OLD DOMINION UNIVERSITY

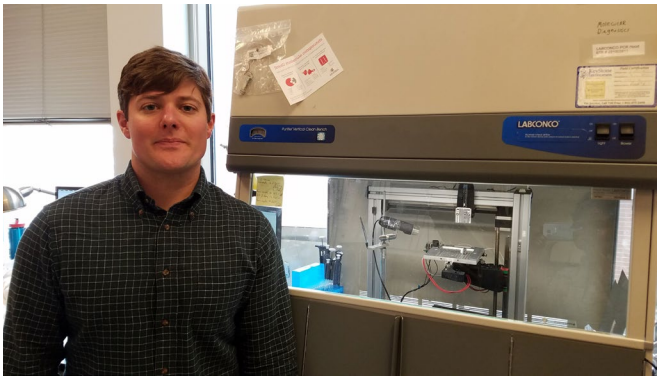
The Graduate School

GRADUATE NEWS

MARCH 2018

From deep reflection, innovation often follows when paired with diligence and thorough research. This month, we're bringing you another example with an up-close look at one of ODU's highly innovative and pioneering minds on campus. Meet John Reid, a Ph.D. candidate in the Biomedical Engineering Program, pioneering work in cancer diagnostics and beyond. He developed a bioprinter, a 3D printer capable of printing biological material, for his lab to answer important questions in molecular biology and to accelerate research. His work has been recognized widely, earning him a highlight in the journal, *Biofabrication*, in 2016 (http://iopscience.iop.org/journal/1758-5090/page/Highlights-of-2016). His paper, *Accessible bioprinting: adaptation of a low-cost 3D-printer for precise cell placement and stem cell differentiation,* has been downloaded more than 5,300 times and serves as a model for budding researchers looking to probe biological questions. He shows no intention of stopping there, and is eager to share his technology and research. You can catch him on Wednesday, at O'Connor Brewing Co. located at 211 W. 24th S., Norfolk, Va during the next Science Pub lightning Talks (see page 8 of this issue.) Additionally, along with other local stars, he will be presenting at the upcoming Graduate Research Achievement Day on March 29th. Without much ado, we present John in this special interview below.

Student - John Reid - Ph.D. Candidate Biomedical Engineering



What encouraged you to pursue a graduate education?

After my undergraduate years, I worked for one of the most trusted providers of organ transplant solutions, LifeNet Health. I initially applied for a summer intern position, but the person from Human Resources described an open position in the bio-implants division and I took it. I really identified with their mission statement of "Saving Lives, Restoring Health". At LifeNet Health, I gained invaluable experience and understanding of the development of biological implants. I enjoy the challenges associated with the field, and it was there that I learned about future bio-implant technologies and cellular therapies in the field of regenerative medicine. While I was there, I just couldn't escape the feeling that I would limit my future capabilities if I didn't get back and further my studies. I wanted to take my professional career interests to the next level.

What are your hobbies?

I was born and raised next to the coastal waters of Virginia and North Carolina, so I like anything involving the ocean, sand, or surf. Any time conditions are good, I'm usually thinking about surfing or fishing. Also, I like anything that uses a remote control, but quadcopters and RC planes are probably my favorites. I have recently been doing a lot of aerial drone photography.

What is your research about?

The core of my research, and pretty much the main focus of most tissue engineers, really tries to identify how the 10 trillion cells in our bodies, which have the same genetic information, make the numerous types of tissues, each with a different form and function. It turns out that a substantial amount of gene expression in cells originates from signals from their micro-environment. But, as with most things, our ability to study this has been limited due to a lack of available technology. For example, cells in 2D can't carry out their tissue-specific functions because the iconic, flat surface of a plastic petri-dish fails to mimic the real-world conditions. As a result, we now understand that the structure of a tissue or organ is indispensable for its function. This is a big deal because most of the information about cell biology we have today originated from two-dimensional (2D) cultures. Thus, many treatment options currently available to clinicians were derived from the flat-plastic, 2D, monolayer cultures. So, while numerous genomic and gene expression arrays can provide evidence of a cell's status or identity, these results mean little unless we can provide the cells with a 3D environment that recapitulates the real-world structure.

