2021 Intermountain and California-Southern Junior Science & Humanities Symposium

MONTANA TECH

Instagram: #mttechscience21

Facebook: @MontanaTechScienceandEngineeringFair

Contents

About JSHS

The Intermountain JSHS is one of 48 regional Symposia that feed into the National JSHS. The JSHS Program promotes original research and experimentation in the sciences, engineering, and mathematics at the high school level and publicly recognizes students for outstanding achievement. By connecting talented students, their teachers, and research professionals at affiliated Symposia and by rewarding research excellence, JSHS aims to widen the pool of trained talent prepared to conduct research and development vital to our nation. Please visit **jshs.org** for more information.

About The Institute for Educational Opportunities at Montana Tech

The Institute for Educational Opportunities is a consortium of programs developed to provide K-12 and college students with the tools and support they need to achieve success in higher education.

Since 1994, the Institute has focused on students who show high aptitude in science, technology, engineering and math (STEM) and pairs them with programs that meet their individual needs. Students enrolled in Institute programs are given one-on-one attention and support, ensuring that they receive the tools they need to achieve their dreams.

As part of its commitment to student success, the Institute offers programs to develop teachers. A number of professional courses and other resources are available to teachers interested in adding more challenging rigor to their curriculum.

Conveniently located in the Health Sciences Building on the Montana Tech campus, The Institute's resources are available to those interested in supporting lifelong learning for students.

Director's Welcome

It is my privilege to welcome you to the Junior Science and Humanities Symposium joint event of the Intermountain and California Southern Regions.

While 2021 is Montana Technological University's seventh year of hosting the symposium, this year's event is anything but business as usual. The pandemic changed the definition of normal for all of us, including the Symposium. We are excited to be new to hosting the California-Southern Region and to be administering these Symposiums entirely virtual. We thank you in advance for your flexibility and understanding. Blazing new trails is often a bumpy road. The IJSHS team took on these logistical challenges due to our strong commitment to support student scholars.

Support for those of you who take on the most complex of scientific challenges is paramount! The technological advances that will take us through and beyond this pandemic is derived from creative people, who through perseverance in tackling complex problems make an enhanced world.

The hard work and enthusiasm that is evident in the preparation of your technical papers, gives us great hope for the future. Through such probes for understanding, you lay the foundation for breakthroughs and accomplishments that will repay you in terms of personal satisfaction. More importantly, it will repay in multitude by its benefits to society.

We encourage all student scholars participating this year to strive for excellence, innovation, and invention throughout your scientific and engineering studies and careers. We wish you all the greatest success in your scientific pursuits far into the future.

Amy Verlanic
Executive Director, Institute for Educational Opportunities

Sponsor's Welcome

It is my privilege to welcome you to Montana Tech and the Intermountain Junior Science and Humanities Symposium. Montana Learning Center at Canyon Ferry Lake is proud to have the opportunity to partner with the Institute for Educational Opportunities at Montana Tech and to be a sponsor of this exciting event.

As the Executive Director of the Learning Center, a leader in STEM (science, technology, math and engineering) education in Montana, I want to applaud and congratulate you for participating in the Symposium for your dedication, enthusiasm and hard work. It's thrilling to see your intelligent and creative thinking about a wide variety of scientific, social science and humanities topics.

Participation in this Symposium enhances your participants' thinking, writing and presentation skills. More importantly, it opens a world of possibilities for your future, in terms of post-secondary education and potential careers. Many of you will become the educators, innovators and leaders of tomorrow.

It is especially meaningful for us to see students participating in this Symposium who are or have been participants in the Learning Center's summer science camps, the Learning Center's NASA-affiliated programs or both. The Learning Center strives to be a place where students from elementary school through college and teachers from elementary school to high school can come together to solve problems, create and be empowered. Its camps and NASA educational programs provide students with STEM immersion experiences and internships, friendship building and recreation. Its world-class observatory, which includes the largest public access telescope in Montana, gives students, teachers and members of the public the opportunity to learn about the night sky. Its teacher training programs help educators expand their skills and knowledge, giving them the tools they need to help their students succeed in an increasingly complex world.

I wish all of you the greatest success in this Symposium and in your educational and career pursuits far into the future.

Ryan Hannahoe

Executive Director, Montana Learning Center at Canyon Ferry Lake

Research Paper Reviewers

Adam Maes, TRIO Coordinator - Montana Tech

Bev Hartline, Emeritus Faculty - Montana Tech

Bill Kellogg, NorthWestern Energy

Brahmananda Pramanik, Associate Professor - Montana Tech

Caitlin Cooley-Chamblin, Instructor - Montana Tech

Carrie Vath, Assoc. Vice Chancellor/Dean of Students - Montana Tech

Curtis Link, Associate Dean - Montana Tech

Dalton Caron, Montana Tech

Dario Prieto, Assistant Professor - Montana Tech

Debbie Bristol, Arizona Sun Realtor

Douglas Coe, Emeritus Faculty - Montana Tech

Douglas Galarus, Associate Professor - Montana Tech

Geri Nauck, Concord University/Upward Bound

Grant Myhre, DJ & A Engineers, Planners and Surveyors

Gretchen Druliner, Field Coordinator - Clark Fork Watershed Education Program

Hannah Sylvester, Admission Counselor - Carroll College

James Cabe, Principle Analyst, Pacific Northwest National Laboratory

Jennifer Dobb, EHS Consultant - Consulting Services

Jessica Solberg, Montana State University

Josh Ralph, Montana Tech

Joyanna-Lynn Borgagna, Montana State University

Karen Wesenberg, Instructor - Montana Tech

Katherine Zodrow, Associate Professor - Montana Tech

Kerrie Berger, Montana Fish Wildlife and Parks

Lisette Druliner-Kim, DVM, cVMA, Seven Cedars Veterinary Acupuncture and Medicine

Mark Majerus, USDA Botanist/Agronomist (retired)

Melinda Smith, PhD student - Northern Arizona University

Michael Hessler, Montana Tech

Michele Marsh, Montana Department of Environmental Quality

Research Paper Reviewers cont.

Randi Phelps-Potaznick, Oregon Health & Science University

Rayelynn Brandl, Director Clark Fork Watershed Education Program

Rhonda Coguill, Highland Point, Inc.

Robert Chamblin, Instructor - Montana Tech

Ronald Breitmeyer, Associate Professor - Montana Bureau of Mines and Geology, Montana Tech

Ryan Hessler, Montana Tech

Ryan Munson, Instructor - Montana Tech

Sarah Lux, Retired Doctor of Internal Medicine

Sarah Urban, AP & Honors Biology Instructor - Capital High School

Shari Curtis, Butte Public Library

Vanna Boccadori, Montana Fish Wildlife and Parks

Oral Presentation Judges

Abby Peltomaa, Water Quality Coordinator - Butte Silver Bow

Bev Hartline, Emeritus Faculty - Montana Tech

Bobbi Coughlin, Accountant - Fard Tax Accounting

Brahmananda Pramanik, Associate Professor - Montana Tech

Clarie Pichette, Biology and Project Lead the Way Principles of the Biomedical Sciences - Helena High School

Ezra Peisach, Rutgers, The State University of New Jersey

Gordon Sheldon, Electronics and Robotics Teacher, Glacier High School

Joel Graff, Associate Professor - Montana Tech

Laura Marsh, Antonio Ruiz de Montoya University

Marilyn Alexander, Retired co-founder/co-director - Montana Science Institute, now known as the Montana Learning Center

Michele Marsh, Montana Department of Environmental Quality

Rebecca Linden, Botanist

Sarah Seitz, Montana Department of Environmental Quality

Sophia Tsai, Research Scholarships Coordinator, UC San Diego

Tom Pedersen, Montana Conservation Corps Board Member, 2012 Teacher of the Year, Capital High School

Tom Ritzdorf, Great Northern Innovations

Tyler Rogers, Research Programs Coordinator, UC San Diego

Poster Judges

Abby Peltomaa, Water Quality Coordinator - Butte Silver Bow

Adam Maes, TRIO Coordinator - Montana Tech

Brahmananda Pramanik, Associate Professor - Montana Tech

Brandon McLean, TRIO Coordinator - Montana Tech

Jackie Timmer, Assistant Professor/Chief Chemist - Montana Bureau of Mines and Geology/Montana Tech

Leigha Bradford, Montana Tech

Natasha Chadwell, Program Admin for Mathematics and Computer Science - Montana Tech

Nicolas Fleming, Montana Tech

Polly Summers - TRIO Montana Tech

Sarah Seitz, Montana Department of Environmental Quality

Sierra Hancock, Montana Tech

Tom Reget, TRIO Student Support Services - Montana Tech

Winchester Kessler, Montana Tech

Schedule

Thursday, March 4, 2021 - All times are MST

9:00 AM

All Students and Judges can start logging into Zoom Rooms to make sure you are connected and in correct room.

9:30 AM

Welcome with Dr. Carrie Vath, Montana Tech Associate Vice Chancellor/Dean of Students, and review of the day's events with Tom Reget

10:00 AM

Symposia Sessions - See Symposia sessions for detailed schedule (pages 10-13).

12:30 PM

* Virtual Tours - We here at Montana Tech are disappointed that you are not able to visit us on our campus and see Montana this year. While we tried, we were not able to get guided Virtual Tours set up for you to experience; however, we have some amazing countryside and destinations that we want to share with you. Check out some of our amazing places listed on page 16.

