

# BIOSYSTEMS ENGINEERING

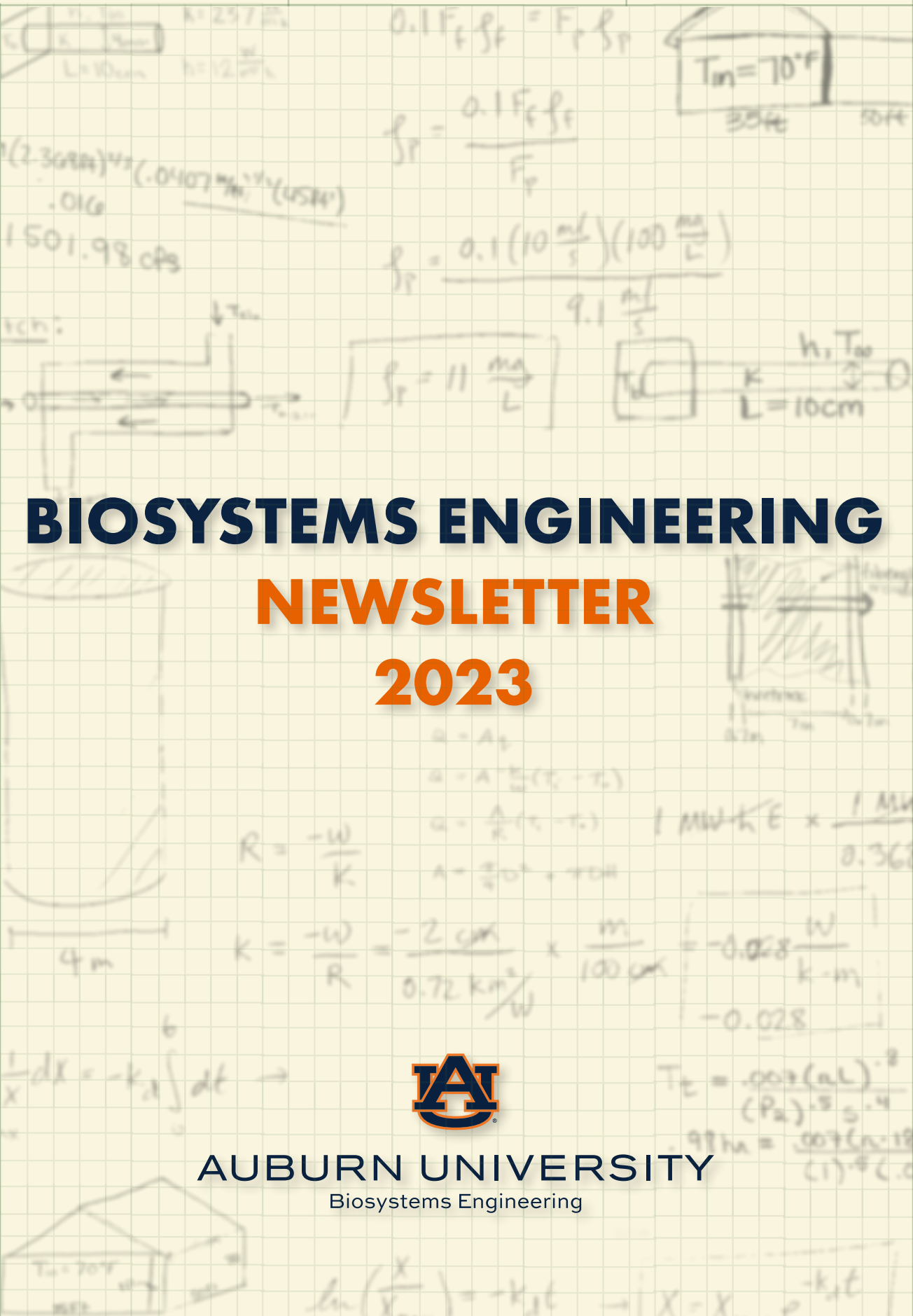
## NEWSLETTER

### 2023



AUBURN UNIVERSITY

Biosystems Engineering



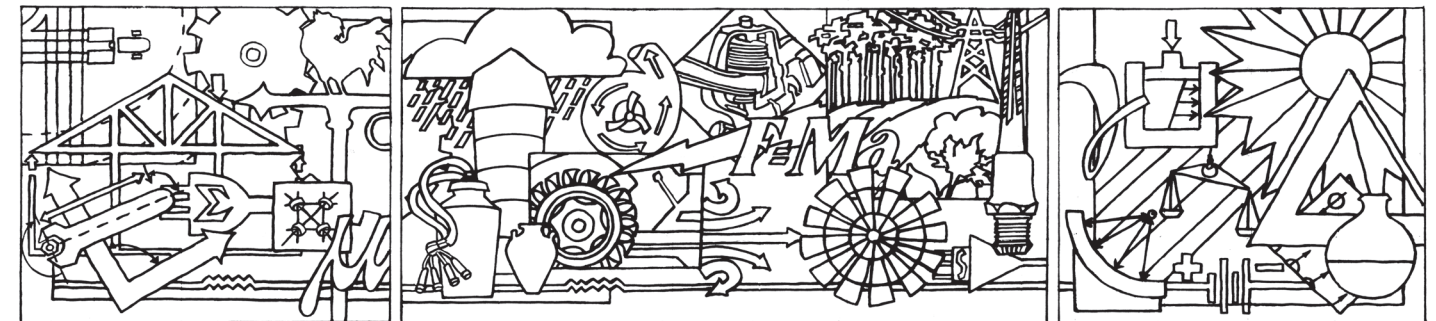
# A MESSAGE FROM THE DEPARTMENT HEAD

Thank you for reading another edition of the departmental newsletter, which contains a snapshot of the great achievements of the faculty, staff, and students in the department throughout 2023. I hope the front page of the newsletter brought good memories for you as an engineering graduate. As we have done in the past, we have featured a faculty member (Dr. Anna Linhoss), students that participated in study abroad programs, and new additions to our departmental family. Also featured is our technology management major (BATM) that was started in 2019, quotes from some of the undergraduate and graduate students that graduated in 2023 about their Auburn and Biosystems Engineering experience, and a short description of the senior design projects that placed during poster competition.



There are other features in the newsletter that I am convinced you will enjoy reading. I am particularly proud of the achievements of my faculty colleagues for securing grants from highly competitive and prestigious funding agencies, publishing in diverse and peer reviewed journals, and how they sincerely embrace the spirit of “continuous improvement”. As I have done in the past, I am including one of my favorite quotes “Even if you’re on the right track, you’ll get run over if you just sit there” – Will Rogers. Last but not least, I encourage you to try the word search on page 29 of the newsletter and also read more about the department on our website: [www.eng.auburn.edu/bsen](http://www.eng.auburn.edu/bsen). Thank you again for your support of the department. War Eagle!

