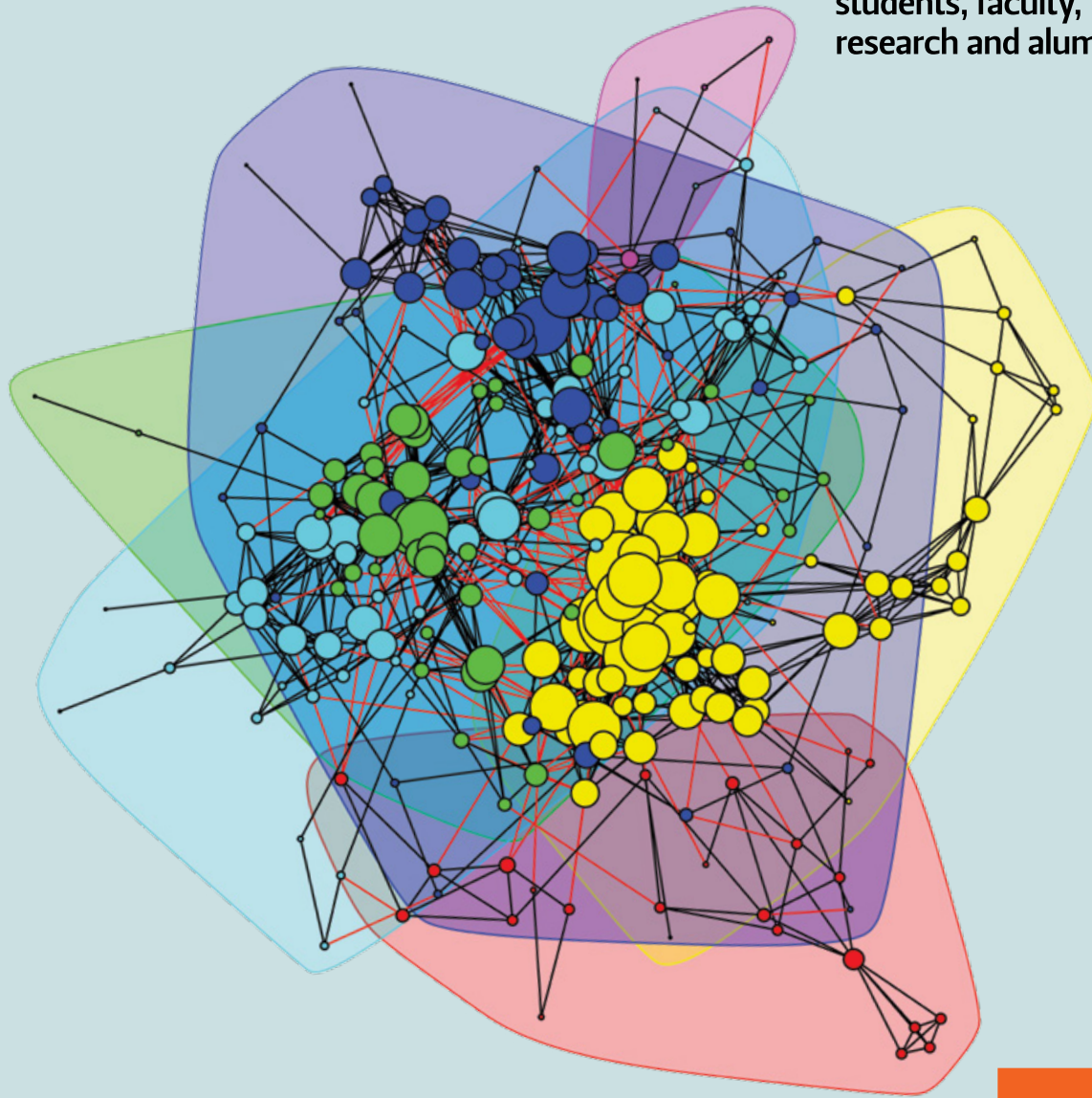


Small Talk

SPRING
2017

Microbiology news,
students, faculty,
research and alumni



Editor

Debbie Farris

Copy Editor

Katharine de Baun

Designer

Sharon Betterton

Department of Microbiology

Jerri Bartholomew, Dept. Head

Publisher

Department of Microbiology
Nash Hall 226
Oregon State University
Corvallis, OR 97331

On the cover: This graphic depicts zebrafish gut microbiota interacting with one another upon exposure to the antibiotic triclosan. The circles represent specific bacteria that are found in the microbiome and the lines indicate which bacteria ecologically interact with one another (e.g., shared metabolism, competition). The large colored polygons represent highly interconnected groups of bacteria. Collectively, this network illustrates how gut bacteria influence one another upon triclosan exposure and identifies potential keystone species of bacteria.



Small Talk

SPRING 2017

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Our amazing undergraduates balance academic life with transformative experiences

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We are growing thanks to the generosity of our alumni and friends!

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Research gains momentum with fieldwork worldwide

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Congratulations to our recent microbiology graduates and alumni!



FROM THE HEAD

Welcome to our annual newsletter! As we move forward towards a new year, it is a good time to look back at all of the accomplishments and changes of 2016.

It was a great year in terms of student success. We graduated 216 Bachelors, one M.S. and eight Ph.D. students. We launched new courses for our biohealth sciences majors and received approval for a pre-med option for microbiology majors. For a second year, our students hosted their own research symposium, drawing speakers from across the Pacific Northwest.

It's also been a banner year for faculty travel and research funding. Our faculty have conducted research in the North Atlantic, the Sargasso Sea, the Mediterranean and the South Pacific. They won four major National Science Foundation awards on an array of topics from cheating in bacteria to the role of viruses in coral reef health. Successful patents and new discoveries abound. Look for these stories in the research section (pages 14–20).

We've had our share of goodbyes and hellos, with three retirements and four new hires. Peter Bottomley retired after 37 years, and Bruce Geller after 30 years. Both continue as emeritus faculty engaged in active research. Camille Partridge, hired to work in the media kitchen in 1980, also retired.

New hires include Andrew Thurber, an assistant professor for our new aquatic microbiology option; Emy Daniels, who replaces Camille; and two professional advisors, Alex Beck and Barbara Kessel.

We've also been busy with SPARK, a year-long, campus-wide collaboration between art and science. Working with The Arts Center|Corvallis, we hosted four workshops where visual artists, writers, poets and musicians were challenged to translate our science into their medium. Their work culminates in a show, "The Microbiome: Seeing the Unseen," as part of a campus-wide Microbiome Initiative this spring. Meanwhile, student artists intern in our labs and at sea, creating art that shines a new lens on our research.

Finally, I want to thank our generous alumni and donors. Limited budgets are always a challenge, but with the help of our donors our undergraduates benefit from new equipment, participate in research, and travel to conferences. Throughout these pages, we'll share many stories about how your support has enhanced our students, our faculty and our work.

I look forward to meeting more of you in the upcoming year.

Jerri Bartholomew, Head, Microbiology

EVENTS



APRIL 8

STUDENT SYMPOSIUM

3rd Annual Microbiology Student Association Symposium—open to the public

APRIL 13–MAY 27

MICROBIOME EXHIBIT

"Seeing the Unseen," Collaboration with The Arts Center|Corvallis and part of SPARK, a yearlong celebration of the interplay between art and science

MAY 5

SCHOLARSHIP LUNCHEON

Honoring Undergraduate Microbiology scholarship recipients

MAY 11 & 12

OSU MICROBIOME INITIATIVE (OMBI)

Training Workshop (May 11, all day)
Ed Yong (May 11, 5:30 p.m.)
Horizon Room, Memorial Union
Research Forum (May 12, all day)

JUNE 16

GRADUATION CELEBRATION

Microbiology and BioHealth Sciences Graduation Celebration

On the move

Our amazing undergraduates balance academic life with transformative experiences

CONNECTING WITH THE PROFESSIONAL WORLD OF MICROBIOLOGY

The Microbiology Department is excited about the opportunities we are able to provide to our undergraduate students, due to generous gifts and strong support. One highlight is the chance to attend professional conferences. This gives students a glimpse into the professional world, with opportunities for networking and the chance to explore new directions. The American Society for Microbiology (ASM) meetings in Seattle and Boston were funded in part by generous donations from **Joel Peterson** and **Sheila Van Zandt**.

Here, in her own words, is how one student benefited:

“I’ve never been to the East Coast before, so when the opportunity was available to visit as part of the trip to ASM, I decided to give it a shot. While I loved Boston, I was even more blown away by the conference itself. It was far more than even my wildest dreams could have imagined. The sheer number of groups represented was unfathomable, making me realize how many options I have with my major beyond the medical track. I had, prior to the conference, started to feel disheartened with my major, realizing that I do not have the aptitude for medical school, but this opened my mind to all the possibilities. Even better, I was able to connect with a gentleman at the University of Washington about doing fluorescent microbial art with the

students I teach...to introduce them to the wonders of microbes.

I truly enjoyed the conference and all the fascinating presentations. I hope that the students going to ASM Microbe next year enjoy it as much as I did, and that it opens up new avenues of exploration for them, like it did for me.”
—Ashley M

STUDENT CLUBS

The **Microbiology Student Association (MSA)** brings undergraduate students interested in microbiology together to engage in microbiology-related events. Our main goals during the 2015–16 school year were to provide students with a platform to interact with each other, to help students deepen their passion for microbiology and to give back to our community. We planned a variety of events this past year to achieve these goals.