* Judges go back to designated rooms for deliberations

1:30 PM

Poster Presentations available for view (https://institute.mtech.edu/symposia-schedule/)

1:45 PM

JSHS Evaluation - Mandatory (https://institute.mtech.edu/symposia-schedule/)

2:00 PM

Sponsor Presentations
* Ryan Hannahoe, Montana Learning Center (http://montanalearning.org/)
* Theresa Rader, UNITE

2:15 PM

Awards Ceremony with Ricardo Sanon

Intermountain Symposia Sessions

First Session, 10:00-11:00 AM MST

Zoom Room 1

10:00 Jason Cui
10:20 Ansel LaPier
10:40 Clara Tandar

Zoom Room 2

10:00 Sayge Barkley
10:20 Braden Collard
10:40 Emmett Seto

Zoom Room 3

10:00 Jaden Koon
10:20 Wyatt Manthey
10:40 Nikhila Narayana

California-Southern Symposia Sessions

First Session, 10:00-11:00 AM MST

Zoom Room 4

10:00 Andrew Gao
10:20 Elita Yang
10:40 Elanor Jung

Zoom Room 5

10:00 Stanley Liu
10:20 Jennifer Lew
10:40 Nithin Parthasarathy

Zoom Room 6

10:00 Ashwin Sivakumar
10:20 Sanjana Gurram
10:40 Kate Wang

Intermountain Symposia Sessions

Second Session, 11:20-12:20 PM MST

Zoom Room 1

11:20 Jeena Alborano
11:40 Daphne Liu
12:00 Lydia Garrick

Zoom Room 2

11:20 Jasper Thomas
11:40 Sophia Dulin
12:00 Eden Maxwell

Zoom Room 3

11:20 Olivia Gunderson
11:40 Margaret Mattson
12:00 Theodore Van Deren

California-Southern Symposia Sessions

Second Session, 11:20-12:20 PM MST

Zoom Room 4

11:20 Atulya Mandyam

11:40 Katherine Kricorian

12:00 Nitin Sreekumar

Zoom Room 5

11:20 Edmund Sumpena

11:40 Aaron Chang

12:00 Junyao Sun

Zoom Room 6

11:20 Audrey Wong

11:40 LeAnn Tai

12:00 Elisha Johnston

Things to do in Montana

We here at Montana Tech are disappointed that you were not able to visit us on our campus and see Montana this year. However, we have some amazing countryside and destinations that we want to share with you.

Anaconda Smoke Stack State Park (https://fwp.mt.gov/stateparks/anaconda-smoke-stack)

Butte America - Largest Superfund in North America (https://pitwatch.org/)

Butte-Anaconda National Historic Landmark District (http://butte-anacondanhld.blogspot.com/)

Glacier National Park (https://www.nps.gov/glac/planyourvisit/things2do.htm)

Granite Mountain Speculator Mine Memorial (http://www.minememorial.org/)

Little Bighorn Battlefield National Monument (https://www.nps.gov/libi/index.htm)

Lost Creek State Park (https://fwp.mt.gov/stateparks/lost-creek)

Montana Bureau of Mines and Geology (http://www.mbmg.mtech.edu/)

Museum of the Rockies in Bozeman (https://museumoftherockies.org/exhibitions)

Our Lady of the Rockies (https://www.ourladyoftherockies.net/)

Virginia City & Nevada City Ghost Towns (http://virginiacity.com/)

World Museum of Mining (https://miningmuseum.org/

Yellowstone National Park (https://www.nps.gov/yell/planyourvisit/index.htm)

Opening Ceremony - Dr. Carrie Vath

Dr. Vath is a California native receiving her Bachelors of Science in Zoology from Humboldt State University; she received her Masters of Science in Interdisciplinary ecology with a concentration in Anthropology and a PhD in Interdisciplinary Ecology with a concentration in Zoology from University of Florida. She also completed certificates in Environmental Education and Communication and Tropical Conservation and Development. Dr. V first became involved in student affairs as an undergraduate at Humboldt State where she worked as a campus tour guide, recruiter, and orientation leader. While pursuing her MS and PhD at University of Florida, she coordinated the undergraduate tutoring program, held student government offices including Department President, Senate Representative, and Chair of new student orientation. Her academic background had her traveling all over the world (she has been to 31 countries) where she studied various primates, worked with local communities and taught college students. Dr. V began her career at Montana Tech as the Director of Student Success in 2014 and has been the Associate Vice Chancellor/Dean of Students for the past four years. She uses her background as an ecologist to help college students navigate the university ecosystem.

Awards Ceremony - Ricardo Sanon

Ricardo entered his first year as the Director of TRIO Upward Bound and Upward Bound Math and Science in 2020. Ricardo, a Brockton, Mass. native, is a proud first-generation college graduate and has called Butte his home for seven years. When he is not getting involved with the community, Ricardo enjoys being with his family and supporting the Diggers!

Intermountain Regional Finalists

1. Jason Cui, Fairview High School
2. Clara Tandar, West High School
3. Margaret Mattson, Fairview High School
4. Sayge Barkley, Baker High School
5. Eden Maxwell, Hellgate High School

Intermountain Poster Winners

1. Nathan Bruns, Hellgate High School
2. Marion Jones, Hellgate High School
3. Harveanna Lee, Hellgate High School

California Southern Regional Finalists

1. Stanley Liu, Arcadia High School
2. LeAnn Tai, Arnold O. Beckman School
3. Atulya Mandyam, Westview High School
4. Elanor Jung, Mt. Carmel High School
5. Edmund Sumpena, Westview High School

California Southern Poster Winners

1. Kyle Tianshi, The Cambridge School
2. Amy Wang, Westview High School
3. Timothy Zheng, Cate School

Regional Finalists' Awards

1st Place receives $2,000 scholarship

2nd Place receives $1,500 scholarship

3rd Place receives $1,000 scholarship

In addition to scholarships, the Departments of the Army, Navy and Air Force invite the top five finalists from each Regional Symposium to the National JSHS Symposium to present their original research; expenses paid. The 1st and 2nd place regional finalists will present their research in the oral competition to compete for National JSHS scholarships. The 3rd, 4th and 5th place regional finalists will present their research in the poster competition to compete for cash awards.

Regional Teacher Award

JSHS honors individual teachers and their schools' contributions to advancing student participation in STEM research. Each Regional Symposium presents a $500 cash award to a dedicated educator.

National Finalists' Awards

1st Place receives $12,000 scholarship

2nd Place receives $8,000 scholarship

3rd Place receives $4,000 scholarship

For National Poster Competition

1st Place receives $550 cash

2nd Place receives $450 cash

3rd Place receives $350 cash

Intermountain Oral Presenter Abstracts

Jason Cui, Fairview High School, Fairview, CO

Teacher: Maxine Morris

Supervising Scientist: Dr, Dong Tian, University of Colorado

Thursday, March 4, at 10:00 AM - Room 1

Sodium benzoate, a food preservative, shortens lifespan, accelerates neurodegeneration, causes larval lethality, and induces premature aging

Sodium benzoate is one of the most commonly used preservatives in the food industry. Although the compound is recognized as safe by the FDA, the effects of sodium benzoate on human health have been of interest to both the public and the scientific community. The nematode Caenorhabditis elegans (C. elegans) is an ideal model organism to study the health effects of sodium benzoate because of its simplicity and its well established genetic toolkit. In this study, I found that sodium benzoate restricts C. elegans growth, causes larval lethality, shortens lifespan, induces premature aging, and accelerates neurodegeneration. At high concentrations, sodium benzoate caused significant lethality in larvae. Sodium benzoate functions in parallel with the insulin/IGF-1 pathway to decrease lifespan. Using an Alzheimer's disease model that expresses human beta amyloid peptides, sodium benzoate was revealed to also significantly accelerate neurodegeneration. Sodium benzoate induced age-pigments in young worms through accumulating age-pigments in lysosome-related organelles (LROs), contributing to premature aging and neurodegeneration. Using GFP marker strains and quantitative RT-PCR assays, I uncovered the role of sodium benzoate in suppressing the irg-1 innate immunity gene expression. The compromised innate immunity response is another underlying mechanism for the phenotypes described above. Overall, these results reveal the long term detrimental effects of sodium benzoate on animal health and it may have similar consequences on human health.

Ansel LaPier, Central Valley High School, Liberty Lake, WA

Teacher: Tanya LaPier

Mentor: Dr. Kimberly Clary, Eastern Washington University

Thursday, March 4, at 10:20 AM - Room 1

Development of a Clinical Force Measuring Walker to Optimize Recovery After Open Heart Surgery

Patients often need to use their arms to assist with functional activities, but after open heart surgery pushing with the arms is limited to < 10 lb to help minimize force across the healing sternum. Currently, there is no method for measuring arm weight bearing force through a walker with patient populations. The ultimate goal for my project was to design and construct an Clinical Force Measuring (CFM) walker for rehabilitation professionals to utilize with patients recovering from open heart surgery to safely perform functional mobility tasks using < 10 lb of arm weight bearing force. This research project included 3 interrelated parts that sequentially built on each other. First, I conducted a secondary data analysis comparing arm weight bearing force during functional mobility tasks in a cohort of younger vs older subjects. Results suggested that patients recovering from open heart surgery, particularly older ones, may not be able to accurately estimate using arm force < 10 lb during weight bearing activities and feedback (visual and auditory) is effective for improving accuracy. This analysis and preliminary study established proof-of-concept, the need for a CFM walker, and the efficacy of its use with feedback training. Next, a qualitative study to garner feedback from rehabilitation professionals regarding a CFM walker prototype was conducted. From transcribed interviews, key statements and phrases were grouped and ''themes'' emerged to guide device revisions. Lastly, fabrication and testing of a lightweight, streamline, cost effective CFM Walker prototype with a simply visual display and auditory cue was completed.

