

The mammalian superior colliculus and its non-mammalian homolog, the optic tectum (OT), are midbrain structures that integrate multimodal sensory inputs and guide non-voluntary movements in response to prevalent stimuli. Recent studies have implicated this structure as a possible site affected in autism spectrum disorder (ASD). Interestingly, fetal exposure to valproic acid (VPA) has also been associated with an increased risk of ASD in humans and animal models. Therefore, we took the approach of determining the effects of VPA treatment on zebrafish OT development as a first step in identifying the mechanisms that allow its formation. We describe normal OT development during the first 5 days of development and show that in VPA-treated embryos, neuronal specification and neuropil formation was delayed. VPA treatment was most detrimental during the first 3 days of development and did not appear to be linked to oxidative stress. In conclusion, our work provides a foundation for research into mechanisms driving OT development, as well as the relationship between the OT, VPA, and ASD.

Biology Open 1 January 2023; 12 (1): bio059567. doi: https://doi.org/10.1242/bio.059567



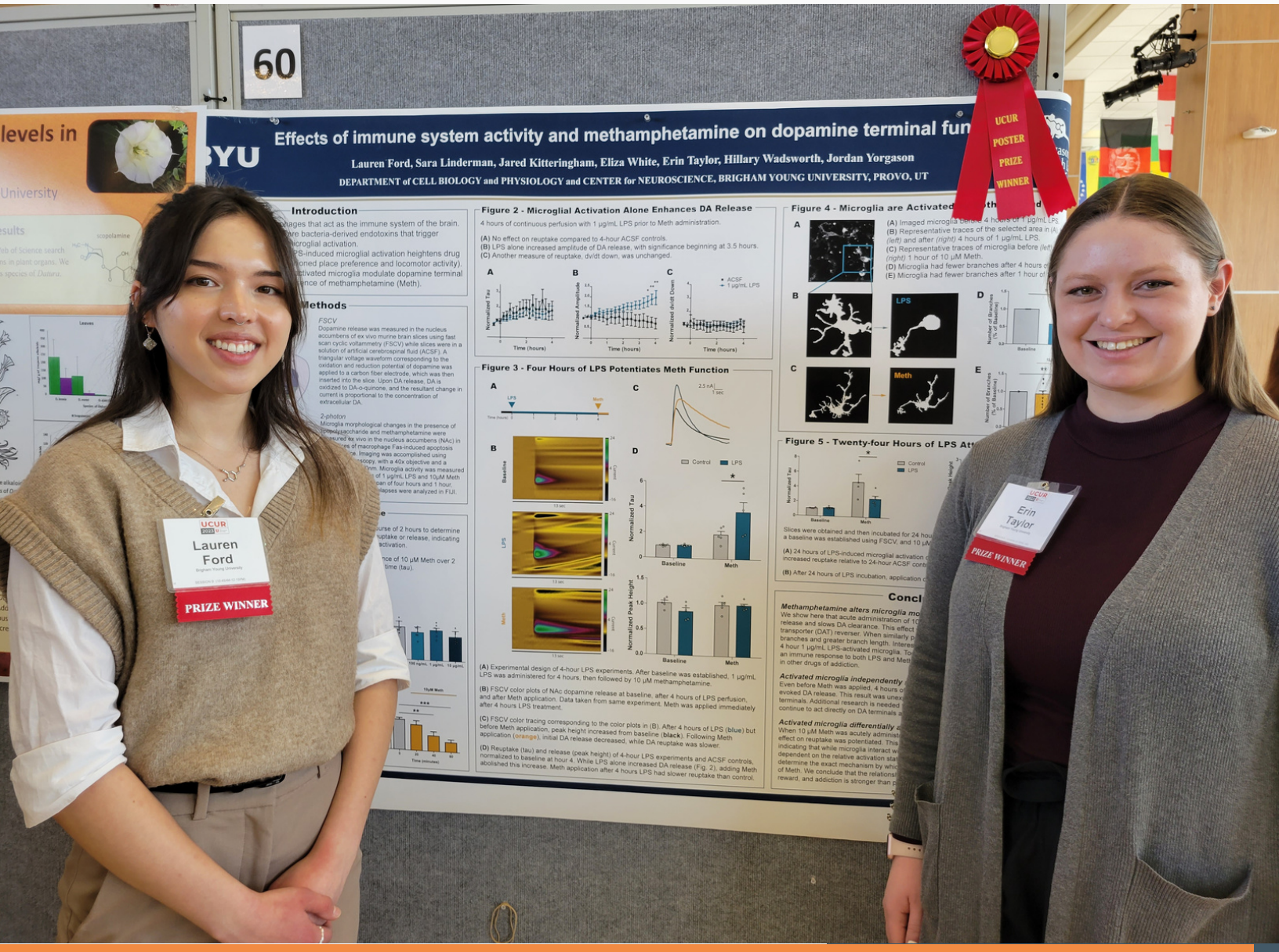


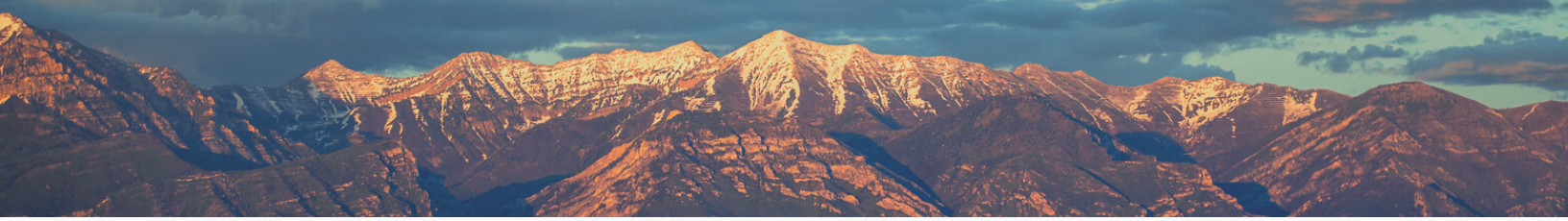
Best in STEM Winner at Utah Conference on Undergraduate Research

LAUREN FORD

The mesolimbic dopamine pathway is an area of active research in neuroscience due to the importance of understanding addiction and its resultant societal and economic consequences. Much of addiction research is focused on immune interactions because of the high association of drug use with infection. Recent work has focused on native macrophages known as microglia, and methamphetamine interactions with ventral tegmental area dopamine neuron function (Wang et al., 2019). It appears that microglia contribute to methamphetamine effects on dopamine release through cell body interactions. However, it is unknown whether microglia at terminal regions such as the accumbens are involved in psychostimulant effects.

Lipopolysaccharides (LPS) stimulate inflammatory responses in microglia, giving us a very useful tool for studying effects of immune activation on dopamine terminal function. However, the effects of LPS stimulation on this reward pathway have not been quantified using modern techniques such as fast-scan cyclic voltammetry. In this study, we will evaluate the effect of LPS on electrically evoked dopamine release in conjunction with methamphetamine, which enhances dopamine release through dopamine transporter interactions. Our research will establish mechanistic data on immune activation and methamphetamine interactions.





