

Oct. 2018

# GEORGIA PATHWAYS

M A G A Z I N E

Women in STEM

Georgia  
Corp of Engineers

Challenging Yourself

OutTeach  
*Empowering*

Mercer Engineering

Photo of Cumberland Island Georgia / ROBERT WOJTOWICZ



How can **TEALS** help your school build and grow its **computer science (CS)** program?



#### Professional Development

from trained technology professionals on a volunteer basis who are partnered with teachers to provide instruction and support.



#### Curricula and Resources

developed by experienced educators and computer science professionals, designed specifically for high school teachers and students.



#### A Clear Pathway for Students

to learn computational thinking, problem solving, programming, and computer science concepts that are applicable in whatever field they enter.



#### A Community for Teachers

to build their CS teaching capacity through ongoing training, instructional resources, and a network of support.

**Learn more about the TEALS support model, curricula resources, and apply to be a partner school at: [tealsk12.org/schools/](https://tealsk12.org/schools/)**

**50%**

of participating students are more likely to pursue a **computer science career** because of TEALS

**Helped 475**

high schools build and grow their CS programs since 2009 with more than

**2,300**

individual volunteers!

**37,500**

students have learned CS in TEALS classes since **2009**

**Microsoft Philanthropies TEALS**

Computer science in every high school  
[tealsk12.org](https://tealsk12.org)



We are please to present another edition of Georgia Pathways™ STEM Magazine!

In early November, the U.S. Department of Education announced it had fulfilled its directive to invest \$200 million in STEM education. In total, the Department earmarked \$279 million for STEM discretionary grant funds for fiscal year 2018.

The investment includes funding for education, innovation and research; supporting effective educator development; pathways to apprenticeships for high school career and technical education students, innovative approaches to literacy and more.

This is a landmark step for STEM education across our country, and in Georgia. The Department also acknowledged that there is more work to be done. There are still “leaks” in the STEM education pipeline, the Department acknowledged in a media release.

For example, 80 percent of eighth graders attend a school that offers Algebra I, but only 24 percent of these students are actually enrolled in the course. Likewise, access to algebra in eighth grade is inconsistent across the country, as is access to STEM education.



Across Georgia, educators, parents, administrators and educational leaders are working hard to make sure STEM is well promoted, well funded and accessible.

Part of the mission of this publication is to make sure that information, tips, inspiring stories and great examples of STEM programming, activities and leadership are promoted and celebrated.

Inside this latest issue, you can great information about STEM education programs, data and easy projects that you can use. We hope you will share these with others as well, as we all work to increase access to STEM education opportunities.

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.

PRESIDENT/CEO  
Larry K. Williams

PUBLISHER  
Wayne Carley

EXECUTIVE DIRECTOR/EDITOR  
Errika Moore

CONTRIBUTORS  
Mary Kay Boler, TAG-Ed Staff  
Shanice Saunders, TAG-Ed Staff  
Dr. Reginald Turner, TAG-Ed Staff

The Technology Association of Georgia (TAG) and  
TAG Education Collaborative  
75 5th Street, Suite 625 Atlanta, GA 30308

<http://www.tagedonline.org>

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



## Women in STEM

*Errika* Moore

## OutTeach

*Suzannah* Koilpillai

## Challenging

*Brenda* Skoczelas

## Female Nobility

*Maya* Chande

## Women in Engineering

Dr. *Melinda* Hollingshed /  
Mercer University

## Good Times in Ga. Schools

Dr. *Caittin* McMunn Dooley

## STEM / Corp of Engineers

*JoAnne* Castagna, Ed.D.

## From the Executive Director

In this season of Thanksgiving, please allow me to say “Thank You” to all of you. Because EVERY day you touch the lives of students and encourage them to imagine “what’s possible.” Because every day you shift paradigms and you change trajectories. And with each class or with each program you represent the intersection of hope and reality!

I also want to say “Thank You”...because I don’t know how often you have the opportunity to hear that. So many times, teaching, educating and encouraging can be a thankless job. You’re investing in the lives of students without actually knowing what the return on your investment will be. But every day you make that altruistic commitment with the belief that you’re creating your “dent in the universe.” If your students did say thank you, they might say something like this:

*“A wonderful teacher, understood me so well,  
Helped me up, whenever I fell.  
Even when I made a big mistake,  
You said we learn, the more we make.*

*Your smile has always been very kind,  
You challenged me to expand my mind.  
Obstacles I faced, in me you believe,  
You always told me, I could achieve.*

*When I needed help, you took the time,  
You never gave up, no matter the climb.  
Thank you so much, for showing me the way,  
I simply don’t know, how I could repay.”*

*By Martin Dejnicky*



So I thank you for impacting the lives of our Georgia students without the expectation of a payback, a dividend or anything beyond the hope that they’ll go make the world a better place!

