

SMALL

TALK

FALL 2017

Microbiology students, faculty,
research, news and alumni



Oregon State
University

SMALL
TALK
Fall 2017

Editor

Debbie Farris

Writer

Katharine de Baun

Designer

Sharon Betterton

**Department of
Microbiology**

Jerri Bartholomew, Head
Mary Fulton, newsletter
coordinator

Publisher

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

Stay connected

Please volunteer as a way of giving back. Mentor students, give a lecture on campus, coach students about career paths or hire an intern. Contact us at:



microbiology@oregonstate.edu



OSUScience

College of Science

science.oregonstate.edu

**College of
Agricultural Sciences**

agsci.oregonstate.edu



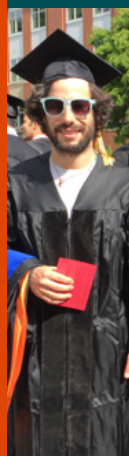
2



7



10



16

Contents



6 Feature

2 **Bright Minds, Bold Moves**

Enriching education with transformative experiences

6 **Feature**

OSU Microbiome Initiative: Unseen worlds come to light

7 **News & Awards**

Innovation, new faces, well-deserved recognition



On the cover: Interpretation of the Microbiome by Portland artist Susan Circone

10 **Innovation in our labs**

Research that makes a difference

15 **Alumni & Friends**

Together we are making a growing impact

16 **Bon Voyage!**

Recent graduates are ready to change the world

FROM THE HEAD

Jerri Bartholomew

Department Head



Welcome to our annual newsletter! We are excited to share our successes from last year and our plans for the year ahead.

For history buffs, the Department of Microbiology is one of the oldest departments at Oregon State, originating as a single course in bacteriology in 1899. Research at that time focused on bacterial diseases of crops, an agricultural focus that still continues today, particularly in salmon and plant health and food and soil microbiology. However, our research has expanded to explore microbial communities in aquatic environments as diverse as coral reefs and the deep ocean, how bacteria communicate and how microbiomes evolve and function. You will read about some of our research accomplishments in the pages ahead.

We are very proud of our undergraduates. This fall our enrollment stands at over 900 students in both the BioHealth Sciences and Microbiology majors. Our students are actively engaged, participating in research, professional clubs and outreach events. We are happy to share some of their stories here. Our new aquatic microbiology option will teach students the role that microbes play in aquatic ecosystems, complementing the university's Marine Studies Initiative. Our faculty play key roles in other programs, such as Kate Field's involvement in the

Bioresource Research Program (see p. 8).

Last spring we graduated seven Ph.D. and two M.S. students, and this fall we welcome seven new graduate students. We launched an accelerated master's program, enabling motivated undergraduates to enroll in a master's program while finishing their bachelor's degree.

Last year we celebrated SPARK, the year of arts and science, and Microbiology was a leading participant, collaborating with the Corvallis Art Center on the exhibit "Microbiomes: To See the Unseen" and a performance event that featured poetry and music. Our students were involved in outreach with artists, grade schools and the community – exploring the connections between art and science and reaching over 3,000 people. I also taught an experimental class, The Art of the Microbiome, and the department acquired a microbial art collection (featured on the cover), so visit and ask for a tour!

Finally, there is so much that we could not have accomplished without our generous alumni and donors. You have helped us by providing funds for scholarships, travel to conferences and research experiences. In these pages, enjoy stories about our faculty and students and the impacts your gifts have made. Thank you!

EVENTS

November 15, 2017

Evolution of a Superbug

The Arts Center | Corvallis,
6 p.m.

November 16, 2017

*Microbiology Seminar:
Michael Baym, Ph.D.,
Harvard Medical School*

3:00 p.m., Linus Pauling
Science Center 402

November 29, 2017

*School of Life Sciences
Synergy Seminar*

February 2018

Annual OSU Food Drive

April 7, 2018

*4th Annual Microbiology
Student Association
Symposium*

May 7, 2018

*Annual Microbiology
Scholarship Luncheon*

June 15, 2018

Graduation Celebration

BRIGHT MINDS, BOLD MOVES

UNDERGRADUATES ON THE MOVE

Networking at the ASM Microbe Conference

Emaan Khan (B.S. '17): I had the privilege of attending the 2017 American Society of Microbiology Microbe Conference last June in New Orleans, Louisiana. It provided a unique opportunity to explore a wide array of microbiology, learn about groundbreaking discoveries and network with established microbiologists.

I was also thrilled for the opportunity to present my honors thesis research in Dan Rockey's Lab on *Chlamydia abortus* with a poster showing the abundance and expressive variation of certain polymorphic membrane proteins within *C. abortus* through fluorescence microscopy. It was very exciting to meet scientists who also study chlamydia and provided further insights into my research.

I am very grateful for the support from the Honors College, the Department of Microbiology and the Rockey Laboratory which made this experience possible. It was a memorable highlight of my undergraduate education.

BioHealth Science Club

Our year began early with Welcome Week's Beaver Fair on the MU Quad, where we enticed new students with

club-branded items and business cards publicizing club meetings, field trips and volunteer opportunities. Our outreach efforts continued throughout the year, culminating with the spring College of Science Fair. We hosted fun science game tables and dispensed health-related trivia to hundreds of passing students while they enjoyed free hot cocoa and Voodoo Donuts. We bid a bittersweet goodbye to many of our graduating students and officers, who will be missed as they move on to graduate school and exciting career opportunities.

Throughout the year, we performed community service and went on field trips. One notable event was a visit to PeaceHealth Hospital in Eugene, where we learned how to process patients' lab specimens, the reasons for testing and how to interpret results. It was invaluable exposure for students working toward a career in lab science as well as medical fields.

The club organized many educational events. For example, we offered American Health Association Basic Life Support/CPR training for students to renew their membership or learn those invaluable skills for the first time. We hosted guest speakers who talked about the practice of medicine in diverse environs, the difference between osteopathy and allopathy, and osteopathic manipulation. Other

speakers helped members prepare for interviews, craft mission statements, apply to grad schools and build resumes.

Making connections that count

The **Microbiology Student Association** has spent the year hosting more social events and improving our annual research symposium. We shared new volunteering opportunities, enjoyed social icebreakers and planned events, including a hike to Bald Hill to get to know new members, a Thanksgiving potluck open to the department, a winter faculty mixer and a field trip to Conversion Brewing to learn about fermentation.

Our biggest event was our Annual Research Symposium, featuring 10 researchers from across the Pacific Northwest (including four from OSU), who presented their groundbreaking work. We invited all students at OSU and Linn-Benton Community College and the Corvallis community to the symposium.