Christina Small

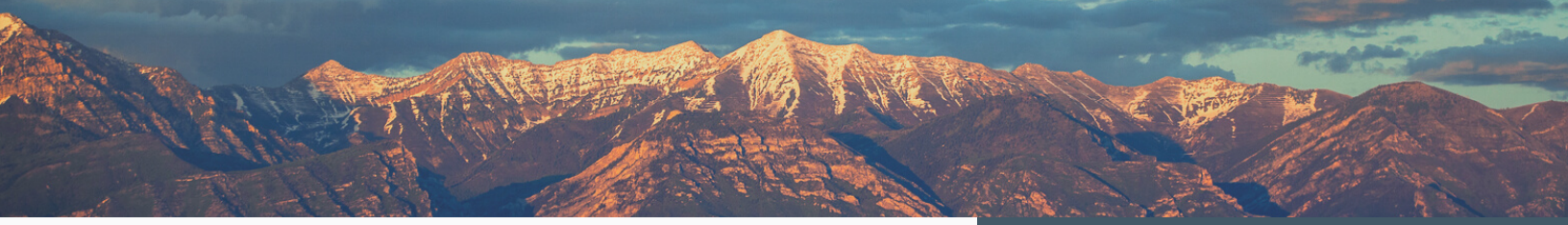
RAWLINSON SCHOLARSHIP RECIPIENT

This scholarship has helped alleviate my financial concerns so that I can focus on my studies and future educational pursuits and helps me be more available to mentor other students in our campus community. I have enjoyed my studies, especially the opportunity that I have to participate in research and gain hands-on experience in the field of neuroscience. That is one of my favorite things about getting to attend to BYU.
I also enjoy getting to serve as a leader in BYU's chapter of NAMI (National Alliance on Mental Illness) which helps address the mental health needs of students on campus and raises mental health awareness in our community. This helps me merge my studies about the brain with my desires to help others who suffer from mental illness and difficulties. I also have enjoyed the opportunity that I've had at BYU to work as a teaching assistant for various neuroscience classes, this has helped me deepen my understanding of the material and has showed me that I want to have the opportunity to teach in my future career.

Joakim Ronstroem

RAWLINSON SCHOLARSHIP RECIPIENT

I moved to Utah from Sweden to start the Neuroscience PhD program. I am a 4th year graduate student in Jordan Yorgason's laboratory where we study how addictions operate within the brain. I specifically chose to study how morphine alters some neural circuits within the amygdala and how stressful life-events changes the neural environment making subjects more prone to relapse. We recently submitted an article on this subject for publication. I hope to complete my dissertation within the next year or two and continue my work as a scientist in a research industry position. I am going to continue to research substance use disorders and help people with drug addictions. The options for this education that I am receiving here are many and this award is making these possibilities even greater. This award is helping me focus more intensely on my research by reducing the financial stress that sometimes comes as a result of being a graduate student.



Neuroscience Endowment Fund

DEAR ALUMNI, COLLEAGUES, AND STUDENTS,

Imagine if you could help students achieve their educational goals and learn through experience. By donating to the Neuroscience Endowment Fund we are able to provide funding for:

- Scholarships
- Internships
- Experiential learning experiences

All funds go directly to the students. We are asking for your help as we cannot do this without you. Please join us in supporting students in their neuroscience education.

If you wish to donate, please scan the QR code below.

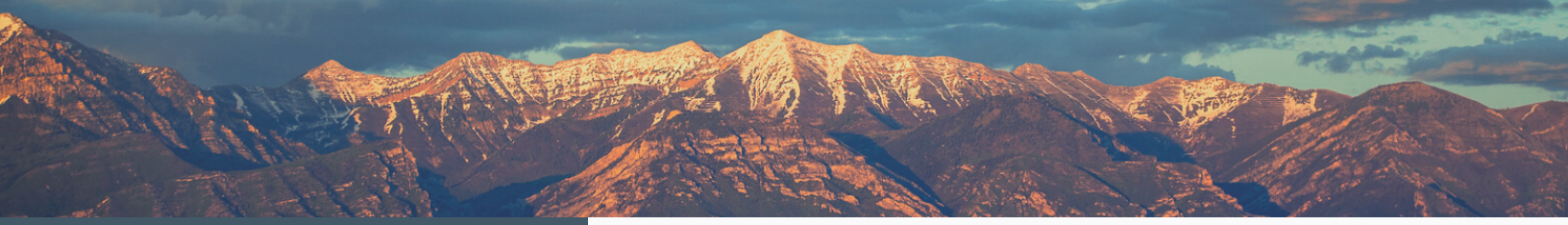
INSTRUCTIONS

- Search: “Select other funds” box and choose “BYU” under “Other Funds”
- Scroll down to "Neuroscience Annual Fund” and hit “Select" (this will add the Neuroscience Fund Option)
- Enter an amount and then scroll down to the Frequency and Method of Payment sections
- In the section “Add Comment or Memoriam Information,” select the “Comments or instructions” box and enter the Neuroscience Endowment Fund to which you would like to donate

We want to thank you for all your generous donations that have changed the lives of so many students and families. We could not do it without you!

