
2016—2017 ANNUAL REPORT
RESEARCH
ENGAGED
UCDAVIS
TECHNOLOGY MANAGEMENT AND
CORPORATE RELATIONS
TECHNOLOGY MANAGEMENT & CORPORATE RELATIONS

THE 3 BRANCHES OF TMCR

Innovation*Access*:
Stewards intellectual property and negotiates licenses

Office of Corporate Relations:
Develops and manages strategic relationships with industry partners

Venture Catalyst:
Supports the development of new ventures fueled by university research

GREETINGS

FROM UC DAVIS

I am delighted to report another great year of achievements in commercial and economic impact enabled by the Technology Management and Corporate Relations (TMCR) division of UC Davis' Office of Research.

New university inventions reached an all-time high and the number of new startups matched our previous record of 14! Additionally, we saw continued corporate research engagement with the university, with $61.5 million in industry-funded research being initiated and undertaken last year, enabling the development of novel technologies and the realization of the commercial potential of faculty research.

As you will see in this year's report, the breadth of our inventions, technologies and startups continues to reflect our status as one of the most comprehensive research universities in California — generating novel solutions to problems that affect people around the world.

Narrowing the growing disconnect between academia and the general public's view regarding the value delivered by higher education requires close, continuous and contextually-relevant community engagement, especially in those areas that align with the economic prosperity of our communities. This past year, we worked effectively with the California State Legislature, in collaboration with our colleagues in Government and Community Relations and under the umbrella of the UC Office of the President, to assist in the development of Assembly Bill 2664 — aimed at expanding the innovation and entrepreneurship infrastructure within the UC system. The objective of this unique legislative initiative, through which each of the 10 UC campuses received $2.2 million from the state, is to drive regional economic development through expansion of the infrastructure necessary for continued growth in the commercialization of university technologies and the high-value jobs these engender to support a thriving local, regional and state economy. With this funding, we are expanding our programs and enhancing our network of startup incubators in collaboration with our committed university partners, which include the Mike and Renee Child Institute for Innovation and Entrepreneurship, the Engineering Student Startup Center, the Office of the Provost, the Internship and Career Center, Graduate Studies and other entrepreneurially focused campus stakeholders.

We expect the 2017–2018 fiscal year to be similarly impactful, and know that this sustained success will only be possible through the continued collaboration and support of the extended UC Davis family of friends, within which we count you as an important member. As always, I encourage you to contact me or anyone in the TMCR team with questions or to discuss opportunities to align your efforts and enthusiasm for technology commercialization and economic impact with ours. Thanks again for your stalwart support, and I look forward to having the opportunity to share our progress and plans for the future with you in person.

Sincerely,

DUSHYANT PATHAK
Associate Vice Chancellor
Technology Management &
Corporate Relations

CREATING A BETTER WORLD THROUGH

BOLD INNOVATION

Creating a better world — that is the common thread that inspires the world-leading research, innovation and technology development at UC Davis.

Whether it is protecting the world's food supply, advancing human and animal health, fueling next-generation technologies or developing sustainable environmental solutions, we thrive on enriching all forms of life by producing novel insights and elegant solutions to some of the world's most complex challenges.

Our strength lies in our cross-disciplinary collaboration, where scientists, engineers and physicians work together to deliver breakthrough discoveries and imaginative technology solutions. These solutions not only enrich lives but are also a strong contributor to our local and national economy. In the previous year alone, UC Davis received $783 million in research funding, filed 170 new patent applications and spurred the formation of 14 startup companies.

Our Technology Management and Corporate Relations (TMCR) division — one of three divisions within the Office of Research — serves as the primary campus resource for the translation of research and innovation into commercial impact. We enable technology development, from conception to commercialization, by providing the tools, services and connections that empower our university's bold and imaginative researchers.

"UC Davis has grown to become one of the region's most powerful engines of innovation and economic development. This growth, fueled by the innovative services and programs offered by our Technology Management and Corporate Relations division, is **expanding the impact of our university's research and development across the world."**

— CAMERON CARTER
Interim Vice Chancellor for Research

TMCR's goal is to transform today's research into tomorrow's successful commercial and economic impact. We ensure that campus research and the nascent technologies emerging from this research seed new industry directions, products and services that can address the needs of regional, state and global communities.

TMCR is organized in three units that work collaboratively to cultivate innovation, propel venture formation and invigorate corporate partnerships. Our team works closely with entities and stakeholders within and outside the campus. On campus, TMCR collaborates with faculty, students, staff, the Sponsored Programs office, the Mike and Renee Child Institute for Innovation and Entrepreneurship, Development and Alumni Relations, as well as with other innovation-directed teams and administrative units. Externally, TMCR engages with industry partners, entrepreneurial service providers, investors, entrepreneurs, incubators, accelerators, government and policy stakeholders and stewards of regional economic development.

#1
IN THE WORLD FOR VETERINARY SCIENCE

63
STARTUPS OVER THE LAST 5 YEARS

$783m
IN RESEARCH FUNDING

#1
NATIONALLY FOR AGRICULTURAL SCIENCE

Ranked as one of America's **top hospitals**

FUELING

INNOVATION

As one of the most comprehensive universities in California, UC Davis drives innovation by bringing together **engineers, clinicians, scientists** and **business professionals to develop novel solutions that address critical issues.**

A breakthrough treatment, a safer food supply, a better way to learn — each has the power to transform our world.

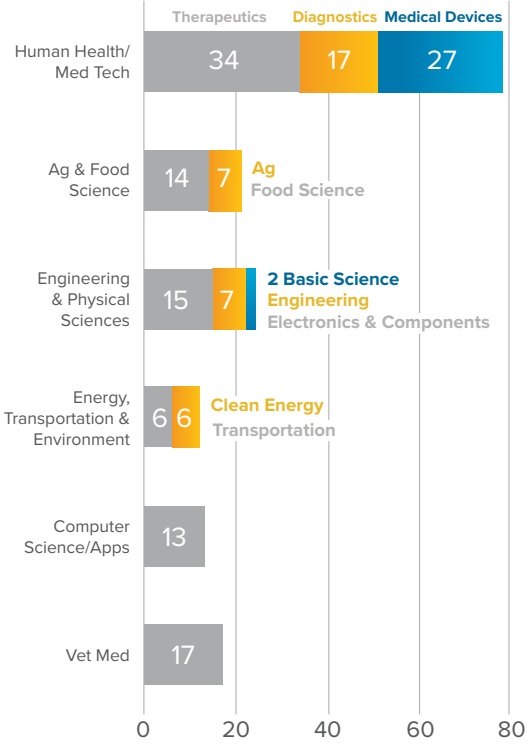
TMCR plays a critical role in enabling campus innovation by supporting entrepreneurship, cultivating intellectual property and establishing connections to the marketplace.

