January 2023

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Computer Careers

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Fine-tuned science

James Webb Delivers





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The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEAM learning opportunities and connecting them to Technology Association of Georgia (TAG) resources. Formerly the TAG Foundation, TAG-Ed is a 501(C)(3) non-profit organization formed by TAG in 2000. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEAM education in Georgia.

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English Class is STEM BEVERLY CLAYTON

Computer Science

Desalination STAFF CONTRIBUTOR

Nina Balke - Fine-tuned science ASHLEY C. HUFF / ORNL Happy New Year! Welcome to the first issue of Georgia Pathways Magazine for 2023.

With every new year comes new opportunities, especially for those preparing to enter the workforce or learn new skills. While achieving a certain level of academic rigor is considered an important aspect of career preparedness for students, more and more importance is being placed on the value of experiential learning. As a result, internships and apprenticeships have become essential ways for candidates to make themselves stand out in the labor market.

By partaking in an internship, students get the opportunity to not only gain first-hand experience in the working world but also understand the career trajectory of their desired profession. Starting March 1st, TAG-Ed will be seeking students with the desire to continue their post-secondary studies in a STEM-related field to join our summer internship program, which we have extended to include both high school and college-level students. We will also be seeking companies interested in training their workforce in accordance with the needs of their industry, ensuring access to a pipeline of qualified talent.

While the importance of internships is largely undisputed, apprenticeships have yet to be widely adopted outside trade industries, despite their long history in the U.S. However, they provide a great way for young talent to gain hands-on experience while being compensated.

Employers across the United States recognize the benefit of hiring apprentices, especially for technology-based positions such as cyber Technology Association of Georgia



security. According to the Department of Labor, there are currently 714 registered apprenticeship programs and 42,260 apprentices in cybersecurity-related occupations. Since Jan. 20, 2021, 199 new programs have been created — a 28% increase.

TAG-Ed hosts a statewide technology apprenticeship program to meet the demands of the tech industry's workforce, and applications are now open. Be sure to visit the website to apply for an apprenticeship and gain training, certification and placement.

No matter what opportunities or challenges come our way this year, one thing is certain: Georgia's incredible STEAM community has the ingenuity and determination to face them head on. Here's to a successful and fulfilling year ahead!

Larry K. Williams President TAG / TAG-Ed

Larry K. Williams serves as the President and CEO of the Technology Association of Georgia (TAG) and President of the TAG Education Collaborative (TAG-Ed). TAG-Ed's mission is to strengthen Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting Technology Association of Georgia (TAG) resources with leading STEM education initiatives. Watson Orchestrate

Put talent and diversity at the center of the recruiting experience with ThisWay® Global & IBM®

Technology Association of Georgia (TAG) Ed has established a strategic partnership with IBM & ThisWay to provide members with a streamlined talent acquisition solution.

TAG members can now utilize an IBM Watson Orchestrate[™] digital worker (digey) and ThisWay's platform to improve their workflow, increase organizational diversity, and instantly identify top candidates for every job.

BENEFITS



Increase your efficiency

Assign your digey the mundane tasks that slow down your workflow.



Optimize reach

Create and post new job opportunities to attract qualified, diverse talent.



Expand your resource pool

Instant access to 169 million diverse candidates.



Assess candidates

Quickly surface qualified candidates for your open jobs based on your criteria.

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Diversify your talent network

Source from our network of over 8,500 diversity-based organizations.

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Use fair recruitment practices

Reduce bias and increase organizational diversity.





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Discover the technology that over 5,000 companies are using to build their talent pipeline for 2023.





James Webb space Telescope Delivers

On station and working hard.



Georgia Pathways Magazine has been following the James Webb construction since 2017 as is an excited as anyone about being on station and working hard to inspire and deliver answers and more questions about our universe.

JWST offers never before seen resolution and sensitivity from long-wavelength (orange-red) visible light, through near-infrared to the mid-infrared (0.6 to 27 micrometers). While Hubble has a 7.9 foot mirror (light collector), the JWST features a larger and segmented (multi-part) 21 foot primary mirror.

