the Center for Advanced Surface Engineering

RESEARCH
EDUCATION
ECONOMIC DEVELOPMENT

Arkansas NSF EPSCoR
Summer 2016 Newsletter

The Center For Advanced Surface Engineering

CASE
A new collaboration between higher education, government and industry, working together to:

» Reduce costs and environmental impact of manufacturing

» Improve recovery for brain trauma patients

» Design better filters from forestry byproducts

» Develop new surface materials with adjustable properties

» Build the nation's first statewide high performance cloud

» Train the next generation of scientists and STEM skilled workers

Visit arkepscor.org for more info about CASE

LOOK FOR THIS MICROSCOPE THROUGHOUT THE NEWSLETTER TO FIND FUN EXPERIMENTS AND ACTIVITIES!

THE JOURNEY OF EPSCoR

The National Science Foundation (NSF) established EPSCoR in 1979 because Congress was troubled by the uneven distribution of federal research and development grants. After World War II, federally funded academic research grew dramatically, but national science policy at the time tended to funnel resources to a small number of institutions. Funding was distributed toward the few states and institutions that had historically benefited, which ignored the dramatic growth in regional educational and research institutions.

EPSCoR, which stands for "Experimental Program to Stimulate Competitive Research," was the answer. Today, four other federal agencies have followed NSF in creating EPSCoR or similar programs: the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), and the Departments of Energy (DOE) and Agriculture (USDA).

EPSCoR helps researchers and institutions improve their research capabilities and quality in order to compete more effectively for "mainstream" competitive research funds. EPSCoR expands and improves the research capability of scientists and institutions in eligible states, allows them to compete more effectively for "mainstream" federal academic research and development money, builds eligible states' technical workforces in order to foster innovation and to contribute to the state's and the nation's economy.

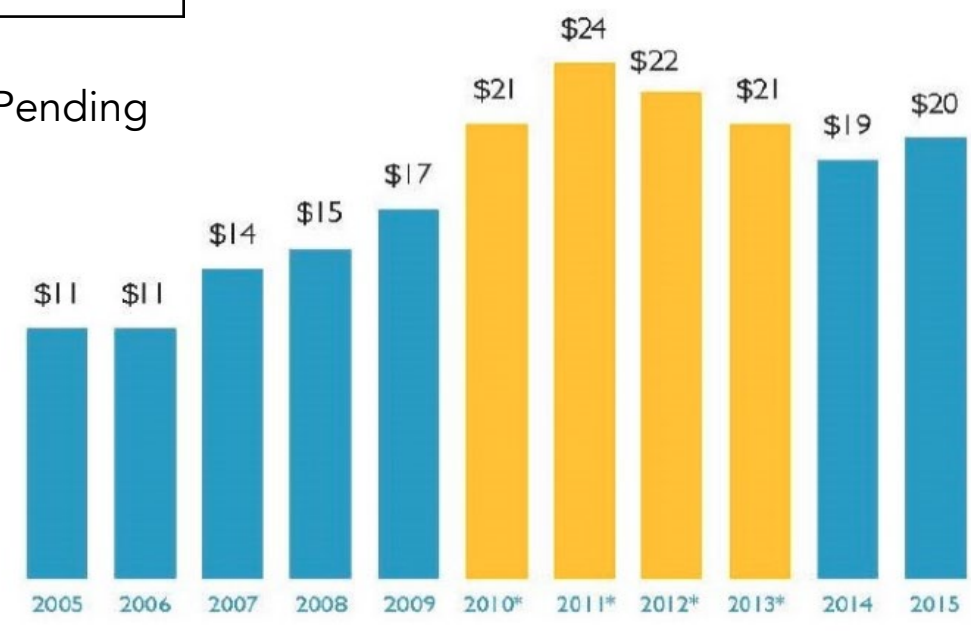
Visit epscorideafoundation.org for more info about EPSCoR nationwide

Grant Period	Amount (with State match)	Additional Funds Generated
2007 - 2010	$13,500,000	$15,049,719
2010 - 2015	$24,000,000	$76,255,721*
2014 - 2017	$3,150,000	$436,000*
2015- 2020	$24,000,000	$15,307,926

The charts to the left and below show past NSF funding to Arkansas and the resulting additional funds secured.

* ~$40M Pending

ARKANSAS NSF epscor



CELL TALK

Dr. Rajshekhar Kore (pictured right) is a postdoctoral fellow in the Radiation Oncology department at the University of Arkansas for Medical Science. His research deals mainly with exosomes, which are small nano-sized particles that are excreted by almost every type of cell in the human body, as well as other organisms like plants. Each exosome holds a particular set of proteins, and they are transferred throughout the body from cell to cell. After an exosome leaves a cell, it follows a pre-determined pathway and enters other cells.

Dr. Kore is studying the pathway that each exosome takes, and how different stimuli or outside factors can affect the pathway.The potential applications of this research would be to use exosomes as specialized targeting systems for drug delivery or imaging. Dr. Kore and his colleagues recently discovered that the surface material exosomes are grown on in the lab can affect the protein content of the exosome, which in turn affects the cells it talks to. The environment of the cell that produces the exosomes can have an impact on many other cells in the body depending on the proteins inside the exosome. If researchers could understand how the proteins inside the exosomes are determined, it could significantly impact treatments and diagnosis of many diseases.

