The TREND in Engineering

THE UNIVERSITY OF WASHINGTON COLLEGE OF ENGINEERING NEWSLETTER SPRING 2015

A Simple Injection Could Save Your Life

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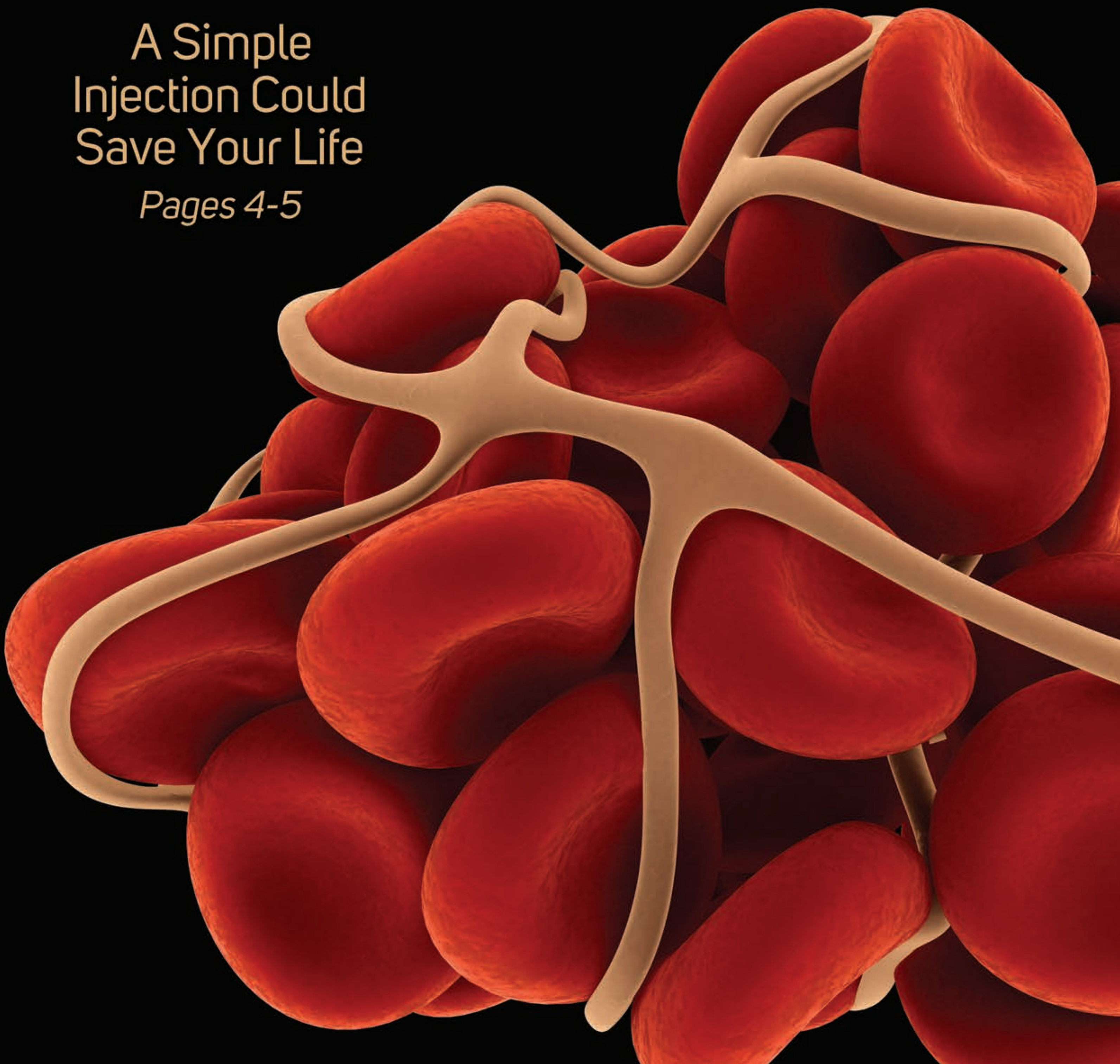


