## 56TH ANNUAL JUNIOR SCIENCE & HUMANITIES SYMPOSIUM

## **TENNESSEE REGIONAL**

MARCH · 4-5 · 2021 VIRTUAL EVENT





Ĩ

- 調- 調







THURSDAY, MARCH • 4 • 2021 ALL TIMES EST

OPENING REMARKS PRESENTATION OF COLORS & NATIONAL ANTHEM WELCOME FROM DR. PAUL JAFFE	10:00 - 10:30 AM
POSTER SESSION	10:30 - 11:30 AM
BREAK FOR LUNCH	11:30 AM - 1:00 PM
GO OUTSIDE! GET FRESH AIR! GET AWAY FROM SCREENS!	
TICKLE COLLEGE OF ENGINEERING	
INDUSTRIAL & SYSTEMS ENGINEERING	1:00 - 1:20 PM
MECHANICAL, AEROSPACE AND BIOMEDICAL ENGINEERING	1:20 - 1:40 PM
NUCLEAR ENGINEERING	1:40 - 2:00 PM
OAK RIDGE NATIONAL LABORATORY	
OAK RIDGE LEADERSHIP COMPUTING FACILITY TOUR	2:00 - 3:00 PM
FUN ACTIVITY ACTIVITY FOR STUDENTS!	3:00 - 4:00 PM

## PROGRAM AND AGENDA

FRIDAY, MARCH • 5 • 2021 ALL TIMES EST

A.	OPENING REMARKS	9:00 - 9:10	AM
	ORAL PRESENTATIONS SESSION 1	9:10 - 12:00	ΡΜ
	<b>BREAK FOR LUNCH</b> GO OUTSIDE! GET FRESH AIR! GET AWAY FROM SCREENS!	12:00 - 1:00	ΡM
	ORAL PRESENTATIONS SESSION 2	1:00 - 3:45	ΡΜ
	BREAK GO OUTSIDE! GET FRESH AIR! GET AWAY FROM SCREENS!	3:45 - 4:00	ΡΜ
	UNIVERSITY OF TENNESSEE PRESENTATIONS DEPARTMENT OF MATHEMATICS	4:00 - 4:20	PM
	DEPARTMENT OF CHEMISTRY	4:20 - 4:40	ΡΜ
	PRE-HEALTH TRACK AT UTK	4:40 - 5:00	ΡΜ
	TJSHS AWARDS CEREMONY KEYNOTE SPEAKER: CHRISTEN CARADINE	7:00 - 8:00	ΡΜ

# **STUDENT PRESENTATIONS** POSTER

THURSDAY, MARCH • 4 • 2021 ALL TIMES EST

## **Poster Session**

## 10:30-11:30 am

## Daniel Joy, Oak Ridge High School

Using Data Science to Explore Historical Trends and Predict Future Rates of COVID-19

## Kurt Schelzig, Hillsboro High School

The Development of an Improved Wireless Energy Transmission System and Adapter

## Akhilsai Ujjina, East Hamilton High School

Data Informatics Approach for Managing Water Crisis During Pandemic Situations

# STUDENT PRESENTATIONS ORAL

FRIDAY, MARCH • 5 • 2021 ALL TIMES EST

## **Session 1** 9:10 am - 12:00 pm

#### 9:10 am

**Skyler Stone, Cleveland High School** The Classification of Crayfish in Mouse Creek, Cleveland, TN in Oct. 2020

#### 9:30 am

Rishi Soni, Cleveland High School

Developing a Fish Image Classification System for Mouse Creek, Cleveland, TN using Machine Learning

#### 9:50 am

Vivian Song, Hamilton County Collegiate High School

The Potential of Different Rice Varieties as a Natural Water-Resistant Adhesive

#### 10:10 am

Astha Sinha, Girls Preparatory School Experimenting with Nanotechnology

#### 10:30 - 10:45 am BREAK

10:45 am Ridhima Singh, Farragut High School Understanding the Impact of Landscape Patterns on the Urban Heat Island (UHI) Intensity

#### 11:05 am

Saksham Saksena, Houston High School Omnidetector: Universal Screening Test for Cancer, Stroke from Atrial Fibrillation, and COVID Thrombophilia

#### 11:25 am

**Cheryl Quartey, Hume-Fogg Academic High School** Bioinformatic Analysis Predicts Novel Tissue-Specific Enrichment of Nucleoporin Gene Regulators

#### 12:00 - 1:00 pm BREAK FOR LUNCH

## **Session 2** 1:00 - 3:45 pm

#### 1:10 pm

**Grace Maddox, Cleveland High School** Assessing Stream Health as it Pertains to Plethodontid Salamanders at Several Sites within the Cherokee National Forest