In fact, this issue features an article of someone who is also the epitome of selflessness. She’s someone who simply wants to share what she’s earned, what she’s developed and/or what she’s garnered over time by paying it forward. She’s decided to pay homage to her personal pathway by creating a better pathway for others. She’s someone who could have allowed her challenges and then her success to be hers alone. But instead she decided to invest a future that will allow success to happen for others instead.

Again, in this season of thanksgiving, because people like you and Dorren Schmitt exist...I say THANK YOU!

Sincerely,



Executive Director

TAG Education Collaborative





# WOMEN IN STEM CONFERENCE

WYNDHAM RESORT, AN OFFICIAL WALT DISNEY WORLD RESORT

FEBRUARY 13-15, 2019

*"Inspiring educators and mentors for the next generation of women and underrepresented populations"*



## Why should I attend?

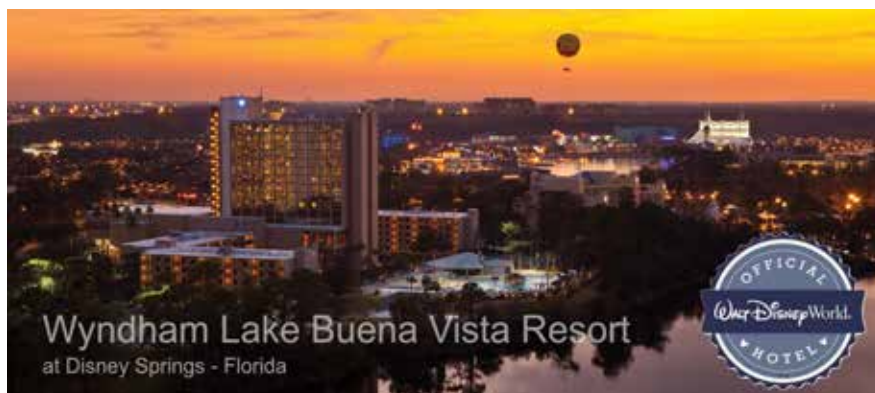
- To grow STEM leadership and build a STEM culture across their communities
- To empower STEM educators
- To integrate STEM across a diverse and underrepresented populations
- To learn real world application-based, STEM integration experiences

## Who should attend?

- K-16 STEM Educators
- School and District Administrators
- Guidance Counselors
- Community Partners
- Post-Secondary Administrators
- Title I Schools

For more information, please contact Steve Wolfe at [swolfe@neponline.org](mailto:swolfe@neponline.org)

Or visit us online at [www.neponline.org](http://www.neponline.org)



# Women in STEM

by Errika Moore



Dorren Schmitt

*H*ow do you say, “This is important to me”, in a way that people will always know that it’s important to you? Recently one of TAG Education Collaborative’s Board Members decided that ensuring a programming commitment to Girls in STEM in the future was an important statement to make through an unprecedented contribution to TAG-Ed.

Dorren Schmitt is the Director of Technology Engineering at the Weather Channel where she’s worked for 18 years. She is responsible for leading groups of technical professionals (Networking, Storage, and System and Database Engineers and Desktop Support) in a highly dynamic and a 24x7 on-air distributed environment, delivering outstanding service quality and end-user experience while supporting real-time business demands. Prior to working at the Weather Channel Dorren worked as a statistical consultant and as a professor at the University of New Orleans.