"I have enjoyed my studies, especially the opportunity that I have to participate in research and gain hands-on experience in the field of neuroscience."

CHRISTINA SMALL



Lab Snapshots

PERRY RIDGE'S LAB

We are working on identifying variation in nuclear-encoded genes that affect mitochondrial function in Alzheimer's disease. We are also researching the intersection of environmental risk factors and genetics in Alzheimer's disease.

JEFF EDWARDS LAB

In my lab we have been performing brain slices for experiments examining the ketogenic diet impact on cognition in the brain.

SHAWN GALE'S LAB

My research assistants have been helping work on a review of papers regarding the neuropsychiatric and neurocognitive effects of the 1918 flu pandemic.

DERIN COBIA'S LAB

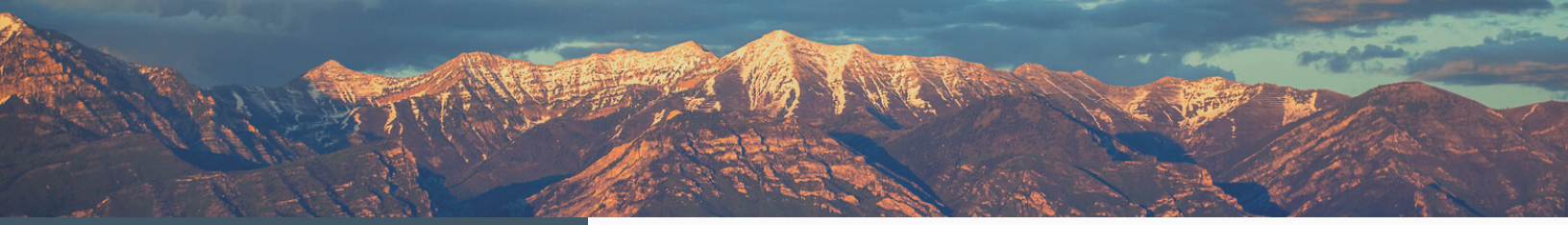
My lab is learning basic programming skills, to use to process brain scans and analyze them using various neuroimaging tools. We are looking at brain scan in populations that have schizophrenia, dementia, and traumatic brain injuries.

MICHAEL STARK'S LAB

We are studying early embryo development with a focus on neural tube defects resulting in spina bifida and anencephaly.

JARED NIELSEN'S LAB

We recently finished collecting MRI data and started analyzing it. Our participants engaged in a six-week study of brain plasticity. We acquired frequent MRI scans before, during, and after a two-week period when they wore a cast on their dominant arm.



Lab Snapshots

STEVEN CHARLES LAB

In the Neuromechanics Research Group, we are currently focusing on ways to suppress tremor in patients with Essential Tremor. Recent studies have found that electrically stimulating muscles at a low level (above sensory threshold but below motor threshold) can reduce tremor, but no studies have determined the optimal stimulation frequency. We recently ran a study in which we electrically stimulated wrist flexor and extensor muscles synchronously at 15 different stimulation frequencies in 21 patients with Essential Tremor. Surprisingly, none of the 15 frequencies had a significant effect on tremor. We conclude that asynchronous (out-of-phase) stimulation of antagonist muscles is necessary for effective tremor suppression.

