

# BULLETIN

**CREATIVITY • INNOVATION • SERVICE**

Hallmarks of excellence in higher education. Keys to success in life. Be a part of it. Ask how.

## Update on sponsored programs during the COVID-19 response

As of now, we are relying on individual sponsors for guidance for dealing with the effects of the evolving COVID-19 crisis on recipients' ability to fulfill our programmatic and administrative obligations.

Individual sponsors' websites and email lists provide updates on the agency-specific responses/plans regarding submission deadlines, reporting deadlines, work stoppages or slowdowns, and possible project period extensions.

Do not hesitate to contact your pre-award specialist or award manager with any questions or concerns about your awards or proposals.

Please know that MTSU's generous continuation of wages for undergraduate students who are unable to report for work will be charged to your grants INITIALLY and TEMPORARILY. Those expenses will not be passed on to sponsors. The Budget Office will move those relief wages to a University account in the future.

While individual agencies may ultimately allow compensation paid during work stoppages, we do not expect that to be a statewide or federal across-the-board response. In addition, in those cases where the compensation is allowed, we have no indication that additional funding will be available to pay for the effort necessary to fulfill the project once work resumes. If grant-funded student workers do report for work, their time should be reported and charged to the grant. Also, pursuant to the message from Human Resources on the matter, graduate student assistants must report to work in order to receive compensation, in the form of wages or stipend, and to continue to qualify for tuition assistance.

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# FUNDING OPPORTUNITIES

Also be aware that our subscription funding opportunity search engine, GrantForward, is providing free access to funding opportunities related to COVID-19. Their list will be updated daily: [grantforward.com/grant-covid](https://grantforward.com/grant-covid)

## National Endowment for the Humanities (NEH)—Digital Humanities Advancement Grants (DHAG)

Deadline: June 30

[neh.gov/grants/odh/digital-humanities-advancement-grants](https://neh.gov/grants/odh/digital-humanities-advancement-grants)

Digital Humanities Advancement Grants (DHAG) support innovative, experimental, and/or computationally challenging projects at different stages throughout their lifecycles, from early startup phases through implementation and sustainability. Experimentation, reuse, and extensibility are hallmarks of this program, leading to innovative work that can scale to enhance scholarly research, teaching, and public programming in the humanities. This program is offered twice per year. Proposals are welcome for digital initiatives in any area of the humanities.

## National Endowment for the Humanities (NEH)—Summer Stipends

Internal deadline: Express interest to ORSP at [research@mtsu.edu](mailto:research@mtsu.edu) by June 8

[neh.gov/grants/research/summer-stipends](https://neh.gov/grants/research/summer-stipends)

The Summer Stipends program aims to stimulate new research and dissemination in the humanities by supporting full-time, tenure-track scholars for advanced research of value to humanities scholars, general audiences, or both. The program supports research at any stage, but early-stage research and late-stage writing are priorities. Summer Stipends support continuous full-time work for two consecutive months. NEH funds may support recipients' compensation, travel, and other costs related to the proposed research.

*Each institution is limited to two applicants. In order to apply, faculty must be nominated by their institution. Please notify ORSP at [research@mtsu.edu](mailto:research@mtsu.edu) by June 8 if you want to be considered for a nomination.*

## Tennessee Board of Regents (TBR)—Student Engagement, Retention, and Success (SERS)

Internal deadlines: Notify ORSP at [research@mtsu.edu](mailto:research@mtsu.edu) by April 24

Full proposal due to ORSP at [research@mtsu.edu](mailto:research@mtsu.edu) by May 1  
[tbr.edu/oesi/student-engagement-retention-and-success-initiative-sers-instructions-and-information](https://tbr.edu/oesi/student-engagement-retention-and-success-initiative-sers-instructions-and-information)

For this year, the funding level for the SERS grants has increased to \$50,000 for either a pilot program or a program enhancement. Applications will be accepted in two areas:

- Student recruitment and engagement grants (for underserved student populations)
- Faculty/staff-focused grants (training and/or professional development for employees with a focus on diversity, equity, and inclusion)

*These proposals must undergo a legal review before submission, so ORSP has established the schedule posted above to accommodate that review.*

## Research and Development in Forensic Science for Criminal Justice Purposes, Fiscal Year 2020

Deadline: May 18

[nij.ojp.gov/funding/opportunities/nij-2020-17294](https://nij.ojp.gov/funding/opportunities/nij-2020-17294)

The National Institute of Justice (NIJ) seeks proposals for basic or applied research and development projects. NIJ forensic science research and development grants support projects that will 1) increase the body of knowledge to guide and inform forensic science policy and practice or 2) lead to the production of useful material(s), device(s), system(s), or method(s) that have the potential for forensic application.