We also enjoyed mixing microbiology with art through several community and outreach events like SPARK: A Year of Arts and Science, AWSEM (a girls-in-science club at Garfield Elementary School), and Mi Familia, an event introducing diverse and underrepresented students and their



Microbiology Student Association
(above) at Discovery Days (below)



A Sargasso Sea Summer

Microbiology major **Michelle Michelsen** went on her first research cruise to the Bermuda Institute of Ocean Sciences (BIOS) this summer on board the RV Atlantic Explorer, supported by a National Science Foundation grant. Working under Rachel Parsons, BIOS researcher and Microbial Ecology Lab manager, Michelsen conducted research for microbiologist **Stephen Giovannoni** on the distribution of the deep ocean bacterioplankton SAR202, which play a key role in global carbon cycles. She learned new microscopy protocols and used the imaging facility at BIOS to determine abundances of different SAR202 groups from samples taken from the Western Sargasso Sea. Back on campus, Michelsen and Zach Landry created fluorescent probes to bind specifically to ribosomes in different groups of SAR202 cells.

families to college life and OSU. We have really enjoyed sharing our love of science and microbiology with children and the general public. Overall, it was an amazing year and we are looking forward to the next!

New weapon for superbugs

Christina Moody recently helped microbiologist Bruce Geller's research team capture the world's attention with the construction of a powerful molecule that can inhibit the deadly antibiotic-resistant bacteria responsible for tens of thousands of fatalities across the globe. She replicated in-vitro experiments that confirmed the molecule's ability to restore the bacteria's susceptibility to the antibiotic meropenem. The experience has raised the credibility of this already accomplished young scientist (Ford Scholar, OSU Diversity Achievement Scholar, Fred and Mary Brauti Pre-Medical Scholar) to even greater heights and has inspired her to pursue research on microbial agents of human disease.

SURE Science opens doors

Six students won awards from Summer Undergraduate Research Experience in Science (SURE Science), a competitive program that supports undergraduate science students pursuing summer research: BioHealth Sciences majors **Ido Almog** (see page 4 sidebar), **Lindsay Hirsh**, **Jessica Hodgen**, **Christopher Lee** and **Alamjit Nagra**; and microbiology major **Whitney Weber**. They found research positions in the areas of biochemistry, pharmacy, integrative biology and veterinary medicine.

Creative bibliotheca

Lihani Du Plessis (BioHealth Sciences) received one of two Library Undergraduate Research Awards, awarded to students who, through the comprehensive use of the Oregon State University Libraries, demonstrate outstanding research, scholarship and originality in writing a paper or completing a project.



Michelle Michelsen
on board the RV
Atlantic Explorer



A summer of hands-on research

*A five-minute chat with BioHealth Sciences sophomore **Ido Almog** on his way to the lab...*

Why did you decide to apply for a SURE Science summer research grant?

I wanted to apply what I've learned and gain skills in a laboratory setting, especially given OSU's reputation for hands-on undergraduate research.

What in your background prepared you to engage in research?

High school classes in chemistry, biology, genetics and human anatomy created a solid foundation before I arrived here. I began applying for research opportunities as a freshman after finishing my first term of general chemistry, thanks to support and coaching from the OSU STEM Leaders Program, which is designed to increase the diversity and success of undergraduates in STEM fields.

What is the nature of your research and the results so far?

My objective is to test the prediction

that long-lived little brown bat (LBB) cells will be more resistant to protein aggregate accumulation (associated with diseases like Alzheimer's) than short-lived TADA cells, due to increased proteostasis, the process by which cells regulate proteins to maintain health. If our hypothesis is true, it would indicate that proteostasis is an essential mechanism for controlling protein aggregation in long-lived species, a result which would have a direct impact on human aging.

What was the most rewarding part of your research?

Collaborating with lab members and learning all the amazing things they have taught me about the studies of aging.

What was the most challenging part?

Dealing with adversity and frustration when things didn't go as planned because of problems out of my control. For example, our computers crashed while gathering data. Bouncing back taught me much about persistence.

Have you gained confidence?

Yes, my skills have improved immeasurably, especially the creativity, communication, and organization skills used daily in the lab and in the field. I have much more to learn and am looking forward to my continuing work in the lab this year!

UPDATES FROM GRADUATE STUDENTS AND POSTDOCS

Hats off to...

Postdoc **Cleo Davie-Martin** for her \$1,000 award from the OSU Postdoctoral Association to expand her project with undergraduate researcher Duncan Ocel investigating the volatile organic carbon fingerprint of the abundant marine cyanobacterium *Synechococcus*.

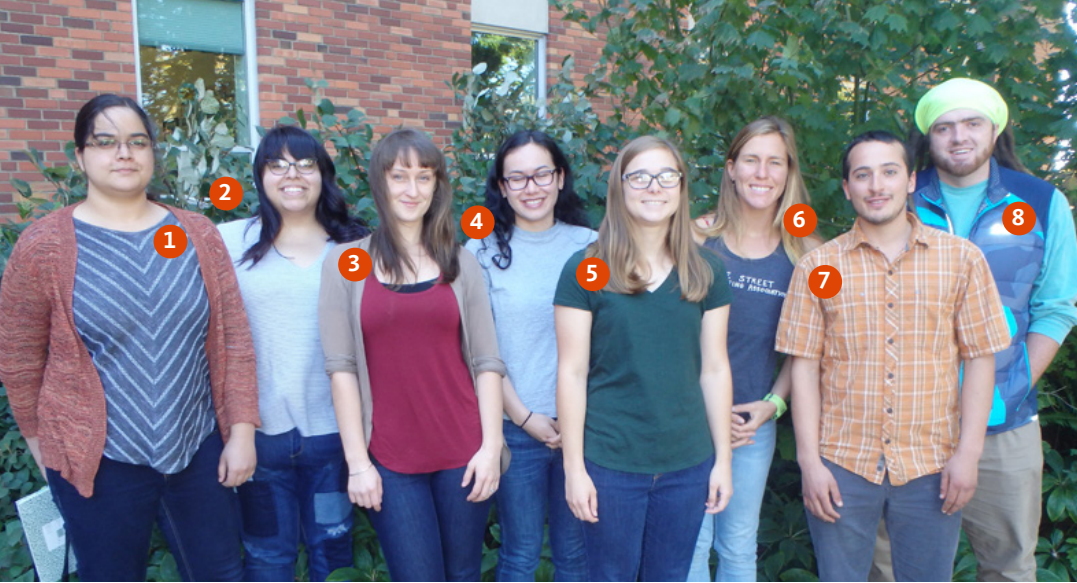
Ph.D. student **Becca Maher** (Vega-Thurber Lab) for her prestigious 2017 National Science Foundation Graduate Research Fellowship Program (NSF GRFP) award, which recognizes and supports outstanding master's and doctoral students who have demonstrated high potential in STEM disciplines very early in their graduate training. Maher will use her award to investigate how predation by parrotfish and elevated nutrient levels combine to affect coral microbiome and increase the rate of coral death.

