Aug 2018

GEORGIA PATHWAYS
MAGAZINE

Digital Media In Georgia
Dr. David P. Lieberman

Liana Brackett
Meteorologist / The Weather Channel

Georgia Schools Rising UP
Dr. Caitlin McMunn Dooley

Engineering Art

TAG Technology Association of Georgia

TAG TAG-Ed Education Collaborative

2018 STEM/ STEAM Forum

October 22-23, 2018

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Register today for the 2018 Georgia Department of Education STEM/ STEAM Forum. Participate in workshops, panels, and keynote sessions to ignite STEM and STEAM teaching and learning in your district, school, or classroom. This conference is a great way to network and learn new ways that interdisciplinary practices can engage students and prepare them for the future workforce.

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Georgia Pathways™ STEM Magazine seeks to bring attention to the ways in which we can foster, celebrate and innovate STEM fields and education programs -- and the opportunities that exist for meaningful career pathways in science, technology, engineering and math.

The hope is that by sharing meaningful, interesting and useful content, we help create and fuel an ecosystem that is increasingly accessible to learners and educators across a spectrum of backgrounds, geography and interests.

By continuing to read and engage with us through this medium, you become a part of that mission. I hope that you will continue to share each edition, with your networks so that we can continue to raise awareness and encourage students and teachers who are building the momentum around STEM education.

As summer begins to come to a close, be sure to leverage the features from our thought leaders, as well as the stories of students who are finding their way from classroom to career through STEM pathways.

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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From the Executive Director

School is well underway and new experiences begin anew…

Here at TAG-Ed and Georgia Pathways™ STEM Magazine there's nothing more energizing than the buzz and the optimism that comes with a new school year. A new set of classes OR a new set of students where everyone starts with a clean sheet and a new world of opportunities. But it's also a new educational season to inspire or to be inspired. And our hope is that as you push forward into a new year, you'll leverage our monthly online magazine as a source of inspiration, helpful insight or simply a valued content source to support the classroom experience.

Georgia Pathways™ strives to engage the mind, stimulate new thoughts and ideas and broaden access and exposure regarding "what's possible." So whether it's an article identifying the exciting ways to engage or introduce students to coding and technology through digital media or a motivational article sharing how an early infatuation with space sparked an interest in Atmospheric Science and an eventual journey to Meteorology, there's no limit to the content we're willing to share.

But now that we've launched 8 issues, we'd simply ask you to not only continue reading…but continue to share content and what's happening in your world.

Remember that this is a collective effort to not just impact a few…but to impact many! So please continue to read, enjoy and share Georgia Pathways™ STEM Magazine. And leverage the magazine to inspire, encourage and empower greatness amongst students. Because as Eric Micha'el Leventhal once shared, ***"Our children are only as brilliant as we allow them to be."***

Sincerely,

Erika Moore

Executive Director
TAG Education Collaborative

Georgia's Need for Unified K-12 Curricula in Digital Media

By Dr. David P. Lieberman

There is no question today's youth are attracted to, and raised on, a culture of digital media never before seen.

A Washington Post article back in 2015 with data from the independent non-profit research group Common Sense Media found teens were spending an average of nine hours a day consuming media whether it be online, video games, television, or on their phone. My own granddaughter Zoè, not yet 2, is capable of demonstrating algorithmic thought navigating her

own tablet device. Likely any child with a cell phone demonstrates rudimentary programming skills on a daily basis. This opens a world of opportunity to educators and school administrators. Previously promoting STEM education often, and unfortunately, disenfranchised the very youth we wished to attract on the basis of what was seen as dry or "nerdy" careers in science, technology and math.

We now have the opportunity to engage and excite students to learn coding and technology around the basis of digital media developing creative content for film, music, video games, web and social platforms while simultaneously acquiring the very programming skills leverageable across the gamut of business and tech careers.

The need for school districts to modify current curricula around coding and digital media is immediate and essential. Data and information is transforming quickly to the multimedia age with video and 3D content quickly replacing previous essential data sets such that a 2017 Wired Magazine article bore the imperative title "the Next Big Blue-Collar Job is Coding."

Georgia as a leader in both technology and media is excellently positioned to take a leadership position implementing curricula for the coming wave. With the existence of Turner, CNN, The Weather Channel, and now Georgia being designated as number one (above London, LA, and NY) for film and production , the need for skilled coders knowledgeable in web and

digital media is positioned to grow exponentially with the recent announcement of a $2.5B Facebook Data Center, the new Cybersecurity center being constructed in Augusta, and Amazon's potentially locating its HQ2 to the Atlanta Area.

Creating a cohesive and unified curriculum in Digital Media in Georgia is not without its challenges requiring participation from different players. From the Administrator's perspective the problem is locating suitably trained teachers. Often a coding or math teacher may want to engage students to participate in an activity like a coding 'Game-athon' but completely without any relateable experience and thus discouraged. In fact, any teacher wishing to teach digital media in the Georgia school system is often posed with the problematic requirement there is no suitable GACE test beyond that of "Media Specialist" which is geared primarily toward library positions.

From the level of workforce and corporate development, companies would need to be engaged to assist refine an often overwhelming skill set to those essential to the curriculum. All too often a student is immediately discouraged from a job search encountering employers on a website like Indeed who want someone proficient in HTML, C++, Python, Ruby on Rails,

CSS, and Ajax. From an educator's perspective it is frustrating advising a student who comes to me indicating they don't have the time or money to attain certification in technologies they may never actually use (and will likely be obsolete in a few years anyway).

Speaking with heads of human resources at some of Atlanta's technology firms, there is discussion of refining entry level job requirements to a meaningful skill set. From my point of view, if you teach a student algorithmic thought with one stable 'C' based language, they are able to then export those skills to most other platforms (for instance Java or one of the C-based video game scripting environments).

Perhaps the largest challenge is at the level of the school district. Beyond a cohesive curricula across all levels and

schools, there would need to be a defined set of software tools and media production workstations.

I think too often schools are discouraged with the thought they need to build large outdated television or film 'studios' and unfortunately opt to get third party educators offering diverse and inconsistent "STEAM" related

teaching environments (i.e. a mobile lab) can effectively reduce cost to the district.

In conclusion, Georgia, and the world, are posed with an exciting challenge to finally implement STEM education across all levels to catch up with the new economy based on digital media technologies.

activities to the students when in fact all that is required is consistent software platforms with workstations for each student. Granted, keeping the workstations up to date with software licenses and peripheral devices has budgetary considerations, however, the use of corporate partners or mobile

Hayley Tsukayama, "Teens Spend Nearly Nine Hours Every Day Consuming Media," The Washington Post, (November 3, 2015).

Clive Thompson, The Next Big Blue-Collar Job is Coding," Wired, (February, 8, 2017).

FilmL.A., 2016 Feature Film Study.


Atlanta's
Liana Brackett
Meteorologist
Sunny and STEM

Liana Brackett

Meteorologist for The Weather Channel

by *Wayne* Carley

I like to think my infatuation with space sparked my journey into meteorology. When I was a kid, I truly believed I would be an astronaut when I grew up. It wasn't until I realized I was afraid of heights that I started thinking of other career options. I landed on meteorology after a high school internship with the Chicano News Media Association in San Diego.

I was initially thinking of pursuing journalism, but I loved the meteorology side of broadcasting and decided to pursue it completely by graduating from the University of California - Davis (UC Davis) with a Bachelor of Science in Atmospheric Science. I haven't let go of my space dream, but now it's more that I want to see a rocket launch rather than launching myself into space!

