November 2019

GEORGIA PATHWAYS
MAGAZINE

Wings of Passion
Turbulent Career Paths

"Stempower"
Mentoring

Computer Science

How The Brain Works Best 2

TAG Technology Association of Georgia

TAG TAG-Ed Education Collaborative

No matter what you teach, understanding how the brain learns, both yours and your students, is critical for best outcomes.

That's why this issue is for you.

Use it in class.
Forward this to your students parents.
Make this a new connection for curiosity and interaction.

Submit an article: wayne@stemmagazine.com

Welcome to our latest edition of Georgia Pathways STEM Magazine.

The rise of STEM education and emphasis on STEM learning is clearing a brightly-lit runway for students who take off in pursuit of technology careers. But the efforts can't come fast enough.

The U.S. Bureau of Labor Statistics projects that from 2018 to 2028 that occupations in the fields of computers, engineering, science and math will have about 705,200 annual average openings. More than half of those projected openings are in the computer and information technology area, with software developers predicted to have the most openings.

There are not yet enough skilled graduates to fill those openings now, but STEM education efforts could change that course. STEM education as a tool for workforce development remains more vital now than ever and there are an increasing number of innovative approaches and funding initiatives that are working in favor of increased STEM.

This year, the U.S. Department of Education has pledged to invest an additional $200 million in STEM education efforts. Howard University, for example, recently received a $4 million donation to support STEM education efforts. Even high-profile techies like Facebook's "Hardware Boss" Andrew "Boz" Bosworth are getting in on the action. Bosworth, a 4-H alum, recently made a $1 million personal investment to support 4-H STEM efforts.

These efforts will go a long way towards encouraging and inspiring students to pursue a degree in a technology field that is ripe with job opportunities. Considering that many STEM programs target underserved youth, the investments provide benefits and returns on critical levels and add tremendous velocity to overall economic growth and opportunity for all.

This publication was created to encourage educators, parents and students to adopt, create and participate in STEM efforts.

As you read through this issue, you will pick up new tips and information about STEM that I hope you will share. Each article and feature could ignite a learning engine or power up the inspiration needed for a student's dreams to take flight. I hope you will pass this edition along.

Thanks for your support!

Larry K. Williams
President
TAG-Ed

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

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.

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To understand STEM...

...you must DEFINE STEM, but you cannot define an acronym using the words it stands for; *you must define the words the acronym stands for.*

Universities and organizations around the world continue to debate what a STEM career is. 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)

MATHEMATICS: "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.

Georgia Tech Students Develop **Stempower** to Mentor Fourth and Fifth Grade *Girls* in STEM.

Stempower Becomes New Outreach Initiative of the Center for the Study of Women, Science, and Technology.

Partnering with the Girl Scouts of Greater Atlanta, two Stempower mentors meet bimonthly with fourth- and fifth-grade girls in a given troop. Stempower has become one of the outreach initiatives of the Center for the Study of Women, Science, and Technology (WST), with eight Tech mentors and 100 Girl Scout mentees in the U.S.

When five Georgia Tech students — Brenna Fromayan, Natalie Leonard, Wendy Ng, Anokhi Patel, and Kaitlin Rizk — co-founded Stempower in 2014, they wanted to boost the flagging self-confidence of young women in science, technology, engineering, and mathematics (STEM) fields, despite their natural interest and ability.

"As women pursuing STEM degrees from Georgia Tech, Stempower was personally relevant to all of us from the beginning," remarked Leonard, an undergraduate in the School of Psychology. "The majority of the co-founders had a role model who provided direct encouragement. Yet for girls growing up without a role model, where can they turn for support?

Annette Filliat

We knew that we needed Stempower to fill this gap."Stempower is a mentoring program offered by Georgia Tech women students that encourages girls to explore STEM and learn key character values. Partnering with the Girl Scouts of Greater Atlanta, two Stempower mentors meet bimonthly with fourth- and fifth-grade girls in a given troop. Each meeting is comprised of a different STEM activity — building rockets, making circuits, or learning to code — paired with a character lesson like encouraging questions and valuing mistakes.

"Research shows that young women start losing interest in math and science during middle school. We created Stempower to mentor elementary school girls in STEM, thereby increasing their self-confidence and providing relateable role models," said Rizk, an undergraduate in the H. Milton Stewart School of Industrial & Systems Engineering.

Three years later, after initial support from the Grand Challenges Living and Learning Community, Stempower has become one of the outreach initiatives of the Center for the Study of Women, Science, and Technology (WST), with eight Tech mentors and 100 Girl Scout mentees in the U.S. Stempower was also launched at Uganda's Makerere University after Rizk witnessed similar women's empowerment issues during a service project a few years ago. In fact, now since 2016, the program has had more than 200 girls participate. Eighty percent of the girls are now more interested in STEM, and 63 percent have higher self-confidence.

"After mentoring for years, I still clearly remember my first meeting with a troop," Leonard reflected. "The meeting opened with a broad discussion about women scientists and engineers. Upon mentioning Mae Jemison, the first African-American woman astronaut, girls raised their hands and jumped up and down for the opportunity to tell me what they already knew

about her. After this first meeting, I walked away impressed by their knowledge and energy and encouraged that supporting these girls through Stempower would help each of them thrive."

According to Carol Colatrella, professor in the School of Literature, Media, and Communication, assistant dean for graduate studies, and co-director of WST, "We are excited to support Stempower as their efforts align with WST's mission and goals to promote the recruitment, retention, and advancement of women students and faculty in STEM fields."

Stempower has expanded to now provide summer camps at Georgia Tech. Stempower Summer Camps expose girls to real-world STEM concepts in a fun supportive atmosphere! Our day camps take place at Georgia Tech and will center around a hands-on project that teach tangible skills and connect their work to cutting-edge research that's done on campus.