The **Canadian Space Agency** also played a big part in this project along with an international collaboration of about 17 countries led by the NSA, and with significant contributions from the European Space Agency. It is named after James E. Webb, the second administrator of NASA, who played an integral role in the Apollo program.

JWST's capabilities enable a broad range of investigations across the fields of astronomy and cosmology. One particular goal involves observing some of the most distant events and objects in the Universe, such as the formation of the first galaxies. Another goal is gaining a better theoretical understanding the formation of stars and planets. The fuel capacity is designed for a ten year mission, we hope, compared to over 25 years so far for the Hubble Telescope. The Hubble cost was about 2.5 Billion dollars where as the James Webb has cost 8.7 Billion dollars.

Keep in mind that what we see when we look up at the stars at night, are the light and events that happened millions of years ago and that light is just now getting here. Visible light waves travel at about 670,616,629 mph (miles per hour). How fast is that? A person traveling at the speed of light could circle the earth 7.5 times in one second. By comparison, a person in a jet aircraft, moving at a ground speed of 500 mph, would cross the United States once in 4 hours.

The light from our nearest neighbor star, Proxima Centauri, is 4.2 light years away.

So let's do the math: How many miles does light travel in one Earth year?

Hint: Multiply light miles per hour (given in last paragraph) times hours in a day times days in a year. The answer is how many miles per year light can travel.

Now multiply that answer times 4.2 and **that's how many earth miles it is to our nearest neighbor star.** A really big number (write it down).



Astronomy measures positions, luminosities, motions and other characteristics

For advanced or really curious students, take it to the *next level*:

We can only travel at about 24,000 miles per hour in a current space craft with our technology.

So take your answer of how many Earth hours it takes to get to Proxima Centauri, Divide *by how fast we can go....*24,000 miles per hour

Divide by hours in a day

Divide by days in a year

Your answer: You get how many of our Earth years it would take to get to Proxima Centauri. Now that we've figured that out, it's about 70,000 light years to our nearest neighboring galaxy. A telescope sounds like a much better idea.

The JWST will operate near the Earth-Sun L2 (Lagrange) point, approximately 930,000 mi (1,500,000 km) beyond the Earth. A Lagrange point is a location in space where the combined gravitational forces of two large bodies, such as Earth and the sun, equal the centrifugal force felt by a the telescope. The interaction of the forces creates a place of equilibrium or balance where a spacecraft or telescope may be "parked" to make observations.

By way of comparison, Hubble orbits 340 miles (550 km) above Earth's surface, and the Moon is roughly 250,000 miles (400,000 km) from Earth. This is too far away for us to repair it or make changes, so we have to get it right before launch. Objects near this point can orbit the Sun while remaining in a constant position with the Earth, allowing the telescope to remain at a roughly constant distance and use a single sunshield to block heat and light from the Sun and Earth.

This has already been a very exciting visual exploration "deep" into space, showing us new and never before seen images of our universe.....gathering lights from about 13 Billion years ago that's just now arriving at Earth. To the right is an image of a protostar and its dark cloud, both named L1527, are located in the Taurus star-forming region some 460 light-years from Earth. Scientists estimate L1527 to be around 100,000 years old, which is relatively young in star terms—this hot, bright celestial body still has a long way to go before it becomes a full-grown star. (Our sun, meanwhile, is around 4.6 billion years old.) Researchers consider L1527 a class 0 protostar, which represents the earliest stage of star formation.

Eventually, L1527 will create its own energy via the nuclear fusion of hydrogen, which is a hallmark of stars. But for the time being, it's still an unstable, puffy bundle of gas that's continuing to gather mass. For comparison, L1527 is around 20 to 40 percent the mass of the sun.

Take some time and explore the career opportunities that involve astronomy and its related professions. Perhaps you will discover an area of interest you had not considered before. If nothing else, invest in a small and affordable home telescope and be awestruck by what you can see from your own back yard.



English Class is totally STEM

Integration into your class today and everyday is vital

by Beverly Clayton

"My class is not a STEM class. I'm an English teacher."

If I may, let me gently correct you. Yes, you are a STEM teacher as you are using, expecting and encouraging *STEM skills* with every assignment, lecture and test.

