



## 2013 Biosystems Engineering Showcase

April 18, 2013

Kellogg Hotel and Conference Center  
Michigan State University

### Biosystems Engineering

Biosystems engineers integrate and apply principles of engineering and biology to a wide variety of socially important problems. The MSU biosystems engineering program prepares graduates conduct the following:

- Identify and solve problems at the interface of biology and engineering, using modern engineering techniques and the systems approach.
- Analyze, design, and control components, systems, and processes that involve critical biological components.

MSU biosystems engineering graduates are having a positive impact on the world, working in areas such as ecosystems protection, food safety and biosecurity, bioenergy, and human health.

A logo icon consisting of a 2x2 grid of squares. The top-left square contains a green leaf, the top-right square contains a green sun, the bottom-left square contains a green water drop, and the bottom-right square contains a green Erlenmeyer flask.

**BIOSYSTEMS**  
and Agricultural Engineering

*Integrating Engineering and Biology Since 1906*

# Participants / Schedule

## Biosystems Design Project Participants

Steven Archer	Ryan Gardner	Kyle McLachlan	Sarah Steudle
Maureen Berryman	Kristen Henn	Ethan Nussdorfer	Jacob St. Louis
Adrienne Bunce	Matthew Herman	Michael O'Meara	Benjamin Thomas
James Burns	Derek Hladki	Kayvon Parvizi	Kaitlin Ward
Kunal Choubey	Nathan Jandernoa	Lucas Poquette	Tyler White
Matthew Crowder	Elyse Kutsche	Ander Rochefort	Joshua Wolter
Luke DeSmet	Jena Laur	Kristin Sanburn	Jamie Yeung
Younsuk Dong	Jinsha Li	Maddie Saylor	Paul Zeltzer
Kelsey Downey	Robert McGuire	Stacey Stark	Yingkui Zhong

## A Showcase of the Program and Students

**April 18, 2013**

Presented by Faculty and Students in the Biosystems Engineering Program  
College of Agriculture and Natural Resources and the College of Engineering  
Michigan State University, East Lansing, MI 48824

The Kellogg Hotel and Conference Center at Michigan State University

### **Centennial B & C**

12:30 - 2:00 p.m.	Lunch (Doors open at 12:00 p.m.)
2:00 - 2:15 p.m.	Industry Briefing on Program Assessment
2:15 - 2:30 p.m.	Break

### **Auditorium**

2:30 - 3:15 p.m.	Senior Student Design Presentations (scheduled at 15 minute increments) <ul style="list-style-type: none"><li>• Redesign of ProMix Batter Mixer Cooling Mechanisms</li><li>• Emission Mitigation from Confined Animal Feeding Operations (CAFO) Using Wet Scrubbers and an Algae Culture</li><li>• Water Quality Best Management Practices Design for a City of Lansing Re-Development Project</li><li>• Dried Blood Spots Optimization for DNA Extraction</li><li>• Evaluating and Modeling of a Plastic Bottle Rinser</li></ul>
3:15 - 4:00 p.m.	Break
4:00 - 5:15 p.m.	Senior Student Design Presentations (scheduled at 15 minute increments) <ul style="list-style-type: none"><li>• Torrefaction Process Improvement</li><li>• Integration of Aquaculture, Anaerobic Digestion, and Hydroponic Systems</li><li>• Hydroponic Processing Optimization for Mung Bean Sprouts</li><li>• Electrocoagulation Flotation Treatment System for Anaerobic Digestion Effluent</li><li>• Chestnut Chip Dehydration System Design</li></ul>
5:15 - 5:30 p.m.	Break

### **Red Cedar A & B**

5:30 - 6:30 p.m.	Reception, Student-Industry Interaction & BE 230 Poster Presentation
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### **Lincoln Room**

6:45 - 8:30 p.m.	Dinner (prior reservation required)
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# Team Projects