If interested in becoming a mentor, contact stempower.gt@gmail.com or to learn more about Stempower, visit www.stempowerinc.org

Institute Diversity, visit www.diversity.gatech.edu.

Stempower co-founders from left:
Brenna Fromayan, Anokhi Patel, Kaitlin Rizk, and Natalie Leonard (not pictured - Wendy Ng)

Computational Thinking:
A Hidden Hero in Early STEM Learning

By Dr. *Cory* A. Bennett and Dr. *Beverly* Ray

STEM teaching and learning often focuses on the four main areas within STEM—namely science, technology, engineering, and mathematics—with a heavy emphasis in science in many schools. However, one critical area of STEM that is often overlooked is computational thinking, which is part of the skill set necessary for coding.

According to one of the experts in the field, Jeannette Wing, computational thinking "involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science." The ways of thinking about and doing mathematics, not simply calculating solutions to exercises, are similar in many ways to computational thinking and provide a great place to introduce computational thinking into the early elementary curricula.

At its core, computational thinking is centered in 21st century values such as using technology to create and innovate, collaborate, and become adaptive when using tools to analyze, understand, and solve societal and global problems. We know from research that students across grade levels learn and retain more when they are exposed to, and engage in, authentic and relevant experiences. Coding is all that and more.

For younger students, meaningful learning experiences with coding will feel like "play" despite being a rich and complex cognitive process. These complex or technical opportunities to play forces students to consider the ***why's*** of dynamic situations while allowing them to emulate STEM behaviors and develop cooperative problem solving social skills. When the experience is right, even the youngest students can effectively think and behave like young STEM "experts."

For teachers, this means facilitating STEM learning rather than leading or directing learning as STEM ways of thinking requires students to learn to ask questions and interact as a member of a group of learners. However, many teachers think that coding is an advanced skill that is more appropriate for the later elementary grades. Nothing could be farther from the truth.

There is an overwhelming amount of digital and virtual resources available for learning computational thinking through coding. So much so that the use of technology for technologies sake will not be an issue. As such, we are sharing one way of introducing computational thinking in the early grades, through the use of coding with micro -robots, which could be helpful for those stepping into the world of teaching it to young students for the first time.

Overview of the Ozobot Micro-Robot

Ozobots are tiny "smart robots" about the size of a golf ball that use colored markers to move across a 2-dimensional plane, like a piece of paper. By creating a sequence of different colored lines, with varied patterns drawn a student programming the Ozobot begins to learn the basics of coding. For example, a student might draw a black curve or a line with a marker and then embed the following sequence—short red, short black, short red—to make the robot speed up.

Using black, blue, green, and red markers (we have found that any marker that makes about a 1 cm wide mark will work) various code can be "written" to make the robot perform different actions. In working with students one of the fun aspects is to have them figure out what combination of commands create a particular action and then have the one who "discovers" the command name it.

For example, some student names for commands include slow snail, speed up, whirl wind, tornado, or jumping lines. When you purchase the Ozobots, a printed guide for all of the commands is provided as is access to additional resources such as free introductory and advanced lessons and a teacher's guide. These materials can be found on line at www.ozobot.com/education.

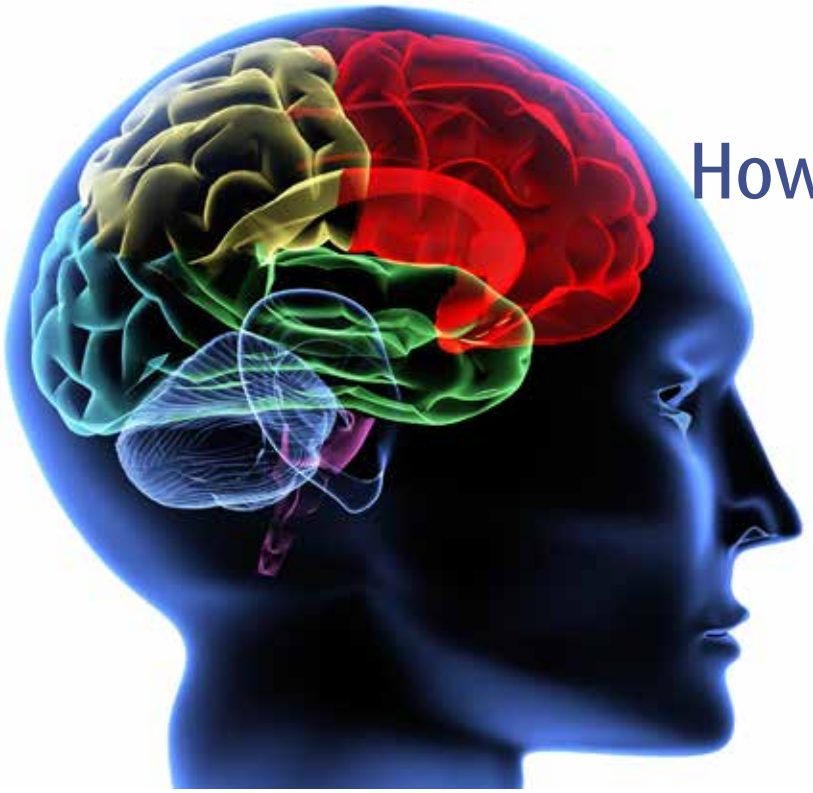
Notes for Teaching

Effective use of any new instructional tool or technique, such as micro-robots, requires pre-planning and a commitment to creating interdisciplinary learning experiences. Without that commitment, including careful alignment of use to regional, national, and/or international standards for learning, use may not go beyond play. And while play can be an important avenue to couch learning, it needs to be deliberately aligned to learning outcomes.

Additionally, do not hesitate to let students teach you what they have learned about coding. From our experiences, the best classroom applications come from teachers who professed to not being an expert but were willing to put these and other coding tools in students' hands and learned from them, too.

