Fall 2020

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ORSP Mission Statement
ORSP provides information, services, and support to members of the UA Little Rock community to enable them to compete successfully for outside funding to conduct scientific research; create works of art; compose music; write books and articles; improve their performance in the classroom; and better serve their students, professions, and the public.

Carnegie Classification
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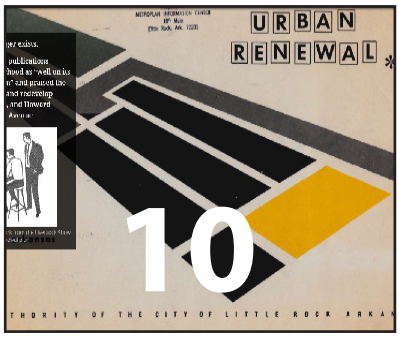

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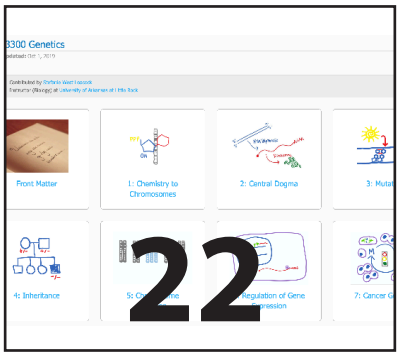

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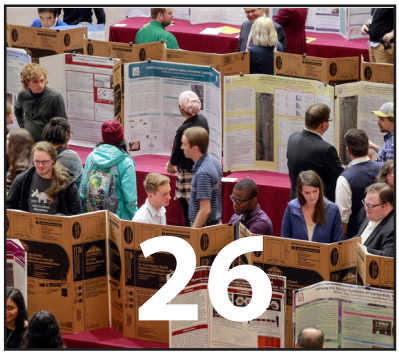

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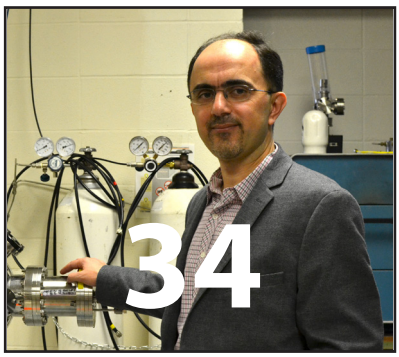
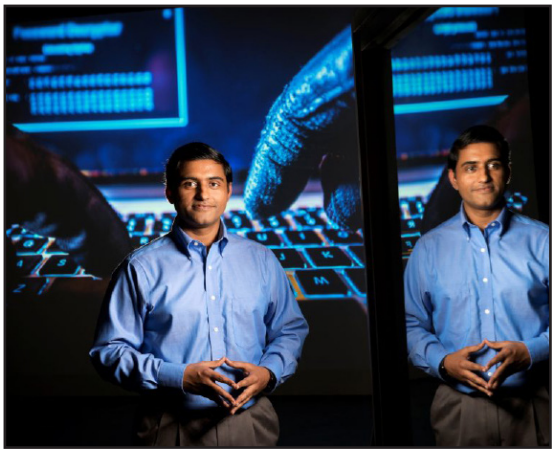


IN HOT WATER

RESEARCH NEWS

COSMOS Installed as Designated Research Center



In July, the Arkansas Department of Higher Education approved the establishment of the Collaboratorium for Social Media and Online Behavioral Studies (COSMOS) as a designated research center at UA Little Rock. COSMOS is led by Dr. Nitin Agarwal, the Jerry L. Maulden-Entergy endowed chair and a professor of information science.

Jan Springer Named Director of Emerging Analytics Center

On July 30, Dr. Jan Springer was named the director of the Emerging Analytics Center at UA Little Rock. Springer replaces Dr. Carolina Cruz-Neira, who is now a professor of computer science at the University of Central Florida. The Emerging Analytics Center focuses on virtual and augmented realities, immersive visualization, technology infrastructure, and cybersecurity. Springer joined UA Little Rock in 2018.

Dr. Anindya Ghosh Receives 2020 Faculty Excellence Award for Research and Creative Endeavors

Dr. Anindya Ghosh is the 2020 recipient of the Faculty Excellence Award for research and creative endeavors. This award is given to researchers at UA Little Rock whose research or creative endeavors are particularly successful and recognized locally, regionally, and nationally.

Arkansas Remembers Dr. Mary Good's Legacy

Esteemed researcher and founding dean of the Donaghey College of Engineering and Technology Dr. Mary Good passed away on Nov. 20, 2019. Good led a 46-year career in academia, public service, and public service, and served under presidents Jimmy Carter, Ronald Reagan, George H.W. Bush, and Bill Clinton. From 1993-1997, Good was the Under Secretary for Technology in the United States Department of Commerce.

RESEARCH NEWS

Arkansas Remembers Dr. Yupo Chan's Legacy

Esteemed researcher Dr. Yupo Chan passed away on February 5, 2020, after battling cancer. Chan joined UA Little Rock to become the founding chair of the systems engineering department in 2000. Chan was named a Visionary Arkansan by the *Arkansas Times* in 2018 for his work with NASA to launch a satellite that monitors atmospheric conditions in the state of Arkansas.

Chan received his bachelor's in civil engineering, master's in transportation systems, and doctorate in operations research from the Massachsetts Institute of Technology.

Dr. Mary Yang Receives Nearly $445,000 to Develop Deep Learning Methods to Identify Cells that Promote Complex Disease Development

Dr. Mary Yang, Professor of Information Science and Director of the Midsouth Bioinformatics Center at UA Little Rock, has received $443,854 from the National Institutes of Health to develop unique deep learning methods to identify key cell networks in complex diseases. This knowledge will help doctors and scientists further understand how complex diseases evolve and develop in the body, and how to identify effective drug targets. Yang's deep learning model focuses on developing high-resolution single-cell genomic analytics techniques to capture cell differences with detail and clarity. By clearly characterizing cell differences, scientists can better identify cells that cause diseases to advance and evolve. This technique will allow more specialized, targeted treatments to different cells in the body.

AEDI Receives CARES Act Funds to Help Arkansas Economy Recover

UA Little Rock received $300,000 from the U.S. Department of Commerce's Economic Development Administration to help with Arkansas' eonomic recovery plan. The Arkansas Eonomic Development Institute at UA Little Rock will work with Arkansas State University to create an Arkansas Recovery and Resiliency Plan in partnership with eight planning and economic development districts.

Doctoral Student Wins Award for Innovation

Computer and Information Science doctoral student Karen Watts DiCicco recently won an Award for Innovation at the National Technology Community 2020 Conference. This award recognizes students who creatively integrate technology into the delivery of educational programs or in the administrative systems that support educational programs. DiCicco is the digital and IT innovation manager at the University of Arkansas System Division of Agriculture.

Cyber Boot Camp

The CyberGym prepares high school students to defend users from cyber attacks

Every year, cybersecurity becomes more and more imperative as our infrastructure increasingly relies on integrated networks and electronic devices in our everyday lives. From smartphones, to cloud services, to corporate servers housing sensitive data, cybersecurity offers the protection needed to keep life moving. Because of this necessity, students will need foundational knowledge early to gain the skills needed to protect our infrastructure and privacy. To accomplish this task, states across the country are requiring computer science, coding, and cybersecurity classes in high school curriculum.

In 2015, the Arkansas Department of Education began requiring school districts in the state to offer high school computer science courses. In these courses, students can emphasize in programming, networking, or information security. Through this curriculum, students are evaluated through various processes such as perseverance, ability to collaborate and communicate, problem solving, and proper use of tools. These various processes will give students the foundation they need to work with technology at a high level in the workforce.

These requirements are part of Arkansas Governor Asa Hutchinson's strong initiative to increase coding and computer science curriculum in the state. In December 2019, he created the Computer Science and Cybersecurity Task Force, a group of industry and educational leaders tasked to evaluate and suggest improvements to K-12 cybersecurity and computer science education.

"If we are going to give our students the best computer science education possible, we must constantly assess our progress and implement the programs that will attract and inspire our students and educators, Governor Hutchinson said in a press release. "When our goal is a first-rate computer science education for our students, our educational innovation will continue as a model for the rest of the nation."

Cyber Workout Missions

The UA Little Rock computer science department is at the forefront of this educational initiative. Philip Huff, assistant professor of cybersecurity at UA Little Rock, leads the UA Little Rock CyberGym, a comprehensive program that creates cost-effective modules and curriculum for Arkansas high school students.

Using Google Cloud software, these learning modules, called "workouts," train students in safe virtual environments to perform various cybersecurity protection missions.

Using a cloud environment allows for more flexibility and resource management, Huff explains. Instead of using proprietary hardware and software in one physical location, students can access the workouts on demand from any device with a browser. This approach is faster and less expensive than creating a traditional cybersecurity lab.

"It gave us the ability to very early start rapidly developing this environment where any student would be able to access it," Huff said.

In this cloud setup, students log into the courses from a school device, such as a Google Chromebook, and perform all the required modules from the internet browser.

Once the student has completed each task, their lab is reclaimed back into the cloud. New modules for the next student can be set up in about five minutes. They can even work at home on their assignments.

"It's really allowed the hands-on activities needed for learning cybersecurity," Huff said. "It has lowered the bar for what it requires to participate in that environment. Schools and students without many resources can still have high-quality lab exercises."

One workout exposes students to the threat of malware, a group of malicious software attacks that can compromise data and systems with viruses.

Another workout introduces students to ransomware, an attack that enables hackers to ransom company data and agree to give it back for a price.

Along with these modules, the CyberGym trains students for reconnaissance missions that allow them to search through a network to find vulnerabilities in the system and secure exposed and susceptible environments.

Virtual Curriculum

The Cyber Gym is also partnering with the Arch Ford Education Service Cooperative's Virtual Arkansas, a virtual education program designed to create virtual curriculums for Arkansas students. While UA Little Rock is supplying the workout activities, Virtual Arkansas is creating the lesson and assessment materials and distributing them to the classrooms.