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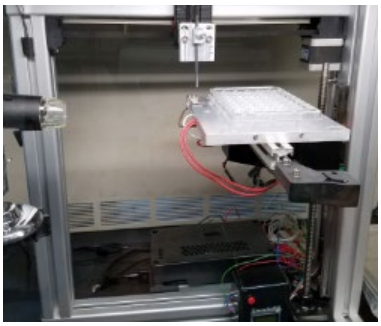
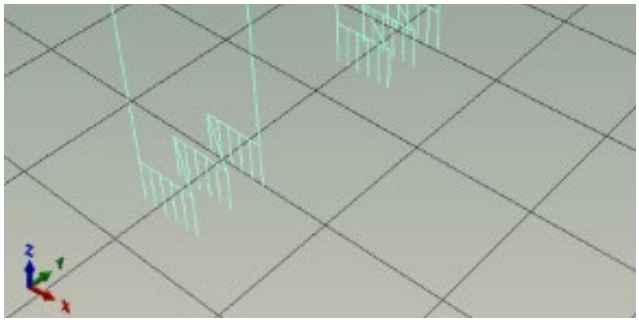
Student - John Reid - Ph.D. Candidate Biomedical Engineering (Continued)

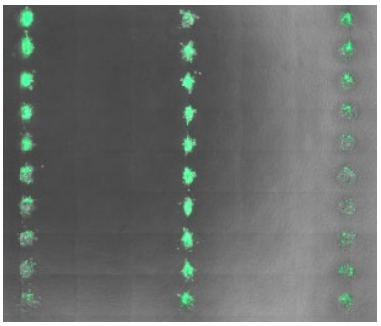
One of my advisers confirmed this experimentally using animal models. Dr. Bruno, and his colleagues described the ability of the developing mammary gland to 'reprogram' tumorigenic cells, testicular cells, and stem cells to function like normal mammary tissue. The fact that testicular cells were able to create milk under these conditions should say enough. While these studies taught us that the environment of the normal mammary gland is capable of 'normalizing' multiple cell types, these studies rely on animal models, which limits our ability to identify the specific features of this reprogramming process. To overcome these limitations researchers have made in vitro 3D models for this type of thing, but they are inefficient and don't provide the resolution or reliability needed to conduct 'good science'. Thus, a huge challenge for breast cancer research comes from the need to incorporate 'context' into in vitro research models. My research with Dr. Sachs and Dr. Bruno began with the task of developing a 3D bioprinting device to reliably create 3D in vitro models of the breast. I used Solidworks and a 3D printer to design and modify a 3D printer into a 3D bioprinter. Using the bioprinter, we can now create and control the 3D environments with a significantly increased level of precision. For example, with the precision of our bioprinter, we can print a single cell in a specific location in 3D gels. This allows us to design 'micro-environments' that better recapitulate the in vivo situation. So, my research focuses on using 3D bioprinting to design and investigate 3D environments related to breast cancer. We are constructing in vitro models of human breast epithelial tissues to identify signaling elements in the breast which present 'contextual' information that influence the gene expression in breast cells. Basically, trying to replicate the findings of Dr. Bruno's small animal studies, using in vitro models with human based 'bio-inks' instead.



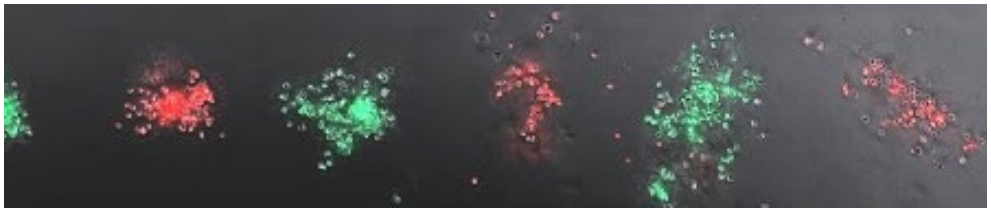
Stem Cell Lab Bioprinter



Above: Printing Path Via Software



Resulting Print: Organized Arrays of Human Breast Organoids



Printing Multiple Cell Types (spaced about the width of a human hair)

What have been your greatest challenges so far?