In early elementary settings, using age-appropriate technology, like

Ozobots, to develop computational thinking can create opportunities to support or introduce critical ways of STEM thinking. Through such interactions, even students in early elementary
grades can become more interested, motivated, and curious about coding. Learning while using robots might feel like play to students but watch as they engage in problem solving, participate in rich technical discussions, and carefully critique and analyze the tasks in front of them. You can create opportunities for students travel beyond the four walls of the classroom and participate in meaningful STEM learning by
thinking computationally.



How the Brain Learns Best

Part 2

by Jay McTighe and Judy Willis

Dopamine: The Brain's Pleasure Drug

If you know pleasure, you know dopamine. Seeking and experiencing pleasure are innate survival features of the brain. When dopamine is released throughout the brain, it promotes feelings of pleasure, a deep satisfaction, and a drive to continue or repeat the actions that triggered the pleasurable response.

You might already be familiar with dopamine in its other function as a neurotransmitter. Neurotransmission involves axons and dendrites, two kinds of extensions of neurons that act as senders and receivers, respectively, of neural electrical signals. Dopamine carries these signals from the axons of one neuron, across a liquid-filled gap called a synapse, to the dendrites of another neuron.

The action of dopamine that is relevant to the pleasure or reward response derives from triggers that stimulate its release from a holding center called the nucleus accumbens, found near the amygdala This increase in circulating dopamine is seen in all mammals and activates those feelings you experience as intrinsic pleasure and satisfaction.

Making correct predictions is one of the strongest dopamine elevators. The dopamine-reward response to making accurate predictions promotes survival in mammals because the intrinsic pleasure that comes from accurate predictions drives the brain to remember and use memory circuits that have guided previously successful predictions.

Experiencing accurate predictions and

the resulting satisfaction of goal achievement leads the brain to remember the related choices, behaviors, actions, decisions, and responses and to seek more opportunities to repeat them. Concomitant effects include enhanced attentive focus, motivation, curiosity, memory, persistence, and perseverance.

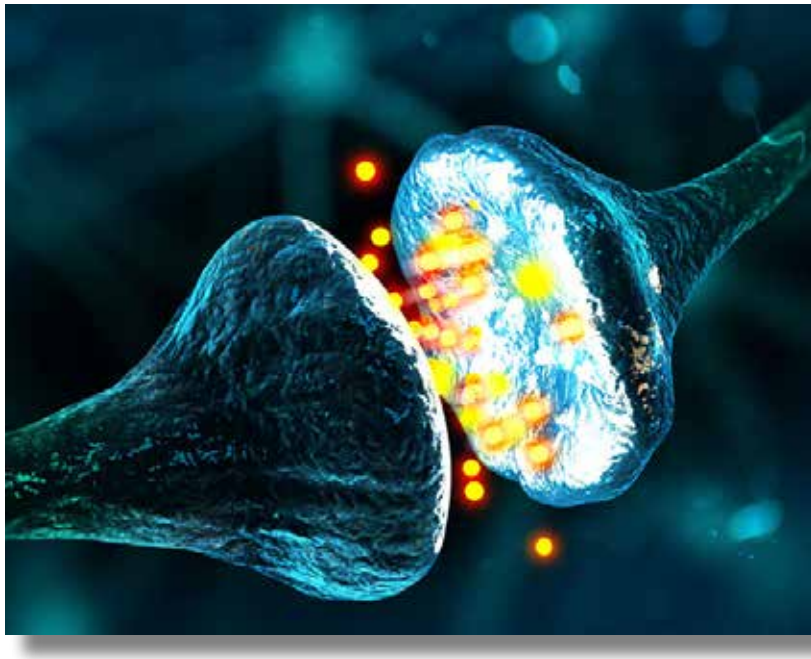
There are intrinsic impediments to optimally processing learning through the brain. As you've read, the RAS and the amygdala are filters programmed to determine what information gets through and where it is directed.

To further optimize students' success in school, you can engage the dopamine-reward response to motivate the brain to put forth the mental effort needed for new learning. This is true even for things that are not immediately recognized as relevant or pleasurable. Academic effort can be stimulated by tapping into the brain's programming to focus attention and apply effort when pleasure is the anticipated expectation.

By showing students that they have the power to improve and by providing opportunities for them to see progress toward goals, they'll come to understand that their own effort may control the outcome.

The **Brain's** Neuroplasticity

A long-held misconception asserted that brain growth stops with birth, only to be followed by a lifetime of brain-cell death. Now we know that although most of the neurons where information is stored are present at birth, there is lifelong growth and expansion of the abundant connections through which neurons communicate. Neuroplasticity refers to the brain's continuous capacity to generate new neural networks in response to stimuli.



The expression "neurons that fire together, wire together" refers to the process by which the brain constructs neural networks. The increased strength of the connections between neurons that sustain memory derives from the repeated activations of those networks. Every recalled memory or memory-directed pattern activates electrical signals (firing) from neuron to neuron to stimulate a constructive process that strengthens the memory circuit.

This is an aspect of neuroplasticity—the enhancement or modification of memory networks through repeated activation.

The neuroplastic response includes the building of more neuronal connections as well as the thickening of the layers of insulation, called myelin, around existing connections. A greater number of connections among neurons in a circuit means faster and more durable communication efficiency, just as adding lanes to a highway improves traffic flow. The addition of layers of myelin around the axons increases the speed of information travel and protects the circuit from being easily eroded through disuse.

Through the neuroplastic response, the brain strengthens the circuits used most frequently, enhancing their speed. Strengthening and speeding neuron-to-neuron communication provides longer-term durability and access—that is, memories are accessed and retrieved more efficiently and they last longer. For example, when children are learning to tie their shoes, they repeatedly practice the steps.

In so doing, the associated neurons repeatedly activate in sequence, strengthening the circuit of connected neurons each time. Practice results in the establishment of a "shoe-tying" network. The abundance of dendrites, enhanced by thick layers of insulating myelin around the axons, allows that behavior to become increasingly efficient and, eventually, automatic. Through neuroplasticity, the brain is molded by experience to reshape and reorganize itself so that we awake with a "new" brain each morning!

