

58TH ANNUAL JUNIOR SCIENCE & HUMANITIES SYMPOSIUM

TENNESSEE REGIONAL

MARCH • 9-10 • 2023



PRE-COLLEGE RESEARCH EXCELLENCE PROGRAMS









PROGRAM AND AGENDA

THURSDAY, MARCH • 9 • 2023 ALL TIMES EST

BREAKFAST AND REGISTRATION STUDENT UNION, BALLROOM B	7:30 - 8:30 AM
OPENING REMARKS	8:30 - 8:45 AM
STUDENT UNION, BALLROOM A PRESENTATION OF COLORS: UT ARMY C WELCOME FROM DR. TOM BROADHEAD	OLOR GUARD
ORAL PRESENTATIONS 1 BALLROOM A	9:00 - 10:40 AM
BREAK	10:40 - 11:00 AM
ORAL PRESENTATIONS 2 BALLROOM A	11:00 - 12:40 PM
LUNCH AND DEPARTMENTAL BROWSE BALLROOM B	12:45 - 1:40 PM
ORAL PRESENTATIONS 3 BALLROOM A	1:50 - 3:10 PM
BREAK	3:10 - 3:30 PM
ORAL PRESENTATIONS 4 BALLROOM A	3:30 - 4:50 PM
DINNER BALLROOM B LEAH GUTZWILLER, UNIVERSITY OF T	5:30 - 6:30 PM ENNESSEE
TRIVIA GAMES BALLROOM B	6:30 - 7:30 PM

PROGRAM AND AGENDA

FRIDAY, MARCH • 10• 2023 ALL TIMES EST

BREAKFAST BALLROOM B	8:00 - 8:45 AM
POSTER PRESENTATIONS BALLROOM A	8:30- 10:00 AM
LOAD BUSES FOR TOURS	9:40 - 10:00 AM
 A - COLLEGE OF VETERINARY MEDICINE B - DOUGHERTY ENGINEERING LAB TOURS 	10:00 - 10:45 AM
BREAK	10:45 - 11:00 AM
LUNCH BALLROOM B	11:00 - 11:45 AM
KEYNOTE SPEAKER DR. TONY SCHMITZ	11:45 - 12:30 PM
TJSHS AWARDS CEREMONY BALLROOM A	12:30 - 1:00 PM

WELCOME AND KEYNOTE

TJSHS OPENING REMARKS THURSDAY, MARCH 9 - 8:30 AM EST THSHS KEYNOTE SPEAKER, FRIDAY, MARCH 10 - 11:45 AM EST



Dr. Tom Broadhead Professor Emeritus of Geology

University of Tennessee, Knoxville TJSHS Welcome and Opening Remarks

Dr. Tom Broadhead received his BS in Geology from Emory University in 1972, his MA in Geology from the University of Texas at Austin in 1975, and his PhD in Geology from the University of Iowa in 1978. He joined the geology faculty at The University of Tennessee in 1978, pursuing research in teaching in the field of paleontology. Dr Broadhead and his graduate students studied the marine fossils and rocks of the Paleozoic Era in eastern and middle Tennessee, supported by local and national research grants, including the National Science Foundation.

Although retired from UTK, Dr. Broadhead continues to serve this great institution as chair of the advisory board of the McClung Museum and now as interim director of Pre-College Research Excellence Programs.



Dr. Tony Schmitz

Professor, University of Tennessee, Knoxville Joint Faculty, Oak Ridge National Laboratory TJSHS Keynote Speaker

Dr. Tony Schmitz received his BS in Mechanical Engineering from Temple University in 1993, his MS in Mechanical Engineering from the University of Florida in 1996, and his PhD in Mechanical Engineering from the University of Florida in 1999. He completed a post-doctoral appointment at the National Institute of Standards and Technology (NIST) and was then employed as a Mechanical Engineer from 1999-2002. Dr. Schmitz accepted an appointment in the University of Florida's Department of Mechanical and Aerospace Engineering in 2002 and joined the Mechanical Engineering and Engineering Science Department at UNC Charlotte in 2011.