Clara Tandar, West High School, Salt Lake City, UT

Teacher: Crystal King

Supervising Scientist: Trudy Olivier, University of Utah and Huntsman Cancer Institute

Thursday, March 4, at 10:40 AM - Room 1

Synergy Screen of NIH Oncological Drug Set VII in Combination with Aurora Kinase B Inhibitor to Enhance Chemotherapeutic Sensitivity in Small Cell Lung Cancer

Small cell lung cancer (SCLC), though comprising only 15% of lung cancers, is highly aggressive. Despite available platinum-based agents, resistance develops rapidly, accounting for a 2-year survival rate of 6% in patients. Suppression of tumor suppressors, p53 and pRb (retinoblastoma) and overexpression of MYC family of proto-oncogenes are some of the molecular footprints in the variant cell type and more resistant form of SCLC. Strategies that involve inhibiting Aurora Kinase B (AURKB), a key enzyme in mitosis and meiosis, have been shown to create vulnerability in SCLC mouse models. To explore the therapeutic potential of this strategy, the synergistic effects of Barasertib, an AURKB inhibitor, was tested in combination with 96 approved drugs from the NIH Oncological Drug Set VII individually to illuminate possible drug combinations exhibiting synergistic cytotoxicity. An in vitro primary drug screen was performed to identify the most efficacious drug combination using a CTG cell viability assay. Results from the cell viability study and linear synergy score were used to select 12 drugs for extensive secondary screen investigation. ZIP, Bliss, and HSA synergy models elucidate the most promising synergistic cytotoxicity combinations of Everolimus, Temsirolimus, and AZD8055 in combination with Barasertib among all variant SCLC cell lines. Interestingly, all three agents are inhibitors of mTOR (mammalian target of rapamycin), a key protein kinase that regulates cell growth, proliferation, and protein synthesis, suggesting a novel approach in SCLC drug therapy. This study is the first to suggest a synergistic effect between mTOR and AURKB inhibitors to heighten chemotherapeutic sensitivity in the variant subtype of SCLC.

Jeena Alborano, North Toole County High School, Sunburst, MT

Teacher: Amanda Nix

Thursday, March 4, at 11:20 AM - Room 1

Assessing the Antimicrobial Effectiveness of Glucose Oxidase Enzyme Enhanced Synthetic Honey

The purpose of this investigation was to determine the effectiveness of glucose oxidase enzyme-enhanced honey as an anti-microbial agent against Bacillus megaterium, Micrococcus luteus, Pseudomonas fluorescens, Rhodospirillum rubrum, Serratia marcescens, and Escherichia coli. For experimentation in this investigation, volumes of 5 µl and 15 µl of powdered glucose oxidase enzyme were mixed with 15 µl of raw, diluted honey. Following this, the respected "5 µl" and "15 µl" volumes of synthetic honey were applied using a micropipette technique to blank sterile disks and placed onto a petri dish of all bacterial strains listed (5 dishes for each strain). One blank sterile disk (for the control) and one tetracycline disk (to use as a standard for comparison) was also added to each bacterial plate. The dishes were then incubated at 37 degrees Celsius. For 72 hours, at 24-hour increments, petri dishes were observed, and the zones of inhibition were recorded in millimeters. With a majority of these tests showing statistical significance, it is very possible that glucose oxidase enzyme-enhanced synthetic honey is a potential antibiotic solution against all bacterial strains tested.

Daphne Liu, West High School, Salt Lake City, UT

Teacher: Enrique Arce-Larreta

Mentor: John Capodilupo, CTO, WHOOP Inc.

Thursday, March 4, at 11:40 AM - Room 1

Using Machine Learning to Predict Physiological Metrics from PPG Pulse Shapes

Photoplethysmography (PPG) is an optical technique to detect changes in blood volume by measuring backscattered light from a photodiode. Literature suggests that the pulse wave recorded by PPG contains information about vascular health and elasticity, however current analyses are restricted by noisy and limited data. This study uses WHOOP's large proprietary dataset from May-June 2020 to investigate age information which may be encoded in PPG pulse waves. Three predictive models are built: Ridge Regression, Partial Least Squares (PLS) Regression, and Autoencoder. Common PPG features are extracted from the waveforms and used to build the Ridge Regression model. The PLS Regression model is constructed to reduce the features to fewer uncorrelated components. The Autoencoder model encodes pulse signals to a latent space. Each model is analyzed for its utility in predicting someone's age. The PLS model performs the best, with age predictions within the correct decade 83% of the time and correlation coefficient significantly higher than the aging index reported in literature ($R = 0.721$ vs. $R = 0.296$). Variability between model predicted ages (cardiovascular age) and biological ages (true age) could be attributed to individuals having unusually healthy or unhealthy physiological systems for their age. Significance tests are performed and show strong evidence that variability in classification results may indicate health discrepancies in someone's cardiovascular systems. This study provides a non-invasive alternative for individuals and physicians to make quick and efficient cardiovascular health judgements from outside of the clinic. Further study could probe how behavioral choices affect the cardiovascular system.

Lydia Garrick, Sentinel High School, Missoula, MT

Teacher: Kelly Nelson

Supervising Scientist: Cindee Yates-Hansen, University of Montana

Thursday, March 4, at 12:00 PM - Room 1

GEF Activity on Gai as a Function of Mutated RIC-8A Structures

Heterotrimeric G-proteins send signals throughout cells through the process of guanine nucleotide exchange. For Gi, a specific type of G-protein, this exchange is facilitated with the help of a chaperone protein and guanine exchange factor (GEF), Ric-8A. Ric-8A is an essential protein, and a deficiency of Ric-8A in mice has been found to "[lead] to increased anxiety and [cause] problems with spatial memory and relearning, suggesting that [Ric-8A] has an important role in the regulation of memory and emotional behavior" (Tõnissoo et al., 2010). To learn more about Ric-8A and identify potential pharmaceutical targets, sites for mutations have been identified that should increase understanding of Ric-8A's interaction with the G ai subunit of Gi. By transforming the plasmids, lysing the cells, purifying the proteins, and conducting a tryptophan assay, it will be possible to monitor these mutated Ric-8A's GEF activity on Gai, and compare them to that of the wild type Ric-8A. If there is a difference between the GEF activity of the mutated and wild type Ric-8A, this will indicate that the selected residues play an important role in GEF activity. Data collection will begin as soon as the mutated plasmids have been delivered.

Sayge Barkley, Baker High School, Baker, MT

Teacher: Linda Rost

Thursday, March 4, at 10:00 AM - Room 2

Development of Bio-plastic from Feather Keratin

A majority of plastic is currently nonbiodegradable and is plaguing the planet, but it is essential for many processes and products. The goal was to create a biodegradable plastic prototype using extracted feather keratin. Feathers are ideal because they do not have many commercial uses and they are a byproduct from poultry farms. Keratin was extracted using chemical processes then combined with a plasticizer glycerol. It was difficult to extract adequate amounts of feather keratin to make bioplastic samples. Tilapia keratin from a supplement pill was also used to make bioplastic to compare. The prototypes all had differences in physical appearance, viscosity, and yield. The feather keratin produced a thin, flaky bioplastic. The tilapia keratin bioplastic was produced with different amounts of glycerol. The lower amounts of glycerol produced a flaky bioplastic and the higher amounts produced a more viscous and liquidy bioplastic. The prototype with 25% glycerol produced the best bioplastic, which was tacky and cohesive. Future research and experimentation is needed to solve problems with useability and durability. The texture and malleability of the keratin bioplastic will need to be adjusted to compensate for regular plastic use.

Braden Collard, Hellgate High School, Missoula, MT

Teacher: Willow Affleck

Supervising Scientist: Richard Hutto, Professor Emeritus University of Montana

Thursday, March 4, at 10:20 AM - Room 2

What Affects Bird Diversity in Urban-Rural Transition Zones?

Scientists have studied bird diversity of the transition zones between urban and rural habitats significantly less than either strictly rural or urban habitats. For this study, bird counts were conducted and foliage layers were measured at each of 57 points located throughout the suburban transition zone of the Rattlesnake corridor north of Missoula, Montana. Foliage Height Diversity and other independent variables were then compared with bird diversity as well as with the abundance of individual species. Ninety-seven total species were detected in the Rattlesnake corridor, many of which were to be expected, though some rarer species were also found, including Cliff Swallows, Red-naped Sapsuckers and a Say's Phoebe. No strong correlations arose between species diversity or abundance and any of the independent variables. The most likely causes for this are the uniformity and relatively small size of the Rattlesnake corridor and the adaptability of many of the species detected. Nonetheless, this research adds to the greater knowledge of birds and bird diversity in the transition zones between urban and rural habitats, and suggests the Rattlesnake corridor as a good model for developers to use in the future when designing wildlife-friendly neighborhoods. It also emphasizes the importance of integrating natural surroundings into neighborhoods and cities, and that strong planning can allow wildlife and people to coexist.

Emmett Seto, Ed W. Clark High School, Las Vegas, NV

Thursday, March 4, at 10:40 AM - Room 2

Modeling the Relationship between Cobalt Supply and Carbon Emissions from Cars in the United States

Carbon emissions affect our planet significantly, as they contribute greatly to global warming and climate change. According to the United States Environmental Protection Agency (EPA), thirty four percent of 2018 carbon emissions were from the transportation sector, the largest sector of carbon emissions. These emissions primarily come from burning fossil fuels for mostly petroleum-based vehicles. A potential way to reduce the combustion of fossil fuels and carbon emissions from the transportation sector is the introduction of more electric vehicles into the market, which emits significantly less CO2 than the conventional car. Despite the clear environmental benefits, electric vehicles still experience a low adoption rate due to the higher purchase price compared to the conventional car. The primary reason for the high purchase price of electric vehicles is the high prices of minerals such as cobalt that are required to build the electric vehicle's battery, which nearly makes up 50% of the total electric vehicle's cost. However, if the supply of the minerals such as cobalt were increased, the prices of the minerals would decrease, consequently, decreasing the cost of battery and the overall purchase price of electric vehicles. With a lower purchase price, more electric vehicles would be purchased by consumers, and as a result, a possible decrease in carbon emissions. To assess this relationship between an increase in cobalt supply and carbon emissions from cars in the United States, this paper creates and evaluates an Excel based model that evaluates this relationship incorporating different variables and values.

