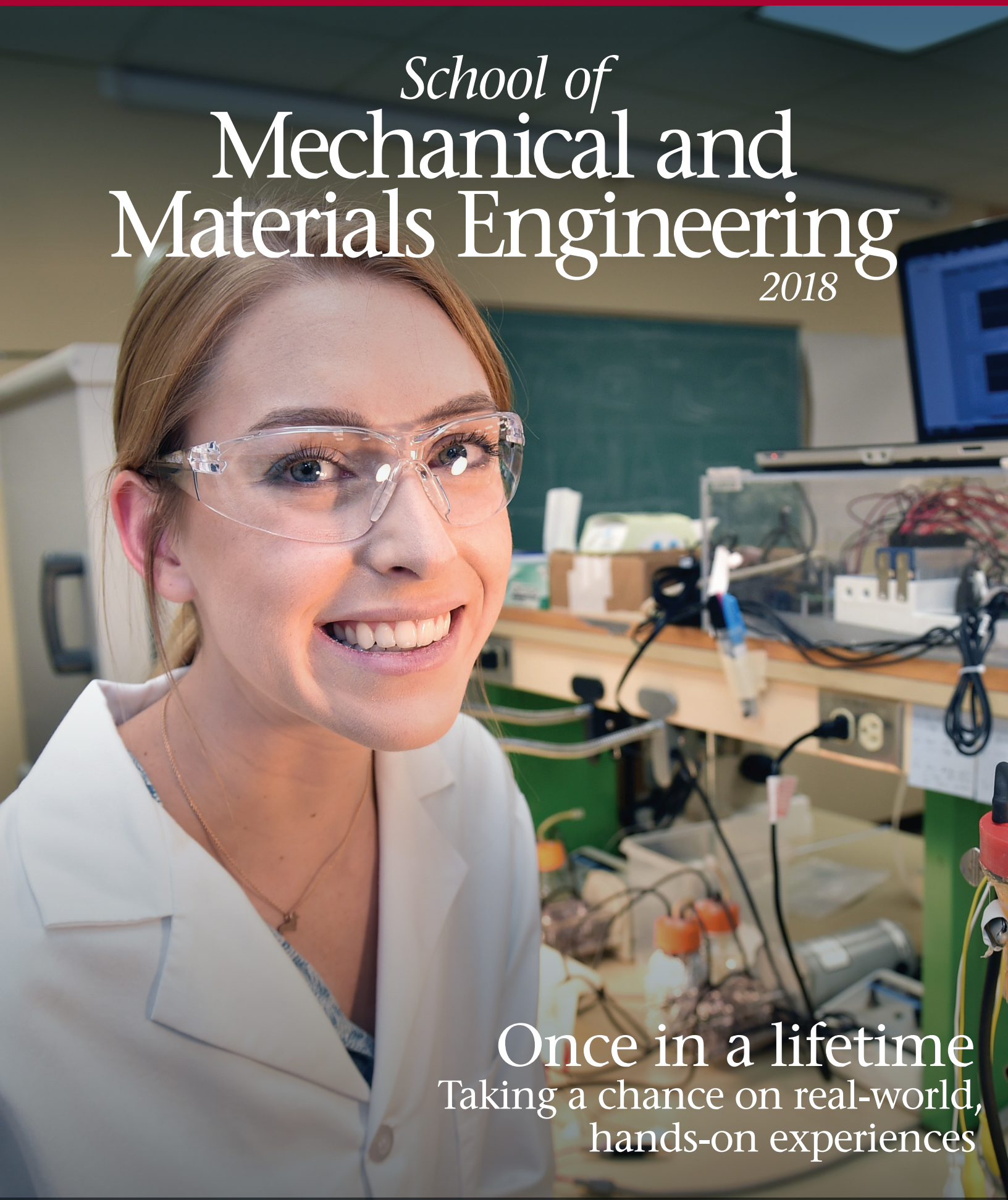

# *School of* Mechanical and Materials Engineering

*2018*

## Once in a lifetime

Taking a chance on real-world, hands-on experiences

WASHINGTON STATE UNIVERSITY

# Director's Message

Dear alumni and friends,

I feel privileged to have recently assumed the position of director of the School of Mechanical and Materials Engineering (MME). We have much to be proud of, and we hope to move the school forward in all aspects of its engagement in the coming years. The two most important areas where we will seek significant enhancements in the next few years are in the employment outcome of our graduating students and our research engagement.

