CHEMICAL ENGINEERING | UNIVERSITY of WASHINGTON

Catalyst

FALL 2018

BUILDING A DATA SCIENCE PORTFOLIO

ChemE capstone projects pair students with industry and academic partners

By Lindsey Doermann

What does natural language processing have to do with protein expression? On the surface, not a whole lot. But this past spring, Josh Smith made a connection between the two — and found it rather powerful. Smith and fellow ChemE graduate students Jay Rutherford and Christopher Nyambura employed the principles of a machine-learning algorithm that's used to glean meaning from gobs of text to create a kind of "grammar" for proteins. From there, they trained an algorithm to predict how well different proteins could be synthesized.

Smith's team was one of 12 to work with an industry or academic partner on a data-intensive capstone project. Graduate students complete these capstones to round out a nearly year-long data science training program led by ChemE professors David Beck and Jim Pfaendtner. ChemE and UW's Clean Energy Institute partner to offer the program, which started with an emphasis on clean energy applications. With every year, it's taking on a broader molecular science scope to equip students with the skills to handle complex data sets across all areas of ChemE research.

"Molecules don't limit themselves to clean tech," says Beck. "The fundamental aspects of data science are applicable to many areas." So Smith's

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Knowledge and solutions for a changing world

MESSAGE FROM THE CHAIR

When I took the helm of the department five years ago, there was much I wanted to accomplish. Chief among this was to build on our wonderful "ChemE family" tradition to foster a culture of inclusion, innovation and altruism: a culture that would run deep and wide, and one that would support every chemical engineering student, staff and faculty member on their journey to achieve their highest potential. With my term as chair coming to a close at the end of December, I am proud of where we stand and amazed by what we have collectively accomplished.

It all starts with people. Five outstanding new hires have added vibrancy and momentum to our ranks. (The department will soon have 27 faculty — the largest it's ever been!) Our faculty has retooled the undergraduate and graduate curriculum to expose students to crucial societal issues such as sustainability, emerging opportunities such as data science, and alternative career paths such as entrepreneurship — all through the lens of chemical and molecular engineering. Our students are more numerous, more productive, and more engaged in department life than ever. Our professors continue to be recognized with the highest honors nationally and abroad, and our staff works tirelessly at improving infrastructure and processes.

Thanks to the generosity of our alumni and friends, we have established new scholarships and fellowships to support our most deserving students, and we have added six named professorships to an already impressive roster of endowed and term positions. (Over 60 percent of our faculty now holds a named professorship or chair, a record in the College of Engineering). Also with the help of our alumni, we have transformed how we teach, do research and conduct business in Benson Hall. We've established shared instrumentation facilities and graduate student offices, and created new teaching, computing, meeting and advising space. What's more, the department's exciting strategic initiative in data science is moving full steam ahead with a new M.S. program that will be offered for the first time in fall 2019.

This summer, a group of us in Chemical Engineering, Materials Science and Engineering, Chemistry, and Biochemistry, with colleagues at partner institutions, won a $10.75 million award from the U.S. Department of Energy to create an exciting new interdisciplinary Energy Frontier Research Center: the Center for the Science of Synthesis Across Scales (CSSAS), of which I serve as director. While I will miss my role as chair, I look forward to bringing CSSAS online and to position it for scientific success. It has been a privilege to serve as the eighth chair of Chemical Engineering, and an honor to lead this extraordinary community. I look forward to Dean Bragg naming my successor and to helping new leadership take the department to the next plane of excellence.

— François Baneyx
Department Chair and Charles W.H. Matthaei Professor

Continued from cover

team worked with pharmaceutical company Novo Nordisk on a bioinformatics project relating to protein expression. Other teams took on problems ranging from chiller plant efficiency to sensor accuracy to chemical toxicity.

The master's and Ph.D. students who completed the data science capstones came from across the College of Engineering and the Department of Chemistry, with strong ChemE representation.

No previous experience in data science was required; in the winter quarter, students took two data science classes to learn concepts and tools, then applied that training to real-world problems in the spring. "For most students, all they've seen is the academic side," says program manager Kelly Thornton. "This [program] shows them other paths."

Beck and Pfaendtner worked with sponsors to scope out data-intensive projects that teams of 3 – 5 students could complete in one quarter. Then they found students with the interest and the right mix of skills to take them on. Smith said his team met with its Novo Nordisk sponsor right away to create a strategy, and they corresponded regularly throughout the project. To top it off, they got to check out the company's facilities in the South Lake Union area of Seattle.

Additionally, the student teams all got together every two weeks for a "stand-up," during which a representative from each project shared their status, goals for the

Data science can create a bridge between experts in the hard sciences and those in machine learning — and generate novel solutions as a result

Some of the data science capstone projects that ChemE students completed in spring 2018

- Characterizing proteins with neural networks, with sponsor **Novo Nordisk**
- Detecting sensor drift in chiller plants, with sponsor **Optimum Energy**
- Using image processing and self-learning to identify the best rooftops for solar panels in Anchorage, Alaska, with sponsor **Alaska Center for Energy and Power**
- Predicting climate change sentiments by applying deep learning to Twitter data, with sponsor **KPMG**
- Predicting chemical toxicity using deep learning, with sponsor **Pacific Northwest National Laboratory**

upcoming weeks, and issues blocking progress. Beck found that teams had a lot to share with each other; he said the "few" minutes allotted to each team often turned into many, as classmates exchanged resources and offered up new ideas. The quarter concluded with a showcase at which students presented their projects. In addition to displaying their work at a poster session, each team gave a one-slide presentation in the style of an elevator pitch.

