Sept. 2025

GEORGIA PATHWAYS

MAGAZINE

Catalyst for Change
Gigaplex Academy

Georgia's Future:
The Case for Registered Tech Apprenticeships
Dr. Loretta Daniels

Engineering Equity

The STEM of NASCAR

The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEM 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 2002. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEM education in Georgia.

President / CEO
Larry K. Williams

Executive Director
Dr. Loretta Daniels
http://www.tagedonline.org

Publisher
Wayne Carley
wayne@tagonline.org

I am pleased to introduce the September issue of Georgia Pathways Magazine, highlighting the forces shaping our state's fast-growing innovation economy. Across industries such as healthcare, logistics, manufacturing, and agriculture, employers are seeking talent prepared for an increasingly technology-driven future. Georgia is well-positioned: the U.S. Bureau of Labor Statistics reports the state added more than 186,000 STEM jobs between 2017 and 2021—a 9.6% increase, more than double the national average. Today, STEM positions represent nearly one-third of Georgia's workforce and generate close to 39% of its economic output.

Sustaining this momentum requires strong educational pathways that build both technical expertise and adaptability. This issue highlights several promising examples: a partnership between Gigaplex Academy and the Georgia Technology Student Association preparing students for tomorrow's STEM careers; Engineering Equity, which explores how innovative design can expand opportunity; and From STEM to Systems, which underscores why robust STEM education is vital for meeting future challenges.

Readers will also discover breakthroughs in ecological research through Photosynthesis Gene Discovery and the science behind auto racing in The STEM of NASCAR. Finally, Leadership Begins with SEL illustrates how social and emotional learning builds the foundation for effective workforce leadership.

TAG
Technology Association of Georgia

As Georgia's innovation economy accelerates, so too does the demand for adaptable leaders. To help meet this demand, TAG offers the Pathways to Leadership Certificate Program, a year-long professional development program that equips mid-level tech professionals with the skills to lead confidently in a rapidly changing industry.

We are also proud to partner with IBM SkillShare to provide learners with 7,500 certification courses, expanding access to critical training, including generative AI certifications designed for educators. Together, these initiatives strengthen Georgia's future workforce and ensure continued leadership in technology and innovation.

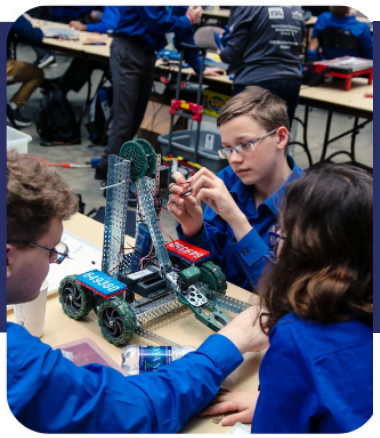
Larry K. Williams
President
TAG / TAG-Ed

Larry K. Williams serves as the President and CEO of the TAG and the TAG Education Collaborative. 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.

GigaplexAcademy

Exciting Partnership Announcement!

Georgia TSA
TECHNOLOGY STUDENT ASSOCIATION



19,773 Students in 244 Local Chapters

- Personalized Student Engagement
- Purposeful Fundraising and Networking
- Digital Portfolio for Storytelling

Gigaplex Academy and Technology Student Association (TSA) Partner to Empower Students

Georgia's Career and Technical Student Organizations (CTSOs) have long been a place where students grow their leadership, sharpen technical skills, and prepare for the future. Among them, the Technology Student Association (TSA) stands out for its focus on engineering, STEM, and innovation. A new partnership between TSA and Gigaplex Academy is set to take student opportunities even further, and create new ways for educators, parents, and employers to work together.

Catalyst: A New Tool for Students and Chapters

At the center, is Catalyst, Gigaplex Academy's student success platform. Catalyst starts by guiding each student through a process of self-discovery.

That purpose connects directly to TSA activities. Competitions and projects aren't just boxes to check; they become platforms for meaningful growth and real-world impact. Students gain confidence as they see how their efforts tie to college and career possibilities.

Fundraising with Meaning

Catalyst also makes fundraising easier and more purposeful. Each student receives a personalized fundraising page, similar to GoFundMe, where family and community members can invest in their personal growth and journey. Instead of selling products that may not feel relevant, fundraising is tied to student goals and accomplishments.

"A new program connects student purpose to competitions, projects, fundraising, and career pathways."

"Impressed with Gigaplex Academy's product and Fundraiser for TSA. This innovative tool is making a realimpact at our school!"

Mrs. Shenica Bridges-Mathieu
Engineering and Technology Teacher / CTAE / Arabia Mountain High School , Dekalb County Schools

Over time, these pages grow into digital portfolios. Students and chapters can showcase competitions, projects, achievements and social support in a professional, shareable format. This feature also gives advisors a valuable tool for tracking progress and celebrating success.

Benefits for Advisors, Parents, and Employers

For TSA advisors, Catalyst brings structure and simplicity. With students working from action plans, chapters become easier to manage and more aligned. For parents, Gigaplex Academy helps shift the mindset from "college prep as competition" to a journey of self-discovery, offering peace of mind in an often stressful process.

For employers, the potential could be especially exciting. Catalyst portfolios offer a direct window into the purposeful skills and accomplishments of Georgia students. Companies seeking future talent could identify motivated young people early, support them through internships or mentorships, and ensure the next generation of workers is prepared and inspired.

An Invitation to Collaborate

The partnership between TSA and Gigaplex Academy marks a new chapter for career-tech education in Georgia. It's a chance to align student purpose with workforce needs, while empowering teachers, parents, and chapters with better tools.

Educators, parents, and especially employers are invited to learn more about how they can get involved. By supporting this initiative, businesses can help strengthen their own talent pipeline — while giving students the confidence and clarity they need to thrive.

Together, TSA and Gigaplex Academy are sparking the future — one student, one chapter, and one purposeful project at a time.

Engineering Equity:
Reimagining STEM Through Design

By Dr. Natoshia Anderson

Equity in STEM isn't just about who shows up, it's about what systems were built to keep others out in the first place. The lack of representation of women, especially women of color, in science, technology, engineering, and math is NOT a pipeline issue. It's a design flaw.

As an engineer, I was taught that every problem has a solution, you just have to design it. That same thinking is exactly what we need when we talk about educational equity. Instead of asking, "How do we fix underrepresentation?" we need to ask, "What systems, structures, and beliefs created it in the first place?"

This is the foundation of Equity by Design—an intentional approach to disrupting the status quo in STEM learning environments. It's not about tacking equity onto existing programs as a feel-good afterthought. It's about baking it into the foundation of how we build curricula, fund programs, select teachers, train educators, assess students, and connect learning to real-world opportunity.

