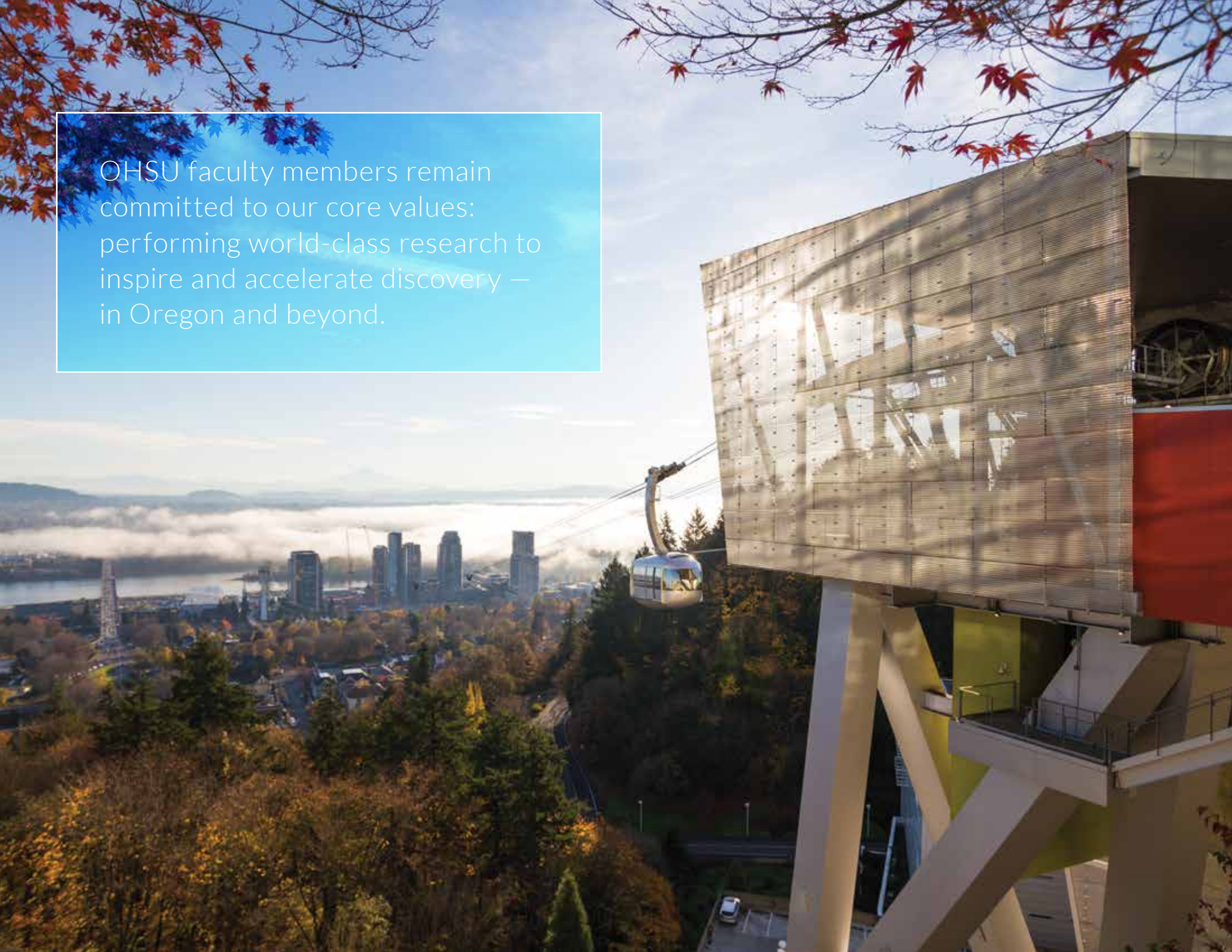


OHSU RESEARCH

Report of Research 2016



OHSU faculty members remain committed to our core values: performing world-class research to inspire and accelerate discovery — in Oregon and beyond.



From the Senior Vice President for Research

The past 12 months have marked tremendous success for OHSU research despite the difficult funding climate we and many other institutions navigated this year. I'm proud of our researchers, who brought in nearly \$390 million in extramural funding in 2016 and published their work in high-profile, top-tier journals. These accomplishments illustrate the high-quality, life-changing research that continues to take place at OHSU.