Next generation in STEM

Mentoring is a known way to strengthen the STEM pipeline from high school to college. Kudos to postdoc **Julie Alexander** (Bartholomew Lab) for mentoring Hayden Smith and Tiffany Huang, high school interns from Saturday Academy's Apprenticeships in Science & Engineering program. During eight weeks of the summer students participated in laboratory outreach and fish husbandry, studied the fish parasite *Ceratonova shasta*, created activities for da Vinci Days and performed field work on the Klamath River.

In their own words: New graduate students

7 Benjamin Americus: I am interested in the conservation of wild salmon stocks and the proliferation



of sustainable aquaculture. While sometimes conflicting, these two goals can be pursued simultaneously through the careful anticipation of increased competition, genetic introgression and disease transmission. I will investigate parasites that are transmissible between cultured and wild stocks of salmonids and responsible for extensive mortality among both populations. Analyzing gene expression of these parasites during infection may develop treatments for better disease management.

5 Kristina Baker: My research focuses on microbial communities in lagoons on the northern coast of Alaska. Seasonal shifts in salinity, temperature, freshwater runoff and increasing permafrost thaw are all potential factors in shaping these communities. This is part of a larger, Long Term Ecological Research Network study aimed at understanding how changing factors affect estuarine food webs.

3 Kalyn Hubbard: In collaboration with the Confederated Tribes of the Warm Springs of Oregon Reservation, U.S. Fish and Wildlife Service and Oregon Department of Fish and Wildlife, my goal is to discover the role of pathogens in juvenile and pre-spawn mortalities of adult spring Chinook salmon. We will use quantitative polymerase chain reaction analyses of both bi-weekly and longitudinal water samples, conduct sentinel fish exposures and perform necropsies.

1 Jayanthi Joseph: I am investigating the pathogenesis of *Mycobacterium avium* and related species to learn about intracellular survival mechanisms and host response.

2 Elizanette Lopez: *Toxoplasma gondii* is currently the second most common foodborne illness in the United States. Utilizing zebrafish as a high-throughput, biomedical model allows for future discovery of drugs to combat the chronic stage of toxoplasmosis. My research aims at improving the current zebrafish model by understanding immunological mechanisms within the organism.

6 Katie McConnell: I am interested in the roles microbial communities play in ecosystems. My work will focus on links between biogeochemical cycling, viral infection and endosymbiotic dinoflagellates in overall coral physiology and reef health.

4 Michelle Pombrol: I am interested in the connections between phytoplankton physiology and gene expression and ocean biogeochemical cycles. My research will focus on the role of microbial communities in carbon sequestration to the deep ocean.

8 Parker Smith: I am interested in studying quorum sensing, iron acquisition and social cheating in *Pseudomonas*, a common bacterium that can cause disease in plants, animals and humans.

Sparking passion through outreach

Postdoc **Armanda Rocco** was involved in a series of outreach events this past year. In connection with the Microbiomes: Seeing the Unseen art show (see p. 7), she visited 5th grade classes at Liberty Elementary School to teach them about pond microbes and how to view them under the microscope. Working with a local artist, the students made a 3D art project on pond microbes and displayed their work.

Rocco also became an Oregon Museum of Science and Industry (OMSI) Science Communication Fellow after completing four training workshops on how to engage the public with STEM research, culminating in the designing of a hands-on activity based on her research at OSU. This summer she participated in a Meet a Scientist event at OMSI where she presented her “Recycling the Dead in the Hunt for Nitrogen” activity to the public. Rocco will continue to engage the public with more outreach this coming year.



OMBI Microbiome Initiative: Unseen worlds come to light

A palpable urgency is driving microbiome research globally. With chronic diseases on the rise, ever-increasing ecological disruptions, and a mounting need to improve plant and animal agricultural productivity, more and more scientists are looking to microbiomes for answers. While tiny in size, these communities of microscopic organisms have profound effects and may hold the key for an improved understanding of animal, plant and ecological health.

To help catalyze the potential of microbiome research, Oregon State University launched the OSU Microbiome Initiative (OMBI) in 2017, led by **Thomas Sharpton**. An assistant professor with joint appointments in microbiology and statistics, Sharpton brings expertise in two symbiotic areas that give him an edge and a wholly unique perspective on microbiomes. In 2016, in recognition of his leadership in microbiome research, Sharpton was invited to the White House for the launch of the National Microbiome Initiative (NMI), a new \$121 million federal program to maximize \$500 million in philanthropic support from private foundations in order to study the microbes in humans, crops, soils, oceans and more.

Today OMBI, one of only a handful of NMI-designated regional centers supported by the National Science Foundation (as well as OSU and the Department of Microbiology) is opening up new scientific and environmental applications of microbiome science. The ultimate mission is to advance discoveries of how microbiomes affect their environments, develop interdisciplinary collaborations, teach and train students in microbiome science, partner with industry to translate discoveries into applications and educate the public about the promise and power of microbiomes.

In May, OMBI hosted a series of inaugural events over two days that advanced this mission. More than 45 researchers — including undergraduates and professors from OSU, the University of Oregon, OHSU and Portland State University — participated in a day-long workshop on how to generate and analyze microbiome data, benefiting from computing resources made available by OSU's Center for Genome Research and Biocomputing.

Ed Yong, award-winning science journalist and author of *I Contain Multitudes*, presented a lecture on the invisible and teeming world of microbes across a range of species to a packed room of more than 300 scientists and

members of the community. Yong painted a vivid picture of a future where humans nurture microbes to cultivate their beneficial effects. He will return to Corvallis in July 2018 as a keynote speaker at the International Symbiosis Society meeting, hosted by Oregon State.

The final event was a research symposium on the state and future of microbiome research that featured seven scientists from universities, national laboratories and research centers, including OSU microbiology faculty, and was attended by scientists from across the country.

Last August, Sharpton again represented OMBI at an invitation-only National Institutes of Health workshop about the future of microbiome medicine. With the support of the public and a very talented team of researchers led by Sharpton, OMBI promises to probe new understandings of microbiomes with the potential to revolutionize health, environmental science and more.

Ed Yong



NEWS & AWARDS



Researchers and artists collaborating at the Microbiome: To See the Unseen exhibit

SPARK: Synergy between arts and science

As part of SPARK, a yearlong celebration of the convergence between arts and science, the Department of Microbiology collaborated with The Arts Center, Corvallis to challenge artists to think about how we see the unseen world of microbes. In a series of workshops, graduate students talked about their research and interacted with artists, musicians and writers through hands-on laboratory exercises. These artists then interpreted what they learned through art, and in April, their work was displayed at The Arts Center's culminating exhibit "Microbiome: To See the Unseen" as well as at several smaller venues on campus. In a performance event sponsored by the Spring Creek Project, poets and musicians also shared their microbial compositions.

