86th ANNUAL

MINNESOTA STATE
SCIENCE & ENGINEERING FAIR

STEP INTO THE FUTURE
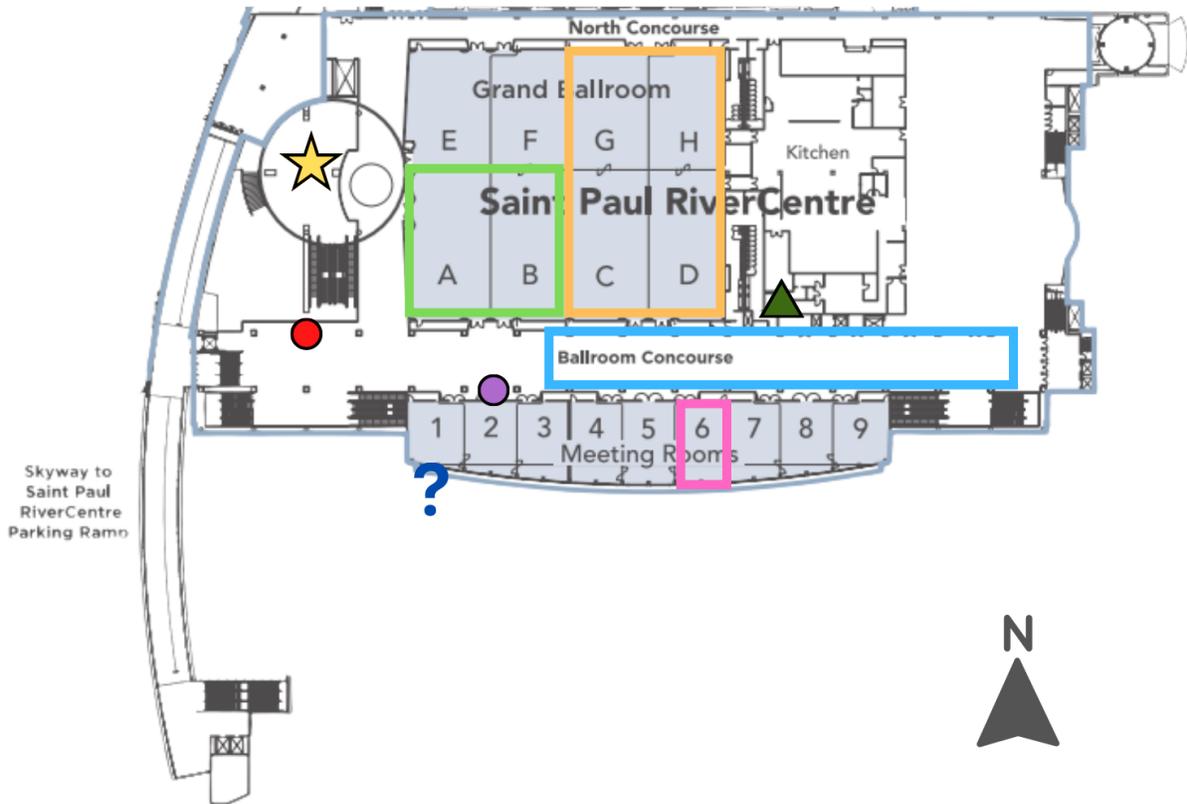
MARCH 24th, 2023 @ THE SAINT PAUL RIVERCENTRE

PRESENTED BY THE

1873 - 2023
150 YEARS

MINNESOTA ACADEMY OF SCIENCE

Map of St. Paul RiverCentre

All activities will occur on the RiverCentre's second floor

Judge Headquarters & Check-in / Evening Student Social
Grand Ballrooms A & B

Project Presentation Hall
Grand Ballrooms C, D, G & H

Exhibitor Showcase
East end of Ballroom Concourse

Multifaith/Quiet space
Meeting Room 6

? Help Desk
Meeting Room 1

ExploraDome

Student Check-in
West end of Ballroom Concourse

Chaperone Check-in
Outside of Meeting Room 2

Bathrooms

Program cover design by Vunley Long

Table of Contents

We need your feedback!

You may have noticed a lot of changes to the State Science Fair this year. We want to hear what you think of this year's event—and what our priorities for next year should be! Your input also helps us evaluate this program and let our supporters know how important science fair participation is to you. ***Please participate in the interactive feedback options available in the exhibit hall this year—and complete your online survey.*** Scan a QR code below or visit mnmas.org/2023-state-science-fair-details to access online surveys.

Student Survey   **Teacher/Parent Survey**   **Judge/Volunteer Survey**

Event Schedule

86th Annual Minnesota State Science & Engineering Fair (MSSEF)

Wednesday, March 22

7:30 - 8:00 pm | Virtual Welcome Ceremony with Keynote Address by Antavia Paredes-Beaulieu.

The Medicine Wheel as a Scientific Paradigm: STEM Education and Discovery from an Indigenous Perspective.

Check zFairs or mnmas.org/2023-state-science-fair-details for event link and live-streaming information.

Friday, March 24

7:00 am - 9:00 am: Student Check In & Project Set Up Time | *Ballrooms C, D, G & H*

9:15 am - 9:30 am: In-Person Kick Off & Morning Announcements | *Ballrooms C, D, G & H*

9:30 am - 10:30 am: Student Peer Networking | *Ballrooms C, D, G & H*

Time for students to view each other's projects and network in the project hall. Students with EVEN-numbered projects remain at their boards for 30 minutes while ODD-numbered projects walk around and then vice versa.

9:00 am - 10:00 am: Judge Check In | *Ballrooms A & B*

10:00 am - 10:30 am: **Judge Welcome & Announcements** | *Ballrooms A & B*

11:00 am - 2:00 pm: Lunch on your own | *St. Paul RiverCentre*

Deli cart available in the Ballroom Concourse. Headwaters Cafe located on the first floor of the RiverCentre.

10:00 am - 5:30 pm: Exhibitor Showcase & Exploradome | *Ballroom Concourse*

MAS encourages attendees to take part in the STEM enrichment options available throughout the day, including the Exhibitor Showcase, the Bell Museum traveling planetarium (Exploradome), the photo booth, and the Science Museum of Minnesota.

10:30 am - 1:00 pm: Odd Number Projects Judging | *Ballrooms C, D, G & H*

Project Presentation Hall remains closed for judging all ODD numbered projects. Student and judge access only.

1:30 pm - 4:00 pm: Even Number Projects Judging | *Ballrooms C, D, G & H*

Project Presentation Hall remains closed for judging all EVEN numbered projects. Student and judge access only.

4:30 pm - 5:30 pm: Public Viewing | *Ballrooms C, D, G & H*

All are welcome in the Project Presentation Hall to explore student projects in person.

5:30 pm - 6:00 pm: Project Disassembly | *Ballrooms C, D, G & H*

Students remove all project materials from the Project Presentation Hall and any wrap-up announcements will be made.

6:00 - 7:30 pm: Student Social Hosted by Morgan Mohler | *Ballrooms A & B*

Includes fun trivia and prizes! Pizza, salad, and chicken tenders served. Pre-registration required to form trivia teams.

Sunday, March 26

2:00 pm | Virtual Awards Ceremony emceed by Morgan Mohler

Check zFairs or mnmas.org/2023-state-science-fair-details for event link and live-streaming information.

zFairs Virtual Project Showcase
Key: MAS Public-2023

SCAN ME

2023 Keynote Speaker

Antavia Paredes-Beaulieu will address participants in a keynote speech titled, *The Medicine Wheel as a Scientific Paradigm: STEM Education and Discovery from an Indigenous Perspective,* at the Minnesota State Science and Engineering Fair Welcome Ceremony on March 22, 2023, at 7:30 pm.