This year also brought new investments in research. Such investments include recruitment of faculty and scientific leaders to major instrumentation and facilities, and support for training grants, including diverse scholars. We expect to reap the rewards of this investment in years to come: Our goal is to draw on this momentum and catalyze the next generation of discovery.

We also saw major growth in our technology transfer and business development operations, with significant increases in everything from material transfer agreements to the number of patents filed and awarded. This success demonstrates OHSU's growing role in the innovation landscape in Portland, helping to drive jobs and economic growth in our region.

Of course, none of our success would be possible without the talent, creativity and persistence of our faculty. In spite of a challenging funding environment and much uncertainty, our OHSU faculty remains committed to our core values: performing world-class research to inspire and accelerate discovery – in Oregon and beyond.



Daniel M. Dorsa, Ph.D.
SENIOR VICE PRESIDENT FOR RESEARCH



New Research Leadership

Investing in a new wave of discovery across campus

OHSU recruited five new leaders in 2016 to build on some of its greatest research strengths. Recruiting this caliber of leadership underscores OHSU's commitment to continued excellence in research from basic science to clinical interventions to the social determinants of health.

David Bangsberg, Sadik Esener, Marc Freeman, Bita Moghaddam and Carsten Schultz are each working in fields that will see — due to recent innovations and new approaches — significant leaps in discovery. They will bring in new talent and develop novel technologies, interventions and ideas to address some of the most intractable problems in biomedical research.



David Bangsberg, M.D., M.P.H.

Founding dean, OHSU-PSU School of Public Health

David Bangsberg is internationally known for developing creative,

interdisciplinary approaches to public health. Under his leadership, the global health program at Massachusetts General Hospital grew to support institution-wide entrepreneurship, with programs ranging from medical technology innovation to global disaster response and community health. At the University of California, San Francisco, he created one of the leading programs on health disparities among the urban poor in the United States. Bangsberg is also renowned for work on social, economic and structural barriers to HIV/AIDS care in sub-Saharan Africa.

As the founding dean of the new collaborative OHSU-PSU School of Public Health, Bangsberg's research agenda builds on the collective strengths of both institutions to address the health of Oregonians. OHSU brings expertise in biomedicine, biostatistics and epidemiology, complemented by PSU's expertise in health policy and community and urban health.

Bangsberg earned his M.D. from Johns Hopkins University School of Medicine and his master's in public health from the University of California, Berkeley.



Sadik Esener, Ph.D.

Wendt Family Endowed Chair in
Early Cancer Detection
Director, Knight Cancer Institute
Center for Early Detection
Research

A scientific innovator, Sadik
Esener's achievements range
from developing diagnostic

biochips to creating nanoscale cancer-fighting "smart bullets" that deliver treatments to tumor cells. At the University of California, San Diego, he directed several centers of excellence, including the Cancer Nanotechnology Center of Excellence, where he explored ways to use nanoscale devices to detect and target cancerous tumors.

As director of the Knight Cancer Institute Center for Early Detection Research, Esener is expanding on the center's pioneering work in precision cancer medicine by focusing on reimagining early cancer detection. He will recruit 20 to 30 senior scientists with backgrounds ranging from cancer biology and oncology to medical engineering.

Esener earned his Ph.D. in engineering physics and applied physics from the University of California, San Diego, and his master's from the University of Michigan's Rackham Graduate School.



Marc Freeman, Ph.D.


Director, Vollum Institute

Marc Freeman's research has
changed our understanding of
neurodegenerative diseases.
Degeneration of axons is a
hallmark of all neurodegenerative
diseases such as Alzheimer's, ALS
and Huntington's, but how axons

destroyed themselves in these conditions remained a mystery. His laboratory at the University of Massachusetts Medical School was the first to identify a signaling pathway mediated by dSarm/Sarm1 that is activated in neurons after injury and in neurodegenerative disease, and which actively promotes axon auto-destruction ("axon death") and in turn functional loss in patients. Blockade of Sarm1 signaling is now a major therapeutic goal for the field, the hope being that blocking axon death will prevent axon loss in neurodegenerative conditions.