Over the past decade, our school has seen tremendous growth, as our program has expanded both in numbers and across the state to Bremerton and Everett. Our undergraduate student population is the largest in its history, and our graduate student and postdoctoral researcher populations are also growing, underpinned by continuously increasing annual research expenditures.

We have an awesome legacy to follow. Our school has been fortunate to have had luminaries like Clarence Zener and John Hirth associated with it, eminent past directors like Stephen Antolovich and O. A. Plumb, two current members of the National Academy of Inventors and the Washington State Academy of Sciences, and 17 fellows of professional societies. We are committed to chart a course to build and improve on this legacy.

During the past five years, several outstanding faculty members have joined the School of MME. We have strong research activities in additive manufacturing; materials engineering with applications spanning over nuclear materials, bio-implants and microelectronics, among others; control systems; energy systems including batteries, fuel cells, and hydrogen power for space-flight; sports engineering; and mechanics and thermo-fluid applications in traditional and emerging areas. Over the next few years, our aim is to strategically add to this expertise so that our undergraduate and graduate students are exposed to areas of current importance and are highly sought after as employees or graduate students.

It's an exciting time in Washington state and the region as high-tech industries are thriving, and demand for engineers is high. I greatly look forward to moving our programs forward in training our students for these high-tech, emerging industries and to better meeting the needs of the twenty-first century workplace.

Thank you for your strong and continuing support of the school.

Indranath Dutta
Director

## Advisory Board



**On the cover:** Roslyn VanSickle made the most of her opportunities at WSU. See story, page 3.

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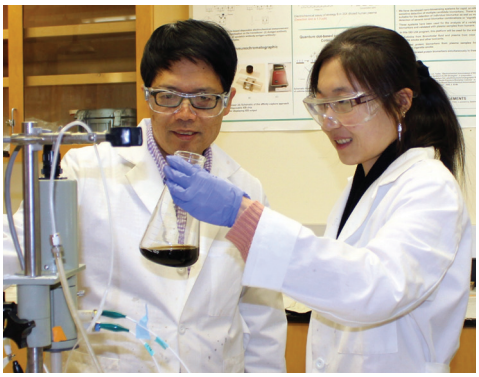
School of Mechanical and Materials Engineering researchers are working to create a sustainable energy future, to apply technology to preserve our quality of life, and to educate tomorrow's innovators.

# Water-splitting for a future hydrogen economy



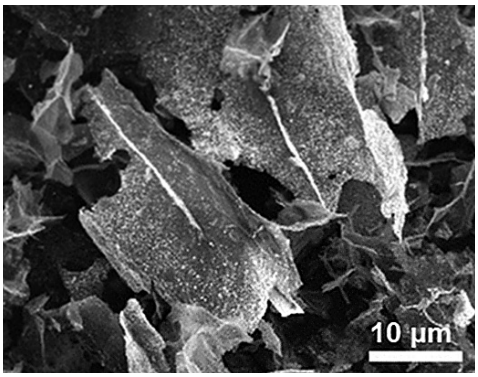
Researchers can create large amounts of inexpensive nanofoam catalysts that can facilitate the generation of hydrogen on a large scale by splitting water molecules.

Washington State University researchers have found a way to more efficiently generate hydrogen from water—an important key to making clean energy more viable. Using inexpensive nickel and iron, the researchers developed a very simple, five-minute method to create large amounts of a high-quality catalyst required for the chemical reaction to split water. They describe their method in the journal *Nano Energy*.

Energy conversion and storage is a key to the clean energy economy, and one of the most promising ideas for storing renewable energy is to use the excess electricity generated from renewables to split water into oxygen and hydrogen. In their work, the researchers, led by professor Yuehe Lin, used two abundantly available and cheap metals to create a porous nanofoam that worked better than most catalysts that currently are used.