## Research and Evaluation for the Testing and Interpretation of Physical Evidence in Publicly Funded Forensic Laboratories, Fiscal Year 2020

Deadline: May 18

[nij.ojp.gov/funding/opportunities/nij-2020-17293](https://nij.ojp.gov/funding/opportunities/nij-2020-17293)

The National Institute of Justice seeks proposals for research and evaluation projects that:

- Identify and inform the forensic community of best practices through the evaluation of existing laboratory protocols, and
- Have a direct and immediate impact on laboratory efficiency and assist in making laboratory policy decisions.

## Inclusion Across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES)

Deadline: July 13

[nsf.gov/pubs/2019/nsf19600/nsf19600.pdf](https://nsf.gov/pubs/2019/nsf19600/nsf19600.pdf)

These Planning Grants build capacity to a) facilitate innovative partnerships, networks, and theories of action for broadening participation in science, technology, engineering, and mathematics (STEM) at scale and b) lead to the establishment of future centers, alliances, or other large-scale networks to address a broadening participation challenge.



Samantha Cantrell

## FROM THE DESK OF . . .

Samantha Cantrell

### Figure in proposal's indirect costs

When you start thinking about the budget for your proposal, keep in mind that indirect costs are an essential component of that budget. Indirect costs are actual costs to the University for facilities and administrative support not paid directly by grants.

Unless a funding agency explicitly limits indirect costs at a lower level, MTSU utilizes a federally negotiated rate of 30.8% of modified total direct costs (MTDC). MTDC excludes the following direct costs from the calculation: capital equipment (a single item costing \$5,000 or more with a life expectancy of three years or longer); participant support (costs that directly benefit trainees); tuition and fees; scholarships and fellowships; and the cost of subawards in excess of \$25,000.

#### HERE TO HELP!

For assistance with finding and preparing for funding opportunities, please contact your ORSP pre-award specialist:

**Samantha Cantrell**  
[samantha.cantrell@mtsu.edu](mailto:samantha.cantrell@mtsu.edu)

615-494-8751

*Behavioral and Health Sciences, Liberal Arts, Media and Entertainment, Jones College of Business, Walker Library, University College, non-academic units*

**Jolene Gordon**  
[jolene.gordon@mtsu.edu](mailto:jolene.gordon@mtsu.edu)

615-898-5894

*Basic and Applied Sciences, College of Education*

## Grant Writing Enhancement Program

The Grant Writing Enhancement Program (GEP) is a professional development experience of direct individual and group support for faculty and administrators, regardless of their level of grant writing experience.

The goals of the Grant Writing Enhancement Program include:

1. Prepare scholars to be leaders in their fields.
2. Strengthen a culture across campus of expectations, opportunity, and rewards for faculty engagement in sponsored programs.
3. Increase the number of faculty and administrators successfully engaged in grant writing at MTSU.
4. Increase the number and dollar value of externally funded projects, programs, and centers across the University.

To meet these goals, the Office of Research and Sponsored Programs (ORSP) has developed a three-year curriculum consisting of the following components: Professional Development (Year 1), Grant Writing (Year 2), and Award Management (Year 3).

If you are interested in learning more about GEP, please visit [mtsu.edu/research/GEP/index.php](https://mtsu.edu/research/GEP/index.php).



ORSP recommends that faculty with active or planned work with federal agencies periodically visit the Council on Government Relations' comprehensive directory to federal agency guidance during the public health emergency: Institutional and Agency Responses to COVID-19 and Additional Resources. [cogr.edu/institutional-and-agency-responses-covid-19-and-additional-resources](http://cogr.edu/institutional-and-agency-responses-covid-19-and-additional-resources)

Also be aware that our subscription funding opportunity search engine, GrantForward, is providing free access to funding opportunities related to COVID-19. Their list will be updated daily: [grantforward.com/grant-covid](http://grantforward.com/grant-covid)

## Trainings and Workshops

The ORSP is developing our campus training schedule for the 2020–21 academic year. If there is a particular workshop you would like for us to offer, please send your requests to [jamie.burriss@mtsu.edu](mailto:jamie.burriss@mtsu.edu).