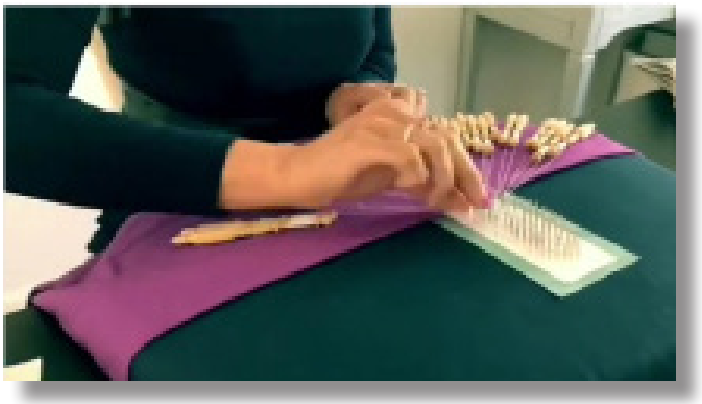
My late grandma, Nana Vern, hands down inspires me, even to this day. She was the one who instilled in my sister and I the idea we could do anything we put our minds to regardless of our gender or race, which is just the fuel a young girl needs to foster that belief in herself. And believe me, I ran with it! She was a trailblazer herself, working at a male-dominated Chevron oil refinery in the San Francisco Bay Area during the 1960s and 1970s. She never let anyone tell her she couldn't do something, and passed that on to me.

The fact that weather changes all the time is the most exciting aspect of my career. It does help living in a location where you see a variety of weather, but working at The Weather Channel is even better! There is always some type of weather happening across the entire nation. It's the ultimate never-ending challenge. It's almost like a puzzle, putting all of the known weather parameters together and combining it with our knowledge about a region's terrain and climate to forecast. I personally love the challenge, even though it can be frustrating when Mother Nature doesn't cooperate.

As a weather forecaster for the National Weather Service (NWS) in Portland, Oregon, I'll never forget getting a call from a fisherman who was traveling north toward Canada and needed a forecast. I gave him the forecast, warning him that he'd likely run into higher waves and some storms a few days into his trip. About a week later, he called back for his return trip forecast and requested me...all because he said my forecast was spot on and he was completely prepared for the waves and storms! That was a game changer for me because it made my forecast extremely personal.

The Atmospheric Science program at UC Davis was closely aligned with the engineering degree, so we took the same math, computer programming, and even several engineering classes before breaking off for our specialized fields. My career and my degree are completely intertwined with STEM so every day I'm using those skills at work.

I love that the Arts have been added for STEAM because many scientists also have a creative side. Many of my co-workers are also musicians, artists, and writers in their free time...and I am no exception. I design clothes and make my own lace by hand.



Working for The Weather Channel has been a dream come true. As an On-Camera Meteorologist, my work involves staying aware of the big weather stories of the day, working alongside our amazing team of weather producers and directors, and keeping the public safe with our forecasts. Honestly, it's a blast talking about the weather all day!

There are differences between my experience at the National Weather Service (NWS) and in Broadcast Meteorology. I remember it was a big deal that my NWS office had "a lot" of women, and by that I mean there were seven women total in an office of more than 30 people. In the TV world, there are a larger number of women; even our vice president of content and programming is a woman, which is awesome. My hope in the future is to have way more diversity in gender, race and more in meteorology.

My biggest hope for readers to take away from this is to be bold and courageous. I wouldn't be where I am today without having the boldness to take those risks and push myself to achieve more as a meteorologist. Even to leave my position as a forecaster in the National Weather Service to take a chance in the TV world, took some major courage and support from my family and friends! Life is way more fun when you keep those challenges coming.

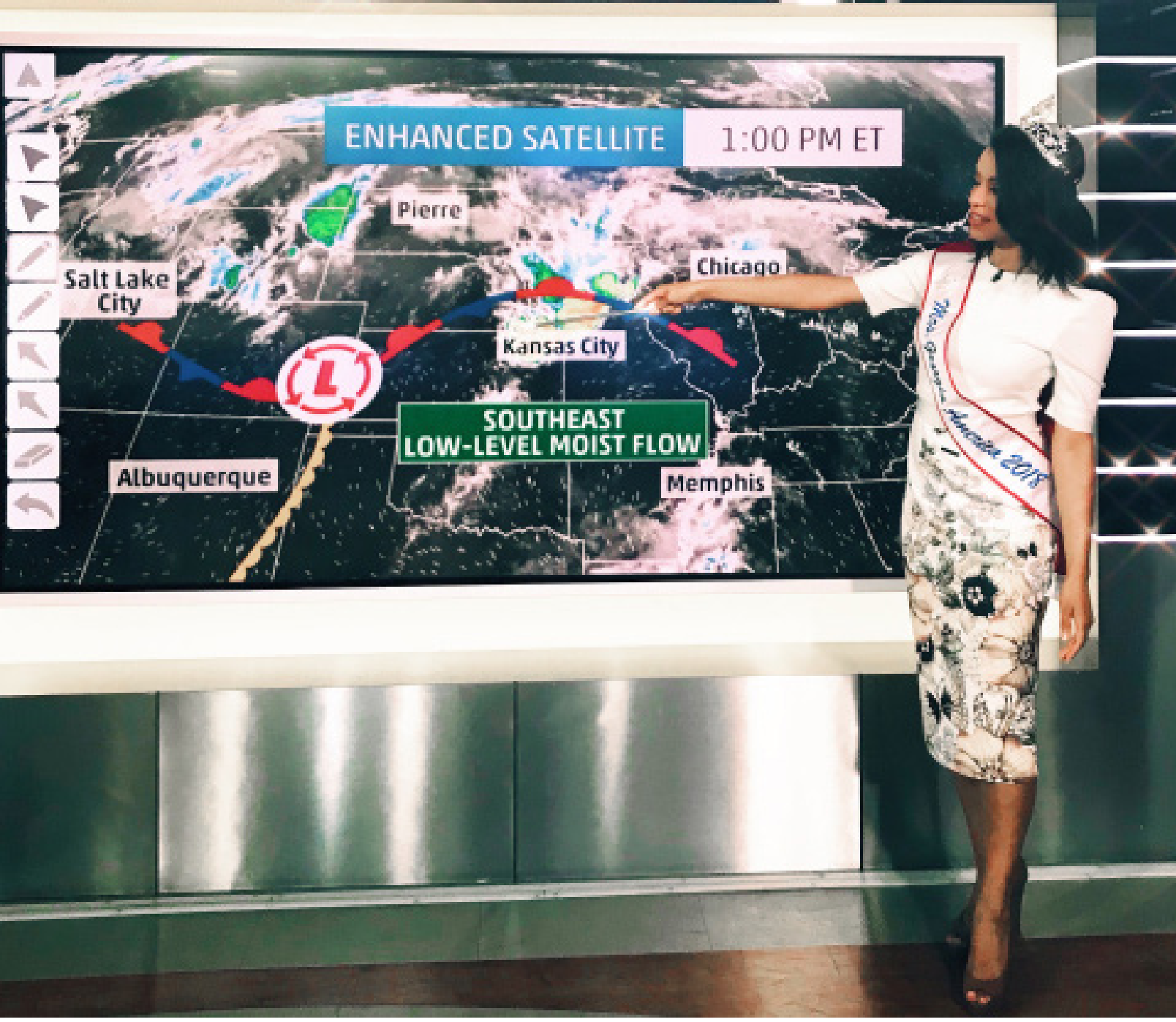
It doesn't matter if science, tech, engineering or math comes naturally to you or not. I remember I had a science teacher in high school who encouraged me *NOT* to pursue science because I struggled in chemistry. Thank goodness I believed in myself and my abilities and had family members speak truth into my life. Your belief in yourself needs to be stronger than your reliance on other's opinions.