- Dr. Oladiran Fasina



## AWARDS

### Outstanding Student Award

Ed Williams - Engineering  
Jacob Sizemore - Agriculture

### Outstanding Alumni Award

Marc Ivey

### Auburn University Graduate Council Master Thesis Award

Olamide Durodola

### Kim de Rubertis Student Scholarship

Anna Lancaster

### Outstanding Staff Award

Caroline Whiting

### 2023 ASABE Presentation Excellence Award

Preetika Kaur  
Zach Morgan  
Manish Sakhakarmy  
Sharif Shabani

### Outstanding Faculty Award

Dr. Brendan Higgins

### Bary M. Goldwater Scholarship

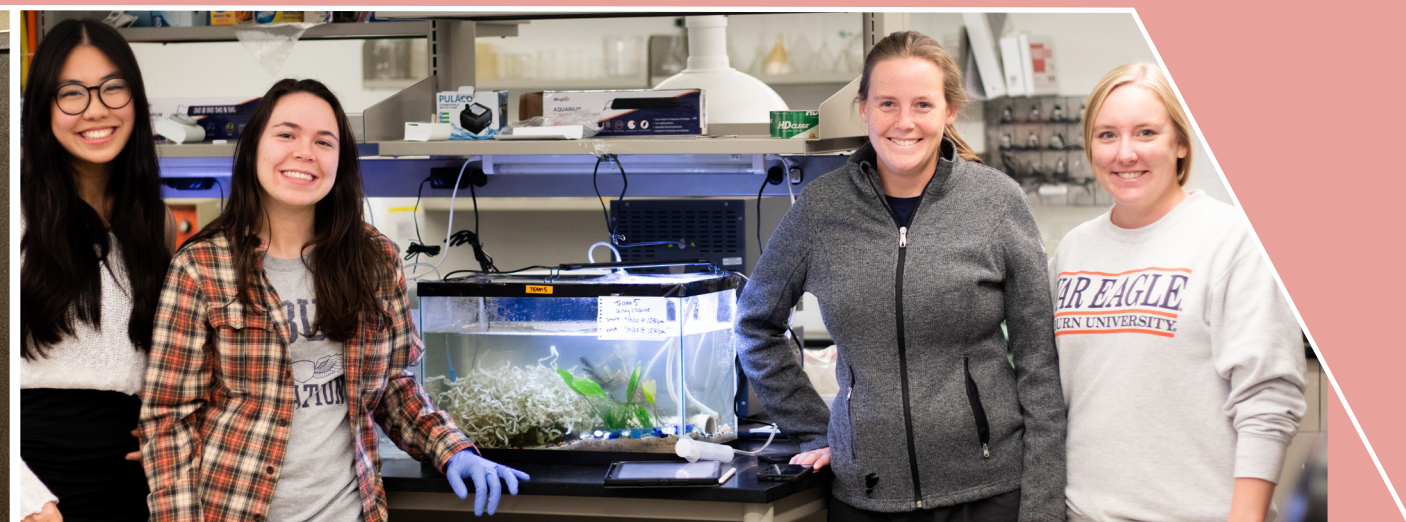
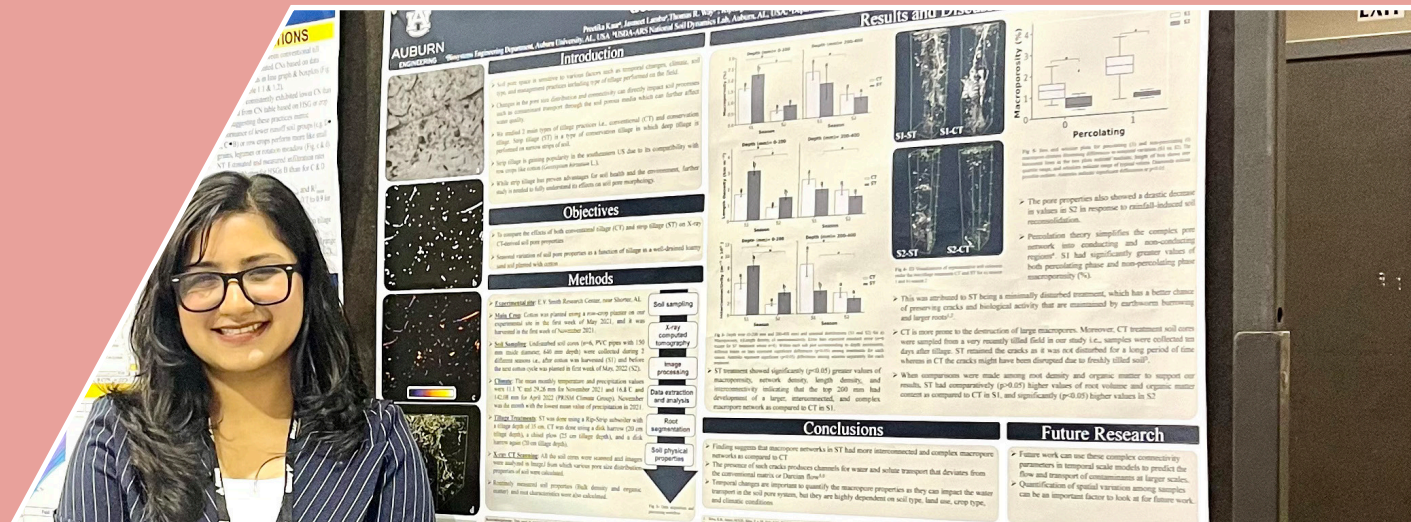
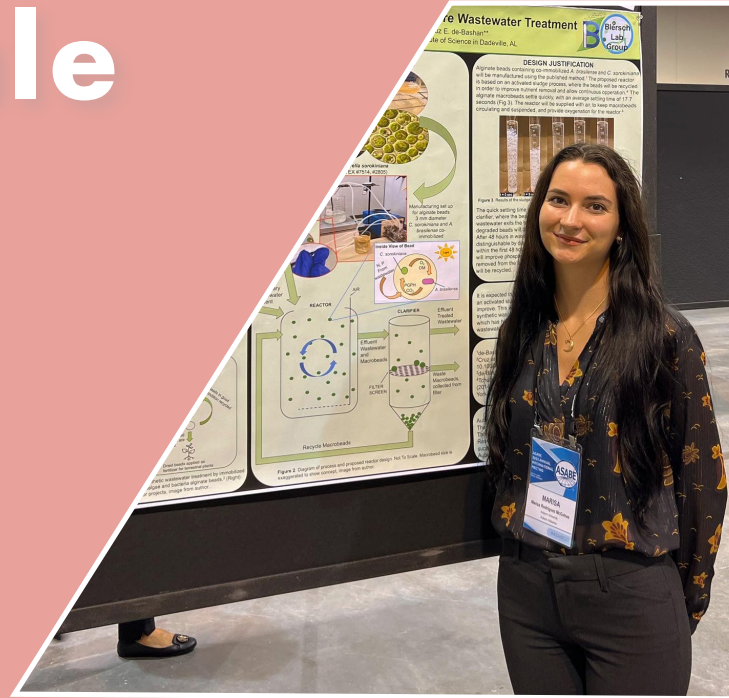
Ayden Kemp

### Graduate Engineering Research Showcase Best Poster Presentation

Olumide Falana  
Shima Rezaei  
Hamid Syed  
Vishawjot Sandhu

# 52% Female

# Auburn University's highest engineering female percentage.



# OUR GROWTH

## NEW FACULTY



In 2022, Dr. Saravanan Shanmugam joined as an Assistant Research Professor after earning his M. Tech. in Industrial Biotechnology from SASTRA Deemed University and a Ph.D. in Environmental Engineering from the University of Windsor. He previously served as an associate scientist at AgraCity Crop & Nutrition Ltd., Ontario, Canada. Between 2016 and 2018, he worked as a post-doctoral fellow in Dr. Sushil Adhikari's group. Currently, Dr. Shanmugam supervises students working on their thesis and conducts research on upcycling poultry waste nutrients into sustainable feed. His feed involves using bio-based approaches such as yeast and black soldier fly larvae cultivation.



Dr. Carson Edge is no stranger to the Biosystems Engineering Department, since he completed his bachelor's, master's, and Ph.D. in Biosystems Engineering at Auburn University. He joined the department in 2022 as an Assistant Professor working on applied poultry research with the National Poultry Technology Center (NPTC). Dr. Edge continues to represent our department at the Tennessee Valley Research and Extension Center in Madison, Alabama where he works with poultry producers in the Northern Alabama region.

## PROMOTIONS

Dr. Jesse Campbell was promoted to Associate Extension Professor as a result of his commitment inside and outside of the Department. He continues to work with poultry farmers, producers, and corporate representatives to provide technical consultation on poultry housing ventilation, design, construction, and more. Dr. Campbell continues to play a major role in developing hands-on modules and trainings for instructional purposes.



Dr. Jeremiah Davis, director of the National Poultry Technology Center (NPTC), was promoted from Associate Professor to Full Professor. His research and extension programs focus on improving the sustainability of commercial poultry production in Alabama and beyond. Dr. Davis' combination of his research and extension scholarships significantly impacts the poultry and livestock housing field. His research program focuses on improving the sustainability of commercial poultry production in Alabama and beyond.



# NEW STAFF



Our new Academic Advisor, Caitlyn Jones, hails from Ocala, Florida, and holds a degree in Animal Science from the University of Florida. With two years of residence in Auburn, she brings a wealth of experience as a former high school agriculture teacher and animal nutrition sales professional. Caitlyn provides academic advising for students in the two undergraduate majors in the department, Biosystems Engineering and Biological and Agricultural Technology Management.



Paige joined the department in 2023 after moving to the Auburn/Opelika area from Lyons, Indiana. She studied at Indiana University and worked for the USO, a nonprofit organization that supports US military members and families. As the Administrative Specialist, Paige provides administrative support where she hires research assistants, plans departmental events, and provides support for any additional administrative needs.



Trent began his journey with the Biosystems Engineering Department in 2019 as an undergraduate student and later became a student employee 2020. In 2023, Trent graduated from the department with a bachelor's degree in Biological & Agricultural Technology Management. Trent is a Research Assistant in the department and is primarily involved with collecting field data related to UAV and geospatial applications.