Dr. Schmitz accepted a Joint Faculty position with the University of Tennessee, Knoxville, (UTK) and Oak Ridge National Laboratory (ORNL) in 2019. The appointment is with the Mechanical, Aerospace, and Biomedical Engineering department at UTK and ORNL's Manufacturing Demonstration Facility. His most recent appointment is Director of the Southern Appalachian Machine Tools Network (SEAMTN), a consortium of companies, colleges and universities, national laboratories, non-profit organizations, and the Tennessee state government that seeks to strengthen the US industrial base by investing in machine tool research and development, education, workforce development, and supply chain support. He continues his manufacturing research in support of the US machine tool industry with an emphasis on machining dynamics, metrology, machine learning, and additive manufacturing.

STUDENT PRESENTATIONS ORAL

THURSDAY, MARCH • 9 • 2023 ALL TIMES EST

Oral Session 1

9:00-10:40 AM

9:00 Mohamed Sankari, Hillsboro High School

Biomedical Sciences Optimizing the Cell Culture Procedure in a High School Laboratory

9:20 Ciarra Davis, Columbia Central High School

Engineering & Technology Energy Generated by a Piezoelectric Nanogenerator: Can a Piezoelectric Nanogenerator Produce Enough Energy to Power a Small Appliance?

9:40 Calvin Fairhead, Hillsboro High School

Engineering & Technology Qualitative and Quantitative Analysis Procurement Tool Development: Focus on Main Battle Tanks

10:00 Hadyn Simmons, Columbia Central High School

Engineering & Technology AeroPi - Creation of an Indoor "Smart" Vertical Aeroponic Tower

10:20 Tyler Wiggins, Signal Mountain Middle - High School

Engineering & Technology A Study and Comparison of Nuclear Technologies on An Interplanetary Scale: Fulfilling the Energy Requirement with Sustainable Infrastructure

Break

10:40-11:00 AM

Oral Session 2

11:00-12:40 PM

11:00 Ella Brown, Columbia Central High School

Environmental Sciences Plants vs Mechanical Filters: Can Plants Filter Water as Efficiently as Mechanized Filters?

11:20 Micaela Masterson, Columbia Central High School

Environmental Sciences How Is Acidification Affecting Sea Life?

11:40 Adithya Sastry, Farragut High School

Environmental Sciences CO2 Capture from Vehicle Exhaust Using the Dry Carbonate Process

12:00 Mary Neas, Columbia Central High School

Physical Sciences Bi-g Energy: Why Do Bismuth Crystals Form Their Unique Structure, and Can the Process be Replicated?

STUDENT PRESENTATIONS ORAL

THURSDAY, MARCH • 9 • 2023 ALL TIMES EST

Oral Session 2, continued

12:20 Nicholas Podar, Oak Ridge High School

Medicine & Health Towards Personalized Medicine: Using Machine Learning to Predict Immunotherapy Effectiveness on Heterogeneous Tumors in Silica

Oral Session 3

1:50-3:10 PM

1:50 Joseph Blair, Oak Ridge High School

Mathematics & Computer Science Using Deep Neural Networks to Identify Exoplanets

2:10 Jerry Xiao, Memphis University School

Mathematics & Computer Science Bounding the Beta Invariant of 3-Connected Graphs

2:30 Patton Duvall, Columbia Central High School

Life & Behavioral Sciences Olfaction Reaction: The Effects of Familial Predisposition on Olfactory Response

2:50 Blake Hazen, Columbia Central High School

Life & Behavioral Sciences The Sight of Music: Does Visualization of Music Decline with Age

Break

3:10-3:30 PM

Oral Session 4

3:30-4:50 PM

3:30 Owen Hollis, Columbia Central High School

Life & Behavioral Sciences I Didn't Mean It That Way!: Are the Four Temperaments a Viable Way to Assess Predisposition?