Another side of neuroplasticity, beyond building and strengthening myelinated connections, is known colloquially as the "use it or lose it" phenomenon. Without the stimulation of the electrical activity generated by use of a network, there is a gradual loss of connecting dendrites and thinning of the myelin, eventually leading to their dissolution, or pruning.

Teachers are familiar with this mental pruning in a form that is often referred to as the "summer slump." Without regular use, students are likely to "forget" what had been previously taught and will require considerable review and even reteaching to reacquire their previous learning. Another example of pruning is experienced when we don't remember the foreign language we studied in high school if we don't use it regularly.

Although it may seem unproductive for the brain to prune things that have been learned, recall the brain's high metabolic demands. Without this pruning, the brain's limited resources would be spread too thin to support its efficient operation.

The major roadways of neuron-to-neuron connections are in the cerebral cortex, and there are not many branching connections between them. The pattern is comparable to a view of the major cross-country highways from five miles above Earth, without the side streets.

The filling in of the brain's cognitive map takes place over time as students actively

engage in mental manipulations of information. Key learning activities planned through the curriculum planning framework Understanding by Design, such as exploring essential questions and engaging in authentic tasks, build and expand the cognitive networks needed for conceptual understanding and transfer.

How the **Brain** Remembers

New memory construction takes place after new sensory information leaves the amygdala and enters a brain structure called the hippocampus, whose name derives from the Greek word for seahorse, because of its resemblance to that creature.

This structure is where new sensory intake connects to a bit of pre-existing memory and consolidates from immediate into short-term memory.

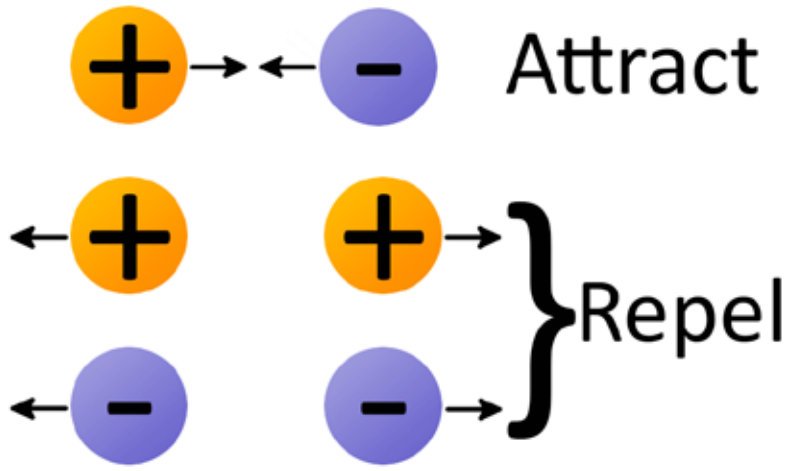
None of our memories are held in single neurons. It has been a momentous evolutionary extension that has enabled communication among hundreds and thousands of neurons, each holding tiny memory pieces, to recall even the simplest concept or perform the most basic tasks, such as clapping one's hands.

Memory is stored in separate hemispheres of the brain, based on the sensory modality (e.g., vision or hearing) in which it is experienced. These multiple storage areas are linked by dendrites and axons.

The brain develops stronger and extended memory circuits when new learning is connected to multiple circuits by recognizing the common threads among existing circuits or experiencing the learning through multiple sensory modalities, such as vision, hearing, and movement.

Here's an example: If students learn about the positive and negative charges of magnets and relate the information to other memory circuits that include the concepts of positive and negative (evident in things such as emotions, electricity, numbers, or economic influences), they will store and can retrieve what they learned about magnets through multiple pathways.

If positive and negative magnetic forces are further related to a story in which opposites attract, thinking about that story can retrieve an even more detailed memory of facts related to magnets.



Storage of memory in neural networks based on patterns (relationships) has evolved into a very effective system in which the brain accesses prior knowledge to enable it to make connections to new information and situations. For example, memory based on patterns and relationships guides children to avoid objects designated as hot. It takes only one or two negative experiences of feeling the discomfort of touching a hot stove or campfire, along with hearing the word hot or seeing flames, for their brains to construct the relational memory cementing the notion that the word hot stands for things that should not be touched. In short, they learn.

Have you ever read aloud a familiar story or poem and left out a word or phrase that is often repeated or rhymed? If so, it is likely that children have jumped in to complete that sentence. Their action reflects the brain's use of patterning. In mathematics, pattern recognition is what

allows students to predict the next number in a sequence or to recognize which procedure to apply when word problems use phrases such as all together, remaining, or left over.

"Knowing how the brain makes connections can help teachers maximize learning in their classroom."

Activating students' existing relevant prior knowledge takes place when they understand a framework into which the new learning belongs. This awareness guides the brain to recognize connections with existing memory networks in the hippocampus. Knowing how the brain makes connections can help teachers maximize learning in their classrooms, especially because students themselves do not always make connections between what they already know and new information being taught.

To ensure that there is related existing memory in the hippocampus to link with the new input, it is essential to help students become aware of their prior knowledge. When new information is presented with some foundational pattern recognized by the brain, memory networks incorporate it more efficiently.