Right now, STEM education too often follows a one-size-fits-all model. That model assumes access, resources, and cultural neutrality—and completely misses the fact that students don't all come to the classroom with the same experiences or opportunities. So, while we may hand out the same materials, we are not giving everyone an equitable shot at success.

Let's be real: students can't learn coding if they don't have Wi-Fi at home. They can't envision themselves as scientists if their science curriculum never reflects their communities. They won't persist in engineering if the learning spaces they walk into are hostile, dismissive, or isolating. Equity by Design means anticipating these barriers and building systems that ***account for*** and ***remove*** them.

Here's what that actually looks like:

- Culturally responsive STEM instruction that acknowledges and celebrates the diverse experiences students bring with them.

- Access to high-quality resources regardless of a student's zip code, including devices, software, and mentorship.

- Partnerships with industry and community organizations that build authentic connections between students and future career pathways.

- Professional learning for educators to equip them not just with content knowledge, but with tools to create inclusive, anti-racist, and gender-equitable classrooms.

This is not about charity. This is about redesigning systems so that talent and brilliance—*from every corner of every community*—can thrive.

When we design for equity, we expand the boundaries of what's possible. We stop seeing certain groups of students as "at-risk" and start seeing them as untapped potential. We stop measuring success by standardized test scores and start asking whether our systems are cultivating problem solvers, innovators, and critical thinkers who are prepared to lead in a tech-driven world.

Equity by Design demands that we shift from reactive to proactive. From surface-level diversity to deep structural change. From celebrating access to demanding outcomes. And let's be honest: this kind of design work is messy. It requires examining our biases, disrupting comfortable systems, and taking risks. But the alternative is maintaining the status quo, where brilliance is overlooked, innovation is stifled, and entire communities are left behind.

So, the question isn't whether equity belongs in STEM. The question is: are we willing to do the work to design for it? Because if we are, then the future of STEM won't just be smarter, it'll be more just, more inclusive, and infinitely more powerful. And that's a blueprint worth building.

Dr. Natoshia Anderson, a former Mechanical Engineer turned STEM Educator and Consultant, is the Founder and CEO of Anderson Strategy Group LLC. Renowned for her podcast, STEMming in Stilettos™, she champions the voices of minority women in STEM. Dr. Anderson has actively developed impactful STEM curricula for 100+ organization all over the world and has fosters educational partnerships.

An inspiring speaker and author, her latest book contributes to books like Triumph in the Trenches and children's literature such as ABC Engineering, London Gets Curious, ABC's of AI. Holding degrees in Mechanical Engineering, an MBA, and a Doctorate in Educational Leadership, Dr. Anderson is dedicated to mentoring and increasing STEM opportunities for minority women and girls globally. #STEMAdvocate #WomenInSTEM #EducationalLeader

Share this issue with your students, peers, parents and industry professionals you know. Make this a new monthly connection for curiosity, interaction, college prep and career development.

Many parents really enjoy this content as they too pursue their personal life-long learning goals.

Local industry and government leaders need to know about this resource as their future employees decide and prepare how to spend their careers.

From STEM to *Systems*:

Why the Future Isn't Leaving STEM Behind. It's Calling It Higher

By **Shelly Muñoz** / STEM Leader, Workforce Innovator, and Advocate for Rural Equity

Last year, a group of 8th graders in rural Minnesota designed a 3D-printed fishing lure and pitched it to a local outfitter. The school called it STEM. The students said, "This feels like something I could actually do in real life—or even turn into a career or business". For them, it wasn't just an assignment, it was their first step into the world of work, and it mattered.

Across the country, whispers are growing louder: "Is STEM getting left behind?" It's a fair question. CTE programs (*Career Technical Education*) are booming. AI has exploded across the educational landscape in the past year, transforming everything from lesson planning to assessment. And many STEM coordinators, especially those in rural or under-resourced communities,

are scrambling to rebrand, reframe, or even defend the relevance of their work. But here's the truth: STEM isn't disappearing. It's transforming, and those of us in the STEM ecosystem need to stop asking, "How do we save STEM?" and start asking "How do we evolve it?"

CTE and AI Didn't Replace STEM: They're Built on It.

Career pathways and technical education are surging for good reason. They offer relevance. They close equity gaps. They lead to jobs. But peel back the layers of high-demand careers, from advanced manufacturing to digital marketing to sustainable agriculture, and what you'll find underneath is STEM:

- Engineering principles
- Scientific process
- Computational thinking
- Data analysis

Likewise, AI doesn't exist apart from STEM. It ***is*** STEM at an exponential scale. Understanding algorithms, ethics, and digital fluency is impossible without science, tech, math, and logic foundations. AI isn't erasing STEM; it's demanding a deeper version of it.

"AI isn't the enemy of education. But it will expose the irrelevance of anything disconnected from real-world learning."
— Superintendent

"What's Really Happening?"
A Shift from Subjects to Systems

STEM used to be a set of disciplines. Now, it's becoming a way of thinking, designing, and solving across systems. When you combine STEM with CTE, you get innovation labs that mirror real industry spaces. When you integrate STEM with AI, you create students who can navigate and shape digital futures.

When STEM meets mental health, it becomes a tool for healing through design, expression, and story. When it connects to community, it becomes intergenerational, culturally rooted, and deeply human.

"STEM isn't getting smaller, it's getting smarter."
— Shelly A Muñoz

What Educators Must Do Next

If you're a STEM leader, teacher, or advocate, now is the time to move forward, not cling backward.

- Reframe STEM as workforce education. Design learning that feels like work, solves real problems, and prepares students for actual careers, not just test scores.

- Integrate AI as a teaching assistant, not a threat. Use it to speed up planning, deepen inquiry, and explore ethics. Teach students to create with it, not just consume it.

- Partner with CTE, don't compete with it. Co-develop programs that blend welding with geometry, fiber arts with product design, and robotics with local manufacturing.

- Champion equity at every turn. Ensure rural, Indigenous, and underrepresented communities aren't just accessing STEM, they're shaping what it becomes.

"Our job isn't to prepare kids for one path. It's to open every path."

- Shelly A Muñoz

What the Next 5 to 10 Years of STEM Innovation Will Look Like

We are entering a golden age of redefinition, where STEM will no longer be confined to lab coats and formulas. The most innovative programs will be:

1. Career-Connected and Student-Designed

- In Brainerd, MN, students are engineering 3D-printed fishing lures to learn hydrodynamics and launch real microenterprises.

- In Chicago Public Schools, students redesign urban greenhouses using climate sensors.

- In St. Vrain Valley Schools in Colorado, high schoolers in the P-TECH program code for nonprofits and graduate with associate degrees.

- Advance CTE reports that students in career-connected STEM are 21% more likely to complete a postsecondary credential.

- XQ Institute predicts capstone-style projects will become the new high school standard.