GARRETT CARDON

Our lab has recently been involved in examining the neural and behavioral correlates of atypical sensory processing in autism. We now have evidence that aversion to unpredictable situations is highly related to sensory difficulties in this population. In our sample, this behavioral pattern was associated with decreased functional connectivity between the cerebellum and sensory regions of the brain, as well as between nodes of the default mode network.

JORDAN YORGASON LAB

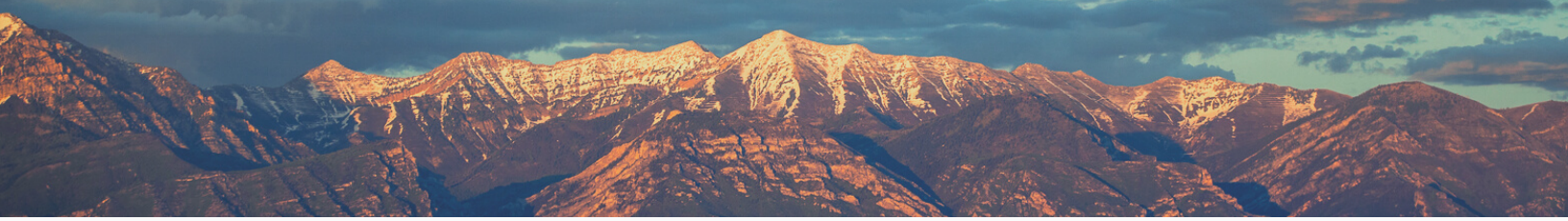
Dr. Jordan Yorgason is a neuroscience researcher specializing in the study of the neural mechanisms involved in motivation and learning. Leveraging his expertise, Dr. Yorgason is collaborating with a multidisciplinary team including Dr. Nancy Fulda from Computer Science, Dr. Wood Chiang and Dr. Karl Warnick from Electrical Engineering to develop innovative computational tools for artificial intelligence. By integrating insights from neuroscience with state-of-the-art technology, the team aims to advance our understanding of how motivation and reward systems can be incorporated into next generation AI, with the potential to revolutionize machine learning through development of neuromorphic computing.

DIXON WOODBURY'S LAB

It is well known that alcohol alters neuron function by affecting proteins in the pre- and post-synaptic membranes. Using a model system, we have now shown that alcohol can affect exocytosis (the actual process of neurotransmitter release) by acting just on the membranes and not the proteins involved in fusion of vesicles to a membrane. We have had two publications published in the last 6 months.

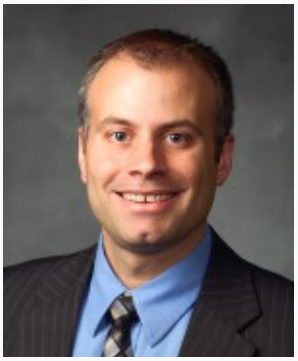
Coffman, R.E., K.N. Kraichely, A.J.B. Kreutzberger, V. Kiessling, L.K. Tamm, and D.J. Woodbury. 2022. Drunken lipid membranes, not drunken SNARE proteins, promote fusion in a model of neurotransmitter release. Front Mol Neurosci. 15:1022756.

Coffman, R.E., and D.J. Woodbury. 2022. Effects of anesthetics on membrane fusion and exocytosis. In Exocytosis: From Molecules to Cells. IOP Publishing.



Welcome to our newest members of the Neuroscience Faculty

STEFANIA ASHBY



PERRY RIDGE

RYLEY PARRISH

GARROT CARDON

Thank you to our retiring Neuroscience Faculty for all your contributions, support, and dedication to our Neuroscience students.

