

College of Science

# ANNUAL REPORT

2017-2019

Stepping up to the world's greatest challenges.



**Oregon State**  
University

College of Science highlights for the fiscal years  
beginning July 1, 2017 and ending June 30, 2019.

Oregon State is a profoundly public-spirited university characterized by world-class researchers and collaborative community-builders intent on serving people across the state, the nation and the world.

This powerful drive reflects our institution's status not only as a Land-Grant university, but also a Space-Grant, Sun-Grant and Sea-Grant university. These designations signal Oregon State's ability to receive federal funding for research projects that benefit the larger community.

**Science plays a key role in that quest.** The College of Science is deeply engaged in solving many of the most pressing challenges we face as a society.

Together we ignite a passion for science in all learners and move discoveries from the lab to people's lives. The university's broad research, scholarship, teaching, service and discovery enterprise encompasses all areas of science.

### **From ploughs to touch screens**

Science has played a founding role in carrying out Oregon State's **Land Grant** mission from its origins in the Morrill Act of 1862. The College's pioneering programs and research in biohealth, the life sciences, marine and environmental sciences, and statistics help us adapt to changing social and economic needs. Through evidence-based programs, science provides both a body of evidence and a mode of inquiry that leads to world-changing discoveries.

Local, state and global industries have profited from sustainable materials that began as lab experiments in Gilbert Hall, from more efficient batteries and greener touch screens, to a new heat-resistant paint using a historic new blue pigment discovered here.

### **Harnessing natural resources**

The OSU **Sun Grant** program is aimed at creating sustainable green technologies to meet growing energy demands and promote opportunities for bio-based economic growth in rural communities.

Our physicists and chemists have been at the forefront of innovation to enhance energy generation and protect the global environment. The College is a key player in the field of renewable energy technologies, including developing transparent conductors and photovoltaic materials for efficient light emission and the conversion of solar energy. Our scientists have invented new hydrogen-ion, potassium-ion, sodium-ion and dual-ion batteries with broader potential for energy storage, ushering in an era of renewable and sustainable energy devices.

*(Continued on inside back cover).*







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# Science for a better world



## We have a thirst for knowledge and a hunger for action.

Oregon State Science attracts inquisitive scholars and bold doers from around the world. Through teaching, research and innovation, our public-minded College pursues its mission to serve Oregon and the world, boldly stepping up to the challenges that only science can address.

The motivation to advance science runs deep in our College. Our belief in the power of science to improve society drives how we pursue exceptional teaching, promote groundbreaking research and foster innovation. Our mission energizes how we champion student success and inclusivity.

Science that sits on a shelf helps no one: We seek out ways to translate discoveries into action. Together, our scientists and students are bettering the world — mitigating climate change, using data science to enhance economic development, improving animal and human health and identifying new sources of renewable energy and sustainable technology.

The research and teaching mission that drives us has a global reach, taking our scientists to remote coral reefs in the Solomon Islands, international non-governmental organizations around the world, the U.S. National Science Board and Apple and Samsung boardrooms.

We do this while supporting a culture of inclusive excellence as a top priority. We are investing in the tools, people and resources that empower all of our students to reach their academic and life goals, not just a select few. Our faculty and instructors work hard to ensure that the potential of a life-changing education holds true for all OSU students who study science.

The stories in this report demonstrate what can be achieved when scientists step up to be a force for good in the world. OSU Science is improving the health of our planet and its people, and propelling the College to new heights.

**Left 1:** Participation in the Tropical Ecology and Conservation Program in Costa Rica was an “eye-opening” experience for zoology senior and aspiring ecologist Rachel Blood.

**Left 2:** Felipe Barreto integrates physiological and biochemical experiments with genomic and computational approaches to

study how marine organisms evolve. **Left 3:** An accomplished scholar, Mary Beisiegel incorporates her research and evidence-based pedagogical models into teaching. **Above:** Milan Sengthep’s memorable trip to Orpheus Island to survey coral and fish communities was her first field work experience.





It is my pleasure to present this report on the activities of the College of Science during the academic years 2018 and 2019 (July 2017 through June 2019).

In my first two years as dean during this report's time frame, I had the great privilege to experience this extraordinary academic community in action. I am energized by our scientists' drive to develop and promote a deeper knowledge of the world and its people. I am inspired by the conviction and collaborative spirit of our faculty and students, and I am encouraged by the generosity and partnership of our alumni and friends. Our College leadership has impressed me with their resourcefulness as we've worked together to further align our efforts to the Strategic Plan and galvanize resources to help faculty and students develop and promote a deeper knowledge of the world and its people.

But perhaps what strikes me most is this community's wholehearted belief in the urgent need to harness science to address society's most important problems. I hold the conviction that science is the most vital force for good in human history. The world's ability to address important societal problems requires knowledge and innovations that can only arise from scientific research that pursues the fundamental

questions and translates ideas into action. With growing urgency and conviction, our world-class faculty tackle those challenges and make lasting contributions to our state, the nation and the world — from protecting the ocean from acidification to analyzing how gut microbiome influences human health to developing cancer-fighting drugs. Our faculty are renowned researchers who step up to create new knowledge and initiate action to tackle the urgent challenges of our day.

In the time period covered in this report and beyond, I have been inspired by all the ways the College of Science continues to address issues of global concern and prepare future science leaders. You can read highlights of those endeavors in this report and more recent achievements in Impact, the College's online magazine.

I hope in the pages that follow you will share my excitement about our potential for making the College stronger, more inclusive and more deeply engaged with the world's most pressing problems.



**Roy Haggerty**  
Dean, College of Science



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# Our Research

Tackling critical challenges for Oregon and the world



## We are moving discoveries from the lab into people's lives.

Research is the cornerstone of our quest to create a healthier, more sustainable future. As one of only two universities in the country with federal land-, sea-, space- and sun- grant designations, our scientists pursue research projects that tackle big questions in fundamental science on everything from genetic code expansion to uncertainty quantification in the climate system. Researchers in our seven academic divisions have made us global leaders in ocean conservation, materials and biomedical sciences.

What impact have we had on the world? Our scientists and alumni invented the first inorganic blue pigment in more than 200 years, developed polymer-coated razor blades and the first commercially available personal computer, assisted the Obama administration in the creation of Marine National Monuments in the waters of New England, Hawai'i and the Pacific islands, and launched pioneering technology for transparent electronics leading to Apple's retina display monitor. Between

2017 and 2019, our faculty were awarded \$28M in research funding to carry forward projects that encompass ocean health, genetics, human health associated microbes, aging diseases and cosmological phenomena.

Those same researchers mentor our undergraduate and graduate students, fostering inquisitive minds and research ambitions.

Our lab innovations have fueled startup technology, contributing state-of-the-art analytical machinery to mass spectroscopy, medical sensors and semiconductor engineering. These lab-to-market innovations are transforming industry and benefiting society. Thanks to our scientists and researchers, Corvallis, Oregon, is the No. 2 metropolitan area in the nation for most issued patents per capita. Their rich and varied contributions to the research ecosystem at OSU has made the university first among Pacific Northwest universities for innovation, and 33rd in the nation.

**Left 1:** Francis Chan installs sensors in the Oregon intertidal zone to monitor ocean acidification. (Photo by the Surfrider Foundation). **Left 2:** An alkaloid isolated from the plum yew shows promise in cancer medicines. Chemist Chris Beaudry works to make synthesis of this compound more efficient.

**Left 3:** Weihong Qiu's research into molecular motors could shed light on new treatment approaches for certain types of cancers. **Above:** New crayon "bluetiful" was inspired by YInMn blue, developed by the Mas Subramanian laboratory. (Photo by Patrick Shuck at Crayola).

# Turning the tide on marine health



Our marine scientists engineer solutions to large-scale environmental challenges posed by climate change. We lead the Partnership for Interdisciplinary Studies of Coastal Oceans, or PISCO, which started at OSU 20 years ago under the leadership of **Bruce Menge**, Wayne and Gladys Valley Chair in Marine Biology. With funding of \$55.7M over the years, PISCO scientists have been at the forefront of research on ocean acidification, marine protected areas, fisheries management and ocean hypoxia, bringing significant benefits to coastal communities. Marine science in the College has transformed our knowledge of marine ecosystems, created unprecedented opportunities for our students and has led to globally recognized programs in environmental sciences and conservation biology.

### Fighting against hypoxia in the Pacific

Marine ecologist **Francis Chan** is a leading expert on ocean hypoxia, or oxygen depleted waters that are unable to sustain life, killing off marine species from corals to oysters and crabs. With the help of a \$1M National Oceanic and Atmospheric Administration grant, Chan is extending his collaborations with Oregon fishermen and the crabbing industry to map and track the extent of the hypoxia. They are identifying “hot spots” and potential refuge areas and developing predictive models of when and where low oxygen will occur that affect Dungeness crabs and fish.

“Our ocean is changing, and when we first measured hypoxia off Newport in 2002, we thought it might be a local phenomenon,” said Chan. “That is no longer the case. Low oxygen is striking a big swath of the West Coast and is returning year after year.” The new data will help fill existing data gaps critically needed to make good management decisions that will fortify the marine environment and fisheries.

### Warm oceans need cool science

The Sargasso Sea near Bermuda holds the key to understanding how a parasitic cycle triggered

by warming waters can affect the survival of phytoplankton — microscopic marine algae, such as diatoms, which have thrived in the ocean for 100 million years and may account for 20% of all oxygen production on Earth. Phytoplankton rule photosynthesis and are a key to forecasting climate change.

After pioneering work on how phytoplankton acclimate to fluctuating climate conditions and their effect on food webs and photosynthetic energy allocation, microbiologist **Kimberly Halsey** has turned her attention to the cycling of volatile organic compounds (VOCs). The latter are produced primarily by phytoplankton and are metabolized by bacteria or enter the atmosphere, where they play roles in atmospheric chemistry. Among other findings, Halsey’s research highlights the effect of VOCs on climate regulation, the marine carbon cycle and the diverse ways in which they cycle through the environment.

### Beach grasses protect coastal ecosystems

Global sea level has risen about eight inches since 1880 and continues to rise, increasing the odds of devastating floods in coastal cities. Community ecologist **Sally Hacker’s** research on the influence and role of beach grasses to protect coastal sand dune ecosystems from chronic sea level rise has significant implications for the environment, human life and property. Her research illuminates the ways in which four common dune grass species found in the Outer Banks in North Carolina aid sand accretion and dune formation, influencing how well those dunes protect our coasts from flooding. Hacker has demonstrated that climate change may affect the survival of beach grass species, which in turn will weaken sand dunes and make coastlines vulnerable.

As part of a NOAA-funded team of scientists, Hacker is also developing the Coastal Recovery from Storms Tool for coastal North Carolina, a modeling tool that will predict how barrier islands and sand dunes function and recover following storms.

Kim Halsey and postdoc Cleo Davie-Martin collect seawater to analyze the gases produced by phytoplankton. Their research is revealing complex roles for these gases, including how and why they are exchanged between microbes.

# Advancing facts in an age of skepticism



As the effects of climate change touch every community and ecosystem on our planet, our scientists are offering practical, proven solutions that people and policymakers can act upon now to minimize impacts, increase resilience and create a healthier future.

### A new paradigm of opportunity for our oceans

**Jane Lubchenco**, Distinguished OSU Professor and Steve Gaines ('82), distinguished professor and dean of the Bren School of Environmental Science and Management at the University of California Santa Barbara, proposed a "new narrative for the ocean" in an editorial published in the journal *Science*. Lubchenco, Wayne and Gladys Valley Chair in Marine Biology, and Gaines advocate for rejecting the competing myths that the ocean is either too big to destroy, or that it is too far gone to save. Their new paradigm for the sea requires policymakers and the public to embrace the opportunities that new solutions present and to rally together to insist on their implementation. Lubchenco and Gaines published their editorial in June 2019 to coincide with a United Nations report on the threats facing our oceans, which was released during World Climate Week.

### Using math to add to the climate conversation

Mathematician **Juan Restrepo** is combining data and weather models to inform climate change issues. He uses computational tools to demonstrate that it is extremely likely that human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century — pushing back against skepticism that global warming is accelerated by humans. Restrepo's work adds greater weight to the International Panel on Climate Change report, which represents the

consensus of the best peer-reviewed assessments by climate scientists worldwide.

### Minimizing wildlife impacts of renewable energy with statistics

Wind and solar energy are critical pathways to achieving a greener, less carbon-intensive future, but how do they affect wildlife? The Endangered Species Act requires that wind farms pay particular attention to endangered or threatened species. Statistician **Lisa Madsen** is partnering with the U.S. Geological Survey to develop a methodology to estimate the total mortality of bats, birds and other small creatures on wind farms and solar facilities. Developing statistically accurate fatality prediction and estimation tools can help government agencies, such as the U.S. Fish & Wildlife Service and the Bureau of Land Management, make better decisions about species management and develop design operations to minimize the impact to wildlife, thus reducing environmental damage.

### Saving Atlantis: a feature-length documentary in search of hope and solutions for corals

The world's coral reefs are one of the most diverse habitats. They are often called "the rain forests of the ocean," but accelerated coral bleaching is jeopardizing their future and impacting hundreds of millions of people who depend on them for their survival. Oregon State filmmakers produced *Saving Atlantis*, a feature-length documentary available on Amazon Prime, in which they follow coral microbiologist **Rebecca Vega Thurber** and other OSU researchers on a four-year journey to uncover the causes of coral decline and find solutions before it's too late. Filmed in the Caribbean, Australia, Hawai'i, the South Pacific and the Red Sea, *Saving Atlantis* offers viewers a worldwide tour of one of the greatest ecological challenges of our time.