"This is the first time school has felt like real life. I'm not just learning—I'm building something that matters."
- Student

2. Powered by AI but Rooted in Humanity

- Fresno Unified is using AI to support multilingual learners and lighten teacher workloads.

- Tools like MagicSchool.ai and Eduaide.ai are helping teachers co-develop content, freeing them to focus on students.

- Students use AI to brainstorm science topics, debug code, and create study tools with thoughtful guidance.

"AI gives me back time, but it doesn't give students back trust. That's still my job."
— Middle school teacher

3. Intergenerational and Interdisciplinary

- In Hawaii, students study STEM through ancestral navigation and environmental stewardship.

- Coding clubs are emerging in rural libraries where teens and elders solve problems together.

This model doesn't just include more voices. It redefines what counts as knowledge.

4. Mobile, Modular, and Microcredentialed

- Mobile labs in West Virginia and Georgia bring hands-on STEM to underserved communities.

- Arizona State University and LinkedIn Learning offer microcredentials in AI, climate science, and cybersecurity to teens.

- Montana schools are developing digital portfolios tied to local industry credentials. This isn't just about learning. It's about giving students proof of their value.

5. Creatively Bold and Soulfully Relevant

- At High Tech High in San Diego, students use poetry, design, and activism to create tech-integrated social change.

- Future Builders Labs combine engineering with healing circles and storytelling to serve underserved youth.

- Teachers are co-planning with artists, tribal leaders, and therapists to nurture whole-child development through STEM.

"I didn't know I was smart until STEM helped me solve a real problem."
— Middle school student

Final Word: The Future of STEM

We don't need to defend STEM, we need to unleash it — as the connector between classroom and career, data and humanity, invention and healing. Let CTE rise. Let AI grow. Let STEM evolve with them. Because the future doesn't need another acronym. It needs architects of possibility. STEM doesn't need a revival, it needs a reframe, and the leaders who will shape it next are already in classrooms, maker spaces, and tribal learning circles. The question isn't whether STEM has a future, but "who will build it?".

To understand STEM...

...you must DEFINE STEM. You cannot define an acronym without defining each of the words the letters stand for.

Universities and organizations around the world continue to debate what a STEM career is, but there is no doubt that "every career" uses STEM skills and this observation remains the focus of STEM Magazine.

Science: "The systematic accumulation of knowledge" (all subjects and careers fields)

Technology: "The practical application of science" (all subjects and careers)

Engineering: "The engineering method: a step by step process of solving problems and making decisions" (every subject and career)

Math: "The science of numbers and their operations, interrelations, combinations, generalizations, and abstractions" (every career will use some form[s])

For a moment, set aside any preconceived notions of what you think a STEM career is and use the above dictionary definitions to determine the skills used in any career field you choose.

These definitions are the "real" meaning of STEM and STEM careers.

Editorial: Beyond the Degree. Why Registered Tech Apprenticeships Matter for Georgia's Students

By Dr. Loretta Daniels

As an educator and organizational leader, I deeply believe in the value of higher education. I encourage every student to pursue a two-year or four-year degree if that path aligns with their goals. But I also believe in meeting students where they are. To those who are unsure about college, or are unable to afford it, it's essential for us to promote equally rigorous, career-driven alternatives that yield upward mobility. Registered Tech Apprenticeship Programs offer alternative pathways as strategic first steps toward long-term success in high-demand industries.

Recent national data shows that college enrollment among high school graduates has dropped from 66.2% in 2019 to 62.8% in 2024. Meanwhile, apprenticeship programs have grown steadily, with over 667,000 active apprentices in the United States in 2024, up from 360,000 in 2015. In Georgia, there were 333,000 job openings in May 2025 alone, many in high-skill, middle-wage tech sectors. These indicators tell us that we need diverse strategies to align student potential with employer demand.

Tech apprenticeships offer real opportunity. Employees learn on the job, earn a paycheck, and receive industry-recognized credentials. These aren't unpaid internships; they're formal employee programs recognized by the U.S. Department of Labor. Fields like cybersecurity, cloud computing, and AI now offer apprenticeships with entry points that lead to long-term employment, upward mobility, and often employer-funded education benefits, without requiring a traditional degree. Tech apprentices who later pursue a degree can benefit, as many companies provide tuition assistance as a fringe benefit, which can reduce or even eliminate the need for student debt. Participants in TAG Ed's Registered Tech Apprenticeship Program gain real-world experience, mentorship, and career-aligned training with employers who are invested in their growth.

Choosing a registered apprenticeship is not a rejection of higher education, it's a strategic choice for those seeking employability in the present with the flexibility to pursue advanced degrees in the future. This path offers dignity, structure, and support, especially for individuals from working-class backgrounds. As educators, we must ensure that students know all their options. Apprenticeships should be elevated alongside traditional degree pathways. They're a smart choice, especially in a state like Georgia where demand for tech talent continues to grow. If we want to truly prepare students for the future, we need to give them access to every tool that helps them succeed and gets them hired.

Registered Tech Apprenticeship Program

Georgia's first nationally registered tech apprenticeship program

For applicants:

A thriving career in technology awaits you! No prior technology experience or degree is required to start paid on-the-job training at major companies!

For employers:

TAG-Ed has adapted the Registered Apprenticeship model to create a simplified path to qualified and certified talent. Access an array of tech talent address digital skills shortages!

Apprentice Journey

Interview with Employer	Begin Related Technical Instruction	Join Team	Meet with Mentor Monthly	Retrained!
				
Interview and Select Apprentice	Designate Mentors and Managers	Initiate Work Plan	Meet with TAG-Ed on the 1, 5, and 10 Month Marks	Extend Offer

Employer Journey

- Higher retention rates
- No college degree or prior technical experience required
- Save costs over traditionally sourced talent

OAK RIDGE National Laboratory

Landmark photosynthesis gene discovery boosts plant height, advances crop science

By Stephanie Seay / ORNL

A team of scientists with two Department of Energy Bioenergy Research Centers — the Center for Bioenergy Innovation, or CBI, at Oak Ridge National Laboratory and the Center for Advanced Bioenergy and Bioproducts Innovation, or CABBI, at the University of Illinois Urbana-Champaign — identified a gene in a poplar tree that enhances photosynthesis and can boost tree height by about 30% in the field and by as much as 200% in the greenhouse.

The gene, which scientists named Booster, also increased the biomass of another plant species, Arabidopsis, or thale cress, indicating the potential for higher yields from other crops if successful on a larger scale.

Booster was identified in Populus trichocarpa, or the black cottonwood tree, a species that thrives from Baja California in Mexico into northern Canada. This tree is recognized as a leading candidate as a feedstock for making biofuels and bioproducts.