Ms. Paredes-Beaulieu descends from the Mille Lacs Band of Ojibwe and grew up in South Minneapolis. She attended South High School and earned her Associates Degree at Minneapolis College as a *Power of You* scholar. She continued her studies in chemistry at Metro State University as an *Increasing Diversity in Environmental Careers Fellow*, as well as abroad in Cuernavaca, Mexico as a *Gilman International Scholar*. Antavia has been a PhD student of chemistry at the University of Minnesota where she helped teach undergraduate analytical chemistry labs and spent time researching and synthesizing porous nanoparticles for PFAS phytoremediation as a *3M Science and Technology Fellow*. She is currently the Green Tech Instructor at MIGIZI, a Minneapolis organization with a mission to provide a strong circle of support nurturing the educational, social, economic, and cultural development of American Indian youth.

2023 Awards Ceremony Emcee

Morgan Mohler, the 2023 Minnesota State Science & Engineering Fair Award Ceremony Emcee, is a graduate from Viterbo University with a Bachelor of Science in Biochemistry. She currently works as an Associate Clinical Research Coordinator in the Center for Multiple Sclerosis and Autoimmune Neurology (CMSAN) at Mayo Clinic in Rochester. In this work, she coordinates tracking research studies from start to finish while "offering countless patients a glimmer of hope moving forward in life navigating their diagnoses."

As Miss St. Croix Valley, her mission is to teach others how to achieve their dreams and goals no matter what their circumstances are. In Morgan's free time, she enjoys playing games, coaching softball, reading, and playing sand volleyball.

Come meet Morgan at the Student Social where she will lead the trivia and fun!

Minnesota Academy of Science

Welcome from the Minnesota Academy of Science Board President

On behalf of the Minnesota Academy of Science Board of Directors, I welcome you to the 2023 Minnesota State Science and Engineering Fair!

By earning your place at the State Science Fair from your school and regional fairs you take your place as one of the top student scientists in Minnesota. No matter what you become in life or what you do, you are now part of the Minnesota Academy of Science family. Whether you win an award or not, being at the State Science Fair and the journey you took to get here are the true awards. You are all winners—you all earned your spot in this competition and you are phenomenal.

Thank you to the parents, teachers, advisors, and volunteers for all you have done. The Minnesota State Science Fair wouldn't be able to happen without your support. Thank you for gracefully handling the piles of paperwork, late hours, driving students, and experiments taking over your lives.

Congratulations to each of the student scientists who earned the right to compete at this event. We are proud of all of you. We look forward to seeing what each of you will accomplish.

Sincerely,

Dr. Cindy Ward-Thompson
President, Minnesota Academy of Science

Minnesota Academy of Science Board of Directors

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Minnesota Academy of Science

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MSSEF Event Sponsors

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MAS Contributing Sponsors

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General Dynamics Mission Systems

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About the Minnesota Academy of Science

The Minnesota Academy of Science (MAS) is a statewide 501(c)(3) nonprofit organization. We serve K-12 and undergraduate students, educators, and schools as well as STEM graduates and professionals seeking to network and volunteer. Our programs and operations are funded through the state of Minnesota, corporate sponsorships, foundation grants, registration fees, and individual donations.

OUR MISSION

We are not just focused on science! MAS remains committed to advancing science, technology, engineering, and math (STEM) in Minnesota by connecting Minnesotans of all backgrounds with resources and opportunities to engage in STEM learning, research, and communication—and to recognize excellence in these areas.

OUR BELIEFS & CORE VALUES

We believe STEM literacy benefits our entire community and that all students deserve access to meaningful and fulfilling STEM activities throughout their education. We strive to conduct ourselves in keeping with our core values of innovation, equity, integrity, and community.

OUR PROGRAMS & RESOURCES

We create opportunities for access and engagement through our five core programs—*State Science Bowls, State Science Fair, Junior Academy, Winchell Symposium, and FORSE Mentoring & Enrichment*—and through our online resources and communications. Visit **mnmas.org** to learn more!

OUR HISTORY

This year—2023—marks our *150th anniversary!* Visit mnmas.org/history to explore our new interactive timeline and digital archives and learn more about our history of promoting science in Minnesota.

1873 - 2023
150 YEARS

OUR MEMBERS

With our new membership structure, MAS is building a stronger community of STEM enthusiasts. MAS is giving 2023 memberships to *all* donors as well as *all* students, educators, and volunteers participating in our programs and events. *Yes, this means YOU!* MAS invites you to stay connected to MAS throughout the year and attend our **virtual Annual Meeting in May**.

f @MNAcademyofScience @MinnesotaAcademyofScience @MNAcadSci @MNAcademyofScience in @Minnesota Academy of Science

Connect - Learn - Register - Donate - Volunteer

mnmas.org

Exhibits & Activities

The Minnesota Academy of Science thanks the following organizational partners—dedicated supporters of the STEM education and Minnesota State Science & Engineering Fair!

Exhibitor Showcase

The Exhibitor Showcase is located on the east end of the Ballroom Concourse. Swing by to participate in hands-on STEM activities, meet Minnesota STEM professionals, provide Science Fair feedback, pick up free tickets to the Science Museum for today (while supplies last), and much more!

American Society of Plumbing Engineers - MN Chapter
10:00 am - 5:00 pm

The Minnesota Chapter of the American Society of Plumbing Engineers is a local networking community of Plumbing Engineers. We find ways to continue learning and give back to our industry and community.

The ASPE booth will feature a working display showing engineering at work in a plumbing application along with computer software demonstrating how we design a plumbing system.

Beckman Coulter
10:00 am - 5:00 pm

A global leader in advanced diagnostics, Beckman Coulter has challenged convention to elevate the diagnostic laboratory's role in improving patient health for more than 80 years. Our mission is to Relentlessly Reimagine Healthcare, One Diagnosis at a Time – and we do this by applying the power of science, technology and the passion and creativity of our teams. Our diagnostic solutions are used in complex clinical testing, and are found in hospitals, reference laboratories and physician office settings around the globe.

At the Beckman Coulter table, talk with professionals and get to know what they do and choose a branded giveaway. Dr. Arnold Beckman created the pH meter. Come do a simple pH experiment. Learn the basics of acids and bases by putting pH strips into different liquids. The scope of Dr. Beckman's invention reaches many industries, not just healthcare . . . from water treatment, to food science, to healthcare, etc.. So, accurate measurements of pH are important!

Bell Museum
10:00 am - 5:30 pm

The Bell Museum, Minnesota's official natural history museum and planetarium, is located on the University of Minnesota Twin Cities campus in Saint Paul. Take amazing journeys from the far reaches of the cosmos to deep inside the human brain in the Whitney and Elizabeth MacMillan Planetarium. Explore the origins of the universe, the diversity of life on Earth, and take a walk through the state of Minnesota, featuring our world famous wildlife dioramas. Engage all your senses in our Touch & See Lab with 10,000-year-old fossils, living plants and animals, and more. Wander outside on our green roof and observation deck, and explore the learning landscape of native plants, geology gardens, and solar station.

The Bell Museum table will have a selection of museum specimens to learn about, in addition to some Bell Museum freebies and information about our programming.

Data Classroom
10:00 am - 5:00 pm

DataClassroom is an educational technology company founded by public school teachers and scientists to support the teaching of data skills in grades 6-12 and at the college level.