ACTIVITY: INTERACTIVE FRICTION LAB

Have you ever had a carpet burn after someone pulled you across the floor? Why is it you can warm up your hands, if you rub them together? Even without electricity when two surfaces rub against each other, it causes friction, with a byproduct of heat. In this interactive inquiry-based activity for approximately grades 8-11, students will learn about friction using different types of materials and

Activity link: http://tiny.cc/465vcy

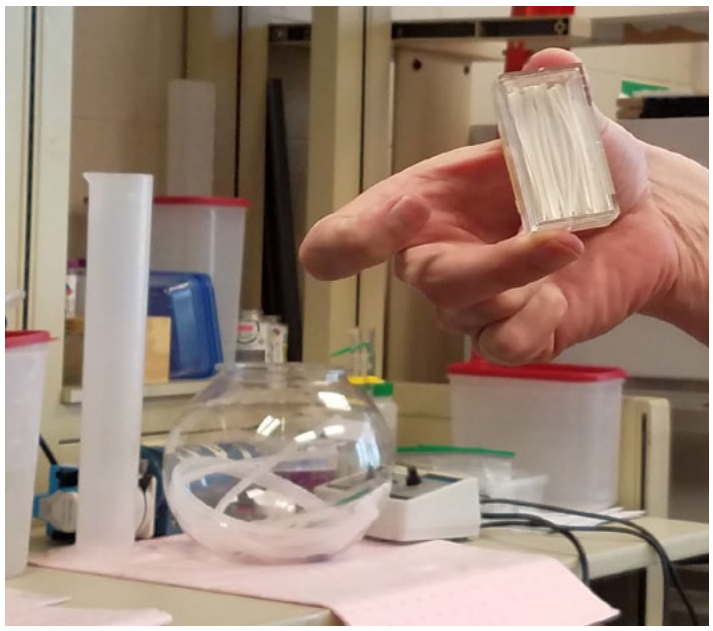
DESIGNING BETTER FILTERS

Dr. Jamie Hestekin is a chemical engineer at the University of Arkansas at Fayetteville who works on the cellulosic team in the Center for Advanced Surface Engineering (CASE). Hestekin is researching how casting cellulose membrane material with different formats that could affect the filtration properties of the material. This type of work falls under membrane and materials science. Eventually, Hestekin wants to be able to easily customize cellulose membrane pore sizes and filtration properties for different applications.

Cellulose fiber comes from byproducts of the forestry industry, which means it's eco-friendly and can be used to create high-value products for low cost. Hestekin usually casts cellulose membrane material into one of two shapes: a flat sheet or a hollow fiber (like a straw or tube). The castings are made with soluble or insoluble cellulose fibers, which allows the researchers to customize the properties of the membranes that they are creating.

After casting, Hestekin and his students perform tests on the resulting membrane material to examine the properties of it and how it can be utilized. One of the tests is called evapoporametry, which involves examining how a liquid evaporates from the material over a period of time, which tells the researchers about the structure underneath the material. Another test involves the machine pictured below on the left, a hollow fiber membrane unit. Hestekin places the material inside the unit and passes water through it. This method can separate proteins and larger molecules from the water.

Potential applications of this could be for food manufacturers to separate alpha lactubumin from beta lactoglobulin. The two products then have different values and uses. The first protein is used to enhance baby formula and help with infant brain development. The second protein is clear when it dissolves in liquid, so you could have protein enriched soft drinks or sodas. The filter could also be used to remove lactose proteins from whey in milk, to make whey supplements for lactose-intolerant people.



Above Left: The Hestekin lab's hollow fiber membrane testing unit.
Above Right: Dr. Hestekin holding a sample of some cellulose membrane material.

Above: Dr. Jamie Hestekin, Membrane Scientist & Chemist (see article on previous page)
Below: One of Hestekin's students, Meaghan Williams, working in the lab.

ACTIVITY: MAKE YOUR OWN CRAZY PUTTY

Using some everyday household items such as borax, water, PVA glue and food coloring, make some crazy putty that you can squish in your hands, mould into shapes or even bounce on the ground. This activity is for elementary-middle school students and involves basic physical chemistry and materials science. Activity link: http://tiny.cc/2n4vcy

The Arkansas State University Bridging the Divide program hosted a booth during the 2016 Annual State Conference this year. Graduate students Klarissa Kahill and Marla Moland presented their research at the poster session, and along with Kandi Granberry (program manager) and Malathi Srivatsan (PI), provided information to the conference attendees about the program.

Bridging the Divide is pleased to welcome the 2016 program participants. These 9 students will participate in a summer research experience designed to prepare them with the skills they need to enter graduate research STEM degree programs. The overall goal of the program is to increase the number of underrepresented minority students completing PhD programs in Arkansas.

For more information about Bridging The Divide, visit: www.astate.edu/a/bridge-program/

YouTube

Visit our YouTube channel (@arepscor) for video updates from our students and faculty.