Booster is a chimeric gene that contains sequences from three originally separated genes, and has been preserved in poplar with minimal changes over evolutionary time. The gene plays an important role in photosynthesis, the process plants use to convert sunlight, carbon dioxide and water into glucose — the building block for cellulose, starch and other macromolecules related to food and fuel production.

Chimeric genes have unique origins and are thought to enable evolutionary changes that help plants adapt to new environments. In the case of Booster, the ORNL team determined that it contains three different DNA origins. One segment is from a bacteria found in the poplar tree's root system; one segment is from an ant that farms a fungus known to infect poplar; and one segment is from the large subunit

A team of scientists discovered a naturally occurring gene in the poplar tree that enhances photosynthetic activity and significantly boosts plant growth. The gene, Booster, contains DNA from two associated organisms found within the tree, and from a protein known as Rubisco that is essential to photosynthesis. Credit: Andy Sproles/ORNL, U.S. Dept of Energy

of Rubisco, an abundant protein found in plant chloroplasts.

Chloroplasts are the principal cell structures that house the photosynthetic apparatus converting light energy into the chemical energy that fuels plant growth. The Rubisco protein functions as the plant's "carbon-grabber," capturing carbon dioxide from the atmosphere. Scientists have for years been working on ways to boost the amount of Rubisco in plants for greater crop yield and absorption of atmospheric CO2.

When researchers created poplar trees with greater expression of the Booster gene, their Rubisco content and subsequent photosynthetic activity soared, resulting in plants that were as much as 200% taller when grown in greenhouse conditions, as described in the journal *Developmental Cell.*

The trees demonstrated up to 62% more Rubisco content and about a 25% increase in net leaf CO2 uptake. In field conditions, scientists found that higher expression of Booster resulted in poplar trees up to 37% taller, with as much as 88% more stem volume, increasing biomass per plant.

Scientists inserted Booster in a different plant, Arabidopsis, resulting in a similar increase in biomass and a 50% increase in seed production. This finding indicates the wider applicability of Booster to potentially trigger higher yields in other plants.

Multiple benefits from a single enhancement

Poplar and Arabidopsis are known as C3 plants, a category that includes key food crops such as soybeans, rice, wheat and oats. The Booster gene has the potential to increase bioenergy crop yields without requiring more land, water or fertilizer, supporting a robust bioeconomy. If Booster works similarly in food crops, higher yields could reduce food scarcity around the world.

"Growing high-yielding, perennial bioenergy crops on marginal lands unsuitable for conventional agriculture can help us meet rising demand for liquid biofuels for hard-to-electrify sectors like aviation," said Jerry Tuskan, CBI director and a Corporate Fellow at ORNL who coauthored the paper. "Fast-growing, resilient feedstock plants can stimulate the bioeconomy, create rural jobs, and support forecasted demand for energy."

"This discovery could be a game-changer in terms of a big stimulation of photosynthesis and plant productivity," said Stephen Long, a leading authority on plant photosynthesis and professor at the University of Illinois Urbana-Champaign, who is also a coauthor in his role with the Illinois-led CABBI. "While we need to test more widely to be sure we can reproduce the results on a large scale, the fact that it worked in a completely unrelated plant indicates that it could work over a wider range of plants."

Next steps in the research could encompass multilocation field trials of poplar and other bioenergy and food plants, with researchers recording plant productivity in varying growing conditions to analyze long-term success, Long said.

The discovery was the result of a collaboration between two DOE centers where scientists focus on developing improved bioenergy feedstock plants along with efficient methods to process plants into advanced fuels and products.

In this photo from July 2024, ORNL's Biruk Feyissa, left, holds a five-month-old poplar tree expressing high levels of the Booster gene, while then-colleague Wellington Muchero holds a tree of the same age with lower expression of the gene. Credit: Genevieve Martin/ORNL, U.S. Dept. of Energy

Collaboration links large genetic database, photosynthesis expertise

At the ORNL-led CBI, scientists have studied poplar for years as a fast-growing, nonfood perennial crop for feedstock production. They assembled the first genome-wide association study, or GWAS, of Populus trichocarpa by sampling from 1,500 trees in the wild and

analyzing their physical characteristics and genetic makeup. The GWAS, one of the first and largest of its kind, identified more than 28 million single nucleotide polymorphisms that act as biological markers, helping scientists locate genes associated with certain traits such as plant growth; carbon, nitrogen and lignin content; and how efficiently the plants use water.

Scientists from CBI and CABBI used the GWAS population to look for two candidate genes that had been linked to photosynthetic quenching, a process that regulates how quickly plants adjust between sun and shade and dissipate excess energy from too much sun to avoid damage. CABBI scientists leveraged screening techniques they had developed to conduct rapid phenotyping of poplar in trial gardens in Davis, California. Initial screenings did not immediately turn up the genes they were looking for. But further molecular analysis of one candidate gene turned out to be Booster, which influences the two genes CABBI had predicted to be key to improved photosynthesis.

The research was supported by CBI and CABBI, both sponsored by the DOE Office of Science Biological and Environmental Research Program. The project used the high-throughput, world-leading imaging capabilities of ORNL's Advanced Plant Phenotyping Laboratory, which enabled rapid, automated measurement of leaf size changes in poplars expressing the Booster gene in a greenhouse environment.

Whole-genome sequencing and other RNA analyses were conducted by the Joint Genome Institute, or JGI, a DOE Office of Science user facility at Lawrence Berkeley National Laboratory. The project used high-performance computing resources of the Oak Ridge Leadership Computing Facility, a DOE Office of Science user facility at ORNL.

Opening a new avenue of scientific thinking

"Conserved chimeric genes such as Booster are often disregarded as non-functional, evolutionary artifacts that no longer influence plant processes," said ORNL's Biruk Feyissa, who led the gene's molecular analysis and is first author on the paper. "But here we proved just the opposite. Our molecular and physiological validation confirmed that Booster enhances photosynthesis so that plants perform better under steady and fluctuating light conditions."

"The discovery opens up a new avenue of scientific thinking," Tuskan said. "We tend to think of photosynthesis as a difficult-to-improve process. But in fact, the molecular machinery surrounding photosynthesis has continued to evolve as plants adapted to their environment. In this case, the exchange

of DNA with associated organisms changed a biological process in a fundamental way."

Other scientists on the project include co-lead Steven Burgess of CABBI and the Carl R. Woese Institute for Genomic Biology at Illinois; co-lead Jay Chen, ORNL Plant Systems Biology group leader; Jin Zhang, Timothy Yates, Kuntal De, Sara Jawdy, Dana Carper, David Weston, Paul Abraham and Jennifer Morrell-Falvey of CBI/ORNL; Elsa de Becker and Coralie Salesse-Smith of CABBI/Illinois; Margot SS Chen and Chung-Jui Tsai of CBI/University of Georgia.