## Redesign of ProMix Batter Mixer Cooling Mechanisms

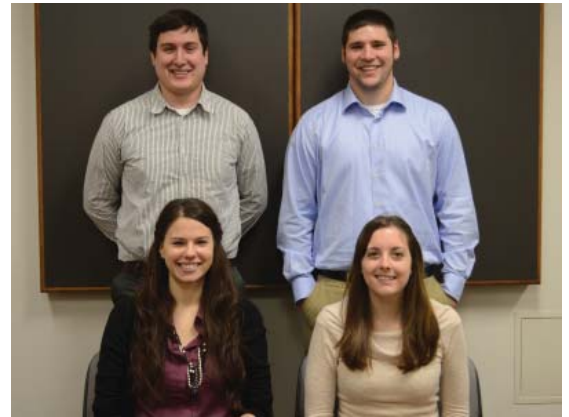
Regulations from the FDA require a batter mix added to food to be at 50°F or below in order to comply with food safety. JBT Foodtech is setting a more stringent temperature reduction to 45°F.

The objective of this project is to redesign the batter coolant system on the ProMix continuous batter mixer in order to reduce the temperature of the mix 10°F in 20 minutes and then maintain a temperature between 40 and 45°F in order to ensure compliance with FDA/USDA regulations.



**Faculty Advisor**  
Bradley Marks

**Sponsor**  
JBT Food Tech



**Team Members (B to F, L to R)**

Michael O'Meara  
Lucas Poquette  
Adrienne Bunce  
Stacey Stark

## Emission Mitigation from Confined Animal Feeding Operations (CAFO) Using Wet Scrubbers and an Algae Culture

Animal feeding operations emit large quantities of ammonia gas and particulate matter. These emissions affect the health of workers and residents in the surrounding area. Without emission mitigation animal feeding operations will not be able to continue to expand with growing demand for meat and dairy products.

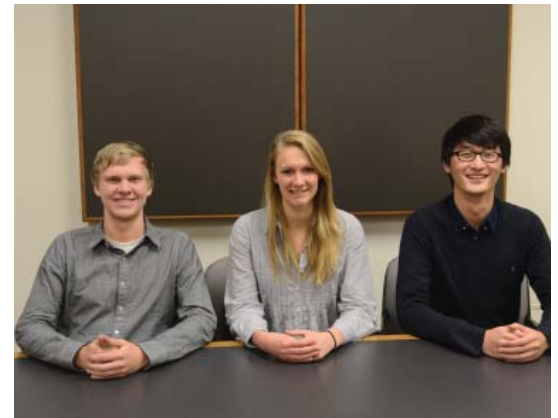
The team will design an integrated wet scrubber system which will shower ventilation exhaust air and absorb the ammonia and particulate matter. The effluent water will be used in an algal cultivation greenhouse system to recycle the water, while developing value-added products from the algae, such as fertilizer.



**Faculty Advisor**  
Yan Liu

**Sponsor**  
MSU Extension, Wendy Powers

**Faculty Co-Advisor**  
Jeff Li



**Team Members (L to R)**

Benjamin Thomas  
Elyse Kutsche  
Yingkui Zhong

# Team Projects

## Water Quality Best Management Practices Design for a City of Lansing Re-Development Project

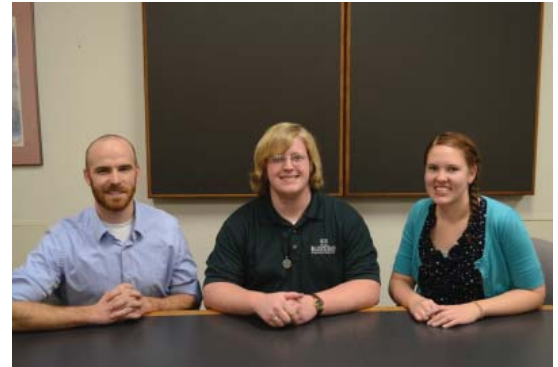
Urban landscapes have a high percentage of impervious areas increasing stormwater runoff times and peak flow conditions. Using best management practices from the Michigan Low Impact Development (LID) Manual, runoff can be managed to reduce the quantity and improve the quality of the stormwater.

The team will design an efficient stormwater runoff treatment system for the redevelopment of a parking lot in downtown Lansing in compliance with Michigan LID techniques.