LITERACY ACTIVITY: LEARNING ABOUT WOOD

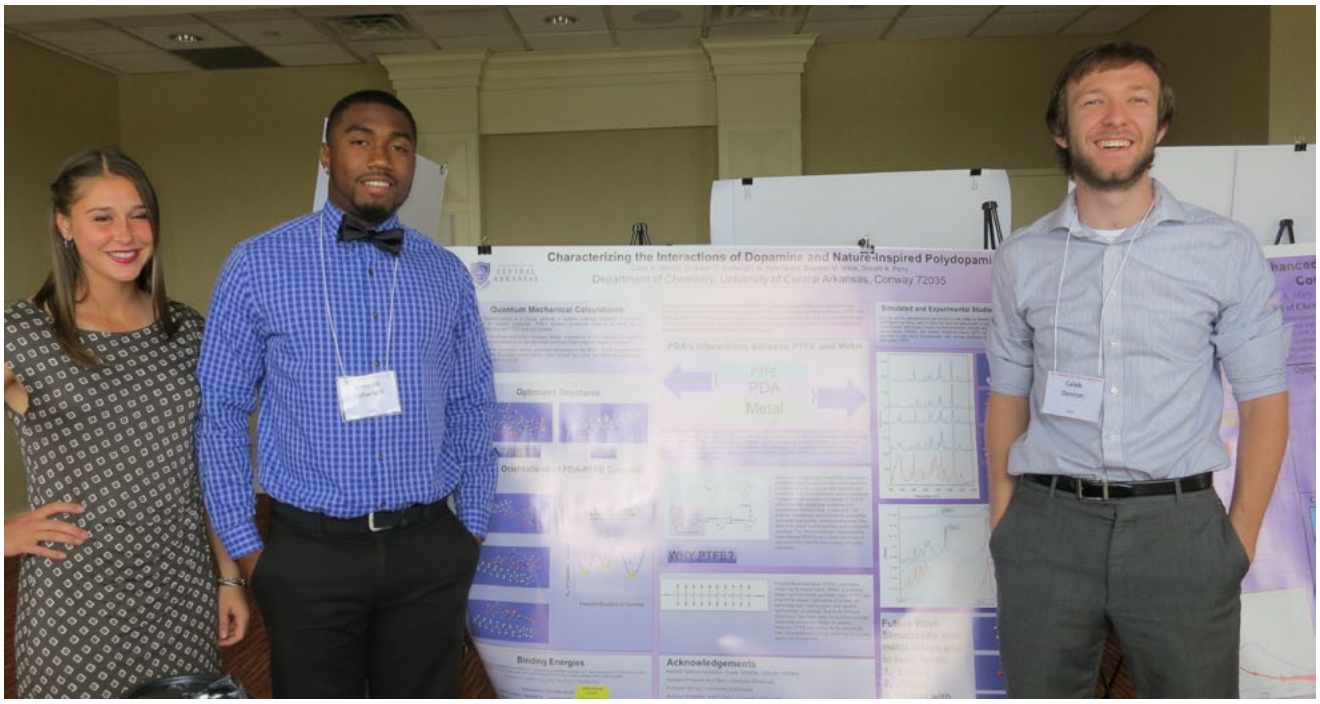
In this remedial reading activity for 3rd and 4th grade, students will read an article about wood and renewable resources, then discuss what they learned. Activity link: http://tiny.cc/024vcy

EPSCoR EVENTS

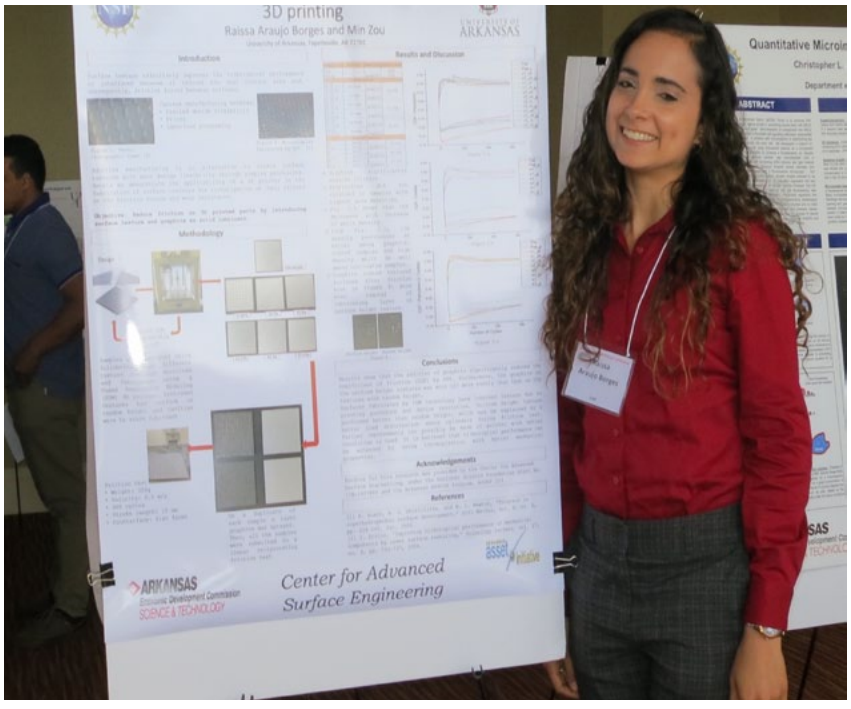
Check out the events page on our website for info on past and future events:
http://www.asta.arkansas.gov/ASSET_conference.html

