



MICHIGAN STATE
UNIVERSITY

2012 Biosystems Engineering Showcase

April 19, 2012

MSU Union

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.


and Agricultural Engineering

Integrating Engineering and Biology Since 1906

Participants / Agenda

Biosystems Design Project Participants

Kathleen Balaze	Sarah Fink	Pawel Kargol	Claire Schuurmans
Dylan Comer	Andrew Franco	Philip LaMothe	Tara Sliwinski
Emily Campbell	Juliana Henriques	Gretchen Merkel	Miranda Sperry
Jeffrey Crandell	Ian Hildebrandt	Kevin Messing	William Stieber
Lauren Deitz	David Hochhalter	Lindsey Reynolds	Kevin Swahn
Lara Ejups	Joseph Horbatch	Megan Robb	Eric Werner
Jessica Emery	Michael Huarng	Corey Scheffler	Michael Zanotti

A Showcase of the Program and Students

April 19, 2012

Presented by

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

The MSU Union at Michigan State University

Parlor A & B

- 12:00 - 2:00 p.m. Lunch
2:00 - 2:15 p.m. Industry Briefing on Program Assessment
2:15 - 2:30 p.m. Break

Parlor A & B

- 2:30 - 4:30 p.m. Senior Student Design Presentations (scheduled at 15 minute increments)
- Eutrophic Pond Restoration and Toxic Cyanobacteria Mitigation
 - Automated Aquaculture Feeding System for Yellow Perch
 - Beneficial Utilization of Apple Pomace by Means of Extrusion and Tray Drying Methods
 - Water Purification System for a Developing Country
 - Tank Cleaning System Optimization
 - Model of Torrefaction Bioenergy System and Supply Chain
 - Integrated Solar Heated Anaerobic Digester and Treatment Wetland
- 4:30 - 4:45 p.m. Break
4:45 - 5:45 p.m. Concurrent Project Review Panels

Parlor C

- 5:15 - 6:30 p.m. Reception/Student-Industry Interaction & Engineering Analysis of Biological Systems
(BE 230) Poster Presentation

Ballroom

- 6:45 - 8:30 p.m. Dinner

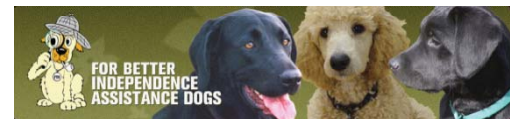
Team Projects

Eutrophic Pond Restoration and Toxic Cyanobacteria Mitigation

For Better Independence, a non-profit organization located in Leslie, Michigan, is losing useable land due to the excessive expansion of an existing pond wetland system, resulting in economic loss. Furthermore, excess nutrient inputs have resulted in highly eutrophic conditions in the body of water, therefore raising concerns of toxic cyanobacteria blooms, negating its use.

The team's project design was three-fold: restoring the pond to non-eutrophic conditions, reclaiming land, and mitigating potential health risks from toxic cyanobacteria through prevention and detection. To restore the pond system to initial capacity, a stretch of effluent tile drain was identified for replacement.

A vegetative buffer strip and best management practices were developed to rehabilitate the ponds to non-eutrophic conditions. Furthermore, the team has researched and recommended cyanobacteria inhibition methods along with a decision tree to identify the potential presence of toxic cyanobacteria, which can be implemented immediately.



Team Members (L to R & T to B)
William Stieber, Harrisonburg, VA
Jeffrey Crandell, Grand Blanc, MI
Emily Campbell, Fraser, MI
Joseph Horbatch, Northville, MI
Gretchen Merkel, Marshall, MI

Sponsor/Mentor
For Better Independence



Faculty Advisor
Dawn Reinhold

Team Projects

Automated Aquaculture Feeding System for Yellow Perch

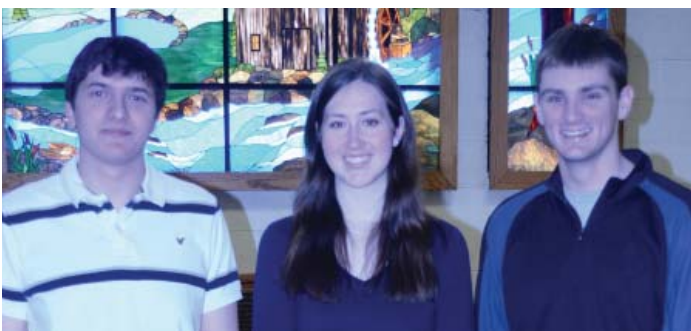
Yellow perch are in high consumer demand in the northern United States. A commercial fishing ban on yellow perch in the Great lakes has made aquaculture systems a popular source of this fish. Unlike other species, little research has been done to optimize growth of yellow perch in aquaculture farms including the amount of feed, time of feeding, and water quality parameters. This created the need for a data collection system to identify parameters for optimal and healthy fish growth and the development of an optimization approach.