These assessment criteria align with the Arkansas Department of Education's Information Security, Advanced Information Security, and National Initiative for Cybersecurity Education (NICE) standards. If the students wish to further their education in cybersecurity, these standards will set them up for higher level cyber security certifications after graduation.

The CyberGym is housed in the Emerging Analytics Center on the UA Little Rock campus. This three-year program will also incorporate the University of Central Arkansas' Cyber Range Program. UA Little Rock will build modules for the first two years, and the University of Central Arkansas will build modules for the third year.

Several UA Little Rock students are involved in CyberGym and help Huff develop modules and specific reconnaissance missions. He is specifically working with the Cybersecurity Club, a student organization designed to train students in cybersecurity competitions such as Collegiate Cyber Defense Competition and MITRE STEM Capture the Flag, among others.

Using Artificial Intelligence

Huff also leads projects incorporating machine learning and artificial intelligence to defend computer systems. As more and more data are generated, it will become difficult for humans to defend these systems on their own. Cyber security experts, Huff explains, will need to rely on robust artificial intelligence and machine learning strategies to combat cyber attacks. Recently, the Emerging Analytics Center was awarded a $2.7 million grant with the University of Arkansas, Fayetteville, to develop machine learning and natural language processing technologies for defending networks in the energy sector.

Additionally, they are working with the Forge Institute through the American Cyber Alliance to train the private sector in cyber network defense. The Forge Institute is an Arkansas-based initiative designed to encourage and enable public-private partnerships in economic development and cybersecurity initiatives. The Emerging Analytics Center has also received Department of Energy SEEDS grant funding through the University of Arkansas, Fayetteville, to use machine learning to determine system vulnerabilities, improve cybersecurity visualization techniques and improve digital forensics in industrial control systems.

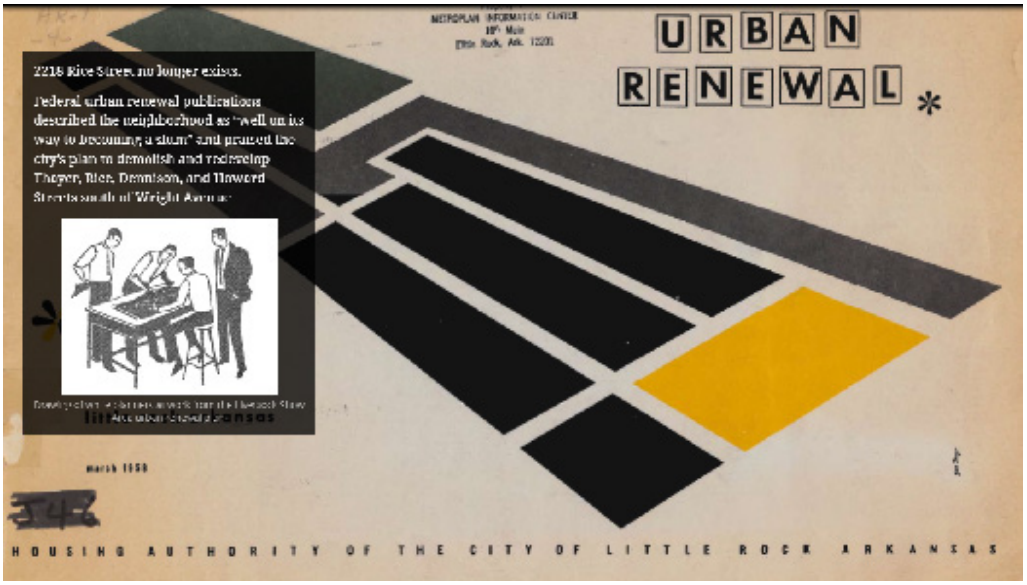
"Machine learning and AI automation is big for cybersecurity because the people charged to protect the systems can't really keep up with the amount of incoming data, both from the logs that are coming in along with the networks and the vulnerabilities," Huff said. "There's just too much data for humans to process, so it's a good application to try to find ways to improve automation in that area to where the defender is better armed to understand how well they are defended."

WIth this future in mind, Huff and the UA Little Rock Department of Computer Science are determined to fill the gap of upcoming cybersecurity jobs that will be necessary in the future. Currently, they are working to create a new Bachelor of Science in Cybersecurity degree program that is planned to start in the fall 2021 semester. This new program will bolster the already strong cybersecurity training culture established on the campus.

These opportunities will prepare students for the cyber security jobs necessary to keep society functioning. With the programs developed by the Cybergym and other curricular resources, Arkansas students will be well prepared for this new future.

Mapping Renewal

The Center for Arkansas History and Culture shows the history of redlining and Urban Renewal in Little Rock



Every city must constantly evolve and plan to foster growth, cultural vibrancy, and economic development for the betterment of all its citizens. But these strategies must be implemented carefully in order to maintain their respect and dignity. Without evaluating the impact that planning and development has for businesses, transportation, and new forms of housing, this form of urban evolution can cause great damage to a city and its inhabitants.

In the mid 20th-century, the city of Little Rock had its own unique history of controversial development policies. Dubbed, "urban renewal," a term used in cities around the country to describe city improvement and expansion in the 1950s, this strategy resulted in the segregation of African American communities and their migration to the farthest corners of the city.

Urban renewal was born out of the U.S. federal Housing Act of 1949, a piece of legislation that helped develop public housing projects and increased the U.S. government's role in housing mortgages. One goal of this act was to finance efforts to clear decaying low-income neighborhoods.

This "slum clearance" initiative took citizens out of decaying homes and placed them in new public housing projects. However, many historians and cultural anthropologists now see that this initiative is one factor that increased segregation. By classifying many black communities as "slums," government officials now had legal means to move them into housing projects away from the center of town.

"Many downtown areas, many areas of African American residents were bulldozed under the idea that they were slums," Dr. John Kirk, Donaghey Distinguished Professor of History at UA Little Rock said in a video interview.

"We have given almost everything we have had except our very life blood over a long period of years to pay for these homes, improvements, and educate our children. Now for the Housing Authority to come up and say that we must move away to a much less desirable, convenient, and suitable location is far more than we can understand or submit to willingly."

Housewives of Dunbar group petitioning against efforts to relocate to new housing projects in Little Rock in 1952

However, Kirk explains, this was specifically difficult for Little Rock because the racial makeup of the city was very mixed. Many white and African American neighborhoods were close to each other. Before this initiative, Little Rock was progressive in the sense that it was not illegal for African Americans and whites to live in close proximity. With urban renewal, however, city planners were legally allowed to separate these communities by withholding mortgages to some neighborhoods in the city and building housing projects on its outskirts. As economic development increased in the western part of the city, housing projects increased in the east.

"Historic maps document that those predominantly affected by urban renewal programs were African American communities. It's important to make these maps and other historical resources available to understand the full effects of how urban renewal changed Little Rock's landscape." Shannon Lausch, archivist at the Center for Arkansas History and Culture at UA Little Rock said.

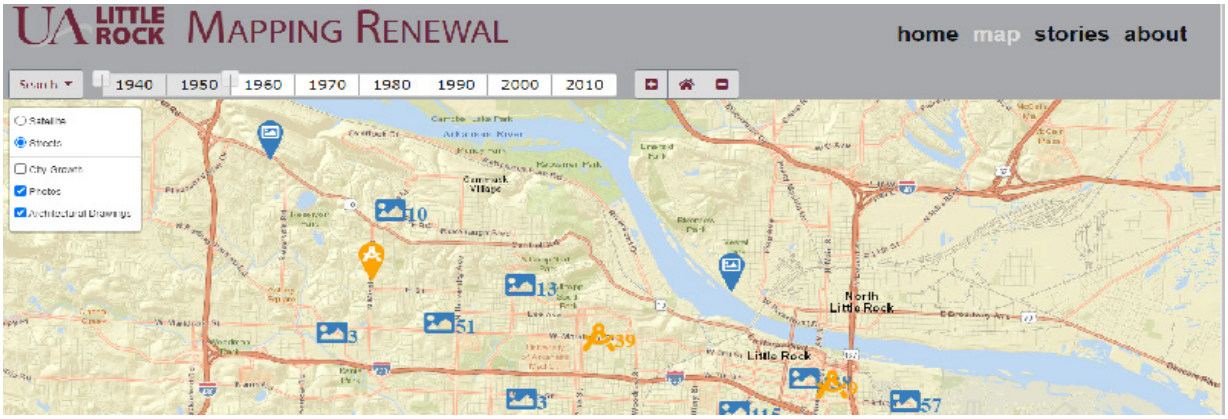
"During this time, Little Rock schools were being desegregated, and so Little Rock applied for all of these urban renewal programs, and oftentimes they're targeting these largely black neighborhoods. And what happened was they would demolish these neighborhoods and then build public housing on the outskirts of the city. So instead of discriminating against the black community by saying you can't go to these schools, they started geographically segregating people."

In essence, Lausch explains, this provided a way to resegregate schools by geographic boundaries.

Mapping the Past

The Center for Arkansas History and Culture has created an expansive and detailed resource that shows the effects of urban renewal policies in Little Rock. Funded by the National Endowment for the Humanities, the "Mapping Urban Renewal" project is a detailed, user-friendly digital resource that allows users to view the city through different decades using a current map. The map includes a timeline and is overlaid with icons that house images and architectural drawings.

As you click through different decades in the timelines, the images and drawings will change according to the time. This allows users to instantly view different historical elements in the city. Most of the images come from the Earl Saunders Collection at the center. Saunders was a professional architectural photographer in Central Arkansas in the mid 20th-century. One of the hardest hit areas was the Dunbar neighborhood community.