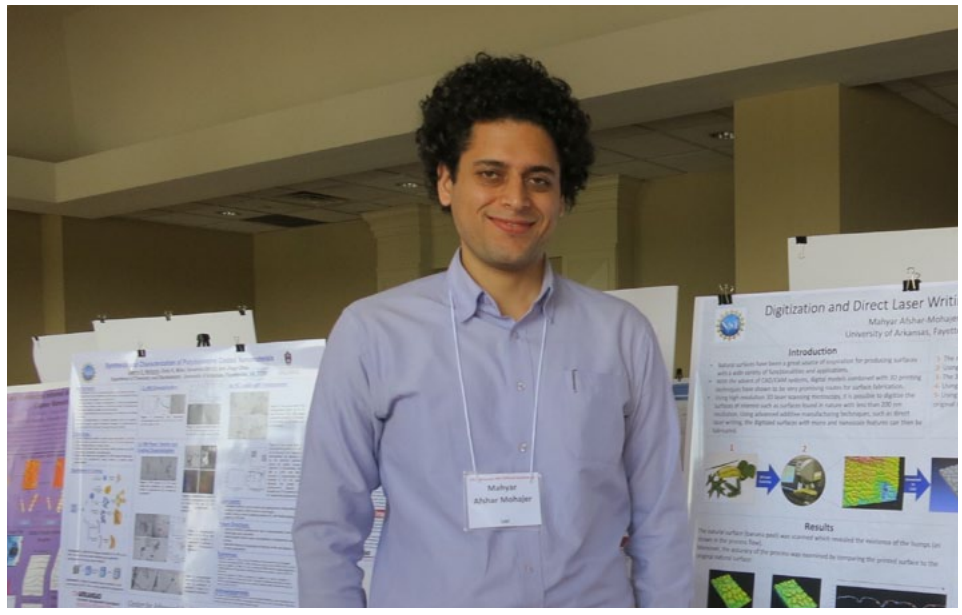
2016 EPSCoR Annual Conference: Attendees at the 2016 EPSCoR Annual State Conference observed research presentations from dozens of faculty and students. This is the only meeting of the year where all EPSCoR participants from each NSF project can get together and discuss their work and future collaborations.

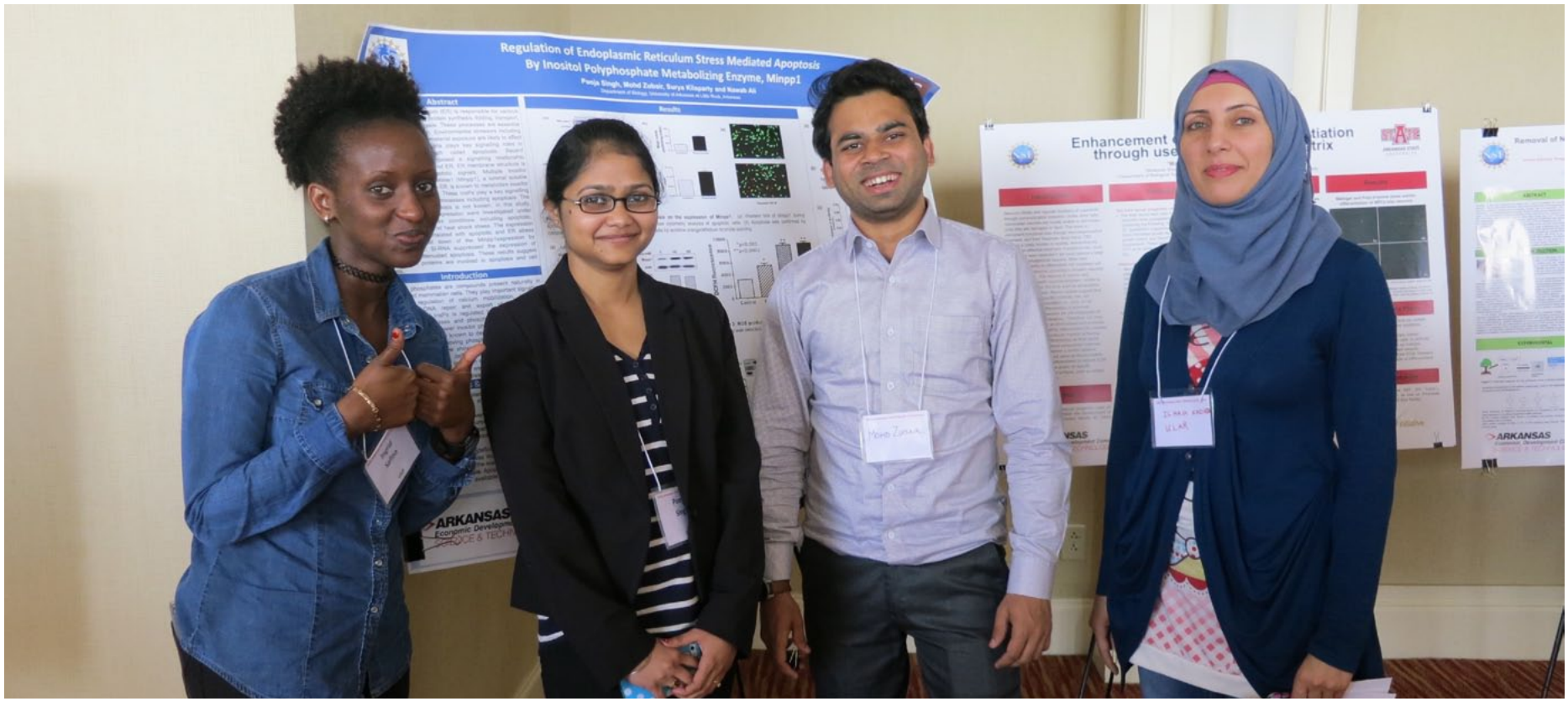
External Advisory Board Q&A: Each NSF EPSCoR project is reviewed by an external advisory board (EAB). The board is typically made up of faculty from other universities and research labs around the country, and practicing professionals from the industry or discipline of the project focus. The EAB reviews the proposed research, the work completed, talks to the participants, and files a report to the project leadership with recommendations for the following years.



