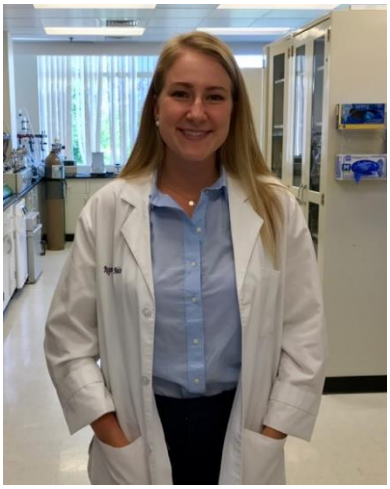
Wake Forest School of Medicine

Institute for Regenerative Medicine

WFIRM Summer Scholars Program 2017 – Scholar's Blog
Summer Scholars 2017 Profiles



Katherine Bolten

Temple University, Bioengineering, Spanish

Faculty Advisor: Dr. Anthony Atala, Professor, Director of WFIRM

As an aspiring physician, I believe involvement through research is an important way to put my bioengineering education to use and make an impact in the field in which I work. In the bioengineering department at Temple University, I work in Dr. Nancy Pleshko's Tissue Imaging and Spectroscopy Lab, where I participate in the project to develop a noninvasive technique to assess potential cartilage implants using NIR spectroscopy. My work in the lab also includes carrying out the biochemical assays to determine the composition of cartilage in each sample, which is used to support the spectroscopic data gathered. Apart from my major bioengineering, I also am working towards my minor in Spanish, which was inspired by my medical mission trip to Nicaragua from June - August 2016, where I worked alongside the clinic team to advance the prenatal program.

Through doing research at Temple, I acquired a strong interest in regenerative medicine, particularly relating to bone and cartilage. In effort to expand my research experience, I was urged by several mentors to apply to the Summer Scholars Program at the Wake Forest Institute for Regenerative Medicine. I am honored to be here this summer working under Dr. Anthony Atala and Dr. Sang Jin Lee as part of the team undertaking the bioprinting amputee prosthesis project. Current prosthetic devices undergo many challenges and result in bone loss and infection in 60% of combat amputees. In effort to direct mechanical stress to the bone and avoid heterotopic osteogenesis, the project aims to directly anchor the bone to a bioprinted, porous titanium scaffold. My project is particularly focused on the bone-scaffold interface, where I will assess the quality printed cell-laden hydrogels in effort to better incorporate bone tissue into the titanium collar. While my project may be small in comparison to the larger goal of the amputee project, I feel blessed to have the opportunity to experience ten weeks at WFIRM and am sure that this summer will have a resounding impact on myself as a scientist.

Beyond this summer, I will be returning to Temple University in the Fall as a Junior. Next spring, I intend to apply to medical school and continue my journey towards a career in medicine. In the future, I plan to pursue my passion for research on top of my medical career, as WFIRM has convinced me is possible. It would be my dream to attend the Wake Forest School of Medicine and return to continue doing research at WFIRM in my future. I would like to thank the WFIRM staff for the incredible opportunity to join the team this summer and all of the guidance, both personal, scientific, and professional, each member has given me.

Allison Boone

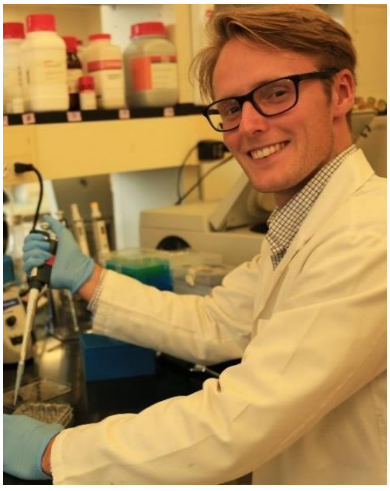
Davidson College, Biology

Faculty Adviser: Sean Murphy, PhD, Associate Professor

I am a recent graduate from Davidson College with a major in Biology and a minor in Chemistry. I first became interested in research through high school science classes, and that interest continued to grow as I enrolled in Chemistry and Biology courses at Davidson. During my senior year of college, I gained my first experience working in a research lab, where I investigated the effects of hookah smoke on lung cell viability as part of a group investigation led by Dr. Karen Bernd. While working on this project, I had the opportunity to delve into lung physiology more than in my previous courses, which catalyzed my interest in studying respiratory conditions.

This summer, I am very excited to work with Dr. Sean Murphy on his project developing lung organoids to model *Bordetella pertussis* infections. In individuals with cystic fibrosis, certain types of bacteria can form biofilms in the lungs, which can lead to recurring infections. Creating an efficient and effective model for studying biofilms is essential to developing new modes of treatment against biofilm forming bacteria, and is part of what we hope to accomplish. This summer specifically, I will build organoids using the lung-on-a-chip method, attempt to optimize microfluidics used within the system, and assess the system's ability to model biofilms via *Bordetella pertussis* infection.

After completing WFIRM's research program, I hope to work for two years before possibly pursuing a PhD. My short time at WFIRM has already solidified my interest in pursuing research in the long term, and has provided me with invaluable experiences and guidance.



Egil Brudvik

Union College, English, Psychology

Faculty Advisors: Graça Almeida-Porada, MD, PhD, Professor; Christopher D. Porada, PhD, Associate Professor

My name is Egil Brudvik and I am a Norwegian international student and a rising senior at Union College in Barbourville, Kentucky. At Union, I study English and Psychology with a concentration in Pre-Medicine. My interest in biomedical research was sparked by my participation in the 2016 Student Training and Research Program at the Augusta University Graduate School. During my time in Augusta, I worked in the lab of Dr. Lin Mei where I studied the effects of postnatal termination of GABA transmission on perineuronal net formation.

After a wonderful summer at Augusta University, I was inspired to continue my research efforts in another undergraduate research program. I found the WFIRM Summer Scholars Program to be especially appealing because of the Institute's interdisciplinary and collaborative nature. I was very attracted to the idea of being able to work alongside world-renowned researchers of many different

disciplines in a team-based environment. I also figured that the groundbreaking science done at WFIRM would allow me to step out of my comfort zone and gain exposure to completely new fields of research.

