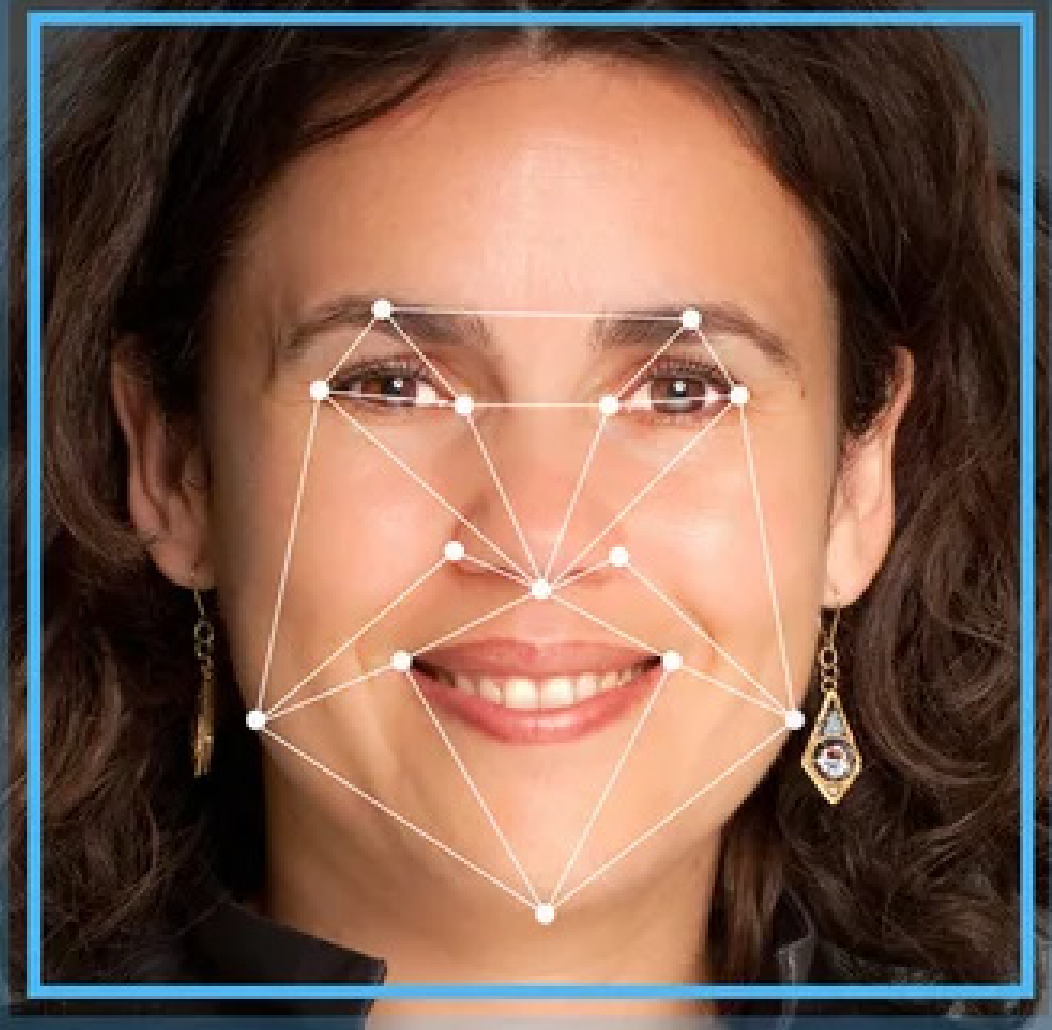
February 2023

GEORGIA PATHWAYS

M A G A Z I N E



Facial Recognition?

Chemistry By Design

Virtual Learning

TAG Technology Association of Georgia

TAG TAG-Ed Education Collaborative

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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Georgia Pathways Magazine services the STEAM education industry needs of the state of Georgia. This magazine is viewed by the consumer with the understanding that the information presented is from various sources from which there can be no warranty or responsibility by the Technology Association of Georgia, the Technology Association of Georgia Education Collaborative and/or their affiliates as to legality, completeness or accuracy.

Welcome to the February 2023 issue of Georgia Pathways Magazine.

In today's rapidly evolving world, STEM (Science, Technology, Engineering, and Math) is a driving force behind the progress that enhances our daily lives. According to the U.S. Department of Commerce, STEM jobs are growing at a rate of 24%, compared to a mere 4% growth in other industries. This makes STEM education crucial for nurturing the next generation of innovators.

Throughout the U.S., 36 million people work in diverse occupations that require STEM knowledge and expertise, accounting for 23% of the total workforce. The growth of STEM jobs, which has increased by 79% since 1990, highlights the increasing importance of STEM education for students of all ages. And, with new technology comes job opportunities in fields that were previously nonexistent. For example, the role of a Big Data Engineer was unheard of just a few years ago, and by 2030, 85% of STEM jobs are expected to be created to fill roles that have yet to exist.

It is evident that a basic understanding of math and science will be necessary for most jobs in the future. Unfortunately, the average math and science scores of students in the U.S. lag those of other developing countries.

As such, the celebration of Georgia STEM Day aims to raise awareness about the significance of STEM education in our state. On March 3rd, thousands of people across Georgia will participate in a variety of STEM-related activities, providing an opportunity for students, educators, schools and companies to come together and celebrate the importance of STEM.

At its core, STEM is about setting future leaders on a path toward success. Investing in STEM education means investing in a brighter future for the next generation, and we must work together to make this a reality for all students. So, be sure to visit **https://www.tagedonline.org/georgia-stem-day/** to register for Georgia STEM Day 2023.

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.

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TAG-Ed Education Collaborative

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.

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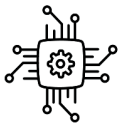

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Learn more

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TAG | TAG-Ed Education Collaborative

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A LEGACY OF INNOVATION

Georgia TSA
TECHNOLOGY STUDENT ASSOCIATION

WWW.GATSA.ORG

Georgia Technology Student Association

A 60 Year Old Secret No More

By Steve Price

Yes! There ARE successful, meaningful and productive programs in Georgia's middle and high schools! Let me introduce you to GA TSA, the Georgia Technology Student Association.

We were TSA before ***they*** were!

Our student association was founded in 1962, moves into its 61st year in the 2022-23 school year. This organization is the inter-curricular CTSO (career and technical student organization) to the STEM/Engineering & Technology Education Pathway Courses in Georgia's middle and high schools. The student association, its activities, contests is embedded in the pathway curriculum. GA TSA is a charter affiliate of National TSA.

TSA is one of the seven nationally recognized CTSOs in Georgia. GA TSA is all about "Learning to LEAD in a Technical World". Embracing innovation and evolution over the last half a century, the mission of GA TSA is to foster in its membership successful leaders and responsible citizens in a technological society through co-curricular activities within the technology education program; which include communication, leadership, and competitive skill development in modern classroom/laboratory environments.

One of the main, ongoing concerns in our state's schools is the drop-out rate. Here's proof that these integrated student organizations make a positive difference - Georgia's CTSO members' graduation rate is 97% and in TSA, 3/4ths of them are college bound. The word "options" is an important concept within the pathway courses and in TSA. Aside from experiencing processes, systems and practice in a variety of engineering career fields, our students may decide to go to a Career and Technical College and be a technician, go further and get their engineering degree and certification in their chosen field of engineering, or some take what they have learned and start their own side business even while they are enrolled in their secondary school program.

The heart of TSA is its competitive events. Combined, there are over 80 individual and team events on separate middle and high school levels plus an additional 5 that are state-only. Student members are challenged with contests that reflect our engineering and design focus as well as leadership skills.

The GA State Leadership Conference in Athens is our "Super Bowl", where 3000 Georgia Engineering & Technology Education Students converge to exhibit their talents and skills through competition.