The Endangered Species Act requires that wind farms pay particular attention to endangered or threatened species, which can be killed if they accidentally collide with turbine blades. Lisa Madsen's work to track wildlife mortality will ultimately make green energy safer for them.

# Evolving materials for the 21st century





Materials science research in the College goes far beyond the confines of the laboratory, improving the lives of individuals, fueling industry growth and benefiting society as a whole. From the invention of environmentally sustainable color pigments to advances in new electronics, our chemists and physicists are setting high standards for innovative research.

### A blue that never fades

**Mas Subramanian**, Milton Harris Chair of Materials Science, attained world renown after creating the first new blue pigment in 200 years. Discovered in an OSU chemistry lab in 2009, YInMn blue — an amalgam of yttrium, indium and manganese — has sparked a revolution. It served as the inspiration for a new blue crayon color, “Bluetiful,” launched by Crayola after a worldwide naming contest in 2017. YInMn blue was approved for commercial sale by the Environmental Protection Agency. Commercially known as Blue 10G513, the vivid, safe and durable pigment has been mass produced for use in industrial coatings and plastics by the Shepherd Color Company.

Australian paint company Derivan developed YInMn blue into a new hue of blue acrylic paint, named Oregon Blue, as part of its famous line of Matisse acrylic paints. YInMn blue was a centerpiece in beach renovations in northeastern Japan that was rocked by the 2011 earthquake and tsunami. When the beaches reopened in 2018 in Soma City, located close to the Fukushima nuclear power plant, the ceremonies featured beach flags and artwork that were painted with an exact replica of YInMn blue created by the Japanese paint company Holbein and christened Soma Blue.

“I am delighted that a scientific discovery can impact social causes globally. It is a great honor that YInMn blue had a role to play in this beautiful journey of inspiration,” said Subramanian.

### New materials for a sustainable future

Organic semiconductors derived from natural products can benefit the planet in a number

of ways. Physicist **Oksana Ostroverkhova** has discovered a sustainable, low-cost, easily fabricated alternative to silicon in certain optoelectronic applications. The organic blue-green pigment xylindein, used by humans in artwork for hundreds of years, is secreted by two wood-eating fungi in the *Chlorociboria* genus and displays extraordinary environmental stability as well as unexpectedly good optoelectronic performance. Ostroverkhova and collaborators have shown that, when blended with a non-conductive polymer, xylindein has promising optical and electronic properties.

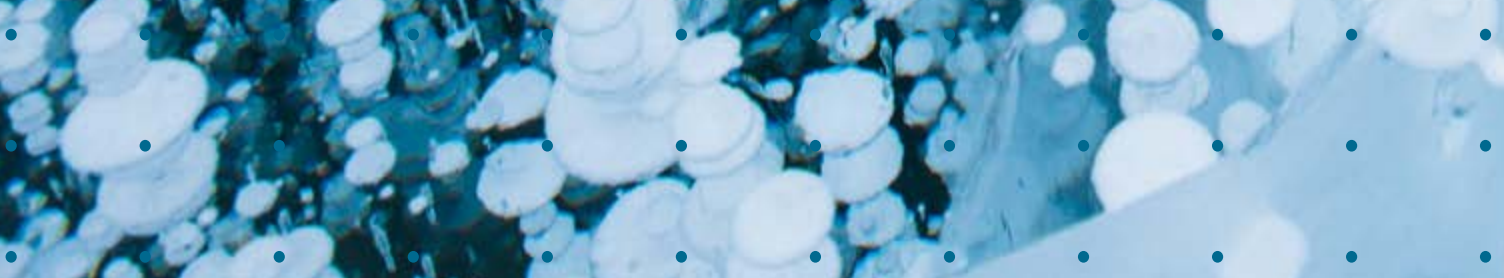
“Xylindein will never beat silicon, but for many applications, it doesn’t need to beat silicon,” Ostroverkhova said. “It could work well for depositing onto large, flexible substrates, for instance, in the making of wearable electronics.” The research breakthrough marks the beginning of a whole new class of organic electronic materials.

### Enhancing liquid crystal displays

Physicist **Matthew Graham** and chemist **Paul Ha-Yeon Cheong** have teamed up to tackle fundamental challenges that inhibit the performance of photovoltaic and thin film display transistors (TFTs). Photovoltaics are one of the largest renewable energy and electricity sources in the world, and thin film display transistors are the enabling technology for the active matrix liquid crystal displays commonplace in laptops, mobile phones and TV screens. Their lab’s multi-year funded relationship resulted in a “Density of States” Microscope for which Apple has requested patent rights. This novel microscope solves the dominant problem limiting the performance and semiconducting behavior of thin film display transistors by optically and spatially mapping the energy distributions of an amorphous oxide thin film such as indium gallium zinc oxide (IGZO) — widely used to manufacture TFTs — leading to enhanced electronic properties of IGZO TFTs. By working together, Graham and Cheong have shown how their unique capabilities can be adapted to solve problems that even the world’s largest conglomerates are ill-equipped to tackle.

Naturally occurring pigment xylindein (produced by the fungus *Chlorociboria*) shows promise as an ecologically friendly and inexpensive electronic material.

# Mining data to fuel change



Our researchers expand the reach of data sciences to confront challenges in human health and disease, find solutions to global environmental crises and launch new software deciphering the mysteries of fundamental science. Data-driven discoveries and research are interdisciplinary and boundary-defying in nature, engendering collaborations across statistics, mathematics and physics as well as biohealth, bioinformatics and the life sciences.

### Big data tool improves understanding of connections between disease and mutations

Led by biochemist **David Hendrix**, Oregon State researchers have developed a computer program that represents a key step toward better understanding the connections between mutant genetic material and disease. Known as bpRNA, the software is a big-data annotation tool for secondary structures in ribonucleic acids (RNA).

RNA works with DNA to produce the proteins needed throughout the body. DNA contains a person's hereditary information, and RNA delivers the information's coded instructions to the protein-manufacturing sites within the cells. Many RNA molecules do not encode a protein, and these are known as noncoding RNAs. "There are plenty of examples of disease-associated mutations in noncoding RNAs that probably affect their structure, and in order to statistically analyze why those mutations are linked to disease, we have to automate the analysis of RNA structure," explains Hendrix. The software will enable scientists to identify statistical trends that shed light on RNA structure formation and open the door for machine learning algorithms to predict secondary RNA structure in ways that haven't been possible before.

### Statistical innovations unravel the human microbiome

The human microbiome — the vast collection of microorganisms living in and on the bodies of humans — can lead us to a better understanding of human health and disease, not to mention

accelerate the development of therapeutic drugs. However, the vastness and complexity of microbiome data require advances in statistical methodology and software for an accurate analysis of host-microbiome interactions. Statistician **Yuan Jiang** and his team are developing novel statistical methods to bridge the gap between the human microbiome and microbiome-based healthcare. Supported by a \$775K award from the National Institutes of Health, Jiang and his collaborators are developing pioneering network models and software that will transform the discovery of how human microbes interact with one another and influence or respond to their host.

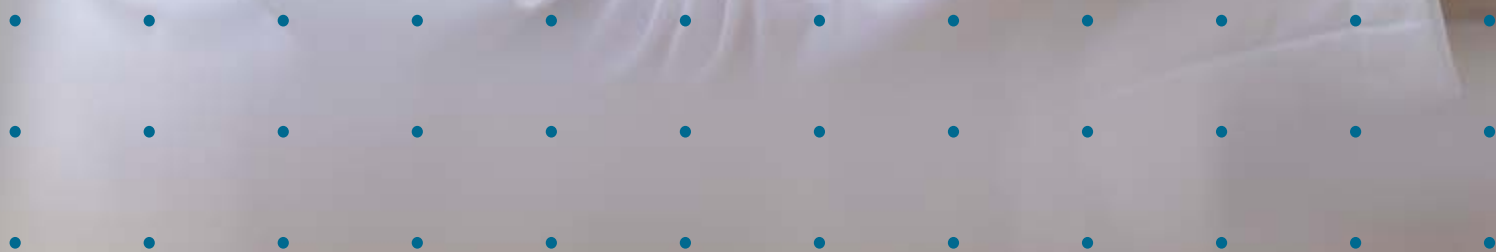
### Interdisciplinary approach to climate and energy

Mathematician **Malgo Peszynska's** interdisciplinary research combines modeling, data science and simulations to tackle mathematical and computational challenges that arise from changes to permafrost or deep ocean sediments due to warming sea temperatures. Permafrost and ocean warming cause the release and transport of methane gas from underlying methane hydrate layers, an ice-like substance that traps methane molecules. Upon disturbance of favorable climatic conditions, methane might escape to the atmosphere.

Geoscientists recognize the tremendous importance of methane gas as a crucial element of the global carbon cycle, a contributor to climate change as well as a possible energy source, yet the study of gas hydrates is relatively uncharted territory for computational mathematics. By developing new algorithms and a mathematical framework to better analyze and simulate the hydrate model, Peszynska and her collaborators are providing valuable insights into the complex and delicate geomechanics of flow, transport and phase transitions of ocean sediments and permafrost layers — and the possible subsequent release of methane — in response to increased temperatures.

Methane hydrate, an ice-like substance containing methane molecules trapped in a lattice of water molecules, are present in large amounts along continental slopes and in permafrost regions, such as Lake Baikal in Siberia.

# Reaching new heights in biomedical discovery



Biomedical research at the College is leading to cutting-edge discoveries — from novel instrumentation to an explosion of new research on human-associated microbial communities and health. Biochemical discoveries to fight infections have generated new scientific knowledge with the potential to improve clinical care. Our scientists are harnessing the power of global collaborations to deepen understanding and address the most important concerns in human health.

### Breaking new ground in autism research

Microbiologist **Maude David** is working toward finding new treatments for autism spectrum disorder (ASD) which now affects 1 in 59 children in the United States. The condition is reported to occur in all racial, ethnic and socioeconomic groups.

David and her collaborators received a \$2M federal grant to identify possible connections between the microbiome — microbial organisms living in the human gut — and autism. In a unique crowd-sourced clinical study of children with ASD and their neurotypical siblings, David identified several microbial strains that are either lacking or enhanced in children with ASD. Detecting these functional differences between the gut microbiome of autistic and typically behaving children will further our understanding of the underlying mechanisms of the associations between gut microbiome compositions and autism. David's goal is to pave the way for future therapeutic interventions and improve patient care in autism by identifying novel gastrointestinal biomarkers that may have an impact on behavior.

### Advancing disease research with new startup technology

A pathbreaking new invention by biochemist **Joseph Beckman** is transforming mass spectrometry, an analytical technique used to determine the weight, structure, chemical properties and identities of the compounds being studied. Beckman's startup e-MSion, founded with this technology entered into a co-marketing agreement with Agilent Technologies in Santa Clara, California, a development that will benefit scientists studying

everything from cancer-fighting drugs to methods for detecting explosives. The e-MSion method is called electron capture dissociation and uses low-energy electrons to gently fragment molecules, allowing scientists to conduct research in new ways and across many diverse fields. This constitutes a vast improvement upon current methods used to analyze molecules and compounds, removing significant hurdles faced by the biopharma industry. The highly innovative technology allows for the identification and quantification of biological macromolecules with increased speed, accuracy and better quality data, which will accelerate the ability of investigators to probe disease mechanisms.

### Vitamin D to the rescue

A spate of remarkable research findings have uncovered the broader role of vitamin D in fighting life-threatening infections and diseases. Biochemist **Adrian Gombart** has discovered that nanofiber-based wound dressings loaded with vitamin D spur the production of an antimicrobial peptide, a key step forward in the battle against surgical-site infections. Surgical-site infections are the most common health-care associated infection. Each year in the U.S. alone, nearly 300,000 surgical patients develop an infection within 30 days of their operation and more than 13,000 die from it. The dressings Gombart and his collaborators created proved capable of delivering vitamin D, and they significantly induced production of a peptide that kills microbes by disrupting their membranes.

### Decoding the microbiome's connections to health

Our microbiologists have made an important advancement in understanding the roles that gut bacteria play in human health. **Thomas Sharpton** and his students analyzed metagenomic data from nearly 2,000 human fecal samples to determine the association between specific gut microbiome protein variations and Crohn's disease, obesity, Type 2 diabetes and colorectal cancer. Their research paves the way for doctors to use microbiome information to diagnose diseases more specifically, quickly and less invasively.

The Thomas Sharpton lab develops bioinformatics tools that improve the analysis of microbiome function and investigates the relationship between gut microbiome diversity and inflammatory bowel disease.



**New insights  
for battling cancer**

Scientists in our College are working hard to prevent the suffering and death caused by cancer. According to the National Cancer Institute, more than 1.5 million cases of cancer are diagnosed every year in the U.S. alone. Our researchers investigate the causes behind cancer metastasis, uncover new sources of drugs and discover novel therapeutic interventions against different cancers.

### Advancing cancer treatments to spare healthy cells

Biochemist **Maria Franco** has uncovered important protein modifications, opening up a possible avenue for cancer therapies that don't have the side effects of many current cancer treatments. She is doing so by identifying a protein modification that specifically supports proliferation and survival of tumor cells. The serendipitous protein-modification discovery occurred while studying neurofibromatosis type 2. The condition is characterized by the development of tumors of the nervous system. Franco found that an oxidant called peroxynitrite reprograms specific proteins in the tumor leading them to acquire new characteristics that support proliferation of tumor cells. The key to combating some cancers may lie in targeting peroxynitrite production exclusively in tumor cells as a new therapeutic strategy for the treatment of tumors of the nervous system, with minimal to no side effects on normal tissues.