The project I will be working on this summer is part of an initiative from NASA to establish an understanding of the potential health risks of extended space travel, mainly with a deep space mission to Mars in mind. I will be focusing my attention on how prolonged exposure to microgravity conditions might affect the human body. We will test whether microgravity (µG) acts in concert with solar particle event (SPE) and galactic cosmic ray (GCR) radiation to produce deleterious effects on the human hematopoietic system, which may lead to an enhanced risk of leukemogenesis, as a result of increased genomic damage to cells of the hematopoietic system.

After I graduate from Union College next spring, I plan to return to Europe to attend medical school. I hope to be able to pursue a career as a physician-scientist that can make a difference in both clinical and academic medicine. After my experiences here at WFIRM, I am more convinced than ever of the important role biomedical research will play in my future endeavors.

David Cleveland

University of Michigan – Ann Arbor, Biomedical Engineering
Faculty Advisor: In Kap Ko, PhD, Assistant Professor

I am a rising senior at the University of Michigan majoring in biomedical engineering and minoring in physics. I first became interested in biomedical research during my freshman year of high school. I took a biology class that year that focused on human anatomy, and when we started studying kidneys and the renal system, I was hooked. While I wasn't able to pursue biomedical research in high school, I never lost my desire to learn more about kidneys. Once I discovered the limitations of dialysis and transplant surgeries, I decided to work as hard as I could to be part of a team that would usher in the age of artificial organs.

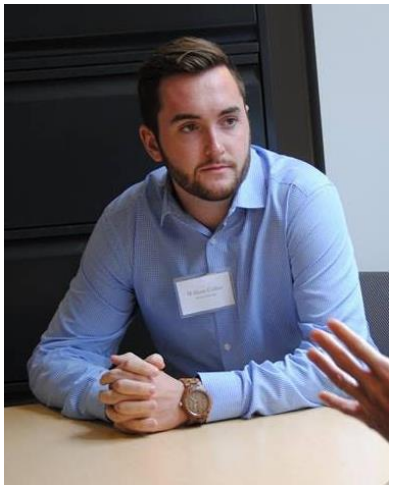
At Michigan, I spent a summer and a semester working on a project that used ultrasound exposure to increase the rate of angiogenesis. Through this experience, I learned that vascularizing tissue is the greatest limiting factor in our ability to make functional artificial organs. This led me to apply to the WFIRM Summer Scholars program, where they do research that tries to tackle this problem directly.

This summer, I am working with Dr. In Kap Ko to develop an *in vitro* study into accelerated angiogenesis. Previously in Dr. Ko's lab, they have been able to create a renal vascular construct, that is, a set of hollow tubes in the exact shape of a kidney's arteries and veins. I'm working on finding a way to get endothelial cells to invade this construct so that functional blood vessels can be formed. In order to address this problem, I'm performing transwell migration assays, where endothelial cells grow through a membrane towards an area with a high concentration of growth factors. Our hope is that by immobilizing growth factors on the vascular construct, endothelial cells will invade the construct in the transwell migration assay fast enough to make functional blood vessels within a few days.

After finishing the summer program, I plan to return to Michigan for my senior year and then attend graduate school to get my PhD in biomedical engineering. My experiences at WFIRM have encouraged me to continue to chase after my dream of making artificial kidneys, and I cannot thank WFIRM enough for all of the guidance, instruction, and professionalism that they have given me.

William Collier

Purdue University, Biochemistry, Premedical
Faculty Advisor: Shay Soker, PhD, Professor



My name is Will Collier and I am a rising Junior at Purdue University studying Biochemistry, Premedical. I am originally from Fishers, Indiana; about half an hour north of Indianapolis. During my time at Purdue, I have gained research experience working as an undergraduate in a plant genetics lab. However, outside of the classroom and lab, I serve as an executive board member of my fraternity's chapter and I am a member of Purdue's premiere improv comedy group, The Crazy Monkeys. I am also trained as a Certified Nursing Aid and have a passion for providing healthcare to people of all ages and backgrounds. I aspire to be a surgeon and researcher who utilizes the full potential of regenerative medicine; making WFIRM the perfect place to experience what truly is the future of medicine.

This summer I will be working under Dr. Shay Soker and Dr. Mahesh Davarasetty engineering 3D microenvironments to model cancer growth, metastasis, and extra cellular matrix (ECM) remodeling. The ability of cells to remodel the ECM is a major mechanism behind cancer proliferation and metastasis. One example within the body where this can be seen is the phenomenon behind colorectal cancer's desire to metastasis predominately to the liver. For my experiments, rather than using a 2D model, engineering 3D microenvironments *in vitro* will give us a more accurate view of how these mechanisms work within the body. I will be using a collagen-based hydrogel as a scaffolding for cells to adhere, grow, and form "organoids." From there, I can run experiments on these organoids such as inhibiting or overexpressing possible oncogenic pathways like LOX, MMP, ROCK, and EZH2.

After this summer at WFIRM, I will continue to pursue my undergraduate degree in Biochemistry at Purdue. As of now, I plan on experiencing more of the clinical side of medicine by shadowing doctors or working as a scribe. It is my desire to attend medical school and possibly practice as a sports orthopedic surgeon. Regardless of the career path I choose, however, I will carry my experiences at WFIRM with me. I would like to thank all of WFIRM for the opportunity, support, and guidance in making this summer a fun and successful one!