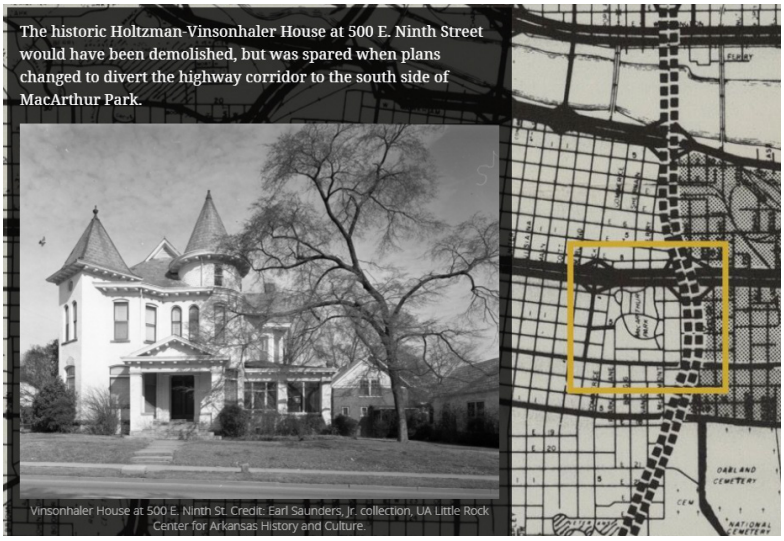


Timeline of Little Rock development on Mapping Renewal website created by the Center for Arkansas History and Culture

A vibrant mix of wealthy, middle, and lower class families, this community was heavily targeted for redevelopment by city developers and sold to private developers and new homeowners. Urban renewal advocates cited Dunbar as a "slum" area of the city eligible for clearance, despite the fact that many occupants included wealthy and middle class black families.

Residents of the community pushed back and filed four lawsuits to prevent their homes from being bulldozed. Citing the loophole that eminent domain can be transferred to private citizens and corporations, however, the courts ruled against the residents and allowed urban renewal efforts to proceed. The website also includes three interactive story maps written by Acadia Rohwer, a graduate assistant at center.

Along with a detailed narrative of Slum Clearance policies, Rohwer also dives into the racial effects of school segregation and the construction of Interstate 630, a main thoroughfare that connects the eastern and western parts of the city. This expressway eliminated many black neighborhoods and parts of 9th Street, an area that housed several black businesses and entertainment venues.



Excerpt from the I-630 Development Story Map on the Mapping Renewal website from the Center for Arkansas History and Culture

Lausch believes this digital project will increase accessibility to Little Rock history. Instead of physically traveling to the archive to look at the collection's photos, this interactive timeline allows users to immediately see these artifacts anywhere in the world. During the development of this project, the center created focus groups to observe how users without an archival background searched through various historical artifacts.

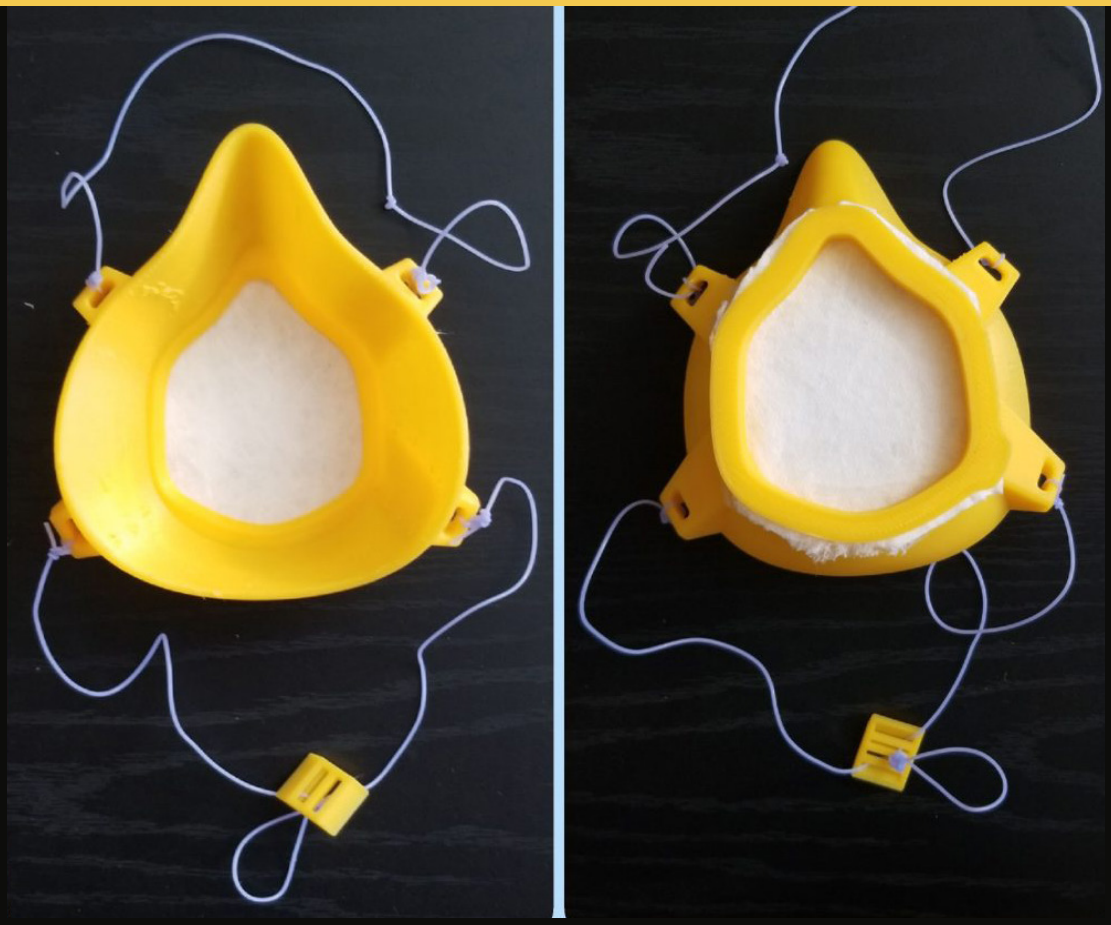
Community Support

With the help of the CRUX Lab in the UA Little Rock Department of Rhetoric and Writing, the center conducted usability studies to discover what keywords people used to search for specific historical data. These studies helped the research team see how the website should be designed and developed. They also reached out to teachers and students to ensure that it would be useful in the center. This community feedback, Lausch explains, is key to making their website as accessible as possible to students, teachers, and the general public. The center also worked with the Arkansas Economic Development Institute to program the website and georeference the materials on the map. For design help, the center turned to the art and design department and the information science department at UA Little Rock.

This collaborative effort combines the arts, humanities, and sciences to seamlessly work together to create an accessible website for educators, students, and the general public. The research team not only wants to paint a picture of urban renewal's effects, it also wants to give a detailed picture of life in 20th-century Little Rock. Many photos in the collection show businesses, retail centers, churches, and other public locations that are no longer in existence.

"We want the website to be useful and accessible for anyone interested in Little Rock's history – whether they simply want to look up a specific address on a historic map or investigate the effects urban renewal had on the city."

These locations show a way of life that is different, and at the same time, similar to what we see today in the city. The ultimate goal is not only to show the errors of the past, but to give a holistic view that helps citizens and leaders think about how policies can truly affect citizens and cultures.



RESPONDING to the CALL

The impact of UA Little Rock researchers and community leaders in 2020

The world in 2020 is fatigued. At the beginning of the year, people from every corner in the world rapidly changed the way they functioned in the matter of weeks. From encountering a new virus that increased at breakneck speed, to witnessing continued injustice in communities, the events of 2020 have reshaped our lives and forced us to question how our society functions and help those in need.

But this fatigue has not stopped researchers and community service leaders from responding to the call to save lives, change systems that promote inequality and injustice, and lessen the burden for those on the front lines.

This vocation is especially true for UA Little Rock researchers and community service leaders who have committed to this service since the beginning. Our institution has a rich history of being on the front lines to help our communities and save lives. We still have a long way to go, but we're committed to the hard work it takes to bring about change, growth, and healing.

"Growth economies and healthy communities are undergirded by an active research and development sector," UA Little Rock Chancellor Christina Drale said. "UA Little Rock is committed to helping Arkansas thrive through its research mission and its ongoing engagement with research partners."

Creating a Better Society

For decades, UA Little Rock has served Arkansas communities by providing educational opportunities to students who may not have the resources to succeed in sciences, arts, and the humanities. These programs, such as Children International, MidSOUTH, The Jodie Mahony Center for Gifted Education, and TRiO, are essential to eradicating inequality and providing the same level of education to all walks of life.

It is also important to recognize the errors of our past in order to create a more just society for all and prevent atrocities from happening again. Dr. Brian Mitchell of the history department and his students have extensively researched racial injustices in Arkansas and honored those who have suffered from these crimes.

Archivists and students at the UA Little Rock Center for Arkansas History and Culture have created a detailed digital exhibit to show the disastrous effects of Urban Renewal policies on African American communities in Little Rock. As we confront our city's history of racism and inequality, this exhibit shows how we need to undo these policies to create a more connected city.

The Little Rock Congregations Study, led by Dr. Rebecca Glazier, Gerald Driskill, and Kirk Leach, works with religious leaders in Little Rock to show how faith-based community engagement affects our city. Recently, they discovered that improving race relations is a critical concern to faith leaders in the city. In a recent survey, all faith leaders who paricitpated responded "important" or "very important" to this topic. By understanding this imperative issue, faith and social justice leaders can work together to begin healing our city.

"Places of worship and people of faith have always played a powerful role in mobilizing people to fight

UA Little Rock Children International

for justice and in healing past wounds," Glazier said. "The early results from our 2020 study reveal that there is still a lot of hope in our city. Communities of faith are key to making that happen."

Helping Arkansas Businesses

Another important aspect of creating a better society is to support small businesses in our community. As COVID-19 impacts small businesses in the state, the Arkansas Small Business Technology Development Center (ASBTDC) has been on the economic front lines to provide assistance. ASBTDC provides extensive resources and funds to mitigate the impact of COVID-19 on small businesses.