As director of the Vollum Institute, Freeman will advance its track record of important discoveries in basic neuroscience. His agenda also includes leveraging key discoveries in basic neuroscience to address challenging neurological disorders. Through fostering outstanding basic neuroscience discovery at the Vollum relevant to human disease, Freeman hopes to help strengthen interactions between basic and translational researchers and ultimately impact the treatment of neurological disorders.

Freeman earned his master's of philosophy and Ph.D. in biology at Yale University, where he completed his doctoral training in the laboratory of John Carlson. He then trained as a postdoctoral associate at the University of Oregon with Chris Q. Doe.



OHSU's new research facility, the Center for Radiochemistry Research, opened in

SEPTEMBER 2016.

The center provides scientists with a suite of powerful imaging tools and expertise, including a cyclotron for isotope generation.



Bita Moghaddam, Ph.D.

Chair, Department of Behavioral Neuroscience, School of Medicine
Ruth G. Matarazzo Professor of Behavioral Neuroscience

Bita Moghaddam is known for her successful translational research projects in psychiatric disorders, including

schizophrenia. While at Yale University's Department of Psychiatry, her work made possible the discovery of the first non-monoamine targeting compound for treatment of this brain disorder. As professor of neuroscience, psychiatry and pharmaceutical science at the University of Pittsburgh, Moghaddam continued her focus on the cellular basis of psychiatric disorders. Currently, Moghaddam is working to understand what goes off course during the development of the adolescent brain when most psychiatric disorders begin.

As chair of the Department of Behavioral Neuroscience, Moghaddam will create a long-term plan for the department, including fostering new areas of research. A primary goal is to translate basic behavioral neuroscience findings into treatment and prevention strategies.

Moghaddam completed postdoctoral training in pharmacology at Yale University after receiving her Ph.D. in biochemistry from the University of Kansas.



Carsten Schultz, Ph.D.

Chair, Department of Physiology and Pharmacology, School of Medicine

Carsten Schultz combines chemistry, biochemistry and cell biology to understand how cells exhibit their function. He is known for

his contributions to chemical strategies that allow labeling of proteins and cellular messengers in intact cells. His group at the European Molecular Biology Laboratory in Heidelberg created novel fluorescent sensors and reporters to investigate lipid signaling and protein-lipid interactions.

As chair of the Department of Physiology and Pharmacology, Schultz will build new collaborations and expand chemical biology research within the department. Indeed, he sees chemical biology's next step as requiring even broader cross-disciplinary collaboration. That next step is to move from biological to medical applications where new chemical tools are used to help monitor drug action and disease progression.

Schultz earned his Ph.D. in chemistry from the University of Bremen in Germany. He trained with Nobel laureate Roger Y. Tsien and was a postdoctoral researcher at the University of California, San Diego.

Research Spotlight

The Adolescent Brain Cognitive Development — ABCD study — is the largest study of child health and brain development in the United States.

Imaging the Developing Brain

Physical activity, time spent in front of screens, length and quality of sleep, sports injuries and substance use — each has an impact on the developing adolescent brain. But detailed information about the specific effects of these experiences has been challenging to measure, in part because it has been difficult to see into the brain.

Now three OHSU researchers, part of a national team from 19 institutions, are using OHSU's extraordinary neuroimaging resources to investigate the effects of adolescent substance use on teenage brains. This year, Damien Fair, Bonnie Nagel and Sarah Feldstein Ewing began recruiting for a study examining cognitive and social development in approximately 10,000 children over the course of 10 years. The researchers bring expertise from behavioral neuroscience, psychiatry, pediatrics and advanced imaging to this longitudinal study of the developing brain — the Adolescent Brain Cognitive Development study or ABCD study. The project is funded by the National Institute of Drug Abuse at the National Institutes of Health, U01DA041148.

The study asks a variety of questions about substance use and development. For example, it compares the impacts of occasional and frequent use of marijuana, alcohol, or nicotine, and it explores the extent to which factors such as head trauma or genetics affect whether someone begins to use drugs or alcohol.

Much of the research for the ABCD study at OHSU will use the Advanced Imaging Research Center, one of only a few facilities in the world to house powerful

12- AND 7-TESLA MAGNETIC RESONANCE IMAGING SCANNERS.