Nancy Contreras-Quinteros

Appalachian State University, Chemistry

Faculty Advisor: Stephen Walker, PhD, Associate Professor

I am a rising senior at Appalachian State University majoring in Chemistry and minoring in Cell and Molecular Biology. I have been interested in a career in medicine since my senior year in high school where shadowing a physician help me discover my passion for women's health. During my sophomore year in college, I had the opportunity to do scientific research working as a synthetic organic chemist in Dr. Nicholas Shaw's laboratory at Appalachian State University, a position I have held for two years. My research project focuses on conducting thiolation reactions in novel sol-gel derived 'nano-reactors.' Thiolation reactions performed traditionally are subject to long reaction times and are low yielding which typically necessitates purification. My research in the laboratory focuses on asking important questions such as, "Can sol-gel 'nano-reactors' be used to conduct thiolation reactions?", "Do sol-gel 'nano-reactors' decrease reaction time?", Do sol-gel 'nano-reactors' increase synthetic yield?". I immensely enjoyed the work I did which lead to my desire to peruse research as a career. What leads me to WFIRM was some of the amazing work being done by many of the researchers in the department as well as my interest in getting exposure to research in the biomedical field.

This summer, I am working with Dr. Steve Walker on a project is to isolate, quantify, and analyze micro-vesicles known as exosome found in serum samples of children with regressive autism spectrum disorder and ilecolitis. To quantify and analyze the exosomes techniques TEM images and a Nano-Tracking analysis will be performed. The exosomes will then be analyzed for the presence of different miRNAs. The miRNA profiles will be developed for both the controls and sample patients to analysis for similarities in miRNA expression to identify possible biomarker for Ileocolitis in children with ASD.

After finishing the summer program, I will finish my senior year of college and then apply to an MD/Ph.D. programs with a focus on women's health. The WFIRM summer program will have given me the right tools and experience I will need to continue to peruse my dream of doing research in women's health. Regenerative medicine is such a new and expanding field, and my experience in this programs will allow me to gain the knowledge I can later use as an OB/GYN to ensure my patients are always getting the best treatment available.

John Craig

University of Texas – Austin, Biomedical Engineering

Faculty Advisors: Thomas Shupe, PhD, Assistant Professor; Aleks Skardal, PhD, Assistant Professor

I am a rising sophomore at the University of Texas at Austin in biomedical engineering. I first became interested in biomedical engineering my junior year of high school. My dad is an orthopedic surgeon and until then I had always aspired to follow in his footsteps; however, my junior year I took an aptitude test in Atlanta, Georgia. My results were originally unpleasing. My suggested career was

Journalism. I had no intention in straying away from the medical field and was unsatisfied with my initial results. I consulted my monitor about the results, and soon discovered my suggested career – Journalism – was based on the creativity and thinking sections. I had scored extremely high in all creative fields. After my consultation I was told a career in research would be a good way to take advantage of my aptitudes. I immediately began to look into my career options.

Not long after my consultation I discovered the field of biomedical engineering and was extremely intrigued. I began research on both osteoarthritis and heart valve replacement my junior year in high school – two topics in which there was meaning for me. Although I had no resources and could only outline experiments, these experimental procedures are saved and I hope to one-day reach my goal of carrying out each.

By my senior year of high school, I was deep into biomedical engineering and was accepted into my dream school – The University of Texas at Austin. The Cockrell School of Engineering at Austin is an amazing resource and I was very excited. I continued to pursue research as I previously interned under Dr. Atala following high school with small amounts of help for the Body-on-a-Chip Technology. This experience confirmed my love for biomedical engineering research.

This summer, I am working with Dr. Shupe and Dr Skardal on a relatively new project. This project is the testing of a new biomaterial based on silicon dioxide as a bandage. This particular biomaterial has shown miracle healing potential in unofficial settings. My project consists of testing as many hypotheses in ten weeks to analyze the biological pathways behind this bandage. The main hypothesis currently includes testing for various phenotypes of macrophages, which regulate inflammation. Our hope is to finish this experimentation by mid-summer and potentially consider other hypotheses.

After finishing Summer Scholars, I plan to return to the University of Texas at Austin and continue to pursue my Biomedical Engineering major as I explore potential double majors in chemistry or computer science. Following undergraduate school, I plan on attending school for either a Masters or Doctorate degree in route to receive a PhD in biomedical engineering. My experiences at WFIRM have allowed me to realize not only my potential in the research field, but my love for it as well. I cannot thank Wake Forest and WFIRM enough for allowing me to broaden my research experience, and I look forward to potentially working with the program in the future.

Williams Dean

University of North Carolina-Greensboro, Biology
Faculty Advisor: Baisong Lu, PhD, Assistant Professor

I am currently studying Biology in a Post-Baccalaureate program at the University of North Carolina – Greensboro. Previously, I attended Western Carolina University and graduated with a degree in Emergency Medical Care. Upon graduation I moved back to my home city of Winston-Salem and became employed as a Paramedic for Forsyth County. Being back in school after working in the field has been a truly amazing experience. Biology has been a very fascinating field to study, and the classes have given me a strong background to learn from this summer. My curiosity for regenerative medicine began when the Institute was established in Winston when I was

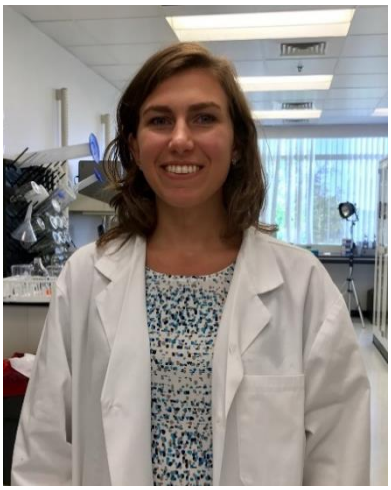
growing up. The institute encompasses many different areas of medicine that are using technology to advance the role of tissue engineering for patients. This combination of biology and technology here at WFIRM is what brought me to pursue research during the summer.

This program offers a unique opportunity for one to be engaged in the advancing research in today's fields. My project here at WFIRM this summer will be working with the CRISPER/CAS9 gene editing tool. More specifically, I will be researching with my mentor, Dr. Baisong Lu, on better ways to deliver the system into cells. Currently, there are many challenges associated with this system, such as off target binding, but the delivery of the actual system is one of great importance. By developing a better/more efficient way to introduce the Cas9 protein into the cells transiently, the variety of diseases that could be treated is exponential. CRISPR/CAS9-guidance RNA is becoming a revolutionary gene editing tool that is on the forefront for great achievements in the world of genetics, and it is truly amazing to be able to study it this summer.