Aside from winning Battle Royale in Fortnite… well, as a biomedical engineer, you get to work on the engineering topics like electronic circuit designs, computer programming, mechanical engineering, and then couple all of this to bio-chemistry and cell biology. So, my greatest challenge is keeping up with current technologies and discoveries from these separate fields, and then 're-mixing' them to further my own projects. This can lead to some interesting research, like using robotics to orient pulsed electric fields around bioprinted neuronal stem cells in biomimetic, brain-scaffolds to get differentiated neurons… and this is also why I find BME to be a very rewarding profession.

How far have you been able to get?

When I had a working prototype bioprinting platform, I 3D bioprinted some neuronal stem cells with some 'bio-ink' and they formed structures which looked like neurons. Recently, I have been using my bioprinter to direct the formation of large mammary epithelial cell structures. These structures are hollow, ductal structures which resemble those observed in the breast. As the main goal is to use my bioprinter as a special tool to investigate the role of microenvironment on cellular processes related to breast cancer, I also have methods for introducing additional cell types, growth factors, and bio-conjugated microbeads into 3D bioprinted structures. We have had some promising results, and we are working on using cells taken from patient tissue samples.

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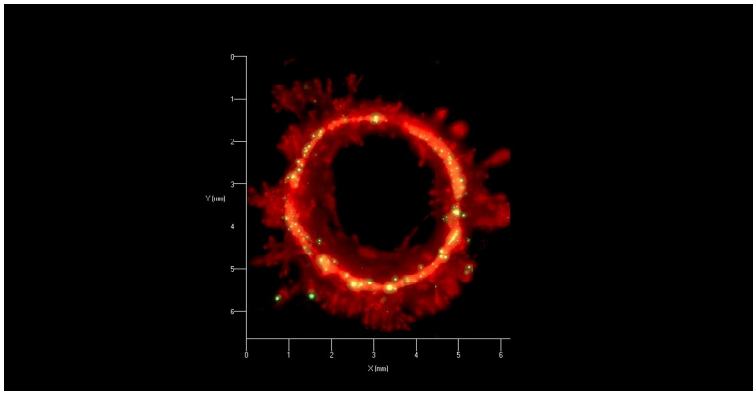
Student - John Reid - Ph.D. Candidate Biomedical Engineering (Continued)

What are you going to do next?

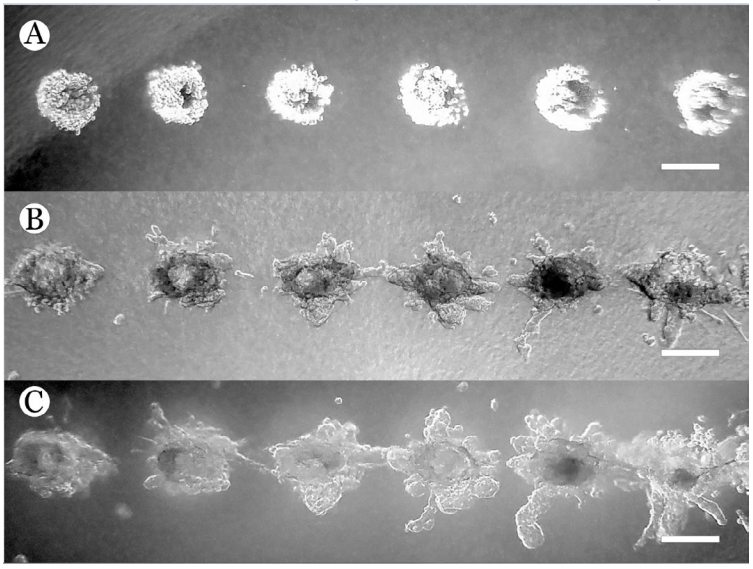
I believe this experience, combined with my engineering knowledge of 3D printing hardware and techniques has given me the ability to develop new approaches and protocols to contribute to the development of high-throughput assays for screening tumor samples, pharmaceutical testing and tissue engineering. More than anything, I want to continue to innovate and develop bioprinting technology to save lives and restore health.