In the fall, club advisors **Linda Bruslind** and **Jeneva Anderson** took a group of students to the American Society of Microbiology Northwest Conference (ASM NWC) in Seattle, where attendees networked with professionals and heard about a broad range of topics in microbiology.

MSA wanted to share what we learned at the ASM NWC and other similar conferences with the community here at Oregon State, so we planned our own research symposium in the spring. We invited 10 speakers from universities in

Oregon and Washington to share their research with us, on topics ranging from dengue fever to the innate immunity of the eye. With the support of the Department, MSA hosted a successful symposium and we hope to continue this tradition in future years.

Other events such as a Thanksgiving social, a fieldtrip to 2 Towns Ciderhouse, and a bake sale to benefit the Linn Benton Food Share helped MSA reach its goals for the 2015–16 school year.

We are incredibly thankful for the Department’s and MSA’s ability to use microbiology to create a welcoming community and facilitate lasting friendships.

—Emaan Khan & Vanlena Le, 2015–16 MSA co-Presidents

The **BioHealth Sciences (BHS) Club** was established in fall of 2015 with a mission to help prepare all BHS students for post-baccalaureate health profession careers. We accomplish this goal by providing volunteer opportunities, coordinating training sessions, inviting guest speakers to campus and organizing field trips. We also provide space for students to socialize with like-minded people, provide academic support and offer a platform for upperclass students to share their academic and out-of-the-classroom experiences, and wisdom, to new students.

Last fall, the officers of the BHS Club

coordinated a field trip to PeaceHealth Medical Laboratory in Springfield, OR where they toured the microbiology, flow cytometry, urine analysis, blood bank and pathology departments. This trip was an applicable experience for students who hope to work in a medical laboratory setting, and likewise for students who will be ordering diagnostic lab tests during their careers.

During spring term of last year, the officers of the club coordinated a CPR training session in collaboration with the American Heart Association and pre-professional clubs across campus to successfully certify more than 40 students. Certification allowed students to easily obtain jobs this past summer. The club is planning a similar event for this academic year.

The BHS Club hosted numerous professional guest speakers, including dentists, doctors, nurses, as well as representatives from graduate programs and student success centers across campus. This year, the club will kick off our speaker series with an osteopathic physician who will talk about the profession and his path as an undergraduate.

We continually strive to support and encourage students to work towards their career goals, while connecting with their fellow students and with faculty.

Wait, there's more! Read about undergraduate research on page 16.



American Society of Microbiology Northwest Conference (ASM NWC) in Seattle



Biohealth Sciences students practice taking blood pressure



Kelly Girouard and Hannah Mathews represent Biohealth Sciences Club at the COS science fair



American Society for Microbiology Conference (Boston): Emaan Khan, Vanlena Le, E. Seul (Elizabeth) Kim, Rachel Conover, Ilya Bobrovnikov, Elise Ewens, Aparna Govindan, Stephanie Mikkelsen, Eugenia (Jana) Rott

Bright minds

Updates from our graduate students and postdoctoral researchers

WELCOME NEW GRADUATE STUDENTS!

Damien Barrett (Bartholomew Lab): I am interested in the genetic architecture of disease resistance in salmonids. My research is focused on identifying resistance genes in rainbow trout (*Oncorhynchus mykiss*) to the myxozoan parasite *Ceratomyxa shasta*.

Lindsay Collart (Dreher Lab): I am interested in cyanobacteria genetics and ecology. My project will be focused on identifying drivers of population dynamics in freshwater cyanobacterial blooms.

Jesse Coutu (Jin Lab): I am interested in studying viral latency and the development of novel antiviral therapies that combat this viral strategy of immune evasion. My current research focuses on studying the molecular virology of a recently discovered latency associated factor (ORF6) found in Koi Herpesvirus. I will study ORF6's function during viral latency with a particular focus on the role of ORF6 in apoptosis (programmed death of cells).

Bailey Keefe (Bermudez Lab): My research interests include learning more about how pathogens cause disease in both humans and animals. The project I will be working on explores the host-microbe interaction between *Mycobacterium avium* and human respiratory epithelial cells. Specifically, I am looking at their ability to form microaggregates and identifying the proteins and their

function used in this process.

Grace Klinges (Vega-Thurber Lab): Coral reefs occur in a wide array of hydrologic settings throughout the Indian, Pacific and Atlantic Oceans and are exposed to many different environmental stressors, so it is crucial that we understand how biogeography and hydrology affect coral symbiont diversity and community structure. My research will use innovative data visualization methods to evaluate variation in the coral holobiont at local and regional scales throughout the South Pacific.

Rebecca Maher (Vega-Thurber Lab): I am studying how environmental stressors alter the coral host and its associated microbes. I will be conducting field and tank experiments at the Gump Research Station on Moorea, French Polynesia, to investigate how parrotfish predation and nutrient enrichment combine to cause coral mortality.

Bryce Penta (Halsey Lab): I am interested in the role of phytoplankton physiology on marine biogeochemical cycles. Currently, I am working on studying phytoplankton physiological responses during acclimation to seasonal deep mixing of the ocean. I plan to extend my research to investigate the role of various phytoplankton groups, such as mixotrophs (phytoplankton that can photosynthesize and consume organic carbon) on ecosystem production.

Tanner Robinson (Schuster Lab): My research interests lie in understanding

the social behaviors of bacteria, focusing primarily on quorum sensing in *Pseudomonas aeruginosa*. I am currently working on a project to determine the requirements for true quorum sensing.

Quinn Washburn (Giovannoni Lab): The goal of my research is to develop throughput cultivation methods for understanding microbial communities.

TRAVELS AND ADVENTURES

Last year, **Ryan McMinds**, a Ph.D. student in the Vega-Thurber Lab, was quoted as saying "Life as a graduate student can be summed up best with this statement: *Well, I just hit 50,000 miles that I've flown for this project.*" Since then, Ryan has logged an additional 28,000 miles (plus or minus), with trips to French Polynesia, Saudi Arabia, Hawaii, Panama and Curacao. He now has his feet happily on the ground in data-processing and paper-writing mode.

Taking a different path, another student in the Vega-Thurber Lab, **Stephanie Rosales**, packed her bags for a land-locked location: Nepal! Through the NSF Graduate Research Internship Program (GRIP), which seeks to expose graduate students to research environments outside of academia, Stephanie's first stop was the Smithsonian National Zoo (SNZ), Washington, D.C. There she received training on diagnostic procedures for Elephant endotheliotropic herpesvirus (EEHV).

“EEHV is a rapidly progressing disease in Asian elephants that presents characteristic symptoms, including lethargy, edema of the head, cyanosis of the tongue, oral ulcers, tachycardia and internal hemorrhaging. If left untreated, EEHV usually results in the death of the animal within 1–7 days after clinical signs arise. So early detection is essential to increase survival rates.

“During my training at the SNZ, I learned to process trunk washes (saline wash from the trunk of elephants) and use PCR (polymerase chain reaction) for EEHV detection. The Zoo was an enriching, two-week experience where I had the opportunity to meet researchers outside my field and learn about the unique research opportunities that are made possible by the Smithsonian’s rich, historic datasets. It was also a plus that I could retreat to the Orangutan or coral reef exhibits during breaks!

“The adventure continued in Nepal where I had to apply my new EEHV diagnostic skills. In Chitwan, Nepal, elephants have recently been diagnosed with EEHV, but the prevalence in the population is unknown. Although my supervisor at the Smithsonian and I planned this trip extensively with the Center of Molecular Disease-Nepal (CMDN), the logistics of the trip fell apart the day of my arrival. Luckily, Dr. Vega-Thurber had trained me to handle less-than-ideal fieldwork situations.



New Microbiology graduate students. L to R, Back Row: Quinn Washburn, Bryce Penta, Jesse Coutu, Damien Barrett. Middle: Lindsay Collart, Tanner Robinson, Becca Maher. Front: Bailey Keefe, Grace Klinges.



Stephanie Rosales collecting samples for Elephant Endotheliotropic Herpesvirus in Nepal.



Grad student Kelsey McBeain aboard the R/V Atlantis



Grad student Scott Klasek spent the summer sailing in the Arctic Ocean to study methane sediments. Core sampling (L) aboard the RV Helmer Hanssen (R).

“So with some perseverance and a lot of help from the National Trust for Nature Conservation in Chitwan, I was able to collect trunk washes and process the samples from a cohort of Asian elephants. However, this story is ‘to be continued’ as my samples are sitting in a freezer at CMDN. In the future, I hope not only to examine EEHV prevalence, but also the microbiome of these samples.”

Kelsey McBeain (Kim Halsey Lab) had the amazing opportunity last May to study the North Atlantic phytoplankton bloom and all of its influences (as many as we can measure, at least) on a month-long research cruise with the North Atlantic Aerosols and Marine Ecosystems Study.

In summer 2016, **Wei Wei** (Walt Ream Lab) traveled to Singapore on a National Science Foundation East Asia and Pacific Summer Institute fellowship to conduct research on plant metabolomics at the National University of Singapore. Wei is studying the interactions between the bacterial plant pathogen *Agrobacterium* and its hosts. *Agrobacterium* species can genetically modify plants.

Wei’s research focuses on identifying how an *Agrobacterium* virulence protein, GALLS-CT, alters plant gene expression during infection. She spent 10 weeks in Singapore investigating how GALLS-CT expression changes the secondary metabolite profile of plants. Plant metabolites are the functional products of genes that affect many essential plant processes. Her research aims to improve current methods of *Agrobacterium*-mediated genetic technologies for plant modification.