Following my summer research here at WFIRM, I will be returning to UNC-G for one more semester as I work on my path to ultimately attend Medical School. While I plan on pursuing the specialty of Emergency Medicine as a career, the experiences I've had over this summer have opened my eyes to the endless possibilities that regenerative medicine has to offer. I am beyond excited to participate in the research program this summer, and I look forward to what the future holds.

Amelia Hurley-Novatny

University of Maryland, College Park, Bioengineering
Faculty Advisors: Sang Jin Lee, PhD, Associate Professor;
James Yoo, PhD, Professor, Associate Director, CSO



I attend the University of Maryland, College Park. I'm currently finishing my Integrated Life Sciences honor's program citation. I am entering my junior year studying bioengineering with a focus on biomechanics and biomaterials. Specifically, I would like to apply this to musculoskeletal tissue engineering.

I started my research my senior year of high school at a small private research institute in Rockville, Maryland. I worked an immunology lab that focused on Schistosomiasis research and production of research materials. I worked to develop SOPs to increase production to meet demands. Currently, I am in the Tissue Engineering and Biomaterials Lab at UMD. I did research on tissue engineering of feline ovaries for about a year. In the fall, I will start an independent project on engineering of the ligament-bone enthesis as part of the bioengineering honor's program.

At WFIRM, I am working under Dr. Lee and Dr. Yoo. I am doing musculoskeletal research with co-culture of chondrocytes and osteoblasts. The ultimate goal of this study, which is beyond my time here, is to develop a physiologically relevant engineered articular cartilage construct to repair cartilage defects due to diseases such as rheumatoid and osteoarthritis among others. If my project is successful, it will be an important turning point for the overall project. Good results will indicate that it is possible to engineer a complex structure. My project involves 3-D printing of stem cell-laden hydrogels and analysis of the success of differentiation of those constructs looking at cell morphology and gene expression.

After graduation, I plan to pursue an MD/PhD with a focus in orthopaedics and tissue engineering. I am very thankful to the series of events that have led me here, as I love Winston-Salem and WFIRM. This is a great opportunity that I enjoy greatly.

John Latimer

Stanford University, Biology

Faculty Advisor: Anthony Atala, MD, Professor, Director of WFIRM

Mentor: Renata Magalhaes, MD

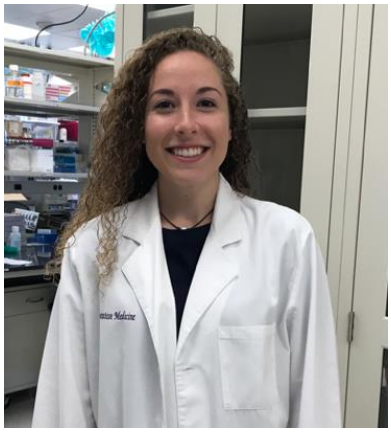
I am a rising senior at Stanford University majoring in biology. My interest in regenerative medicine began last summer when I worked for a startup company in San Francisco called Ankasa Regenerative Therapeutics. The goal of Ankasa is to develop a WNT based strategy for tissue regeneration. I worked extensively with optimizing a protein manufacturing process in the hopes of scaling up their production. Ankasa's motivation stems from about 15 years of basic research performed at Stanford, and, thus, showed me how an idea becomes a product. I enjoyed being on the edge of innovation and working in a fast-paced environment. My work with Ankasa led me to apply to regenerative medicine programs across the U.S., including the summer scholar program at WFIRM.

I look forward to being at the forefront of medical advancements at the Wake Forest Institute for Regenerative Medicine this summer. With additional supervision provided by Dr. Renata Magalhaes, I will work to characterize the structure and physiology of bioengineered uterine tissue. Dr. Magalhaes has used a rabbit model to study the effect of a PGA-PLGA scaffold in regenerating a surgically removed portion of the uterus. The rabbits in the study either received no scaffold, a non-seeded scaffold, or a scaffold seeded with autologous uterine cells. I will use a variety of imaging techniques, including scanning electron microscopy and fluorescence microscopy, to analyze the structure of the scaffold as well as the structure of the different uterine tissues in the study. Hopefully, the scaffold, seeded or non-seeded, will prove to regenerate a functional organ in the model.

I have one year left at Stanford, and am currently applying to medical schools with the hope to matriculate in the fall of 2018. I want to pursue a career as a practicing doctor while running my own lab at a university. My experience at WFIRM has solidified my interest to pursue research in regenerative medicine in the future and I cannot thank all of the people at WFIRM for this opportunity.

Emily Long

Pennsylvania State University, Biomedical Engineering
Faculty Advisor: Emmanuel Opara, PhD, Professor



I am a rising senior at Penn State majoring in Biomedical Engineering within the chemical track. Last May I began working in a bioimaging and nanoparticle lab at Penn State in the Department of Material Science under Dr. Adair. I synthesize calcium phosphate nanoparticles to encapsulate fluorescent dyes or therapeutics for drug delivery. Last year, I worked on a scale-up project to make the manufacturing of nanoparticles more efficient.

After working in a research lab for a year, I knew I wanted to gain more experience over the summer. I was drawn to the research focusing on Type I diabetes at WFIRM. In my physiological systems class at Penn State, I studied the effects of Type 1 diabetes on different parts of the body, and simulated the disease using a computer model. Working under Dr. Opara will give me the opportunity to combine and apply my knowledge of diabetes and research to the field of regenerative medicine.

