UCLA INVENTS

OFFICE of INTELLECTUAL PROPERTY

Volume III, 2008

DRIVING INNOVATION TO MARKET

UCLA

"UCLA is a big city school. It's not
out somewhere in No Man's Land.
It's here in one of the most important
metropolitan centers in the world:
L.A. The Capitol of Now.
UCLA feeds off that. And the city
and its entrepreneurs/creators,
feed off it, too."

— Richard Ziman,
Chairman of AVP Advisors, LLC

UCLA OIP
OFFICE OF INTELLECTUAL PROPERTY

CONTENTS

They do more than pass out knowledge around here. They create it.

Letter from the Vice Provost

DRIVING INNOVATION TO MARKET

A new drug to fight cancer. A better way to combat heart disease. Portable wearable kidneys. It's all in a day's work for the UCLA Office of Intellectual Property and Industry Sponsored Research, (OIP-ISR) team that creates and fosters innovative university-industry partnerships.

Here and abroad, our campus collaborators are moving research from the lab to the marketplace. I am pleased to invite you to read our third issue of UCLA Invents, which highlights a number of promising projects, including several that are international in scope.

In fact, the number of international companies that are undertaking the development of UCLA technologies is rising. International companies are becoming increasingly interested in licensing UCLA's discoveries in health care, green technologies and information technology. It's not a surprise, then, that California was named one of the top five states in the nation that are innovative leaders, as measured by international patent applications, in a recent Ewing Marion Kauffman Foundation study. Currently, we have 38 licensees of UCLA patents from other countries.

As more and more pharmaceutical and biotechnology companies have sought our help to develop the next-generation therapeutics through basic translational and clinical research, UCLA scientists have risen to the challenge. Take, for example, Agensys, a local biotech company and one of the earliest UCLA faculty startup companies. It was created to develop treatments for prostate cancer and was recently purchased by a large Japanese pharmaceutical company (see article on page 6).

Health care technology is not the only place where UCLA plays a pivotal role in education, basic and applied research, and technology transfer to benefit the public good. Faculty in engineering and the physical sciences are actively seeking alternative energy technologies. And, while there is a persistent concern that the United States is falling behind in educating future scientists and mathematicians, UCLA faculty are embracing the role of teaching young students, for example, about nanoscience and producing innovative materials to help outstanding math teachers carry out their mission. All these stories are available in this issue.

You can count on us to continue to foster innovation within our campus community, to find novel ways to efficiently forge industry collaborations, to facilitate the commercialization of UCLA technologies to benefit society and to promote economic growth in California.

We welcome you to contact us and look forward to working together.

Kathryn Atchison, *D.D.S., M.P.H.*

OIP @ A GLANCE

TOP 10 REVENUE-PRODUCING TECHNOLOGIES FOR FY2007

1. Medical coil device for aneurysm treatment
2. Biodegradable medical coil device for aneurysm treatment
3. Nicotine patch — smoking cessation
4. 4H2 antibody-based research reagents
5. High-resolution gamma ray detector for microPET imaging
6. Diagnostic test for gastrointenstinal diseases (Crohn's and IBD)
7. Diagnosis, prevention and treatment of a clinical subtype of ulcerative colitis
8. Glycosylated Chinese hamster ovary cells (CHO cells) for research and drug discovery
9. Embolism Retrieval Device
10. Method for obtaining pomegranate tannins

As one of the nation's leading research universities — public or private — UCLA has become the engine for real time, real world accomplishments that enrich our community, our nation, our world on a daily basis.

"UCLA research is an enormous, diverse enterprise. Just look at the breadth and depth of new knowledge that flows from here year after year."

— Paul Boyer, *UCLA Professor Emeritus of Biochemistry, 1997 Nobel Prize for Chemistry*

IP PROTECTION, TECHNOLOGY TRANSFER AND RESEARCH ACTIVITIES FOR FY2007

Invention disclosures	252
New U.S. patent filings	125
Secondary filings	160
Issued U.S. patents	42
First foreign filings	97
License and option agreements	49
Confidentiality agreements	162
Letter agreements	37
Inter-institutional agreements	15
Material transfer agreement (case related)	31
Material transfer agreement (non-case related)	760

OIP OVERVIEW

TOTAL INVENTION PORTFOLIO	1,388
TOTAL ACTIVE U.S. PATENTS	415
TOTAL ACTIVE FOREIGN PATENTS	530
TOTAL ACTIVE LICENSE AGREEMENTS	220

UCLA and its researchers deliver practical results that can generate income and jobs for the regional economy, because the university is a source of ideas, talent and intellectual property.

INTERNATIONAL REACH

AWAK

LIFE-SAVING FASHION STATEMENT

Martin Roberts, Ph.D., and David B. N. Lee, M.D.

"In deciding to license our patent rights to AWAK Technologies, we were excited that this technology may have a significant impact on the standard of care for patients in this area of high unmet medical need."

Kidney disease sufferers are virtual prisoners of their condition, chained to a dialysis machine for hours at a time, several times a week. But now two intrepid UCLA and VA Greater Los Angeles Healthcare System scientists have found a way to liberate them. Martin Roberts, Ph.D., and David B. N. Lee, M.D., have invented a wearable kidney device, worn as part of the apparel, which allows patients to live more normal lives. The unit provides continuous cleansing of the blood, 24 hours a day, seven days a week, removing toxins and excess salt and water.

The invention has been licensed by UCLA and the VA to AWAK (Automated Wearable Artificial Kidney) Technologies of Singapore, founded in 2007 to pioneer the development of artificial wearable kidneys. Roberts and Lee serve as the company's chief scientists.

Roberts published a paper in 1974 in which he suggested the feasibility of building a wearable artificial kidney, and he has been working toward that end ever since. Co-inventor Lee was equally eager to bring about this breakthrough because he has had to tell too many patients that they must undergo dialysis, which, he says, is like giving them a jail sentence due to the current technology. Nearly all patients must go to a dialysis unit three times a week, where they are hooked up to a machine that draws their blood out over a four-hour period, removes toxins and pumps the blood back.

"Being on dialysis markedly restricts an individual's choice in all aspects of living," Lee says, adding that it also leads to "poor health and early death."

Instead of drawing blood out of the patient, the portable unit will use the body's own peritoneal cavity, or the abdomen, as the dialysis membrane. A modified saline solution will flow into the cavity through a surgically implanted catheter, removing toxins and then returning to the wearable unit for cleansing and reuse.

"In deciding to license our patent rights to AWAK Technologies, we were excited that this technology may have a significant impact on the standard of care for patients in this area of high unmet medical need," says Earl Weinstein, Ph.D., assistant director of UCLA's Office of Intellectual Property.

The first version of the unit consists of a vest that weighs about six pounds, equipped with a battery, pumps and a storage container for the saline. Eventually, the inventors hope to get the weight down to four pounds, and the unit could be worn as a belt.

The vest can be removed at bedtime and placed on a nearby table, where it will continue to work through the night. That around-the-clock function — continuous protection, mimicking the way a normal kidney works — is extremely important, the inventors say, because with present technology, toxins and excess salt and water remain in the body most of the time, eroding the health of the patient.

Lee says patients receive the news that they must undergo dialysis, using present technology, with "elements of helplessness, hopelessness, disappointment and dismay."

But with the wearable kidney, patients will be able to work, play, or do anything they want, just as though their kidney was functioning properly.

