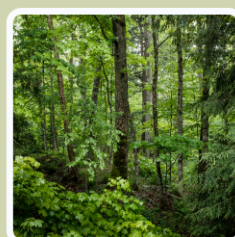
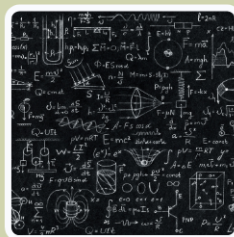
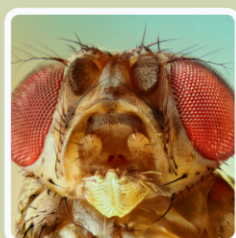
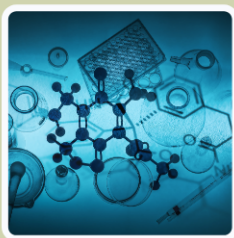




53rd Annual  
North Central  
Junior Science  
& Humanities  
Symposium



MARCH 23-30, 2021

The Minnesota Academy of Science  
[www.mnmas.org](http://www.mnmas.org)

# Junior Science & Humanities Symposium Team

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## **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](http://mnmas.org).

# Welcome from the Minnesota Academy of Science

## Board President

On behalf of the Board of the Minnesota Academy of Science, I would like to welcome everyone to the Virtual 2021 Junior Science & Humanities Symposium.

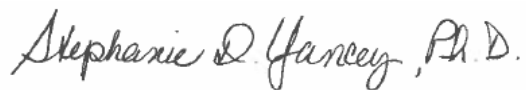
Congratulations to all of the Regional JSHS winners. And if you are participating through the Open Competition route, welcome!

Remember that all of you are the best and brightest from your respective regions and schools. Be proud of that accomplishment! Those of us who will judge your papers and presentations want to encourage your curiosity, enthusiasm and joy in learning about the world around you and how it works. Whether it's a new way of building a robot, finding a new species, or figuring out a mathematical proof, it's about the journey and what you learned, not about who "wins". No matter the outcome of JSHS this time, we hope that you will continue to pursue your dreams. The world is waiting for you.

But most of all, what I wrote in 2016 still applies: have fun and don't forget to breathe!

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

Sincerely,



President, Minnesota Academy of Science





## What is 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.

### Regional Symposia

Forty-eight regional symposia are affiliated with the JSHS program, reaching over 10,000 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. While review or library research is a part of the research process, these investigations alone are not appropriate.

To learn more:

[About JSHS](#)

[JSHS Scholarships & Awards](#)

[National JSHS](#)

## 2021 JSHS Schedule

**Project Judging Round 1:** March 23, 2021 at 8:00 a.m. thru March 27, 2021 at noon.

**Callbacks Announced:** March 27, 2021 at 2:30 p.m.

**Callbacks Project Judging:** March 27, 2021 at 4:00 p.m. thru March 28, 2021 at 8:00 p.m.

**Callbacks Q & A:** March 28, 2021, 4:30 p.m. - 6:30 p.m.

**Winners Announced:** 2021 JSHS/SSEF Virtual Awards Ceremony - March 30 at 6:30 p.m. [CLICK HERE TO JOIN ZOOM WEBINAR.](#)

The ceremony will be immediately followed by all awards being posted online at [mnmas.org/2021-jshs-awards](https://mnmas.org/2021-jshs-awards). (The page will be unlocked right after the awards ceremony to allow for public viewing.)

# Awards



## **Regional JSHS Teacher Award sponsored by National JSHS**

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

## **Regional JSHS Finalists Awards sponsored by National JSHS**

- An expense-paid trip to the National JSHS is typically awarded to five finalists at each regional symposium. The 59th National JSHS will be held April 14-17 2021, as a virtual competition. The National JSHS brings together 245 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 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 awarded to the 3rd, 4th, and 5th place finalists at each regional symposium.
- A total of \$4,500 in undergraduate scholarships 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

### **Outstanding Achievement Award**

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

### **Presidential Awards**

The Presidential Awards, sponsored by the Minnesota Academy of Science, recognizes one student in each category who has done excellent research. The seven winning students receive a certificate and letter of congratulations.