This past year, UC Davis generated 294 invention disclosures, an all-time high for the university. During the same year, 84 new patents were issued based on previous submissions, and 170 new patent applications were filed. These inventions cross a wide range of applications, with the majority relating to advancements in human health. Intellectual property officers within Innovation*Access* work closely with inventors to evaluate and manage intellectual property developed at UC Davis — with the ultimate goal of advancing new technologies that benefit society. TMCR has developed several programs to help spur innovation and accelerate new technology development. The Science Translation and Innovative Research (STAIR™) grant program provides funding and support to help innovators demonstrate proof-of-concept and commercial feasibility for their technologies, bridging the funding gap that plagues innovators in the early stages of technology commercialization. To date, a total of $897,000 has been awarded to 19 faculty members as part of this innovative program.

Venture Catalyst added the Data, Informatics and Application Launch (DIAL™) grant program to support commercial opportunities in software, informatics and data science. Structured similarly to the STAIR grant program, the DIAL program is enabled by funding provided by the State of California under the UC Innovation and Entrepreneurship Expansion Bill, AB 2664.

UC Davis Generated 294 Invention Disclosures during FY 2016-2017

Number of Inventions Disclosed by Sub-Category



Note: chart excludes an additional 129 inventions categorized as “Tangible Research Property”

"The public mission of UC Davis is inextricably linked with the innovative spirit that drives our faculty, students and staff to transform their **research**, **academic pursuits** and **passion** into **life-changing societal impact."**

— **Dushyant Pathak**, Associate Vice Chancellor for Research and Executive Director of Venture Catalyst at UC Davis

AGREEMENTS

Exclusive Plant and Utility Licenses	22
Non-Exclusive Plant and Utility Licenses	62
Letter Agreement/Options	24
Material Transfer Agreements	777
Data Transfer Agreements	80
Copyright Licenses	135

INVENTIONS/PATENTS

Records of Invention	294
U.S. Patents Filed	167
Foreign Patents Filed	3
U.S. Patents Issued	44
Foreign Patents Issued	40

UC Davis Chancellor's Innovation Awards:

Launched in 2016, the UC Davis Chancellor's Innovation Awards recognize faculty, students, staff, community partners and industry leaders for their work, dedication and success in achieving societal impact through innovations in technology and social engagement.

The 2017 UC Davis Chancellor's Innovation Award Recipients:

Innovator of the Year:

Lara Downes
Artist in residence at the Mondavi Center for the Performing Arts

Innovator of the Year:

Jorge Dubcovsky
Distinguished professor of plant sciences and Howard Hughes Medical Institute researcher

Innovative Community Partner of the Year:

Vivek Ranadivé and the **Sacramento Kings organization**

Lifetime Achievement Award for Innovation:

Gary Snyder
Poet, essayist, lecturer, environmental activist and professor emeritus of English

STAIR™ Mentor Profiles

A powerful and unique feature of the STAIR™ grant program is the engagement of industry mentors with all grant finalists and awardees. This guidance has been cited by grant recipients as an invaluable part of the program.

To date, over 20 external industry experts have provided mentoring through this program, giving generously of their time and experience. Special mention is deserved for the following friends of the university, who have been actively involved with the program since its very inception.

Rick Beberman

Beberman serves as commercial and strategy advisor to several early-stage digital health companies, including Sense.ly, PREPARE and Mediforests. Prior to this, he led the business development group for Health Care Investment Visions, an organization that invests in early-stage health information technology companies.

Robert E. Dunkle

Dunkle has more than 25 years of experience leading business growth in life sciences, including therapeutics, diagnostics and gene expression analysis platforms. He has raised over $35 million in venture capital and served as CEO of three life science companies as well as vice president at the world's largest cheminformatics company.

John Selep

Selep has been bringing new technologies to market for nearly three decades as a business executive, investor, advisor and mentor. Selep is the founder of AgTech Innovation Partners, serves on the board of directors of the Sacramento Angels and is a principal advisor at the Larta Institute.

Bill Shelander

Shelander is chief operating officer and co-founder of Anven (a company developing breakthrough diagnostics and therapeutics for Alzheimer's disease), co-director of the Cleantech to Market program at UC Berkeley's Haas School of Business and a lecturer at the Environmental Entrepreneurship and Innovation program at Stanford University. Previously, he was the commercialization lead for Lawrence Berkeley National Laboratory.

Samuel Wu, MD, PhD

Wu has been a health care venture capital investor since 2002. He is a founding partner at Acuris, which was recently launched by the MedImmune Ventures team out of AstraZeneca. Previously, he was the managing director of MedImmune Ventures' West Coast office and a principal at SV Life Sciences.

Ilan Zipkin, PhD

Zipkin is vice president of business development at the Parker Institute for Cancer Immunotherapy, where he brings together scientists, clinicians and industry partners to build a coordinated approach to cancer immunotherapy research. Zipkin has more than 16 years of life science venture capital experience, including institutional and corporate venture investing, company management and board of director roles.

STAIR™ Grant Recipients

Gino Cortopassi
Professor, Department of Molecular Biosciences

Alexey Tomilov
Assistant Project Scientist, Department of Molecular Biosciences

Cortopassi and Tomilov have identified several compounds that significantly inhibit Shc, reducing the body's susceptibility to pediatric nonalcoholic fatty liver disease.

Richard Levenson
Professor and Vice Chair, Department of Pathology and Laboratory Medicine

Farzad Fereidouni
Assistant Project Scientist, Department of Pathology and Laboratory Medicine

Levenson and his team have created an innovative method for spectral imaging that drastically reduces the amount of data needed for analysis. Their novel approach uses a conventional camera sensor fitted with either a filter wheel or beam-splitting optics.

Kai Liu
Professor, Department of Physics

Liu and his team invented a new method that creates stable skyrmion lattices at room temperature and in zero magnetic field, making them an excellent candidate for energy-efficient data storage as well as other nanoelectronics applications.

Tony Simon
Professor, Department of Psychiatry and Behavioral Sciences

Simon has developed a "neurotherapeutic" video game to help address the cognitive deficits of children with genetic disorders such as chromosome 22q11.2 deletion, Fragile X, and Turner and Williams syndromes, among others.