#### 1:30 pm

**Junyi Li, McCallie School** Automatic Music Generation Based on Deep Learning Algorithm

#### 1:50 pm Holden Korbey, Hillsboro High School Density-Dependent Effects of Lonciera maackii Allelopathy

#### **2:10 - 2:25 pm** BREAK

#### 2:25 pm

**Eyrin Kim, Farragut High School** Analyzing Disparities of Eviction During the COVID-19 Pandemic Through Spatial Statistical Analysis

#### 2:45 pm

**Raymond Jin, Farragut High School** The Relationship Between Tropical Cyclone Translation Speeds and Aerosol Concentration

#### 3:05 pm

Noah Graybeal, McMinn County High School Masking The Problem: Examination and Analysis of Currently Available Facial Masks and Re-Designed Improvement to Help Prevent Respiratory Exacerbations

#### 3:25 pm

**Charles Eichman, Hillsboro High School** Effects of diammonium phosphate on Saccharomyces cerevisiae Growth and Metabolism

3:45 - 4:00 pm BREAK

# PARTICIPATING SCHOOLS

Brentwood Academy, Brentwood, TN - Williamson County

Chattanooga School for the Arts & Sciences - Chattanooga, TN -Hamilton County Teacher: Ty Campbell

Cleveland High School, Cleveland, TN - Bradley County

Teacher: Jeannie Long

East Hamilton High School, Ooltewah, TN - Hamilton County

Farragut High School, Knoxville, TN - Knox County Teacher: William Reynolds

Girls Preparatory School, Chattanooga, TN - Hamilton County Teacher: Keith Sanders

Hamilton County Collegiate High School at Chattanooga State, Chattanooga, TN - Hamilton County Teacher: Kelly Davis

Hillsboro High School, Nashville, TN - Davidson County Teacher: Joshua Swartz

Houston High School, Germantown, TN - Shelby County Teacher: Abigail Simone

Hume-Fogg Academic High School, Nashville, TN - Davidson County Teacher: John Lee

McCallie School, Chattanooga, TN - Hamilton County Teacher: Caleb Bagby

McMinn County High School, Athens, TN - McMinn County Teacher: Cynthia Moses

North Greene High School - Greeneville, TN - Greene County Teacher: Olivia Kuper

Oak Ridge High School, Oak Ridge, TN - Anderson County Teacher: Deanna Pickel

Ravenwood High School - Brentwood, TN - Williamson County

# OPENING REMARKS AND WELCOME

TJSHS OPENING REMARKS THURSDAY, MARCH 4 - 10:00 AM EST



## Dr. Paul Jaffe

Electronics Engineer and Researcher U.S. Naval Research Laboratory (NRL)

Dr. Paul Jaffe is an electronics engineer and researcher with over 25 years of experience at the U.S. Naval Research Laboratory (NRL). He has led or held major roles on dozens of space missions and on breakthrough technology development projects for civilian, defense, and intelligence community sponsors, including SSULI, STEREO, TacSat-1, TacSat-4, ORS, MIS, PRAM, CARINA, RSGS, PTROL, S2FOBs, and LEctenna.

He was responsible for electrical system and spacecraft computer hardware development. He served as coordinator and editor of two solar power satellite study reports and was the principal investigator for a ground-breaking space solar research effort.

His current roles include program management and systems engineering of a portfolio of projects. He serves as a lecturer for the Aerospace Engineering Department at the University of Maryland. He has over 50 journal, conference, and patent publications and is the recipient of numerous awards. Dr. Jaffe has made many international speaking and media appearances, including as a TEDx speaker, on MSNBC, and the Science Channel's "Through the Wormhole with Morgan Freeman." He is also active in educational and STEM outreach.

## **KEYNOTE SPEAKER** TJSHS AWARDS CEREMONY

FRIDAY, MARCH 5 - 7:00 PM EST



## **Christen Caradine**

Infection Preventionist and Registered Nurse in the Healthcare Acquired Infection Program Tennessee Department of Health

Christen Caradine is an Infection Preventionist and Registered Nurse with the Tennessee Department of Health in the Healthcare Acquired Infection Program. Christen completed her undergraduate studies in nursing at the University of Tennessee Knoxville where she is currently completing her Doctorate of Nursing Practice (DNP) and will graduate in May 2021.

In the field of research, Christen served on an epidemiology research study in collaboration with the Tennessee Department of Health, Emory University, and the University of Utah entitled "Extensively Drug Resistant Organisms: Improving Understanding Of Care Patterns In Long Term Care Facilities". As a part of her DNP research, she implemented an antimicrobial stewardship program in an enhanced respiratory care unit to combat the increase of drug resistant organisms in healthcare settings. Additionally, she served as a facility site coordinator in the production of an "Extensively Drug Resistant Acinetobacter Baumannii" manuscript in September 2019.