Graduate and undergraduate students and postdocs worked with teaching

artists at four rural elementary schools. They transported microscopes to examine pond water, then explained microorganisms and how they interact with us. The students created art, using various media from claymation videos to block prints to portray what they had learned. The results were insightful and definitely entertaining. If you are curious, visit The Arts Center website.

Collaborations also led to the development of a new undergraduate course, The Art of the Microbiome, where students learned about microbiomes and then worked with an artist to explore the concept artistically. Students shared that exploring science through art reinforced ideas and helped them retain the information better.

Stop by and visit this new art collection when you are in Corvallis! You can also download or purchase the art show catalogue for \$15 via The Arts Center website: theartscenter.net.

Opening STEM pathways for rural, diverse students

Fifty-two high school students spent four days on campus this summer immersed in STEM to participate in the Summer Pathways Program. The Department of Microbiology hosted the students at the John L. Fryer Aquatic Animal Health Lab, where they had a tour, gained hands-on experience with fish dissections and operated microscopes to examine some intriguing parasites. The experience gave them the chance to interact with students and learn about college life at OSU.

The program, supported by the Oregon Pacific Area Health Education Center, introduces high school students from rural and diverse communities across the state to healthcare careers and college exploration in hopes that they will return to their communities after they have finished their education.



Student success in BioResource Research

Microbiologist **Katharine Field** has hit upon a winning formula for student success as Director of the BioResource Research (BRR) major in the College of Agricultural Sciences. BRR provides research-based, interdisciplinary education, in conjunction with a rigorous biosciences curriculum and opportunities for experiential learning and professional development in resource management, agriculture, and environmental, food and health sciences. Students in BRR choose among 13 options (areas of concentration), take upper-division option courses, do a faculty-mentored research project, write a thesis in the format of a journal article and present a public seminar. Students are engaged in all stages of active science, from research theory and methodology to proposal writing, experimental design, data presentation and scientific writing.

The BRR program is *inclusive*, open to any student at OSU. It is well-documented that taking part in undergraduate research benefits not just exceptional students, but all students. BRR has been particularly strong in enrolling and graduating underrepresented minority (URM) students. Since program inception, 23 percent of BRR graduates have been URM; currently more than 30 percent of BRR students are URM.

Although BRR is 27 years old, its approach and practices are consistent with the latest educational research on how people learn in STEM and it has been notably successful, with an average 85 percent six-year graduation rate for the last 10 years. This surpasses OSU's overall rate of 63 percent on average. The BRR major appeals both to exceptional students looking for a challenging education

and students who don't necessarily learn well sitting in a typical classroom. BRR's required research project allows students to actualize their education while gaining professional skills through experiential learning. Approximately 80 percent of BRR students eventually enroll in a graduate or professional program.

Field has strengthened BRR by securing outside funding. As director, she has obtained more than \$4.5 million in grants, principally through the USDA, to support scholarships for underrepresented and first-generation students and bioenergy education.

The interdisciplinary structure of BRR has allowed Field to design new options and minors that provide a cutting-edge education in emerging cross-disciplinary fields, drawing together interested faculty from across campus, state and federal agencies and experiment stations. Examples include BRR's Genomics/Bioinformatics option (2007), Climate, Biosystems Modelling option (2010), and Bioinnovations online minor (2017, in development with the College of Business).

Welcoming new faces

We are happy to welcome new faculty member **Maude David** and her spouse **Kenton Hokanson**, who will join us in January. David will have a joint appointment with the College of Pharmacy and will play a role in developing undergraduate curricula in bioinformatics. She joins us from the Department of Pediatrics at Stanford University, where she also worked at Second Genome, a microbiome company. David is co-founder of ENOVEO, an environmental bioinformatics company. Her research interests are broad: from permafrost microbial communities to the analysis of gut microbiota dysbiosis and



Educational Resource Excellence Awardee
Linda Bruslind



Ruth Milston-Clements
was promoted to senior
faculty research assistant



New faculty members
Maude David and
Kenton Hokanson



Goldwater Fellow and BRR graduate
Alejandra Marquez Loza

genomic variants associated with autism, where she is employing techniques like crowdsourcing to accelerate discovery. With her expertise in bioinformatics, data sciences and the gut microbiome, she provides a good complement to faculty working in this dynamic field and with OMBI (see p. 6).

Hokanson will be joining us as an instructor. He is a recent neuroscience graduate from the University of California, San Francisco. He is excited to be joining us winter term and will be teaching undergraduate courses in microbiology and biohealth sciences and advising undergraduates. Hokanson will also work on developing an electrophysiology core facility in the Department of Biochemistry and Biophysics.

Faculty awards

Thomas Sharpton, assistant professor of microbiology and statistics, received the Dean's Early Career Impact Award for exceptional achievement in research and education by a tenure-track faculty. Sharpton has acquired a national reputation for his work in microbial bioinformatics.

Since joining OSU in 2013, Sharpton has published 15 papers, including one in *Proceedings of the National Academy of Sciences*. The latter has opened new doors in microbiome exploration by bringing statistical acumen to bioinformatics. This approach, which was challenging to implement, applies evolutionary methods to detect long-term historical trends in host/microbe co-evolution.

Among his greatest achievements are developing new technologies, such as sifting families (SFAMS), a system for classifying protein diversity, and his recently published method for automating gene family abundance estimation from metagenomics data. Sharpton's study on the disruption of the zebrafish microbiome as a result of exposure to the antimicrobial agent triclosan was featured in *TIME* and *Fortune* magazine. In 2014 OSU selected him as the university representative for the National Microbiome Initiative Rollout at the White House Office of Science and Technology Policy (OSTP). He was also the lead author of OSU's response to OSTP's Call for New Commitments on microbiome research.

Linda Bruslind, microbiology senior instructor and head advisor, received

the university's Educational Resource Excellence Award, partly in recognition of her development of an open source general microbiology textbook (open source means that the textbook is available online to be freely used without copyright restrictions). The textbook is an important step in making college affordable and accessible.

Ruth Milston-Clements, facility manager for the John L. Fryer Aquatic Animal Health Laboratory, was promoted to senior faculty research assistant.



Thomas Sharpton receives the Dean's Early Career Impact Award, with Jerri Bartholomew

INNOVATION IN OUR LABS

Enigmatic parasites: Bartholomew Lab

Our research on myxozoans continues to intrigue. These enigmatic microorganisms are now firmly ranked as the most speciose parasitic members of the Cnidaria, a large group that includes corals and jellyfish. In continuing our core research on the diseases they cause in fish, we are also examining their evolution to parasitism.