In explaining their project, Smith and his group showed how they sought a more streamlined way of predicting what proteins would be easy or difficult to produce. Recombinant proteins have many applications in biology and medicine, including biopharmaceuticals and other areas of interest to Novo Nordisk. A faster way to screen peptide sequences could in theory lead to more efficient drug development or improved protein manufacturing processes.

Existing methods of determining protein expression levels have involved running data through multiple steps using a suite of software. Novo Nordisk challenged the team to simplify this process. The students' approach drew from natural language processing algorithms that determine the thrust of movie reviews. The machine "reads" scores of articles and essentially learns if words have positive or negative connotations; then it can group films into hits and flops.

The data science team trained its algorithm on a relatively small "big data" set of 45,000 peptide sequences. The way Smith tells it, they treated each amino acid as a word and each peptide sequence as a sentence. And they found that their model did in fact learn — it grouped similar proteins together. Beck calls their result a "beautiful single model," and the students are now preparing a paper to submit for publication.

Smith is now finishing his Ph.D. and hopes to transition into a data science role within the biotech sector. He says that what he found challenging about the capstone project — the exchange of information between disparate fields — was also inspiring. He sees how data science can create a bridge between experts in the hard sciences and those in machine learning — and generate novel solutions as a result.

On top of this, Beck and Pfaendtner see a unique opportunity for students to build soft skills such as project management and stakeholder engagement. The training sets up a win-win: preparing students for new, highly-prized data science jobs, and giving industry partners a leg up in leveraging what might otherwise be unwieldy data streams. Look out for this new breed of chemical engineer.

Does your company or organization have a data science project that ChemE students could take on?

Program directors are currently developing capstone projects for trainees for the spring 2019 quarter. Please contact Jim Pfaendtner at *jpfaendt@uw.edu* to explore the capstone program and other ways to connect around data science.

NEW RESEARCH FRONTIERS

UW, PNNL to host energy research center focusing on bio-inspired design and assembly

By James Urton

The United States Department of Energy has awarded an expected $10.75 million, four-year grant to the University of Washington, the Pacific Northwest National Laboratory and other partner institutions for a new interdisciplinary research center to define the enigmatic rules that govern how molecular-scale building blocks assemble into ordered structures — and give rise to complex hierarchical materials.

The Center for the Science of Synthesis Across Scales, or CSSAS, will bring together researchers from biology, engineering and the physical sciences to uncover new insights into how molecular interactions control assembly and apply these principles toward creating new materials with novel and revolutionary properties for applications in energy technology.

"This center seeks to understand the fundamental rules of how order emerges from the interaction of simple building blocks," said CSSAS Director François Baneyx, the Matthaei Professor and Chair of the UW Department of Chemical Engineering. "What are the energetics, rates and pathways involved, and what properties emerge when simple components come together in increasingly complex layers? Those are some of our driving questions."

The UW-based CSSAS is among the newest members of the Energy Frontier Research Centers announced June 29 by the Department of Energy. These centers, operated out of universities and national labs, are funded by the Department of Energy and devoted to specific goals in energy science. The work at the CSSAS will focus on understanding the principles of "hierarchical synthesis" — the process by which molecules come together, bind, interact and create layer upon layer of higher-ordered structures.

CSSAS experiments will focus on protein-based building blocks, but will also probe protein-like synthetic compounds called peptoids as well as inorganic nanoparticles. Studying the biologically inspired assembly of these systems individually and in combination will shed new light on how living organisms, through billions of years of adaptation and evolution, have created complex hierarchical systems to solve a host of challenges, said Baneyx.

Understanding hierarchical synthesis would allow engineers to design and build new materials with unique properties for innovative technological advancements that can come about only when scientists exert precise control over a material. For example, controlling how charges move precisely through a material — or how a substrate is shuttled between the active sites of a series of enzymes positioned with nanoscale precision — could be key to creating new materials for energy storage, transmission and generation. The precision control that scientists envision could also yield functional materials

Studying biologically inspired assembly will shed new light on how living organisms, through billions of years of adaptation and evolution, have created complex hierarchical systems to solve a host of challenges

that are self-healing or self-repairing, and have other custom physical properties designed within them.

"Scientists have been trying to create these types of innovative materials largely through 'top-down' approaches, and often by reverse engineering an interesting biological material," said Baneyx. "We will begin with the blocks themselves, exploring how order evolves in the synthesis process when the blocks are put together and interact."

CSSAS research will focus on three major areas:

- Investigating the emergence of order from the interactions of individual building blocks, be they peptoids, inorganic nanoparticles or protein-based particles
- Probing how hierarchy unfolds as these building blocks are combined to construct lattices, active structures and hybrid materials
- Using machine learning, computational simulations and big data analytics to learn new ways to control the assembly dynamics of hierarchical structures

These investigations will build upon work conducted at the UW Institute for Protein Design, led by UW biochemistry professor and Howard Hughes Medical Institute investigator David Baker, and harness the expertise of researchers at the University of Chicago, the Oak Ridge National Laboratory and the University of California, San Diego.

The CSSAS effort was enabled by the Northwest Institute for Materials Physics, Chemistry, and Technology, or NW IMPACT, which was formally launched earlier this year by UW President Ana Mari Cauce and PNNL Director Steven Ashby to fertilize cross-disciplinary collaborations between UW and PNNL researchers. NW IMPACT co-director Jim De Yoreo, who is the PNNL chief scientist for materials synthesis and simulation across scales and also holds a joint appointment at the UW in both chemistry and materials science and engineering, will serve as the deputy director of CSSAS.