Science is the "systematic accumulation of knowledge" and is <u>absolutely neces-</u> <u>sary</u> for any term paper, history lesson or learning evaluation. So, there is the "S" in STEM. The use of Google, online libraries, computer and software use, all of which are a daily part of your class and homework assignments is obviously the "T" for technology. They are only "users" of the technology rather than innovators, but still attached to the "T".

"E" for engineering is the use of the engineering method (a decision making process) that make a term paper or other writing assignment impossible to accomplish without. Simple decisions about how to organize and prioritize content is a perfect example of that method. We use it 10 times a day if not more, and English class is no exception. Math, the "M" of STEM is also used to a lesser degree perhaps, but used non the less. From a simple "word count" calculation, which happens to tie in closely to the engineering method of decisions, to statistics, dates, time spans and more, some level of basic math is included.

Here we have shown how STEM skills are a regular part of the typical English class. The question remains, is the English teacher even aware of this. I'll stick my neck out and suggest "no", not for most. Why not?



It may be a simple lack of awareness, which happens to be a primary objective of STEM Magazine. "But why should I really care?"

Students NEED to see the practical connection between what is being taught and why they need to learn that information. Name one career that does not require some form of written communication daily, either from filling out forms or sending E-mails to clients or preparing written presentations to acquire new customers or clients?

The skill set needed is not just creative writing, but the *complete set* of STEM skills and more importantly, the knowledge that they are <u>using them.</u>

Aside from your curriculum, this too is your responsibility to adequately prepare your student to enter the work force.

Here is your "Verbal Integration" opportunity and it only takes about *30 seconds*.

• Bring to the attention of your students that they are using a type of science to do their assignment (*the systematic accumulation of knowledge*).

Now they begin to make a conscience connection between the assignment and the "S" in STEM. The journey begins. If you have another 30 seconds, ask someone to name any job that requires writing something regularly. This simple and "non-curriculum" type of integration and awareness has value far beyond our understanding, both for the educator, student and parent.

You're smart enough to make these types of connections in your subject field so I'll end the article here, but our responsibility as educators to prepare our students goes well beyond our specific subject field and this type of easy integration should not be a burden to any of us. Fact is, it can be fun and potentially improve the performance of students as they make these connections early in their scholastic development.





TACKLING THE GREAT TEACHER RESIGNATION – ONE TEACHER AT A TIME

By Nancy George / SMU



College students like Mary Cabanas are in the pipeline to relieve the impact of widespread teacher resignations threatening U.S. public education. But what sets Cabanas apart is that she will enter a tough profession with her eyes wide open, thanks to determination, mentorship and training from SMU's Simmons School of Education and Human Development.

"Ongoing problems in education have been magnified by the pandemic and the political division in the U.S.," says Stephanie Knight, Simmons School dean. "And previous approaches to solving the teacher shortage, like alternative certifications, haven't worked."

Teachers need to develop knowledge and skills in the classroom early in their teacher education, Knight says. They also need higher pay and to be treated like professionals, which includes the opportunity to be collaborative and creative, Knight says.

Cabanas' trajectory as an education student may be a model for other students. She has taken collaboration with other future teachers into her own hands, forming SMU's first student organization for education majors. But instead of taking field trips and hosting guest speakers, each week the Hilltop Educators meet to discuss controversial subjects in education, like book bans and school shootings.

The senior mathematics and education major has been planning to become a teacher since 8th grade. She worked in a classroom early, observing and even teaching a pre-K class as a future teacher intern in high school. At SMU, she is a recipient of the Noyce Teacher Scholarship, which commits her to teach math at a high-need school after graduation in exchange for a scholarship funded by the National Science Foundation.

Mentorship by Noyce Scholar faculty sponsors has opened other doors for Cabanas. On Saturday mornings, she can be found on campus assisting in an education research project comparing the effectiveness of using iPads vs. virtual reality to teach geometry. She also spent a summer researching best practices in math education by watching videos of math teachers and coding their teaching practices.