INNOVATION BOLSTERED

BY STATE INVESTMENT

A $22 million investment from the state is propelling new innovation and entrepreneurship efforts across the University of California by bolstering the system's infrastructure, incubators and entrepreneurship education programs. Each UC campus received $2.2 million in one-time funding in February 2017 from Assembly Bill 2664, the Innovation and Entrepreneurship Expansion authored by Assembly member Jacqui Irwin, D-Thousand Oaks, and signed last fall by Governor Jerry Brown.

"By expanding our innovation and entrepreneurship infrastructure and support programs, UC Davis has the opportunity to effectively translate the almost $800 million of annual research funding it receives into accelerated regional and statewide economic growth through talent development, workforce preparation, technology commercialization and startup formation," said Dushyant Pathak.

The state's investment is supporting new and expanded activities and programs that provide direct benefit to campus innovators and entrepreneurs across all disciplines, schools and colleges, as well as to local entrepreneurs whose research can be expected to result in regional economic impact.

Venture Catalyst has developed a strategic plan for investing AB 2664 funds that focuses on four main categories, all of which integrate a broader emphasis on economic engagement through collaboration with community partners and the regional innovation ecosystem:

1. Expansion of proof-of-concept grant programs to demonstrate commercial feasibility for university technology and boost innovation across a wide range of disciplines
2. Business training and mentorship programs focused on building workforce skills and practical experience in business, entrepreneurship, technology commercialization and startup development
3. Incubator and accelerator programs that provide work and lab space, research and development equipment and instrumentation and support resources for entrepreneurs
4. Enhanced support for populations and communities underrepresented in STEM and technology entrepreneurship

While the implementation time frame for investing the AB 2664 funds runs through the 2018–2019 fiscal year, several new and expanded programs have already been launched. Venture Catalyst completed the first cycle of the Data, Informatics and Application Launch (DIAL™) grant pilot program, providing funding of close to $60,000 to support translational science and innovative research. Investments were also made to expand the capacity and capabilities of the university's Distributed Research Innovation and Venture Engine (DRIVE™) Network by purchasing new lab equipment for the UC Davis-HM.CLAUSE Life Science Innovation Center.

By expanding our **innovation** and **entrepreneurship** infrastructure and support programs, UC Davis has the opportunity to effectively translate the almost **$800 million of annual research funding** it receives into **accelerated regional and statewide economic growth.**

TREATING CELIAC DISEASE SYMPTOMS WITH

SYNTHETIC DNA

Justin Siegel, assistant professor of biochemistry and molecular medicine at UC Davis, and a team of researchers from the University of Washington have developed a therapeutic enzyme that may be able to treat celiac disease, an autoimmune disorder triggered by ingesting gluten.

The disease, which triggers damage to the microvilli in the intestine, is associated with a wide variety of health problems, including vitamin and mineral deficiencies (which lead to other health problems like osteoporosis and anemia), lactose intolerance, infertility, nervous system disorders, failure to thrive in children and other complications. Studies estimate the disease affects about 1 percent of the population worldwide. The only existing treatment is to completely avoid ingesting gluten.

The enzyme, KumaMax, works by breaking down the immune-reactive parts of gluten in the stomach, thereby avoiding the painful symptoms and damage done in the small intestine from accidental gluten ingestion. The enzyme was developed using synthetic DNA through a process that allows researchers to essentially copy, edit and move genes to yield the desired sequence and construct the ideal candidate.

Siegel is a co-founder and scientific advisor for a spinoff company, PvP Biologics, which licensed the intellectual property developed jointly at University of Washington and UC Davis. In January 2017, PvP Biologics announced a deal with Takeda Pharmaceuticals, which invested $35 million to move the enzyme through phase I clinical trials with an exclusive option for purchase of the company.

PvP Biologics is conducting safety testing in animals with plans to pursue human clinical trials later this year.

"The real possibility to affect millions of people around the world has really driven my research in new directions," said Siegel. "We are just starting to understand the complex relationship between our health and the food we eat. **I think this will be a major step forward in developing a new paradigm for how we interact with our food."**

PIANIST LARA DOWNES RECOGNIZED FOR

INNOVATIVE COMPOSITION

Lara Downes, artist-in-residence at the Mondavi Center for the Performing Arts and director of the center's National Young Artists Program, was recognized as one of the innovators of the year as part of the 2017 UC Davis Chancellor's Innovation Awards. Downes is an internationally recognized pianist and recording artist, whose work has touched many people through her albums and concert performances as well as through her outreach and mentorship of youth nationwide.

"Lara Downes, through her many stellar contributions in the field of music, has furthered UC Davis' goals of artistic excellence, high-quality education and promoting understanding among people from diverse backgrounds," said then Interim Chancellor Ralph J. Hexter.

Downes' innovation in music and artistic communication spans many genres. In October 2016, she released the album, *America Again*, which was inspired by Langston Hughes' 1935 poem, "Let America Be America Again."

America Again debuted in the top 10 on the Billboard Classical charts and was picked by NPR as one of "10 Classical Albums that Saved 2016." This past year she collaborated with U.S. Poet Laureate Rita Dove to launch the My Promise Project, a community transformative initiative that focuses on themes of promise, potential, citizenship, community, compassion, communication, self-awareness and self-esteem.

"Music starts conversations," said Downes. "Music is a place where people can come together from different perspectives and different backgrounds — and maybe even different sides of a divide — and find some common ground."

Downes added, "I feel a responsibility to reach out and give back. I want to communicate that music has meaning, that young people can dig under the surface to find something profound and timeless that applies to their own experience, their own history."

IMPROVING THE LIVES OF COMPANION ANIMALS VIA

STEM CELL THERAPY

Dori Borjesson, a board-certified veterinary clinical pathologist and director of the Veterinary Institute for Regenerative Cures at UC Davis, is conducting research at the forefront of regenerative medicine, targeting exciting new areas of stem cell use to treat disease in dogs, cats and horses.

Borjesson, along with Associate Professor Boaz Arzi and their team at the Veterinary Institute for Regenerative Cures, has generated mesenchymal stem cells from bone marrow, adipose tissue and umbilical cord blood/tissue and studied the effect of these cells on immune cell function.

