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Innovation is a term that is bandied about so frequently in today’s society that it has, in the minds of many, lost its meaning. But other than a tag line used to sell cars or household appliances, what does the idea of innovation truly signify?

The Merriam-Webster Dictionary defines “innovation” as the introduction of something new or a new idea, method, or device. It is this concept that lies at the heart of university-based research and technology commercialization.

America’s research universities play a unique and essential role in modern society. They bring together the brightest scientific minds and the facilities, resources, and intellectual freedom necessary to explore the boundaries of human knowledge. Fueled primarily by the financial support of government agencies, in addition to foundations and industry partners, university researchers have been the source of technologies that have shaped the world as we know it. While universities have been in the business of generating new knowledge for centuries, the systematic process of commercializing new ideas is a more recent phenomenon that can be traced to the passage of the Bayh-Dole Act in 1980. The law was founded on the principal that ideas created with taxpayer support should ultimately benefit society and its citizens. It is from this concept that the sophisticated technology transfer functions that are now common in research universities emerged.

Since the law’s passage, the commercialization of academic innovation has accelerated. During this period, universities have spawned more than 7,000 companies, more than 6,200 licensed products, more than 160 new therapeutic drugs, and generated hundreds of thousands of jobs. Publicly-funded research is responsible for such discoveries as hollow optical fibers, nicotine patches, the code that powers Google, numerous life-saving vaccines including the first to prevent a cancer, cell phone technologies, and the entire biomedical industrial sector. According to a former president of NASDAQ, some 30 percent of that index’s total value is rooted in federally-funded, university-based innovation.

The University of Rochester, for its part, has made significant contributions to our innovation economy and has leveraged its research enterprise to generate technologies that not only touch the lives of millions across the globe, but also form the basis of new products and companies. This report contains examples of what is yet to come. Whether it is new imaging technologies that can more accurately diagnose breast cancer, a platform to identify new drugs to treat age-related diseases, or a way to harness the power of internet-based crowdsourcing more effectively, University of Rochester scientists are committed to making the world “ever better.”
Research funding is the catalyst for the technology commercialization process. Grant awards not only provide the resources necessary to pursue specific scientific ideas, these investments also trigger a self-sustaining “engine” that supports the University’s research enterprise. As illustrated to the right, the University’s researchers use funding to generate new technologies (innovation) that can then be licensed to companies for commercial development. Royalty revenue generated from these agreements then flows back to the University and is re-invested in our scientific infrastructure.

**Funding Proposals Submitted**

The funding proposal represents the first step in the process of discovery, collaboration, and creation of intellectual property. The University of Rochester, though small when compared to many other research-intensive universities, has extremely productive faculty who submit a high volume of funding proposals. There were 2,070 proposals submitted in FY 2012 for a total of $1.86 billion. This includes new, renewal, and continuation applications. It also includes funds requested for the entire project period of the proposed activity, which could be two years or longer, along with one year amounts for continuation proposals and individual projects.
Awards Received

The University of Rochester received 455 new awards in FY 2012 totaling more than $347 million. This figure represents actual amount awarded, which is usually for a period of one year or less. Future year commitments are not included.

Research Expenditures

Sponsored program expenditures are widely used by universities for benchmarking purposes. At the University of Rochester, sponsored program expenditures exceeded $383 million dollars in FY 2012. This represents a slight decline from the previous year, attributable primarily to the expiration of American Recovery and Reinvestment Act-related project funding.

Research Profiles

America’s great universities generate the innovation that has the potential to improve lives and form a foundation for the next generation of technology-driven products and companies. The University of Rochester — which has a long and distinguished history of scientific achievement — is such an example.

Rochester-developed technologies have had a positive impact on millions of people around the globe and our researchers continue to seek solutions to society’s most daunting problems.
Partnership Focuses on Creating New Drugs

One of the persistent barriers to the commercialization of university-based technologies is the daunting number of scientific and regulatory hurdles that scientists must overcome during the period after federal research funding has run out and before industry steps in and takes over. This phenomenon is particularly pronounced in the field of medicine, and even more so in drug development, where the pharmaceutical industry has become far more selective and risk-averse when considering new drug candidates. Consequently, many promising scientific breakthroughs remain frozen at an early stage of development in academic labs.