### Research paves way for new source of leukemia drug

Chemist **Christopher Beaudry** and colleagues patented a method for analogs of homoharringtonine (HHT) with improved pharmaceutical properties. HHT is a plant alkaloid isolated from the plum yew *Cephalotaxus harringtonii* grown in Asia. It was approved for use in the U.S. in 2012 for the treatment of chronic myeloid leukemia. HHT shows great promise as a starting point for the development of new medicines for multiple forms of cancer besides leukemia, however, it is highly expensive and difficult to acquire both as a chemical and as a medicine.

Maria Franco (pictured with undergraduate mentee Dorice Goune Goufack) in collaboration with scientists at UCF and NYU has identified a protein modification that could be used to target tumor cells without the unwanted side effects of many cancer treatments.

Beaudry and his collaborators have developed the technology for an efficient chemical synthesis of HHT which will quadruple the chemical yield. They will also develop analog or comparable versions of designed HHT-compounds that can be tested for effectiveness against several types of cancer cells, with the potential to lead to the development of powerful cancer-fighting drugs.

### Blocking cancer in its tracks

A breakthrough discovery by physicist **Bo Sun** moves us closer to making effective metastatic cancer treatments a reality. Sun and his collaborators have discovered that breast cancer cells metastasize through distinct cellular mechanisms and structures. They were able to track the migrating cells using microscopy and classify the cancer cells to anticipate a cell's next move, utilizing machine learning methods. This allowed Sun and others to closely study the elusive yet highly invasive journeys of cancer cells in order to stabilize or block their movement. "Now we understand which language the cells are speaking," said Sun. His team is carrying out further research that will contribute to a comprehensive understanding of the underlying regulatory mechanisms driving phenotypic plasticity in cancer progression as well as new screening and therapeutic strategies that specifically target phenotype transitions.

### Solving a longstanding protein puzzle

Biophysicist **Weihong Qiu** has solved a longstanding puzzle concerning the design of molecular motors, with the potential to lead to medical innovations that will terminate cancer progression. The research involved kinesin-14s: tiny, protein-based motors that convert chemical energy into mechanical energy to generate the directional movements and forces necessary to sustain life. Qiu's fundamental insights into the role played by the atypical structure of kinesin-14s in promoting the growth of cancer cells offers a pathway to halt those cells: with drugs that alter the structure of this sub-group of kinesins, thus grinding the molecular motor to a halt and killing the cell.

# Crossing the threshold: A new era of astrophysics





OSU physics is uncovering the mysteries of the universe and accelerating discoveries in particle physics. Our scientists tackle questions about the nature of space, the properties of matter and the origins of the universe with the help of experimental data and high-precision measurements. They lead flagship global collaborations dedicated to the detection of elusive matter and have played influential roles in the most important astrophysics discoveries of the 21st century.

### Colliding black holes and neutron stars

**Xavier Siemens**, who joined OSU from the University of Wisconsin-Milwaukee (UWM), has made significant contributions to gravitational-wave astronomy, a field that came into prominence with the first-ever detection of gravitational waves in 2015, followed by the historic observation of the collision of two neutron stars in 2017. A leading expert in gravitational-wave astronomy, Siemens has been a member of the Laser Interferometer Gravitational-Wave Observatory, or LIGO, Scientific Collaboration that announced these discoveries and participated in its Burst Search Group, as well as the Neutron Star Search Group. He also served as co-chair of the LIGO Scientific Collaboration's Calibration Team for nearly a decade. LIGO was responsible for the monumental discoveries of colliding black holes and neutron stars. At UWM, Siemens directed an NSF center dedicated to expanding and coordinating the North American low-frequency gravitational wave detection effort, and he hopes to establish a similar center at OSU. Siemens has received more than \$29.34M in funding from NSF and has authored over 250 publications.

### Unraveling the mysteries of gamma rays

For the first time in human history, scientists detected gravitational waves released by the collision of two neutron stars. The 2017 breakthrough event involving a pair of exploding neutron stars produced gravitational waves, a short duration gamma-ray burst (GRB) and a resplendent kilonova.

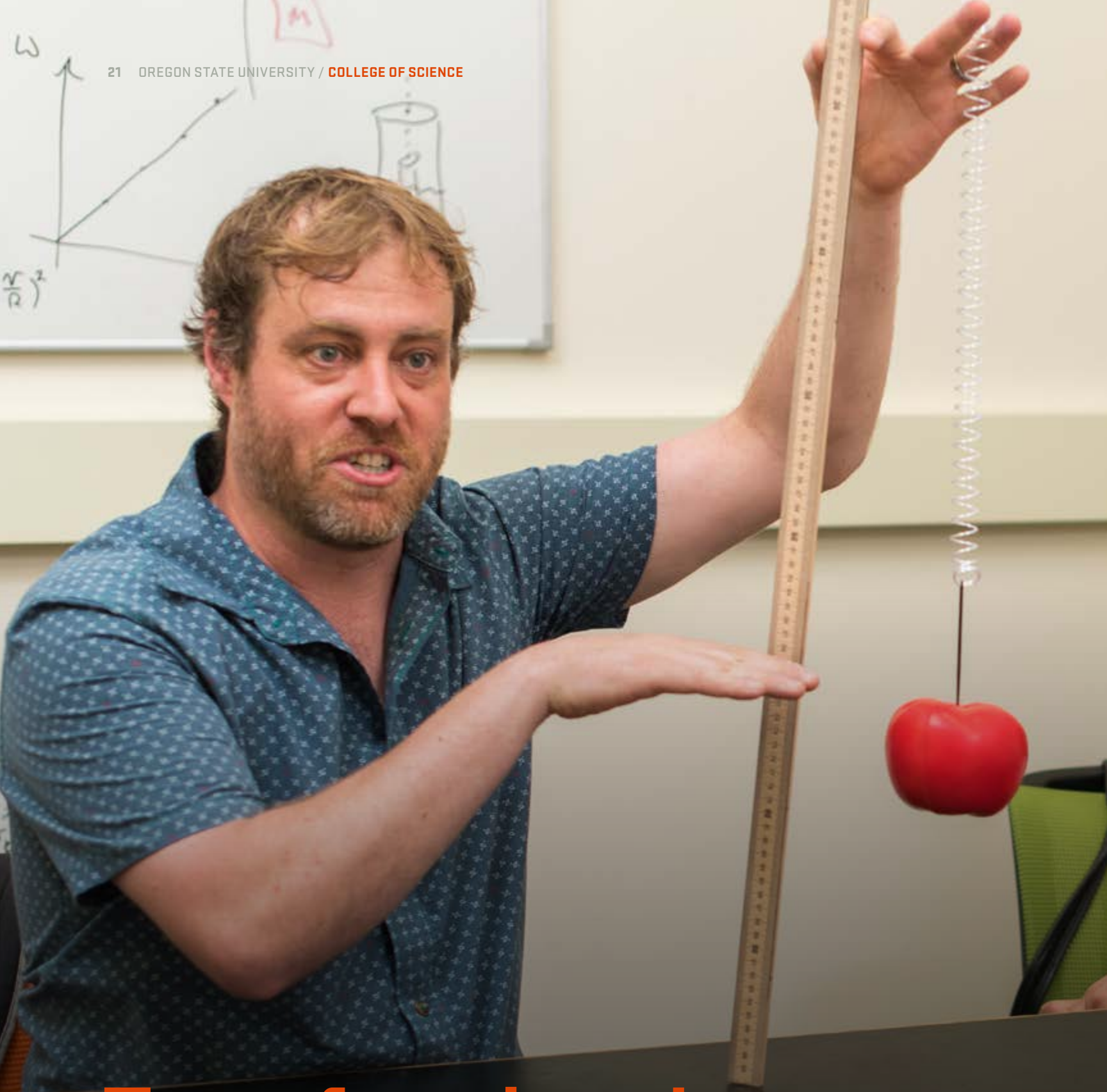
A few months before the event, astrophysicist **Daive Lazzati's** research had predicted that, contrary to earlier estimates by the astrophysics community, short GRBs associated with the gravitational emission of binary neutron star coalescence could be observed even if the gamma-ray burst was not pointing directly at Earth. GRBs are the universe's most powerful electromagnetic events, occurring billions of light years from Earth and able to release as much energy in a few seconds as the sun will in its lifetime. Following the 2017 collision, Lazzati and his team were once again able to confirm independently that the union of two neutron stars did cause a short gamma ray burst. Those findings represent a key step forward in astrophysicists' understanding of the relationship between binary neutron star mergers, gravitational waves and short gamma-ray bursts.

### At the helm of an international neutrino experiment

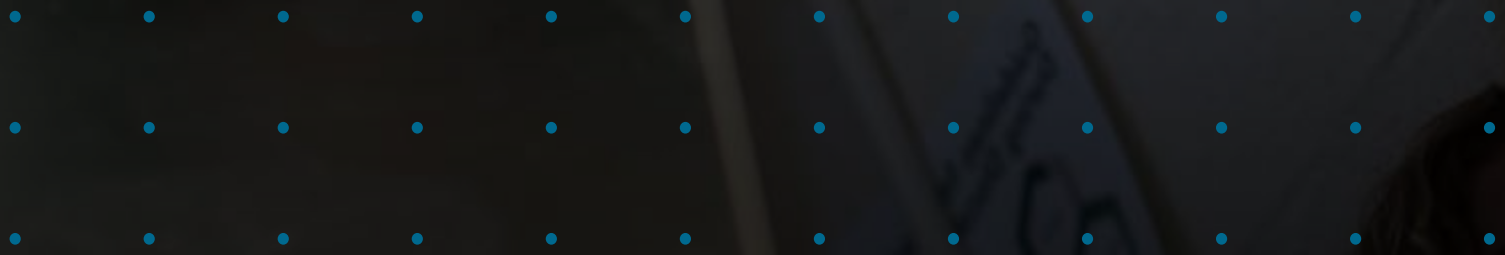
Physicist **Heidi Schellman** is a leader in the world of neutrino physics, the smallest elementary particle sometimes called ghost particles due to their elusive nature. Schellman leads the Deep Underground Neutrino Experiment (DUNE) Collaboration Computing Consortium. DUNE, hosted by the U.S. Department of Energy's Fermi National Accelerator Laboratory, is a huge, international collaboration of more than 1,000 scientists, engineers and researchers from around the globe, destined to become the first in a new generation of enormous neutrino detectors.

By studying neutrinos, Schellman and others will unlock answers to why we live in a "matter-dominated" universe. The experiment will use Fermilab's powerful particle accelerators to send the world's most intense beam of high-energy neutrinos to DUNE's massive neutrino detectors, which will explore their interactions with matter. Schellman was the first woman to lead a major particle experiment in the U.S. and has played leading roles in other large-scale national and international particle and neutrino experiments.

This 10 m<sup>3</sup> ProtoDUNE — a 1/25 scale prototype of the ultimate DUNE detector — will house 'only' 800 tons of liquid argon. Photo courtesy of CERN.



# Transforming the landscape of learning



Strengthening our prized educational mission, we continue enhancing innovative teaching initiatives that are adopted throughout the nation. With the aid of prestigious grants and awards, our scientists are broadening STEM education to ensure equitable access and inclusive excellence. Our award-winning programs have improved student success, retention and graduation rates and have gained recognition as national models in building fluency in STEM fields.

### Champions of student success

The **Department of Physics** was chosen by the American Physical Society (APS) as one of the top three universities for improving undergraduate physics education in 2018. The APS Award for Improving Undergraduate Physics Education recognizes significant impact on the learning experiences of physics majors. For more than 20 years, the Physics Department has been at the forefront of wide-ranging curricular innovations through the Paradigms in Physics project that has made the department a national leader in undergraduate STEM education. One of the grandest experiments in science education at Oregon State, the Paradigms Project overhauled and modernized the upper-division physics curriculum to better reflect the ways in which professional physicists think about the field, replacing traditional teaching styles with interactive and engaging methods to facilitate student learning and problem-solving. The Paradigms project has been funded by 11 National Science Foundation (NSF) awards totaling over \$3M since the program's inception in 1996. The undergraduate physics program continues to break the mold of conventional classroom dynamics through a variety of well-researched active-engagement teaching strategies, flipped classrooms and pairing online resources with active learning.

### Employing the power of computing to better teach mathematics

Mathematician **Elise Lockwood** won a grant from Google to enhance and increase integration between computer science education and mathematics teacher education curriculum. The

project aims to equip more teachers to teach computational concepts and practices in Oregon high schools. Lockwood and her collaborators say that this is especially important for Oregon “where many school districts have a growing population of minority youth within the educational system who are experiencing lower graduation rates than white peers and are relegated to low-track courses and below grade-level learning.”

