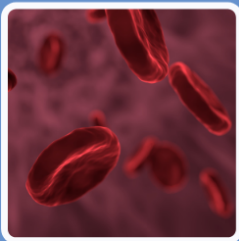




54th Annual
North Central
Junior Science
& Humanities
Symposium



MARCH 20-31, 2022

The Minnesota Academy of Science
www.mnmas.org

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North Central JSHS Team

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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 2022 Virtual North Central Junior Science & Humanities Symposium (JSHS). Congratulations to all of the Regional JSHS winners and welcome to those participating through open competition.

You have shown yourselves to be the top student scientists in your regions. We are proud of you and hope you are proud of yourselves. Those of us who judge your papers and presentations want to encourage your curiosity, enthusiasm, and joy in learning about the world around you and how it works.

No matter the outcome of this year's JSHS, we hope that you will continue to pursue your dreams. Be always curious, always learning, and always growing. The world is waiting for you.

To all the parents, teachers, volunteers and MAS board and staff - THANK YOU for your support and hard work. JSHS wouldn't be the success it is without you.

Sincerely,



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



About the North Central JSHS

JSHS is sponsored by the research arm of the Department of Defense and administered in cooperation with nationwide colleges and universities by the National Science Teaching Association. JSHS aims to prepare and support students to contribute as future scientists and engineers conducting STEM research on behalf of or directly for the Department of Defense, the Federal research laboratories, or for the greater good in advancing the nation's scientific and technological progress.

Forty-eight regional symposia are affiliated with the JSHS program, reaching thousands of high school students and teachers throughout the United States and Puerto Rico, and in the Department of Defense Dependents Schools, Europe and Pacific Rim Regions. JSHS regional symposia invite the participation of all high school students who have completed an original research investigation in the sciences, engineering, or mathematics to apply to the regional symposium and vie for awards and recognition, including the opportunity to advance to the National Symposium. Investigations reporting on experimental, field, observational, or applied research are eligible.

To learn more:

[North Central JSHS](#)

[JSHS Scholarships & Awards](#)

[National JSHS](#)

About the Minnesota Academy of Science

Founded in 1873, the Minnesota Academy of Science (MAS) is a statewide 501(c)(3) organization 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. To learn more about our programs, connect with us, volunteer, or make a donation to support our work, please visit mnmas.org.

2022 JSHS Schedule

Sunday, March 20

8:00 am | Project judging for Round 1 begins

Thursday, March 24

6:00 pm | Project judging for Round 1 ends

8:30 pm | Announcement of students advancing to the Callback Round

Project judging for Round 2 begins

Saturday, March 26

5:30 - 7:30 pm | Callback question and answer sessions via Zoom

Sunday, March 27

Email announcement of students advancing to the National JSHS (by noon)

Monday, March 28

Registration for the in-person event at the Science Museum of Minnesota on March 31: Watch your email for details and registration information

Wednesday, March 30

7:00 pm | Awards ceremony - [Click here to join via zoom](#)

Immediately after the ceremony, award winners will be posted at mnmas.org

Thursday, March 31

11:00-4:00 | In-person event at the Science Museum of Minnesota



Wednesday, April 20 - Saturday, April 23

National JSHS competition in Albuquerque, New Mexico

2022 Keynote Speaker



[Dr. Nisha Botchwey](#) will address participants in a keynote speech at the 54th Annual North Central JSHS and the 85th Annual Minnesota State Science and Engineering Fair virtual awards ceremony on March 30, 2022 at 7:00 pm.

Dr. Botchwey began serving as the dean of the University of Minnesota Humphrey School of Public Affairs in January 2022. Her research and teaching have been at the nexus of environmental and health policy and the built environment, with a special focus on youth engagement and health equity. The impact of Botchwey's public health and social justice work was recognized in 2021 with the prestigious [Dale Prize for Excellence in Urban and Regional Planning](#), and in 2016 by the White House Council on Women and Girls.

Previously, Dr. Botchwey served as associate dean at Georgia Tech Professional Education, where she played a key role in leading the school's response to the COVID-19 pandemic. Dr. Botchwey was also a tenured associate professor in Georgia Tech's School of City and Regional Planning and director of the School's Healthy Places Lab.