Academic medical centers, including URMC, have stepped up efforts to help push these ideas further down the development pipeline. In 2011, the Medical Center launched a new collaboration with Moulder Center for Drug Discovery Research at Temple University that will help scientists more actively identify and guide new compounds from the earliest stages of research along the path to becoming a new drug.

The Moulder Center was founded by a former pharmaceutical executive and is home to a unique, state-of-the-art laboratory that brings together pharmaceutical talent, instrumentation, and software to create one of the nation’s top centers for integrated drug research.

The partnership complements URMC’s strength in fundamental biomedical research; specifically, identifying molecular and genetic “targets” that trigger disease. The agreement enables scientists at the two institutions to collaborate and move these discoveries to the next stage of research by identifying compounds that act upon these new targets and may ultimately form the basis for new drugs. URMC scientists now work with Moulder Center’s to rapidly screen large numbers of compounds to identify novel drug candidates that can then undergo the battery of pre-clinical tests in the lab and in animal models necessary to ensure that they are stable, not toxic, and act as intended.

To accelerate this collaboration, URMC and the Moulder Center have jointly funded a Drug Discovery Pilot Award Program that will give scientists the resources necessary to conduct early stage drug development. The fund’s inaugural projects include two separate efforts to tap into different therapeutic properties of the cancer drug tamoxifen. One study, led by Mark Noble, Ph.D. and Alison Frontier, Ph.D., seeks to make the cancer cells found in basal-like breast cancers — a particularly aggressive and deadly form of the disease — more vulnerable to treatment. Another, led by Damian Krysan, M.D., Ph.D., is exploring the anti-fungal properties of the same drug.

The fund is also supporting two early stage exploratory projects that will help scientists match molecular targets with drug candidates through the use of advanced screening — or high throughput — technologies. Alan Smrcka, Ph.D. and David Goldfarb, Ph.D. are seeking to identify molecules that target longevity genes and prevent or delay age-related diseases and Richard Phipps, Ph.D. and Collynn Woeller, Ph.D. are investigating a compound that will inhibit excessive scar formation — a significant barrier to recovery that often accompanies wound repair, corneal injury, and tissue transplants.
Converting an Unruly Mob into a Productive “Crowd”

Crowdsourcing uses many minds — usually anonymous and linked through the internet — to solve problems that could otherwise require more expertise, time, money, or a defined and dedicated set of experts. But while it provides many benefits, crowdsourcing also has challenges. Tasks usually must be controlled through custom interfaces that require substantial programming. In addition, the workers who sign on to a task may not have the particular skills needed for that problem, some workers might be unreliable, and some may even be malicious. It is also very difficult to provide the kind of quick feedback to a crowd that helps improve performance.

Jeffrey Bigham, Ph.D. and his team have introduced a new system that goes a long way to solving these problems. Called Legion, the system allows the use of the graphic user interfaces that workers are already using, and it provides what the researchers call a flexible mediation network, a way of synthesizing the input of multiple crowd workers to provide collaborative, real-time control to arrive at the best choices.

After trying out several different approaches, Bigham and his colleagues found that the best way to mediate between the choices of many remote workers was to choose, at regular intervals, a leader whose choices are most consistent with those of the whole group. Because different workers will be “best” at different times, Legion makes these calculations in real time, switching to whichever worker is the best reflection of the consensus at a given time.

“Legion may make it possible for a diverse and dynamic group to act collectively as a single, optimized operator,” said Bigham. “This would effectively offer me a really awesome worker who could do complex control tasks, and with the interfaces I already have. Such tasks could include crowdsourcing — instead of outsourcing — data entry into an Excel sheet. Or it could allow people to control a robot remotely. And this leads us to some exciting future research questions as well, including how to provide good feedback to all the workers, or how a crowd could be introduced to a task by a simple demonstration.”
Invention Disclosures

In FY 2012, the Offices of Technology Transfer received 132 invention disclosures — an increase of 3% from the previous year. These disclosures named 212 inventors from 51 University departments and units, 30 collaborators from 15 other universities and research hospitals, 2 collaborators from non-profit entities, and 7 collaborators from the for-profit sector.

