ABOUT US
The annual National MD-PhD Student Conference is a unique assembly held at the Copper Mountain Resort. It aims to unite MSTP students, alumni, and faculty from across the country to explore the intersections of research and medicine, focusing on diverse careers, healthcare policy, and scientific breakthroughs. The conference offers prestigious keynote speakers, student oral and poster sessions, a diverse career panel, and breakout sessions that encompass various topics of interest to MD-PhD students. This is a great event to meet colleagues and mentors, learn about opportunities available to MD-PhDs, and discuss exciting science every year. This event is almost entirely student run and organized; the planning and organizing committee each year is made up of a small group of current MD-PhD students at the University of Colorado.
Table of Contents

WELCOME ......................................................................................................................... 2
MEET YOUR STUDENT PLANNING COMMITTEE ........................................................... 3
NEW THIS YEAR! .................................................................................................................. 6
COPPER MOUNTAIN RESORT MAP .................................................................................. 7
CONFERENCE SCHEDULE ................................................................................................. 8
KEYNOTE SPEAKERS .......................................................................................................... 9
   DR. JACQUETTA TRASLER, MD-PhD ............................................................................. 9
   DR. MANU PLATT, PhD .................................................................................................. 9
   DR. KERRY J. RESSLER, MD-PhD .............................................................................. 11
DIVERSITY, EQUITY, & INCLUSION: ............................................................................. 12
   DR. PAULA BRAVEMAN, MD, MPH ............................................................................ 12
BREAKOUT SESSIONS .................................................................................................... 13
   ETHICS DISCUSSION: DR. MATTHEW WYNIA, MD ................................................... 13
   RESEARCH IN RESIDENCY DISCUSSION .................................................................. 14
STUDENT ORAL PRESENTATION SCHEDULE AND ABSTRACTS ............................. 15
   SESSION 1 ...................................................................................................................... 15
      I. Neuroscience (Ptarmigan A) ................................................................................... 15
      II. Molecular Biology (Ptarmigan C) ......................................................................... 16
   SESSION 2 ...................................................................................................................... 18
      I. Physiology (Ptarmigan A) ...................................................................................... 18
      II. Immunology and Microbiology (Ptarmigan C) ..................................................... 20
   SESSION 3 ...................................................................................................................... 23
      I. Bioengineering (Ptarmigan A) ................................................................................. 23
      II. Cancer Biology (Ptarmigan C) .............................................................................. 25
POSTER SESSIONS ......................................................................................................... 28
   POSTER SESSION I ...................................................................................................... 28
   POSTER SESSION II .................................................................................................... 34
2023 DIVERSITY TRAVEL AWARDEES ........................................................................ 41
SUNDAY MORNING ACTIVITIES ...................................................................................... 42
SPONSORS ......................................................................................................................... 44
STUDENT PARTICIPANTS ................................................................................................. 45
Welcome

Welcome to the 38th Annual National MD/PhD Student Conference! The National MD-PhD Student Conference brings together students, faculty, and alumni from over 60 institutions across the country to interact with and learn from each other in beautiful Copper, Colorado. At the conference, attendees engage in discussions with current and aspiring physician scientists about current scientific developments and explore career issues specific to the MD-PhD program. This event is almost entirely student run and organized; the planning and organizing committee each year is made up of a small group of current MD-PhD students at the University of Colorado.

We would like to thank our Keynote speakers – Kerry Ressler, MD/PhD, Manu Platt, PhD, and Jacquetta Trasler, PhD – for making the journey to share their work with us. We are also grateful to the discussion leaders and PSTP directors for taking the time to lead discussions and share their insights with us.

We hope that you gain insights into your own research and career as you participate in the scientific and career-oriented portions of the conference, as well as make certain to enjoy the surroundings of the Rocky Mountains. Please note that the most up to date information on the conference can be found on the socio app, with additional information found on the website (https://medschool.cuanschutz.edu/mstp/md-phd-conference). If you need anything during your time here, please do not hesitate to ask one of the conference organizers.

Sincerely,

The 2023 Organizing Committee
Meet Your Student Planning Committee

The planning committee each year is largely run by a small group of volunteer MD-PhD students at the University of Colorado! All the members participated in activities related to conference planning, with each member spearheading specific tasks.

**Shanawaj (Roy) Khair, GS4: Co-Chair, Communication Liaison, DEI and Ethics Sessions Organizer, & Copper Resort Liaison.**

Studies effects of ethanol intoxication and scald burn injury on lung inflammation.

**Austin Jolly, GS5: Co-Chair, Keynote Speaker Coordinator, Copper Resort Liaison, & Sunday-Funday Activities Facilitator**

Studies cardiovascular biology and epigenetic regulation to prevent stiffening of blood vessels.

**Annika Gustafson, GS2, PSTP Showcase Planner**

Studies the role of SIX1 muscle development and rhabdomyosarcoma
Emily King, GS4, Posters and Oral Presentations Coordinator
Studies the roles of pulmonary macrophages in lung injury and repair.

Nickole Moon, GS4, Keynote Speaker Coordinator
Studies the impact of paternal stress on extracellular vesicles and offspring neurodevelopment.

Keith Dodd, GS2, Registration and Website Coordinator
Studies the relationship between brain networks and obesity in schizophrenia

Yvonne Cui, MS1, Posters and Oral Presentation Organizer
Interested in studying cancer immunology
Dustin Fykstra, MS1, Social Media Director
Interested in studying neuroimmunology, neurodegeneration, and cancer immunology

Jacob Cox, MS1, Audio-Video Technology Support, Sunday-Funday Activities Facilitator
Interested in studying cardiovascular biology and neurodevelopment.

Anna Hasche-Kluender, MS1, Meals Selection Coordinator, Cooper Resort Liaison
Interested in bacteriology and the microbiome
New This Year!

The committee works hard each year to provide several avenues for feedback and to listen to this feedback to help continually improve the conference. To address as much of the feedback as possible, here are some of the changes that have been implemented this year: (1) Sunday now only includes breakfast and the Sunday Funday activities. This allows students to relax more on the final day, explore, and have more travel choices to return home. To accommodate this change, the conference now also begins on Friday morning instead of evening, with provided lunch starting at 12PM, and the first Keynote at 12:30PM. (2) Longer breaks (30 minutes) are now standard between most major events, with several including coffee and snack options. This allows for more cushion and chances for attendees to relax. (3) There is now both a Diversity, Equity, and Inclusion (DEI) Speaker session and an opportunity to talk more with the speaker over lunch. While events in general at the conference are usually optional for attendees, we strongly encourage all attendees to attend the DEI Speaker session. (4) The PSTP panel has been slightly modified into a small group session with a focus on discussing what research in residency can look like. There is also still the beloved PSTP Showcase session where students can meet with PSTP directors directly to discuss their programs. (5) Concrete events now typically start later and do not go as late, as they have sometimes in prior years, to try to better accommodate jetlag and time zone differences. (6) We have been able to increase the number of our diversity travel awards from 10 to 14 this year!

All these modifications have required changes to the number and type of events offered. Despite this, we have still included a diverse and full array of events, including three incredible Keynote speakers, Breakout Discussions in Ethics and Research in Residency, a DEI Speaker, DEI lunch discussion, two Poster Sessions, four sets of Oral Presentations, Sunday Funday Activities, and more! Please continue to feel free to provide feedback (positive and constructive) either in person during the conference, or in the provided form emailed after the conference.
Copper Mountain Resort Map
# Conference Schedule

All times listed in **Mountain Standard Time**

## Friday, July 7th

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Room/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM – 12:00 PM</td>
<td>Registration, Poster Set-Up</td>
<td>Kokopelli’s Trail</td>
</tr>
<tr>
<td>12:00 PM – 1:30 PM</td>
<td>Lunch</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>12:30 PM – 1:30 PM</td>
<td>Keynote Address: Dr. Jacquetta Trasler, MD, PhD</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>1:30 PM – 2:00 PM</td>
<td>Coffee Break</td>
<td>Kokopelli’s Trail</td>
</tr>
<tr>
<td>2:00 PM – 3:00 PM</td>
<td>Oral Presentations #1: Neurosci. and Molecular Bio.</td>
<td>Ptarmigan Rooms</td>
</tr>
<tr>
<td>3:30 PM – 4:30 PM</td>
<td>Research Ethics Discussion* Research In Residency*</td>
<td>Ptarmigan Rooms</td>
</tr>
<tr>
<td>5:00 PM – 5:15 PM</td>
<td>American Physician Scientist Association Presentation – Eric Cramer</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>5:15 PM – 6:30 PM</td>
<td>Dinner</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>5:30 PM – 6:30 PM</td>
<td>Keynote Address: Dr. Manu Platt, PhD</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>7:00 PM – 8:30 PM</td>
<td>Poster Session #1, Cash Bar</td>
<td>Kokopelli’s &amp; Jack’s Banquet</td>
</tr>
</tbody>
</table>

*Breakout Discussions include two 30-minute discussions. One on Ethics, and another on Research in Residency.

## Saturday, July 8th

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Room/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 AM – 9:00 AM</td>
<td>Breakfast, Poster Set-Up</td>
<td>Jack’s</td>
</tr>
<tr>
<td>9:00 AM – 10:00 AM</td>
<td>Oral Presentations #2: Physiology &amp; Immunology</td>
<td>Ptarmigan Rooms</td>
</tr>
<tr>
<td>10:30 AM – 11:30 AM</td>
<td>DEI Talk: Dr. Paula Braveman</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>11:45 AM – 1:00 PM</td>
<td>Lunch with DEI Speaker</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>1:30 PM – 2:30 PM</td>
<td>Oral Presentations</td>
<td>Ptarmigan All Rooms</td>
</tr>
<tr>
<td>3:00 PM – 4:00 PM</td>
<td>PSTP Showcase</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>4:00 PM – 5:30 PM</td>
<td>Poster Session #2</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>6:00 PM – 7:00 PM</td>
<td>Keynote Address: Dr. Kerry Ressler, MD-PhD</td>
<td>Bighorn Room A</td>
</tr>
<tr>
<td>7:30 PM – 8:30 PM</td>
<td>Dinner</td>
<td>Copper Station East Village</td>
</tr>
<tr>
<td>8:30 PM – 9:30 PM</td>
<td>Awards and Closing Remarks</td>
<td>Copper Station East Village</td>
</tr>
<tr>
<td>9:30 PM – 9:45 PM</td>
<td>Sunday Activities Debrief</td>
<td>Copper Station East Village</td>
</tr>
</tbody>
</table>

## Sunday, July 9th

<table>
<thead>
<tr>
<th>Event</th>
<th>Room/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Copper Station East Village</td>
</tr>
</tbody>
</table>
### Keynote Speakers

**Dr. Jacquetta Trasler, MD-PhD**

*Distinguished James McGill Professor in Pediatrics, Human Genetics and Pharmacology at McGill University*

Jacquetta Trasler, MD, PhD is a Distinguished James McGill Professor in Pediatrics, Human Genetics and Pharmacology & Therapeutics at McGill University and Senior Scientist at the Research Institute of the McGill University Health Centre (RI-MUHC). She directs the Developmental Genetics Laboratory at the RI-MUHC. Amongst her leadership roles, Dr. Trasler is a past president of the Canadian Fertility and Andrology Society, and has served as Scientific Officer and Chair of the Canadian Institutes of Health Research (CIHR) Endocrinology Peer Review Committee, Scientific Director of the Montreal Children’s Hospital Research Institute, Deputy Director/Chief Scientific Officer of the RI-MUHC, Member of the Institute Advisory Board of the CIHR Institute of Genetics, and Member of the CIHR Stem Cell Oversight Committee. She has mentored a number of trainees, directed the McGill University MD/PhD Program from 1999-2007, and remains a devoted advocate for the MD/PhD path. In 2022, Dr. Trasler was elected Fellow of the Canadian Academy of Health Sciences and awarded the American Society of Andrology Distinguished Andrologist Award for her outstanding contributions to the progress of andrology. Her translational research profile focuses on the epigenetic, molecular, and developmental regulation of gene expression in the germline and early embryo. More specifically she studies DNA methylation and genomic imprinting and the molecular and cellular targets for drug effects on germ cells and embryos. Ongoing studies include effects of drugs, diet (folate) and assisted reproductive technologies on the epigenome of germ cells and embryos and the implications for transgenerational passage of epigenetic defects.