Our collaborators around the world continue to proliferate. Along with the University of Haifa, we are investigating the structure and function of the parasites' polar capsules and how they are similar to the stinging cells of their free-living relatives. Dorothee Huchon from the University of Tel Aviv recently spent a year in our lab investigating the myxozoans' mitochondrial genomes, finding them to have incredible variety. Postdoc **Gema Alama Bermejo** left our lab to take a position in Argentina, but continues to collaborate on parasite genomics and transcriptomics. Isaure de Buron, College of Charleston, and Esteban Soto, University of California, Davis, are applying our parasite detection and monitoring systems to different marine and freshwater systems to describe infection dynamics and novel myxozoans.

We welcome two new graduate students. **Kalyn Hubbard**, recipient of an Oregon Department of Fish and Wildlife (ODFW) Graduate Fellowship, will continue monitoring efforts to better understand juvenile and pre-spawn mortality of Chinook salmon in the Deschutes River Basin, a collaborative effort with the Warm Springs Tribe, Lower Columbia River Fish Health Center and the ODFW. **Ben Americus** will investigate polar capsules by looking at the transcriptomes of different spore stages.

Several undergraduates conducted interesting research this year, including **Emily Lawrence**, who developed a means to detect polychaete eDNA in water samples, and **Molly Unsworth**, from Whitman College, who discovered the host of a new myxozoan parasite.

Safe cryopreservation: Kent Lab

For her master's thesis, **Lauren Norris** (B.S. '17) investigated the ability of key fish pathogens of zebrafish to survive freezing temperatures and cryopreservation. Zebrafish are one of the most commonly used animal models in biomedical research, surpassed only by mice. Resource facilities like the NIH Zebrafish International Resource Center (ZIRC) in Eugene, Oregon, are the main providers of thousands of zebrafish

wild-type, mutant and transgenic lines. In addition to stocks of live zebrafish, sperm cryopreservation allows ZIRC to maintain the vast array of zebrafish lines that they receive from outside facilities. Hence, as with cryopreserved sperm of humans and cattle, there is a concern about the risk of transmitting pathogens to progeny with these specimens.

Norris investigated the ability of five of the most important zebrafish pathogens to survive freezing and thawing under both standard cryopreservation and freezing without cryopreservant. She found that pathogens survived to some degree in all specimens except for one. Given the risks of pathogen survival and possible transmission, we recommend that all sperm samples and donor zebrafish be tested for pathogens before they are used for cryopreservation.

Norris is currently a faculty research assistant working with **Justin Sanders** (College of Veterinary Medicine and former microbiology graduate student) on the development of salmon pathogen tests for environmental DNA testing through a grant from the U.S. Army Corps of Engineers, Portland District. Her master's degree was supported by a National Institutes of Health grant to promote diversity in health-related research.

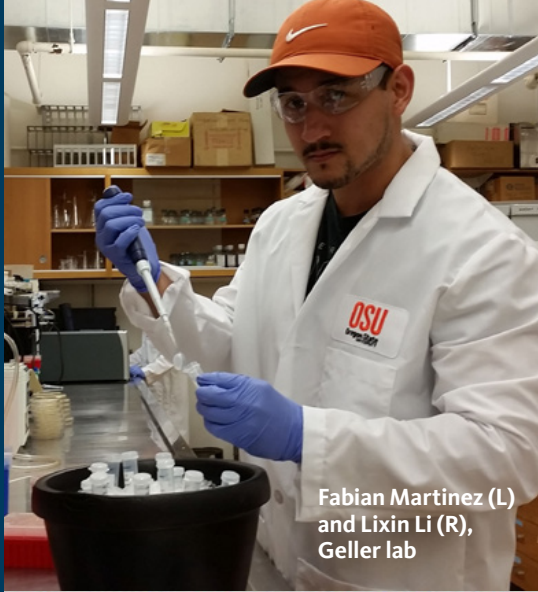
Fighting superbugs: Geller Lab

Antibiotic resistance is a serious, worldwide problem. One of the most dangerous types of resistance is carried by a fairly recently discovered gene called NDM, or New Delhi Metallo-beta-lactamase, which is found in three species of antibiotic-resistant bacterial pathogens. By designing a DNA-like molecule (called PPMO) that penetrates the bacteria and disables the NDM gene, the Geller Lab has restored antibiotic susceptibility. Our lab showed that treating infected mice with a combination of PPMO and a penicillin-like antibiotic increased survival by 92 percent.

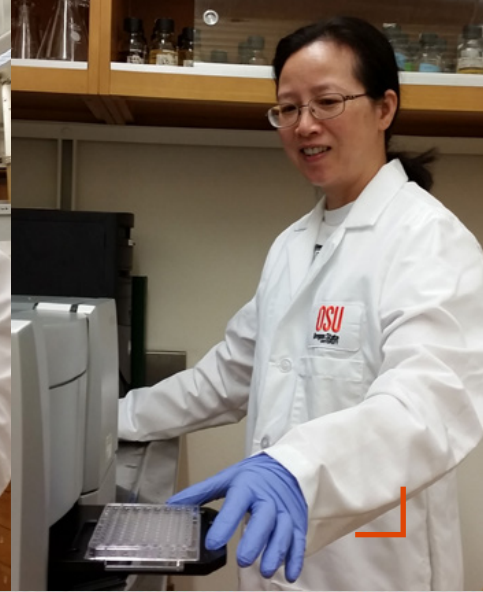
Another extremely problematic resistance gene is Mcr, which causes resistance to colistin, an old antibiotic that was discontinued decades ago because of its toxicity but is still used today when every other antibiotic fails. With colleagues from the University of Texas Southwestern Medical Center in Dallas, the Geller Lab has shown that a PPMO targeted to Mcr restores susceptibility to colistin.

Another strategy is to kill antibiotic-resistant pathogens directly by treating them with a PPMO that interferes with one of their genes required for viability, a strategy the team has deployed against a number of pathogens. More recently the lab has demonstrated this approach with *Pseudomonas*, one of the most antibiotic-resistant types of bacteria that often infects patients with cystic fibrosis or extreme burns. Our results showed that a PPMO targeted to an essential gene killed 99.9 percent of *Pseudomonas* in a mouse model of pneumonia.

Overall, the Geller Lab continues to develop PPMOs that either kill pathogens directly, like an antibiotic, or interfere with antibiotic-resistance genes and be used in combination therapy with a standard antibiotic. It is possible that a PPMO could reach human testing in about three years.