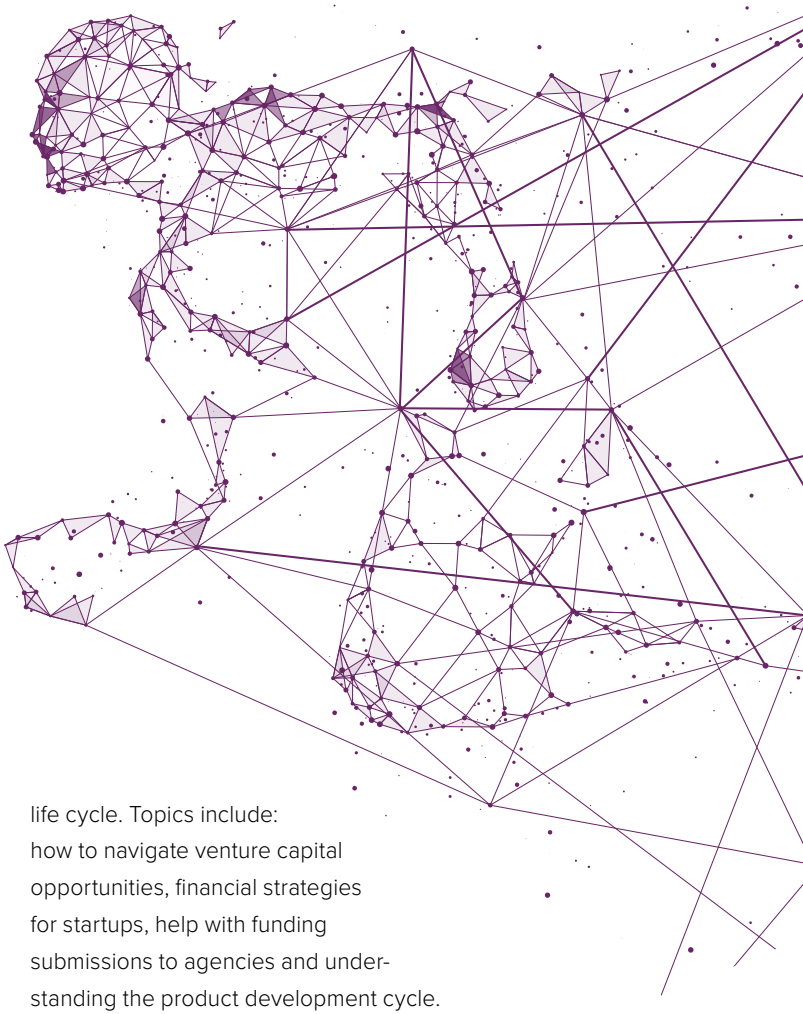
The team has developed a stem cell therapy to treat chronic oral inflammatory disease as well as a biomarker for predicting whether there will be a response to therapy. They have developed a stem cell treatment for feline chronic gingivostomatitis. Chronic gingivostomatitis is an immune-mediated oral mucosal inflammatory condition that causes painful mucosal lesions that markedly reduce quality of life and often require long-term immunosuppressive therapy that has significant associated risks and side effects.

Proof-of-concept studies in cats have shown that treatment with autologous and allogeneic adipose-derived mesenchymal stem cells has been effective in treating chronic gingivostomatitis, with results that demonstrate substantial improvement and even clinical cures in about 70 percent of cat patients. The team is now in the process of submitting a Pre-Investigational New Drug application to the FDA to conduct a clinical trial in human patients with oral lichen planus, a similar oral inflammatory disease.

The intellectual property from Borjesson's work has been licensed by VetCell Therapeutics. The company plans to commercialize Borjesson's stem cell treatment for feline chronic gingivostomatitis.

GUIDING NEW

VENTURES



Venture Catalyst, within the division of Technology Management & Corporate Relations, **provides a range of services, connections and resources** to help campus innovators and entrepreneurs transform their technologies into successful startup businesses. And the hard work is paying off. UC Davis now averages **more than one startup a month, with 14 enabled over the last year alone.**

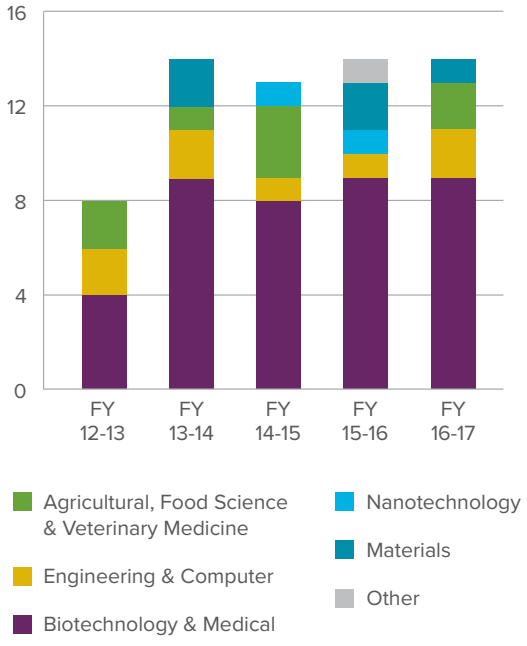
The technologies licensed by, or otherwise enabling these companies, address a wide range of commercial needs, such as detection of critical agricultural diseases, prevention of arthritis caused by injuries and pathogen detection for food safety. In addition to the beneficial applications of their products, these companies are poised to produce high-value jobs that benefit our regional economy.

This past fall, 10 UC Davis-affiliated companies were among the 17 finalists for the inaugural Sacramento Region Innovation Awards. The 2016 program was sponsored by the law firm Stoel Rives LLP, accounting firm Moss Adams LLP and the *Sacramento Business Journal* — recognizing the pioneering innovations and significant regional impact these companies are providing. Three UC Davis startups (Barobo, Inc., Evolve BioSystems, Inc. and RF Biocidics) received awards in their designated areas of focus.

Venture Catalyst is enabling these and other entrepreneurs through its Smart Toolkit for Accelerated Research Translation, or START™ program, which provides a comprehensive suite of services needed to successfully form and grow new ventures. Since its inception, the START program has attracted more than 100 participants — with 45 added in the past year.

Support is also offered in the form of educational and networking events. Venture Catalyst hosts a seminar series called *Knowledge Exchange* that brings in speakers from various segments of the innovation and entrepreneurship life cycle. Topics include: how to navigate venture capital opportunities, financial strategies for startups, help with funding submissions to agencies and understanding the product development cycle. Venture Catalyst also collaborates with the Davis Postdoc Entrepreneurship and Career group (DPEC) to host events that connect postdoctoral fellows and graduate students with industry leaders and career opportunities.