**Dr. Manu Platt, PhD**

*Inaugural Director of the NIH Center for Biomedical Engineering Technology Acceleration*
Dr. Manu Platt is the inaugural director of the NIH-wide Center for Biomedical Engineering Technology Acceleration (BETA Center), housed within the National Institute of Biomedical Imaging and Bioengineering (NIBIB) Intramural Research Program. In addition, Dr. Platt is NIBIB associate director for Scientific Diversity, Equity and Inclusion.

Previously, Dr. Platt was professor and Associate Chair of Graduate Studies in the Walter H. Coulter Department of Biomedical Engineering at the Georgia Institute of Technology and Emory University. He also was Georgia Research Alliance Distinguished Cancer Scientist and Deputy Director, Interdisciplinary Bioengineering Graduate Program at Georgia Tech Walter H. Coulter Distinguished Faculty Fellow.

Dr. Platt’s science interest was cultivated as a middle and high school student during his participation in FAME (Forum to Advance Minorities in Engineering), a science and engineering enrichment program at Delaware State University in Dover, DE. Dr. Platt earned a Bachelor of Science Degree in Biology from Morehouse College and was distinguished as an ARCS Foundation Scholar and a NASA Scholar. During his senior year at Morehouse, he began tissue engineering research with Dr. Robert M. Nerem in his lab at the Georgia Institute of Technology where he would ultimately join for his graduate studies where he earned his PhD under the direction of Dr. Hanjoong Jo studying mechanosensitive regulation of endothelial cell biology and its role in cardiovascular disease. Dr. Platt was in the second class of the newly established joint Biomedical Engineering Ph.D. Program between Georgia Tech and Emory University School of Medicine which has now been the #2 program in the country for more than a decade and has an excellent MD/PhD program.

After postdoctoral research at MIT with Drs. Linda Griffith and Douglas Lauffenburger, in 2009, Dr. Platt began a tenure track faculty position in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory. He has developed a diverse, robust research program with focuses on proteolytic mechanisms of disease, translational approaches to reduce strokes in people affected by sickle cell disease and harnessing proteolytic networks and systems biology tools to predict disease progression in patients with breast cancer which has led to work investigating mechanisms underlying aggressive breast cancers in young women in Ethiopia.

Dr. Platt is an outspoken leader for his community and an avid supporter of his undergraduate and graduate students from a number of diverse backgrounds and experiences. He has participated in conversations with the Gladstone Institute on issues surrounding Diversity and Inclusion, and Anti-Racism. He participated in Discussions on Science and Diversity through Yale School of Engineering and Applied Science. Dr. Platt has graduated ten Ph.D. students under his
advise with four of whom have gone on to begin tenure track professors at top universities, three of them being Black women, and another to a tenure track teaching position. Other graduates have entered industry positions, medical writing, public-partner biotech relationships, and more. He is proud of all of them! We are thrilled to welcome Dr. Manu Platt to the 38th Annual National MD-PhD Student Conference.

Dr. Kerry J. Ressler, MD-PhD

Chief Scientific Officer and James and Patricia Poitras Chair in Psychiatry at McLean Hospital

Kerry J. Ressler, MD, PhD, is chief scientific officer and James and Patricia Poitras Chair in Psychiatry at McLean Hospital, and Professor of Psychiatry at Harvard Medical School. He is current president of the American College of Neuropsychopharmacology (ACNP) and a past president of the Society for Biological Psychiatry. Dr. Ressler is a former Howard Hughes Medical Institute Investigator and is a member of the National Academy of Medicine. Dr. Ressler’s lab focuses on translational research bridging molecular neurobiology in animal models with human genetic research on emotion, particularly fear and anxiety disorders. He has published over 500 manuscripts ranging from basic molecular mechanisms of fear processing to understanding how emotion is encoded in a region of the brain called the amygdala, in both animal models and human patients.

The Ressler lab uses well-established mouse models to examine different aspects of fear learning (e.g., acquisition, consolidation and extinction). To do this, they utilize a variety of molecular-genetic neurocircuitry tools such as optogenetics, DREADDs, cell-type specific calcium imaging and transcriptional profiling and DNA methylation analyses combined with viral-vector and transgenic manipulations. These models allow the lab to investigate the role of different brain regions, in particular the amygdala, as well as neural cell populations, and the underlying gene regulation in these cells in fear processing. Furthermore, his work examines how these mechanisms may be involved in the development of fear-based disorders in humans, such as Post-Traumatic Stress Disorder (PTSD), anxiety, depression and other stress-related syndromes. Additionally, Dr. Ressler’s lab utilizes data collected from human clinical populations to identify genetic traits and neural processes that may contribute to the development of these illnesses and provide novel targets for research using animal models. By gaining a more mechanistic understanding of how fear works in the mammalian brain, Dr. Ressler’s discoveries contribute to the development of novel treatments, and possibly even the prevention, of fear based psychiatric illnesses.
Diversity, Equity, & Inclusion:

Dr. Paula Braveman, MD, MPH

Professor of Family and Community Medicine and Founding Director of the Center for Health Equity at the University of California, San Francisco

Paula Braveman, MD, MPH, is Professor of Family and Community Medicine and Founding Director of the Center for Health Equity at the University of California, San Francisco (UCSF). For more than 25 years, Dr. Braveman has studied and published extensively on health equity and the social determinants of health and has worked to bring attention to these issues in the U.S. and internationally. During the 1990s, she collaborated with World Health Organization staff in Geneva to develop a global initiative on equity in health and health care. She was the Research Director for the Robert Wood Johnson Foundation’s national commission on the social determinants of health in the U.S. Throughout her career, she has collaborated with local, state, federal, and international health agencies to see rigorous research translated into practice with the goal of achieving greater equity in health. She was elected to the National Academy of Medicine in 2002. Her book “The Social Determinants of Health and Health Disparities” was recently published by Oxford University Press.
Breakout Sessions

Ethics Discussion: Dr. Matthew Wynia, MD

Director of the Center for Bioethics and Humanities at University of Colorado Denver Anschutz Medical Campus

Dr. Matthew Wynia is the Director of the Center for Bioethics and Humanities at University of Colorado Denver Anschutz Medical Campus. His training is in internal medicine, infectious diseases, public health and health services research. He received his MD degree at Oregon Health Sciences, School of Medicine in Portland Oregon and earned his MPH from Harvard University School of Public Health in Boston, MA. Dr. Wynia’s career has included developing a research institute and training programs focusing on bioethics, professionalism and policy issues (the AMA Institute for Ethics) and founding the AMA’s Center for Patient Safety. His research has focused on novel uses of survey data to inform and improve the practical management of ethical issues in health care and public policy. He has led projects on a wide variety of topics related to ethics and professionalism, including understanding and measuring the ethical climate of health care organizations and systems; ethics and quality improvement; communication, team-based care and engaging patients as members of the team; defining physician professionalism; public health and disaster ethics; medicine and the Holocaust (with the US Holocaust Memorial Museum); and inequities in health and health care. He is on the Board on Health Sciences Policy of the National Academies of Sciences, Engineering and Medicine, and has served on committees, expert panels and as a reviewer for The Joint Commission, the Hastings Center, the American Board of Medical Specialties, federal agencies, and other organizations. Dr. Wynia is the author of more than 160 published articles, chapters and essays, co-editor of several books, and co-author of a book on fairness in health care benefit design. His work has been published in JAMA, the New England Journal of Medicine, Annals of Internal Medicine, Health Affairs, and other leading medical and ethics journals, and he is a contributing editor for the American Journal of Bioethics. He has discussed his work as a guest on the BBC, ABC News, CNN, MSNBC, National Public Radio and others. We are very excited to have Dr. Matthew Wynia to the 38th Annual National MD-PhD Student Conference and lead our ethics session.
## Research in Residency Discussion

<table>
<thead>
<tr>
<th>School</th>
<th>Program</th>
<th>Representative(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington University in St. Louis</td>
<td>Dermatology PSTP</td>
<td>Dr. William McCoy, MD, PhD</td>
</tr>
<tr>
<td>Harvard</td>
<td>Internal Medicine PSTP</td>
<td>Dr. Jatin Vyas, MD, PhD</td>
</tr>
<tr>
<td>UC San Francisco</td>
<td>UCSF Physician Scientist Scholar Program</td>
<td>Dr. Arun Wiita, MD, PhD</td>
</tr>
<tr>
<td>The Ohio State University</td>
<td>Surgery Residency</td>
<td>Dr. Ginny Bumgardner, MD, PhD</td>
</tr>
<tr>
<td>Columbia University</td>
<td>Anesthesiology Physician Scientist Research</td>
<td>Dr. Charles Emala, MD</td>
</tr>
<tr>
<td>Vanderbilt University</td>
<td>Internal Medicine PSTP</td>
<td>Dr. Patrick J. Hu, MD, PhD</td>
</tr>
<tr>
<td>University of North Carolina Chapel Hill</td>
<td>Internal Medicine PSTP</td>
<td>Dr. Joseph (Alex) Duncan, MD, PhD</td>
</tr>
</tbody>
</table>
Student Oral Presentation Schedule and Abstracts

Session 1

I. Neuroscience (Ptarmigan A)

Lesion Mapping of Central Post-stroke Pain, Hassan Ahamed, University of Iowa

The neuroanatomical sites associated with the development of central post-stroke pain (CPSP) have not been well defined outside of the thalamus. Our goal was to test the hypothesis that lesions of the ascending pain pathway extending from the brainstem to the cerebral cortex would provide a more robust predictor of CPSP than focusing exclusively on the thalamic node of this pathway. We created an a priori region-of-interest (ROI) of this ascending pain pathway, including the spinothalamic tract, a posterolateral thalamic region, and white matter extending to the posterior insula and secondary somatosensory cortex. We investigated lesion location of 37 individuals with CPSNp, identified by reviewing electronic medical records (N = 37) versus a comparison group of individuals with stroke without pain (N = 96). Three approaches were used: 1) we compared lesion intersection with this a priori ROI between groups, 2) we performed a data-driven multivariate lesion-symptom mapping analysis, 3) we used network mapping to evaluate the broader structural and functional connectivity patterns significantly associated with CPSP. Our results show that CPSP lesions overlapped with the ascending pain pathway ROI to a greater extent than comparison lesions (p < .01). This ROI was more sensitive and had a greater effect size relative to an ROI limited to the thalamus. Lesion-symptom mapping identified a region of the right thalamus and white matter between the thalamus and insula associated with CPSP (r = .29, p < 0.001). Principle component analysis (PCA) of functional connectivity MRI (fcMRI) demonstrated a broad CPSP network that included the thalamus and insula. Structural lesion network mapping highlighted the white matter fibers in the right brainstem and right cerebral white matter, adjacent to the thalamus. Taken together, these analyses support the notion that CPSP is not a ‘thalamic’ syndrome but rather is associated with lesions of the ascending pain pathway.

