

Spring 2013

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# Environmental Engineering and Earth Sciences

## Undergraduate Programs Thriving



The Environmental Engineering and Earth Sciences (EEES) Department is home to three undergraduate programs: Environmental Engineering (EnvE), Biosystems Engineering (BE), and Geology. This past year, the programs enrolled approximately 180 students, and will have well over 200 students in the upcoming fall semester. This growth, while posing challenges, ushers in an exciting new time for the EEES department. Each program places a strong emphasis in hands-on as well as technical knowledge, and the curriculums contain many labs and offer some flexibility for students. The programs also offer many opportunities to explore beyond the classroom through creative inquiry, research and student organizations. All three programs are housed in Brackett Hall on campus with the vast majority of classes and labs being taught in this location. Program faculty also have offices in this location and the students have study spaces and lounges available for use.

The newest engineering degree at Clemson, the Environmental Engineering program graduated its first cohort of 12 students in May 2013. The degree is experiencing high demand, with the upcoming cohort approaching 45 students. According to **Dr. Tom Overcamp**, program coordinator, the EnvE degree draws students with a desire to help the people and world around them. With that attitude, the students develop strong beliefs and have the ambition to make an impact on society beyond their classroom learning. Through the EnvE curriculum, students receive a strong engineering and science core knowledge, and are introduced to the topics of water and wastewater treatment, air pollution, risk assessment and pollution prevention among many others. The program is currently seeking accreditation and hopes to have the final verdict in Summer of 2014. So far everything looks great with 11 out of 12 students passing the Fundamentals of Engineering (FE) exam on the first attempt.

Ask any student about the BE program and the first thing they will tell you is that they love the closeness of the faculty and students in the major. Led by **Drs. Caye Drapcho, Tom Owino** and **Terry Walker**, the BE program encourages students to get involved and apply the knowledge they are obtaining in the classroom in a very hands-on manner. Almost every class incorporates some form of experiential learning, including laboratory, field, fabrication and computer modeling and design exercises. BE labs allow students to try their hand at designing, fabricating and testing microbial fuel cells, brewing beer and analyzing it for sugar and alcohol content, producing biodiesel at lab and pilot scale using waste cafeteria oils, learning techniques for land surveying using Total Station equipment and designing stormwater retention structures. Incorporated into the EEES department 2 years ago, the program has been in existence in various forms since the 1950's, was formerly in the College of Agriculture, Forestry and Life Sciences. The program is ABET accredited, and was just recertified in 2012. With two new faculty joining the program in Fall 2013, the program is expected to continue to expand in size and in research activity.

The Geology program, although small, has one of the most hands-on programs in the university. It focuses on field-based learning through field trips and a required field course. The courses are also designed to allow students to pass the Professional Geologist certification exam if they so choose. As part of the degree, all students are required to complete original research through Creative Inquiry courses. Some projects undergraduate students have been involved in over the past year have included the following: geologic mapping of the SC upstate; studying geological indicators of climate change; working with the dam removal on 12 Mile Creek and characterizing the soils and erosion process; looking at geodeformation or the response of earth to natural and anthropogenic disturbance; and investigating the properties and possibilities of rain gardens. Geology students study the Earth's past to help understand the present and plan for the future, a perfect complement to the engineering programs.

Outside the classroom, the students are heavily involved in student organizations and campus activities. Each program has a primary student organization affiliation, Biosystems Engineering – BE Club (associated with ASABE), Environmental Engineering – AWWA, and Geology – Geology club. Many students are also involved with Engineers without Borders, Clemson Engineers for Developing Countries and Students for Environmental Action as well as many different Creative Inquiry Classes. These groups regularly hold social, education and professional development activities such as picnics, hikes, career panels, and field trips. Undergraduate programs may require a fair amount of administration, but at the end of the day, seeing the potential the students have and the significant contributions the graduates will bring about in the world makes it worth every minute! To learn more about the Creative Inquiry program, visit: <http://www.clemson.edu/academics/programs/creative-inquiry>

## Faculty Profile



Dr. David Freedman, Professor, joined the Department of Environmental Engineering and Earth Sciences at Clemson in 1996. Prior to Clemson, he received a BS degree in Environmental Sciences at the University of Wisconsin-Green Bay, a MS in Environmental Engineering from the University of Cincinnati, and a PhD in Environmental Engineering from Cornell University. He then joined the faculty in Civil and Environmental Engineering at the University of Illinois.