Our tentative schedule includes the following trainings and workshops:

- Scholarship and Cybersecurity (rescheduled from March 2020)
- Collaborative Grant Writing
- Women in STEM
- Exploring Research Experiences for Undergraduates (REU)
- Post-Rejection Planning and Triage
- Philosophy of a Proposal Budget
- Converting a Basic Topic to “Innovative” and “Interesting”
- Working with Undergraduate Researchers
- Developing a Proposal for the CAREER Award
- Working with Foundations
- Entrepreneurship
- Working with Tennessee Agencies
- Intellectual Property, Technology Transfer, and Commercialization

## STUDENT RESEARCH SPOTLIGHT

### Big congratulations to the following students for their recent successes!

**Lucas Remedios**, a Computer Science major, has been accepted into the Computer Science Ph.D. program at Vanderbilt University. Faculty mentor: Joshua Phillips

**Kayley Stallings**, a double major in Biochemistry and Fermentation Science, has been accepted into the Biological Sciences Ph.D. program at Clemson University. Faculty mentor: Keely O'Brien

**Robyn Sessler**, a Psychology major, has been accepted into the Quantitative Psychology master's program at Middle Tennessee State University.

**Jared Frazier**, a Chemistry and Computer Science major, was selected from a competitive pool of candidates for a summer internship through the DAAD RISE (Research Internships in Science and Engineering) Germany program. DAAD RISE is funded by the German Federal Foreign Office and offers undergraduate students from North American, British, and Irish universities the opportunity to complete summer research internships at top German universities and research institutions. Faculty mentors: Mengling Zhang and Gregory Van Patten

*To view student publications and creative projects, please visit our newly created website: [mtsu.edu/urc/publications-projects.php](http://mtsu.edu/urc/publications-projects.php)*

## PRESENTERS SELECTED FOR NATIONAL CONFERENCE ON UNDERGRADUATE RESEARCH (NCUR)

While NCUR 2020 was cancelled due to the COVID-19 pandemic, we would like to feature our undergraduate researchers who were selected to present at the National Conference on Undergraduate Research in Bozeman, Montana. Here are their projects and abstracts.

### Autumn Martin

#### Fixed and Growth Beliefs about Different Ability Domains among College Students

Faculty mentors: Tom Brinthaupt, Ryan Korstange (Psychology)



Mindset theory looks at how basic abilities are perceived and is very relevant to the academic setting. Individuals can view abilities as either something that are innate and unchangeable (fixed) or something that have the possibility of being developed (growth). My research project expands the concept of mindset theory to look at not only academics and social skills, but also to consider a multitude of other domains (leadership skills, athletics, and artistic abilities). I wanted to see if fixed or growth mindset beliefs reflect a general trait that applies across multiple domains, or if there could be differentiation depending upon the ability domain in question.

For this project, I manipulated Dweck's eight-item mindset instrument (DMI) (P'Pool, 2012) for each individual domain. Students (N=209, 110 women, 99 men) rated each domain in terms how stable or changeable they believe it is. I wanted to see if there was any potential differentiation in skill/ability beliefs across gender, grade level, or ethnicity. Our results show that, overall, the domains seemed to correlate positively, meaning that over the different domains, students are generally consistent in whether they believe their skills or abilities are changeable or stable. We found slight, but non-significant, differences in beliefs based on gender. There was also some evidence of differentiation in the domains, with students reporting higher levels of growth beliefs in the intelligence and leadership domains compared to the athletic and artistic domains.

The domains that were chosen for this study are ones that a college student could be presented with at some point during their college experience. Understanding how students perceive themselves in those multiple domains can allow researchers to see if mindset is a trait that is specific to a certain domain or if it extends to their general perception of everything related to their college experiences.

### Kaitlyn Berry

#### Mismatch Negativity Responses to English Vowel Sounds During an Audiovisual Oddball Task

Faculty mentors: Emily Farris, Tim Odegard (Psychology)



This study explored the automaticity of grapheme-phoneme correspondences. Past research has investigated this multimodal integration using an audiovisual oddball paradigm. For this paradigm, a standard stimulus is presented over multiple trials, and an infrequent deviant oddball occurs rarely. Electroencephalogram (EEG) recordings captured during this task reveal a greater negative deflection following the presentation of a deviant compared to the standard. This negative component is called the mismatch negativity (MMN), and it is thought to reflect a violation of representations in working memory.