Tau Seeding in the Healthy Brain, Michael LaCroix, University of Texas Southwestern

Accumulation of intracellular assemblies of the microtubule-associated protein tau (MAPT) underlies the group of diverse neurodegenerative diseases termed tauopathies. The origin of sporadic tauopathies remains elusive amidst a growing body of evidence that suggests tau can behave in a prion-like manner and that seed-competent tau monomer (Mₖ) itself can encode the information required for templated aggregation of tau assemblies. The transition from inert to seed-competent tau species is proposed to underlie the critical step to pathology. However, it remains possible that seed-competent tau strains exist that do not represent pathology. We
have developed an antibody (MD3.1) that efficiently isolates low amounts of tau seeds from healthy brain. Using highly specific, ultra-sensitive tau biosensors combined with immunopurification with MD3.1, we detected significant seeding activity in an age-diverse cohort of tauopathy negative control brain. Seeding activity was detected in the parietal cortex, while the cerebellar cortex was absent of detectable tau seeds. We observed no correlation between seeding activity and age. Tau isolated from the cortex of aged human tau knock-in mice showed no seeding activity. Our results suggest that tau seeds are present at low levels in the cortex of all healthy adult human brains and the presence of tau seeds in healthy brain has regional and species specificity. Given tau’s ability to efficiently propagate strains in vivo, and the presence of tau seeds in healthy adult human cortex, we propose that its ability to assemble into self-replicating structures may reflect a normal function that goes awry in disease states.


3D standard reference brains serve as a key resource to promote collaboration via multi-team science approaches to unravel details of neural development, function, and disease. Current evaluation of developmental mouse brain cellular resolution data relies on 2D reference slices to delineate anatomical regions. The lack of standard 3D reference atlases has hindered data integration across various mouse brain development studies. Here, I present multimodal 3D developmental common coordinate frameworks (DevCCFs) at embryonic day (E)11.5, E13.5, E15.5, E18.5, and postnatal day (P) 4, P14, and P56) that account for evolving morphology through mouse brain development with anatomical segmentations defined by a developmental ontology. At each age, I used Magnetic Resonance Imaging data from male and female mouse brains to generate undistorted morphologically averaged atlas templates. Additionally, I created templates from light sheet fluorescent microscopy at all ages and serial two-photon tomography at postnatal ages using data acquired in our lab. I mapped these templates, as well as 2D Allen Institute gene expression data, to the MRI templates, enabling data from various cellular-resolution imaging modalities to be easily imported to the DevCCF. Subsequently, I manually generated 3D segmentations for the DevCCF at each age according to a developmentally stable ontology. These developmental segmentations were mapped across ages, demonstrating differential growth trajectories by ontologically distinct brain regions. To summarize, the DevCCF is an openly accessible resource for large-scale data integration and analysis aimed at gaining a comprehensive understanding of brain development.

II. Molecular Biology (Ptarmigan C)

An extended wave of global mRNA deadenylation sets up a switch in translation regulation across the mammalian oocyte-to-embryo transition, Katherine Lee, University of California San Diego

The oocyte-to-embryo transition (OET) occurs in the absence of new transcription and relies on post-transcriptional mechanisms to control gene expression. One important mechanism
involves changes in mRNA polyadenosine (poly(A)) tails, where cytoplasmic polyadenylation has been shown to activate translation and deadenylation leads to translational repression and decay. However, the transcriptome-wide landscape of mRNA poly(A) tail lengths across the entire OET in mice—and how changes in poly(A) tails affect translational efficiency across the OET in mammals—remain unknown. Here, we perform long-read RNA sequencing to determine and compare poly(A) tail lengths and mRNA abundance transcriptome-wide in mice across five stages of development from oocyte to embryo. Integrating these tail length data with recently published ribosome profiling data at the same stages of development, we demonstrate that poly(A) tail length is coupled to translational efficiency across the entire OET. We uncover an extended wave of global deadenylation during fertilization, which sets up a switch in translation control between the oocyte and embryo. In the oocyte, global deadenylation leads to an unexpected, attendant increase in translational efficiency for short-tailed maternal mRNAs that resist this wave of tail shortening. In contrast, a large group of maternal mRNAs deadenylated and translationally repressed during this wave remain stable and are broadly readenylated to drive translation activation in the early embryo. These findings point to a developmental switch across the OET, with translation heavily regulated by global tail shortening in the oocyte and by tail lengthening in the embryo. Together, our data provide an important resource and insight into the mechanisms by which cytoplasmic polyadenylation and deadenylation dynamically shape poly(A) tail length in a stage-specific manner to orchestrate development from oocyte to embryo in mammals.

**IL-22-induced MASTL stabilization in colon epithelial cells: exploring a novel mechanism for colitis recovery and CAC development, Kristina Pravoverov, University of Nebraska Medical Center**

Colitis-associated cancer (CAC) is one of the most devastating complications of longstanding inflammatory bowel disease (IBD). Understanding the mechanisms underlying the switch from damage to dysplasia in IBD is critical for identifying novel therapies that facilitate mucosal healing while mitigating CAC risk. MASTL, a key player in cell growth and repair pathways, is also upregulated in sporadic colorectal cancer and CAC. Preliminary data from our group demonstrates that intestine-specific MASTL knockout (KO) mice exhibit impaired recovery from colitis. Interleukin (IL)-22 is a cytokine that helps restore intestinal homeostasis and barrier integrity following injury, but is also elevated in CAC. Given the functional similarities between IL-22 and MASTL, we hypothesize that IL-22 signaling increases MASTL expression to promote intestinal epithelial regeneration following colitis. However, chronic upregulation of MASTL by IL-22 may contribute to CAC development.

Investigation of a clinical link between MASTL and IL-22 in publicly available datasets found that MASTL and IL-22 were significantly elevated in biopsies from late-stage ulcerative colitis patients vs. controls, and that MASTL upregulation was associated with high IL-22 expression. Then, we showed that IL-22 increases MASTL expression in multiple colon cell lines and impedes IL-22-induced cell proliferation and downstream signaling. Of the IL-22 effectors known to regulate MASTL, inhibition of Akt activation with LY294002 abrogated IL-22-induced MASTL upregulation in colon cell lines. Further, we found increased carbonic anhydrase IX
(CAIX) expression and association with MASTL in IL-22-treated cells. Carbonic anhydrase IX is known to be associated with colitis and CAC development. Inhibition of CAIX with U-104 prevents IL-22-induced MASTL and cell survival enhancement. Thus, we show that IL-22/AKT signaling increases MASTL by promoting its stabilization via CAIX association to regulate cell survival.

*Toward Multiplexed Single-Cell Western Blotting Using DNA Barcoded Readout, Mariia Long, University of Pennsylvania*

Cell functional states can change rapidly, especially during development and disease. Although cell type and state are commonly read out through the genome and transcriptome, proteins and their post translational modifications (PTMs) are thought to more proximally set cell state. Elucidating single cell proteomes poses a major technical challenge as mammalian cells are estimated to contain 10^10 protein molecules and 10^4 PTMs at a given moment in time. Moreover, unlike transcripts, proteins cannot be amplified to aid in their detection. Therefore, single-cell proteomics has significantly lagged single-cell genomic and transcriptomic tools like scRNA-seq, particularly in scalability to whole-proteome quantitation. We are tackling this significant technological gap using a novel tool called single-cell proteome sequencing. We analyze proteins from single cells using electrophoretic separation similar to existing scWestern technology and then perform DNA-based information encoding and analyze barcodes by next generation sequencing (NGS) in high-throughput. We developed readout of protein information comprising two barcodes 1) Antibody ID delivered via DNA-tagged antibodies to identify protein, 2) Size ID oligonucleotide delivered via DNA microarray that encodes spatial coordinates. We quantitatively characterize several crucial aspects of technology including 1) protein immobilization efficiency ranging 80%-95%, 2) retention of single cell protein separation morphology via immobilization-dominant protein transfer, 3) limit of detection of assay ranging from 105.7 down to 102.9 GFP molecules detected with fluorescently-tagged and enzyme-tagged antibodies respectively. We also present preliminary data suggesting compatibility of DNA barcoding system with NGS. Our long-term research objective is to obtain high resolution catalogues of single-cell proteomes using our tool to transform analytical capabilities in cell development, differentiation, and disease.

**Session 2**

1. **Physiology (Ptarmigan A)**

*CGRP Signaling in Meningeal Lymphatic Vessels Contributes to Migraine Pathophysiology, Nathan Nelson-Maney, University of Northern Carolina*

Migraine is a highly prevalent neurovascular condition characterized by elevated calcitonin gene related peptide (CGRP) in the cerebral circulation. It was recently re-discovered that there
are lymphatic vessels present in the meningeal covering of the brain, and while the physiology of these vessels is currently debated, their roles in migraine remain unknown. I hypothesize that migraine-associated CGRP acts on meningeal lymphatic vessels to cause reduced cerebrospinal fluid drainage and that this change in flow contributes to migraine pathophysiology. To test this hypothesis, I have used mice treated with nitroglycerine (NTG), which develop a migraine-like syndrome that faithfully recapitulates human pathology, characterized by increased CGRP in the cerebral circulation, cerebral blood vessel dilation, pain behavior, and responsiveness to CGRP inhibiting therapeutics. I have demonstrated using translating ribosome immunoprecipitation that the translational profile of meningeal lymphatic vessels is altered by NTG mediated chronic migraine. I have also demonstrated that mice lacking the CGRP receptor components critical for CGRP signaling, calcitonin-receptor like-receptor (CLR), specifically in lymphatic endothelial cells exhibit reduced pain and light avoidance behavior when exposed to NTG compared to control mice treated with NTG. Building from this finding I have demonstrated both in vivo and in vitro, that migraine-related CGRP signaling reduced meningeal lymphatic vessel permeability and cerebrospinal fluid drainage. Collectively, these studies will improve our understanding of migraine pathophysiology, the function and dysfunction of meningeal lymphatics, and provide insight into the brain-lymphatic barrier.