Jasper Thomas, Hellgate High School, Missoula, MT

Teacher: Willow Affleck

Thursday, March 4, at 11:20 AM - Room 2

How Beaver Dam Analogs Effect Sediment Depth and Composition in a Low Order Stream in Lolo National Forest

Beavers are considered ecosystem engineers due to their unique ability to impose significant changes on their environment through dam construction. Dam building has many positive effects on the environment such as improving water quality, reconnecting streams to floodplains, mitigating the intensity and frequency of fires, erosion, incision, flood, and drought events. They also create productive habitat for many species of plants and animals. Due to the numerous benefits of beaver dams on a stream ecosystem, the implementation of human-made beaver dams, called beaver dam analogs or BDAs, has become an increasingly popular restoration method. It is expected that BDAs may increase sediment deposition, which raises the stream bed and filters out suspended sediments. This helps to improve downstream water quality and to restore incised streams. However, it is unknown how effectively BDAs do this. This study measured the sediment depth and composition of sediment samples taken upstream and downstream of each BDA of a complex in Lolo National Forest, which may indicate how effective BDAs are at filtering suspended sediments out of the water. The measurements were taken at sample locations along transects at uniform distances from each analog. After which the data was averaged for each type of sample location and the averages were compared to identify trends in the data. The results indicate that BDAs are quite effective at increasing sediment deposition in low order streams, indicating that they may be a powerful restoration tool to help mitigate and even reverse incision, as well as improve water quality.

Sophia Dulin, Baker High School, Baker, MT

Teacher: Linda Rost

Thursday, March 4, at 11:40 AM - Room 2

Development of Natural Paint from Clinker Pyrometamorphic Rock

Paint is used for protecting surfaces and for art. Many paints contain volatile organic compounds (VOCs) when their binders and thinners are combined that can be harmful to humans and the environment. The purpose of this project was to create a paint that is low in VOCs with more natural binders and thinners and a natural pigment. Multiple paint recipes were created using clinker rock, collected from southeastern Montana. Clinker rock is formed from heating sandstone by underground coal beds. It only exists in certain areas in the Midwest. The clinker rock was used as a pigment and mixed with different natural binders and solvents, including citrus thinner, glycerin, and linseed oil. The best recipe for both paper and canvas was the pigment, glycerin, and citrus thinner. Paints that were mixed longer had much better results. Paints can be made from natural pigments and low VOC, natural binders and solvents. These paints can be safer for people to use, for air quality, and better for the environment.

Eden Maxwell, Hellgate High School, Missoula, MT

Teacher: Willow Affleck

Supervising Scientist: Bill Rosen, M.D., Private Practice & University of Montana Neural Injury Center

Thursday, March 4, 12:00 PM - Room 2

Natural Occurrence of a Visual Midline Shift in the General Population

Visual Midline Shift, a type of post trauma vision syndrome, is a common symptom following concussion, a type of mild Traumatic Brain Injury (mTBI). The purpose of this study was to determine if there is a naturally occurring Visual Midline Shift in the general, non concussed population. If so, this would be cause for a reevaluation of current concussion testing screening protocols. Participants completed a questionnaire detailing their concussion history and were then evaluated using four visual screening assessments designed to detect a Visual Midline Shift. The results demonstrated that of the participants without knowledge of a concussion, 10% exhibited a Visual Midline Shift. Additionally, the results demonstrated that 50% of individuals with a history of concussion also exhibited a Visual Midline Shift. The application of this study into diagnostic concussion testing has the potential to change the way concussions are diagnosed.

Jaden Koon, North Toole County High School, Sunburst, MT

Teacher: Kelly Nelson

Supervising Scientist: Sarah Certel, University of Montana

Thursday, March 4, at 10:00 AM - Room 3

Testing the Requirement for a Glutamate Autoreceptor in Drosophila Male Aggression

Out-of-context aggression is a serious problem for humans. It causes issues for aggressors and their victims as well as physicians in charge of taking care of aggressors. This research looks to solve the issue of aggression by understanding it at the synapse of neurons in drosophila brains, so that eventually a new pharmaceutical can be created to combat the problem more effectively than current solutions. Research will specifically look at two autoreceptors (presynaptic neurotransmission receptors that regulate neurotransmission) and their effects on aggression. The first autoreceptor being DmGluR which regulates the neurotransmitter Glutamate, and the second, Oct**α**2R which regulates Octopamine. Experiments will compare aggression levels in flies with reduced autoreceptors with control groups at regular autoreceptor levels. Results are expected to show that the absence of autoreceptors lowers aggression. Pictures of fly brains show where autoreceptors are expressed. Early research shows that there are very few neurons that express Octopamine and Glutamate which means that these few neurons, out of the thousands in a fly brain, have a large impact on overall aggressive behavior.

Wyatt Manthey, North Toole County High School, Sunburst, MT

Teacher: Amanda Nix

Thursday, March 4, at 10:20 AM - Room 3

Hydroelectric Home

Electricity and water are both used in almost every aspect of life in today's society. My project is a way to combine both of these, by using the water that people use every day to produce electricity.

My goal for this project was to create a generator that would run off the flow of water in household pipes or other sources of water flow. Using a corkscrew style propeller that was attached to a rod on the inside of a pipe, I was able to make the rod turn, which would turn a generator on the extremities of the pipe.

At the end of the project I was able to produce a maximum of 2.3 volts with a flow rate of 27.09 gallons per minute. The minimum flow rate that my device would produce electricity at was 11.79 gallons per minute.

This project is able to contribute to society by taking advantage of one aspect of life, water, and using it to produce another aspect of life, electricity. The objective I set for myself at the beginning of the project was to generate electricity using water flow. I met this objective as shown from my results above.

Nikhila Narayana, Rocky Canyon High School, Highlands Ranch, CO

Teacher: Amanda Karcz

Thursday, March 4, at 10:40 AM - Room 3

Catching the Sun: Harnessing Stokes Shift to Increase Solar Cell Efficiency

Even though sunlight is a clean source that easily meets the planet's energy needs, we cannot utilize it adequately (conventional solar cell efficiency (CSCE) is only 15-22%), partly because the cells cannot use UV radiation. I hypothesize that CSCE can be increased by improving UV capture, utilizing fluorescence. If successful, this could greatly improve renewable energy production and reduce fossil fuel dependence. Fluorescence occurs when electrons absorb incident photons, are excited to higher energy levels, and later re-emit lower energy photons (Stokes Shift). I chose cheap, non-toxic, 365nm UVA-excitable fluorophores that emit visible light, which is better absorbed by conventional solar panels (CSP). I generated fluorescence by shining UVA light onto fluorophore solutions enclosed in a bag placed on a CSP. I measured voltage and current with a multimeter and calculated power in watts for UV light (control) and each fluorophore (experimental groups).

Paired samples t -tests between UV and fluorophore generated wattages revealed that only laundry detergent statistically significantly increased UV capture. To control the experiment-wise error rate that arises when using multiple t -tests, Bonferroni corrections were applied, reducing alpha level to 0.005.

Study limitations include the production of large amounts of visible light by the UVA bulb; true UV radiation generates little/ no power in CSPs, augmenting the improvement by fluorophores. That laundry detergent increased UV capture despite this fact is impressive, suggesting that greater CSCE is achievable by using fluorophores. Further research involves using pure UV light and integrating fluorophores into CSPs without reducing visible light capture.

Olivia Gunderson, Baker High School, Baker, MT

Teacher: Linda Rost

Thursday, March 4, at 11:20 AM - Room 3

Bioinformatic Investigation of Prion Protein Sequences from Multiple Species

Transmissible Spongiform Encephalopathies are 100% fatal degenerative diseases of mammalian brains. The prion protein becomes misfolded and harmful to healthy prion proteins, causing irreversible brain damage and eventually leading to impaired functions depending on the area of the brain primarily affected by the aberrant protein. These diseases are categorized by incredibly long incubation periods, some taking several decades to ever show visible symptoms, but in any case these diseases are fatal. Well known TSEs include Bovine Spongiform Encephalopathy (BSE) in cattle, Chronic Wasting Disease (CWD) in deer and elk, Scrapie in sheep, and Creutzfeldt-Jakob Disease (CJD) in humans. The purpose of this study was to compare the amino acid sequences of the prion proteins of several of the aforementioned mammals in order to determine if there were differences that may affect the transmission or acquisition of TSEs. I hypothesized that there would be distinct differences between seven different mammal species, and the null hypothesis was partially rejected. The amino acid sequences of the Cattle, Yak, and Zebu were nearly identical to each other- however when those three were compared to Sheep, Human, Mouse, and Elk PRNP protein, there were a few differences among the seven sequences. This finding is important due to the elusive nature of TSEs and if we can better understand the differences in the proteins which contribute to TSEs, and can potentially lead to tools to either negate their effects or detect and contain misfolded prion proteins before they can spread.