Got a question about working with science fair data? DataClassroom wants to help! Stop by the booth to talk with University of Minnesota's Dr. Tim Mitchell of the College of Biological Sciences about how to best work with data for science fair projects. Dr. Mitchell studies the ecology, evolution, behavior and physiology of plants and animals and how they respond to our changing world. Currently he explores the impact of human activities on butterfly populations near roadways around the state of Minnesota. Dr. Mitchell will be happy to answer your questions about your data, data in general, and show you how the DataClassroom web-application can help. Live demos of the DataClassroom web-app will be conducted at the booth.

Market Science
10:30 am - 2:30 pm

Market Science is a team of scientists from the University of Minnesota, and around the Twin Cities, sharing science through hands-on learning activities for kids, delving into scientific questions for market goers, and starting conversations between researchers and their communities.

Participants will learn about plant adaptations to their environment and then try to guess which plant belongs in which ecosystem based on their various structures and characteristics. Participants can then design and create their own fictional plant to survive in a particular biome using materials provided.

Minnesota Academy of Science
10:00 am- 5:30 pm

The Minnesota Academy of Science (MAS) is a statewide nonprofit and the proud organizer of the Minnesota State Science and Engineering Fair. Each year, our STEM programs and resources impact thousands of Minnesotans, including students, educators, families, and STEM professionals.

Stop by our booth to chat with MAS representatives, make a Science Fair button, take a picture in our photobooth, learn about the Junior Academy, and give us your feedback about Science Fair!

Minnesota Valley National Wildlife Refuge
10:00 am- noon

Visit Minnesota Valley National Wildlife Refuge any time of the year to enjoy natural habitats of Minnesota wildlife. Prairies, wetlands, bottomland forests and other woodlands provide a peek at wildlife on the edge of the Twin Cities urban community.

Come by the Minnesota Valley National Wildlife Refuge table for a pollinator seed ball activity and a bird banding tool demonstration.

Seagate Technology
10:30 am - 5:30 pm

Seagate Technology crafts the datasphere, helping to maximize humanity's potential by innovating world-class, precision-engineered data storage and management solutions. A global technology leader for more than 40 years, the company has shipped over three billion terabytes of data capacity.

Come by the Seagate Technology table for an Introduction to hard drives and hard drive technology. Demos include wafer to slider exploded view, deconstructed hard drive, HAMR hard drive with viewing window, live Mach2 drive, and old vs new drive. A hands-on demo entitled bit stop watch will be available for students to learn about binary code and the speed of hard drive storage.

Science Museum of Minnesota
10:00 am- 5:00 pm

Stop by the Science Museum's booth to learn more about the museum and pick up a free wristband to visit the museum (across from the RiverCentre). Offer good for today only (Friday, March 24, 2023). *A limited number of wristbands are available.*

The Works Museum
10:00 am- 1:00 pm

The Works Museum is a non-profit with the mission to inspire the next generation of innovators, engineers, and creative problem solvers. Through our interactive exhibits, hands-on workshops, and inspiring special events, we ignite interest in STEM learning for children in grades K-6.

Visit The Works Museum booth to investigate reflection, patterns, and symmetry as you build a colorful kaleidoscope to take home.

University of Minnesota Masonic Cancer Center & Institute for Engineering and Medicine
10:30 am - 5:00 pm

The University of Minnesota Masonic Cancer Center (MCC) and the Institute for Engineering and Medicine (IEM) often collaborate on opportunities for students.

Come by the MCC and IEM table for career information, real human tissues for analysis, and plenty of giveaways.

ExploraDome

Join the Bell Museum for an immersive and unique show in their traveling planetarium, the ExploraDome! The ExploraDome travels throughout the state of Minnesota visiting classes, school fairs, and community events. You can find more information about how to book the ExploraDome for your school or event on the Bell Museum website (www.bellmuseum.umn.edu/exploradome).

ExploraDome shows available today:

Zoom | The audience decides where to go in this program, from Earth to the edge of the observable universe and anywhere in between. The journey will help students appreciate the scale of the Solar System, galaxy, and universe, the vast distance separating these objects, and how these objects change over time.

Mars: The Ultimate Voyage | On a 2-year journey across space, how will astronauts stay motivated? How will they stay healthy? What challenges will they face along the way? Our newest Bell original production, *Mars: The Ultimate Voyage*, dives into these questions while showing what the first journey to Mars might look like—and how creativity, communication, and collaboration come together to ensure safe, deep space travel.

Science Museum of Minnesota

Stop by the Science Museum's booth to pick up a free wristband to visit the museum today, located directly south across Kellogg Blvd from the RiverCentre! Each group of 10 or fewer minors must include an adult chaperone. **Valid today only (March 24) from 10 am - 8 pm. Good while supplies last.**

The Science Museum of Minnesota is dedicated to collaborating with our community to create a world where everyone has the power to use science to make lives better. Between our interactive exhibits, collection with over two million objects, and continuous scientific research, we believe there's always something new to discover.

MSSEF Photo booth

Snap a pic at the 2023 Minnesota State Science and Engineering Fair photo booth! Share your photos with us by either emailing them to info@mnmas.org or using the hashtag #MSSEF on social media.

(f) @MNAcademyofScience (O) @MinnesotaAcademyofScience (y) @MNAcadSci (d) @MNAcademyofScience (in) @Minnesota Academy of Science

The photo booth's backdrop is a piece entitled "Fig eater" by local artist Rachel Collier. Rachel Collier is an interdisciplinary artist whose work focuses on the release of internal visual language held in the emotional body resulting in imagery that is radically uplifting, riding the line between the mysterious and the familiar. "Fig eater" is tufted hand dyed wool, acrylic, and nylon on canvas. Find Rachel's contact information and more of her work at rachelcollier.com.

Awards

About the Minnesota State Science & Engineering Fair

The mission of the Minnesota State Science & Engineering Fair is to encourage Minnesota students to become informed and engaged citizens who are well versed in the practices and ideas of science and to support them as they pursue pathways in science, technology, engineering, and math (STEM). MSSEF introduces students to new concepts, inspires them to research topics of personal interest, and provides opportunities for networking with professional scientists and their peers. The Minnesota Academy of Science is proud to provide the MSSEF.

An annual competition since 1938, MSSEF showcases the research of Minnesota's most curious, persistent, and engaged STEM students. Each year, hundreds of middle school and high school students qualify to advance from Regional Science Fairs across Minnesota to present their research at the state level. Students compete for prizes and awards worth more than $15,000, sponsored by dozens of corporations, nonprofits, government agencies, and professional scientific societies. Learn more in the pages that follow.

Again this year, award winners will be announced in a live, virtual presentation and all awards will be posted immediately following the virtual ceremony on the MAS website: mnmas.org.

Minnesota Academy of Science Grand Awards

The Grand Awards recognize excellence in scientific research at the middle school and high school level. The top 5% of projects presented at MSSEF receive the Gold Award, the next 10% of projects receive the Silver Award, and the next 15% of projects receive the Bronze Award. Projects are ranked according to judge scores and the competitiveness of the category in which students present.

Minnesota Junior Academy of Science

Top-scoring high school presenters from the Minnesota State Science & Engineering Fair will be invited to join the Minnesota Junior Academy of Science (MJAS), an honorary society and leadership group of high school and college students from Minnesota who have demonstrated excellence in scientific research. As members of the MJAS, students will have opportunities to network and become leaders and ambassadors for STEM and STEM education at the local, state, and national levels. All inducted MJAS members have the opportunity to attend the American Junior Academy of Science (AJAS) Annual Meeting and become AJAS Lifetime Fellows. Learn more at mnmas.org/junior-academy or stop by the MAS booth for more information.