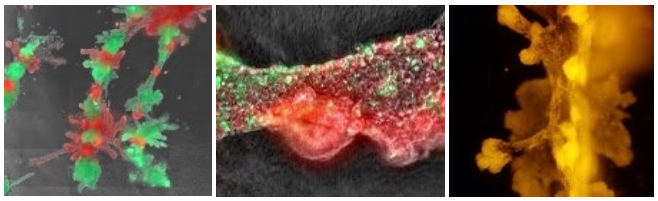
Bioprinted Chimera: human breast epithelial-structure containing normal cells (red) and tumorigenic (breast cancer) cells (green)

Can you give us a paragraph from your PhD dissertation?

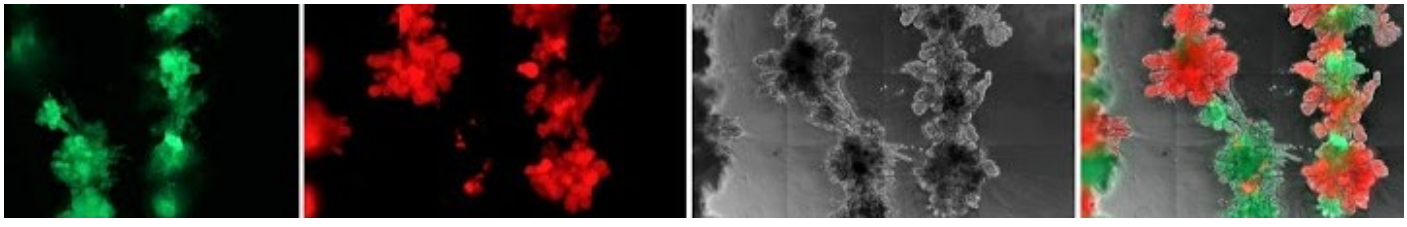
"From the bumblebee bat to the blue whale, the mammary gland distinguishes mammals from all other animals. As much remains to be learned about how the genotypic abnormalities associated with breast cancer elicit the phenotypic changes related to the tumor microenvironment, any technology capable of systematically investigating these mechanisms will be useful. Here we detailed the custom-design and use of 3D bioprinting systems to improve upon conventional methods for studying tumor cell behavior in 3D assays. These results indicate microfabrication techniques have the potential to become valuable tools in mimicking distinct properties of the in vivo situation and provide new perspectives and opportunities for future research design. In addition to acting as a multipurpose technique for a range of applications, we believe the imaginative, new perspectives and opportunities provided by these bioprinting techniques may serve as an important diagnostic platform for cancer patients, revolutionize the field of biomedical implants, and increase the overall ability to practice personalized medicine."



Growth and development of bioprinted, human breast-organoids at day 1, 4 & 7



Bioprinting enabled the formation of large contiguous structures from interactions among neighboring organoids



Same Chimera : Different Filters highlighting separate members

If you were given $50,000 in funding, what would you research, and how?

If I had 50k in funding, I would re-design and remodel my current bioprinter. I have a few new ideas for advancing our current bioprinting technology, however, I have yet to get these designs out of the drawing pad and onto the bed of the 3D printer. So, basically... I would buy a lot of stuff, re-design some things, and then use the 3D printer to 'birth' a bioprinter 2.0.

Postdoc Profile - Dr. James hodges

Please describe your area of research?
I work in molecular spectroscopy. This means that I study what colors (wavelengths) of light molecules emit and absorb. Using this information, the temperature, chemical composition, and various other physical parameters can be determined just by studying the light emitted or absorbed by a molecule. I apply these techniques to the atmosphere and interstellar space.

What got you into it?
I have always been interested in chemistry, physics and science. This goes back to my elementary school education, where I learned about matter and atoms. I thought it was interesting. I went to college for polymer material science, and read an article about interstellar chemistry in C&EN. I was fascinated by this and went to grad school to study spectroscopy.

What excites you about it?
It is about peering into the unknown, scraping together whatever data you can gather (either in the lab or with telescopes), and making predictions on a grand scale.