Margaret Mattson, Fairview High School, Fairview, CO

Teacher: Paul Strode

Supervising Scientist: Dr. Nipam Patel, University of Chicago

Thursday, March 4, at 11:40 AM - Room 3

Compartmentalization in Lepidopteran Development: Location and Interaction of the Anterior-Posterior Compartment Boundary in Genus Morpho

Compartments in development are defined as separate cell populations that organize cell destiny and differentiation. Of particular interest is the anterior-posterior compartment. First analyzed in D. melanogaster, it is necessary to expand clonal analysis outside of simple model organisms to further the current extent of developmental knowledge. This study investigated the location of the anterior-posterior compartment in genus Morpho using clonal analysis with gynandromorphism as the coloration mutation for tracing. Specimens were adjusted in size and shape to fit a template before clones were traced. Fiji (Image J2) analysis revealed that in the forewing, the boundary follows the M1 vein before bisecting the discoidal cell, and in the hindwing, the boundary is located between the M1 and M2 veins before similarly bisecting the discoidal region. There is a notable discontinuity in the curve of the boundary line that presents opportunity for further analysis related to evolutionary advantage of discontinuous shape. The results of this analysis resolve the dispute regarding the location of the boundary.

Theodore Van Derne, Beaverhead County High School, Dillon, MT

Teacher: Kelsey Zitzer

Thursday, March 4, at 12:00 PM - Room 3

Improving The Germination Of Cicer Milkvetch By Overcoming The Hard Seed Coat

The purpose of this research project is to improve the germination of cicer milkvetch in order to increase winter forage yields and quality for ranchers. Cicer milkvetch is a nitrogen fixing legume that retains its leaves after freezing. Cicer milkvetch is hard seeded. The hard seed makes cicer difficult to germinate the year planted. My research is focused on improving cicer germination at the time of planting. My treatments are freeze, freeze/thaw, and ice . Freeze, freeze/thaw, and ice showed improvement in the germination rate compared to the control. I recommend producers plant cicer milkvetch seed when the soil temperature has cooled to, and will remain below 50°F, until spring when more of the hard seed will germinate. The literature says the cicer milkvetch seeds increase germination as the seed ages. My seeds, stored at room temperature, have not shown an increase in the control germination between the first, second third and fourth year of my research.

California-Southern Oral Presenter Abstracts

Andrew Gao, Canyon Crest Academy, San Diego, CA

Teacher: Wendy Slijk

Thursday, March 4, at 10:00 AM - Room 4

Integrative Bioinformatics Analysis Identifies Noninvasive miRNA Biomarkers for Lung Cancer

Non-small cell lung cancer (NSCLC) affects millions of people. While treatments have improved, the 5-year survival rate of NSCLC patients is still only 21%. Early diagnosis is essential for increasing survival as treatments have higher effectiveness at earlier stages. Noninvasive blood-based liquid biopsy tests for NSCLC are useful for diagnosis and prognosis. MicroRNA (miRNA) and messenger RNA present in blood can serve as biomarkers for such tests. The present study identified 13 miRNAs that are underexpressed in the tissue and blood of NSCLC patients. Following Kaplan Meier analysis, miR-140-3p, miR-29c-3p, and miR-199a-5a were selected as candidate biomarkers, demonstrating statistically significant prognostic power. A ROC analysis of miR-140-3p expression between NSCLC patients and controls had an area under the curve value of 0.85, indicating discriminating power. Functional enrichment analysis of the miRNA target genes revealed several overrepresented pathways relevant to cancer. Eight target genes were hub genes of the protein-protein interaction network and demonstrated prognostic power. A combination of IL6, SNAI1, and CDK6 achieved a hazard ratio of 1.4 with $p < 0.001$. Since all selected miRNA biomarkers were underexpressed in both tissue and blood, detecting the expression of a biomarker miRNA in blood provides information on its expression in tissue as well. One contribution of the present study is that miR-140-3p has not previously been characterized as a blood-based biomarker for lung cancer. It may be a useful biomarker for prognostic and diagnostic tests and should be further investigated.

Elita Yang, Pacific Ridge School, Carlsbad, CA

Teacher: Liz O'Brien

Mentor: Dr. Robert Sah, University of California San Diego

Thursday, March 4, at 10:20 AM - Room 4

Centrifugal Cleansing Of Osterochondral Cores Is Not Similar For Human And Bovine Calf Samples

Osteochondral allografts are human tissue grafts used to treat cartilage injuries exposing underlying bone, which are generally effective but have caused few osteochondral defects. Bovine calf bone samples show promising similarities, indicating that it may be a suitable substitute for human bone. The objective of this project was to conduct a preliminary experiment and power analysis to determine whether bovine calf bone could be a substitute for human bone in future transplanted osteochondral cores by comparing marrow release of bovine calf and human osteochondral cores through various intensities of centrifugation. Another aim was determining if possible differences in the subchondral bone plate's porosity between the femoral condyle and tibial plateau bone cores would affect marrow release. Cylindrical osteochondral cores were procured from the human femoral condyle, bovine femoral condyle, and bovine tibial plateau. All study groups were μCT scanned before undergoing centrifugation at forces of either 1000xg, 3000xg, or 10,000xg. Each sample was centrifuged for 10s, 30s, 100s, and 300s consecutively, and the mass of the core and released marrow output, was measured between each trial, to see differences in the composition of the osteochondral bone of the 2 species. After 300 seconds, micro CT images were taken of all the study groups, to study the subchondral plate's porosity, the trabecular bones' thickness. Based on the results, bovine calf and human osteochondral cores do not exhibit similar marrow release by centrifugation, indicating that the bovine calf bone may not be a suitable candidate for human bone.

Elanor Jung, Mt. Carmel High School, San Diego, CA

Mentor: Dr. Lee, University of California San Diego

Thursday, March 4, at 10:40 AM - Room 4

A Coarse-Grained Model for Molecular Dynamics Simulation of a Novel Treatment for Klebsiella *pneumoniae* Disrupting the Outer Membrane

Antibiotic resistance is a rapidly growing problem that results from mutations in bacteria after previous exposure to medication. Klebsiella *pneumoniae* exhibits among the highest rates of antibiotic resistance and is currently the main cause of carbapenem resistant infections. Infections caused by this gram-negative bacterium have spread to all parts of the world, yet there are no clinically effective treatments available for many who contract K. *pneumoniae* . Artilysins, proteins each composed of an endolysin and a lipopolysaccharide (LPS) degrading peptide fused together, are a possible alternative to antibiotics for Gram-negative bacterial infections. In an earlier phase of this project, an Artilysin to target K. *pneumoniae* was designed and a homology model was created of its endolysin portion. In the current stage of this project, a computational model of the rest of the Artilysin is created and validated using Ramachandran plot analysis. Molecular dynamics simulation of the model shows that both the potential energy and the RMSD stabilize, indicating that the Artilysin is stable in water at body temperature. Finally, the Artilysin model is used to create an equilibrated coarse-grained system of the Artilysin 15 nanometers above a model of an outer membrane that resembles that of K. *pneumoniae*. The system is shown to be equilibrated properly by verifying that the potential energy has stabilized. This system can be used in the future for steered molecular dynamics and umbrella sampling to extract the free energy profile. This can be used to observe the effects of the LPS-degrading peptide on the outer membrane.

Atulya Mandyam, Westview High School, San Diego, CA

Mentor: Himanshu Mishra, University of California San Diego

Thursday, March 4, at 11:20 AM - Room 4

Novel Biomarker for Identification of Bipolar Disorder Treatment Response

Bipolar disorder (BD) is a mental disorder causing severe fluctuations between two mood sets: a manic and depressive stage. Few patients respond to the current FDA approved treatments for BD, and nonresponders tend to commit suicide. It is confirmed that lithium, an FDA approved drug for BD, somewhat moderates the mood swings associated with BD, affecting the manic stage more than the depressive stage. However, published literature shows that only some BD patients respond to lithium treatment. Therefore, discovering potential biomarkers for lithium responsiveness would assist with optimizing treatment strategies for BD. In order to discover biomarkers, recent studies have developed an accurate biological model for BD by using induced pluripotent stem-cell (iPSC) technology. Therefore, using iPSCs derived from BD patients that were lithium respondent and nonrespondent would assist with discovery of biomarkers for lithium responsiveness. My project used neural progenitor cells (NPCs) differentiated from iPSCs derived from BD patients that were lithium respondent and nonrespondent as well as control subjects. My results demonstrate that NPCs from control subjects and lithium nonresponders showed significant cell death after exposure to the neurotoxic psychostimulant methamphetamine. Notably, NPCs from lithium responders failed to show cell death after methamphetamine exposure. Given that lithium treatment and response is characterized by inhibition of release of the neurotransmitter dopamine, and that methamphetamine produces cell death by increasing the release of dopamine, my study reveals that a lack of cell death by methamphetamine in NPCs from lithium responders could be used as a biomarker for lithium responsiveness.

Katherine Kricorian, Santa Susan High School, Simi Valley, CA

Mentor: Karin Kricorian, MiOra

Thursday, March 4, at 11:40 AM - Room 4

COVID-19 Vaccine Acceptance and Beliefs among African-American and Hispanic Populations

The COVID-19 pandemic has disproportionately impacted communities of color, with Black and Hispanic Americans experiencing high rates of morbidity and mortality. However, research suggests that these groups may have greater reluctance to get the COVID-19 vaccine. Research was conducted to explore this finding and reduce vaccine hesitancy.

An online survey was conducted among a representative population of US residents in January, 2021. A total survey sample of N=1,950 respondents completed the survey, including N=1,248 non-Hispanic Whites, N=235 non-Hispanic Blacks, and N=304 Hispanics of any race.

Blacks and Hispanics were less willing to receive the COVID-19 vaccine than Whites (22.6% for Blacks vs. 43.6% for Whites, $p<0.05$; 43.6% for Whites vs. 41.4% for Hispanics, ns). A significant proportion of Blacks and Hispanics said they would be more willing to be vaccinated against COVID-19 if medical professionals of their race/ethnicity discussed the vaccine in the media (28.1% of Blacks and 23.7% of Hispanics vs. 9.7% of Whites, both comparisons $p<0.05$).