Advances in neuroimaging allow the team to precisely define the effects of substance use on white matter and other components of the brain.



Damien Fair, P.A.-C., Ph.D.

Assistant Professor, Departments of Behavioral Neuroscience and Psychiatry

Assistant Scientist, Advanced Imaging Research Center

Neuroscientist Damien Fair has advanced the scientific understanding of differences in developing brains with and without neuropsychiatric disorders. His studies of maturation in typically and atypically developing brains use functional and functional connectivity magnetic resonance imaging to understand how disorders such as ADHD begin. He is exploring ways to better characterize individual patients with psychopathologies to help guide future diagnostic, therapeutic and genetic studies.



Bonnie Nagel, Ph.D.

Associate Professor, Departments of Behavioral Neuroscience and Psychiatry

Neuropsychologist Bonnie Nagel's primary research focuses on exploring typical adolescent brain and cognitive development using structural and functional neuroimaging and neuropsychological assessment techniques. She is investigating methods to distinguish neurobiological phenotypes of addiction risk that are consequences of drug and alcohol use during adolescence. This research builds on her investigations into the relationship of variables such as reward-based structural and functional networks to the emergence of psychopathology.



Sarah Feldstein Ewing, Ph.D.

Associate Professor, Department of Child and Adolescent Psychiatry

Child Psychologist Sarah Feldstein Ewing has extensive experience utilizing a variety of evidence-based approaches to prevent and intervene with adolescent health risk behavior, including cannabis use, alcohol use and HIV/AIDS risk behavior. She has enrolled over 1000 unique youth within her large-scale clinical trials and published widely regarding the developmental fit, neurocognitive mechanisms, gender differences and cross-cultural models for this developmental stage. She has also developed a highly-innovative NIH-funded line of translational research evaluating the connections between basic biological mechanisms and adolescent treatment outcomes.



Oregon Clinical and Translational Research Institute

Improving human health by enhancing
clinical and translational research

The Oregon Clinical and Translational Research Institute promotes scientific collaboration, research growth and the translation of biomedical advances into the community. OCTRI enhances the efficiency and quality of clinical and translational research with funding from the NIH Clinical and Translational Science Awards and a significant commitment from OHSU.

The Clinical and Translational Research Center provides unique resources to help OHSU and other scientists perform clinical studies. Staffed with skilled research personnel, the center supports research disciplines ranging from metabolism and genetics to rare diseases and neuroscience. The facility includes inpatient and outpatient rooms and infusion chairs for clinical research that can also accommodate temporal isolation for sleep studies. Additional resources include a bionutrition unit for nutrition-related studies, a study coordinator unit for support of study conduct throughout OHSU, and a core laboratory for sample processing, storage, and analytic and genetic assays. With these unique resources, the CTRC can support a wide range of intensive phenotyping and experimental therapeutic studies that cannot be conducted in other facilities at OHSU or in the region.

The CTRC supports inpatient and outpatient research for studies ranging from

INTENSIVE

PHENOTYPING

with one-on-one nursing to

PHASES 1 AND 2

therapeutic infusions of experimental drugs.