Brandon Kieft (Ryan Mueller Lab) spent

last summer doing research at Kwansai Gakuin University in Sanda, Japan. The work was funded by the NSF and The Japan Society for the Promotion of Science and focused on the application of Raman microspectroscopy and stable isotopes to study amino acid utilization by microbial communities in Osaka Bay.

Eric Moore and fellow Halsey Lab member **Kelsey McBeain** traveled to New Orleans last February for the Ocean Sciences Meeting. “We both presented posters on our research to marine scientists from around the world, attended over 50 presentations, toured two research vessels and enjoyed the famous sights, sounds and tastes of vibrant New Orleans.”

Scott Klasek (Rick Colwell Lab) spent three weeks last summer sailing in the Arctic Ocean with scientists from the Arctic University of Norway Center for Arctic Gas Hydrate and Environment.

“The objective of the cruise was to use a remote-operated vehicle (ROV) to obtain detailed maps of seafloor communities where methane from sediments leaks into the overlying ocean. Using the ROV, we took samples of sediments, water, rocks, gases and animals to investigate how carbon and other nutrients are cycled in these unique ecosystems.”

Courtney Armour (Tom Sharpton Lab) was one of 14 graduate students around the world awarded the Association for Computing Machinery Society Special Interest Group on High Performing Computing/Intel Computational & Data Science Fellowship. This three-year fellowship will help to support her large-scale data analysis of the gut microbiome.



Graduate student Brandon Kieft



Wei Wei (center right) in Singapore, on a NSF East Asia & Pacific Summer Institute fellowship



Graduate student Scott Klasek



Graduate student Courtney Armour (photo by An Vuong)



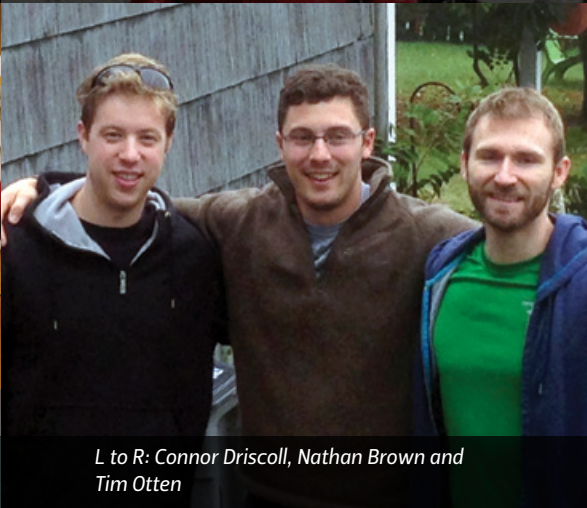
Dr. Gema Alama Bermejo



Dr. Cleo Davie-Martin



Armanda Roco



L to R: Connor Driscoll, Nathan Brown and Tim Otten

POSTDOCTORAL RESEARCHERS

Dr. Gema Alama Bermejo (Bartholomew Lab) began a tenure-track position at the National Scientific and Technical Research Council in Argentina. She is developing a research program on marine parasites that will cultivate myozoans to myoliquefy commercial fish fillets using genomics and other molecular approaches she learned at OSU.

Dr. Cleo Davie-Martin (Halsey Lab) received the OSU Postdoctoral Association's Professional Development Award, allowing her to attend a workshop and conference on proton-transfer-reaction mass spectrometry (PTR-MS) in Austria last February. She then ventured into the North Atlantic Ocean in May 2016 to observe the spring bloom, once again taking with her our resident PTR-MS (James, Mr. 007) to measure the cycling of volatile compounds by marine plankton.

Armanda Roco is a new postdoc working with Professors Mueller, Myrold and Kleber in Crop and Soil Science. Her Ph.D. work at Cornell University focused on soil denitrifier community ecology and she is currently working on a mass spectrometry-based proteomic project to understand how protein turnover affects organic nitrogen availability in soils.

Tim Otten, a postdoc in the Dreher Lab, started his own company, Bend Genetics LLC, in Sacramento, CA, using genetic and toxin analysis to monitor/research harmful cyanobacterial algal blooms.

BRINGING THE WORLD TO OSU

The Department of Microbiology hosts visiting professors from a variety of universities and countries. These exchanges enrich the department in so many ways, fostering collaborations that have profound impact on our research. This year saw the following researchers in our laboratories:

Dorothee Huchon Pupko, Israel (Bartholomew Lab)

Tamar Lotan, Israel (Bartholomew Lab)

Chengzhong Yang, China (Bartholomew Lab)

Choonbok Song, South Korea (Kent Lab)

Qiao Yang, China (Giovannoni Lab)

Miwa Satoshi, Japan (Oregon Department of Fish and Wildlife)

Joe Ortiz, Kent State University, OH (Dreher Lab)

Anindo Choudhury, St. Norbert College, WI (Kent Lab)



Help from our friends

We are growing thanks to the generosity of our alumni and friends!

UNDERGRADUATE SCHOLARSHIPS

At our annual undergraduate awards luncheon in May 2016, 17 students were presented with scholarships totaling \$26,000. These scholarships may be targeted to achievement, need or discipline, but together they are critical to our students' success. And students are extremely appreciative.

"This departmental scholarship will allow me to focus on my microbiology classes to work towards my career goal of going into the dental field. I also want to conduct more microbiology-related research, possibly doing a dual graduate degree program. On behalf of my family and myself, thank you so much for giving to the department."

—**Aparna G.**

"Thank you for your generous donation making the Middlekauf Scholarship possible. I am a junior in microbiology and am interested in food microbiology and quality assurance. This scholarship is a huge blessing to me as I would not be able to afford tuition without your help. I am honored to be receiving this award." —**Ryan W.**

"I'm so honored to be the recipient of your scholarship. You have given me the opportunity to pursue many opportunities due to this scholarship. I can continue to pursue microbiological research and spend my time helping with community services. With this award you are able to relieve some of my financial burden." —**Dang D.**

SHEILA VAN ZANDT RESEARCH EXPERIENCE SCHOLARSHIP

A new opportunity for students was unveiled this year: the Sheila Van Zandt Research Experience Scholarship, which was awarded to two graduate/undergraduate research teams. The students developed a proposal and budget, then obtained the support of a faculty mentor for the project. This has been a tremendous opportunity to promote graduate student mentorship of undergraduates and to allow them to experience what it is like to administer a small research project. It also helps the department to promote diversity by providing minority students with research experiences.

Impact of bacteriocins on siderophore diversity in *Pseudomonas*.

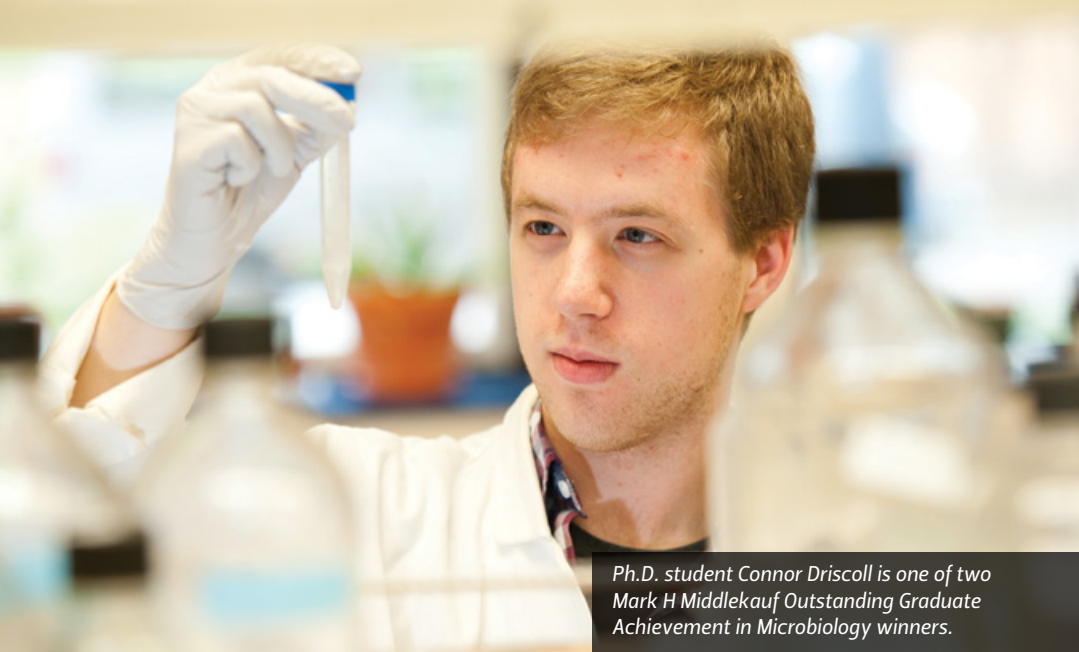
"I have been able to continue working on a spring term project, thanks to the Sheila Van Zandt Scholarship. I am experiencing the highs and lows that come with research, while at the same time gaining valuable insight into the field. As a microbiology major I believe it is important to have a solid assessment of what research is like before graduating. Working with a mentor is allowing me to gain insights from the perspective of a mentee, which will be valuable in the future if I am mentoring someone else." —**Amandip S.**

"As a graduate student in the Schuster Lab, I study the evolution of iron chelating siderophores and their

receptors. The funding from the Sheila Van Zandt Student Research Experience Scholarship has made it possible to collaborate with Amandip Singh, a motivated undergraduate who recently joined our lab. Amandip's involvement significantly improves the pace of lab work and facilitates the sharing of ideas which guides our next steps. In addition to providing an opportunity for Amandip to engage with scientific research, I am gaining important experience which will improve my skills as a mentor." —**Joe Sexton**

Identification of *Burkholderia* species associated with secondary infections in stranded harbor seals on the Pacific Coast.