Stress-Mediated Cellular Allostasis is Communicated by Extracellular Vesicles to Enhance Sperm Physiology, Nickole Moon, University of Colorado

Chronic parental stress influences reproductive outcomes and postfertilization offspring development. However, the mechanisms underlying cellular reprogramming and somatic to germ cell signaling in reproductive tissues following chronic stress are unclear. Mechanistic studies in males identified lasting changes following stress at epididymal epithelial cells (EECs) that provide sperm with essential maturation signals. Furthermore, the glucocorticoid receptor (GR) is necessary for the stress response, and therefore a key target orchestrating adaptation following a challenge, or allostasis. To examine the hypothesis that stress initiates GR-dependent allostatic reprogramming, we reduced EEC GR expression in our mouse model of paternal chronic stress. Two clusters of GR-dependent co-regulated genes were detected in the active EEC translatome related to chromatin and mitochondrial processes. Moreover, CUT&RUN-seq revealed that stress increased binding by the transcriptional repressor, H3K27me3, and that associated genes influence mitochondrial processes. As stress-responsive energy regulators, mitochondria are likely allostatic mediators. Using cellular respirometry, we found that prior stress decreased EEC mitochondrial respiration, and that GR knockdown protected against this effect. As extracellular vesicles (EVs) secreted by EECs convey cargo that are altered by stress and necessary for sperm maturation, we assessed EVs as intercellular communicators of energy regulation. Amazingly, stress-EV exposure increased sperm mitochondrial respiration. As stress mediated allostatic changes in EECs clearly influence sperm physiology via EV cargo, our ongoing longitudinal human subjects studies will assess the impact of adverse childhood experiences and perceived stress on sperm motility, small RNAs, and EV cargo that program reproductive and developmental effects. Together, these studies
demonstrate a GR-dependent molecular mechanism of allostasis following stress that regulates somatic to germ cell signaling and begin to assess how such processes influence human biology. Furthermore, as these regulatory mechanisms broadly apply to cellular programming and communication, they inform our understanding of the enduring effects of stress on overall health and development.

*Human pancreatic pseudoislet system reveals cell-to-cell contact and hypoglycemia as mechanisms underlying α cell dysfunction in type 1 diabetes (T1D), Yasminye Pettway, Vanderbilt University*

In T1D, autoimmune destruction of islet β cells leads to hyperglycemia and altered islet composition. Additionally, individuals with T1D show impaired glucagon responses to hypoglycemia, which presents a major challenge for insulin therapy. Previous data from our group showed that while remaining β cells in islets from T1D donors have nearly normal function, α cells have impaired glucagon secretion and altered gene expression. The reason(s) for these intrinsic α cell changes are unknown but may include loss of α-to-β cell contact, chronic hyperglycemia, and/or repeated hypoglycemic events.

To test these hypotheses, we utilized cell sorting of human islets from donors without diabetes to create α cell-enriched (“T1D-like”) pseudoislets. Pseudoislets were transduced with GCaMP6f and their function assessed *in vitro* by live-cell imaging and microperifusion, allowing for synchronous capture of intracellular Ca^{2+} ([Ca^{2+}]_i) signal and glucagon secretion. Our initial results show altered α cell [Ca^{2+}]_i signaling and reduced function in T1D-like pseudoislets compared to those with a normal proportion of β cells. To understand the impact of chronic hyperglycemia, we transplanted pseudoislets into Nod-SCID-IL2Rγnull; RIP-Diphtheria Toxin (DT) Receptor mice made diabetic by DT-mediated depletion of endogenous β cells. In DT-treated mice, α cells in T1D-like pseudoislets expressed the β cell-enriched transcription factor NKX6.1, recapitulating previous findings from primary T1D islets. To mimic repeat hypoglycemia, we intermittently exposed T1D-like pseudoislets to low glucose *in vitro*, using those remaining in basal glucose as control. Following multiple exposures to low glucose, T1D-like pseudoislets had reduced glucagon secretion in the presence of both low and high glucose. These data suggest that loss of β cell contact and repeated exposure to low glucose impair α cell function. Further, chronic hyperglycemia may lead to changes in α cell identity state after β cell loss.

**II. Immunology and Microbiology (Ptarmigan C)**

*High-titer IgG Elicited by a Bacteriophage Virus-like Particle Displaying the Major Outer Membrane Protein VD4 Epitope Protects Against Urogenital Chlamydia Infection, Mandy Collar, University of New Mexico*

*Introduction:* A prophylactic vaccine aimed at controlling the high prevalence and associated morbidity of *Chlamydia trachomatis* (Ct) infection remains an urgent public health need. Here, we utilize a novel vaccine platform within the Ct field, bacteriophage virus-like particles (VLP),
to target conserved epitopes within a Ct adhesion factor, the VD4 epitope of the Major Outer Membrane Protein (VD4 MOMP). We hypothesize that targeting conserved epitopes within a key adhesion factor could provide neutralizing cross-protection against all Ct serovars.

**Methods:** We chemically conjugated the conserved epitopes of VD4 MOMP to the surface of the bacteriophage Qβ VLP to create a vaccine representing all urogenital Ct serovars (Qβ-VD4 VLP). Qβ-VD4 VLP immune sera was used to test antibody functionality *in vitro* via ELISAs. Qβ-VD4 VLP was also utilized to immunize female Balb/c mice to investigate longevity of peripheral and vaginal antibody response, and vaccine efficacy against vaginal *Chlamydia* challenge via IVIS.

**Results:** Qβ-VD4 VLP vaccination elicited high-titer IgG antibody responses and immune sera bound to the cognate antigen of all urogenital serovars via peptide ELISA. Further, immune sera bound to all urogenital Ct serovars via EB ELISA, illustrating ability to bind to native conformation antigen. Vaccine efficacy was tested using a vaginal *Chlamydia* model. By day 4 post-infection there was a statistically significant decrease in bacterial burden in vaccinated mice, which was maintained through the peak burden of infection. Together, this resulted in a 1.27 log decrease in mean bacterial burden, compared to the control group. Additionally, peptide-specific antibody titers were long-lived in this murine model, lasting at least 39 weeks post-vaccination.

**Conclusion:** We demonstrate that Qβ-VD4 VLP induces high-titer antibodies that remain long-lived and are present within the vaginal mucosa. Immune sera IgG antibodies are able to bind to not only all urogenital Ct serovars (D-K), but also ocular trachoma and lymphogranuloma venereum serovars, suggesting that this vaccine may provide cross-protection to all human Ct serovars. Further, the vaccine decreased bacterial burden in a relevant murine vaginal challenge, in which protection is afforded primarily by antibodies.

**Pseudomonas Aeruginosa Lipid A 2-Hydroxylation Impacts Host Recognition and Immune Response in Cystic Fibrosis, Casey Hofstaedter, University of Maryland,**

*Pseudomonas aeruginosa* (*Pa*) is a Gram-negative bacterium that causes chronic lung infections in cystic fibrosis (CF) patients. *Pa* undergoes functional and structural alterations to adapt to the unique environment of the CF airway. One change involves structural modification of lipid A, the membrane-bound component of LPS and TLR4/MD-2 complex ligand. These modifications influence signaling through TLR4, impacting the host immune response and ultimately treatment and clinical outcomes. Here, we characterize the role of two dioxygenases, LpxO1 and LpxO2, that are capable of site-specific 2-hydroxylation of *Pa* lipid A secondary acyl chains. To investigate the clinical relevance of *Pa* LpxO1 and LpxO2 in CF, we performed whole-genome sequencing on a cohort of 179 longitudinal isolates from 22 CF patients. We identified 4 strains from 2 patients with SNPs in *lpxO1* and 6 strains from 4 patients with SNPs in *lpxO2*. MALDI-TOF mass spectrometry of purified lipid A revealed loss of 2-hydroxylation, further confirming these as loss-of-function mutations. To evaluate the impact
of these unique lipid A structures on immune recognition, we performed LPS stimulation assays using macrophage NF-κB reporter cell lines and purified LPS from defined LpxO1 and LpxO2 mutants. This revealed decreased TLR4 recognition when lpxO2-dependent hydroxylation was absent from lipid A. We then performed LPS stimulations of primary monocyte-derived macrophages (MDMs) from CF and non-CF subjects. In non-CF MDMs, both lpxO1 and lpxO2 mutants showed decreased pro-inflammatory cytokine production (e.g., IL-6, MIP-1α, IL-8) compared to WT LPS; however, CF MDMs revealed decreased cytokine production for only lpxO2-deficient LPS, with no change for lpxO1-deficient LPS. This suggests CF macrophages recognize lipid A structural variation differently and may help us understand drivers of lipid A structural variation in CF. Lastly, we evaluated Pa lipid A gene expression in vivo using a murine lung infection model. LpxO2 expression is elevated in vivo when compared to in vitro growth, whereas lpxO1 expression is unchanged, demonstrating independent regulation and unique roles for these two enzymes in vivo. Taken together, our data indicate important and distinct roles for LpxO1 and LpxO2 in Pa virulence and host response during CF airway infection.

The Commensal Microbiota Programs T Cell Responses to Influenza A in Newborns Through the Circadian Gene NFIL3, Jake Stevens, University of Cincinnati

Newborns have the highest infection-related mortality of any age group with viral pneumonia causing most of the estimated 1 million deaths per year. The perinatal environment profoundly affects future lung health, an idea termed “the fetal origins of health and disease.” Antibiotics are a common early life exposure in many groups of susceptible newborns that disrupt normal commensal microbiota progression. This disruption then impacts immune system development needed for defense against pneumonia. We aimed to explore mechanistic links between antibiotic-induced changes in gut microbiota and lung defenses against Influenza A (IAV). Upon infection with IAV, the frequency of virus-specific, lung-resident CD8+ T cells was significantly reduced in antibiotic-exposed (ABX) newborn mice compared to sucralose control (CTL) at 10 days post infection. Furthermore, lung-resident memory CD8+ T cells remained diminished into adulthood in mice exposed to antibiotics as newborns. Using co-transfer experiments, we demonstrated an intrinsic defect in CD8+ T cells from ABX newborns. To characterize these intrinsic changes, we leveraged single-cell sequencing to build gene regulatory networks. Early life antibiotic exposure strikingly disrupted several circadian rhythm networks in pulmonary CD8+ T cells, including Nfil3, suggesting a mechanism for antibiotic disruption of mucosal CD8+ T cells. To support this, we showed both a significant reduction of NFIL3+ CD8+ T cells in ABX mice and a worsened outcome to IAV in mice whose T cells lack NFIL3. By understanding how the microbiota programs pulmonary immunity, we hope to change the newborn period of susceptibility to one of opportunity for better outcomes.
Session 3

I. Bioengineering (Ptarmigan A)

An Autonomous Medical Robot for Accessing Peripheral Lung Nodules, Inbar Fried, University of Northern Carolina

Bronchoscopy is currently the safest and least invasive method for diagnosing suspicious lung nodules as cancer. While existing systems enable physicians to access nodules near airways of sufficient diameter to accommodate the bronchoscope, they struggle to accurately access peripheral nodules due to decreasing airway diameter, increased respiratory motion in peripheral lung regions, and the density of anatomical obstacles such as blood vessels in the lung parenchyma. These challenges limit the number of patients that benefit from bronchoscopy leading to secondary invasive procedures and delayed diagnoses. To overcome these challenges, we developed a medical robot that uses a steerable needle — a flexible needle that can take curved paths — to navigate around obstacles and access otherwise hard-to-reach peripheral lung regions. The needle is passed through the working channel of a traditional bronchoscope by a physician and is then autonomously steered by the robot through the lung parenchyma to its target. We developed motion planning algorithms that compute a safe obstacle-avoiding trajectory for the robot to follow. To demonstrate our robot’s ability to accurately and safely access lung targets beyond the reach of existing tools, we compared it to a physician performing traditional bronchoscopy in ex vivo porcine lungs. Our robot achieved an average targeting error under 4mm over 10 needle deployments compared to 13mm average error over 11 deployments for traditional bronchoscopy. To evaluate the clinical feasibility of our robot, we performed 3 needle deployments in 2 in vivo porcine experiments. Our robot’s average targeting error was under 3mm, demonstrating its ability to successfully operate in living lungs with respiratory motion. By integrating the robot with existing bronchoscopes, we increase its potential availability to patients without access to subspecialized physicians or tertiary care centers and limit the additional physician training required.