INTERNATIONAL REACH

THEMIS MEDICARE

SIMPLIFYING STATIN

When Yi Tang, Ph.D., discovered a simpler, cheaper way to produce the cholesterol-lowering compound simvastatin — the active ingredient in Zocor — a dozen drug manufacturers around the world began beating a path to his door.

With demand for inexpensive generic drugs heating up, everyone wanted a slice of that prized cake. Merck & Co.'s patent for the statin drug Zocor had expired, intensifying fierce competition to devise a less expensive way to produce the blockbuster drug that combats heart disease.

Tang, an assistant professor of chemical and biomolecular engineering, found a way. He turned the half-dozen steps needed to convert a fungus to simvastatin into just one step.

"A statin manufactured by the UCLA method may be coming to a drugstore near you," Tang says. Tang and UCLA's contributions to a newer, more affordable version of Zocor could give more people a chance to lower their risk of heart disease.

To make simvastatin, manufacturers currently rely on chemical synthesis, using solvents and reagents — an expensive multi-step process that seemed to have no further room for improvement.

"Instead of focusing on synthetic efforts, we tried to use biological catalysts to perform this conversion in a single step," Tang says. He started with *Escherichia coli (E. coli)*, a bacterium of the intestinal tract that is "the workhorse organism in biotechnology." Tang notes that he used safe *E. coli*, "not the infectious ones you hear about on TV. … This is a biotechnology grade, not [fast-food] grade." With *E. coli* and an enzyme that could modify the fermentation process, Tang and his colleagues set out to simplify the technology.

"We did some protein engineering to optimize the performance of the enzyme, and we did some metabolic engineering to optimize the efficiency of the live cells that we use to do the conversion," he says. "These combined efforts yielded the very robust new process for making this important drug."

The process was also more environmentally friendly and far more efficient, converting 99 percent of the raw material to the final product, compared to 70 percent with the current technology. And Tang's process took only a single step.

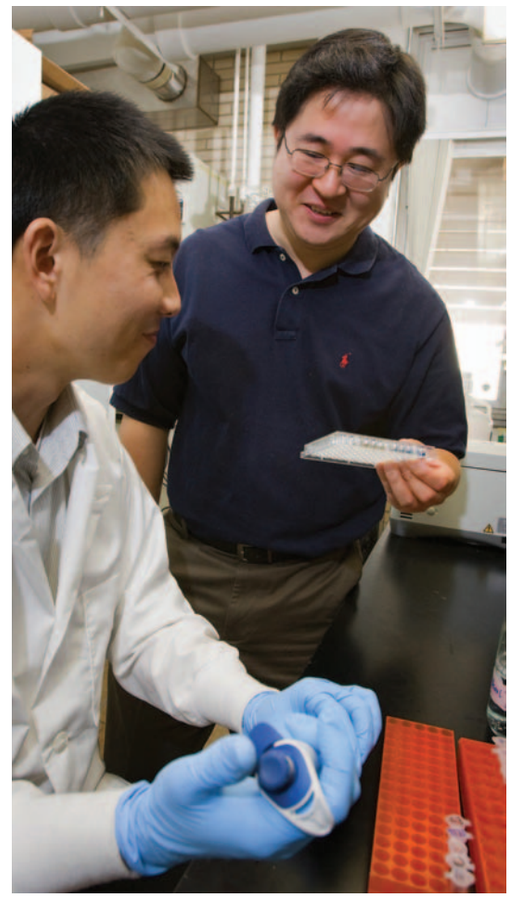
UCLA patented the process and licensed it to two companies, one in India and the other in the United States, in order to increase the probability that this method for making generic simvastatin would be used commercially. This is the first commercial partnership that UCLA has formed with a company in India, and one of the first with a company in Asia. It reflects a growing trend to team up with international companies, which are increasingly looking to the United States for new technologies.

It remains to be seen whether the process developed in Tang's lab can be scaled up to an industrial level, but there are good reasons for trying.

"It could dramatically decrease the cost" of the drug, Tang says, by eliminating so many steps. Competition is fierce, however. Tang estimates that there are 20 companies in China, 15 companies in India and others spread around the world that are now using various technologies to manufacture the generic version of Zocor.

Generic drugs can sell for half the price of their name-brand originals, and the marketplace for generics is now global in scope. Zocor was Merck's best-selling drug, and the various statins produced by other companies are in great demand.

"It's a war of attrition," Tang says. "Whoever can make it the cheapest wins."



Yi Tang, M.D. (right)

"Instead of focusing on synthetic efforts, we tried to use biocatalysts to perform this reaction in a single step."

INTERNATIONAL REACH

AGENSYS

CREATING CANCER KILLERS

Arie Belldegrun, M.D.

"The creation of Agensys exemplifies the creativity and drive of UCLA's faculty entrepreneurs. They represent the new scientists of the 21st century...."

— Kathryn Atchison, *D.D.S., M.P.H., Vice Provost, UCLA OIP*

One group of UCLA faculty entrepreneurs can attest to the fact that the boundaries of the Westwood campus are only as limited as their imagination. In reality, the ideas that spin off from the work going on in campus research labs have crossed oceans and continents to garner international attention worth millions.

Follow the path of one small Santa Monica company that was founded in 1997 as UroGenesys by professors and researchers, mostly from UCLA's urology department in conjunction with Don Rice, Ph.D., who came in as a co-founder, bringing a breadth of experience from Teledyne, Inc. The early goal was to discover genes and develop drugs to use in the treatment of prostate cancer. Toward that aim, the Office of Intellectual Property (OIP) licensed four patents to the fledgling company, which used them to raise $8 million in the first round of financing.

Today, that same company, which changed its name to Agensys, Inc. in 2001, has grown from a handful of workers into a robust biotechnology company with more than 100 employees and a specialty in conducting antibody R&D for 14 different cancer types. It is now a complete biopharmaceutical company capable of bringing a product through preclinical validation, toxicology studies and early-stage clinical trials. In December 2007, Agensys was acquired by the second largest pharmaceutical company in Japan, Astellas Pharma, Inc. In a press release announcing the acquisition, Rice, president and CEO for Agensys, commented, "We were attracted by Astellas' desire to build on the core Agensys team to accelerate our discovery and commercial efforts, while working together to achieve our shared vision of building a global leader in biologics and oncology."

"Agensys was sold for $537 million, but, more importantly, it is here to stay in Los Angeles and will continue to grow and contribute to our academic and biopharmaceutical community," says company co-founder Arie Belldegrun, M.D., chief of urological oncology at UCLA, the Roy and Carol Doumani Chair in Urological Oncology. A portion of that selling price went to UCLA as part of a groundbreaking licensing agreement in which the university received part equity in the firm as partial consideration.

UCLA's OIP played a pivotal role in getting the company started. In the start-up phase, UCLA helped to facilitate and "nurture" the research, Belldegrun says. "Then, as we grew, Agensys started doing everything in the company, but the proximity to the campus played a major role in its success."

"The creation of Agensys exemplifies the creativity and drive of UCLA's faculty entrepreneurs," says Kathryn Atchison, D.D.S., M.P.H., UCLA vice provost for intellectual property and industry relations. "They represent the new scientists of the 21st century. ...They act not only as creators of new knowledge, but as international entrepreneurs who can convert breakthrough technology into products that save lives."