Destinee started her career in the US Air Force Reserve as an Aircrew Flight Equipment Technician before relocating to the Auburn-Opelika area. In 2022, she joined the Biosystems Engineering department as a Research Aide, responsible for maintaining the safety and cleanliness of our laboratories and assisting in resolving technical and IT issues. Destinee manages all these responsibilities while simultaneously pursuing her bachelor's degree in Geographic Information Science (GIS) at Troy University.



John earned his degree in Forest Engineering from Auburn University in 1990. After having a long career with the U.S. Forest Service, he joined the Biosystems Engineering Department in 2022 as a Research Engineer. John supports Dr. Tim McDonald's research on forest harvesting productivity study and moisture loss in southern pine after harvesting.



Zach received his bachelor's and master's degree from the department. For his graduate program, his thesis focused on wastewater reclamation hydroponic systems exploring the synergy between engineered living systems and inorganic mechanical systems. As a Research Engineer, Zach assists graduate students and faculty members with resources that are needed to conduct their research effectively.

# FACULTY SPOTLIGHT

**Dr. Anna Linhoss, Associate Professor**

## TELL US ABOUT YOURSELF

I was born and grew up in Eastern Virginia on the Chesapeake Bay. I graduated from the University of Colorado in 1997 with my bachelor's in Anthropology, and after graduating, I realized the importance of a technical background. I enrolled at The University of Georgia, earning my master's in Agricultural and Biological Engineering in 2005 and finished with my Ph.D. in 2011. When I'm not busy teaching and involved in research, I enjoy painting, drawing, hiking, and planted aquariums.

## WHY AUBURN UNIVERSITY?

It's a combination of so many things! Auburn, Alabama itself is a great area with that small town aesthetic. The university is awesome with excellent students and top tier research. Not to mention, you are less than two hours away from the nearest airport to travel anywhere.

## TELL US ABOUT YOUR INDUSTRY EXPERIENCE

I've worked as an entomologist for mosquito control in Savannah, Georgia, a GIS specialist for MacTech in Gainesville, Florida, and an environmental scientist for Buck Engineering in Asheville, North Carolina. I've been working on hydrology and understanding how water moves through different systems. I enjoy the coastal systems because studying the tides, salinity, storms, and sea level rise makes it very complex which gives me a lot to work with.

## TELL US ABOUT BIOSYSTEMS

I fall in the Ecological Engineering category under the biosystems umbrella. I use soft engineering techniques to understand how to engineer with nature and solve a lot of our environmental problems. Most of my work is focused on modeling, a form of engineering that can be applied to systems to simulate huge virtual experiments.

## BEST PART OF THE JOB?

The best part of my job is that it involves both research and teaching. I have a curious mind and I can find solutions to any problem involving my research. I enjoy interacting with my students and help them learn what I am passionate about. After a stream assessment lab, a couple of my students expressed how much they enjoyed the lab. Knowing that I gave those students an experience that they enjoyed and learned from is really fulfilling to me.

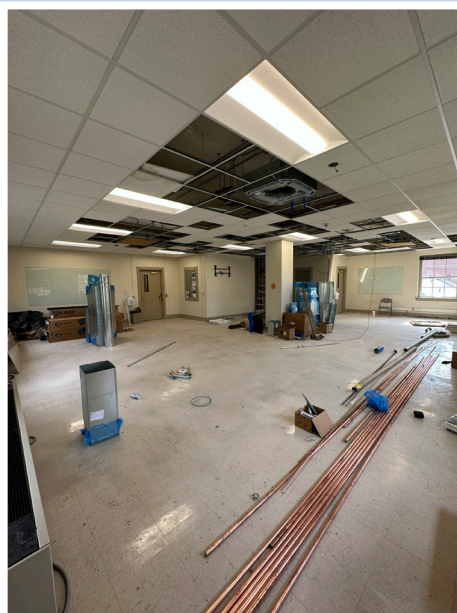
## ANY ADVICE?

The best advice I received along with way is if you want to get something done, get a degree in a STEM field. Those degrees are geared towards problem solving, fixing things, and making a difference. To me, that has been very fulfilling and helped me think about the environment in that perspective.



# CLASSROOM RENOVATIONS

BEFORE

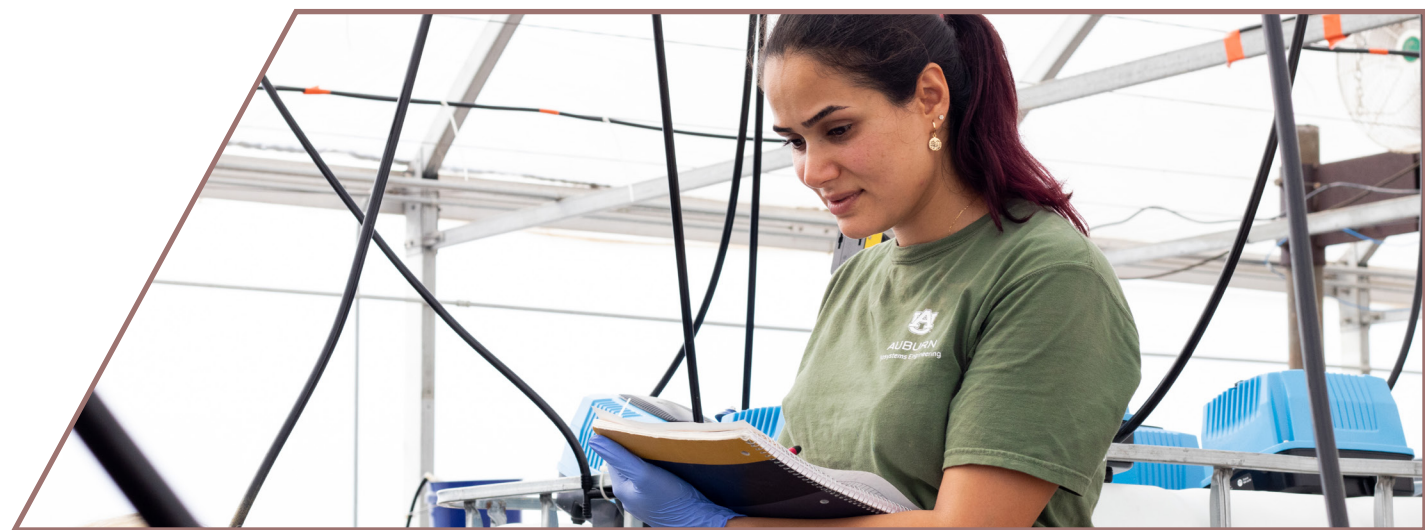


AFTER



During the summer of 2023, Corley classrooms underwent a remarkable metamorphosis, transitioning from manual fan coil units to state-of-the-art thermostats. This transformative journey has bestowed upon the Corley classrooms an unparalleled level of temperature comfort. Auburn University Facilities Management's steadfast dedication has been instrumental in achieving this breakthrough, ensuring that every Corley classroom now offers a heightened level of comfort. The integration of cutting-edge HVAC systems, motion-activated lighting, new computers, and high-resolution monitors has increased the functionality and elevated the learning environment in the Corley classrooms.

**95% Job placement  
within six months  
of graduation.**



## **BIOLOGICAL & AGRICULTURAL TECHNOLOGY MANAGEMENT**

Biological & Agricultural Technology Management (BATM) is a dynamic major that immerses students in hands-on learning, guiding them through the intricacies of designing and developing agriculture and biological equipment using cutting edge technology. The curriculum is designed to equip students with a comprehensive skill set combining technology, science, and business management that prepares them to tackle the complex technological challenges prevalent in modern agriculture and biological systems.

In recent years, BATM has undergone significant enhancements, marking a commitment to staying at the forefront of education and technology. Notable additions include Dr. Mark Dougherty's Fall 2022 course, "Ag Technology Geospatial Application", and the incorporation of Writing Enriched designations into four key courses. Four Biosystems Engineering

faculty members (Dr. John Linhoss, Dr. Anna Linhoss, Dr. Mark Dougherty, and Dr. Oladiran Fasina) participated in workshops that are designed to elevate writing strategy skills and strategies for BATM and Biosystems Engineering students.

The culmination of the program is the senior capstone project, where students collaborated with industry partners such as Greenpoint Ag to conduct a feasibility study on innovative spreader technology. Interactions with Biosystems Engineering Alumni, Daniel Mullenix and Trey Colley provided valuable insights into delivering high-quality results for a client.

Current enrollment in the BATM program is 35. As the program continues to grow, our primary focus remains on recruiting high-quality students dedicated to shaping the future of agriculture and biological technology.