# Projects by Category

<b>Biomedical Sciences</b>		
BIOMS-010	Christine Song	Cure of Breast Cancer - Year 4: The First Discovery of New Target Therapy for Aggressive Hormonal Breast Cancer using Clinical Database and 3D Model
BIOMS-014	Gwen Eichfeld	Determining the Relationship Between Cross-Cultural Interpersonal Distance Preferences and Early COVID-19 Case Frequency Using Multivariable Regression Analysis
BIOMS-039	Vaughn Hughes	Using Artificial Intelligence and Electronic Health Records to Build a COVID-19 Testing Model
BIOMS-040	Quentin Hughes	An Active Role for Machine Learning in the Diagnosis of Cardiac Arrhythmias, Year 2
BIOMS-046	Evelynn Shero	The Effect Different Forms of Sugar Have on Glucose Levels During Metabolization
BIOMS-048	Ellen Guo	Distinctive mutation profiles of SARS-CoV-2 spike protein in different geographic regions of the United States
BIOMS-050	Sydney Peng and Johnny Yue	Upsurge of the Glycolytic Pathway in Cancer: A Dynamic Network Analysis of Oncogenic Mutations in Phosphofructokinase-1
BIOMS-052	Paige Jacobson	COVID-19 and Lyme Collide
BIOMS-054	Emelyn Beaster	Using Phytoaccumulation To End Mineral Deficiencies
BIOMS-064	Levy Sahoo	Riding the Pandemic Rollercoaster: Business Strategies for Valleyfair Amusement Park in the Midst of COVID-19
BIOMS-066	Hubert He	Analysis of Gene Expression Changes Influenced by Various Severe COVID-19-associated Single Nucleotide Polymorphisms
BIOMS-074	Fazila Mohamed Prem Navaz	Mitigating Metastasis: Utilizing cancer-associated fibroblasts to stop the spread of cancer
BIOMS-077	Julia Karls	Mighty Muscles: Examining Teratoma-derived Muscle Stem Cells and the Behavioral Tendencies of These Powerful Cells
<b>Chemistry</b>		
CHEM-024	Benjamin Rex and Grayson Roberts	Growing Fuel: Enhancing Phytoplankton Growth with Ferrous Sulfate to Reduce the Cost of Biofuel
CHEM-025	Dominic Greco and Benjamin Kroul	Mighty MOFs: Using Novel Catalysts to Produce Components of Recyclable Plastics
CHEM-045	Maggie Banks	Salt and Paper: Using Papermaking Techniques to Engineer a Plant-Based Piezoelectric Transducer with Rochelle Salt to Generate a Resilient, Eco-Friendly Source of Voltage
CHEM-080	Allison Habib	A Chemical Analysis of Surface Waters
<b>Engineering Technology</b>		
ENGT-008	Jennifer Oettinger	Where the Rubber Meets the Road: The Development of an Innovative, Reusable, and Energy-Efficient Filter for Microplastics Created Through Tire Wear
ENGT-035	Will Anderson	A Comparison of Three Wing Configurations at Different Heights in Ground Effect



ENGT-037	Billal Saidi	Engineering A Cost-Effective Ventilator
ENGT-043	Nikolas Liepins and Levi Mellin	SPYGLASS: Eye-controlled camera glasses
ENGT-082	George Richards and Will Sweeney	A.L.M.E. Assistive Lifting Machine for Elders: Engineering a solution to fall-recovery-related injuries in seniors and caregivers
<b>Environmental Science</b>		
ENVS-005	Hans Xu	The Effect of Microplastics on Radish Growth
ENVS-012	Will Sedo	Identifying the Growth Window for <i>Didymosphenia geminata</i> : A Method for In-lab Growth
ENVS-013	Jack Hlavka	Treatment of Simulated Acid Mine Drainage with <i>Desulfovibrio Desulfuricans</i>
ENVS-018	Christina Radichel and Ayres Warren	You Are My Soil-Mate: The Effects of Fertilizer Composition on Radish Growth
ENVS-022	Ivy Ferstan and Amrit Menon	Pulling Apart Plastic: Measuring the effectiveness of wax worms, bacteria, and fungus in breaking down biodegradable plastic
ENVS-027	Yohanes Eshete	The Effect Pollutants have on <i>Daphnia Magna</i>
ENVS-036	Isabel Medrano	The Impact of Elapsed Burn Time on Restored Prairie Plant Biodiversity and Soil Nutrient Content
ENVS-041	John Cardwell	Testing the Waters: Engineering an Innovative Method of Water Health Analysis, Year II
ENVS-042	Gavin Kimmel	Examining the Relationship Between Socioeconomic Status and Soil Macronutrient Levels
ENVS-044	Rowan Rock	This study was done to evaluate mealworms' ( <i>Tenebrio molitor</i> ) ability to biodegrade Polystyrene (PS) and the use of their gut bacteria to isolate and identify microbes that could metabolize PS, possibly in a wastewater treatment plant. The question w
ENVS-053	Gavin Kratcha	An Analysis of Agricultural Tile Drainage and the Impact of Crop Residue Retention
ENVS-055	Emma Kratcha	Soil Farms: A New Approach to Cropland Restoration
ENVS-059	Omar Elkhateeb	Emulating 100 years of Climate Change
ENVS-061	Pilar Saavedra-Weis	The Effect of Rising Temperature on the Polystyrene Degradation Rate of the Superworm, <i>Zophobas atratus</i>
ENVS-062	Beau Plante	Invasive Buckthorn: What effect does the presence of buckthorn leaves in the soil have on non-invasive plant growth (grass)?
ENVS-067	Emaleigh Olesiak	Air Air Everywhere
ENVS-069	Grace Lavan	Human Effects on Gray Wolf ( <i>Canis lupus</i> ) Den Relocation Distance in Northeastern Minnesota
ENVS-070	Emily Sapyta	The use of different concentrations of tannic acid (St. Louis River water) and non-resistant <i>Staphylococcus aureus</i> on the bioremediation of motor oil contaminated aquatic systems
ENVS-072	Katelin Flack	The importance of disposing yard waste properly
ENVS-073	Harmony Tracy	Tough Turkeys: What effect does climate change have on the home range of Wild