Our 2015 graduates will soon enter a workforce where the professional opportunities are vastly different than they were just 5 or 10 years ago. Accordingly, the landscape of engineering education is changing more swiftly than ever before. As fundamental shifts occur in technology and society we must consider the role engineers will play and how we will prepare students to lead and succeed. Recently we completed a five-year strategic plan for the college that underscores our commitment to provide our students with a world-class engineering education. One of our goals is to "build interdisciplinary collaborations that inspire innovation." Our feature story exemplifies that goal and shows that it can lead to life-saving impact.

Another goal in our strategic plan is to "create industry and community partnerships to increase our impact." Over the last few months we've launched two new programs that are tangible demonstrations of our commitment to this goal. You can read about both programs, the Washington Innovation Advantage and the Boeing Advanced Research Center, in this issue.

Spring quarter is a busy time for our students and faculty. Our seniors are wrapping up their capstone or senior design projects, and many students are participating in competitions. I recently attended the Alaska Airlines Environmental Innovation Challenge, an event where students pitch their innovations in clean technology, renewable energy and water resource management. Engineering teams have historically secured the grand prize at this event and I'm pleased to report that this year was no exception. I'm proud of our talented and entrepreneurial students.

This quarter is filled with many events including the annual Diamond Awards dinner and, of course, commencement. I hope to see you on campus soon.

Mike Bragg
Frank & Julie Jungers
Dean of Engineering

New Washington Innovation Advantage program to optimize industry sponsored research

In an effort to make it easier for businesses to partner with the UW in transforming discoveries into innovative solutions, the university is launching a new "pre-packaged" intellectual property (IP) program for sponsored research.

The Washington Innovation Advantage program allows industrial sponsors and UW researchers to opt into set financial terms for non-exclusive or exclusive commercial licenses for intellectual property up front, at the time the sponsorship agreement is negotiated. By providing companies with a convenient and cost-effective means to license intellectual property before a project begins, this new program streamlines execution of sponsored project agreements, reduces financial uncertainty for sponsors, and minimizes the time spent on licensing negotiations. The Washington Innovation Advantage program aims to increase transparency and reduce barriers to industry research engagements with the University.

With this new pre-packaged IP program, companies pay a fixed percentage of the project cost for an exclusive worldwide license to any IP that is developed on their funded project. A royalty of one percent applies if net product sales exceed $20 million. Businesses can ensure patent filings associated with the technology developed during the research project meet their strategic goals, and are free to sublicense at any time. The program also offers an option for a non-exclusive commercial license to project IP for a lower cost.

Mechanical engineering students team "FireBee" a double winner at the Alaska Airlines Environmental Innovation Challenge

On April 2 a group of 22 student teams from seven colleges and universities across the state of Washington, gathered at the Seattle Center to pitch their innovations in clean technology, renewable energy and water resource management. Throughout the afternoon these innovative and entrepreneurial students demonstrated their prototypes and fielded questions on everything from technology issues to market viability from a room full of 160+ judges and another 100 guests.

A team of three mechanical engineering undergraduate students took home both the $15,000 Grand Prize and the $5,000 Clean Energy Prize for their idea, FireBee. FireBee is a portable thermoelectric generator that turns cooking fires into personal power stations, creating an alternative energy source for people around the world who live off the grid.

College Leadership on the Move

Anthony Waas new chair of the William E. Boeing Department of Aeronautics & Astronautics

Anthony Waas, an international leader in aerospace, arrived in January from the University of Michigan to serve as chair of aeronautics and astronautics. Waas brings research expertise in composite structures and lightweight materials as well as a long history of working with The Boeing Company, General Electric, and the automotive industry. Waas is best known for his modeling tools in assessing compressive strength, damage tolerance and durability of aircraft composites.

Brian Fabien appointed associate dean of academic affairs

Brian Fabien, a professor of mechanical engineering, has been named associate dean of academic affairs. In this role he will focus on the college's academic programs and initiatives that support student success. He will work to improve the student experience and explore new opportunities for engineering students.