HELPING CALIFORNIA KIDS WITH THE NUMBERS GAME

When it comes to kids and algebra — the math monster for any middle schooler — California isn't hitting its numbers. Algebra is too hard for as many as 50 percent of all California eighth-graders — all of whom, however, are required to take it. But they have help in the form of the UCLA Center for Mathematics and Teaching, Inc. (CMAT), which has created a textbook endorsed by the state of California that could help students learn math.

It started when Shelley Kriegler, Ed.D., faculty advisor Ted Gamelin, Ph.D., and their colleagues in the UCLA math department found teaching materials woefully lacking for eighth-grade algebra students throughout California. They decided to fix the problem themselves by creating a new way to help students who were failing the state-mandated standards.

Wanting to direct the marketing and use of the textbook, UCLA's Office of Intellectual Property helped CMAT by devising an agreement so the foundation could license the copyright and serve as publisher for the textbook. "We came up with a very nice agreement so that our private foundation will be selling the materials and doing the training, and the University is going to get a licensing fee," Kriegler says. "What's cool about this is we have written something that has potential for commercial success, and we wanted to do it in such a way that it would benefit the university and math education in general, as opposed to just trying to sell it to a private publisher."

"It's a very conceptualized program that's organized into weekly consumable packets, so the kids who are struggling get a fresh start each week. The math in it is very mature, but it's accessible even to eighth-graders."

Kriegler is director of UCLA's Math Content Program for Teachers and Students, a group that has strived for nearly a decade to raise money, mostly through grants, to help teachers learn better techniques to teach math. "The money started to dry up" at about the same time the state was developing plans to require all eighth-graders to take algebra, she says.

"Probably more than 50 percent of them aren't ready to take algebra in the eighth grade," Kriegler says. Part of the reason is poor instruction, she says, "and a lot of it is just maturation. They're just not ready for abstract thinking yet."

Many eighth-graders needed help. Traditional textbooks seemed inadequate, so the Center for Mathematics and Teaching, Inc. came up with an "out-of-the-box" program, as Kriegler put it, after conferring with mathematicians and math educators.

"It's a very conceptualized program that's organized into weekly consumable packets, so the kids who are struggling get a fresh start each week," she says.

Shelly Kriegler, Ed.D.

"The math in it is very mature, but it's accessible even to eighth-graders."

The effort was supported initially by a pilot program involving 3,000 students, then grew to 10,000 students. School districts paid a fee for each student, providing the funds to move the project into high gear.

The UCLA program was submitted to the state as a textbook, and in 2007 it was one of only 11 algebra-readiness programs adopted for K-8 schools. It is among the top three or four programs that school districts are choosing, Kriegler says. Her group also plans to market the program nationally.

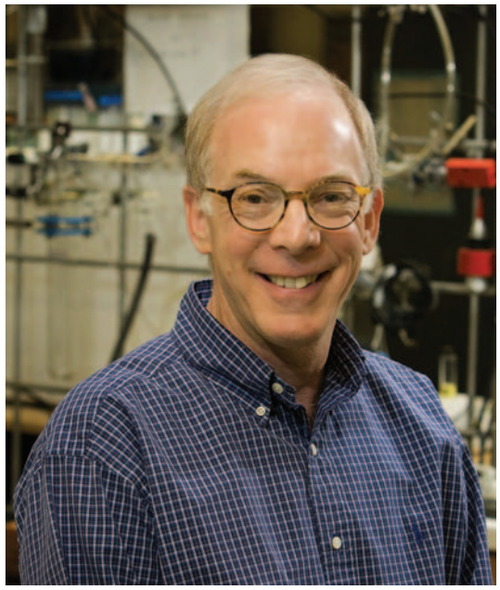
"To develop something from scratch in two years is pretty impossible," she adds. "So the fact that we did it at all was pretty surprising. But we did."

STARTUPS

APIERON

Jeffrey Zink, Ph.D.

Bruce Dunn, Ph.D.



BREATHE EASY

Bhairavi Parikh, a biomedical engineer from the Bay Area, was thinking of forming a new company to develop tools to fight asthma. Her interest in the field was personal — her husband, Rajiv, who had just received his M.B.A. from Harvard, had suffered from the respiratory disease throughout his childhood.

She found the help she needed in the UCLA laboratories of Jeffrey Zink, Ph.D., a professor of chemistry, and Bruce Dunn, Ph.D., a professor of materials science and engineering. Dunn and Zink's research into new materials that have both chemical and biological properties was exactly what Parikh needed to develop a new sensor that can help physicians refine the correct medication for people suffering from asthma.

"Our work in the beginning was just exploratory," says Dunn, who had teamed up with Zink to explore "sol-gel" materials — materials that move from a solution to a gel — to see if they could produce a glass matrix through chemistry rather than heat. They succeeded, resulting in a robust glass matrix that could incorporate biological molecules such as enzymes and other proteins, Dunn adds.

Although the initial research was aimed at producing a whole new generation of materials that were part-biological and part-chemical, it seemed logical that the matrix could be used as a chemical sensor.

"The material is able to change color when a chemical comes in," Zink says.

Soon after the process was patented by UCLA, Bhairavi Parikh appeared at Dunn's lab. "She was a scientist with a company in the Bay Area, and she was very interested in our materials," Dunn recalls. "She came down to visit and talked to us and got a good idea of how the materials worked. We didn't hear again from her for a while; then she and her husband visited, and she says, 'We're going to start a biosensor company, and we're going to use your materials.' "

With a license from UCLA in hand to use the sol-gel process, the Parikhs founded Apieron, Inc., in Menlo Park, Calif., in 2001, where they developed a nitric oxide sensor called Insight. The glass matrix invented by Dunn and Zink is porous and thus permeable to nitric oxide. When the gas enters the matrix, it attaches to highly specific protein molecules. Light passing through the sensor produces a measurable optical signal proportionate to the concentration of nitric oxide.

Nitric oxide is a known indicator of inflammation, so the concentration can tell a physician how well a patient is responding to therapy. Thus, very subtle changes can be made in medication.

After the completion of clinical trials, Apieron received U.S. Food and Drug Administration approval to market the sensor to physicians earlier this year. As the Parikhs have experienced personally with their own daughter, about 44 percent of all asthma hospitalizations are children. The development of this technology can mean relief for asthma sufferers like Rajiv and his daughter.

Meanwhile, back at UCLA, Dunn and Zink have continued their research.

"We can make what we call 'designer sensors' for anything we want to detect," Dunn says. "We're also using this approach for drug delivery, where the material would actually release some of the biomolecules, like antibiotics."

The advantage? The material lends itself well to the delivery of drugs that are very aggressive, "that you can't encapsulate very easily" in a pill, Dunn says.

Whatever is new, whatever is next, these academic researchers are on the collaborative front line to find better ways to manage disease.

STARTUPS

INTERNAL IMAGES AT THE RIGHT EXPOSURE

cat

CAT scans save lives, but the familiar medical diagnostic tool is also a major source of man-made radiation, and that has some researchers worried. In a UCLA lab, John Miao, Ph.D., associate professor in the Department of Physics and Astronomy, and his graduate student, Ben Fahimian, are developing new techniques that dramatically cut the radiation that CAT scans produce.

"There are 65 million CAT scans performed every year in the United States," says Miao. "That's a dramatic increase from 10 years ago."