# RESEARCH EXPERIENCE FOR UNDERGRADUATES

The Research Experience for Undergraduates (REU) program provides an intensive ten-week research opportunity that focuses on the conversion of biological waste into valuable products. Nine selected students were successfully matched with faculty mentors to undertake a multidisciplinary research project spanning biosystems engineering, chemical engineering, materials engineering, biology, and horticulture.

A significant breakthrough emerged in the field of aquaponics during this endeavor, particularly in discovering that a split root system significantly influences the root architecture of tomato plants irrigated with brackish water. This development represents a crucial step towards the viability of brackish aquaponics. The implications of this research extend far beyond aquaponics, impacting fields such as aquaculture, environmental engineering (specifically wastewater treatment), medicine (with potential applications in medical sensors), and materials science (in the creation of novel building materials).

Data collection for this project centered on three key sources: pre- and post-tests gauging the fellows' perceptions of research and their academic self-efficacy, weekly surveys measuring their experiences in their research work, and a final focus group exploring their overall program experiences. An analysis of the focus group data revealed that the fellows' journey was marked by significant personal growth and learning. They acquired practical skills, delved into interdisciplinary insights, and embraced novel perspectives through hands-on laboratory work. This experience enhanced their communication, critical thinking abilities, and research independence, fostering a mature approach to analysis and autonomy.

Furthermore, this project contributed to the educational development of the REU students by offering structured professional development workshops. These workshops proved highly beneficial to the students, providing guidance on reading and writing scientific manuscripts, preparing presentations, and designing posters. Considering their success, several faculty members at Auburn University have expressed interest in utilizing the workshop materials for a new undergraduate research professional development course. Thus, the impact of this grant is set to endure long after its conclusion.



## 2 MAJORS

**Biosystems Engineering**  
Ecological Engineering  
Bioprocess Engineering  
Forest Engineering

## Biological & Agricultural Technology Management



**Dr. Brendan Higgins is leading a \$10 million NIFA-SAS grant to re-imagine controlled environment agriculture.**



[Read More Here](#)



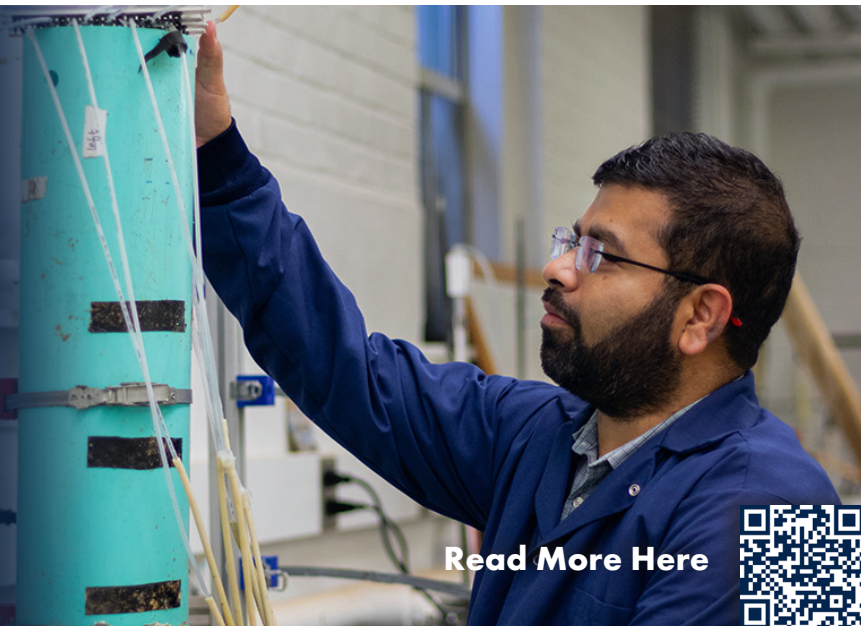
**Dr. Adhikari and Dr. Hossein Jahromi secured a \$1 million phosphorus mitigation grant from NIFA.**



[Read More Here](#)



**Dr. Jasmeet Lamba secured a \$6 million grant from NSF to evaluate greenhouse gas emissions from ag systems.**



[Read More Here](#)



**Dr. Jahromi leads a \$650K NIFA grant to develop a new generation of biolubricants.**



[Read More Here](#)



**Dr. Sushil Adhikari leads a \$2 million DOE project to produce hydrogen from blended feedstock.**



[Read More Here](#)



**Dr. John Linhoss leads a \$298K NIFA grant to evaluate the effects of natural versus artificial lighting in broiler houses.**



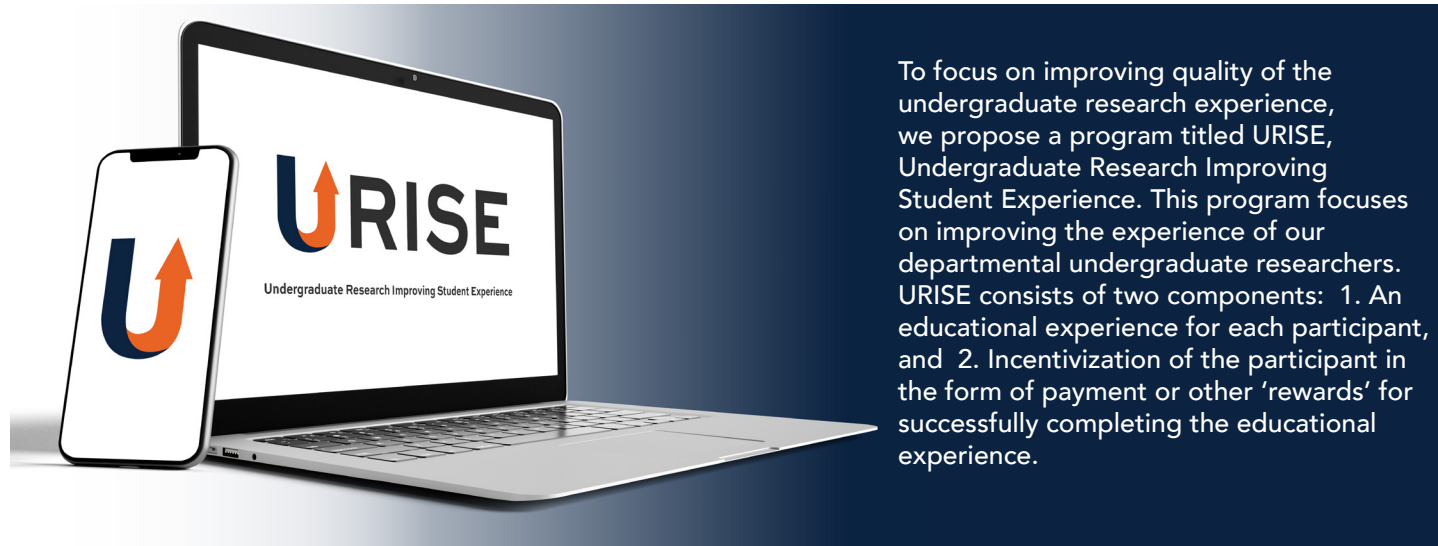
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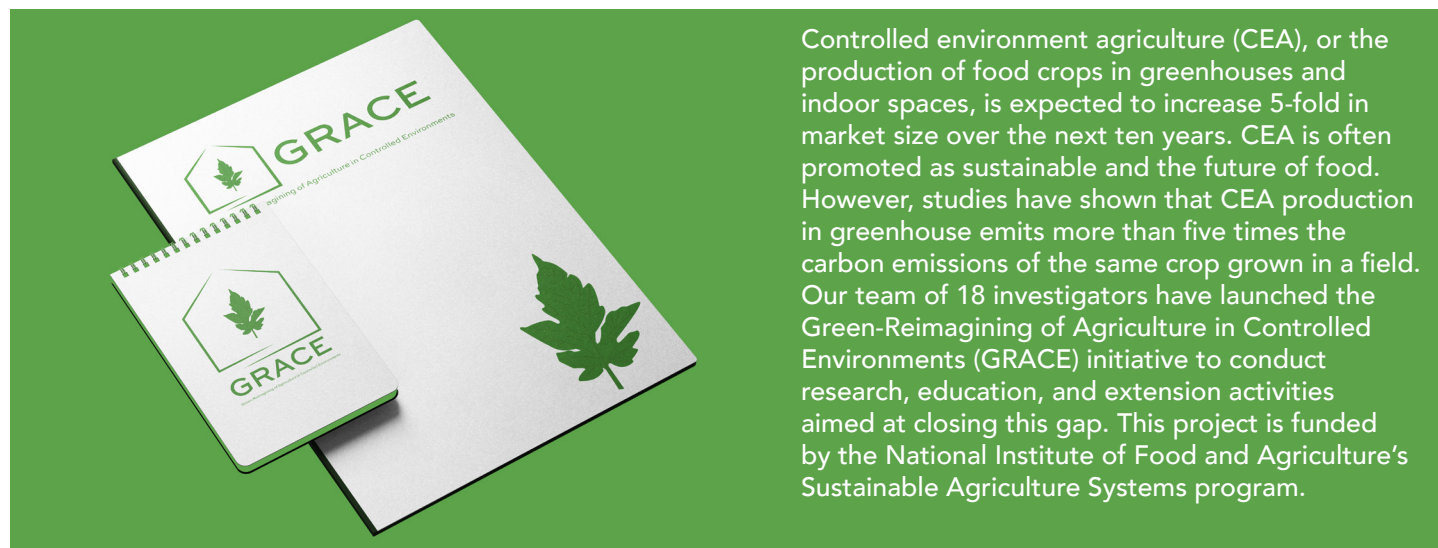
# FROM GRANT TO BRAND



