March 2025

GEORGIA PATHWAYS

MAGAZINE

Digital Equity in Rural Georgia

5 Practical STEM Career Tips

The STEM Of Firefighting

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

Education is a foundation of workforce and economic development in Georgia. As our state has been recognized as the best place to do business for the eleventh consecutive year, establishing an education pipeline to develop skilled labor is crucial for producing the workers needed to support our grow-ing industries. Georgia's pre-k-12 education ranks 25th in the country, with a high school graduation rate of 84.1%, just below the na-tional average of 86%. Approximately, 17.3% of Georgia's rural population lacks a high school diploma, compared to 10.6% in ur-ban areas. While there are certainly a variety of factors that influence a complex problem such as this, this statistic does highlight a problem that needs to be addressed.

Georgia has the third-largest rural student population in the nation, with nearly 380,000 attending rural schools. With less dense populations and businesses, these rural schools can often lack the same quality of ed-ucational resources, funding, and exposure to potential careers that students in urban areas benefit from. Access to computer sci-ence coursework in high school correlates with higher employment rates and increased early-career earnings. Unfortunately, many students in these rural schools may be un-aware of the opportunities in technology due to their distance from metropolitan areas with large technology companies.

To address this challenge, initiatives like TAG-Ed and Georgia Tech CEISMC's Rural Computer Science Initiative are striving to make STEM education more accessible to students from all backgrounds, regardless of where they live or their financial circum-stances.

TAG
Technology Association of Georgia

These programs utilize virtual learning tools to deliver interactive coursework, helping students deepen their knowledge of science, technology, engineering, and mathematics. In addition, TAG-Ed's high school internship program gives students practical experience, enabling them to apply what they've learned in real-world environments while developing essential industry skills.

As the demand for skilled workers continues to rise, it is important that we create equita-ble educational resources and experiences that prepare Georgia's youth for the future. With the combined efforts of organizations and communities, we can close the gap and ensure that every student has the opportu-nity to thrive in an increasingly technolo-gy-driven world. For more information on TAG-Ed's STEAM education programs and events, please visit tagedonline.org.

Larry K. Williams
President
TAG / TAG-Ed

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

Digital Equity in Rural Georgia

By Wayne Carley

While a majority of Georgians have access to broadband, a substantial number of homes and businesses, especially in rural areas, lack reliable, high-speed internet. Access is one aspect with the concerning challenge being affordability.

Why Broadband Is Important In Rural Georgia

Broadband, or reliable high-speed internet, allows people more affordable and efficient access to basic amenities such as education, health care, public safety and government services. As the majority of Georgia is rural, this importance is highlighted by our growing dependence on internet access.

Affording people opportunities to participate in online learning and distance education is growing at a rapid pace and high-speed internet networks enhance educational experiences by providing students and teachers with access to an array of resources, including text-based materials, photos, videos, music, animations, interactive lessons and oral history collections. Broadband also opens classroom walls, allowing

students to participate in distance learning opportunities at any time from any location they can access the internet, such as libraries, school and home.

Beyond educational applications, the growing dependence on internet and Wi-Fi access by the agriculture industry, local governments and public safety programs is of utmost urgency. There are a variety of challenges to make access available and affordable.

Increasing access to residential broadband infrastructure

- Execute Capital Projects Fund Program
  - o Timeline: 2023 to 2026 (American Rescue Plan Act requirements)

- Execute the Broadband Equity, Access and Deployment (BEAD) Program
  - o Extend last-mile broadband infrastructure throughout the state.
  - o Timeline: 2023 to 2030 (consistent with Infrastructure Investment and Jobs Act BEAD requirements)

- Invest in the development and expansion of broadband infrastructure.
  - o Expand broadband access in un-served areas that are hub zones, federal opportunity zones, and communities densely populated with low-income individuals.

Key Access Indicators

Every Georgian can access 100/20 Mbps at home, with a baseline of 90 percent, a short-term goal of 95 percent and a long-term goal of 98 percent if they have the technology for access, such as cellphones and computers. This is not always affordable and the at home technology is often cost prohibitive for lower income families and communities.

- Every Community Anchor Institution can access 1/1 Gbps, with a short-term goal of 95 percent and a long-term goal of 98 percent.

- Push broadband subscription statewide through a holistic awareness campaign, with a baseline of 81.3 percent of all residential locations in the state subscribed, a short-term goal of 86 percent and a long-term goal of 90 percent.

- Encourage a significant increase in broadband subscription for Georgians living in counties with the highest digital inequities, with a baseline of 80.2 percent of locations subscribed to broadband in targeted counties, a short-term goal of 85 and a long-term goal of 90.

The practical applications of broader, affordable internet access have a direct impact on Georgia economy, services and safety.

Entrepreneur Opportunities

High-speed internet enables local communities, regions and nations to develop, attract, retain and expand job-creating businesses and institutions.

Productivity and efficiency of businesses

High-speed internet also improves the productivity and profitability of large, small and home-based businesses and allows them to compete in local, national and global markets.

Remote health care services

High-speed internet makes remote access to clinical services possible for patients and provides significantly improved, cost-effective access to quality health care. It also allows physicians to monitor their patients through innovative home health devices, avoiding expensive house calls and giving patients real-time feedback.

Reliable government services

High-speed internet helps government agencies improve quality, lower costs and increase transparency by improving internal operations and making it easier for residents to interact with them online. Most essencial and productive interactions are electronic and remote.

Remote working savings

Studies show that commuters drive 53% to 77% less on days they telecommute than on days when they drive into work. In a three-day-a-week telecommuters can save an average of $5,878 per year in travel costs and reduce potental polluntants by 9,060 pounds environment.

Friends and family entertainment and connection.

High-speed internet is essential to enjoy 21st-century entertainment.

Streaming video, online gaming and connecting with friends and relatives via social media are only possible because of broadband.

Environmental sustainability

High-speed internet allows buildings to communicate with utilities and utilities to communicate with each other and the energy market, providing real-time information to both buildings and homes. These include smart buildings and smart grids, which hold great promise for dramatic reductions and greater efficiencies in energy consumption.