The results suggest opportunities to increase media representation of Hispanic and Black medical professionals discussing the COVID-19 vaccine in order to decrease vaccine hesitancy among Hispanic and Black individuals. Culturally tailored messaging and communication tools could improve COVID-19 vaccine rates within minority communities.

Nitin Sreekumar, Troy High School, Fullerton, CA

Mentor: David Frankhouser, PhD.

Thursday, March 4, at 12:00 PM - Room 4

Variation in Gene Expression Reveals Genes Predictive of Overall Survival in the Triple-Negative Breast Cancer Subtype.

Breast cancer (BC) subtypes are categorized by their molecular subtype as ER+, PR+, HER2; and the deadly triple-negative (TN) which lack these receptors. I tested the following hypotheses 1) whether the variation in the subtypes of BC is due to differential gene regulation and 2) to test the clinical relevance of the variation. I used bioinformatic tools to analyze publicly available BC data from The Cancer Genome Atlas (TCGA). Normalized gene expression and corresponding clinical data of BC patients were downloaded using the TCGA Biolinks R package. Dimensionality reduction methods (PCA analysis and uniform manifold approximation and projection (UMAP)), k-means clustering, and Kaplan-Meier survival plots were used to analyze data. The results revealed one unique UMAP cluster, which comprised of mostly TN samples (labeled as TN-UMAP). Differential gene analysis of the TN-UMAP cluster revealed a bimodal distribution of 10 genes within the TN-UMAP. Survival analysis of the full dataset/within the TN-UMAP group revealed high expression of MHY7, XPB1, and IGFBP5 confers an overall better survival. This study shows that visualizing global gene expression through UMAP may be a valuable method for classifying TN phenotypes. Future studies of gene expression variation between these groups may help to explore TN heterogeneity to design precision therapies.

Stanley Liu, Arcadia High School, Arcadia, CA

Mentor: Suraiya Rasheed, University of Southern California

Thursday, March 4, at 10:00 AM - Room 5

A Microfluidic Device for Blood Plasma Separation and Fluorescence Detection of Biomarkers Using Acoustic Microstreaming

Human blood plasma contains biomarkers that are used for clinical diagnosis of various diseases. However, the blood of some patients is hemolyzed rapidly due to the rupture of cell membranes and releases chemicals and biological molecules that yield false-positive fluorescence detection results due to autofluorescence. The standard method for plasma separation is centrifugation, which is difficult to be integrated with downstream biomarker detection. In this project, an integrated microfluidic device for blood plasma separation and fluorescence detection of biomarkers was developed. Using the principle of bubble-induced acoustic microstreaming, whole blood controls spiked with fluorescently tagged antibodies to HIV-1 p24 protein were tested, yielding ~ 31.8% plasma yield with 99.9% plasma purity within five minutes. The separated plasma was then routed to an integrated micro-mixing chamber and mixed with HIV-1 p24 antigen conjugated beads. The bound p24 antigen-antibody complexes were captured by acoustic microstreaming and detected using a fluorescence microscope. These experiments demonstrated a detection limit of ~17 pg/µL of p24 antibody in the plasma. The microfluidic device successfully separated plasma from the whole blood control using acoustic microstreaming and integrated with acoustic micro-pumping and micro-mixing for enrichment of biomarkers by mixing p24-bound beads with fluorescently tagged antibodies. The beads with antigen-antibody complexes were efficiently captured in a separate compartment for fluorescence detection of biomarkers. Integration of multiple functionalities on this single disposable microfluidic chip can facilitate rapid detection of biomarkers and be used for monitoring patients' specimens in real time. This work was recently published in a peer-reviewed journal.

Jennifer Lew, Palos Verdes Peninsula High School, Rolling Hills Estates, CA

Mentor: Derek Fong, PE, California Public Utilities Commission

Thursday, March 4, at 10:20 AM - Room 5

Aluminum-Calcium Composite Conductors: The Future of America's Power Grid

The current research investigated the potential benefits of replacing Aluminum Conductor Steel Reinforced (ACSR) conductors with Aluminum-Calcium Composite (Al-Ca) conductors. The research hypothesized that Al-Ca would exhibit greater conductivity across all operating frequencies and diameter sizes than ACSR. Further, the research hypothesized that the superior yield strength of Al-Ca would allow for significantly longer conductor span lengths than ACSR, therefore allowing an electric circuit to be supported on fewer towers. As a result, the cost to construct and operate new transmission lines will decrease. These savings can improve the financial viability of renewable energy projects, which would be a boon to the environment. To test the hypothesis, the research created an electromagnetic model of a conductor that is applicable to both homogeneous and non-homogeneous material. The model can determine both the conductor's conductivity and its cross-sectional current density distribution. Experiments were carried out to determine the electrical properties of Al-Ca and ACSR at frequencies of 0 Hz, 50 Hz, and 60 Hz. In all cases, the research found that Al-Ca had 8% to 11.5% greater conductivity than ACSR depending on the conductor diameter. With greater conductivity, circuits made of Al-Ca would experience less power loss from resistive heating. Additionally, the research found that the superior yield strength of Al-Ca allowed for much longer span lengths, resulting in a 35% reduction in the number of necessary support towers when compared to ACSR. As support towers can comprise as much as half of construction costs, using Al-Ca can lead to significant savings.

Nithin Parthasarathy, Northwood High School, Irvine, CA

Mentor: Prof. William Speier, Department of Radiology, UCLA

Thursday, March 4, at 10:40 AM - Room 5

New Brain Computer Interfaces for Neurologically Impaired Subjects Augmented with Gaming Technology to Improve Cognitive functions in ADHD Subjects

Amyotrophic lateral sclerosis (ALS), a progressive neuromuscular degenerative disease, restricts patients' communication capacity a few years after onset resulting in a severe degradation in their quality of life. ALS patients currently have a means to communicate through non-invasive brain-computer interfaces (BCI).

Efficiency and speed of BCI interfaces depends on how well optimized it is. A slow or error prone interface limits the user's ability to communicate. This research first introduces new and novel BCI schemes including probabilistic flashboard scanning using sophisticated language models. Inspired by the field of data compression, Huffman codes are adapted for BCI. The new Huffman scanning was shown to have as much as 50% improvement over conventional schemes. Interestingly, appropriately upgrading current schemes with language models and word completion algorithms approaches the Huffman performance. Finally, the entire implementation is migrated to a Raspberry Pi creating a sub 100$ interface!

The second part of this research pertains to applying the developed BCI techniques to potentially mitigate "distraction/ mind-wander" and ADHD. Novel computer games applying "Neuro-feedback" are developed to help subjects refocus when distracted. Two examples of games with such feedback overlays: a BCI based "*Typewriter*" and a BCI based "*Crossword puzzle*" are developed. With extensive simulations, even using partial feedback was shown to dramatically reduce user distraction. Medium to long distractions were perfectly detected. Even with partial feedback, subjects improved their BCI performance by over 50%. A new and novel direction was set in BCI opening rich topics for future study.

Edmund Sumpena, Westview High School, San Diego, CA

Teacher: Domingo David

Thursday, March 4, at 11:20 AM - Room 5

Digital IoT Geofencing for Anti-Wandering Application: A Machine Learning Approach

Wandering is a serious problem for people with dementia or developmental disabilities. This group includes patients of Alzheimer's disease, autism, Down syndrome, or other neurological disorders involving memory loss. Wandering can lead to serious injury or fatality. Most existing solutions to this problem are reactive, involving searching for patients after they have wandered away. In many cases, they require costly and manual police search and rescue operations. Many wanderers also live in an environment with limited or no anti-wandering infrastructure, making this group more vulnerable.

To mitigate the negative and possibly tragic consequences of wandering, early detection of patients leaving the safe zone is crucial. I developed a geofencing technology that complements existing solutions by adopting a preventative or proactive approach to the problem. The technology uses a flexible, indoor-compatible, and privacy-protecting machine learning algorithm. With this system, a caregiver sets up a predefined digital safe zone using an Internet of Things (IoT) device or phone. In its training phase, the system learns environmental signals and improves its detection over time by adapting to its dynamic surroundings. It analyzes the environmental signal signatures to determine if the patient is within the safe zone using a classification model. The patient is tagged with a Bluetooth low energy beacon, allowing the system to continue monitoring the patient's location even when the patient is not carrying the phone. I experimentally validate the performance of the geofencing technology. The results reflect the algorithm's high adaptivity and accuracy in a wide range of environments.

Aaron Chang, Arcadia High School, Arcadia, CA

Mentor: Dr. Zhihong Hu, Doheny Eye Institute

Thursday, March 4, at 11:40 AM - Room 5

An Automated Approach to Segment Optical Lesions Using Deep Convolutional Neural Networks

A genetic eye disorder known as Stargardt macular degeneration results in the continuous deterioration of vision. The disease stems from the retina, which is the thin layer of tissue at the back of the eye that receives light. The Stargradt disease targets the center of the retina, or the macula. This part of the eye is responsible for sharp central vision (foveal vision) and is crucial in precise tasks such as reading, driving, and recognizing faces. This project attempts to integrate multiple deep convolutional neural networks with the U-Net structure in order to employ different filter and image sizes targeted towards varying lesion sizes to obtain ideal segmentation results. First, the data is cleaned, sorted, and statistically examined. In order to optimize the performance, multiple deep convolutional neural networks used with varying filter sizes (2-7) and image sizes (256 x 256 and 512 x 512 square pixels) were tested and compared. Using the Dice Similarity Coefficient (DSC) statistic, the data can be analyzed in order to choose the most optimal combination of image size and filter size. The experiment demonstrated that the performance of specific machine learning models on medical images can be optimized through accurate choosing of different filter and image sizes.