Cecilia Giachelli selected as chair of Bioengineering

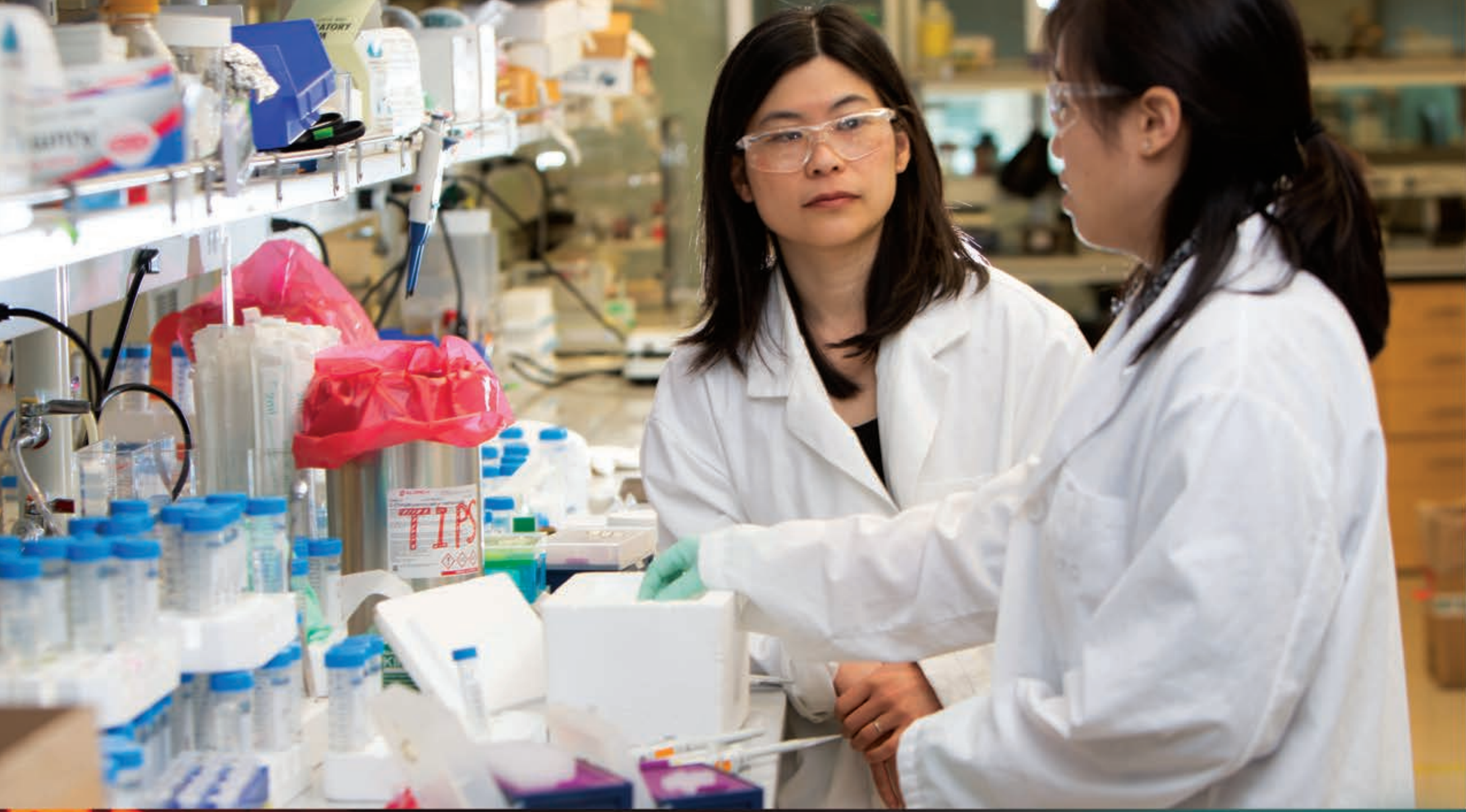
Cecilia Giachelli, who has served as acting chair since fall 2013, has been appointed chair of the Department of Bioengineering. Her deep experience in both medicine and engineering will continue to strengthen interdisciplinary ties and position the department to grow and excel in the coming years. Giachelli is internationally recognized for her work in the area of vascular calcification leading to the development of molecular and cellular therapies for chronic kidney disease and atherosclerosis.