Revitalizing urban communities

Fully wired communities in reinvigorated neighborhoods can provide residents with opportunities to take career and skill development classes at community centers, allow for more effective public safety and contribute to greater economic growth, entrepreneurship and job creation.

Support for people with disabilities

Through various broadband-based applications and supporting technologies, those who are deaf or hearing impaired can use webcams to communicate with one another through sign language. People who are blind or visually impaired can use screen reader programs that audibly describe website material to users. Software programs now exist to interpret screen content into Braille. Broadband also permits users of telecommunications relay services to use video relay services to communicate more readily with voice telephone users.

Our dependence on technology across all aspects of our life is only increasing exponentially and the lack of equity for the population of Georgia runs the risk of an every widening gap. Our awareness of this imbalance is the first step in correcting the inequity as well as our support of federal, state and local funding efforts to provide financial means to these communities across our state.

5 Practical Tips For A Successful Career In STEM

By Dr. Donald E. Spratt

Be nice!

We've all heard about six degrees of separation – the idea that everyone on the planet are six or fewer connections away from one another (i.e. "friend of a friend"). In the science world, it's more like three degrees of separation. The science community is small, so to have a successful and fulfilling career in science it is important to always be kind and collaborative. Scientists talk with each other, especially when it comes to potentially hiring someone for their research group or company.

Hiring committees are increasingly more cautious when hiring and perform their due diligence by having online background checks and/or speaking directly with references over the phone or by Skype for job candidates.

The proverb, "People may not remember exactly what you did or what you said, but they will always remember how you made them feel" is very applicable in science. First impressions matter and you want to make sure you leave a positive impression with everyone you meet during an interview. Having polite email and phone correspondence with your interviewers before, during, and after an interview is an also important yet commonly overlooked aspect of securing a job in STEM.

Companies want to hire talented people that will strengthen the atmosphere and culture of their workplace and have the potential to grow into a contributing member of their team. So please – be polite, be punctual, and above all, be nice.

Network, Network, Network!

Making meaningful connections is vital to becoming successful in science. Serendipity is an amazing phenomenon where chance encounters can create lucky opportunities and open doors to new careers for you that you may have never considered before.

Expanding your network can also help you identify potential mentors that can give you invaluable guidance on how to navigate your next steps in your career. For some young scientists that are introverts, this can be a daunting or downright terrifying experience. Don't be shy – many senior scientists are ready, willing and eager to support the next generation of scientists navigate the job market.

A great venue to grow your network is at conferences – each person that comes to your talk or by your poster to learn about your research could potentially become a new network connection. There are also career workshops held around the country that could be a good platform for you to learn more about STEM career options.

Many universities and colleges have started to build their own LinkedIn-like platforms to connect students with potential internships or jobs, with many alumni joining these social networks to actively help and/or recruit from their alma mater. Informational interviews are another great way to build your network where you can gather firsthand information from an expert about the realities of working within a particular field and are an

excellent way to learn more about a potential career or company environment before you apply for a job. Get out there and make a new connection or friend in the science community!

Be tenacious / strive for excellence!

Many science students work long hours in the lab thinking that if they work hard enough they will get that elusive result to complete their thesis or to publish a paper in an illustrious journal.

For some this approach will lead to success; for others, the upsetting reality is that their project might not work out and they will struggle with feelings of disappointment. This can sometimes make young scientists question why they are in the field at all.

Surround yourself with smart people in a positive work environment that will support your career growth and give you the mentorship you need at the right time. Tenacity, patience, and stick-to-itiveness are the hallmarks of a successful scientist. "Dust yourself off and get back in the ring" is an excellent phrase to keep motivated and approach your career in STEM – never give up!

Don't be afraid of take on a new challenge!

Techniques learned in classroom or the lab are often translatable to other science fields. Just because you worked in a specific area of research doesn't mean you have to work in that area for your entire career. Many successful scientists adapt and take on challenging projects that peak their interest. I would argue that the true measure of the mettle of a scientist is not specific techniques or lab skills they have mastered, but the actual approach they take to answer the scientific question they want to answer that matters.

Most interviewers are not particularly interested in hearing a long drawn out discussion on your research thesis you completed last month or a few years ago – they want the short, snappy two-minute synopsis. They are more interested in hearing about how you approached a challenging problem and

if you were able to overcome an obstacle leading to success.

It is also important for all scientists to become effective communicators to share our knowledge and love of the natural world with the general public. Scientists have a role to play in helping to improve scientific literacy for the masses – whether it be at work, in your community, or at a party – as well as inspiring the next generation of students to pursue careers in STEM.

While this can be challenging, it is vital that young scientists joining the workforce step up to help shape the narrative for how science is perceived in this day of misinformation and sensational headlines – let's all work together to cut through the noise.

Always be passionate about science and never stop learning!

Many strong resumes these days list the techniques that people have mastered, which is a good thing. But what separates the good candidates from the amazing candidates during their interviews is their undeniable and overflowing love for science. All employers are looking for people that are excited and passionate about research and want to build a team of smart and welcoming thinkers. I teach many students that work in my research lab or have taken

my classes that "science is not a race, it's a journey!" It is a life-long and noble pursuit. Always be curious and try to carve out time in your schedule to learn about new developments and advances in your field.

Go to a symposium, listen to podcasts, read books and magazines – expand your mind and scientific interests. Learning doesn't stop when you close your last text book or write your final exam – science is always evolving and it is important that you stay engaged and grow with the science community.

About the author -

Don Spratt is an Associate Professor in the Gustaf H. Carlson School of Chemistry & Biochemistry and the Director of STEM Summer Undergraduate Research Opportunities at Clark University.

His NIH and MLSC funded research group focuses on the structural and mechanistic studies of the HECT E3 ubiquitin ligases and homeodomain transcription factors using biophysical approaches. Dr. Spratt was a 2021 Jack W. Lund Clark Community Achievement Awardee for his initiative to make STEM education and laboratory research experience real for hundreds and Innovation. He received his Ph.D. in Chemistry from the University of Waterloo and his B.Sc. in Biochemistry from Mount Allison University.

TAG | TAG-Ed Education Collaborative

ATTENTION HIGH SCHOOL JUNIORS AND SENIORS!