Gail Taylor of CBI/University of California, Davis; Meng Xie of Brookhaven National Laboratory; Dhananjay Gotarkar of the University of Missouri; Kerrie Barry of JGI/Lawrence Berkeley National Laboratory; and Jeremy Schmutz of JGI and HudsonAlpha. The paper is dedicated to the memory of Wellington Muchero, project co-lead and former ORNL plant scientist and geneticist.

UT-Battelle manages ORNL for DOE's 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:
energy.gov/science

Stephanie Seay , Senior Science Writer and Communications Specialist.


KENSELOWSKI
STEWART
EDWARDS
LOGANO
PENNZOIL
Ford
22
FUSION
14
78
TRUEX JR.
KURT BUSCH
DILLON

The STEM of NASCAR

A 670 Horsepower Career Path

By Wayne Carley

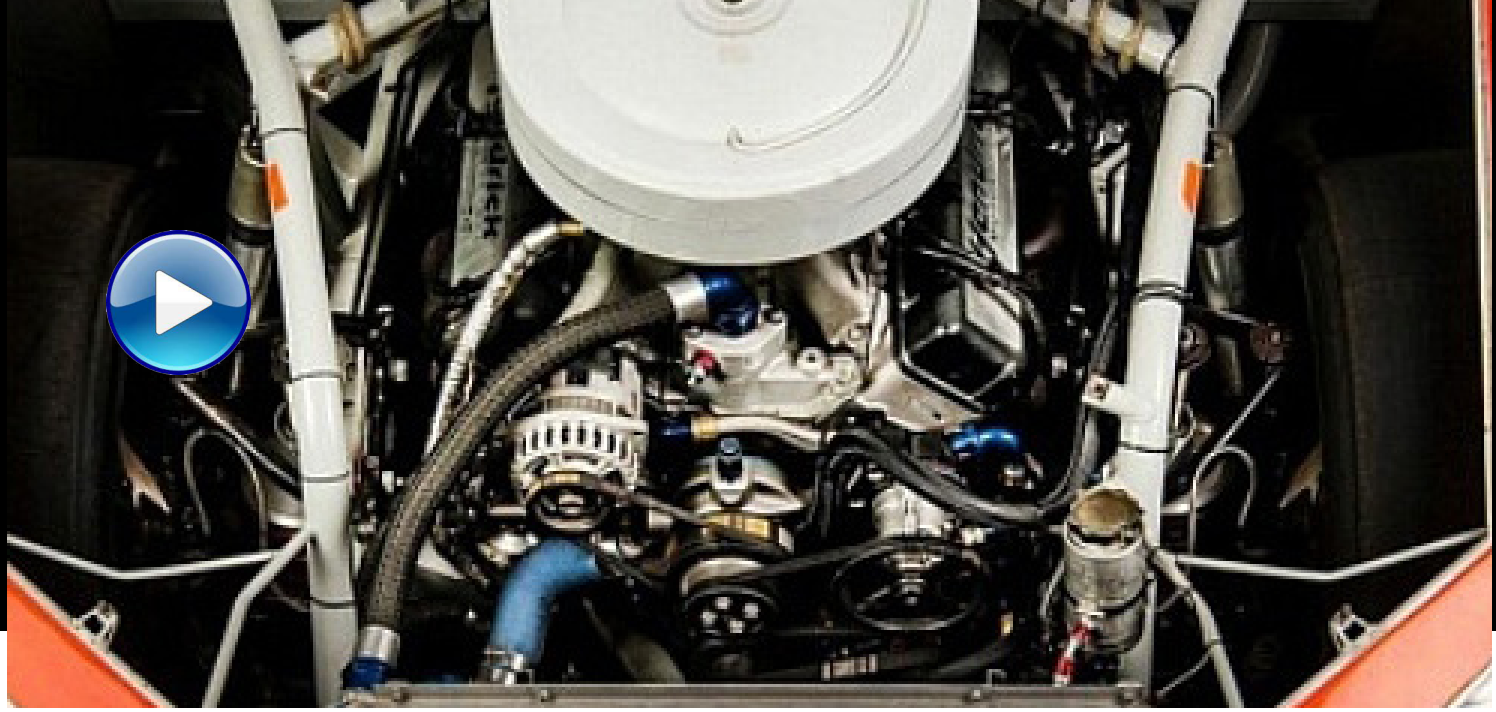
The science, technology, engineering and math of NASCAR and motor sports are extraordinary and an excellent example of how the array of career opportunities available within this sport fit most any career category you can imagine. Motor sports is a broad and complex industry generating billions of dollars with diverse arena's and racing associations that include NASCAR, Formula One, Drag Racing, Speed Boats, motorcycles, trucks, carting and so many more, not to mention the tracks and venues that host these events globally.

This is the first in a series of articles on the STEM of NASCAR, highlighting many of the career paths available and how the components and responsibilities of a racing team and their car incorporate **science** (the systematic accumulation of knowledge), **technology** (the practical application of the science), **engineering** (the problem solving and decision making), and **mathematics** (the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions).

In the beginning, the race cars were driven off the street and onto the track, but as performance and technology advanced, dramatic changes were made to cars resulting in the racing machines of today that are more complicated and technologically sophisticated.

Thanks continues to go out to Bill France who in 1947, organized the first meeting to discuss the creation of the National Association for Stock Car Auto Racing - NASCAR, and the rest is history.

We'll give a brief overview of the structure and limitation rules associated with the physical and mechanical aspects of the car, and focus on the mechanics each team employees to carry their driver to victory. Future articles will include the physics of aerodynamics, physiology and psychology associated with the driver, track design, new innovations, and a look down the road at where NASCAR may be in 5 years.

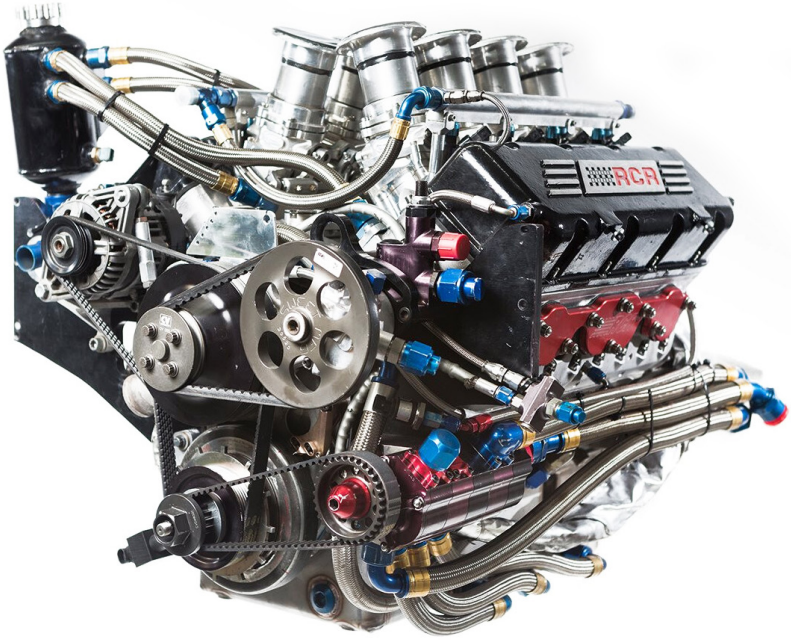


"There's nothing stock about a stock car"

NASCAR has very specific guidelines of race car construction that must be followed precisely and are checked prior to each racing event, whether it is the teams short track car or long track car. These limitations can level the playing field in most regards, promoting a more competitive racing experience regardless of the financing available to the team. The idea is to make the race more about driver ability and less about a possible unfair advantage through financing or unusual components.