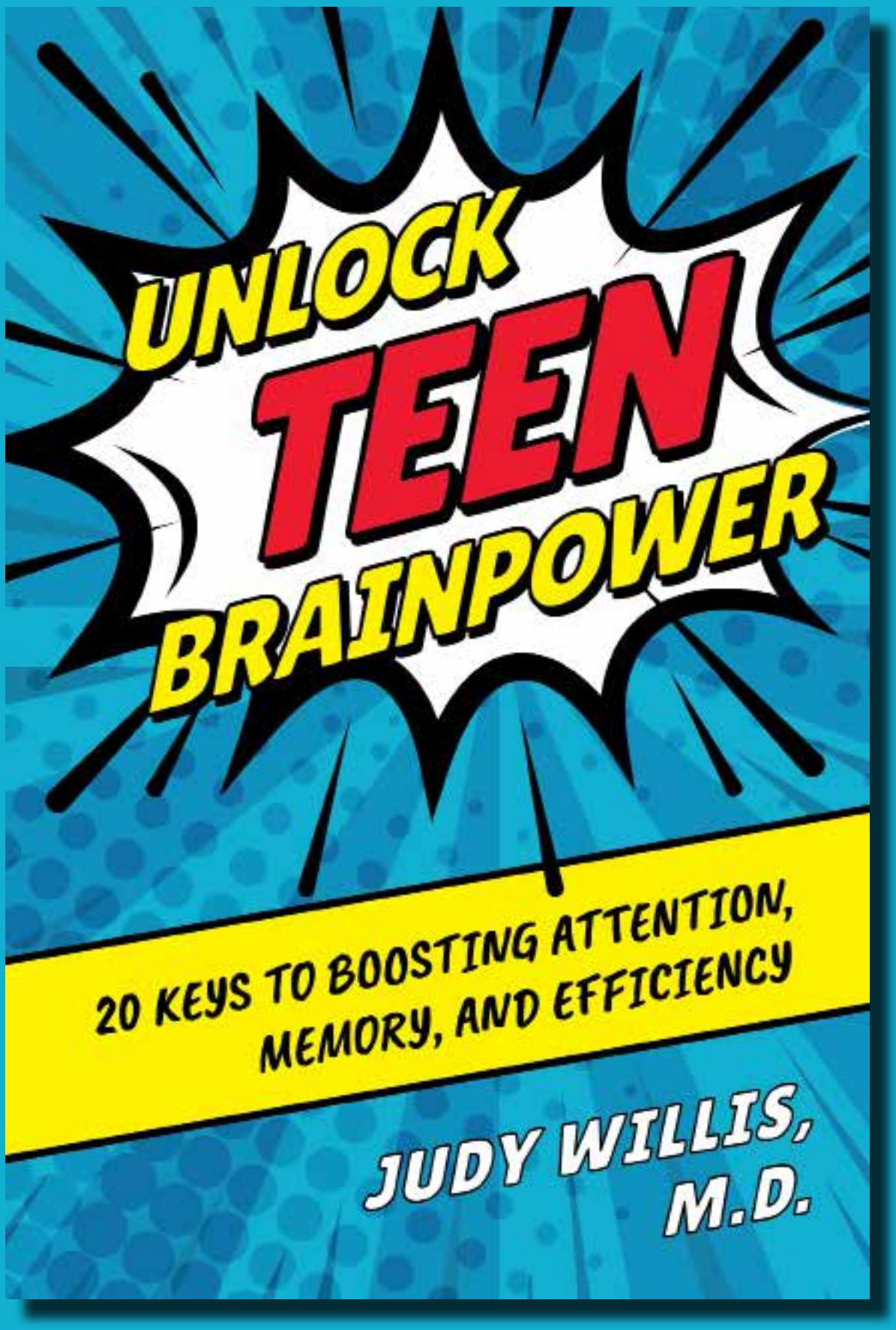
For example, when students are learning about triangles, you can start by reminding them about other shapes with which they are already familiar, such as squares and circles.

Illustrating how a square can be cut or folded to create a triangle and how two equal triangles can be put together to create a square will promote the linking of the new (triangle) to the known (square).

With a successful pattern match, the new information encodes into a short-term memory circuit. Strategies to ensure activation of prior knowledge include the use of pre-assessments, advance organizers, essential questions, concept maps, graphic organizers, and "hook" activities.

Editors note: I suggest ordering this book, on the next page, for an authoritative plunge into better understanding your students and yourself for a more comprehensive and effective curriculum.

Knowing how the brain works best is a vital key to effective teaching and classroom environment management.



Unlock Teen Brainpower is available at -

Amazon Rowman and Littlefield Barnes and Nobles

Diversifying Tech Starts With Ensuring Equitable Computer Science Education

By Allison Scott and Julie Flapan

We see the impact of technology in every aspect of our lives. The tech sector plays a major role in our nation's economy, producing nearly one-quarter of the nation's economic output and projects to add over 1 million job openings in the next decade.

Tech giants like Google, Apple, Microsoft, and Facebook create products which have impacts across the globe, while creating jobs and wealth. And beyond these companies, sectors as diverse as defense, transportation, entertainment and agriculture are increasingly driven by technology and reliant on a tech-savvy workforce.

But, if you look inside these companies, on their engineering teams, in their boardrooms, and in the neighborhoods and communities in which their employees work and live, you will see an increasingly segregated picture. Black, Latinx, and Native American professionals are vastly underrepresented in tech fields, representing only 8 percent of the Silicon Valley tech workforce and 15 percent of the national computing workforce. Less than 30 percent are women, and less than 2 percent are women of color. There is little to no racial or gender diversity in the creation of new technologies, business ventures, or in investment, limiting our innovation potential.

These trends are similar at every stage of the computing pipeline, and nowhere is it more evident than in K-12 education, where far too few students are learning the computing knowledge and skills needed for participation in the future tech-driven workforce.

In California, the tech capital of the world, only 39 percent of its high schools offer computer science courses, and just 3 percent of California's 1.9 million high school students took a computer science course in 2017. Computer science is often only offered in high-income areas with less diverse student populations. Students of color, rural students, and low-income students are much less likely to have access to these foundational courses or to be actively engaged in them.

Despite significant efforts from national, state and local leaders, agencies, and organizations, these trends are similar across every state. By the end of high school, only a select few students have developed foundational computing skills and knowledge needed to pursue degrees and careers in computing-related fields.