The goal of the Auburn University Rural Partnership Institute (AURPI) project is to leverage modern technologies to advance rural Alabama through poultry production and forest products. The inter-disciplinary team from Colleges of Agriculture, Engineering, and Forestry, Wildlife, and Environment will develop technology solutions that will assist producers and processors of poultry and forest products to improve their competitiveness and sustainability while addressing cyber-physical vulnerabilities due to use/adoption of modern technologies.



To focus on improving quality of the undergraduate research experience, we propose a program titled URISE, Undergraduate Research Improving Student Experience. This program focuses on improving the experience of our departmental undergraduate researchers. URISE consists of two components: 1. An educational experience for each participant, and 2. Incentivization of the participant in the form of payment or other 'rewards' for successfully completing the educational experience.



Controlled environment agriculture (CEA), or the production of food crops in greenhouses and indoor spaces, is expected to increase 5-fold in market size over the next ten years. CEA is often promoted as sustainable and the future of food. However, studies have shown that CEA production in greenhouse emits more than five times the carbon emissions of the same crop grown in a field. Our team of 18 investigators have launched the Green-Reimagining of Agriculture in Controlled Environments (GRACE) initiative to conduct research, education, and extension activities aimed at closing this gap. This project is funded by the National Institute of Food and Agriculture's Sustainable Agriculture Systems program.

# MAKING HISTORY



KOLLAN SPRADLIN

Kollan Spradlin is a 2011 Biosystems Engineering graduate and is recognized in the Auburn Alumni Association's 20 under 40 list. Kollan a civil and environmental engineer who works as a group leader in the Tampa, FL. office of SCS Engineers, one of the largest recycling and solid-waste consultation firms in the world. He is a certified hazardous materials manager and professional engineer licensed in Alabama, Florida, and Tennessee. (Scan QR Code to read more)



JUSTUS SMITH

Biosystems Engineering senior and Auburn Engineering Without Borders President Justus Smith received the Auburn Water Student Spotlight and is featured on the award-winning #Ginning Podcast. Justus embodies the "Auburn spirit" through his unwavering pursuit of knowledge, desire to explore diverse perspectives, and passion for serving his global community. (Scan QR code to listen)



CAMILLE COLTER

Camille Colter graduated from the department Spring of 2023 and left her mark in the College of Engineering. After winning the Engineering Together Design Competition, Camille's illustrations of diversity, equity, and inclusion are printed on various Samuel Ginn College of Engineering merchandise, as well as displayed throughout the Auburn engineering facilities. Her recognition continued as she appeared on the Sustain(ABILITY) Podcast sharing sustainability tips. (Scan QR code to listen)



AYDEN KEMP

Biosystems Engineering senior Ayden Kemp received the Astronaut Foundation Scholarship and the highly competitive prestigious Goldwater Scholarship. The Goldwater Scholarship is designed to foster and encourage outstanding students to pursue research careers in the fields of natural sciences, engineering, and mathematics. This is the first time that a BSEN student has received this award! To hear more about Ayden's success, check out his episode on the award-winning #Ginning Podcast. (Scan QR code to listen)



ANNA LANCASTER

Biosystems Engineering senior Anna Lancaster received the prestigious Kim de Rubertis Student Scholarship. This scholarship awards undergraduate and graduate students in the field of dams, levees, and water resources, as well as provide opportunities in professional organizations. Anna, along with three other scholars, attended the USSD Conference in Charleston, SC where she presented her research on internal Erosion in Unsaturated Slopes and was awarded first prize. Check out her feature on the award-winning #Ginning Podcast. (Scan QR code to listen)



NATALIE HODGE

Biosystems Engineering graduating senior Natalie Hodge was selected to lead the Samuel Ginn College of Engineering at the 2023 fall commencement. Hodge interned at the Alabama Department of Environmental Management and Spire in Montgomery and Opelika, updating databases and working in pipeline management. Post-graduation, she plans to join Jacobs Engineering in Montgomery as an environmental engineer. Hear more about Natalie's BSEN journey on the award-winning #Ginning Podcast. (Scan QR Code to listen)



# 2023 ASABE INTERNATIONAL MEETING



In July 2023 over 40 Biosystems Engineering faculty, staff, and graduate students attended the 2023 annual American Society of Agricultural & Biological Engineers meeting in Omaha, Nebraska. ASABE is an educational and scientific organization dedicated to the advancement of engineering applicable to agricultural, food, and biological systems. During the 2023 meeting, the following four BSEN graduate students received the ASABE Presentation Excellence Award:

Preetika Kaur  
Zach Morgan  
Manish Sakhakarma  
Sharif Shabani

# 2023 VERMA GRADUATE STUDENT WORKSHOP



Dr. Brahm and Sudha Verma established a Graduate Student Leadership Workshop endowment. The purpose of the workshop is to provide opportunity for PhD students to develop their own leadership talents and skills by learning and experiencing the combined qualities of servant-visionary-transformational leaders. In the summer of 2023, six BSEN PhD students participated in the inaugural workshop. President Roberts, Provost Nathan, Dean Patterson, Dean Eden, and the Verma family graced the workshop opening with their presence. Thank you Dr. Brahm and Sudha Verma for your generous donation!



# ENGINEERING DAY 2023

Auburn University's Samuel Ginn College of Engineering hosts an annual open house known as E-DAY, a significant event tailored for students exploring a career in engineering. This exceptional occasion serves as a gateway for students to explore Auburn's campus, the various engineering programs, and discover the opportunities presented by the Samuel Ginn College of Engineering.

Geared towards seventh through twelfth graders, E-DAY facilitates one-on-one interactions with both students and faculty. Attendees have the chance to engage with interactive exhibits, labs, and gain insights into admissions processes and scholarship opportunities. This year, the Department of Biosystems Engineering took center stage, showcasing a diverse array of exhibits, including our bioretention cell, biofuel cells, student design lab, precision agriculture, aquaponics, and crayfish lab.

Featuring our comprehensive program with 21 tours led by 42 enthusiastic guides, we welcomed over 600 students, teachers, and parents. The event successfully highlighted the Department of Biosystems Engineering's rich offerings, providing a dynamic and informative experience for all participants.

# SENIOR DESIGN

Our senior design class tasks students with real-world design projects to gain industry experience. These top four student groups created sustainable and cost-effective solutions for the project sponsor/client.

### East Perdido Bay Islands Restoration Design

Client: Judy Haner, Marine and Freshwater Programs Director for The Nature Conservancy in Alabama  
Team Members: Kristen Black, Daniel Chapman, Katie Harmon, & Dylan Levering

#### Background

Artificial islands, or spoil islands, were formed in Eastern Perdido Bay during the construction of the Intracoastal Waterway. With increasing tourism and human traffic, the spoil islands have become a source of native habitat sanctuary. Over time, the islands have lost a significant amount of land area and volume due to storm events, boat traffic, and human activity (Figure 7). Restoring and enhancing these islands will increase the surface area and allow for native vegetation and wildlife to have a place of sanctuary.

#### Design Elements

Figure 2. Proposed placement of design elements

Figure 3. Living shoreline and beach nourishment

Figure 4. Signage and beach nourishment area

Figure 5. Existing seagrass to remain undisturbed

#### Island Area Change

Figure 7. Change in island land area from 1994 to 2020

#### Cost Estimate

Description	Quantity	Unit Price	Total Cost
Breakwater Construction	2000 TONS	\$ 125	\$ 250,000.00
Island 2 Fill	8500 CY	\$ 20	\$ 170,000.00
Island 3 Fill	7500 CY	\$ 20	\$ 150,000.00
Island 4 Fill	9000 CY	\$ 20	\$ 180,000.00
Vegetation	100,000 FACH	\$ 4	\$ 400,000.00
Signage	80 FACH	\$ 200	\$ 16,000.00
<b>TOTAL</b>			<b>\$ 1,156,000.00</b>

Figure 8. Total cost estimate for restoration design

#### Summary

Island one is completely submerged due to irreparable erosion processes. Because of this, it is recommended to use this as a borrow site for sediment. Islands two and four will receive sediment placement on the west side of the existing surface. Breakwaters will be implemented to reduce tidal force. Island three will only have sediment added to the southwest side. No hard structures are necessary on this island. Rabbit Island will be omitted from the restoration plan due to the relative lack of deterioration seen from 1994 to present.