2022 JSHS Awards

Regional JSHS Teacher Award sponsored by National JSHS

A \$500 award is given to the teacher of the first place student winner, honoring the individual teacher and their school's contributions to advancing student participation in research.

Regional JSHS Finalist Awards sponsored by National JSHS

- An expense-paid trip to the National JSHS is typically awarded to five finalists at each regional symposium. The 60th National JSHS will be held April 20-23 in Albuquerque, New Mexico. National JSHS brings together more than 200 high school students who qualify by submitting and presenting original scientific research papers in regional symposia held at universities nationwide. Approximately 130 high school teachers, mentors, university faculty, ranking military guests and others also attend and join in encouraging the future generation of scientists and engineers and celebrating student achievement in the sciences.
- An invitation to formally present their original research investigation at the National JSHS is awarded to the 1st and 2nd place finalists at each regional symposium.
- An invitation to present their research in a display board viewing for peers and families at the National JSHS is awarded to the 3rd, 4th, and 5th place finalists at each regional symposium.
- A total of \$4,500 in undergraduate scholarships is awarded at \$2,000, \$1,500, and \$1,000 to the 1st, 2nd, and 3rd place regional symposia finalists (scholarship payable upon matriculation and upon meeting the JSHS scholarship conditions).

National JSHS Symposium Awards

Significant awards are available to students who compete in the national symposium. The Departments of the Army, Navy, and Air Force jointly sponsor the following undergraduate scholarship awards for national students: six \$12,000 1st place awards, six \$8,000 2nd place awards, and six \$4,000 3rd place awards.

Minnesota Academy of Science Awards



Outstanding Achievement Award

The Outstanding Achievement Award, sponsored by the Minnesota Academy of Science, is given to eight students who conduct exceptional scientific research and presentation of their results. The six winning students receive a certificate and a \$50 award.

Minnesota Junior Academy of Science (MJAS)

Top-scoring high school presenters from the JSHS and the Minnesota State Science & Engineering Fair and will be invited to join the 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.

Presidential Awards

Up to eight Presidential Awards are given to students to recognize their contributions within each submission category. Each winner receives a special certificate to acknowledge their work.

Projects by Category

Biomedical Sciences

- 02: *A Look into the Tiny Earth: Finding Antibiotic Producing Bacteria in Yellowstone Soil*
Elizabeth Levinshteyn (Spring Lake Park High School)
- 08: *Cure of Breast Cancer - Year 5: A Novel Approach to Treating Hormonal Breast Cancer using Diabetes Medication through Clinical Database and 3D ex vivo Model*
Christine Song (Mayo High School)
- 11: *The Disinfectant Properties of Nuphar advena*
Johanna Bernu (Cloquet Senior)
- 15: *Don't Forget About Caspase-2: Analyzing the Binding Site Specificity of a Protein Linked to Alzheimer's Disease*
Romy (Elizabeth) Peterson (Breck School)
- 23: *How Fluoride Impacts the Efficacy of Mouthwash on Streptococcus Salivarius Bacterial Colonies*
Ella Passe (Convent of the Visitation School)
- 34: *Overcoming melphalan resistance in the treatment of multiple myeloma*
Isha Kapoor (Mayo High School)
- 49: *The Effects of Different Mouthwashes on Bacteria*
Madeline Olsen (Burnsville High School)
- 51: *The Electromyographic Evaluation of the Bilateral Muscle Asymmetry of the Latissimus Dorsi in Martial Arts and the Effect of Real-Time Biofeedback on Technique Improvement*
Karen Nakamura (Math and Science Academy)

Chemistry

- 22: *Gluten Free or Gluten Debris: Prolamin and Glutelin Levels in Oat Flours*
Cady Pagel (Convent of the Visitation School)
- 28: *Knots or Not? Using electricity to study DNA entanglements in nanochannels*
Sarah Peterson & Kendall White (Breck School)