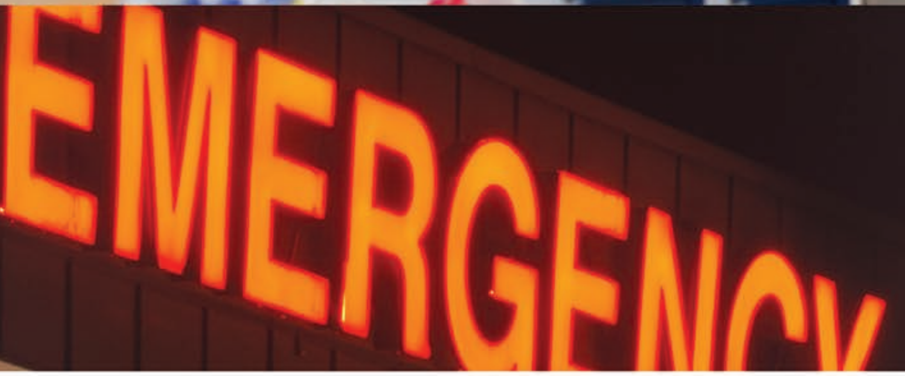
CEE's Pedro Arduino named new associate dean of infrastructure

Pedro Arduino, professor of civil and environmental engineering, was named associate dean of infrastructure. He assumes this role at an important time for the college with the construction of the Nano Engineering & Sciences Building, remodeling of Fluke Hall, and extensive remodeling projects in the planning stages. Arduino will work to develop high-quality facilities for research and education programs.

Radha Poovendran to lead Electrical Engineering

Electrical engineering professor and founding director of the Network Security Lab, Radha Poovendran, was appointed as the new chair of electrical engineering in January. He is the associate director of research of the UW Center for Excellence in Information Assurance Research and Education. Poovendran's research interests are in the areas of wireless and sensor network security, adversarial modeling, privacy and anonymity in public wireless networks, and cyber-physical systems security.





Campus Cross-Links

Collaboration leads to new treatment for traumatic injuries

By Sarah DeWeerdt

Cross-links make things stronger. That's the idea behind PolySTAT, a UW-developed material designed to strengthen blood clots and stop bleeding in people with severe, life-threatening injuries. It also describes the process that led to the innovation, which may one day save the lives of countless trauma patients and soldiers wounded on the battlefield.

The project, led by professor of bioengineering Suzie Pun and professor of emergency medicine Nathan White, represents one of those rare but thrilling scientific episodes where discovery unfolds smoothly and quickly: barely two years elapsed between the researchers hatching the idea and having results ready to submit to a top scientific journal. By building on each other's strengths, the pair precisely defined the problem — and quickly forged a solution.

White came to the University of Washington in 2010 looking to work collaboratively on technologies to stop bleeding, the second leading cause of death from traumatic injury. When he found out about Pun's work, he had an inkling she might be able to help and set up a meeting.

Pun, a biomaterials specialist, had worked with doctors before, but her focus was getting drugs to the central nervous system or delivering them precisely to cancer cells. "I had a lot of really basic questions," Pun recalls of that first, hour-long meeting about three years ago that launched their collaboration. "What is in a clot? How does a clot form?"

Under normal conditions, the body's clotting system is exquisitely tuned to respond rapidly to injuries without interfering with the flow of blood through healthy vessels. Circulating blood cells called platelets form a temporary plug at the site of a cut, which is reinforced by a net of proteins called fibrin. More than a dozen enzymes called clotting factors help to orchestrate the process.