"The Sheila Van Zandt Student Research Experience Scholarship enriched my scientific knowledge in a variety of ways. I was able to practice essential lab skills and familiarize myself with laboratory equipment, while also applying the material I learned from previous microbiology classes, such as DNA cloning, gel electrophoresis and data analysis. In my opinion, this was the best way to understand my topic of interest and also gain insight on what happens before a scientific journal article gets published. Additionally, this opportunity allowed me to connect with personnel and build a relationship with both my lab principal investigator and graduate student mentors. Although I have an interest in pursuing medicine, my lab research experience



Ph.D. student Connor Driscoll is one of two Mark H Middlekauf Outstanding Graduate Achievement in Microbiology winners.

will open doors for future medical research.” — **Natalie L.**

“The Sheila Van Zandt Scholarship was a rewarding mentoring and training experience. The opportunity provided a platform to advise and improve my teaching skills. For instance, I was responsible for training Natalie in laboratory skills, presentations, writing and note taking. Also, it was a great chance to show Natalie the dedication and time involved in the scientific process. Overall, this was an educational experience that has enhanced my training as a scientist and helped train a young microbiologist.” — **Stephanie Rosales**

GRADUATE SCHOLARSHIPS/FELLOWSHIPS

This year we presented six awards at our first-ever graduate awards luncheon:

Mark H. Middlekauf Outstanding Teaching & Service in Microbiology was awarded to **Prabhat Talukdar**.

Mark H Middlekauf Outstanding Graduate Achievement in Microbiology was awarded to **Connor Driscoll** (Dreher Lab) and **Eric Moore** (Halsey Lab).

Joan Countryman Suit Graduate

Scholarship was awarded to **Connor Driscoll** (Dreher Lab) and **Omran Muslin** (Giovannoni Lab).

Harriet M. Winton Scholarship was awarded to **Claire Howell** (Bartholomew Lab).

Tartar Fellowship was awarded to **Eric Moore** (Halsey Lab).

MICROSCOPE GIFTS

Alumnus Bob Foote (Geology, '83; Geophysics, '85) made another generous gift this year that was matched by his former employer, Chevron. This gift enabled the purchase of additional new microscopes for our teaching labs, so now we have replaced nearly all of our older models with brand new ones!

JOHN L. FRYER FELLOWSHIP

As part of the 25th year celebration of the **John L. Fryer Aquatic Animal Health Lab**, we reached out to former students, collaborators and friends, asking them to consider donating to this fellowship. Many stepped forward with generous gifts, and because of this we are able to offer several terms of full support each year for a graduate student conducting research on infectious diseases of fish.

HONOR ROLL

Recognizing the Department's annual supporters who have made outright gifts or pledge payments totaling \$1,000 or more between July 1, 2015 and December 31, 2016.

Anonymous (1)
 Joy Asbury
 Matthew A. Bacho '92
 Jerri Bartholomew '85
 Mary E. & Michael J. Burke
 Robert W. Foote '83
 Janna E. Ford '99
 William R. Ford '65
 Gregory D. Geist '72
 Warren J. Groberg, Jr. '73
 Frances T. Hall '52
 Charles A. Hays '85
 Karen S. & Ronald P. Hedrick '75
 Linda L. & Richard A. Holt '88
 Judith F. & Paul R. Kenis '66
 Scott E. LaPatra '79
 Joyce '78 & Thomas C. McLean '75
 Cynthia & Michael M. Mueller
 Madeleine C. Deininger & Joel E. Peterson '69
 Matthew E. Stinson '12
 Joan Countryman Suit '53 & Herman D. Suit
 Sheila Griep Van Zandt '59
 Harriet M. Winton Fund of The Oregon Community Foundation
 James R. Winton '81

THANK YOU!

If you notice any inaccuracies, please contact Penny Hardesty, Director of Donor Relations, OSU Foundation, Penny.Hardesty@oregonstate.edu or 541-737-1469.

News

Innovation, rejuvenation, hires, promotions and awards



“I have had a lifelong passion for art and science and feel that I was made for this show. I have a Ph.D. in molecular biology and was a molecular microbiologist for 20 years before starting my second career as a sculptor. The majority of my sculptural work is inspired by microbes, plants

*and animals and how they move and protect themselves. I am particularly drawn to creatures in nature that walk the line between beguiling and terrifying. I envision **Endulata bas** as a creature stolidly and gracefully navigating the currents of the deep ocean. It is unclear whether she is*

ferce or innocuous. Her rich exterior color directs the focus of the lines of her undulated appendages.”

— Kristin Levier

Learn about Microbiology-inspired art on the next few pages.



WELCOME NEW FACULTY AND STAFF

Andrew Thurber (above), our newest faculty member, has a joint appointment with the College of Earth, Ocean, and Atmospheric Sciences. He researches how microbial processes fit into the overall ecosystem function of marine systems. His current projects range from identifying how sulfide and changing food supply may impact the Manila clam population, thus addressing a food security issue of Native Americans in Washington state, to identifying factors that control the distribution of bacteria and archaea in the deep-subsurface off of the South China Sea and India.

This year he returns to Antarctica with his graduate student to study how methane, a potent greenhouse gas, is consumed in the cold and isolated waters of the southern continent. Thurber will share his research with students in an aquatic microbiology course.

Our biohealth sciences advising team was completed this year with the hiring of **Alex Beck**, who has worked at OSU for more than 13 years, and **Barbara Kessel**, who comes to us from Oregon Coast Community College where she was an advising specialist for six years.

Emy Daniels joined the department, replacing Camille Partridge in the media kitchen. This position supports our teaching laboratories. Emy previously worked for the Scripps Institution of Oceanography.

CONGRATULATIONS!

Rebecca Vega-Thurber was promoted to associate professor this year. In addition, she was selected by the Faculty Recognition and Awards Committee as the 2016 recipient of the OSU Impact Award for Outstanding Scholarship.

Ruth Milston-Clements, manager of the John L. Fryer Aquatic Animal Health Laboratory, was selected as the 2016 recipient of the Agricultural Research Foundation Faculty Research Assistant Award.

Jeri Bartholomew received the S.F. Snieszko Distinguished Service Award from the American Fisheries Society (AFS) for her outstanding accomplishments in the field of aquatic animal health. This lifetime achievement award is the highest honor presented by the Fish Health Section of the AFS. Jeri's decades of research on salmon parasites and her directorship of the J.L. Fryer Aquatic Animal Health Laboratory have deepened our understanding of how infectious organisms sicken salmonids and other freshwater fish, generating forecast models of how climate change might affect the interaction. Her research has advanced the microbiological understanding of the host-pathogen dynamic, producing practical recommendations for fisheries that have already been put into use.

INNOVATIONS IN LEARNING

Dr. **Linda Bruslind** completely overhauled her "General Microbiology" course last summer, to teach in a more engaging and innovative way. Fundamental to this was her authoring of an open source textbook, with the help of experts at OSU Open Campus who are dedicated to providing free access to learning tools for students. Along with the textbook, Linda designed a series of in-class activities

for students to work on in small groups, fostering cooperation and active learning of the course concepts. The redesigned course was well received by students and resulted in the highest assessment scores to date. She plans to implement the new model for her spring term Microbiology 302, adding the use of undergraduate learning assistants to provide additional resources for the 200 students that typically take the course.

"I absolutely loved how MB 302 was taught during the summer! I felt like the expectations of the class were really clear as the lectures, worksheets and textbook were all similar in style and information. The class was really organized, with the assignments in class ...[forcing] me to think about the concepts on my own with the ability for Q&A time during class rather than making time for teacher's office hours after individual study. The textbook was really easy to read (I ended up reading other portions of the textbook for fun!). Dr. Bruslind is a fantastic lecturer and really brought together all learning styles for a course that was focused on the success of its students!"
— **Michelle M.**, undergraduate

In building a unique curriculum for our biohealth sciences major, we developed three new courses. **Jeneva Anderson** developed a new writing intensive course, "Microbial Influences on Human Health," which was taught for the first time last spring and will be offered online this spring.

Thomas Sharpton introduced the "Human Microbiome" course, where students learn about the biodiversity, function and medical importance of the communities of microorganisms that inhabit the human body.

Michael Kent taught "Mechanisms of Disease," which introduces students to the basic principles of disease.

SPARK

ARTS + SCIENCE @ OSU
2016-2017

This year, OSU's Division of Arts and Sciences, which includes the College of Science, launched a series of events to celebrate and highlight the relationship between art and science. As part of this yearlong event, the Microbiology Department is collaborating with The Corvallis Arts Center (TAC) on a microbiology-based art show, **Microbiomes: To See the Unseen.**

The project focuses on microbial systems that affect human health, the biodiversity of animal species and air, earth and water quality, asking both artists and researchers, *how can we see the unseen?* Microbiology tries to measure, visualize and understand complex microscopic systems in the same way artists seek understanding for life's many questions. In the exhibit, artists will document and interpret complex research concepts to bring greater understanding to the public, and offer a unique perspective to the scientific community.

The exhibition runs April 13–May 27, 2017, and includes invited and juried visual artists, musicians and poets. We plan to host several events, including a speaker, a music performance and poetry readings. We are also producing an exhibit catalog and video to expand the audience of this project. For information and updates, visit our website: microbiology.science.oregonstate.edu/spark.