3:50 Venkata Palanati, McCallie School

Life & Behavioral Sciences The Harmful Effect of Ammonia on Human Lung Cells

4:10 Amanda Shelton, Hillsboro High School Life & Behavioral Sciences

Learning from Mistakes: The Benefit of Incorrect Worked Examples

4:30 Chloe Stokes, Central Magnet School

Life & Behavioral Sciences Understanding 8D Music Perception Using Mobile EEG

STUDENT PRESENTATIONS POSTER

FRIDAY, MARCH • 10 • 2023 ALL TIMES EST

8:30-10:00 AM

Nishanth Basava, McCallie School

Environmental Sciences The Cytotoxic Effect of Silver Nanoparticles on Human Lung Cells

Allyson Casteel, Columbia Central High School

Environmental Sciences Recycling Grey Water: Can Plants Tolerate It?

McKensie Clay and Lilly Lewis, Chattanooga School for the Arts and Sciences

Environmental Sciences Going Green by Going Green

Ruhaan Singh, Farragut High School

Environmental Sciences Understanding the Variability of Wildfire Occurrences in the United States

Audrey Benson, Ravenwood High School

Life & Behavioral Sciences The Effect of Gamification in Early Education Knowledge and Retention

Anna Bigelow, Hillsboro High School

Life & Behavioral Sciences Analyzing the Impact of a Lesson about Managing Stress on Students

Anna Chen and Ruby Phillips, Chattanooga School for the Arts and Sciences

Life & Behavioral Sciences It's Not Me, It's You: The Impact of Suggestibility on Memory

Campbell Hunt, Hillsboro High School

Life & Behavioral Sciences Identifying the Behavioral Adaptations of Individuals with a Differential of Experience within Virtual Reality

Nicholas Yan, Farragut High School

Mathematics & Computer Science Two Orders of Magnitude of Acceleration in Finite Difference Simulation for Diffusion Magnetic Resonance Imaging Signals

Claire Zhang, Brentwood High School

Medicine & Health Point-of-View - A Statistical Analysis of N95 Mask on Blood Oxygen Level

PARTICIPATING SCHOOLS

School	Teacher/ Sponsor	City	County
Brentwood High School	Dr. Qi Zhong	Brentwood	Williamson
Central Magnet School	Gene Cowart	Murfreesboro	Rutherford
Chattanooga School for the Arts & Sciences	Kelly Davis	Chattanooga	Hamilton
Columbia Central High School	Kate Sneed Emily Stafford	Columbia	Maury
Farragut High School	Kelley Loveday Nick Reynolds Chandramouli Sastri	Knoxville	Knox
Hillsboro High School	Ann Brown Joshua Swartz	Nashville	Davidson
McCallie School	Dr. Ashley Posey	Chattanooga	Hamilton
Memphis University School	Dr. Haidong Wu	Memphis	Shelby
Oak Ridge High School	Rick Archibald Debsindhu Bhowmik	Oak Ridge	Anderson
Signal Mountain Middle/High School	Dr. Ryan Rawl	Signal Mountain	Hamilton



STUDENT GUEST SPEAKER

THURSDAY, MARCH 9, 6:10-6:30 PM



Leah Gutzwiller University of Tennessee Haslam Scholar Current UTK student

Leah Gutzwiller is a senior biomedical engineering major and Haslam Scholar at the University of Tennessee, Knoxville. Having participated in research for 6 years, Leah has extensive experience in the fields of neurology, oncology, and cardiology. In high school, Leah was president of a Molecular Modeling SMART team that researched, modeled, and presented work in experimental biology. At UTK she began working as an undergraduate research assistant initially in a Computational Neurology lab and currently in a Cardio-Oncology lab. In 2020, Leah was awarded a National Science Foundation grant to study blood clot composition at The University of Texas at Austin.