But when traumatic injury causes major blood loss, this system becomes dysfunctional. The body "starts to make these straw-house clots that just get blown away by the flow of blood," says White, and its clot-removal system becomes overactive, breaking down incipient clots too quickly.

Many trauma patients die from blood loss within minutes of reaching the hospital. Many others never make it there.

The researchers realized that, with a few tweaks, the materials Pun's lab had been working with might be able to address these problems. Her team was using a process called controlled polymerization to make large molecules with precise composition and size. They were also perfecting ways to attach short chains of amino acids called peptides to these polymers, so they could precisely bind to particular molecules in the body.

"When I think back on it, it's kind of amazing, because our technology was just right there waiting for Nathan to walk in the door," said Pun. "We had just never thought to target clots."

Within a couple months of that first meeting, Leslie Chan, a graduate student in Pun's laboratory, had designed and produced the molecule that is now called PolySTAT: a polymer backbone attached to multiple short loops of a peptide that binds to fibrin, a major component of blood clots. "I've been saying it the whole time, this works way better than I thought it was going to work," White says.

The availability of flexible, no-strings-attached funding sources also contributed to the project's rapid pace. The researchers pooled discretionary funds from White's training grant and Pun's Robert J. Rushmer professorship in engineering for their initial proof-of-concept studies. "These things start small, with a meeting, and it's all about momentum," White says. In contrast, the traditional approach of applying for grants would have meant waiting a year or more to move forward with the science, and losing that momentum in the meantime.

PolySTAT has a number of advantages over existing strategies to treat severe bleeding: it doesn't need to be refrigerated, and it isn't likely to cause immune reactions the way human blood products can. Although the combination of components hasn't yet been tested in humans, the polymer is an ingredient in contact lenses, while the peptide has been used to help doctors image clots.

Once injected into the body, PolySTAT circulates harmlessly until it encounters fibrin. Then, its peptide loops bind to the fibrin in multiple places, cross-linking the proteins and strengthening the clot.

"The beauty of this is that you don't need to know where a patient is bleeding from," White says. That could be especially important in patients with internal bleeding, where locating the source can be difficult and time-consuming. But PolySTAT does so effortlessly.

The molecule's mechanism is inspired by Factor XIII, a component of the body's natural clotting system. But Factor XIII is an enzyme, so it creates these cross-links through chemical bonds, while PolySTAT becomes physically incorporated into a clot. This makes the clot less vulnerable to being broken down

while the body's clot-removal system is overactive.

In the first round of test-tube experiments, PolySTAT didn't appear to strengthen clots at all. "If it had just been me I wouldn't have been able to troubleshoot that experiment," Pun says. But White, with his deep understanding of the body's clotting system, recognized that the researchers had used too much PolySTAT. The fibrin binding sites were oversaturated and the polymer couldn't link different strands together.