Disclosed inventions covered a broad range of scientific endeavors, including:

- A filter that produces super-resolution images for ultrasound, radar, sonar, and other pulse-echo imaging systems;
- A device to close holes in blood vessels following surgical procedures;
- A physician’s pocket reference card designed to help providers improve quality of care based on Centers for Medicaid and Medicare Services and Joint Commission coding rules;
- A modular laser system that provides a more efficient and cost-effective method of administering photodynamic therapy for treatment of cancer and other localized diseases;
- A DNA-based method to determine the presence of (or the susceptibility of developing) Facioscapulohumeral Dystrophy and a new method to treat the disease.

Intellectual Property Protection

In order to commercialize new technologies more effectively, universities often seek protection for their intellectual property. At the University of Rochester, 5 copyright registrations and 170 patent applications were filed in FY 2012. Of these patent filings, 58 were new matter filings, while 112 were continuations of applications filed in previous years.

Copyright and Patent Applications Filed in FY 2012 (by application type)

Patents Issued

In FY 2012, the University of Rochester was granted 26 U.S. patents and 10 foreign patents. These 36 patents cover 32 different technologies.

Of the 26 U.S. patents, 14 pertain to the life sciences (11 therapeutics, 2 diagnostics, and 1 vaccine technology), while 12 pertain to the physical sciences (3 imaging, 3 optics, 2 nanotechnology, 1 computer software, 1 fuel cell, 1 solar voltaic cell, and 1 digital camera imaging).
Patented URMC Technology Improves Breast Cancer Detection

Appropriate screening and early detection of breast cancer are among the most explosive women’s health issues of recent times. Since not all tumors are visible with conventional mammography, the race is on for better ways to capture detailed images of breast tissue.

A system developed at URMC offers much promise. Called cone beam computed tomography or the Koning Breast CT, it was designed to locate cancers obscured by dense tissue, to distinguish between malignant lesions and benign lesions that look suspicious, and to measure whether a tumor has shrunk following treatment.

Although it’s unlikely the system will replace mammography as a frontline screening tool for every case, researchers believe it will be widely used when additional scans are warranted. The technology combines the advantages of digital x-ray with computed tomography to produce three-dimensional pictures without having to compress the breast tissue. It virtually eliminates tissue overlap and superimposition of structures, which are two factors often responsible for failure to diagnose breast cancer early, when it is most treatable. From a patient’s perspective, it is more comfortable than conventional mammography: the scanner acquires an extensive set of images in 10 seconds while the patient lies on her stomach on a cushioned exam table.

Ruola Ning, Ph.D., Professor of Imaging Sciences at URMC, invented the system and founded Koning Corporation, located in Henrietta, N.Y., to test, manufacture, and sell the imaging systems. The University licensed the technology to Koning, and holds a small equity share in the company. Ning also holds an equity share in Koning.

It is possible the U.S. Food and Drug Administration (FDA) will evaluate the technology for market approval in 2013. Until then, pre-market, multi-center clinical trials are continuing. More than 500 scans have been obtained, resulting in engineering and software improvements. Radiologists have been comparing scans from patients who have already received a cancer diagnosis following a mammogram and biopsy, to subsequent scans from the Koning Breast CT.

In addition, Avice O’Connell, M.D., Director of Women’s Imaging at URMC, recently has been leading a study to find out if the technology can precisely and more accurately show tumor shrinkage during and after neoadjuvant cancer treatment. If so, the imaging system could be offered in addition to a physical examination in this setting.

