

# SHOWCASE 2022

A hybrid event highlighting  
senior design projects and  
student achievements

**MICHIGAN STATE**  
UNIVERSITY

Department of Biosystems  
and Agricultural Engineering



The Biosystems Engineering (BE) Showcase is a long-standing highlight of the BE calendar. The feature of the day is the presentation of final design reports from our two-semester senior capstone design projects: these projects are the culmination of our students' undergraduate program. Showcase brings together the

entire BE community — student teams, project clients, our Industry Advisory Board, faculty, other BE students, and friends and family — to get a brief glimpse of the final design reports from these projects.

In a year that has continued to involve special challenges, we are proud of our students for persevering in their coursework, especially in senior design. I also want to express my deep appreciation to Drs. Dana Kirk and Luke Reese for managing senior design, to all the faculty advisors for the project teams, to the project clients for supporting our program, and to our Industry Advisory Board – whose expert insights, support, and evaluation of the projects are mission-critical to our overall program success and meeting our accreditation requirements.

Thank you!

*Bradley Marks, Ph.D., P.E.*

Professor and Department Chair

BE Senior Design is a unique, two-semester experience that prepares students for successful careers solving challenging problems in food, energy, environment and health.

In Senior Design, teams of three to five students are paired with real-world clients to work on an actual issue the client is facing. With the help of a BE faculty mentor, these teams work with their client to come up with a solution for the problem using the technical knowledge they've accumulated during their time at MSU. Students also develop skills in teamwork, project management and communication.



The nature of the two-semester structure allows students to take a deeper dive into a project and establish a stronger relationship with their team and client, similar to an industrial co-op. The extended time on the project allows the students to become more knowledgeable about the specific problem and solutions they're working to address. In addition, students experience a more realistic ebb and flow of team and client dynamics that prepare them for the start of their professional career. As an instructor, there's nothing better than seeing your students' hard work come to fruition. It's always exciting when our Senior Design students see their work implemented by clients — and sometimes, receive job offers from them. We're honored to lead this course and eager to share all of the hard work our students have put into their projects over the course of this year.

*Dana Kirk, Ph.D., P.E.*

Associate Professor

*Luke Reese, Ph.D.*

Associate Professor



(L to R) Chris Wentworth, Emily Ajemian, Taryn Hanses, & Ashley Hestad

## **BIGGBY® COFFEE Store-level Environmental Assessment: Data Analysis and Visualizations**

### **Team Go BIGGBY® or Go Home**

Sponsor: BIGGBY® COFFEE (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Chris Saffron

BIGGBY® Coffee was founded on community values and is eager to embrace more sustainable business practices. Given this desire to operate more sustainably, BIGGBY® now needs enhanced analytic processes. A system which presents understandable resource use data to executives for making environmentally conscious business decisions would benefit them. This project developed a system for tracking the consumption of inputs and production of waste in BIGGBY® franchises and used existing data to generate non-technical data visualizations. These visualizations will direct company focus and strategy for improving business sustainability decisions.



(L to R) Alex Seybold, Sidney Fenton, Erica Peer, & Brian Bilan

## **Ingham County Fairgrounds and Potter Park Zoo Organic Waste Management**

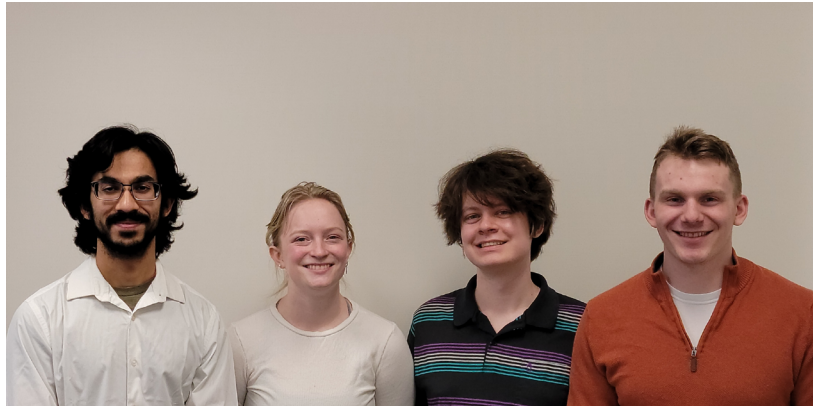
### **Team The Red Pandas**

Sponsor: Ingham County (Fairgrounds and Potter Park Zoo)

