



MICHIGAN STATE
UNIVERSITY

2015 Biosystems Engineering Showcase

April 16, 2015

Kellogg Hotel & 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 to 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.

MICHIGAN STATE
UNIVERSITY

Department of Biosystems
& Agricultural Engineering

Participants / Schedule

Biosystems Design Project Participants

Danielle Boileau	Elizabeth Gregory	Mariana Madrigal-Martinez	Brian Smith
Quincy Brissette	Andris Grinvalds	Gina Masell	Andrew Stoffel
Andrew Brown	Kyle Guyer	Celina Merhi	Mackenzie Tocco
Robert Bruhn	Dimitrius Innis	Kristine Nguyen	Samantha Walby
Sarah Buchholz	Stephen Jones	Hannah Pichner	Alexander Whitlow
Xuhao Dai	Nicole Kruse	Lauren Prochazka	Alexis Wloch
Lucas Flynn	Rachael Kurzeja	Christopher Ross	
Taylor Folkertsma	Brody Lawrence	Scott Rubin	

A Showcase of the Program and Students

April 16, 2015

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

Kellogg Hotel & Conference Center, 219 S. Harrison Road

Centennial B & C

12:30 - 2:00 p.m.	Lunch (Reservations required, 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 - 3:45 p.m.	Senior Student Design Presentations (scheduled at 15 minute increments) <ul style="list-style-type: none">• Anaerobic Digestion: A Pre-feasibility Study• Utilization of Chitosan as a Biopesticide Extracted from Sugar Beet Pulp• JBT FoodTech Continuous Freezer Conveyor Belt Cleaning System• Torrefaction of Biomass• Wearable Phototherapy Device for Jaundice Treatment
3:45 - 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">• Integrating Water and Energy Engineering with Ecotourism in a Costa Rican Aboriginal Community• Green Infrastructure Design Project• Wastewater Treatment Electrocoagulation• Optimizing Wastewater Irrigation for Food Industry Application• Reducing Spoilage Microorganisms in Cherry Pomace

Red Cedar A & B

5:30 - 6:30 p.m.	Reception, Student-Industry Interaction & BE 230 Poster Presentation
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Big Ten C

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

Anaerobic Digestion: A Pre-feasibility Study

Granger is a waste hauling and landfill gas collection company operating throughout the nation. Granger is interested in increasing power production at their Grand River site, and they believe anaerobic digestion could be a potential solution to generate an additional 600kWh. The “Power Grangers” team is conducting a pre-feasibility study of an anaerobic digester to determine whether it can be implemented into their current system. This study includes the formulation of a feedstock blend for optimal methane production, an anaerobic digester design, a recommended use for the digestate, operational and regulatory challenges, and a complete economic analysis of the overall system.



Team Members (L to R)
Mariana Madrigal-Martinez
Taylor Folkertsma
Lauren Prochazka



Faculty Advisor
Dana Kirk, PE

Sponsor
Granger



Utilization of Chitosan as a Biopesticide Extracted from Sugar Beet Pulp

Michigan Sugar produces 25,000 tons of sugar beet pulp per year, predominately used as a low value animal feed. Due to the increasing competitiveness of sugar beet processing, it is critical to develop a more valuable by-product. Team “Sugar Be-ets” project goal is to utilize wet sugar beet pulp by applying the biological method of simultaneous saccharification and fungal fermentation to produce chitosan for use as a bio-pesticide.



Team Members (L to R)
Samantha Walby
Elizabeth Gregory
Andrew Brown



Faculty Advisor
Yan “Susie” Liu

Sponsor
Michigan Sugar Company



Team Projects

JBT FoodTech Continuous Freezer Conveyor Belt Cleaning System

The “Clean Freeze” team project is to design a continuous, run cold, external belt rinser and drier for a JBT GC M10 Tight Curve spiral freezer. After frozen food product exits the freezer, the system will clean the belt of built up frost and food debris with an optional allergen abatement method and then completely dry the belt before food is placed on it.

Client deliverables for this project include a mathematical model of the design, a tested prototype design, a full-scale design recommendation, a complete bill of materials, and an economic feasibility analysis.



Team Members (L to R)

Stephen Jones
Scott Rubin
Danielle Boileau



Faculty Advisor
Sanghyup Jeong



Faculty Advisor
Phil Hill

Sponsor
JBT FoodTech
(under non-disclosure agreement)



Torrefaction of Biomass

Greenhouse gas emission regulations are increasing thus creating demand for practical energy alternatives. An alternative being studied is torrefied woody biomass pucks that can act as “drop ins” for coal plants. The puck hydrophobicity is the focus of the project. In order to achieve hydrophobicity comparable to coal, different alternatives will be analyzed including hydrophobic coating applications, altering the process conditions and a binding agent. A break-even analysis will be conducted in order to determine the necessary cost of a carbon dioxide tax on coal in order for the biomass pucks to be competitive.