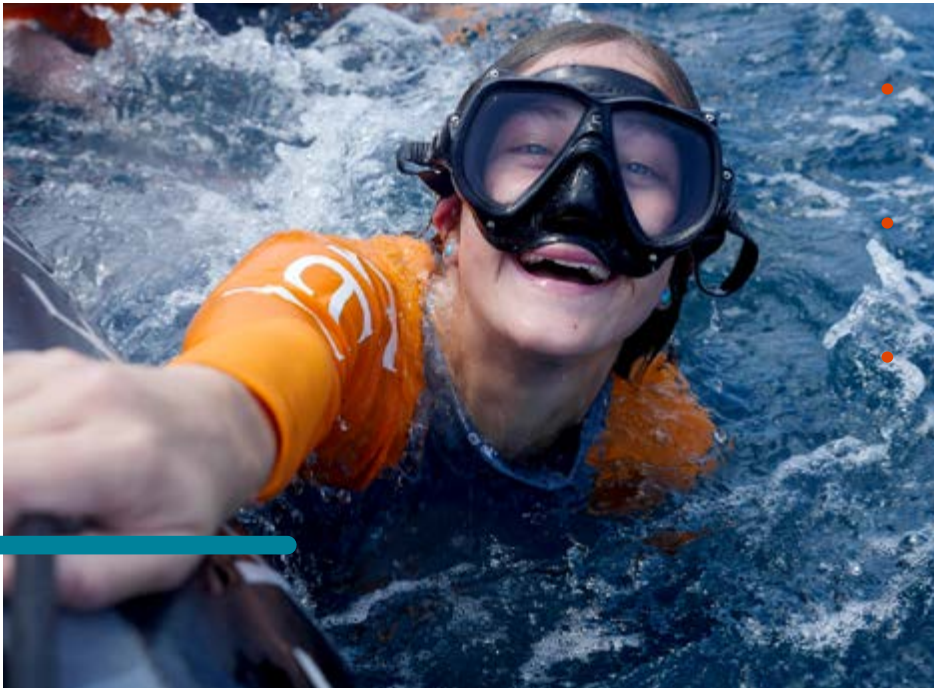
The grant was awarded as part of Google's growing efforts to support excellent, cutting-edge research in academia. As part of the project, Lockwood develops teaching modules for mathematics education students at OSU to build their computer science knowledge and skills. In the process, the students learn the basics of computational thinking, which they can apply in their future careers as teachers.

Lockwood is a globally renowned expert on the role played by students' computational thinking and activity in mathematical and STEM learning. Her research on using basic Python programming for undergraduate combinatorial problem solving, supported by a prestigious \$800K five-year NSF CAREER Award, paves the way for novel and creative methods of using computing to help in the teaching and learning of mathematics.

### Inspired physics teaching methods shared nationwide

Physicist **David Craig** leads an NSF-funded five-year, \$2.2M project to help physics departments at colleges and universities in the United States improve their programs and instruction. The project aims to address a variety of challenges facing one of the least diverse of all disciplines. Craig is the co-chair of the American Physical Society's EP3 Project — Effective Practices for Physics Programs. The purpose of the EP3 Project is to gather research-based knowledge, tools, information and documented best practices, and then create training and support structures to help departments and programs implement the information and create, evaluate and improve their individual programs.

Instructor KC Walsh has transformed introductory physics classes at Oregon State, reducing the DFW (drop-fail-withdraw) rate from 36 percent to just 13 percent.



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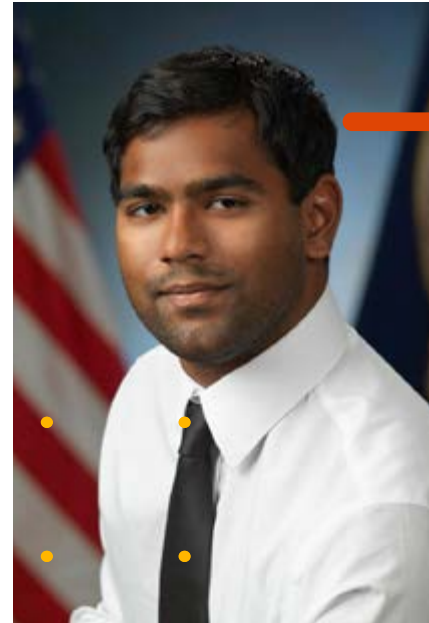
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# Our Students

Helping a new generation  
step into a strong future



## Student success is why we are here.

In the College of Science, we know that our students come first. Every day, we are amazed by the courage and resilience they show in the face of today's challenges. We support their resolve to become the next generation of scientists who will uncover solutions that contribute to the health of our planet and its people.

We celebrate and support their determination to achieve and make a lasting difference. One of our highest goals is to provide the support and tools to ensure that all of our students — especially first-generation or under-represented minority students — can succeed and gain the lifetime benefits of a college degree. Recognizing the ways in which student learning changes over time, we are proactively evolving how we teach to maximize comprehension, retention and application to help students succeed.

During the last two years, our students achieved wonderful successes. They have secured prestigious research internships, received nationally and internationally competitive awards and landed exciting jobs. Importantly, among our 2018–19 cohort of 3,000+ undergraduates, 41% received scholarships that helped them fulfill their academic goals, thanks to our generous alumni and friends.

Private support helps ensure students can excel. Many students featured in this report — and more than 300 of their peers — received support from a number of scholarships in the College which can be viewed at [science.oregonstate.edu/scholarships](https://science.oregonstate.edu/scholarships).

We are grateful to be a part of these stories, which highlight the direct impact of student support resources on forming a better-prepared and more diverse cadre of graduates and professionals.

**Left 1:** Grace Klinges swims with dolphins alongside the research vessel *Tara* during an expedition to sample corals (Photo by Vincent Hilaire, Tara Expeditions Foundation).

**Left 2:** Learning Assistant and peer mentor Marina Aguinaga works with students in Nathan Kirk's biology class.

**Left 3:** Diego Rodriguez has worked in Afua Nyarko's lab since his sophomore year. With Rodriguez, Ethiene Kwok, Nyarko, and graduate students Kasie Baker and Amber Vogel.

**Above:** Graduate student Tyler Parsotan is a NASA award recipient, which supports his work on gamma ray bursts.

# Reinventing education to put students first



One of our highest priorities is creating and supporting a culture of inclusive excellence. This means putting the resources in place to empower science students to set and reach their own academic and life goals. Our latest strategic plan asserts that “inclusive academic excellence is our north star.” We still have work to do, but we are very proud of the work the College has done in this area. In the last few years, we have launched initiatives that put student success at the forefront of all we do.

### Enhancing students’ success through connection and care

The university-wide **Beaver Connect** mentoring program is one of several initiatives that have helped improve undergraduate student success, leading to the highest ever first-year retention rate of 85.4% at Oregon State in June 2019. The program is co-led by College of Science Dean Roy Haggerty and Dan Larson, vice provost for student affairs.

Since launching in fall 2018, Beaver Connect has served more than 580 students across the university. It strives to develop stronger relationships between faculty and students, with the goal of improving student retention and graduation rates. The program connects underrepresented minority students, first-generation students and students with high financial need to mentors during their first year at Oregon State. The mentors — faculty volunteers and peers in their junior or senior years — support students as they adjust to college life, focusing on issues that make the transition for some of these students particularly challenging.

More than 100 faculty across academic programs have volunteered as mentors. The attrition rate for underrepresented students in STEM fields is particularly high, with only a quarter of those who enroll receiving a STEM degree.

Yet research shows that mentorship programs like Beaver Connect can go a long way in mitigating the disparity in graduation rates in STEM disciplines by

helping students form a stronger self-identity as scholars by recognizing their full potential for success.

After just one year, Beaver Connect has already made a difference. Those who participated in one or more mentoring sessions had a higher GPA, as well as higher rates of persistence and retention in their programs. The first-year retention rate for participants, the majority of whom were first-generation students and students of color, was 88.4%. This is 7.4 percentage points higher than a matched cohort of students who did not participate. Because of its success, OSU may expand Beaver Connect to help narrow the achievement gap and reach its goal retention rate of 90% for first year Pell-eligible, first-generation and underrepresented students.

### Peer learning: A smart pathway to deeper comprehension

The **Learning Assistant program** (LA program) addresses the challenge of how a single instructor can communicate effectively in classes that number 500 or more students. The LA program enlists the help of advanced undergraduates by placing them in introductory courses to facilitate peer-to-peer learning. The program was founded by Lori Kayes and Devon Quick, senior instructors in the Department of Integrative Biology, and Dennis Bennett, director of OSU’s Writing Center.

“LAs support course transformation by facilitating more student-centered methods of teaching and learning, for example, peer engagement or increased student discourse during lecture time, which are essential in large-enrollment classes,” Kayes said.

Data shows that in addition to increasing the number of students who pass their introductory biology and physics courses, students in LA-supported classes feel more connected to their departments, receive more feedback and have more positive attitudes toward problem-solving. Since its launch, the program has grown to impact more than 3,500 students every term

Biology student Dalton Lewis and biochemistry and biophysics student Brenna Stevens discuss career goals and opportunities with a representative from Umpqua Research at Science Pro, the College’s annual career workshop.

in introductory courses in physics, statistics, mathematics and more.

Initially funded by a \$2M grant from the National Science Foundation, this successful initiative will continue to thrive, thanks to support from science alumni David Vernier (General Science, '76) and his spouse, Christine Vernier, and Ron Schoenheit (Mathematics '65), a College of Science advisory board member.

“Having a peer learning assistant available to help a student grasp a difficult concept can make a huge difference,” said Christine Vernier. “Our hope is that the program is also helpful to the learning assistants by helping them gain confidence.”

### More resources and research opportunities

Opened fall 2017, the **Science Success Center** provides a wide range of academic and developmental support, including resource connection, career planning and opportunities to de-stress from busy college life with student-focused programming. A welcoming and bright environment, the Center has hosted over 2,500 visits since it opened.

The Center's Peer Advisors are an invaluable part of our College, contributing in numerous ways to enrich science, learning, community and engagement. They are passionate about sharing their knowledge about OSU, science and student life with fellow students. Peer Advisors are available in-person or by phone every weekday to answer questions about science majors, classes, research, internships, study abroad opportunities and science student clubs. They help many students register for classes, apply for scholarships and feel welcome in our community.

The Science Success Center also runs the **Summer Undergraduate Research Experience Program (SURE Science)**, which in summer 2019 enabled 40 students to conduct paid research with donor-supported awards totaling more than \$220K. Science students in the SURE Science Program prepare for their future by providing potentially

life-changing opportunities. Undergraduate research often plays a key role in developing student-faculty relationships and gives students hands-on learning experiences that help them grasp the practical applications of science beyond the scope of the classroom.


The scholarships provide full-time students with the opportunity to conduct paid hourly research for as many as 440 hours over the summer for up to \$5K with an additional \$500 stipend that can be used to fund activities that support their research. By providing fellowships to the greatest possible number of students, these awards enable many undergraduate students to pursue career goals that might otherwise be unattainable.

### Preparing students to be career ready

The Science Success Center also runs **Science Pro**, an innovative career program designed specifically for science and mathematics students. The annual event includes employer information sessions, a career panel and a career pathway lunch. Launched in 2019, Science Pro provides students the opportunity to explore career and internship options, hone their professional skills and develop their professional networks by connecting with alumni and potential employers. The program draws industry professionals in biotech, government agencies, national laboratories, technology companies and more.

The **Integrated Professional Development (IPD)** program has provided integrated experiential learning aimed at enhancing students' abilities to perform at a high level in a professional setting. Over 1,000 students in IPD took the Professional Development for Biologists courses for freshmen biology majors between 2017 and 2019. IPD also integrated key curriculum for professional preparation into a graduate-level capstone course for the Masters of Science in Data Analytics program. A three-term professional development program for undergraduate students developed by the IPD team was designed around the cohort-model where students receive professional one-on-one coaching and instruction while building professional relationships with their peers.



A young man with dark hair, wearing a maroon button-down shirt and dark jeans, is standing in a classroom. He is gesturing with both hands as if explaining something. In the foreground, the back of a student with long blonde hair wearing a blue and white striped shirt is visible. The background is filled with other students seated at desks, slightly out of focus.

“Having a peer learning assistant available to help a student grasp a difficult concept can make a huge difference.”



# Our undergraduates aim high



### First gen senior MIT-bound

As the first in his family to graduate high school, **Diego Rodriguez** sees many years of schooling in his future. The biochemistry and molecular biology and psychology double major wants to pursue an M.D.–Ph.D. after graduating in 2020. First, he plans to return to his lab at the Broad Institute where he spent summer 2019 at the Broad Summer Research Program (BSRP). The BSRP at MIT and Harvard is an extremely prestigious program that accepts less than one percent of all applicants.

Rodriguez has been a valued member of biochemist Afua Nyarko's lab since 2017 and coauthored a publication in the *Journal of Biological Chemistry*. His numerous awards, including the Marion B. Seward Distinguished Undergraduate Award from the American Society of Biochemistry and Molecular Biology, are a testament to his extraordinary dedication and talent.

### Biochemist sweeps top awards

**Delaney Smith** is one of the most awarded undergraduate students in College of Science history. In 2018, she was the only student in the state of Oregon to receive the Barry Goldwater Scholarship after receiving an honorable mention the year prior. She is an OSU Presidential Scholar as well as a recipient of the Tunison Scholarship from OSU's chapter of the honor society Phi Kappa Phi, which is awarded for impressive scholarly achievements.

In 2019, Smith received the National Science Foundation graduate fellowship for her research project in biochemist Elisar Barbar's lab on the characterization of how phosphorylation of disordered regions of certain cellular units modulates the activity of the motor protein dynein.

Smith also received the highly coveted Fulbright award, which took her to Belgium after she graduated from OSU in June 2019 to conduct research at the University of Ghent. After concluding her Fulbright fellowship, Smith plans to attend graduate school to study biophysics and chemical biology.

Delaney Smith's extraordinary scientific accomplishments and awards throughout her undergraduate career reflect her joy for the scientific process, which she describes as "unpredictable, yet utterly gratifying."

### Applying ethics to field of optometry

In 2018, honors biohealth sciences junior **Sydney Phu** took one step closer to realizing her ambition to be an optometrist. She was accepted to the Mayo Clinic's prestigious 10-week Summer Undergraduate Program in Biomedical Ethics Research internship in Rochester, Minnesota. Phu was one of only five students to be chosen for the competitive program and the first ever OSU student to be selected.