We invite you to show your support for the future designers, inventors, innovators and engineers and be a conference sponsor or sponsor one or more of our events. We also have a "Engineering and STEM Experience" event where virtually every attendee visits the table displays of our business and industry and post-secondary education participants from 9am until 3pm on Friday during the conference.

attendance records, topping out at the State Conference, where over our largest conference record of 3000 is shaping up to be passed this March.

The 85 individual or team competition events that are provided by National TSA and GA TSA's state specific events involve hands-on problem solving and the names of the events are as varied as the STEM skills that they require for success. Every event has a leadership/job skills aspect and finalists are interviewed. Animatronics, 3D Animation, Drones, Prepared Presentation, Technology Bowl, Scientific Visualization, Photographic Technology, Debating Technological Impacts, Chapter Team

"Show your support for the future Georgia designers, inventors, innovators and engineers"

Georgia TSA remained on top this year for most chapters in the nation with 221. (GA TSA has had that position for 10 years) We were second by one chapter for high school chapters in the nation with over 160 chapters and the second largest number of middle school chapters with more than 80 chapters, with over 25,000 members representing every corner of our state.

This year was full of honors and accomplishments for GA TSA. Once again, after our conference events are pushing or breaking previous all-time

Parli-pro event, Engineering Design, Flight Technology Software Development, Coding System Control Technology On demand Video, Webmaster are just some of the high School level events. GA TSA Chapters also are involved with "signature events" that are in concert with other nationally recognized STEM/Engineering and Technology centered competitions.

GA Chapters have teams successfully competing in VEX Robotics, VEX IQ (for middle school), Jr. Solar Sprint, Electrathon Electric Vehicles, Green

Challenge Electric Vehicle race, TEAMS and more.

GA TSA produces student leaders on the state level as well as students who have been elected to one of the six student officer positions on the National TSA level. Since the very first chartered year of the national association, which was known as the American Industrial Arts Student Association (AIASA) in 1978, Georgia students have held a total of 18 year-long National Officer Positions including the current Vice President, Carson Schmitt of Ola HS, (the 10th National Officer from GA since 2012), Jack Crawford of Lowndes HS served as National TSA President 2016-17 and Alex King of G.W. Carver in Columbus was elected National President 2018-19. They were the first two TSA presidents from GA.

GA TSA's State Conference will be in Athens for the 14th consecutive year. March 16-18, 2023. Through the support of our business and industry partners, top placing students in all of the competitive events as well as newly elected state officers receive over $20,000 in National Conference travel scholarships of at least $200 each.

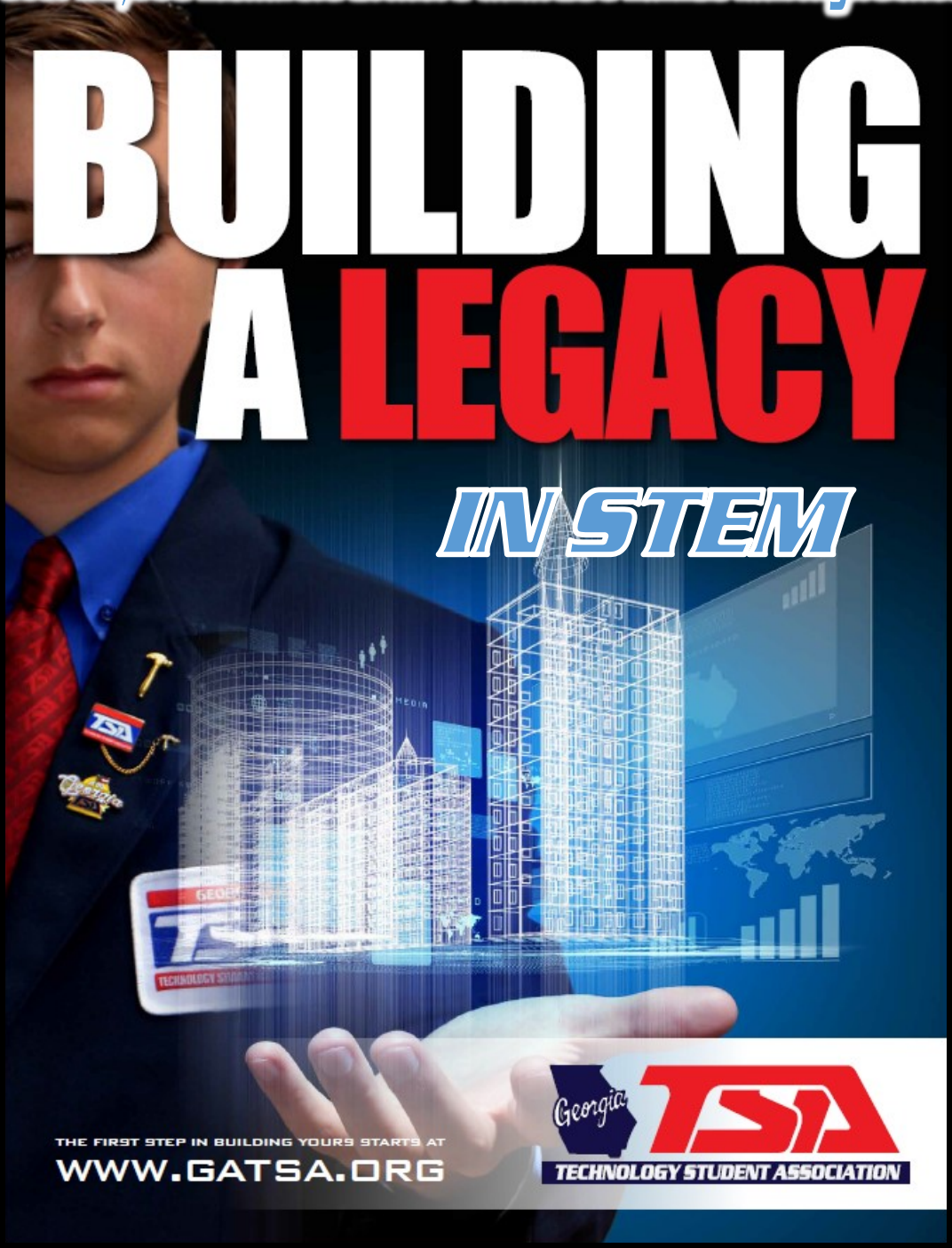
Steve Price
GA TSA Executive Director

Visit us – www.gatsa.org . We're on Twitter, You Tube – Georgia TSA. Or Contact Steve Price – sprice@gatsa.org

Georgia Technology Student Association

Engineering and Technology Education's Inter-Curricular Student Leadership Organization

Over 22,000 Members in more than 230 Middle and High Schools Across Georgia



TSA partners with universities, companies and other organizations to promote a variety of STEM competitions and opportunities for students and teachers. TSA is supported by educators, parents and business leaders who believe in the need for a technologically literate society.

Four conferences are held during the school year:

CORE (Chapter Officers Retreat for Excellence) - September

Tech Day Rally and competitions—October

Leadercon Conference and events on Jekyll Island — November

and the GA TSA State Leadership Conference with over 70 Leadership and STEM aligned competitive events— March

Support the next generation of innovators, problem solvers and designers

Be a Volunteer Be a Sponsor Be a Presenter Be a Mentor

Contact Steve Price, Executive Director
sprice@gatsa.org or 678-551-0840

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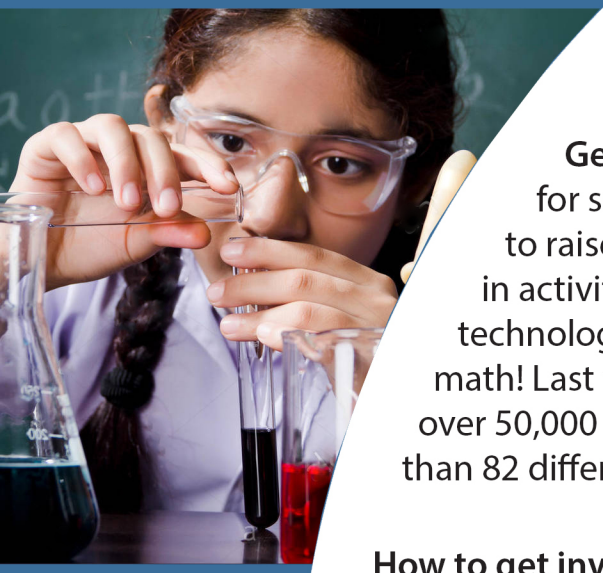


TAG EDUCATION COLLABORATIVE PRESENTS

GEORGIA STEM DAY

March 3, 2023

Georgia STEM Day is a day for schools & organizations to raise awareness and engage in activities involving science, technology, engineering and math! Last year's event attracted over 50,000 students from more than 82 different school districts in the state.