J. DEE HIGLEY

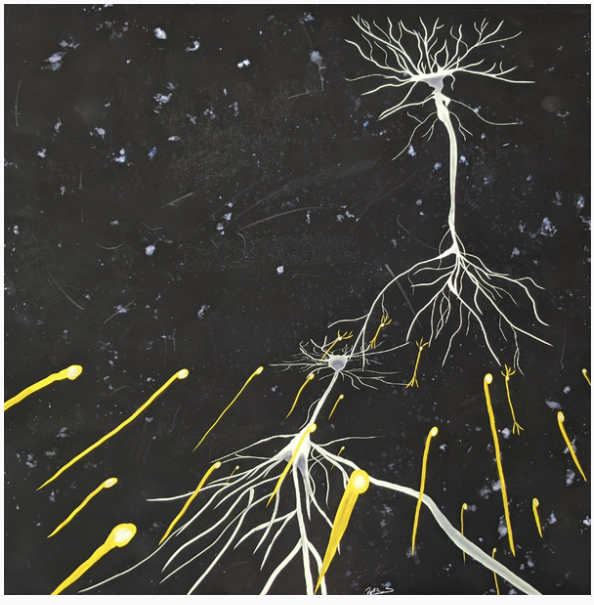
SCOTT STEFFENSEN
EMERITUS PROFESSOR

2023 Neuroscience Art Contest Winners

1st Place

"The Fruits of Neurogenesis" by Olivia Hansen

This piece depicts a brain with neurons, foliage and flowers radiating from it. I've always thought neurons resemble flowers. This is fitting because the more we nourish certain areas of our lives, the more we grow since those specific neuronal pathways are being used more. Each neuron has a small icon next to the soma to indicate the pathway it contributes to. My piece represents the "fruits" of neurogenesis. Almost all neuron formation occurs during embryonic development. This artwork symbolizes the growth and utilization of the neurons formed in utero. As we grow up and learn new skills, these neurons become part of the trillions of pathways that make up our unique neuronal fingerprint.



2nd Place

"Celestial Synapse: Christ Connection to Man's Neural Creation" by Amulek Brenes

I drew influence from Greg Dunn, a renowned neuroscientist and artist, especially his artworks titled Neurogenesis I and Neurogenesis II, and a handful of others. Young neurons use mature neurons to make connections at the correct places. The same is with Christ. As we grow and mature, using Jesus as a guide, we can reach our ultimate goal of being with God again. Neurogenesis and the Book of Genesis involve the creation of the human mind. Genesis describes humans as created in God's image and given the ability to grow and change. Similarly, neurogenesis allows the brain to continue developing and adapting throughout life, leading to new skills, memories, and experiences.

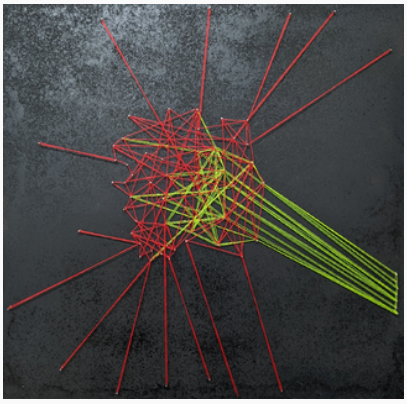
2023 Neuroscience Art Contest Winners

3rd Place

"Abigail's Anencephaly" by Katrina Lantz

Anencephaly is a neural tube defect that interrupts the early development of the brain. My portrait of my first daughter, Abigail Réileen Lantz, shows how an interrupted neurogenesis, along with cells that would have differentiated into her skull (cranial vault), limit the life of an individual. I wasn't happy with the images that come up with a Google search on "anencephaly" because I found them hopeless and dehumanizing. This portrait of a baby with anencephaly shows her full humanity in her short life. She lived for 22.5 hours.

Honorable Mentions



"Pathfinder" by Rhen Davis (Left)

Pathfinder depicts a growth cone which is a structure at the end of developing neurites made of microtubules (shown in green) and action fibers (shown in red). This piece embodies neurogenesis because its subject is an essential part of how neurons develop and find a path to their targets.

"Neurogenesis" by Amaya Chikmi (Right)

I used white charcoal for the background, which is just a bunch of cells involved in neurogenesis. The main focus, done with hot glue which was then painted over, is radial glial cells with neurons migrating upwards, which were also made of hot glue, but covered in a mosaic of magazine bits.