Before coming to WFIRM, I did not have a background in regenerative medicine, but I was excited to learn about all of the opportunities the field offers, and the translational work being performed. At WFIRM I am working on the bioartificial pancreas project under Dr. Opara, which uses alginate to encapsulate islets and immunotherapeutic stem cells for transplantation into the pancreas. My project this summer focuses on optimization of a microfluidic device to control the shape and size of the alginate microbeads. Moving forward, I will encapsulate mesenchymal stem cells that produce immunosuppressive molecules to combat the cytotoxic T-cells responsible for the destruction of pancreatic beta-cells and cause Type 1 diabetes.

In the fall, I will return to Penn State to finish my degree and complete my thesis focusing on the diagnosis and treatment of leukemia through the use of nanoparticles. After graduation, I plan on working for a pharmaceutical company in the research and development department to gain experience before pursuing higher education. I would like to thank Dr. Opara and his team, the Henley Fund, and the WFIRM staff for supporting me this summer, and allowing me to work alongside some of the top scientists in the field of regenerative medicine.

Nickolas Mundo

Texas A&M University – Corpus Christi, Mechanical Engineering
Faculty Advisors: Sang Jin Lee, PhD, Associate Professor; James Yoo, PhD, Professor, Associate Director, CSO

I am a senior mechanical engineering major at Texas A&M University – Corpus Christi. I first became interested in medicine when I started volunteering at an animal rehabilitation center, the Texas Sea Life Center, my freshman year of college. There, I mainly cleaned animal enclosures and feed the animals; but I, also, was able to observe the residing veterinarian and staff preform surgeries on sea turtles and birds. I fell in love with the practice, and its ability to help and nurture those who cannot help themselves.

I have always been fascinated by the complexity of biology; so I have been taking biology course alongside my mechanical engineering courses. During my junior year, I started doing research for my genetics professor: looking for genetic differences between oysters capable of adhering to different substrate materials. The goal, of this research, was to make the selection of oysters for the creation of artificial reefs more effective.

To be honest, I have never been certain as to what I want to pursue for a profession. My adviser actually was the one who suggested I look into biomedical engineering during my junior year. From there, I learned about tissue engineering and knew it was something I wanted to pursue in the future. I was able to participate in a contest through the Biomedical Engineering Department at Texas A&M University – College Station. My team and I were awarded first place for our redesign of an endotracheal tube and laryngoscope. This encouraged me to pursue biomedical engineering further.

I applied to Wake Forest Institute of Regenerative Medicine because I have become fascinated by the possibility of artificial organ generation, and the gift it can bring to someone's life. This summer, I am working under Anil Kumar P.R. and Mohamad Ali to develop a new novel bioink for 3-Dimensional printing of kidney constructs. I mainly will be testing different formulations of bioink and assessing the mechanical and biological properties. I am grateful to be a part of this team, striving to develop a new novel way to help those inflicted with kidney failure.

I will finish my undergraduate degree in December of this year, 2017. After I graduate, I will be pursuing medical school or veterinarian school. I hope to take the skills and knowledge I learn at Wake Forest to help others in the future.

Jennifer Paxton

Winston Salem State University, Exercise Science

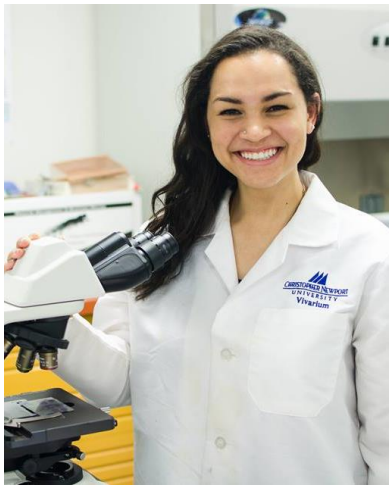
Faculty Advisor: Yuanyuan Zhang, MD, PhD, Assistant Professor

Currently, I am a junior at Winston Salem State University studying Exercise Sciences. I began my college experience at Forsyth Technical Community college in Applied Sciences and Nursing. In that program, I gained knowledge watching surgeries and learning about the interdisciplinary team in a hospital. I enjoyed the atmosphere so much that I decided that I wanted to study more about physical therapy and rehabilitation. I chose to continue my education at Winston Salem State University in Exercise Sciences to gain a foot hold on a new educational path. It was here that my professor Dr. Chad Markert held a lab to teach my class how to make agarose hydrogels as a medium for cell growth. I automatically was hooked. At this point I had to know more about regenerative medicine. Around this time, I had spoken to a lady who swore by her results in stem cell therapy, and so I could not wait to join WFIRM.

My WFIRM project for the summer is "Non-Invasive Cell Tracking Using Brighter Red Transferred Luciferase for Potential Application in Stem Cell Therapy". Cell tracking is done using a florescent microscope, and brighter red is a fluorescent protein that allows cells to glow under a fluorescent microscope. Luciferase is from firefly and is a great way to see cells under a microscope. I will be mixing

these two to better explain where stem cells migrate, differentiate and their paracrine effect once injected into the human body. We also want to know more about a cells lifespan. I am working my mentor Dr. Zhang and his awesome team of doctors. I am having an amazing summer internship full of new techniques, hypothesis, and collaborative ventures.

My future research plans and goals are to attend graduate school. My disciplines of interest are to physical therapy, rehabilitative engineering, and clinical engineering. I am hoping to work more with children with Duchenne muscular dystrophy, and cerebral palsy.