Prior research has observed differences in MMN to occur across individuals who vary in age or reading skill proficiency. Much of the existing research explored languages where phonemes map to a restricted number of graphemes. In contrast, less research has been conducted in more orthographically complex languages. In English in particular, vowel phonemes map to numerous graphemes.

Method: In the current study, undergraduate students completed an audiovisual oddball task where grapheme "a" was presented with either short a (standard), short o (deviant 1), or schwa (deviant 2). Outside of the experimental context, all three phonemes correspond to grapheme "a," yet they differ in the extent to which they may correspond with additional graphemes. It was hypothesized these differences in linguistic features of the chosen vowel sounds would modulate observed MMN responses.

Results: Results indicate the MMN was distributed largely in the frontocentral areas of the brain for both deviant phonemes as expected, with more topographically widespread findings observed for deviant 2 (schwa). Furthermore, presentation of the schwa sound, which occurs with a wide variety of letter patterns, was associated with a greater negativity than the short o deviant. Conclusions: These data suggest statistical features of the relationship vowels have with graphemes can modulate the automaticity of the associative response evoked by the presentation of a grapheme.

## Robyn Sessler

### Experimental or Linguistic Frequency? A P300 Analysis of Grapheme-Phoneme Correspondence

Faculty mentors: Emily Farris, Tim Odegard (Psychology)



Knowledge of grapheme-phoneme correspondences is crucial to reading comprehension. Sometimes this mapping is straightforward; however, in English, several phonemes may correspond with a single grapheme, resulting in more complexity. Previous research on the neural underpinnings of language processing use event-related potentials such as the P300, which is a positive change in brain activity in response to an unexpected stimulus thought to be related to attention, memory, and inhibition. The P300 is commonly elicited using active and passive versions of the oddball paradigm, in which a frequently occurring standard stimulus is presented along with an infrequent “deviant.” Less research has examined how stimulus characteristics modulate this response. This study investigated the P300 response to stimuli differing in their linguistic frequency within the English language.

Undergraduate students completed a passive audiovisual oddball task in which the visual stimulus of grapheme “a” was held constant and the concurrently presented auditory stimulus was one of three phonemes: short a (standard, common), short o (deviant 1, uncommon), or schwa (deviant 2, very common). Outside of the experimental context, all three phonemes correspond to grapheme “a” but they differ in the extent to which they may correspond with additional graphemes, which may influence the magnitude and topography of the associated P300.

As expected, both deviants showed a stronger P300 effect relative to the standard phoneme. Deviant 1 has a narrow range of possible phoneme-grapheme correspondences and exhibited a more widespread effect over both the frontal and parietal areas, while deviant 2 only showed this effect in the frontal area. However, deviant 2, which occurs with a wide variety of letter patterns, had a stronger amplitude response in the frontal region. This finding suggests that linguistic frequency outside of the experimental context may influence neural processing of linguistic stimuli.

## Robyn Sessler

### If the Model Fits: A Factor Analysis of the Five-Facet Mindfulness Questionnaire

Faculty mentor: Cameron Gordon (Psychology)



Over the last several decades, mindfulness has become a very popular topic in psychology. Mindfulness, defined as present moment awareness and curiosity, has been shown to improve health and well-being through a variety of mindfulness-based interventions. The Five-Facet Mindfulness Questionnaire (FFMQ) has become a popular measure for mindfulness, as it conceptualizes mindfulness into five factors: Observing, Describing, Acting with Awareness, Nonreactivity to Inner Experience, and Nonjudgement to Inner Experience. Over the last several years, several studies have investigated how the five-factor model fits different samples with different demographics, specifically community versus clinical samples. The literature shows inconsistency over whether the five-factor model fits different samples with both adequate and inadequate fit reported for community and clinical samples. Therefore, this study sought to replicate these studies in order to determine if the five-factor model adequately fits a community sample (N = 211).

Given previous research, several confirmatory factor analyses (CFA) were run: the original five-factor model, a five-factor hierarchical model with total mindfulness as an overall construct, four-factor hierarchical and non-hierarchical models excluding Observe, a facet known to behave differently in meditators versus non-meditators, and a six-factor model that split Acting with Awareness into two separate factors, in line with previous literature. All of the models demonstrated poor fit for the data (all RMSEA < 0.07, indicating fair fit; however CFI < 0.90 and NNFI < 0.90, indicating poor fit). These results suggest that the five-factor model may not adequately fit this community sample, despite sufficient item loadings onto each respective factor. Given the inconsistency in the literature and that some researchers suggest conceptualizing mindfulness in fewer or additional factors, future work is necessary to measure different aspects of mindfulness in a consistent, meaningful way.