Fabian Martinez (L)
and Lixin Li (R),
Geller lab



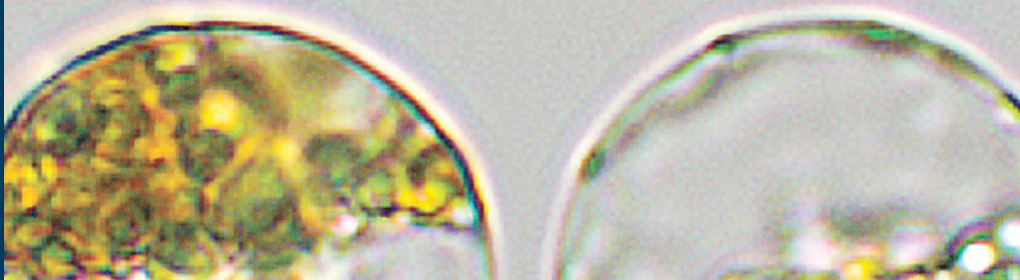
Discovering diatom sex: Halsey Lab

Graduate student **Eric Moore** made an exciting discovery using an old-style light microscope rescued from surplus five years ago, reminding us of the powers of careful observation and a curious mind. He observed that a key marine diatom has both an asexual and a sexual phase in its life cycle, and that ammonium induces them to enter the sexual cycle. Moore's discoveries were published this year in *PLoS One*, and received a nice bit of media attention, including NPR Science Friday's "A Peek Into The Sex Lives Of Algae."

Undergraduate **Briana Bullington** (B.S. '16) helped Eric with his research, laboriously hand-counting sexual cell types, collecting cells on weekends, and extracting RNA for gene expression analyses to confirm changes in meiotic genes following ammonium induction. Current microbiology student **Jordan Coehlo** is continuing this project, thanks to support from a Sheila van Zandt Scholarship (see p. 15).

Postdoc **Cleo Davie-Martin** and graduate student **Bryce Penta** were recently at sea studying photosynthetic metabolism in the North Atlantic Ocean, the third of four NASA-sponsored cruises to understand the ecological factors controlling the annual massive phytoplankton bloom event and how it interacts with the atmosphere. Davie-Martin is investigating the range and amounts of small volatile organic compounds produced by marine phytoplankton. These compounds have multiple pathways in the environment, providing growth substrates to other plankton, deterring competition, and influencing aerosol and cloud formation, with potential implications for climate regulation.

Kelsey McBeain graduated with her master's degree and is now a lab technician at the University of California, Santa Barbara; her personality and hard work are missed. We welcomed two new graduate students, **Lindsay Collart** and **Michelle Pombrol**, and we are excited to learn where their investigations lead.



Toxic blooms: Dreher Lab

Cyanobacterial blooms continue to occur with high frequency in Oregon's lakes and reservoirs, sometimes to deadly effect. In one of the largest recorded episodes of cyanotoxicosis in farm animals, 31 steer died rapidly after drinking from a farm reservoir with a large *Anabaena* bloom near Lakeview, Oregon, in 2017. High concentrations of the liver toxin microcystin were found in both the lake water and rumen contents of one of the dead steers. *Anabaena* seems to be the source, but we are still conducting studies to verify this as cyanobacterium is not commonly associated with the high levels of microcystin that were seen during this event. To help clarify, we are comparing the episode to two other recent Oregon cases in which high levels of microcystin have been provisionally linked to *Anabaena*, Lake Billy Chinook and Odell Lake.

Anabaena-dominated blooms in Oregon waters are often non-toxic, and the hope is that comparing the genomes and toxigenic potential from these three sources will enable us to better understand the risk and design better molecular probes to monitor and distinguish between toxic and non-toxic blooms.

Oregon coast microbes: Mueller Lab

Our first Ph.D. candidate, **Sam Bryson**, successfully defended his dissertation this year, coinciding with the publication of his third first-author manuscript from his dissertation in *The ISME Journal*. His research applies novel mass spectrometry-based approaches to study the metabolic activities

of microbial cells in natural environments. These methods have provided unique insights into microbial communities and the distinct ways they use various resources for growth and survival.

Ph.D. student **Brandon Kieft** is following up on these findings by examining carbon cycling in estuaries and near-shore environments, with a focus on how terrestrial organic matter is used by resident microbes. He was awarded an NSF fellowship to participate in the East Asia and Pacific Summer Institute program. There, he worked with Dr. Shinsuke Shigeto of Kwansai Gakuin University in Osaka, Japan to learn an innovative method for examining microbial metabolic activities, applying it for the first time to aquatic microbial cells. He also went on his first research cruise last winter on OSU's R/V Oceanus, to analyze how storm-driven pulses of nutrients from the land influence Oregon coast marine microbial communities.

Other Ph.D. students have been busy working on the Oregon coast, too. **Hanna Kehlet Delgado** completed an exhaustive sampling of the Whiskey Creek Oyster Hatchery in Netarts Bay to define how microbes affect the health of oyster larvae produced on a commercial scale. **Winni Wang** has been researching the effects of nutrient loading on the seagrass bed microbiome, one of the first experiments to be conducted in the newly opened seawater experimental facility at Hatfield Marine Science Center.

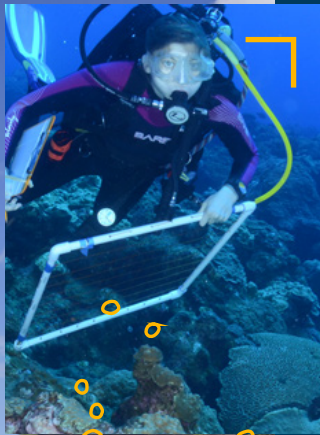
Postdoc **Armanda Roco** has been busy as a new Oregon Museum of Science and Industry (OMSI) Fellow (see p. 5).





Solomon island
Overlay: Rebecca
Vega-Thurber

Mo'orea, French
Polynesian islands
Overlay: Becca Maher



Worldwide adventures: Vega-Thurber Lab

This has been a monumental year. We have gained three new Ph.D. students (**Grace Klinges**, **Becca Maher** and **Adriana Messyasz**), graduated one (**Dr. Stephanie Rosales**, sent off **Alec Eastman** ('17) to the University of California, Santa Barbara for graduate studies in marine microbiology, and hired an amazing lab manager and technician, **Emily Schmeltzer**. A remarkably talented artist, **Briana Leahy**, has taken our research efforts in new directions and enhanced our outreach dramatically with a series of marine-themed comic strips for K-12. As usual, we had many exciting scientific adventures, from Nice, France, to Australia; Noumea and Chesterfield Islands; Papua New Guinea and the Solomon Islands; Tahiti; Palau; the Philippines; Hong Kong and New Zealand.

Academically it's also been a standout year. We have published seven manuscripts on the microbiology of marine habitats and animals, including a major synthesis in *Nature Reviews Microbiology* on the role of viruses in coral reef health, a collaboration between two former postdocs, **Adrienne Correa** (now a tenure-track professor at Rice University) and **Jerome Payet** (now in Byron Crump's Lab), and my collaborator/spouse microbiologist **Andrew Thurber**. We won an NSF Biological Oceanography Grant Award to quantify how viruses in both the water column and the corals themselves contribute to reef health.