In addition to her research, Leah spends much of her time leading and serving in campus organizations. She is president of the Biomedical Engineering Society, president of Honors and Scholars Ambassadors, Chair of the Undergraduate Student Senate, and an engineering ambassador. Leah has been recognized as a leader through her selection as a 2021 Emerging Leader, a 2021 Leadership Knoxville Scholar, a 2022 Society of Women Engineers Collegiate Leadership Insitute Member, a National Academy of Engineers Grand Challenge Scholar, and a Fullbright Fellowship Semi-Finalist. She looks forward to continuing her education in a PhD program in either biomedical engineering or clinical science upon her graduation in May 2023.



DEPARTMENTAL BROWSE SESSION

THURSDAY, MARCH 9TH, 12:45-1:40 PM



Herbert College of Agriculture

College of Arts & Sciences artsci.utk.edu

Department of Anthropology and McClung Museum anthropology.utk.edu mcclungmuseum.utk.edu

> Department of Earth & Planetary Sciences eps.utk.edu

> > Tickle College of Engineering tickle.utk.edu

Department of Industrial & Systems Engineering ise.utk.edu

Department of Mechanical, Aerospace & Biomedical Engineering mabe.utk.edu

Department of Nuclear Engineering ne.utk.edu

Office of Undergraduate Admissions admissions.utk.edu

> Honors & Scholars Programs honors.utk.edu

> > University Libraries lib.utk.edu

JUDGING PANEL



Dr. Brett G. Compton

University of Tennessee Department of Mechanical, Aerospace, and Biomedical Engineering

Dr. Brett Compton is an associate professor of mechanical engineering at the University of Tennessee, Knoxville. Brett moved to UTK from Oak Ridge National Laboratory where he was a staff scientist in additive manufacturing (AM) at the Manufacturing Demonstration Facility (MDF).

The MDF is the Department of Energy's flagship additive manufacturing center, and his research there included thermo-mechanical modeling of large-scale polymer composite AM and in situ thermal monitoring of metal powder bed systems.

Prior to moving to Tennessee, Dr. Compton was a Postdoctoral Research Fellow in the Lewis Group in the School of Engineering and Applied Sciences and the Wyss Institute for Biologically Inspired Engineering at Harvard University, where he developed materials and techniques to 3D print short fiber-reinforced epoxy resins to enable bio-inspired, lightweight polymer composites with controlled fiber orientation. He received his Ph.D. in Materials Science from the University of California, Santa Barbara, and his B.S. in Mechanical Engineering from the University of Kentucky.

Dr. Compton's current research activities include the development and study of thermoset feedstock materials for AM of lightweight composites, foams, and cellular structures; study of the effects the 3D printing process on properties of composites with anisotropic filler materials; and novel printing techniques to control microstructure and mesostructure in printed composites and cellular materials.

JUDGING PANEL



Dr. Wilfred Post Retired Research Scientist

Dr. Wilfred M. Post retired in 2013 as a senior scientist in the ORNL Environmental Sciences Division, a staff member of ORNL's Climate Change Science Institute (CCSI), and an adjunct professor in the Department of Ecology and Evolutionary Biology at the University of Tennessee, Knoxville.

Dr. Post is a recognized expert on soil carbon dynamics nutrient relationships between soil and vegetation, and the impact of species recomposition on ecosystem processes. He has developed approaches to representing the impact of land-use change and climate change in terrestrial biogeochemistry models. He has more than 100 peer reviewed open literature publications and co-authored two books. He has a Ph.D. in Ecology from the University of Tennessee, Knoxville, and an M.S. in Botany and a B.S. in Mathematics from the University of Wisconsin, Madison.



JUDGING PANEL



Dr. Doris D'Souza University of Tennessee Department of Food Science

Dr. Doris H. D'Souza, is a Professor of Food Microbiology and Food Virology Sections in the Department of Food Science at the University of Tennessee Institute of Agriculture.