Faculty Advisor: Dr. Dawn Dechand



The Ingham County Fairgrounds and Potter Park Zoo have been seeking ways to increase their sustainability practices while decreasing their waste management costs. The team has designed a waste composting solution to be implemented at the Ingham County Fairgrounds that will handle both sites' animal waste in an environmentally and economically friendly way. The compost solution was designed for annually 8,000 yd<sup>3</sup> and would prevent the current 7,000 yd<sup>3</sup> of waste from entering a landfill. The compost solution at the fairgrounds will create a value-added product which reduces reliance on chemical fertilizers while simultaneously decreasing waste disposal costs for both sites.



(L to R) Arun Kammanadiminti, Melanie Stoughton, Skijlar Howerzyl, & Jack Kivi

## Nitrogen Stripping and Ozonation Columns for Wastewater Treatment In Remote Army Bases

### Team DOD

Sponsor: Department of Defense  
Faculty Advisor: Dr. Wei Liao, PE

Our team designed an intermediate step in a wastewater treatment system for the Department of Defense. The US Army spends around \$8,900 to transport water to soldiers in forward operating bases every year. Our goal was to reduce the amount of ammonia, turbidity, and COD levels in the wastewater to reduce the load that will be filtered out in later steps. The design includes a nitrogen stripping column and an ozonation column. This system is important to help cut costs while maintaining the necessities for US soldiers who are deployed abroad.



(L to R) Ian Klug, Tala Abdulqader, Kase Nelson, & Andrea Ma

## Optimizing an Ozone Processing System Against *E. coli* on Whole-muscle Beef

### Team Grobbel

Sponsor: EW Grobbel (project under Non-Disclosure Agreement)  
Faculty Advisor: Quincy Suehr

EW Grobbel is a Detroit based meat processing facility. The objective of the project was to improve the current ozone processing procedure for *E. coli* reduction. A pilot-scale ozone applicator was developed to replicate EW Grobbel's equipment. The factors tested were spray nozzle type (hollow cone or full cone) and composition of spray (water or ozonated water). Whole muscle beef samples were surface inoculated with *E. coli* and subjected to different combinations of these variables. The impact of the tested factors on water usage and *E. coli* reduction on the samples was quantified and analyzed.



(L to R) Zach Tonnerre, Hannah Craig Malich, Sierra Veenkant, Stephanie Starr, & Peyton Carroll

## Protein and Lactose Recovery

### Team Whey Stream Team

Sponsor: Tillamook (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Bahar Aliakbarian

Tillamook is a dairy manufacturer seeking to optimize their liquid whey process for higher recovery of whey protein. Liquid whey is a by-product of cheese making and must be refined to remove solids and fat for conversion to whey protein powder. Solids and fat removal is accomplished through a clarifier (removes cheese fines), and a separator (skims fat). A systematic approach for improvement based on available resources was recommended. First, a clarifier discharge matrix for maximum removal of cheese fines. The removal of fines at an optimal time will allow for the machines to run efficiently. Second, automated turbidity sensors detect and remove cheese fines in real-time. This increases the efficiency compared to the first option and decreases operator involvement. Third, retooling of the plant and the purchase of new equipment will allow for optimal whey processing and recovery rates. Retooling consists of moving machinery from one plant to the other, doubling the processing, and purchasing consists of buying newer, larger equipment. Both retooling and purchasing will increase the capacity of whey processing by 25%.



(L to R) Nicolas Scamardi, Chehak Arora, Katie Blouin, & Maryam Ezz

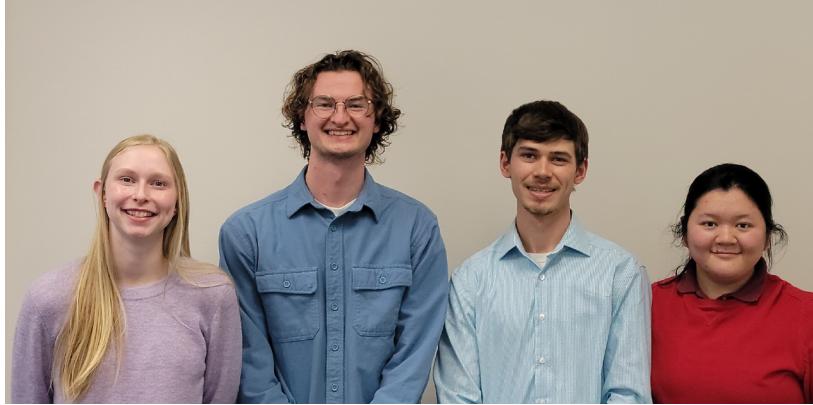
## Packaging line improvement Using Arena Simulation Software at a Pharmaceutical Plant