**Radina Porashka,  
Mary Parsley,  
Sauleen Shamdeen,  
and Nathan Smith**

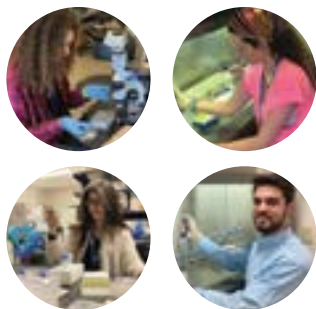
**Survey of Mosquito  
Predatory Ciliate  
Lambornella for Potential  
Biological Control**

Faculty mentor: Anthony Farone (Biology)

Mosquitoes are known for being vectors of transmission of various diseases, including malaria, Zika virus, West Nile virus, and yellow fever. With the current concern over mosquito-borne viral infections, it is worth revisiting the possibility of growing the ciliated protozoan, *Lambornella*, for biological control applications. The purpose of this study was to identify, isolate, and culture *Lambornella clarki* to utilize as a potential biological mosquito control.

The ciliated protozoan *Lambornella clarki* and other *Lambornella* species are known to target mosquitoes, specifically mosquito larvae. *Lambornella* parasitize mosquito larvae by attaching to the exterior of the larval cuticle, then form a hole in the cuticle and enter the hemocoel, thereby invading the tissue and killing the larva. The specificity of *Lambornella* to target mosquitoes and its high infectivity rate for the larvae have led to the suggestion that the organism could be used for the biological control of mosquito populations. In order to achieve these results, we collected water samples locally and from Florida and California.

Ciliated protozoa were isolated by a variety of techniques and cultured in various media. DNA from isolates was amplified using the PCR to confirm the identity of the ciliate. Out of 37 samples, 19 of them were identified as potential *Lambornella* candidates. Potential *Lambornella* candidates will be tested for their ability to grow to large numbers by culture. Identifying appropriate culture media and conditions will be vital to use *Lambornella* as a natural biological control instead of current potentially hazardous chemical control agents.



**Sara Moore and  
Rebekkah Riley**

**Inducing Somatic  
Embryogenesis in Grape  
(*Vitis aestivalis* "Norton/  
Cynthiana") Tissue Callus Derived from Ovary and  
Anther Explants**

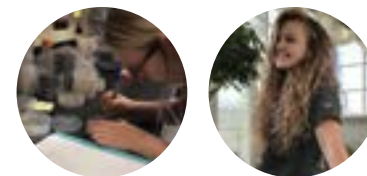
Faculty mentor: John DuBois (Biology and University Honors)

The grape plant *Vitis aestivalis* "Norton/Cynthiana" is known for its hearty nature and low maintenance. However, this grape is also known for its poor propagation. Plant tissue culture is one method that has been used to propagate other recalcitrant species. The first goal of this research was to propagate undifferentiated cell growth, or callus, from anther and ovary tissues of immature flower buds.

Callus growth was successfully achieved using a Lloyd and McCown basal nutrient tissue culture media. Healthy callus tissue was quickly created from the ovary tissue, whereas callus was not immediately successful from the anther tissue. Anther explant tissues had to remain on the media for several weeks longer than expected before the callus began to grow.

The second goal of this project is to successfully generate somatic embryogenesis from the callus. Both the anther and ovary callus are being placed on embryogenic tissue culture media in order to promote embryogenesis. As *Vitis aestivalis* is not easily propagated, the embryogenic tissue media must be carefully made and adjusted to find the exact mix of cytokinin and auxin concentrations that will generate embryogenesis. Somatic embryogenesis in *Vitis aestivalis* has been attempted using callus generated from leaf explant tissue, but to date has had no success. The use of floral tissues has shown some success in other grape species.

Successful completion of these goals would allow for plantlet production, and ultimately, reintroduction of this species into vineyards as a fungal endophyte free plant.