The past year brought other major advances, too. Early in 2012 the European Union ruled the scanner was in compliance with EU medical-device regulations, allowing Koning to market the system throughout Europe. The company also received enough venture capital to update systems for clinical trials in China, and in South Carolina, where national pioneer and expert in breast imaging and digital mammography, Etta D. Pisano, M.D., Dean of the College of Medicine, Medical University at South Carolina, agreed to evaluate the system in preparation for the FDA approval process.
The University of Rochester is firmly committed to translating research into products and services that benefit society and advance human knowledge. We embrace our role as bridge from science to everyday application. At the same time, we realize that the University can only take a new technology so far. It is therefore critical that we work closely with entrepreneurs, investors, community resources, and industry partners to translate our discoveries into new products and services.

Licensing Agreements

The University successfully completed 21 new licensing agreements in FY 2012. These included 8 exclusive licenses, 6 non-exclusive licenses, 1 exclusive option, 3 copyright licenses, 1 biological material license, 2 miscellaneous agreements. In addition, 6 amendments to existing agreements were negotiated at the request of licensees.

Of the 21 new agreements, 8 were with existing pharmaceutical, biotechnology, or medical device companies, 5 were with companies in the start-up stage, and the remaining 3 were with healthcare, governmental, or academic organizations.

The University of Rochester has experienced a steady growth in the number of technologies licensed to the private sector. Over the past 10 years, the number of existing University agreements increased by more than 157%. The University is also striking these agreements at a faster pace. The number of new license agreements negotiated annually has nearly doubled since FY 2003.
Licensing Royalties

While royalty revenue generated from licensing is not the only metric of success, it is an important measure of the public utility of technologies discovered at the University. It also reflects the degree to which licensees have advanced the development of new products and services for the benefit of society.

Royalty revenues exceeded $39.4 million in FY 2012 — a slight decrease from FY 2011. This decrease can be credited to the expiration of patents on some highly successful technologies. The Association of University Technology Managers (AUTM) recently released the results of its annual survey of technology transfer activities for FY 2011 and the University of Rochester ranked 12th in the nation in royalty revenue for the second year in a row.

When measured against our peers, the University of Rochester is one of the most productive institutions in the nation in terms of royalty generation. Using a three-year average (FY 2009 – FY 2011), the University ranks 13th, only behind much larger entities, such as MIT, NYU, Columbia University, Stanford University, and the state university systems in California, Texas, Minnesota, and Massachusetts.

When licensing revenue is normalized across top-earning institutions according to the size of the research enterprise, the University rises to 5th in the nation.
Calorics Explores the Links between Age, Nutrition, and Disease

What can the humble yeast cell tell us about human health? The answer, according to University of Rochester biologist David Goldfarb, Ph.D., is “quite a bit,” and this insight is now the foundation of a technology and a new company — Calorics Pharmaceuticals — that could help scientists uncover novel ways to treat a range of age-related diseases.

The focus of Goldfarb’s work is on the molecular pathways that regulate the aging process. The foundation of his research is an observation that is somewhat counterintuitive: the denial of nutrition can activate a response within cells that actually cause them to live longer and healthier.

“The depletion of nutrients short of malnutrition triggers an ancient response within cells to sustain life,” said Goldfarb. “It turns out that dietary restriction rewires metabolic and cell cycle pathways so that they operate more efficiently. In animal models, dietary restriction extends lifespan and is therapeutic for a number of age-related conditions, such as cardiovascular disease, metabolic conditions, inflammation, and cancer.”

“The goal is to essentially fool the body into thinking it is being deprived of nutrients, thus mimicking the benefits of dietary restriction,” said Goldfarb.

Enter Saccharomyces cerevisiae, commonly known as brewer’s or baker’s yeast which, according to Goldfarb, “appears to age and die by some of the same mechanisms as human cells.”

This observation encouraged Goldfarb and his team to develop a set of unique assays that employ yeast to screen for compounds that extend lifespan — and thereby identify small molecules that could form the basis for new drugs. The advantage of this technology is the capacity to screen large chemical libraries composed of hundreds of thousands of molecules rapidly for compounds that mimic dietary restriction and extend yeast lifespan. This approach is also revealing new biology about poorly understood aspects of dietary restriction and cellular aging. The assay has already identified a compound that reduces inflammation in animal models.