"This center's focus is ultimately on unlocking potential," said Baneyx. "Once we understand the fundamental rules governing the assembly of bioinspired building blocks, we will be able to design new materials to meet a broad range of technological needs."

ALUMNI UPDATES

DONOR SPOTLIGHT

Jay ('73 B.S. ChemE, '75 MBA) and Rosie Tomlin

By Kaitlin Colleary

Jay and Rosie Tomlin understand the burden of financing education first-hand. They both paid for college independently and recall how challenging it could be. The Tomlins do not have children, but they believe whole-heartedly in investing in young people. "We are very impressed when we talk to ChemE students about their experiences in class and research. It is commendable that they effectively use the gift of scholarship to give back to the world."

Jay and Rosie Tomlin with current Tomlin Scholar, Jackson Heffley

Jay began his studies in the UW ChemE department 50 years ago. The many fond memories from his student days include favorite classes such as Unit Ops and time spent with professors. Rosie grew up in Malaysian Borneo. At that time in her community, college opportunities were limited, but she was a bright student and worked hard in order to come to the U.S. and earn two college degrees.

Seven years ago, Jay and Rosie were working on their estate plans and decided to designate a future gift to the department. When they met with the Office for Planned Giving and the ChemE Advancement team to explore bequest options, they learned about how an endowed scholarship fund could benefit future ChemE students. After considering the options, they decided they wanted to see the impact of their giving during their lifetimes.

In 2011, they established the Tomlin Family Endowed Scholarship Fund and have since met all six Tomlin Scholars at the annual donor luncheon. One of the scholars has maintained contact with them — a delightful bonus to their philanthropy. The students Jay and Rosie have met over the years have inspired them to continue donating and growing the scholarship fund. Beyond the personal satisfaction they reap from philanthropy, they hope the ChemE students they support may also be inspired to give back one day.

50TH REUNION

ChemE Class of 1968 Returns to UW

ChemE department chair François Baneyx and professor John Berg greeted alumni from the Class of 1968 as they gathered to commemorate their 50th reunion in Benson Hall. In recognition of 50 years of accomplishments, Baneyx presented the alumni with commemorative "stoles of gratitude." The reunion was celebrated along with the ChemE graduation ceremony in June 2018.

Left to right: Chair François Baneyx, Don Jeter, Paul Boys, Thomas Temple, Paul Hendrickson, Thomas Spink, Charlie Sleicher, professor John Berg

Calling all members of the ChemE Class of 1969!

We hope you will join us for your 50th reunion, celebrated in June with the 2019 ChemE graduation. Come back to campus to reconnect with classmates, visit with faculty, and be formally honored during the graduation ceremony. An official invitation with all of the details will be mailed in early spring, but please contact Chloe DeWolf-Domingo, Assistant Director of Advancement, at *cdewolf@uw.edu* or 206-616-8310 with immediate inquiries.

2018 R. Wells Moulton Distinguished Alumni Awards

Since 1993, the Moulton Awards have recognized UW chemical engineering alumni who have made exceptional contributions in industry, academia, government or public service

DISTINGUISHED ALUMNUS IN ACADEMIA

Steven C. George ('95 Ph.D.)

©UC Davis Health

Steven C. George is a professor of biomedical engineering at the University of California, Davis. His current work focuses on creating tissue-engineered models of the cardiac, pancreatic, and cancer microenvironments using induced pluripotent stem cell and microfabrication technology. George is a fellow of the American Institute of Medical and Biological Engineering and the Biomedical Engineering Society. He has published more than 110 peer-reviewed manuscripts, and he recently co-founded two start-up companies: Kino Biosciences and Immunovalent Therapeutics.

Prior to moving to UC Davis in 2017, he spent 19 years on the faculty at the University of California, Irvine. There, he pursued a range of research interests including pulmonary gas exchange, lung mechanics, engineered tissue vascularization, and "organ-on-a-chip" technology. He was UCI's founding chair of the Department of Biomedical Engineering and the founding director of the Edwards Lifesciences Center for Advanced Cardiovascular Technology. In 2014, he moved to Washington University in St. Louis, where he chaired the Department of Biomedical Engineering.

George earned his bachelor's degree in chemical engineering from Northwestern University, his M.D. from the University of Missouri School of Medicine, and his Ph.D. in chemical engineering from UW.

DISTINGUISHED ALUMNA IN INDUSTRY

Jill Seebergh ('91 M.S., '95 Ph.D.)

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Jill Seebergh is a Senior Technical Fellow at Boeing with expertise in coating materials and processes, including adhesion and interface science, colloidal science and multifunctional coatings. In her current role, she provides leadership in the development and implementation of chemical technologies that improve aircraft safety and performance, while reducing manufacturing flow time and environmental impact.

Seebergh received a B.S. in chemical engineering from Lehigh University and an M.S. and Ph.D. in chemical engineering from UW. She represents Boeing on the International Advisory Board of the IntAIRCOAT International Networking Forum on Aircraft and Aerospace Coating and is a member of the Editorial Review Board for the *Journal of Coatings Technology and Research*.