Development of a Microneedle Patch for mRNA Vaccination, Sophia Sakers, Georgia Institute of Technology

mRNA vaccines offer a rapid, scalable option for mass vaccination. However, traditional intramuscular (IM) vaccination is painful, requires trained medical personnel, and generates sharps waste. A microneedle patch (MNP) is a skin patch with an array of micron-scale needles made from a dissolvable polymer matrix to encapsulate drugs or vaccines for transdermal delivery. Microneedles press into skin with less pain than IM vaccination and dissolve, releasing the vaccine without sharps waste. The dried formulation may also offer increased thermostability. The goal of this study is to design an MNP to stabilize mRNA in lipid nanoparticles (LNPs).
mRNA-LNPs were formulated with microfluidic mixing, concentrated with tangential flow filtration (TFF), and loaded into polymeric MNPs by micromolding. Stability and function of the mRNA-LNP-MNP system were measured through analysis of LNP size (by dynamic light scattering), degree of encapsulation (by Ribogreen assay), in vitro cellular expression (in RAW 264.7 and Vero cells), and in vivo expression of reporter mRNA (by mouse model with IVIS imaging).

First, mRNA-LNPs were concentrated with TFF at low flow rates to load up to 2 µg mRNA in the small volume of MNP needle tips. Second, various excipients were screened. A formulation of polyvinyl alcohol (PVA) and sucrose preserved size and function of mRNA-LNPs in an MNP while forming strong needles for skin insertion. Third, the MNP manufacturing process was designed to minimize mRNA exposure to destabilizing temperatures. In both in vitro and in vivo studies, application of mRNA-LNPs from this MNP design resulted in clear protein expression. This expression was lower than that of fresh mRNA-LNPs, and we hypothesize this is due to encapsulation loss during drying, indicating an area for future improvements.

The studies performed indicate that mRNA-LNPs can be stabilized in an MNP. Future studies are needed to investigate the immunogenicity of mRNA-LNP-MNPs for vaccination.

Development and Deployment of a Multimodal Colposcope for Real-time Cervical Cancer Detection, Yajur Maker, Rice/Baylor University

Introduction: Over 311,000 women die from cervical cancer annually, which can be attributed to a lack of access to diagnostic exams in low- and middle- income countries (LMICs). [1] This study presents the Multimodal Mobile Colposcope (MMC), an optical imaging system that combines a Pocket Colposcope for widefield imaging and a high-speed, high-resolution microendoscope (HF-HRME) for sub-cellular imaging with deep-learning image analysis models to automate cervical cancer diagnosis at a low-cost, with high accuracy.

Materials and Methods: The MMC was used by experts at Barretos Cancer Hospital, Brazil as shown in Fig 1A. The clinicians used the Pocket Colpo and HF-HRME, and live video feeds of the two devices were simultaneously saved and displayed. An automatically generated heatmap helped identify lesions, followed by placement of the HRME probe on high-risk areas of the heatmap. HRME images were scored in real-time by an automated algorithm to provide a diagnosis and guide the clinician to biopsy high-risk areas for comparison of the MMC to the gold-standard of pathology.

Results and Discussion: Example images of the novel lesion and squamocolumnar junction detection heatmap are shown in Fig 1B. The results from a representative MMC imaging session are shown in Fig 1C, showing agreement between the MMC system and pathology results. These scores were generated using a multi-task network, which achieved a sensitivity of 0.93 and specificity of 0.57 in a retrospective analysis for diagnosing cervical cancer, comparable to expert colposcopy. [2] Now, over 450 patients have been imaged as part of a
larger study for prospectively validating the MMC, showing promising agreement with gold standard pathology.

Conclusions: The MMC shows potential in supporting cervical cancer prevention in LMICs by automatically detecting cervical precancer and cancer with high accuracy. It offers the potential for single-step diagnosis without the need for biopsies and pathology in LMICs.

II. Cancer Biology (Ptarmigan C)

Loss of the MGAT5 glycosyltransferase sensitizes pancreatic tumor cells to immune clearance, Erin Hollander, University of Pennsylvania

Pancreatic ductal adenocarcinoma has a five-year survival rate of less than 12%, a dismal rate attributed to a difficulty in early detection and a lack of effective treatments. One potential target is the glycosyltransferase MGAT5, which catalyzes the formation of β1,6-N-acetylglucosamine branched glycans. Overexpression of MGAT5 has been implicated in tumor growth and metastasis in multiple cancers.

Using a panel of clonal cell lines that recapitulate the immune heterogeneity of PDAC, we found that loss of MGAT5-mediated N-glycans allows for T-cell mediated abrogation of tumor growth. Mice which have been immunized with MGAT5 knockout tumor lines are then able to clear multiple wild-type tumor lines, suggesting a strong immune memory response is generated in response to the MGAT5 knockout lines. By contrast, MGAT5 loss has no impact on tumor cell growth in vitro. Immune phenotyping of the tumor microenvironment of MGAT5 WT and KO tumors revealed an increase in markers of T cell activation, and T cells in draining lymph nodes of these tumors had significantly increased intracellular TNFα and IFN-γ.

To delineate the mechanism underlying this robust tumor clearance, OT-I T cells targeting the strong antigen ovalbumin were cultured with both MGAT5 WT and KO tumors cells engineered to express ovalbumin. The KO tumor cells had a higher rate of killing by T cells in the co-culture. Additionally, MGAT5 KO cells were found to be exceptionally sensitive to TNFα-mediated cell death even at very low concentrations.

Taken together, these results are consistent with a model in which loss of MGAT5-mediated N-glycans increases the sensitivity of tumors to T cell killing through the TNFα pathway, allowing for the formation of a durable immune response. Finally, MGAT5 knockout tumors treated with immune checkpoint blockade had significantly decreased tumor size and increased survival over controls, suggesting MGAT5 has potential as a novel target for pancreatic cancer.

Identifying a RAD18/UBC13-dependent mechanism of replication fork recovery to modulate chemoresponse in BRCA1-deficient cancers, Emily Cybulla, St. Louis University
Mutations in the breast cancer susceptibility genes \textit{BRCA1} and \textit{BRCA2} are associated with an increased lifetime risk of breast and ovarian cancers. The BRCA proteins play a well-established role in double-stranded DNA break repair, and recent studies have revealed an emerging role of BRCA1/2 in replication stress response. While replication forks are extensively degraded by nucleases in BRCA-deficient cancer cells, activation of specialized fork recovery mechanisms enables resumption of DNA synthesis and promotes cell survival. My project aims to define this fork recovery mechanism in BRCA1-deficient cells and to identify potential recovery factors that can be targeted to improve chemotherapeutic response in BRCA1-mutated breast and ovarian cancers.

To monitor perturbations in replication fork dynamics on a genome-wide scale, we utilize a DNA fiber assay technique measuring rates of fork recovery and replication fork degradation. In parallel, electron microscopy analysis allows direct visualization of replication fork intermediates. Cell survival assays are employed to test how loss of fork recovery factors impacts cell proliferation and chemotherapeutic response in BRCA1-deficient cells.

Our results reveal that RAD18 and UBC13, which catalyze ubiquitination of Proliferating Cellular Nuclear Antigen (PCNA), promote fork recovery in BRCA1-deficient, but not BRCA2-deficient, cancer cells. In addition, loss of RAD18 in BRCA1-deficient cells significantly slows cell proliferation, and UBC13 inhibition further sensitizes cells lacking BRCA1 to the replication stress inducer Hydroxyurea (HU). To extend our findings to human cancer tissues, we use immunohistochemistry with ovarian tumor microarrays to show that RAD18 protein levels are elevated BRCA1-deficient tumors. Moreover, increased RAD18/UBC13 pathway expression is linked to shortened progression-free survival in BRCA1-deficient ovarian cancers.

Based on our findings, we hypothesize that RAD18, UBC13, and PCNA ubiquitination may represent novel targets to improve chemoresponse in BRCA1-deficient cancers that rely on fork recovery mechanisms for survival.

\textit{Utilizing zebrafish to characterize the role of miR-21 in hepatocellular carcinoma, Chad VanSant-Webb, University of Utah}

The incidence of hepatocellular carcinoma (HCC) in the United States is rising, in large part due to the increasing obesity epidemic and its association with metabolic dysfunction-associated steatohepatitis (MASH). RNA-based treatments for liver disease and HCC are an exciting possibility as the liver readily takes up oligonucleotides, facilitating hepatic delivery of RNA-based therapies such as microRNA (miRNA) mimics and antagonists. miRNAs are small RNA molecules of 20-22 nucleotides that regulate the translation of mRNA. miRNA-based treatments have shown promise in treating hepatitis C. It has been shown that miRNAs are dysregulated in serum and liver tissues of patients with liver disease and HCC, but functional roles for these miRNAs are not well defined.
We used Nanostring and RNA sequencing to identify dysregulated miRNAs in patients with MASH, MASH-driven HCC, (MASH-HCC) and in transgenic zebrafish with HCC driven by activated β-catenin (ABC-HCC). β-catenin is one of the most commonly mutated genes in MASH-HCC. We found significant overlap in dysregulated miRNAs between MASH-HCC and ABC-HCC. One such miRNA was miR-21, which was enriched in ABC-HCC compared to non-transgenic control siblings and was increasingly upregulated in patients from MASH to MASH-HCC. To investigate the role of miR-21 in disease initiation and progression, we created transgenic lines of zebrafish to either constitutively overexpress or sponge miR-21 specifically in hepatocytes. miR-21 overexpression significantly increased liver size of wild-type larvae and further exacerbated liver enlargement of ABC-HCC larvae at 6 days post fertilization (dpf). Conversely, sponging miR-21 had no significant impact on liver size of wild-type larvae, but significantly ameliorated ABC-HCC liver enlargement at 6 dpf. When given a high cholesterol diet to model lipid dysregulation, miR-21-overexpressing zebrafish showed significantly decreased hepatocyte steatosis compared to non-transgenic control siblings. Our results suggest that miR-21 plays a conserved role in hepatocarcinogenesis and influences hepatic lipid metabolism.
Poster Sessions

Poster Session I

Sponsored by FAER

1. **Keith Dodd**
   University of Colorado, Anschutz Medical Campus
   Relationship Between Functional Connectivity and Weight-Gain Risk of Antipsychotics in Schizophrenia

2. **Kallen Schwark**
   University of Michigan
   Clinical response to the PDGFRA inhibitor avapritinib in high-grade glioma patients

3. **Leelabati Biswas**
   Rutgers University
   The Genetics of Pregnancy Loss: Validating a Novel Predictive Biomarker of Egg Quality

4. **Miguel Paredes**
   University of Washington
   Early undetected dissemination across countries followed by extensive local transmission propelled spread of the 2022 mpox epidemic and limited the impact of vaccination

5. **Karl Foley**
   University of Rochester
   PP1B opposes classic PP1 function, inhibiting spine maturation and promoting LTP

6. **Nate L. Overholtzer**
   USC-Caltech
   Delay Discounting and Resting State Functional Brain Connectivity in Childhood Obesity

7. **Tanner Martinez**
   University of Chicago
   CUX1 levels control hematopoietic stem cell fate and plasticity

8. **Razaq Durodoye**
   Case Western Reserve University
   Evidence of potential natural selection in African Americans
9. **Rebecca Rubinstein**  
   University of North Carolina at Chapel Hill  
   Human milk oligosaccharides and Campylobacter jejuni infection risk in Nicaraguan children.

