Oregon State UNIVERSITY

College of Science

ACADEMIC ANNUAL REPORT, 2014-15
College of Science – September 2015

COLLEGE-LEVEL PERFORMANCE

The College of Science had a record year for research funding with an increase of 230 percent since 2013, demonstrating excellent leadership in research and scholarship. The College has some work to do in terms of providing a strong transformative experience to students. Deeply committed to developing a robust, diverse science community, the College is proud of its 32 percent surge in minority students and steady growth of six percent among international students. We will continue to champion diversity and inclusion as we develop a welcoming community for international students and underrepresented populations. We plan to and need to do better and will increase our international student population, which has remained relatively flat for a decade.

The College continues to attract some of the best and brightest students at OSU and saw a 51 percent increase among high achieving students since 2013. At times, the rigor and size of our programs are challenging for some students. The College trails other colleges across campus in OSU's SP 3.0 metrics, such as first-year retention, 6-year graduation rate, and junior transfer graduate rate metrics. However, Science has the second highest graduation rate (84.5 percent) among students who start in Science and go on to graduate from another college at OSU. Yet we struggle with a few key student success indicators, such as first-year retention and graduation rates for traditional students and junior transfer students. Our 2015-2020 Strategic Plan will launch efforts to develop transformative student success initiatives that will address both retention and graduation rates.

Several factors may cause science students to leave their major. For example, students may change their minds about their major, have had inadequate mathematics and science preparation in high school, and/or we may need to increase our student support to help them successfully transition to college. We are exploring these potential causes and will use the predictive analytics data to illuminate the issues and inform our thinking about solutions. Effective advising and strong mentoring are key to helping students identify an appropriate major and for their ultimate success. The College is making significant investments into developing a transformative educational experience for science students, including: education abroad, undergraduate research, career development, internships, living learning communities, mentorship, experiential learning and outreach.

In terms of credit hours taught, the College saw flat growth with a seven percent dip in upper division courses and a three percent growth in lower division courses. Graduate credit hours grew modestly at about four percent, roughly on par with the university. Undergraduate enrollment looks fairly flat this fall compared to OSU's uptick in undergraduate enrollment (9.6 percent); the College has a 10 percent growth in graduate enrollment for fall term, which tracks with OSU's graduate enrollment.

The College has made strategic investments in new faculty hires that will enhance our scientific and teaching excellence as well as our diversity. Specifically, faculty growth was about eight percent among tenure-track faculty, whereas investment in professional faculty declined 19 percent. Future investments may be needed to provide effective administrative support for faculty and enhanced student support services to provide a truly transformative educational experience in the College of Science. The overall budget growth for the College was lower than other units on campus, growing by nine percent. However, research grant funding since 2013 exploded with 230 percent growth—far and above the highest on campus. The number of research grants and contracts increased 34 percent. Regarding private gifts, the College experienced a solid year with a 15 percent growth in fundraising. The College of Science expanded OSU's impact across the state, region, nation and beyond through nine inventions and discoveries of intellectual property and/or commercial potential.

Last year, the College awarded nearly 19 percent more degrees overall. Science had the second highest growth in undergraduate degrees, awarding 21 percent more since 2013 compared to OSU's average growth of 14 percent during the same period. The College awarded just two percent more master's degrees and six percent more doctoral degrees compared to OSU's growth of 14.6 percent of PhDs during that time. Science continues its tradition of strong doctoral program that expands the nation's intellectual capital, awarding the second most PhDs at OSU with 37. The College recognizes the tremendous opportunity for growth in Master of Science degrees. Our strategic plan will seek to capitalize on focused areas of growth for master's and doctoral degrees.

To share the extraordinary stories of our faculty, students and alumni, the College launched an alumni magazine, *iMPACT*, and a blog-type website to better communicate these stories to our key audiences, impact.oregonstate.edu. To raise its visibility and strengthen its community, the College awarded its first-ever Alumni Awards and held its first Distinguished Lecture Series, "From Big Data to Big Statistics" delivered by John Sall, co-founder of SAS Institute. The College hosted alumnus Michael Waterman, a founder and current leader of computational biology. To bestow honors on alumni at the department level, Biochemistry & Biophysics issued its first Distinguished Alumni Award to alumna Grace Sun, internationally renowned scientist whose research focuses on brain lipids and signaling pathways related to aging and neurodegenerative diseases. Chemistry established an Alumni Seminar Series to cultivate a strong community and to recognize alumni. The Department of Mathematics published an alumni newsletter, its first in more than five years.