Christen was honored to serve as a keynote speaker during the 2019 Smoky Mountain Fall Conference of American Professionals in Epidemiology and Infection Control, presenting a talk entitled: "Non-Traditional Infection Control: Thinking Outside the Acute Care Box". Christen holds a certification in Infection Control and Epidemiology by the Certification Board of Infection Control (CBIC). She is a member of both the local and national chapters of the Association for Professionals in Infection Control & Epidemiology, as well as both the local and national chapters of Sigma Theta Tau. Christen is an active participate in the Knoxville East Tennessee Healthcare coalition and is a member of the Graduate Student Nursing Association.

# JUDGING PANEL

POSTER PRESENTATION SESSION THURSDAY, MARCH 4



### **Betsy Chesnutt, PhD**

Lecturer, Department of Engineering Fundamentals The University of Tennessee, Knoxville

Dr. Betsy Chesnutt holds a PhD in Biomedical Engineering and is a Lecturer in Engineering Fundamentals at the University of Tennessee, Knoxville, where she teaches first-year engineering students and is involved with several engineering outreach programs. She

currently researches engineering education, with a particular focus on K-12 engineering education and teacher training, and she also has experience conducting research in the area of biomaterials and tissue engineering.



### Doris D'Souza, PhD

Associate Professor of Food Microbiology and Food Virology Sections, Food Science and Technology University of Tennessee, Knoxville

Dr. Doris H. D'Souza, is an Associate Professor of Food Microbiology and Food Virology Sections in the Department of Food Science and Technology at the University of

Tennessee, Institute of Agriculture. Her research program includes rapid and sensitive molecular detection of foodborne bacterial and viral pathogens; their transmission, tracking and persistence; novel and natural control and intervention strategies and genomic approaches to understand and determine modulation of the gut microbiota by bioactives. Dr. D'Souza earned her B.S. in Microbiology/Biochemistry, 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.



#### Wilfred Post, PhD 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 of Ecology and Evolutionary Biology at the University of Tennessee, Knoxville. He 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 coauthored two books. Post 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.



### Sudip Seal, PhD

Senior Scientist, Oak Ridge National Laboratory Associate Professor, Tickle College of Engineering University of Tennessee, Knoxville

Dr. Seal is a Senior Scientist in the Computer Science and Mathematics Division, Oak Ridge National Laboratory and an ORNL-UT Associate Professor of Electrical Engineering and

Computer Science at the University of Tennessee, Knoxville. He holds Ph.Ds in Computer Engineering and Theoretical High Energy Physics. Dr. Seal researches in scalable parallel algorithms for large-scale applications of traditional and Al-driven methods in science and engineering and is currently involved in projects related to fusion, neutron and materials sciences.

# JUDGING PANEL

ORAL PRESENTATION SESSION FRIDAY, MARCH 5



#### **Betsy Chesnutt, PhD**

Lecturer, Department of Engineering Fundamentals The University of Tennessee, Knoxville

Dr. Betsy Chesnutt holds a PhD in Biomedical Engineering and is a Lecturer in Engineering Fundamentals at the University of Tennessee, Knoxville, where she teaches first-year engineering students and is involved with several engineering outreach programs. She

currently researches engineering education, with a particular focus on K-12 engineering education and teacher training, and she also has experience conducting research in the area of biomaterials and tissue engineering.



### Scott Emrich, PhD

Associate Professor, Electrical Engineering & Computer Science The University of Tennessee, Knoxville

Dr. Emrich is an Associate Professor of Electrical Engineering and Computer Science at the University of Tennessee, Knoxville. He holds a PhD in Bioinformatics split evenly between theoretical biology and high performance algorithms in computer science. Dr. Emrich

researches in computational genomics and DNA sequence analysis and related informatics with an emphasis on global health and ecological applications. He is currently involved in projects related to protein folding, malaria parasite genetics, biofuel stock improvement, and data science/machine learning applied to genomic applications.



## Marcin Nowicki, PhD

Research Assistant Professor, Entomology & Plant Pathology The University of Tennessee Institute of Agriculture

Dr. Marcin Nowicki is a Research Assistant Professor in Entomology & Plant Pathology. His professional interests include invasive species, speciation, plant biochemistry, environmental inferences, comparative genomics, and crop resistance breeding. His areas

of expertise are plant biochemistry & molecular biology, population genetics analyses & programs, plant live & fixed staining & microscopy, and proteomics. He earned his M.S. in Warsaw, Poland, M.S. Exchange in Hiroshima Japan, Ph.D. in Aachen, Germany, Postdoc at Michigan State & InHort pl, Poland, and Postdoc, EPP-UTIA. His work has had an impact on diversity of rubber dandelion, species diversity of Asian dogwoods, population genetics of eastern Redbud, utility traits tracking in flowering dogwoods, genus-wide SSR analysis of Helianthus spp, invasiveness of callery pear vs. native species diversity, and species identity and diversity of downy mildew pathogens: P. tabacina, and Ps. cubenis vs. Ps. humuli. In his scant free time, Dr. Nowicki enjoys geeking out with an obscure epic fantasy book, swimming (hard under COVID), or optimizing that next new piece of software. As a certified lab-rat, Marcin loves extending that experience into testing new exciting protocols for cook-outs with his dearest-and-nearest; all are still accounted for, remain in great health, and demand seconds and thirds!