UC Davis Startups: Last Five Years



Venture Catalyst START Suite of Programs and Services

LegalNet™
Incorporation and startup legal support

MICA™
Market Intelligence and Competitive Analysis reports

MentorNet™
Access to networks of experienced industry professionals and mentors

Grant Workshops
SBIR and STTR grant writing and submission workshops

VentureNet™
Commercial bank, human resources, business vendors and contract service providers

Academy Support
Sponsorship and support for participation in the Mike and Renee Child Institute for Innovation & Entrepreneurship's Entrepreneurship Academies

Venture Catalyst helps campus entrepreneurs by connecting them to a network of thematically oriented startup incubators, both on and off campus. This Distributed Research Incubation and Venture Engine (DRIVE™) program was established in 2015 and has grown to include eight members. Recent additions include I/O Labs and The Urban Hive.

DEVELOPING ULTRASONIC

TOUCH-FREE SENSING TECHNOLOGY

As devices get smaller and more powerful, the need for more efficient and natural user interfaces becomes more important. Startup Chirp Microsystems believes that the next evolution of advancements in user experience will be based on sound principles — literally. The company has licensed foundational technology, developed at UC Davis and UC Berkeley, which utilizes ultrasound waves and echolocation to sense the three-dimensional location of objects in our everyday environment.

David Horsley, professor in the UC Davis Department of Mechanical and Aerospace Engineering and chief technology officer at Chirp Microsystems, worked with colleagues at the Berkeley Sensor & Actuator Center to develop this novel technology. The team has created a miniature sonar sensor by combining microelectromechanical systems (MEMS) ultrasound transducers and ultralow-power integrated circuits in a tiny, millimeter-scale package. Using echolocation techniques similar to those used by bats, their technology enables precise range-finding at distances of several meters while requiring less power and offering superior accuracy than other commercially available technologies.

Chirp's product offerings target a range of applications, including virtual reality (VR), security cameras, tablets and wearable devices.

The startup held its first public demonstration of its ultrasonic sensing technology at the 2016 Consumer Electronics Show. The company is now working with leading VR system providers to introduce ultrasonic motion-tracking for mobile VR and gaming platforms.

AcenXion Biosystems	AimRNA	ASTRONA	Beiwe Pharma	Bionate	CardioProbe	cognivive
Digital high resolution and high throughput PCR system	Novel technology for high-yield production of biologic RNA agents for improved RNA therapeutics	RNA-based molecular biology and nano-technology to identify pathogens	Mitochondrial targeted therapeutics for orphan disease indications	Direct production of sugar acids and oligomers from cellulosic biomass	High throughput cardiotoxicity screening and high content cardiac function assays	Developing evidence-based digital therapies in mixed reality video game form to reduce cognitive impairments

UC Davis Startups Launched in FY 2016–17

ADVANCING

INFANT HEALTH

In May 2017, Evolve BioSystems Inc., a spin-off from the UC Davis Foods For Health Institute (FFHI) that is developing novel solutions to restore and maintain a healthy newborn gut microbiome, completed a $20 million Series B financing to help fund the commercialization of its products.

The company is developing activated probiotic and prebiotic products based on research that shows the infant gut microbiome plays a critical role in the development of a healthy immune system and early metabolic programing as well as meeting the infant's nutritional requirements.

Evolve's founding team, which includes UC Davis faculty members Bruce German, David Mills, Carlito Lebrilla and Daniela Barile, along with former FFHI Assistant Director Samara Freeman, has been conducting research at the forefront of infant nutritional health for over a decade, focusing on the key role that breast milk plays in creating a healthy intestinal tract.

The funding is expected to support ongoing clinical activities, operational expansion and the launch of the company's initial commercial products.

FURANICA	Luminance Biosciences	PhotonLab	CERTUS CRITICAL CARE	PVP BIOLOGICS	Tesio Pharmaceuticals	XTB LABORATORIES
Development of Furan Fatty Acids (FuFAs), naturally occurring lipids in fish oils, as nutraceuticals and pharmaceuticals that could protect cardiovascular health	Development and rapid translation of companion diagnostics and therapeutics	Industrial mass production of inexpensive photosensors, photosensor arrays, and radiation detectors	Novel medical devices to optimize the care of the critically ill and wounded — improving ventilation, fluid administration and hemorrhage control	Development of engineered enzymes to treat celiac disease	Preventing arthritis after injury	Early detection and rapid response to critical agricultural disease infestations

USING STEM CELLS TO TREAT

BONE DISEASE

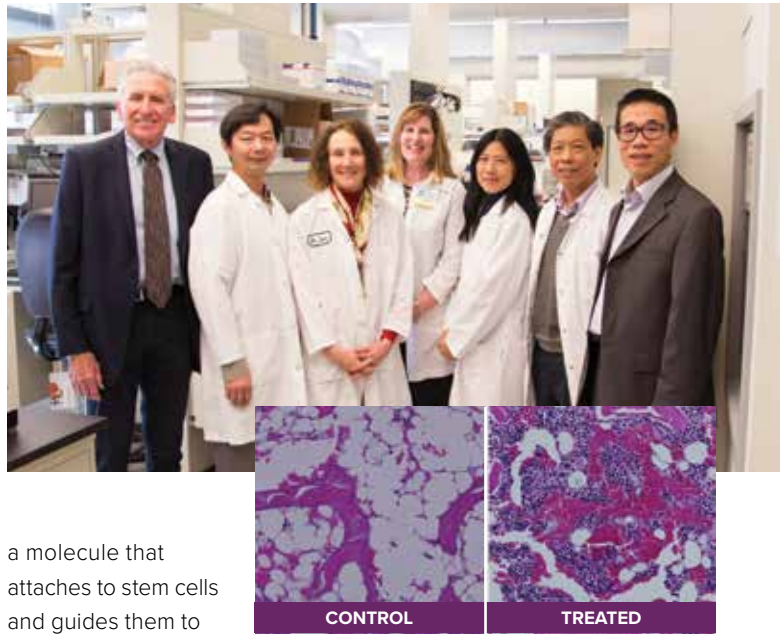
In early 2017, local startup Regenerative Arthritis and Bone Medicine Inc. (RABOME) licensed a class of drugs developed at UC Davis that holds potential for treating diseases associated with bone loss and inflammatory arthritis.

The company is developing a hybrid molecule, LLP2A-Alendronate, which has been found to effectively direct mesenchymal stem cells (MSCs) to induce bone regeneration in animal models. The compound works by guiding transplanted and endogenous MSCs to the surface of the bone, where they differentiate into bone-forming cells, thereby increasing bone mass and strength. These cells are also immune modulating — helping to reduce inflammation at the target sites.