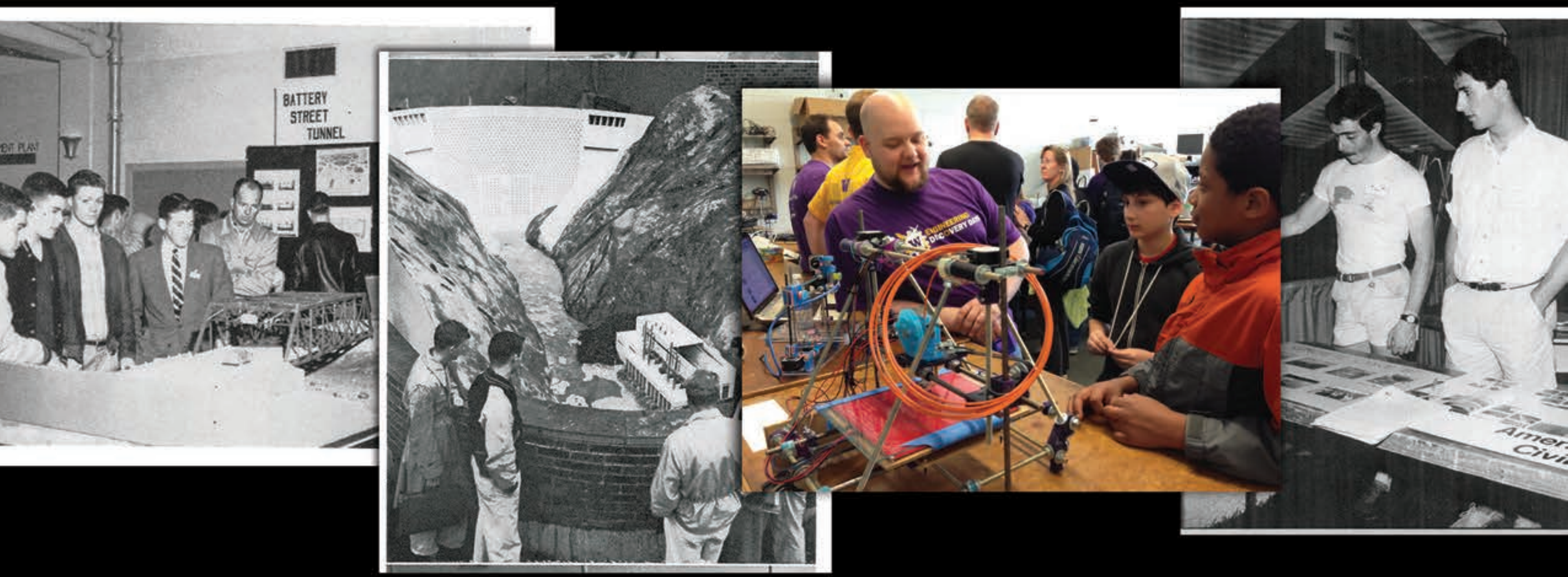
"We actually had a material that ended up working, but we might not have known that," says Pun. Collaborative cross-links to the rescue once again.

At the right concentration, though, PolySTAT works wonders. In a rat study, all 5 animals treated with PolySTAT survived a potentially lethal cut to the femoral artery, the large vessel that supplies blood to the leg. By comparison, groups of 5 rats given other treatments had 0 to 2 survivors each, the researchers reported in March in *Science Translational Medicine.*

Next, the researchers will need to see how PolySTAT works in larger animals and conduct safety studies. They say human trials are perhaps five years away.

In the meantime, the collaborative network is expanding. Pun and White are working on other ways to affect the clotting system with PolySTAT or similar molecules, and are forging cross-links with experts in these areas. For example, they are investigating the possibility of using PolySTAT to treat the inherited clotting disorder hemophilia, and contemplating new molecules that could help break up unwanted clots such as those that cause heart attacks or pulmonary embolisms.

"The first major hurdle is to access the clot," says White. "So now we know we can get there . . . All these other sorts of opportunities are now available."



From Curling Irons to 3D Printing, Discovery Days Celebrates 100th Anniversary

By M. Sharon Baker

The chance to see cutting-edge technology at work —curling irons and electric powered cooking—drew hundreds to the UW campus for an open house more than 100 years ago. Denny Hall was so crowded that they had to turn people away, according to early reports.

That success inspired what's now known as Engineering Discovery Days, a two-day event staged in more than 15 buildings and labs around campus. This year's event marked its 100th anniversary.

Thousands crowded Engineering Discovery Days exhibits earlier this month to see technology that is just as futuristic as curling irons were a century ago; only now, they are coming to see 3-D printers and Google Glass in action.

"The opportunity to experience the University of Washington's engineering departments in approachable, hands-on ways, imprints future possibilities and helps parents, teachers, and students envision the path taken to become an engineer," said April Yantis, a 7th grade literature teacher at Olympic Middle School in the Shelton School District.

Yantis brings about 250 rural students to Discovery Days each year, providing them with a unique opportunity for students who don't usually have access to the UW. She started the annual trip three years ago after noticing the success a neighboring district had when it connected the middle school marching band with the UW's marching band, an annual visit that increased that district's eventual attendance at the UW from a single student to many.