Launch your future in technology—turn your STEAM skills into real-world experience!

The TAG-Ed Internship Program offers exceptional high school students with a technology career path, the opportunity to learn in a real-world environment and get hands-on experience in a field of study relating to Science, Technology, Engineering, Arts, or Math (STEAM). Students are matched with companies based on related interests and qualifications. The internship is for a minimum of eight (8) consecutive weeks.

Who Can Apply:

- High School Juniors and Seniors

Benefits:

- Valuable workplace experience
- Mentorship opportunities
- Workforce readiness skills
- Clarity for future careers

Program Overview:

- Interns receive a $1500 stipend upon completion of their internship
- The internship spans eight consecutive weeks during the summer.

For more information,
CLICK HERE!

tagedonline.org | internships@tagonline.org | @TAG-Ed

OAK RIDGE National Laboratory

Risk and reward: Peter Fuhr, takes sensing technology to the next frontier… again

By S. Heather Duncan / ORNL

Peter Fuhr's work in science is often visible passing through the night sky overhead. NASA satellites, launched at the beginning of his long career, still carry the semiconductor laser diode arrays that he helped build. They capture measurements such as variations in Earth's gravitational field which affect its distance from the moon.

ORNL researcher Peter Fuhr has been at the forefront pioneering work in deploying sensing systems in ways that vary from satellites to drones to the human body. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy

Now a researcher and group leader at the Department of Energy's Oak Ridge National Laboratory, Fuhr continues to push the boundaries of optical and sensor technology in applications ranging from fighting wildfires to operating the immense floodgates protecting Venice, Italy. Fuhr's path is marked by an oddball creativity that can't confine itself to challenges in a single field. No idea is too far out to try out. His many inventions and start-ups before joining ORNL proved his ability to bring bold ideas to life.

Fuhr has installed sensors in some surprising places: rappelling down dam faces with a battery-powered circular saw, in the Old Faithful geyser at Yellowstone, and even inside humans. He invented a sensor to detect mad cow disease in the exhalations of bovine breath. Fuhr investigated how to feed a cotton plant so it produces electrically conductive fibers, enabling more security features in paper money. If his research topics have a theme, it's practicality – solving real-world problems in real time.

Fuhr's pioneering work in networked sensor systems for structures earned him the Presidential Award for Excellence in Research. He was also recognized as a lifetime senior member of the Institute of Electrical and Electronics Engineers and a Fellow of the International Society for Automation.

His influence is likely to be lasting, as his imagination and infectious zeal have driven him to mentor generations of new engineers.

In chaos, there's opportunity

Fuhr remembers the moment it all started. At age 6, watching the sole TV channel available in his small northern Minnesota town, he saw a news report about the invention of the laser. Young Peter scrambled to cut a hole in a shoebox, placed a flashlight inside, and told his family: "I'm going to build lasers."

He never wavered. Fuhr went on to attend one of the largest high schools in the country in Indianapolis, Indiana. Its size made it unwieldy and chaotic, but the variety of available course laid the foundation for him to earn degrees in physics and mathematics at Beloit College.

"In chaos, there's opportunity," Fuhr says. (It could be his motto.)

After college, Fuhr took a job as a space optical physicist for a NASA contractor and then became a full employee at NASA's Goddard Space Flight Center – while pursuing advanced degrees in electrical engineering. It was here that he worked on the satellite laser diode project while also writing his dissertation at Johns Hopkins University on intersatellite optical communication

using laser diode arrays.

Fuhr mentored interns even while a graduate student at NASA. "I got bitten and smitten by that bug," he said. "I love the different perspectives and the youthful enthusiasm associated with students and young researchers." After a brief stint with industry designing laser diodes for telescopes, Fuhr turned to teaching, first at the University of Vermont and then at San Jose State University in California.

In Vermont, Fuhr developed a fiber optic sensor to be placed inside a person. It was made to gauge strain in the fabric threads used for ACL replacements. Tracked over several years, the sensor data helped surgeons understand how much to tighten the screws securing the tendon replacement for restoring both immediate range of motion and long-term control.

Initially tested in grocery store chicken wings, the sensor later had a personal impact when Fuhr's wife tore both of her ACLs. Her doctor in California had read Fuhr's research and utilized its findings in her treatment.

At San Jose State, Fuhr founded the Institute for Sensors and Wireless Networking, a research and development center on 20 acres within NASA's Ames Research Center. Fuhr supervised 33 faculty members who were tackling research in sensors, fiber optic and wireless communications, and photonic systems and components.

In those days, Wi-Fi was young. Fuhr helped link the powerful telescopes outside San Jose directly to NASA. "We built the longest-distance, highest-speed communication system on the planet at the time," he said. "That was absolutely fun."

Ready for a break from the university environment, Fuhr became chief scientist for a company that used wireless chemical sensors to check cargo ships for bombs and facilitate customs inspections from offshore. He then founded several companies based on concepts that intrigued him, like distortion in fiber optic signals or the ability to see radio waves.

The businesses translated these ideas into practical solutions for timely problems by developing wireless systems for industrial automation, sensors for mad cow disease and sensors detecting either cell phones in prisons or roadside bombs in war zones.

Demonstrations of these technologies for the U.S. government led the DOE to invite Fuhr to provide Congressional briefings about industrial wireless sensing systems. This expertise brought him to the attention of ORNL, which recruited Fuhr in 2010. He now leads

Peter Fuhr cultivates a democratic group dynamic and a spirit of fun in his Grid Communications & Security Group while mentoring students and young researchers. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy

the Grid Communications and Sensing group in the Energy and Technology Sciences Directorate, with a dual research faculty appointment at the University of Tennessee, Knoxville, and its Bredesen Center.

Building teams, taking risks

At ORNL, Fuhr spearheaded a national grid timing and cybersecurity initiative and helped build a close research relationship with innovative utility partner EPB of Chattanooga. At ORNL's Hardin Valley campus, Fuhr founded the Grid Operations and Analytics Laboratory, or GOAL, with a 10-gigabyte-per-second direct fiber optic link to EPB for real-time data feeds. Modeled on a utility command center, GOAL acts as a test bed for grid monitoring and cybersecurity breakthroughs.