In addition, Cabanas helped analyze the effectiveness of demonstrating to students how workers use math in their careers. "I'll take what I've learned from research into my classroom," Cabanas says.

Participating in education research gives Noyce Scholars the opportunity to be part of a larger academic community dedicated to bringing evidence-based practice to education, says Annie Wilhelm, one of Cabanas' Noyce Scholar mentors and an associate professor of teaching and learning at SMU's Simmons School.

"Research gives students the opportunity to connect what they are learning in class with the K-12 classroom," Wilhelm says.

Cabanas' motivation is personal – she wants to teach because teachers made a difference in her life. She moved with her family from Mexico to Texas and, as a 12-year-old middle schooler, faced the challenges of 7th-grade along with the task of learning English and settling in to Garland, Texas.



"My teachers saw my potential," she says. *"As a newcomer, I was scared. It helped to know there were adults who were there for me."*

Cabanas should find plenty of teaching openings when she graduates. Almost two in five teachers plan to quit in the next two years, according to a June survey of members of the American Federation of Teachers. After graduating in May of 2023, Cabanas plans to begin work at SMU on her Master's degree in math education while completing her student teaching in fall of 2023. Her dream is to teach math at North Garland High School, where her teachers were so influential to her.

"I have to do this for the next generation," she said. "If not me, who will?"



Teacher A needed STEM career



Top Reasons

Computer Science is the Best Subject To Study for Success in the 21st Century

By Mike Blackwell

Success in the 21st century is largely determined by a person's ability to use computer-based systems. Computer science has been ranked as the top subject for success according to Forbes, and it's also one of the most in-demand jobs in today's economy, with all types of industries looking for skilled professionals.

Since there is a global shortage of tech workers, people with these skills can often command high wages, enjoy a positive work environment, and a rewarding career. By 2030, there might be a global shortage of 85.2 million software engineers.

Computer science is a highly sought-after field of study. There are so many reasons why more and more students are flocking to this subject. But what makes it stand out from the crowd? Let's take a look at the top reasons why you should study computer science if you're considering your future career options.

A Future Ready Skill Set

As technology continues to advance, demand for qualified workers will continue to increase. This imbalance between available jobs and qualified labor has resulted in a large opportunity for students who are considering pursuing a career in computer science.

In a world that is rapidly digitizing, careers in computer science are becoming increasingly important. With a skill set that is both in demand and versatile, learning to code is a brilliant investment of time and effort. As this digital realm continues to evolve, the role of computer science in schools becomes evermore crucial, as the next generation will need to be well versed in this field. There are many reasons why studying computer science is a valuable investment. Not only will you gain awesome technical skills for your future career, but it also opens the door to a variety of nontraditional careers.

It's In Demand

It seems that with every development, machines are taking on new tasks and becoming more intelligent. Computer science is a very in-demand subject; it's a growing field that the Bureau of Labor Statistics projects will grow 15% from 2021 to 2031, much faster than the average for all occupations." This is due to the fact that computers, smartphones, and other devices are an essential part of modern life. More and more people are using these devices every single day, which means that more and more jobs are opening up in the computer science fields.

If you think that demand is high now, just wait until you see how many computer science jobs there will be in the future. 682,000 new jobs are expected to be created during the decade. This might seem like a no-brainer, but it's always better to study something that is in demand. It means there will be plenty of jobs available for you once you graduate.

Computer science is a very popular subject, and is used in almost every industry, from finance to healthcare. It will give you skills that are applicable to many different jobs. The US Department of Education reports that from 2011-2021, the number of computer and information sciences bachelor's degrees grew 144%.

According to the Computer Technology Industry Association, the global information tech industry reached a value of \$5 trillion. Imagine that one dollar equaled one penny. If you changed \$5 trillion into 5 trillion pennies, those pennies could stack from the earth to the moon over 20 times.



Code.org says that 90% of parents believe that their local high schools should offer computer science classes to their students. Plus, lots of parents, teachers, and principals believe that studying computer science is as important or more important than studying "math, science, history and English."