Regeneron International Science and Engineering Fair Award

The Regeneron International Science and Engineering Fair (ISEF) Award recognizes up to four of the top high school projects. Winners receive an expense-paid trip to compete in ISEF, the world's largest pre-college STEM competition. This year, ISEF, will take place May 13-19 in Dallas, Texas, at the Kay Bailey Hutchinson Convention Center. Regeneron ISEF 2023 will be a fully in-person event complimented by a virtual site where finalists will share their projects online. Learn more: societyforscience.org/isef/

Seagate Awards

MAS thanks Seagate Technology, Premier Sponsor of the State Science & Engineering Fair, for their continued support of STEM education in Minnesota. Seagate remains the global leader in data storage solutions, developing amazing products that enable people and businesses around the world to create, share, and preserve their most critical memories and business data.

Seagate Excellence in Science Mentoring Award

The Seagate Excellence in Science Mentoring Award recognizes outstanding science teachers from around the state who find creative ways to nurture students' interest in scientific research and discovery. The award acknowledges teachers who go above and beyond the classroom to promote STEM education in their schools and who encourage students to engage in hands-on projects and experiences outside the classroom.

Seagate Technology gives two mentoring awards – one for a teacher with one to 10 years of experience and another for teachers with more than 10 years of experience. Award recipients receive a $1,000 award and a Seagate portable hard drive. The teachers' schools or science programs also receive a $1,000 award.

Seagate Rising Star Award

The Seagate Rising Star Award recognizes two emerging student scientists whose projects not only exemplify excellence in their category but also demonstrate high degrees of difficulty, thoroughness, complexity, creativity, innovation, and effective communication. One high school student and one middle school student each receive a $2,000 award, a trophy, and a Seagate portable hard drive.

Seagate Emerging Scientist Award

The Seagate Emerging Scientist Award recognizes excellent scientific research conducted by students competing for the first time. The top 10% of first-year students receive trophies.

Special Awards

The Minnesota Academy of Science thanks the following organizations for sponsoring awards as part of the Minnesota State Science & Engineering Fair. Awards are listed alphabetically by organization. For award details and prize information, visit mnmas.org/state-science-fair-awards. All awards and award winners will be showcased at mnmas.org/2023-ssef-awards immediately following the March 26 virtual award ceremony.

3M | Consumer Innovation Award & Science Applied to Life Award
Abbott – Minnesota Women in STEM Chapter | The Female in STEM Excellence Award
American Chemical Society – Minnesota Section | Outstanding Experimental Project in Chemistry
American Fisheries Society – Minnesota Chapter | Aquatic Sciences Excellence Award
American Heart Association | The American Heart Association Community Impact Award
American Institute of Professional Geologists | Geology, Earth Science, Environmental Science, and Sustainability Excellence Award
American Psychological Association | Outstanding Research in Psychological Science
American Society of Plumbing Engineers (ASPE) | Best Display of Mechanical Engineering
Association for Women Geoscientists | Student Award for Geoscience Excellence
Beckman Coulter | Excellence in Science Awards & Excellence in Engineering Awards
Bolton & Menk | Bolton & Menk Young Inventor Award
Broadcom Foundation | Coding with Commitment Award
DiaSorin | Merit Award & Relativity Award
Ecolab | Ecolab Food Safety Award & Ecolab Water Vision Award
Emerson Women's Impact Network | Female in STEM Excellence Award
Good Chemistry | Good Chemistry Prize for Creativity
Institute of Food Technologists – Minnesota Section | Institute of Food Technologists Food Science Award
Land O' Lakes | Land O'Lakes Award for Food Innovation
Lemelson Foundation | Lemelson Early Inventor Prize
LHB | LHB Outstanding Engineering or Building Science Award & LHB Outstanding Sustainability Award
Minnesota Environmental Health Association | Minnesota Environmental Health Association Award for Excellence in Environmental Health Science
Mortenson Environmental | Mortenson Environmental Excellence Award
National Aeronautics and Space Administration (NASA) | Earth Systems Science Award
National Oceanic and Atmospheric Administration (NOAA) | Taking the Pulse of the Planet Award
Regeneron | Regeneron Biomedical Science Award
Ricoh | Sustainable Development Award
Science Museum of Minnesota | Science Museum of Minnesota Best Exhibit Award
Society for In Vitro Biology | Outstanding Achievement for Ability and Creativity in In Vitro Biology
Society for Science | Community Innovation Award & Thermo Fisher Scientific Junior Innovators Challenge
Society for Science & National Geographic Society | The 2023 National Geographic Society That's Geography! –Cultivating Empathy for the Earth Award
University of Minnesota College of Biological Sciences | College of Biological Sciences Budding Scientist Award
U.S. Agency for International Development (USAID) | Science Champion Award
U.S. Air Force | Air Force Achievement Award
U.S. Metric Association | Best Use of the International System of Units
U.S. Navy | Naval Science Award
U.S. Stockholm Water Environment Federation | Stockholm Junior Water Prize
Yale Science & Engineering Association | Most Outstanding Exhibit in Computer Science, Engineering, Physics, or Chemistry

Thank You Special Awards Judges!!

Middle School Projects by Category

Animal Sciences

MS-ANIM-038, Bristol VanGuilder: What effect does several IQ tests have on trained dogs vs untrained dogs?

MS-ANIM-089, Ella Brinkman: The effect chemical and physical sunscreen on brine shrimp

MS-ANIM-090, Aubrey Evenson: The Effects of Environmental Enrichment on Gerbil Health

MS-ANIM-734, Lincoln Kampf: The Nose Knows

MS-ANIM-794, Michael Beckey: Sneaky Squirrels

Behavioral and Social Sciences

MS-BEHA-039, Peyton Feehan: What effect does different type of sports have on Go/NoGo (recognition) reaction time?

MS-BEHA-040, Adriana Mondati: Does your personality correspond with what you rate different pets?

MS-BEHA-041, Olivia Berg: Any kid will run an errand if you ask at bedtime what effect does screen time have on hours we sleep

MS-BEHA-042, Raiden Pratt: Why Are(n't) You Attractive?

MS-BEHA-043, Abigail Isaacson Basketball

MS-BEHA-091, Evangeline Peters Smits: Examining the amount of sleep a student at John Adams Middle School needs in order to feel well-rested

MS-BEHA-093, Marjorie Tweedy & Jack Wagner: How do different ingredient substitutes for common allergens affect the perceived taste and texture of a cookie?

MS-BEHA-094, Sia Sood: Emotion Recognition in Young Adolescents

MS-BEHA-097, Sawyer Pierce & Martin Wieland: The effects of caffeine on video game performance

MS-BEHA-098, Samantha Saiki: How do cats respond to different bird calls?

MS-BEHA-101, Alexandra Mora, EmmaClaire Park & Cassidy Schlicht: Does a person's personality affect how big their handwriting is?

MS-BEHA-103, Julia Wang & Yufei Zhou: Does the number of instruments you play have an impact on your memory?

MS-BEHA-105, Faith Coffman & Bella Crow: Which Focusing Tools Affect Students Ability To Focus?

MS-BEHA-106, Juliette Beyder: Does candy relax the mind?

MS-BEHA-121, Sarah Dingli: Does having siblings influence your choice to cooperate with others?

MS-BEHA-156, Aaron McMullen: The application of prospect theory on the undeveloped frontal lobe

MS-BEHA-739, Ayla Stock: All Eyes On You

MS-BEHA-745, Yulian Montecinos Sanchez: Don't Leave Me Behind!

MS-BEHA-751, Zoey Schaffhausen: Does Smell Affect Taste?

MS-BEHA-757, Ethan Nguyen: Does Color Affect Productivity?