Inspired by synesthesia, a condition that causes some people to experience one sense through another, Fuhr recently invented a method to encrypt grid communication data into a constantly-changing color palette. The colors were further hidden within digital images and tested with EPB using the GOAL fiber link. This spring, Fuhr's team demonstrated at EPB a drone-based sensing approach for inspecting power grid equipment.

Fuhr has seen the rise of new technologies from lasers to the internet, Wi-Fi and drones. Yet he never tires of applying the newest tech to tackle the newest challenge – now artificial intelligence, quantum communications and virtual reality.

"What interests me is the intersection of different technologies," Fuhr said. "This is a great moment with better, cheaper batteries, microcontrollers, the Internet of Things – here I can bring all these innovations together."

That dynamic mixing is fruitful partly because of the eclectic group of people he also brings together in a collaborative atmosphere. Fuhr's team often spends time elbow-to-elbow around a big table, whether head-down in independent projects or wisecracking their way through a brainstorming session. When choices must be made about next steps in the research.

Fuhr asks each person to evaluate the options and contribute their opinions. The group usually reaches a natural consensus that makes a vote unnecessary – although Fuhr may hold one anyway.

Everyone's input receives equal consideration, including feedback from the team's many early-career researchers and the rotating lineup of UT graduate students. Fuhr incorporates opportunities into each project to fill gaps in their expertise and build their skills, growing the next generation of innovators.

He also shapes a creative space for their ideas to flow. Behind the collaboration table in the GOAL lab looms a metal contraption resembling a tangle of shiny pipe joints, which Fuhr found in the excess pile from another lab. With modulating colored lights inside, it now resembles a cross between a lava lamp and a Star Trek refugee, embodying the spirit of whimsy and imagination that Fuhr encourages among team members.

The moment someone steps into the lab, Fuhr poses a wacky question with a straight face – and just a little eyebrow waggle. He might ask, 'Did you ever ponder the best gift you could give your favorite boutique deli?" (He did. He explains how he designed and constructed a laser-based ham slicer.) Or did he ever tell you about that time he watched his high-altitude research balloon fall from 120,000 feet, waiting for it to crash into a school or church? (Rice plants were the only casualties.)

Fuhr's madcap project summaries, big bowls of candy and giant screens scrolling dramatic research footage make the GOAL lab a popular tour stop for visitors and government officials.

But even without this colorful scenery, the ideas he explains are intriguing. By his own admission, 70% of his projects are "way out there" -- either literally with satellites and atmospheric balloons, or figuratively with haptic glove controls and a ballet of automated

inspection drones.

But that's how Fuhr thinks it should be. He believes in the principle that science involves risk. Why try something if you already know it will work? Flipping through futuristic images of grid sensing tools under development, Fuhr added, "It's a stretch, yeah -- but it's cool. Who else is doing stuff like this?"

Credit: Carlos Jones/ORNL, U.S. Dept. of Energy

UT-Battelle manages ORNL for the Department of Energy'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**.

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 | TAG-Ed Education Collaborative

HIGH SCHOOL INTERNSHIP PLACEMENT PROGRAM

Help build the future technology workforce: today's STEAM students!

The TAG-Ed Internship Program offers exceptional high school students with a technology career path, the opportunity to learn in a real-world environment and get hands-on experience in a field of study relating to Science, Technology, Engineering, Arts, or Math (STEAM). Students are matched with participating companies based on related interests and qualifications. The internship is for a minimum of eight (8) consecutive weeks.

Who Can Apply:

- High School Juniors and Seniors (Age 17+)

Benefits:

- Valuable workplace experience
- Mentorship opportunities
- Workforce readiness skills
- Clarity for future careers

Program Overview:

- Interns receive a $1500 stipend upon completion of their internship
- The internship spans eight consecutive weeks during the summer, starting June 2nd.

For sponsorship opportunities, contact bebita@tagonline.org

For more information, visit **tagedonline.org**

The STEM of *Firefighting*

By Wayne Carley

Our continuing battle against fires like those that have recently inflicted monumental devastation and tragedy across our nation and the world require us to better understand the career choice of firefighter, the immense burden of this responsibility and the educational commitment necessary as a STEM career.

As elite first responders, firefighters across the profession use STEM skills daily for their personal survival and our protection, both to life and property. There is no doubt that this is a STEM Career in every way. From structural fires and airport protection, to wildfire smoke jumpers and naval ship fire protection, STEM skills are mandatory for success.

Using the definition of STEM as our guide, we'll start with the Science of Firefighting, (***Science: the systematic accumulation of knowledge***). The vast volume of information available and necessary for effective firefighting continues to change and grow with new technology and techniques as well as the tried and true.

It's important to understand that there are five basic classes of fires, each requiring specific equipment, knowledge, techniques and concerns.

- **Class A**: solid materials such as wood or paper, fabric, and some plastics
- **Class B**: liquids or gas such as alcohol, ether, gasoline, or grease
- **Class C**: electrical failure from appliances, electronic equipment, and wiring
- **Class D**: metallic substances such as sodium, titanium, zirconium, or magnesium
- **Class K**: grease or oil fires specifically from cooking

The Science of Firefighting

(accumulation of knowledge)

Firefighters need every piece of equipment and tech available to effectively fight fires and respond to emergencies. The following ***partial*** equipment list used in all forms of firefighting on land and sea must be familiar to all firefighters.