Miao and Fahimian's work on existing scanners promises to slash radiation exposure by 40 to 50 percent. The two scientists linked up with MedTech Catalyst, an East Coast venture capital company to create a startup firm, TomoSoft Technologies, located in Beverly Hills. They licensed the rights to commercialize the technology from UCLA's Office of Intellectual Property and applied for and received a $1 million UC Discovery Award (a university-industry matching fund program) to advance the development.

"Studies show that over the long term the radiation dose [of CAT scans] can cause cancer," Miao says. CAT scans account for only 15 percent of the total number of medical examinations in the United States, but they account for approximately 70 percent of the radiation dose, he adds.

CT scanners use X-rays to produce three-dimensional internal images of the entire body, showing such things as abnormal structures and tissues, and guiding surgeons to the precise location for the placement of instruments or surgery. The donut-shaped scanner rotates around the patient, lying on his or her back, and uses X-rays to take many two-dimensional images, called projections, around a 360-degree rotational angle. A computer then uses the projections to create cross-sectional pictures, or three-dimensional images.

"We can do it with half [the exposure]," Miao says, because the new algorithms he and Fahimian are creating will need 40 to 50 percent fewer projections to generate images of equal quality. That translates into much lower levels of radiation with no reduction in quality.

Miao and Fahimian are still in the research phase of their work, but they expect to develop and market a complete software package.

"MedTech Catalyst was interested in the vital work occurring in Dr. Miao's lab and the passion and intelligence of both Dr. Miao and Benjamin Fahimian," says Michael Sinsheimer, founder of MedTech. "The findings to date in their work can make a huge contribution to medicine in making diagnostic imaging safer and more accurate."

TOMOSOFT

John Miao, Ph.D., and Ben Fahimian, graduate student

"The findings to date in their work can make a huge contribution to medicine in making diagnostic imaging safer and more accurate."

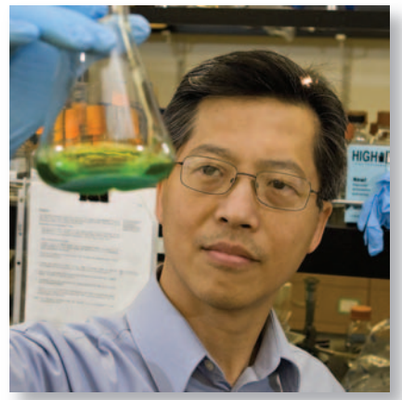
ENERGY CENTER SHOWCASE

HOW UCLA IS HELPING

BIOFUEL BREAKTHROUGH

We all know the days of carefree gas guzzling are gone for good. We all know that the global energy crisis threatens the economic, social and political stability of the entire planet. So what are we going to do about it?

Some researchers think this challenge demands big thinking. But James C. Liao, Ph.D., professor of Chemical and Biomolecular Engineering in the Henry Samueli School of Engineering and Applied Science, thinks the solution may be small. Very small. Like bacteria.



James C. Liao, Ph.D.

Liao has genetically modified *E. coli* bacteria and programmed it to convert sugar into isobutanol, a next-generation biofuel that burns cleanly and is easy to transport and store. Even better, it can be used in conventional gasoline engines. The technology has been licensed by the university to Gevo, Inc. of Pasadena through an exclusive royalty-bearing license.

Isobutanol has many advantages over ethanol. It is more efficient, so cars get better mileage, and it has less water than ethanol, so it can be transported through existing gasoline lines instead of expensive trucks.

"You can put it in your gas tank, either 100 percent or mixed with gasoline in any percentage you like," Liao says.

E. coli does not normally convert sugar into isobutanol. Therefore, Liao and his colleagues inserted two non-native genes in the microbe, and it began to produce small quantities of isobutanol. A few other genetic modifications and the conversion rate increased dramatically, but another hurdle loomed. The fuel it produced was toxic to the microbe, decreasing its efficiency.

A few more tweaks and the bug became more tolerant of isobutanol. Liao's team is trying to raise the tolerance even more, but as he puts it, the microbe has "already passed the bar." He hopes to see the biofuel on the market in three or four years.

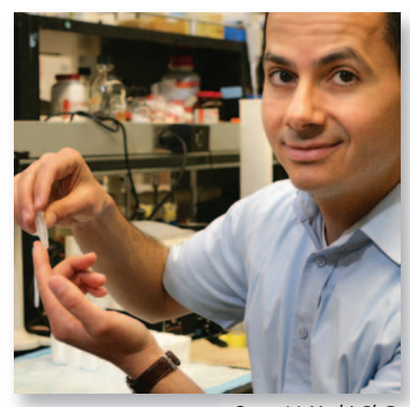
CLEANER COAL

Barring some science-fiction-type breakthrough, scientists believe we're going to be dependent on fossil fuels to provide energy for many years to come. However, that doesn't mean we have to resign ourselves to high-polluting coal-fired power plants. Omar M. Yaghi, Ph.D., professor of Chemistry and Biochemistry, created a "new kind of chemistry," as he calls it, that could dramatically reduce the carbon dioxide that coal plants now release.

"It's a way to stitch molecules together into extended networks to make porous material," Yaghi says. These porous materials can be designed to capture carbon dioxide and store it like a reservoir. "No carbon dioxide escapes. Nothing escapes unless you want it to do so. We believe this is a turning point in capturing carbon dioxide before it reaches the atmosphere."

Yaghi's Center for Reticular Chemistry has created new classes of materials with weird-sounding names — ZIFs, COFs and MOFs — that could solve a wide range of problems. These "molecular sponges," as Chemistry World magazine called them, have potential applications ranging from selectively capturing carbon dioxide in smokestacks to storing hydrogen as fuel for anything from laptop computers to automobiles.

The most recent members of Yaghi's menagerie are zeolitic imidazolate frameworks (ZIFs), which are porous crystalline materials with a cage-like structure. They work sort of like a fishnet, letting some materials in while keeping others out.



Omar M. Yaghi, Ph.D.

Reticular chemistry "allows us to design hundreds of new structures" where each of the components are tailored for a specific task, he says. "The components of each structure can be called a hub and

TO POWER THE FUTURE

a strut, and the hubs are linked with a strut to make extended frameworks of any composition and any functionality. So a number of applications are now being pursued that span all sectors of the economy, from health to petroleum refining to renewable energy."

News of Yaghi's technology spread rapidly after research papers were published in several leading journals, and "hundreds of companies are very interested in this chemistry," he says. His lab is working closely with BASF, the global chemical company headquartered in Germany, which partly funds his research at UCLA. BASF is scaling up and marketing these compounds for various uses, including the separation of gases and storage of hydrogen and biofuels, as well as carbon dioxide capture.

Vasilios Manousiouthakis, Ph.D.

THE HYDROGEN HIGHWAY

Some potential solutions to the energy crisis seem tantalizingly close, yet are still far away. Water, as every grade-school kid knows, consists of two parts hydrogen and one part oxygen. So why not just separate the two elements and use the hydrogen to power our vehicles? It sounds easy, but water has to be heated to over 2,000 degrees Celsius to thermally decompose.

Now Vasilios Manousiouthakis, Ph.D. and his colleagues in UCLA's Hydrogen Engineering Research Consortium have created technology that will break water down at a much lower temperature, maybe as low as 900 Celsius. That's low enough, he says, to produce hydrogen in your own backyard.

"You could fuel up at home," he says.