MS-BEHA-762, Joshua Wolf: Does Eating Different Food Affect Reaction Time?

MS-BEHA-769, Vivian Elfering: What Your Favorite Color Says About YOU!

MS-BEHA-795, Tobias Oostendorp: How Brain Development Affects Creativity

MS-BEHA-798, Julia Kappenman: Does Testing on Computers vs Paper Change Students' Test Scores

MS-BEHA-801, Mia York: Are Adults Smarter Than 5th Graders?

MS-BEHA-816, Kiera Hoven, Nora Jaster & Gracelyn Kersey-Schutta: Science of Annoyance/ Song Survey

MS-BEHA-831, Hodan Hassan, Riyan Mohamed & Muntaz Mohamed: Can Peppermint Improve Color Visual Reaction Times

Biochemistry

MS-BCHM-046, Emma Morton, Emilia Nephew & Josephine Nephew: Which Liquids Most Damage Your Teeth? AKA Your Dentist Was Right!?

MS-BCHM-173, Logan Ballard & Annabelle Simoneau: Science Hair Project

MS-BCHM-785, John Trinacty: The Benefits of Dairy and Non-Dairy Ice Cream

Biomedical and Health Sciences

MS-BMED-064, Rylan Buschman: Fighting the Flu: How Your Immune System Uses Its Memory

MS-BMED-111, Hayley White: The Effects of Body Temperature on Reaction Time

MS-BMED-116, Beckett Fleming, Lauren Marquardt & Dexter Williams: Do School Cleaning Supplies Actually Work?

MS-BMED-117, Urizen Fuhrer: Chemicals or Calories: Which is more dangerous?

MS-BMED-160, Loujane Omar & Cesar Rios-Rodriguez: Keeping our home environment clean

MS-BMED-773, Rosa Martin: Does Exercise Affect Blood Glucose Levels?

MS-BMED-804, Will O'Shaughnessy: Can People Taste the Difference Between Artificial Meat and Real Meat?

MS-BMED-848, Ethan Hoekman: Electrolytes: A Shocking Truth

Cellular and Molecular Biology

MS-CELL-108, Carson Herr & Samuel Razidlo: Are UV Sanitizers Worth It?

MS-CELL-110, Artina Kazemi & Zoe Zhang: Do Over-the-Counter Antidepressants Work: Effects of St. John's Wort on Stress in Zebrafish Embryos

MS-CELL-779, Riddhi Singhvi: CRISPR-ing Up the Genes: A Tale of Two Experiments

Chemistry

MS-CHEM-048, Aubrey Bosick-Reynolds: What does sand, salt, and sugar have on ice how fast ice melts?

MS-CHEM-049, Peyton Werner: Fermentation in sauerkraut

MS-CHEM-123, Elsa Koepp & Lillian Paulsen: A Big Fat Problem

MS-CHEM-125, Joshua Park: How Fast Do Marshmallows Burn Based on the Brand?

MS-CHEM-126, Joseph Kochan: Trying vegetable acids on baking soda

MS-CHEM-169, Jackson Spaeth: I've been there once or ice; A study of melting ice

MS-CHEM-732, Annika Schultz: Flour Power

MS-CHEM-735, Noor Alaoua: Counting Calories

MS-CHEM-740, Alice Bender: Which Sports Drink is the Most Hydrating

MS-CHEM-744, James Griffiths: The Conductivity of Common Household Drinks

MS-CHEM-783, Jocelyn Guasco: Does Different Liquids Affect the Sublimation of Dry Ice

MS-CHEM-809, Lily O'Brien: How the Type of Flour Affects the Quality of a Cupcake

MS-CHEM-814, Ellie Nelson: Which Storage Method Keeps Fruit Fresh for the Longest Period of Time?

MS-CHEM-852, Odessa Kruah: Baking Towers

MS-CHEM-856, Carlee Shenkle: Sugar Vs Sugar: Which is More Dense?

MS-CHEM-861, Leah Benoit: Butter's Role in the Science of Baking: Amount of Butter and Height of a Brownie

MS-CHEM-866, Tenley Fransen: The Impact of Salt on Apples

MS-CHEM-871, Connor Danielson: Water: Making it Clean

MS-CHEM-876, Teagan Zins: Parting with pancakes

MS-CHEM-881, Annabel Edson: Frizz Forecast: How Humidity Impacts Hair

MS-CHEM-885, Makena Mbuba: Bubble Trouble 2.0: How Glycerin affects the height, strength, and speed it takes foam to rise

MS-CHEM-890, Kallie DoBrava: Chips of fire

MS-CHEM-894, Milkahlyne Muriithi: pH Madness- "How do different makers impact the pH level of water?"

Earth and Environmental Sciences

MS-EAEV-050, Gracie Young: What effect does the type of soil (sand, sand and topsoil, and just topsoil) have on number of ridges transferred to a cast fossil?

MS-EAEV-051, Trevor Zaitz: How Do Landforms Affect a Tornado's Path?

MS-EAEV-060, Jeremiah Bents & Finley Holz: Wolf (Canis lupus) Tendicense on the Fond du Lac Reservation

MS-EAEV-061, Melanie Buhs: The Pollinator Effect: What effect does water quality education and a pollinator garden have on Eagle Lake water quality?

MS-EAEV-063, James Matti & Raelynn Wuollet: Duckweed clean water

MS-EAEV-128, Lauren Arnold & Bethany Collett: Conditions promoting and hindering mold growth on bread

MS-EAEV-129, Bhavya Yerriboyina: Thirsty for the Truth: Uncovering the Safety of Various Drinking Waters

MS-EAEV-130, Sanvitha Vallurupalli: Roots to the Rescue; Do Plants Reduce Erosion?

MS-EAEV-131, Jaxson Greshik: Does soil type affect nitrogen leaching into groundwater?

MS-EAEV-132, Jack Slaggie: How soil material affects building stability.

MS-EAEV-170, George Spaeth: This is a Thick Topic. The Study of Effects of Viscosity with Hydroelectric Generation

MS-EAEV-749, Mardhav Shriram: pHenomenal Filtering: How Different Grades of Sand Impact Potability of Water

MS-EAEV-754, Alexander Ebert: Cold Crystals: How Does Environmental Temperature Affect Crystal Growth

MS-EAEV-759, Molly Wesolowski: Bottled Erosion - Landscaping Materials Impacting Soil Erosion

MS-EAEV-763, Batoul Taha: What is the Effect of Outdoor Air Pollution (Fall and Winter) on Air Quality in Different Outdoor Locations (Forest, Train Station, Neighborhood)?

MS-EAEV-771, Isabelle Wegener: The Potential Impact of Climate Change on Brine Shrimp

MS-EAEV-818, Olivia Senger: How Does Climate Change Affect Plant Growth?

MS-EAEV-913, Lucy Brondum: Does Talking to Plants Affect Their Growth

Energy: Sustainable Materials Design

MS-EGSD-057, Hendrix Wilkinson: Hurricane House: What effect does house design have on if it can withstand high winds?

MS-EGSD-058, Amelia Sandy: What conditions are best for creating Methane gas from cow Manure and compost?

MS-EGSD-135, Gavin Groehler, River Quimby & Elliott Winter: Produce Power!