Engineering & Technology

- 19: *Everything you 'Kneed': Development of an adjustable, above-knee prosthetic capable of performing multiple activities*
Nathan Walsh (Breck School)
- 27: *Improving Home Hot Water Efficiency*
Tanmay Iyer (Mayo High School)
- 33: *Optimizing Waterflow in a Simulated River Environment*
Will Sedo (St. Paul Academy & Summit School)
- 35: *Project SERSI: Smartphone Enabled Robotic Sign-Language Interpreter*
Ruth Mellin & Alexander Moore (St. Paul Academy & Summit School)
- 37: *Recycled Plastic for Resilient Infrastructure*
Benjamin Chen (St. Paul Academy & Summit School)
- 59: *Water You Risking? Developing a Novel Maze to Assess the Effects of Thirst on Risk-Taking Behavior in Mice*
Trisha Samba & Amira Sinclair (Breck School)
- 60: *Wi-C.A.R.E: Wifi Computer-Assisted Remote Eldercare (Year 3)*
Shreshth Shrivastava (Eden Prairie High School)

Environmental Science

- 01: *An Innovative Approach to Manage the Environmental Impact of Agricultural Drainage Water*
Gavin Kratcha (Hankinson Public School)
- 03: *A Plant With Promise: Using Engineering Principles to Create an Eco-Friendly Manufacturing Process for a Biodegradable Piezoelectric Transducer*
Margaret Banks-Hehenberger (Mounds Park Academy)
- 04: *Agriculture in the Big City: Studying the effectiveness of soil treatments on weed growth*
Roxy Neset (Orono Senior High)
- 16: *Effect of Ethanol and Octocrylene on the Cell Growth and Chlorophyll-a Levels of *Cyclotella meneghiniana**
Linnea Cooley (St. Paul Academy & Summit School)
- 17: *Effects of the Line 3 Pipeline on Gray Wolves (*Canis lupus*) on the Fond du Lac Reservation*
Grace Lavan (Cloquet Senior)
- 30: *Legacy contaminants: An extensive study of historic land use and contamination in the East Phillips neighborhood of Minneapolis to prioritize future monitoring and restoration efforts*
Ahreum Ham (East Ridge High School)

- 32: *Novel Cellulose Carbon Fiber Based Biofilm for Airborne VOC Filtration*
Ellen Guo (Mounds View High School)
- 36: *Quantitative analysis of the effects of climate change on wildfire occurrence and severity in NEMN*
Emelyn Beaster (East High School)
- 38: *Reducing Freshwater Acidification*
Annika Bartucz (Century High School)
- 42: *Sustainable bioplastics: seaweed and hemp-based alternatives to fossil fuel-based plastics*
Kyla Fung (Minnetonka High School)
- 43: *The Capacity of Pea Plants for Associative Learning*
Sophia LeMire (Sacred Heart School)
- 50: *The Effects of Temperature on Learning Complex Tasks in Red Harvester Ants*
Per Johnson (St. Paul Academy & Summit School)
- 52: *The Extreme Cold in the Context of a Warmer Planet and a Cooler Solar Cycle*
Andrew Bai & Annie Bai (St. Paul Academy & Summit School)
- 53: *The More we Work Together, the GREENER our world will be!*
Paige Jacobson (Grand Rapids Senior High)
- 54: *Wastewater Treatment: The Use of Mealworm Gut Bacteria (*Tenebrio molitor*) to Isolate and Identify Bacteria that can Biodegrade Polystyrene*
Rowan Rock (Cloquet Senior)
- 57: *Type of Filter Media's Effect on Nitrates in Artificial Aquatic Systems*
Victoria Biggs (Burnsville High School)

Life Sciences

- 07: *A Chemical-Free Apple Tree Cultivation Technique*
Grace Finnerty (Cotter High School)
- 21: *Secure the Manure: Utilizing sequential fiber methods to assess the effect of manure on forage nutritive value of Medicago Sativa*
Abirami Rajasekaran & Harini Senthilkumar (Eden Prairie High School)
- 26: *Impact of Critical Parameters on Rhizopus Stolonifer Growth: Implications to Food Shelf Longevity and Economics*
Rushil Khadilkar (Wayzata High School)
- 44: *The Effect of Temperature Variation on the Development and Adult Function of Vanessa cardui*
Nina Chafee (St. Paul Academy & Summit School)