Team Members (L to R)

Lucas Flynn
Xuhao Dai
Mackenzie Tocco



Faculty Advisor
Christopher Saffron

Sponsor
Heat Transfer
International (HTI)



Team Projects

Wearable Phototherapy Device for Jaundice Treatment

Jaundice, or hyperbilirubinemia, is a medical condition that affects approximately 60% of newborns. It is caused by an excessive formation of the product of red blood cell breakdown (bilirubin) in the blood. Current treatments include blue light phototherapy administered in an incubator. This treatment method is expensive and disrupts critical mother and infant bonding time.

A design is proposed for a safe and wearable phototherapy treatment device that prevents the separation of mother and infant. The device is intended to be a portable and affordable treatment method for developing countries where jaundice is prevalent and power sources are limited.



Team Members (L to R)

Alexis Wloch
Celina Merhi
Sarah Buchholz



Faculty Advisor
Timothy Whitehead



Faculty Advisor
Steve Marquie

Sponsor
Biosystems &
Agricultural
Engineering

Integrating Water and Energy Engineering with Ecotourism in a Costa Rican Aboriginal Community

Team “Shuabb Systems” has designed an integrated system to provide potable water, wastewater treatment, and energy production for an ecotourism project led by the Shuabb Aborigine Women Association in Costa Rica. By integrating green technologies such as water filters, anaerobic digestion and constructed treatment wetlands, the project aims to secure clean water for human consumption and treat solid waste and wastewater, while creating renewable energy on site. The project is in cooperation with the Gender Equity Office from the Technological Institute of Costa Rica, and can demonstrate the economic value of such development in a region with limited access to public services.



Team Members (L to R)

Gina Masell
Nicole Kruse
Brian Smith



Faculty Advisor
Dawn Reinhold

Sponsor
EPA



Indigenous Innovations

Team Projects

Green Infrastructure Design Project

Project sponsor Tetra Tech is working to reduce stormwater runoff in Detroit in order to mitigate sewer system overflow. Team “Flood Control” is working on a Low Impact Development design to capture and treat runoff at Thomas J. Edison Elementary School.

Best management practices (BMPs) will be introduced to control and limit the flow rate of stormwater runoff entering the sewer system. Stormwater runoff reduction will decrease the amount of raw sewage disposal into local water bodies and have added environmental benefits. Project deliverables include hydrological models proving that BMPs meet project objectives, CAD drawings of BMPs, and a detailed cost analysis of the final design.



Faculty Advisor
Pouyan Nejadhashemi

Sponsor
Tetra Tech



Team Members (L to R)
Alex Whitlow
Chris Ross
Andrew Stoffel

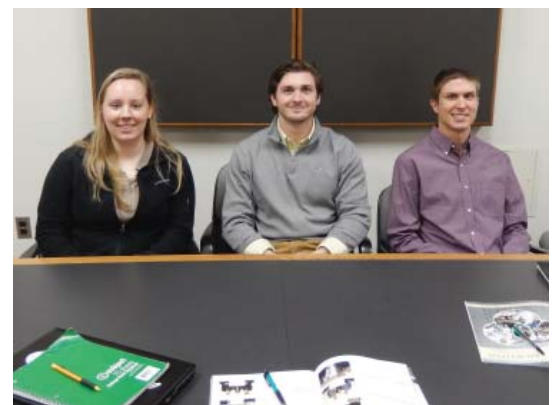
Wastewater Treatment Electrocoagulation

Team “Meat the Spartans” is working with Bellingar packing, a small-scale meat processing facility in St. Johns, Michigan. The team’s objective is to design and construct a system to scale up to treat 9,000-12,000 gallons of wastewater weekly and comply with MDEQ and EPA discharge standards while producing renewable energy and solid waste fertilizer. The treatment system consists of an anaerobic digester to initiate breakdown of the solids within the wastewater and generate biogas, used to offset natural gas consumed for heating water, followed by an electrocoagulation reactor, which charges solid particles to adhere to one another for easy removal as a concentrated fertilizer.



Faculty Advisor
Wei Liao, PE

Sponsor
Bellingar Packing



Team Members (L to R)
Hannah Pichner
Dimitrius Innis
Andris Grinvalds



Team Projects

Optimizing Wastewater Irrigation for Food Industry Application

The purpose of this project is to identify and address problems encountered in the center pivot irrigation wastewater treatment process of a food production company. This project uniquely combines aspects of the mechanical, chemical, and biological areas as it looks at refining a process as a whole, rather than just a specific point in the process. It is through providing solutions to the identified problems that the team will deliver supported recommendations to better optimize the current process and improve adherence to standards set forth by the appropriate government agencies.