**Faculty Advisor**  
Pouyan Nejadhashemi

**Sponsor**  
Tetra Tech, Inc.



**Team Members (L to R)**  
Joshua Wolter  
Matthew Herman  
Maureen Berryman

## Dried Blood Spots Optimization for DNA Extraction

The Dried Blood Spot (DBS) technique is an effective way to screen for diseases and genetic disorders for patients who do not have much blood to give, access to veins to draw blood such as infants and the elderly, and also for those who live in low resource areas.

Improvement of the method can make blood testing more efficient and much more cost effective. The project goal is to increase the yield of DNA that can be extracted from a DBS sample in the most cost effective and time-efficient manner.



**Faculty Advisor**  
Evangelyn Alocilja

**Sponsor**  
Biomedical Laboratory Diagnostics



**Team Members (L to R)**  
Kayvon Parvizi  
Steven Archer  
Kunal Choubey

# Team Projects

## Evaluating and Modeling of a Plastic Bottle Rinser

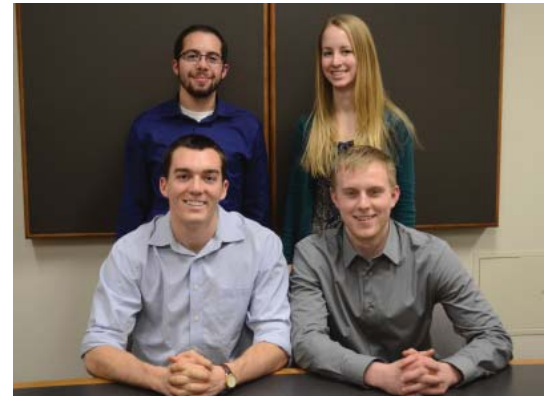
The bottle rinser is the last step in decontamination before the product is hot-filled into the containers. When the bottle rinser operates optimally, the risk of public safety or fiscal loss due to microbial or foreign material contamination is significantly reduced.

The project goal is to design a process to reduce microbial contamination and reduce foreign materials in the packaging bottles before the bottles reach the hot-fill beverage lines at the Ocean Spray® juice factory.



**Faculty Advisor**  
Kirk Dolan

**Sponsor**  
Ocean Spray®



**Team Members (B to F, L to R)**

Paul Zeltzer  
Jena Laur  
Tyler White  
Matthew Crowder

## Torrefaction Process Improvement

Typical torrefaction product yields are approximately 70%; however, HTI experiences a low product yield for their torrefaction process. Large particle size distribution and large variance in the shape of wood chips make it difficult to ensure complete biomass torrefaction.

Green Coal Inc. will design a method to increase the product yield of HTI's torrefaction process while consistently and completely torrefying biomass of varying size and shape.



**Faculty Advisor**  
Chris Saffron

**Sponsor**  
Heat Transfer International



**Team Members (L to R)**

Kristen Henn  
Jamie Yeung  
Kaitlin Ward  
Jinsha Li

# Team Projects

## Integration of Aquaculture, Anaerobic Digestion, and Hydroponic Systems

Currently, aquaculture is expensive and has a long payback period after an initial capital investment. Incorporating aquaculture with anaerobic digestion and hydroponics adds an additional source of revenue to the system along with the reduction of operational costs through the combustion of gas produced from an anaerobic digester.

The team will optimize an anaerobic digestion system using fish carcass and wastewater from an existing aquaculture facility, with the products from the anaerobic digester used as fertilizer and an energy source to maximize yield in a hydroponic system.



**Team Members (L to R)**

Derek Hladki  
Kristin Sanburn  
Nathan Jandernoa



**Faculty Advisor**  
Dana Kirk

**Sponsor**  
Aquaculture Research Corp.

## Hydroponic Processing Optimization for Mung Bean Sprouts

Mung beans are grown hydroponically from seed to sprout in 5.5 days where they are used in La Choy™ products by ConAgra®. The process has not been modified in over four decades and observable losses in yield and sprout quality are evident.

The goal of this project is to increase profit by optimizing the hydroponic system which is lacking in rich, white sprouts due to a pH imbalance and water shortage. Multiple production processes are being investigated to reduce a .6% loss of quantity due to pH imbalance and a 10% loss due to water shortages.