MS-EGSD-154, Ellie Hahn: Biomass Energy

Engineering: Biomedical

MS-ENBM-120, Samuel Kaspar: Machine Learning solution to improve care management for pneumonia

Environmental Engineering

MS-ENEV-010, Rohan Sharma: Water from sunlight and thin air

MS-ENEV-781, Amina Zahid: Unlimited Energy

MS-ENEV-786, Emaan Moheet: Developing and Testing a Low-Cost Hydraulic Flood Barrier to Protect Rural Communities

Engineering Technology: Statics and Dynamics

MS-ETSD-052, Ethan De Pree: Baking a Raspberry Pi: Building and Stress Testing a Lunchbox Computer

MS-ETSD-053, Graham Blackwood: Crushing It! Comparing Submarine Designs

MS-ETSD-054, Makenzie Little: What is the best way to desalinate water?

MS-ETSD-055, Rain Kilic: What's the heaviest object the hydraulic can hold?

MS-ETSD-056, Ernest Wilson: Secrets of towing: How does angle affect pulling power?

MS-ETSD-174, Janaya Albers: Just Take the Shot

MS-ETSD-787, Mercy Baur: The Night Slipper

MS-ETSD-792, Olive Grantham: Yoke Note

MS-ETSD-800, Oluwademilade Aroloye: EARTHQUAKE

MS-ETSD-805, Logan Ford: Electric Cars...Minnesota Winters

MS-ETSD-810, Eeshal Syed: Frcition's Factors

MS-ETSD-815, Zachary Larson: An Investigation Into Counter-Weight and Elastic Catapults and Their Applications in Snowball Fights

MS-ETSD-822, Iain Rolfes: Which Bridge Design is the Strongest: Truss, Suspension, or Beam

MS-ETSD-827, Olin Rahn: Is an Active Wing Better for Braking than a Normal Wing?

MS-ETSD-923, Makena Steinke: Just keep rolling

Materials Science

MS-MATS-137, Rathan Duggirala: De Novo Synthesis of Bio-Paint Using Bacteria; Analysis of Spectral Trends and Comparison to Commercial Paint

MS-MATS-140, Caroline Chon & Aoife Loftus: What is the Best way to Prevent Rust?

MS-MATS-152, Bodie Felosi & Cora Metelak: Batteries vs Extreme Temperatures

MS-MATS-157, Clay Wenzel: What's Hot with Rust?

MS-MATS-776, Shagun Shrivastava: 100% Biodegradable Plastic! Is it True? (Year 3)

MS-MATS-820, Nicolas Trujillo: How to Finally Descale your Dishes

MS-MATS-823, Kaitlyn Mulle: The Sandwich Bag Battle

Microbiology

MS-MCRO-065, Abigail Dahl-Foucault: What effect does the type of sweetener (aspartame vs. sugar) have on probiotic bacteria growth?

MS-MCRO-066, McKenna Gandhi: The effect of hand sanitizer on the hand bacteria's antibacterial resistance to ampicillin

MS-MCRO-802, Payton Nguyen: Hidden Dangers

MS-MCRO-833, Olivia Byers: The Sweet Side of Fermentation

MS-MCRO-836, Addy Larson: Does the Classroom Affect How Dirty your Hands Are?

Physics and Astronomy

MS-PHYS-067, Claira Krzewinski: The Double-Slit Experiment

MS-PHYS-068, Addison Monson: What type of magnet works best for an electromagnetic train

MS-PHYS-141, Brijen Tollefson: The fading night sky

MS-PHYS-142, Tanner Vite: Insulating the next generation of rockets

MS-PHYS-143, Seung-Yoon Lee: How does color affect heating by absorption of light?

MS-PHYS-144, Patrick Luckey: What is the best bike gear for different level grounds

MS-PHYS-158, Maria Presa: How does arm position affect the speed and velocity of a spin on ice?

MS-PHYS-838, Cale Stanley-Wornson: Fishing Line Strength

MS-PHYS-841, Shaina Lowe: J.W.S.T. Sunshield

MS-PHYS-846, Siri Westberg: Does Money Buy Distance?

MS-PHYS-850, Emma Bacigalupo: Batter Up

MS-PHYS-859, Logan Hovanetz: Ramping Up Speed

MS-PHYS-864, Vedant Chetan: Electromagnets: How strong are they?

Plant Sciences

MS-PLNT-069, Emilia Swenson: What Fruits or Vegetables have more Vitamin C?

MS-PLNT-070, Eva Morgan: Magnetic Growth

MS-PLNT-148, Evangeline Ellenbaum, Salma Jilaow & Avery Wagner: How does different colored plants affect plants positively, negatively, or the same

MS-PLNT-149, SaiSudeeksha Kusampudi: How plants grow depending on the amount of soil

MS-PLNT-155, Evo Miltich: Mushroom Mash-Up

MS-PLNT-175, Alexis Scheid: Rock and Grow the Reprise: The Study of How Sound Waves Affect the Germination and Growth of Plants

MS-PLNT-812, Ethan Finch: Analyzing the Influence of Weather on the Sap Production of Maple Trees to Create a Sap Volume Prediction Algorithm

MS-PLNT-869, Sophia Minakova: Growing Seeds in Microgravity

MS-PLNT-883, Ellie Morris: How Wind Speed Influences the Growth of Plants

MS-PLNT-887, Kaia Mayes: What Substances Make Cut Flowers Last Longest?

MS-PLNT-924, Fahtima Komara: What the Plant: Water Amount and Height

Robotics and Intelligent Machines

MS-ROBO-151, Barrett Parker & Aidan Steele: Building an ROUV

Systems Software

MS-SOFT-119, Bergen Jacob: Green Teen: A Website/Mobile Application to Influence Consumer Choice

Thank you science teachers and project mentors!

High School Projects by Category

Animal Sciences

HS-ANIM-011, Emmett Rose: How does weather affect deer movement?

HS-ANIM-012, Willow Casey: Does the size of the dog affect the amount of bacteria in their mouths?

HS-ANIM-016, Grace Lavan: A Continuation Study of the Effects of Line 3 Oil Pipeline Construction on Gray Wolves (Canis lupus) on the Fond du Lac Reservation

HS-ANIM-073, William Campion & Grayson Fister: Breeding Apistogrammas

HS-ANIM-817, Chloe Chu: Lighting the Way to Healthy Snakes: The Effect of Artificial UVB Light on Vitamin D Levels in Boa imperators

HS-ANIM-847, Norah Dillner & Linnaea Dillner: Atta and Acromyrmex Waste Deters Tropical Agricultural Pests

HS-ANIM-853, Nadia Wang: Don't Be Coy, Decoy!: Determining the minimal length needed for a non-neutralizing antibody to bind to a "decoy" epitope on the GP5 protein of PRRSV

HS-ANIM-858, Shreya Sekar: Beeping Blanding's! Using radiotelemetry data and ArcGIS to correlate turtle sightings with habitat features to focus conservation and protection efforts

Behavioral and Social Sciences

HS-BEHA-006, Caleb Smith: Perceived Stress and Anxiety Attributed to North American Outbreaks of Rabbit Hemorrhagic Disease (RHDV2) and COVID-19

HS-BEHA-018, Ethan Lavan: Effects of the Pandemic/Food Supply Chain, City Populations, and Time on Urban Chicken Keeping

HS-BEHA-019, Alexander Leach: How Does Age and Gender Affect Conformity?