Over time, modifications to the car have continued, to increase performance and safety. There is a choice of 3 approved engines but the basic shape of the body, fuel, tires, suspension, transmission, and electronics are identical. The detailed list of NASCAR requirements is very specific and non-negotiable: **https://nascar101.nascar.com**

Through the science (accumulated knowledge) of racing, NASCAR determined their preferred engines to be used, manufactured by Ford, Chevrolet and Toyota. In general, the gasoline combustion engine (piston driven) is limited to 358 cubic inches (v8) and 675 horsepower with an approved list of mechanical components to be incorporated in their final design.



Engine Science / The Job of the Mechanic

The engines purchased by the teams may be about equal in most regards, but it's the teams mechanics who transform the ordinary into extraordinary.

Engine mechanics are a true form of "engineer" best defined as problem solvers and decision makers. The possible problems being, why didn't the engine perform as expected and how can we fix that? Keep in mind that this career path goes far beyond NASCAR to every engine in every car, ever built – and those yet to come. If you like to work with your hands and get greasy, this career path is for you.

Each team is allowed to make ever so slight physical changes to the engine that on the surface may seem inconsequential, but over the course of a few hours and hundreds of miles, may result in:

- great distances ahead or behind the competition
- reliability of function issues
- fuel efficiency differences
- responsiveness and power output

A few of those approved changes are minor machining of cylinder inner dimensions (increase in compression and power), and changes in the mass (size and weight) of the overall engine and a few components.

These changes are limited but can be dramatic by the end of the day.

The "raw" engines are sold to the teams by their chosen manufacture (mentioned earlier) allowing the team mechanics to begin their total rebuild to include their preferred modifications based on past builds - but the limits are firm and inspected thoroughly by NASCAR.

The implementation of these minor modifications is documented in great detail, both electronically and physically, during and after the race. This data is used for later review to prepare for the next engine build and race. This accumulated knowledge (science) makes all the difference in the world to the mechanics as they decide (engineering method) what worked and what didn't after the last build.

The "how do we do better" equation (***problem solving***) is a post-race ritual as construction of the next engine is already underway. A millimeter here or there, an extra turn of the screw left or right, one less ounce or a minor shift in center of gravity may make all the difference in next weeks' race results. The 1-2% of mechanicals variations made can win or lose the event, and it's certain that all 40 of the NASCAR entries are doing the same weekly.

Common questions mechanics may ask during their engine design are:

- How long do we have to run?
- What engine temperatures can we tolerate?
- What's the weather forecast?
- What weaknesses do we anticipate during the race and what can we adjust in the pit?
- How did the last build perform?

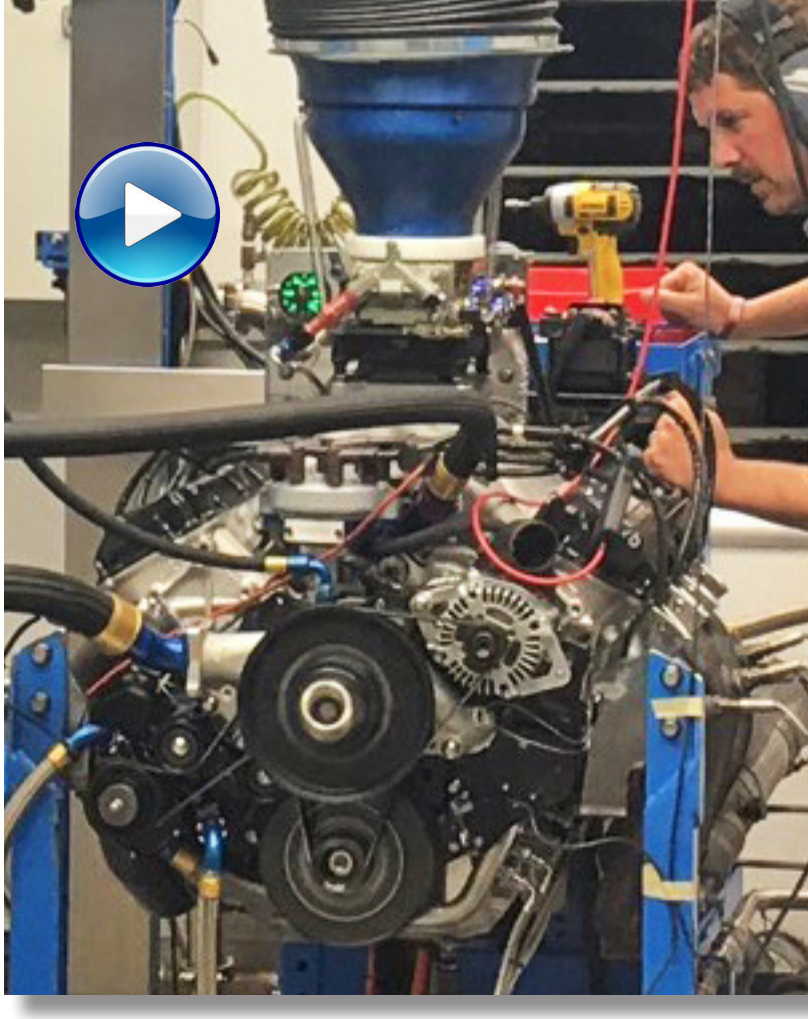
After each race, the mechanics complete disassemble the engine and inspect every part. Some parts may be reused while others are discarded. It's here where the mechanic (engineer) gains important information (science) about the wear and tear of mechanical components, thus helping to make critical decisions (engineer) to improve the next outcome. Since there is a small group of mechanics involved on every team, collaboration and communication are also critical during post race

evaluation and decision making for future builds.

We've talked about the science and engineering, so let's move on to the technology and mathematics of NASCAR engines. Technology is defined as the "practical application of science", so the accumulated knowledge we've described is now applied through more efficient use of available customizing, monitoring and efficiency of the engine.