The objectives of the project were to design an automated feeding and sensor system to reduce labor intensity and collect all data needed to create a predictive feeding system maximizing fish growth while minimizing feed waste. Benefits of optimization include more consumer acceptable fish and reduction in wasted feed, leading to a higher profit.

An automated feeding system was constructed and placed in a grow-out tank at the sponsor's facility. Sensors were selected. A harness was built to house the sensors in the tank. Data is collected through LabVIEW and can be viewed remotely over the web. An email alert will be sent if any parameters are out of bounds. Recommendations on how to proceed with optimization will be made based on a simple nitrogen mass balance and statistical analysis.



Sponsor/Mentor
Aquaculture Research Corp.



Team Members (L to R)
Andrew Franco, Dexter, MI
Tara Sliwinski, Fraser, MI
Kevin Swahn, Dearborn Heights, MI



Faculty Advisor
Yan Liu



Faculty Advisor
Steve Marquie

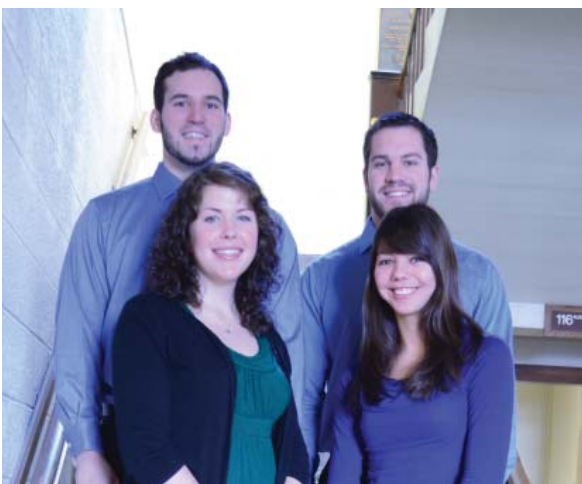
Team Projects

Beneficial Utilization of Apple Pomace by Means of Extrusion and Tray Drying Methods

PepsiCo has large amounts of fruit and vegetable by-product waste that accumulate each year and is sold as cattle feed. The by-product of apples, known as apple pomace, has significant amounts of total dietary fiber and quercetin. Once stabilized, the pomace can be added as an ingredient to existing and future products for increased nutritional value. The objective of this project is to provide PepsiCo with economic analyses of three processes to stabilize the apple pomace, as defined by reducing the moisture content to less than 10% to inhibit the growth of microorganisms.

Three processes will be analyzed for stabilization effectiveness and nutrient content. Cost will be calculated by determining energy usage and equipment specifications. Pomace will be pressed prior to processing for each of the three following processes: tray drying; tray drying and extrusion; tray drying and extrusion with added flour.

A final report with details of the cost and a sensitivity analysis for each process will be provided to PepsiCo. This data can be used as a starting point to decide if it is feasible to stabilize the byproducts for future use as an ingredient.



Team Members (L to R & T to B)
Philip LaMothe, Lake Orion, MI
Pawel Kargol, Canton, MI
Claire Schuurmans, Byron Center, MI
Juliana Henriques, Sao Paulo, Brazil



Sponsor/Mentor
PepsiCo



Faculty Advisor
Kirk Dolan



Faculty Advisor
Bradley Marks

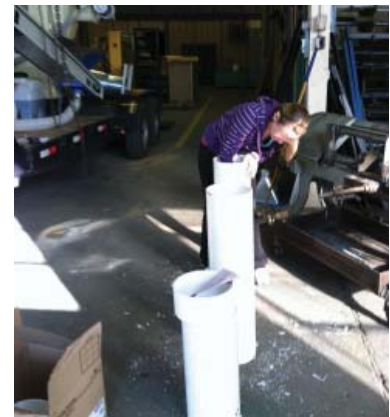
Team Projects

Water Purification System for a Developing Country

Over 1 billion people, typically in the developing world, do not currently have access to safe drinking water. The poorest inhabitants of the world survive on less than \$2 a day and live where average conditions do not provide for adequate wastewater treatment and sanitation. This lack of water access leads to widespread illness, disease, and death.