## Omar Aly

**Species composition of forensically-important flies associated with human decomposition at the Anthropology Research Facility of the University of Tennessee**



Faculty mentor: Yanseung Jeong (Biology)

Forensic entomologists use insect evidence to reconstruct the circumstances of a crime scene at/around the time of event (e.g., estimation of time since death, determination of body movement). Forensically-important flies (FIF) are found in various stages of human decomposition. They lay eggs on a body and their maggots consume soft tissues, which significantly affect the pattern and rate of decomposition. The Anthropology Research Facility (ARF), the so-called "Body Farm," at the University of Tennessee has been used for human decomposition research for 40 years. Despite the important role of FIF in the process of human decomposition, it has not been fully investigated what species of FIF are present at the ARF. The purpose of this study is to investigate the seasonal and regional composition of FIF species at the ARF. This long-term study will serve as a basis to evaluate the effect of different FIF species on human decomposition.

Flies were collected from 27 traps across the ARF twice a month between March 2018 and April 2019 (No flies were caught between December 2018 and March 2019). As of November 2019, morphological identification has been completed on 75% of the sample (2,513 out of 3,357 flies). Blowflies (Diptera: Calliphoridae) comprise approximately 94% of ID'ed flies. Out of 16 blowfly species identified, *Phormia regina* turned out to be most dominant in the spring and summer, but *Lucilia coeruleiviridis* was the most dominant species in the fall. A significant change in the regional composition of FIF species by season was also noticed.

Decomposition states of nearby bodies appeared to influence the regional distribution of the flies. Deeper knowledge about the species composition and activities of FIF at the ARF will enhance understanding on human decomposition and, eventually, contribute to a more accurate estimation of time since death in a crime scene.

## Gabriella S. Morin

**Determining How Disease-Associated Mutations Affect the Dynamics of Mitochondrial Recruitment and Loss of the Mitophagy Regulator, Parkin**



Faculty mentor: David E. Nelson (Biology)

The PINK1:Parkin mitophagy pathway is a mitochondria-specific form of autophagy that destroys damaged, dysfunctional mitochondria within cells, thereby maintaining the health and integrity of mitochondrial networks. Loss of function mutations in the genes encoding PINK1 and Parkin, the principal regulators of the pathway, are associated with the neurodegenerative disorder Parkinson's disease (PD). At polarized mitochondria, PINK1 is rapidly processed and degraded. However, damage-induced loss of mitochondrial membrane polarization (MMP) promotes stabilization of PINK1 on the outer mitochondrial membrane (OMM), recruiting cytosolic Parkin to form phospho-polyubiquitin chains (ppUb) on OMM substrates, which serve as binding sites for autophagy receptors. If loss of MMP is transient, the process of mitophagy can be interrupted and PINK1 will be rapidly degraded within a matter of seconds or minutes. However, we have observed that Parkin often persists at the OMM for many minutes after restoration of MMP. We hypothesize that the slow degradation of ppUb chains after repolarization is responsible for Parkin retention.

To test this, we have reconstituted Parkin-null HeLa cells with EYFP-tagged wild type Parkin or a variety of Parkin mutants including the E3 ligase dead mutant R275W, which is recruited with the same kinetics as WT Parkin post loss of MMP. We show that after restoration of MMP, R275W dissociates from the OMM more rapidly than WT Parkin. This is consistent with the hypothesis that ppUb chains are required for Parkin retention at the mitochondria following repolarization.



## Kayley Stallings

### Effect of Tea Brewing Temperature and Tea Concentration on the Microbial Profile of Kombucha

Faculty mentor: Keely O' Brien  
(Agriculture)



Kombucha, a fermented tea made with a symbiotic colony of bacteria and yeast (SCOBY), has been touted as a health beverage for years. Previously, the health benefits attributed to kombucha have been primarily anecdotal; however, as kombucha consumption has increased over recent years, scientists are beginning to question what causes the supposed benefits, with many researchers attributing the advantages to kombucha's microbial ecosystem. Previous research examining kombucha produced with different types of tea demonstrated many variations in the microbiome. Therefore, manipulating the amount of tea used and the tea brewing methods may affect the microbiome of kombucha as well. This study was conducted to determine how different kombucha production techniques—tea concentration and tea steeping temperature—alter the kombucha's microbiome.

For this project, kombucha was made using varying concentrations of black tea and a range of brewing temperatures to determine if either had an effect on the microbial profile. The teas were fermented to the desired end-point and were then plated on selective agars to identify and quantify the types of microbes present. The results of this study will provide further insight into how different production practices affect the microbial profile of kombucha and how that might translate to the wellbeing of the consumer.