Mechanics will explore alternate materials (approved), styles and effectiveness of a variety of parts to potentially solve problems, monitor performance electronically and catch potentially poor trends in engine behavior and perhaps find that critical little tweak that will give them the edge they have been looking for.

In the shop, as the build is underway, an array of tools from wrenches and screw drivers, to microscopes, scanning equipment, vibration sensors and pressure gauges will be used to examine the metals, expansive behaviors and responses from the engine during testing. Monitoring an engine's internal functions during its operation is an amazing opportunity to see into the heart of the power plant for the mechanics. Having the ability to monitor friction, pressures, temperatures, movement, part interaction, vibrations



and power output provide the information needed for the mechanics to "fine-tune" the engine for what they hope is a winning combination.

The importance of mathematics in an engine build cannot be overstated. The typical combustion engine has about 200 parts that need to work as one to be most effective. How those parts fit together is a matter of micrometers (25,400 micrometers per inch) and must be measured precisely using tools such as:

- Micrometer Set
- Dial Bore Gauge
- Dial Caliper
- Snap Gauges

Knowing how to use these tools is certainly a systematic accumulation of knowledge (science). Using them effectively is a must as incorrect measurements during the build do not lead to the winners circle. As engines heat up, metals expand changing how many engine parts fit together, affecting function and performance. The mechanical engineer knows this, anticipates it, and compensates for it. After the post race tear-down, they learn from it.

- Depth Micrometer
- Dial Indicator
- Magnetic Base
- Calibration Blocks
- Rod Bolt Stretch Gauge
- Height Micrometer
- Stroke Gauge
- Leakdown tester
- and Camshaft Lift Check, to name a few.

So, with 40 cars on the track, all with essentially the same engine, it's interesting to see the wide variety of differences in engine performance, reliability and results at the checkered flag.

Stay tuned for more careers in NASCAR from STEM Magazine.

Share this issue with your students, peers, parents and industry professionals you know. Make this a new monthly connection for curiosity, interaction, college prep and career development.

Many parents really enjoy this content as they too pursue their personal life-long learning goals.

Local industry and government leaders need to know about this resource as their future employees decide and prepare how to spend their careers.

Why Leadership Begins with Social and Emotional Learning

By **David Adams**, CEO, The Urban Assembly

When we talk about preparing young people for the workforce, we often focus on test scores, technical training, and career pathways. These are important—but they aren't the full story. In today's economy, where teamwork, communication, and problem-solving define success across industries, one quality stands out: leadership. And not just the formal kind with titles and corner offices, but the everyday leadership that shows up when someone takes initiative, motivates a group, manages conflict, or stays composed under stress. So where does that kind of leadership come from? Increasingly, the answer is high-quality social and emotional learning.

Social and emotional learning helps students develop the skills to understand themselves and others, manage

their emotions, make thoughtful decisions, and build positive relationships. These may sound like personal development goals, but they are the very foundation of leadership and, by extension, workforce readiness.

Recent research conducted by Riverside Insights, Urban Assembly, and the Fordham School of Social Service provides compelling links between social and emotional learning competencies and leadership potential. The study examined how students' scores on the DESSA (Devereux Student Strengths Assessment)—a leading social and emotional learning measure—correlated with key employability skills from the ACT WorkKeys system, including work ethic, collaboration, resilience, creativity, integrity, and leadership.

The findings were telling. Leadership had a .45 correlation with overall social and emotional competence, a .43 correlation with decision-making, and a .42 correlation with self-awareness.

These are statistically moderate to strong relationships, especially in education and social science contexts.
To put this in perspective, consider the correlation between height and weight. It's typically around .60, meaning that as height increases, weight tends to increase too—though not perfectly.

Another familiar benchmark: the correlation between SAT scores and a student's first-year college GPA is approximately .40. That means social and emotional skills are at least as predictive of leadership as standardized test scores are of academic success. Put another way, a correlation of .45 between social and emotional competence and leadership suggests that students who show strong self-awareness, empathy, and emotional regulation are signifi-

cantly more likely to demonstrate leadership skills in the workplace.

What's powerful about this finding is that it shifts our understanding of leadership development. Too often, we treat leadership as something that starts in adulthood—with internships, business courses, or formal mentorship. But the truth is, the skills of leadership are formed much earlier, through the kinds of everyday interactions students have in classrooms, school clubs, sports teams, and peer relationships.

Consider a high school student who volunteers to mediate a disagreement in a group project. He listens carefully to both sides, keeps the discussion on track, and helps the team reach a compromise. That's conflict resolution, empathy, and problem-solving in action—all core social and emotional learning skills. Or imagine a middle school student who motivates her classmates to keep going on a tough science experiment, reframing failure as part of learning. That's optimistic thinking and influence, both of which fall under the leadership umbrella.

What social and emotional learning provides is not just emotional literacy—it's the infrastructure for leadership. Skills like self-management help students stay organized and composed. Relationship skills build trust and cooperation. Social awareness fosters the capacity to understand diverse perspectives, an essential trait in inclusive leadership. And responsible decision-making helps students navigate choices with clarity and purpose.

Employers increasingly recognize this. Surveys from the World Economic Forum and the National Association of Colleges and Employers (NACE) consistently rank communication, teamwork, adaptability, and leadership among the top competencies sought in new hires.

These are not isolated technical abilities—they are complex social and emotional skills applied in a work environment.

By investing in social and emotional learning, schools are not simply teaching students how to be "nice." They are developing students who can lead teams, manage stress, navigate ethical dilemmas, and inspire others. These are not extras—they are essential.

Social and emotional learning provides the soil in which these capabilities grow. And the data is clear: students who are strong in social and emotional learning are far more likely to become the kind of leaders our workplaces—and our communities—need.

Accelerate Your Career with AI Certification

Start with the Microsoft Azure AI Fundamentals courses where you'll learn the foundation of modern artificial intelligence (AI) and machine learning (ML). This will enable you to recognize common applications of AI and identify the available AI services in Microsoft Azure.

- 4 Week Course | 10 hours/week
- 100% Online, Instructor led
- Equipped to pass the AI-900 exam
- Exam voucher included
- Price: $750

Once you have the fundamentals or programming experience, you can be eligible for the Microsoft Azure AI Solutions course. This is where you'll gain a comprehensive understanding of the of the responsibilities encompassing the design, deployment and maintenance of AI solutions.

- 8 Week Course | 8-10 hours/week
- 100% Online, Instructor led
- Equipped to pass Azure AI Associate AI-102 exam
- Exam voucher included
- Price: $2,400

Ask About Bridge Builders Scholarship: TAG Bridge Builders and SkillStorm are committed to promoting equity and diversity in the workforce. Apply for a scholarship tailored to serve minorities in Georgia who are looking to advance their tech careers.

Sign up for a course today!

