

# The Critical Thinker

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## BioMEDS Purpose:

- Provide students a platform from which they can critically discuss and learn about the myriad of bioengineering research areas, staying current with an ever changing biomedical landscape.
- Provide opportunities to give back to the community through education outreach focused in science and mathematics.
- Encourage students to foster a sense of pride and accomplishment in their major as well as their institution .

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## Student of the Semester: C. Alex Lindburg

Alex Lindburg, a senior bioengineering student at Clemson, was recently awarded the BMES Undergraduate Student Award. Alex took time out of his busy schedule to answer some questions about his experiences at Clemson, his research and his plans for the future.

### What made you decide on Bioengineering as your major?

I originally planned on going to medical school, and discovered that bioengineering majors typically scored highest on the MCAT. Bioengineering also provided a solid back-up plan if I changed my mind and decided medical school wasn't for me. With bioengineering you get to learn medical terminology that you aren't introduced to as a chemistry or biology major. You also get to solve real-world problems throughout your curriculum as opposed to solely learning about systems and how the body works.

### Can you tell me about the research you do in Dr. Delphine Dean's lab?

I am studying the effects of radiation on articulating cartilage of the joints. There are two major groups radiation affects: cancer patients who are treated with radiation therapy and astronauts who are exposed to cosmic radiation during spaceflight. Our research involves irradiating the experimental group (both mouse and pig models) and analyzing the radiation's effects on the knee joint. We want to determine if the radiation is affecting the tissue superficially or if it is affecting the tissue throughout. Our hypothesis is that the x-rays are penetrating the tissue and damaging a protein that is responsible for the structural viability of the cartilage. These proteins affect the water concentration levels, which allow the cartilage to withstand the compressive forces seen in the body.



Dr. Dean and her summer research group, including Alex Lindburg

### What have you learned by doing research at an undergraduate level?

I have gained a lot of teamwork and communication skills from doing research. My project incorporates a lot of collaboration from other labs and institutions. Radiation research is very expensive and it has been vital for our project that we work with other institutions in order to reduce costs.

### What has been the most influential experience you have had as an undergrad?

My most influential experience was studying abroad in Europe for five weeks. Throughout my travels, I was exposed to the global Clemson community. It was amazing to see that every place we went we would find someone from Clemson, and we had an instant connection. Plus, studying abroad made me realize that the

world does not revolve around myself or the USA, and it made me appreciate different cultures and lifestyles.

### Does anyone stand out in your mind that has helped you succeed as an undergrad?

Dr. Delphine Dean. I started working with Dr. Dean at the end of sophomore year and absolutely loved her brilliance and enthusiasm for her work. Seeing her success has constantly motivated me to accomplish my goals during my career at Clemson.

### Do you have any advice for other undergrads?

Get to know your professors! Don't just go to class and remain unseen. They will be more than willing to help you out if they see you are active in class and you are making an effort to succeed.

## Inspiring Young Engineers at Midway Elementary



Sallie Ware helping with an Engineering Project at "Coffee with the Principal"

Beginning this semester, BioMEDS partnered up with Midway Elementary to offer members the opportunity to give back to the community in a way that promotes STEM (Science Technology Engineering and Mathematics) programs. STEM Club teaches programming and robot construction to students from the 3<sup>rd</sup> to 5<sup>th</sup> grade. As volunteers, members assist the students as they work with robots to engineer solutions to the week's challenge. A past challenge had students program robots to clear an obstacle, pick up a ball, and then maneuver over to a specified location to deposit the ball. This task tested student's abilities

to collaborate with team members, adapt designs after each test, and to account for the variability in their systems. Coffee with the Principal is an event in which students and their parents team up to solve an engineering challenge. As volunteers, BioMEDs members partner with students whose parents cannot attend, enabling the student to participate alongside their peers. At the first grade Coffee with the Principal, students were tasked with constructing a "bone carrier" for a dog from a toilet paper roll, paper, and pipe cleaners. With their unique perspectives Midway students constructed many diverse and creative solutions.