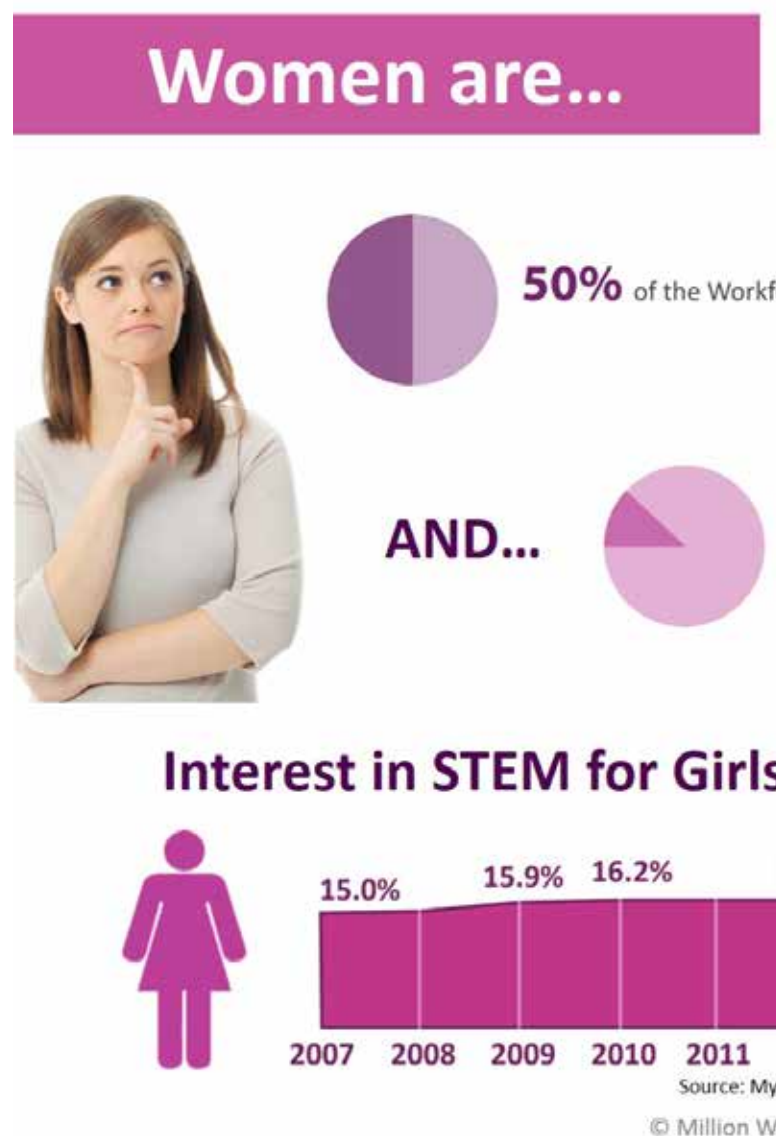
As someone who's lived most of her life as an anomaly (i.e., one of a handful of women getting her undergraduate and graduate degrees in mathematics and statistics – literally only 1 or 2 out of 40 in her graduate classes), she knows what it's like to strive despite the odds...or the "statistics." The women in her graduate school program developed their own support group since there weren't a lot of role models or organizations to yield support in the 80's.

Organizations like the American Association of Mathematics existed. But at the time, women only represented a small percentage. So as she continued to matriculate through her career, she developed an appreciation for ensuring that other young women could have the support needed to pursue their dreams, interests and opportunities in STEM.

Statistics from the national Department of Commerce, Department of Education and even the Million Women Mentors initiative all acknowledge that the percentage of women in STEM fields is still outpaced by men 3:1. And in fact, although women represent 50% of the workforce, currently they only represent 24% of the STEM workforce.

And My College Options recently shared in 2018 that the percentage of girls interested in STEM at high school

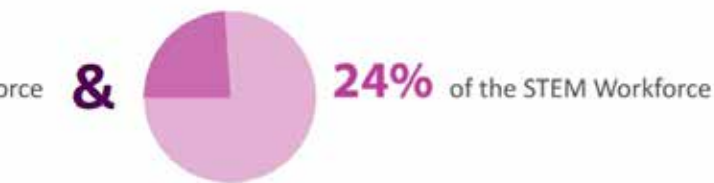
graduation is unfortunately declining. So Dorren has been committed to changing the narrative, making an impact and making a difference for young girls in STEM.



### ***Where Did Your Passion Come From?***

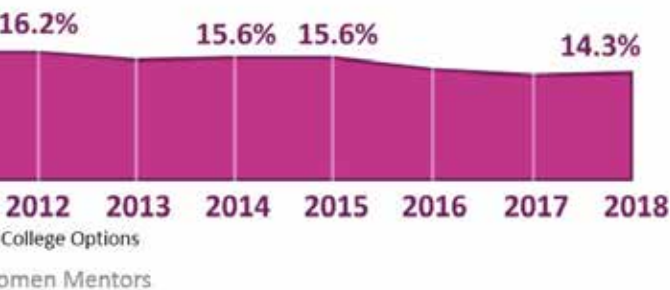
Her passion to make a difference began with her parents. Her parents supported her interests and allowed her to evolve into the STEM champion that she is today.