#### Acknowledgments

- Dr. Mark Dougherty and Mr. John Spencer, Auburn University
- Dr. Anna Linhoss, Senior Scientist
- Mrs. Judy Haner, Marine and Freshwater Programs Director for The Nature Conservancy



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Team Members: Kristen Black, Daniel Chapman, Katie Harmon, Dylan Levering

### Utility Task Vehicle Based Fire Ignition & Suppression System Design

Auburn University - Biosystems Engineering  
Client - Dr. John Kush  
Faculty Advisor - Dr. Tim McDonald  
Bradley Lowery - Ed Williams - Logan Suddath

#### Problem Statement

Dr. John Kush, a faculty member at Auburn University, has made great progress in his research on fire ignition and suppression systems. He has developed a prototype for a fire ignition and suppression system that is designed to be used on a utility task vehicle (UTV). The system is designed to be used on a UTV that is used for fire ignition and suppression on a farm or ranch.

#### Design Objectives

- Design an ATV-mounted fire ignition and suppression system that is safe and efficient.
- Design an ATV-mounted fire ignition and suppression system that is easy to use.
- Design an ATV-mounted fire ignition and suppression system that is cost-effective.

#### Final System Assembly

The final system assembly consists of a UTV-mounted fire ignition and suppression system. The system is designed to be used on a UTV that is used for fire ignition and suppression on a farm or ranch.

#### Cost Estimate

Description	Quantity	Unit Price	Total Cost
UTV	1	\$ 1,000.00	\$ 1,000.00
Fire Ignition System	1	\$ 200.00	\$ 200.00
Suppression System	1	\$ 200.00	\$ 200.00
Control Panel	1	\$ 100.00	\$ 100.00
Wiring	1	\$ 100.00	\$ 100.00
Tools	1	\$ 100.00	\$ 100.00
<b>TOTAL</b>			<b>\$ 1,700.00</b>



This design will serve the common landowner in applying controlled burns to their property in a safe and affordable way. By utilizing the common drip torch and being applicable to most common ATV systems, landowners will be able to better apply prescribed burns with a vast reduction in manual labor and an increase in the safety and mobility of those igniting the fires. By increasing the ease of which controlled burns can be conducted, there will be a positive effect on wildlife ecosystems, habitat management, timber production, or whatever land use goal a particular landowner might possess.

Team Member: Bradley Lowery, Ed Williams, Logan Suddath

### Bioremediation through Floating Wetland Nutrient Reduction

Client: Cindi Malinick, Director of the Jule Collins Smith Museum  
Undergraduate Students: Isa Bivins, Spencer Overton, Ansley Scott  
Faculty Advisor: Dr. David Biersch

#### Background

The Jule Collins Smith Museum pond has an excessive amount of Nitrogen (N) and Phosphorus (P). These excess nutrients cause eutrophication, which lead to harmful algal blooms and proliferating invasive species. Floating treatment wetlands (FTW) are buoyant platforms that hold aquatic vegetation to improve water quality through nutrient remediation. These proposed FTWs will be used as a functional art exhibit to prevent eutrophication.

#### Plant Selection

Selected vegetation consists of 4 emergent macrophytes native to Alabama including *Juncus effusus*, *Iris virginica*, *Citrus americanum*, and *Habenaria repens*. Biannual harvesting of plant shoots removes nutrients, including Nitrogen and Phosphorus, absorbed from pond water supply by plant roots.

#### Nutrient Uptake Analysis

Species	TN uptake (mg/kg/day)
<i>Juncus effusus</i>	40.3
<i>Iris virginica</i>	0.49
<i>Citrus americanum</i>	0.95
<i>Habenaria repens</i>	0.72

#### Cost Analysis

Materials	Quantity/1 FTW	Price/FTW (\$)
Bamboo (5", 2" diam)	4 poles	20
Wood Sealant	1 gal	60
Stainless Steel Bolts (1-1/2")	4 bolts	1
Galvanized Steel Cloth	24 sq ft	14
Hydroponic Clay Pebbles	30 gal	90
Plants	28	140
<b>Annual Maintenance</b>		
FTW Pruning	0.5 hr	15
Resealing Wood	1 hr	20
<b>Subtotal</b>	<b>1 FTW &amp; Maint.</b>	<b>374</b>
<b>Total</b>	<b>10 FTW &amp; Maint.</b>	<b>3740</b>

#### Conclusion

Total Nitrogen in the pond is projected to decrease by 10% within 6 months following installation of 10 biodiverse FTW mats. This eco-friendly design maintains the museum aesthetics and remains under the \$5000 budget.

#### Acknowledgments

- Dr. Jon Davis and Dr. Mark Dougherty, Auburn University
- Patrick Thompson-Arborelius, Auburn University



The Jule Collins Smith Art Museum pond has an excessive amount of Nitrogen (N) and Phosphorus (P). These excess nutrients cause eutrophication, which lead to harmful algal blooms and proliferating invasive species. Floating treatment wetlands (FTW) are buoyant platforms that hold aquatic vegetation to improve water quality through nutrient remediation. These proposed FTWs will be used as a functional art exhibit to prevent eutrophication. Total Nitrogen in the pond is projected to decrease by 10% within 6 months following installation of 10 biodiverse FTW mats. This eco-friendly design maintains the museum aesthetics and remains under the \$5,000 budget.

Team Members: Isa Bivins, Spencer Overton, Ansley Scott

### Floating Wetland Design for Bioremediation of Nutrient Pollution at the Jule Collins Smith Museum Pond

Client - Mr. Andy Bannan, DSM Director of Operations  
Design Team - Morgan Aldridge, Isabel Bela, Laura Rose Cole, Julia Kullander  
Auburn University, Department of Biosystems Engineering

#### Introduction

The pond maintained by the Jule Collins Smith Art Museum (Auburn, AL) collects nutrients from landscaping on the property. This has resulted in eutrophication of the pond (3300 ug/L N, 360 ug/L P). Mediation of this issue is required for improving aesthetic appeal as well as creating a hospitable environment for the pond's inhabitants. The proposed solution for the water quality issues is the introduction of nutrient-absorbing plant life to the pond via a floating wetland to take up 10% of existing nutrients. The design will incorporate plants into the ecosystem of the pond through a buoyant structure containing a root-stabilizing substrate. The wetland must be large enough to house the amount of plants necessary for efficient bioremediation while not exceeding 30% of the pond's surface area.

#### Visuals and Details

Figure 1. Floating wetland base model

Figure 2. Wetland location

Figure 3. Site layout with watershed delineation

#### Plant Selection

- Pontederica cordata* (Pickerelweed)
- Saururus cernuus* (Lizard's Tail)
- Iris virginiana* (Blue Flag Iris)
- Citrus americanum* (Swamp Lily)
- Habenaria repens* (Dog Orchid)
- Conoclinium coelestinum* (Blue Mistflower)
- Hypericum densiflorum* (St. John's Wort)
- Xyris* spp.

#### Cost Estimate

Item	Quantity	Unit Price	Total Cost
4" Schedule 40 Pipe	144	\$ 1.44	\$ 207.36
4" Schedule 40 Elbow	144	\$ 1.44	\$ 207.36
1/4" Plastic, quality	144	\$ 1.44	\$ 207.36
1/4" Plastic, quality	144	\$ 1.44	\$ 207.36
1/4" Plastic, quality	144	\$ 1.44	\$ 207.36
<b>Total</b>			<b>\$ 839.74</b>

#### Summary

In order to achieve the objective of lowering the excess nutrient content in the pond to below the eutrophication threshold of 0.80 mg/L for dissolved nitrogen and 0.05 mg/L for dissolved phosphorus, a 3' unit, honeycomb-style base structure was designed to support a variety of wetland plants that uptake nitrogen and phosphorus.