As technology plays an increasingly larger role in our economy, two important trends are converging: The nation is becoming more diverse, while our needs for a skilled computing workforce continue to grow. The exclusion of women and underrepresented people of color limits the robustness of the national computing workforce, hampers future economic growth and competitiveness, impedes innovation, restricts access to high-opportunity jobs and exacerbates economic inequality.

We see this as a systemic challenge, one which is situated within a broader societal context of policies and practices which have disproportionately marginalized communities of color in access to quality education, employment, wealth, health, and well-being among communities of color. And therefore, there is no quick fix.

As a nation, if we want to maintain our role as a global leader in technology and innovation, we need a bold vision to develop and support a diverse and robust computing workforce. This begins with an investment to ensure all students have

access to a rigorous K-12 computer science education as a critical foundation for participating in the workforce of the future. K-12 computer science education is only one stage of the computing pipeline; we need a coherent system to align K-12 and postsecondary education, multiple pathways to enter careers in tech, and to hold tech companies accountable for recruiting, hiring and retaining a diverse workforce.

How do we get there? We can start by articulating the importance of computer science as a critical literacy required for all students and ensuring CS counts towards graduation and university admissions requirements.

We must invest heavily in the preparation and professional development of teachers to teach culturally responsive curriculum and implement high quality computer science education across all schools, serving all students, with attention to the needs of under-resourced schools and communities.

We must ensure that schools and communities have equitable financial resources and technology infrastructure, in hardware, software, and connectivity. We must address the implicit biases and structural barriers that prevent all students from participating and engaging in computer science coursework. And we've got to confront larger issues of educational inequality, from access to preschool to disparities in Advanced Placement coursework, that disproportionately affect low-income students of color.

We must avoid one-off solutions, short-term exposure to activities, and easy policy wins instead of addressing the long-term strategies needed to improve access and equity in computer science education.

Our nation is facing a pivotal moment to examine and address historic inequities and create an equitable, inclusive and effective economic future for our nation. We need the contributions of all students, especially low-income students, students of color, and girls, in the technology sector and the broader technology-driven economy.

Expanding participation in technology will benefit our nation's ability to create new products and solutions, improve entrenched societal challenges, and address negative effects of technology--from algorithmic bias and privacy issues to income and wealth inequality. Our students deserve our investment. Let's ensure all students are prepared to power our nation's technology-driven future.

Allison Scott, Ph.D., is the Chief Research Officer at the Kapor Center for Social Impact. Julie Flapan, Ed.D., is the Director of the Computer Science Equity Project at UCLA Center X, where she leads the Computer Science for California Initiative (CS for CA).

Encouragement and Support Are Keys to Aviation Education

United hosts AOPA High School Aviation STEM Symposium

By David Tulis

"Don't let other people discourage you from achieving your dreams," he told more than 350 science, technology, engineering, and math (STEM) educators during the two-day gathering that focused on leadership, best learning practices, and hands-on projects designed to engage youth in aviation.

The event included a dozen breakout sessions; keynote addresses from leaders at United Airlines, Uber Elevate, and the Air Force; as well as opportunities for teachers to network and share ideas.

Among the attendees was Kevin Moss, a California high school teacher and a rusty pilot who was excited to "get back into aviation" after serving in the U.S. Marine Corps as a helicopter pilot. The Army and Navy Academy aviation program founder said he was offered a regional airline position but turned it down to dedicate himself to helping young people achieve their goals. "That lit a spark and I've been going 110 miles per hour ever since."

Moss met retired Piedmont Air Lines Capt. Warren Wheeler, a North Carolina flight instructor, when the two picked up their registration materials, and it led to a chat about college football. Moss was incredulous when United Airlines check pilot Capt. Ray Evans stopped by to weigh in on the weekend's sports news and scooped both of them up for a Boeing 737 simulator flight.

Evans led them to one of the company's 32 multi-million dollar flight simulators housed at United's Flight Training Center, the location for the 2019 aviation STEM symposium and one of the world's largest airline pilot training facilities.

Photos by David Tulis

Evans challenged the two pilots with emergency scenarios including a failed engine on takeoff. "It's pretty cool how realistic it is," said Moss, who occupied the first-officer position and helped Wheeler keep the jetliner's nose on the horizon during the high-density-altitude scenario.

Then they switched roles and Moss flew an ILS Category 1 approach down to the minimum altitude. He managed a smooth landing, marveled at the glass-cockpit instrumentation, and conceded that his students "could probably do a lot better than me" because of their familiarity with video games. He presumed he maintained the overall advantage "because they can't explain where density altitude comes from and that's why they need me," he deadpanned.

United Airlines Senior Vice President of Flight Operations Bryan Quigley told educators that the aviation industry was striving to catch up on hiring demands in the face of impending pilot retirements, continued growth, and worldwide demand for air travel. "I do believe the demand is intense for pilots and I do believe there is a pilot shortage out there," he told them. "We need new blood and new talent, and we need them in all areas" of aviation, he added.

SINCE 1939
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U.S. Air Force Lt. Gen. Jacqueline Van Ovost said during an afternoon keynote that the future of flight is both "in [the] air and in space—and in manned and unmanned operations." She asked educators to look for the "diamond in the rough" students and to nurture them until they shine.

Texas science teacher and private pilot Larry Anderson said he was "excited" to learn about the AOPA high school aviation STEM curriculum because "aviation is one of the best formats for teaching life skills." He added that the "amazing" feeling of flying can't be described "until you've experienced it for yourself." The football coach and former aircraft owner said he came out of semi-retirement to teach aviation because of a shortage of science teachers in his school district. "We need you—we absolutely need you," echoed Susan White, the senior manager for pilot recruiting at United Airlines during a panel discussion on career choices. "You are making a difference in the world of aviation."

AOPA has coached hundreds of teachers and provided them with classroom resources and hands-on training that make learning fun and informative, while exposing students to aviation careers that they may not have previously considered. In the current school year, more than 5,000 ninth-, 10th-, and 11th-graders at 161 schools in 34 states are utilizing the program.