**Team Members (B to F, L to R)**

Kelsey Downey  
Ander Rochefort  
Sarah Steudle  
Maddie Saylor



**Faculty Advisor**      **Faculty Co-Advisor**  
Shiny Mathews      Ajit Srivastava

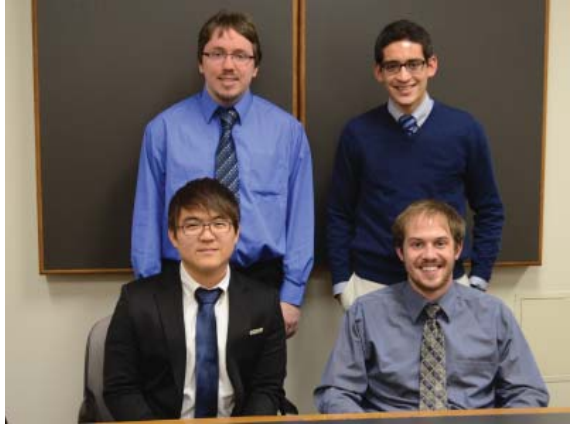
**Sponsor**  
ConAgra Foods®

# Team Projects

## Electrocoagulation-Flotation Treatment System for Anaerobic Digestion (AD) Effluent

Conventional chemical and physical treatments of agricultural, municipal and industrial residual waste streams do not provide an efficient solution with a small footprint and limited chemical utilization. This presents the need for a cost-effective, high strength water treatment and reclamation system.

The goal of this project is to investigate the effectiveness of coupling dissolved air flotation and electrocoagulation-flotation technologies in treating liquid AD effluent to improve upon the efficiency of the processes when utilized independently and to recover nutrients.



**Team Members** (B to F, L to R)

Robert McGuire  
Ryan Gardner  
Yoonsuk Dong  
Luke DeSmet



**Faculty Advisor**  
Wei Liao

**Sponsor**  
DQY Agriculture Co., LLC

## Chestnut Chip Dehydration System Design

Chestnut chips are a value-added product that can be used as an ingredient, eaten as a snack, or milled into flour. In order to realize the market potential of chestnut chips, chip drying techniques must be investigated and optimized to make the production of chestnut chips economical.

By determining the theoretical drying parameters, investigating alternative systems, and performing economic analyses, the optimal dehydration system for chestnut chips can be determined. A tool must be developed that determines the optimal dehydration system parameters.