## Research Highlights of the Semester

### Marcella Elpers Laboratory of Orthopedic Design and Engineering

There is a wide range of information available on the ultra-high molecular weight polyethylene component of total knee replacements (TKR) compared to that of the metallic femoral component. My task, along with several other members of our lab, has been to take a more in depth approach at the counter metallic bearing surface of TKRs, with my work focusing mainly on the NexGen Posterior Stabilized design. This has involved designing and imple-

menting a new qualitative and quantitative scoring methodology for the tibial and femoral TKR components as well as completing a detailed surface roughness analysis of the metallic femoral components. My goal is to increase the understanding of the damage observed after retrieval of these femoral components to gain knowledge of what these implants experience inside the body and to assist in improvements of future designs.

Our project seeks to examine the biomechanical behavior of the abdominal aorta as it is subjected to varying pressure loads by generating 3D models that will allow us to measure changes in the geometry of the aortic wall. The goal is to obtain 3D image compilations of the specimen that allow us to investigate relationships that might exist between pressure loading and geometric changes in the aortic wall. The project has two distinct parts: a physi-

cal, polycarbonate bath where the abdominal aortic tissue will be tested as well as the computer programming aspect. Thus far, the polycarbonate bath has been constructed and manipulated with various gears, rods, bearings, etc. and is nearing completion. A connection between the Harvard Pump (which introduces pressure loading to the aortic specimens) and the computer has been established, but additional work is still necessary.

### Nitin Balakrishnan and Brad Jones Cell Mechanics and Mechanobiology Laboratory

### Katherine Luffy

#### Creative Inquiry: Engineers without Borders (EWB)

The purpose of EWB is to support sustainable community-driven development programs worldwide. The Clemson chapter of EWB is currently working on projects in Guatemala and Liberia. Last May, I traveled with the Liberia group and built a peanut sheller, remodeled rabbit hutches, initiated the construction of a digester, and began a rice-tilapia integration pond. I am currently working with the public-health group in Libe-

ria. We plan to raise money to buy simple incubators that the community desperately needs as well as focus in on the problem of malaria in the community. We plan to research and educate villagers on how the use of herbs can aid in Malaria related problems. Until recently, Liberia has been in the midst of civil war and we are trying to help this community get back on their feet, while living a happy, healthy, and sustainable lifestyle.



BioMEDS mentors with their "adopted" students at "coffee with the principal" at Midway Elementary

## Study Abroad Opportunities in Bioengineering

### Pamplona, Spain: Home of the Famous Bull Stampede

- Courses offered at the Pamplona Spanish Learning Institute
- First Summer Session 2011
- 5 weeks, 6 credits
- Optional Independent Travel
- Contact Dr. John Desjardins (jdesjar@clemson.edu)



### Singapore: Stem Cell Research Hub

- Offered Spring 2011, Summer 2, Summer Internship in Company, or a full academic year
- Research areas: Biomaterials, Nano-electronics, Ecomaterials and Clean Energy Research
- Contact Dr. Frank Alexis (falexis@clemson.edu)



## Research Highlights of the Semester Continued

### Laila Roudsari Institute for Biological Interfaces of Engineering

I am currently working on an independent research project under Dr. Karen Burg and Dr. Timothy Burg. The focus of this collaborative study is designing a bioprinting system that can build functional tissues and tissue test systems. One of the challenges is that cell aggregates clog the nozzle of the cartridge, which blocks printing from being able to occur. Also, cell settling in the cartridge over time prevents a high level of precision of cells printed per

drop. Therefore, I have designed a device to facilitate suspension of cells during printing in order to more closely obtain drop-on-demand precision with cell number and cell placement. Numerous tests on the initial prototype I built show that it does effectively keep cells suspended. The next prototype I am working on will be built on a rapid prototyping machine using a model I developed using Solidworks software.