HS-BEHA-020, Lucia Nelson: Study Notes: A Continuation on How Music Affects Learning

HS-BEHA-176, Hazel Striker: Psych: The Effect of Priming on Juvenile Response

HS-BEHA-178, Elsa Bieger & Stella Strong: Studying the Effect of COVID Learning Models on MCA and ACT Scores

HS-BEHA-179, Angelina Nicholas: Investigating the Effects of Artificial Melatonin on REM Sleep

HS-BEHA-182, Herimann Frost: The Psychological Effects of Colored Lights on Performance

HS-BEHA-742, Rita Li: The influence of foreign language music lyrics on memory

HS-BEHA-829, Noah DeMichaelis: Music and the Mind: the Intersection of Reading Readiness and Musical Proficiency

HS-BEHA-834, Sydney McDaniel: Pregnancy, Policing, and Unequal Policies: A cross-sectional analysis of police contact and adverse birth outcomes in US-born Black, White, and Foreign-born Black women

HS-BEHA-845, Ava Jaffe & Romy Peterson: Face Your Fears: Creating a system to study how mice over come their fears

HS-BEHA-851, Shreya Ramraj: How does divorce affect sleep patterns in young adults?

HS-BEHA-857, Jack Hickey: Measuring the Effect of Physical Exercise and Working Memory Tasks on Statistical Learning in Adolescents

HS-BEHA-862, Kareena Israni: Bringing meaning to numbers: Randomized controlled trials that inform candidates about which centers transplant patients like them.

HS-BEHA-872, Ayeza Moheet: Can Subliminal Messaging be Used to Influence the Decisions and Choices of Middle and High School Students?

HS-BEHA-920, Caleb Li & Selena Qiao: Grogginess Begone: A Study of the Effects of Alarm Sounds on Sleep Inertia

Biochemistry

HS-BCHM-014, Aidan Moeller: Quantitative analysis of protein in poultry eggs

HS-BCHM-824, Noah Khemakhem: The effect of pH on the ability of P. porifera to filter nickel from seawater

HS-BCHM-863, Julia Harms: Unraveling Alzheimer's: An Investigation into Potential Inhibition of Alzheimer's Tau Aggregation by Cinnamaldehyde

Biomedical and Health Sciences

HS-BMED-029, Johanna Bernu: Disinfectant Properties of Nuphar advena: An Ethno-pharmaceutical Approach

HS-BMED-030, John Mceachran: How Does Caffeine Affect The Heart?

HS-BMED-032, Amir Mamedov & Adele Mamedova: Master Your Sleep

HS-BMED-079, Abhinav Koppulu: Angiographic Assessment of Multiple Flow Diverting Devices to Treat Intracranial Aneurysms In Vitro

HS-BMED-163, Josiah Copeland: Feel the Burn

HS-BMED-736, Sahwa Ibrahim: Calorie Exertion Accuracy in Males and Females

HS-BMED-741, Fahima Rashid: The effect of potassium, magnesium and calcium on heart rate

HS-BMED-891, Ivy Miller & Corinne Moran: Deciphering DUX4: Is transient expression of DUX4 sufficient to cause muscular dystrophy?

HS-BMED-892, Kendall White: The Perfect Solution: Optimizing an enzyme-linked immunosorbent assay to determine antibody concentrations in glioblastoma patients

HS-BMED-897, Saloni Somia: The Effect of Calcium Signaling on Cell-Cell Fusion

HS-BMED-900, Jaxon Bain: The Acute Effects of Beet Powder on Cardiovascular Vitals During Exercise

Cellular and Molecular Biology

HS-CELL-076, Isha Kapoor: Overcoming Melphalan Resistance in the Treatment of Multiple Myeloma- Year 2

HS-CELL-186, Mari Pulver: Study of the Effect of High Frequency Sound on Cellular Reproduction

HS-CELL-747, Henry Choi: The Effect of Gefitinib on Cell Proliferation and Invasion in 2D and 3D Cultures of MDA-MB-231 Breast Cancer Cells

HS-CELL-766, Samuel Bae & William McNally: The Pleiotrophin Puzzle: Investigating the expression of pleiotrophin in post-injury adult cardiac mouse hearts

HS-CELL-772, Lydia Kahsay: Examining the Effect of the Interleukin-10 Cytokine on Induced Inflammation Markers within the MCF-7 Breast Cancer Cell Line

HS-CELL-777, Arreh Jain: Beyond neurons—mapping the fine-scale organization of blood vessels in the brain may provide new insights into the mechanisms of dementia

HS-CELL-782, Steven Yang: Preposterous Proteoglycans! Defining the Role of CSPG4 in Pancreatic Cell Invasion and Spheroid Formation to Achieve Effective Immunotherapy Treatments

HS-CELL-915, Samuel Thibodeau: Inhibitory effects of curcumin on HEK cell growth

Chemistry

HS-CHEM-021, Tanner Risley: Determining The Absorbance Of Pen Ink With A Colorimeter

HS-CHEM-022, Morgan Houle: How Salt Affects Water Tension and Waters Cohesive Properties

HS-CHEM-023, Ethan Perrotti: Determining the pH of Candy Using A Vernier pH Probe

HS-CHEM-025, Madison Roen & Apres Surla: The Effects Of Emollients In Lip Balm

HS-CHEM-185, Lily Aakre: The Effect of Varying Waters on the Qualities of Kombucha

HS-CHEM-753, Aaron Lindeman: Creating An Environmentally Friendly Dry-erase Ink Composition

HS-CHEM-758, Julia Colbert: Teeth Cleaning Chewing Gum

HS-CHEM-789, April Wang: A paper-based colorimetric biosensor to detect Ciprofloxacin in water

HS-CHEM-868, Ajmal Abdirahman: Drug Solubility

Computational Biology and Bioinformatics

HS-CBIO-078, Jeffrey Wang: Development of Deep Neural Network Architectures for Lupus Anticoagulant Testing Interpretation

HS-CBIO-080, Alexandre Zoghby: How did the stringency of various government responses affect cumulative number of deaths related to COVID-19?

HS-CBIO-081, Andrew Sun: Generalization of a Regression Model Predicting Access to Health Care

HS-CBIO-083, Albert Hu: Ultrasound Microvessel Imaging in the Detection of Tumors

HS-CBIO-746, Emily McNeil: Evaluating the extent to which ML could be a viable option in ASD diagnosis

HS-CBIO-755, Chetan Boddeti: The clash between researchers: Conquering the interactions of the cell within a database to facilitate research collaboration and scientific advancement

Earth and Environmental Sciences

HS-EAEV-007, Nathan Klitzke: The effects of different nutrients on plants

HS-EAEV-017, Camilla Beaster: The Effect of Neodymium Magnetic Fields on Artemia.

HS-EAEV-027, Emelyn Beaster: Sequestration of polluted runoff using recycled microplastics

HS-EAEV-084, Sean Koenigs: Drinking Nitrates

HS-EAEV-167, Micah Johnson: Hot Topic

HS-EAEV-183, Isabella Wimmer: The Study of Aquatic Plants Effect on Polluted Waters

HS-EAEV-764, William Richardson: Studying the Impact of Microplastics on Quinoa Growth

HS-EAEV-793, Mina Adabag: Lead's Butterfly Effect: Determining the impact of Lead Pollution on Danaus plexippus and Pieris rapae

HS-EAEV-803, Sanjana Kollipara: Turn Around, Don't Drown! Evaluating deviations from the median in historical climate data and comparing the emergency response and mitigation plans of Hennepin and St. Louis Counties

HS-EAEV-807, Isabela Snow: The Effects of Atrazine on Aquatic Environments and the Functionality of Filters to Reduce Effects

HS-EAEV-873, Lynne Hu: A Comparison of Thymus Vulgaris and Origanum Vulgare in the Adsorption of NO2 and NO3 in Aquaponics Systems

HS-EAEV-918, Fatima Syeda & Maryam Syeda: Zebra Mussel Repellent

Embedded Systems

HS-EBED-774, Rishi Bhargava & Humza Murad: Project WASP: Watering Atmospheric Self-Irrigating Planters

HS-EBED-813, Shreshth Shrivastava: Wi-C.A.R.E: Wifi Computer-Assisted Remote Eldercare (Year IV)