How to get involved:

- Educators: Incorporate fun and innovative STEM activities into your classroom on March 3rd.
- Companies: Volunteer to speak at a local school about your exciting STEM career, or host a feld trip for students at your business for local students.
- Partners: Promote STEM Day by providing resources and activity ideas for participants!

#GASTEMDay

Group and student applications are available online.

Register Today Here

For more information, please visit our website: www.tagedonline.org

For questions, contact Heather Maxfield at heather@tagonline.org

UNIVERSITY OF GEORGIA

New Facial Recognition Technology Scans Your Ear

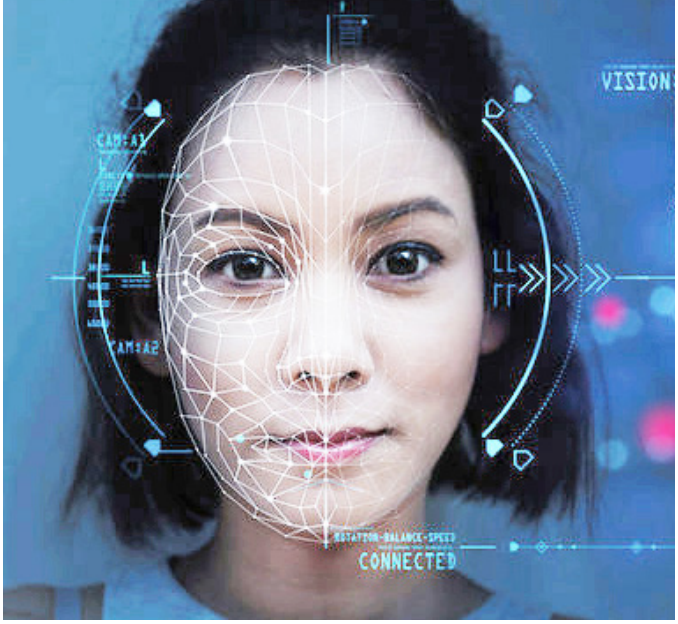
By Olivia Randall

In the post-COVID world of face coverings and heightened hygiene awareness, the need for new authentication methods that don't require a person's full face to be visible has arisen.

New research from the University of Georgia may soon have people using their ears to get into their devices rather than their face or thumbprint.

The ear is one of the few body parts that remains relatively unchanged over time, making it a useful alternative for technology requiring face or fingerprint recognition, said Thirimachos Bourlai, lead author of the study and an associate professor in the UGA College of Engineering. The ear recognition system Bourlai's team developed correctly authenticates individuals with up to 99% accuracy, according to the new study (depending on the dataset and model used for testing).

Ears are unique to an individual in much the same way as a fingerprint. Even identical twins' ears have differences, the researchers said. An added bonus is that ears don't age the same way an individual's face does, with the exception of the earlobe, which drops lower over the years.



The ear recognition software works similarly to face recognition. When a person gets a new phone, they have to register their fingerprint or face for the phone to recognize them. New devices often require users to place their fingers repeatedly over the sensor to get a full "picture" of their fingerprint. And face-recognition technology relies on users moving their faces in certain ways in front of their camera for the device to effectively capture their facial features. Bourlai's proposed ear recognition algorithm works the same way.

"New ear identification technology up to 97.25% accurate"

"The phone captures multiple samples of a person's identity, and the images are temporarily saved in your device," said Bourlai. "Just like you have to use a live fingerprint to unlock your phone and compare it to your registered one, you would have to use the live ear to unlock it.

"This is actually not the first time ear recognition has been used for security," said Bourlai. "There are many unique ways to recognize individuals utilizing other traditional modalities, such as through their face, fingerprints and iris. Ear recognition is just another exciting modality that we need to start talking more about due to its benefits, despite the understandable challenges of self-capturing an ear image."

While setting up a biometric device, the algorithm takes multiple samples of a person's identity, such as facial images or fingerprints, and logs them into the device. When you go to unlock your device using a biometric, it takes a live sample to compare it to the logs on the device, such as a picture of your face or in this case, a picture of your ear.

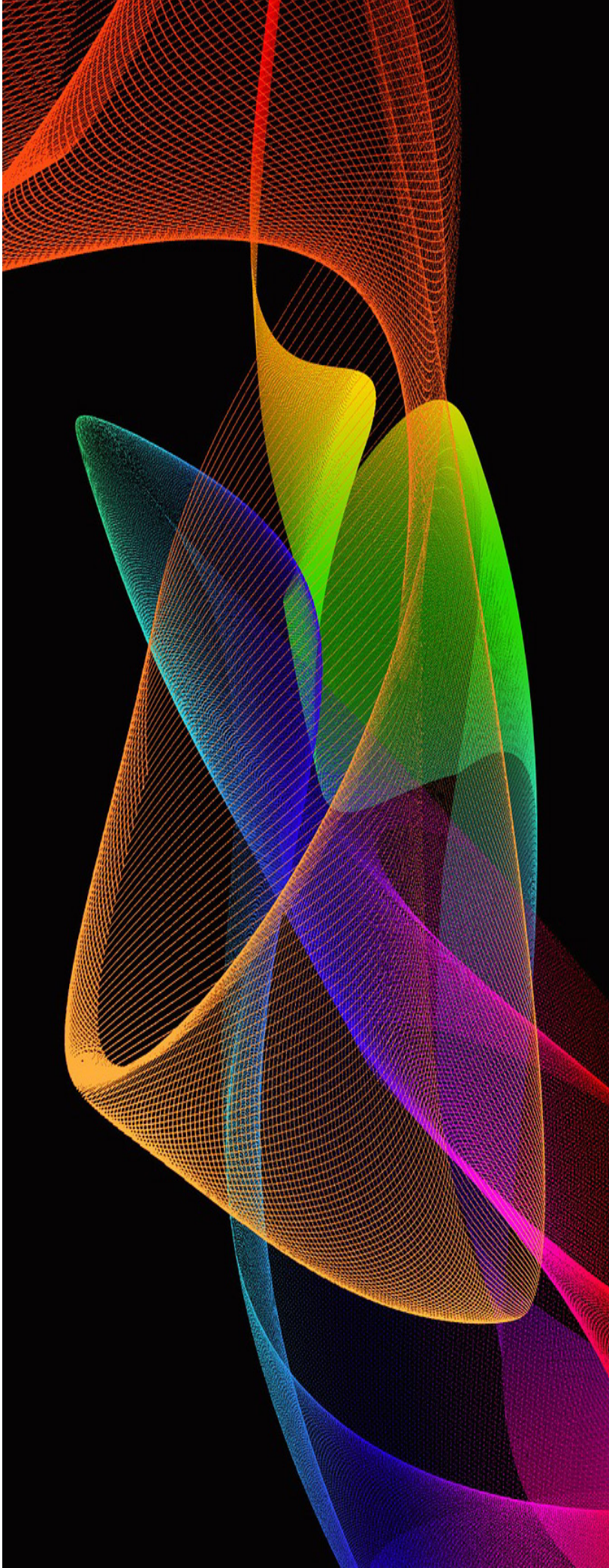
Bourlai's software uses an ear recognition algorithm to evaluate ear scans and determine if they are suitable for automated matching. He employed a variety of ear datasets with a wide range of ear poses to test the software.