Phu was inspired to apply for the internship after taking a philosophy and religion course on biomedical ethics and participating in the Bioethics Club. In both settings, she learned about pressing ethical issues in the healthcare system. Phu is interested in applying ethics to the field of optometry in order to increase patients' quality of life in a way "that allows people to interact and be engaged in their world."

### Goldwater scholar sees a future in physics

**Ryan Tollefsen**, an Honors College double major in physics and mathematics, was one of four Oregon State students awarded the 2019 Goldwater Scholarship. He aspires to be a professor of physics one day, specializing in quantum cosmology and applications of nuclear fusion.

In the lab of physics professor Oksana Ostroverkhova, he works on developing stable and durable thin-film semiconductors. A skilled programmer, Tollefsen has created a code in Python and Labview to help automate and control complex experiments on semiconductors for his laboratory. In summer 2018, he received a Research Experiences for Undergraduates fellowship to work at MIT.

"I can now confidently state that there couldn't have been a better undergraduate program for me than OSU physics. Interacting with physics professors, friends and doing research in Weniger Hall have been the happiest parts of my educational journey so far," said Tollefsen.



# Graduate students: Shaping tomorrow's solutions



### Exploring the most powerful explosions known in the universe

Physics fourth-year graduate student **Tyler Parsotan** was awarded the Future Investigators in NASA Earth and Space Science and Technology (FINESST) award in the astrophysics category. The grant will provide \$45K annually for up to three years.

Parsotan works with astrophysicist Davide Lazzati on understanding the most powerful explosions in the universe known as gamma-ray bursts. Within a few seconds, the explosions will produce more energy than our sun will emit in its entire lifetime.

Originally from New York, Parsotan is a first-generation student whose family is from Trinidad and Tobago. “This fellowship is a testament to the great science that goes on in the physics department,” Parsotan said. “I hope that others — especially first-generation students — can take inspiration from the fact that working hard can lead to success no matter how impossible it may seem at the time.”

### Building our future with the next generation of diverse scientists

The first in her family to attend college, chemistry Ph.D. student **Ana Arteaga** was one of three graduate students at Oregon State to receive a 2019 GEM Fellowship. GEM’s mission is to enhance the value of the nation’s human capital by increasing the participation of underrepresented groups at the master’s and doctoral levels in engineering and science.

Arteaga, who works in the May Nyman Lab conducting nuclear research, worked at Pacific Northwest National Laboratory in 2019 gaining valuable experience in a scientific setting working alongside top researchers. A distinguished communicator, Arteaga also received the 2018 SACNAS (Society for the Advancement of Chicanos/Hispanics and Native Americans in Science) Graduate Student Presentation Award, which is given to the top nine percent of participants.

In addition to his ambitious research goals, Kamron Kayhani is developing workshops to increase opportunities for students from underrepresented groups to gain applicable laboratory skills via experiments in physiology and genetics.

### A drive to battle global climate change

Between 2018 and 2019, six of the 21 OSU recipients of the prestigious National Science Foundation Graduate Research Fellowship (NSF GRFP) came from the College of Science. The award is the country’s oldest fellowship program and provides an annual stipend of \$34K for three years for graduate students in STEM fields.

Ph.D. student **Kamron Kayhani** received the NSF GRFP award for generating new insights about the ability of mitochondrial evolution to buffer organisms against rising temperatures associated with global climate change. Kayhani’s identity as a second-generation Iranian American and a queer individual inspired his work on creating resources for LGBTQ and other underrepresented students to be successful in scientific careers.

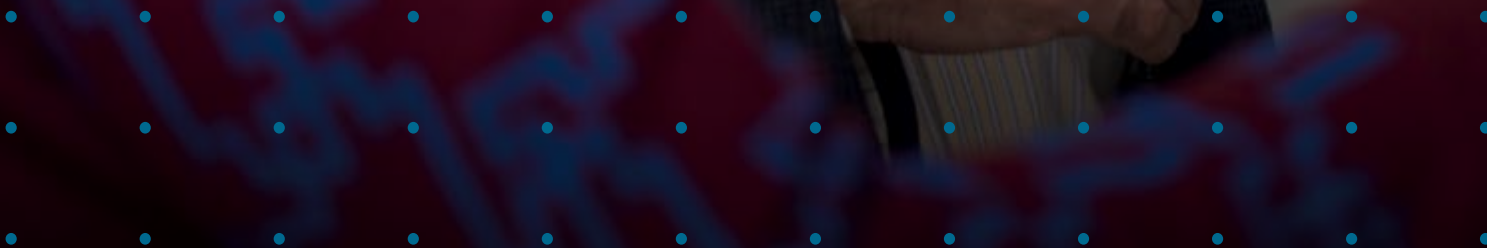
Ph.D. student **Grace Klinges** received the award for discovering a new genus of bacteria that could be significant for future preservation of coral reef ecosystems as well as recovery of affected corals. She named the new genus *Marinoinvertibrata* because the bacteria inhabit marine invertebrates, primarily corals and sponges. Her research on corals has taken her to far-flung parts of the world—the island of Mo’orea in French Polynesia, the Solomon Islands, Papua New Guinea, France and Taiwan.

### Protecting wild salmon and advocating for underrepresented students

Ph.D. student **Nicole Hams** landed an internship through the U.S. Fish and Wildlife Service’s prestigious Directorate Fellowship Program, developing non-lethal assays for the detection of infectious pancreatic necrosis virus in the salmonid species at Dworshak National Fish Hatchery. With biochemist Colin Johnson, she co-authored a paper on a deafness-causing protein published in the National Academies of Sciences. As the Western Regional Representative to the interdisciplinary National Black Graduate Student Association, Hams advocated for underrepresented minority students in science and for civil rights on the OSU campus.



# Building inclusive excellence in science



Equity, justice and inclusivity are at the heart of great science. The College of Science draws its strength from a wide-ranging community of scholars and students representing different races, ethnicities, genders, faiths, sexual orientations, perspectives and backgrounds. We are an advocate nationally and locally for equity and access to an excellent higher education in science. We are working to foster higher enrollment, retention and boost graduation rates of first-generation and underrepresented minority students. We have a growing SURE Science summer scholarship program, thanks to generous donors, that supports students from non-traditional backgrounds to pursue paid research opportunities. Our faculty and administrators have made inclusive excellence a foundation for teaching, research, outreach and engagement throughout the region.

### A lifetime of building diversity and mentoring excellence

Korvis Professor of Statistics **Javier Rojo** received the Dr. Etta Z. Falconer Award for Mentoring and Commitment to Diversity at the Infinite Possibilities Conference. This award, sponsored by the Mathematical Sciences Research Institute, recognizes those who demonstrate a commitment to mentoring and increasing diversity in the mathematical sciences. Rojo leads and directs the nationally recognized Research for Undergraduates Summer Institute of Statistics (RUSIS), which was selected by the American Mathematical Society for its award “Mathematics Programs That Make a Difference.” Funded by the National Science Foundation and the National Security Agency for the last 17 years, RUSIS is the country’s first Research Experiences for Undergraduate program in the field of statistics. It has a strong track record in recruiting, training and guiding underrepresented minority and economically disadvantaged students towards advanced degrees in mathematics and statistics.

### Reinventing structures and policies to advance equity

Faculty in the College work closely with the NSF-supported \$3.5M OSU Advance program to

increase the participation and advancement of women and underrepresented minority students and scholars in science. As an OSU Advance Faculty Fellow, mathematics professor **Vrushali Bokil’s** leadership in advancing equity, justice and inclusion has had a substantial impact on the Department of Mathematics and the College. After participating in the 60-hour immersive Oregon State Advance Seminar, which takes participants deep into the literature on difference, power and discrimination within STEM disciplines, Bokil developed and embedded Advance materials into the professional development seminar for mathematics graduate students and for students across the College. Bokil’s work is making organizational structures and policies more inclusive and equitable, and her innovations are bringing about a deep understanding of the value of diversity.

### Breaking down the barriers to a STEM education

Efforts to enhance inclusion, access and equity in science education at OSU received a significant impetus with a five-year \$1M grant from the Howard Hughes Medical Institute (HHMI) to improve instruction in undergraduate STEM classrooms. The ambitious project is called Inclusive Excellence @ Oregon State. OSU was one of 33 colleges and universities that HHMI selected in 2018 for its Inclusive Excellence initiative. As co-project leads, biology instructor **Lori Kayes** and **Mary Beisiegel**, associate professor of mathematics, are leading teaching and learning initiatives and institutional transformation to break down barriers students face when pursuing a STEM education.

Kayes, Beisiegel and other collaborators established an inclusive excellence academy where faculty from OSU and area community colleges can explore how to make STEM teaching more inclusive and improve students’ sense of belonging and persistence in STEM. As the number of Inclusive Excellence Fellows grows, the researchers look forward to widely implementing teaching practices that are supporting diversity and inclusion in STEM fields.



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# Our Outreach

Collaborating with partners and spreading a love of science





## The thrill of discovery is for everyone.

At the College of Science, outreach is one of our guiding principles. It ensures that the critical work we do spreads beyond our boundaries and contributes to a healthier and more sustainable future.

Oregon State University's buildings and state-of-the-art facilities make an ideal setting for national and international conferences. Over the past two years, thousands have convened on our campus to share ideas, advance new solutions to big challenges, foster scientific curiosity and connect with a global community. These meetings elevate the work of our scientists and the role the university plays in fostering innovation.

Outreach also helps us deepen our engagement with our community here in Oregon. Distinguished lectures featuring our own faculty and visiting

experts allow students, faculty and the greater Corvallis community to learn something new, be inspired and reflect on the value of science.

As the College of Science, we are also dedicated to cultivating a diverse and well-rounded cadre of future scientists and innovators. Throughout the year, we host a number of events geared toward K-12 students and their families to celebrate the wonders of science, instill a desire to explore their world and cultivate future world-changers.

Together, these efforts are fostering a greater community of science enthusiasts, supporters and advocates who can elevate and amplify our research discoveries to state, national and international levels and inspire future generations of science leaders.

**Left 1:** *I Contain Multitudes* author Ed Yong joins the 2018 International Symbiosis Society Congress at Oregon State as its keynote speaker. (Photo by James Duncan Davison).

**Left 2:** Children at Discovery Days get an up close look at bones from Rebecca Terry's paleobiology research group.

**Left 3:** Latinx high schoolers gather for Juntos Chemistry Overnight Camp, an immersive taste of college life and hands-on chemistry labs. **Above:** Nicole Hams spends time in Puerto Rico after Hurricane Maria helping to repair cisterns and create curriculum about the importance of water quality.



# Harnessing a global network



Researchers come from around the world to work at Oregon State and advance new ideas and innovations that are transforming our world. Over the past two years, hundreds of scientists from outside Oregon and the U.S. have convened on our campus to enjoy our facilities, catalyze big ideas and share discoveries to address some of the biggest challenges of our time.

Oregon State hosted the **9th International Symbiosis Society Congress** in 2018, which brought together 400 symbiosis scientists from 20 nations and featured a keynote talk by acclaimed science journalist Ed Yong, staff writer for *The Atlantic* and author of the bestselling book on the human microbiome, *I Contain Multitudes* (2016). Associate professor of microbiology **Rebecca Vega Thurber** was also a plenary speaker at the Congress.

The Department of Biochemistry and Biophysics hosted the second **Genetic Code Expansion (GCE) Conference** in 2018, attracting 125 attendees from academia, research institutions and industry from around the world eager to share their research at the frontiers of this rapidly growing interdisciplinary field. Associate professor of biochemistry and biophysics **Ryan Mehl** organized the event.

Preceding the conference was a week-long **GCE workshop** for participants to bring their experiments to Oregon State's Unnatural Protein Facility to collaborate, problem solve and make new discoveries in the first-of-its-kind laboratory that gives researchers full access to current non-canonical amino acid protein production capability.

Seventy participants from around the world gathered at the University for the **38th Annual Crown Gall Conference** in October 2017. The two-

day event was co-hosted by the departments of Microbiology and Botany and Plant Pathology.

Our scientists also connect with a global network far beyond campus, meeting with researchers around the world to share their findings at international conferences.

Marine ecologists **Jane Lubchenco and Kirsten Grorud-Colvert** attended the fifth and sixth annual **Our Ocean Conferences** in Indonesia and Norway, respectively. At both conferences Lubchenco and Grorud-Colvert, along with a number of graduate students, shared findings on the progress more than 200 countries are making toward their 2014 ocean conservation pledges to establish, fund or enhance more marine protected areas. They found that 46% of all pledges have been completed and another 49% show evidence of at least some progress.

Two graduate students, **Vanessa Constant and Jenna Sullivan**, who attended the 2018 Our Ocean Conference also attended the **International Marine Conservation Congress** in Kuching, Malaysia where they met with leaders responsible for many of the protected-area promises.

Mathematician **Malgo Peszynska** was chosen as one of the plenary speakers at the **2017 Society for Industrial and Applied Mathematics Conference** in Erlangen, Germany.

Biologist **Dee Denver** gave a talk entitled "From Bodhi Trees to Biotechnology: Exploring the Intersections of DNA and Human Intention" at an international symposium in Shenzhen, China organized by the Venerable Dr. Yifa, a Chan Zen Buddhist nun. The talk was live-streamed to more than 900,000 people across China.

The Genetic Code Expansion Conference draws scientists from around the world. During the week-long GCE Workshop, participants bring their own experiments to OSU's Unnatural Protein Facility, which provides current GCE technology as well as theoretical and practical training from experts.