### Team Perrigo

Sponsor: Perrigo (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Kirk Dolan

The team worked with Perrigo to discover the best combination of variables, machine speeds, to achieve maximum output on a packaging line. The goal of this project was to increase efficiency by identifying and resolving bottlenecks to optimize operations using Arena simulation software. Arena allowed the testing of different machine speeds with three separate configurations on a single bottle size. Taking an engineering approach simulating the packaging line will allow future configurations to be easily analyzed and implemented. This solution could be expanded for different bottle sizes, configurations, and production lines at Perrigo.



(L to R) Kristin Danz, Ian Chesla, Brenden Kelley, & Lisa Zou

## Improved Hydraulic-powered Plastic Mulch Removal Implement for MSU Student Organic Farm

### *Team Student Organic Farm*

Sponsor: MSU Student Organic Farm  
Faculty Advisor: Dr. Ajit Srivastava

The Student Organic Farm senior design team was tasked with creating an implement to remove and collect plastic mulch covering from raised rows soil beds. The implement attaches to a three-point hitch toolbar and uses a disk to split the plastic mulch down the middle, an L-shaped tillage blade to undercut the plastic on the soil edges, and a hydraulic motor to spin the plastic collection reel. The design is projected to save \$2,000 in annual labor costs, reduce collection time by 2/3, and reduce the amount of plastic remaining in the soil after collection.



(L to R) Zachary Buhro, Jordan Neal, Kaitlin McHenry, & Trenten Beemer

## Microscale Biogas Plant Design

### *Team Goloka*

Sponsor: Goloka Ecology Model  
Faculty Advisor: Dr. Dana Kirk, PE

The Goloka Design Team was tasked with turning 3 cu. ft. per day of plant biomass from two onsite greenhouses and manure from seven cows into a renewable energy source. Due to the high solids content of the feedstocks, ranging from 29.1 – 43.3% total solids, it was determined a high solids digester would be the appropriate design. The low-tech design utilizes 55-gallon drums and a heating chamber to perform the mesophilic digestion process. The digester will produce nearly 17,657 cu. ft. of biogas per year which contains a maximum of 51% methane. The biogas will be burned in a furnace to provide heat to the digester and greenhouses. The digestate will be used as an organic fertilizer.



(L to R) Tyler Stump, Aubrie McCleery, Julie Celini, & Yassah Bah-Deh

## Residual Product Recovery From Manufacturing Tanks for Unilever

### Team Unilever

Sponsor: Unilever (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Yan “Susie” Liu

At the manufacturing level, Unilever strives to “make living more sustainable”. By recovering residual product in production tanks, Unilever can successfully take steps towards their company goal. The team evaluated tank surface application of a lubricant (i.e., polyalphaolefin (PAO)), addition of a vibrational accessory, and the combination of both to aid in the removal of residual product. Small-scale experimentation was performed on each solution with 76% residual recovery for the highest viscosity product when solutions were combined. The promising results should encourage future large-scale experimentation.



(L to R) Nick Saba, Ashley Xu, Shreyas Ramachandran, & Nyilah Congress

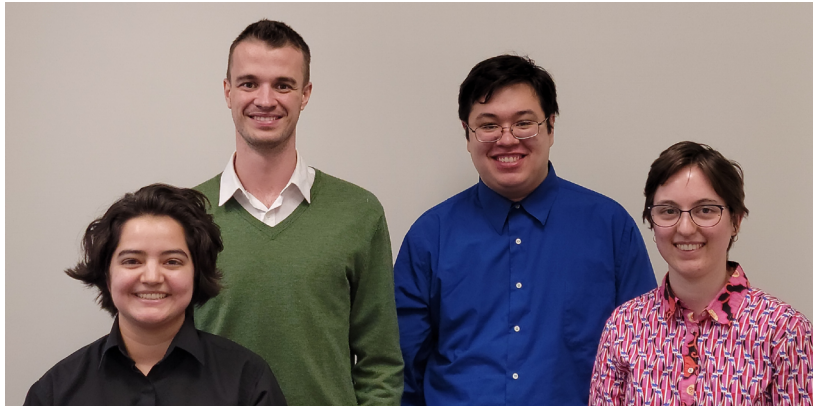
## Sterilization Analysis of Evaporator Coil Using UVC Light for Industrial Food Processing Freezers