UCLA has a patent pending for what's called a "thermochemical cycle for water splitting." Chemical reactions inside closed loops within the cycle make it possible to decompose the water somewhere between 900 C. and 1,200 C.

"That's pretty hot, but not crazy," Manousiouthakis says. "We make glass at such temperatures. There are several industrial processes that take place in these conditions. Nuclear reactors operate at around 900 C."

He believes the cycle could be heated to the necessary temperature by a solar collector of about three meters in diameter. That's small enough to fit in a modest backyard, and no fossil fuels would be involved.

SESAME SEED-SIZE BATTERY

Ever since the beginning of the age of "electrification," scientists and engineers have struggled with a fundamental problem: How do you store electricity until you need it? One way is in a battery, but batteries are too heavy and expensive, and they are so large they dictate the size of many things that use them.

"What we are able to do now is make incredibly small batteries" that still pack a serious punch, says Bruce Dunn, Ph.D., professor of Materials Science and Engineering.

Bruce Dunn, Ph.D.

Today's batteries are two-dimensional, with a layer of anode, a layer of cathode and a layer of electrolyte. Dunn is working in the third dimension, which consists of "an array of pins that are all sort of sticking up in the air. So the area they take up is pretty small, but they go up into a third dimension," providing more storage space for the chemical energy that will convert to electrical energy.

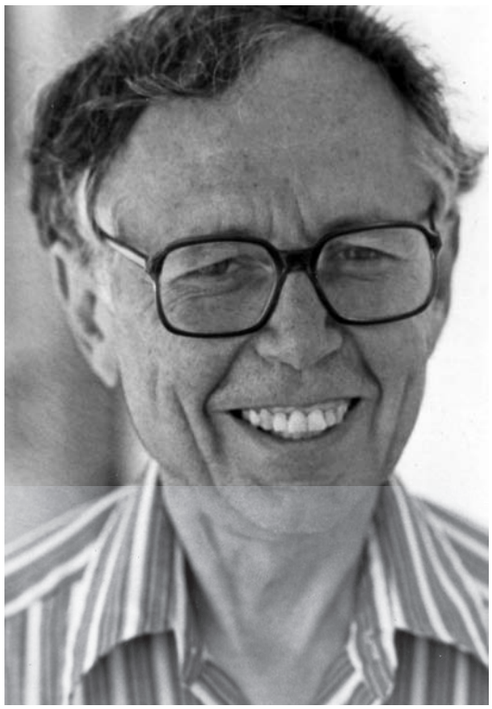
Dunn says he can build batteries so small they will fit on a semiconductor chip and power incredibly small devices.

With these and many other projects, it's clear that wherever and however we get our energy in the future, UCLA will be in the forefront of the science — and that's the kind of power we can all enjoy.

ENERGY CENTER SHOWCASE

LICENSING

A NOVEL IDEA THAT STOPS A DEADLY ADDICTION AND SAVES LIVES



Murray Jarvik, Ph.D., M.D.

Smoking kills hundreds of thousands of people every year. Thousands more survive because they quit. And many — maybe most — quit because of Murray Jarvik's nicotine patch.

A legendary UCLA scientist, Murray Jarvik, Ph.D., M.D., who passed away in May 2008 at the age of 84, created the now famous patch with Jed Rose, Ph.D., then a postdoctoral fellow in Jarvik's psychopharmacology laboratory in Westwood, in the 1990s. But the story of this famous life-saver began decades before.

In 1970, Jarvik published a paper proposing that nicotine was the cause of addiction to cigarette smoking. It was the first time that smoking was shown to be addictive. By the next decade, at UCLA, he and Rose were investigating "green tobacco illness," a malady that affected tobacco farmhands in the South. The scientists began researching whether absorbing tobacco through the skin, via a patch that delivered nicotine directly into the body, could be a solution to the problem associated with trying to quit smoking.

The researchers knew that small doses of nicotine might help break the habit, and Jarvik's earlier work with chewing gum had helped, but it had not been totally successful. During a family reunion, Jed told his older brother, Dan Rose, M.D., a family physician in private practice in Healdsburg, Calif., about his effort to find a way to help people quit.

"I recall saying 'You know, it would be kind of sexy to give the nicotine transdermally,' " Dan Rose says. Skin patches that transmit drugs were already available for nitroglycerin and motion sickness.

It was also the beginning of a daunting challenge. Some researchers said it wouldn't work because the skin is a strong nicotine barrier, and there were many unknowns, including the correct dosage. The Bruin scientists also faced another big hurdle: They couldn't get approval to run experiments on test subjects.

So they decided to test their idea on themselves, with Rose as the first subject.

They found that with the patch, heart rates increased, adrenaline began pumping and all the symptoms experienced by smokers were present.

In 1984, the researchers published the first paper on their work, triggering interest from other labs. The Swiss firm Ciba-Geigy was licensed by UCLA to use the technology, and in 1991 Ciba-Geigy (now Novartis) produced the Habitrol patch. Other companies followed soon with their own patches.

The nicotine patch was first available in the United States by prescription for smoking cessation in 1992. Four years later, it was approved for over-the-counter sale.

For UCLA, the breakthrough was rewarding. In terms of licensing fees and royalties, the nicotine patch ranked second in income in the UC system in 1992, and was still number four in 1995. It is still known nationwide as one of the more successful translations of university basic science to a product that improved the public's quality of life.

But the real winners are the smokers who've kicked the habit using the patch. Smoking kills more than 400,000 people in America every year, and most people who quit on their own eventually start smoking again. But with the nicotine patch, studies show that ex-smokers are twice as likely to remain cigarette-free. Anywhere from just under 10 to 20 percent of people who quit through the use of the patch don't relapse. One estimate pegs the total number of successful quits using the patch at more than 13,500 people.

"While the nicotine patch is now a widely known product on the market, it started out as a novel concept from a group of imaginative thinkers at UCLA," concludes Claire Wake, Ph.D., assistant director of licensing and material transfer agreements in the Office of Intellectual Property. "These were inventors who were able to be catalysts for launching an idea from curiosity and research into a positive and viable product for society."

LICENSING

BRIDGE OF SMILES

Dental implants can restore a beautiful smile and the joy of eating, eliminate the need for those clacking dentures and maybe even fill a few gaps in the social calendar. But they are expensive, require repeated visits to the dental office and rely on technology that hasn't changed much in 45 years.

"Ten percent of adults, or a third of the people who are 65 or older in this country, have no teeth," says Takahiro Ogawa, Ph.D., D.D.S., associate professor in UCLA's School of Dentistry. "Dental implants are a routine practice, but we treat only 2 percent of the potential patients. So we have to develop more efficient implants."

A revolution may be just around the corner, though, thanks to two discoveries made in Ogawa's laboratory. Using two different fields to radically enhance the performance of implants — photo-functionalization and nanotechnology — Ogawa's research may soon give hope to denture-wearers everywhere.

Until now, people in need of dental implants have traveled a rough road. Ninety-eight percent of the people in this country who need implants rely on dentures, bridgework or nothing at all. Fixed bridges often cause problems with adjacent teeth, and removable dentures may cause loss of bone where the teeth are missing.

Implants are permanent, but they involve a multi-stage process with an artificial root, made of titanium, which is literally screwed into the jawbone. An extension is attached to the root, followed by artificial teeth. The cost is about $3,000 for a single tooth, and it frequently is not covered by insurance.