"You are going to change the world," said AOPA President Mark Baker, who thanked teachers for their untiring support of youth. "You are changing young people's lives, I guarantee it."

The 2020 AOPA High School Aviation STEM Symposium will be held in Orlando, Florida, November 9 and 10, 2020.
The 'You Can Fly' program and the Air Safety Institute are funded by charitable donations to the AOPA Foundation, a 501(c)(3) organization. To be a part of the solution, visit www.aopafoundation.org/donate.

Wings

of Passion

by Wayne Carley and Azam Shaghaghi

Mélanie Astles is five times aerobatics French champion and finished several times in the top ten World and European championships. Now, as a pilot in the Red Bull Air Race Challenger Cup, she writes a page in history of aviation by being the first woman to ever compete in the RBAR.

Mélanie's story is one of passion, perseverance and overcoming the odds. Nobody believed that she could fulfill her childhood dream to become a pilot when she quit school at 18 to enter active life. When she took a job in a petrol station in Roquebrune Cap Martin, in the South of France, where she lived, the dream seemed far away.

But thanks to her relentless work, she became manager of several petrol stations. She was then able to save money to pay for flying lessons, which she started at age 21. In her very first year in aerobatics competition, she snatched victory at the French Cup in the "Espoir" category.

With a steady and constant progression, she worked her way up the categories, winning national championships and her place in the prestigious Aerobatics French Team. In 2014, she was seventh overall at the Aerobatics World Championships, "Advanced "level and first at the female ranking. In 2015, she ranked world fifth best female pilot in the highest category "Unlimited", and was a member of the French team which won the world title.

The following is candid interview with Mélanie about her flying career and STEM applications.

- How old were you when you started flying?

My love for planes dates from my very early childhood as far as I can remember. As young as 7 or 8, I wanted to become a fighter plane pilot. However, it is only after I quit school on impulse at 18 to start earning money, that I finally had the opportunity to take my first flying lesson only at 21.

- How important is understanding aerodynamics as a racing pilot?

On the circuit, we are subjected to aerodynamic forces. Our task is to understand them in order to counteract them. For example if I take a turn, I put my ailerons to the left, therefore creating a differential drag, this will have to be counteracted.

Another example: the stall, when we pass a certain angle of attack, there will be no more wing lift. To go fast, we need to stay close to this limit, showing how important it is to understand it.

- Were there any special education requirements to enter this career?

My own path is not the typical one. I lacked the maths and science background demanded of pilots.

So I studied privately to obtain the academic diploma necessary to reach the level. At the same time, I was working in gas stations, and saved money from my salary to pay for enough lessons to obtain my Private Pilot License, with the minimum number of hours. I studied to enter the prestigious ENAC School (Ecole Nationale de l'Aviation Civile), where I finally obtained my Professional License.

Parallel to studying I developed my passion for aerobatics, and I very quickly won titles, national, European and world. I reached the Unlimited

level in Aerobatics (the highest) in 2015, which opened the door to applying to compete in the RBAR.

- Air racing has been male dominated. Do you have any comments on gender acceptance and competition?

Even today, it is still not easy for women to succeed in air racing. You need a strong and determined personality to fit in. Aviation in France is a strongly male dominated activity and only 7% of women hold a pilot's license. It would be wrong not to say that discrimination is latent in male dominated sports, like in any type of activity or trade. Things can sometimes be difficult, but women have to keep a positive attitude at all times, and just concentrate on their objective. If we complain, it will be shrugged off as being a "woman thing".

Of course, as women, our sports career is sometimes shorter if we decide to start a family; pregnancy and having children is quite often the reason why some of us quit the sport. So female pilots probably will face sexism, but you just have to believe in yourself and focus on your project. At the Red Bull Air Race, I am treated not as a woman pilot but just as a pilot. Everybody is equal in the cockpit in competition.

- Tell us about the physical effects and demands of your sport.

Physically, of course, we need to be able to pull up to 10 G's, and you can only achieve that by serious constant physical training. Unlike fighter plane pilots, we do not wear G-suits, the difference being that they have to bear g-forces over a long period of time. In aerobatics we also have to sustain high g's, but on short successive laps of time. So of course, physical breath control exercises
are essential. We also do a straining maneuver, when you tense everything up, hold your breath in short bursts and pull against it.

You make your head feel a little buzzy, and it forces the blood back into your brain, and clears your vision.

To build up my physical endurance, I train six days a week; I run for an hour and bike for two hours, twice a week.

Then I punch and run intervals for an hour or two, once a week. I do bodybuilding two or three times a week.
At RBAR, my main challenge has been to learn to fly at low attitude, and master the speed. In aerobatics, we are judged on the quality of the figures, at RBAR, we fly low against the clock.

- Since engineering is really about decision making and problem solving, how frequently before and during an event do you find yourself using the engineering method of decision making?

Before each flight or event, it is important to raise the problems, the possible errors, what we call the threats. The mnemonic way for me is P.A.I.M.E.

P. for Pilot, - am I in good shape, did I have a good sleep etc.-->. find a solution, e.g. be even more attentive.

A. for Avion (Plane) – in good order, checked

I. for Infrastructure – e.g. last weekend Porto track- in case of threat what decision to avoid crowd = land on water.

M. for Meteo – e.g. threat = clouds above the bridge to enter the track at Porto last week - decision = annul flight or plunge deeper through the clouds.

E. for Environment. E.g. Porto = water ; Spielberg = mountains – decision taken according to the elements around.

We need to scan all the possible threats in all aspects. And for each threat, find a solution to counteract it upstream, not waiting for the threat to become reality.

I guess this is the similarity with engineering, before building a bridge, a railway… an engineer must be going through a similar process of thinking.

- Science by definition is the systematic accumulation of knowledge. Tell us about the knowledge you've had to gain to be an air racer.