The College of Science is committed to advancing the university priorities of student success and equalization, a transformative educational experience and strengthening OSU's impact throughout Oregon and beyond. We have highlighted examples of our collective achievements and the impact on students, OSU, Oregon, the nation and the world. This is not an exhaustive list, but it represents our momentum and successes for the year.

PROGRAMATIC ACHIEVEMENTS

I. Outcomes that contribute to a transformative educational experience for all learners (Goal 1)

The College of Science made solid progress in providing transformative, meaningful and memorable experiences for our students to support their future success. We have developed several new degrees and options. We launched a course that introduces students to mathematical software and offered two new options for mathematics majors: an Applied and Computational option and a Mathematical Statistics option—the only program of its kind among public universities in Oregon. We are also scaling up Molecular Biology Laboratory/Writing Intensive Curriculum, a course-based undergraduate research experience, to accommodate more students. The new Biology major requires an additional lab experience and a signature lab experience so students can define a sub discipline or a career goal.

To leverage the Chemistry Departments' excellence in online learning and course development, they led a workshop for other departments about topics such as Ecampus support for courses/programs, technology development, process for creating and managing large foundational classes online as well as lab courses online. We submitted a proposal for an online master's degree in Data Analytics, an online Certificate in Data Analysis, the first three online courses in physics, and a new online Introductory Biology series featuring a high-quality, hands-on laboratory.

In addition, science faculty have developed innovative teaching models and tools that put pedagogy first and use emerging technology in their classrooms. For example, Physics doubled enrollment in its studio-based course sequence in Physics for Scientists and Engineers, attracting more than 400 students to the weekly 2-hour studio sessions who engaged in active learning in small groups. Students were more

confident and much less likely to withdraw or to receive a failing grade. These courses received partial support from NSF's ESTEME WIDER grant. Physics introduced flipped classrooms with a significant online component as part of the non-calculus physics sequence. The instructor was recognized as an innovator by Pearson Education and received an Action Research Fellowship through OSU's ESTEME program to study the impact of online tools on student success. Renowned for its history of innovative evidence-based advances in teaching physics, Physics was invited to present a workshop sponsored by the APLU and Sloan Foundation about transforming upper division physics teaching.

To maximize classroom learning and support student success, the College worked hard to offer more opportunities for students to participate in experiences that are transformative, meaningful and memorable. We hosted 10 undergraduate math students in the summer Research Experience for Undergraduates, an NSF-funded program where students conduct research guided by mathematics faculty. Chemistry created a Student Success Committee, which has an explicit goal of improving and equalizing student success. The department refocused office staff in order to have a dedicated Undergrad Coordinator to assist its growing undergraduate student population, thanks to support from the College and creative budgeting. The Integrative Biology Department is one of two who is piloting the EAB Student Success Collaborative for OSU. In collaboration with the Academic Success Center, Integrative Biology faculty are training undergraduate learning assistants to assist both majors and non-majors in high-enrollment courses in the anatomy and physiology series. To develop students' soft skills, we hired an instructor-advisor in microbiology who will develop a Writing Intensive Curriculum course for BioHealth Sciences students. Approximately 70% of microbiology undergraduates participated in experiential learning activities. Biology majors participated in many experiential learning activities: 40% completed an internship, 60% did undergraduate research, 30% taught, 43% had a clinical experience, 49% participated in service projects, 52% joined a professional or student organization, and 52% held a leadership position.

To incorporate high impact practices to enhance student success, we revamped our biochemistry and biophysics undergraduate curriculum to map to the core concepts in NSF's Vision and Change rubrics. We revamped the Biology and Zoology majors to give students more time for research opportunities, internships and international experiences. We developed a new program, "Global Health Experience in Haiti," in which 20 microbiology students gained international experience in health care in an underdeveloped country.