"Thank goodness I believed in myself."

My pursuit of meteorology paved the way to the pursuit of the crown. I won the title of Mrs. Georgia America 2018 in my first pageant ever. This pageant was definitely a different type of challenge, but some of the same tools I use as a meteorologist, such as speaking in front of an audience, problem solving, and being in a fast-paced environment, all of which came in super handy in the pageant world.

It's a fun and important journey I'm on...especially as I represent other female scientists and both the Mexican- and African-American communities. I want a child to see me on TV or in this magazine and think to themselves, I can do that too!

Liana Brackett is an on-camera meteorologist for The Weather Channel, who recently joined the network from Fox

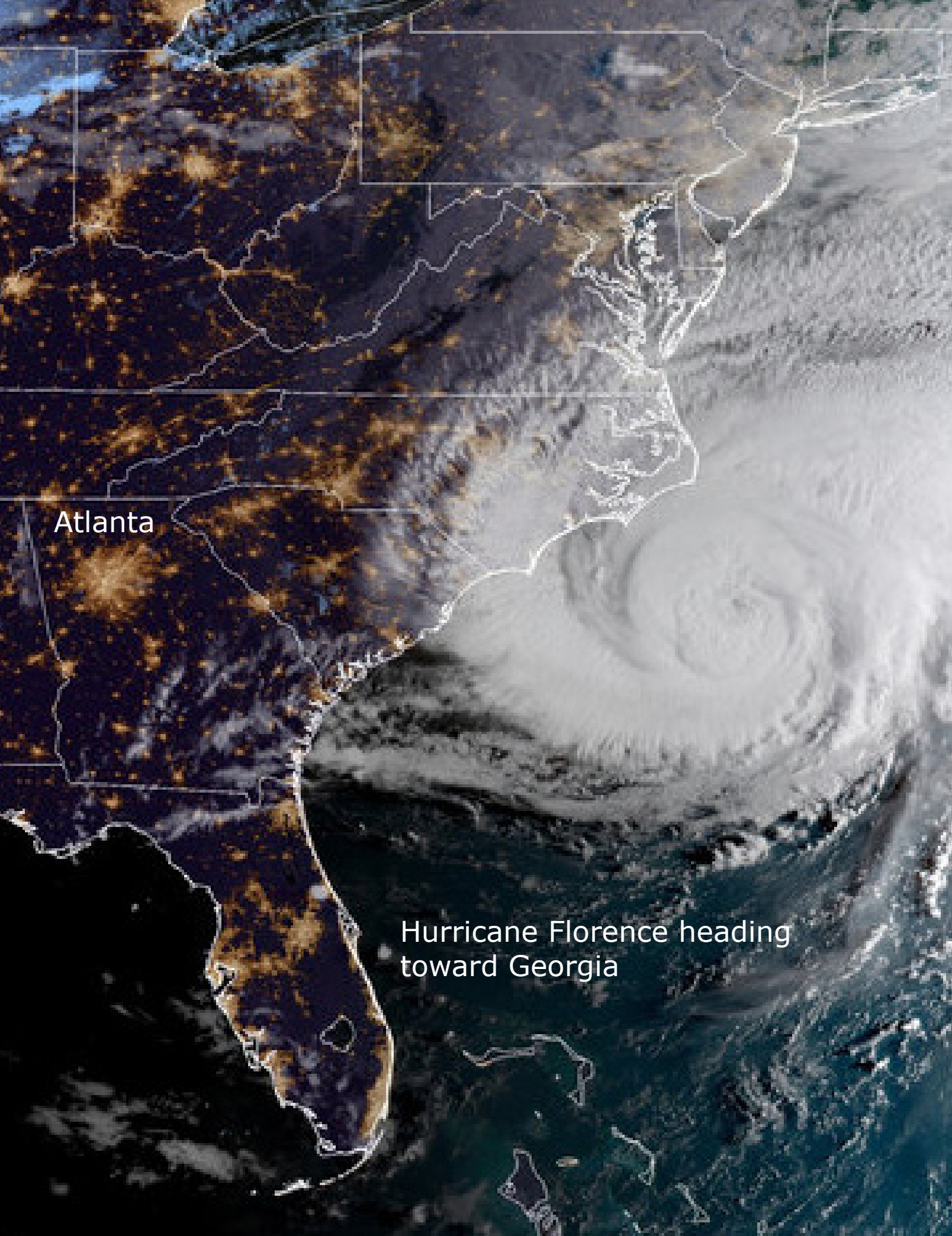


12 Oregon in Portland, Oregon where she served as meteorologist.

Originally raised in Temecula, California, Brackett began her weather journey at Arizona State University where she initially studied broadcast meteorology. Fascinated with weather forecasting, she decided to change her major and transfer to University of California, Davis to study meteorology.

She graduated with a Bachelor of Science in Atmospheric Science in 2009. Liana started her career working as a meteorologist for the National Weather Service in Portland, Oregon.

She spent over six years issuing watches, warnings, and advisories for southwest Washington and northwest Oregon. She received several awards for outstanding forecasting and teamwork during significant weather outbreaks with the National Weather Service.


Atlanta
Hurricane Florence heading
toward Georgia

Georgia's Public Schools Rising Up

Caitlin McMunn Dooley, Ph.D.

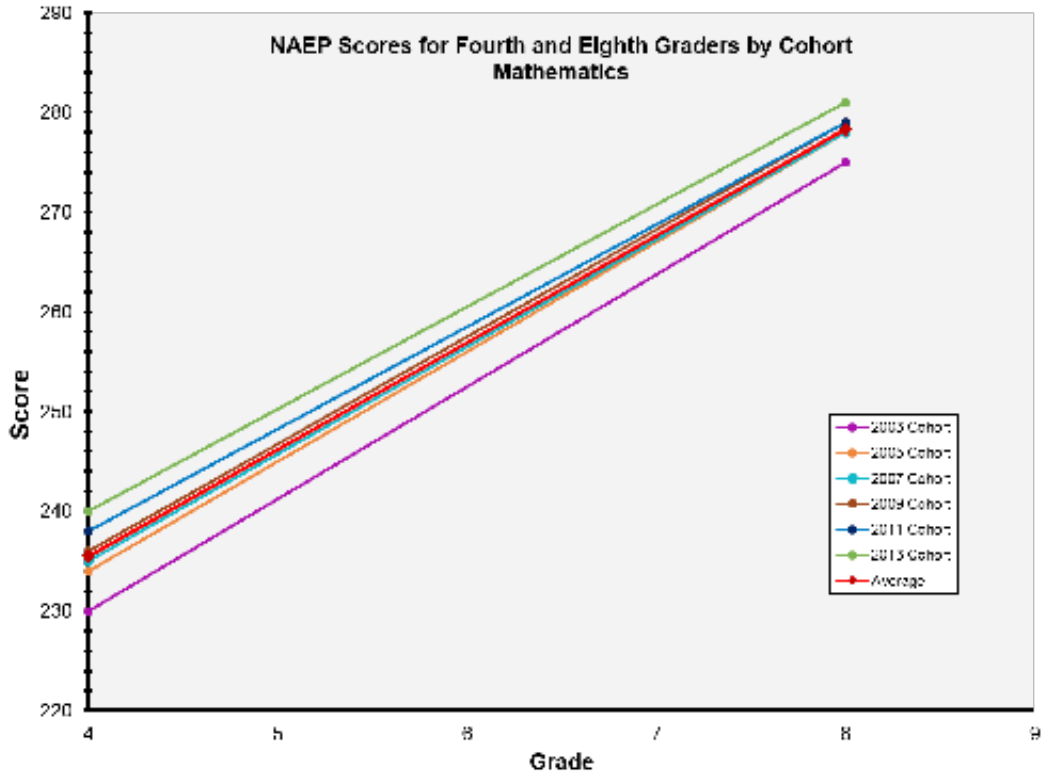
Educators across Georgia have come back into their buildings to welcome students for another year of learning. As business and industry partners engage with these educators and their students, they may benefit from knowing the outcomes of Georgia's public schools.