10. **Hallie Gaitsch**  
    Johns Hopkins University  
    Characterizing oligodendrocyte lineage cell dynamics during remyelination

11. **Amanda McGann**  
    University of Cincinnati  
    The effect of antagonism of miR-324-5p on epileptogenesis following intrahippocampal kainic acid injections in mice.

12. **Nathan Calzadilla**  
    University of Illinois Chicago  
    Preclinical study utilizing metabolomics in SERT knockout mice reveals novel therapeutic targets for intestinal inflammation

13. **Giovanni Botten**  
    The University of Texas Southwestern Medical Center  
    Structural Variation Cooperates with Permissive Chromatin to Control Enhancer Hijacking-Mediated Oncogenic Transcription

14. **Peter Zhang**  
    Medical College of Wisconsin  
    Covariate adjusted group sequential tests for survival probabilities

15. **Brenda Seymour**  
    University of Colorado  
    Bacterial indole is required for collagen-induced arthritis through enhanced Th17 immunity

16. **Nicholas Ringelberg**  
    University of North Carolina at Chapel Hill  
    Differential neuronal populations drive behavioral phenotypes in a mouse model of Angelman syndrome

17. **Cameron Menezes**  
    University of Texas at Southwestern  
    Determining the In Vivo Impact of Mitochondrial Energy Loss in the Liver
18. Kelsey Kines  
University of Colorado  
Age-associated changes in the mammary epithelium elucidate a role for SEMA7A in breast cancer.

19. Yi Fan Chen  
Case Western Reserve University School of Medicine  
Novel Class of XPO1 Modulators Enables Non-Toxic Therapeutic Targeting of T Cell Activation

20. Ashley Brown  
Medical College of Wisconsin  
PIM kinases are essential for CD8 T cell effector function and metabolism during chronic viral infection

21. David Broadbent  
Michigan State University  
Dissecting the Regulatory Mechanisms of Autophagosome Biogenesis

22. Grant Higerd-Rusli  
Yale  
Inflammation differentially controls transport of depolarizing Nav versus hyperpolarizing Kv channels to drive rat nociceptor activity

23. Marina Han  
University of Washington  
Photoconvertible fluorescent protein-tagged tau exhibits exceptional stability in a C. elegans model of tau proteostasis

24. Noah Gavil  
University of Minnesota  
Chronic antigen in solid tumors drives a distinct program of T cell residence

25. Matthew O’Neill  
Vanderbilt University School of Medicine  
Development of a Calibrated Multiplexed Assay to Facilitate the Clinical Interpretation of Putative Splice-altering Variants

26. Kieran Tebben  
University of Maryland, Baltimore  
Age and parasitemia explain most of the variation in host and parasite gene expression among Malian children infected with P. falciparum
27. **Bayardo Garay**  
   University of Minnesota Medical School  
   Dual inhibition of MAPK and PI3K/AKT pathways enhances maturation of human iPSC-derived cardiomyocytes

28. **Emily Mendez**  
   University of Texas Health Science Center at Houston/MD Anderson Cancer Center  
   Cell-specific differential gene network regulation in opioid use disorder

29. **Ashley Tetens**  
   Johns Hopkins School of Medicine  
   Mapping of the DNA Methylome of DIPG Reveals Profound Stochasticity That is Responsive to Pharmacologic Modulation

30. **Duncan Smart**  
   Vanderbilt University School of Medicine  
   Immunophenotyping of leukocytes in human heart failure identifies coordinated pro-inflammatory response

31. **Fathima Mohamed**  
   University of Minnesota  
   Mitochondrial pyruvate carrier inhibition attenuates the germinal center reaction and treats murine chronic graft versus host disease

32. **Brian Goldspiel**  
   University of Pennsylvania  
   Elucidating the Roles of the Branched Chain Amino Acids in Macrophage Function

33. **Dhruba Banerjee**  
   University of California, Irvine  
   The Generation of Position Correlated Cells across Primary Sensory Cortices

34. **Nathaniel Skillin**  
   University of Colorado  
   Stiffness anisotropy coordinates supracellular contractility driving long-range myotube-ECM alignment

35. **Yunli Chu**  
   Vanderbilt University  
   Charting single cell signaling across acute myeloid leukemia phenotypic landscapes
36. Adrien Honcoop  
University of Nebraska Medical Center  
A Qualitative Exploration of COVID-19 Vaccine Hesitancy among Parents

37. Olivia Bednarski  
Indiana University School of Medicine  
Species-level analysis of stool bacteria in Ugandan children reveals association with clinical presentation of severe malaria.

38. Alice Chu  
Michigan State University  
Unravelling the role of TGF-β signaling on vascular proliferation in pulmonary arterial hypertension

39. Gunseli Wallace  
University of Michigan  
Auditory lipidomics, an approach to identify unique molecular effects of noise trauma

40. Yunyoung Kim  
Renaissance School of Medicine at Stony Brook University  
Colorectal cancer-associated mutations impair EphB1 kinase function

41. Uma Kantheti  
University of Colorado Anschutz  
Programmed death ligand 1 interactions in the regulation of dendritic cell migration

42. Gopika SenthilKumar  
Medical College of Wisconsin  
Activation of Piezo-1 Prevents Human Microvascular Endothelial Dysfunction During Acute Inhibition of Ceramide Formation

43. Joyce Tran  
University of California, San Diego  
Investigation of Fmnl2 in Central Nervous System Development

44. Matthew Jotte  
University of Chicago  
Combined deficiency of chromosome 7 myeloid tumor suppressors enhances chemotherapy resistance

45. Dene Betz  
UT Health Sciences Center San Antonio
Transcriptional analysis of regions undergoing post-stroke plasticity after photothrombotic stroke in mice

46. Simrita Deol  
Northwestern University  
Comparative evaluation of synthetic cytokines for enhancing production and performance of NK92 cell-based therapies

47. Chris Li  
University of Miami Miller School of Medicine  
Strategies to Attenuate the Indirect Alloimmune Response in Encapsulated Pancreatic Islet Transplantation

48. Sarita Deshpande  
University of Chicago  
Insights into Neural Network Behavior using 4D Entropy: A Novel Quantitative Metric of Network Activity

49. Jovanka Ravix  
University of Miami Miller School of Medicine  
BRCA2 haploinsufficiency driven neoplastic events in the fallopian tube epithelia

50. Ali Ranjbaran  
Wayne State University  
Single-cell profiling of transcriptional changes associated with neighborhood stress in immune cells of children with asthma

51. Maria Ortiz  
SUNY Upstate Medical University  
Assessing the role of Abi1 in allo- and autoimmune pathologies

52. Emily Jang  
NYU  
Cortical and thalamic engagement of cholinergic interneurons in nucleus accumbens core

53. Rebecca Slotkowski  
University of Nebraska Medical Center

54. Olivia C. Smith  
University of Minnesota  
Interrogating sensing and alarm functions of resident memory T cells at the organismal level
55. **Oygul Mirzalieva**  
Louisiana State University Health Sciences Center School of Medicine  
The Role of Isg15 in Maintenance of Er-Mitochondrial Contacts and Calcium Transfer in Ataxia Telangiectasia

56. **Nicole Ochandarena**  
University of North Carolina at Chapel Hill  
Molecular architecture of opioid-sensitive neurons in the cerebral cortex

**Poster Session II**

1. **Aishwarya Iyer**  
University of Maryland School of Medicine  
Investigating the Molecular Pathogenesis of a Novel MYBPC1 Duplication Mutation Linked to Myopathy with Tremor

2. **Thomas Scott**  
University of Virginia  
TRPS1 modulates estrogen receptor activity in luminal breast cancer cells

3. **Arnav Rana**  
State University of New York Upstate Medical University  
Cardiac Benefit in a Mouse Model of Mitochondrial Originating Cell Stress

4. **Matthew Cheung**  
University of Alabama at Birmingham  
Spatiotemporal immune atlas of the first clinical-grade, gene-edited pig-to-human kidney xenotransplant

5. **Shreya Bellampalli**  
Mayo Clinic  
Mechanisms of osmosensing in GI enteroendocrine cells

6. **Emily Isenstein**  
University of Rochester Medical Center  
Using EEG and Virtual Reality to Study Active and Passive Touch in Autism

7. **Justin Couetil**  
Indiana University School of Medicine
Diagnostic Evidence Gauge of Spatial Transcriptomics (DEGAS-ST): Using transfer learning to map clinical data to spatial transcriptomics in prostate cancer

8. **Robert Rosen**  
Rutgers Robert Wood Johnson Medical School  
The Macrophage-Endothelial Interface Regulates CAR T-cell Toxicities In Vitro

9. **Alison Livada**  
University of Rochester  
Lung megakaryocytes are tissue resident, arise independent of HSCs, and contribute to recovery in low platelet states.

10. **Gelare Ghajar-Rahimi**  
University of Alabama at Birmingham  
Acute kidney injury results in sustained, long-term alterations of kidney lymphatics

11. **Rose Marie Akiki**  
Medical University of South Carolina  
Essential role for a novel long-non-coding enhancer RNA (eRNA) and associated R-loops in activity-dependent development of maladaptive depressive- and addiction-related behaviors

12. **Douglas Fritz**  
University of Colorado  
One size fits all doesn’t fit: the "best" ways to statistically model data in spatial transcriptomics

13. **Wolfgang Beckabir**  
University of North Carolina-Chapel Hill  
Entinostat and neoantigen vaccination reduce bladder cancer resistance to immune checkpoint blockade

14. **Yueqi Ren**  
University of California, Irvine  
Improving clinical efficiency in screening for cognitive impairment due to Alzheimer’s

15. **Yu Par Aung**  
Virginia Commonwealth University  
MCTR3 Dampens Inflammatory Responses to Cigarette Smoke and Poly(I:C) in Small Airway Epithelial Cells by Differential Regulation of microRNAs
16. Jeremy Chang  
Tri-Institutional MD-PhD Program in New York City  
Smc5/6’s multifaceted DNA binding capacities stabilize branched DNA structures

17. Carley Miller  
University of Colorado Anschutz  
Stress causes cell-type, synapse, and sex specific changes in ventral subiculum microcircuitry and output to the bed nucleus of the stria terminalis

18. Matthew Eason  
University of Maryland School of Medicine  
Overexpression of the Obscurin Pleckstrin Homology Domain in Triple Negative and HER2 Positive Breast Cancer Cells Reduces Migration, Invasion, and Chemoresistance to Doxorubicin

19. Madeline Alizadeh  
University of Maryland School of Medicine  
Right-sided Colon Involvement is a Predictor of Extra-Intestinal Manifestations of Inflammatory Bowel Disease in Patients with Both Crohn’s Disease and Ulcerative Colitis

20. Mohamed Khalil  
Medical College of Wisconsin  
Interleukin-7 Receptor (IL7R) and CD3E are necessary components in the development of NKG2CHigh memory NK cells during HCMV infections

21. P. Cody He  
University of Chicago  
Exon architecture and exon junction complexes control m6A methylation and gene expression

22. Shaker Dukkipati  
University of Nebraska Medical Center  
Spinal cord H-reflex post-activation depression is linked with hand motor control in adults with cerebral palsy

23. Erin Wildermuth  
University of Maryland School of Medicine  
Preclinical evaluation of an antisense oligonucleotide gene therapy for Huntington’s disease using single-cell genomics
24. Benjamin Fixman  
University of Southern California  
The Effect of APOBEC3A-Mediated RNA Editing on Human Papillomavirus Infectivity

25. Erica Nebet  
Renaissance School of Medicine at Stony Brook University  
Characterization of disease-associated variants in the NMDA receptor M3 segment

26. Christopher Monti  
Medical College of Wisconsin  
Computational modeling of virus-source dependent replication variability in HCMV-infected ARPE19 cells

27. Wesley Huang  
University of Michigan  
Fibroblasts sensitizes intestinal epithelial cells to ferroptosis in inflammatory bowel disease (IBD)

28. Matthew Sipple  
University of Rochester School of Medicine and Dentistry  
Isolating the role of myotonia in myotonic dystrophy type 1 myopathy.