The WSU researchers collaborated on the project with researchers at Advanced Photon Source at Argonne National Laboratory and Pacific Northwest National Laboratory. The collaborative work was funded by a WSU startup grant and by the U.S. Department of Energy. ∎

# Improving sodium-ion batteries




Scanning electron microscope images of tin oxide graphene hybrid materials for sodium-ion batteries

Sodium-ion batteries might soon provide a less expensive, viable alternative to lithium-ion batteries thanks to research developed at Washington State University. The new technology also would help solve material sustainability issues by alleviating the mining of lithium—a diminishing resource. Led by professors Min-Kyu Song and Yuehe Lin in the School of Mechanical and Materials Engineering, the researchers used tiny tin oxide nanocrystals supported on a graphene structure to vastly improve the battery. The technology also could be used in lithium-ion batteries, making it more attractive for manufacturing. They recently published their work in the journal *Nano Research*. The researchers also worked with Xiaolin Li, a staff scientist at the Department of Energy's Pacific Northwest National Laboratory, who provided expertise on cathode materials. ∎

# Bone growth improved with curcumin

Bose's team found that curcumin from the spice tumeric improved bone-growing capabilities by 30–45 percent.

A WSU research team is bringing together natural medical cures with modern biomedical devices in hopes of bringing about better health outcomes for people with bone diseases.

In this first-ever effort, the team improved bone-growing capabilities on 3D-printed, ceramic bone scaffolds by 30–45 percent when coated with curcumin, a compound found in the spice, turmeric. They have published their work in the journal, *Materials Today Chemistry*.

The work could be important for the millions of Americans who suffer from injuries or bone diseases like osteoporosis. Turmeric has been used as medicine for centuries in Asian countries, and curcumin has been shown to have antioxidant, anti-inflammatory, and bone-building capabilities. The work, funded by the National Institutes of Health, is led by Susmita Bose, Herman and Brita Lindholm Endowed Chair in the School of Mechanical and Materials Engineering. ∎

# Research Updates

**Regents Professor Hussein Zbib** is collaborating with Rahul Panat of Carnegie Mellon University on a 3-year National Science Foundation grant for work on a breakthrough additive manufacturing method for high-strength lightweight 3D micro-architectured materials. The researchers developed a unique, 3D manufacturing method that for the first time rapidly creates and precisely controls a material's architecture from the nanoscale to centimeters—with results that closely mimic the intricate structure of natural materials like wood and bone. The work has many high-tech engineering applications. The research will also involve the development of multi-scale mechanical models that consider the effect of microstructures and length scales specific to additive manufacturing.

**John Swensen** received a 3-year National Science Foundation grant for smart material composites and the design of internal structural geometry for tunably-compliant soft robots. In many biological systems, animals are able to change their soft tissue stiffness through muscle contractions and modification of internal fluid pressures. This project will show researchers how to use controllable compliance in robotic components to obtain the benefits of soft materials—adaptability, fault tolerance, and safety—while also providing greater force and manipulation capabilities. The results could have a wide range of applications, including in-home health care, medical interventions, factory automation, and disaster response.

**John McCloy and Scott Beckman** received a $1.74 million grant from the Department of Energy's Office of River Protection to develop fundamental understanding of glass nuclear waste forms for the Hanford Waste Treatment Plant in Richland, Washington. The formation of the mineral, nepheline, is a fundamental impediment to the successful adoption of some glass formulations for treatment of nuclear waste. As part of this effort, the researchers are investigating ancient glass materials that have aged in natural environments for hundreds to thousands to millions of years. Study of these materials and their alteration over time will lead to better models for glass durability and could result in significant cost savings by avoiding over-engineering of multi-barrier waste repositories.

**Dustin McLarty** received a $678,000 grant from the U.S. Department of Energy's Advanced Research Projects Agency-Energy to further hybrid power systems research. By developing hybrid power systems using pressurized solid oxide fuel cells, McLarty's proposed system design will increase the flexibility and lower costs while still exceeding the DOE's efficiency targets. If successful, this new hybrid power system would bridge the natural gas powered energy industry of today with the all-renewable energy systems of the future. "The difference between a traditional fuel cell and the solid oxide fuel cell is what you can do with it, such as coproducing hydrogen and natural gas," McLarty said. "This makes it a technology that works as a generator today and grid scale energy storage for renewable energy in the future."