She likes that the outdoor engineering exhibits are easy to access, and offer quick displays and demonstrations that kids love. She makes it a point to show students at least two demonstrations inside a laboratory in different engineering buildings. "These set the stage, creating a fuller understanding of the equipment, work groups, and settings for students," she said.

When students visit those labs, they find faculty members like Eric Chudler, a UW research associate professor of bioengineering. He likes sharing his love of neural engineering with younger students and seeing their eyes light up when they learn something new. "When we demonstrated our muscle-controlled arm wrestling game, many found it incredible to learn that their bodies could generate electricity and then you could use that electricity to do things," said Chudler, who is also the executive director of the Center for Sensorimotor Neural Engineering.

At Discovery Days, he also likes dispelling scientific myths. The brain scientist is often asked whether humans can use more than 10 percent of their brains: "Despite what Hollywood tells us in movies like Limitless or more recently, Lucy, we really use 100 percent of our brains." While young students are often disappointed to learn this, the question opens the door for a larger conversation and new understanding for the students, Chudler said.

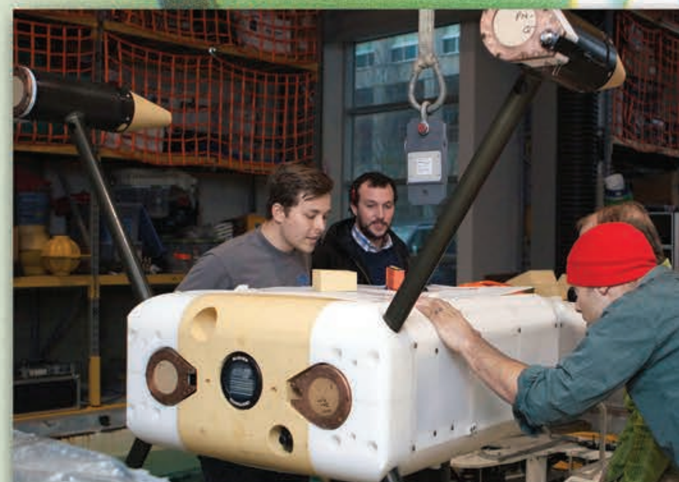
Meeting professors and research students in their environments makes science and engineering less intimidating. "If students see themselves on campus, imagine themselves in the classes, and become comfortable considering projects and coursework they haven't even imagined, we have a chance to interest students in highly technical careers," Yantis said. And that's probably the goal organizers and faculty had when they created the event back in spring 1914.

RESEARCH BREAKTHROUGHS

"Millennium Falcon" to monitor effects of tidal, wave energy on marine habitat *By Michelle Ma*

Researchers building a new underwater robot they've dubbed the "Millennium Falcon" certainly have reason to believe it will live up to its name.

The robot will deploy instruments to gather information in unprecedented detail about how marine life interacts with underwater equipment used to harvest wave and tidal energy. Researchers don't fully understand how animals and fish will be affected by ocean energy equipment. This instrument seeks to identify potential risks.



"This is the first attempt at a 'plug-and-socket' instrumentation package in the marine energy field. If successful, it will change the way industry views the viability of environmental research and development," said Brian Polagye, assistant professor of mechanical engineering and one of the project's leaders.

The UW team tested the robot underwater for the first time in January on campus. Researchers will continue testing in Puget Sound. They hope the tool will be useful for pilot tidal-and wave-energy projects and eventually in large-scale, commercial renewable-energy projects.

The instrument package has a stereo camera to collect photos and video; a sonar system; hydrophones to hear marine mammal activity; sensors to gauge water quality and speed; a click detector to listen for whales, dolphins and porpoises; and even a device to detect fish tags. A fiber-optic cable connection back to shore allows for real-time monitoring and control.

The breadth of sensors and various conditions this instrument can measure is unprecedented. The tool can attach to most types of underwater infrastructure allowing researchers to deploy the instrument far offshore and recover it quickly at a relatively low cost.