One of our most exciting publications, "An Anna Karenina Principle for Microbiomes," suggests that the microbiomes of diseased or stressed individuals vary wildly whereas those of healthy creatures are similar. The work, spearheaded by **Jesse Zaneveld**, former postdoc and current tenure-track professor at University of Washington in Bothell, was featured by science writer

Ed Yong in a very flattering *Atlantic* article.

The lab continues to receive numerous honors and awards. **Vega-Thurber** served on a distinguished keynote panel at the American Society of Microbiology Society along with two National Academy members. Graduate student **Ryan McMinds** was awarded the Middlekauf Award for Outstanding Student Scholarship. With five publications to his name, Ryan's work on the co-evolution of bacteria with corals will undoubtedly make a major contribution to our understanding of coral microbiology.

Grace Klinges and **Adriana Messyasz** both received OSU Provost Awards for their first year of graduate study. Grace has also received two awards from OSU's President's Commission on the Status of Women to relay our Tara expedition findings at a Paris research consortium. Adriana, who is working on the viruses of corals, won a Clinton Foundation award to link K-12 training between the inner city of New York, where she grew up, to the remote islands of French Polynesia, where she does her research.

Becca Maher, also a first year, was recently awarded a prestigious three-year NSF Graduate Research Fellowship to study the interacting effects of nutrient pollution and predation on coral health. She is currently conducting her first studies on the island of Mo'orea, French Polynesia. An undergraduate student received a SURE Science award to join us in Mo'orea to study the combined effects of nutrient pollution and thermal stress on coral microbiology.

Lastly, **Stephanie Rosales** ('16) is a senior bioinformatics researcher at NOAA in Miami, a tremendous promotion for a recent Ph.D.



Rainbow trout gut microbiomes are affected by domestication



Health and the gut microbiome: Sharpton Lab

An abundant and diverse community of microorganisms resides deep within our bowels. Though tiny in size, these microbes collectively have a profound effect on our health and are integral to our nutrition, immunity and even behavior. The Sharpton Lab seeks to discover the mysterious molecular mechanisms through which the gut microbiome influences our physiology, and hopefully learn how to manipulate microbiomes to prevent and treat disease. Toward this goal, we published a landmark manuscript that reveals how the metabolic capabilities of the gut microbiome change as inflammatory bowel disease develops, resolving the biochemical pathways through which the gut microbiome may contribute to disease onset and severity.

Several Ph.D. students in the lab are expanding our research.

Courtney Armour compared the gut microbiomes of over 2,000 clinical patients and identified microbial species and biochemical pathways to diagnose various diseases, including liver cirrhosis, diabetes and inflammatory bowel diseases. Postdoc **Christopher Gaulke** and veterinary medicine Ph.D. student

Holly Arnold identified gut bacteria that are typically conserved among healthy mammals. **Nicole Kirchoff** is exploring how domesticating rainbow trout affects their gut microbiome to impact the success of the fish in nature. **Quinn Washburn**, who is co-mentored by **Stephen Giovannoni**, has begun a project to culture and study virtually all members of the gut microbiome by combining robotics, DNA sequencing and good old-fashioned culturing techniques.

Our lab continues to engage in education and outreach. **Tom Sharpton** leads the OSU Microbiome Initiative (OMBI, see p. 6) and spoke at several meetings of health care professionals, including the annual Obesity Society Meeting. The lab led a Summer Undergraduate Research Experience for four students from across the country. **Christopher Gaulke** advanced an undergraduate training program in the lab, and along with undergraduate **Lexi Wilson**, published a manuscript describing the genome sequence of a novel gut bacterium.

The social life of bacteria: Schuster Lab

Even bacteria cooperate and communicate, and the Schuster Lab studies their secret social lives, a type of microbial “sociology.” A new study, led by graduate student **Joe Sexton** and funded by the National Science Foundation, examines how cooperative behavior is maintained in the face of cheating, finding that the costs of cooperation are highly contextual and depend on specific nutrient conditions.

The lab has also bid farewell to two Ph.D. students, **Joe Sexton** and **Kyle Asfahl**, who have graduated and are pursuing postdoc positions, and welcomed graduate student, **Parker Smith**, who has joined us from Western Oregon University to work on phenotypic heterogeneity in bacterial populations. Graduate student **Tanner Robinson** has been in the lab for a year and is making good progress on mapping the genetic changes that occur in cooperating bacteria over time.



Graduate student Joe Sexton, in the Schuster Lab

ALUMNI & FRIENDS

Together we are making a growing impact

Far-sighted endowment fosters mentorship and spurs research

The Sheila G. Van Zandt Student Research Experience Fund Endowment, currently in its second year, funds teams of undergraduate and graduate students who develop a research proposal, create a budget and secure a faculty mentor. By wisely combining mentorship with hands-on research, the fund accelerates experiential learning, graduate teaching and project administration skills all at once. This year two teams received scholarships.

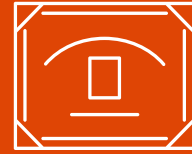
Undergraduate **Jordan Coelho** and graduate student **Eric Moore** collaborated on a study of the diatom lifecycle and its influence on the ecology of marine ecosystems under the direction of microbiologist **Kim Halsey** (see p. 11). Isolating progeny resulting from diatom sexual reproduction events, Coelho used time-lapse and fluorescent microscopy to observe cellular changes in diatoms across the lifecycle. She learned how to perform DNA extractions, microsatellite region PCR (polymerase chain reaction) and gel electrophoresis to confirm genetic exchange in mating diatoms.

Moore is grateful for the opportunity to work with such a talented student as Jordan, saying “she really takes it seriously, and we are both excited to present the results at the Ocean Sciences Meeting in February.”

In the second project, undergraduate **Sonora Meiling** and graduate student **Adriana Messyasz** examined the effects of nutrient enrichment on the coral microbiome through a bleaching event under the supervision of microbiologist **Rebecca Vega-Thurber** to explore how corals that survived one bleaching event react to a second one. Both students traveled to the island of Mo’orea in August to collect samples.

A common mission for fish health

The Oregon Department of Fish and Wildlife (ODFW) has been an important partner since the 1960s, reflecting the strong agricultural mission of our department. The Fish Health Unit of ODFW is located on the fifth floor of Nash Hall, and the agency has coordinated many student research experiences, providing cell cultures and bacterial isolates for lab courses and sometimes employing our graduates. Since 2005, ODFW has funded a



Undergraduate scholarships

Eighteen microbiology undergraduates were honored at our annual scholarship luncheon in May.

In addition to our department awards totaling \$25,000, 17 microbiology students received a total of \$49,250 and 45 biohealth science students a total of \$98,450 in scholarship awards from the College of Science, thanks to generous alumni and friends.

Graduate scholarships and fellowships

This year, 11 graduate students received awards at a special reception at The Art Center during the “Microbiomes: To See the Unseen” exhibit.

scholarship that supports a graduate student working on a topic relevant to its mission.