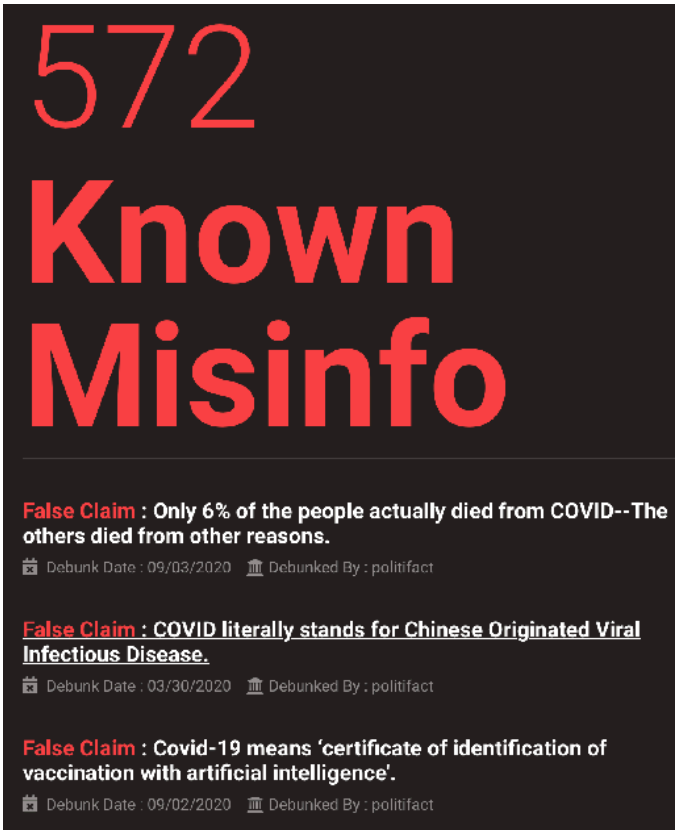

Trigun Maroo

Researchers on the Front Lines

Faculty and student researchers at UA Little Rock have also responded to the call in 2020. When hospitals in Central Arkansas were desperate for personal protective equipment to treat COVID-19 patients, doctoral student Trigun Maroo briefly turned his attention away from his research project to create face masks for hospital workers using a 3D printer.

This selfless act is just one example of the many extraordinary students on campus who use their skills to respond to the call.

"Projects that impact the community positively and directly have been my interest," Maroo said. "This special opportunity was no different, and I contacted Dr. [Andrew] Wright immediately. Dr. Wright has been very kind and has supported me a lot in this endeavor. I am very grateful to him."



Additionally, the Donaghey College of Science, Technology, Engineering, and Mathematics worked with the Little Rock Chamber of Commerce to create face shields for a hospital in Little Rock using a 3D printer.

Eradicating Misinformation

As our society moves faster through social media, finding the right information and disregarding misinformation can be more difficult than ever before. Dr. Nitin Agarwal and his students worked with Arkansas Attorney General Leslie Rutledge and the Arkansas Research Alliance to create a website that specifically targets misinformation regarding COVID-19. As the social media landscape grows, it will become even more important to identify harmful misinformation.

Responding to the Future

As we move forward to 2021 and beyond, we will continue to see the impact of researchers and community service leaders in our lives.
UA Little Rock students, faculty, and staff will remain dedicated to the hard work necessary to improve our communities, make scientific discoveries, and provide the best resources and opportunities to student researchers. These core aspects haven't changed in our decades of service, and they will continue to serve as our world changes.

"UA Little Rock is committed to helping Arkansas thrive through its research mission and its ongoing engagement with research partners."

Dr. Larry Whitman wearing face shield created by the Donaghey College of Science, Technology, Engineering, and Mathematics

Dr. Gregory Guisbiers and his laser setup for creating nanoparticles

Laser Precision

Dr. Gregory Guisbiers and students combat antibiotic immunity With lasers

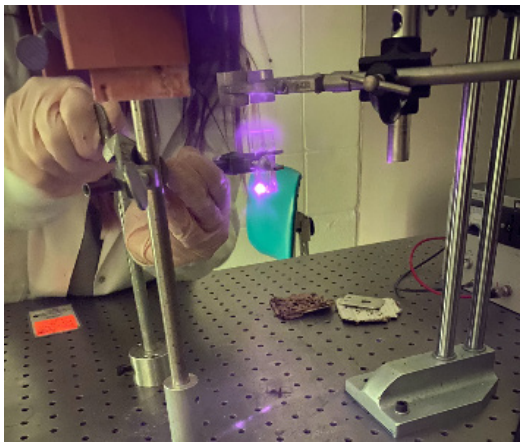
The growing resistance to antibiotics and other forms of infection treatment is becoming a growing threat around the world today. Many infections that at one time were treated with antibiotics are now becoming immune to this form of treatment. According to the Center for Disease Control, at least 2.8 million people are diagnosed with antibiotic-resistant infections every year from which 35,000 die. Additionally, a number of cancer cells are becoming resistant to chemotherapy.

According to the World Health Organization, "antimicrobial resistance threatens the very core of modern medicine and the sustainability of an effective, global public health response to the enduring threat from infectious diseases."

This growing trend is encouraging doctors and scientists to formulate new ways to combat these diseases. Dr. Grégory Guisbiers from the Department of Physics and Astronomy at UA Little Rock and his students are working hard to find a solution using nanomedicine, the practice

of using nanomaterials in medicine. Along with Dr. Thomas J. Webster from Northeastern University, Guisbiers is experimenting with a new method to create pure naked nanoparticles. The nanoparticles are considered "naked" when they do not have any other substances surrounding them.

"The surface of the particle is totally naked, so it can interact very efficiently with the bacteria itself" Guisbiers said.



Inserting the target into the laser beam path

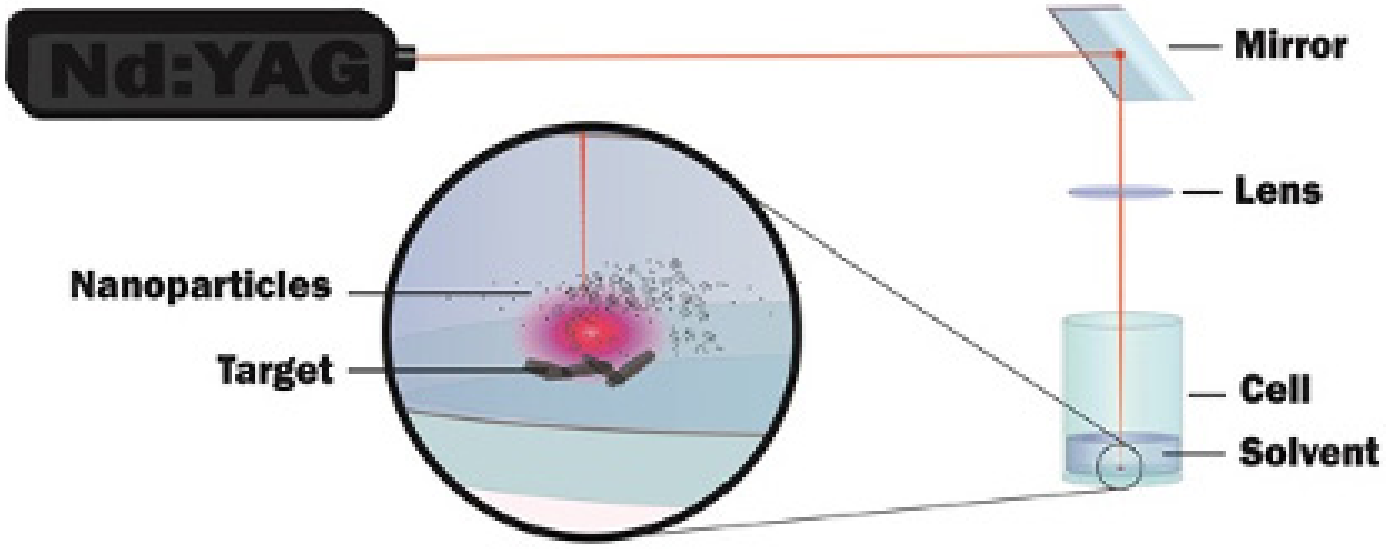
These tiny "naked" nano-drugs are made of selenium, an essential mineral that shows promising benefits in cancer, cardiovascular, thyroid, and disease research. Selenium is a rare mineral found in the Earth's core that has been classified as a critical resource by the American Physical Society and Materials Research Society. The project's research team is making the most of this chemical element by using lasers to create a unique selenium nano-drug.

This eco-friendly method can create nanoparticles sized between a few to several hundred nanometers with various morphologies from spheres to rods or wires. The size and shape of the nanoparticles are controlled by the laser's parameters such as power, fluence, repetition rate, and wavelength. To set up this process, the target made of selenium pellets is placed in a chemistry flask and covered with a solvent, a liquid that allows materials to form a solution. Selenium is a chemical element found in metal sulfide ores and often used in multivitamins. The laser, placed on the opposite side of the flask, shoots to a mirror. The mirror directs the laser down to a lens and onto the selenium pellets. The laser exposes the pellets to radiation, which changes the color of the liquid and produces the nanoparticles.

Once synthesis is complete, Guisbiers and his students send the samples to Northeastern University in Boston to test their anti-bacterial and anti-cancer properties. Before shipment, the particle mixture solution's concentration is determined by Atomic Emission Spectroscopy, a chemical analysis method that determines the amount of particles in the solution.

The research team uses Dynamic Light Scattering to measure the nanoparticles' size.

Currently, the research team has tested the nano-drug on four different strains of bacteria at different concentrations: MRSA, E. coli, S. epidermidis, and P. aeruginosa. As the nanoparticles' concentration increases, the rate of bacterial survival rapidly diminishes. Since the nanoparticles are "naked,"



Graphic detailing the synthesis protocol called Pulsed Laser Ablation in Liquids (PLAL). Credit: Matthew Kisper

they can directly interact with the bacteria very efficiently at a lower concentration than if they were chemically synthesized.