The Clinical and Translational Research Center provides

30 STAFF MEMBERS

100 CLINICAL PROTOCOLS ANNUALLY

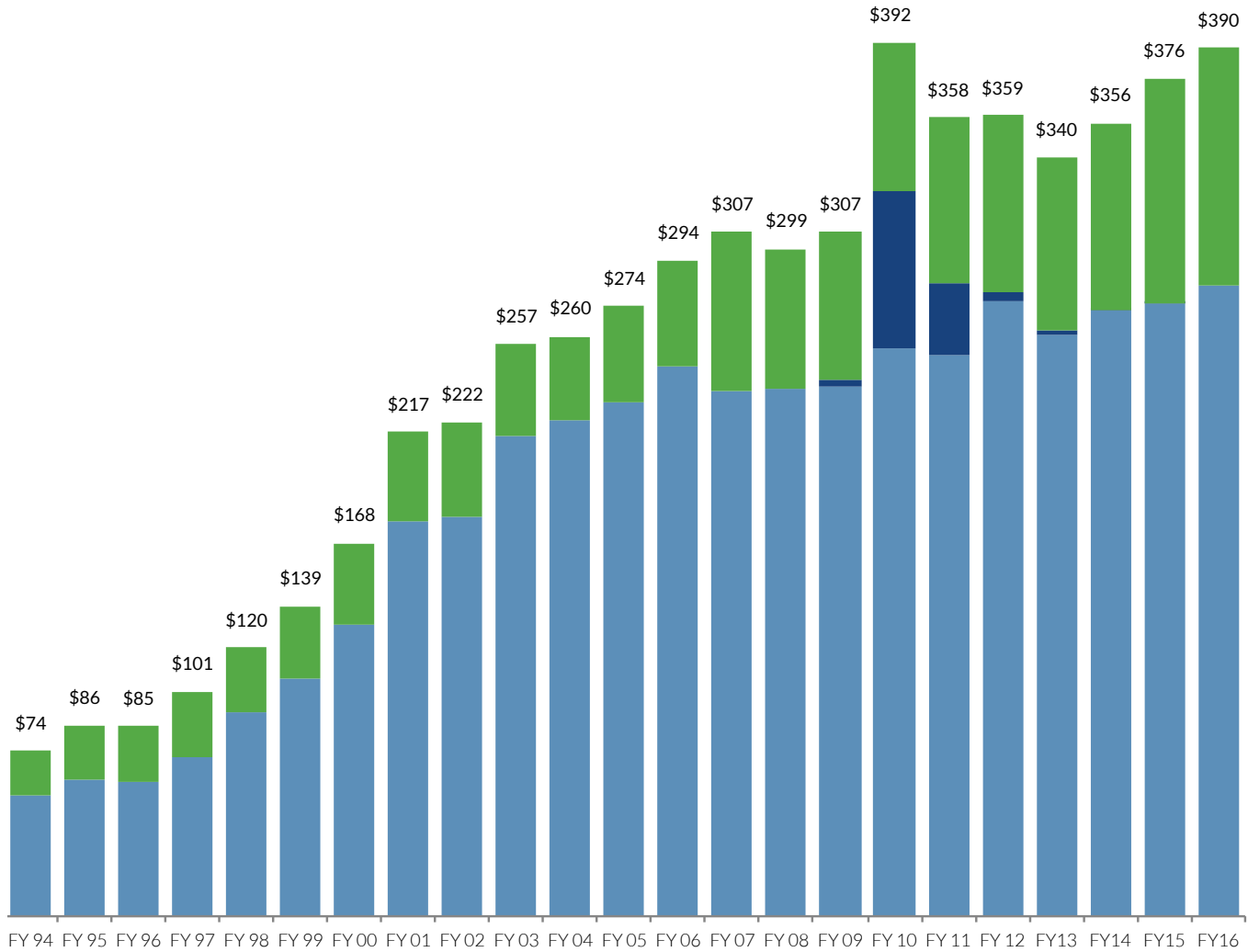
4000 OUTPATIENT VISITS PER YEAR

35,000 SAMPLES COLLECTED PER YEAR

300,000 SAMPLES STORED PER YEAR

Research by the Numbers

In fiscal year 2016, OHSU investigators were awarded **\$389.6 million** in grants and contracts — despite a decline in real federal dollars supporting research.



Sources of research funding

Funding for research conducted at OHSU comes from a broad base of sources supporting discovery in basic science, clinical research and public health.

The \$283 million in support from federal sources contributes significantly to Oregon's economy. In FY 2016, 91 percent of OHSU's research funding came from out of state. This funding stimulates job growth, provides tax revenues and creates new products and technologies.

More than 400 awards from private sources and more than 500 awards from industry sponsors totaled \$103 million, reflecting the overall strength of OHSU's relationships and collaborations.