Her research program includes developing rapid and sensitive molecular methods for foodborne bacterial and viral pathogen detection, tracking and understanding their transmission and persistence; novel and natural control and intervention strategies to enhance food safety and for industrial applications, and genomic approaches to understand and determine modulation of the gut microbiota by bioactives.

Dr. D'Souza earned her B.S. in Microbiology/Biochemistry from St. Xavier's College, University of Mumbai, India and her Ph.D. in Food Science & Technology (Microbiology) from The University of Georgia, Athens, Georgia. Before joining the University of Tennessee in 2006, Dr. D'Souza was a Postdoctoral Research Associate in the Department of Food Science, North Carolina State University, Raleigh, North Carolina.



ADMINISTRATIVE STAFF



Dr. Tom Broadhead Interim Director, Pre-College Programs

Pre-College Research Excellence Programs Office of Undergraduate Admissions The University of Tennessee, Knoxville



Trixie Stengle Coordinator, Pre-College Programs

Pre-College Research Excellence Programs Office of Undergraduate Admissions The University of Tennessee, Knoxville



Heather McQueary Associate, Pre-College Programs

Pre-College Research Excellence Programs Office of Undergraduate Admissions The University of Tennessee, Knoxville

TENNESSEE SPONSORS AND SUPPORTERS

The Junior Science and Humanities Symposium, Tennessee Regional, is hosted by the University of Tennessee, Knoxville, and is administered through the Pre-College Research Excellence Programs in the Office of Undergraduate Admissions, Division of Enrollment Management. Judges are provided by the University of Tennessee, Knoxville and the Oak Ridge National Laboratory.

NATIONAL SPONSORS

The Junior Science and Humanities Symposium, Tennessee Regional, (JSHS-TN) is a Department of Defense sponsored STEM program (U.S. Office of the Secretary of Defense and the U.S. Departments of the Army, Navy, and Air Force) in cooperation with leading research universities throughout the nation. The Department of Defense generously provides funding for the National Symposium and the JSHS-TN scholarships. The JSHS-TN program is administered nationally through the National Science Teaching Association.

FINANCIAL SUPPORT

The Junior Science and Humanities Symposium, Tennessee Regional, is provided by a grant from the National Science Teaching Association. The University of Tennessee Pre-College Research Excellence Programs, Office of Undergraduate Admissions, Division of Enrollment Management provides supplementary support.



TATES OF

61ST NATIONAL JUNIOR SCIENCE & HUMANITIES SYMPOSIUM SPONSORED BY THE U.S. DEPARTMENT OF DEFENSE AND THE U.S. DEPARTMENTS OF THE ARMY, NAVY, AND AIR FORCE.

APRIL 12 - 15, 2023

The 61st National JSHS will be held April 12-15, 2023, as an in-person symposium. 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.

THE COMPETITION

All regional symposia student finalists are invited to present their research at the National JSHS. The top two regional delegates will present their research in the oral session to compete for military-sponsored undergraduate, tuition scholarships. All other regional delegates will present their research in the poster session to compete for cash awards. Sessions will be organized by categories that are selected by the students during the registration process.

THE SCIENTIFIC AND EDUCATIONAL PROGRAM

All students will participate in interactive activities to enrich their JSHS experience and to engage with DoD researchers, laboratories, and related STEM organizations and professionals. Unique opportunities for JSHS students include:

- The Student Research Presentations, the highlight of the National JSHS, feature the STEM achievements of outstanding students representing the U.S., Puerto Rico, and the DoD Dependents Schools of Europe and the Pacific.
- DoD STEM Experiences allow students and teachers to engage with DoD's world-class STEM professionals and provide exposure to the Department's cutting edge research and technologies.
- Banquet and Awards Ceremony recognizes all participants and announces scholarships awarded to students in each competition category of the oral session categories of the National JSHS competition.

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IN PARTNERSHIP WITH



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