The development of this novel therapy is the result of a successful research collaboration between two teams at UC Davis: a group of experts on bone health, led by Nancy Lane and Wei Yao from the Center for Musculoskeletal Health, and a group of medicinal chemists, led by Kit Lam and Ruiwu Liu from the Department of Biochemistry and Molecular Medicine.

The use of stem cells as therapeutic agents is a growing field, but directing stem cells to travel and adhere to the surface of bone for bone formation has been an elusive goal in regenerative medicine.

"There are many stem cells, even in elderly people, but they do not readily migrate to bone," said Yao, co-inventor and associate professor at UC Davis. "Finding a molecule that attaches to stem cells and guides them to the targets we need provides a real breakthrough."



Late last year, RABOME received approval from the Food and Drug Administration to begin phase I clinical trials to evaluate the safety of the drug in humans.

VentureNet™ Partners

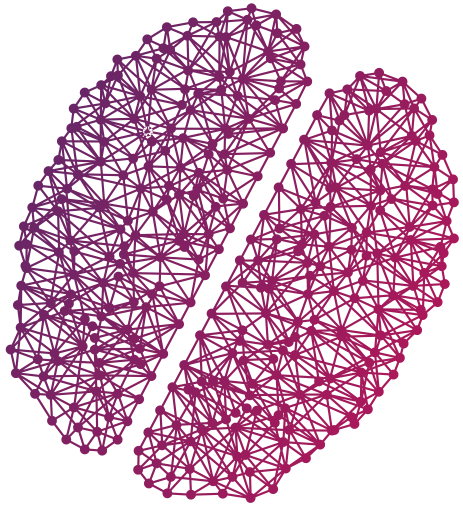
The Venture Catalyst START™ program provides the building blocks to equip UC Davis–affiliated entrepreneurs and campus innovators with the tools they need to form and grow successful companies. One of these tools is the VentureNet program, which provides a variety of targeted services addressing the specific needs of startups.

First Northern Bank, a locally owned community bank headquartered in Dixon and the first member of VentureNet, is actively assisting eight university-affiliated startups by providing a dedicated relationship manager and a bundle of business banking services tailored to the needs of startups. First Northern is also available to assist startups by making connections to small business lending opportunities. Louise A. Walker, president and CEO, facilitated the partnership with Venture Catalyst and identified a specific point of contact to work with entrepreneurs participating in the START program.

Carbahal & Company, a Davis-based accounting firm, has provided advisory

HELPING MOTHERS

WITH POST-PARTUM DEPRESSION



While this report focuses on many of our recent startup companies, we also want to recognize the exciting progress that some of our more established licensees have made over the past few years. As one example, Sage Therapeutics, a clinical-stage biopharmaceutical company developing treatments for life-threatening central nervous system disorders, is developing a broad pipeline of novel compounds in areas where new treatment options are critically needed, including major depressive disorder, essential tremor, Parkinson's disease, orphan epilepsies and post-partum depression.

Post-partum depression (PPD) is a serious and debilitating condition that affects an estimated one in five women in the U.S. after childbirth. Mothers with PPD may experience symptoms of extreme sadness, anxiety and exhaustion. Current treatment options are limited to counseling and the cautious use of antidepressants.

In 2013, the Regents provided Sage with materials and data from the laboratory of Michael Rogawski, M.D., professor of neurology and director of the UC Davis Institute for Neurotherapeutics, that helped in the initiation of clinical development of Sage's lead compound, brexanolone (also referred to as SAGE-547), which is being evaluated in two phase III clinical trials for PPD. Brexanolone is SAGE's proprietary intravenous formulation of allopregnanolone, a naturally occurring neuroactive steroid that acts as a synaptic and extrasynaptic modulator of the gamma-Aminobutyric acid ($GABA_A$) receptor. SAGE has also licensed a portfolio of brexanolone-related patent applications based on Rogawski's work at UC Davis.

In 2016, brexanolone was granted breakthrough therapy designation from the U.S. Food and Drug Administration and PRIority MEdicines (PRIME) designation from the European Medical Agency for the treatment of PPD. It is just one of several compounds the company is developing in its portfolio of neuropsychiatric programs. Sage's proprietary chemistry platform has generated multiple new molecules that target $GABA_A$ and N-Methyl-D-aspartic acid (NMDA) receptors, which are broadly accepted as impacting many psychiatric and neurological disorders.

services to three university-affiliated startups since being integrated into VentureNet earlier this year. The company helps entrepreneurs by assisting with tax returns, state filings and bookkeeping as well as offering a special startup partnership package of accounting services. Jennifer Nitzkowski, a partner at Carbahal & Company, helped develop the VentureNet partnership and has taken an active role in working directly with the startups participating in the START program.

We would like to thank these and our other partners for helping to build a robust network of resources that provide campus entrepreneurs with the services they need to succeed.

Louise Walker
President & CEO
First Northern Bank

Jennifer Nitzkowski
Partner
Carbahal & Co.

ENERGIZING

CORPORATE ENGAGEMENT

Identifying and developing strong relationships with industry continues to be an important driver of **innovation** and **translational partnerships** at UC Davis.

Through participating in university-industry collaborations, students receive valuable workforce training, better preparing them for jobs in the future. In addition, these collaborations enable university discoveries to be transformed into commercially viable products, advancing the societal impact of our research. Industry engaged research at UC Davis represented close to 8 percent of all research awards, with $61.5 million in total support this past fiscal year.

The Office of Corporate Relations serves as the liaison between the campus and corporate communities, linking UC Davis resources and research expertise to specific needs of industry and opportunities for the campus faculty. This team works closely with faculty, staff, students and campus leadership, taking a comprehensive and integrated approach to effective corporate engagement.

This past year, the Office of Corporate Relations engaged with over 120 companies, which included focused interactions with over 175 faculty members and another 140 staff and students across the campus. These targeted engagements serve as the basic building blocks that drive the pipeline of opportunities for collaborative research endeavors between companies and UC Davis.

The Office of Corporate Relations also showcases the university's research assets through industry-engaged events and conferences. In one example, the team partnered with Seed Central, a public-private partnership supporting the seed and agtech industry, and offered a panel discussion titled, "Women in Biotechnology: Launching Early Career Women into Biotech." The event incorporated 14 student and industry speakers in a dynamic discussion that focused on understanding the opportunities and challenges of working in the agricultural, medical and industrial biotechnology sectors. Industry panelists included Susan Turner, senior vice president of research for BioConsortia; Poornima Parameswaran, co-founder of Trace Genomics; and Debbie Yaver, managing director at Novozymes. The event attracted over 280 registered participants.