Preparing Students for the Future

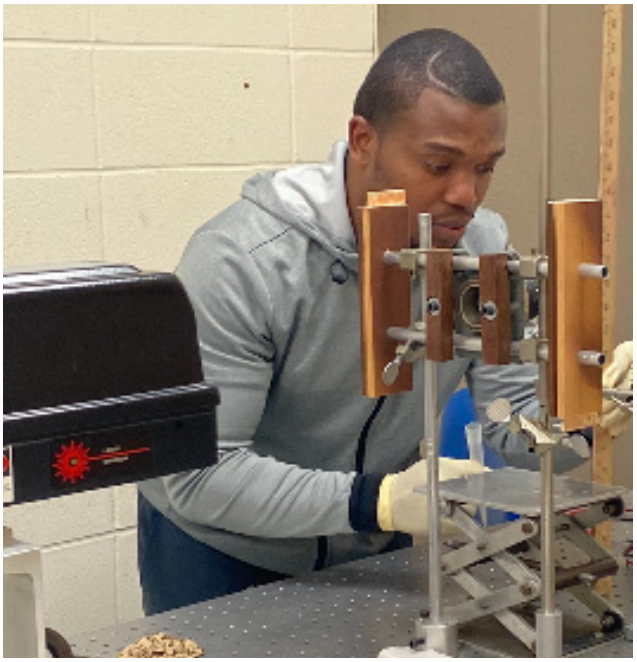
Three graduate and six undergraduate UA Little Rock students are involved in Guisbiers' lab group. They get first-hand research experience by synthesizing the nanoparticles themselves. Not only do they run experiments in the lab and learn how to characterize their own samples, but they also have the chance to collaborate on writing research papers. Dr. Guisbiers keeps pushing his students to publish.

"Whatever your result is, it has to be reported, Guisbiers said. "If it is not reported, your result simply does not exist because it did not reach the community."

Students working with the selenium nanoparticles were credited in the article, "Naked Selenium Nanoparticles for Antibacterial and Anticancer Treatments" published in *ACS Omega*, an international peer-reviewed journal edited by the American Chemical Society.

Several students working with Guisbiers are recipients of the UA Little Rock Signature Research Experience grants. This unique program is designed to inspire undergraduate students to pursue research and creative projects that will enhance their learning experience on campus.

Each recipient receives $1,000 to undergo a research project, creative activity, or community service project. Four students have received this funding to work with Guisbiers on this project. According to



Student Evan Hicks setting up laser area to create nanostructures

Guisbiers, this project is very enticing to students who want to enter medical school after they graduate from UA Little Rock.

"When I ask the students what they want to do, I try to find a project that matches their interest with my interest, so there is a compromise," Guisbiers said. "And they always tell me they want to go to med school or work with nanoparticles that have fancy properties like antibacterial or anti-cancer properties."

Induction ceremony of the 2020 UA Little Rock Student Research and Creative Works Expo with some of the awardees from Dr. Guisbiers' group (From left to right: Tina Hesabizadeh, Atikhur Rahman, Dr. Guisbiers and Patrick Taylor)

The Power of Nanotechnology

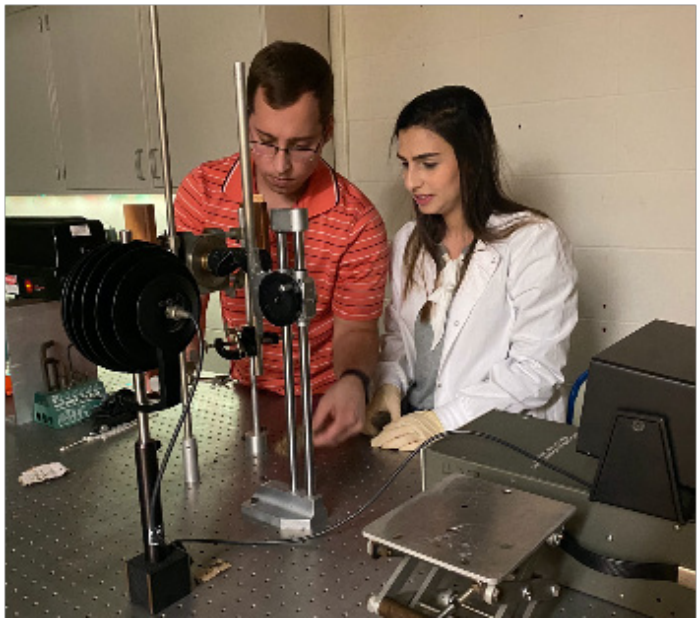
Guisbiers and his students also apply this laser technology to other applications besides nanomedicine. They also create quantum dots, tiny crystals that transport electrons, with this technology. Nanotechnology, he explains, can open the door to new discoveries in materials science due to its ability to modify the main characteristics of materials.

"The main idea of nanotechnology is that when you shrink the size of your material, you're modifying the physical and chemical properties of the material," Guisbiers said. "And we try to bet on that to get new and exotic properties that we cannot get with bulk material, even if it's the same compound… the main idea is to control the size, shape, and composition, so we can tune their properties."

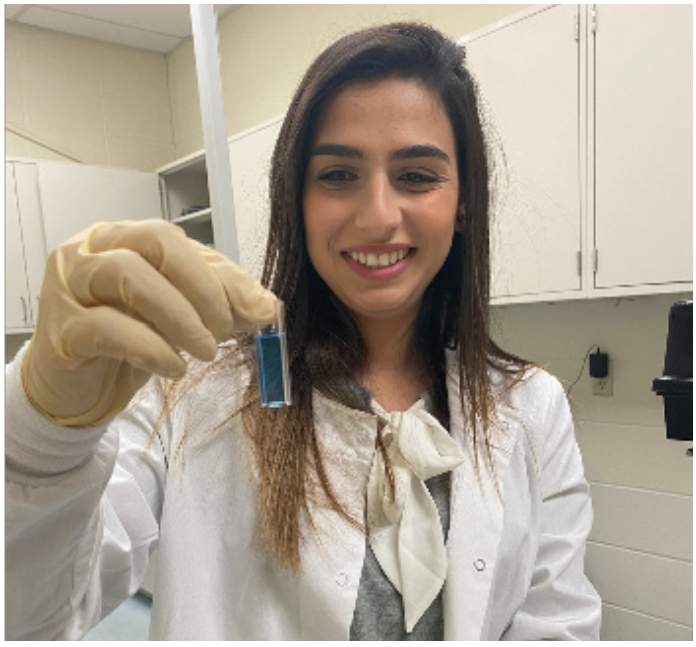
One example he gives is the color change in gold. Once gold has shrunk to a smaller size, the colloidal solution of gold nanoparticles becomes purple. This physical modification fundamentally changed the optical properties of gold.

"When students see that with their own eyes, they get on board immediately," Guisbiers said. "As everybody knows, 'seeing is believing.'"

As he moves forward with his research, he will continue mentoring students and introducing them to new experiments and ideas for using nanotechnology to enhance society, cure diseases, and discover new ways to implement nanomaterials in our daily life. By training a group of future scientists and medical doctors, UA Little Rock students will be equipped with the knowledge they need to move forward with new advances in nanomedicine and other forms of nanotechnology, especially at a time when it is needed more than ever.



Students Patrick Taylor and Tina Hesabizadeh focusing the infra-red laser beam



Student Tina Hesabizadeh holding copper selenide nanoparticles after laser treatment

Open Access Knowledge

Two UA Little Rock professors expand open-source textbook platform

Two decades into the 21st century, the Internet has become an imperative tool in higher education. Students and teachers now have more digital tools than ever before to enhance learning and provide greater opportunities to apply concepts to real-world problems.

Even in 2020, faculty and students are still discovering how interconnected networks can enhance learning and knowledge making. And now that the 2020 pandemic has forced instructors and students into remote learning, this platform has become even more valuable than before.

Going Beyond the Page

Dr. Robert Belford from the chemistry department and Dr. Stefanie Leacock from the biology department are working to enhance the LibreTexts Project system, an open-source interconnected digital textbook platform that allows faculty and students from across the world to develop, share, and access a large library of custom textbooks. Libretexts was created to decrease the reliance on purchasing expensive textbooks and allow students to access quality content in a free, open environment. The project is funded by a $4.9 million award from the U.S. Department of Education to the University of California, Davis. From that funding, UA Little Rock received $90,000 to assist with the project. According to LibreTexts project director Delmar Larson, the goal of the project is to help students save at least $50 million in textbook costs over three years in a thousand classrooms.

"We recognize that millions of students and parents are counting on us to achieve a significant impact through this project, and we are committed to living up to that potential," Larsen said in a 2018 press release.

UA Little Rock is one of the institutions directly involved with LibreTexts. Belford and Leacock are actively enhancing the system by creating annotations and a general tag taxonomy. This annotation system enhances LibreTexts by indexing specific terminology that students can search. Belford began working on the project in 2014 when it started as ChemWiki, a hyper library that only allowed a certain number of chemistry faculty to publish on the pages. Later, ChemWiki expanded into STEMWiki, and incorporated other STEM disciplines. STEMWiki was rebranded to Libretexts when the humanities disciplines were included. Libretexts now includes twelve libraries and has produced 1,100 printable books.

Dr. Robert Belford

Remixing Content

The system allows teachers to modify the textbooks to their student's specific needs. For example, if a teacher wants to apply a section of physics into their chemistry lesson, they can drag and drop a physics concept into their existing textbook. This customizable format allows teachers to specifically tailor their lessons for their students.

"I can mix and match, not only within my discipline, but across the disciplines," Belford said. "So imagine if UA Little Rock had a math class and a chemistry class. The chemistry class had prerequisites in math. Then I could go back and pull in my chemistry book review material from the very math modules that they use within the hyper library."

Libretexts also allows students to directly customize the textbooks through annotations. Hypothes.is is a web annotation system integrated into Libretexts that allows students to discuss specific passages of text that can be filtered and ranked for credibility. It also allows them to tag specific lines of text that will aggregate different links relevant to the content.

Teaching Faculty How to Program

LibreTexts allows faculty and students to create documents, visualizations, live code, narrative text, and equations through its Jupyter Notebook system. This system is an interactive platform that creates content from programming languages such as R and Python.