Team Members (L to R)

Quincy Brissette
Kyle Guyer
Brody Lawrence



Faculty Advisor
Steve Safferman, PE



Faculty Advisor
Steve Miller, PE

Sponsor
Major Food Manufacturer

Reducing Spoilage Microorganisms in Cherry Pomace

Team “Microbe Busters” are to create a design to reduce the amount of spoilage microorganisms in cherry pomace, a byproduct of tart cherry juicing, without degrading positive phytochemical attributes of the pomace.

Client deliverables include a design with optimized operation parameters, testing that demonstrates the design solution’s effectiveness, a vendor recommendation, and an economic analysis of operation and capital costs associated with the design.



Team Members (L to R)

Caleb Bruhn
Kristine Nguyen
Rachel Kurzeja



Faculty Advisor
Kirk Dolan



Faculty Advisor
Daniel Guyer

Sponsor
Food Processor
(under non-disclosure agreement)

Showcase Sponsorship



Thank you to John Bean Technologies (JBT) Corporation, a leading supplier of integrated food processing solutions, for support of a 2014/15 Senior Design project and the BE Showcase. 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/>



Thank you to ConAgra Foods for supporting and sponsoring BE Showcase events. ConAgra branded and private branded foods are in 99 percent of America's homes. ConAgra's website states, "At ConAgra Foods, we believe in the power of great food. Food you turn to every day, food you count on as part of your life. We make food that does more than satisfy your hunger — it actually gives you less to worry about and more to look forward to. That's what we do here at ConAgra Foods: We make great food — everyday food — in extraordinary ways.

Find the food you love on store shelves, where you can choose from our retail brands such as Hunt's®, Orville Redenbacher's®, and Healthy Choice®, or choose from our wide variety of private branded food sold as retailer's store brands. Our food can be found in almost every aisle of the grocery store, covering more categories than any other packaged food company in the United States. We also have a strong foodservice business that supplies frozen potato and sweet potato products as well as other vegetable, spice, and bakery products to commercial and foodservice customers.

ConAgra Foods is one of North America's largest food companies with 33,000 employees. ConAgra's history began in 1861 with the Van Camp's® Pork and Beans brand. You might remember a Pork and Bean senior design project from last year.

For more information, visit the ConAgra Food website at <http://www.conagrafoods.com/>

Biosystems Engineering 2015 Distinguished Alumni Award

Chris Daubert

Dr. Christopher R. Daubert is head of the Department of Food, Bioprocessing and Nutrition Sciences at NC State University, where he has been a faculty member since 1997. He holds a bachelor's degree in agricultural engineering from The Pennsylvania State University (1991) and a Ph.D. degree in agricultural engineering and food science from Michigan State University (1996). In addition to administrative responsibilities, Daubert directs the Food Rheology Laboratory. An internationally-recognized expert on food rheology and texture, Daubert applies fundamental engineering principles and physical-chemical models to explain ingredient functionality known to impact food quality. He and his research team have published more than 100 peer-reviewed manuscripts and chapters, while mentoring more than 20-graduate students and post-doctoral engineers and scientists. In 2005, NC State University recognized Daubert for instructional excellence by naming him to the Academy of Outstanding Teachers. Dr. Daubert is a member of numerous professional organizations, including the Institute of Food Technologists which will recognize him as a Fellow in 2015. He recently concluded service as editor-in-chief of the prestigious Journal of Texture Studies and continues to serve the editorial board of the Journal of Food Process Engineering. He is a past president of the NC State chapter of Sigma Xi research society, and previously served as associate director of the university's Golden LEAF Biomanufacturing Training and Education Center. Dr. Christopher R. Daubert continues making outstanding contributions to agriculture through his dynamic food engineering teaching and research programs and with visionary leadership as department head of a highly respected food science program.



Biosystems Engineering 2015 Outstanding Alumni Award

Eric LaChapelle

Eric LaChapelle is a senior Systems Engineer for Lockheed Martin, headquartered in Bethesda, MD. He holds a bachelor's degree in Biosystems Engineering from Michigan State University (2006) and a master's degree in systems engineering from George Washington University (2009). His work with Lockheed Martin has spanned satellite ground system development through vehicle launch and mission operations. In his current role of Technical Lead, Eric leads teams of engineers in accomplishing program milestones, identifying/mitigating risk, and identifying anomaly/failure root cause while ensuring technical quality of products and compliance to process and engineering best practices. Eric has also led and supported proposal efforts in support of new business capture. Eric enjoys working with college interns and new hires, and is a mentor for junior engineers across the company.