# Enlightening ideas: Distinguished science lectures



The College of Science offers two college-wide lecture series — the Distinguished Science Lecture and the F.A. Gilfillan Memorial Lecture — that offer opportunities for experts from outside OSU and from our faculty to present their pioneering research and offer new perspectives in science to stimulate dialogue, educate, inspire shifts in how we think and advance science for a better future.

Our Distinguished Lecture series features experts from outside the university while the Gilfillan Lecture is given by a faculty member of the College who demonstrates a long and exceptional scientific career with scholarly achievements widely recognized nationally and globally.

### A historic understanding of climate change

**Warren Washington**, a renowned climate scientist and OSU alumnus, presented the 2019 Distinguished Lecture. Washington is a Distinguished Scholar at the National Center for Atmospheric Research in Boulder, Colorado, where he has spent his entire professional career. After completing his bachelor's degree in general science and his master's degree in meteorology at Oregon State, he continued on to Pennsylvania State University where he became

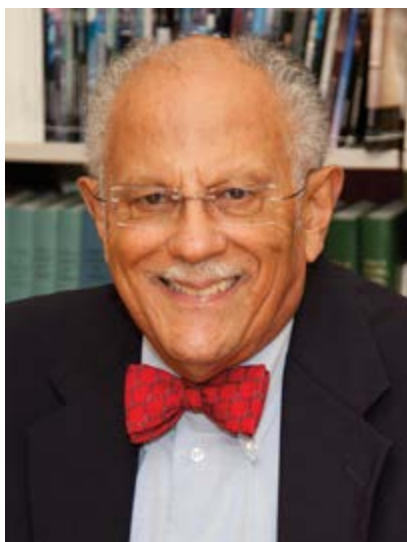
the second African American to complete a Ph.D. in Atmospheric Sciences. Washington was a key member of the Intergovernmental Panel on Climate Change that was awarded the Nobel Peace Prize in 2007, and in 2010, Washington was awarded the National Medal of Science.

### Catalyzing the transformation of science learning

Physics Professor **Corinne Manogue** presented the 2018 F.A. Gilfillan Memorial Lecture, discussing her experiences leading a highly successful curriculum redesign of the physics major as a model to explore the possibilities for learning reform in science, technology, engineering and mathematics (STEM) in the university. The stimulating talk opened up new ways of understanding physics and the path to educational transformation.

### Scientific discoveries from the alphabet soup of nuclear waste

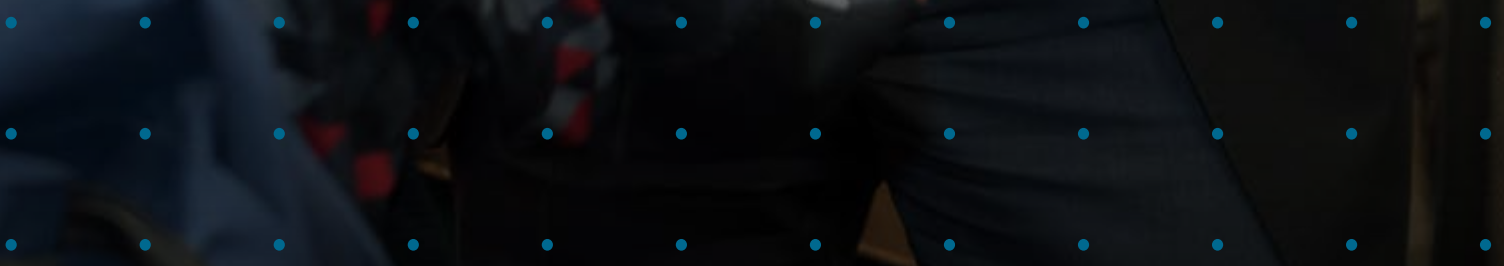
Chemistry Professor **May Nyman** presented the 2019 F.A. Gilfillan Memorial Lecture, in which she shared her experiences discovering new chemical processes and materials to clean up radioactive waste, degrade chemical warfare agents like nerve gas and support sustainable methods for nuclear fuel processing.



Meaningful lectures on pertinent topics by (left to right) alumnus Warren Washington, Professor Corinne Manogue and Professor May Nyman spark joy and provoke deep thought among students, faculty and our local community.



# Inspiring tomorrow's science leaders



Between 1990 and 2016, careers in science, technology, engineering and math (STEM) grew 79% — from 9.7 million to 17.3 million — outpacing overall U.S. job growth. The College of Science is deeply committed to providing deep and enriching science experiences to our local and regional community to help foster future STEM leaders. These engagements also expand our community of friends, supporters and allies that are spreading the word about our research and influence smart policies at state and federal levels.

One of the most exciting events of the past two years was the 2017 Total Solar Eclipse. Tens of thousands of people descended on Corvallis for the **OSU150 Space Grant Festival**, the first of four festivals celebrating the university's 150th anniversary. Our astronomer-in-residence, Randall Millstein, narrated the various natural phenomena taking place during the eclipse to the crowds gathered at Peavey Field, from diurnal birds flying home to their roosts and bats in the air to the eclipse wind that swept over the crowd. The three-day festival offered family-friendly exhibits, talks, activities and entertainment leading up to the main event on August 21.

Another highlight was our first annual **Dam Proud Day**, a one-day campus-wide giving campaign. The College of Science raised more than \$38K from a broad base of supporters from alumni and faculty to parents and students. The funds supported scholarships for undergraduate research, first-year students and student travel.

To encourage more girls to pursue an education and career in STEM subjects, the College co-hosted **Discovering the Scientist Within**, an annual free half-day workshop held in March for female middle schoolers from across the state.

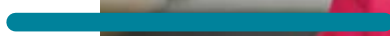
Hundreds of girls got to engage in experiments and discover the fun and exciting world of science.

**Discovery Days**, a beloved campus outreach tradition for more than 20 years, brings more than 1,500 kids to Oregon State University's campus twice each year. The College of Science-sponsored program immerses students from across the state in a wide variety of hands-on learning exercises to spur an interest in STEM subjects and inspire our future science leaders.

In 2019, Oregon State hosted its third biennial **Juntos Family Weekend** to showcase educational pathways, resources and family support OSU offers for prospective LatinX students and their families. Later in the summer, the College hosted the Juntos Chemistry Overnight Camp that immersed 22 LatinX high school students in hands-on lab experiments and gave them a taste of college life.

Our students have also found ways to have an impact beyond Oregon. For spring break 2018, College of Science students joined a group of 31 undergraduates, graduates and postdoctoral scholars and faculty on a **service trip to Puerto Rico** to help rebuild the educational infrastructure and restore natural resources destroyed after Hurricane Maria struck the island the previous September. Partnering with Puerto Rico's land grant university, University of Puerto Rico Mayaguez, the groups helped repair the Segunda Unidad Bernaldo Mendez Jimenez school in San Sebastian in the northwest part of the island. They rebuilt roofs and sidewalks, landscaped, set up bee boxes, created raised garden beds, provided water quality testing, delivered agricultural curriculum and painted a mural honoring Puerto Rican agriculture.

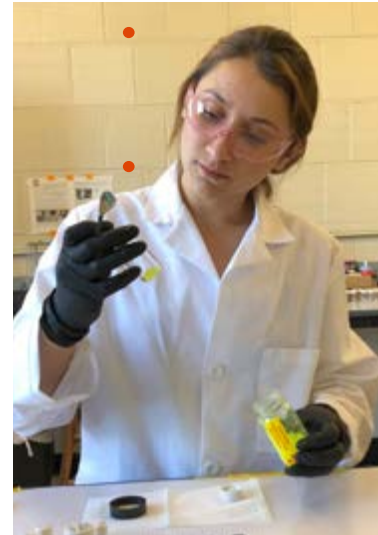
Sponsored by the Colleges of Science, Agricultural Sciences and Engineering, Discovery Days strives to inspire future generations of doctors, scientists, engineers, mathematicians, physicists and aspirants for other growing STEM careers.



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# Our Honors



National and international recognition





## Our scientists have gained renown by addressing critical challenges.

From getting elected to preeminent scientific bodies to netting competitive awards, our faculty and students were honored for achieving distinction in research, scholarship, teaching and outreach.

Between 2017–2019, science faculty were recognized for path-breaking contributions in the fields of biological sciences, chemistry, biophysics, fisheries and marine ecology. Five scientists were named Fellows of the American Association for the Advancement of Science as well as the Society for Industrial and Applied Mathematics, and three faculty members received Fulbright awards to establish research and education programs in Malta, Norway and Poland. Faculty were also recognized for lifelong leadership in science and exceptional mentoring of underrepresented students in the mathematical sciences.

Our students are the College's biggest strengths and their achievements testify to the strength of

our research and teaching programs. They continue a legacy of exceptional achievement by winning prestigious awards and fellowships.

Biochemistry student Delaney Smith ('19) won awards across the spectrum: She was the only Goldwater scholar from Oregon in 2018 and also received a Fulbright award as well as the National Science Foundation Graduate Research Fellowship. Physics graduate students Tyler Parsotan and Robert Jacobs were among 120 recipients nationwide of a prestigious NASA fellowship in the fields of Earth science and astrophysics. Between 2017–2019, six students won Fulbright awards to pursue research and teaching across the globe

We are very proud of our researchers and students for their outstanding scientific achievements, exceptional dedication to mentorship, as well as their significant contributions to Oregon State and the national and global scientific communities.

**Left 1:** Jane Lubchenco's work to advocate for science shows the importance of science communication as a bridge between research and policy. **Left 2:** Ana Arteaga's pursuit of research and science communication has earned her well-deserved recognition. **Left 3:** As a Fulbright Scholar, Kevin Ahern took

his knowledge and passion for teaching to Malta. **Left 4:** Yearning to make an impact and see the world, Dang Duong (center) committed to both through international internships. **Above:** Bo Sun's work in multicellular signaling pathways has been recognized with an NSF CAREER award.

## Faculty awards, 2018–2019

### Biochemistry and Biophysics

Biochemist and emeritus professor **Kevin Ahern** won a prestigious Fulbright Award to Malta.

**Michael Freitag** was elected a 2018 Fellow of the American Association for the Advancement of Science (AAAS), in the field of biological sciences for his contributions to fungal genetics and genomics.

### Chemistry

Nuclear chemist **Walter Loveland** was named a Fellow by the American Chemical Society (ACS).

**Mas Subramanian** was named a 2018 AAAS Fellow. He was chosen for his contributions to material chemistry, “particularly for several ground-breaking functional materials discoveries and transforming them into knowledge and practical applications.”

### Integrative Biology

**Jane Lubchenco** was elected to the Pontifical Academy of Sciences (PAS), which traces its roots back to 1603 when Galileo was the leader of the first academy. The PAS is limited to 80 members, appointed by the Pope and elected for their outstanding scientific contributions and high moral character.

**David Maddison** was elected a 2018 AAAS Fellow in the field of biological sciences for his work in phylogenetics systematics and beetle evolutionary biology.

### Mathematics

**Juan Restrepo** was named a 2018 Fellow for the Society

of Industrial and Applied Mathematics.

**Elise Lockwood** won a prestigious Fulbright award to Norway where she investigated the role that computing can play in students’ learning of mathematical concepts. Lockwood also received the John and Annie Selden Prize for Research in Undergraduate Mathematics Education from the Mathematical Association of America.

### Microbiology

**Jerry Bartholomew** was selected as a 2019 Fellow of the American Fisheries Society, the oldest and largest organization dedicated to advancing fisheries science and conserving fisheries resources.

**Tom Sharpton** was awarded the Phi Kappa Phi Emerging Scholar Award.

### Physics

**Bo Sun** was awarded \$740K as part of a five-year National Science Foundation (NSF) CAREER Award for his project, “Understand the multiplexing and communication in multicellular sensory response.”

**Matthew Graham** was selected to serve as an Optical Society of America (OSA) Ambassador.

## Student Awards, 2018–19

Three science students were awarded the prestigious Barry Goldwater Scholarship in spring 2019: **Kendra Jackson**, an honors student majoring in biochemistry and molecular biology; **Isabella Karabinas**, an honors

double major in biochemistry and molecular biology and psychology; and **Ryan Tollefsen**, an Honors student who double majored in physics and mathematics.

Biochemistry and biophysics students **Jenna Beyer** ('19) and **Delaney Smith** ('19) and integrative biology doctoral students **Zechariah Meunier** and **Kamron Kayhani** received prestigious National Science Foundation Graduate Research Fellowship Program (NSF GRFP) awards in 2019. Biochemistry and biophysics alumna **Lynda Bradley** (B.S. '15) also won a GRFP.

**Ana Arteaga**, a chemistry doctoral candidate, was awarded the 2018 SACNAS Graduate Student Presentation award.

Honors biochemistry and biophysics senior **Delaney Smith** ('19) was a 2019 Fulbright Fellow at Ghent University in Ghent, Belgium. Integrative biology Ph.D. student **Andrea Burton** was also awarded a Fulbright Scholarship as a teaching assistant in Romania.

### Physics doctoral students

**Robert Jacobs** and **Tyler Parsotan** won the prestigious NASA FINESST (Future Investigators in NASA Earth and Space Science and Technology) Fellowship.

A Gilman International Scholarship, awarded by the U.S. Department of State, took biochemistry-biophysics and Spanish major **Scout Osborne** to Puebla, Mexico in 2019. Osborne studied at the Universidad de las Américas-Puebla.

**Vanessa Constant**, an integrative biology doctoral candidate, received the 2019 Katherine S. McCarter Graduate Student Policy Award from the Ecological Society of America.

Integrative biology Ph.D. Student **Anne Devan-Song** won the American Association for University Women Fellowship. She studies complex systems at the human-wildlife interface.