Energy: Sustainable Materials Design

HS-EGSD-005, Mitchel Masters: Optimizing a Tesla Turbine

HS-EGSD-778, Maggie Banks: Wood-n't It Be Nice: Toward a Continuous Piezoelectric Charge Pump

HS-EGSD-819, Yash Dagade: WATT from VAWT : Design of A Novel Vertical Airborne Wind Turbine (VAWT) Clean Energy Farm

HS-EGSD-877, Sarah Zamudio: Making Natural Gas from Compost

Biomedical Engineering

HS-ENBM-075, Sreyoli Bhattacharya: Creating A Kidney: How Stem Cells Might Be Used to Bioengineer a Vital Organ

HS-ENBM-825, Lukas Murdych: Study of the effects of various classical guitar supports on muscular tension

HS-ENBM-882, Karen Nakamura: Personalization of Deep Brain Stimulation Surgery Pre-Operational Planning: Integration of 7-Tesla MRI Segmentations into 3-D Brain Visualization Platform

Environmental Engineering

HS-ENEV-830, Ana Stewart: The Application of Mushroom Mycelium as a Biomaterial and Leather Alternative

HS-ENEV-835, Anika Lang: Valorization of winery wastewater to grow Chlorella vulgaris

HS-ENEV-839, Khadija Kouser: Designing Testing a Solar-Powered, Eutrophication-prevention (SPEP) Robot for Stagnant Waters

HS-ENEV-888, John Liu: Green Electronics: A Feasible Solution to Reduce E-waste Pollutions

HS-ENEV-917, Jasmine Goldsmith: A comparison of bamboo and conifers species' efficiency at removing contamination from water similar to that of SouthEast Asia

Engineering Technology: Statics and Dynamics

HS-ETSD-026, Daniel Dutcher: How Voltage is Affected by Multiple Cells in a Saltwater Battery

HS-ETSD-184, Hadley Christianson: Weather or Not to Fly: Building an All-Inclusive METAR Map

HS-ETSD-844, Noah Getnick: Following the Flow: Expanding the Capabilities of a 2D Fluid Simulation to Study Biomimetic Bodies

HS-ETSD-854, Trisha Samba & Amira Sinclair: Your Training H.I.R.O.: Developing a "Haptic Interface for Real-time Optimization" of Out-of-water Swimming Form

HS-ETSD-860, Lily Salyards: Aerodynamic optimization of proposing and ground-force in Formula 1 vehicles

HS-ETSD-865, Muminah Nihaar Mohammed: Unbind the Blind

Mathematics

HS-MATH-168, Johnathan Biebighauser: Good, Weather, Best: Using Existing Weather Forecasts to Produce an Accurate Weather Forecasting System

HS-MATH-870, Andrew Zhang: Extremal problems on the Steiner k-distance and the Steiner k-Wiener index

Materials Science

HS-MATS-164, Noah Carlson: Colors and Squares: A Study on Rubik's Cubes

HS-MATS-875, Julia Vladimirov: Testing the toxicity of a composite cassava starch/chitosan/PALF/ZnO bioplastic

HS-MATS-884, Rick Qian: Saving our Soils: The role of water hydration states in a bacteria-derived biopolymer hydrogel to control soil erosion

HS-MATS-914, Ericka Miller: Blood Spatter Analysis

HS-MATS-922, Noah Measells: Development of dual material glove protectors for skiing and snowboarding

Microbiology

HS-MCRO-033, Haley Geiger: Bacteria and Disinfectants

HS-MCRO-071, Rhees Cragun: The Effects of Salt Stress on Freshwater Cyanobacteria

HS-MCRO-159, Danielle Wang & Dean Wang: Treatment of SARS-CoV-2: A Prescription Framework to Predict Novel Drug-Drug Interaction Risks with Machine Learning (Year 2)

HS-MCRO-180, Katrina Roberts: The Exploration on the Effects of Essential Oils on Bacterial Growth

HS-MCRO-889, Dureti Gamada: Fungi vs. Bacteria: Using Beneficial Microbes Naturally Recruited by Corn Crops to Combat Corn Fungal Pathogens

HS-MCRO-893, Griffin Anderson: Identification of Trends in Commercial Oil-Instigated Bacterial GrowthTthrough Production of Lipase-Precipitate

HS-MCRO-895, Shelby Molina Larson: The Quantification and Persistence of Fusarium moniliforme on Maize Kernels Stored with the Intent of Producing Ethanol and its Potential Relationship with Increasing Cancer Rates in Minnesota

HS-MCRO-898, Andrew Moline: Mastering Microbes: Exploring the Effect of Temperature on Yeast Metabolism

Physics and Astronomy

HS-PHYS-161, Adam Jacobson & Paige Jacobson: Radiation Cessation

Plant Sciences

HS-PLNT-034, Parker Sickmann: Microgreens to Microgravity: Exploring the efficacy of seedlings as a food source for space exploration

HS-PLNT-037, Jase Matuszak, Kara Williams-Olsen & Miley Young: Heavy Metals And Their Affects On Plant Growth Using Carbon As A Remediation Strategy

HS-PLNT-166, Isaac Mauch: Studying the Practicality of Bio-Fertilizers Use in Agriculture

HS-PLNT-171, Ava Johnson: The study of different types of water on the growth and germination of plants in the ecosytem

HS-PLNT-733, Finn Emerson: Alternatives to Herbicide Treatment of Invasive Buckthorn

HS-PLNT-743, Tyler Clair & Quinn Hughes: Using Monte Carlo Simulation to Optimize Vitamin C Production in Lactuca sativa by Varying Light Intensity and Wavelength, Year II

HS-PLNT-748, Jordi Malaret: Resistance to abiotic stress due to overexpression of SUPA gene in Arabidopsis thaliana

HS-PLNT-752, Aisha Abdulwali: Effect of UVB irradiation on the vitamin D concentration in Lolium Perenne and Lentinula Edodes

HS-PLNT-799, Sarah Peterson: Protecting Plants: Investigating the relationship between fertilizers and insect damage in an urban garden

HS-PLNT-896, Sriram Sureshkumar: Impact of Biochar as soil amendment on produce yield (Year 1)

Robotics and Intelligent Machines

HS-ROBO-086, Xavier Mogensen & Hasan Mohammed: Coding Communication: Sign Language

HS-ROBO-087, Armita Kazemi: Diagnosing Brain Tumors from MRI Images using Deep Transfer Learning

HS-ROBO-088, Marc Zoghby: Leveraging Generative Adversarial Networks to Synthesize Brain MRI Images

HS-ROBO-756, Meiling Mathur: Machine learning for detecting warning signs of carpal tunnel syndrome in violinists

HS-ROBO-761, Valerie Nelson: Spectroscopy and Machine Learning for the Prediction of Impurities in Recycled Plastics

HS-ROBO-765, Krish Inba Rajashankar: A machine learning based identification and analysis of early call terminations in contact centers

HS-SOFT-082, Felix Lu: An uncertainty estimate of deep-learning image noise reduction methods for tumor size measurement in computer tomography

HS-SOFT-729, Lakshika Nanda Kumar Reddy: Detecting Cataracts From Front-View Retinal Images Using Machine Learning

Translational Medical Science

HS-TMED-077, Christine Song: Cure of Breast Cancer - Year 6: Novel Approaches in the Therapy of Metastatic Breast Cancer using Clinical Databases and 3D Organoid Model

HS-TMED-919, Adam Bravo: Lipid Nanoparticle PEGylation for Optimized in Vitro Transfection

Special Thanks

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