Hayley Premo

Christopher Newport University, Neuroscience

Faculty Advisor: Dr. Tracy Criswell, PhD, Assistant Professor

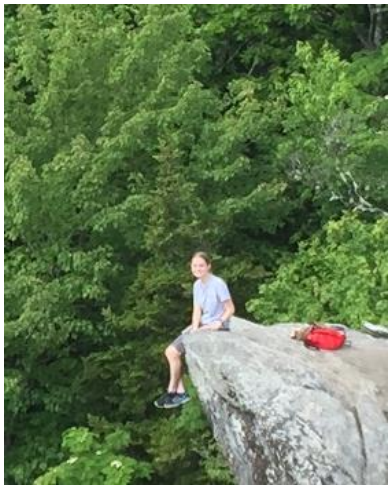
I recently graduated from Christopher Newport University with a Bachelor's of Science in Neuroscience and a minor in Leadership Studies. I'm a pre-med student and have just finished applying to medical schools. However, research has always been a significant part of my undergraduate career. At Christopher Newport, I participated in two different labs, leading projects in both. I'm originally from Winston-Salem so one of the reasons (among many others) that I applied to the WFIRM Summer Scholar program was to be able to come back home for a summer while being able to continue carrying out scientific research. I first became interested in regenerative medicine during one of my neurobiology classes when we began learning about neurodegenerative disorders. I developed an interest in Alzheimer's Disease in particular and began looking at regenerative medicine as being utilized as a potential treatment. I wanted to learn more about this type of medicine and how it's evolving when I discovered the WFIRM program. The interdisciplinary and immersive nature of the program seemed like an ideal environment to be introduced to the field of regenerative medicine.

This summer, under the mentorship of Dr. Tracy Criswell, I will be studying the effects of radiation on skeletal muscle progenitor cells. One of the treatments for certain types of cancer, especially for soft tissue sarcomas, is radiation therapy. However, this therapy tends to lead to muscle weakness and a marked decrease in mobility, thus decreasing the quality of life for these patients post-treatment. Although this is a common and consistent issue, the ways in which radiation affects the cellular activities of muscle is still unclear. Therefore, this summer I will be culturing muscle progenitor cells, also called satellite cells, and exposing them to different doses of radiation. After exposure, we will be observing dose-dependent and time-dependent changes in cell morphology, growth, and phenotypic expression. This experiment will hopefully provide some preliminary data regarding the effects of radiation on skeletal muscle progenitor cells and create a foundation on which to build future experiments.

As for my future plans, as I previously mentioned I have just finished the process of applying to medical schools (one of which is Wake Forest!) and will hopefully be admitted into the entering class of Fall 2018. Although I'm sure my areas of interest will change, I'm hoping to go into surgery or geriatrics. In addition, I am planning to spend a few years abroad serving impoverished populations and providing free medical care to those in severe need.

Caroline Sane

Georgia Institute of Technology, Chemical and Biomolecular Engineering
Faculty Advisor: Anthony Atala, MD, Professor, Directory of WFIRM



I am a rising junior majoring in Chemical and Biomolecular Engineering at the Georgia Institute of Technology. Before coming to WFIRM, I worked in a Metabolomics lab in Synthetic Biology to create a hybrid promoter element to be utilized in a zinc biosensor *Escherichia Coli* for detection of zinc deficiency. *E. coli* cells were grown in a repressed state (white) and engineered to respond to zinc by the production of pigment. The goal of the project was to ultimately develop a field-deployable model that could address existing detector concerns of high cost, complexity, and limited transport.

I first became interested in biotechnology in high school when I was briefly introduced to genetic engineering in an introductory biology class. I did a bit of research on my own and soon after encountered the field of tissue engineering. The ability to regenerate tissue and help patients greatly intrigued me, and led me to apply to Georgia Tech to pursue an engineering degree.

As there are many applications of chemical engineering, I remain uncertain as to which career path to pursue. I believe I will only know through experience, which is the reason why I chose to apply to WFIRM.

At WFIRM, I am working under Goodwell Nzou in Dr. Anthony Atala's lab to develop an in vitro model of the blood brain barrier (BBB). Having a functional model of the BBB is critical in the testing of drugs and neurotoxicity for treating patients with neurodegenerative disorders. Existing models are not functionally equivalent to the true human BBB; our model addresses this issue with the incorporation of all six major brain cell types on the basis that crucial interactions and secreted factors between these cells enables the formation of a functionally equivalent human BBB model.

Mark Schwartz

Saint Louis University, Biomedical Engineering
Faculty Advisor: John Jackson, PhD, Associate Professor

This fall I will be a junior at Saint Louis University majoring in biomedical engineering and minoring in French. My first step into the biomedical field was In high school, during which I worked 3 summers for a medical company testing a device for blood purification. From then I was hooked on BME. Although I realized that the device side of the field didn't interest me as much as the biological side, I knew that I wanted to study biomedical engineering in college. Last year I took my first physiology course, immediately interested in the pancreas's hormone secretion and the kidneys. Unfortunately, I was not able to feasibly participate in research last year at SLU due to a semester

abroad, so I didn't get the opportunity to engage in research with the organs I found most interesting in my physiology course.

After not doing research at school last year, I knew I needed to find a summer program to help me dive deeper into the field. The WFIRM Summer Scholars Program was at the top of my list of applications; it had everything I was looking for. It looked like the institute was doing incredible research that was more physiology-based and less biomedical instrumentation and device-focused, which was exactly what I wanted to do.

This summer, I will be working with my faculty advisor Dr. John Jackson and mentor Dr. Sittadjody Sivanandane to test the viability of different ovary cells harvested from young rats *in vitro*. I will be using a small chip with a slow fluid flow through the media holding the cells, extracting hormones and imaging my cells on a weekly basis to see how functional the cells are *in vitro* in terms of their hormone production and ratio of live to dead cells. This setup's data will compare to that collected from my control, cells sitting in stagnant media with half the media changed every few days. Theca and granulosa cell hormone secretion will be analyzed, as will the maturation of primordial ovarian follicles. The hope for this summer is to assess the viability of ovarian cells in terms of proper function *in vitro*, contributing towards a larger project aimed at finding an alternate remedy to in vitro fertilization for infertile women or women at risk of becoming infertile.

Returning to St. Louis in the fall, my goal is to enter a research lab at the Washington University School of Medicine, participate in an industry-based internship next summer and graduate with a degree in biomedical engineering in the spring of 2019. After this, I would like to jump into work at biotechnology or pharmaceutical company and within a few years attend graduate school. Whether or not I would like to pursue my PhD will be a decision I make in coming years, but I hope that the amazing researchers at WFIRM will be able to guide me towards my true research passion this summer through their expert guidance and mentorship.