The College increased research and internship opportunities for undergraduates by funding six summer research awards for underrepresented minorities and students from diverse backgrounds. Chemistry expanded its David Wong Summer Internship Program to help 17 students obtain science positions this year. Physics students obtained prestigious summer internships at CalTech, UCLA, Fermilab and General Atomics and engaged in campus research supported by SURE and URISC grants.

The College also supported STEM youth. Physics hosted four young women as part of the Science and Engineering Summer Experience for Youth program for a 1-week research immersion experience. We strengthened outreach to transfer students from Linn Benton Community College, building a strong pipeline of students. Physics faculty created Spanish language science events for K-12 across the state.

The College showed leadership in student success initiatives across campus. Chemistry faculty are leading the NSF Wider Grant to improve student success and assessment. They studied student success by using paired pre- and post-content questions to measure learning, comparing online and on-campus courses, as well as content to examine year-over-year results. Biochemistry & biophysics faculty are leading the new 5-year NSF "STEM Leaders" iUSE grant in which underrepresented minorities and/or women

students in engineering participated; 37 of 40 completed their first year. Integrative Biology developed training for a new undergraduate mentoring program launching this fall and will open a new student lounge to foster collaboration and support among students. We instituted prerequisites in lower division mathematics courses and redesigned them to create smaller classes emphasizing student participation.

To expose underrepresented minorities and women to professional opportunities and diverse science leaders, Physics is planning the Northwest Conference for Undergraduate Women in Physics to be held on campus in January 2016, bringing 150 young women scientists to campus for two days of educational sessions and networking opportunities industry. Microbiology faculty took 22 microbiology students to the NW regional conference of the American Society for Microbiology conference in Seattle and four students to the national ASM conference in New Orleans with support from a $15,000 philanthropic gift.

Mathematics developed a new PhD qualifying exam preparation course led by a senior graduate student to increase the number of students who pass the exam. They also changed how it administers the exam and offered, separated the content in the exam to allow for greater flexibility and offered the exam two more times each year. Physics teamed up with the Graduate School to successfully recruit a McNair Scholar to the physics graduate program. We successfully recruited five women microbiology graduate students including one African-American with funding through an NIH diversity initiative.

These efforts have contributed to our successes. The undergraduate statistics classes have record enrollment and continue to be in high demand each term. In 2015, the department graduated 30 majors, bringing it into the top 20% of graduating classes of from any physics PhD-granting program in the country. Biochemistry/Biophysics received extremely high marks from reviewers on their 10-year reviews of its undergraduate and graduate programs and received accreditation for its undergraduate program by the ASBMB, a major professional organization for biochemistry and molecular biology. The Microbiology program also had its 10-year review this year and reviewers found “a thriving growing program that is attracting and graduating highly accomplished students.” The Microbiology major is our third largest undergraduate major in the College with 330 students and 79 graduates last year, an all-time record. In 2014, we launched the BioHealth Sciences major (formerly General Sciences), which moved 640 students into the Department of Microbiology where they would get stronger advising support. Biology graduates scored in the 83rd percentile on the Educational Testing Service Biology Major Field Test, with students at 509 colleges and universities taking the exam.

To promote lifelong learning in science and advance OSU’s mission of educating a scientifically literate citizens, we launched #Vividscience as part of our General Biology series for nonmajors. This innovative learning program offers students a way to explore the intersection between art and science design and teaching through public outreach on social media and public displays.

II. Demonstrating leadership in research, scholarship and creativity while enhancing preeminence in the three signature areas of distinction.

The College of Science promoted/granted tenure to 17 faculty this year, recognizing their outstanding accomplishments. Both faculty and staff continue to receive national and international recognition for their outstanding scholarship, teaching, research and leadership. For example, Integrative Biology professor Jane Lubchenco had another phenomenal year which included the following awards: the Stephen H. Schneider Award for Outstanding Climate Science Communication, the World Academy of Sciences Medal, being named US Science Envoy and receiving the prestigious Tyler Prize**.** Our Physics

Department head was named chair of the American Physical Society committee on Careers and Professional Development as well as the Vice-Chair of the C11 Commission of the International Union for Pure and Applied Physics as well as to the science advisory boards for the European Center for Nuclear Physics (CERN), Brookhaven and Jefferson National Laboratories. Current and emeritus faculty were named Fellows of the American Association of Physics Teachers. Another physics faculty received the 2015 OSU Alumni Association Distinguished Professor Award, the inaugural Dr. Russ and Dolores Gorman Faculty Scholar and one of seven international scientists awarded the title of "TUM Ambassador" by Technical University of Munich research alumni. Our Biochemistry & Biophysics Department head was elected a Fellow of the American Association for the Advancement of Science and named OSU Distinguished Professor, bringing our total number of distinguished professors to 19.