Teaming up with Aqua Clara International (ACI), a non-profit organization based in Holland, MI, the team worked to develop a community-sized water purification system. This system will provide 4,000 liters per day for a developing country. Aligning with the goals of ACI, the water must be clean and safe according to the World Health Organization standards, cost less than \$0.001 per liter to operate, and be effectively utilized by the local residents.

A system was created that incorporated a primary filtration method and secondary disinfection component. The primary filtration method is a sand filter and the secondary disinfection component is an ultra violet light system. A prototype was constructed to perform tests on. The team hopes to travel to Nicaragua in May to implement the system at a location familiar to Aqua Clara International.



Sponsor/Mentor
Aqua Clara International



Team Members (L to R)
Lindsay Reynolds, Royal Oak, MI
Megan Robb, Gaylord, MI
Sarah Fink, Wixom, MI



Faculty Advisor
Theodore Loudon

Team Projects

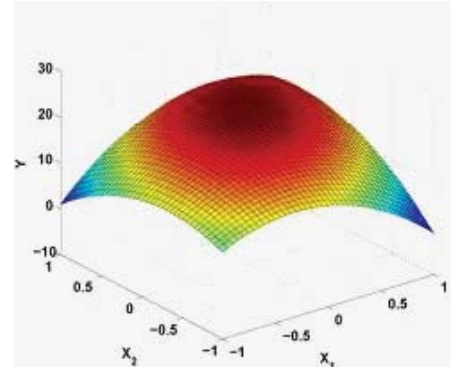
Tank Cleaning System Optimization

Perrigo is the largest manufacturer of private label over-the-counter pharmaceuticals in the United States. Production of a bismuth-based stomach relief medication results in residue buildup on the walls of mixing tanks, necessitating workers to enter the vessel and manually scrub the interior. This practice raises issues such as worker safety and increased production time, labor, and energy costs.

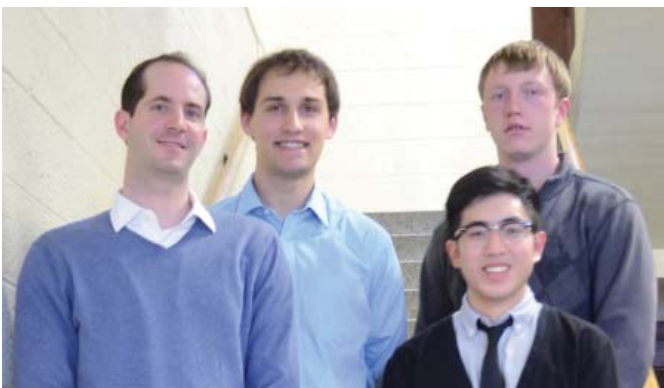
In order to address the cleaning issues, a holistic method was developed that examined both production and cleaning practices. Computational fluid dynamics, a modeling approach involving numerical methods, was used to analyze mixing. In addition, an experimental approach was used to examine how multiple factors affect removing residue build up.

A bench-top experiment was developed in order to simulate the mixing and cleaning process steps. Optimal detergent concentration, time, and temperature were determined through statistical analysis of experimental data, and a mathematical equation was developed describing the impact that each factor has on the cleaning process. Additionally, COMSOL's computational fluid dynamics model was used to improve the quality of mixing, and to determine areas of concern.

After analysis of empirical and theoretical results, recommendations were proposed to improve the manufacturing protocol of Perrigo's bismuth-based, stomach relief medication.



Sponsor/Mentor
Perrigo Pharmaceuticals



Team Members (L to R)
Michael Zanotti, Traverse City, MI
Ian Hildebrandt, Ionia, MI
Michael Huarng, Northville, MI
Dylan Comer, Traverse City, MI



Faculty Advisor
James Steffe

Team Projects

Model of Torrefaction Bioenergy System and Supply Chain

Public Act 295 (PA 295), also known as the “clean, renewable and efficient energy act” of Michigan, was signed into law in October 2008. This legislation promotes clean and renewable sources of energy by 2015, and requires providers to deliver 10% of power from renewable resources. Because of PA 295, the burning of biomass, a biological material from plant material, is being considered for use in the current energy generating infrastructure, including coal-burning facilities. Biomass has a lower energy value than coal; however, pretreatment can increase its energy value to become more similar to coal.