Artist workshops: To help artists learn more about the science of microbiology and to explore a microbiome themselves, we hosted

four artist workshops in microbiology laboratories. The first workshop was held at the John L. Fryer Aquatic Animal Health Laboratory. Artists heard from researchers and graduate students about investigations into aquatic microbiomes. They had the opportunity to culture organisms from different water sources and to examine these environments more intimately under the microscope. Participants were provided nutrient agar plates to culture microbes from soil, water and even their own bodies.

Subsequent workshops were held in the microbiology teaching laboratory. Artists heard talks by microbiology graduate students about microbes that inhabit soil and aquatic environments, the air and the human body. The artists toured working laboratories, explored microbiomes that they cultured themselves under microscopes, and even painted with bacteria. Since different bacteria can produce a variety of pigments, the artists “painted” with a palette of *Pseudomonas aeruginosa* (blue-green), *Pseudomonas aureofaciens* (orange), *Serratia marcescens* (red), *Micrococcus luteus* (yellow), *Staphylococcus aureus* (pale yellow) and *Bacillus subtilis* (white).

MICROBIOLOGY-ART OUTREACH

As part of the exhibit *Microbiomes: To See the Unseen*, graduate students from the department are participating in a series of outreach activities with local elementary schools. Between October 2016 and May 2017, graduate students are giving microbiology lessons and leading hands-on demos for more than 220 students in the schools. The students will then work with artists to take what they've learned and create artwork reflecting

their interpretations of the microbial world. The students' artwork will be featured in The Corvallis Arts Center in the final art exhibit this spring.

RESIDENT ARTISTS

In addition to the microbiome art exhibit, researchers in the department are hosting and collaborating with art students and artists in their laboratories to help them interpret our discoveries and to engage a broader audience in our research.

Karl Payne: A senior in engineering minoring in fine arts, Karl is working in the Bartholomew Lab on a sculpture of the Willamette River that will find its home in the west patio of Nash Hall. This metal and glass sculpture is a collaboration with Jerri Bartholomew and its design was influenced by discussions with scientists who have worked on the river.

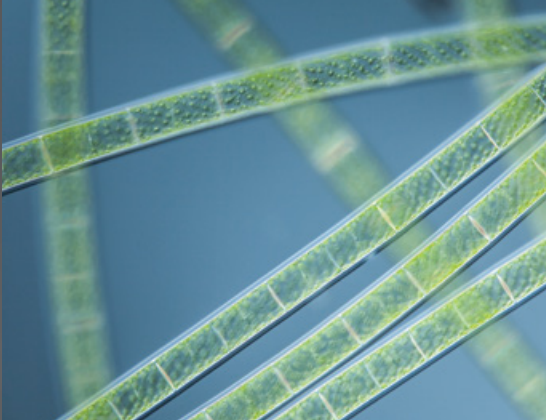
Samm Newton: is pursuing an M.A. in OSU's new Environmental Arts and Humanities Program. She is currently spending time in Steve Giovannoni's lab examining microbial communities and how the metabolic processes of bacteria contribute to global biogeochemical cycles. Samm is working on a collection of paintings, prose, poetry and photography inspired by ocean microbiomes.

Brianna Leahy: An illustrator and sculptor living in the Willamette Valley, Brianna is currently working with the Vega-Thurber Lab to create scientific illustrations for textbook and journal publications. She is also collaborating with the lab to create a comic series for web-based outreach. Their goal is to inform and inspire children and youth to get interested in science.



"Dispersion" by Chi Meredith portrays the movement of microbes from one area into another.

Johanna Rotko's "Yeastograms" are created by exposing yeast to ultraviolet light.



Work by Diane English inspired by cell walls (right). "I love how cell walls when viewed through a microscope look very organic and at the same time very architectural."



Laura Reichenbach's fiber art Beyond the Naked Eye makes use of diatomic forms (above)

Complex Communities by Laura and Tom Sharpton is an interactive artwork designed to aesthetically demonstrate this temporal change in microbiome biodiversity.

From our labs

Research gains momentum with fieldwork worldwide

DREHER LAB. The Dreher Lab has seen some major transitions this year, with two graduate students, Nathan Brown and Connor Driscoll, completing their Ph.D.s, and postdoc Tim Otten leaving for the exciting work of starting his own company. They were all in the lab for a number of years, and have produced some excellent studies and left a lot of fantastic groundwork for future research on the cyanobacteria that occur in the Pacific Northwest. We have embraced the use of genomics to describe the genomes of the cyanobacteria that bloom in lakes such as Upper Klamath Lake, Dexter and Detroit Reservoirs in the Cascade foothills and Anderson Lake in Washington State. These lakes are where the cyanobacteria are a problem either because they disrupt the lake ecology or because they produce toxins that are a public health concern.

We have used to advantage a recently developed DNA-sequencing technology (PacBio, produced by Pacific Biosciences) which can produce much longer units of primary DNA sequencing data than the more commonly used Illumina technology. The longer “reads” have allowed us to determine the complete genomes of several bacteria (every single nucleotide, which is currently not the norm) and to show that this is important because a few key genes can be missed when other technologies are used. We have applied our genomic studies to examine bacteria that form a community based on *Aphanizomenon flos-aquae*, which

blooms in Upper Klamath Lake, as the primary producer. We have identified *Anabaena* as the producer of the unpleasant flavor product, geosmin, in a drinking water reservoir in Kansas, and we have tracked the *Microcystis* genotypes over an eight-year period in Copco and Iron Gate Reservoirs on the Klamath River in Northern California.

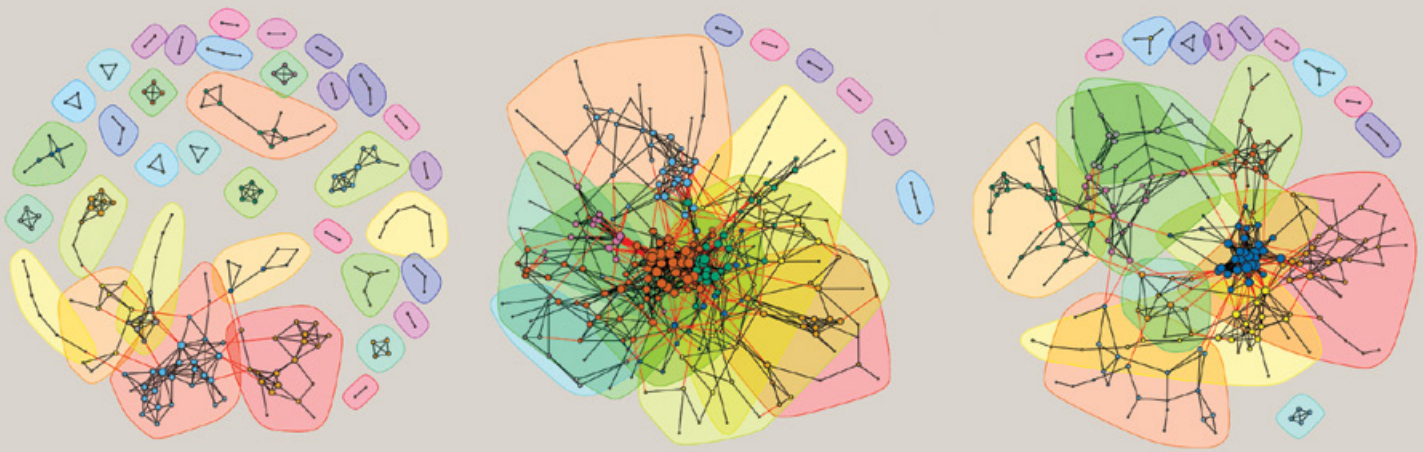
We also have a long-term dataset from Dexter Reservoir near Eugene, which will form the basis for the thesis research of first-year graduate student Lindsay Collart, who until recently worked on *Microcystis* blooms in Lake Erie. Her research will seek to explain why blooms disappear or transition to a different species, so that we can predict such dynamics in the future. During collections to Oregon blooms this summer, recent microbiology undergraduate Briana Bullington helped to recognize coordinated self-induced cell lysis, apparently triggered by some stress signal, as a potential mechanism for bloom termination in local cyanobacterial populations.

SHARPTON LAB. We had a lot of fun this past year. We graduated our first Ph.D. student, Melissa Conley, published several manuscripts on microbiome health and received multiple grants, including a major award from the National Science Foundation. Thanks to this award, we are now working to develop computational methods that will reveal specific members of the microbiome that are important to ecological and human health. We are

also actively exploring how changes in the operation of the gut microbiome influence human and animal health and evolution. This includes a new study of the salmon gut microbiome and the role it plays in salmon ecology. Our biggest research story of the year was work led by Christopher Gaulke, a postdoc in our lab, wherein we showed that exposure to triclosan, a consumer-grade antibiotic, rapidly perturbs the gut microbiome. This story was covered by many news agencies including *Fortune* and *TIME* magazines.

In addition, Tom was fortunate enough to participate in the rollout of the National Microbiome Initiative at the White House in May. Several Ph.D. students in the lab were awarded research fellowships. We are also having a great time integrating computational and bioinformatic methods into graduate and undergraduate courses. In fact, Tom developed an upper division microbiology course, “The Human Microbiome” that was offered for the first time this year. The students were enthusiastic and did great with this new subject material. Our lab is equally excited about what the next year will bring!