50% drop out in the first 10 years

## at Graduation is Declining



4

After beginning to read books at the age of 3 she developed multiple interests with chemistry sets, train sets, Legos and Lincoln logs and even eventually paleontology. And over time her interest evolved into areas such as spatial relationships, building things, problem solving and simply making things better.

For Dorren, these interests created a foundational affinity for mathematics and eventually statistics specifically. And fast forward to 2018, her deep understanding of data, data analytics and how all of this now translates into the Weather Channel's new Immersive Mixed Reality (IMR) presentation style are the things that make learning and her STEM experience...FUN!

She knows that women and girls (40% of our population) have a different view in problem solving. So she brings this view point to work every day. Dorren shared that "as we continue to build out technology, we need to ensure that the technology meets our [women] needs similar to everyone else; and if we incorporate the way women think about things it will help us to broaden how we address problems. "

Karsten Strauss shared in a Forbes article earlier this year that "A company with a more diverse representation in senior management achieving greater

profits is not breaking news.” And in essence diversity of thought continues to be the cornerstone of business success.

But he also shared that in fact, findings from a January 2018 McKinsey report “shows that gender diversity in management positions actually increases profitability more than what was assessed previously. In the firm’s previous analysis, companies in the top 25th percentile for gender diversity on their executive teams were 15% more likely to experience above-average profits.

The latest data shows that likelihood has grown to 21%.” Dorren believes that women have a greater tendency to analyze and evaluate before engaging in a problem, there’s greater synthesis in the beginning. And this type of analysis adds value to any team.

### ***Why Is Important to Invest Now? Why in TAG-Ed?***

“Investing in opportunities for girls and young women in STEM isn’t a new mindset for Dorren Schmitt. In her hometown of New Orleans, Louisiana, Dorren graduated from St. Joseph Academy. Although her high school closed, the sister academy in Baton Rouge is still open. At St. Joseph Academy Baton Rouge, an all-girl school, she created an endowment to support the ongoing sustainability of a STEM Lab.”

Joan Laplace, the Mission Advancement Associate Director St. Joseph Academy, shared “Dorren Schmitt’s accomplishments in mathematics, statistics and information technology make her an inspiration for the young women of St. Joseph’s Academy to witness the success she has achieved in what are traditionally seen in the U.S. as male-dominated fields.

Her forward-looking decision to establish an endowed fund to enhance the STEM lab at St. Joseph’s means the school will give students even greater opportunities in science, technology, engineering and mathematics long into the future.” And as she continues to lead... Dorren Schmitt graciously represents the first personal donor to TAG Education Collaborative to help ensure that TAG-Ed will forever have a commitment to girls in STEM.

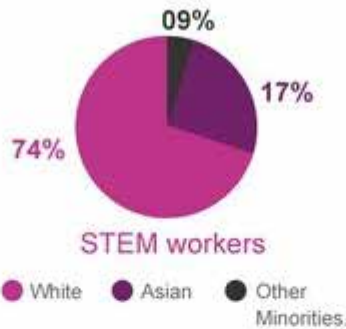
She could have decided to invest and will her commitment to many different organizations...but instead she selected organizations that are reflective of her personal passions and commitments to society. Dorren is passionate about supporting children, supporting the well-being of puppies and furthering and diversifying STEM Education. And she’s simply decided to make her commitments known sooner rather than later to hopefully inspire others. Many make these types of decisions much later in life. But Dorren hopes to



# STEM Facts on Women & Girls



74% of STEM workers are male.  
Only 26% are female.



STEM workers

● White ● Asian ● Other Minorities.

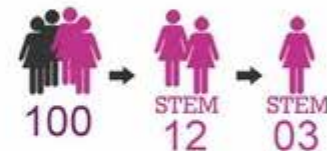


Women comprise more than 20% of engineering school graduates, yet only 11% of practicing engineers are women



Women were 28% of all workers in S&E occupations in 2010, up from 21% in 1993

Women's presence among computer/mathematical scientists declined from 31% to 25% over the period, but only because men's rate of growth in this area was higher than women's. The number of women working in computer/mathematical sciences has increased more than in any other broad occupational area.



Of 100 female bachelor students, 12 graduate with a STEM major but only 3 continue to work in STEM fields 10 years after graduation.



The wage gap between women and men is much smaller in STEM occupations than other occupations. In STEM fields, women earn \$0.92 for every \$1 earned by men, compared to \$0.77 for other fields.



Although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs.