Integrative biology postdoctoral scholar **Allie Graham** received an NSF Postdoctoral Research Fellowship.

## Faculty Awards, 2017–18

### Chemistry

**Mas Subramanian** was awarded the 2018 Distinguished Alumnus Award by his alma mater, Indian Institute of Technology, Madras, known as the MIT of India, where he received his doctorate degree.

### Integrative Biology

Biologist **Sally D. Hacker** was elected a 2017 Fellow to the American Association for the Advancement of Science for her “distinguished contributions to the field of coastal ecology, particularly investigating the importance of native and non-native species interactions to community structures, function and services.”

**Jane Lubchenco** was honored by the National Science Board with the 2018 Vannevar Bush Award, recognizing “lifelong leaders in science and technology who have made substantial contributions to the welfare of the nation through

public service.” Previous award winners include Linus Pauling and David Packard, the founder of Hewlett-Packard.

**Jaga Giebultowicz**, an expert on biological (circadian) clocks and their functions in organism health, was awarded a Fulbright research and teaching scholarship for the year 2017–18.

### Mathematics

Mathematician **Elise Lockwood** received a five-year \$800K National Science Foundation CAREER Award for her project, “Developing Undergraduate Combinatorial Curriculum in Computational Settings.”

### Microbiology

Microbiologist **Michael Kent** received the Outstanding Steward of Zebrafish Husbandry Award.

### Physics

**Heidi Schellman**, Department of Physics head, was chosen as Chair of Commission 11 of the International Union for Pure and Applied Physics.

### Statistics

**Javier Rojo**, the Korvis Professor of Statistics, won the 2018 Dr. Etta Z. Falconer Award for Mentoring and Commitment to Diversity.

## Student Awards, 2017–18

Two science Ph.D. students received prestigious National Science Foundation Graduate Research Fellowship Program awards. **Rebecca Mostow** in integrative biology and **Grace Klinges** received the fellowship in 2018, as did

alumni **Marie Klein-Gordon** (Microbiology, '16) and **Trevor Shear** (Chemistry, '16).

Microbiology alumni **Dang Duong** ('18) and **Grace D'Angelo** ('17) were selected for the Fulbright Scholarship in 2018. Duong was awarded an English Teaching Assistantship to Kazakhstan. D'Angelo used her Fulbright towards earning an M.S. in marine microbiology.

**Jenna Sullivan**, a Ph.D. biology student won an Ecological Society of America's 2018 Katherine S. McCarter Graduate Student Policy Award.

**Delaney Smith**, a junior biochemistry and biophysics major, received the Barry Goldwater Scholarship for 2018. Her research focused on the molecular mechanisms of alcohol addiction.

Biochemistry and biophysics doctoral student **Nicole Hams** completed a highly selective 12-week internship as part of the U.S. Fish and Wildlife Service's prestigious Directorate Fellowship Program.

Biochemistry and biophysics graduate student **Nathan Jespersen** in the Elisar Barbar Lab received a 2017–18 STEM Chateaubriand Fellowship from the Embassy of France in the United States.

Microbiology senior **Julianna Donohoe** was awarded a Benjamin Gilman International Scholarship to study in Spain.



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# Our College

Advancing science, building leaders



# The world can count on us for a healthier, more sustainable future.

**Our mission: To advance science and build global leaders for a healthy people, living on a healthy planet, in a healthy economy.**

For nearly a century, the College of Science has pushed the boundaries of knowledge and possibility, pursuing inquiry that crosses disciplinary boundaries and stretches from fundamental discoveries to innovation and leading-edge applications. Research flourishes in our seven departments and academic programs across the mathematical, physical and biological sciences and in our state-of-the-art centers, programs and facilities.

An incubator for innovation, the College strengthens pathways for scientists and partners to develop their ideas into solutions that meet pressing needs in the market. Our scientists

envision what is possible through research, collaboration and inspired problem-solving, and turn their groundbreaking discoveries into solutions of high value to society.

Our mission is at the intellectual heart of Oregon State University's larger mission as a comprehensive, research intensive public land-grant university, one of only two universities in the U.S. to have land-, sea-, space- and sun-grant designations with the common commitment to exceptional teaching, research and engagement in Oregon and beyond.

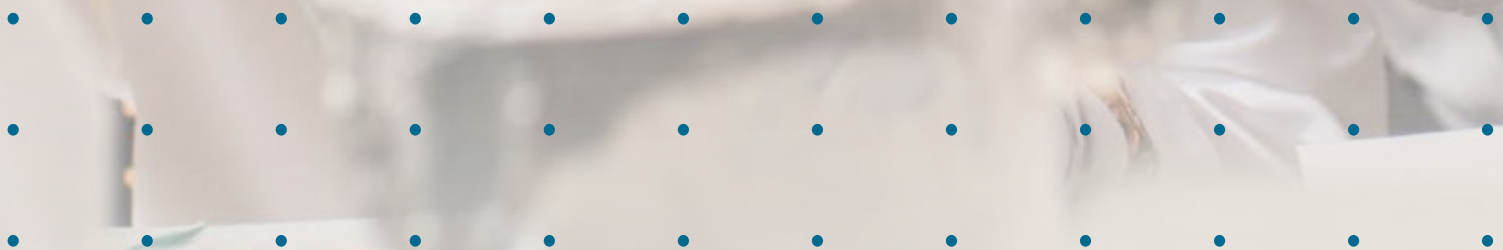
Our distinction lies in the depth of our work in the life, physical, mathematical and computational sciences. Through investment in these areas, we build future leaders ready to engage science that improves our world.

**Left 1:** Director of the Unnatural Protein Facility Ryan Mehl works with undergraduate and aspiring pediatric oncologist Sonia Grutzius. **Left 2:** To help young students better understand ocean ecology, microbiology graduate student Quinn Washburn developed the board game Oligotrophic.

**Left 3:** Lori Kayes integrates interactive technology and active learning processes to enhance engagement and learning in large-format courses. **Above:** Three million specimens reside in the Oregon State Arthropod Collection, making it the largest entomological research collection in the Pacific Northwest.



# Scientific discovery for a healthier world



## Majors

Biochemistry and Biophysics  
 Biochemistry and Molecular Biology  
 Biology  
 BioHealth Sciences  
 Chemistry  
 Mathematics  
 Microbiology  
 Physics  
 Zoology

## Master's Degrees

Biochemistry and Biophysics  
 Chemistry  
 Integrative Biology  
 Mathematics  
 Microbiology  
 Physics  
 Statistics, including Data Analytics (online)

## Doctoral Degrees

Biochemistry and Biophysics  
 Chemistry  
 Integrative Biology  
 Mathematics  
 Microbiology  
 Physics  
 Statistics

## Departments

Biochemistry & Biophysics  
 Chemistry  
 Integrative Biology  
 Mathematics  
 Microbiology  
 Physics  
 Statistics

Biochemistry and molecular biology major Luz Jovita Dimas works in Viviana Perez's Lab studying cell aging and prevention of cellular damage.

## By the numbers

**3,245**

undergraduates on all campuses

**469**

graduate students on all campuses

**148**

OSU-Cascades undergraduate and graduate students

**122**

Ecampus undergraduate and graduate students

**121**

tenure/tenure-track faculty

**192**

total faculty

**3.63**

average GPA of incoming students

**31%**

of Honors College students are science majors

**65%**

average medical school admittance rate, one of the highest in the country

**6/7**

Goldwater Scholars at Oregon State were science majors, 2017-19

**4/11**

OSU Fulbright Scholars were science majors, 2018-19

**19/55**

OSU Fulbright Scholars were science majors since 1965

**22**

Distinguished Professors, the highest of any college at Oregon State

# Facilities that foster exploration





The College of Science works in partnership with the Research Office and others to support top-of-the-line facilities that allow our researchers and students to make discoveries that contribute to a healthy, environmentally sound and technologically advanced world. Our instrumentation and synthesis capabilities are world class and a point of pride for us — we stay on the cutting-edge of technology and make our labs and equipment available both to partners in industry and to faculty and students across the entire OSU community.

### Nuclear Magnetic Resonance Facility

A state-of-the-art facility that offers a range of spectrometers and internationally-recognized faculty expertise to support world-class research at Oregon State and throughout the Pacific Northwest region.

### Electron Microscope Facility

Top-of-the-line electron microscopes, including an FEI Titan with ChemiSTEM technology, serve faculty, students and industrial collaborators with a range of imaging solutions. Every year, the facility supports over \$45M in research grants. It holds a subscription to the world's largest and most reliable diffraction database, the International Centre for Diffraction Data.

### Oregon State Microbiome Initiative

Part of a \$121M federal initiative, this virtual center for microbiome research and education is part of a new wave of research on the invisible but influential world of microbial communities that is poised to transform society.

### OSU Mass Spectrometry Center

A central pillar in a network of interdisciplinary research at Oregon State that advances work in environmental health, biomedical and biological sciences and any research utilizing cutting-edge mass spectrometry instrumentation.

### Materials Synthesis and Characterization Facility

This comprehensive innovation center serves as a hub for materials and device development on campus and provides researchers with

deep experience in thin-film deposition, device fabrication and materials analysis.

### Center for Genome Research and Biocomputing

The Center offers leadership, training and services in genome-enabled and data-driven research in the life and environmental sciences to faculty and students at OSU, the region, and — via annual workshops and conferences — across the country.

### Unnatural Protein Facility (UP Facility)

The UP Facility gives researchers from across the region and the world full access to current non-canonical amino acid protein production capability and genetic code expansion technology for academic studies. Through annual Genetic Code Expansion workshops and a biannual conference, the facility helps scientists to further their own research using UP Facility ncAA-protein technology and staff expertise.

### John L. Fryer Aquatic Animal Health Laboratory

This lab is a regional fish disease facility dedicated to the study of organisms infectious for salmonids and other species of freshwater fish. It is named for Dr. John L. Fryer, who pioneered the fish disease research program at Oregon State University.

**The College also has two world-renowned collections which both further biological research and serve as natural history museums to stoke the curiosity of all age groups.**

### Oregon State Herpetological Collection

With more than 60,000 ethanol-preserved amphibians and reptiles, and approximately 24,000 frozen tissue samples, this collection has excellent representation for sites in the Pacific Northwest and includes the largest collection of garter snakes (*Thamnophis*) in the world.

### Oregon State Arthropod Collection

A valuable research collection of nearly three million insect and mite specimens, chiefly from the Pacific Northwest.

Using NMR, biophysicist Elisar Barbar has gained new insights into intrinsically disordered proteins, a hot topic in medical research due to the critical role they play in cellular functions.



# Science champions: Board of Advisors

A grid of small blue dots is located at the bottom of the page, below the main text.

**Jan Armstrong ('57)**

Retired Director of Community Relations  
Kansas City Southern Industries

**Scott Clark ('08)**

Founder and CEO  
SigOpt

**Megan Cook ('09)**

Manager of Education Partnerships &  
Programs, Ocean Exploration Trust

**Judy Faucett ('70)**

Retired Senior Vice President  
Equitable Life Assurance (now AXA US)

**Eileen Hartmann ('74, '76)**

Retired  
Certified public accountant

**Keith E. Krueger ('86)**

Private dental practice  
Bend, Oregon

**Prabu Nambiar ('88)**

Founder and Principal  
Syner-G Pharma Consulting

**Joel Peterson ('69)**

Founder  
Ravenswood Winery

**Heather Runes ('01)**

Head of Quality Services  
Genentech

**Ronald Schoenheit ('65)**

President  
Cascade Coil Drapery

**Luisa Snyder ('09)**

Dentist  
Snyder Family Dentistry

**Michael Waterman ('64, '66)**

Emeritus University Professor  
University of Southern California

**Brad Zenger**

Founder and Managing Director  
Pivotal Investments

New board member and 2019 Young Alumni Awardee Megan Cook inspires young scientists by bringing them the excitement of ocean discoveries via live broadcast expeditions on the seafloor. Her work aboard the Exploration Vessel *Nautilus* combines scientific discovery with science communication.



# Gaining ground



The **College of Science** has made encouraging progress in the last two years, strengthening our confidence that we will meet our goals to achieve inclusive excellence and boost our position as a national and global center for excellence in research and scholarship.

We have experienced strong gains during the period, with accomplishments in the areas of student retention and success, enhanced diversity, world-changing research, expanded inventions and increased private donor giving and grants. These gains are the result of the considerable hard work of many people in the College community, and demonstrate our aligned commitment to investing in research and innovation, prioritizing student success and continuing our work on equity, justice and inclusivity.

We appreciate the ongoing and absolutely vital support of our faculty, staff, students, alumni and friends, and we are propelled by their belief in our mission. Together, we aim to create and sustain a College in which the brightest researchers and most aspiring students, whatever their economic or

cultural background, can thrive and reach their full potential as scientists.

### Extraordinary people, strong support

Philanthropic support continues to enhance virtually every aspect of the College of Science — from laboratory and academic facilities to student financial support and research that is impacting local communities in Oregon and the world.

In FY 2019, the College received \$9.98M in private support from 1,034 donors, with more than \$2.6M going toward scholarships, fellowships and student awards. Contributions to endowed faculty and other faculty awards were \$2.06M. Program support for students and faculty brought in more than \$1M. Private donors also contributed \$1.5M to facilities.

In FY 2018, the College received \$5.4M from 970 donors. Our donors contributed about \$2M for scholarships, fellowships and student awards, \$504K to endowed faculty and other faculty awards, \$1.2M to program support for students and faculty, and \$10K to facilities.