MUELLER LAB. We welcomed two new members to the lab this year. The first is second-year graduate student Winni Wang, who joined us last summer to begin working on a new project examining nutrient cycling in seagrass meadows. Sampling



This figure illustrates how ecological relationships among gut bacteria change upon exposure to the antibiotic triclosan (Sharpton Lab).

for this project started last summer with collections taken from Mallorca, Crete, Valencia, Canary Islands and Sardinia. Also joining the lab as a new postdoc is Armanda Roco, who comes to us from Cornell University where she completed a Ph.D. focused on characterizing microbes that perform denitrification reactions in forest soils. Armanda's research will apply her skills to a collaborative research project that seeks to examine organic nitrogen turnover across distinct soil types found throughout Oregon.

Lastly, I am very pleased to say that Sam Bryson's first manuscript from the lab was published this year in the journal **mSystems**. The quality of Sam's work was recognized by its selection as the "Editor's Choice" for that volume and through two short interviews that Sam gave for a blog on the American Society for Microbiology (ASM) website and for *The Scientist* magazine. Bryson, S., Li, Z., Pett-Ridge, J., Hettich, R.L., Mayali, X., Pan, C., and Mueller, R.S. (2016). *Proteomic Stable Isotope Probing Reveals Taxonomically Distinct Patterns in Amino Acid Assimilation by Coastal Marine Bacterioplankton*.

SCHUSTER LAB. The Schuster Lab studies the principles of cooperation and conflict in bacteria. The evolution of cooperation remains a central paradox in biology: Why should an individual carry out a costly cooperative behavior for the benefit of others? To help answer this question, we investigate two tractable bacterial model systems, cell-to-cell communication and cooperative iron acquisition. They are widespread and vitally important processes in many microbes, with implications in soil ecology, agriculture and medicine. Both processes involve the secretion of compounds that not only benefit the producing cell, but neighboring cells as well. Intriguingly, some cells have the ability to steal these compounds from the producing cells, thus saving on production costs.

Together with graduate students Kyle Asfahl, Joe Sexton and Tanner Robinson, we aim to find out how and why these cooperative behaviors are nevertheless maintained. As part of this effort, Kyle Asfahl has published a comprehensive review of recent advances in the field. *Asfahl KL and Schuster M (2016) Social interactions*

in bacterial cell-cell signaling. FEMS Microbiol Rev. pii: fuw038, Epub ahead of print.

VEGA-THURBER LAB. It's been another wonderful year for the Vega-Thurber Lab. We have continued to travel the world to investigate the roles of viruses and bacteria in the evolution, ecology and health of threatened species and ecosystems. First, Rory Welsh graduated with his Ph.D. last December and received an Oak Ridge Institute for Science and Education fellowship to work at the Center for Disease Control. His Ph.D. work on bacterial predators was highlighted in ASM's magazine, *Microbe*.

Stephanie Rosales successfully defended her Ph.D. in December. Her work on the viral and microbial pathogens in stranded seals was recently published in *PLoS One*. Stephanie also presented this work at ASM this year and was featured in ASM's education magazine. Stephanie also was awarded an NSF Graduate Research Intern Program fellowship to work with the Smithsonian in Nepal to study elephant viruses. Ryan McMinds

traveled around the world including Saudi Arabia, Hawaii and Panama to collect samples for his dissertation project on the co-evolution of bacteria with corals, presenting to the International Coral Reef Symposium in July. Lastly, Vega-Thurber recently sailed on the research vessel *Tara* to collect and process coral samples from Easter Island to Tahiti. Her lab is leading an international effort to understand the coral reef microbiome across the entire Pacific Ocean.

BARTHOLOMEW LAB. The core research of our lab focusses on an endemic myxozoan parasite of salmonid fishes, *Ceratonova shasta*. We use caged fish, field water sampling and invertebrate host sampling to generate spatial and temporal parasite abundance data in three major rivers in the Pacific Northwest. These data inform epidemiological and predictive models to understand the environmental variables linked to disease-related mortality in salmonids (Julie Alexander and Sascha Hallett, research associates).

Other *C. shasta* studies include investigation of fish mucosal immunity and resistance mechanisms (Laura Taggart-Murphy, M.S. candidate) and identification of disease-resistance genes (Damien Barrett, Ph.D. candidate). Plus we have ongoing studies using transcriptomics and genomics approaches to understand the structure and function of the parasite's 'stinging' cells (equivalent to cnidae in jellyfish), which initiate the infection process (Gema Alama Bermejo, postdoc; Stephen Atkinson, research associate; Tamar Lotan, collaborator, University of Haifa, Israel).

We embarked upon several new

collaborations this year. Gael Kurath (United States Geological Survey, Seattle branch) and postdoc Rachel Breyta will be using phylogenetic modeling to better resolve patterns in parasite genotype and spatial and host distribution. Dorothee Huchon (Tel Aviv University, Israel) is spending a year on sabbatical with us to work on the elusive structure of the mitochondrial genes of myxozoans. Chengzhong Yang (Chongqing Normal University, China) joined us last March to investigate host-parasite molecular evolution with a focus on myxozoans and fish. Closer to home, we are working with Meghna Babbar-Sebans (civil and construction engineering) and her Ph.D. student Amir Javaheri to model parasite transport under different flow regimes.

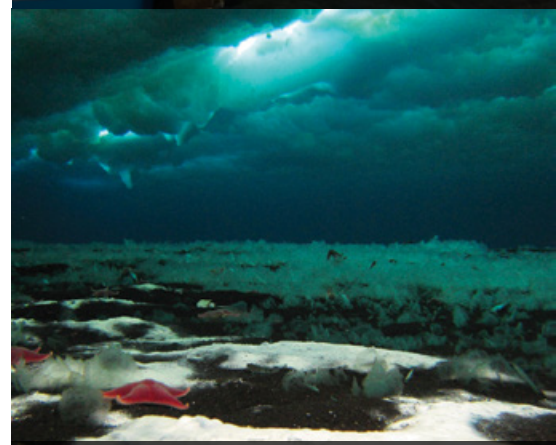
HALSEY LAB. While I stayed on land this year, two members of the lab (Dr. Cleo Davie Martin and M.S. student, Kelsey McBeain) spent last May in the North Atlantic aboard the *R/V Atlantis* studying the annual spring phytoplankton bloom and the volatile compounds released by plankton to the atmosphere (The North Atlantic Aerosols and Marine Ecosystems Study, naames.larc.nasa.gov).

In the lab, Eric Moore (Ph.D. student) has made some exciting discoveries about diatom interactions and growth behaviors, for which he was awarded a departmental scholarship. Kelsey found that as food sources, phytoplankton can taste like a four-star meal or like cardboard depending on the species and environment. Her work has serious implications for trophic interactions, especially as nutrient-limited regions of the ocean expand.

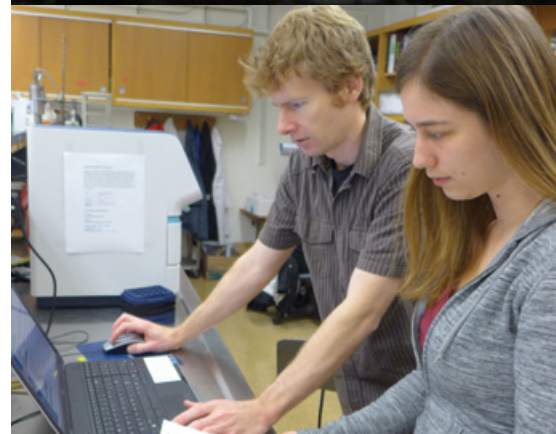
Very tricky experiments conducted by Nerissa Fisher (M.S., 2015) showed



Water sampling in the Mediterranean near Majorca (Mueller Lab)



A methane-fueled habitat for Thurber Lab to explore how microbes limit greenhouse gasses.



Dr. Stephen Atkinson and graduate student Claire Howell (Bartholomew Lab)



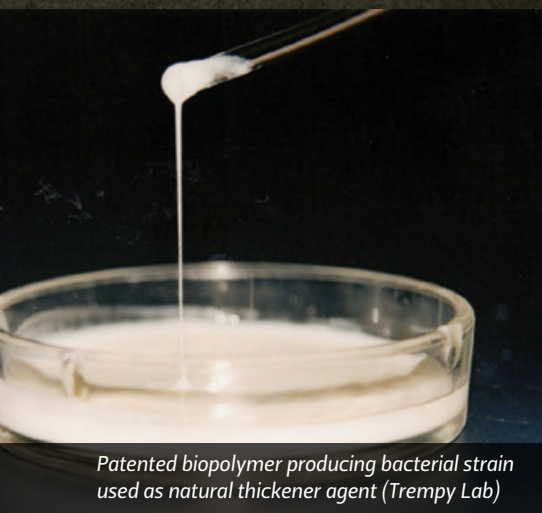
Theo Dreher's Lab uses genomics to understand the molecular biology of algal blooms.



Dr. Bruce Geller, professor of microbiology



A nematode in the intestine of a zebrafish (Kent Lab)



Patented biopolymer producing bacterial strain used as natural thickener agent (Trempey Lab)

that diatoms are remarkably efficient at very low light. Her data suggest that diatoms can shift energy flow through different metabolic pathways depending on light availability, and this “pathway gating” allows diatoms to persist through the dark days of winter. This strategy may explain why diatoms are commonly the first group of phytoplankton to bloom in the early spring (Halsey and Fisher, 2016. *Photosynthesis Research*). Finally, we welcome Bryce Penta (Ph.D. student), who joined the lab this fall.