Women with STEM jobs earned 33 percent more than comparable women in non-STEM jobs, considerably higher than the STEM premium for men. As a result, the gender wage gap is smaller in STEM jobs than in non-STEM jobs.

motivate others by serving as a leader in this partnership with TAG-Ed.

Her specific commitment to TAG-Ed comes from a lineage deeply entrenched as a servant leader in the Technology Association of Georgia (TAG). She's actively been a part of the TAG fellowship for over 10 years attending/supporting multiple events, supporting WIT (Women in Technology) Girls (in particular the Get IT Event

and serving on or leading multiple society boards like the Systems Engineering SIG and DevOps boards. Dennis Bruce, Chair of the TAG Transportation Technology Board stated, "Dorren's involvement in TAG, including the Societies she participates in and her charitable contributions to TAG causes are an indication of her passion and commitment to the Technology Sector in Georgia."

## ***How Would You Like to See This Commitment Make a Difference?***

Dorren would love for her commitment to help create an enriching experience for middle school girls through various TAG-Ed events, opportunities and experiences. Experiences that allow them to develop a rich imagination and appreciation for STEM. She recognizes that enabling them and empowering them to keep the kindle and passion for STEM, particularly when others may tell them that STEM isn't for them, is critical at that age.

And in fact, it would be ideal if these were not only events that engage middle school girls but actually encourages them to work together, to support each other and in essence enabling them to become like a cohort. A cohort where they watch each other grow, evolve and flourish in their STEM success and achievements.

And as a result, hopefully they won't feel like "an anomaly." TAG-Ed's Executive Director Errika Moore shared that "We are truly humbled, honored and appreciative of Dorren's gracious commitment to the future of STEM for young girls. As an Engineer for the past 20+ years, I've had multiple opportunities to share Dorren's experience as an anomaly. And as an organization TAG-Ed will absolutely uphold

her desire to ensure that young girls are not only exposed to what's available in STEM in the world around them...but that they know that they're A PART of that world."

## ***As a Leader, What's Your Message to Others?***

Dorren states that "As long as someone speaks your name, you're always alive. And you can always make a huge impact on a cause and/or an idea by establishing a lasting gift to your community, society or broader." For her, it's a belief that you can either watch or wait for something to happen. Or you can be the change that you want to see by making it happen yourself.



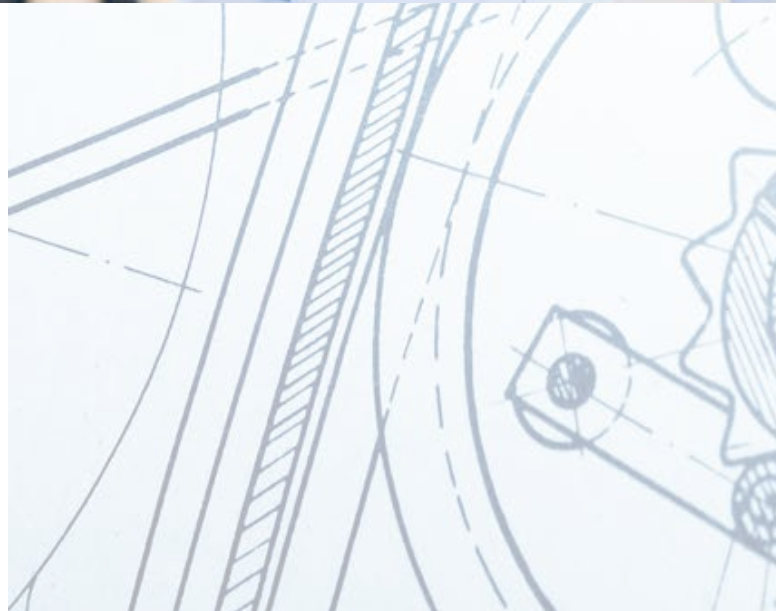


So her encouragement to others – “make a decision to invest your time, effort and/or resources in opportunities that can make a difference for others. Any contribution is important! Writing a check is the easiest thing that someone can do. But giving back our time to students and our world is something we’re supposed to do. It can start at home with your children and/or it can happen on a broader scale with your community.”



Formerly as a graduate student/professor she didn’t have a ton of money but she could still dedicate her time and her talent. She’s glad to now have others ways that she can give as well.

Dorren Schmitt is TRULY a SHERO who’s Making a Difference and Making An Impact!