Metric	Baseline 2014	Recent 2017	Current 2019	Target 2020
Bachelor's Degrees Awarded	530	577	<b>563</b>	680
Master's Degrees Awarded	51	56	<b>61</b>	65
Doctoral Degrees Awarded	28	55	<b>55</b>	38
First-Year Retention Rate	86%	81%	<b>85.4%</b>	91%
Six-Year Graduation Rate	63%	67%	<b>70.5%</b>	67%
Junior Transfer 4-Year Graduation Rate	53%	59%	<b>65.4%</b>	72%
High-Achieving Oregon High School Graduates	46%	57%	<b>53%</b>	52%
U.S. Minority Students* in the College	29%	30%	<b>36.4%</b>	35%
International Students	6%	7%	<b>7%</b>	13%
External Funding	\$18M	\$19M	<b>\$23M</b>	\$21M
Invention Disclosures	14	7	<b>13</b>	22
Annual Private Giving and Grants	\$4M	\$6M	<b>\$9.98M</b>	\$6M

\* Includes African-American, Asian, Pacific Islander, Hispanic, Native American, or those reporting "two or more races." Excludes international students.



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# Our Faculty

Transforming ideas into solutions



## Outside-the-box thinkers. Innovators and creators. Our faculty are leaders.

Marine ecologists. Materials chemists. Biophysicists. Climate scientists. Astrophysicists. Microbiome surveyors. Data scientists. College of Science faculty are leaders in their fields. Innovators and creators. Outside-the-box thinkers. Disruptors of the status quo. Together, they form an extraordinary teaching and learning community at the heart of Oregon State University.

Our faculty are leaders who work at the intersection of the biological, mathematical, physical and data sciences. They are known for advancing basic and applied research — making contributions to society that help cement OSU's place in the top 1% of universities worldwide.

We are proud of the commitment to students that our faculty and instructors demonstrate in the classroom, laboratory and in their roles as mentors and advisors. Here professors and students

work together to investigate, explore and make discoveries with far-reaching impacts.

Our faculty also share a deep commitment to fundamental research and discoveries that improve the quality of life for everything and everyone on the planet. They are deeply engaged in education, advocacy and outreach efforts to expand scientific literacy, maximize the impact of scientific research and inform policy on a local, national and global level.

We are proud of the collaboration and innovation exemplified by our faculty across seven departments and a wide array of fields — from microbiology to marine science, from biohealth to data analytics, mathematics to materials and from physics to chemistry. Our scientists envision what is possible through research and inspired problem-solving, turning their groundbreaking discoveries into solutions of high value to society.

**Left 1:** Dr. Russ and Dolores Gorman Faculty Scholar Janet Tate is advancing research on new semiconductors to solve energy problems. **Left 2:** Distinguished Professor Sally Hacker studies how dune grasses can protect coastal communities against storm damage. **Left 3:** Milton Harris Chair of Materials Science

Mas Subramanian created the first inorganic blue pigment in more than 200 years. **Above:** Wayne and Gladys Valley Co-Chair in Marine Biology Bruce Menge's work with ocean ecosystems has benefited both OSU students and Oregon coastal communities, industries, and state agencies.

# Renowned leaders: Faculty highlights





## Distinguished Professors

2019

**Mas Subramanian**, Chemistry

**Virginia Weis**, Integrative Biology

2018

**Janet Tate**, Chemistry

2015

**Andrew Karplus**, Biochemistry and Biophysics

2013

**Joseph Beckman**, Biochemistry and Biophysics

2012

**Andrew Blaustein**, Integrative Biology

**Stephen Giovannoni**, Microbiology

2010

**Balz Frei**, Biochemistry and Biophysics

2006

**Douglas A. Keszler**, Chemistry

2005

**Bruce A. Menge**, Integrative Biology

1990s

**Arthur W. Sleight**, Chemistry

**Jo-Ann Leong**, Microbiology

**Jane Lubchenco**, Integrative Biology

**James D. White**, Chemistry

**Christopher Mathews**, Biochemistry and Biophysics

**Donald J. Reed**, Biochemistry and Biophysics

1980s

**T. Darrah Thomas**, Chemistry

## American Association for the Advancement of Science

**Christopher Bayne**, Integrative Biology

**Andrew Blaustein**, Integrative Biology

**Michael Freitag**, Biochemistry and Biophysics

**Sally Hacker**, Integrative Biology

**Andrew Karplus**, Biochemistry and Biophysics

**Walter Loveland**, Chemistry

**Mas Subramanian**, Chemistry

**Jane Lubchenco**, Integrative Biology

**David Maddison**, Integrative Biology

**Bob Mason**, Integrative Biology

**Christopher Mathews**, Biochemistry and Biophysics

**Bruce Menge**, Integrative Biology

**Vince Remcho**, Chemistry

**Bob Smythe**, Statistics

## National Academy of Sciences

**Jane Lubchenco**, Integrative Biology

## American Academy of Arts & Sciences

**Jane Lubchenco**, Integrative Biology

**Bruce Menge**, Integrative Biology

## Endowed science faculty

**Jerri Bartholomew**, Microbiology

The Emile F. Pernot Distinguished Professorship in Microbiology

**Joe Beckman**, Biochemistry and Biophysics

Margaret W. Terrill Linus Pauling Research

Innovator Faculty Scholar

**Mary Beisiegel**, Mathematics

Whiteley Faculty Scholar

**Paul Ha-Yeon Cheong**, Chemistry

Bert and Emelyn Christensen Professor

**Lori Kayes**, Integrative Biology

College of Science Faculty Scholar

**Jane Lubchenco**, Integrative Biology

**Bruce Menge**, Integrative Biology

Wayne and Gladys Valley Chairs in Marine Biology

**David Maddison**, Integrative Biology

The Harold E. and Leona M. Rice Professorship in Systematic Entomology

**Vince Remcho**, Chemistry

The Patricia Valian Reser Faculty Scholar

**Javier Rojo**, Statistics

Korvis Professor of Statistics

**Kyriakos Stylianou**, Chemistry

Terence Bradshaw Chemistry Professor

**Mas Subramanian**, Chemistry

Milton Harris Chair of Materials Science

**Janet Tate**, Physics

Dr. Russ and Dolores Gorman Faculty Scholar

Distinguished Professor Stephen Giovannoni (left) and Associate Professor Kim Halsey have been studying the cycling of volatile organic compounds by microbes for over a decade.



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# Our Alumni

Leading the way forward



## Our alumni through the decades have made a global impact.

Our community of 30,000+ alumni form a vast worldwide network of friends, donors and advocates for science. Ever since the early decades of the 20th century, our alumni have used their knowledge and voices to transform the world through discovery.

**Linus Pauling ('22)**, founder of the fields of quantum chemistry and molecular biology, is the only individual to be awarded two unshared Nobel Prizes (Chemistry in 1954 and the Nobel Peace Prize in 1962).

**Milton Harris ('26)** developed the world's first water-repellent, flame proof and rot proof clothing, in use during WWII. He also developed a coating to keep razor blades from rusting, revolutionizing the shaving industry.

**Warren Washington ('58, '60)** is a renowned climate scientist and the 2010 recipient of the National Medal of Science, the nation's highest science award.

**Kent Thornburg ('70)** is a globally acclaimed scientist in cardiovascular physiology, adult-onset chronic disease and maternal-fetal health, broadening our understanding of how the environment in the womb can be a determinant of disease later in life.

**Marian Waterman ('81)** discovered a protein involved in cancer metastasis. She is director of the Cancer Research Institute and professor of microbiology and molecular genetics at University of California, Irvine's school of medicine.

**Malin Young ('92, '94)** leads the science and technology strategy at Pacific Northwest National Laboratory, exploring large-scale challenges in science, energy, the environment and national security. She was elected a Fellow of AAAS in 2019.

**Scott Clark ('08)**, one of Forbes' 30 under 30 in 2016, is co-founder of SigOpt, a software company that uses machine learning and algorithms to optimize user experience for websites.

**Left 1:** Climate scientist Warren Washington. (Photo courtesy of the University Corporation for Atmospheric Research).

**Left 2:** Ava Helen Miller and Linus Pauling on Graduation Day, 1922. (Photo courtesy of Oregon State University Libraries Special Collections & Archives Research Center).

**Left 3:** Kent Thornburg directs the Center for Developmental Health in the Knight Cardiovascular Institute and the OHSU Bob and Charlee Moore Institute for Nutrition & Wellness.

**Above:** Marian Waterman's research seeks to understand how dysfunctional Wnt signaling pathways can cause cancer.



# Living legends



## From refugee to renowned surgeon and humanitarian

**SreyRam Kuy ('00)** is an acclaimed general surgeon, healthcare executive and quality improvement researcher. But her life journey is an unlikely one. Born in a Cambodian death camp in 1978, Kuy was injured during a bombing that took place as her family fled into Thailand when she was three. A volunteer Red Cross surgeon saved her life and inspired her life's work.

Kuy's family arrived in Corvallis as refugees in 1981. Despite their educated, middle class background in Cambodia, her parents could only find low-wage jobs in the U.S. "My mom used to mop the floors of the operating room and now I work as a surgeon; my dad mopped floors at Oregon State University, and that's where I graduated," Kuy said. "That is how amazing America is."

A recipient of multiple awards and honors, Kuy currently serves as Deputy Chief Medical Officer for Quality and Safety for the Veterans Affairs South Central Network, which oversees more than 50 VA Medical Centers and outpatient clinics. She earned her medical degree at Oregon Health & Science University in Portland in 2005, and a master's in health services from Yale in 2009. Kuy tries to give back whenever she can. She provides free surgery to low-income patients and volunteers to raise money for wounded veterans and to combat human trafficking.

## Historian of America's first moon missions

To coincide with the 50th anniversary of the first moonwalk by the astronauts of Apollo 11, in June 2019, physics alumnus **Brandon Brown ('97)** wrote *The Apollo Chronicles, Engineering America's First Moon Missions*, an account of the experiences of the earthbound engineers who worked on the successful space mission.

The son of a NASA engineer who worked on the Apollo missions, Brown completed his bachelor's degree in physics from Rice University and earned

Dr. SreyRam Kuy ('00) is a prominent surgeon, healthcare executive, writer, scholar and academic. She has distinguished herself as a multifaceted doctor making a difference inside and outside operating rooms.

his Ph.D. at OSU studying vortex dynamics in superconductors. A longtime interest in writing led him to complete postdoctoral work in science communication at the University of California, Santa Cruz. Now a professor and chair of physics at the University of San Francisco, Brown's research includes work on superconductivity and sensory biophysics.

Brown published his first book, *Planck: Driven by Vision, Broken by War* (Oxford University Press), a biography of Max Planck and his path through World War II, in 2015. The book won a number of awards including "best history book of 2015" (Times of London), a "best science book of 2015" (Science to the People), and the 2016 Housatonic Award for nonfiction.

## Science at Oregon State: Doorway to the world

**Michael Waterman ('64, '66)** is a founder and leader of computational biology and a renowned human genome theorist. His work laid the foundation for what would become the Human Genome Project. Currently a Distinguished Institute Professor for the University of Virginia's Biocomplexity Institute, Waterman is also a Professor Emeritus of Biology, Mathematics and Computer Science at the University of Southern California.

A native Oregonian, Waterman earned bachelor's and master's degrees in mathematics at OSU and a Ph.D. in statistics and probability at Michigan State University. He previously held appointments at Tsinghua University in Beijing, Fudan University in Shanghai and Los Alamos National Laboratory, among others.

Waterman is an elected member of both the U.S. National Academy of Sciences and Engineering, the American Academy of the Arts and Sciences, and both the French and Chinese Academies of Sciences. "For me, OSU was the doorway to the rest of the world," he said. In 2020, Waterman accepted a position on OSU's College of Science Board of Advisors.





*(Continued from inside front cover).*

### **A new era of marine research**

The University's **Sea Grant** made OSU one of the nation's first four Sea Grant colleges established by President Lyndon Johnson in 1966. For more than half a century, Oregon Sea Grant has served the state, region and nation to help people understand, rationally use and conserve marine and coastal resources.

Our marine scientists have made important discoveries about how changing marine resources, fisheries and environmental conditions affect coastal communities, leading to new legislation to protect our oceans.

We are at the helm of research efforts to better understand how climate change is impacting aquatic species, weather patterns and ocean ecosystems.

Microbiologists and biologists here study diseases in aquatic animals ranging from corals and sea stars to salmon, examine the marine microbiome to understand carbon cycling and cloud formation, and investigate how warming waters affect marine ecosystems across the West Coast.

Mathematicians and statisticians employ environmental big data, modeling and data visualization to understand extreme weather events, design marine protected areas and track the effects of a warming climate in oceans.

### **Unlocking the mysteries of space**

Oregon State is the lead institution for the Oregon **Space Grant** Consortium, the statewide network of universities, colleges, museums, educators, researchers, students and science professionals that promotes STEM education while recruiting and training NASA's next diverse workforce.

The College of Science is working at the heart of this mission. Our scientists and alumni have been involved in this century's greatest discoveries — the detection of gravitational waves and gamma-ray bursts. Our astrophysicists predicted the discovery of a short gamma-ray burst a month before international scientists detected it, and were also part of a team of astronomers who used a network of telescopes from around the world to take the first-ever picture of a supermassive black hole. They have advanced new research findings that lay bare the fundamental secrets of the universe.

As one of only two universities in the country with land-, sea-, sun- and space-grant designations, Oregon State and the College of Science have demonstrated their breadth and depth within all these areas — from the bottom of the ocean, to the soil where we grow our food, the air we breathe and the farthest reaches of space.

Across all four grants, the College of Science plays a vital role. **Working for a better world, OSU Science boldly steps forward to meet the greatest challenges of our time.**



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