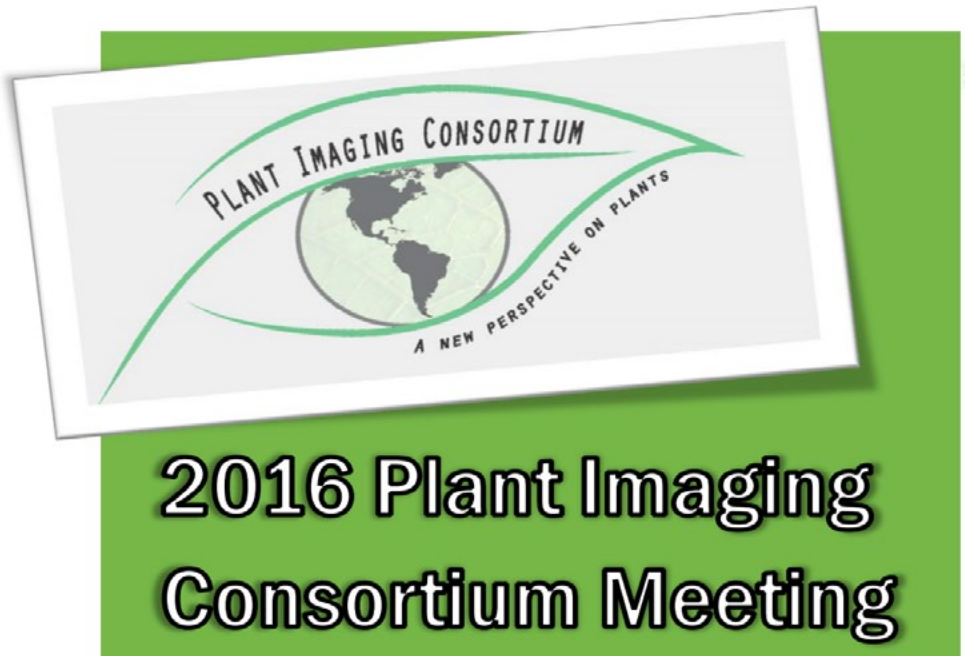
Student Poster Session: During the 2016 Annual Conference, students present their research projects via poster session to other students, faculty, and the external advisory board. Overall, the CASE project has hired dozens of students from undergraduate and graduate degree programs all over the state. The poster session allows the students some practice presenting their research and networking with students from a variety of other programs and institutions.







Clockwise from top left:
Kate Myers (UCA), Grekeem Cartwright (UCA), Caleb Denton (UCA), Mahyar Afshar Mohajer (UARK), Ilham Kadhim (UALR), Mohd Zubair (UALR), Pooja Singh (UALR), Ingrid Safina (UALR), Raissa Araujo Borges (UARK).



Plant Imaging Consortium Annual Meeting: The second annual Plant Imaging Consortium Meeting took place on July 7-8, 2016 at the Chancellor Hotel in Fayetteville AR. Project participants from Missouri and Arkansas gathered to discuss their research. The students also competed in a poster session. The conference program is available on arkepscor.org under the conference page. Check out the PIC website: http://plantimaging.cast.uark.edu/

The NSF-funded Plant Imaging Consortium (PIC) brings together experts in plant biology, radiochemistry, phenomics, imaging, and computational biology to apply high-throughput phenotyping and molecular imaging techniques to the study of plant stress biology. High-throughput phenotyping (HTP) allows breeders to screen large populations of plants quickly and efficiently, and to quantify numerous complex traits that are not obvious to the naked eye. Molecular imaging (MI) techniques such positron emission tomography (ie. PET scans) utilize radioactive, fluorescent, or luminescent probes to elucidate the physiological processes that govern stress tolerance or susceptibility in plants. Together, these bioimaging technologies have transformative power to link genotype to phenotype and identify genetic sources of stress tolerance for crop improvement. PIC hopes to achieve these goals:

- Make infrastructure for HTP and MI accessible to plant biologists throughout Arkansas, Missouri, and beyond

- Develop new protocols and analysis tools to use HTP and MI to study the spatial and temporal dynamics of plant stress responses

- Promote community standards for the design, analysis, and reporting of HTP, MI, and other bioimaging experiments

- Strenghten education and workforce development in biology, chemistry, and computational science