GELLER LAB. Antibiotic resistance is an escalating, world-wide problem that has gained urgency in the past decade. Many strains of bacterial pathogens have become resistant to multiple antibiotics, and some are now resistant to all standard antibiotics, which makes treatment difficult. Indeed the mortality rate from infection with many strains of multidrug-resistant bacteria is estimated to be 50%. To make matters worse, it's been decades since a single, new class of antibiotics has been approved for many of these pathogens. A post-antibiotic era is no empty threat. When physicians and research scientists consider the most urgent medical problems we face as a world-wide community, antibiotic resistance is certainly among the top concerns. This is not only because of the pragmatic consequences, but also because it means the loss of one of the greatest achievements in the history of medicine.

Dr. Bruce Geller has been working on a new kind of antibiotic (called PPMO) that can kill multidrug-resistant bacteria. Compared to all of the other antibiotics approved by the FDA to date, PPMOs have a unique ability to block the expression of specific bacterial genes, making it impossible for the

bacteria to live. Because humans have different genes than bacteria, PPMOs don't attack human genes.

In a new twist, we have modified PPMOs so that they no longer kill the bacteria, but instead prevent the antibiotic-resistance genes from functioning. This restores the effectiveness of formerly useless antibiotics, which can then be used in combination with our compounds to kill antibiotic-resistant bacteria. The technology discovered in this NIH-funded project has been patented and licensed to Sarepta Therapeutics. Additional testing is underway, and it is our hope that clinical trials required for FDA approval will commence within a couple of years.

KENT LAB. The zebrafish has become a very important vertebrate model for biomedical research. The main research focus of the Kent Lab is the investigation of infectious diseases using zebrafish. The research has two aims: study diseases that impact zebrafish facilities, and study human pathogens or their surrogates using the zebrafish model.

Important findings this past year include documenting that *Pseudoloma neurophilia*, a very common parasite in zebrafish labs, causes behavioral changes. The parasite causes fish to be “hypervigilant” and exhibit behaviors consistent with those exposed to anxiety stressors (Spagnoli et al. 2015; 2016). Zebrafish are now a common model in behavior research, and given how common the parasite is, it may be an important cause of non-protocol induced variation in this type of research, as recently reported in *Nature News* (Szilágyi 2016). Sean Spagnoli led this research in the Kent

Lab as a Ph.D. student, and he is now on the faculty in the Department of Biomedical Sciences here at OSU.

We are also investigating the cause of a common intestinal cancer of zebrafish, in collaboration with Karen Guillemin and her team at University of Oregon through a joint NIH grant to Guillemin and Kent. Discovering the cause of this common zebrafish cancer would benefit the zebrafish research community and may lead to a useful model to study gastrointestinal cancers of humans, a leading cause of cancer deaths in the United States.

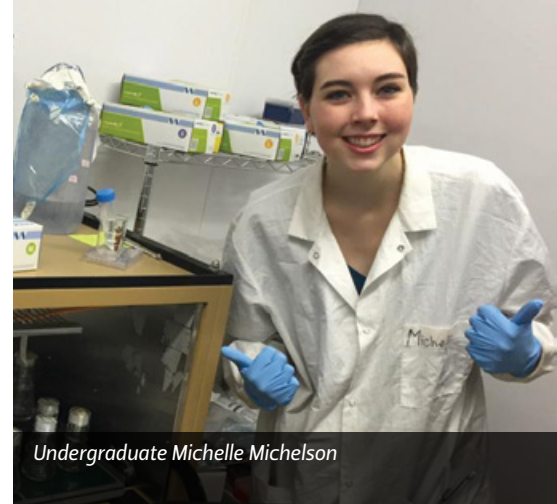
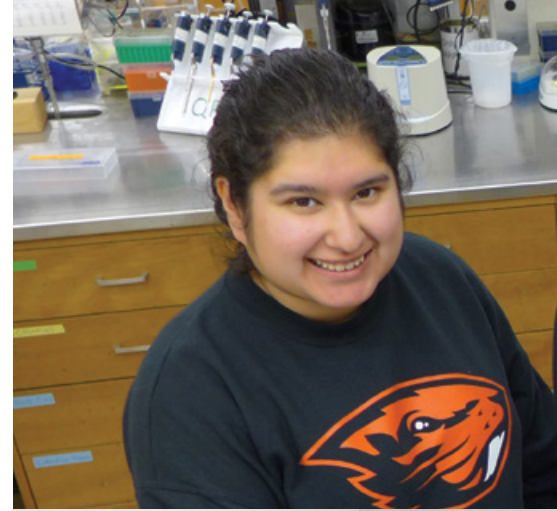
Through transmission studies in the Kent Lab we have shown that an infectious agent is clearly causing the cancer. Study of the microbiome has consistently indicated that a *Mycoplasma sp.* is associated with the cancers, and may be the cause. We have cultured the *Mycoplasma sp.* for affected zebrafish, and experiments will soon be conducted to determine if this is truly the cause, rather than simply a bacterium that happens to proliferate in cancerous intestines.

Another study on the zebrafish intestinal microbiome entails a collaboration with Tom Sharpton, who has joint appointments in the departments of microbiology and statistics. With experiments led by Chris Gaulke in the Sharpton Lab, we discovered that a common nematode parasite profoundly alters the bacterial microbiome of zebrafish (Gaulke et al. 2016). These findings are important for researchers studying the zebrafish microbiome and dysbiosis, and perhaps will lead to a model to study parasite-bacteria interactions in the gastrointestinal tract.

GIOVANNONI LAB. The Giovannoni Lab had a busy year of ocean cruises and transitions. Graduate student Omran Muslin perfected technology for measuring osmolyte compounds in seawater. Postdoc Luis Bolanos moved to Corvallis from Universidad Nacional Autónoma de México to work on the North Atlantic phytoplankton bloom project. Luis spent last April on his first scientific voyage. Postdoc Jimmy Saw joined us from Uppsalla, Sweden, where he co-discovered Lokiarchaeota. Jimmy is now working on SAR11 genomics and dissolved organic matter metabolism under the auspices of BIOS-SCOPE, a new grant based in Bermuda.

Last fall, new graduate students Samm Newton and Quinn Washburn joined the lab. Samm, an environmental arts and humanities student, is putting art and science together to tell stories, and got her science initiation in September on board the research vessel *Atlantic Explorer*. Quinn is also working with the Sharpton Lab to develop automated, high-throughput culturing methods. Zach Landry is finishing his research, which may be the first to recognize an ancient metabolism that evolved to oxidize stable forms of organic matter. Microbiology student Stephen Noell also went to sea and is busy optimizing tools for measuring dissolved organic matter uptake by SAR11. The lab received a new grant from NSF to explore functional and genomic diversity in vitamin B1 metabolism and impacts on plankton networks and productivity, and is looking forward to an active year ahead exploring this topic.

TREMPY LAB. With a focus on microbial applications, my research program expanded efforts in technology transfer activities. This past year, I



Undergraduate Michelle Michelson



Undergraduate Duncan Ocel



Undergraduate Ian Humphreys



Undergraduate Rosio Lopez-Arellano assisted by Jamie Graen



Undergraduate Madison Messmer



Undergraduate Molly Unsworth

continued to seek opportunities to move patented technology discovered “at the bench” in my research program to the commercial sectors. In 2016 we learned that one of my patented biopolymer-producing bacterial strains was enjoying commercial success for use as a natural, organic and potentially probiotic thickening agent in fermented food products. The commercial global market for polymers, including bacterial biopolymers, has an expected worth of \$7 billion dollars by 2018 through uses in the food, petroleum, biomedical and pharmaceutical industries. And recent reports from other research programs link biopolymer-producing probiotic organisms with health benefits, with global demand for probiotic products expected to reach \$45 billion by 2018.

We are replicating our commercial success through the characterization of other biopolymer-producing bacterial strains with probiotic potential. Discovered by my research program, these new natural bacterial isolates, with novel combinations of phenotypic and genotypic traits, are commercially desirable. Karen Dierksen continues to serve as my senior scientist while I, too, still work at the lab bench. We recently characterized gene sequences of newly discovered, unique combinations of genes responsible for the biopolymer phenotype desired in fermented food products. This past year I began a new position at OSU, serving as associate vice provost of academic affairs. Although my departmental teaching and service activities are reduced, I continue to work with Karen and a few undergraduate students in the lab!

REAM LAB. Our laboratory studies an *Agrobacterium rhizogenes* effector protein that suppresses antibacterial defense responses that normally limit

infection of host plants, including *Arabidopsis thaliana*. This effector protein appears to trigger expression of a microRNA that silences a family of known defense genes, thereby increasing susceptibility to infection by *Agrobacterium*.

Also, we are collaborating with Jeff Chang, Marilyn Miller and other colleagues from the Department of Botany and Plant Pathology in an effort to sequence the genomes of 500 strains of *Agrobacterium*. This analysis revealed an unexpected finding: most strains isolated from woody species are “nopaline-type” strains, whereas most of those isolated from herbaceous plants are “octopine-type” strains. In the laboratory, both types cause crown gall tumors on either woody or herbaceous hosts, so the preference of a particular host in nature was unexpected. Five of the strains from Marilyn’s collection comprise a new species in the genus *Agrobacterium*, sharing ~86% sequence identity with their closest known relatives. In addition, Marilyn and I have sequenced the genomes of several *Pseudomonas* strains isolated from crown gall tumors. We hope this analysis will help us understand the microbial communities that inhabit crown gall tumors.