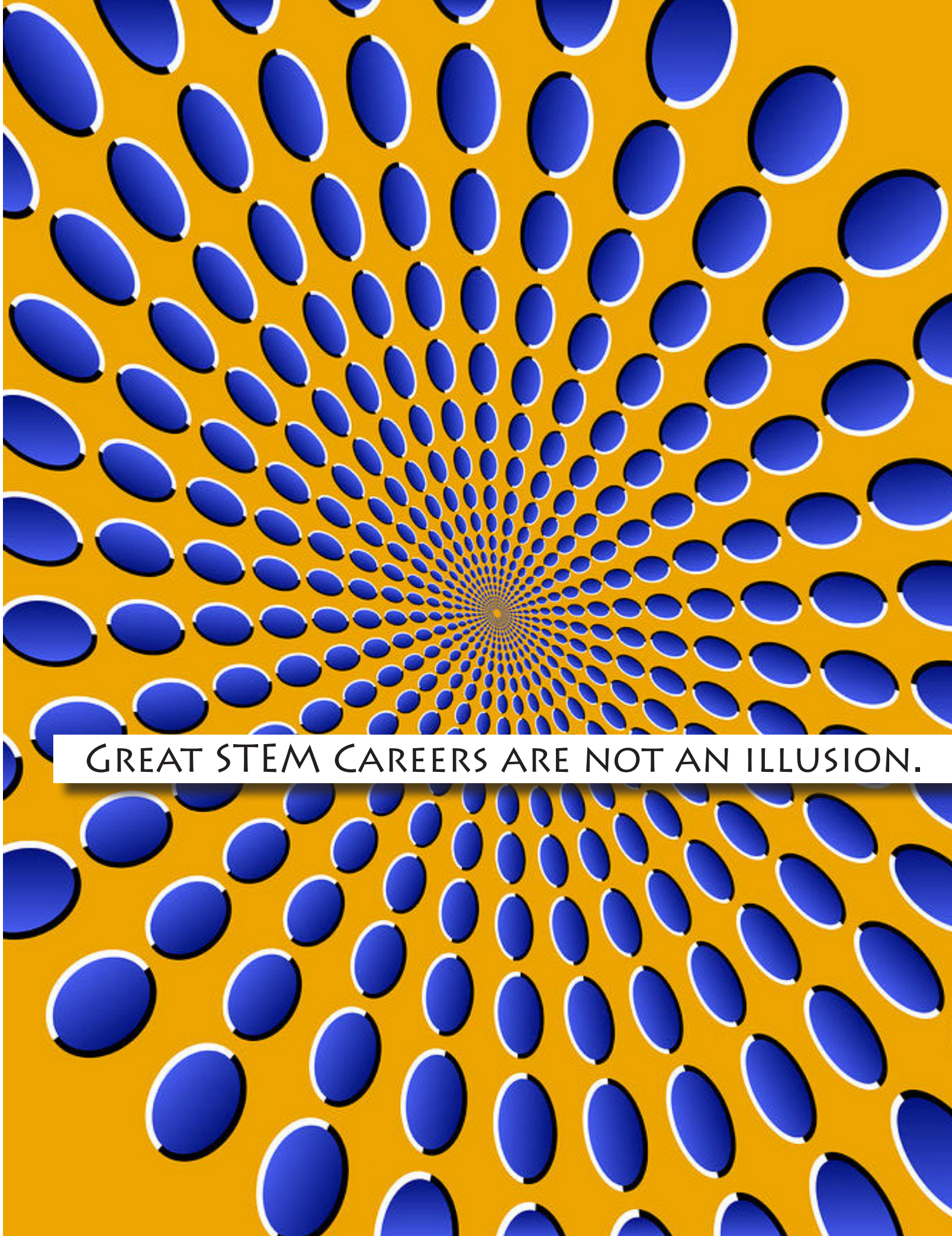
Bourlai tested his algorithm using two different existing datasets of ear images. In one dataset, the system performance increased from 58.72% to 97.25% accuracy compared to prior ear recognition software, and with the

other, performance improved from 45.8% to 75.11% when compared to the baseline approach.

To make sure the system could work even with busy images, Bourlai and his team assessed several models, using ear images affected by image noise factors, including variations of blurriness, brightness and contrast. Ear recognition software could be used to enhance existing security systems, such as those used at airports around the world, and camera-based security systems, Bourlai said. His team also plans to enhance their proposed ear recognition algorithm to work well with thermal images as well to account for darker environments where it might be difficult to capture clear visible band images using conventional cameras.

Bourlai is the founder and director of the Multi-Spectral Imagery Lab in UGA's Driftmier Engineering Center. His lab specializes in biometrics and has extensively studied the usage of multispectral imaging sensors, including thermal imaging.




Great STEM Careers are not an illusion.

GPB Teams with the Georgia Council on Economic Education and FableVision Studios to Launch **Start It Up!**

By Mandy Wilson

Georgia Public Broadcasting (GPB) has teamed up with the Georgia Council on Economic Education (GCEE) and FableVision Studios to launch Start It Up!, a new online game aligned to Georgia high school economic standards.

GPB first announced last December that it had received a $175,000 grant from Truist Foundation to create the new game, which allows players to experience making realistic decisions surrounding starting a small business.

Game play is linked to real-world examples and helps students and young adults understand the complexities of opening a business, including the risks and rewards of entrepreneurship, how to get funding for an idea, why small businesses sometimes fail after a few years, and what decisions help businesses succeed.

"We are proud to add Start It Up! to our collection of innovative, free resources for teachers and students," said Laura Evans, Director of Education at Georgia Public Broadcasting. "Gamifying complex topics such as starting a new business from scratch has shown to increase student engagement and comprehension."

In Start It Up!, players begin by selecting the type of business they want to open from a variety of options, including manufacturing, professional services, store fronts, and others. With the help of a mentor, students make choices about funding, hiring, advertising, producing, and other day-to-day decisions faced by real businesses. Over a simulated four quarters, players experience the many ebbs and flows associated with opening and running a business.

"GCEE is excited to once again partner with GPB to bring teachers another high-quality teaching resource," said Chris Cannon, the Associate Director and Chief Program Officer of GCEE. "Entrepreneurship has the potential to change lives, but it is not easy. This online experience will help teachers prepare students interested in starting a business for the real-world challenges."

Start It Up! is available now at gpb.org/start-it-up and includes teaching materials designed to help high school teachers teach entrepreneurship effectively. This project was made possible with generous support from Truist Foundation.

Previous collaborations between GPB and the GCEE include Econ Express, a game-changing, free online resource that helps teachers and students learn, practice, and assess basic economic concepts. GPB, GCEE and FableVision have also created a financial literacy game targeting middle and high school students. Lights, Camera, Budget!

As one of the largest PBS stations in the nation, Georgia Public Broadcasting (GPB Media) has been creating content worth sharing for 60 years. With nine television stations, 19 radio stations and multi-faceted digital and education divisions, GPB strives to educate, entertain and enrich the lives of our viewers and listeners with programming that includes statewide radio news, current affairs, high school sports, educational resources for teachers and students and enlightening programs about our state like Georgia Outdoors, Political Rewind and more. For more information, visit www.gpb.org.

OAK RIDGE National Laboratory

Santa Jansone-Popova: Chemistry by design

By Ashley C Huff / ORNL

An organic chemist at Oak Ridge National Laboratory, Santa Jansone-Popova focuses on the fundamental challenges of chemical separations that translate to world-changing solutions for clean water and sustainable energy. For Jansone-Popova purpose is a strong motivator, but so is art. Real-world opportunities develop from basic research to design novel chemical

Organic chemist Santa Jansone-Popova designs new chemical architectures to support chemical separations that lay the groundwork for clean water and energy advances. Credit: Carlos Jones/Oak Ridge National Laboratory, U.S. Dept. of Energy.

architectures, she says. "To push what is possible, we will need to create structures that have never been made before."