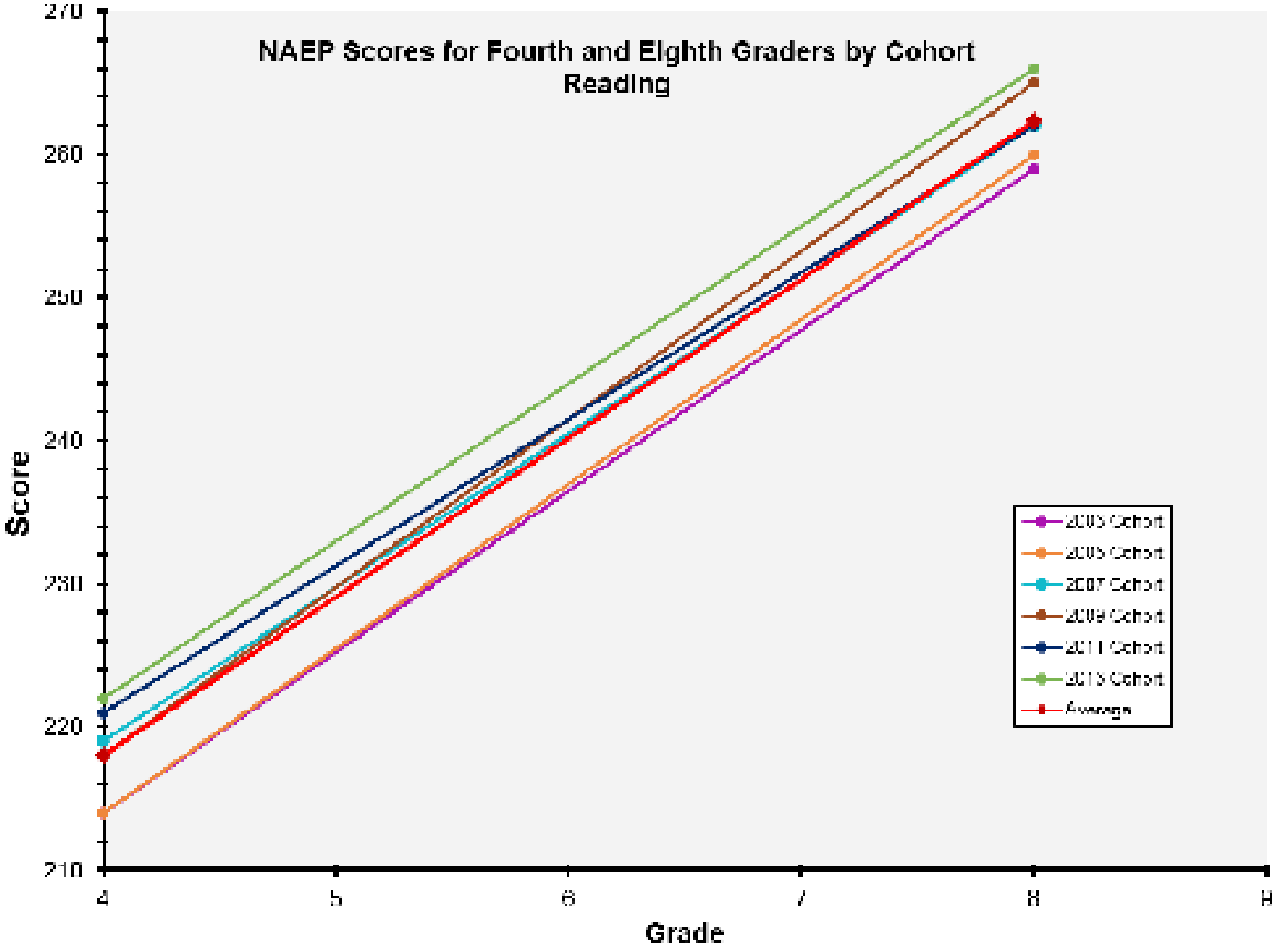
Georgia is viewed as one of the fastest growing states in terms of educational performance, according to the National Assessment of Education Progress (NAEP). A 2017 study by the Urban Institute shows Georgia ranked as 13th in education progress. The NAEP is a national assessment conducted every other year on a sample of students.

The NAEP is given to fourth and eighth graders (in other words, it is not administered in other grades between K-8).

We can look at these cohorts of students who begin in fourth grade and move into eighth grade to see how well the system is serving students over time. The graphic below shows cohorts starting in 2003 through 2017.

The 2003 cohort was in fourth grade in 2003 and in eighth grade in 2007. Likewise, the 2013 cohort was in fourth grade in 2013 and in eighth grade in 2017. This is what Georgia's growth looks like across cohorts for math and reading on the NAEP:





When analyzing these graphics, it's important to note a few observations:

- Fourth graders are performing better with each cohort

- Eighth graders are preforming better with each cohort

- The slope represents growth over time. We want to make that slope steeper. We need to get better faster.

These graphs show only math and reading. These are important indicators for the "health" of the system, but they are not representative of the whole system.

So what is the Georgia Department of Education doing to get better faster? We are focusing on the whole child, ensuring that every child comes prepared for learning, every school creates the conditions for learning, and every student and teacher has what they need to reach their full potential.

With the leadership of State School Superintendent Richard Woods, we are using the Continuous Improvement strategy to get better faster. In the next issue, I will elaborate on where we're going.

"Children struggle to hold pencils due to too much tech", doctors say.

By Barbie Clarke

"Children need opportunities to develop hand strength and dexterity needed to hold pencils".

Children are increasingly finding it hard to hold pens and pencils because of an excessive use of technology, senior pediatric doctors have warned.
An overuse of touchscreen phones and tablets is preventing children's finger muscles from developing sufficiently to enable them to hold a pencil correctly, they say.

"Children are not coming into school with the hand strength and dexterity they had 10 years ago," said Sally Payne, the head pediatric occupational therapist at the Heart of England foundation NHS Trust. "Children coming into school are being given a pencil but are increasingly not be able to hold it because they don't have the fundamental movement skills.

"To be able to grip a pencil and move it, you need strong control of the fine muscles in your fingers,. Children need lots of opportunity to develop those skills."

Payne said the nature of play had changed. "It's easier to give a child an iPad than encouraging them to do muscle-building play such as building blocks, cutting and sticking, or pulling toys and ropes. Because of this, they're not developing the underlying foundation skills they need to grip and hold a pencil."

Six-year-old Patrick has been having weekly sessions with an occupational therapist for six months to help him develop the necessary strength in his index finger to hold a pencil in the correct, tripod grip.