Seebergh spoke at the 2018 UW chemical engineering graduation ceremony, which took place in Kane Hall. In her address, Seebergh fondly remembered her time in Benson Hall and with professor John Berg, and the unending inspiration she has received from her ChemE classmates. "My classmates turned into my best friends, and some even into my colleagues," Seebergh told the graduating class. "This community supported me through some of the most challenging times in my life: school, work, being a parent. I hope you look around you today and see a community that will be here to support you for the rest of your life."

DIAMOND AWARD FOR DISTINGUISHED ACHIEVEMENT IN INDUSTRY

Jud Virden ('83 B.S., '91 Ph.D.)

©Matt Hagen

Jud Virden, associate laboratory director at the Pacific Northwest National Laboratory (PNNL), received the UW College of Engineering's 2018 Diamond Award for Distinguished Achievement in Industry. The Diamond Awards honor outstanding alumni and friends who have made significant contributions to the field of engineering.

Through Virden's 26-year career at PNNL, he has developed world-leading partnerships to drive successful innovations in energy technology, transportation and other markets. In his role in PNNL's Energy & Environment Directorate, Virden leads 1,000 scientists, engineers and staff, and directs an annual budget of $235 million.

Virden played a major role in establishing the U.S. Department of Energy's anchor program on solid oxide fuel cells, helping develop viable energy products for industrial and commercial applications. He drove a public-private partnership with USCAR (Ford, GM, Chrysler) to create a $26 million emissions-reduction cost share program, and with Honeywell and other manufacturers on a $90 million cost share program for engine performance improvements. He also worked with the DOE to create the Grid Modernization Laboratory Consortium, which brings together experts to collaborate on R&D to transform the nation's electricity grid for the 21st century.

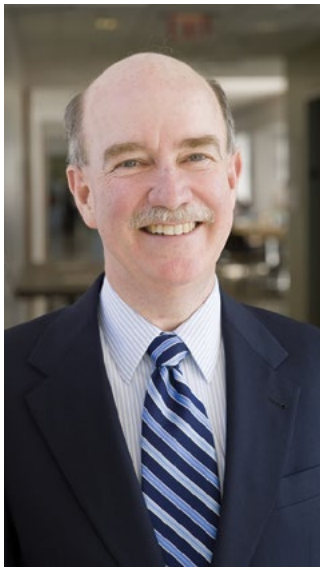
As a recognized expert in national energy policy, Virden has been called to testify before the Washington state legislature and the U.S. Congress on issues including energy storage and grid cybersecurity. He was elected as a member of the Washington State Academy of Sciences in 2014 and to its board in 2017. At UW, Virden is coordinating efforts with PNNL and the Clean Energy Institute to advance solutions in renewable energy.

2018 BRUCE A. FINLAYSON LECTURES

Robert C. Armstrong

Robert C. Armstrong, director of the MIT Energy Initiative (MITEI), presented the 2018 Finlayson Lectures in May. Named in honor of Bruce A. Finlayson, the Rehnberg Chair Professor Emeritus of Chemical Engineering at UW, the lecture series is now in its sixth year and features chemical engineers who demonstrate exceptional scholarship, teaching and service in their field.

Armstrong's first lecture focused on the challenges of decarbonizing electricity systems — and the technologies emerging to tackle those challenges — as global energy demand grows. The second presented the results of MITEI's Future of Solar Energy report. The report reflects on the current technical, commercial and policy dimensions of solar energy. Further, it makes policy recommendations regarding more effective support for R&D, technology demonstration and solar deployment.



Armstrong directs the MITEI, which links science, innovation and policy to transform the world's energy systems. A member of the MIT faculty since 1973, Armstrong served as the head of its chemical engineering department from 1996 to 2007. His research interests include energy, the rheology of complex materials and polymer fluid mechanics.

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INNOVATIONS IN TEACHING

Kitchen Engineering

By Lindsey Doermann

Cooking is an art and a science. And if you ask UW professors Lilo Pozzo and Nate Sniadecki, it's also the perfect window into a smorgasbord of engineering concepts.

Pozzo, of ChemE, and Sniadecki, a mechanical engineering professor, have created a culinary-focused freshman course called Kitchen Engineering to introduce students to fundamental concepts across all of the engineering disciplines. As UW freshmen can now be accepted directly into the College of Engineering, this new class can help them make the best choice from their menu of engineering options.

Pozzo said that developing this course made her think about how cooking — a personal interest of hers — relates to more than just chemical engineering. Colloids, her research focus, show up everywhere in the kitchen in the form of foams (e.g. whipped cream), emulsions (e.g. mayonnaise), smoke, and more. But chefs also need to know about the structure of muscle, as do bioengineers. And developing designs for stand mixers, microwaves, dishwashers and even efficient kitchen layouts are, at their core, engineering problems.

Pozzo and Sniadecki collaborated with area chefs to present their lectures. They designed the course so that one class per week featured cooking demonstrations, while the other dove deeper into the related engineering concepts. In the investigation of heat transfer, for example, chefs compared how cooking duck breasts differed by starting them skin up versus skin down. The results clearly showed how the skin, when facing down first, insulated the meat and prevented it from overcooking. At the same time, the fat rendered nicely and the skin crisped.