Junyao Sun, The Webb Schools of California, Claremont, CA

Sponsor: Jun Li, The Webb Schools of California

Thursday, March 4, at 12:00 PM - Room 5

Using ResCNN to Classify ECGs Through Intra and Inter-patient Models

Death from heart disease ranks first in the United States and the world. Electrocardiogram(ECG) is generally used to detect heart rate signals, and then medical professionals distinguish heart arrythmia and diagnose heart disease types. This paper builds 5 models using conventional neural network(CNN) to help identify and classify ECGs in situations without a cardiologist or boost cardiologist's efficiency by using models to classify ECGs. The models are separated between intrapatient and interpatient, both uses randomized ECG recordings from MIT-BIH arrythmia database. Intrapatient model uses point-based preprocessed data that classifies recordings based on characteristic waves, and the same set of ECG recording for training and testing. While interpatient can learn and test with different patient's ECGs, and period-based preprocessed data are used to classify recordings based on period of waves. The highest accuracy of the two intrapatient model reaches 94%, and the highest accuracy of three interpatient model reaches 83% during testing.

Ashwin Sivakumar, Flintridge Preparatory School, La Canada Flintridge, CA

Mentor: Dr. Alexis Mychajliw, Middlebury College, VT

Thursday, March 4, at 10:00 AM - Room 6

Is the Introduced Wild Turkey (*Meleagris gallopavo*) in California an Ecological Substitute for the Extinct California Turkey (*Meleagris californica*)?

Restoring the ecosystem function of faunal species driven to extinction at the end of the Pleistocene is a growing area of interest in conservation biology. One highly controversial method to accomplish this is taxon substitution, or the introduction of non-native species closely related to an extinct or extirpated native species. However, because taxon substitution has never been intentionally implemented on a large scale, our empirical understanding of the technique remains poor. In this study, a possible accidental case of taxon substitution is investigated. Wild turkeys (*Meleagris gallopavo*) are a non-native, potentially invasive species in California, but are closely related to the California turkey (*Meleagris californica*), a native species driven to extinction at the end of the Pleistocene. In order to help determine whether the former is fulfilling the latter's niche, a species distribution model (SDM) for *M. californica* based off fossil occurrences is constructed and projected into present climatic conditions. This model projection is then compared to an SDM for *M. gallopavo* based off current observations. Quantitative indices of model overlap and variable importance strongly suggest that *M. gallopavo* in California today largely occupies geographic and environmental spaces similar to those used by *M. californica*. Future analyses using different techniques will be needed to crystallize the precise ecological effects of *M. gallopavo* in California and confirm or falsify the species' role as an ecological substitute.

Sanjana Gurram, Westview High School, San Diego, CA

Teacher/Mentor: My-Nga Ingram, Westview High School

Thursday, March 4, at 10:20 AM - Room 6

Optimizing Plant Cellulose for Cost-Effective and Environmentally Benign Oil Spill Mitigation

Since 1970 approximately 1.7 billion gallons of oil have bodies of water globally. Currently, there is a lack of fast-acting strategies. As a result, there is often a delay to enact mitigation efforts, which results in exponentially higher costs and more adverse impacts on fragile aquatic ecosystems. I hypothesized that the chemical and physical modification of plant cellulose will result in a crystalline, hydrophobic substance that selectively absorbs hydrocarbons, the major constituents of industrial oil, therefore providing a novel solution to this issue. I subjected cotton cellulose to acid hydrolysis and dried the result to create a light, solid substance that is highly oil absorbent and hydrophobic, as evidenced by the heightened oil absorption and insignificant water absorption. The resulting substance is very efficient, as its hydrophobicity is optimal for selective oil absorption in bodies of water. Also, this substance's derivation is very low in cost, and it can be produced in a large sheet form that can be quickly implemented in the area of a spill. Additionally, it is entirely composed of EPA-approved chemicals, mostly cellulose, which is a very abundant and biologically stable plant material. Because of its environmentally benign chemical composition, low cost, and facile derivation procedure, this substance can be easily mass-produced and implemented as a fast-acting and environmentally benign method of oil spill mitigation.

Kate Wang, Canyon Crest Academy, San Diego, CA

Mentor: Dr. Igor Tsigelny, University of California San Diego

Thursday, March 4, at 10:40 AM - Room 6

Machine Learning and Pharmacophore-Based Drug Discovery for Treatment of Duchenne Muscular Dystrophy

Duchenne Muscular Dystrophy (DMD) is a neuromuscular disease that causes progressive muscular degeneration. A significant percentage of DMD cases are caused by premature termination codon (PTC) mutations in the dystrophin gene, leading to the production of a truncated, non-functional dystrophin polypeptide. PTC-suppressing compounds (PTCSC) have been developed in order to restore protein translation by allowing the incorporation of an amino acid in place of a stop codon. However, limitations exist in terms of efficacy and toxicity. To identify new compounds that have PTC-suppressing ability with the potential for less toxicity and greater efficacy, existing PTCSC were selected and clustered, allowing for the construction of a common pharmacophore model. A machine learning (ML) model was developed for prediction of new PTCSC based on the chemical properties of known compounds. A search of the NCI compounds database was conducted using the pharmacophore-based model, and a search of the DrugBank database was conducted using pharmacophore-based and ML models. Thirty drug compounds were selected as a consensus of pharmacophore-based and ML searches. The results suggest notable correspondence of the pharmacophore-based and ML models in prediction of new PTC-suppressing compounds. The most potent compounds warrant further investigation for pharmacodynamic characterization and experimental validation. Among these compounds, the FDA-approved drugs are likely candidates for repurposing to treat DMD. The methods developed may also be applied to other drug repurposing studies.

Audrey Wong, Arnold O. Beckman High School, Irvine, CA

Teacher: Michael Tran

Mentor: Dr. James Li, Ardent Academy

Thursday, March 4, at 11:20 AM - Room 6

The Effects of Different Modes of Vocalization and Food Consumption on the Level of Droplet Transmission of Bacteria

The enigmatic patterns of COVID-19 transmission that fueled the pandemic has popularized research in respiratory transmission. COVID-19, which travels efficiently through tiny respiratory droplets expelled during expiratory activities (e.g. coughing, singing), has led to the implementation of social distancing and mask donning by public health organizations. However, the many published papers that studied COVID-19 transmission continue to debate the merit of the different public health policies. This particular study focuses on droplet transmission of bacteria expelled through the mouth and captured on petri dishes set at different distances during various activities. The goal is to assess the validity of the CDC physical distancing guideline (3 feet) and how certain activities modify the level of bacterial transmission. By measuring the bacterial count in petri dishes after various activities and food intake, we determined that the mode of vocalization and type of food consumed can have a significant impact on transmission of bacteria. Furthermore, our results are consistent with the CDC three-foot physical distancing guideline for droplet transmission of bacteria. While we recognize that bacteria are larger than viruses and may not transmit as far, our findings on the types of activities that influence transmission may still inform on aspects of COVID-19 transmission.

LeAnn Tai, Arnold O. Beckman High School, Irvine, CA
Mentor: Dr. Joshua Silva, USC School of Pharmacy

Thursday, March 4, at 11:40 AM - Room 6

Dietary Flavonoid Dihydromyricetin (DHM) Ameliorates Alcohol-Induced Intestinal Microbiome Changes Associated with Alcoholic Liver Disease

Chronic alcohol consumption contributes to systemic, multi-organ injury. In addition to multi-organ injury, chronic alcohol abuse has been found to shift microbiome populations in the small intestines. Dihydromyricetin (DHM), a natural flavonoid extracted from *Ampelopsis grossedentata*, significantly reduces alcoholic liver disease (ALD) outcomes following chronic alcohol (ethanol/EtOH) abuse. However, many questions remain about DHM's multi-targeted therapeutic responses for the prevention of ALD. We hypothesized that DHM would conserve beneficial bacterial population changes after chronic ethanol consumption. This project investigated the efficacy of DHM in modifying gut microbiota populations in comparison to ethanol-fed mice. Collaborators at USC School of Pharmacy conducted a forced drinking alcohol study using C57BL/6J mice alongside daily DHM administration (5 and 10 mg/kg; intraperitoneal (i.p.)). Following ethanol studies, mice were euthanized, and 16S rRNA sequencing was performed on intestinal tissues. Statistical analysis using GraphPad PRISM 8 was conducted to analyze the effect of DHM on microbiome populations and diversity using a 2-way ANOVA followed by a Bonferroni's test. We found that ethanol modified bacterial phyla, family, and diversity in the gut, resulting in increased populations associated with inflammation. DHM-treated mice showed similar gut microbiota distribution to the control, suggesting a reversal of the ethanol-mediated changes in microbiome shifts. Therefore, DHM modified the microbiome populations and diversity, meanwhile preventing ALD in mice models, suggesting that DHM can be utilized for multiple targets that reduce the onset of ALD. These findings collectively indicate that DHM can provide protection against ALD and other potential disorders resulting from gut dysbiosis.

Elisha Johnston, Joseph Lister High School for Biomedical Sciences and Technology, Rancho Palos Verdes, CA

Sponsor: Dr. Michael Johnston, Joseph Lister High School for Biomedical Sciences and Technology

Thursday, March 4, at 12:00 PM - Room 6

Hypertonic Dextrose Stimulates Chondrogenic Cells to Deposit Collagen and Proliferate

Hypertonic dextrose (HD) injections (prolotherapy) for osteoarthritis are reported to reduce pain and improve joint function. While the mechanism is unknown, cartilage regeneration is hypothesized. The objective of this *in vitro* study is to identify an HD concentration that stimulates chondrogenic cells to increase metabolic activity and then investigate whether this concentration induces chondrogenic cells to deposit collagen and increase proliferation.