Belford uses this opportunity to teach students how to input content by coding in these languages, a skill not usually associated with chemistry classes. Students in these classes can search for chemical and bioactivity data from the PubChem database from the National Institutes of Health and input it into their assignments. This merging of chemistry and coding lays the groundwork for new possibilities to use computer science concepts with the traditional sciences.

Dr. Kamran Iqbal from the systems engineering department has incorporated LibreTexts into his online classes. Currently he is using LibreTexts to write his textbook, Introduction to Control Systems. "Overall, I have found LibreTexts pretty easy to use," Iqbal said." There is excellent product support available from the developers."

Dr. Shanzhi Wang of the chemistry department also worked closely with Belford to develop an extensive Libretexts library for UA Little Rock. "In LibreTexts, I was able to put the essential learning materials together in an online textbook to focus students' attention, and include links to more remotely related biochemistry materials, thereby minimizing distraction while still providing additional reading materials for interested students," Wang said.

Dr. Stefanie Leacock

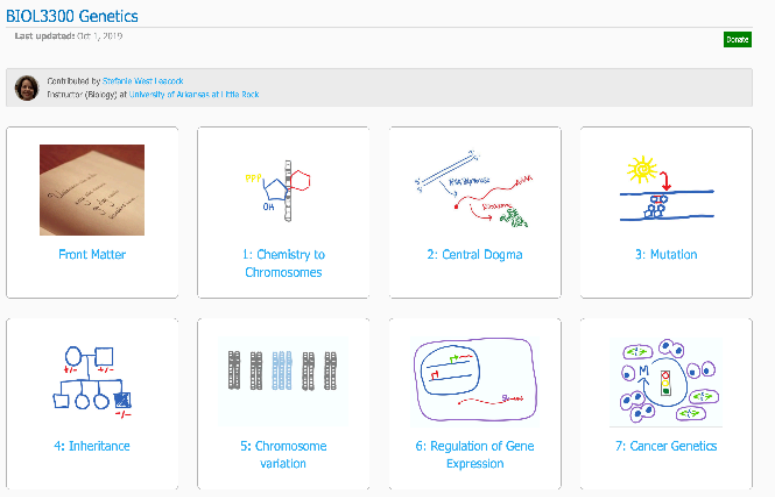
Dr. Noureen Siraj from the chemistry department shares a similar sentiment. "I had a great experience with LibreText and my students also liked that free online resource. I also recommended my students to use LibreText for other courses such as General Chemistry 2 and Analytical Chemistry 1."

Increasing Content

Leacock is a biology professor who uses LibreTexts in her genetics course, a subject she has taught since 2011. When she arrived on the UA Little Rock campus in 2019, she was asked to join Belford on this three-year grant to write content for genetics courses. While LibreTexts houses content for many introductory biology courses, it is still lacking in

genetics material. Her goal in this project is for her genetics class to be completely textbook-free in three years.

One thing she has noticed over the years is how outdated the traditional textbook content becomes as genetics research increases. Libretexts enables her use to use content found in traditional textbooks while supplementing it with current research as new scientific discoveries increase. She was also encouraged to develop videos that are specific to her classes. Creating video content for her class instead of merely posting outside content enables her to connect to her class in a new way.



"This is the way that our students connect to knowledge. They can go on YouTube and search for whatever, but it's not going to be my voice," Leacock said. "It's not going to be the way I explain it in class, the way I communicate with them, or the way I'm going to test them on it. It doesn't matter if there's this great video if I'm not going to question you about that on the test." Leacock believes that LibreTexts enables teachers to cater to diverse learning styles and populations and not rely so much on the traditional learning model.

Because in the end, the most important aspect of learning is fully understanding a subject on a deep level rather than on acquiring surface-level knowledge that solely focuses on memorizing facts.

"We need to, number one, realize that all of our students don't learn that way, especially in a diverse population...and think about what can bring us all together. What are the most important concepts that I would like for you to take from this class?" `

LibreTexts even allows Leacock to easily deliver primary scientific literature for her students by providing links in the course module. From this, they can see current research in real time, something that was not easily available several years ago. "When I was in college, we hardly ever read scientific literature like primary research papers," Leacock said. "And I think part of it was access...but now I can send students links, a lot of articles, or they can get it through the library. So they can have current research in their hand in a way that I never did as an undergraduate."

Leacock is now using LibreTexts in her developmental biology course, which studies the growth and development of plants and animals. She's still discovering how to modify her course content in a way that helps her students, but overall she feels this new platform empowers her to take control of her class in a new and different way.

Instead of beginning her class with concepts normally taught at the beginning of the semester, she's now seeing what topics would best work for her class.

"We need to, number one, realize that all of our students don't learn that way, especially in a diverse population...and think about what can bring us all together."

"In the past I used a commercially available genetics textbook. I know for a fact that many students did not buy this textbook or even check out the reserve copy that I placed on hold at the library," Leacock said. "As such, they were relying on only the information that we covered in class to learn the material."

Leacock understands why some students take this route due to the increased cost of textbooks along with the cost of the class itself. Additionally, a semester-long course can rarely cover all of the contents of a textbook. With LibreTexts, however, Leacock can use a free platform that will only show what they will cover in the course. She has already seen improvements in her students' ability to solve problems on tests.

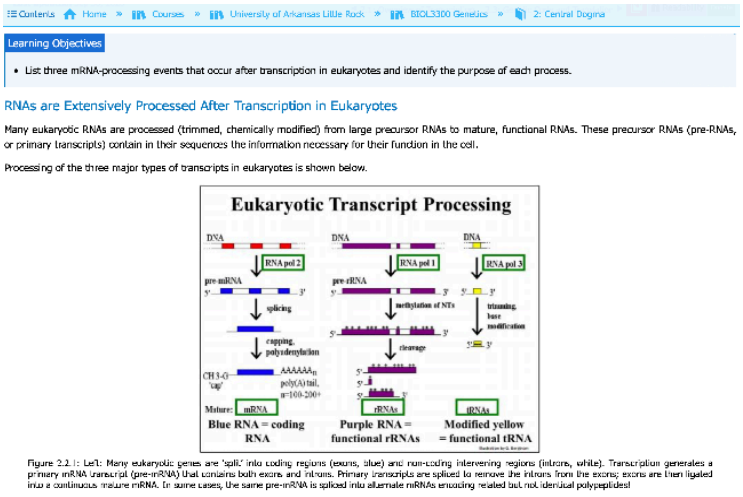


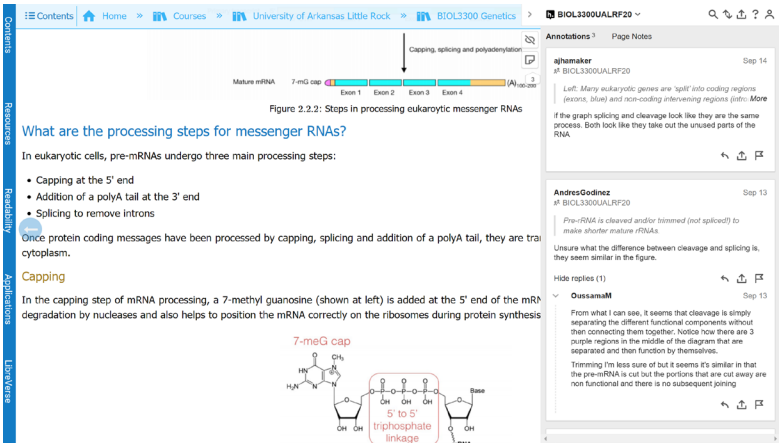
Figure 2.2.1: Left: Many eukaryotic genes are 'split' into coding regions (exons, blue) and non-coding intervening regions (introns, white). Transcription generates a primary mRNA transcript (pre-mRNA) that contains both exons and introns. Primary transcripts are spliced to remove the introns from the exons; exons are then ligated into a continuous mature mRNA. In some cases, the same pre-mRNA is spliced into alternate mRNAs encoding related but not identical polypeptides!

Lesson overview in Leacock's genetics course in Libretexts

Critical Tool for 2020

The LibreTexts project has been an important tool to Belford and Leacock long before the 2020 pandemic, but now that students and instructors are leaning on remote learning, this tool is even more valuable for student success--not only because it's a powerful online platform, but also due to the flexibility that allows students to succeed by tailoring the textbook directly to the needs of the students. According to the LibreTexts Analytics dashboard, Libretexts has received over 496 million hits since its inception. In 2020, the chemistry textbooks alone received 60 million hits.

"I want the students to know that this is made for them and for their success and I think this connects to our goals for recruitment and retention," Leacock said. "I got involved with this grant before COVID, but now the reasons are even more compelling."



Students working out a confusing topic in Leacock's course through LibreText. These comments will be available to future students in the course

Virtual Expo

The 2020 Research and Creative Works Expo quickly adapts to a virtual event

Every year, the Student Research and Creative Works Expo showcases the tireless work of student researchers at UA Little Rock. Students who participate in this event work with a mentor to contribute to a research or creative project and communicate their process clearly and effectively. They are judged based on the quality of their presentation, uniqueness of their research, ability to summarize problems and findings, and the soundness of their methodology.

The event was originally planned to be held in the Jack Stephens Center on April 27, the same location that it was held in 2019. But due to the COVID-19 outbreak, organizers had to move the event to a digital location. Students uploaded their presentations into Whova, a digital event management app that allowed attendees to view and judge research and creative projects just as before in person. Judging took place from April 27-May 1, 2020.