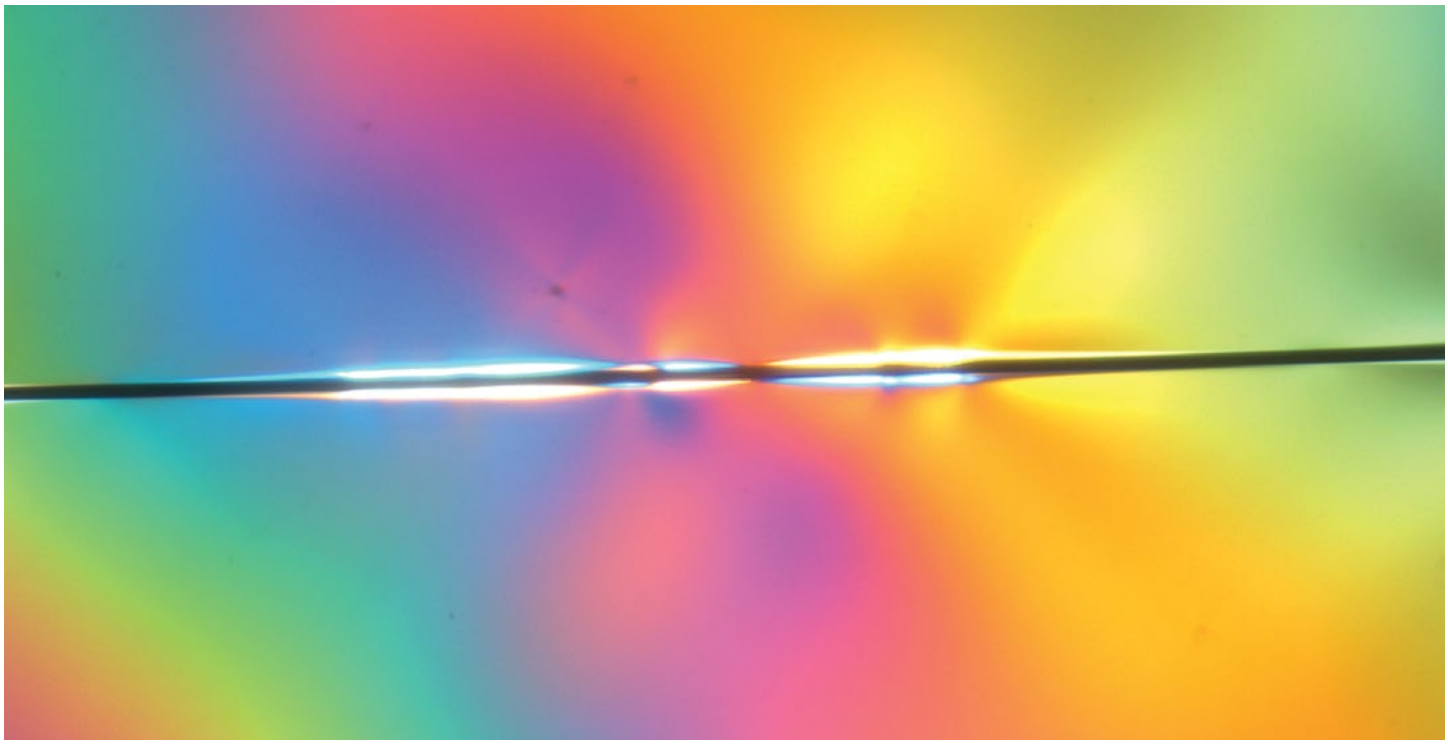
The professors won a Strategic Instruction Initiative award from CoE to develop Kitchen Engineering. The purpose of the award is to move the curriculum toward more project-based learning to engage first- and second-year students. They debuted the course in spring 2018 with an enrollment of 36 and hope to offer more spots in the spring 2019 class.

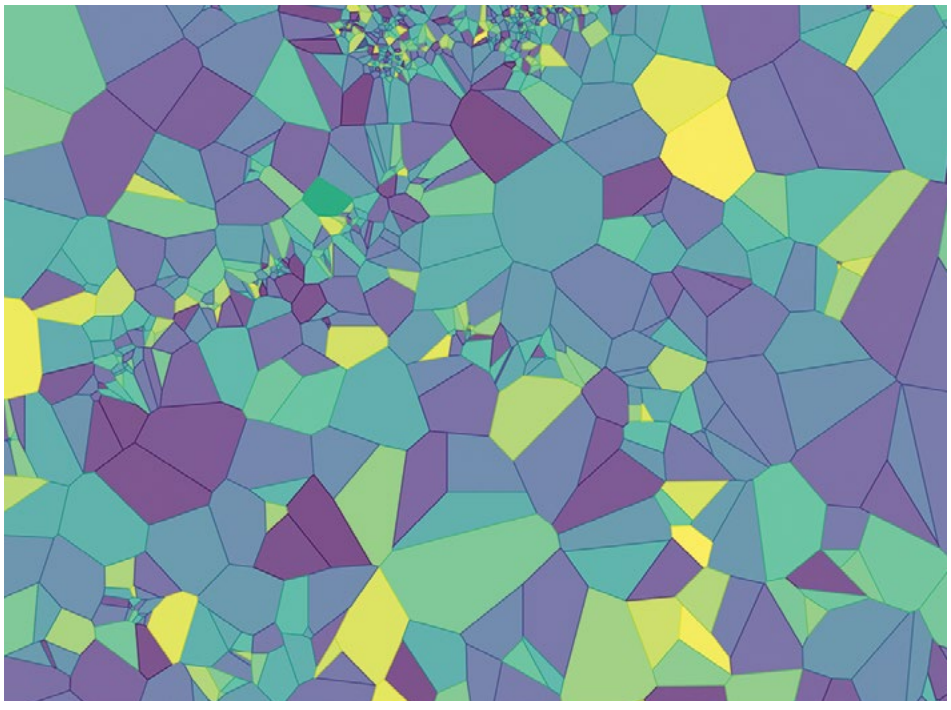
Just imagine the outcome: college freshmen who have enthusiasm for engineering — and know their way around a kitchen.