UNDERGRADUATE RESEARCH

Michelle Michelson has been working in the Giovannoni Lab since her freshman year. She is studying the inhibition of *Pelagibacter* growth by organic compounds. Michelle formed her own hypothesis and is hoping to help solve the long-standing problem that a majority of the microbial cells in nature can’t be grown in laboratory culture.

Duncan Ocel, (botany and plant

pathology) is quantifying the amount of primary production lost as volatile organic carbon in a globally significant cyanobacterium in the Halsey Lab.

Kayla Stalheim, a senior microbiology major, attended the Volcano Conference in Chemical Biology in Washington State last February to present her work in Sandra Loesgen's lab on fungal epigenetics.

Jessica Hodgen spent last summer researching core circadian clock genes in *Drosophila melongaster* fruit flies, more specifically how the rhythmic expression of these genes influences the aging process. She learned sophisticated laboratory techniques that allowed her to determine gene expression levels in various fly genotypes and statistically analyze how the late-life rhythmic expression of certain clock genes impacts the longevity, activity levels and stress resilience of older flies.

Jessica plans to continue conducting research in the Giebultowicz Lab (integrative biology) this winter upon returning from studying abroad in England and hopes that her research will contribute to better understanding of the roles of circadian clocks in healthy aging. Jessica's research is funded jointly by the Departments of Microbiology and Integrative Biology.

Ian Humphreys, a Junior majoring in microbiology, is continuing his research in Jane Ishmael's laboratory (Pharmacy) last fall with matching support from the Departments of Microbiology and Pharmaceutical Sciences. The Ishmael Lab studies mechanisms of cell stress and death in response to natural product cytotoxins with the goal of inspiring new drug

development for cancers that remain difficult to treat.

Ian works with a cyanobacterial compound called coibamide A that was discovered by College of Pharmacy collaborator Kerry McPhail in the fast-moving waters off the Pacific coast of Panama. This compound cuts off the cancer cells' ability to communicate with blood vessels and other cells, eventually starving the cell and triggering cell death. Ian works independently with a range of human cancer cell types to understand the signaling pathway that is responsible for coibamide-induced death.

In the Bartholomew Lab, OSU STEM leader **Rosio Lopez-Arellano** learned how to extract DNA from water samples and to identify and isolate the invertebrate host of a salmon pathogen, *Ceratonova shasta*, from sediment samples. These samples were then used by Honors College student **Madison Messmer** to investigate relationships between the invertebrate host genotype and parasite infection. And Whitman College undergraduate student **Molly Unsworth** joined us for a summer internship to investigate why particular genotypes of *C. shasta* have persisted above the dams in the Klamath River even though their fish host is no longer being stocked there.

UNDERGRADUATES COMMUNICATE THEIR SCIENCE

Students conducting undergraduate research present their findings each term at our department colloquia. Spring term awards are given to the best presentations as ranked by faculty.

In 2015–2016, the following students received the departmental **Undergraduate Awards for Best Research Presentations:**

Senior **Elyssa Armstrong** (Bermudez Lab, Veterinary Medicine), "Establishment of an in vitro model to study persistence in *Mycobacterium avium*."

Senior **Megan Huber** (Robinson Lab, Wood Science and Engineering) "Peruvian fungal pigment production."

Senior **Amandip Singh** (Schuster Lab, Microbiology) "Evolution of siderophore receptors in *Pseudomonas aeruginosa*."

Junior **Zachary Konkel** (Loesgen Lab, Chemistry), "Antibiotic activity against methicillin-resistant *Staphylococcus aureus* from an Oregonian *Aspergillus*."

Sophomore **Bryna Rackerby** (Crump Lab, Ocean Ecology), "Microbial diversity in the Mekong River."

Alumni

Congratulations to our recent microbiology graduates and alumni!

Saeed Banawas (Ph.D. '16)—Assistant professor, Medical Laboratories Department, College of Applied Medical Science, Majmaah University, Saudi Arabia. Dr. Banawas is working as a vice dean of scientific research at Majmaah University and teaching applied clinical microbiology. “People here are happy that I graduated from OSU!”

Lauren Brooks (Ph.D. '16)—Postdoctoral Scholar, Life and Environmental Sciences, School of Natural Sciences, University of California, Merced. She is doing evolutionary and microbiome research and having a blast!

Nathan Brown (Ph.D. '16) is doing a postdoc at the University of Leicester in the UK to work on the use of bacteriophages to treat bacterial infections.

Michael Dobie (M.S. '16)—Bacteriologist for Oregon Freeze Dry Foods.

Connor Driscoll (Ph.D. '16) is finishing publications and interviewing for jobs in Seattle.

Zach Landry (Ph.D. '16)—Postdoc in the Giovannoni Lab.

Sasha Rose (Ph.D. '16)—Postdoc in the Bermudez Lab.

Dan Tanaree (Ph.D. '16).

Rory Welsh (Ph.D. '15) is now working at the Center for Disease Control in

Atlanta on an ORISE fellowship. He is currently researching the origins of a newly discovered fungal pathogen that has become antibiotic resistant and is infecting patients across the country.

Steve Hubbs (B.S. '16) is now in graduate school studying clinical microbiology at Oregon Health & Science University (OHSU).

Aidan Maxwell (B.S. '16) graduated and is working as a lab technician at OHSU at the Vaccine and Gene Therapy Institute in Beaverton where he works on HIV therapies using a non-human primate model system.

Ariel Liberda (B.S. '16) graduated and is a histology lab technician at Bend Dermatology.

Lmar Babrak (Ph.D. '15) is a postdoc at the Agricultural Research Service where he makes monoclonal antibodies to deploy onto immunoassays to detect pathogens.

Nerissa Fisher (M.S. '15) is now a Ph.D. student at the University of Technology in Sydney, Australia.

Marius Ibuye (B.S. '15 Biohealth Sciences) is now in the OSU Pharm. D. program.

Hannah Turner (B.S. '14) just had her second paper published in *Science* on the Ebola vaccine. She was Valerian's undergraduate researcher for a while and then worked with Vega-Thurber

before applying to graduate school. She is working with the Scripps Institute and focuses on raising antibodies against the Ebola virus. She is the second author on this *Science* paper, her second paper: science.sciencemag.org/content/early/2016/02/17/science.aad5788

Dr. Nitzan Soffer (Ph.D. '14) is a research scientist at Intralytix in Baltimore, MD, where she studies phage therapy for human diseases.

Paul Carini (Ph.D. '13) just became an assistant professor at the University of Arizona.

Hyatt Green (Ph.D. '11) is an assistant professor of microbiology in the Department of Environmental and Forest Biology at the State University of New York, College of Environmental Science and Forestry.



Department of Microbiology

Nash Hall 226
Oregon State University
Corvallis, OR 97331

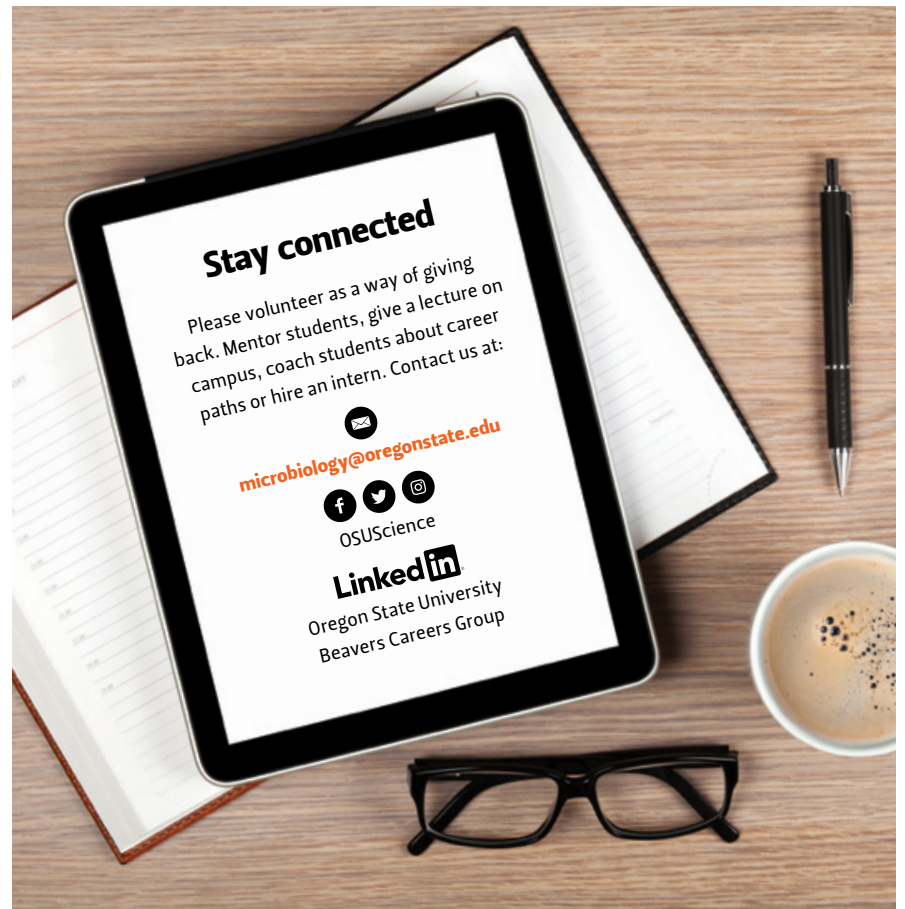


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