For the procedure to be successful, the titanium root must bond to the jawbone. The application of implants is often limited due to the poor bonding capacity of bone caused by various conditions, such as narrow or short jawbone, or aged, diabetic or porous bone. That's where the UCLA professor's discoveries come into play.

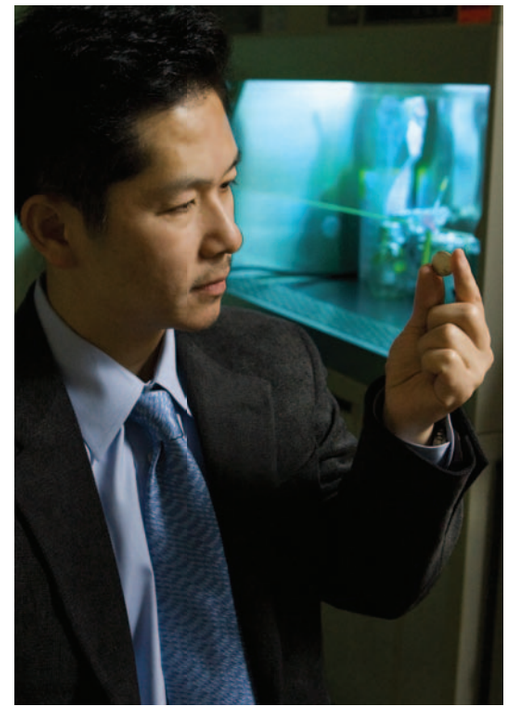
"We have two approaches," Ogawa says. "One involves photo-functionalization, which uses ultraviolet light activation to enhance the bone-bonding capacity of the implant. After the implant surface is treated with UV rays, the titanium attracts more bone-making cells and necessary proteins. That will make it bond faster and stronger."

The second discovery involves nanostructure, refining the bond even further on a near-molecular scale. Ogawa discovered the nanostructuring technology of titanium and used it to create a new surface for implants.

"Photo-functionalization and nanostructure work synergistically," Ogawa says. "The photo-functionalization optimally stimulates the bone-making cells, encouraging more cells to work faster. The nanostructure can actually enhance the interlocking of the titanium surface and bone."

So promising are these breakthroughs that they have already been licensed by UCLA to an American blue-chip company in the dental implant field. The company is expected to produce the first implants in late 2009.

Ogawa has already started worldwide promotion of the new technologies and underlying science. He'll speak at several international conferences, including the prestigious Center of Excellence Science Council Symposium in Japan in November 2008, the International Association for Dental Research in Miami in April 2009 and the International College of Prosthodontics conference in South Africa in September 2009.



Takahiro Ogawa, Ph.D., D.D.S.

The new technologies have other potential uses as well. Any implants made of titanium — orthopedic implants, artificial joints, plates, screws and pins used in spine surgery — can benefit from the technology. But for now, the UCLA professor hopes his work will lead to implants that are cheaper, faster, versatile and more durable.

"It's been 45 years since we started dental implants," Ogawa says. "It's been the same material and the same surface. The history is about to change."

PROFILES

SMALL MIRACLES, BIG SCIENCE

George Gruner, Ph.D.

It is no exaggeration to say that George Gruner, Ph.D., is a one-man technological revolution. Since his arrival at UCLA in 1980, Gruner, a Distinguished Professor of Physics and Astronomy, has created two startup companies — and is launching a third — in nanotechnology, a field that is expected to change much of the world around us. He is a pioneer in this science of the infinitely small, where materials are manipulated on the molecular level, with multiple applications in a vast array of other fields, from alternative energy to flexible electronics.

And Gruner is right in the middle of it. So far, Gruner's work has led to 30 patents, some held by UCLA and some held by the companies he has founded, Nanomix, Inc., and Unidym, Inc. Nanomix has pioneered the use of tiny sensors for chemical and biological detection. Unidym, a UCLA spin-off he founded in 2005, develops electrical components based on carbon nanotubes, a new class of materials with electrical, mechanical and thermal properties.

"We are contributing to high-tech jobs in California, and many of my former students now work for these companies," says Gruner, twice honored by the World Economic Forum, which includes among its members many of the world's leading political and industrial leaders. The forum's Technology Pioneers Award, which honors corporations and their leaders for work that can "change the world," went to Nanomix in 2004 and Unidym in 2008. Gruner is believed to be the only person so honored twice.

These companies are not only bringing new ideas to the marketplace. They are bringing new materials to replace old standbys that are nearing their limits. What excites Gruner most about nanotechnology is that it "is a platform that, through the design of new materials and devices, will enable a wide range of products that will impact practically every aspect of our lives.

"This is one of the major paradigm changes of this century," adds Gruner, one of the most frequently cited physicists in the world. "Old materials like copper or silicon are becoming scarce. They are not very environmentally friendly, they are getting very expensive and it takes a lot of energy to process them. We are replacing them with new materials that are cheap, can be processed at room temperatures, and which have novel properties."

Unidym, for example, is using nanoscale materials to produce transparent, electrically conducting films for many applications like touch screens for laptop computers, light-emitting diodes and solar cells.

"Solar energy is a huge area, and solar cells need these films as electrodes," he says. Using this technology, solar cells could literally be sprayed on a wall or painted on a roof, thus greatly expanding the possibilities in this critical technology.

Gruner was appointed professor of physics at UCLA in his early 30s after a scientific sojourn through some of the world's leading research institutes. After receiving his doctorate in Budapest, Hungary, where he began his rise to world fame, he served as a visiting professor at major universities in London, Italy, Germany, France and Switzerland before arriving at his current post.

Of all his achievements, Gruner is perhaps proudest of seeing his research and creative ideas transported into the marketplace for the production of new materials and jobs that are changing people's lives. He started Unidym in 2005 with three employees, most of whom were part-time workers. The company now has 50 employees, and Gruner still serves as the company's chief scientist.

Gruner says that to start a new company, an entrepreneur needs a good project with significant market potential and a support structure. "Being at UCLA enables me to access funding, and it allows me to build a patent portfolio," he says.

PROFILES

BIG IDEA FOR A SMALL SCIENCE

How do you teach ninth-graders about a radically new science that is hard to grasp, even for some professionals? Simple. You don't tell them what it is — you show them how to do it.

That is the basic philosophy behind the NanoScience Institute, a UCLA outreach program that is helping high school science teachers introduce teenagers to the remarkable world of nanoscience, the science of the infinitely small that could revolutionize fields ranging from medicine to electronics.

The program is the brainchild of Sarah Tolbert, Ph.D., professor of chemistry and biochemistry, who teamed up with the California NanoSystems Institute at UCLA and what she calls "a bunch of gung-ho graduate students and postdocs." Many of these graduate students are funded by a National Science Foundation IGERT training grant called the Materials Creation Training Program. Working together, they created a series of experiments that give high school students a hands-on introduction to nanoscience. Under Tolbert's direction, UCLA graduate students walk a select group of high school science teachers — most of them from the Los Angeles Unified School District (LAUSD) — through six workshops during which they perform nanoscience experiments.

The teachers then return to their schools with a kit and a lesson plan that help them perform an experiment with their own students. Teachers are also given a video of the experiment to use as a refresher. The goal is to show the teachers — and thus the students — that nanoscience is not all that intimidating.