#### Wilfred Post, PhD 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 of Ecology and Evolutionary Biology at the University of Tennessee, Knoxville. He 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 coauthored two books. Post 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.

## **ADDITIONAL SESSIONS** THURSDAY, MARCH 4

#### 1:00 - 1:20 pm EST



### Laura O'Shaughnessy

Assistant Professor of Practice, Industrial & Systems Engineering University of Tennessee, Knoxville

### Rachel Ware

Senior and Outreach Ambassador University of Tennessee, Knoxville

Session Description: Information and Discussion about the exciting intersection of engineering and business - Industrial Engineering!

#### 1:20 - 1:40 pm EST

### **Doug Aaron, Ph.D**

Assistant Department Head, Undergraduate Programs, Mechanical Aerospace and Biomedical Engineering University of Tennessee, Knoxville

Session Description: An introduction to the people, activities, and organizations that make MABE a vibrant department.

1:40 - 2:00 pm EST



Jamie Coble, Ph.D Associate Professor, Nuclear Engineering **Emily Hutchins** Ph.D Student University of Tennessee, Knoxville

Session Description: Nuclear engineering is a diverse field that touches on many aspects of our lives, often without us even knowing! Students at the University of Tennessee study the fundamental elements of nuclear engineering to positively impact global challenges, from clean energy production to medical imaging and treatment to safe deep space exploration. Learn more about how you can make a difference with nuclear engineering.

#### 2:00 - 3:00 pm EST

#### **Subil Abraham**

High Performance Computing Engineer, Operations-Productions Group Oak Ridge National Laboratory

Session Description: A virtual tour of the Oak Ridge Leadership Computing Facility



## **ADDITIONAL SESSIONS** FRIDAY, MARCH 5

#### 4:00 - 4:20 pm EST



#### Joan Lind, PhD

Associate Professor, Director of Math Majors & Minors Department of Mathematics University of Tennessee, Knoxville

Session Description: Since research in math generally does not involve labwork, the idea of math research can be more mysterious. Come and find out what it means to do research in math and glimpse the variety within mathematical research.

4:20 - 4:40 pm EST



**Mike Best, PhD** Professor, Director of Graduate Studies Department of Chemistry University of Tennessee, Knoxville

Session Description: Pre-recorded virtual tour of research labs and facilties followed by a discussion about pursuing a career in chemistry with Q&A

#### 4:40 - 5:00 pm EST



**Shanna Pendergrast** Associate Director, Arts & Sciences Advising Services University of Tennessee, Knoxville Kat Powell Academic Advisor, Arts & Sciences Advising Services University of Tennessee, Knoxville

Session Description: Are you a student thinking about pursuing a career in the health professions? If so, this session is for you! During the session we will discuss what it means to be a college student on a pre-health path. Our interactive session will conclude with some resources to assist you in exploring your interests in health care.

## JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM, TENNESSEE REGIONAL ADMINISTRATIVE STAFF



## Thomas Broadhead, PhD Lead Pl

Director of Undergraduate Academic Advancement Office of Undergraduate Admissions The University of Tennessee, Knoxville



## **Susan Troop** Assistant Director, Pre-College Programs

Office of Undergraduate Admissions The University of Tennessee, Knoxville



### **Jason Moody** Administrative Specialist, Pre-College Programs

Office of Undergraduate Admissions The University of Tennessee, Knoxville



### **Jaime Morales** Graduate Student Assistant, Pre-College 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 jointly sponsored by the research offices of the United States 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.













## **59TH NATIONAL JUNIOR SCIENCE & HUMANITIES SYMPOSIUM** U.S. ARMY, NAVY, AND AIR FORCE SPONSORED

## APRIL 14 - 17, 2021

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.

## 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.

The Junior Science and Humanities Symposium, Tennessee Regional, is sponsored by the United States Departments of the Army, Navy, and Air Force, and is administered by the National Science Teaching Association in cooperation with the University of Tennessee, Knoxville.

IN PARTNERSHIP WITH



The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment and admission without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, gender identity, age, physical or mental disability, genetic information, veteran status, and parental status.