Torrefaction is a thermochemical reaction of biomass that produces a water-resistant material with a high energy value. This pretreatment process is being considered because biomass retains 90% of the energy in 70% of the original mass. The product of torrefaction is a hydrophobic, brittle, high-energy material. While torrefaction is a relatively new concept, still in the research phase, a desire exists to better understand the entire bioenergy supply chain. The team’s goal was to create a model to represent the torrefaction bioenergy system from tree harvest to end use in the coal plant.

Information was gathered from external sources and experimental data. This included equipment and operating costs as well as mass and energy balances on the torrefaction system. A final Excel model was produced in which users can input energy requirements or available harvesting land to understand the requirements to support their bioenergy system. The end user of this model will likely be an individual or group considering the use of torrefied biomass as an energy source.

Mass Balance on each component of system

Woods/Cultivation			
Inputs	Units	Amount	Outputs
Poplar	Kilograms	1000	Raw Biomass
Willow	Kilograms	1000	Ag. Run-off
Fertilizer 1	Kilograms	100	Surface water run-off
Pesticide 1	Kilograms	200	
Water	Kilograms	500	
Fuel	Kilograms	400	

Harvesting			
Inputs	Units	Amount	Outputs
Fuel	Kilograms	1000	Raw Biomass

Chipping			
Inputs	Units	Amount	Outputs
Fuel	Kilograms	1000	Raw Biomass
Raw biomass	Kilograms		

Transportation AAA			
Inputs	Units	Amount	Outputs
Fuel	Kilograms	1000	CO2
			Water

Dryer			
Inputs	Units	Amount	Outputs
Raw Biomass	Kilograms	1000	Wetp
			Dry Biomass

heating value of off-gas stream to see if energy sufficient to dry and torrefy biomass

Torrefier(s)			
Inputs	Units	Amount	Outputs
Dry Biomass	Kilograms	100	Torrefied Biomass
Air (heats)	Kilograms	100	Off-gas
Nitrogen	Kilograms	100	

torrefied yield vs. temperature vs. res. Time torrefaction yield as a %

Grinder			
Inputs	Units	Amount	Outputs

Notes Customer inputs Customer outputs Summary ME EB Mass Balance



MICHIGAN STATE UNIVERSITY | Extension

Sponsor/Mentor
Mark Seamon, MSU Extension



Team Members (T to B)
Kevin Messing, Ubly, MI
Corey Scheffler, St. Joseph, MI
Lara Ejups, Bay Shore, NY
Jessica Emery, Rockford, MI



Faculty Advisor
Chris Saffron

Team Projects

Integrated Solar Heated Anaerobic Digester and Treatment Wetland

Livestock and agricultural production generate large amounts of organic waste. In Central America, 20% of GDPs are from this sector. Converting this material to clean and affordable electricity through anaerobic digestion can increase the amount of reliable energy available to this region. Anaerobic digestion is the microbial conversion of organic carbon into biogas in the absence of oxygen. Combining this process with solar heating will increase the overall efficiency of the system, creating higher energy yields.

Biogas, a product of digestion, can be combusted to produce energy but typically 30-40% of the biogas produced is used to heat the system, required to maximize biogas yield. The combination of solar heating with anaerobic digestion eliminates the use of biogas for heating, thereby maximizing the amount that can be converted to electricity. Utilizing a treatment wetland in conjunction with anaerobic digestion further reduces the adverse environmental impacts associated with organic waste streams.

Solar heating, anaerobic digestion, and wetland treatments have been extensively studied; however, integration of these components has not. The team designed and constructed a lab-scale system that integrated a solar-heated anaerobic digester and a wetland suitable for digester effluent. Additionally, the team developed a LabVIEW program to monitor and control the system. For the next two years, the system will be used to collect data for feedstock variability and scale-up in Central America.