Art and science

As a teenager in Latvia, Jansone-Popova craved a narrative of possibility. She excelled at chemistry in high school and could easily imagine a path leading to university and professional opportunities as a scientist, but she wanted to keep her options open. At heart, she was free-spirited and passionate about a lot of things. "There are so many possible futures," she said. "Who knows what you want to do forever when you are young?"

She kept a running list of potential subject areas she would select for the centralized exams required for college admissions in Latvia—math, German, science, and art—eventually settling on chemistry and design. She was confident enough to sit for the 3-hour design exam without ever having taken a single art class. Her "perfectly adequate" illustration may have scored poorly, but she aced the chemistry exam.

In college, Jansone-Popova was drawn in by the art and science of "total synthesis," a reverse-engineering approach to developing new, complex chemical structures.

A synthetic organic chemist looks at compounds in nature and tries to break apart intricate structures into smaller pieces and then reassemble everything, she explained. "It's like solving a puzzle," she said, something she knew would fascinate her forever.

While completing undergraduate studies at the University of Latvia, Jansone-Popova worked at the Latvian Institute of Organic Synthesis, gaining hands-on lab experience in the craft of making organic compounds. The job positioned her well for graduate studies at the University of Houston, where she continued to explore total synthesis and developed new methods for creating multi-ringed carbon structures known as polycycles.

After earning a Ph.D. in 2014, Jansone-Popova joined ORNL's Chemical Separations group, where her background in organic synthesis has been an asset to the fundamental work of separating and extracting elements, especially metals. The bridge from understanding how metal ions behave to creating new materials to recover valuable elements or remove contaminants from the environment starts with fundamental discoveries that lead to new ways of thinking and problem-solving.

Problems in solution

Jansone-Popova's early research at the lab focused on small-molecule synthesis. Supported by the Department of Energy's Office of Science, she made ligands, or metal-binding molecules, that self-assemble to form complex structures, such as triple-stranded helixes. The work has since expanded to larger molecular networks, like polymers, which chain together many small molecules. An important application of the basic research is to make polymers that efficiently select chromium.

Hexavalent chromium—prominent as a health risk in the movie Erin Brockovich—is an extremely toxic industrial pollutant in waste streams that can end up in the environment. "There are commercially available resins to remove chromium, but our basic-to-applied goal is to improve the efficiency of adsorbents," said Jansone-Popova. "To do that, you need a material that is highly selective, meaning it can pick out chromium among all of the other elements present."

One of the challenges of creating materials that can select chromium in industrial waste, uranium in seawater, radioactive metals in nuclear fuel, or carbon dioxide in gas emissions is that there are competing elements in these solutions that can impact the efficiency of your approach. How do you get chromium but not sulfur, arsenic or selenium, which are also contaminants in water?

"Fundamental research is what allows us to answer these kinds of questions and move forward," said Jansone-Popova. "The real-world value of fine-tuning selectivity and efficiency is that you enable materials that work faster, cost less and offer realistic options for widespread uses."

Endless possibility

Fully artist and chemist, Jansone-Popova designs with molecules to achieve new chemical structures that underlie endless possibilities in separation science. Translating fundamental research to support additional energy missions is an important outgrowth of the work.

Some of the most promising energy advances, such as CO2 capture, critical material recovery and desalination, are all dependent on chemical separations.

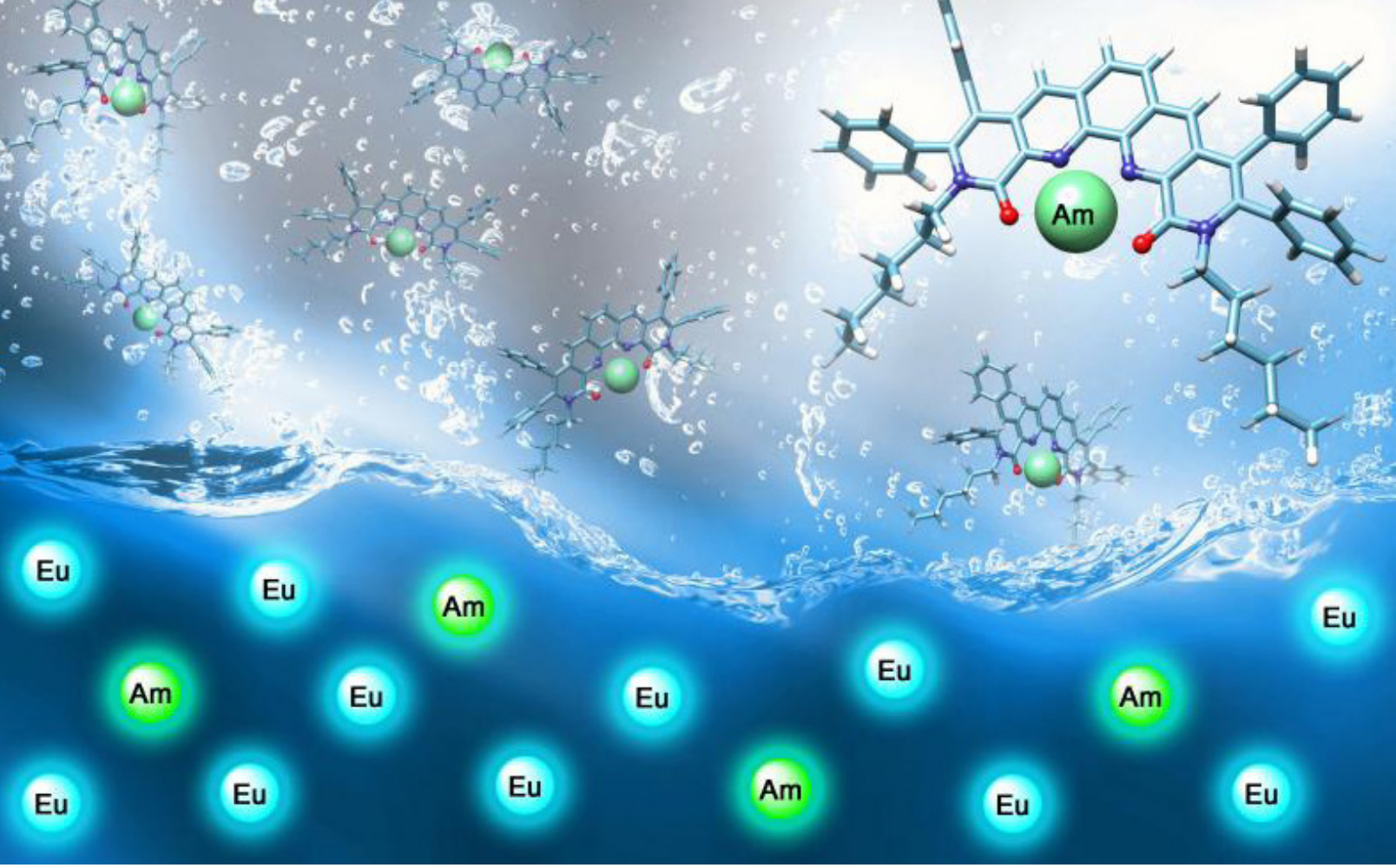
Jansone-Popova's research plays a key role in the Critical Materials Institute—a DOE Energy Innovation Hub funded by the Advanced Manufacturing Office of the Office of Energy Efficiency and Renewable Energy—in strategies to recover rare earth elements and other critical materials used in clean energy technologies, including wind and solar power, electric vehicles and energy-efficient lighting. Through the CMI, Jansone-Popova collaborates on efficient lanthanide separations.