His mother, Laura, blames herself: "In retrospect, I see that I gave Patrick technology to play with, to the virtual exclusion of the more traditional toys. When he got to school, they contacted me with their concerns: he was gripping his pencil like cavemen held sticks. He just couldn't hold it in any other way and so couldn't learn to write because he couldn't move the pencil with any accuracy.

"The therapy sessions are helping a lot and I'm really strict now at home with his access to technology," she said. "I think the school caught the problem early enough for no lasting damage to have been done."

Mellissa Prunty, a pediatric occupational therapist who specializes in handwriting

difficulties in children, is concerned that increasing numbers of children may be developing handwriting late because of an overuse of technology.

"One problem is that handwriting is very individual in how it develops in each child," said Prunty, the vice-chair of the National Handwriting Association who runs a research clinic at Brunel University London investigating key skills in childhood, including handwriting.

"Without research, the risk is that we make too many assumptions about why a child isn't able to write at the expected age and don't intervene when there is a technology-related cause," she said.
But Barbie Clarke, a child psychotherapist and founder of the Family Kids and Youth research agency, said even nursery schools were acutely aware of the problem that she said stemmed from excessive use of technology at home.

"We go into a lot of schools and have never gone into one, even one which has embraced teaching through technology, which isn't using pens alongside the tablets and iPads," she said. "Even the nurseries we go into which use technology recognize it should not all be about that."

Although the early years curriculum has handwriting targets for every year, different primary schools focus on handwriting in different ways – with some using tablets alongside pencils, Clarke said.
Karin Bishop, "It is undeniable that technology has changed the world where our children are growing up," she said. "Whilst there are many positive aspects to the use of technology, there is growing evidence on the impact of more sedentary lifestyles and increasing virtual social interaction, as children spend more time indoors online and less time physically participating in active occupations." she said.

Why STEM

Education Needs Mixed Reality Technologies

by *Clemens* Braakmann

"*A*sk: What do you want now?

Free yourself from thinking about the limitations of the technology and let your imagination take you to what things do you want to have done, what problems do you want to solve". Quotes like this one, made by Andra Keay of Silicon Valley Robotics, put the fascination that lies behind engineering and STEM in incredibly simple words. Solving the problems of today and tomorrow is a crucial part of what children should be enabled to do, however this is only a fraction of the overall importance of STEM education today.

According to the World Economic Forum, 65% of all current primary students are set to work in jobs that do not even exist yet, while the European Commission forecasts an 'eSkills gap' of 500.000 ICT professionals missing by 2020.

All different, but most often struggling

But where are we, on our mission to revive the quite traditional subjects that make up STEM, like mathematics, physics, IT and more? Around the world, STEM policies are being implemented by governments, but each of them faces their individual problems. In all of Europe, a lack of leadership and the required 'digital mindset' on all levels is often claimed to be one key barrier, while individual countries like Germany miss the required infrastructure for effective learning of digital STEM skills in school. Others face a shortage of teachers in the STEM area, which is reinforced by the fact that one third of European teachers are over 50 years old and the subsequent generation effect.

Here in the U.S., where STEM and digital skills are emerging as a key focus of many school districts and the relevant leadership are easier to be found, other problems stand in the way. The two most significant?

The first is inflexible planning. Many times before, standardized schedules, tests and a mass processing of students in a one-fits-all approach have been linked to the skill gaps we are currently facing. Still, standardized testing preparation and state curricula take up all the time available to teachers and allow for no flexible teaching time, which would often be needed to identify individual student's talents and encourage them to utilize them in STEM.

The second problem then, as you would expect, is money. Tackling problems like the eSkills gap is costly, and more so is building the expensive IT infrastructure that many see as a key requirement. Although the importance of STEM has been realized around the US, the average public school teacher still pays $3,500 out of their own pocket for class supplies due to a lack of funding, accounting for more than 6% of their average yearly gross salary.

And the students?

A lot has happened in recent years around STEM, and although it is often being described as a new approach to educating our students for the future, the aforementioned are some of the problems STEM still faces on the educator's side.

But then, there is the students' side as well. The truth is, students usually care very little about the name of the curriculum, they care about their classrooms and the lessons they receive, and it has even been found that STEM appears overly abstract to the youth.

Part of the forecasted eSkills gap is the high anticipated demand for creativity, critical thinking and complex problem solving. Current student generations lack these skills, and acquiring them demands for the secure environment in which students can start experimenting and finding their own way to solve a task at a very young age. Obviously, this experimenting is at the heart of all scientific progress and is therefore closely linked to STEM learning.

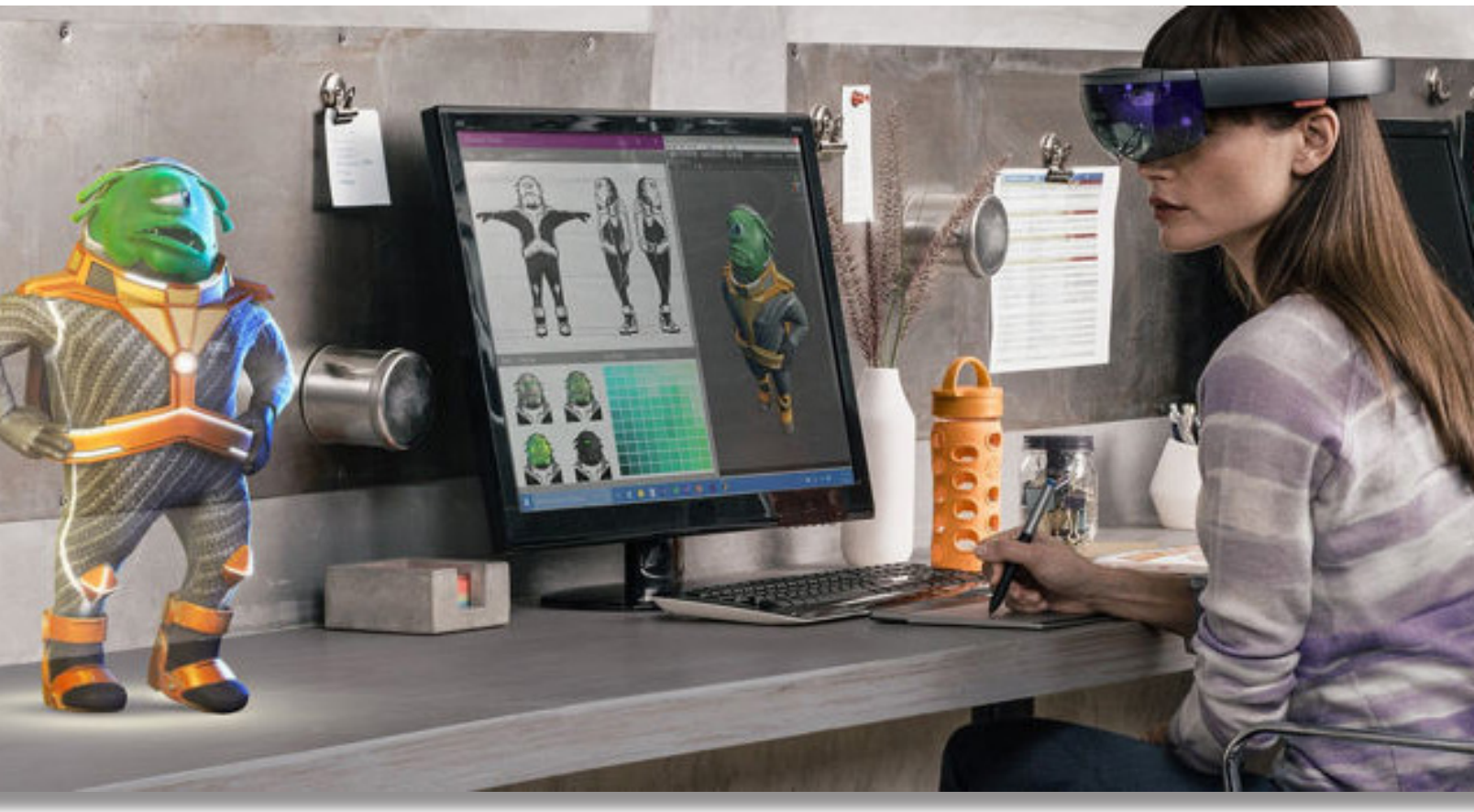
This is the point at which teaching methods need to be revised. Every day, students are surrounded by a digital environment that is much more digitized and content-rich than their classroom. School becomes more and more of an unpleasant duty that cannot keep up with the wonders of the Internet