What encouraged you to pursue a graduate (and or postdoctoral) education?
This will seem like a cop-out answer, but I always just knew I had to get the Ph.D. and the postdoc is practically a requirement to any position either in government or academics. I did have plenty of encouragement from my high school chemistry and physics teachers. My college professors saw that I had a talent for science and they gave me a great deal of support.

What made Old Dominion University stand out?
I wanted to work for the man who literally wrote the book on modern spectroscopy, Peter Bernath.
Since he works here, I came here.

What encouraged you to choose your current field?
I just found myself interested in the energetics/internal structure of molecules through my studies. Studying atmospheric and interstellar chemistry and spectroscopy is a great fit and very important to the growth of greater human knowledge.

What do you like most about ODU?
I like living in the area. I did graduate school in Illinois, and it was cold and far from the beach. I grew up in South Carolina, and I have enjoyed spending time at the beach and nature here in Virginia.

What have been your greatest challenges so far?
Trying to record the spectrum of Lithium hydroxide in the gas phase. I have completely failed to get enough molecules hot enough without them decomposing into lithium oxide. My group is going to continue working towards it.

Describe your awards.
I was awarded a Goldwater Scholarship and National Science Foundation Graduate Research Fellowship. These are my highest achievements.

What is your philosophy of teaching and learning?
Formative feedback is key. Students need feedback and guidance through the reasoning/learning process to arrive the desired learning objective. Requiring students to DO science in the classroom, make predictions etc. is the mode to engage in formative feedback. You need to experience the process and practice it to become good at it.

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Postdoc Profile - Dr. James hodges (Continued)

Who are some guiding or influential figures in your life?
My graduate advisor Ben McCall, my graduate school mentors Kyle Crabtree and Brian Siller, and my postdoctoral advisor Peter Bernath. These people are responsible for me as a scientist as I am today. I don't really have any figures in science that I hold on a pedestal because all people a flawed and I don't see any value in modeling my life after a great figure in science.

What do you like most about your research or feel will be its largest implication(s).
I enjoy improving the precision of measurements to help astronomers make better predications. What people don't often talk about in astronomy is how the error bars, the uncertainty of the measurement, are very large. Working in the laboratory can reduce the size of those bars and increase the confidence with which an astronomer can make a prediction or describe an environment.

How do you give back to the community?
I like to volunteer for science outreach. I had more time as an undergraduate but last year, I participated in the Norfolk Public Library's STEM career day.

What is/are a funny experience(s) that you have had at ODU?
Probably none that I can share in good conscience, because they happened at the bar with colleagues.

What do you feel could be improved at ODU?
The chemistry department could really use a glass blower and have staff in the machine shop. I am working as part of the postdoctoral advisory board to make postdoctoral experiences with the university more uniform and smooth.

What do you consider to be your particular strength(s)?
I am an analytical thinker. I usually can cut right to the heart of the problem and I am good at attacking it from multiple directions. This often will result in a break-through one way or another.

How would your professors and colleagues describe you as?
Thorough. Driven. Focused. Irreverent when I am relaxed.

What do you look for in your academic colleagues?
Engaging, intelligent, socially responsible citizens.

Tell us about your vision of the field: where do you think the field is headed in the next five years?
Spectroscopy of exoplanetary atmospheres are going to be a huge thing. We are going to have a better understanding of what other planets have in their atmospheres.

How does that relate to the preparation of professional educators?
Well, there will be some cool new electives.

What do you consider to be the appropriate role of service in the teaching, research and service mix?
I think service should be the smallest chunk because the principal job of a faculty (in my admittedly limited and probably biased view) is to curate/create knowledge, and then transfer that knowledge to others. However, I do think that faculty need to be engaged in the community. I certainly try to be. I think it matters too, both the reputation of the school/faculty member, but I also think there is a social responsibility to engage and improve society.

Faced with many competing demands on your time, how do you determine your priorities?
I read a book called Checklist Manifesto. I have about a dozen lists that I update before bed each night. These lists are prioritized. It is literally the only way that I get things done.