The majority of rare earths are lanthanides, a group of 15 metallic elements grouped near the bottom of the periodic table with the actinides. "When you mine rare earths, they are naturally lumped together in ore, so separating one from the mixture is challenging," said Jansone-Popova. Her team recently demonstrated a praseodymium-neodymium separation strategy with unprecedented potential.

Jansone-Popova also contributes new insights to the lab's decades of expertise in lanthanide and actinide separations related to the nuclear fuel cycle. Supported by the Office of Nuclear Energy, Jansone-Popova helps discover new

ligands for efficiently separating radioactive elements, like americium. Removing americium from used nuclear fuel can significantly reduce the radiotoxicity and heat load, allowing for safer and more efficient geological storage with significantly reduced space needs.

Collaboration has a huge impact on science advances, says Jansone-Popova. "At the lab, people are eager to work together to solve problems, which pushes everyone forward."



A tetradentate ligand selects americium (Am, depicted by green spheres) over europium (Eu, blue spheres). Red indicates oxygen atoms and purple, nitrogen atoms that are the key to the ligand's selectivity. Image credit: Oak Ridge National Laboratory, U.S. Dept. of Energy; illustration by Alexander S. Ivanov and Santa Jansone-Popova

Jansone-Popova values the lab's warm welcome, she says. "Supportive management and passionate scientists to work with have helped me grow professionally." Chemistry is a shared passion with her husband, Ilja Popovs, a scientist in the Nanomaterials Chemistry group. The couple's other passion is their nine-month-old son, Andy, an independent soul like his mother, still looking upon a world of possibilities.

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 huffac@ornl.gov


Chemist
A great STEM career

How Virtual Learning
Supports My Dream of Becoming an Environmental Scientist

By **Adam Jacobson**
Minnesota Connections Academy

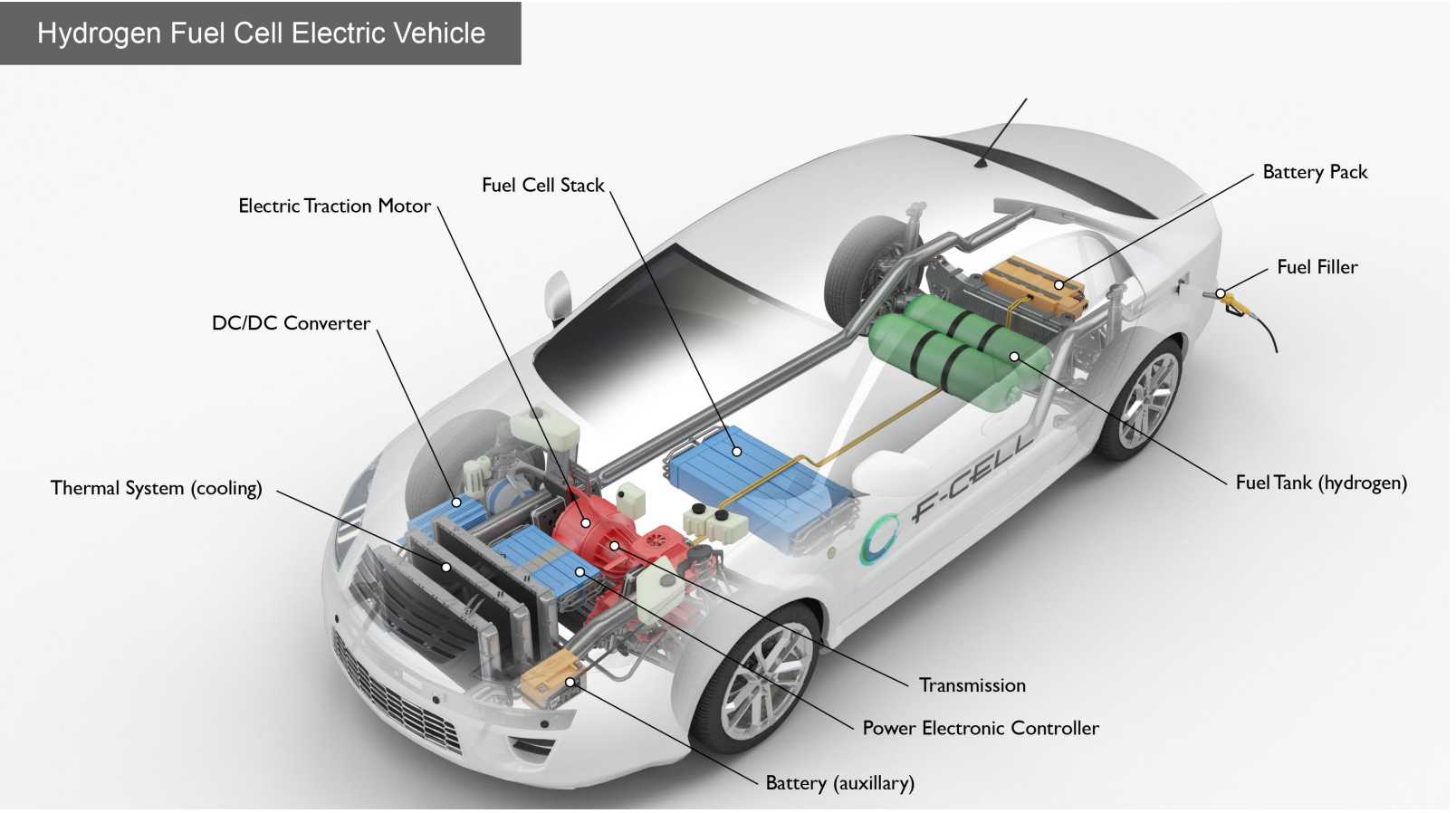
From torrential downpours and flooding to endless drought and dropping water levels, we're seeing climate extremes more and more often across the country and the world. Some adults wonder why these things are on my mind and don't always take me seriously because I just finished 8th grade. But that's actually the main reason I'm thinking about climate change.

I'm only 14 years old, so I'll likely live on this earth for 80 more years! I want to live in a healthy environment, and I want the same for the rest of my generation and future generations. I also want to play a role in making the world a better and cleaner place. That's why I'm interested in studying to become an environmental scientist with a focus on renewable energy sources.

In school, I get a lot of support from my teachers so I can do just that. I go to an all-virtual school called Minnesota Connections Academy. The flexibility it gives me has been really helpful as it allows me to explore my interests in a very personalized way.

For example, I was able to see what it's like to be an environmental scientist through my project for this year's Minnesota State Science & Engineering Fair. I decided to focus my research on reducing our dependency on fossil fuels because that's one of the major ways we can slow down the effects of climate change. It's also a huge undertaking that will require a lot of different solutions.

When I started exploring ideas I wanted to pursue in that area, I came across cars that use hydrogen as a fuel source. I'd never heard of that before but knew right away that's what I wanted to focus on for my science fair project.



First, I learned as much as possible about hydrogen and its many uses. Hydrogen is made up of one proton and one electron, which makes it the simplest and most abundant element on earth. However, it doesn't usually exist by itself in nature, so it has to be produced from compounds that contain it, like water. While hydrogen is not an energy source itself, it is an energy carrier that can deliver or store large amounts of energy. When it's used in fuel cells, it can generate electricity, or power and heat.

Right now, almost all the hydrogen consumed in the U.S. is used for refining petroleum, treating metals, producing fertilizer and processing foods. Liquid hydrogen is also used as rocket fuel, which NASA started doing back in the 1950s, and hydrogen fuel cells are used to power the electrical systems found on spacecrafts!

When hydrogen is consumed in a fuel cell, it produces only water, electricity and heat, which means almost zero greenhouse gas emissions. It can also be applied in a lot of different ways across transportation, commercial, industrial, residential and portable energy sectors. I was particularly interested in using hydrogen for transportation when I learned that the industry is the biggest carbon emissions producer in the U.S. The emissions primarily come from burning fossil fuels for our cars, trucks, ships, trains and planes, so I knew hydrogen could make a real difference in this area of our lives.