A Chemistry professor was named Oregon Scientist of the Year by the Oregon Academy of Science and elected a Fellow of AAAS. Other faculty recognition includes: Northwest Region Award for Volunteer Service to the American Chemical Society, President's Commission on the Status of Women University Mentoring & Professional Development Award and an NSF CAREER Award.

Our faculty are actively advancing OSU's three areas of distinction. Mathematics, Integrative Biology and Statistics faculty actively participated in organizing the Marine Studies Initiative with some serving on the Task Force on Bioinformatics and Computational Biology Curricula to develop an undergraduate program in "Biological Data Sciences." Chemistry established its first-ever departmental vision statement that seeks to expand and cultivate transdisciplinary research opportunities on campus and with industry partnerships and align with OSU's areas of distinction: improving human health and promoting innovation and economic prosperity by developing and designing new materials and chemical processes for a sustainable future.

Our academic programs continue to rise in prominence. For example our Zoology graduate program is ranked in the top 10 among all land grant institutions based on FSPI analysis using Academic Analytics. Our Mathematics Department commands a major presence in the actuarial industry in Oregon as a result of a hiring a faculty coordinates our Actuarial Program and who also brings a wealth of industry experience and connections as a Fellow of the Casualty Actuarial Society.

Our students continue to receive recognition. Highlights from this year include: a microbiology student was named OSU Undergraduate Research Student of the Year, 29 students were inducted into the Phi Kappa Phi Honor Society, a physics graduate student received the 2014 OSU Distinguished Master's Thesis Award, one student received a German Academic Exchange fellowship, another was selected as a Fulbright alternate for Germany and yet another won the Undergraduate Research Presentation Award at the national meeting of the American Physical Society. Students produced some phenomenal research: working on a research team that discovered certain animals can produce a sunblock compound naturally, publishing their research in *Nuclear News*, using DNA sequencing and genetic screening tools to analyze genes of viruses from the bovine herpesvirus-1 outbreak among many others.

Graduate students continued to attract recognition for their academic excellence, including the OSU 2015 CGS/ProQuest Distinguished Dissertation Award in the Biological and Life Sciences; a graduate student poster award and "lightning talk" prize at Center for Genomic Research in Biocomputing conferences; Best Poster award at the "Proteins" Gordon Research Conference; P.F. Yerex & Nellie Buck Graduate Fellowship; three ARCS Foundation Fellows, two NSF Graduate Research Fellowship Program awards, an ESA Graduate Student Policy Award, NSF IGERT Fellow in Aging Science and a Graduate Research Fellowship Program award, Graduate Student Award in Environmental Chemistry from the

American Chemical Society and countless others. Postdoctoral Fellows in mathematics continue to achieve tremendous success: one has taken a tenure-track position at the University of Washington at Bothel and another is joining the University of Arizona in a tenure-track position

The excellence of our faculty enabled us to recruit extraordinary talent in key areas of distinction. For instance, we recruited several outstanding Statistics faculty who enriched our expertise in emerging areas: one with expertise in statistical genomics research from the University of Chicago; two faculty with expertise in environmental statistics were attracted to the department's strong reputation in this area—one from University of Washington who received the prestigious NSF Career Award and one from University of Chicago; and another from the University of California- Berkeley with expertise in big data.