29. Natalie Bennett  
Vanderbilt University  
Gli2 as a Potential Mediator of Tumor-Immune Crosstalk in Bone Metastatic Breast Cancer

30. Maya Lozinski  
University of Chicago  
Market Size and Trade in Medical Services

31. Natalya Motyka  
Tulane University School of Medicine  
Emergence of the IL-33/IL-33R signaling axis during ETEC pathogenesis

32. Nicholas Brennan  
State University of New York Upstate Medical University  
The role of perturbed mitochondrial protein import in progressive muscle wasting.

33. Brianna Ramirez  
University of Texas Southwestern Medical Center
34. Congzhou Sha  
Penn State College of Medicine  
Differentiable rotamer sampling with molecular force fields

35. Raquel Ortega  
University of Colorado  
Investigating the role of PARP inhibitors on MMEJ

36. Evan Tracy  
University of Louisville  
*A Case of Hereditary Hemorrhagic Telangiectasia Type 1 Complicated by Recurrent Deep-seated MSSA Infections*

37. Shreya Desikan  
SUNY Downstate Health Sciences University  
*A MACS protocol for purification of untouched germinal center B cells from unimmunized or germinal center-induced mice*

38. Narges Pourmandi  
University of Michigan

39. Catherine Beamish  
University of Rochester  
*Arc1, a regulator of synaptic plasticity, rescues latent effects of MeHg on neuromuscular development in Drosophila*

40. Jack Prochnau  
South Texas Medical Scientist Training Program  
*Investigating the Novel Role of DDR2 in Pancreatic Ductal Adenocarcinoma*

41. Adrienne Kambouris  
University of Maryland School of Medicine  
*Combination of Burn Wound Injury and Pseudomonas Infection Elicits Unique Gene Expression that Enhances Bacterial Pathogenicity*

42. Amy van Ee  
Johns Hopkins University School of Medicine
Retinoic acid enhances Poly I:C effects on TLR3 activation via CD14 in regeneration

43. Hannah Batchelor  
Yale School of Medicine  
Plasticity of cortical networks during visual associative learning

44. Abigail Atkinson  
Johns Hopkins School of Medicine  
Androgen Receptor Mediated Regulation of Human Endogenous Retrovirus K in the Brain

45. Austin Todd  
University of Texas Health San Antonio  
Novel animal models of cell-restricted hACE2 expression to study SARS-CoV-2 induced pathology

46. Emily Przysinda  
University of Rochester  
Social brain connectivity differences in schizophrenia during naturalistic video viewing

47. Alexander Smith  
University of Illinois at Urbana-Champaign  

48. Stephanie Busch  
Zucker School of Medicine at Hofstra/Northwell  
Menstrual effluent as a non-invasive source of uterine natural killer cells

49. Karishma Shah  
University of Utah  
Pain Embodiment Measures in Chronic Pain Patients are Associated with Increased Risk for Aberrant Opioid-Related Behavior

50. Ankit Dahal  
University of Rochester  
The molecular mechanism of PMN-MDSC differentiation in the TME of Pancreatic Cancer Ductal Adenocarcinoma (PDAC)

51. Rasa Valiauga  
Loyola Stritch School of Medicine  
The Impact of Diet on Neuroinflammation
52. Yi Zhou  
Virginia Commonwealth University  
Associations Between Changes in Brain Structure and the Development of Suicide Behaviors in the Adolescent Brain Cognitive Development Study.

53. Arnaldo Franco Torres  
University of Miami Miller School of Medicine  
Metastatic pancreatic cancers hyperacetylate chromatin to reprogram metabolism independently of transcription.

54. Philip Barrison  
University of Michigan  

55. Laurel Schappell  
Stony Brook University  
Characterization of Physiological and Inflammatory Changes in the Post-Stroke Lung.

56. Denay Richards  
Princeton University  
Investigating the Role of E-Cadherin in Melanocyte Morphology and Migration.
### 2023 Diversity Travel Awardees

#### 2023 Diversity Travel Awards

<table>
<thead>
<tr>
<th>Name, School</th>
<th>Name, School</th>
<th>Name, School</th>
<th>Name, School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hassan Ahamed, University of Iowa</td>
<td>Amanda (Mandy) Collar, University of New Mexico</td>
<td>Katherine Lee, University of California, San Diego</td>
<td>Yasminye Pettway, Vanderbilt</td>
</tr>
<tr>
<td>Nathan Calzadilla, University of Illinois</td>
<td>Adrienne Kambouris, University of Maryland</td>
<td>Fathima Mohamed, University of Minnesota</td>
<td>Sophia Sakers, Georgia Institute of Technology</td>
</tr>
<tr>
<td>Yi Fan Chen, Case Western Reserve</td>
<td>Mohamed Khalil, Medical College of Wisconsin</td>
<td>Natalya Motyka, Tulane University</td>
<td>Gopika Senthilkumar, Medical College of Wisconsin</td>
</tr>
<tr>
<td>Kit Yee (Alice) Chu, Michigan State University</td>
<td>Fae Kronman, Pennsylvania State University</td>
<td>Miguel Paredes, University of Washington</td>
<td>Joyce Tran, University of California, San Diego</td>
</tr>
</tbody>
</table>
Sunday Morning Activities

Copper is an ideal location for exploring the Rocky Mountains! Several activities will be planned and organized by University of Colorado MSTP students. While these activities are subject to change due to inclement weather, they have usually happened as planned in years past.

**Hiking**

For all hikes, please bring the following: a pair of supportive shoes or boots, sunscreen, water, snack food, loose-fitting clothes, a warm layer, and a rain/wind-resistant layer.

**Easy Hike - Vail Pass:** Just a five-minute drive from Copper, you and your friends will be positioned to explore the easy trails and walk around the Black Lakes near the summit of Vail Pass – the second highest highway pass in the USA. There is a paved trail that borders the lakes, a dirt trail towards Shrine Mountain Pass, and you can walk down to the waterfront and relax in the sun!

*Plan to meet at the Registration Table at 9:00am.*

**Intermediate Hike - Mayflower Gulch:** The Mayflower Gulch Trailhead is a 10-minute drive from Copper and features an intermediate hike, with a length of about 3 miles round trip. From the trailhead, hike the gentle incline through the woods until the trail opens up into a scenic gulch. There, you can explore remnants of an old ghost town and climb up to the high points along the ridge for spectacular views!

*Meet at the Registration Table at 8:30am.*

**Yoga**

Copper hosts Center Pose yoga presented by Subaru every Saturday and Sunday from 9-10 am. The outdoor yoga class is beginner-friendly and they often have extra mats/towels/blankets to borrow. Bring water, sunscreen, and sunglasses!

**What:** Energize yourself with an outdoor yoga class in the heart of Center Village. We will be giving away Jade Yoga mats to first-time attendees (first come, first serve and while supplies last).

**When:** Sunday 9am - 10am

**Where:** Meet Emily at the registration table at 8:45am! We will walk together to: Jacks Lawn, next to Downhill Duke’s in Center Village. We will have a few extra yoga mats to share and you are welcome to bring your own.

**Volleyball**

There’s nothing like a crazy game of volleyball to have a good time! There are some volleyball courts located in the Copper Village, about a 10-minute walk from the Conference Center. If
you want to partake in some fun rallies, come join the game! *Meet at the Registration Desk at 9:15am.*

**Disc Golf Extravaganza!**

Enjoy playing the 9-hole course which starts at Center Village in Copper. The first hole is just to the left of the American Eagle Lift. *Meet at the Registration Table at 9:00am.*

**Day Trip to Frisco**

The cute mountain town of Frisco is about a 10-minute drive from Copper. Frisco features a Main Street with artisan’s shops, bakeries, and souvenir stores. Frisco is right on shores of Lake Dillon and you can spend time on the waterfront or marina and enjoy the views. *Meet at the Registration Desk at 9:30am.*

**Copper Activities Pass**

For $79, participants can purchase an Activity Day Pass for Copper’s many summer activities including: unlimited scenic chair rides, unlimited boating activity sessions and attempts on the Climbing Wall, 2 runs through the Woodward WreckTangle, 1 ride on the Rocky Mountain Coaster, 2 sessions on the Bungee Trampoline, 1 ride on the Go-Kart track and 2 rides on the Zip Line.** Single activity passes can also be purchased for $10-$35 at ticket windows for each activity.

To purchase a pass and for more details visit https://www.coppercolorado.com/thingsto-do/activities-amenities/summer-activity-passes .

**Breakfast and Board Games**

In case of inclement weather, or for those who prefer a more leisurely Sunday morning indoors we will have a room reserved where students can enjoy a variety of traditional games such as Chess and GO as well as modern classics like Catan and Carcassonne. Players of all experience levels are welcome!