Though we will not define each and this is a long list, it's important to understand the ***volume*** of learning necessary. These tools may include:

CO2 (Carbon Dioxide) Fire Extinguishing System
Foam Fire Extinguishing System (AFF):
Water Mist Fire Extinguishing System
Dry chemicals such as Purple K Powder: fighting class B (flammable liquid) fires after Monnex (potassium allophanate), and can be used against some energized electrical equipment fires (USA class C fires).
Inergen Fire Extinguishing System
Adapter (hose couplings)
Air pressurized water (APW) extinguisher
Automatic distress signal unit (ADSU) (An alarm device that signals that a firefighter is in trouble)
Aerial fire apparatus / Aerial ladder platform
Air monitoring meter
Airpack (self-contained breathing apparatus (SCBA).)
Fire apparatus: divided into seven categories by NFPA Standard 1901: Pumper Fire Apparatus,
APW (Air-pressurized water extinguisher),
Aqueous film-forming foam (AFFF)
Attack hose / Attic ladder
Automatic sprinkler systems
Bomb line (A preconnected attack line)
Booster hose (smaller, preconnected to pump of an engine)
Branch pipe (Simple, Diffuser, Landon hand control diffuser, Water mist, Revolving, Duck bill nose)
Bresnan cellar nozzle
Bunkers (protective pants and boots kept near a firefighter's bunk)
Cellar pipe (Cellar nozzle. The Bresnan nozzle inserted through an opening)
CFA 3-thread (A type of coupling)
NIFTI (Naval InFrared Thermal Imager)
Cistern (Underground water storage tank)
Class A, B, C, D, K (Classes of fire extinguisher and corresponding types of fires)
Claw tool / Deck Gun
Closed-circuit SCBA
Closet hook / ladder
Combination nozzle
Compressed air foam system (CAFS)
Cooper hose jacket
MDT (Mobile Data Terminal, typically a specialized laptop)
Deluge gun (A master stream device that can be positioned on the ground)
Deluge system (Type of sprinkler system)
Denver door opener (Heavy pry bars) connected with a hinge, one with an adjustable foot, used for prying open doors.
Denver tool (combination axe, sledgehammer, pry tool, ram, and D-handle pull)
Detection system / Multigas detector
Detergent foam
Divisional valve
Double female (coupling)
Double-headed standpipe
Double male coupling adapter
Dry chemicals (breaks down the chemical chain reaction in the "fire tetrahedron")
Dry hydrant
Dry powders (for use on flammable metals)
Dry sprinkler (pressurized air)
DSU (Distress signal unit)
Eckert hook
Entire Fire Engine (outfitted for firefighting, specifically one outfitted to pump water)
Eductor (Venturi device through which water flows under 200 psi pressure)
Ejector / Ejector pump
Encapsulated suit (HAZMAT protective clothing / gaseous contaminants)
Encoder (tone-generating system for broadcasting one or more tone codes)
Extractor / Extrication gloves
Fire alarm control panels
Fire axe (two types)
Fireboat (A specialized watercraft with pumps and nozzles)
Fit 5 (Handheld fire suppression device designed to be thrown into needed area)

And 5 more pages we will not include.

Consider what may be the most important piece of knowledge needed; the knowledge of your personal abilities, (strengths and weaknesses, both physical and psychological). Avoiding situations that are potentially beyond your ability to manage could unnecessarily risk your life and those of your team members.

This self-awareness is hammered hard during physical training, practice, live drills, early experiences and general testing. It's vital to everyone to see where your limits may be. You, the team and leadership must have the utmost confidence in your abilities when the time comes to be tested with others lives are in your hands.

Remember to include Emergency Medical Training (EMT), water rescue techniques, parachuting, wilderness survival, and physical training that never ends.

What's Burning?

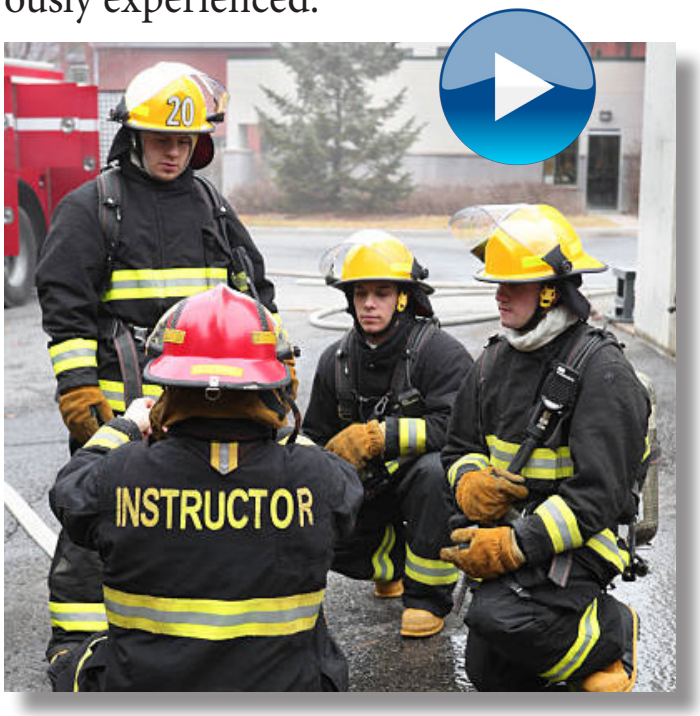
The science or "***learning the accumulation of knowledge***" continues as firefighters must learn and understand the potential risks of the structure or items ablaze, from civilian homes to furniture stores; from gas stations and vehicles, to factories. Everything that burns emits a variety of toxic gases from the plastics, wood, insulation, glues, chemicals, and so on. Smoke and toxic gases

are one of the main causes of death and injury during fires. These hazards are made worse by the increasing use of synthetic materials and chemical additives in modern construction materials. Although furniture and fittings are usually the first items to catch fire, sometimes the building itself ignites early on, adding to the mix of toxic gases produced.

Some of these deadly chemicals include asphyxiation causing CO2 (carbon dioxide), HCN (hydrogen cyanide) Nitrogen-containing fuels (e.g. nylon, polyurethane), NO2 (nitrogen dioxide) Nitrogen-containing fuels, NH3 (ammonia), HCl (hydrogen chloride) , HBr (hydrogen bromide) Bromine-containing fuels (e.g. brominated flame-retardant materials), HF (hydrogen fluoride) Fluorine-containing fuels (e.g. non-stick coating, PTFE, flammability-lowering coating polyvinyl fluoride (PVDF) SO2 (sulphur dioxide) Sulphur-containing materials (e.g. wool), (VOCs) Organic irritants (e.g. acrolein, formaldehyde), Cellulosic materials under non-flaming combustion, Isocyanates Nitrogen-containing fuels and more.