Dr. Freedman has taught a wide array of courses at the undergraduate and graduate levels. He is currently responsible for Introduction to Environmental Engineering I (EES 201), Water and Wastewater Treatment (EES 402/602) and the accompanying laboratory (EES 403) (both team taught with David Ladner), Biochemical Operations in Wastewater Treatment (EES 804), Laboratory in Water and Wastewater Treatment Operations (EES 805, team taught with Tanju Karanfil), and Process and Facility Design for Environmental Control Systems (EES 806, team taught with Tanju Karanfil and Tom Overcamp).

His research focuses on the application of environmental microbiology to development of enhanced methods for biodegrading hazardous organic contaminants. Current studies include development of bioaugmentation cultures for chlorinated ethenes that grow at low pH, evaluation of bioremediation strategies to treat high concentration of halogenated methanes, use of biostimulation to enhance biogeochemical degradation of chlorinated ethenes in fractured sandstone, and studies to evaluate the anaerobic/aerobic oxidation of 1,4-dioxane. Dr. Freedman recently served on the National Research Council's Committee on Review of the Biotreatment, Water Recovery, and Brine Reduction Systems for the Pueblo Chemical Agent Destruction Pilot Plant; this facility will utilize neutralization followed by biotreatment as the technology to destroy munitions containing 2,600 tons of mustard agent.

## Chair's Corner

Dear EEES alumni and friends:

I am pleased to present you with a new issue of our alumni newsletter. We completed another successful academic year and graduated the first cohort of Environmental Engineering undergraduate students. The new undergraduate degree has been growing steadily...reaching about 100-110 students in the program in the coming Fall. Overall, we have about 200 undergraduate and 120 graduate students in the Department. Our students have continued to receive several national and Departmental recognitions. Student clubs have been active with various activities. Please visit the Department web page and especially the "Newsletter Archives" section to read more about student accomplishments along with the events and stories in the Department. Our three undergraduate programs are located on the 3<sup>rd</sup> and 4<sup>th</sup> floor of Brackett Hall. Please do not hesitate to stop by the main EEES Office at 445 Brackett Hall, if you are visiting Clemson. Our staff, Cindy and Jessica, will be happy to give you a tour and tell you more about the Departmental activities.

While being excellent and dedicated teachers and educators, our faculty have been working tirelessly maintaining their research programs and scholarly activities. They received more than \$2M new research awards and produced 64 peer-reviewed publications in the past academic year. We will have two new faculty, Drs. Christophe Darnault and Yi Zheng joining the Department in the Fall. We will include more information about their backgrounds in the next issue. Congratulations to Dr. Brian Powell for winning a prestigious Department of Energy (DOE) CAREER Award for his research project on the examination of actinide chemistry at solid-water interfaces to support advanced actinide separations. There are now six CAREER grant recipients in the Department. The CAREER awards are the highest honors given to young faculty by some of the federal agencies.

We had also another (21st!!) very successful David Snipes Hydrogeology Symposium with over 375 attendees and 30 exhibitors. This is a well-established must go to event for geologists and hydrogeologists. Its influence and attraction pass beyond the boundaries of the Southeastern United States.

And last but not least, I would like to extend special thanks to our Department Advisory Board Members and Department Staff. We have four advisory boards for our different programs; all of them have met in the past year and have provided valuable input for the advancement of the Department. And our staff went well beyond the expectations to accomplish many projects including major renovations and moving projects in addition to their regular duties.