Calorics has been financed through two seed rounds by a syndicate of three top tier Boston and New Brunswick venture capital firms. While the company is managed out of Boston, most of the research and development activity continues to be performed at the University of Rochester in the Departments of Biology and Chemistry.
Bringing the World into Clearer Focus

Millions of people around the globe can see more clearly, thanks to the pioneering work of David Williams, Ph.D., one of the world’s leading experts on human vision. For the last several decades, Williams — the University’s William G. Allyn Professor of Medical Optics, Director of the Center for Visual Science, and Dean for Research in Arts, Sciences, and Engineering — has partnered with physicians and industry to bring new technologies to market that are improving eyesight in the legally blind as well as in those with 20/20 vision.

Rochester has long been a global academic and industrial center of optics research and development. The Institute of Optics has been one of the University of Rochester’s crown jewels since its founding in 1929. The oldest center dedicated to optics research and education in the nation, the Institute has granted almost half of all degrees awarded in optics in the U.S. Rochester-based companies such as Kodak and Bausch & Lomb — often in partnership with the region’s research universities — have been leaders in bringing new advances in optics engineering to the market in the form of new consumer products and medical devices.

It is in this unique environment that Williams and his colleague have been able to apply the complex science behind light, lenses, and imaging to enhance and restore vision.

An early discovery emerged from Williams’ decade-long multi-institutional project with astronomers at the University of California at Santa Cruz. Williams used a technology called adaptive optics, which was first developed for telescopes to take clear pictures of the sky, to study the structure and function of the eye. The teamwork led to the development of techniques for seeing the retina more clearly than ever possible before, even to the level of individual cells in the living retina. The collaboration allowed Williams to develop a method for improving vision by correcting tiny optical aberrations of the eye that were previously undetectable.

Williams has also worked closely with industry partners to bring these technologies into the public domain. Williams is a named inventor on 10 patents and has worked with Bausch & Lomb since 1997 on translating his discoveries in the lab into commercially available products, like revolutionary contacts that can correct for vision abnormalities beyond the focus and astigmatism of traditional lenses. He also has joined with Scott MacRae, M.D., a leader in refractive surgery and Professor of Ophthalmology at the University of Rochester Medical Center, to develop Lasik surgeries that enhance eyesight beyond “perfect” 20/20 vision.

Williams is the author of more than 100 papers, a Fellow of the American Association for the Advancement of Science, and recipient of the Friedenwald Award from the Association for Research in Vision and Ophthalmology, among other honors. In 2003, his adaptive optics phoropter, which allows for more precise corrective lens prescriptions, was named one of R&D Magazine’s top 100 inventions of the year. And earlier this year, Williams received the Antonio Champalimaud Vision Award at a ceremony chaired by the president of Portugal in Lisbon. The award recognized Williams’ work on adaptive optics technologies as a “major breakthrough in the understanding and/or the preservation of vision.”
Fund Aids Development of Promising Neonatal and Breast Cancer Technologies

The University of Rochester Technology Development Fund was created in 2010 to help advance technologies from across the University and to date has funded projects ranging from fuel cell research to vaccine development. A new round of awards focusing on medical technologies was recently approved.

- Scott Seidman, Ph.D. has received support to build a prototype of a device that will enable neonatal intensive care staff to measure more precisely the lung activity of premature infants who require ventilators. Current monitoring systems often fail to detect minute changes that indicate that these infants are not receiving enough oxygen, a condition that can negatively impact development.

- Steve Dewhurst, Ph.D. has received support for his work to identify a drug that could help protect the central nervous system from cancer cells that spread — or metastasize — from breast cancer. Once in the brain and nervous system, these cancers become very difficult to treat and available therapies have significant neurological side effects.

Summary of 2012 Accomplishments

URMC Research Could Extend Life of Arthritic Joints

URMC researcher have shown that a medication already approved to build bone mass in patients with osteoporosis also builds cartilage around joints and could potentially be repurposed to treat millions of people suffering from arthritis.

University Opens Multi-Million-Dollar Nanosystems Facility

A new Integrated Nanosystems Center opened at the University in 2011 and will bring together experts in physics, optics, chemistry, biomedicine, and bioengineering to expand the research and technology commercialization of fuel cells, biosensors, and other high-tech devices important to industry, medicine, national security, and the economy.