When I entered the RBAR in 2016, I had experience in aerobatics competitions, where we are judged on the quality of the figures performed. But I lacked the racing knowledge, I had everything to learn. Luckily at RBAR, we are surrounded by very competent pilots; in particular Paul Bonhomme (three times RBAR world champion, captain of 747 on British Airways).

He has shared with us his knowledge as an engineer, airline pilot, air race pilot, his maturity, and made us aware of the importance of security. He taught me step building, step by step first, and now putting all this together I am able to produce nice results.

- What do you enjoy most about flying and racing?

I love the feeling of escape. It's like there are two different worlds; one on the ground and one in the sky. Having the power to live in both gives you freedom. When in the sky, negative thoughts and problems disappear and I become completely focused on flying. I also love the action part of it: I'm very much into speed, precision and adrenaline rush, be it in training or competition. At RBAR my main challenge has been to learn to fly at low altitude and I love it. And of course, I love the positive reaction of the public, it really lifts me.

- Do you have any comments for young women that may be interested in a flying career?

I get a lot of feedback from young girls writing to me or meeting me at the races. I am happy if I motivate them by my experience. I will just say to them, if you have determination, "Go for it", if it is your dream, and never ever give up.

Failure can and probably will happen, but success will follow if you believe in your project strongly enough. Be proud to be a woman, and stay feminine.

You don't envisage a flying career, but rather you have a need to live a passion. And you owe it to yourself to do everything possible to fulfill that passion. And then, as someone said once, "If you do what you love, you'll never work a day in your life".

- Is there anything else you would like to add for our readers in 67 countries?

My unusual career path has not been easy. But it has helped in building my determination and my strong mental state, while conveying a feminine image. My passion for sport is strong and I always want to go further. I aim at improving all the time as a Challenger pilot to reach one day the Master Class.
I invite you to look at my Internet site melanieastles.com , where you will learn more about my life, my sport, my association, and sponsorship opportunities, an innovating communication solution, to take part in this special adventure.


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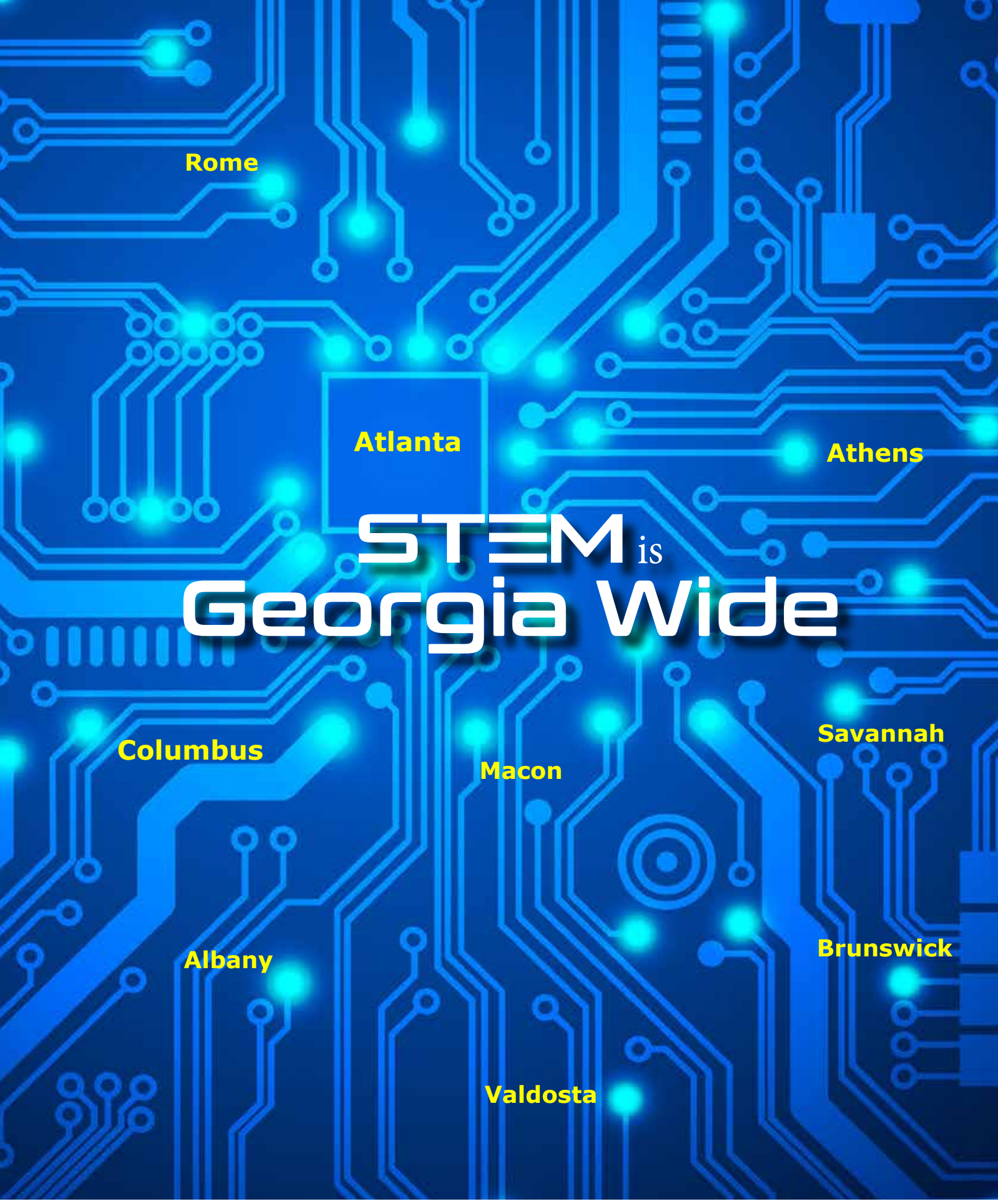

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