### Team Frosties P53

Sponsor: John Bean Technologies (JBT) Foodtech, (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Sanghyup Jeong, PE

Team Frosties P53 completed a series of proof of concept tests to evaluate the use of ultraviolet light (UVC) as a sterilization method on an industrial freezer heat exchanger coil. The current steam sanitation method was compared to the UVC performance data for an economic and feasibility analysis. Within the complex coil structure, desired disinfection light intensities were not reached in the target time period making the concept impractical with the light system used. Future development is necessary to increase light intensity and penetration within the exchanger coil using different configurations such as UV-C LED or UV Cold cathode lamps.



(L to R) Molly Robles, Conor Crennell, Jacob Mears, & Annaliese Marks

## Mobile Decentralized Treatment System for Domestic Septage Utilizing Innovative Aeration

### Team Greener Planet Systems

Sponsor: Greener Planet Systems (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Steve Safferman, PE

Septage, pumped from a septic tank, has high solids and oxygen demand, making it difficult to treat compared to conventional wastewater. The goal of this project was to design a mobile system that treats domestic septage using Greener Planet System's PrO2 equipment. Septage will be pumped normally from septic tanks in a small region and brought to the mobile decentralized septage treatment system. The system is designed to treat 20,000 gallons of septage per day, with an option to periodically relocate. Treatment products will be solids disposed to landfill and low-strength domestic wastewater that can be delivered to a municipal wastewater treatment plant at a reduced cost.



(L to R) Alayna Peterson, Adam Harris, Brenna Tiernan, & Michael Kaven

## Reducing Labor with an Improved Red Swamp Crayfish Capturing Device

### Team InCraysive

Sponsor: Michigan Department of Natural Resources  
Faculty Advisor: Dr. Wei Liao, PE

Red Swamp Crayfish (*Procambarus clarkia*) are invasive in Michigan. They compete with native species and cause infrastructure instability by their deep burrowing. To capture red swamp crayfish more effectively, an improved trap was designed utilizing stimuli (olfactory, thermal, and auditory). Entry valves have nylon bristles to limit escape and the bottom opens for emptying. Trap size was increased to double the holding capacity of crayfish (~90) with bait preserved in an interior compartment. Site visit frequency was reduced to 2 weeks from every week. Rope and a crane system will enhance trap mobility to and from shore improving ergonomics and decreasing workload on DNR staff.







(L to R) Jacob Soullier, Catherine Christenson, Madalyn Allen, & Ryan Snyder

## Sterilization of Male Sea Lampreys With Bisazir

### Team USGS

Sponsor: United States Geological Survey (project under Non-Disclosure Agreement)

Faculty Advisor: Dr. Ilce Medina Meza

The team is working with the United States Fish and Wildlife Service (USFWS) and United States Geological Survey (USGS) to control invasive sea lampreys in the Great Lakes. The team aims to develop an improved male sea lamprey sterilization method. A complete and detailed design has been developed utilizing Bisazir immersion as the sterilization technique. This design increases worker safety and is more efficient than the current injection machine. With immersion in Bisazir the client can increase sterilization from 5,000 to 10,000 lampreys each season and has the potential for automation in the future.