The pond maintained by the Jule Collins Smith Art Museum (Auburn, AL) collects nutrients from landscaping on the property. This has resulted in eutrophication of the pond (3300 ug/L N, 360 ug/L P). Mediation of this issue is required for improving aesthetic appeal as well as creating a hospitable environment for the pond's inhabitants. The proposed solution for the water quality issues is the introduction of nutrient-absorbing plant life to the pond via a floating wetland to take up 10% of existing nutrients. The design will incorporate plants into the ecosystem of the pond through a buoyant structure containing a root-stabilizing substrate. The wetland must be large enough to house the number of plants necessary for efficient bioremediation while not exceeding 30% of the pond's surface area.

Team Members: Morgan Aldridge, Isabel Bela, Laura Rose Cole, Julia Kullander

# RECENT EMPLOYMENT DESTINATIONS

**WESTERVELT**

**GRESHAM-SMITH**

**ALABAMA POWER**

**HUDSONALPHA**

**FORESITE**

**GEORGIA POWER**

**KECK & WOOD**

**THOMAS & HUTTON**

**JOHN DEERE**

**PEPSI CO**

**CARTER & SLOOPE**

**SOUTHERN COMPANY**

**GEORGIA PACIFIC**

**BUSH HOG**

**HAZEN & SAWYER**

**PARKER HANNIFIN**

**FRITO LAY**

**JACOBS SOLUTIONS**

# GRADUATE STUDENTS



My biosystems journey began my freshman year at Auburn University in 2018 when I learned about the major and the department through an ASABE meeting. I was drawn to biosystems because of my interest in practical and sustainable solutions to every day needs, with a particular interest in energy. As an undergraduate, I was a part of the accelerated bachelor's-master's degree program and began working on my master's immediately after completing my bachelor's degree in biosystems engineering, bioprocess option, in Spring 2022.

My research interests center around sustainable development and working to improve the ways in which we manage waste, food, and energy. I got my start in research my sophomore year when I joined Dr. Higgins' lab and was awarded the Undergraduate Research Fellowship to study the interactions between poultry processing antimicrobials and algae grown on poultry processing wastewater for the purpose of algal biofuels. My current research project is to conduct a life cycle assessment on a system that uses anaerobic-digestate grown algae to cultivate zooplankton for fish food. Completing a life cycle assessment will quantitatively characterize its environmental strengths and weaknesses to help inform future sustainable development. Once I complete my master's degree, I will begin work as an environmental advisor with ExxonMobil in Baytown, Texas.



I declared my first major at Auburn University as an Aerospace Engineering student. At some point, I became interested in food production and wanted to be an agriculture engineer. I found Biosystems Engineering at Auburn and started in the program as a freshman. My best friend and roommate were all in biosystems and it was a really welcoming and supportive department. I stayed in Biosystems Engineering for my master's because I thought my classes were hard and interesting. I also wanted to try coding, but applied to a field I already had experience in.

I'm currently working on computer vision, deep learning, and machine learning approaches to high-throughput phenotyping for precision agriculture. I use computer science to automatically process 3D segmentation and reconstruction of below soil root systems and hops plants.

I received my first Ph.D. offer from the Department of Computer Science at NC State University. I'm uncertain about what the next chapter holds, but my computer vision skills are applicable to many fields. I'm considering biomedical engineering, but I am also very passionate about CS education and presenting AI in intuitive and obtainable ways.

# ALUMNI STORIES

**AUDREY GRAY**



My experience in biosystems has felt anything but ordinary. From the first impromptu visit to Corley during my senior year of high school, this department has been so special to me. The knowledge I've gained and the opportunities and instructors, they mean more to me than they will ever know. The education I've had the privilege to receive from this department helped a wide-eyed, ambitious young woman, with a very vague understanding of engineering, discover that she was capable of carving out the future she wanted for herself. Biosystems Engineering encompasses a lot, across varying disciplines and specializations, but these people and this place make it all feel accessible.

**BRADLEY LOWERY**



My time in this department has been nothing short of life changing. After being informed of the department by my high school Ag Sciences teacher and completing a tour, I was certain that there was no place I would rather pursue my education and career. The Auburn creed states "I believe in education, which gives me the knowledge to work wisely and trains my mind and my hands to work skillfully." This department has made those powerful words a reality in my life. My professors have always made me feel a personal connection and provided an environment that was conducive to learning. I have made friends that will last a lifetime and experienced things that have helped mold me into what an Auburn man is supposed to represent. I have had the great fortune of accepting a job offer well before graduation that will allow me to utilize my education and pursue my passions that led me to this great department.

**CAMILLE COLTER**



When I began my engineering career at Auburn, I was in a program that I didn't feel comfortable in but was afraid to "give up". When I finally decided to put my pride aside for a program that would make me happy and fulfilled, I switched to Biosystems Engineering. Upon joining the department, I was immediately welcomed by faculty and students. The community within the program is truly unmatched. Dr. Fasina learned my name within my first month, I found community, I was working in Dr. Adhikari's lab, and I received my first 4.0! The support and kindness I have experienced improved my mental health, showing my decision to join the department was one of the best decisions made in my undergraduate career. Thank you to all my professors, the faculty, and the friends I have made! I will always love the Biosystems Engineering Department and what everyone has done for me.

**JACOB POWELL**



As a freshman, I was changing majors and was encouraged to seek opportunities in engineering. I've always enjoyed the outdoors and wanted my work to have a positive impact on the environment, so biosystems seemed like the perfect fit. The BSEN staff have supported me in this endeavor, not only by ensuring I understood class content, but also by encouraging me to seek engineering experiences and helping me to find those experiences. The professors care about their students' success and want to know them personally. Their classes challenged me to grow both in knowledge and in my teamwork abilities. Biosystems has prepared me to begin my career and make a positive impact!

**TATEM REYNOLDS**



I transferred to Auburn in January 2020, and found the Biosystems Engineering major that fall. Despite COVID and the hardships of transferring, I never once questioned being a part of the Biosystems Department. Even being online, the professors got to know their students and I could tell they really cared about our success. Our major may be small, but I enjoy it because it has given me the chance to form bonds with professors and faculty, as well as build awesome friendships with my peers. Engineering can be difficult, but having a department full of people who truly want you to succeed makes it more fulfilling when you do. I'm proud to be graduating with a BSEN degree, and I feel like I have been set up well for my future.

**TIMOTHY SQUIRES**



The Biosystems Engineering department has created an environment that feels like one big family, while still creating ample opportunities to get out of my comfort zone. Being a part of this close-knit community gives the students and professors the ability to interact with each other on a personal level. I have been fortunate to interact with many successful and hardworking people within this program and on this campus. Through this program, I have built close relationships with peers and colleagues from several backgrounds and cultures. I chose biosystems because the world needs people who see things from a sustainable point of view while providing solutions to issues facing the world today. The small class sizes, rigorous degree path, and family-style environment in biosystems have allowed me to find my home on a campus full of opportunity.

**KRISTEN BLACK**



Auburn has felt like home since the moment I stepped foot on campus. I discovered the Biosystems department during a tour of the College of Engineering at Auburn's annual E-Day. Between my love for science and the environment, I knew immediately this was the place for me. I elected to pursue the Ecological track in Biosystems because it included courses I was most interested in such as Site Design, GIS, Waste Management, and Environmental Engineering. Each professor is passionate about their work and their students. They encourage communication and support you in every way they can. One of my favorite things about my time in Biosystems is how dedicated the professors and department head are, whether it be trips to the field/lab for hands-on experiences or calling you by name in the hall to ask how your semester break was. The Biosystems department is a true family and I have loved every minute of my time here. I have made forever friends and I am proud to say that I have become a well-rounded and well-prepared Biosystems Engineer.

**MORGAN ALDRIDGE**



I grew up in a rural area in Alabama that fueled my passion for the outdoors. From spending time with my dad, a Mining Engineer, I have developed a passion for the world's natural resources and how engineering can utilize and care for these resources. Spending time with my grandparents in summertime gardens led to a love of agriculture. My passion for these things led me to choose Biosystems Engineering because it applies engineering methods to our natural world. During my time at Auburn in the Biosystems department, not only have I found a major that will allow me to combine my interest in the outdoors with my professional career, but also has provided a community of people that have left a strong impact on me. BSEN has led me to life-long friends. The BSEN professors and staff stand out above all others because of their desire to help each student succeed. I am grateful to the Biosystems department for providing me with the academic skills to pursue a professional career and for the family-like community of my peers.

# STUDY

Last Summer I traveled to Japan through the College of Engineering Birdsong Scholarship. Over the course of about 3 weeks I traveled to 6 different major cities in Japan, taking the time to visit local temples, engage with the locals, and sample some of the local cuisines. Some of my favorite memories include being interviewed for live TV during the G7 Summit in Hiroshima, making my own okonomiyaki in Osaka, and hiking with Japanese grandmas in Nikko! I will never forget this fantastic introduction into eastern culture, and am eager to go back again.