To study HD concentration and metabolic activity, ATDC5 chondrogenic cells were cultured in normoglycemic DMEM/ F12 medium, treated with concentrations of HD (4-400 mM), and assayed with the PrestoBlue metabolic activity assay. At the HD concentration identified to produce the highest metabolic activity, advanced light microscopy was used to conduct live imaging of collagen deposition through second harmonic generation microscopy (SHG) and proliferation via two-photon excitation microscopy. Proliferation was additionally assessed with hemocytometer counts.

A concentration of 250 mM HD significantly increased metabolic activity of chondrogenic cells compared to those in the control ($p<0.05$). This concentration led to an increase in collagen deposition compared to that observed in control ($p<0.05$). This HD concentration also led to increases in proliferation of ATDC5 cells relative to that of control ($p<0.001$).

A 250 mM HD solution appears to be associated with increased metabolic activity of chondrocytes, increased collagen deposition, and increased chondrocyte proliferation. These results support clinical prolotherapy research suggesting that intra-articular HD joint injections reduce knee pain and improve function. Further study of HD and cellular processes is warranted.

Intermountain Poster Presenters

Nathan Bruns, Hellgate High School, Missoula, MT
Teacher: Willow Affleck
Testing of Turbulent Air Conditions of Water Deposition for Vacuum Design

Marion Jones, Hellgate High School, Missoula, MT
Teacher: Willow Affleck
Determining the exposure of hazardous air pollutants for wildland firefighters using lab and field observations.

Harveanna Lee, Baker High School, Baker, MT
Teacher: Linda Rost
Exploration of US Cancer Data

California-Southern Poster Presenters

Ayush Agrawal, Canyon Crest Academy, San Diego, CA
Teacher: Jessica Adams
Estimating Environmental Arsenic Contamination Using Hyperspectral Remote Sensing and Deep Learning

Haaris Alam, Portola High School, Irvine, CA
Teacher: Angie Olivares
BLASTing Flu Viruses: Determining the Evolutionary Rate of the Influenza Virus

Sabreen Alam, Portola High School, Irvine, CA
Mentor: Dr. Guillaume Roussel, Department of Physiology and Biophysics, UCI Medical School
Unravelling the Structure of SecA: Analysis of WT- vs. Y134S-SecA

Ka Po Chung, The Webb Schools of California, Claremont, CA
Sponsor: Chun Kit Chung, The Webb Schools
SVM with Histogram Tricks Defeats Deep Learning Model in Heart Sound Classification with Small

Alexander Huang, Arnold O. Beckman High School, Arcadia, CA
Mentor: Wenchao Cao, University of Pennsylvania
Comparing Different Convolutional Neural Network Training Strategies in Low-Level CT Image-Processing Tasks

Yafei Jiang, The Webb Schools of California, Claremont, CA
Sponsor: Yanhua Jiang, The Webb Schools
Research on an arm rehabilitation system based on artificial intelligence

Ophelia Ke, Cate School, Carpinteria, CA
Mentor: Dr. Pingzhang Wang of Peking University and Ivy Mind Analytics
Integrated Analysis of Single Nucleotide Polymorphism (SNP) Sites and Mutations in the Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) Gene

Chloe Kim, Crean Lutheran High School, Irvine, CA
Mentor: Amy Min, Blue Vortex
Reducing Impact of Trauma from Paradigm Shifts

Siddarth Kolla, Irvine High School, Irvine, CA
Mentor: Professor J David Powell, Stanford University
The Implications of the Wide Area Augmentation System on Consumer Devices

Andrei Mandelshtam, University High School, Irvine, CA
Mentor: Daniil Kalinov, Massachusetts Institute of Technology
The Structure of the Positive Monoid of Integer-Valued Polynomials Evaluated at an Algebraic Number

Tae Eun Park, Arnold O. Beckman High School, Arcadia, CA
Mentor, Dr. Peter Chang, Chapman University
Combating Acetaminophen Toxicity Through Sulfur-Containing Compounds in Garlic

Amrutha Srivatsav, Palos Verdes Peninsula High School, Rolling Hills Estates, CA
High Throughput In Silico Identification of Alpha-Synuclein Aggregation Inhibitors in Parkinson's Disease

Kyle Tianshi, The Cambridge School, San Diego, CA
Teacher: Melissa Mayne
Raspberry Pi Powered Microscopic Particle Detector Using Laser Microscopy And Image Processing

Chris Um, Torrey Pines High School, San Diego, CA
Mentor: David Meyer, University of California San Diego
Discrete Time Multiparticle Grover Search

Amy Wang, Westview High School, San Diego, CA
Gender and Racial Bias in Artificial Intelligence-based recruiting systems

Rachel Wen, San Marino High School, San Marino, CA
Mentor: Derek Fong, PE, California Public Utilities Commission
Wake Technology: How to Generate Electricity Using Two Cylinders

Ethan Wong, Arcadia High School, Arcadia, CA
Proverse Yaw Characteristics of a Powered Blended Wing Body Aircraft of a Novel Design and Manufacture

Ellen Xu, Del Norte High School, San Diego, CA
Mentor, Dr. Tremoulet, Kawasaki Disease Research Center
Developing a Robust Deep Learning Tool for Kawasaki Disease Early Diagnosis

Audrey Zeng, Del Notre High School, San Diego, CA
Mentors: Grace Hu and John Wang
The effect of particulate matter concentrations on COVID-19 infection rates in the United States

Michael Zeng, The Bishop's School, La Jolla, CA
Teacher: Ben Heldt
VAMP: A Versatile Autonomous Mobile Robotic Platform for Agility-Centered and Human-Servicing Applications

Timothy Zhang, Cate School, Carpinteria, CA
Sponsor: Qiang Zhang
Detection and Diagnosis of COVID-19 Using Remote Photoplethysmography and Deep Learning

Intermountain Participating Schools

Academy for Math, Engineering & Science, Murray, UT
Baker High School, Baker, MT
Beaverhead County High School, Dillon, MT
Central Valley High School, Liberty Lake, WA
Ed W Clark High School, Las Vegas, NV
Fairview High School, Boulder, CO
Hellgate High School, Missoula, MT
North Toole County High School, Sunburst, MT
Rocky Canyon High School, Littleton, CO
Sentinel High School, Missoula, MT
West High School, Salt Lake City, UT

California-Southern Participating Schools

Arcadia High School, Arcadia, CA

Arnold O. Beckman High School, Irvine, CA

Canyon Crest Academy, San Diego, CA

Cate School, Carpinteria, CA

Crean Lutheran High School, Irvine, CA

Del Notre High School, San Diego, CA

Flintridge Preparatory School, La Canada Flintridge, CA

Irvine High School, Irvine, CA

Joseph Lister High School for Biomedical Sciences and Technology, Rancho Palos Verdes, CA

Mt. Carmel High School, San Diego, CA

Northwood High School, Irvine, CA

Pacific Ridge School, San Diego, CA

Palos Verdes Peninsula High School, Rolling Hills Estates, CA

Portola High School, Irvine, CA

San Marino High School, San Marino, CA

Santa Susana High School, Simi Valley, CA

The Bishop's School, La Jolla, CA

The Cambridge School, San Diego, CA

The Webb Schools of California, Claremont, CA

Torrey Pines High School, San Diego, CA

Troy High School, Fullerton, CA

University High School, Irvine, CA

Westview High School, San Diego, CA

Teachers

Amanda Karcz
Rock Canyon High School, Highlands Ranch, CO

Amanda Nix
North Toole County High School, Sunburst, MT

Crystal King
West High School, Salt Lake City, UT

Enrique Arce-Larreta
West High School, Salt Lake City, UT

Kelly Nelson
Sentinel High School, Missoula, MT

Kelsey Zitzer
Beaverhead County High School, Dillon, MT

Linda Rost
Baker High School, Baker, MT

Maxine Morris
Fairview High School, Boulder, CO

Paul Strode
Fairview High School, Boulder, CO

Tanya LaPier
Central Valley High School, Liberty Lake, WA

Willow Affleck
Hellgate High School, Missoula, MT

Special Acknowledgments

The 2021 Intermountain Junior Science and Humanities Symposium would not be possible without the generous help and support of the student's families, teachers, mentors, sponsors, and school administrators,

A big thank you to the US Army, Butte Recruiting Station, for sponsoring the awards for the poster session.

We could not have made this event happen without our room monitors: Michelle Christianson, Brandon McLean, Nico Fleming, Leigha Acebedo-Bradford, Gretchen Druliner and Chris Doyle. A hearty thank you to you all.

Administrative Oversight and Planning

Alexis Mundis, Project Manager, JSHS

Steve Gammon, Provost and Interm Vice Chancellor Research & Graduate Studies

Bernie Phelps, IJSHS Co-Director, Institute for Educational Opportunities

Tom Reget, IJSHS Co-Director, Institute for Educational Opportunities

Tammy Gordon, IJSHS Logistics Chair, Institute for Educational Opportunities

MONTANA LEARNING CENTER

at Canyon Ferry Lake

ILLUMINATING

YOUNG

MINDS

Montana Tech
1300 West Park Street, Butte, MT 59701
mtech.edu

Institute for Educational Opportunities at Montana Tech
institute.mtech.edu

Intermountain Junior Science and Humanities Symposium
institute.mtech.edu/symposium

Facebook
facebook.com/MontanaTechScienceandEngineeringFair/

National Junior Science and Humanities Symposium
jshs.org