- 47: *The Effect of Varying Concentrations of Miracle-gro fertilizer on Composting Earthworm Ecosystems*
Cooper Danielson (St. Paul Academy & Summit School)
- 55: *Tough Turkeys Year 2: What Habitat Types do Wild Turkeys Now Associate With in Northeast Minnesota?*
Harmony Tracy (Cloquet Senior)
- 58: *Using Monte Carlo Simulation to Optimize Vitamin C Production in Brassica oleracea using Abiotic Plant Stress*
Tyler Clair & Quinn Hughes (Minnetonka High School)

Mathematics & Computer Science

- 05: *Assessing the Impact of Hyperparameter Tuning on the Performance of a Brain Hemorrhage Object Detection Model*
Marc Zoghby (Mayo High School)
- 12: *Does Apple Really Watch Your Sleep? Modifying an algorithm to improve prediction of sleep stages from Apple Watch data*
Akshay Krishna (Breck School)
- 14: *Does ESG investing affect international capital flows? Some evidence from statistical and machine learning methods*
Leon Luo (Wayzata High School)
- 31: *Nimble Navigation: Designing and developing an interactive chatbot with natural language processing to assist visually-impaired users to maneuver in outdoor settings with assurance*
Daniel Wang & Peter Xu (Wayzata High School)
- 56: *Tumor targeting: Utilizing spatial data science techniques to decode the enigmatic immune response with the goal of informing further efforts to develop immunotherapies for tumor treatment*
Srinath Hariharan (Woodbury High School)
- 61: *Overcoming Opioids: Analyzing, characterizing, and quantifying the sentiment of Reddit posts' tone and language prior to a relapse to allow for early intervention*
Stavya Arora (Maple Grove High School)

Medicine & Health / Behavioral Sciences

- 06: *Assessing the Influence of Personality on Active and Passive Procrastination among Adolescents*
Spencer Burris-Brown (St. Paul Academy & Summit School)
- 09: *DBS Discovery: A multifaceted approach to Deep Brain Stimulation with new advances in neurosurgical testing equipment and synchronization of alpha and beta bands for postural instability in Parkinsonian patients*
Ella Alexander & Aayush Goud (Wayzata High School)

- 10: *Defeating dyslexia: A robust meta-analysis of the relationship between hearing and dyslexia to achieve early diagnosis and treatment*
Ziyi (Rick) Qian (Wayzata High School)
- 13: *Does Awareness of Misleading Questions Reduce Memory Inaccuracy?*
Stella Harbson (East High School)
- 18: *Essential Protection: Using UV-sensitive yeast to evaluate essential oils as an alternative to sunscreen*
Ava Jaffe & Amrit Menon (Breck School)
- 20: *Finding Functionality: A Rasch Analysis of a Body Functionality Appreciation Scale*
Sarah Feng & Sydney McDaniel (Breck School)
- 25: *Immune System Innovation: Ushering in a new era of immunology research by characterizing cell populations most impacted by normal microbial exposure for preclinical research and healthcare treatment development success*
Adhvaith Sridhar (Wayzata High School)
- 29: *Learning With Lizards: Assessing the Impact of Human Socialization on Behaviors of *Varanus acanthurus**
Chloe Chu (Breck School)
- 39: *Sepsis Survivor: Characterizing muscle stem cells using RNA sequencing data from a murine surgical model of sepsis for the purpose of preventing sepsis-associated muscle wasting*
Srijani Datta (Eden Prairie High School)
- 40: *Serotonin levels in *Procambarus clarkii* and *Faxonius virilis* exposed to high ambient temperatures*
Adelyn Diaz (Minnetonka High School)
- 41: *Study Notes: How Music Affects Learning*
Lucia Nelson (East High School)
- 45: *Brain Activity Related to Receiving Correct or Incorrect Feedback in Epileptic Patients*
Arul Banerjea (East Ridge High School)
- 46: *The Effect of Toothpaste on Stained Teeth*
Isabel Lange (Burnsville High School)

Physical Sciences

- 24: *How Masks Affect Airflow*
Gabriel Le (Burnsville High School)
- 48: *The Effects of Concrete Texture on Heat Absorption and Emission*
Matt Trussell (Burnsville High School)

Keep in Touch with the Minnesota Academy of Science

We invite you to join the MAS community and help us achieve our vision of a future where Minnesotans of all backgrounds have opportunities to engage in the STEM practices that will benefit their community, education, and career.

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