Tidewater Writing Project By Mindy Gumpert Ph.D. Student

Writing in its many forms is the signature means of communication in the 21st century. The National Writing Project (NWP) envisions a future where every person is an accomplished writer, engaged learner, and active participant in a digital, interconnected world. Through its professional development model, NWP builds the leadership, programs, and research needed for teachers to help their students become successful writers and learners. Studies of student achievement, both local and national, show positive results.

The Tidewater Writing Project (TWP) is a satellite of the NWP. The mission of TWP is to improve student writing and learning in Chesapeake, Franklin, Isle of Wight, Norfolk, Portsmouth, Southampton County, Suffolk, and Virginia Beach.

TWP is located in the Darden College of Education at Old Dominion University (ODU) and for over twenty-five years, the Summer Institute has been training teachers to be Teacher Consultants (TCs). At the Institute, teachers examine issues in the teaching of writing, present and demonstrate approaches to the teaching of writing, study current and past research in the field, and write in various modes and from different points of view, including a position paper on the teaching of writing.

TWP believes their teacher consultants' knowledge, expertise, and leadership are central to developing and sharing writing for 21st Century learners. They recognize that high quality educational experiences are fundamental to social equity and place high value on diversity. They promote exemplary instruction of writing through current research and collaborative experiences across disciplines. TWP has the following aims:

1. To attract teachers of all subject areas K-12, who are interested in improving student writing in their schools.
2. To enable those teachers to come together for several weeks in the summer to explore research on the teaching of writing, various approaches to writing instruction, and alternative models for evaluating writing.
3. To assist teachers in improving their own writing.
4. To develop a corps of teacher consultants in the writing project who can work with other teachers toward improving student writing in all school subjects.

Writers brainstorming ideas for a script for their movie.

Working in conjunction with ODUs Big Blue Camp, TWP offers summer writing camps for children ages 6-12. These camps encourage creativity and out of the box thinking and offer students many avenues to showcase their writing (i.e., movie making, graphic novels, pecha kucha). https://www.odu.edu/partnerships/community/summercamps/bigbluecamp#ad-image-6 (Click on Young Writer's Camp).

These are the dates and themes for the 2018 summer writing camps: July 9-13: Space Camp, July 16-20: Disney/Pixar, July 23-27: Steam Punk, July 30-August 3: Pirate Camp, August 13-17: STEM/Lego Camp. https://www.odu.edu/partnerships/community/summercamps/bigbluecamp.

Tidewater Writing Project By Mindy Gumpert Ph.D. Student (Continued)

Second graders dictating script for The Great Pony Rescue video.

For more information about any of the programs TWP offers or about becoming a member contact:

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Fulbright Student Program Opportunity

Are you interested in augmenting your education via a rich experience abroad? If so, you are encouraged to attend a Fulbright Workshop on March 20, 2018 led by Mr. Grant Stream-Gonzalez, a Fulbright Student Program Advisor working with the Institute of International Education. This is the only Fulbright workshop being offered this year. More information can be obtained at https://us.fulbrightonline.org/.

Graduate Certificate in Community College Leadership

Old Dominion University has a new online, 15 credit hour graduate certificate in Community College Leadership, approved by the State Council of Higher Education for Virginia (SCHEV). This is designed for emerging leaders in community college administration or administrators who have recently transitioned to a community college from careers in other industries. More information can be found at http://odu.edu/education/news/2018/2/odu_to_offer_new_gra.

Editor's Spot

This semester has been quite a ride, and believe me, The Graduate School aims to keep the ride going. I thank each and every one of you who submitted an abstract for our upcoming Graduate Research Achievement Day. For those that attend our upcoming GRAD, keep in mind that a networking event is planned to precede it. I look forward to the community being able to see your research on March 29. I wish you all the best in your endeavors.
-Xavier-Lewis Palmer