We have also been creative in making more dual career hires. We successfully recruited four assistant professors in Integrative Biology, two of which were dual career hires with one focusing on animal physiology and one on neuroscience. Other top choice hires include a quantitative systems biologist with a 70%-30% appointment in Integrative Biology and Mathematics through the Provost's Student Success Hiring Initiative to develop mathematical curricula aimed at students in biological sciences and to create a Mathematical Biology option for math majors; a diversity hire who specializes in marine evolutionary systems biology through the Provost's Marine Studies Initiative; and a dual career hire focuses on evolutionary biology and genetics. Strategically, we have hired outstanding faculty who not only raise our excellence, but who also enhance the diversity in our College. This year we were thrilled to hire an extraordinary female African American biochemist.

Supporting OSU's goal of promoting innovation and economic prosperity, the College recruited a Professor of Practice in Chemistry, whose extraordinary expertise, energy and national leadership experience will benefit our faculty and students. She was named the 2014 Henry Whalen Awardee for Excellence in Business Development and Management by the Chemical Enterprise and will be instrumental in advancing a culture of innovation in the College. Faculty discoveries and breakthroughs significantly contribute to innovation and economic prosperity. Microbiology faculty licensed biopolymer technology for dairy starter cultures to a global market leader in the industry.

The College also had a banner year in terms of research bringing in $26.7 million in research grants, an increase of 230 percent since 2013, demonstrating leadership in research. Faculty across all areas contributed to this success. Our physics faculty received research grants from Hewlett-Packard, from the Spectroscopy Society and two NSF grants. Our physicists also developed a novel hyperspectral imaging facility used by OSU faculty and industry, attracted considerable national and international attention for their research on graphene biosensor in which they collaborated with industry, collaborative research with an entomology professor about the physical basis of vision in native bees may result in potential industry applications in bee attractants for Oregon agriculture. Marine biology faculty collaborated on a new study warning that global warming may increase upwelling in several ocean current systems around the world by the end of this century, causing major changes in marine biodiversity.

Microbiology faculty contributed nearly one-third to the College's total research budget this year bringing $7.4 million in new research grants in an extremely active year which included collaborating on a new $30 million NASA Earth Venture Suborbital Investigations Program Grant, North Atlantic Aerosols and Marine Ecosystems Study. Microbiology also received a project award from the Joint Genome Institute for a pilot project using metabolomics for SAR11 functional genomics. The department is also leading a newly funded $1.9 million NSF Dimensions of Biodiversity Collaborative Research Grant: Coevolution of scleractinan corals and their associated microorganisms with a researcher from Penn

State University. Their research this year has garnered national and international attention: research on coral reefs has reached audiences through OSU films such as "Saving Atlantis", "Saudi Arabia" and "People of the Reef;" research on the far-reaching effects of human pollution on fish in the deep ocean received national media coverage as has their research on harmful algae has shown how these blooms can travel long distances in a river, remaining toxic and posing health risks.

Integrative Biology faculty received $4.9 million in extramural funded grants and awards this past year, including a$409,000 NSF award, a $164,000 NSF award for studying sea star wasting disease, and a $726,000 NIH award to study the population genetics and evolution of the pasasitic worm that causes schistosomiasis, a disease that kills millions yearly. Integrative Biology faculty were published in a number of high-impact journals, publishing nine papers in *PloS One*, three in *Proceedings of the Royal Society* and three in *Molecular Phylogenetics and Evolution*, two in *American Naturalist*, one in *Nature, Ecology, mBio, BMC Evolutionary Biology, Ecology Letters* (recommended by Faculty of 1000).

The College led efforts to secure approximately $2.4 million from NIH, the N.J. Murdock Charitable Trust and OSU for a high-end Macromolecular Nuclear Magnetic Resonance instrument, which is the highest field instrument in the state of Oregon and the region.

III. Strengthening the impact and reach of OSU throughout Oregon and beyond.

Science faculty and students have significantly contributed to raising the visibility and impact of the university. In the spring, the Departments of Mathematics and Statistics co-hosted the Infinite Possibilities Conference that attracted over 175 diverse participants from 19 states, Mexico and Puerto Rico. The conference focused on educating and promoting the careers of underrepresented minority women students in the fields of statistics and mathematics. The conference received funding from NSF, the National Security Agency and OSU.