TOTAL PER NIH AGENCY (FY 2016)

National Cancer Institute	\$38.2 million
National Institute of Allergy and Infectious Disease	\$24.6 million
National Institute of Child Health and Human Development	\$20.6 million
DHHS NIH Office of the Director	\$19.7 million
National Heart, Lung, and Blood Institute	\$16.3 million
National Institute of Neurological Disorders and Stroke	\$16 million
National Institute on Drug Abuse	\$12.8 million
National Institute on Deafness and Other Communication Disorders	\$12.7 million
National Institute of Diabetes and Digestive and Kidney Diseases	\$11 million
National Institute on Alcohol Abuse and Alcoholism	\$10.7 million
National Center for Advancing Translational Sciences	\$10.1 million
National Eye Institute	\$8.5 million
National Institute on Aging	\$8.3 million
National Institute of Mental Health	\$7 million
National Institute of General Medical Science	\$4.9 million
National Institute of Dental and Craniofacial Research	\$2.9 million

BY SPONSOR (FY 2016)

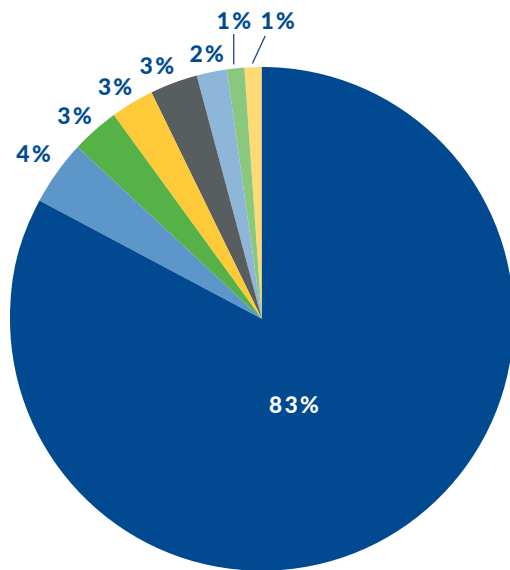
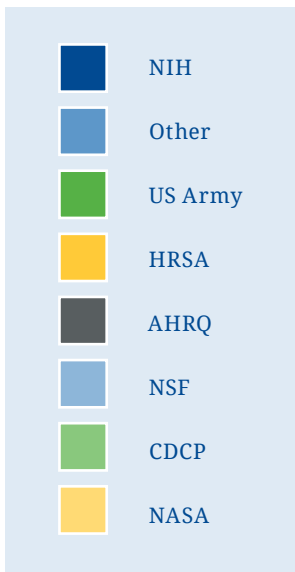
NIH	\$234,320,764
Private	\$51,652,987
Industry	\$51,192,887
Other Fed	\$48,924,073
Other Gov	\$3,512,112

BY ACTIVITY (FY 2016)

Research	\$294,081,014
Clinical Trials	\$65,186,503
Other	\$26,576,629
Instruction	\$3,758,678

TOTAL PER FEDERAL AGENCY (FY 2106)

National Institutes of Health – NIH	\$234,320,764
Other	\$10,639,463
US Army	\$9,848,313
Agency for Healthcare Research and Quality – AHRQ	\$8,487,831
Health Resources and Services Administration – HRSA	\$6,706,092
National Science Foundation – NSF	\$5,461,926
Centers for Disease Control and Prevention – CDCP	\$3,746,428
National Aeronautics and Space Administration – NASA	\$1,541,882
TOTAL	\$283,244,313



More than
1,200
principal
investigators
led research
projects in
FY 2016.

SCHOOL/UNIT

School of Medicine	\$253,667,727
SVP for Research Centers and Institutes	\$106,495,785
Provost Programs and Centers	\$11,068,899
OHSU-PSU School of Public Health	\$8,677,299
School of Dentistry	\$5,868,056
School of Nursing	\$2,974,691
Hospital	\$850,366

FRANCIS COLLINS

director of the National Institutes of Health, spent a day in conversation with OHSU researchers. He's seen here in the lab of Joe Gray, Ph.D., associate director for biophysical oncology at the OHSU Knight Cancer Institute.



Notable grants at OHSU

A sample of
major grants
that reflect
the breadth
and depth of
research at
OHSU.

The U.S. Department of Defense awarded the **University of Pittsburgh**, in collaboration with **OHSU** and the **University of Colorado**, up to \$90 million in research funding over the next decade to improve trauma care for both civilians and military personnel.

The NIH awarded **Markus Grompe, M.D.**, \$9.9 million to investigate new treatments for the life-limiting genetic childhood disease Fanconi anemia.

The NIH awarded **Louis Picker, M.D.**, and his team, along with scientists from Beth Israel Deaconess Medical Center, \$42 million to lead a consortium exploring HIV vaccine candidates and cure strategies.