BiOMEDS field trip to the Bodies Exhibit in Atlanta, GA

### Shelley Floyd Biocompatibility and Tissue Regeneration Laboratory

For three semesters, I have been working in a creative inquiry group with Dr. Jiro Nagatomi and Dr. Dan Simionescu. Our research group is working to create a living tissue engineered heart valve. We are searching for an alternative to mechanical heart valve replacement that will allow better integration when implanted in the body. We use a biodegradable polymer mesh

scaffold that is sutured to form the shape of a native heart valve. The valve scaffold is reinforced with gelatin for cell seeding. Once complete, valves are tested for performance using a pulsatile flow bioreactor. As a group, we have made many adjustments to our valve process and are in the final stages of design as well as compiling a paper for publication.

### Kevin Keith Nanomedicine Laboratory

My research focuses on nanoparticle-derived drug delivery systems. My specific project involves determining how surface properties of nanoparticles interact with blood plasma. This involves immense work with creating and characterizing biodegradable polymers. A second project is focused on determining the synergistic effects of different drug concentrations on various cancer

cells. This project deals heavily with cell culture. In addition to my work with Dr. Frank Alexis, I am involved in a creative inquiry with Dr. John Desjardins. This research centers around orthopedic implants, in particular those that have been explanted from the body. Our main objective is forming a repository of explanted total joint replacements.

## New Addition Fosters Clemson's Commitment to Excellence in Bioengineering

In 2009 the new Rhodes Annex opened its doors to Clemson's bioengineering students, thereby reestablishing the university's commitment to provide South Carolina with an outstanding Bachelor of Science degree in bioengineering. The new addition to Rhodes boasts 29,000 square feet of research labs, collaborative meeting spaces, innovative learning environments and administrative offices. The building was designed with the intention of

integrating research among undergraduate and graduate students and education. To accomplish this, the classrooms come equipped with some of the latest smart classroom technology allowing for remote lecturing. The new building highlights three main areas of research at Clemson University with the addition of three undergraduate laboratories for research in tissue engineering, biomechanics, and bioinstrumentation.



## CONTACT INFORMATION

301 Rhodes Research Center  
Clemson, SC 29634-0905

E-mail: [biomedsc@clermson.edu](mailto:biomedsc@clermson.edu)

Since this is the inaugural issue of "The Critical Thinker," please feel free to contact us with suggestions and/or comments!

**We're on the Web!**  
[sites.google.com/site/clermsonbiomedsc/](http://sites.google.com/site/clermsonbiomedsc/)

### Upcoming Events:

- Career Panel: This provides an opportunity for undergrads to network with medical students, graduate students, and bioengineers in industry  
April 2011
- Public Speaking, Resume and Interview workshops  
Spring 2011
- Undergraduate Research Symposium: Opportunity for students to present their research in a professional environment  
March 2011



Club Picture - BioMEDS 2010

## Letter from the President

As you read through this newsletter, please take the time to appreciate just how remarkable the students in this department are. From implant retrieval protocols to tissue engineered heart valves to cartilage biomechanics, the students in the Department of Bioengineering at Clemson University are making new discoveries in a myriad of exciting fields and are helping to define Clemson's reputation as one of the premier undergraduate programs in the country. One look in the labs in the newly opened Rhodes Annex and you can see the amazing work that is being done, the hands-on learning experience that each student is engaged in, and the invaluable

professors who motivate and inspire our students to achieve their fullest potential.

The Biomedical Engineering Development Society (BioMEDS) was newly branded in the fall of 2010 to project a professional attitude that embraces what it means to be a Clemson University bioengineering student. Our participation in local engineering education programs and Habitat for Humanity builds fosters a spirit of social responsibility and a global mindset that prepares our students to tackle the health issues that threaten the human condition. Our research seminars, career panels, resume and interview work-

shops, public speaking workshops, and research day symposiums highlight the best in each of us, and provide a forum upon which to communicate the very latest in the field of bioengineering.

I am inspired by the progress we have made in the past year and I look forward to future opportunities and growth in our already newsworthy organization.

Thank you for taking the time to join me in honoring the work of our tremendous students.

*Brendan Roach*



On Left (from left to right):  
Brendan Roach (President),  
Alanna Walker (Secretary),  
Laila Roudsari (Treasurer),  
Laura Reese (President-Elect)

On Right: Alexis Richardson demonstrating how a knee implant works to first graders from Clemson Elementary