In June 2017, the Office of Corporate Relations, in collaboration with Venture Catalyst, represented UC Davis at the Biotechnology Innovation Organization International Convention in San Diego. The conference attracted over 16,000 leaders in the biotechnology and pharmaceutical industries, offering a host of new opportunities and promising partnerships. TMCR hosted a booth within the California Pavilion at the convention. TMCR's Dushyant Pathak moderated a panel discussion titled, "Technologies for a Sustainable Future: Leveraging One Health and Engineering Synergies," which included representatives from BASF, Evolve BioSystems and the UC Davis Innovation Institute for Food and Health. TMCR representatives, along with UC Davis faculty, used this international forum for productive engagement with 22 companies interested in advancing research-oriented partnerships with the university.

COALESCING EXPERTS IN SEED BIOTECHNOLOGY TO

DRIVE INNOVATION

Spurred by the university's world-leading research in agriculture, the region near UC Davis has developed a strong and growing cluster of agtech companies, including some of the market-leading specialty crop and vegetable seed companies. In order to leverage this pool of talent and stimulate collaborative advancements and economic development, the UC Davis Seed Biotechnology Center and Seed Quest launched Seed Central several years ago.

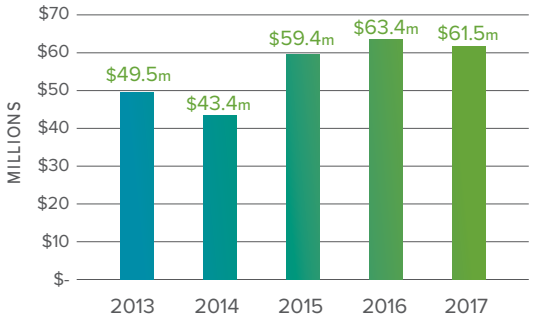
Seed Central facilitates collaboration between industry and the university, with the objectives of spurring innovation, exposing students to career opportunities and expediting the translation of science to commercial applications.

With monthly keynote speakers ranging from world-renowned UC Davis wheat geneticist Jorge Dubcovsky, to Marrone Bio Innovations CEO and founder Pam Marrone, Seed Central facilitates the exchange of knowledge and novel ideas within a network that boasts 2,000 individuals from over 350 companies, universities and research organizations.

Seed Central also promotes career development for students, offering an array of opportunities like off-site company visits, job shadowing, networking events and internships.

UC Davis student Mohan Niroula, who was the recipient of Seed Central's Grand Prize Internship, utilized his experience to obtain a position with VoloAgri Group, focusing on watermelon breeding. "Thanks to the Seed Central Grand Prize Internship, I was able to gain real-world experience around what corporate culture, objectives and goal-oriented research entailed," said Niroula. "The internship helped solidify my decision to pursue a career in plant breeding research and development."

Industry Funding Over 5 Years



This past year, the Office of Corporate Relations **engaged with over 120 companies**, which included focused interactions with over **175 faculty members** and another **140 staff and students** across the campus.

Right: Francois Korn, co-founder and managing director of Seed Central, and Mohan Niroula, recipient of Seed Central's Grand Prize Internship.

BREAKING BARRIERS

THROUGH COMPARATIVE ONCOLOGY

As one of only a handful of comparative oncology programs in the nation, UC Davis is at the forefront of the One Health Initiative, addressing complex health problems on a platform that recognizes the health of animals and people are inextricably linked with each other and the environment — and that discoveries in one can be leveraged for the other.

In this program, veterinarians collaborate with physicians to develop new cancer treatments for pet dogs, which can ultimately be translated into better treatments for human cancer patients. Companion animals, especially dogs, are exposed to many of the same environmental conditions and get many of the same types of cancers as humans. The insights gained from these canine trials can accelerate the development of therapies for human patients.

In one such effort, radiation oncologist Arta Monjazeb from the UC Davis Comprehensive Cancer Center collaborated with William Murphy, professor in the Department of Dermatology, and Michael Kent, an oncologist in the School of Veterinary Medicine, on studies in dogs to test the effectiveness of a novel triple therapy that combines radiation treatment with immune therapies.

By combining conventional radiation and immune therapies for the first time in a canine clinical trial, they have demonstrated the ability to improve the effectiveness of the treatment and extend the lives of some of the trial participants while maintaining quality of life.

"This was a really nice example of how physicians and veterinarians can work together to tackle a disease that affects both species," says Kent, who also serves as director of the Center for Companion Animal Health. "Now our job is to follow up, refine and improve the technique so it can be used for both dogs and humans."

The Office of Corporate Relations worked with Monjazeb and his colleague, John McPherson from the Cancer Center, to arrange meetings with business development representatives from various biopharmaceutical companies through the 2017 J.P. Morgan Healthcare Conference in San Francisco. The meetings opened discussions to explore opportunities to partner on the development of related therapies.

Left: UC Davis radiation oncologists Arta Monjazeb and Michael Kent, with patient Santino Pinkham in the linear accelerator room of the university's Center for Companion Animal Health.

LEVERAGING INDUSTRY STRENGTHS

TO DRIVE IMPACT

UC Davis and Elsevier, Inc., one of the world's major providers of scientific and information exchange and analytics, have partnered to advance two data science initiatives — one focused on environmental research and the other on the effectiveness and efficiency of research at UC Davis. The partnership was facilitated by the Office of Corporate Relations.

In addition to monetary support, Elsevier provides each program access to its proprietary data and analytics tool, called SciVal, which gives insight into research trends, performance metrics and access to data from 8,500 research institutions in 220 nations worldwide.

The faculty lead for one of these projects, Ben Houlton, director of the John Muir Institute of the Environment (JMIE), will utilize the funding and available tools to advance the campus' OneClimate initiative — a unique, holistic approach designed to leverage the broad expertise at UC Davis to develop practical solutions for a sustainable future in the face of a rapidly expanding global population. As part of the initiative, Houlton's team will offer a portal for researchers, industry professionals and the public to search the breadth and global connectedness of JMIE's faculty research. As a hub for environmental research, this tool allows everyone to see the global reach and impact of climate science performed at UC Davis.

"Data is so abundant these days. We have to find new ways to use it to understand and solve pressing sustainability challenges," said Houlton. "The opportunity to team with Elsevier in this new initiative will allow us to take academic research and put it to use for the benefit of people and the planet."