Others include Phenols, Styrene Polystyrene, Benzene, Semi-volatile organic Compounds, (SVOCs), Polycyclic aromatic hydrocarbons (PAHS) (e.g. enzo(a)pyrene) Dioxins/furans with fuels containing chlorine and soot particles of various sizes.

If firefighters are aware of the composition of the burning structure and its contents, they are better able to attack the blaze with the most effective tools and safety techniques in their arsenal; learned, studied, practiced and previously experienced.



The Technology of Firefighting

The definition of "T", STEM Technology, is "***the practical application of science***". Along with equipment to learn we must include the medical training and physical training to supplement the tech. Once equipment or tools have been learned, the firefighter must know how to implement them physically and effectively.

Trained physically, proficient in medical assistance and well versed in all of the firefighting tools in the box, it's

time to *"apply"* these skills in the field. With seasoned and experienced professional firefighters at the helm, the "team" is ready to respond to any number of emergencies, from medical, toxic leaks, downed electrical lines, auto accidents, structure fires and yes, perhaps the occasional cat in a tree. The learned and use of equipment and skills is the "Technology Application" in STEM.

The Engineering of Firefighting

Engineering in the STEM acronym is a ***decision making process and problem solving method***. With certainty, firefighters are facing real problems that need to be solved and the decisions made are a matter of life or death to themselves and the community as a whole. The team leadership bears the load of early decision making about how to deploy the team, with what equipment, and frame a plan of attack to control and extinguish a blaze or crisis. Even as the engines are in route to the site, lieutenants, captains, chiefs and crew are gathering as much information about the destination as possible in advance to formulate their plan and prepare for the worst.

A quick refresher on what the ***engineering method*** of decision making and problem solving for the firefighter:

- **Define the problem**: Identify the need and the problem to be solved. This may have to wait until the crew is on-site with eyes on.

- **Research:** Gather as much information about the problem as is available in the time allowed. This is an urgent need for firefighters.

- **Brainstorm**: Come up with ideas for solutions. This was done over hundreds of hours of training for dozens of different scenarios in all conditions. It's unlikely they will roll up on a situation they have not trained for.

- **Plan**: From training and experience, leadership will pull from a long list of attack plans the team has practiced for and make a decision about how to attack first.

- **Test the plan**: Having chosen a plan of attack, the process begins with a close eye on how effective the plan is going.

- **Evaluation**: Evaluate the plan as it unfolds and make any changes. This is an immediate and ongoing evaluation by the leadership regarding the effectiveness of the chosen plan to fight the fire or emergency, how effective are the early results, and consider the safety of the firefighters. Is there a need to alter the plan, change tactics to another approach, employ multiple teams with different plans, request additional assistance or stay the course?

This process must be done quickly and effectively….a huge responsibility with tremendous risks. There is no time for hesitation. Simultaneously during this process, we must include the 4th aspect of STEM in our conversation.

The Math of Firefighting

(the M in STEM)

The mathematics of STEM is defined as "***The science of numbers and their operations, interrelations, combinations, generalizations, and abstractions***".

Firefighting is no exception in needing and using math on a daily basis to not only do the job but succeed effectively. Firefighters use various mathematical calculations daily to make informed decisions onsite, including estimating fire flow (how fast it's spreading), calculating the necessary water volume based on a building's or field size, determining hose pressure, and assessing fire spread based on factors like wind and slope, often involving basic arithmetic, geometry, and sometimes basic algebra to solve these problems effectively and immediately.

Firefighter Math is a non-IQCS course provided as a resource for firefighters online and provides knowledge of basic math concepts and tools necessary for making math calculations in the field. Topics include calculating tank volumes and flow rates, determining pump pressure and friction loss, understanding maps and location coordinates, and estimating slope.

Additionally, a course like this presents information on calculating flame length, flame height, midflame wind-speed, and other variables related to wild-land firefighting efforts.

Hydraulic Calculations

From figuring out pump discharge pressure, to nozzle reaction, there are some formulas and equations below that firefighters are familiar with.

Fire Flow

When calculating the flow necessary to extinguish a fire, there are two equations that are commonly used in the fire service. The Iowa Fire Flow formula is designed for achieving fire control, not extinguishment, for the single largest open area of a building.

The National Fire Academy (NFA) formula is based on offensive interior operations where ceiling height is no greater than 10ft. Both formulas will help fighters find the approximate needed fire flow during pre-planning, though they will produce slightly different results.

- Iowa Fire Flow: Required Volume = (length x width x height) / 100

- NFA Fire Flow: Needed Flow = [(Length x Width) / 3] x percent of involvement

Fog Nozzle Reaction

The fog nozzle reaction formula can be used to calculate the amount of nozzle reaction you will experience at a given flow rate and nozzle pressure.

NR = .0505 X GPM X √NP
NR: Nozzle Reaction in pounds of force
NP: Nozzle Inlet Pressure in PSI

Pump Discharge Pressure

Pump Discharge Pressure, or PDP, is calculated so that you can properly pump your hose and nozzle combination to achieve your target flow rate. Improperly setting your PDP can cause you to over or under pump a nozzle, which affects flow rate, nozzle reaction, and stream reach.

PDP = NP + FL

Some equations factor in appliances (valves and devices) and elevation using PDP = NP + FL + Appliance Loss + Elevation Loss

NP: Nozzle Pressure in PSI
FL: Friction Loss in PSI

A variety of other equations and calculations are necessary to be the most effective firefighter you can, but the point is that math in a variety of forms is essential in this profession.

9 reasons to become a firefighter

1. Saving lives: Many people become firefighters because they want to save lives. If you pursue this career, you can rescue victims of incidents like house fires and vehicle accidents. You will also have EMT or paramedic training

that you can use to provide victims with medical care before an ambulance gets them to a hospital.

2. Protect Property: Firefighters also protect property. They extinguish fires to help people retain their homes and businesses before they sustain too much damage.

3. Becoming part of a team: As a firefighter, you respond to calls with your crew members to protect the community and each other. You live with fellow crew members at the fire station, where you share responsibilities like cooking and cleaning. Firefighters spend lots of time talking to people in their community.