Sponsor/Mentor
US Department of State



Team Members (L to R and T to B)
David Hochhalter, Detroit, MI
Eric Werner, Kalamazoo, MI
Miranda Sperry, Mason, MI
Lauren Deitz, Clarkston, MI
Kathleen Balaze, Canton, MI



Faculty Advisor
Wei Liao



Faculty Advisor
Dawn Reinhold

2012 Scholarship Recipients

Undergraduate Awards

F.W. Bakker-Arkema Endowed Scholarship
Rachel Kurzeja

A.W. Farrall Scholarship
Ethan Nussdorfer
Kristin Sanburn
Maddie Saylor

Clarence & Thelma Hansen Scholarship
James Burns
Nathan Jandernoa

Howard & Esther McColly Scholarship
Danielle Brickner
Matthew Gammans
Robert Kraemer
Rachel Kurzeja
Allison VanderKolk

George & Betty Merva Scholarship
Elyse Kutsche

DeBoer Family Scholarship/Fellowship Fund
Jena Laur
Sarah Steudle

Graduate Awards

Outstanding BE Research Fellowship & Fitch H. Beach (Honorable Mention) Award
Michael Anderson

Most Outstanding BE Graduate Student Fellowship & College of Engineering Most Outstanding BE Graduate Student
Zhenglong Li

Merle & Catherine Esmay Scholarship
Niroj Aryal

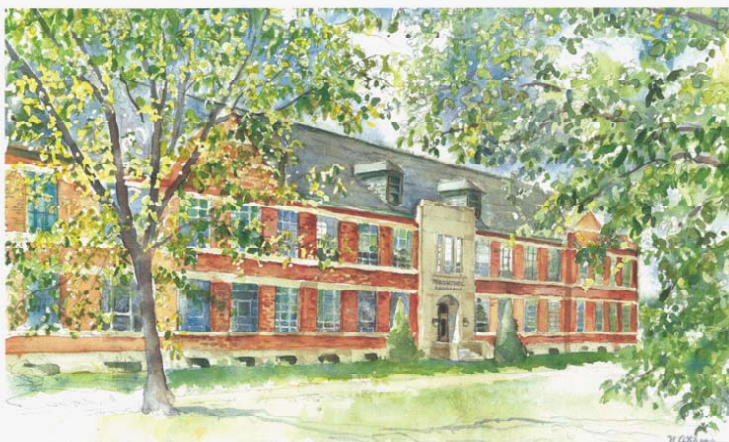
Bill & Rita Stout Scholarship
Zhenhua Ruan

Galen & Ann Brown Scholarship
Ibrahim Greiby

Graduate Research Symposium Awardees
Michelle Packard
Irwin Donis-Gonzalez
Xiaoqing Wang



MICHIGAN STATE
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"Spring"
A.W. Farrall Hall



Biosystems Engineering 2012 Outstanding Alumni Award

Janelle Clark Boosi

Janelle Clark Boosi graduated with a Bachelor of Science in Biosystems Engineering in May 2007. She is currently employed by Kellogg Company as the Morning Foods Business Unit Manager in their Research and Development Pilot Plant in Battle Creek, MI. Prior to her current role, Janelle spent time as a Process Engineer in the Morning Foods Division, an Associate and Assistant Food Technologist in the Core Technology & Cost Optimization group (focusing on the Snacks platform) and a 6-month intern with the Snacks R&D Core Maintenance team.



Janelle manages eight Process Leaders who organize and execute testing in the pilot plant. On a daily basis, she is working with her team, contracted personnel, and customers (developers, food technologists, and engineers) to ensure R&D testing is completed successfully and in a timely fashion. Another integral part of her role is the development of the individuals reporting to her, for whom she focuses on knowledge management, training, and career development.

At Kellogg, Janelle has spent the last 5 years on the team organizing the company's involvement in the Annual Society of Women Engineers (SWE) conference. As a number of positions were added to the Engineering team in 2011, she also spent a large portion of the year leading a team to develop a new on-boarding program.

Outside of Kellogg, Janelle stays involved with multiple causes including a leadership role within the Great Lakes Section of the Institute of Food Technologists, Vice President of the South-Central MI Chapter of SWE, outreach activities with local groups, including Girl Scout troops and Habitat for Humanity and the Western Michigan University SWE Student Chapter.

In addition to her outstanding professional success and service, Janelle is an extraordinary ambassador for the BAE department, as she often can be seen at MSU speaking to BE classes, student clubs, and Engineering Expos about internships, life after college, her personal career path, and Kellogg's in general. Her enthusiasm is contagious and definitely has had a positive impact on hundreds of students in recent years.

If Janelle wasn't busy enough, she and her husband are expecting their first child in early May. Congratulations to Janelle, our 2012 Biosystems Engineering Outstanding Alumni Award winner.

Industry Advisory Board 2011-2012

Steve Steffes, P.E., (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.