# 2018 Awards and Fellowships

### Amit Bandyopadhyay
Herman and Brita Lindholm Endowed Chair

Elected to Washington State Academy of Sciences

### Susmita Bose
Herman and Brita Lindholm Endowed Chair

Elected Fellow, Materials Research Society
Elected Fellow, National Academy of Inventors
Elected Fellow, ASM International
Elected to Washington State Academy of Sciences

### Yuehe Lin
Professor

Listed in Clarivate Analytics' Highly Cited Researchers list

### John McCloy
Professor

Elected Fellow, American Ceramics Society
Received Richard M. Fulrath Award, American Ceramics Society

### Marvin Pitts
Clinical professor

Received WSU Sahlin Faculty Excellence Award for Leadership

### Hussein Zbib
Professor

Promoted to WSU Regents Professor

The School of Mechanical and Materials Engineering offers students opportunities both in and outside the classroom. Our students earn an experience-enhanced education that prepares them to graduate work-ready on day one.

# Once in a lifetime

Roslyn VanSickle has taken advantage of many of the unique opportunities Washington State University offers its students. She has participated in study abroad, research, internships, and entrepreneurship programs. We asked the bioengineering and mechanical engineering double major how these experiences helped her over the course of her academic career, and what advice she has for students to make the most of their time at WSU.

## Research:

"There are research opportunities available beginning freshman year. There's also financial help. When I researched in North Carolina, the program paid for my trip there, my stay, and my trip back, so there was no reason for me NOT to research."

"I say, 'Just do it!'"
—Roslyn VanSickle

## Internships:

VanSickle interned at Schweitzer Engineering Laboratory. "You have to ask questions. These opportunities are learning experiences and those around you want to teach you," she said.

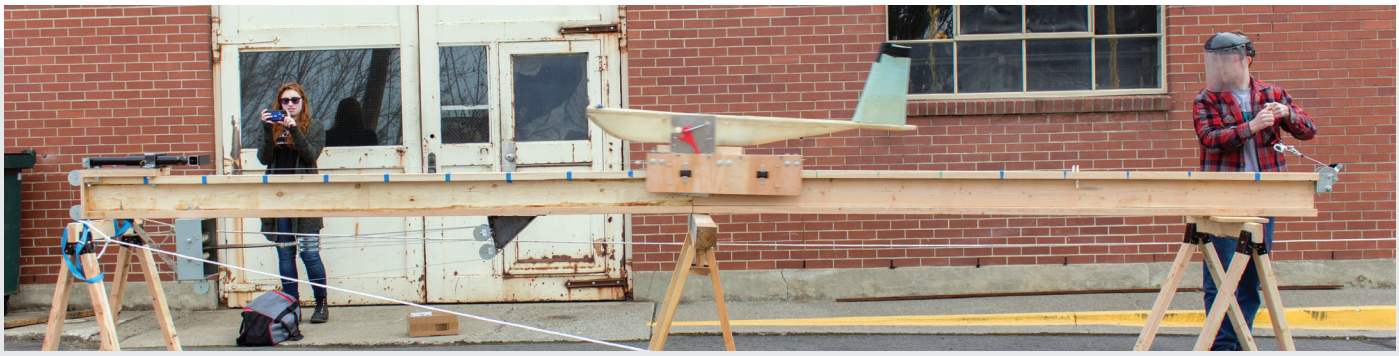
## Student clubs:

VanSickle served as an officer for WSU's student chapter of Society of Women Engineers. "You learn a lot when you're in a club. I learned how to manage my time and how to prioritize so I could be more involved with the activities I was passionate about."

## Entrepreneurship:

VanSickle participated in the Harold Frank Engineering Entrepreneurship Institute, which combines engineering and entrepreneurship with a year-and-a-half long program that starts during the middle of the junior year. "One of the main takeaways is to be persistent and to believe in what you're doing wholeheartedly. I also learned how to take constructive criticism and know when to apply it." As part of the program, the group made a visit to Google headquarters.

# A hands-on introduction to real-world work



A senior design project to build a drone launcher to help track endangered African wild dogs. The students worked with the Painted Dog Research Trust and with MME advisory board member, Gene Jones, on the project.

The School of MME's unique Industrial Design Clinic program provides project-based, experiential learning for students as they work on real-world projects in their capstone senior design classes.