and modern technology. Moreover, school education is growing increasingly complex and data-rich, and this complexity is then paired with old-fashioned teaching methods that are neither interactive, nor well-visualized, nor colourful or fun.

Kids are less interested in analogue teaching methods any longer, and looking at the digital skills that we want to them acquire, teaching them according to often traditional teaching methods is a waste of time, money and potential.

Mixed Reality Technologies:
Data-augmented approaches to real life

But after establishing so many problems and hurdles, what could be used to change it? Clearly, the solution would have to be cost-effective and easy to implement, somewhat curriculum-based so it can supplement standardized prep to make it more efficient, it should not require extensive training or high-level approval and it should be modern, visual and exciting enough to match modern learning demands.



The answer lies in mixed reality technologies, which is an umbrella term for immersive technologies that combine real-life scenarios with digital data. The two most commonly known examples are Virtual Reality and Augmented Reality. While VR can take the viewer to a completely other scenario by creating a virtual environment inside a VR headset, it also often requires large investments in hardware. Especially when looking at the average public school class size in the US of 22 for elementary and 27 for secondary, it becomes clear that we cannot be looking at the solution here.

It is AR that, although often forgotten beside VR, is the proverbial ace up the educator's sleeve. AR, as the name says, "augments" a real-life scenario by adding digital information to the camera perspective of a device. In practice, this means that the world can be explored, while the viewer is being educated about what he or she is seeing. Because it is more software- than hardware-based and does not require additional equipment like headsets, it is perfectly suitable to be used on mobile devices that run Android or iOS and can often be availed of "for free" in Bring-Your-Own-Device (BYOD) programs.

This way, children are being educated using the main tool they tend to interact with all day, creating academically relevant screen time on the one hand, and substantial savings for teachers and education authorities on the other.

Taking a closer look at the funding problems of the US, one major opportunity presents itself in the recently implemented 'Title IV – 21st century schools' of the federal Every Student Succeeds Act (ESSA), which demands for well-rounded educational experience and enables local education authorities to fund programs that their schools need in order to fulfill the standards of the act.

These include STEM Learning, accelerated learning courses and vocational learning, but more importantly, blended learning, the integration of technology in curricula, staff training and last but not least, digital educational content. Within the conditions of these federal grants, the opportunities for plug-and-play AR solutions are countless and when integrating these zero-training technology approaches, schools can make huge leaps in their level of technology integration while spending very little of their funding. Actually, Article IV even limits the allowed spending on IT infrastructure to 15%, leaving enough 'compulsory room' to get educators to invest in academically relevant content and training.

With curriculum-based AR solutions, class time can also be used more effectively. In previous studies, AR has been found to increase knowledge retention by up to 100%, while test scores can be improved by 33% and all learning styles are supported. In effect, this means that, using the same time frame and the same curriculum, but a different tool, students can do their test prep in a way that is way more effective and supports individual preferences and learning styles as opposed to mass processing.

Lastly, AR is exciting. AR can be truly explored, and through the data augmentation creates the linkages between data and real life that are required to truly understand STEM concepts. AR visualizes in 3D what has been taught in books and on blackboards before and gives every student the chance to interact with the subject in their own way.

This way, curiosity is supported, as are abstract thinking and creativity and not to forget, digital skills.

Art in

Engineering

by *Wayne Carley*

A piano sound is unique, not quite like any other instrument and you may wonder how it generates a sounds.

A piano is not a single type of instrument, but two different kinds of instrument in one: it's a string instrument, because the sounds are made with strings, but it's also a percussion instrument (like a drum) because the strings make sounds when piano parts strike them. Listen to the music of a composer like Varèse and you may hear the piano being played percussively— almost like beating a drum.

What actually happens when you press a key of a piano? The key is actually a wooden lever, a bit like a seesaw but much longer at one end than at the other. When you press down on a key, the opposite end of the lever (hidden inside the case) jumps up in the air, forcing a small felt-covered hammer to press against the piano strings, making a musical note.

At the same time, at the far end of the lever behind the hammer, another mechanical part called a damper is also forced up into the air. When you release the key, the hammer and the damper fall back down again. The damper sits on top of the string, stops it vibrating, and brings the note rapidly to an end.

There are many other parts in a piano design to make notes sound louder or last longer. The strings of a piano stretch out horizontally away from the pianist sitting at the keyboard, just as though a piano were a guitar laid flat on its back.

When you pluck a string, it vibrates, sets air molecules in motion and sends the sounds of the strings out toward your ears. To make the sounds louder, there is a large piece of wood mounted underneath them, called the soundboard (or sounding board). When the strings vibrate, the soundboard also

vibrates in sympathy (resonance), just as a wine glass vibrates when a soprano sings a high note nearby.

The soundboard effectively amplifies the strings so they are loud enough to hear. The lid helps the audience too: sound from the strings and the soundboard travels straight up, hits the lid, and reflects out toward the audience.

How do the pedals change the sound?

While the 88 keys on a piano control the musical notes that the pianist can make, the three pedals determine how loud or soft these notes are and how long they last. The pedal on the left is called the soft pedal. Most of the keys on the keyboard hit two or three strings simultaneously when you press them, so you get a richer and louder note.

However, if you press the soft pedal down, the hammers that play the notes shift slightly to one side so they contact fewer strings—making a quieter note. The middle pedal is called the sostenuto pedal: when you press it down, it temporarily deactivates the dampers for the notes that you're playing at the time, and makes them last quite a bit longer.