Students Transform Science into Art

By Stephanie Ashby

In April, UW ChemE held its third annual Science and Engineering as Art competition, and the winners were announced at the department's annual Awards Day ceremony. This year's entries included images of skin cells, brain tissue, plasma, polymers and nanoparticles, all generated through student research and experiments in chemical engineering.





FIRST PLACE

Where the Light Is

By Luke El Khoury

This image **(top)** results from shining cross-polarized light through a single carbon fiber within an epoxy matrix. The rainbow colors come from the strain fields within the matrix. Carbon fibers are as strong as metals but much lighter. Their many uses range from sports equipment to airplane parts. Luke experiments with how to make these materials stronger, lighter, cheaper and easier to produce.

SECOND PLACE

Brownian Motion Stained Glass

By Chad Curtis

This heat map **(bottom left)** shows where nanoparticles are moving faster (yellow) and slower (purple) through a brain slice. Chad is using tools like these to help find improved treatments for childhood brain diseases and injuries.

THIRD PLACE

Quantum Fire

By Brittany Bishop

This piece **(bottom right)** depicts nanomaterial powders dissolving into a solvent under ultraviolet light. At the nanoscopic scale, different-sized particles of the same material will emit different colors, resulting in the effect shown. Brittany is working on creating more-efficient materials — fluorescent nanomaterials, in particular — which can be used in biological imaging, LEDs, solar cells and more.

Honors & Achievements

ChemE Undergraduates Named to the Husky 100

2018 graduates **Amanda Levenson** and **Chester Pham** were chosen as members of the Husky 100 for actively connecting what happens inside and outside of the classroom and applying what they learn to make a difference on campus, in their communities and for the future. The selection process this year was highly competitive, with more than 1,700 nominations and nearly 600 applications from all three UW campuses.

Pontes Wins Selective Research Fellowship

Hugo Pontes, a junior in ChemE, has been named a 2018-2019 Washington Research Foundation Fellow, which will allow him to expand on his research in professor Elizabeth Nance's lab. His project applies the lab's data science tools with data collected from living tissue to understand how specific changes in brain microstructures can be used to predict functional outcomes. Hugo was previously a CoMotion Intern (CoMotion is UW's innovation hub), and in collaboration with professor Lilo Pozzo, has been an active participant in recovery efforts in Puerto Rico following Hurricane Maria.

Campus, State and National Recognition

Sarah Alamdari (Pfaendtner group) won an NSF Graduate Research Fellowship • **Alder Strange** (DeForest group) was honored as the UW President's Junior Medalist • **Brittany Bishop** (Holmberg group) was accepted to the 2018 Washington STEM cohort of STEM Youth Super Advocates • **Andrew White** (formerly of the Jiang lab) won an NSF CAREER Award

2018 ChemE Department Honors

Faculty Lecture Award: **Steven Adelmund**
High Impact Publication Award: **Erjin Zheng**
McCarthy Award for Excellence in Graduate Student Teaching: **Yanbo Qi** and **Griffin Ruehl**
Graduate Student Symposium Best Poster Presentation: **Jac Clark**
Graduate Student Symposium Best Oral Presentation: **Brian Gerwe**

Chemical Engineering Leadership Seminar Series

For 12 years, the Leadership Seminar Series (LSS) has provided ChemE students with the opportunity to learn from alumni leaders whose careers have spanned many industries and sectors. Through their lectures, alumni offer students helpful insights, lessons learned and advice for succeeding in today's professional working environment. LSS explores the depth and breadth of a ChemE degree and the careers that follow. Thank you to the alumni who participated in the 2018 LSS!

Ian Chang ('83 B.S.)
VP, China Operations & Business Development, Boeing

Zach Girod ('14 B.S)
Process Engineer, Emerald Performance Materials

Inne Leung ('11 B.S.)
Associate Scientist, Zymogenetics

Rick Hyman ('78 B.S.)
VP of Business Development, NVIDIA

Erik Byers ('94 B.S.)
Senior Technology Director of NAND Process Integration, Micron

Mark Borysiak ('16 Ph.D.)
Data Scientist, Starbucks

Heather Milligan ('13 B.S.)
Refinery Clean Products Scheduler, Phillips 66

Andy Walker ('96 B.S.)
CEO, Jewel Biotherapeutics

WOMEN IN CHEMICAL ENGINEERING

3rd Annual Fall Industry Panel

Women in Chemical Engineering (WChE), founded in January 2016 by UW ChemE professor Elizabeth Nance with several graduate and undergraduate students, hosted its 3rd Annual Fall Industry Panel on November 8, 2018. The event focused on facilitating prospective and current chemical engineering students' understanding of career paths in a variety of fields.

Fourteen panelists from a wide range of companies provided advice and insights into tech, energy, biopharma, and data science careers, and discussed B.S., M.S., and Ph.D. degree paths toward industry. The event featured two keynote speakers — Marvi Matos of Blue Origin and Andy Walker of Jewel Biotherapeutics — who regaled the more than 200 attendees with stories and lessons learned throughout their dynamic careers. The evening also had multiple refreshment breaks, dinner and a happy hour to facilitate networking amongst attendees and panelists.