**Team Members** (B to F, L to R)

Kyle McLachlan  
James Burns  
Ethan Nussdorfer  
Jacob St. Louis



**Faculty Advisor**  
Daniel Guyer

**Sponsor**  
Chestnut Growers, Inc.

# 2013 Scholarship Recipients

## Undergraduate Awards

### *A.W. Farrall Scholarship*

*Alexa Jones  
Rachel Kurzeja*

### *Clarence & Thelma Hansen Scholarship*

*James Burns  
Matthew Gammans  
Nathan Jandernoa  
Julia Otwell*

### *Howard & Esther McColly Scholarship*

*Keely Chandler  
Paige Crosset*

### *George & Betty Merva Scholarship*

*Anh Bui  
Stacey Stark*

### *DeBoer Family Scholarship/Fellowship Fund*

*Jena Laur  
Kristin Sanburn*

### *Galen & Ann Brown Scholarship*

*James Burns*

## Graduate Awards

### *College of Engineering Outstanding*

*BE Graduate Student  
Irwin Donis-Gonzalez*

### *Outstanding BE Graduate Student Fellowship*

*Zhenhua Ruan  
Sean Woznicki*

### *Outstanding BE Research Fellowship & Fitch H. Beach (Honorable Mention) Award*

*Dharmendra Mishra*

### *Merle & Catherine Esmay Scholarship*

*Melissa Rojas-Downing  
Subhasis Giri  
Georgina Sanchez*

### *Bill & Rita Stout Scholarship*

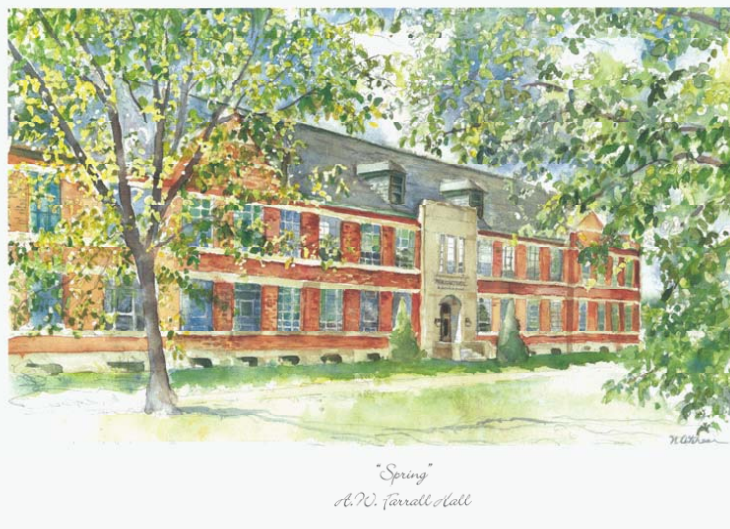
*Rui Chen*

### *Galen & Ann Brown Scholarship*

*Niroj Aryal*

### *Graduate Research Symposium Awardees*

*Shannon McGraw  
Irwin Donis-Gonzalez  
Pichamon Limcharoenchat*







## Biosystems Engineering 2013 Distinguished Alumni Award

### Scott Piggott

Scott Piggott (BS, Biosystems Engineering, 1998; MS, Biosystems Engineering, 2010) was hired as Chief Operating Officer of Michigan Farm Bureau in April of 2012. As Chief Operating Officer, Scott is responsible for planning, managing and supervising all of Farm Bureau's ongoing programs and services. Scott began his career with Michigan Farm Bureau in 2000 as Natural Resources and Right to Farm Specialist and became manager of the Agricultural Ecology Department in 2002 where his responsibilities included environmental issues like air quality, water quality and water quantity. Scott has served on over 20 committees and boards, including co-chairmanship of the Michigan Agriculture Environmental Assurance Program and the Michigan Groundwater Conservation Advisory Council. Scott has been an invited fellow for environmental concerns at Michigan State University, University of Michigan and University of Toronto.

Scott earned undergraduate and graduate degrees in Biosystems Engineering from Michigan State University. He has worked for the State of Michigan and designed air pollution control devices in private industry. Scott lives and works on his family's farm near Fowler, Michigan with his wife Donna and four children.



## Biosystems Engineering 2013 Outstanding Alumni Award

### Adam Eisele

Adam Eisele (BS, Biosystems Engineering, 2003) is currently an environmental engineer with the U.S. EPA – Region 8 in Denver, Colorado, where he specializes in the development and application of advanced air quality monitoring tools. Adam has been with EPA Region 8 since late 2008. Prior to this, Adam received his Master's degree from the University of Colorado – Boulder where he majored in both Mechanical and Environmental Engineering. His thesis work focused on measuring air toxics at the urban/mountain interface along Colorado's Front Range. Adam was recently awarded a PECASE (Presidential Early Career Award for Scientists and Engineers) by President Obama for pioneering research in air quality surveillance and method development.

Adam and his wife Sara recently married in Napa Valley in 2012 and live in Boulder, Colorado. When not thinking about air quality, Adam enjoys mountaineering and skiing, Colorado micro-brews, and repeatedly picking the Spartans to win the NCAA Basketball Tourney despite the string of broken brackets.



# Industry Advisory Board 2012-2013

**Gene Ford**, (Chair) is vice president of global technology management, R&D, at Nestlé Nutrition in Fremont, Michigan. He has more than 25 years of experience in domestic and international product development, manufacturing, logistics, and sales within the consumer food industry. Gene holds a B.Sc. and M.Sc. degrees in Agricultural Engineering and an Executive M.Sc. degree.



**Cassandra Edwards** (Chair Elect) is the Research and Development Manager at ConAgra Foods®. ConAgra Foods® are found in 97 percent of America's households, and 25 of them are ranked first or second in their category. Cassandra holds a B.Sc. degree in Food Engineering and a M.Sc. degree in Mechanical Engineering.