Gene Ford, (Chair-Elect) 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.



Steve Richey (Past-Chair) is Director, Process Engineering at Kellogg Company, the world's leading producer of cereal and a leading producer of convenience foods. Steve holds a B.Sc. and M.Sc. degrees in Agricultural 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. As project manager, he heads water and wastewater projects, site development and building project management. Chad also creates and certifies SPCC plans. In addition, he performs field work, data collection, GPS surveying and conventional surveying. Chad holds a B.Sc. degree in Civil Engineering with a minor in Environmental Engineering.



Cassandra Edwards 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.



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.



Industry Advisory Board 2011-2012

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.



Scott Millsap is International Project 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.



Mike Potts, P.E. is the Plant Technical Manager 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. Mike holds a B.Sc. degree in mathematics and computer science, a M.Sc. degree in Mechanical Engineering in addition to a MBA.



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.



Paula Steiner is a Civil Engineer with the United States Department of Agriculture – Natural Resources Conservation Service. Paula holds B.Sc. and M.Sc. degrees in Biosystems 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.



Special Thanks

2012 Biosystems Engineering Case Studies

Case studies are incorporated into the two capstone design classes to emphasize core Biosystem's Engineering specializations and critical design concepts essential for our students' careers. Each case study was matched to one specialization and one design concept, as listed below. Also listed is the faculty member that coordinated the case study, to whom we express our appreciation.

Case Study 1: Bioenergy concentration and engineering cost estimation concepts – Wei Liao (MSU Biosystems and Agricultural Engineering)

Case Study 2: Food concentration and mathematical modeling concepts – Bradley Marks (MSU Biosystems and Agricultural Engineering)

Case Study 3: Biomedical concentration with data management - Sheridan Kidd Haack (US Geological Survey)

Case Study 4: Ecosystem concentration with instrumentation concepts: Animal Air Quality Research Facility – Steve Marquie (MSU Biosystems and Agricultural Engineering), Andy Fogiel (MSU Animal Science), Wendy Powers (Animal Science and MSU Biosystems and Agricultural Engineering)



Design Project Instructor
Steve Safferman
BE 485/487



Technical Advisor
Luke Reese



Design Project Instructor
Steve Miller
BE 485/487



Showcase Event Coordinator
Barb DeLong

Showcase Sponsor

2012 Biosystems Engineering Showcase Sponsor



Based in Allegan, Michigan, U.S.A., Perrigo Company is a leading global healthcare supplier that develops, manufactures and distributes over-the-counter (OTC) and prescription pharmaceuticals, nutritional products, active pharmaceutical ingredients (API) and consumer products. The Company is the world's largest manufacturer of OTC pharmaceutical products for the store brand market.

Perrigo Consumer Healthcare (CHC) markets a broad line of OTC and nutrition products that are comparable in quality and effectiveness to the advertised brands while saving the consumer approximately 25-30% versus the national brands. Perrigo CHC supplies more than 15 categories and 500 formulas and offers analgesics, cough and cold remedies, and gastrointestinal and feminine hygiene products, as well as vitamins, dietary supplements and nutritional drinks.

More than 8,700 Perrigo employees around the world commit themselves each day to the important mission of making health care affordable. Perrigo's global operations are strategically located in the United States, Israel, Mexico, the United Kingdom, India, China and Australia.

Steve Steffes, Vice President for Operations at the Perrigo New York production facility, is the 2011-12 Chair of the MSU Biosystems Engineering Industry Advisory Board. Thank you Steve and Perrigo Company for all of your support towards the Biosystems Engineering program and the 2012 BE Showcase.

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. The Showcase would not be possible without the on-going support of our alumni, board members, university administration, parents and sponsors.



BAE Chair
Ajit Srivastava



BE Industry Advisory Board

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Gene Ford, Board Chair Elect, Nestle Nutrition, R & D Center
Steve Richey, Past Chair, Kellogg Company
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Chad Ducey, Werks Management, LLC
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Jeffrey Mathews, Pespico {Quaker}
Juanita McCann, USDA - NRCS
Scott Millsap, JBT FoodTech
Valerie Novaes, Tetra Tech, Inc.
Mike Potts, General Mills
Dave Prouty, Heat Transfer International (HTI)
Paula Steiner, USDA - NRCS
Larry Stephens, Stephens Consulting Services, P.C.
Muluken Tilahun - Kraft Foods

Ex-Officio Board Members

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