** All activities are weather dependent, non-refundable, non-transferrable, and we do not offer any refunds regardless of activity closures. Additionally, Activity Day Passes are day specific and we do not offer refunds on partially used day passes.
Sponsors

THANK YOU TO OUR SPONSORS

CU Department of Radiation Oncology
University of Colorado Cancer Center
CU Department of Radiology
CU Department of Pediatric Surgery
CU Department of Psychiatry
CU Department of Pediatrics
CU Division of Plastic and Reconstructive Surgery
CU Department of Physical Medicine and Rehabilitation
CU Division of Medical Oncology
University of Colorado Medicine
CU Department of Orthopedics
CU Department of Ophthalmology
Colorado Nutrition Obesity Research Center
Foundation for Anesthesia Education and Research
American Physician Scientists Association
NOVUS Biologicals
## Student Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abigail Atkinson</td>
<td>Johns Hopkins School of Medicine</td>
</tr>
<tr>
<td>Adam Geber</td>
<td>University of Rochester Medical Center</td>
</tr>
<tr>
<td>Adrien Honcoop</td>
<td>University of Nebraska Medical Center</td>
</tr>
<tr>
<td>Adrienne Kambouris</td>
<td>University of Maryland</td>
</tr>
<tr>
<td>Aishwarya Iyer</td>
<td>University of Maryland School of Medicine</td>
</tr>
<tr>
<td>Alex Camai</td>
<td>University of Colorado</td>
</tr>
<tr>
<td>Alexander Smith</td>
<td>University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>Ali Ranjbaran</td>
<td>Wayne State University</td>
</tr>
<tr>
<td>Alison Livada</td>
<td>University of Rochester</td>
</tr>
<tr>
<td>Amanda Collar</td>
<td>University of New Mexico School of Medicine</td>
</tr>
<tr>
<td>Amanda McGann</td>
<td>University of Cincinnati Medical Scientist Training Program (MSTP)</td>
</tr>
<tr>
<td>Amy van Ee</td>
<td>Johns Hopkins University School of Medicine</td>
</tr>
<tr>
<td>Ankit Dahal</td>
<td>University of Rochester</td>
</tr>
<tr>
<td>Anna Hasche-Kluender</td>
<td>University of Colorado Anschutz School of Medicine</td>
</tr>
<tr>
<td>Annika Gustafson</td>
<td>University of Colorado Anschutz Medical Campus</td>
</tr>
<tr>
<td>Arnaldo Franco Torres</td>
<td>University of Miami Miller School of Medicine MSTP</td>
</tr>
<tr>
<td>Arnav Rana</td>
<td>State University of New York Upstate Medical University</td>
</tr>
<tr>
<td>Ashley Brown</td>
<td>Medical College of Wisconsin</td>
</tr>
<tr>
<td>Ashley Tetens</td>
<td>Johns Hopkins School of Medicine</td>
</tr>
<tr>
<td>Ashlyn Stahly</td>
<td>University of Colorado Anschutz Medical Campus MSTP</td>
</tr>
<tr>
<td>Austin Jolly</td>
<td>University of Colorado Anschutz Medical Campus</td>
</tr>
<tr>
<td>Austin Todd</td>
<td>University of Texas Health San Antonio</td>
</tr>
<tr>
<td>Bayardo Garay</td>
<td>University of Minnesota Medical School</td>
</tr>
<tr>
<td>Benjamin Fixman</td>
<td>University of Southern California</td>
</tr>
<tr>
<td>Benjamin Wong</td>
<td>University of Colorado Medical Scientist Training Program</td>
</tr>
<tr>
<td>Brandon Hilliard</td>
<td>University of Colorado</td>
</tr>
<tr>
<td>Brenda Seymour</td>
<td>University of Colorado</td>
</tr>
<tr>
<td>Brian Goldspiel</td>
<td>University of Pennsylvania Medical Scientist Training Program</td>
</tr>
<tr>
<td>Brianna Ramirez</td>
<td>University of Texas Southwestern medical center</td>
</tr>
<tr>
<td>Cameron Menezes</td>
<td>University of Texas at Southwestern</td>
</tr>
<tr>
<td>Carley Miller</td>
<td>University of Colorado Medical Campus</td>
</tr>
<tr>
<td>Casey Hofstaedter</td>
<td>University of Maryland School of Medicine MSTP</td>
</tr>
<tr>
<td>Catherine Beamish</td>
<td>University of Rochester</td>
</tr>
<tr>
<td>Chad VanSant-Webb</td>
<td>University of Utah MSTP</td>
</tr>
<tr>
<td>Chris Li</td>
<td>University of Miami Miller School of Medicine</td>
</tr>
<tr>
<td>Christopher Monti</td>
<td>Medical College of Wisconsin MSTP</td>
</tr>
<tr>
<td>Clara Si</td>
<td>Vanderbilt University</td>
</tr>
</tbody>
</table>
Congzhou Sha  
Penn State College of Medicine

Cooper Mellema  
University of Texas Southwestern

Courtney Vetter  
University of Colorado Medical Scientist Training Program

Daniel Flanagan  
Emory University

Danielle Cicka  
Emory University

Danielle Xie  
Stony Brook MSTP

David Beltran-Cardona  
University of Colorado MSTP

David Broadbent  
Michigan State University DO/PhD Program

Dene Betz  
South Texas Medical Scientist Training Program

Dhruba Banerjee  
University of California Irvine

Douglas Fritz  
University of Colorado

Duncan Smart  
Vanderbilt University School of Medicine

Dustin Fykstra  
University of Colorado Medical Scientist Training Program

Dylan Calame  
CU Anschutz

Emily Cybulla  
Saint Louis University School of Medicine

Emily Isenstein  
University of Rochester Medical Center

Emily Jang  
New York University

Emily King  
University of Colorado Medical Scientist Training Program

Emily Mendez  
University of Texas Health Science Center

Emily Przysinda  
University of Rochester

Erica Nebet  
Renaissance School of Medicine at Stony Brook University

Erin Fish  
University of Colorado MSTP

Erin Hollander  
University of Pennsylvania

Erin Wildermuth  
University of Maryland School of Medicine

Evan Tracy  
University of Louisville MD/PhD Program

Fae Kronman  
Pennsylvania State University

Fathima Mohamed  
University of Minnesota

Gelare Ghajar-Rahimi  
University of Alabama at Birmingham

Giovanni Botten  
The University of Texas Southwestern Medical Center

Gopika SenthilKumar  
Medical College of Wisconsin

Grace Akatsu  
CU MSTP

Grant Higerd-Rusli  
Yale MD-PhD Program

Gunseli Wallace  
University of Michigan

Hallie Gaitsch  
Johns Hopkins University Medical Scientist Training Program

Hannah Batchelor  
Yale MD-PhD Program

Hannah Beatty  
University of Colorado MSTP

Hassan Ahamed  
University of Iowa Medical Scientist Training Program

Haya Jarad  
University of Colorado MSTP

Hunter  
University of Colorado MSTP
Inbar Fried  University of North Carolina at Chapel Hill
Ira Fleming  University of Colorado
Isabelle Hua  University of Colorado
Jack Prochnau  South Texas Medical Scientist Training
Jackson Stocking  University of Colorado Medical Scientist Training Program
Jacob Cox  University of Colorado
Jacob Rosenthal  Weill Cornell Medical College
Jacqueline Turner  University of Colorado
Jake Stevens  University of Cincinnati Medical Scientist Training Program (MSTP)
Jenna Weber  University of Utah
Jeremy Chang  Tri-Institutional MD-PhD Program in New York City
Jovanka Ravix  University of Miami Miller School of Medicine MSTP
Joyce Tran  University of California San Diego
Juan Santiago Moreno  University of Colorado Anschutz Medical Campus
Julian Maceren  Stony Brook University
Justin L Couetil  Indiana University School of Medicine
Kallen Schwark  University of Michigan
Karisma Shah  University of Utah MD/PhD
Karl Foley  University of Rochester School of Medicine & Dentistry
Katherine Lee  University of California San Diego
Keith Dodd  University of Colorado - Anschutz Medical Campus
Kelsey Kines  University of Colorado
Kieran Tebben  Medical Scientist Training Program
Kirsten Bredvik  Weill Cornell Tri-Institutional MD/PhD Program
Kit Yee (Alice) Chu  Michigan State University DO/PhD Program
Kristina Pravoverov  University of Nebraska Medical Center College of Medicine
L. Nate Overholtzer  USC-Caltech MD-PhD Program
Laurel Schappell  Stony Brook University
Leelabati Biswas  Rutgers University Robert Wood Johnson Medical School-Princeton University
Luke Tomasovic  Johns Hopkins University School of Medicine
Madeline Alizadeh  University of Maryland School of Medicine
Maria Ortiz  SUNY Upstate Medical University
Mariia Alibekova Long  University of Pennsylvania Perelman School of Medicine
Marina Han  University of Washington
Matthew Cheung  University of Alabama at Birmingham
Matthew Eason  University of Maryland School of Medicine
Matthew Jotte  University of Chicago
Matthew Mardo  University of Colorado (Medical Scientist Training Program)
Matthew O'Neill  Vanderbilt University School of Medicine
Matthew Sipple  University of Rochester School of Medicine and Dentistry
Maya Lozinski  University of Chicago
Michael LaCroix  University of Texas Southwestern Medical Center
Miguel Paredes  University of Washington
Ming Suet Kwan  Renaissance School of Medicine at Stony Brook University
Mohamed Khalil  Medical College of Wisconsin
Molly Schieber  University of Nebraska Medical Center
Narges Pourmandi  University of Michigan
Natalie Bennett  Vanderbilt University Medical Scientist Training Program
Natalie Weed  University of Colorado MSTP
Natalya Motyka  Tulane University Physician-Scientist Program
Nathan Calzadilla  University of Illinois Chicago
Nathan Nelson-Maney  University of North Carolina at Chapel Hill
Nathaniel Skillin  University of Colorado MSTP
Nicholas Brennan  State University of New York Upstate Medical University
Nicholas Cordaro  University of Colorado School of Medicine
Nicholas McQuillan  University of Colorado Anschutz Medical Campus
Nicholas Ringelberg  University of North Carolina at Chapel Hill
Nicholas Senofsky  University of Colorado Anschutz
Nickole Moon  University of Colorado Anschutz Medical Campus
Nicole Ochandarena  University of North Carolina at Chapel Hill
Noah Gavil  University of Minnesota
Olivia Bednarski  Indiana University MSTP
Olivia C Smith  University of Minnesota Medical Scientist Training Program
Oygul Mirzalieva  Louisiana State University Health Sciences Center School of Medicine
P. Cody He  University of Chicago
Peter Zhang  Medical College of Wisconsin
Philip Barrison  University of Michigan Medical Scientist Training Program
Rachel Cohen  University of Colorado Anschutz Medical Campus
Raquel Ortega  University of Colorado
Rasa Valiauga  Loyola University Chicago
Razaq Durodoye  Case Western Reserve University
Rebecca Rubinstein  University of North Carolina at Chapel Hill MSTP Program
Rebecca Slotkowski  University of Nebraska Medical Center
Robert Rosen  Rutgers Robert Wood Johnson Medical School
Rose Marie Akiki  Medical University of South Carolina/ Medical Scientist Training Program
Sarita Deshpande  University of Chicago
Selin Ekici  University of Colorado
Shaker Dukkipati  University of Nebraska Medical Center
Shanawaj (Roy) Khair University of Colorado MSTP
Shareef Shaheen Pennsylvania State University
Shrey Thaker Renaissance School of Medicine at Stony Brook University
Shreya Bellampalli Mayo Clinic
Shreya Desikan SUNY Downstate Health Sciences University
Shujian Lin University of Colorado Medical Scientist Training Program
Simrita Deol Northwestern University MSTP
Siyuan Feng Northwestern University Feinberg School of Medicine
Sofia Celli University of Colorado
Sofia Esquibies University of Colorado MSTP
Sophia Sakers Georgia Institute of Technology
Stephanie Busch Zucker School of Medicine at Hofstra/Northwell
Tanner Martinez University of Chicago MSTP
Thomas Scott University of Virginia Medical Scientist Training Program
Uma Kangethi University of Colorado MSTP
Varuna Nangia University of Colorado
Vladimir Khristov Penn State University College of Medicine
Wesley Huang University of Michigan MSTP
William Sheeran University of Colorado
Wolfgang Beckabir University of North Carolina-Chapel Hill
Yajur Maker Baylor/Rice MD/PhD Program
Yasminye Pettway Vanderbilt University School of Medicine
Yi Fan Chen Case Western Reserve University School of Medicine
Yi Zhou Virginia Commonwealth University
Yu Par Aung Myo Virginia Commonwealth University
Yueqi Ren University of California Irvine
Yunli E. Chu Vanderbilt University
Yunyoung Kim Stony Brook University
Yvonne Cui University of Colorado Anschutz Medical Campus