Though, less than one percent of cars run on hydrogen, and most of them are in California because the state's energy commission made a goal of getting 1.5 million zero-emission cars on the road by 2025. I also learned that hydrogen-fueled vehicles aren't just better for our environment than fossil fuels, they're better for our environment than vehicles that run on electricity!

After finding all this out, I narrowed down the focus of my science fair project to explore how we can make hydrogen as efficient and cost-effective as possible because both of those factors have a huge impact on how quickly new technology is adopted. Even though hydrogen is a clean energy that can be made right here in the U.S., it still has to be able to compete with more conventional fuels.

After doing all my research, it was finally time to make my own hydrogen using electrolysis! Electrolysis is the process of separating water into oxygen and hydrogen. Hydrogen can also be made using thermal, solar-driven and biological processes, but those are difficult to do at home.

For my science fair project, I decided to test different kinds of electrodes and electrolytes, like vinegar, sodium chloride, lye and baking soda, to determine which combination worked best. I found that sodium chloride and lye were the most efficient electrolytes and that steel and carbon electrodes performed equally.

I spent nine months doing research, experiments, collecting data and preparing for my science fair presentation, so I was really excited to see all the hard work pay off, especially since I enter the science fair every year. I won a silver medal for being in the top 10 percent of middle school students and got the 3M inventor award for my age category. I think attending Minnesota Connections Academy made both of those possible thanks to my teachers and the flexibility I have going to school not just online, but also year-round.

Often when people hear the words "virtual school," they jump to the conclusion that this way of learning is impersonal and disconnected because it happens on screens instead of in a classroom, but that couldn't be further from the truth. While it might not be for everyone, online school has only furthered my dream of working in STEM thanks to the one-on-one instruction I get from my science teacher. As I was getting ready for the science fair, she was the one I discussed my ideas with, and together, we came up with questions and answers I may not have thought of without her guidance.

Going to school online further helped me prepare for the science fair because I was able to be more in control of my own schedule and learning. I could block out chunks of time to really explore the ideas I had developed with my teacher and then build on them by speaking with experts in climate and the environment. From there, I was able to work through each step of the scientific method at my own pace and give each step whatever time and attention I felt it needed.

As an added bonus, my older sister, Paige, is also into science and had entered the science fair, so we were able to bounce ideas off each other as we worked side-by-side on our projects. I'm not sure that would've been possible without the flexibility of virtual school.

While helping me with my project, my science teacher hosted special sessions where other students could learn about the science fair and what it's like to bring a project from an idea to a presentation before a panel of judges. It was a great opportunity to demonstrate the real-life applications of what we're learning in school and to share my passion for science with my classmates.

From a practical standpoint, I also appreciated that my science teacher offered an incentive for taking part in the science fair. I was able to opt-out of one unit portfolio and substitute that grade with all the work I'd been doing on my project.

For all these reasons I think virtual school can be particularly beneficial for students who know they want to pursue a specific field or are passionate about a certain subject. In my case, the flexibility of learning online allows me to devote as much time as I need to special projects like the science fair. It also means I can attend workshops, go on a field trip or to a museum, and build in other activities that give me different opportunities to learn and get inspired.

As I plan for my future, I'm starting to pick classes that will further support my dream of driving a hydrogen-fueled car when I'm working as an environmental scientist. When we observe the effects of climate change on our planet, it's hard not to be daunted by the bigness of the problem, but my teachers at Minnesota Connections Academy have taught me that I can be part of the solution.

About the Author -

Adam Jacobson is a 9th-grade student at Minnesota Connections Academy. He enters the Minnesota State Science & Engineering Fair every year and won two top prizes at the 2022 edition of the competition.

His future career choice is to be an environmental scientist so that he can make this world a better and cleaner place. If he doesn't go into that field, he wants to become a general surgeon to help people be healthy.


MIRAI

"Representation Matters"

by Errika Moore
Executive Director, SFN

We say that we believe that representation matters…but how do we work together to ensure that representation matters? The STEM Funders Network believes that Representation Matters is an opportunity to curate a centralized STEM K-20 collaborative that focuses on diversity, equity, inclusion, access, and belonging within the STEM K-20 continuum. Not simply a collaborative that ensures DEIAB for all students, teachers, faculty, and higher education administrators throughout the ethos, but a collaborative that focuses on historically marginalized communities within this culture.

A collaborative driven by a holistic, rather than a segmented, approach to the STEM K-20 continuum. A collaborative driven by a strategy that centrally monitors, tracks, and communicates resource availability to optimize collective impact and ensure we uphold the mantra that representation truly does matter.

Our education experts have told us through their own lived experience and professional focus that currently, there isn't a centralized, synergistic source for the lineage of data capture or communications connecting one program to the next – or connecting the historical trajectory of a student from one program to the next.

There isn't a common data share that enables multiple stakeholders to engage synergistically across the K-20 continuum. I am a STEM professional who personifies what they've described. I have benefitted from three national programs that, unfortunately, are not physically linked via a centralized database to reflect their interdependency or mutually beneficial programming. If I didn't "share my story," they would be unaware of their connectivity and the common thread in me and others like me.

So, short of others sharing their stories:

- How do we know we're making a difference if we're not tracking the data and not sharing the information broadly, without a territorial lens?

- How are we statistically and holisti-

cally measuring our collective impact?

- How do we know that we're not losing students in the chasms of the system(s)?

- How are we connecting what's happening locally to what's happening nationally?

- And how are we measuring a student's trajectory from point A to point B?

- Where does that longitudinal data reside? How do we know what's successful and where to pivot?

- How do we ensure that others can glean best or wise practices?

- Without the answers to questions like these, why are we surprised that our disaggregate numbers representing marginalized communities are stagnant and signify disparities to their majority peers?

- And if we can't answer this question, how can we say that "we believe" representation matters?

In 2023 STEM Funders Network is working diligently to create a collaborative that says "yes," representation matters. And because it matters, we are committed to being a unifying source that connects the dots.

We're committed to being a part of a collaborative that's a centralized source that monitors, tracks, and communicates resource availability to optimize collective impact amongst various stakeholders in the K-20 continuum. As a result, we will ensure that representation truly does matter…because the systems and programs are connected via data, and thus diverse representation is positively impacted.

Here's How Representation Matters:

Representation Matters when we ensure all students have an opportunity to learn to read, so they can read to learn. Ferst Readers lists the *Top Fifty Literacy Statistics*. For example, the most significant amount of brain growth occurs between birth and age five. In fact, by age 3, roughly 85% of the brain's core structure is formed, but most of our investments are made in the traditional education years of K 12 (beginning at age five). *"Lifetime Effects: The High/Scope Perry Preschool Study Through age 40." Ypsilanti, MI: High/Scope Educational Research Foundation, 2005.*

Another example is that the developing brain triples in the first year alone and is virtually fully formed by the time a child enters kindergarten. *Eliot, L. (1999). What's Going on in There? : How the Brain and Mind Develop in the First Five Years of Life. Bantam Books.*

Or that given the course of brain development, it is not surprising that young children exposed to certain early language and literacy experiences usually prove to be good readers later. Just as a child develops language skills long before being able to speak, the child also develops literacy skills long before being able to read. *National Research Council. (1998). Preventing Reading Difficulties in Young Children. Washington, D.C.: National Academy Press.*

These disparities are only compounded as students progress through their educational trajectory. Jenny Eisenman, Chief Education Officer at Reading Plus, shared in a July 2021 article[1] for the National Association of Secondary School Principals that when middle and high school principals were asked to choose the greatest challenge they face with their students' literacy development, an overwhelming 63% of respondents cited students who were reading below grade level[2].

This response corresponded with 2019 find-ings that only 34% of eighth-grade students performed at or above the National Assessment of Educational Progress (NAEP) proficient level[3].