During incidents, they meet civilians with various backgrounds and actively listen to their concerns. They often use this information to provide comfort in stressful situations or relay important medical information to health care professionals.

4. Build leadership skills: The position requires you to be a leader. Your ability to make quick decisions in high-pressure situations can help you perform your duties while keeping everyone safe. You may also act as a leader by serving as an example to other crew members and guiding civilians during emergencies.

5. Staying physically fit: Much of their job involves exercising. One of the main hiring requirements is passing a physical fitness test. This test evaluates your ability to perform tasks like climbing stairs, carrying heavy equipment and using force to enter locked doors. Continuous training can help you manage the physical exertion of your everyday duties.

6. Good compensation: The national average salary for firefighters in the U.S. is $48,423 per year, and these professionals have opportunities to earn overtime pay. They enjoy benefits like health, dental and life insurance. They're also eligible for retirement pensions and disability payments if they obtain an injury at work.

7. Job security: Because communities rely on firefighters to protect their

citizens and property, this career usually offers job security. The Bureau of Labor / Statistics expects firefighter employment to increase 8% between 2020 to 2030. You may find positions at local, state or federal government departments or with private companies.

8. Flexible work schedule: Because emergencies can happen at any time, fire departments schedule firefighters to work at all hours. You may be able to pick the hours that suit your preferred lifestyle. Some professionals work 24 hours on and 48 hours off, while others work 10-hour shifts four days in a row or 12-hour shifts three days in a row.

9. Opportunities for career advancement: After gaining experience as an entry-level firefighter, you have many opportunities to advance. Your department may promote you to positions like a lieutenant, captain or assistant chief that provide you with more responsibilities and higher pay.

Firefighters agree that "it's a job like no other" from one day to the next, with the adrenaline rush, drama, challenges, brotherhood and great personal satisfaction. Making a difference doesn't begin to scratch the surface as lives are saved, property protected and you are challenged in character, mind and body.

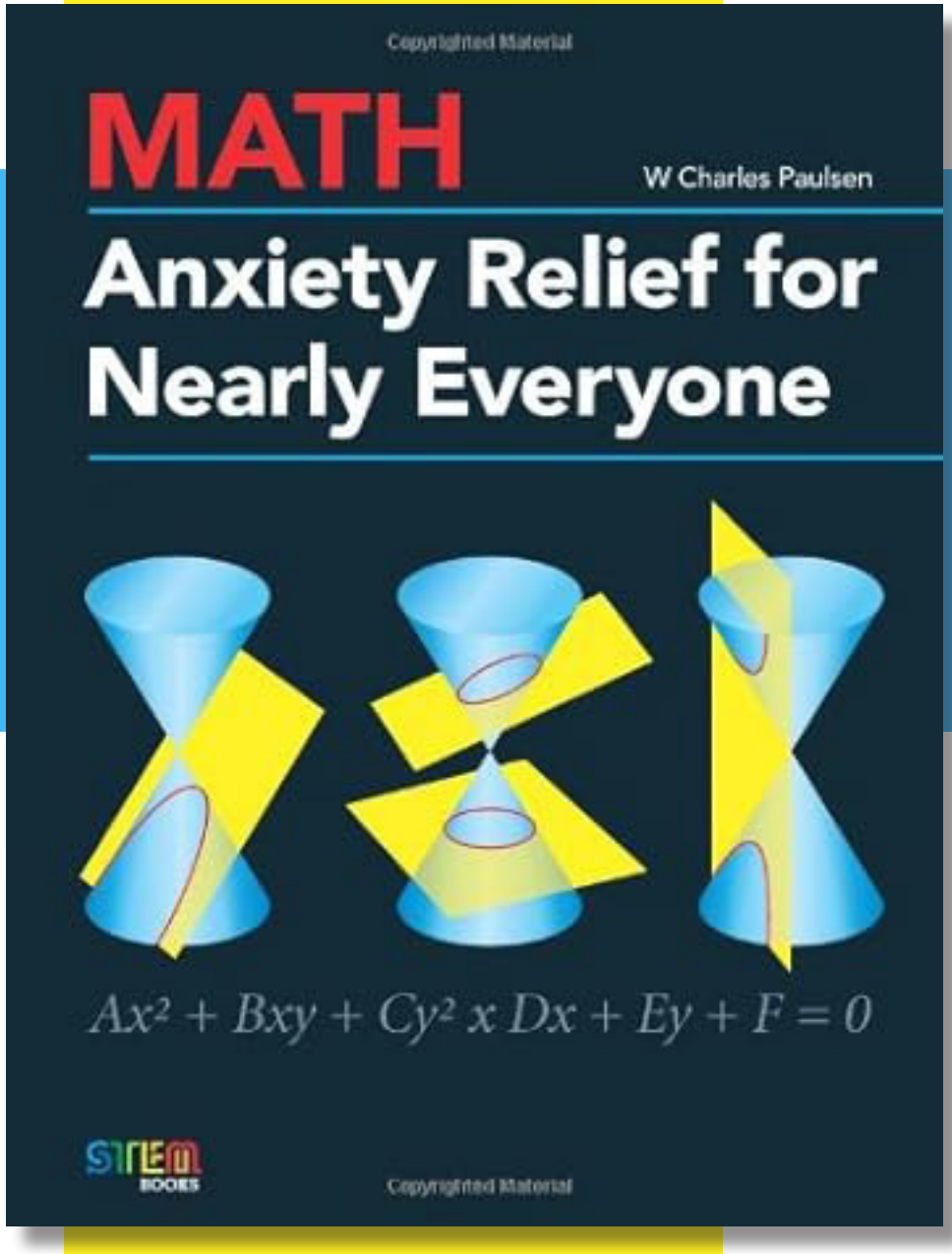
Requirements:

- Be at least 18 years old
- Pass a background check and drug screening
- Have a valid driver's license
- Have a good credit score
- Pass a physical fitness assessment
- Have a high school diploma

or GED. You may improve your job prospects by obtaining an associate or bachelor's degree. Useful programs include those involving fire technology and fire science.