"This whole science is not some mysterious, inaccessible field," Tolbert says. "It's something they can do with methods they understand."

One experiment, for example, involves the "lotus effect."

"In Asia, you see these lotus flowers growing in a scum pond, and while the pond is dirty, the lotus flowers are perfect and clean," she explains. "This is because when water falls on a lotus leaf, it doesn't wet the leaf. It balls up and rolls off. The reason is that the surface of the lotus leaf is nano-rough. The droplet sits on top of little nano-sized pillars and never really touches the surface of the leaf."

In the experiment, the students create surfaces that are nano-rough, just like the lotus leaf. The process forms a "super hydrophobic surface," meaning the rough surface has no affinity for water, which just rolls off, Tolbert says.

Tolbert draws from her own wide-ranging research, which is focused on the creation of advanced new materials with applications in such divergent fields as computer memory, solar cells, batteries and capacitors, and plastic electronics. … Her lab helped design a new material that is as hard as the second-hardest known material, boron nitride.

The nanoscience program — a joint effort of the CNSI, Center X in the Graduate School of Education & Information Studies, and UCLA's Materials Creation Training Program, funded by the National Science Foundation — grew out of concerns among Tolbert's CNSI colleagues that they should reach out to their communities.

"But what made it happen was a great synergy among a bunch of grad students and postdocs who knew a lot of science and were really excited about creating experiments that could be done by high school teachers," Tolbert says. More than 100 teachers have taken part in the program so far, and it has expanded to include qualified teachers beyond the LAUSD.

Sarah Tolbert, Ph.D.

"There is different physics behind each experiment," Tolbert says. For instance, "they make magnetic nanocrystals, and since they are nano-size, they dissolve. And then they can make a magnetic fluid."

They also do photolithography, a process used to make computer chips. "They don't do it on the nanoscale, but they see how easy the chemistry is," Tolbert explains. "And they realize that making a computer chip isn't a magical process. It's just simple chemistry."

Experiments like that, she adds, can really motivate teenagers. "There's so much in the natural world that you can use to excite kids about science," she says. Like the lotus flower thriving in a pond of scum.

PROFILES

HOPE FROM A MUTANT HEART

Paul Bajaj, Ph.D., and Madhu Bajaj, M.D.

UCLA professors Paul and Madhu Bajaj make a great husband-and-wife research team, and couldn't be prouder of their latest project together — even if they did name it Mutant.

Officially called KD1 Mutant, it's a promising new drug that could help heart surgeons reduce bleeding in patients.

That put the Bajajs in the right place at the right time last year, when the federal government banned Trasylol, an important drug that heart surgeons had previously used to stop bleeding. Studies had found that Trasylol may have done more harm than good, causing increased number of deaths related to toxic effects on the heart and kidneys. Withdrawing it from the market forced surgeons to use safer but weaker drugs.

The Bajaj's Mutant could offer surgeons the best of both worlds. It has been licensed by UCLA to a pharmaceutical company and could begin clinical trials in the next year or so.

This is only the latest in a series of projects carried out by Madhu Bajaj, M.D., a physician specializing in pulmonary critical care, and Paul Bajaj, Ph.D., a biochemist and professor at UCLA as well as a member of the UCLA/Orthopedic Hospital combined research program. Paul and Madhu met in India when she was on the faculty of a Bombay medical school.

"We left and came to the United States, and things progressed from there," she says. They have been doing research together since 1987.

"He designs the drug, he analyzes it biochemically, and then I test it in animals and I look at the clinical applications," says Madhu. "So it's a pretty good collaborative situation."

"We knew that Trasylol had a lot of problems" even before it was banned, Paul says. "It's a very powerful drug. It will stop the bleeding in patients, but two weeks later kidney failure will occur in some patients. The surgeons thought they had a successful surgery and the patient is out of the ICU [intensive care unit], but then these side effects appeared."

The Bajajs believe their new drug will do two things no other available drug achieves. Mutant can both stop bleeding without causing the side effects of Trasylol and reduce inflammation that occurs in patients with cardiac bypass surgery.

"During inflammation, the immune system turns against the body, causing damage to major organs," Madhu says. "Trasylol had been found to be effective in reducing inflammation, so our hope is the KD1 Mutant will provide some of that same protection."

KD1 Mutant will go through rigorous, lengthy and expensive trials to see if it can be cleared by the Food and Drug Administration. The Bajajs believe it will.

"I've been in this field of ICU medicine for so many years that I don't feel nervous," Madhu says. "I know that many drugs in clinical trial never go to market, but we believe that KD1 Mutant has the potential to be approved for clinical use."

Besides, they don't have time to worry. They are too busy developing and testing Mutant and other drugs.

TCA MENTORSHIP PROGRAM

& BUSINESS MEETS BRUINS

Great ideas and nifty inventions can easily die on the bumpy road from the lab to the marketplace, but don't look for anyone at the Office of Intellectual Property (OIP) to be daunted by those challenges.

Instead, OIP is working to increase the odds for survival by linking experienced entrepreneurs and investors who have successfully traveled that road before with interested engineering and life science students and their faculty mentors.

> Los Angeles runs on a premium blend of expertise and innovation. Its unique, startup-centric economy couldn't work without a highly educated work force. And vice versa. Universities raise the level of what's possible. They can get academics, researchers, politicians, entrepreneurs, dreamers and doers in the same room to seize moments, face issues, define problems, change priorities, do something.
>
> — Richard Ziman, Chairman of AVP Advisors, LLC

It all began when student leaders asked OIP to help them translate their ideas into marketable products and possibly even start up their own companies.

"We wanted to know how to turn our research into something that someone could actually use," explains Selene Lee, a graduate student in biomedical engineering who had a great invention but wasn't sure how to proceed. So she and several other students approached Kathryn Atchison, D.D.S., who heads up OIP, for help.

Fortunately, Atchison had contacts in the local chapter of a national organization that links investors with budding entrepreneurs, and the students soon began meeting with members of the Tech Coast Angels, the largest organization of its kind in the country.

"The Office of Intellectual Property came to us and said, 'It would be terrific if a few students could be mentored by you guys,' " recalls Richard Morganstern, J.D., an electrical engineer-turned-lawyer-turned-investment-banker and a member of the Tech Coast Angels. That informal beginning in 2006 led to the creation of the Tech Coast Angels Mentoring Program, believed to be the first such program in the country.

"The students who apply for this program really want to know how to do it," says Atchison. "The Tech Coast Angels have the experience. They've all done this before."

To be eligible, the student must partner with a faculty adviser and disclose his or her idea, or that of the faculty laboratory, to the Office of Intellectual Property "so we can be sure the IP is protected," Atchison adds. In addition, the "angels" want to be sure the student has more than just an idea.

"We look for a potential enterprise that appears to meet a market need of some kind," explains Morganstern. In other words, it has to be an idea that has a good chance of flying, backed up by technical expertise. He added that the program benefits the mentors as well as the students and faculty.

"I can tell you it's fantastic," says faculty mentor Edward McCabe, Ph.D., M.D., professor of pediatrics and human genetics and bioengineering. "It has been incredibly useful beyond the project we're being mentored on. I learned the jargon so well that I could actually sound like I knew what I was talking about."

The program, which is run by the students, hasn't produced a startup company yet, but there are many encouraging signs.