Eric has been a Big Brother for the Big Brother Big Sister program in the Denver area for 7 years and loves talking STEM with students of all ages.

Eric resides in Denver, Colorado where he spends his free time fly fishing and snowboarding in the Rockies. Biosystems and Agricultural Engineering thanks Eric, 2015 Outstanding Alumni, for being an exemplary Biosystems Engineering Ambassador.

Industry Advisory Board 2014-2015

Cassandra Edwards (Chair) 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. in Food Engineering and a M.Sc. in Mechanical Engineering.



Mitch Miller (Chair-Elect) 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.



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.

Bryce Feighner, P.E. is Chief of the Office of Waste Management and Radiological Protection 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.



Andrew Knowles is Stein & Freezer Applications/Sales Support Manager at JBT FoodTech, a leading supplier of integrated food processing solutions. Andrew holds a B.Sc. in Biosystems Engineering and a Masters in Applied Statistics.



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.



Richard (Rick) Woodford, P.E. is State Conservation Engineer for USDA - Natural Resources Conservation Service. He provides technical assistance in the field of soil and water conservation, implements NRCS' engineering policy and procedures for establishing technical engineering standards throughout Michigan. Rick holds B.Sc. and M.Sc. degrees in Civil Engineering.



Ashley Julien, E.I.T. is a Water/Wastewater Engineer for Tetra Tech, a leading provider of consulting, engineering, and technical services world-wide. Ashley holds a B.Sc. in Civil Engineering and M.Sc. in Biosystems Engineering.



Gene Ford 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.



Industry Advisory Board 2014-2015

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. 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.



Steve Steffes, P.E. 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.



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, 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

Kyle Guyer, Undergraduate Student Representative

Rebecca Bender, Graduate Student Representative

2015 Scholarship Recipients

Undergraduate Awards

F.W. Bakker-Arkema Endowed Scholarship

*Kayla Cascarilla
Linda Lay*

A.W. Farrall Scholarship

*Xuhao Dai
Christine Isaguirre*

Clarence & Thelma Hansen Scholarship

*Daniel Buhr
Christopher Walker*

Howard & Esther McColly Scholarship

*Joseph Kretowicz
Jillian Toaso
Shuman Zhang*

***John & Julianna Merva Undergraduate
Excellence Fund***

Christine Isaguirre

DeBoer Family Scholarship/Fellowship Fund

*Alexis Baxter
Nathan Majeski
Gina Masell
Aubrey Proctor
Rebecca Prouty*

Robert J. Gustafson Scholarship Award

Anna Nelson

Graduate Awards

***College of Engineering Outstanding
BE Graduate Student Fellowship***

Zhiguo Liu

***BAE Endowed Fellowship
for Graduate Student Excellence***

Rui Chen

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

Sean Woznicki

Merle & Catherine Esmay Scholarship

Ronald Aguilar

Bill & Rita Stout Scholarship

Mahlet Garedew

Galen & Ann Brown Scholarship

Kaitlyn Casulli



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, industry partners, university administration, parents and sponsors. Thank you to everyone who contributes to the continuing BE Showcase success.



BAE Chair
Ajit Srivastava

2014-15 Project Sponsors	Industry Evaluators
Granger	Bryce Feighner, PE, MDEQ Tim Krause, PE, Granger
Michigan Sugar Company	Lisa Buchholz, Dow AgroSciences Danielle Habitz, Kellogg Company Jeff Mathews, PhD, PepsiCo
JBT Food Tech (under non-disclosure)	Andrew Knowles, JBT FoodTech Cassandra Edwards, ConAgra Foods
Heat Transfer International	Bob Ellerhorst, PE, MSU Power Plant Dave Prouty, Heat Transfer International (HTI)
Biosystems & Agricultural Engineering	Ralph Elias, Terumo Cardiovascular Systems Steve Steffes, PE, Perrigo Company
EPA	Larry D. Stephens, PE, Stephens Consulting Ser., P.C. Rick Woodford, PE, USDA-NRCS
Tetra Tech	Andrew Granskog, PE, USDA-RD Ashley Julien - EIT, TetraTech
Bellingar Packing	Michelle Crook, PE, MDA, Env. Stewardship Div. Mitch Miller, General Mills - Yoplait
Major Food Manufacturer	Gene Ford, Nestle Nutrition Nick Tipper, Techmark, Inc. Keith Tinsey, Walther Farms
Food Processor (under non-disclosure)	Steve Richey, Kellogg Company Steve Mohr Muluken Tilahun, Kraft Foods

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

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