UA LITTLE ROCK
CREATIVE WORKS
EXPO

GRADUATE WINNERS

First Place

Coenrad de Jayer and Marinda Nel
Category: Computer Science and Information Science

Title: Business Process Automation: A Workflow Incorporating Optical Character Recognition and Approximate String and Pattern Matching for Solving Practical Industry Problems

Trigun Maroo
Category: Engineering, Engineering Technology, and Construction Management

Title: 3D Printed COVID-19 Face Masks

Sedre'Auna Griddine
Category: Health Science

Title: Exercise Incentive Programs: Motivation and Longitudinal Effectiveness

Mary Melissa Miller
Category: Humanities

Title: Titan's Venus of Urbino: A New Interpretation

Daniel Nde
Category: Physical Science

Title: Investigating Algae-Derived Reduced Graphene Oxide Membranes for Ionic and Molecular Nanofilters

Iris Denmark
Category: Physical Science

Title: Synthesis of Conductive Materials from Chemically Treated Renewable Carbon Precursors for use in Energy Applications

Brandy Dailey
Category: Service Work and Professional Application

Title: Evaluation of Batterer Intervention Programs as a Tool to Enhance Offender Accountability

Jacob Chisom
Category: Social Science

Title: Diffusion of Climate Change Reducing Strategies in Farmers in Southeast Arkansas

First Place Tie

Michael Appiah-Kubi
Category: Life Science: Research

Title: Controlling the Pore Sizes of Graphene Oxide Nanostructures Through Hydrothermal Reactions for Efficient Water Purification

Second Place

Ramiro Serrano Verget
Category: Computer Science and Information Science

Title: Enhancing User Experience in Custom Closets Prototyping

Second Place Tie

Iris Denmark
Category: Physical Science

Title: Synthesis of Conductive Materials From Chemically Treated Renewable Carbon Precursors for Use in Energy Applications

Ranijitha K.H.
Category: Physical Science

Title: Zinc Oxide Nanostructures Synthesized by a Simple Hot Water Treatment Method for Photocatalytic Degradation of Organic Pollutantsin Water

Third Place

Samantha Macchi
Category: Physical Science

Title: Molasses-Derived Silicon, Phosphorus, and Nitrogen Tri-Doped Carbon (Si-PNDC) as Electrocatalyst in ORR for Fuel Cell Application

UNDERGRADUATE WINNERS

First Place

John Clements
Category: Computer Science and Information Science

TItle: HMD-Nased Teleoperation of Wheeled Mobile Robots

Taylor Green
Category: Creative Work

Title: Uncovering Elaine: The Story of the Elaine Massacre of 1919

Justin Bullard
Category: Engineering, Engineering Technology, and Construction Management

Title: Portable Folding Laptop Stand

Humphrey Wanjala
Category: Health Science

Title: Increased HIF Expression in Macrophages Does Not Influence Leishmania Major Parasite Burden

Carmen Gutierrez
Category: Humanities

Title: Nature vs. Nurture: The Roots of Movement Preferences Amongst Dancers

Chandrasimha Penthala
Category: Interdisciplinary

Title: The Synthesis and Testing of Nanostructured Stainless Steel Wires by In Vitro Antibacterial Studies for Dental Application

Katie Matthews
Category: Service Work and Professional Application

Title: Coming Full Circle to Address Food Insecurity in Pulaski Co. Through Gardening, Education, and Outreach

Claire Herman
Combined Categories: Economics and Education

TItle: Direct-to-Consumer Genetic Testing: Ethical Concerns in the Supply Chain of a Consumer's Raw Material Through DNA Testing

First Place Tie

Grace Guzman
Category: Life Science

Title: Epigenetic Pathways of Radiation Induced Cognitive Injury in a Pediatric Murine Model

Meghan Clark
Category: Life Science

Title: Effect of Oxidative Stress on Programmed Cell Death (Apoptosis) Mediated via Endoplasmic Reticulum Multiple Inositol Polyphosphate Phosphatase 1 (Minpp1)

Jacob Earley
Category: Physical Science

Title: Using Short-Range Photogrammetry for 3D Digital Reconstruction of Arkansaurus Fridayi Fossil Bones

Olgaaurora Rodriguez
Category: Physical Science

Title: Biomass-Derived Nanofiltration Membranes for Drinking Water Purification

Katie Zakrzewski
Category: Social Science

Title: Education as Part of Rehabilitation: The Argument for Potstsecondary Education in the American Prison System, and a Grassroots Campaign Plan to Enact Change in Arkansas

Sadie Goss
Category: Social Science

TItle: Paying for Past Crimes

Second Place

Merak Dyer
Category: Engineering, Engineering Technology, and Consruction Management

Title: Kitchen Appliance Automatic Storage and Retrieval System

Emily Junkans
Category: Health Science

Title: A Linguistic Critique of Considerations for Accent Modification Therapy in Speech Language Pathology

Ryan Ronquillo
Category: Computer Science and Information Science

Title: Reversis: Education in Reverse Engineering Cybersecurity Vulnerabilities

Yanping Harville
Category: Life Science

Title: Toxic Effects of Acetaminophen on Bacteria from a Probiotic Supplement Utilized as a Surrogate for the Human Gastrointestinal Microbiome

Margaret Hardeman
Combined Categories: Economics and Education

Title: The Right to Associate and Educate: A Legal Exploration of the 2019 LRSD Teacher Strike

Second Place Tie

Ashley Walker and Brandy Dailey
Category: Social Science

Title: Evaluating Domestic Violence Batterer's Intervention Programs and Their Potential to Reduce Recidivism for Domestic Abusers

Joshua Williams
Category: Social Science

Title: Arab-Israelis in Evolving Isreali Politics

Jess Brasher
Category: Creative Work

Title: 1,000 Cranes, 10,000 Thoughts: Trans Narrative in Performance

LaDarius Doaks
Category: Creative Work

Title: withIN MOTION: BFA Senior Dance Project
Film Biography

Tyler Kee
Category: Physical Science

TItle: Trontium Isotopic Ratios in Central Arkansas: Insight Into Rock Formation and Water Quality

Hannah Krehbiel
Category: Physical Sciences

Title: Application of Ionic Materials in Organic Solar Cells

Third Place

Trey Chancellor
Category: Engineering, Engineering Technology, and Construction Management

Title: Development, Design, and Testing of "Folding Mobile Carpentry Work Bench"

Yousef Elbalawy
Category: Life Science

Title: Effect of Microgravity on the Expression of Multiple Inositol Polyphosophate Phosphatase

Caroline Kornelsen
Category: Physical Science

TItle: Investigation of Förster Resonance Energy Transfer (FRET) in Ionic Materials (IMs)

Third Place Tie

Joseph Kready
Category: Computer Science and Information Science

Title: Neural Code Search

Matthew James
Category: Computer Science and Information Science

Title: Financial Literacy for Adolescents Through Technology

Purviben Parmar
Category: Computer Science and Information Science

Title: Variations in Outcome for the Same Hadoop Map/Reduce Algorithm Implemented on Difference Platforms

Smart Health Initiatives

Dr. Nitin Agarwal works with other researchers to understand health trends in social media platforms

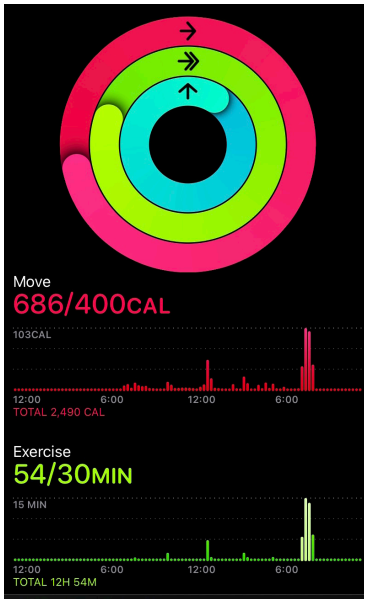
Healthcare in the United States is undergoing a huge transition due to several factors in our society today. One of the largest factors pertains to rising healthcare costs. According to the Centers for Medicare and Medicaid Services, healthcare costs are expected to rise by an average of 5.5% each year for the next 10 years. Hospital care and prescription drug prices are also expected to rise during this timeframe.

Additionally, the rise of consumer health devices and online social groups has created a new paradigm in personal healthcare management. Thanks to personal health trackers such as the Fitbit and Apple Watch, average people now have the ability to track metrics such as heart rate and calories burned. Some devices can even perform an electrocardiogram test. Several users of these devices share their data on social media networks and online forums. These groups can inspire people to exercise more, eat better, and make healthier choices. Several social media users also post pictures of their meals, either from local restaurants or cooked from their home.

Dr. Nitin Agarwal is working with a team of other researchers to capture user data and health habits from social media users in Arkansas and West Virginia. Using the captured data and artificial intelligence, this project is designed to assess common health habits and find distinctive patterns in lifestyle choices. Funded by the National Science Foundation, Agarwal is working with researchers from West Virginia University; West Virginia State University; University of Arkansas, Fayetteville; and University of Arkansas for Medical Sciences.

This four-year project will enable the research team to use artificial intelligence to track public social media posts that show exercise data and food intake. The data from these posts will be stored anonymously without any personally identifiable information included. The idea is not to research health behaviors from specific users, but to understand common health trends from a macro perspective.

"The idea is to compare these two states and find what are the common health behaviors, health attitudes, and then adopt more rigorous approaches



Apple Activity Tracking App

that leverage artificial intelligence and big data to process data streams from disparate sources…" Agarwal said.

The research team will develop artificial intelligence techniques to capture health data produced from fitness trackers and calories ingested from pictures of food posted online. If the meal was eaten at a local restaurant, the data tracker could reference the exact calorie count from their online menu. Currently, this technique is not easy for researchers or data scientists.

"Just measuring the caloric intake from a picture is a massive data science problem, because with pictures, you first have to process them and identify the ingredients," Agarwal said. Are they salty or fatty? So that entails a lot of challenges."

To begin looking for a solution, Agarwal is working with his students to create software that would collect data from social media networks and use machine learning to extract the number of calories from the meal.

"I don't think we're at a stage of predicting what you're going to [eat] tonight, but, based on what you have had, [we can see] how your health or how your choices are impacted, that we can try and assess."

Improving Cardiovascular Health

Researchers in this project are specifically targeting these two states based on their high percentage of cardiovascular diseases and poverty rates. According to the American Heart Association, heart disease is the leading cause of death in Arkansas and West Virginia. Additionally, the rise of cardiovascular healthcare costs places a larger burden on these states due to their increased poverty rates. According to the U.S. Census Bureau, 17.2 percent of Arkasnans and 17.8 percent of West Virginians live below the poverty rate. The research team will use the data to determine if the two states share similar health behaviors.