As the demand for computer scientists is so high, you can expect to make a good salary. People with tech skills often commend better wages than their non-tech peers. While every industry has different salary ranges depending on the particular job, occupations related to computer science tend to pay above the norm. Computer support specialists make an average of \$57,910 per year, web developers earn an average of \$78,300 a year, and computer scientists average \$131,490 annually. For computer scientists, that works out to \$63 per hour.

Computer Science Is A STEM Subject

Since we've talked about what makes computer science so great and the fact that it's in demand, you may be wondering: is it really a STEM subject?

While many people study subjects that aren't relevant to the modern world, computer science is a STEM subject. It's a great subject to study if you want to pursue a career in science, technology, engineering or mathematics. It will give you a solid foundation in these subjects, so you can pursue a career in any of these areas. Computer science is great if you want to pursue a career in a tech company. But if you want to work in the healthcare field, you can still study computer science. It will help you build the analytical skills you need to be successful in any STEM job. If you're torn between two fields and you're not sure which one to study, computer science can be a great option.

Many Career Path Options

Computer science is a great subject to study if you want to pursue a career in tech. You can also become a software engineer or a computer programmer if that's your goal—two jobs that are in high demand. If you want to pursue a career in the healthcare field, you can become a data scientist. There are many other non-tech-related career paths for computer scientists as well. If you want to pursue a career in the finance field, you can become a financial analyst, manager or CEO one day, you can study business. The options are endless.

Britannica defines "computer science" as "the study of computers and computing, including their theoretical and algorithmic foundations, hardware and software, and their uses for processing information." Significant numbers of young people are entering the field as exciting big trends in computer science continue to grow. Some include:

- Artificial Intelligence
- Medical Technology
- Cloud Computing
- Cybersecurity
- Quantum Computing
- Robotics
- Virtual Reality
- Augmented Reality
- Banking
- Statistics
- App development
- Education
- Research and Development



Computer Science Education

According to the "2022 State of Computer Science Education", only 7.3% of elementary school age students and 3.9% of middle school age students enrolled in at least a foundational type computer science class. The number of high school students who enroll in any computer science classes is similarly low. Even though the demand is very high, there should be more students getting a computer science education.

Beyond schools, another avenue to study computer science is through a company. The private sector (businesses) provide a number of good options to study computer science. Computer languages like Python, Java, and Javascript can be learned from high quality providers. Some schools even use fun games like Minecraft and Roblox to teach coding skills.

Computer Science Helps Build Problem-Solving Skills

Not only is computer science a great subject to study if you want to pursue a career in tech, it's also a way to build essential problem-solving skills that can be applied to many different careers. If you want to pursue a career in the medical field, problem-solving is essential. As a computer scientist, you'll learn how to use logic and reasoning to solve complex problems. These skills will be useful in many different fields, including healthcare, finance and business. As you study the core concepts of computer science, you'll learn how to solve complex problems.

This is a skill that you can use in any career path, whether you pursue a degree in computer science or not. You can use these skills to solve problems in your personal life, as well as at work, which can help you advance in your career.

Computer science is the perfect subject to study if you want to pursue a career in tech, or if you want to try something new. It's a very popular subject, and one that is in high demand by employers. There are so many different career paths you can take with this type of education, and it will also help you build essential problem-solving skills.

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Desalination

The Chemical Process and Breakthroughs

Desalination, also called desalting, is the removal of dissolved salts from seawater and in some cases from the brackish (slightly salty) waters of inland seas, highly mineralized groundwaters (e.g., geothermal brines), and municipal waste-waters.

This process renders such otherwise unusable waters fit for human consumption, irrigation, industrial applications, and various other purposes. Existing desalination technology requires a substantial amount of energy, usually in the form of fossil fuels, and so the process is expensive.

For this reason it is generally used only where sources of fresh water are not economically available. In addition, the amount of greenhouse gas emissions and brine wastewater generated by desalination plants pose significant environmental challenges. The desalting of seawater is an ancient notion. Aristotle described an evaporation method used by Greek sailors of the 4th century bce. An Arab writer of the 8th century produced a treatise on distillation. In the 19th century the development of steam navigation created a demand for noncorroding water for boilers, and the first patent for a desalination process was granted in England in 1869.