**Steve Steffes**, P.E., (Past Chair) is Vice President Operations New York with Perrigo, the world's largest manufacturer of over-the-counter store brand pharmaceutical products. Steve was a commissioned officer in the U.S. Army Corps of Engineers. Steve holds a B.Sc. degree in Chemistry and German and a M.Sc. in Environmental Engineering.



**Michelle Crook**, P.E., is an Engineering Specialist in the Environmental Stewardship Division of the Michigan Department of Agriculture. Michelle provides engineering assistance to the livestock and food processing industry and holds a B.Sc. in Environmental Engineering.



**Chad D. Ducey**, P.E., is the Project Manager for Werks Management, LLC. and President of C-JET Energy, LLC. At Werks, Chad heads water and wastewater projects, site development and building project management. At C-Jet Energy, Chad's R & D work centers around innovative ways to create multiple energy and fuel sources from various organic waste products generated from a variety of industries. Chad holds a B.Sc. degree in Civil Engineering with a minor in Environmental Engineering.



**Bryce Feighner**, P.E., is Chief of the Office of Environmental Assistance in the Department of Environmental Quality (DEQ). He has a broad range of education and experience across DEQ programs. Bryce holds a B.Sc. in Agricultural Engineering and a M.Sc. degree in Environmental Engineering.



**Jeffrey Mathews** is Principal Engineer for PepsiCo Beverages. Pepsi Beverages Company (PBC) handles approximately 75 percent of PepsiCo's North America beverage volume. Its diverse portfolio includes some of the world's most widely recognized beverage brands, including Pepsi, Mountain Dew, Sierra Mist, Aquafina, Gatorade, SoBe, Lipton, and Amp Energy. Jeffrey holds B.Sc., M.Sc. and Ph.D. degrees in Chemical Engineering/Paper Science and Engineering.



**Juanita McCann**, P.E., is Agricultural Engineer for USDA - Natural Resources Conservation Service. She works with landowners in the design and installation of animal waste storage facilities, agrichemical handling facilities, mortality composting facilities, waterways, and grade stabilization structures. Juanita holds a B.Sc. degree in Agricultural Engineering.



# Industry Advisory Board 2012-2013

**Scott Millsap** is Freezer Operations Manager at JBT FoodTech, a leading supplier of integrated food processing solutions. Scott holds B.Sc. and M.Sc. degrees in Biosystems Engineering and a MBA degree.



**Valerie Novaes**, is Project Engineer in the Water Resources Department for Tetra Tech, a leading provider of consulting, engineering, and technical services worldwide. Valerie holds a B.Sc. degree in Biosystems Engineering and is currently completing a M.Sc. degree.



**Mitch Miller**, is the Senior Processing System Engineer for the General Mills-Yoplait Plant, Reed City, Michigan. General Mills is among the world's largest food companies with U.S. shoppers on average placing at least one General Mills product into their shopping cart each time they visit the grocery store. Mitch holds B.Sc. and M.Sc. degrees in Agricultural & Biosystems Engineering.



**Dave Prouty** is President of Heat Transfer International which manufactures custom designed process equipment, specializing in biomass gasification/ electric power generation systems that convert solid and semisolid biomass into a combustible syngas. Dave holds a B.Sc. degree in Mechanical Engineering.



**Steve Richey** is Director, Morning Foods, Process Engineering at Kellogg Company, the world's leading producer of cereal and a leading producer of convenience foods. Steve holds B.Sc. and M.Sc. degrees in Agricultural Engineering.



**Larry Stephens, P.E.**, is owner of Stephens Consulting Services, P.C., a 30+ year old engineering firm located in Haslett, MI. Larry holds a B.Sc. degree in Civil Engineering and a M.Sc. in Environmental Engineering. Larry has been very active in the decentralized wastewater treatment industry in Michigan on both the regulatory and the private sides for nearly his entire career.



**Muluken Tilahun** is Associate Principal Engineer at Kraft Foods, the world's second largest food company with annual revenues of \$49.2 billion and 127,000 diverse employees around the world. Muluken holds a B.Sc. degree in Engineering and M.Sc. degrees in Agricultural Engineering and Mechanical Engineering.