Semper Paratus
"Always Ready"


13
HOCKMAN
Smith
Dunning
Williams



FREE DOWNLOAD HERE

STEM Magazine is pleased to offer you this free download of W. Charles Paulsen's book, **MATH, Anxiety Relief for Nearly Everyone.** We will be offering this download until further notice, so please use this valuable in-depth resource to better understand any areas of mathematics you wish.

About the Author:
W. Charles (Chuck) Paulsen

I was born in Detroit and raised in Dearborn, Michigan. The son of a steel trucker. After a rocky start at a community college I got my academic life in order and got a BS degree in Mechanical Engineering from Purdue University. I owe everything to my professors at Purdue who made mechanical engineering a joy to learn. My calculus professor taught me that even engineers need not fear calculus.

Flushed with a strong foundation, I ventured west and received my MS degree in Mechanical Engineering from Stanford University. At that time there was no Silicon Valley, just apricot orchards.

Right out of Stanford I joined the DuPont Company and moved to Chattanooga, Tennessee along with my new wife. We were then transferred to DuPont's Biomedical Products facility in Newtown, Connecticut where I have lived since 1972. At DuPont I discover an emerging technology called the finite element method for stress analysis and feel I was a pioneer in implementing this fantastic software tool. Concurrently I introduced computerized numerical methods in manufacturing and helped build a world class Numerical Control (NC) operation.

During my DuPont career I started teaching mechanical engineering in the evenings at local colleges and universities. I have been doing this continuously since 1969. It was during my appointment at Naugatuck Valley Community College, in 2008, that I was inspired to write my book Math Anxiety Relief for Nearly Everyone. I felt my students needed such a book.

In 1985 DuPont offered its employees a chance for early retirement. I took advantage of the opportunity and became an entrepreneur. Since then my life changed significantly and I have never looked back. I helped start-up two successful engineering software companies after my DuPont "retirement." Being "retired" I am now able to devote more time to writing and teaching.

I am still married to the same woman I met in California back in 1965. We raised two children and have four grandchildren who I encourage to follow their dreams.

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?

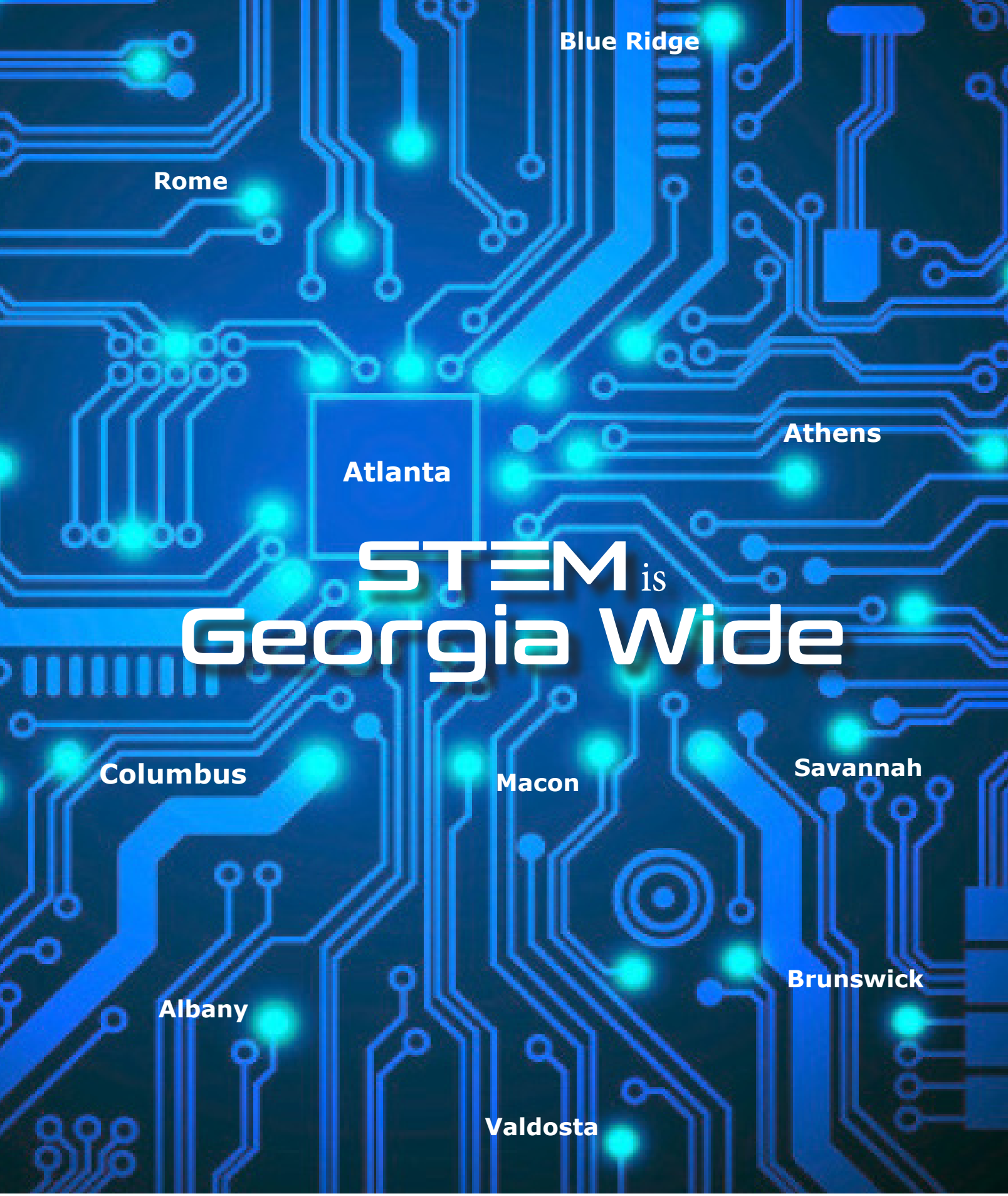
TV pundits and talking heads love to get riled up about whether robots are coming for our jobs — but the truth is that AI will probably create more jobs than it eliminates. And one thing's for sure: understanding how AI works, and mastering AI skills, will be the key to success in tomorrow's ever-changing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

TAG | TAG-Ed
Education Collaborative