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## The Advisory Board

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

### Board

Janelle Boosi ~ Kellogg  
Holly Bowers ~ Consumers Energy  
Jessica Bruin ~ Nestlé Nutrition  
Lisa Buchholz ~ Corteva Agriscience  
Matt Burttt ~ AbbVie  
Shelley Crawford (Chair) ~ Jiffy  
Michelle Crook, PE ~ MDNR  
Laura Doud, PE ~ MDARD  
Cassandra Edwards ~ Tillamook Creamery  
Gene Ford ~ Standard Process  
Jeremy Hoeh, PE ~ MEGLE  
Eric Iversen, PE ~ PEA Group  
Kevin Kowalk, PE ~ EA Engineering, Science, and  
Technology (MI) PLC  
Jeffrey Mathews, PhD ~ PepsiCo Global Beverage R&D  
Mitch Miller ~ General Mills-Yoplait  
Steve Radke ~ John Bean Technologies (JBT)  
Nate Wood, PE ~ Perrigo  
Rob Yoder ~ BDI, Inc.

### Board (Ex-officio)

Todd Forbush, Techmark, Inc. (ASABE MI Section)

If you are interested in sponsoring a BE 485/487 capstone project for the 2022\_23 Senior Design teams, please contact Dr. Dana Kirk at [kirkdana@msu.edu](mailto:kirkdana@msu.edu) or Dr. Luke Reese at [reesel@msu.edu](mailto:reesel@msu.edu).

***Full descriptions, and project posters are at:  
[www.egr.msu.edu/bae/SS22NewsBEShowcase](http://www.egr.msu.edu/bae/SS22NewsBEShowcase)***



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## UNDERGRADUATE SCHOLARSHIPS

### **F. W. Bakker-Arkema Endowed Scholarship**

F.W. Bakker-Arkema was a professor of agricultural engineering at MSU for over 30 years. His scholarship recognizes students that contribute to the cultural and intellectual diversity of biosystems engineering through their leadership experiences.

### **DeBoer Family Scholarship**

The DeBoer Family Scholarship is awarded to students who excel academically and demonstrate a passion for biosystems engineering.

### **A.W. Farrall Scholarship**

The Farrall Scholarship is the most prestigious undergraduate scholarship awarded by the Department of Biosystems and Agricultural Engineering. It is named in honor of A.W. "Doc" Farrall, who chaired the department from 1945-1964 and helped establish the first agricultural engineering Ph.D. program in the nation. Farrall Scholars excel both academically and professionally, and are leaders in the biosystems engineering community.

### **Mynsberge Experiential Learning Scholarship**

See Graduate Scholarships

### **Clarence and Thelma Hansen Scholarship**

The Clarence and Thelma Hansen scholarship is awarded to Michigan natives and U.S. students who have demonstrated academic achievement, leadership, and experience working in agriculture.

### **George E. and Betty L. Merva Endowed Scholarship**

Dr. George Merva was a faculty member in the Department of Biosystems and Agricultural Engineering for 30 years. This endowment, named in his and his wife's honor, recognizes upperclassmen who have demonstrated leadership and academic success.

### **John and Julianna Merva Endowed Scholarship**

Dr. George Merva's father, John, was an immigrant from Slovakia, who, despite receiving no formal schooling and working full time in ore mines, was able to teach himself three languages. In this spirit, the John and Julianna Merva Scholarship is awarded to an undergraduate student who has balanced leadership and academic success, while also working to cover their educational expenses.

### **Howard F. and Esther L. McColly Scholarship**

The Howard F. and Esther L. McColly Scholarship honors Dr. Howard McColly, who served on the faculty of the Department of Agricultural Engineering for more than 21 years, and his wife, Esther. The scholarship is awarded to students who have demonstrated academic achievement, leadership and service to the profession.

### **Michigan ASABE Section Scholarship**

The Michigan Chapter of the American Society of Agricultural and Biological Engineers (ASABE) awards a scholarship to one college freshman and one college sophomore each year. Recipients must be registered as pre- professional members of ASABE.

## FRESHMEN SCHOLARSHIPS

### **Robert J. Gustafson Scholarship**

The Gustafson Scholarship is awarded to students with a high academic ability and/or financial need, with a first preference for incoming freshmen students.

### **Alfred & Mary Murray Scholarship**

The Murray Scholarship is awarded to students with a high academic ability and/or financial need with a first preference for incoming freshmen students.