To raise the visibility of OSU in Oregon, faculty helped organize "Discovering the Scientist Within," an outreach workshop for 120 middle school girls. Graduate students hosted a week-long biochemistry camp for middle school students in partnership with STEM Academy. Our OMSI Science Communication Fellows developed an outreach event based on lab research and presented at OMSI's three "Meet a Scientist" events. We hosted several STEPs teacher workshops last summer: "Climate Change and Ocean Acidification" for 30 participants in collaboration with CEOAS and "Biological Motion through the Lens for STEM educators and students." At an outreach event where science meets art, chemistry faculty showcased the discovery of a new blue pigment at a Benton County Museum arts exhibit and in a series of public lectures The discovery received extensive media coverage and was featured in the *Oregonian*.

The Microbiology Department co-organized the 7th International Symposium on Aquatic Animal Health in Portland, attracting 250 attendees from 26 countries and providing mentoring events for 40 students. Microbiology students organized a 1-day regional symposium in the spring and invited researchers from OSU, OHSU and University of Oregon to speak while students presented posters. Graduate students engaged in outreach activities including local Science Olympiads for middle and high school students, served as mentors for Lego Robotics, participated in OSU STEM Academy and more.

In collaboration with OSU, the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) partnered with Rogue Brewery to develop a Wasted Sea Star Purple Pale Ale to raise awareness of the sea star wasting disease decimating sea star populations on the West Coast. A portion of sales of the purple ale will support the research of OSU and PISCO scientists.

Our materials chemistry research and the Center for Sustainable Materials Chemistry were featured on NSF's video channel, *Science Nation*, and PBS *News Hour* picked up the story. The segment highlighted the next generation of electronic circuits that our research will enable.

To promote OSU around the world, science faculty engaged in many international activities: presenting seminars in Europe, France, China, Korea and Mexico; attending the Flavin Symposium in Thailand; presenting an Erskine Fellow lecturer at the University of Canterbury, New Zealand and in Australia; delivering a lecture on vitamin D and immunity in Japan at the International Conference on Food for Health; had a sabbatical stay in Germany supported by an Alexander von Humboldt Foundation award; hosting four visiting scientists from China, two from Brazil and a student intern from Mexico; and chairing a session at the ISME Meeting in Seoul, South Korea. Microbiology research on novel approaches to combat antimicrobial resistance was featured on *American Society for Microbiology Live*, a press conference on new microbial strategies.

To promote open access to science worldwide, faculty developed a textbook for a global audience, *Biochemistry: Concepts and Connections*, translated *Biochemistry 4th ed*. into Italian, Japanese and Spanish and contracted with the German company Lecturio to develop 10 hours of video lectures for medical students. The free online textbook *Biochemistry Free and Easy* had 40,000 more downloads, providing open access and savings for all learners.

Globally, students engaged with the international scientific community. For the first time, we had an undergraduate admitted to the 2015 Budapest Semester in Mathematics, one of the most prestigious exchange programs for mathematics undergraduates in the world. Graduate students in mathematics participated at meetings in Marseille, Liverpool, Buenos Aires and Toronto. One student chaired a session at the Association for the Sciences of Limnology and Oceanography Meeting in Granada, Spain.

IV. Comments on key initiatives that align with OSU commitments.

The College of Science is deeply committed to striving for excellence, enhancing diversity and fostering harmony. This year the College recruited six extraordinary faculty from diverse backgrounds who are committed to student success and research excellence. These new faculty comprise two underrepresented minorities, three women, and two dual career hires. The Departments of Mathematics and Statistics organized the Infinite Possibilities Conference that celebrated successes of women of color in mathematical and statistical sciences. Departments are proactively inviting seminar speakers from diverse backgrounds. Faculty and students participated in Mi Familia Weekend, LGBTQ events, Black Graduate Student Association events, and a SACNAS conference, one of the largest gatherings of minority scientists in the country. To build an inclusive environment for students of diverse backgrounds, the College developed a partnership with LSAMP to mentor and integrate students into Science to foster their growth and success.

The College is grateful to our alumni, friends and the OSU Foundation for their support for our student and faculty success and for making it another successful year of fund/friend-raising. The College is also appreciative of university investments in our infrastructure enabling faculty and students to reach their full potential.

V. Appendix – Annual Academic Program Review 2014-15 charts