To date, three of our ODFW-supported graduates have landed positions in fish health: **Jayde Ferguson** with the Alaska Department of Fish and Game, **Matthew Stinson** with the Northwest Indian Fisheries Commission and **Michelle Jakaitis** with the Idaho Department of Fish and Game. These graduates are now setting policies to ensure that fish stocks remain a healthy resource for our planet and people well into the future.



Honor Roll

We are proud to recognize the department's annual supporters who have made outright gifts or pledge payments totaling \$1,000 or more between July 1, 2016, and June 30, 2017.

Anonymous (1)
Matthew A. Bacho '92
Jerri Bartholomew '85
Debra Shigeno Bellinghausen '79
and Michael F. Bellinghausen '79
Barbara Chirney Craig '72
and Morrie Craig '65
Janna Ford '99
Ellen & William R. Ford
Gregory D. Geist '72
Judith F. and Paul R. Kenis '67
JoAnn C. and Oren T. Leong
Sharon Magnuson '85
Cynthia and Michael M. Mueller
Madeleine C. Deininger
and Joel E. Peterson '69
Joan Countryman Suit '53
and Herman D. Suit
Sheila Griep Van Zandt '59
Harriet M. Winton Fund of The
Oregon Community Foundation
James R. Winton '81
Ariella and Aaron Wolf

Thank you!

If you notice any inaccuracies, please contact Penny Hardesty, Director of Donor Relations, OSU Foundation, 541-737-1469 or penny.hardesty@osufoundation.org.

New graduates seize the day

Aparna Govindan (B.S. '17) is working for Dr. Scott Wong at Oregon Health and Sciences University's Vaccine and Gene Therapy Institute.

Jeannie Klein-Gordon (B.S. '17) started a Ph.D. program in plant pathology at the University of Florida.

Molla Nawsher (B.S. '17) was accepted into the graduate program at Wagner College in New York City, where he will be pursuing a master of science degree.

Tyler MacDonald (B.S. '17) was hired at BioLegend, a company in San Diego that develops cutting-edge antibodies and reagents for biomedical research.

Allison Schue (B.S. '15) began medical school at Western University's College of Osteopathic Medicine of the Pacific-Northwest (COMP-NW).

Hannah Turner (Botany and Plant Pathology B.S. '17, Vega-Thurber Lab) just had her second paper published in *Science* on the Ebola vaccine (as second author). She recently was hired by the Scripps Institute to work on raising antibodies against the Ebola virus.

Chloe Villagomez (B.S. '14) recently was hired as a research associate at Juno Therapeutics in Seattle, a biotech company that makes cancer immunotherapies using the CAR and TCR technology that she learned about in Professor Lowry's immunology course. She writes: "I want to thank Dr. Lowry for sparking my interest in this field and for teaching such a mentally stimulating but also extremely fun class/lab with very up-to-date science!"

Kyle Asfahl (Ph.D., '17, Martin Schuster Lab): After traveling and writing in Taiwan, Kyle is a senior fellow postdoc in the departments of Microbiology and Medicine at the University of Washington, working in Ajay Dandekar's Lab.

Lmar Babrak (Ph.D., '15) After graduating from the Bermudez Lab, Dr. Babrak went to work for the Agricultural Research Service at the U.S. Department of Agriculture as a postdoc for two and a half years. She is moving to Zurich, Switzerland, where she plans to continue her science work, enjoy much cheese and chocolate and hike the Alps with her husband **Zach Landry**.

Michelle Jakaitis (M.S., '14, Bartholomew Lab) is a microbiologist for the Idaho Department of Fish and Game, working at the Eagle Fish Health Lab.

Zach Landry (Ph.D., '16 Giovannoni Lab). Recently wed to **Lmar Babrak** (above), Zach has a position at the Swiss Federal Institute of Technology in Zurich, where he will continue to study marine bacteria to explore how carbon is transported from the ocean surface to the deep ocean.

Stephanie Rosales (Ph.D., '16, Vega-Thurber Lab) is now a senior bioinformatics researcher, hired through the University of Miami to work at National Oceanic and Atmospheric Administration (NOAA) in Miami, a tremendous promotion for a newly minted Ph.D.

Rory Welsh (Ph.D., '15, Vega-Thurber Lab) is a research microbiologist in the Mycotic Diseases Branch at the Centers for Disease Control and Prevention.

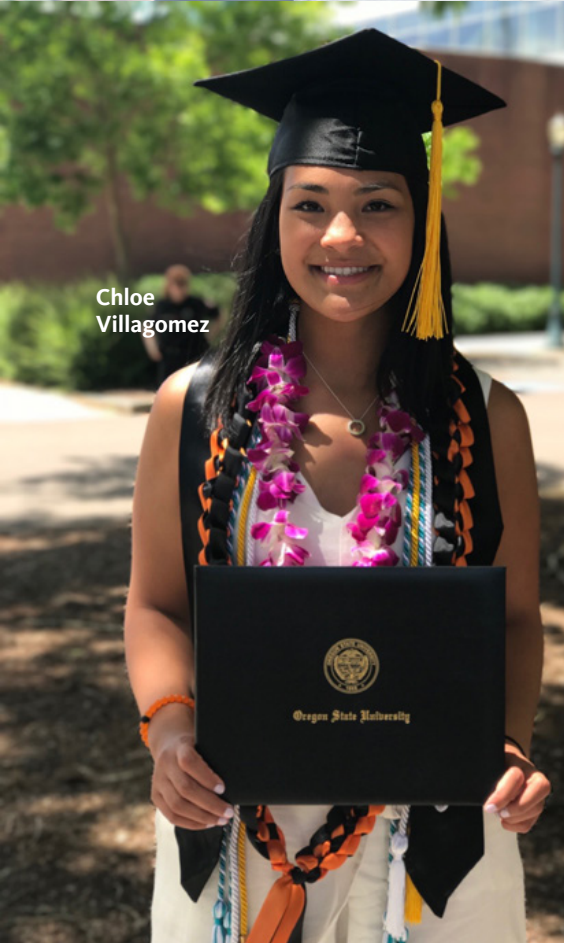
Congratulations 2017 Graduates!



Zach Landry and
Lmar Babrak



Stephanie Rosales and
Becky Vega-Thurber



Chloe
Villagomez



Joe Sexton, Martin
Schuster and Kyle Asfahl



**Oregon State
University**

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



Real Estate = Real Opportunity

Your gift of property can open doors at OSU

Learn how you can boost your retirement plans through a life-income gift, eliminate capital gains taxes, and create life-changing opportunities for students. All with real estate! Contact us today.

Julie Irmer, Office of Gift Planning
800-336-8217 • Gift.Planning@osufoundation.org
osufoundation.org/giftplanning



**Oregon State University
Foundation**