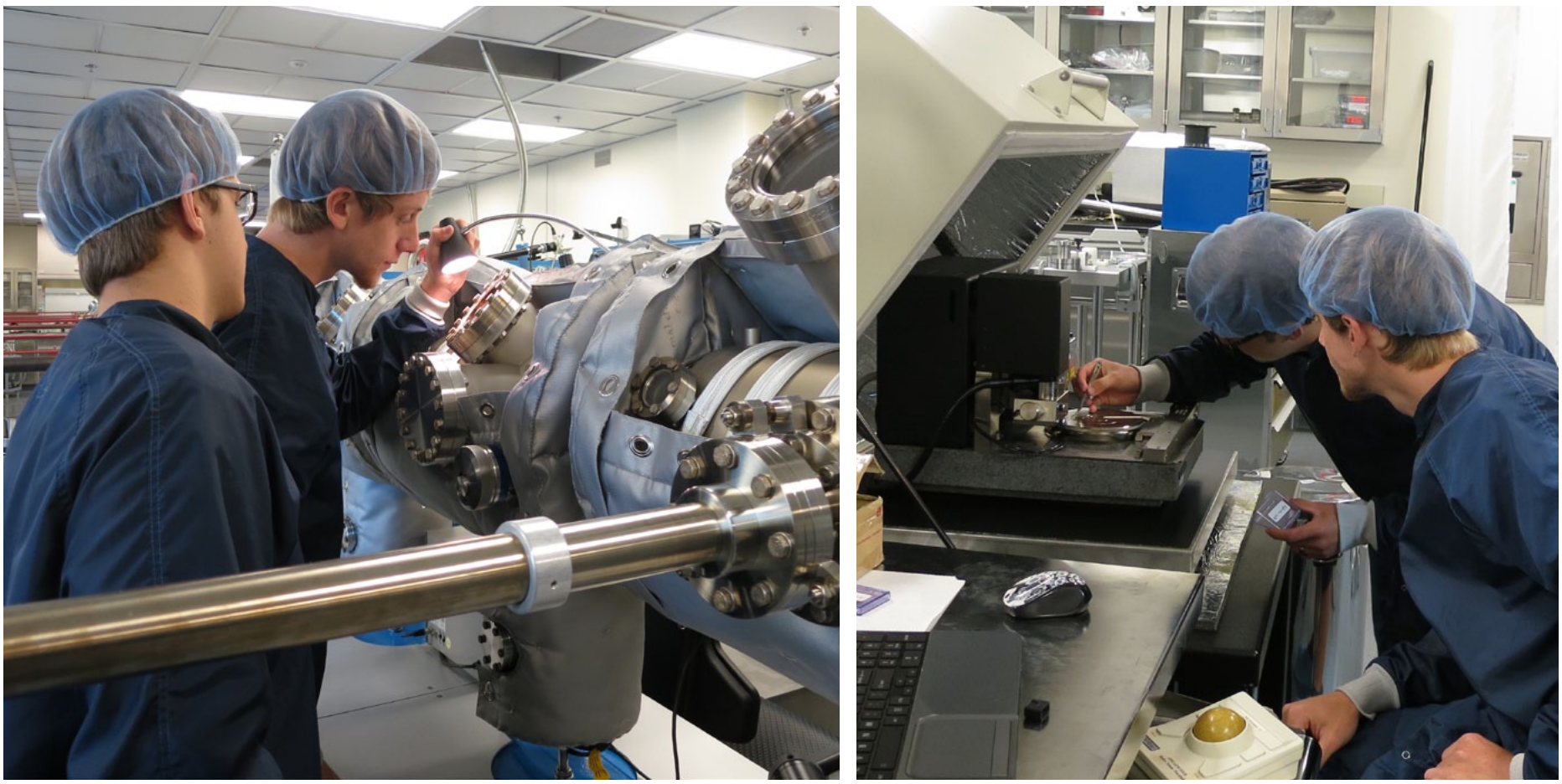
MATERIALS OF THE FUTURE

When you make something small enough to be considered nanoscale (a human hair is 100,000 nanometers wide), the surface begins to play a big role in the behavior of the material. Researchers have discovered that the size and structure of materials on the nanoscale can influence and change hardness, electrical properties, heat conduction, toxicity, even the color of the material.

Dr. Greg Salamo is a researcher from the University of Arkansas at Fayetteville involved in the CASE project. "We want to make materials that have specific properties and applications that current materials don't have," Dr. Salamo recently stated in an interview. "Imagine a surface coating that could be applied to a car windshield that will repel water by the touch of a button inside the car." Dr. Salamo and his team are also working to create surface coatings that reduce friction, to make manufacturing processes more efficient.

"I think that the underlying goal of CASE is to make things better... to engineer better materials that will in turn make better products. We would like to create something that can be applied to an object to reduce friction, and maybe then you flip a switch and it increases friction."

Dr. Salamo is also working to design materials that will change colors when a certain stimulus is applied, for example an electrical field, pressure, or heat. The researchers want to make materials that are highly functional, and have the ability to be tuned or adjusted, like settings on a computer. Another material Dr. Salamo is working on will be able to change colors- magine being able to match your car's paint every day to the clothes you put on each morning. An industrial application of this technology could also be useful in conserving heat, like applying a coating to a roof that automatically lightens during the summer to reflect heat and light, but changes color and darkens in the winter months to absorb heat and lower heating costs.



University of Arkansas undergrad students Alex Schroeder and Garrett Story working in Dr. Salamo's lab.

INSECTS & PLANTS: STUDYING NATURE'S FRENEMIES

Left: Dr. Babst in his office with some of the plants he works with.
Above: Babst with undergraduate Lesly Jean Francois, a student that works in the lab.

Dr. Bejanmin Babst is one of the CASE researchers working on the cellulosic team. His home institution is the University of Arkansas at Monticello, and his background is in horticulture and tree ecology. Dr. Babst is affiliated with both CASE and the EPSCoR Track-2 Plant Imaging Consortium. His team studies a variety of interactions between plants, humans, and insects, including how different types of stress affects plants.