"It could be a first step toward a standardized 'science port' for marine energy projects," Polagye said.

CAMPUS NEWS

Boeing, UW open research lab on campus *By Michelle Ma*

Boeing engineers and scientists have brought their projects to the UW, opening a new research center on campus that will initially focus on advanced assembly and manufacturing technologies.

The Boeing Advanced Research Center, located in the Department of Mechanical Engineering, and affectionately known as BARC, will let students and faculty members work collaboratively with Boeing engineers. Four initial projects focused on automation, robotics, and aircraft assembly are underway.

The center is the brainchild of Jim Buttrick, a Boeing engineer and the center's associate director, and UW professors Per Reinhall and Joseph Garbini. Buttrick saw a good opportunity for students to gain practical experience and Boeing to benefit from more researchers.

Up to eight Boeing engineers kept their full-time positions in the company and moved to the UW lab space as affiliate instructors. Eight graduate students and six faculty members have joined the BARC team.

Each project involves making airplane assembly and manufacturing more efficient, automated and streamlined, and is important to Boeing's product development. Actual airplane parts as well as smaller replicas will live in the UW lab space as the projects develop.

One project is designed to make it easier for mechanics to build the insides of airplane wings–shallow, narrow spaces where it is physically hard to work. Miniature robots or remotely operated vehicles could be programmed to go inside these small spaces and place nuts on bolts, seal seams and inspect the inside of the wing to make sure extra debris is removed. A creative solution to this challenging job could improve quality and consistency on each airplane model, Buttrick said.

Other projects include automating the riveting of fuselages and predicting the final, full-sized shape of certain aircraft structures.

The center's leaders plan to grow the number of projects at the UW and involve more students and faculty members, particularly in composites research.

COLLEGE OF ENGINEERING
UNIVERSITY of WASHINGTON

371 Loew Hall, Box 352180
Seattle, Washington 98195-2180

Michael B. Bragg, PhD
Frank & Julie Jungers Dean of Engineering

Judy Mahoney
Associate Dean of Advancement

Heather Hoeksema
Senior Director of Communications

Mary Macenka
Graphic Design

Send address corrections or comments to:
trenduw@uw.edu attn: Editor

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DIAMOND AWARDS TENTH ANNUAL DINNER

Diamond Awards
Tenth Annual Dinner
Friday, May 8, 2015, 6-9 PM
Don James Center, Husky Stadium, UW Campus

Please join the College of Engineering as we honor these four eminent engineers with 2015 Diamond Awards for their outstanding professional and community achievements.

Alan Miller, *'77 PhD Materials Science & Engineering*
Distinguished Achievement in Industry
During his 34-year-career at Boeing, Alan spearheaded advancements in aerospace materials and production systems, developing innovative composite materials for the Dreamliner and groundbreaking fire-resistant materials that are used in over 90% of today's airplanes.

Milton Zeutschel, *'60 BS Electrical Engineering*
Entrepreneurial Excellence
Milton's ability to recognize an engineering problem and design a marketable solution resulted in the formation of three successful companies. He revolutionized programmable, read-only memory. Today nearly every programmable memory device uses Milton's algorithm and engineering design.

Yaw Anokwa, *'12 PhD Computer Science & Engineering*
Distinguished Service
Yaw's passion for global healthcare along with his technical expertise transformed smart phones into easy-to-use data collection systems to improve patient care in underserved communities. Yaw helped create Open Data Kit (ODK), a free and open-source data collection software, now widely used for climate monitoring, microfinance and public health.

Christophe Bisciglia, *'03 BS Computer Science & Engineering*
Early Career
Christophe is responsible for bringing cloud computing to the forefront of industry and academia. As the co-founder of two game-changing big data companies, Cloudera and WibiData, Christophe pioneered the landscape of big data and transformed the way we store, manage and use data worldwide.

Learn more about the honorees and the dinner at www.engr.uw.edu/da