We greatly appreciate your continuous support and generous donations to the Department. Please note that you can make on-line donations through our web page. They provide important resources to the Department and especially to our students.



**Tanju Karanfil, Ph.D., P.E., BCEE**  
**Professor and Chair**



**Dr. Brian A. Powell** has been awarded a DOE Early Career Research Program award for the project "Examination of Actinide Chemistry at Solid-Water Interfaces to Support Advanced Actinide Separations." This is a \$750,000, 5-year award from the DOE Office of Science, Heavy Element Chemistry program. This work will examine the fundamental chemical properties of actinide elements in aqueous solutions and at solid-water interfaces. Sorption of actinides to solid surfaces such as minerals and soils can limit the movement of actinides in the environment and sorption to engineered solids can facilitate separation of actinides from other waste materials within the nuclear fuel cycle. Understanding and quantifying actinide bonding and reactivity at solid-water interfaces is needed for a wide range of applications such as advanced actinide separation schemes, waste treatment and disposal, understanding actinide behavior under geologic repository conditions, and determining the performance of actinide bearing wastes and waste facilities. A novel aspect of this work will be to

examine sorption processes on a mechanistic basis and quantify the data using a standard thermochemical construct as opposed to the empirical methods commonly employed. Particular attention will be focused on understanding underlying mechanisms of actinide sorption to differing solid phases, understanding underlying mechanisms behind frequent observations of hysteretic sorption and understanding the potential formation of ternary actinide-ligand-surface complexes.



## Department News

### Employment Panel hosted by Clemson Student Chapter of the American Water Works Association (AWWA)



On February 13<sup>th</sup>, the Clemson Student Chapter of the American Water Works Association (AWWA) held their second annual Employment Panel. Four panelists shared their insights about finding and enjoying employment in the water and wastewater industry. Two represented the engineering consulting realm (Flint Holbrook, Senior Vice President with Woolpert, and Keith McLeod, South Carolina Office Manager with URS). One was from the municipal side (Doris Wilson, Director of Public Utilities, Town of Pendleton), and the 4<sup>th</sup> represented an equipment/chemical vendor (Julie Hellman, South Carolina Sale Manager with Hach). Other industry guests attended to network with students. They were John Cook (Advanced Data Mining International), Chris Erickson (CH<sub>2</sub>M Hill), Steven Gagnon (AVANTech), Bob Horner (Weston & Sampson), Jay Mazzei (Brown & Caldwell), Angie Mettlen (WK Dickson), Robert Osborne (Black & Veatch), Dyke Spencer (Powdersville Water District), and Ed Winn (Bend Services). A range of topics were covered during the panel discussion, including how to make the most of your college years to gain valuable experience qualifying you for employment, the oral and written communication skills needed in the industry, and the importance of maintaining good relationships in this close-knit community. After the panel discussion, refreshments were enjoyed while students and industry guests networked. Feedback was resoundingly positive and we look forward to continuing this tradition next year.

**Clemson's Geology Club** has been busy this spring. The club continues to provide tutoring and study sessions for Geol 101 students. The club organized two trips; a 1-day hiking trip in DuPont State Forest and an overnight camping trip at Riley Moore Falls. Two guest speakers came to club events to inform students about AmeriCorps projects in West Virginia watersheds and sustainability efforts in Greenville. The club also set up a booth at the annual Hydrosymposium; and they have elected officers for 2013-2014!

**The Biosystems Engineering Club** recently took a trip to Oklahoma State University to attend the annual South East Region Rally of the American Society of Agricultural and Biological Engineers (ASABE). Five undergraduate Biosystems Engineering students attended the meeting: **Tyler Barzee, Melissa DeSantiago, Taylor Wade, Kyle Mihaljevic, and Zach Wainwright**. Clemson presented the progress of the ASABE chapter that is integrated into the BE Club here and showed off our volunteer projects and student learning initiatives like: Adopt-A-Highway Cleanup, industry speakers, brewery tours, and fundraising activities.