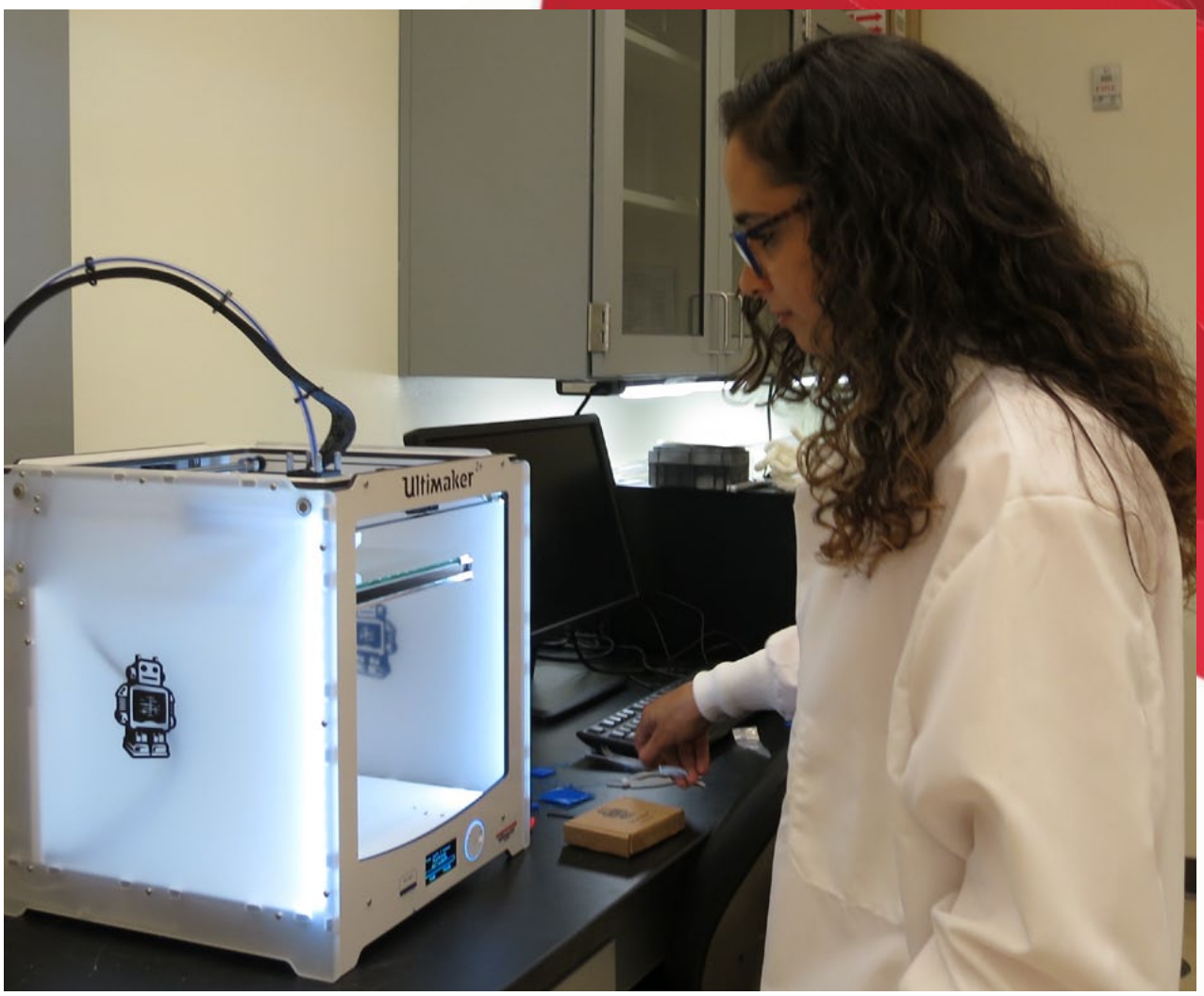
Biochemistry is all about the interaction between environment and genetics. There are a lot of things encoded in the DNA of an organism that determines what the biochemistry will be. There are several different types of insects that negatively affect the growth of the plants, and Dr. Babst wants to understand the different plant responses to these stresses.

Many plants have natural defense systems, such as producing compounds that make the tree taste bad so insects stop feeding on it, or even compounds that produce toxic effects to kill insects or make them sick. This type of study will help us to better understand these pathways and defend our crops from different stressors that hinder growth.

With CASE, Dr. Babst hopes to find new uses for cellulose (a by-product of the forestry industry made from wood pulp) and to determine which trees produce the best cellulose for those applications. Cellulose is an eco-friendly material that can be used to make a variety of things like biodegradable plastics, paper and cardboards, etc. It is easier to extract cellulose from certain tree types than others, so if we want to increase production we must decrease the amount of work involved in the production.

Dr. Babst received a seed grant from the Plant Imaging Consortium, another EPSCoR project that spans Arkansas and Missouri. Under this program, Dr. Babst will work with researchers from Arkansas State University and Washington University to study some types of plants and try to understand more about nitrogen distribution from leaves to other parts of the plant. They want to help reduce the use of nitrogen fertilizers in modern agriculture, which has environmental impacts and is costly to farmers. This team is also working to find the genes that can trick plants into going dormant, which will save the plant's life in freezing temperatures and would help save farmers' crops during hard winters.