Charlie Spong

Clemson University, Mechanical Engineering

Faculty Advisor: Frank Marini, PhD, Professor

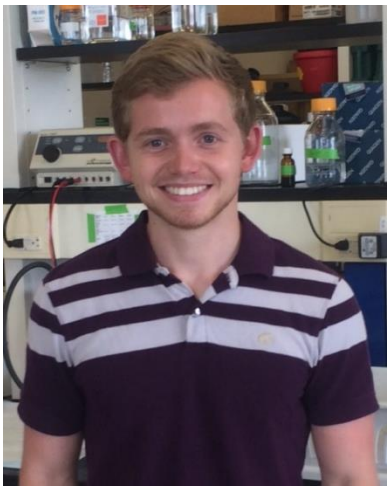
I am a rising sophomore at Clemson University majoring in mechanical engineering. I live in Winston-Salem, NC, where WFIRM is located. Prior to the WFIRM Summer Scholars Program, I had little experience in biomedical engineering research. I have however worked on two main research projects, one in civil engineering, and one combining the interests of mechanical and biomedical engineering.

I began my research right after high school, spending my summer before college working on a research project at Clemson. During that summer, I worked on a prototype blood pump that could imitate a blood graft implemented into a surgery called the Fontan Procedure. The objective of the project was to work towards finding a new treatment for children with Hypoplastic Right Heart Syndrome, a congenital heart defect where the right atrium and critically underdeveloped and thus our device was meant to be implemented to help adequately pump blood to the lungs. Following the summer, I moved into a civil engineering research project that wanted to determine the feasibility of bamboo as a substitute for steel

rebar in reinforced concrete. The project is meant to provide a cheaper, more readily accessible concrete solution for developing countries where bamboo is common, such as Haiti.

This summer, in working with Dr. Frank Marini, I am looking into a program his lab, led by Kyle Cowdrick, developed, called DifferentialZ (hereby DiffZ). The objective of DiffZ is to create a faster way of imaging large fields of view while keeping the ability to image smaller regions of interest at single cell resolution. More specifically, Kyle Cowdrick first tested the program by imaging an entire rat bladder while maintaining high levels of resolution. The program accomplishes this using image stitching, combining many smaller images into one. What sets DiffZ apart from other stitching programs, though, is that it eliminates any wasted imaging space, so as not to waste time imaging unwanted areas of the tissue. Dr. Marini, however, still believes the program can be further automated. He has noted significant work-flow issues which require too much human involvement in working through the DiffZ process. Thus, this summer I will be working, mostly in MATLAB coding software, to help automate this work-flow and make the process even faster.

Once the Summer Scholars program is over, I will be returning to Clemson for my sophomore year, with my sights set on finishing my B.S. in mechanical engineering before possibly pursuing my masters. While I am not sure where exactly life will take me following college or even following this program, I can say for sure that WFIRM has and will continue to give me valuable research and work experience as I pursue my goals.



Eliot Teal

Clemson University, Bioengineering

Faculty Adviser: Frank Marini, PhD, Professor

I just recently graduated from Clemson University in May with a degree in Bioengineering, a concentration in biomaterials, and a minor in chemistry. Next year I will be attending Cornell University to obtain a Master of Engineering degree in biomedical engineering. In the first year of my undergraduate experience I became strongly interested in the application of engineering principles to the development of the medical field. A desire to positively impact the lives and well-being of patients with disease led me to this career path. I have strong interest in the design of medical devices and the role that biomaterials play in their success. I have participated in multiple different research and design projects since, ranging from the design of an orthopedic device, to investigating a new inorganic biomaterial. The field of regenerative medicine has always been intriguing to me, and is what led me to pursue a summer here at the Wake Forest Institute of Regenerative Medicine.

This summer I am working in Dr. Frank Marini's lab on the optimization of a workflow for a new three-dimensional imaging technique. In particular, I will be focusing on improvements at the front end of the process, working on tissue clearing methodology. Traditionally, light scattering and the natural translucency of tissues and organs prevents imaging of samples thicker than 2 mm. Tissue clearing is a technique that renders tissues transparent after exposure to a series of chemicals, and allows imaging of thicker samples. At the conclusion of the program, we aim to have an optimized tissue clearing technique that facilitates improved imaging of various regenerative tissues and organs.

I believe that this program will give me valuable experience in the field of regenerative medicine, that I can take with me as I pursue my master of engineering degree next year. While I have not settled on a specific area of interest within the field of bioengineering, I hope that my experiences at WFIRM can inspire me to a future career in the field of regenerative medicine.

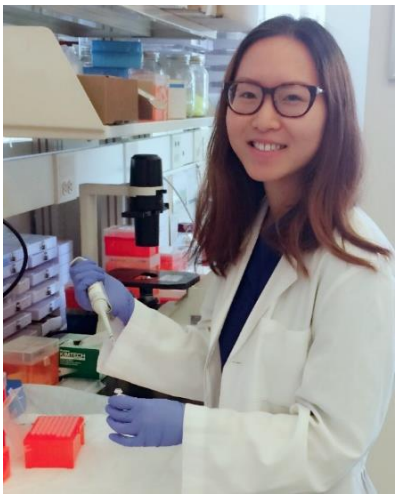
Margaret VanSchaayk

Wake Forest University, Communications
Faculty Advisor: Sang Jin Lee, PhD, Associate Professor

I recently graduated from Wake Forest University with a major in communication and minors in chemistry and biology. I was fortunate to have had the opportunity to gain experience at WFIRM over the past 2 years during undergrad. Prior to joining the summer scholars program, I have been working under the mentorship of Dr. Ji Hyun Kim and Dr. Sang Jin Lee and will continue working with them this summer. I was interested in being a part of the summer scholars program as an opportunity to not only solidify lab techniques and research skills, but to gain expertise in scientific writing and presentation skills. I am excited to be able to work alongside other students with similar interests to mine, to learn from them, to share my own ideas, and to be a part of such a multidisciplinary community dedicated to active participation in scientific advancement.