"Social media provides a macro view of society including, but not limited to, health attitudes, intentions, health conditions, lifestyle choices, overall sentiment, and mood," Agarwal said. " Tapping into such an invaluable data trove is often challenging but rewarding."

Combating Conspiracy Theories

The research team is also focusing heavily on capturing misinformation on health and lifestyle choices on the internet. Agarwal, who has been working in social media research for over 15 years, has worked extensively with the Department of Defense and NATO to identify deviant groups who spread violent propaganda and misinformation on the internet.

The research team will use artificial intelligence to capture health data from public food social media posts. If a restaurant is tagged, they can potentially find the exact calorie intake from the menu

UA Little Rock COSMOS Team

He is also the director of the Collaboratorium for Social Media and Online Behavior Studies (COSMOS) at UA Little Rock, an extensive social media research center that investigates deviant groups, behavior modeling, and social-cyber forensics.

With this cyber forensic background, he wants to identify groups and research the factors that play into spreading health and lifestyle misinformation, such as anti-vaccination campaigns.

"Health misinformation is rampant on social media," Agarwal said. "Several groups have perpetuated phony theories regarding vaccination and autism. These groups claim that vaccinations have led to the rise of autism among kids. Similarly, there are conspiracy theories that have tied statins to cancer, thereby adding anxiety and hesitancy among heart patients towards the drug. Statins are often prescribed to lower cholesterol levels to prevent cardiovascular disorders. Research is needed to better understand why such misinformation can be convincing, despite lacking scientific support for their claims."

Because the Internet and social media networks are still a type of "wild west," Agarwal believes it is important to sift through the noise of misinformation and conspiracy theories in order to advance reliable public health knowledge.

Agarwal works with Dr. Don Adjeroh, Professor and Associate Chair at the Lane Department of Computer Science and Electrical Engineering at West Virginia University. Adjeroh is the lead principal investigator on the project. According to Adjeroh, this project has become even more essential during COVID-19.

"COVID-19 is providing another major challenge for health misinformation," Adjeroh said. "Dr. Agarwal's work in the project is already providing tools for tracking and studying different types of misinformation related to COVID-19."

Training for the Future

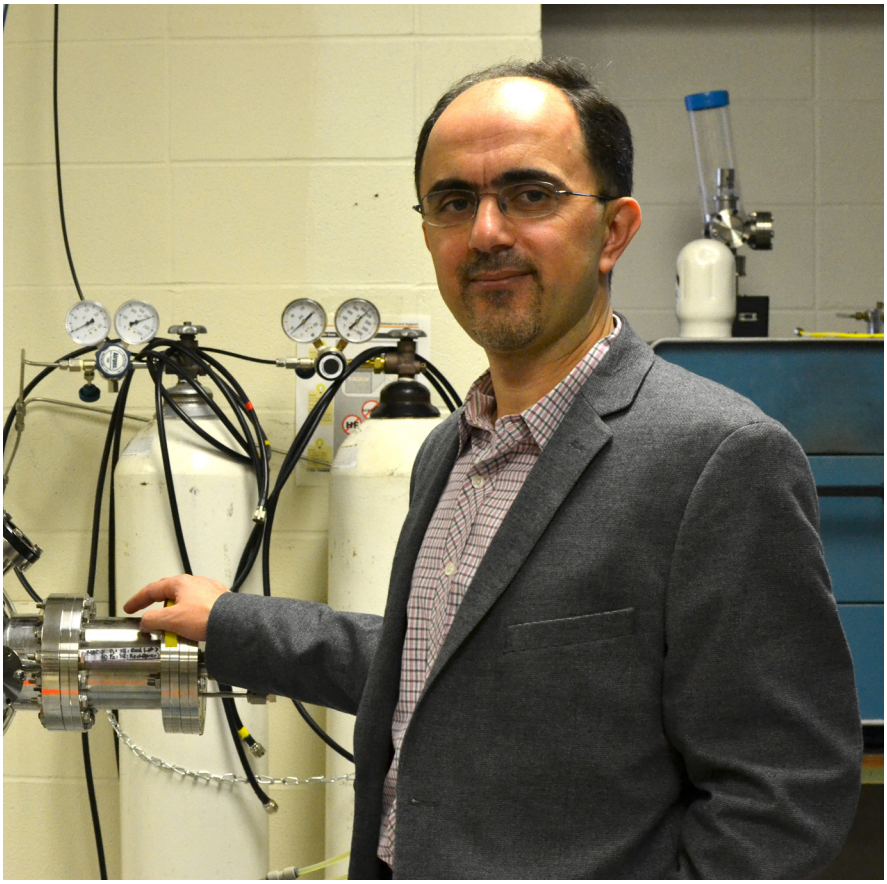
As the project progresses, the research team will hold various workshops to train students and physicians on their process to track this specific data while maintaining privacy and security. In these workshops, they will also help participants find meaningful and reliable social media data.

"These workshops and seminars will prepare graduate students and even the professionals who would like to work in this area about those challenges," Agarwal said. "They will also be prepared in how to address those challenges and discover the tools at our disposal to work in this domain, this high dimensional, high-volume data domain. But then eventually, [they will discover] how all of this data mining process can help you with insights that can help our health professionals make smart decisions."

According to Adjeroh, "already, the research team has held the first of such workshops and seminars. As part of the project, the team held a virtual Summer School on Artificial Intelligence and Smart Health hosted by West Virginia University in July 2020, which attracted over 350 registered participants, from 30 states in the US, and 28 countries." Dr. Agarwal and members of his Collaboratorium (COSMOS) delivered a lecture on social network analysis at the summer school.

In the future, the research team wants to expand this project to the rest of the nation and, eventually, the world. By starting small, they can tweak the systems to ensure what works and what doesn't work, Agarwal said. "The idea is to start local and grow global."

Project is sponsored by the National Science Foundation under Award Number 1920920. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation



Dr. Tansel Karabacak

In Hot Water

Dr. Tansel Karabacak creates supercapactiors using hot water treatment

More than ever, scientists are continually looking for new solutions in energy technology, not just in the products they create, but in the way they are created. In energy production, the process is just as important as the product itself, from the materials used to generate the objects to the byproducts created during the production process. Finding the best solutions to these workflows are essential to an effective fabrication process that uses sustainable, cost-effective methods to create energy resources such as batteries, fuel cells, solar energy cells, and wind turbines.

Super Power

One promising energy resource that scientists are looking to are supercapacitors, small cells that store energy similar to batteries. Unlike batteries that store energy using chemicals, however, supercapacitors use static electricity. They are often found in many different forms of technology such as computers, digital cameras, and smartphones. They can also be combined with other energy sources to enhance energy storage and usage. For example, they can be combined with batteries for even greater amounts

of energy storage. They can also be combined with fuel cells to increase acceleration in electric vehicles. NASA is specifically interested in this technology for space vehicles and space stations. According to the NASA Rocketology webpage, supercapacitors are appealing for this area due to a myriad of factors. First, they have no moving parts, as opposed to batteries that carry liquid. This enables the supercapacitor to handle harsh conditions and usage. Secondly, they don't overheat, so they can handle the most stressful levels of work.

One of the most promising ways to create supercapacitors is with metal oxides, chemical compounds that are created with metal and oxygen that can be used as semiconductors. Currently, however, it's difficult to increase their usage due to their high manufacturing costs and reliance on toxic and carbon-based materials.

Hot Water Treatment

Dr. Tansel Karabacak, Professor of Physics at UA Little Rock, is tackling this problem with other researchers across the state by applying new methods of creating inexpensive, eco-friendly metal oxides. He's specifically working with the NASA Established Program to Stimulate Competitive Research (EPSCoR) program to create these metal oxides simply by using hot water treatment methods. Karabacak is working with Dr. Daoyuan Wang from the University of Arkansas at Pine Bluff in this project. NASA-EPSCoR is a program designed to stimulate competitive aerospace research in the state of Arkansas.

This alternative method can grow metal oxide nanostructures by simply immersing a piece of metal in hot water without using any chemical additives.

"Humans have been exposing metals to hot water for centuries without realizing they could be producing nanostructured metal oxides." Karabacak said. "We have very recently revealed the hot water treatment method as a new and simple way of synthesizing nanostructured metal oxides of various kinds and it presents numerous application opportunities. In this NASA project, we are currently investigating supercapacitor applications due to the high surface area that metal oxide nanostructures (we call them as MONSTRs for short) offer that enhance the charge storage of a capacitor. It is like a tree with lots of small leaves helping the tree capture more sunlight. In our case, we try to capture and store more electrical charge on the surface of MONSTRs."

The research team will synthesize nanostructured copper oxide surfaces and investigate their charge capacity performance. They will also assemble proof-of-concept supercapacitor cells and perform the device tests. "Hot water treatment is very simple from the process point of view. However, the mechanisms of nanostructure formation are not well understood." Karabacak said.

The research team will investigate the chemical and physical mechanisms that can potentially affect the growth dynamics of MONSTRs. The team will study the effects of temperature, dissolved oxygen level, and water purity in these mechanisms.

Additionally, the research team is using a second technique called hot water deposition to create the metal oxide nanostructures on a variety of surfaces.

In this method, both the source metal material and the targeted surface are immersed in hot water. This method allows metal oxide nanostructures to grow on unique surfaces such as mesh, foam, cloth, or glass.

State Collaboration

This collaborative project will enable students from across the state to work on unique aspects of materials science, chemistry, and physics. At UA Little Rock, Dr. Karabacak and his students will prepare the metal oxides nanostructures and conduct material characterization tests. Dr. Wang and his students at the University of Arkansas at Pine Bluff will focus on measuring the electrochemical properties of these metal oxides and performing proof-of-concept supercapacitor cell fabrication and device tests.

As the research team continues to refine this technology, they will be able to find an important solution that can affect not only NASA, but society in general as we continue to look for new ways to produce inexpensive, non-toxic, and eco-friendly energy sources.

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