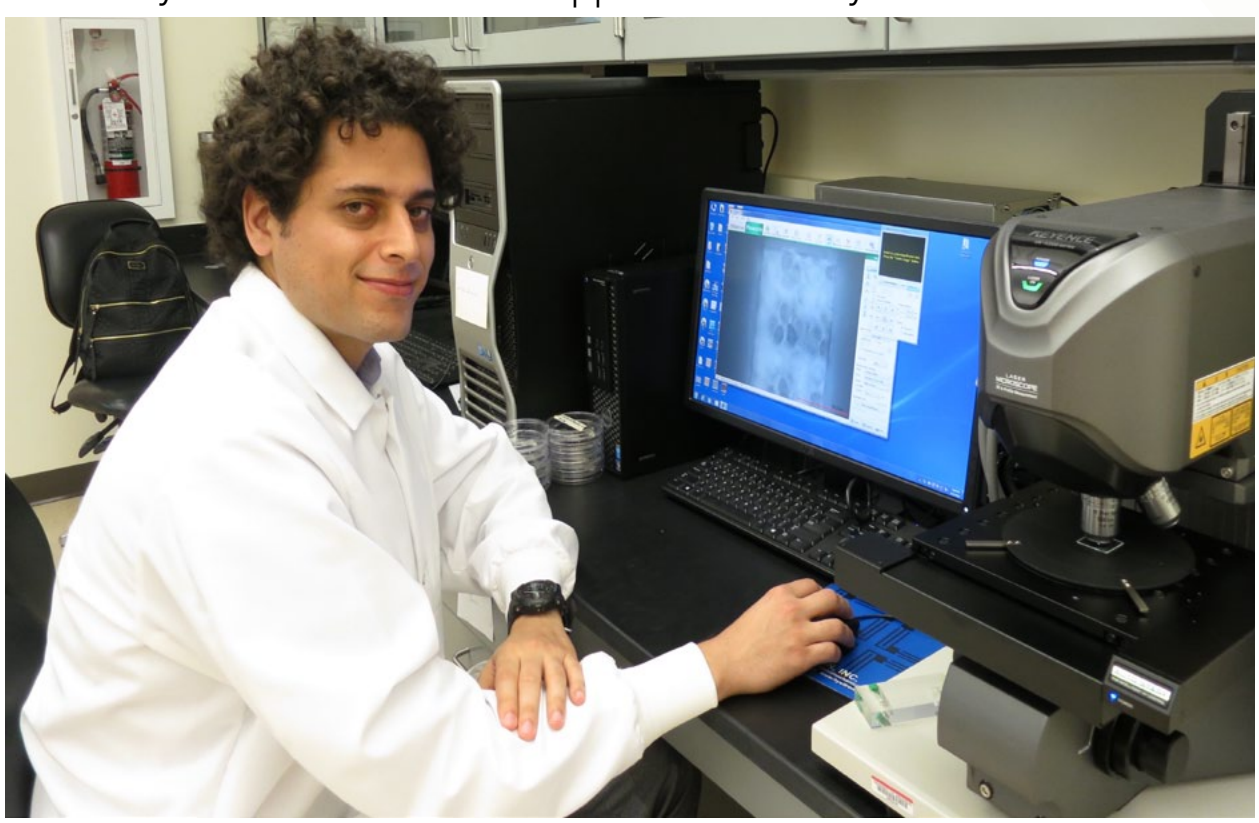
STUDENT SPOTLIGHT



Above: Raissa Araujo Borges is a graduate student in Dr. Min Zou's lab at the University of Arkansas. Dr. Zou is the director of CASE, and her background is in mechanical engineering. Raissa is working on a project that uses 3D printers to create different textures for surface materials.

She wants to understand if certain surface textures reduce friction by reducing the interface area (the real contact area between the two surfaces that are touching). The goal of this project is to improve manufacturing processes and lower costs associated with friction and wear. Manufacturers currently spend lots of money and time replacing parts and tools that wear out, so projects like Raissa's could have a large impact globally.

Below: Mahyar Afshar Mohajer is also a graduate student in Dr. Zou's lab. He studies surface material textures that come from nature, which have been a great source of inspiration for producing surfaces with a wide variety of functionalities and applications. Many new technologies have been created in the past decade which allow researchers to scan things they find in nature on the nanoscale, then reproduce them by fabricating them with complex 3D printing machines. Eventually, this process will be integrated with other fabrication processes to create bio-inspired multifunctional surfaces that can be used for various applications.



Check out the last edition of the newsletter to read about the unusual feature of sea urchin teeth and the properties of lotus leaves for examples of bio-inspired surfaces.

FREE WORKSHOP

RESEARCH & TECH COMMERCIALIZATION

A career development opportunity for researchers or students interested in starting a business

SEPTEMBER 8, 2016

01 ELLEN BRUNE

Ellen Brune, PhD is an award winning presenter and the Founder and Chief Executive Officer of Boston Mountain Biotech (www.mtnbio.com) in Fayetteville, Arkansas. Her research has been funded by over $1.25M in grants from the National Science Foundation and the Arkansas Biosciences Institute. Recently, Ellen has been providing consulting services in the areas of patent development, research validation, commercialization studies, and technology transfer agreements.

02 INTRO TO FEDERAL SBIR/STTR PROGRAMS

Participants will learn about the basic requirements for Small Business Innovation Research/Small Business Technology Transfer program participation, how to get started with the SBIR/SBTTR programs, and tips for success.

NETWORKING LUNCH PROVIDED

REGISTER ONLINE (LIMITED SPACE):

☞ http://tiny.cc/17yrcy

ASBTDC

A-STATE DELTA CENTER, JONESBORO AR
Presentations will also be broadcast online

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