## Aric Moilanen

### Disordered Electron Systems: A Local Quantum Cluster Model

Faculty mentor: Hanna Terletska  
(Physics and Astronomy)



One essential factor in the modeling of quantum electron systems is the presence of disorder. Disorder is a ubiquitous feature of all real materials that can have extremely profound effects on the structural and transport properties of said materials. Disorder can even cause phase transitions in materials, such as the metal-insulator transition brought about by disorder-driven Anderson localization. We use quantum cluster typical medium theory (QC-TMT) to identify when these transitions occur. QC-TMT is an effective medium theory, which employs the typical density of states rather than the average density of states, to distinguish between metal and insulator. As an ad hoc approximation, TMT is extremely dependent on using a good ansatz. However, if attempting to model a complex system, such as an interacting multi-orbital system, the use of a full cluster momentum  $K$ -dependent non-local ansatz makes computation nearly impossible. We tested the validity of using a simplified local-only ansatz for calculating typical density of states, which would make the simulation of such systems viable.

The local ansatz neglects all non-local inter-site ( $K$ -dependent) effects in typical density of states and only considers local (on-site) density of electrons. In our testing, we have found that the local-only ansatz agrees with the full  $K$ -dependent ansatz at disorder values close to the transition. Furthermore, we have established for what criteria, including disorder ranges, this local-only approximation remains valid.

## Travel Support for Undergraduate Research

The Undergraduate Research Center strives to support students in dissemination of their research. Undergraduates who are accepted to present their research at a regional, state, national, or international conference are eligible to receive travel funding. Support includes:

- \$400 yearly maximum for domestic travel and \$500 yearly maximum for international travel
- Awarded travel funds payable on a **reimbursable basis only**

Check out our website for more information: [mtsu.edu/urc/travel.php](https://mtsu.edu/urc/travel.php)

## PRESENTERS SELECTED FOR NATIONAL CONFERENCE ON UNDERGRADUATE RESEARCH (NCUR) (continued)

### Jared Frazier

#### Practical Investigation of Direct Analysis in Real-Time Mass Spectrometry for Fast Screening of Explosives

Faculty mentor: Mengliang Zhang  
(Chemistry)



While the direct analysis in real-time (DART) ionization source coupled with mass spectrometry (MS) is viable for the screening of trace explosives, previous methods require larger amounts of explosive residue for positive identification and are limited by signal suppressing effects of matrices. This work demonstrates novel methods using DART-MS for the high-throughput and sensitive detection of 19 organic explosive residues in four different categories deposited on several substrates.

Explosive residues were selected based on their use in historical bombings that have tragically claimed the lives of civilians and the armed forces of many nations. To combat the

threat of explosives to national security, several methods were investigated using DART-MS. The Quickstrip™ sample card method was used to optimize DART gas heater temperature as well as dopants, which is critical for decreasing the limit of detection for deadly explosives and thereby reducing the likelihood of false negatives. Four sample introducing strategies for DART-MS, including transmission, thermal desorption, closed mesh, and direct-insert methods, were implemented to analyze liquid and dried samples deposited on five substrates. Fabric, leather, metal, plastic, and synthetic skin were selected to simulate realistic matrices for explosive residues.

The effects of substrates on signal suppression as well as limits of detection for different explosives were evaluated. Notably, the high profile explosive hexamethylene triperoxide diamine, used in 2016 New York bombings, could be detected more sensitively than previously. Further, it was found that representative explosives from each category could be detected with nanogram sensitivity and in less than 10 seconds. Therefore, the proposed methods using DART-MS provide prompt analysis of explosives for forensic applications.

## UPCOMING EVENTS AND OPPORTUNITIES

### Online gallery to display Scholars Week posters

While the Scholars Week Poster Exposition scheduled to take place in the Student Union Ballroom must be cancelled, we are pleased to inform you that we are developing an online gallery to display posters.

Presenters, please watch your email the submission deadline for graphics files of completed posters will be on or about April 15.

The Office of Research and Sponsored Programs is developing the gallery cooperatively with the Scholars Week Committee and other colleges' representatives in order to ensure that the online venue supports each college's plans.

Each participant will receive a Scholars Week tumbler and Connection Point button.

More details coming soon! Please continue to check out [mtsu.edu/scholarsweek](https://mtsu.edu/scholarsweek) for updated information.