### ACC Clean Energy Challenge



Clemson University's team, Brewcovery, competed in the ACC Clean Energy Challenge in Raleigh, NC, coming in second place and taking home a \$5,000 prize. The team was composed of **David Thornton, Alex Pellett, Holly Garrett and Dr. Terry Walker** in Biosystems Engineering. Clemson's team, Brewcovery, recovers food and brewery wastes and converts these waste streams into valuable co-products: feed, biofuels and soil amendments utilizing the black soldier fly, *Hermetia illucens*. President Barker has signed the President's Climate Commitment and is dedicated to bringing Clemson's carbon footprint to nil by 2030. With the goal of diverting 100% of Clemson's food wastes into these value-added products, Clemson will reduce their carbon footprint by eliminating transportation of these wastes to the landfill, where they would change into yet another greenhouse gas, methane. In addition, the Brewcovery truck fleet will run on clean-burning biodiesel to further reduce carbon pollution.

### Graduation 2013

Environmental Engineering and Earth Sciences had 31 undergraduate students graduate on May 10<sup>th</sup>; fifteen (15) in Biosystems Engineering, twelve (12) in Environmental, and five (5) in Geology. Many of the students and their families attended a reception hosted by the Department prior to the

evening graduation. Everyone had a great time as students introduced their families to their professors. The faculty presented the graduates to the attendees, and everyone enjoyed delicious snacks!





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## The 21st Annual Clemson/David S. Snipes Hydrogeology Symposium



Another successful symposium was held on April 4<sup>th</sup> at the Madren Center along with field trips on April 3<sup>rd</sup>, 5<sup>th</sup>, and 29<sup>th</sup>. This year's event attracted over 375 attendees – an all-time record! The keynote speech was given by **Dr. Fred Molz**. Fred's talk was "Computer Modeling in Hydrogeology: Where Did It Come From, How Has It Evolved, and Where Is It Going?"

Most attendees were from South Carolina, but there were others from North Carolina, Georgia, Tennessee, Virginia, and Florida. Over fifty oral and poster presentations were given with three consecutive oral presentation sessions. The theme sessions covered these topics: Hydromechanics, Constructed Wetland Treatment Systems, Emerging Contaminants, Groundwater Characterization, Chemical Remediation, Geophysics, Biodegradation, Remediation techniques, and the Clemson Creative Inquiry (CI) undergraduate senior projects. **Ron Falta** gave a talk on "Migration of Exsolved CO<sub>2</sub> Following Depressurization of Saturated Brine". **Stephen Moysey** directed a workshop called "3D imaging of the Subsurface with Multi-channel Ground Penetrating Radar: From Promise to Practice". Graduate students giving oral presentations were **Johnathon Ebenhack, Dave Hisz, Catherine Ruprecht, Alex Beebe, Adam Mangel, Eramus Oware, Jeff Schwindaman, Ruthanne Coffey, Amy Hixon, Alex Hanna, Hilary Emerson, Shanna Estes, and Na Hao**. Geology undergraduates who presented the results of their senior CI research project included **Jonathan Baldwin, Tyler Waterhouse, William Chamlee, MollyJane Lyles, Peter Wylie, Erin Black, and Alex Lefitz**. A complete list of presenters and the titles of their talks can be found at:

<http://www.ces.clemson.edu/hydro/symposium/speaksched.htm>

In addition to the posters, 30 exhibitors from around the US displayed their products and services. After the symposium, a mixer was held at the Geology Museum.

The field trips were led by **Scott Brame**, Jack Garihan of Furman University, and Bill Clendenin, State Geologist for the state of South Carolina. The field trips examined the structural nature of the Brevard Fault Zone as it is currently being exposed at record low water levels on the shores of Lake Jocassee. Over 150 people attended the three field trips.