Corporate, individual and organizational sponsors contributed a total of more than $8,000 to the event. WChE and the Industry Panel Planning Committee, chaired by junior Bri Stokes, are thankful for the support of volunteers, panelists, sponsors and attendees, and are excited to see what is in store for the 4th Annual Fall Industry Panel in November 2019!

For more information about WChE and the Industry Panel, visit *wcheuw.com*. If you or your organization would like to sponsor or be involved in next year's panel, please contact WChE faculty adviser Elizabeth Nance at *eanance@uw.edu*.

Above: Panelists Marvi Matos, Andy Walker, Anne Marie Ou, Natalie Winblade Nairn, Erik Byers, Sara York. Photos by Brittany Bishop. **Below:** Panel moderators Emily Rhodes (undergrad), Mike McKenna (grad), Deana Crouser (undergrad), Monica Esopi (grad), Stephanie Ford (undergrad), Steve Adelmund (grad), Harrison Sarsito (undergrad), Eugene Sim (undergrad). Photo by Lindsey Doermann

FACULTY SPOTLIGHT

Vincent Holmberg is charting a new course in nanomaterials teaching and research

By Lindsey Doermann

If one were to poll students on their favorite classes, quantum mechanics might not rise to the top of the list. Unless perhaps they took Vincent Holmberg's Quantum Mechanics for Chemical Engineers course. Holmberg, a ChemE assistant professor who studies inorganic nanomaterials, developed the class during his first year in Seattle and received a 5.1 out of 5.0 teaching rating for it in fall 2016. In addition, his newly-developed graduate-level Nanomaterials Chemistry and Engineering course was recognized by the Dean's Office as one of the most highly rated courses in the entire College of Engineering in spring 2016. And those represent just half of the courses he has been involved with since his arrival.

Holmberg joined the ChemE faculty in 2015 and wasted no time in setting up ambitious research, teaching and outreach activities. With research, he's engineering the properties of functional nanomaterials that have the potential to be manufactured in a scalable, cost-effective manner. When it comes to batteries, his lab is working to better understand and control the phase transformations, interfacial reactions, and other fundamental processes that occur when you charge and discharge a battery. They are studying the effects of chemical additives, controlled surface chemistry, and engineered electrode morphology in an effort to improve energy storage capacity, charge/discharge rates, and battery longevity.

Holmberg is also engineering functional luminescent and plasmonic nanostructures that can be used to manipulate light for energy harvesting, medical diagnostics and display technologies. He and his colleagues are also excited about upcoming work that "flips the script" and uses light to control, manipulate and produce novel nanomaterials.

Back on the educational front, Holmberg and his graduate student Elena Pandres worked with students and faculty from five departments last summer to help construct a portion of the brand-new Research Training Testbed facility in the Nanoengineering & Sciences Building. The space **(above)** serves as a state-of-the-art clean-energy research facility, where he and his colleagues can also run their new Energy Materials, Devices, and Systems lab course. In the class, students get hands-on experience with clean tech from the molecular scale all the way up to the grid level, doing everything from fabricating thin-film solar cells to building electrical grid simulations. After all the hard work, Pandres showcased the new lab space with a battery technology demonstration for Governor Jay Inslee and Provost Mark Richards in early August.

Holmberg's propensity for inspiring others to think on the nanoscopic scale goes well beyond the classroom. His group is highly committed to STEM outreach, and in an effort spearheaded by graduate student Brittany Bishop, his lab members participated in more than 25 outreach events in the past year. They created demonstrations of quantum dots, wind power, and electromagnetism, and ran them in K-12 schools, at maker faires, and in STEM expos in the greater Seattle area.

To put it simply, Holmberg not only wants to do his own cool science, but he also wants to support others' creative research efforts. He serves as the official Hertz Foundation University Representative for UW and runs regular fellowship information sessions for interested students. He also recently helped the Washington Research Foundation launch its WRF Postdoctoral Fellowship program in an effort to attract new research talent to the state.

He finds UW and the ChemE department an ideal place to accomplish his goals. "I have fantastic colleagues across the department and campus," he says, "and the department is focused on giving students a great education." Quantum mechanics and materials chemistry included.

Daniel Schwartz wins highest U.S. award for STEM mentors

By Suzanne Offen

Daniel Schwartz, professor of chemical engineering and director of the Clean Energy Institute, has received the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring from the White House Office of Science and Technology Policy and the National Science Foundation. The OSTP and NSF recognized Schwartz for his commitment to interdisciplinary graduate education — helping students apply their research to societal and market needs — along with his dedication to recruiting and supporting Native American STEM (science, technology, engineering and mathematics) scholars at the UW.

"I'm proud to join this cadre of dedicated educators and mentors helping students become leading scientists and engineers," said Schwartz. "Focusing on clean energy science, engineering and resource management at UW has brought top students from across the country to Seattle, where they have partnered with Northwest tribes and businesses to ensure the future of energy is being created here."

Starting in 2007, Schwartz launched an NSF-funded interdisciplinary graduate training program that used tribal clean energy research partnerships to attract top Native American students to graduate degree programs in UW's College of the Environment and College of Engineering. The program was continued and expanded in partnership with Washington State University and Salish Kootenai College with U.S. Department of Agriculture funding, eventually including an undergraduate summer research experience program. Since the program launched, 26 students have completed doctoral degrees, with four awarded to Native Americans and four to other underrepresented minorities. Six masters have also been awarded — including two to Native Americans — and a tribal student-led startup company was founded. A signature achievement was the 2016 Alaska Airlines flight from Seattle to Washington, D.C. on fuel partially made from tribal forest thinnings.