SKILLSTORM

SKILLSTORM

AI Skills: The New Currency in Today's Job Market

The AI revolution is here. Ever since ChatGPT arrived on the scene in late 2022, artificial intelligence has been reshaping the way we live and work. What does that mean for tech professionals looking to compete in a changing labor market?

TV pundits and talking heads love to get riled up about whether robots are coming for our jobs — but the truth is that AI will probably create more jobs than it eliminates. And one thing's for sure: understanding how AI works, and mastering AI skills, will be the key to success in tomorrow's ever-changing world of work.

New research shows that a growing number of companies are asking for AI skills in job descriptions — including non-tech roles. And a survey of HR professionals released last month shows that job candidates with AI skills ask for more money during the interview process — and tend to get it once they're hired. Simply put, AI is going to be underpinning nearly every job out there. That's why staying ahead of the latest in AI development is so important.

Building AI skills doesn't just mean learning how to engineer prompts for ChatGPT. It's everything from programming to data modeling and analysis to mastering concepts like machine learning and natural language processing. And if there's anything certain in our fast-paced economy, it's that building AI fundamentals today will translate to career opportunities tomorrow and beyond.

That's where SkillStorm comes in. In partnership with TAG, we offer Microsoft Azure AI courses that are instructor-led, career-aligned tech certification courses and will help you build the AI skills that employers need. From the basics of AI and machine learning to a comprehensive understanding of how to design, deploy, and maintain AI solutions, you'll learn everything you need to accelerate a career in the economy's hottest fields.

It won't be long before all kinds of jobs, all across the economy, require AI skills. And starting now is the best way to accelerate your ascent up the career ladder. Build those skills today and you'll lay the foundation for opportunity for years to come — and set yourself up for success in an AI-driven future of work. Register today to get started with a career in tech.

TAG | TAG-Ed
Education Collaborative

GEORGIA PATHWAYS MAGAZINE

Georgia's most influential workforce development and STEAM magazine which is distributed monthly to over 62,000 individuals state-wide.

Readership:

- **68%** Educators, K-12 Students, Parents, and School Administrators
- **16%** Industry professionals
- **8%** University professors and their students
- **8%** Other interested individuals

Contact Us:

For assistance with sponsorship, advertising, or other inquiries please contact tag-ed@tagonline.org

STANDARD ADVERTISING

Full Page Advertisements Only

- Front Cover: $950
- Inside Front cover: $550
- Back Cover: $375
- Resource Page: $50 / Issue

ARTICLE SUBMISSION PACKAGES

TWO PAGE FEATURE ARTICLE - $2500

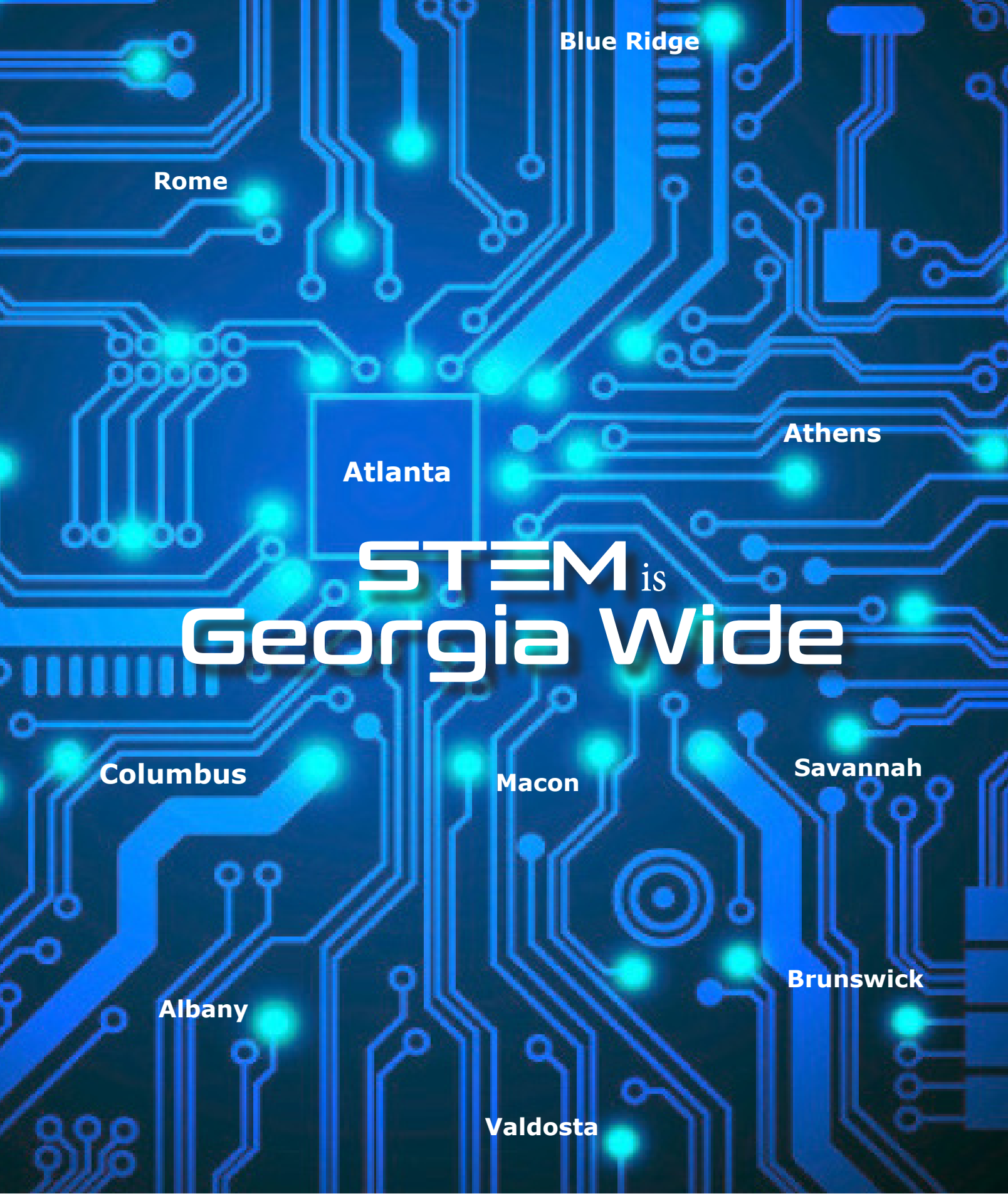
- Full page ad included
- Hyperlink and embedded video capability
- Article title on cover
- Inclusion of programs, events, state initiatives, and efforts of note

TWO PAGE SPREAD ARTICLE - $1000

- Interior location
- Hyperlink capability

ONE PAGE ARTICLE - $1000

- Interior location
- Hyperlink capability



TAG
Technology Association of Georgia

TAG | TAG-Ed
Education Collaborative