**Andrew Granskog, P.E.**, (ex-officio) is State Engineer for USDA Rural Development Community Programs which finances \$50 million in rural water and sewer infrastructure projects per year in Michigan. Andrew has been at USDA for twelve years, was in private consulting for ten years prior and holds B.Sc. and M.Sc. degrees in Agricultural Engineering.



## Ex-officio

Leo Kempel, Acting Dean, College of Engineering

Dan King, Undergraduate Advisor, Biosystems & Agricultural Engineering

Fred Poston, Dean, College of Agriculture and Natural Resources

Luke Reese, Industry Liaison, Biosystems & Agricultural Engineering

Ajit Srivastava, Professor and Chair, Biosystems & Agricultural Engineering

Adrienne Bunce, Undergraduate Student Representative

Georgina Sanchez, Graduate Student Representative

# Special Thanks

## Message from the Chair:

BE Showcase is an annual event to showcase the accomplishments of our students. BE faculty and staff are committed to maintaining excellence of our programs. Showcase would not be possible without the on-going support of our alumni, board members, university administration, parents and sponsors. Thank you to everyone who contributes to the continuing BE Showcase success.



**BAE Chair**  
Ajit Srivastava  
BE 485

<b>2013-13 Project Sponsors</b>	<b>Industry Evaluators</b>
JBT FoodTech - Bob Stacy & Scott Millsap	Mitch Miller, General Mills - Yoplait Plant Muluken Tilahun - Kraft Foods
MSU Extension - Wendy Powers	Michelle Crook, PE, MDA, Env. Stewardship Div. Juanita McCann, PE, USDA-NRCS
Heat Transfer International - Dave Prouty	Dave Prouty, Heat Transfer International (HTI) Chad Ducey, C-Jet Energy, LLC
Chestnut Growers, Inc.	Dave Prouty, Heat Transfer International (HTI) Jeffrey Mathews, PhD, PepsiCo
Tetra Tech - Valerie Novaes	Bryce Feighner, PE, MDEQ Valerie M. Novaes, Tetra Tech
Aquaculture Research Corporation - Mr. Steven Srivastava	Larry D. Stephens, PE, Stephens Consulting Ser., P.C. Michelle F. Crook, PE, MDA, Env. Stewardship Div.
ConAgra Foods® - Cassandra Edwards & Brandon Wagener	Cassandra Edwards, ConAgra Foods Scott Millsap, JBT FoodTech
Biomedical Laboratory Diagnostics - John A. Gerlach	Steve Steffes, PE, Perrigo Company
Ocean Spray® - Ferhan Ozadali	Gene Ford, Nestle Nutrition, R & D Center Steve Richey, Kellogg Company
DQY Agriculture Co. Ltd., China	Chad Ducey, C-Jet Energy, LLC Andrew Granskog, PE, USDA - RD

## Staff:



**Design Project Instructor**  
Dana Kirk  
BE 485/487



**Design Project Instructor  
and Technical Advisor**  
Luke Reese  
BE 485/487



**Showcase Event  
Coordinator**  
Barb DeLong

# 2013 Showcase Sponsor



Thank you to John Bean Technologies (JBT) Corporation, a leading supplier of integrated food processing solutions, for sponsorship and support of a 2012/13 Senior Design project and BE Showcase support. From single machines to complete processing lines, the JBT FoodTech division enhances value and captures quality, nutrition and taste in food products.

The JBT FoodTech offering includes:

- Freezer solutions for the freezing and chilling of meat, seafood, poultry, ready-to-eat meals, fruit, vegetable and bakery products
- Protein-processing solutions that portion, coat and cook poultry, meat, seafood, vegetable and bakery products
- Shelf-stable sterilization solutions for fruits, vegetables, soups, sauces, dairy and pet food products, as well as ready-to-eat meals in a wide variety of modern packages
- Fruit and juice processing solutions that extract, concentrate and aseptically process citrus, tomato and other fruits.

For more information, visit the JBT FoodTech website at: <http://www.jbtfoodtech.com/>

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[www.egr.msu.edu/bae](http://www.egr.msu.edu/bae)

College of Agriculture and Natural Resources  
[www.canr.msu.edu](http://www.canr.msu.edu)

College of Engineering  
[www.egr.msu.edu](http://www.egr.msu.edu)