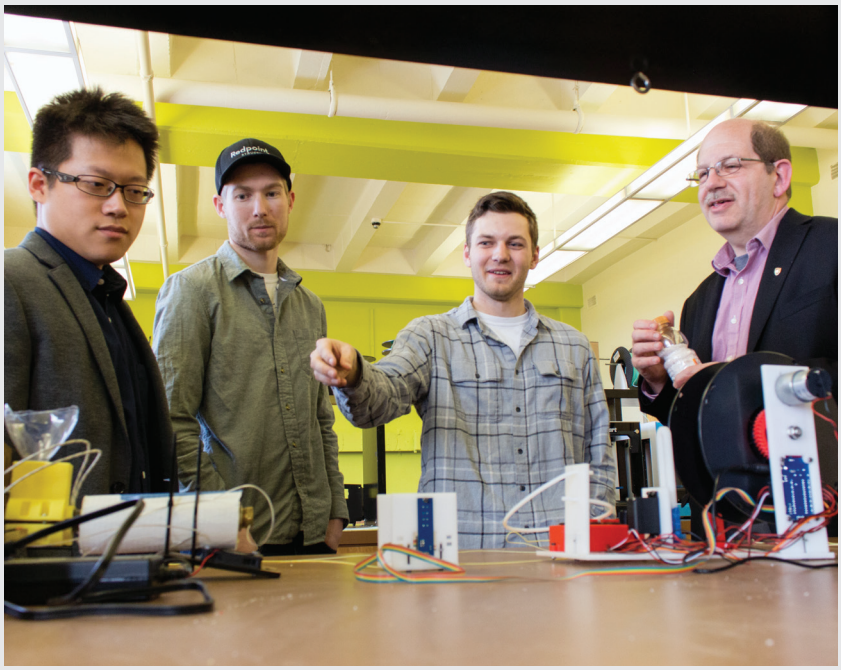
Led by Chuck Pezeshki, director of industrial engagement for the Voiland College of Engineering and Architecture, students have completed more than 300 real-world projects with support and funding from industry partners around the region since the program was established in the 1990s.

As part of the projects, the students follow project delivery timelines, design and deliver product prototypes, and professionally present their work to their clients.

> "The idea embodied in the class is that every student, in the context of a team, will complete an industry ready project."
> —Chuck Pezeshki

Funds from the program, which come from companies, nonprofit organizations, and government entities, support engineering student clubs, participation in student competitions, and the clinic's operations. ∎

# Recycling in 3D



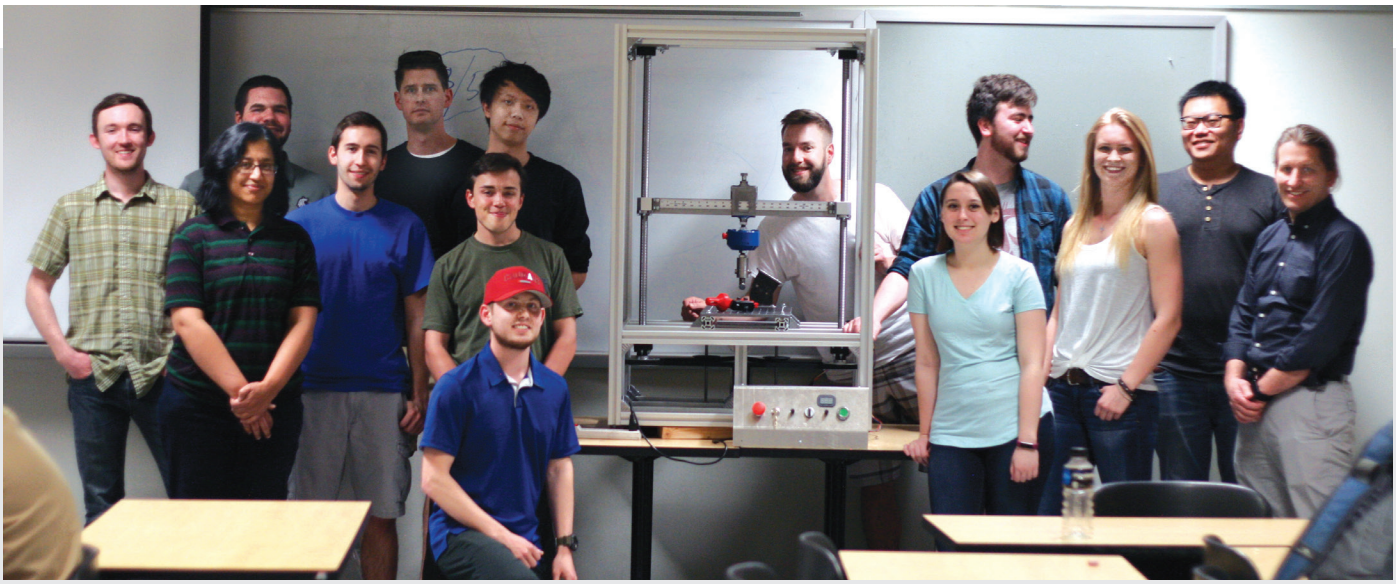
Students developed a unique idea for recycling plastic for use in 3D printers, pictured with Bruce Wollstein (far right), who supported the project.