Researchers Identify Biological Mechanisms Responsible for Growth of Melanomas

Medical Center researchers have made an important discovery about proteins that underlie and stimulate the often deadly skin cancers known as melanomas, opening the door for a more targeted treatment in the future.

University Receives Patent for Implantable Diagnostic Technology

The University of Rochester has received a U.S. patent for a medical device technology that could revolutionize the way that physicians monitor the health of their patients. The device — which consists of an implantable “living chip” — is designed to give doctors real time information on their patients’ health and, more importantly, alert them to a change in their condition.

Throughout its 161-year history, the University of Rochester has been committed to improving the local community as well as the lives of people across the globe. Ranked as the sixth largest private employer in New York State and the largest employer in the Greater Rochester area, the University is an engine for the region’s economy. Beyond Rochester, University technologies have improved the lives of millions in myriad ways, from the printers on their desks, to the vaccines protecting children and adults from diseases like cancer and meningitis.
University to be Part of Intel Labs’ Latest Science and Technology Center
The University of Rochester has joined Intel’s Science and Technology Center initiative and will focus on pervasive computing, which brings together researchers from Intel and universities around the country to create a new breed of mobile, wearable, and cloud-based computing systems that are dependable, fully aware of their users and their activities, and capable of adapting to changes.

Patent Received for Pioneering HPV Vaccine Work
The University of Rochester was awarded a U.S. patent for the creation of virus-like particles that mimic human papillomavirus (HPV) 16, the type of virus that causes the majority of all cancers related to HPV. This discovery is at the root of both HPV vaccines currently on the market.

University Awarded Contract to Establish a Respiratory Pathogens Research Center
A grant from the National Institute of Allergy and Infectious Diseases, which could grow to $50 million, will create a Center to help protect citizens against bacteria and viruses that take aim at the respiratory system. These cause pneumonia and flu, as well as a host of other infections caused by lesser-known but still-deadly microbes as well as a host of bacteria.

True Nature of Astrocytes Revealed
A type of cell plentiful in the brain, long considered mainly the stuff that holds the brain together and oft-overlooked by scientists more interested in flashier cells such as neurons, wields more power in the brain than has been realized, according to new research. The cells, known as astrocytes, are crucial for creating the proper environment for our brains to work.

Excell Partners Receives $2.5M to Support Regional Economic Development
Excell Partners — a regional economic development organization and an affiliate of the University — received $2.5 million from the State of New York’s Innovate NY Fund initiative. These funds will be used to provide critical financial support to early-stage technology companies.

URMC Finds Leukemia Cells Are “Bad to the Bone”
Medical Center researchers have discovered new links between leukemia cells and cells involved in bone formation, offering a fresh perspective on how the blood cancer progresses and raising the possibility that therapies for bone disorders could help in the treatment of leukemia.

University of Rochester and IBM Expand Partnership in Pursuit of New Frontiers in Health
In 2012, the University became one of the first academic institutions in the nation to receive the next generation of IBM’s high performance supercomputers. The new system — called the Blue Gene/Q — is one of most powerful and efficient computer systems in the world and will be part of a new center at the University of Rochester dedicated to health research.

Study: New Huntington’s Treatment Shows Promise
A clinical trial overseen by URMC scientists shows that the compound Coenzyme Q10 reduces oxidative damage, a key finding that hints at its potential to slow the progression of Huntington disease. The discovery also points to a new biomarker that could be used to screen experimental treatments for this and other neurological disorders.
Social Media

The Office of Technology Transfer recognizes that an active and vibrant presence in cyberspace is essential to meet our goals of:

- Promoting available University of Rochester technologies to potential licensees
- Promoting the University of Rochester’s research excellence to industry, alumni, our colleagues in academia, and the local community
- Promoting the Office of Technology Transfer to University researchers

Please join the conversation and follow us on Facebook, Twitter, LinkedIn, and our blog. Links to all platforms can be found on our website at www.urmc.rochester.edu/technology-transfer.