The project I will be working on this summer focuses on single factor testing of growth and neurotropic factors and their effects on skeletal muscle development in 2D and 3D models. In an effort to mimic the developmental effects that neural cells have on differentiating muscle cells, I will test the effects of several growth factors first in 2D cell culture and then in 3D bioprinted skeletal muscle. Through this project, I hope contribute to the knowledge base for developing an ideal combination and ratio of growth and other factors for the development of bioengineered functional skeletal muscle.

Following the summer scholars program, I will return to Wake to complete my masters in bioethics and then begin applying to medical schools next summer. I hope to teach, research, or do service abroad for a year before beginning medical school.



Sue Zhang

University of Rochester, Biomedical Engineering
Faculty Advisor: Hooman Sadri-Ardekani, MD, PhD, Assistant Professor

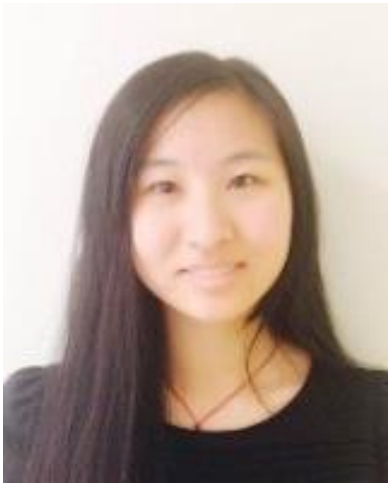
I am a rising senior at the University of Rochester majoring in biomedical engineering, with a concentration in cell and tissue engineering, and minoring in chemical engineering. I became interested in regenerative medicine in high school when a researcher came to my biology course to discuss her research on a degradable wound-healing hydrogel bandage, which was developed to be used on soldiers injured during battle. Amazed by the incredible advancements in regenerative medicine, my interest has since then

evolved into a desire to pursue a career as a researcher, which enables me to translate findings in regenerative research into clinical applications that enhance human health.

At the University of Rochester, I am a part of Dr. Danielle Benoit's research group. My project focuses on using degradable hydrogels for temporal control of nanoparticle-mediated siRNA delivery. Nanoparticle-mediated siRNA delivery via can be used in several types of regenerative medicine applications, including bone fracture healing. Working on this multidisciplinary project gave me the opportunity to learn a several techniques that are fundamental to regenerative medicine research and inspired me to further my training in medical research that has healing potential.

At WFIRM, I am excited to be working as a member of the Male Fertility Research Group (MFRG) under the mentorship of Dr. Hooman Sadri-Ardekani, a clinician and scientist in the field of male reproductive medicine, and Dr.Nima Zarandi, a postdoctoral research fellow. My project this summer is to optimize three-dimensional testis organoid culture system using prepubertal testicular cells. I am working on this project to address infertility in prepubertal males caused by gonadotoxic chemotherapy treatment. In my project, I will use 2D cultured prepubertal testicular cells (including Spermatogonia, Sertoli, Peritubular and Leydig cells) to create 3D testicular organoids system. The main aim of my project is optimizing the testicular organoid formation with the ultimate goal of using this 3D system to mimic testicular function *in vitro*.

After this summer, I am returning to the University of Rochester for my senior year and I plan to attend graduate school to attain my Ph.D. in biomedical engineering. I would like to continue contributing to regenerative medicine research with the excellent training and guidance that I have received at WFIRM.



Suzanne Zhou
Virginia Commonwealth University, Biology
Faculty Advisor: Khalil Bitar, PhD, Professor

I am a rising junior at the Virginia Commonwealth University with a Biology major and Computer Science minor. My first introduction in research was in high school at NC School of Science and Mathematics where I investigated archaea bacteria metabolic pathways and, separately, analyzed clinical data on possible association of blood transfusion with a rare blood-clotting disorder, thrombotic thrombocytopenia purpura. These research experiences served to help connect both highly theoretical research and highly translatable research in my mind.

When I started college, as part of my exploration of the medical field, I started shadowing different types of physicians and areas of medicine. What I saw was a lot of the similar issues that prompt some physicians to approach regenerative medicine. Pharmaceuticals and current treatment routines commonly prove to be inadequate for complete regeneration of the patient's health or come bearing other negative side-effects. An urge to search for a better solution prompted me to join a research lab in my freshman year. Through my work as research assistance on projects that varied from liver scaffolding to bone scaffolding to peptide coated surfaces that enhanced cell attachment, I was introduced to regenerative medicine and its possibilities.

This growing interest has led me to the Wake Forest Institute for Regenerative Medicine (WFIRM) Summer Scholars program. At WFIRM, I am working with Dr. Khalil Bitar, Dr. Prabhash Dadhich and Dr. Elie Zakhem, to create a gastroparesis tissue-based disease model and following possibilities of cell therapies, which utilize neural progenitor cells and interstitial cells of Cajal, to allow for the neo-innervation and restoration of function of the disease model. Gastroparesis is a disorder that is characterized by delayed gastric emptying. As a result, patients suffering from this experience symptoms that ranges from quick satiation to acid reflux to abdominal pain as a result of a buildup of material in their stomach. Treatments for gastroparesis can involve dietary changes or surgical interventions. As these options can become financially burdensome or affect the quality of life for these patients, we are investigating another possible method to treat this disease.

The common pathogenesis of gastroparesis is decreased neural cells and interstitial cells of Cajal (ICC) in the lower part of the stomach, the pylorus. We believe that via cell therapy, we can re-establish the lost motility in this region. To examine this, we will first create a rat tissue model of the disease that lack neural cells and ICCs through appropriate chemical treatment. From here, we will do a combination of experimental and control groups to determine if we can successfully generate neural networks and functionality through the addition of neural progenitor cells and ICCs.

In terms of a future career, I aim to pursue a MD/PhD or an MD with the specific fields to be determined. With the knowledge that I learn this summer, I will apply it to my studies and possible future career as a physician scientist.