The same year, the first water-distillation plant was built by the British government at Aden, to supply ships stopping at the Red Sea port. The first large still to provide water for commercial purposes was built in 1930 in Aruba, near Venezuela. By 2019 about 18,000 desalination plants producing a total of more than 95 million cubic metres (in excess of 3.4 billion cubic feet) of potable water per day were in operation throughout the world.



Desalination processes

Desalination methods can utilize either thermal processes (involving heat transfer and a phase change) or membrane processes (using thin sheets of synthetic semipermeable materials to separate water from dissolved salt).

Multistage flash distillation is a thermal process for desalting relatively large quantities of seawater. Based on the fact that the boiling temperature of water is lowered as air pressure drops, this process is carried out in a series of closed tanks (stages) set at progressively lower pressures. When preheated seawater enters the first stage, some of it rapidly boils (flashes), forming vapor that is condensed into fresh water on heat-exchange tubes.

Fresh water is collected in trays as the remaining seawater flows into the next stage, where it also flashes, and the process is continued. One of the largest of these systems, located in Al-Jubayl, Saudi Arabia, can produce more than 750 million liters (200 million gallons) of desalted water per day.





In small communities where salt water and intense sunlight are both abundant, a simple thermal process called solar humidification can be used. The heat of the Sun partially vaporizes salt water under a transparent cover. On the underside of the cover, the vapor condenses and flows into a collecting trough. The principal difficulty in this process is that large land areas are required, and energy is needed for pumping the water.

Another *thermal process* makes use of the fact that, when salt water is frozen, the ice crystals contain no salt. In practice, however, objectionable amounts of salt water remain trapped between the crystals, and the amount of fresh water needed to wash the salt water away is comparable to the amount of fresh water produced by melting the crystals. *Membrane* processes for desalting include reverse osmosis and electrodialysis. Of the two, reverse osmosis is the more widely used, particularly for desalting brackish waters from inland seas. The salt content of brackish inland water, though undesirable, is considerably below that of seawater.

Electrodialysis uses electrical potential to drive the positive and negative ions of dissolved salts through separate semipermeable synthetic membrane filters. This process leaves fresh water between the filters. In reverse osmosis salt water is forced against the membranes under high pressure; fresh water passes through while the concentrated mineral salts remain behind. To conserve space, the membranes are packaged in multiple layers in a collection of long tubes.

Innovation Is Here





Mina Balke - Fine-tuned science

By Ashley C. Huff / ORNL

When Nina Balke came to the United States on a Feodor Lynen Fellowship for German scholars, her original plan was to complete a year abroad and return home to native opportunities in materials sciences. Nearly 12 years



ORNL scientist Nina Balke uses scanning probe microscopy to explore materials' nanoscale properties and push boundaries in nanomaterials for energy applications. Credit: Genevieve Martin/Oak Ridge National Laboratory; U.S. Dept. of Energy

later, she is still probing the nanoscale properties of materials at the Department of Energy's Oak Ridge National Laboratory and seeking outdoor adventures in the Tennessee Valley.

As a researcher at ORNL's Center for Nanophase Materials Sciences, a DOE Nanoscience User Facility, Balke explores avenues for fine-tuning materials' physical properties to solve energy challenges and expands fundamental research opportunities for CNMS users. "The approaches we are developing at the CNMS to characterize materials bring new experimental capabilities to the science community and enable discoveries that have not been possible before," she said.

BEYOND OFF-THE-SHELF

Supported by the Office of Science, Balke develops microscopy and imaging techniques to study materials at infinitesimal surface dimensions of 10–100 nanometers, the length scale just above atoms—which are tenths of nanometers in diameter—but well below the visible spectrum.

At the nanoscale, materials demonstrate unusual properties that are very different from those observed at the visible scale. Nanosized materials are often stronger, lighter, and more responsive to chemical and electrical reactions than their larger versions. Harnessing these phenomena for nanotechnologies drives the nation's energy advances, boosts performance in computers and electronics, improves medical treatments, and even introduces sunblock and wrinkle-free fabrics to consumers.