Representation Matters when we ensure all students have equitable access to math trajectories that stage them successfully for future STEM opportunities. In the article A Moonshot for Every Kid[4], written by Dr. Ayanna Howard (Dean of Engineering, Ohio State University), Dr. Charles Isbell (Dean of Computer Science, Georgia Institute of Technology), and Dr. Raheem Beyah (Dean of Engineering, Georgia Institute of Technology) for Issues in Science and Technology, January 2022 they stated that *"Among high schools, a status of separate-but-not-equal has been a persistent problem.*

Access to advanced math courses in high school varies according to a student's race, ethnicity, and socioeconomic status; a 2016 study noted that "just a third

of high schools where at least three-fourths of students were Black and Latino offered calculus."

"Given that math is traditionally seen as a gatekeeper course for college STEM majors—the highest math course a high school senior takes has a major influence on both college acceptance and college choice—it comes as no surprise that, at the college level, these disparities continue in engineering and computer science."

I will reference this same article for the following two data points for why representation matters:

- ***Representation Matters** when we ensure all students have an opportunity to see STEM teachers that look like them in K - 12*

- ***Representation Matters** when we ensure all students have equitable preparation for higher education in STEM.*

In this article, Beyah, Howard, and Isbell state that *"inequities still exist even when Black, Hispanic/Latinx, and Indigenous students attend K–12 schools that have programs specifically for advanced students. Since 1998, only 2% of Black students and 3% of Hispanic students have been enrolled in gifted and talented programs in US public schools as compared to 4% of white students and 6% of Asian students.*

Differences in math skills and test scores for those in different demographic groups do not explain this gap in enrollment. Rather, the race of their teachers accounts for the difference: Black students are referred to gifted programs at significantly lower rates when taught by non-Black teachers.

This pattern may be rooted in the ways a teacher's race influences the expectations of the students he or she teaches. One study concluded that when evaluating the same Black student, white teachers expect significantly less academic success than Black teachers. These findings suggest that, by extension, if the engineering and computer science college professoriate does not fully represent the demographics of the students they teach, the same result is likely when it comes to student success and expectations.

In other words, engineering and computer science departments in colleges and universities are also a part of the problem. Just as systemic inequities persist in the K–12 educational system when it comes to STEM, related inequities appear at the college level."

Representation Matters when we ensure all higher education students have an opportunity to see STEM faculty that look like them, and similarly, all higher education faculty have a chance to see higher education administrators

that look like them. Currently, there isn't an equitable and consistent pipeline of minority Deans because there isn't a pipeline of Department Chairs (which is a prerequisite in most instances).

But unfortunately, this disparity is consistent with the lack of minority faculty in the pipeline as well. There have been less than 2.5% black STEM faculty in the higher education system for over twenty years. Diversifying our student population creates a conduit for diversifying the faculty- to-administration representation.

Representation Matters when we ensure more equitable representation in STEM careers and, thus, more significant and equitable economic mobility. The National Math + Science Initiative believes that *"Students who pursue STEM-based careers have greater earning potential and STEM skills increase success in all careers and endeavors. That leads to individual and community prosperity."*

We couldn't agree more. But the researchers at Georgetown University's Center on Education and the Workforce stated in *Mission Not Accomplished: Unequal Opportunities and Outcomes for Black and Latinx Engineers*[5], *"Engineering occupations are some of the highest-paying and most prestigious in the US labor market, but they are also some of the least diverse.*

In 2019 the data showed that of the nearly 1.7 million prime-age engineering workers in the United States in 2019, 81% were either White or Asian, and 84% were men. A mere 3% of engineers working in the field in 2019 were either Black or Latinx women."

[1] *Why Diversity And Equity in Content Matters for Reading Growth.*

[2] *Reading Plus. "Middle and High School Principal Survey," April 2021.*

[3] *National Center for Education Statistics. The Condition of Education: Reading Performance.*

[4] *A Moonshot for Every Kid.*

[5] *Mission Not Accomplished: Unequal Opportunities and Outcomes for Black and Latinx Engineers.*

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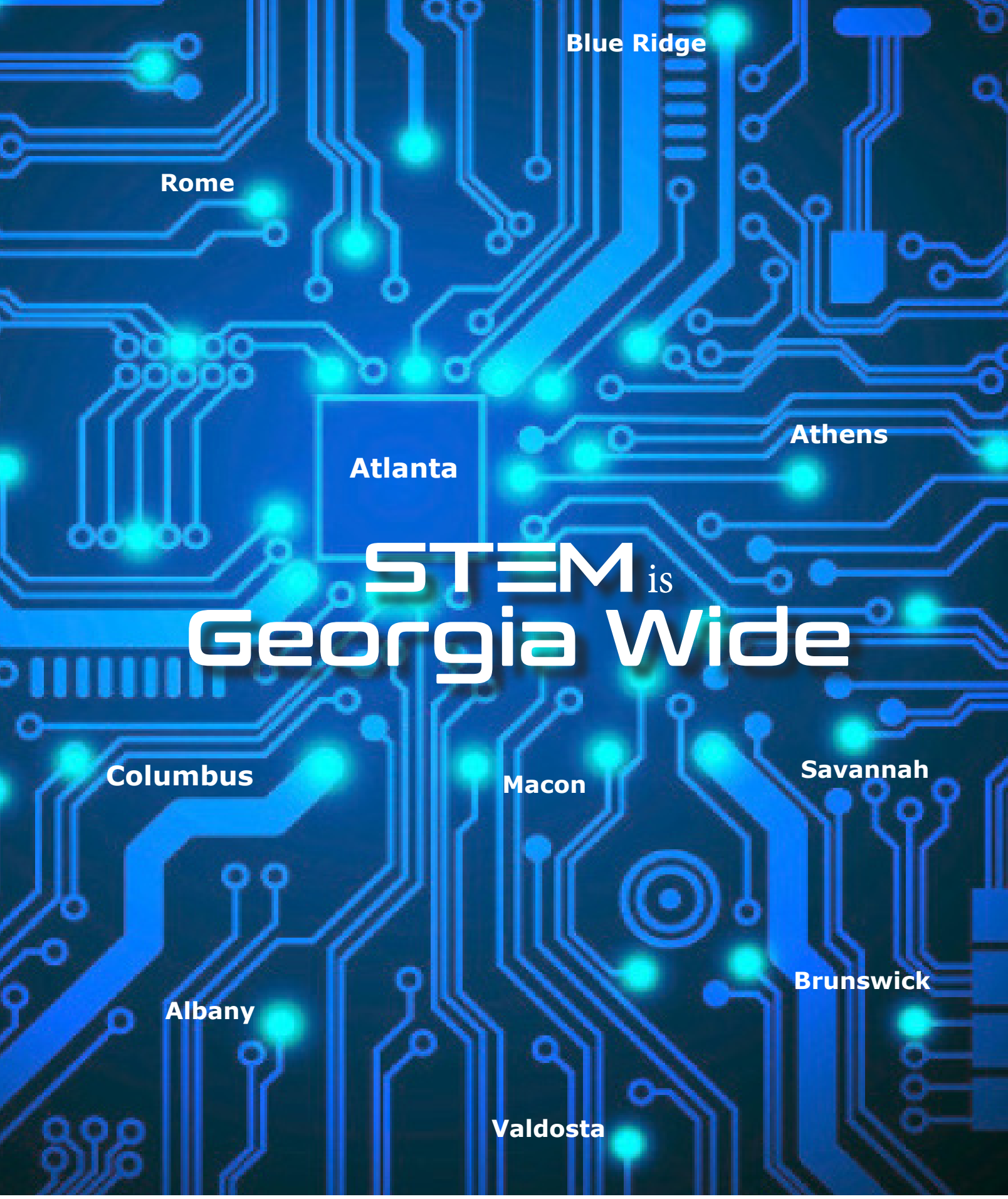

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