~Justus Smith



# ABROAD

This past summer I had the opportunity to study abroad with Lead Greece through their Lead Greece program. I embarked on a four-week study abroad program where we traveled to Athens, Santorini, and Crete. While being abroad, I learned life lessons I could not have learned in a classroom, while also exploring one of the world's most beautiful places. In Athens, we were able to explore through the ruins of Ancient Corinth, and got to explore the Acropolis along with the old city of Athens including parts such as Plaka. In Santorini, we got to hike an active volcano and explore a remote village off the coast. Overall, this experience was one I wouldn't trade for anything.

~Brennan Vincent



In August 2023, I traveled back to Bolivia with Auburn's chapter of Engineers Without Borders. It was such a phenomenal experience to go back to the community and work with an incredible team. This year we took more flow rates of different water sources, helped the community build pipe bridges that were designed in Auburn, and celebrated with them! It was so much fun seeing the familiar faces throughout the community and taking in how much love they show to our team. It's truly amazing seeing the impact Auburn students have on a community hundreds of miles away.

~Anna Inskeep



In light of my summer abroad doing research in Germany, my main takeaway was to be ambitiously independent. Every day at the Leibniz Research Laboratories for Biotechnology and Artificial Organs (LEBAO) was chance to learn new skills, increase my knowledge, and it pushed me to perform out of my comfort zone. This experience influenced my career ambitions by introducing me to a new world of opportunities in the biomedical/bioengineering field and the impact that I can make. I have had the chance to be involved in a research project that serves to develop novel therapies for the treatment of a respiratory disease. I encourage students to take part such experiential/educational trips overseas because it offers a unique chance to learn, make lasting memories, and grow in all aspects.

~Jada Neal




Last summer, I spent three months in Italy and Spain, earning my business minor. I expected an amazing experience, but my expectations were truly exceeded. I was able to learn so much, experience countless new things, meet amazing people, and make the greatest memories. I saw ancient history in Rome, learned how to hike in the Pyrenees Mountains, and achieved my dream of learning how to surf in Portugal. Studying abroad was one of the most amazing experiences, and I would recommend it to anyone willing to take that step out of their comfort zone to learn and explore.

~ Patricia Barnes



Last Summer, I had the privilege of studying Spanish Language and culture in Madrid, Spain for four weeks. The program was filled with enriching experiences, including a wine tasting, flamenco dancing, watching Mamma Mia in Spanish, exploring the Royal Palace and numerous cathedrals, and taking weekend trips to historically significant towns like Segovia and Toledo. One memorable weekend was spent in Mallorca, an island paradise off the East coast of Spain. Although I experienced homesickness, this transformative journey expanded my horizons, improved my Spanish, and boosted my confidence in public speaking. It's an experience I'd recommend to anyone, as it reshaped my perspective on the world and myself.

~ Virginia Keith



Last summer, I traveled to Belgium as part of Texas A&M University's Environmental Science and Engineering Study Abroad Program. The program focused on two engineering courses: wastewater management and air pollution. We complemented our studies with field trips to various Belgian sites discussed in our lectures, including a constructed wetland, wastewater treatment facility, Port of Antwerp, and solid waste treatment facility. Guest speakers from Belgian firms shed light on EU environmental practices and issues like PFAS. Highlights included independent weekend excursions to Cologne, Amsterdam, and Waterloo. My time in Belgium was enriching, offering profound insights into our program's subject matter.

~ Rich Hall



# BSEN WORD SEARCH

I T B G B I O P R O C E S S Q D Y U J J  
W E U R O D J I Y S M H Y F E Z X S P E  
S N E A R B Y D M T T Z G T L W R L R O  
U G U N V E E E N L L J A C R U O G O C  
S I X T R F T B A Y I U W U N Q C R F U  
T N B S Q S G M S G D O I R V I S K E N  
A E I G Y H A Q B A R U I R L F J J S I  
I E D S Y A Q T R B I I X I F O R E S T  
N R O R E F D G P H P E C C A G N G I B  
A I E N V I R O N M E N T U H V H W O V  
B N L R E E E L B Z J K B L L O P R N L  
L G Y Z D I V K H T K R K U Q T K M A P  
E L Z N N A U T P X H E N M Z C U C L V  
F N U M S E N I O R D E S I G N I R O O  
G Y U V P R W M E K K X H G D G P U E Z  
R L Y N F P T Z Q Q I Q S P O K S X Y M  
A Z O G R A D U A T E V A L A E P D Q I  
B Y S G B W K U I G W V O Q L K Q K W D  
R Q K G Q Q V V W Q N C P F B A F G S R  
H T R E S E A R C H E X Y X D B T Q G V

- BIOSYSTEMS
- PROFESSIONAL
- CURRICULUM
- FOREST
- SUSTAINABLE
- ENGINEERING
- GRADUATE
- ENVIRONMENT
- RESEARCH
- SENIOR DESIGN
- BATM
- GRANT
- ECOLOGICAL
- BIOPROCESS
- ALUMNI
- UNDERGRADUATE
- AGRICULTURE



# THE CLASS OF 2023

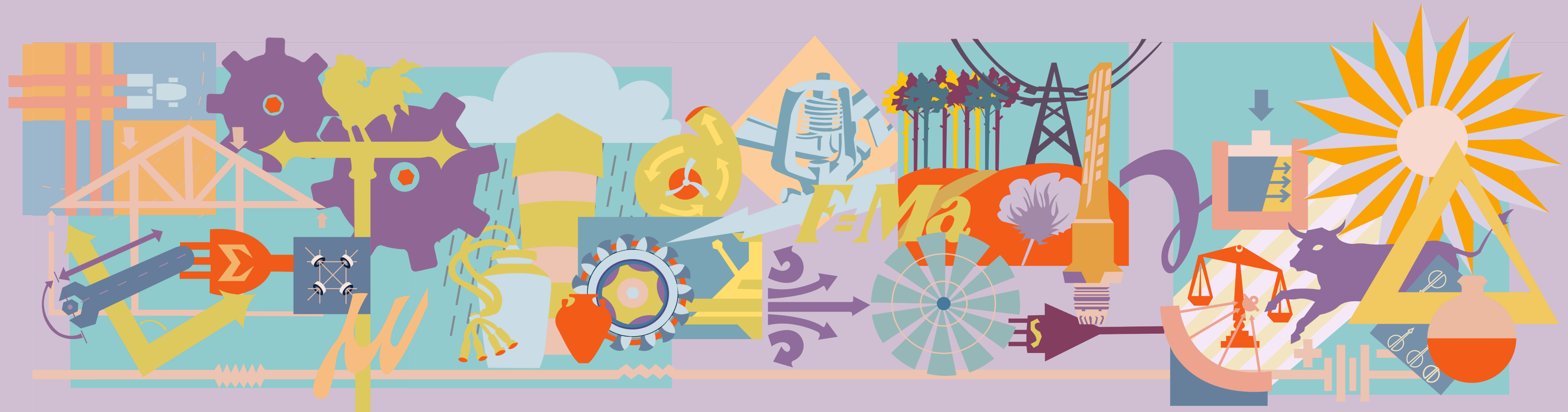


## AUBURN UNIVERSITY ALMA MATER

On the rolling plains of Dixie  
 'Neath the sun-kissed sky,  
 Proudly stands our Alma Mater  
 Banners high.  
 To thy name we'll sing thy praise,  
 From hearts that love so true,  
 And pledge to thee our loyalty  
 The ages through.  
 We hail thee, Auburn, and we vow  
 To work for thy just fame,  
 And hold in memory as we do now  
 Thy cherished name.

# BSEN

# MURAL



This cover art by Anne Hanger is from a drawing and mural painting that was placed in the lobby of the Corley building after a 1985 renovation. Hanger was a professor in the art department at Auburn for 15 years. She currently resides in Staunton, Virginia, where she is retired from teaching and paints full-time. Scan the QR code to watch an animated version of the BSEN Mural.



# BSEN BY THE NUMBERS

## FALL 2023

### UNDERGRADUATE:

**180**      **35**

ENGINEERING STUDENTS      TECHNOLOGY STUDENTS

### GRADUATE STUDENTS:

**37**      Master's: 12  
PhD: 25

### FACULTY:

**19**      5 Licensed PEs  
3 Leadership Appointments

### STAFF:

**13**      Research: 8  
Administrative: 4

To share alumni stories or updates to be featured in future newsletters, please send them to Multimedia Specialist Devontae Lindsey at [dtl0011@auburn.edu](mailto:dtl0011@auburn.edu)

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