The Patient-Centered Outcomes Research Institute granted OHSU investigators **Mark Helfand, Ph.D.**, and his team a major award to study and improve peer review processes.

The U.S. Army awarded a grant to **Leslie B. Hammer, Ph.D.**, of the Oregon Institute on Occupational Health Sciences to help Oregon National Guard and Reserve members re-integrate into the workplace.

The Agency for Healthcare Research and Quality awarded **Debbie Cohen, Ph.D.**, funding to catalyze evidence-based medicine through the Evaluating Systems Change to Advance Learning and Take Evidence to Scale – ESCALATES – project.

The NIH funded a project by **Jay Nelson, Ph.D.**, to target interferon regulatory factors as a way to make vaccines more powerful.

The Susan B. Komen Foundation granted **Lisa Coussens, Ph.D.**, a large award to use macrophage cells to improve the effectiveness of chemotherapy for triple-negative breast cancers.

Bill Rooney, Ph.D., received funding for expanding the capacity of the 3T MRI instrument in the OHSU Advanced Imaging Research Center.

The Prostate Cancer Clinical Trials Consortium awarded **Julie Graff, M.D.**, funding for a phase I/II trial to test whether concurrent treatment with enzalutamide and cabazitaxel is safe and effective for men with metastatic castration-resistant prostate cancer.

Technology Transfer and Business Development

The number of patents filed by OHSU researchers and the success rate of those patents contributed to OHSU's rank as No. 35 on *The Reuters 100: The World's Most Innovative Universities 2016*

Inclusion and placement on the list is based on empirical data ranging from patent volume and success to industry collaborative articles. OHSU scored highly in these categories and for "commercial impact," which is calculated based on citations of academic papers in patent filings.

OHSU researchers disclosed 151 new inventions, were awarded 30 U.S. and foreign patents, and completed 285 service agreements – all increases over 2015. OHSU made 106 license and option agreements in technology – a 41 percent increase.

151

new innovations disclosed (14 percent increase from FY 2015)

422

material transfer agreements completed (11 percent increase from FY 2015)

151

new innovations disclosed (14 percent increase from FY 2015)

165

patent applications filed (38 percent increase from FY 2015)

285

service agreements completed (40 percent increase from FY 2015)

Nearly

\$16 MILLION

awarded under 84 agreements for non-clinical industry sponsored research

73

license and option agreements on OHSU technology (41 percent increase from FY 2015)

30

U.S. and foreign patents issued



OHSU and the Portland Innovation Landscape

Portland is emerging as a hotbed of startups — and OHSU is at the forefront

It used to be that large companies looking for creative new startups to acquire or venture capitalists looking for their next investment would zero in on San Francisco or Seattle. Portland didn't capture their attention. That's changing.

For large pharmaceutical, medical device and IT companies, Portland's startup culture looks promising. Health care and biosciences dominate the startup landscape, and OHSU is taking the lead in supporting these new businesses. Evidence of this can be seen in the Oregon Translational Research and Development Institute's bioscience incubator: Nine of the 17 companies currently in the incubator are based on OHSU research.

OHSU-based companies are growing more diverse as well. Not only are researchers developing "hard" technologies such as vaccines, drugs and medical devices, but they are also creating new companies in digital health. In fact, three of the six OHSU-based companies that began in 2016 are software-based, and OHSU executed more software licenses than patent licenses. Indeed, digital health is an emerging theme for OHSU and Portland.

FY 2016 COMPANIES BASED ON OHSU TECHNOLOGY

CORI² Inc.

A full-featured endoscopy reporting software that matches the speed of dictation with point-and-click operation.

First Ascent Biomedical LLC

Uses drug combination prediction, based on genomics, for recurrent sarcoma patients.

Project Lite Inc.

Reduces hospital-acquired infection by developing sterilization devices for in-line catheters.

Qview Health Inc.

Creates software solutions for managing peer review in the hospital setting.

Regenavid Inc.

Developing a drug target for neuronal regeneration.

SurgiVance Inc.

Developing an all-in-one unit at the surgical location that reduces surgical time, costs, pain and anxiety while improving outcomes.

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