**2021-2022 Undergraduate  
Scholarship Recipients**

**F.W. Bakker-Arkema Endowed  
Scholarship**

Yassah Bah-Deh  
Emily Hamilton  
Kase Nelson Alayna Peterson  
Dipankar Roy Amari Selby

**DeBoer Family Scholarship/  
Fellowship Fund**

Emily Gorr  
Andrew Kearney  
Jack Kivi  
Greg Rouland  
Yashasvi Vaidya  
Chloe Zaborney Kline

**A.W. Farrall Scholarship**

Annaliese Marks  
Alexandria Seybold

**Clarence & Thelma Hansen  
Scholarship**

John Grivins  
Michael Kaven  
Aaron Newberry  
Chris Wentworth  
Jacob Willsea

**Howard & Esther McColly  
Scholarship**

Anna Burgess  
Taryn Hanses

**George E. and Betty L. Merva  
Endowed Scholarship**

Erica Peer

**John & Julianna Merva Scholarship**

Emma Savage

**George A. Mynsberge Experiential  
Learning Fund for Research**

Ian Chesla

**ASABE Michigan Section**

Annaliese Marks  
Alexandria Seybold

**2021-22 Freshmen**

**Robert J. Gustafson Scholarship**

Renae Kenney

**Alfred & Mary Murray Scholarship**

Sebastian Hawkes  
Mackenzie Meerschaert



## Graduate Scholarships

### Outstanding BE Research Fellowship & Fitch H. Beach Award

The Outstanding BE Research Fellowship & Fitch H. Beach Award is presented to one of the top Ph.D. students in the BE graduate program who has excelled in research productivity, and whose work suggests a high-level of direct impact on society. The recipient represents at the college level against similar nominees from other disciplines in the College of Engineering. Funding is based on placement in the competition at the college level and is funded by the College of Engineering and the BAE Endowment for Graduate Studies.

### Most Outstanding BE Graduate Student Fellowship

The Most Outstanding BE Graduate Student Fellowship is awarded to top students in the BE graduate program. It recognizes their recipients' breadth of excellence and direct and indirect contributions to the BAE Department through professional productivity, service to the department and university, and contributions to the extended community. This honor is funded by the BAE Endowment for Graduate Studies, which was from former and current BAE faculty and other donors wishing to support graduate education.

### Galen & Ann Brown Scholarship

The Galen & Ann Brown Scholarship supports graduate students working in the engineering domains that can be related or applied to the fruit and/or vegetable industries, a field to which Dr. Galen Brown dedicated his career. This scholarship is funded by the family of Galen and Ann Brown and others who respected and/or worked with Galen.

### Katherine & Merle Esmay Scholarship

The Katherine & Merle Esmay Scholarship supports international graduate students with a clear passion and plan to return to their home country to implement their knowledge gained through their MSU BAE degree. It is funded by the family of Merle and Katherine Esmay and others who have the passion to make a difference around the globe, like Merle did.

### Mynsberge Experiential Learning Scholarship

Candidates for the Mynsberge Experiential Learning Scholarship must conduct experiential learning research/outreach in water resource recovery, water quality, and/or wastewater treatment. The selected student(s) will work with a BAE faculty member for the experiential learning experience. The award has an expectation that the student presents their experience at a research conference hosted by MSU or a professional society.

## Graduate Scholarship Recipients

### College of Engineering Outstanding BE Graduate Student Fellowship

Ryan Julien

### Outstanding BE Research Fellowship & Fitch H. Beach Award

Ian Hildebrandt

### Galen & Ann Brown Scholarship

Oznur Caliskan-Aydogan  
Carly Gomez

### Katherine and Merle L. Esmay Fellowship

Sami Shokrana

### Mynsberge Experiential Learning Scholarship

Saad Asadullah Sharief

Special thanks to all the alumni, faculty, staff, friends and companies who make our department scholarships possible through their kind and generous gifts.

Interested in supporting scholarships for Spartan biosystems engineers? [Click here](#) to make a donation.

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## About the MSU Biosystems Engineering Program

BE graduates are expected to succeed in diverse careers where they integrate and apply principles of engineering and biology to globally important problems in food, energy, environment and health. This success is attained through a curriculum that focuses on:

- Identifying and solving problems at the interface of biology and engineering, using modern engineering techniques and systems approaches.
- Analyzing, designing, and controlling components, systems and processes that involve critical biological components.
- Demonstrating vision, adaptability, creativity and a practical mindset when solving problems.
- Developing communication skills for technical and non-technical audiences.
- Working with diverse, cross-disciplinary teams.
- Integrating sustainability into all facets of biosystems engineering
- The importance of continued professional growth and ethical conduct.

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