Selene Lee, for example, has progressed significantly with her project. Surgically implanted catheters must sometimes be replaced when they become clogged with cellular material. Selene found a way to cleanse the tubes without removing them from the patient.

Her solution was to implant tiny magnetically driven mechanical components in the tube.

"So if you turn on a magnetic field outside of the patient's body, something that is already implanted will move around in response to the field, and the physical movement is what we're using to remove cellular material," she explains.

Lee initially thought her project could lead to a startup company, but during the mentoring process she concluded that it was more suitable for licensing. UCLA has applied for a patent for the process, and a major pharmaceutical company expects to license it.

While every student's idea may ultimately not yield a dime, the practical knowledge these mentees gain from their mentor "angels" is solid-gold advice.

DRUG DEVELOP

MAKING MIRACLES

If you want to save lives, it's not enough to just invent a new miracle drug.

You need to have the mechanisms and a team in place — academic investigators, company scientists and industry funding — to get the drugs to market.

You need a drug pipeline. And, UCLA, with its unique combination of a world-class medical school, an outstanding research environment that encourages interdisciplinary exploration, and a rich tradition of technology transfer and industry collaborations, is a vital part of this process.

Recognizing this fact, the pharmaceutical industry increasingly has turned to UCLA to partner in developing scientific discoveries that have the potential for bringing the next generation of drugs and medical devices to the patients who need them.

The illustration on the right lists the UCLA medical devices and health care related products that have already made it succesfully through this arduous process.

UCLA's scientists and engineers filed approximately 300 invention disclosures during the fiscal year that ended July 1, 2008. Doing the math, this comes to more than one disclosure every working day of the year.

The filing of an invention report launches Emily Loughran's team at the Office of Intellectual Property (OIP) into action with the dual purpose of protecting the intellectual property and beginning the long process of moving concepts from the laboratory to the marketplace, hopefully resulting in a new drug.

"Our mission is to get the technology out to the marketplace for the public benefit," says Loughran, who oversees UCLA's licensing activities.

Of course, the path isn't always so straightforward. There are many hurdles to overcome, and many potential products, especially new pharmaceuticals, fail during the lengthy clinical trial process required for FDA approval. It's estimated that it takes 10 years and about $800 million to bring a new drug to market, and many fail along the way.

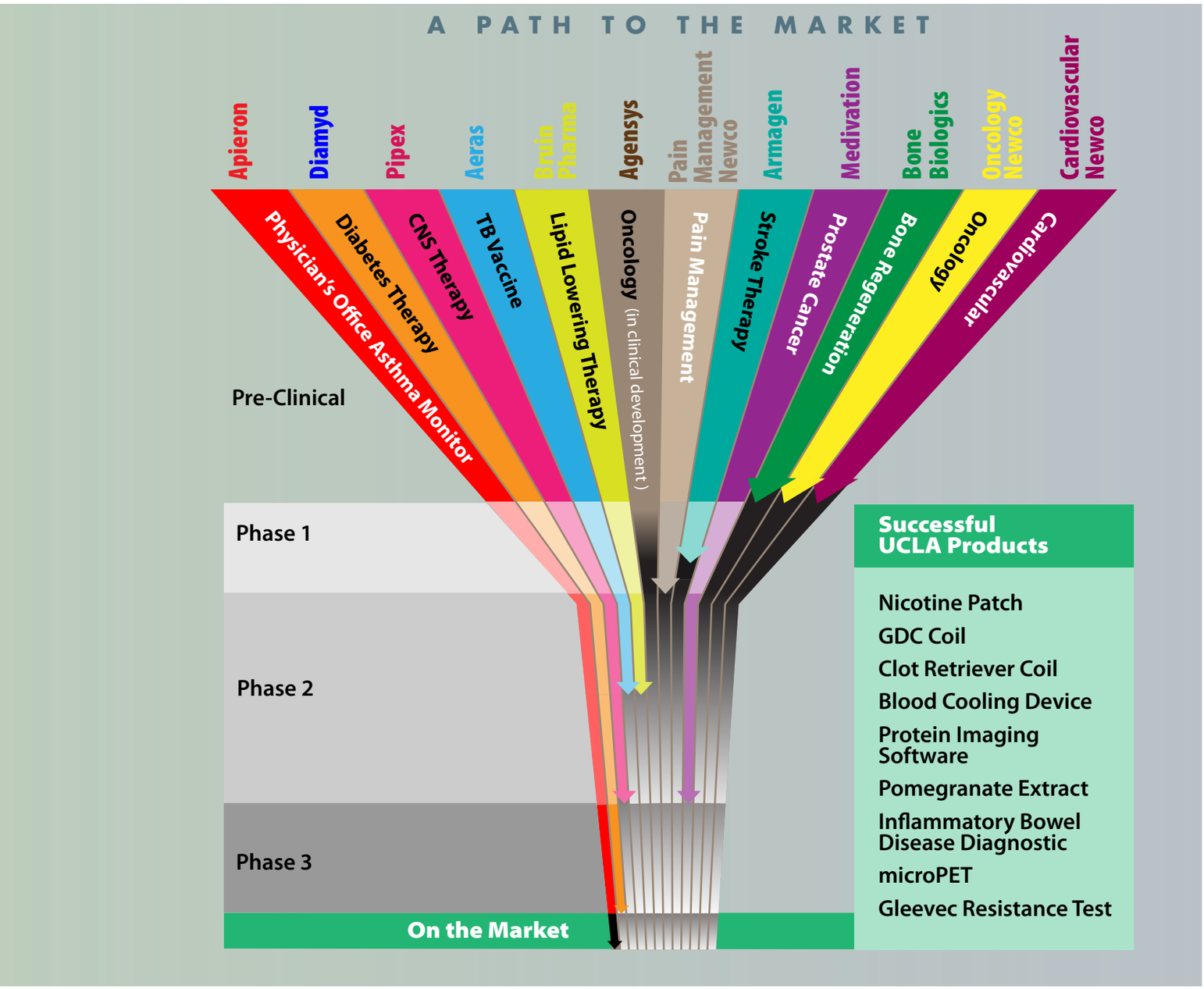
UCLA has produced a rich array of promising new drug candidates. Currently, as described in the pipeline funnel at the right, there are 12 in the pipeline, ranging from a newly approved asthma monitor to discoveries that are still in the preclinical stage but that have already been licensed because of their promise. Several are noted in more detail elsewhere in this booklet.

The OIP team works with UCLA researchers to provide advice and counsel and to help academic scientists navigate through the maze. "It's gratifying to see something that you've worked on finally make it," Loughran says, noting that the university has approximately 200 active licenses and 20 royalty-bearing products. She points out that two UCLA inventions, the nicotine patch and the Guglielmi Detachable Coil used to occlude intracranial aneurysms for stroke patients, have saved countless lives worldwide.

Most inventions are "embryonic" in nature and could evolve in many different ways once they enter the commercial sector, so the process doesn't end with a patent and a licensing agreement. The licensee is required to meet certain deadlines, for example, to start clinical trials, receive FDA approval, and get a product to market. "It's very much of an ongoing relationship between the licensee and our office," Loughran says.

Acting as a guide to help researchers overcome the many obstacles in front of them, she adds that her office colleagues frankly "aren't doing the hard part." The real credit goes to the front-line collaborators. "It's the researcher in the lab who invented this, and the company that commercializes it, who are doing the hard work."

MENT PIPELINE



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