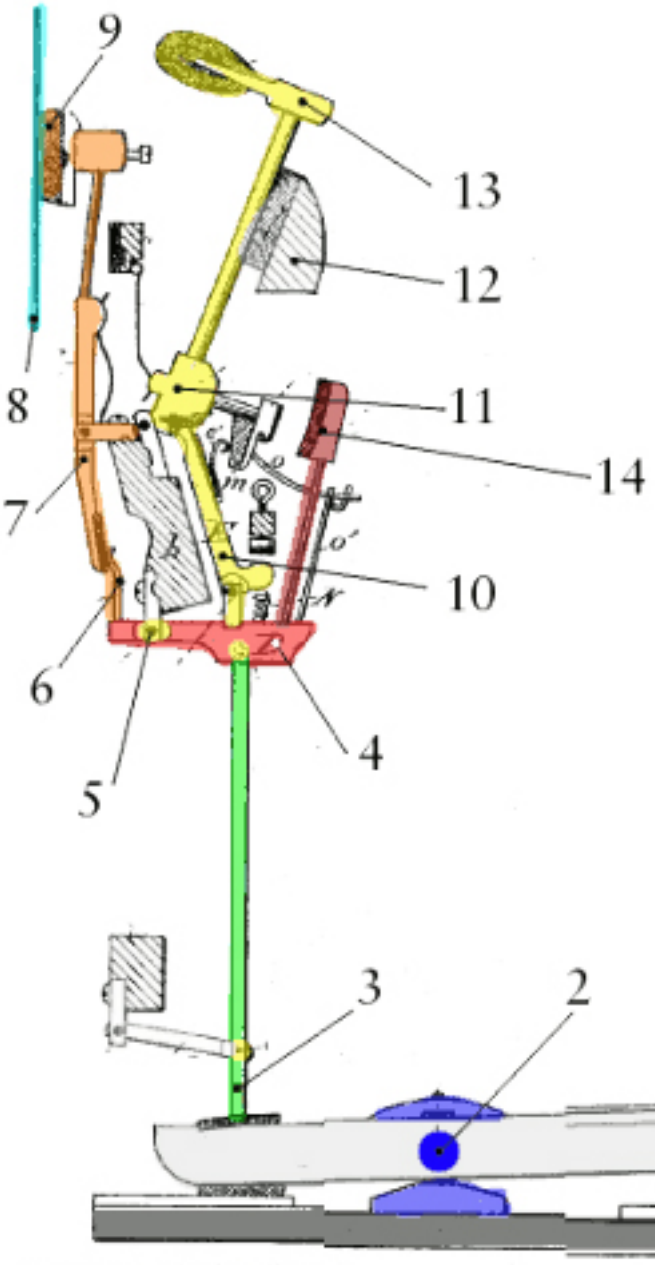
The pedal on the right is called the sustaining pedal. Pressing it down raises all the dampers up in the air so all the notes last longer.

Regarding traditional piano shapes - consider this. Pianos are string instruments. Lower notes need longer strings than higher notes, so the bass strings for the low notes on the left-hand side of the keyboard need to be much longer than the treble strings for the high notes on the right-hand side.

That's why the case or body of the piano is longer on the left than on the right and why it has that unique curved rim. The strings on the left are so long that they cross over, on top of the middle and treble strings to save space. Since each note can have up to three strings, it turns out that there are well over 200 strings inside a piano—each one stretched very tight.

To stop the strings from collapsing the entire piano inwards, the rim and case are reinforced by a heavy cast-iron plate. The plate sits just above the sound board and large metal holes around its edge (known as rosettes or portholes) allow the sound to come up through it.

In an upright piano, things are slightly different. The strings run vertically at the back of the case and the hammers strike them by moving horizontally. It's like a grand piano standing on its end—literally upright.



1. Key (gray).
2. Key pivots about center point (blue).
3. Rod (green, also called the extension) leading up from the back end of the key to the damper and hammer.
4. Rocker (red) to which the hammer and damper are attached.
5. Rocker pivots about this point.
6. Spoon or tongue runs up from rocker to damper.
7. Damper lever (orange).
8. String (turquoise) mounted vertically in this upright piano.
9. Damper (orange).
10. Jack (yellow) operates hammer and damper.
11. Hammer knuckle (yellow).
12. Hammer rest (gray) supports hammer after string has been hit.
13. Hammer (yellow) strikes string.
14. Back check.

STEM CAREERS *Remain Misunderstood*

According to Georgia Colleges and Universities, these are some of their STEM Degrees currently offered.

Not a day goes by that I don't have a conversation with an educator, administrator, student or parent who questions just what a STEM career is. Media attention continues to focus of the obvious; aerospace, scientist, engineer (vague), or math person of some kind.

STEM Magazine continues to strive to clarify the broad scope and varying depths of STEM careers and the skills necessary to perform those.

As you glance over this short list, you'll see surprising and important roles not usually associated with the general perception of STEM careers...but non the less, these are STEM careers requiring STEM skills.

Keep in mind this is only one state, but surely represents our nation's needs. There are of course many more STEM careers of various education levels that currently may not have a Bachelors Degree available, but are still considered STEM Careers.

"Don't ask me, ask the Universities and Corporations that will hire our students".

I know this is a long list, so I've taken to opportunity to arrange them in an unconventional order to get your attention and continue our pursuit of better understand a "real" STEM career.

According to a variety of Georgia Colleges and Universities, these are their offerings for STEM degrees.

Archivists
Preserve documents and records that are historically significant.

Cartographers and Photogrammetrists
Collect, analyze, and interpret geographic information to study and prepare maps.

Geography Teachers
Teach college-level courses in geography.

History Teachers
Teach college-level courses in human history.

Political Science Teachers
Teach courses in political science.

College Vocational Education Teachers
Teach vocational or occupational subjects at the college level.

Cost Estimators
Prepare cost estimates for a variety of projects.

Curators
Oversee collections, such as artwork, collectibles, and historic items.

Dietetic Technicians
Help to provide food service and nutritional programs, under the supervision of a dietitian.

Dietitians and Nutritionists
Advise people on what to eat in order to lead a healthy lifestyle or reach a specific health goal.

Economists
Study monetary, fiscal, and other economic issues and problems.

Epidemiologists
Investigate the causes of health problems in communities or societies.

Geographers
Study the earth and its land, features, and inhabitants.

Historians
Research and understand the past by studying a variety of historical documents and sources.

Hydrologists
Study water that is underground or at the surface of the earth.

Market Research Analysts
Gather information to determine how much demand there is for a product or service in an area.

Non-Destructive Testing Specialists
Test the safety of various types of structures using x-ray, ultrasound, or fiber optic equipment.

Sociologist is a STEM career

Study the behavior of people in groups. The science (systematic accumulation of knowledge) of collecting group data.

Park Naturalists
Plan and conduct programs to educate the public about national, state, or local parks.

Quality Control Analysts
Conduct tests to study the quality of raw materials or finished products.

Sociologists
Study the behavior of people in groups.

Statisticians (our greatest current need)
Create usable information out of numbers and data.

Survey Researchers
Develop or conduct telephone, mail, or Internet surveys.

Technical Writers
Explain technical information through charts and manuals.

There are so many more career opportunities that require STEM skills for both women and men. Just when you thought you knew STEM....

Online Learning Brings Oceans and Marine Biology to Landlocked Classrooms

By Catherine E. Christopher
Curriculum developer and outreach director, Ocean First Education

There's no debate about it—the ocean is a place of wonder and mystery and many Georgia students may never actually see the ocean.

As the world comes to grips with climate change, it's more important than ever that students study ocean science and marine biology to understand the role of the ocean in the planet's health.

But how do you make that experience vivid and visceral if your school is surrounded by cornfields? Or mountains? Or if the closest ocean is hundreds of miles away?

When introducing marine science concepts, start big by introducing the concept of the ocean and all the ways it can be experienced. For instance, students are often introduced to terrestrial ecosystems; the flora and fauna, predator and prey relationships, and the abiotic components that make them unique.

Do the same, only through the lens of the ocean. Explain how it supports life on earth. Then consider tackling the topics that may be of greatest interest to students. Certainly, sharks is one of the first species that comes to mind.

High-definition (and 360 degree) video coupled with next-generation online curriculum can bring sharks splashing around in your classroom. Take that curiosity of sharks to the next level, introduce the marine ecosystem. The ocean is a vast space, filled with many dynamic ecosystems from rocky beaches to deep sea hydrothermal vents.