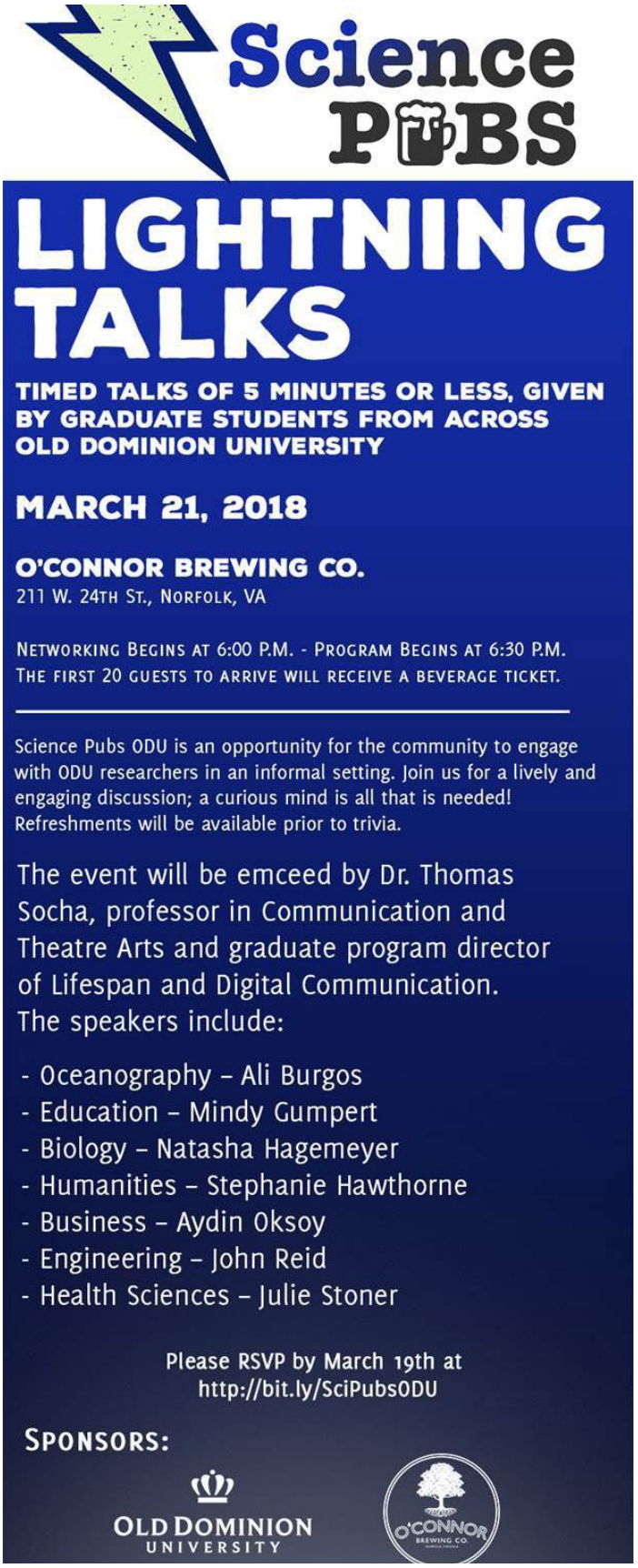
odu.edu/graduateschool

Important Dates From The Office of Research

Event: Science Pub Graduate Student "Lightning Talks"
Time: 03/21/2018 6:00 PM - 03/21/2018 8:00 PM
Location: O'Connor Brewing Co. 211 West 24th St. Norfolk, VA 23517
Description: "Seven graduate students from colleges across the university will discuss their research in five minutes or less, followed by a Q&A. This event is part of the Science Pubs series, a free event that brings research into the community through casual conversation."
RSVP here: https://fs25.formsite.com/researchdev/form102/index.html

Event: Fulbright Info Session
Time: 03/28/2018 1:00 PM - 03/28/2018 2:30 PM
Location: Learning Commons, Room 1311
Description: N/A

Event: Spring into Research
Time: 03/29/2018 8:30 AM - 04/01/2018 10:00 AM
Location: Strome Entrepreneurial Center
Description: "Do you have questions about research at Old Dominion University? Would you like to network with research administrators, grant specialists and others in research at the university? Bring your questions and ideas while you join us for an Open House and refreshments to kick off the spring semester. There will be no formal presentations, so stop by for as long as your schedule allows. Co-sponsored by the Office of Research and the University Libraries."
RSVP here: https://fs25.formsite.com/researchdev/form71/index.html



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