To observe materials on nanometer length scales, Balke uses a scanning probe microscope, a powerful instrument that scans the surfaces of materials with the tip of a 10-nanometer probe—so sharp it cannot be seen with the eye. Unlike optical microscopes, SPMs feel rather than see the way atoms interact, making it possible to measure volume changes in materials caused by various unseen forces of attraction and repulsion.

Balke specializes in developing techniques to examine the chemical, electrical, and mechanical processes combined as "electrochemomechanical" systems—that take place as materials store and supply energy.

"When a voltage is applied to a material, for example, you can look at how the material responds on local scales, meaning you can map out how specific sample areas are involved and how their reactions vary across a sample," she said. While the tools of her trade may make new research areas possible, the vital work of discovery goes well beyond instruments' off-the-shelf capabilities. When testing a hypothesis, off-theshelf instruments can only take you so far, she says.

"The difficulty is that you will always measure something," she said. "The hard part is taking the next step." Materials will respond to an electric field, for example, and instruments can help measure that response, but additional expertise is needed to interpret the results. "Are you observing ions moving through the material or heat or something else?—The biggest challenge is confirming that you are measuring what you think you are measuring," said Balke.

A fundamental part of Balke's microscopy work involves experimenting with many different materials to refine techniques for measuring properties and interpreting the results. The tremendous effort requires a big team, she says. Balke and other members of ORNL's Scanning Probe Microscopy group design experiments, program software, and optimize instruments to advance nanoscience resources, which are shared with other researchers for free through the CNMS user program. PUSHING ENERGY BOUNDARIES

Balke's current research explores fundamental concepts in energy storage at work in the materials that make up batteries, electrochemical capacitors, and other devices that generate as-needed electricity.

A DOE Early Career Award in 2011 jumpstarted her research on energy processes in battery materials. She is also involved in a collaborative effort with the Fluid Interface Reactions, Structures and Transport Center, established in 2009 as a DOE Energy Frontier Research Center at ORNL. FIRST uses CNMS resources to investigate the potential of energy storage materials, and Balke is leading the team's research on "Coupled Electrolyte Ion and Electron Transport in Redox-Active Media."

"One goal for energy storage is to marry the properties of fast-charging capacitors and long-lasting batteries to create materials that can charge quickly and store a lot of energy," said Balke. "Characterizing materials' nanoscale properties can point us toward pathways to tune, or tweak, materials to enhance their performance."

Energy storage is only one pathway among endless opportunities, says Balke. Fundamental insights from her work on energy storage inform universal concepts for fine-tuning material properties for diverse energy applications.

Balke leads an Office of Science-funded program to explore materials' functionality, broadly examining the way ions, or charged particles, move through materials and couple with other material properties.

As an example, her team applied microscopy approaches to a copper-based ferroelectric material (CuInP2S6) with promising chemical and electronic uses. Moving copper atoms from the material's bulk to its surface enhanced electromechanical properties by 45%. She credits ORNL's collaborative environment with driving her research. "The passion and energy of the people you are working with is fuel for discovery," she said. "When you are part of a team where everyone is working together to make an impact, it pushes the field forward."

Balke's work and life are balanced by her passion and energy for discovery. In both areas she believes in jumping into new experiences and fully appreciating the surroundings. Outside of work, she kayaks and mountain bikes, enjoying Tennessee's outdoors with an American husband, two young kids, and a pair of dogs. The CNMS is a DOE Office of Science User Facility available to the science community.

UT-Battelle manages ORNL for the DOE Office of Science. The single largest supporter of basic research in the physical sciences in the United States, the Office of Science is working to address some of the most pressing challenges of our time. For more information, please visit-

https://energy.gov/science.



Ashley C Huff / ORNL



Content Invitation

Georgia PathwaysTM STEM Magazine requests the privilege of including your content or the content of your students in upcoming issues. This is a great opportunity for students to be published and for educators and industry professionals to share their insights and wisdom regarding careers across Georgia.

If you have questions, please contact the publisher at:

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Content submissions:

- Word.doc format
- Completely revised and spell checked.
- Everything as an attachment.
- Unlimited electronic distribution to everyone in Georgia.

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