If your students are interested in sharks, specifically, imagine replacing wolves, the go to terrestrial apex predator, with these ancient marine predators to explain the importance of predators in maintaining a healthy, balanced ecosystem. This can then lead to conversations about education and conservation of an entire group of fish.

For instance, check out this 360 degree video.
Click on arrows, upper left, to change your view and explore the ocean.

After students interact with the video for a few minutes, ask them a series of questions, such as:

- ***Did you see the reptile (sea snake)?***
- ***Describe the shape and color of the fish you observed.***
- ***What were the predominate colors you observed?***

Then have students return to the video to find the answers to those questions. This level of engagement gives students the opportunity to experience a new world on their terms - they are no longer limited by the perspective of the videographer.

This immersive opportunity is engaging, motivating students to want to know more as they go back and watch again and again. Additionally, because students can change their view, the video doesn't get old and can be used throughout the lesson to hone their observation skills and give them the opportunity to apply what they have learned. With this ***one minute long*** video students can identify biotic and abiotic components of a coral reef ecosystem, identify various taxonomic groups and species, as well as observe the properties of light in the ocean.

Joe LaMagna, a biology teacher at New Covenant School in Lynchburg, Virginia didn't let distance from the ocean hinder his desire to expose students to marine science. LaMagna led his class through studies about the impact of sunscreen use in the ocean, the ocean's role in photosynthesis, and coral bleaching caused by warming ocean waters.

All of the studies were enhanced by using online curriculum and high-definition video streamed from the web.

"What we are trying to do is understand the importance of the ocean, even though we live 180 miles away. We needed to learn that everything we are doing with soil and even simple things like how we change our car's motor oil, and deal with the waste, have a direct impact on the ocean's health," said LaMagna.

Teachers can seek online marine science courses that offer access to interviews with leading-edge scientists and up-to-date research. Some courses offer supplemental videos, webinars and imagery that help students better grasp new concepts and keep them engaged throughout the learning process, such as the 360 degree video example above. Online courses that follow Next Generation Science Standards (NGSS) will require students to actively participate through scientific inquiry using critical thinking skills, data analysis and explanation construction based on their observations.

For example, students can investigate the temperature and salinity of the world's ocean using real-time data collected by over 3,900 autonomous buoys. The Argo Buoy Project, out of the University of California, San Diego,

is part of the Global Climate Observing System/Global Ocean Observing System and the data collected is free for anyone to use. The buoys float along the surface of the ocean, then every 10 days drop to 2,000 meters. As they ascend back to the surface, the buoys collect and transmit data regarding temperature, salinity and some of the newer ones provide pH levels. Students can compare and contrast the temperature and salinity of the ocean at depth as well as across the globe using real-time data.

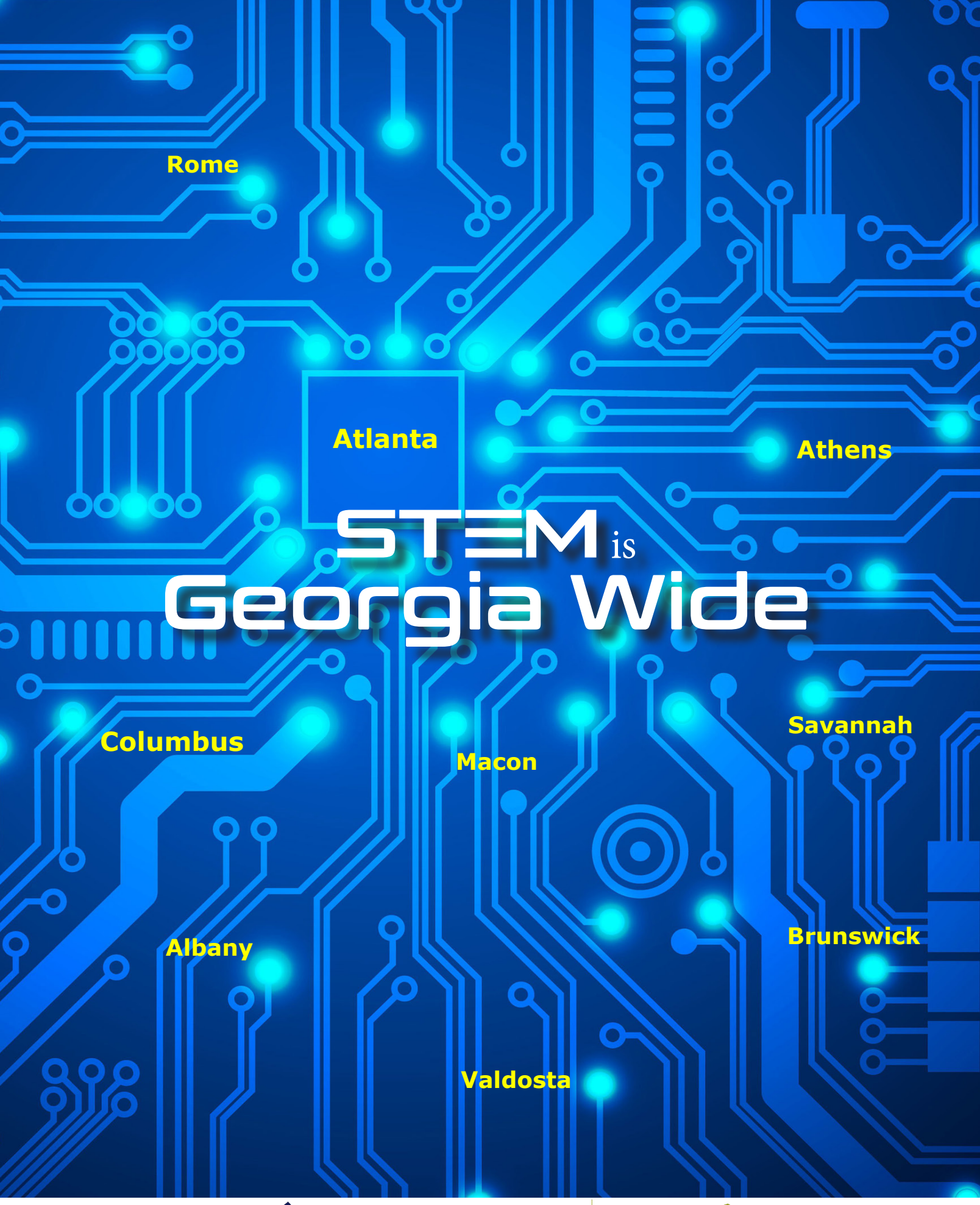
Cyndi Long, an instructional coach in the Greater Atlanta area, says science teachers who are considering the use of online coursework should start by finding out what students know.

"Show a video or photo that captures the mysteries of the ocean or the physical movement and power of the sea," says Long, who is planning to bring online marine biology curriculum to her landlocked school district soon. The district has already used some courses for credit recovery at the high school level.

"Then ask students questions such as, 'What do you notice? Where do you think this is? What is living and non-living?' Based on the concepts students are learning in your class, guide the discussion to find out what knowledge and experiences they already have and what misconceptions are present."

By pulling in a variety of next generation learning tools, from 360 degree videos, webinars, Twitter chats with marine scientists, and online course materials, teachers can bring the ocean to life in the classroom in engaging and memorable ways.

As curriculum developer and outreach director for Ocean First Education, Catherine Christopher is responsible for developing engaging course content and designing online interactives for middle school through adult learners.



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