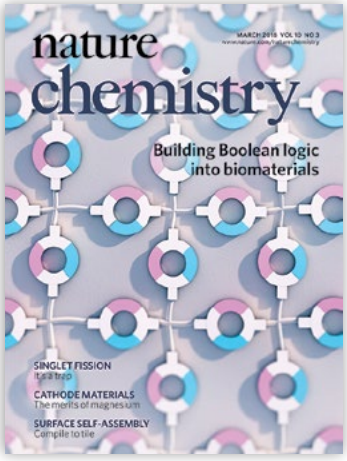
"When you take into consideration the low number of Native Americans succeeding in graduate school STEM programs, you must recognize the number of tribal scholars that Dan has helped succeed, in one way or another," said UW doctoral student Laurel James. "I, for one, would not be where I am today without his mentorship and opportunities for employment as I worked my way through the majority of my Ph.D. as a single parent."

While in Washington, D.C., to receive the award, Schwartz and other recipients participated in the White House State-Federal STEM Summit to identify educational priorities for the nation.

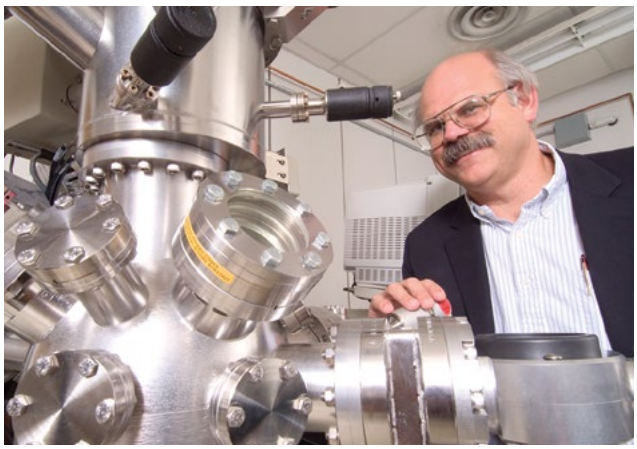
Top Billing for ChemE Research

The DeForest Lab landed two papers on journal covers in early 2018. In a *Nature Chemistry* study, ChemE assistant professor Cole DeForest and colleagues described a new method of highly targeted drug delivery. Their strategy exploits hydrogel biomaterials that release entrapped therapeutics in response to user-specified physiological conditions following Boolean logic.

In *Nature Reviews Materials*, DeForest and graduate student Emily Ruskowitz surveyed how light-responsive reactions can be applied to controlled drug delivery and tissue engineering.



DAVID CASTNER HONORED WITH TOP RESEARCH AWARD



UW ChemE professor David Castner has received the American Vacuum Society's highest research honor, the Medard W. Welch Award. The society recognized Castner "for leading advances in rigorous and state-of-the-art surface analysis methods applied to organic and biological samples." Established in 1969, the award consists of a cash prize, medal, plaque, and honorary lectureship at the AVS International Symposium. Three UW ChemE faculty have now achieved this honor.

Castner accepted the award — one of the highest in the surface analysis field — at the AVS Symposium in October. In his remarks, he thanked students and staff who have supported his work. And he commended his wife, Beverly, for encouraging him to undertake an undergraduate research project despite his singular focus on swimming. After all, he said, "you are only allowed to compete in an NCAA sport for four years, so you need something to do once your eligibility ends!"

Castner's involvement with AVS began when he was a grad student. "This award means a lot to me because AVS has been my main society throughout my career," he said. He has worn many hats at the society, serving as president, sitting on the board of directors and running conferences. He is one of only two people to earn both their highest service and research awards.

In addition to his role in ChemE, Castner is a joint professor of bioengineering and co-director of NESAC/BIO, whose core projects are aimed at advancing state-of-the-art surface analysis in biology and medicine. Among his many honors, Castner also recently received the 2017 ECASIA Award from the European Conference on Applications of Surface and Interface Analysis for the impact he's had on the field throughout his career.

When he has some free time, Castner can be found working on one of his classic cars or fishing for steelhead, salmon and halibut in the Pacific Northwest.

Evans Term Career Development Professors Named

The department is pleased to announce James Carothers and Cole DeForest as the recipients of the Dan Evans Term Career Development Professorships in Chemical Engineering. The professorships (subject to administrative approval) offer three years of support for early-career core faculty members to explore new avenues for research and professional development.

Dan Evans ('66 B.S.), a native of Longview, Washington, went on from ChemE to work for Standard Oil and earn an MBA from the University of Oregon. He then transformed his father-in-law's local plumbing contractor from a 5-person company to one of the largest specialty contractors in the country. He received ChemE's Moulton Distinguished Alumnus Award in 2012.

James Carothers

Cole DeForest

Venkat Subramanian was named a Fellow of The Electrochemical Society • **Lilo Pozzo** won the UW CoE Faculty Award for Teaching • **Jonathan Posner** and colleagues won the UW CoE Team Award for Engineering Innovation in Health • **Elizabeth Nance** earned the Seattle Association for Women in Science Early Career Achievement in STEM Award • **Shaoyi Jiang** gave the Dvorak Lecture at the Czech Academy of Sciences • **Hugh Hillhouse** received $1.5M from the U.S. DOE for work on machine learning for perovskite photovoltaics

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CATALYST | FALL 2018

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College of Engineering Advancement

Send comments and address corrections to
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MASTER OF SCIENCE IN CHEMICAL ENGINEERING

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