WSU's 3D Printing Club is working to develop a recycling program to create 3D-printable filament. The students are building a 3-phase recycling process that includes shredding plastic materials into small pellets for melting; extruding the pellets into 3D-printable, consistently-sized filament; and spooling the filament for printing.

The group was one of three student clubs, including WSU Everett's Mars Rover Team and the Formula SAE Wazzu Racing Team, to receive a grant to develop their project from the Bruce and Barbara Wollstein Endowment in Engineering. Applying for the grant allowed the students to gain real-world skills in presenting their ideas in a competitive, entrepreneurial process.

The 3D Printing Club hopes to eventually work with WSU to set up collection depots to supply the school with cheap filament for all its workspaces. ∎

# Donors support unique student project



Senior capstone students designed a load frame for future classes. The project was supported by alumni and donor gifts.

Dave Torick, an instructor in the School of Mechanical and Materials Engineering, was considering buying a new and expensive load frame for his computer-aided design (CAD) class when he had an idea: why not let the students build it?

So, he asked his senior engineering design students, organized in teams, to build a load frame prototype. A load frame is a structure that allows engineers to test forces on their prototype projects.

The students' project will enable future engineering students to move through the design process faster and more efficiently. They will be able to design, build, and test all in the same room.

The project also provided valuable engineering experience for the current students. The engineering professors acted as customers and challenged the students to see the process as more than a school assignment. Each team developed a load frame design, and one group's project was chosen to be built.

"The project gave students the chance to solve a real-world challenge and the opportunity to walk into a job interview with a meaningful project under their belts," said Torick.

The project came about with significant support from alumni and donors. Engineers from Metrigard, a local company that manufactures and sells machinery, came into the classroom to offer guidance. The students also received help from Kurt Hutchinson, senior instructor, and Robert Lentz, assistant for facilities. Jerry Knoben ('84, Materials Science & Engineering) retired vice president of hardware manufacturing at Microsoft, provided support for additional improvements and updates in the CAD lab.

> "Collaboration is the most important thing for these students to learn because every novel idea begins with discussion."
> —Dave Torick

"The level of support that we have seen is fantastic," said Torick.

Torick hopes to continue teaching the class in future semesters, with more challenging opportunities to engage students, alumni, and local industry leaders. ∎

## 2018 Student Awards

**Mostafa Ahmadzadeh**
Roy G. Post Foundation Scholarship

**Carl Bunge**
NASA Space Grant Fellowship

**Martinus Dewa**
Fulbright Doctoral Award Scholarship

**Kevin Estelle**
National Science Foundation Graduate Research Fellowship

**Christian Ziruk**
Winner, MasterCam Wildest Parts Competition

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Cougs and former Pullman residents bring Cougar Pride to Pyeongchang, Korea while delivering on the first VR experience of the Winter Olympics. L-R: Martin Andersen, Jay Jayaram, Blake Rowe, Ritesh Kale, and Dean Throop.

## From the WSU VR Lab to the Olympics

**This year's Olympics and NCAA Final Four championship games featured immersive virtual reality technology first developed at WSU.**

**As professors at WSU from 1993 to 2015, Sankar and Uma Jayaram researched and developed virtual reality technology. The couple started WSU's Virtual Reality and Computer Integrated Manufacturing Lab (VRCIM) and made seminal contributions in virtual reality applications in engineering design and manufacturing.**

**They went on to develop their pioneering technology and to start their company, 3D-4U, hiring many WSU graduates who had been trained in the VRCIM. The Jayarams' company was purchased by Intel in 2016.**

**The Jayarams returned to the WSU campus this spring to recount their story as part of the Voiland College of Engineering and Architecture's Lanning Lecture.**

**Please support the School of Mechanical and Materials Engineering**

**mme.wsu.edu/giving**