The second initiative, co-led by Duncan Temple Lang, director of the Data Science Initiative, and MacKenzie Smith, university librarian, will utilize the funding to evaluate the effectiveness, efficiency, competitiveness and impact of UC Davis' research, teaching and other academic activities using a data-driven approach. Their goals include improving the institutional effectiveness of large research universities and building more effective models for interdisciplinary collaboration among researchers.

Left to Right: Duncan Temple Lang, Director of the Data Science Initiative; MacKenzie Smith, University Librarian; Brad Fenwick, Senior VP of Global Strategic Alliances at Elsevier; and Paul Dodd, Associate Vice Chancellor for Research.

MULTIPLYING IMPACT

WITH INDUSTRY PARTNERS

Debbie Yaver, managing director of Novozzymes' local R&D facility.

At UC Davis, we understand that bold innovation requires collaborations that extend much deeper than transactional partnerships. We strive to explore creative ways to align strengths with unique opportunities and form connections that lead to novel ideas. Our long-standing partnership with Novozymes, a world leader in biological solutions, illustrates the impact of this approach.

Novozymes' core business is the production of industrial enzymes and microbes, which are used as catalysts to manufacture a variety of products like sugar, bread and biofuels, and as agents to increase yields and protect crops. One of its largest R&D facilities is located in Davis, within walking distance of the campus.

Starting over a decade ago, the company endowed a chair in genomics, which supports research, teaching and service activities at the UC Davis Genome Center. The chair is held by Professor Richard Michelmore, director of the Genome Center. This generous gift has helped develop and apply genomic technologies for the benefit of both campus and company research as well as provide support for the Genome Center to explore avenues of research with high potential.

More recently, in 2015 the company hosted its inaugural global research and development meeting in the U.S. on the UC Davis campus, providing a unique opportunity to connect leading researchers at UC Davis with over 250 of the company's scientists.

In 2016, Novozymes executed an exclusive license agreement for technology stemming from the efforts of UC Davis Professor Johan Leveau. The company is sponsoring a collaborative project under which it, jointly with Leveau, is conducting research to further explore the underlying mechanisms supporting the technology as well as incorporating it into Novozymes' commercial products.

Novozymes also co-leads a graduate-level seminar series at the university, titled *From Discovery to Product: An Introduction to Biotechnology at the Industrial Level*, which includes weekly lectures by senior scientists from the company. This series provides graduate students with direct insight into the complex path of translating discoveries into commercial products.

The company partners with the UC Davis Biotechnology Program to offer sought-after student internships. To date, more than 25 students have benefited from this program, receiving real-world experience with a global industry leader. Novozymes also offers a summer undergraduate internship program which 150 students have participated in over the last 25 years.

The company also encourages its leadership to engage and support female students interested in careers in biotechnology. In 2017, Debbie Yaver, managing director of Novozymes' local R&D facility, participated as a panelist in the Women in Biotechnology seminar hosted by the UC Davis Office of Corporate Relations and Seed Central, a local nonprofit organization.

DEVELOPING

THE NEXT GENERATION WORKFORCE

While much of TMCR's focus is on advancing technologies to drive economic impact and social benefit, we understand that advancing the career paths of our students and researchers also plays a key role in this objective.

TMCR offers several programs that provide students with exposure and training in intellectual property protection and industry engagement — areas that are outside the scope of most traditional educational programs. In addition, the students bring external viewpoints and scientific perspectives that are tremendously valuable to the work that we do.

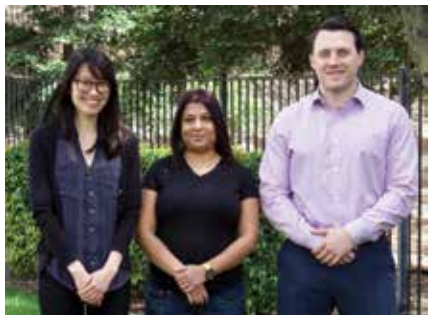
Our pioneering program, which was launched over 10 years ago, began as a partnership with the UC Davis School of Law, offering law students course credit as part of an externship program. This program attracts law students interested in learning more about how to assess the patentability of inventions — pairing them with experienced professionals in Innovation*Access*. During their externships, the students learn both patent filing processes and broader skills associated with how the legal system intersects with managing innovations. To date, over 60 legal externs have participated in the program.

In addition to the law externship program, Innovation*Access* also manages a program that utilizes the technical expertise of graduate students and postdoctoral researchers to support the technology assessment processes associated with filing patents — providing them with hands-on experience and a foundation for a network within industry. The feedback from program participants has been extremely positive, with several expressing increased interest in careers related to intellectual property as a result of their experiences.

The Office of Corporate Relations offers a coveted internship opportunity that allows students to directly engage with industry representatives and learn and build business development skills. This program provides students with exposure to careers beyond the research laboratory. Over the past few years, several graduate students and postdoctoral scholars have had direct experience integrating their specific expertise into a variety of corporate engagements as part of this program.

The Venture Catalyst team offers a student internship that provides market research and competitive assessment experience by incorporating students into its Market Intelligence and Competitive Analysis (MICA™) program for the benefit of faculty startups.

TMCR staff also engage with undergraduate students to provide them with experience and insight into intellectual property management, business development and startup formation.



STEVEN GROSSENBACHER

Steven Grossenbacher, a fourth year Ph.D. candidate in the lab of William Murphy, was the recipient of a six-month internship within the Office of Corporate Relations in 2017.

Having some experience in industry prior to returning to UC Davis for graduate school, Grossenbacher was excited to apply his drug development and modeling expertise toward the advancement of translational immune-oncology research.

Grossenbacher's interests span both basic and translational research, with a particular interest in cancer immunotherapy. His research focused on the use of adoptive natural killer cell therapy for the treatment of solid cancers.

During his internship, Grossenbacher contributed directly to advancing partnerships with biopharmaceutical companies. This included helping identify and make meaningful connections with campus experts as well as coordinating a series of meetings to cultivate potential collaborations.

"During my time with the Office of Corporate Relations, I had the opportunity to work closely with a diverse team of talented people who taught me how to better articulate my scientific expertise for a business setting," said Grossenbacher. "As I transitioned to a career in management consulting for the biopharma industry, what was most helpful was the practical experience I gained in business development and strategic alliance management. Interacting directly with senior leadership teams from Fortune 100 companies prepared me for the next phases of my career in a way that the lab never could."

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