		Turkeys in Northeast Minnesota?
ENVS-075	Abigail Post	Indoor Plants: An Analysis of Their Effect on Ambient Air
ENVS-079	Muminah Mohammed and Noor Omar	One Seed, Infinite Plants
<b>Life Sciences</b>		
LSCI-021	Fiona Kinney and Simren Samba	Fruit Fly Frenzy: Investigating the Development of Insecticide Resistance in <i>Drosophila melanogaster</i>
LSCI-028	George Montague	The effect of UVC exposure on germination rate, time until germination and growth rate in radishes ( <i>Raphanus sativus</i> )
LSCI-032	Eleanor Chen	The Effects of Storage Temperature and Exogenous Ethylene Exposure on the Ripening Rate, Quality, and Glucose Level of Postharvest Ripened Tomatoes ( <i>Solanum lycopersicum</i> )
LSCI-058	Isabel Toghramadjian	Optimizing photoperiod to improve drought tolerance in <i>Arabidopsis thaliana</i>
LSCI-065	Audra Johnson	The Effects of Disinfectants on <i>Escherichia Coli</i> Bacteria
<b>Mathematics and Computer Science</b>		
MCSCI-009	Nathan Krause	Investigations in Topdrops
MCSCI-017	Sahana Mangipudi and Caroline Pirtle	A Schedule a Day Keeps the Doctor Okay: An algorithmic and user-friendly approach
<b>Medicine Health/Behavioral Sciences</b>		
MHBS-006	Richard Xiong	The Development of a Rapid, Scalable, and Low-cost Home Test Kit for COVID-19
MHBS-007	Sophia LeMire	Education in a Pandemic: Identifying Barriers to Learning Success of High School Students in Different Education Modalities in Response to the COVID-19 Pandemic
MHBS-011	James Kung	Influence of Protective Factors and Resilience on Perception of the Police: A Survey
MHBS-020	Nathan DeMichaelis	Learning in the Living Room: What Skills Contribute to Success in Distance Learning?
MHBS-030	Mariya Demaag	The Impact COVID-19 Has Produced on the Social Life of Children
MHBS-038	Tori Thomas	Saving Lives Through Legislation: Addressing Gaps in Coverage for Breast Cancer Screening
MHBS-047	Atreyus Bhavsar	The Spread of Macroscopic Droplets from a Simulated Cough with and without the Use of Masks or Barriers
MHBS-049	Lorien Zhao	Change, Opportunity, Vision, Innovation, and Decision-making (COVID): Business and Personal Strategies for Surviving a Global Pandemic
MHBS-051	Naci Konar-Steenberg	Significant zero: the effect of personality questionnaires on identity-relevant choices.
MHBS-056	Stella Harbson	Persuasiveness of Anecdotal Versus Statistical Information on Attitudes Toward Gun

		Control
MHBS-057	Tanishka Mhaskar	Exploring Electroencephalography: Feasibility of EEG in conjunction to evaluation after sports-related concussion
MHBS-060	Elisa Guo	CD8 T cell epitope generation toward the mutating SARS-CoV-2 spike protein in genetically diverse human population: Implications for disease control and prevention
MHBS-068	Karen Nakamura	Martial arts technique assessment using voluntary muscle contraction and relaxation cycle by surface electromyography (EMG)
MHBS-071	Abirami Rajasekaran and Harini Senthilkumar	Predicting compensatory exercise behaviors from anxiety symptomatology in patients with eating disorders
MHBS-076	Maxanne Millerhaller	The In Vitro Digestion of Animal-based Meat versus Plant-based Meat Alternatives
MHBS-078	Divya Bhargava	No Change? Impact of FDA Warning on the Use of Opioids and Benzodiazepines and Their Effects in Older Allogeneic Hematopoietic Stem Cell Transplant Patients
<b>Physical Science</b>		
PHSCI-033	Jacob Johnson	The Result of Common Building Materials on the Strength of a Radio Signal
PHSCI-034	Tarun Kota	Detection and Characterization of Astronomical Dwarfs using CatWISE
PHSCI-063	Austin Hunter	Analyzing the impact of drafting in cross country skiing with computational fluid dynamics

# Minnesota Academy of Science Regional Junior Science & Humanities Symposium

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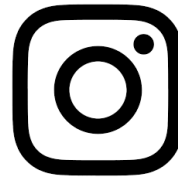
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