# OutTeach

Empowers teachers and students to go outside expectations

by Suzannah Koilpillai

Southeast Regional Executive Director

Elijah struggled in school. Unable to focus, he'd make up any excuse to get up, move around, or distract another student. Then, Elijah's elementary school partnered with Out Teach and his teachers started incorporating outdoor lessons regularly into their instruction.

Suddenly Elijah's lessons were based in the real world and his behavior shifted. "You could see things starting to click," his teacher says. "Now when he's moving around, he's exploring. When he's talking to classmates, he's discussing the lesson. Someone said, 'He's a different kid out here,' but that's not it. It's a better way of learning- learning by doing." These days, Elijah loves discovering new things about the world; in fact, science is his favorite subject. His teacher beams when she talks about his progress.

"Now he's full of wonder and has the confidence to keep trying after a mistake. It's so rewarding to hear him sharing ideas instead of just looking for a laugh."



Teaching outside fundamentally changes learning. Not only does outdoor experiential learning inspire wonder in students, it truly unlocks their potential by adding relevance, purpose, and meaning to daily lessons. Where many students may struggle with concepts taught in a traditional classroom setting, moving those lessons outdoors turns them into real-world experiences. Suddenly the concepts make sense.

Outdoor experiential lessons incorporate critical STEM learning throughout the curriculum. Teachers suddenly understand how to weave lessons together, with science integrated into a literacy lesson, or reading integrated into a math lesson.



Most of us don't go to work everyday in reading or math. Engaging careers require us to utilize skills and knowledge across many subjects, integrating and interpreting complicated sets of information. So let's teach our students the same way, arming them with the skills they need for complex careers.

### ***Why aren't more educators teaching outdoors?***

Teachers traditionally are not trained in outdoor project-based learning best practices. Oftentimes they are uncomfortable taking 25 students into an outdoor environment. But student-led exploration not only fosters engagement, it develops critical 21st century skills like collaboration, creative thinking, and analysis, and ultimately increases achievement. It takes effective training, dynamic outdoor spaces, and ongoing support to empower teachers to conduct standards-aligned experiential lessons outdoors.

Many districts and schools have found the solution. Out Teach (out-teach.org) is a national education nonprofit that implements professional development programs and rich outdoor learning environments needed to unlock student performance in elementary schools. The Out Teach Professional Learning Program is a multifaceted partnership within each school, prov-

en to increase teacher effectiveness and job satisfaction and boost student achievement.



Through full staff trainings, one-on-one instructional coaching, and standards-aligned curricular support, Out Teach empowers teachers to become experts in outdoor experiential learning. And when teachers Out Teach, students outperform.

Out Teach has spent over a decade developing programming and learning environments that fit the academic goals and strategies of school districts. Out Teach works with school and corporate partners to turn under-utilized outdoor spaces into engaging experiential learning labs. Whether we add a few key instructional features or completely transform a space, we create rich learning environments that promote STEM instruction and learning across the curriculum.

Out Teach is proven to increase teacher effectiveness and job satisfaction. As teachers become more effective at using the outdoors as a tool, students become more adept at thinking critically, solving real-world problems, and making cross-curricular connections. When student engagement in the lesson increases, class time becomes more productive, creating a more satisfying work environment for teachers.

When teachers are more effective, and students are more engaged, student achievement increases. By reaching students at an early age and instilling a love for outdoor learning and STEM, they become life-long learners on a path to success to be college and career ready- and not just for today's great jobs. Out Teach students have the skills to create, develop, and achieve



the careers that don't even exist today. Join us as we empower teachers and students to go outside expectations.



**OutTeach**  
*Go Outside Expectations*





industry.

Beginning in outside sales, she moved from key account sales to sales management, and most recently was VP of Sales. In that role, she built and led a strong team that transformed the company from a local business to a national brand, serving the hospitality, landscape, and design industries.

Married to a life-long educator, Suzannah refocused her career with Out Teach to combine her background in leadership with her passion for helping children in high-need communities have access to a transformational education. She believes every child should have equal opportunity to unlock their potential and through Out Teach works to accomplish that mission.

Suzannah lives just outside of Atlanta with her husband and 2 young sons. She has a B.A. in English from Boston College.



Suzannah Koilpillai

Before she was tapped to lead the Out Teach expansion into the Southeast in Spring 2018, Suzannah Koilpillai spent 15 years in business development and leadership in the home and garden



# Out Teach Learning Lab Big Dig

November 7<sup>th</sup>, 2018 - Acworth, GA



**70 volunteers** put in a full day's work to install a new Out Teach Learning Lab!

Now, **650 students** will have access to outdoor learning every day, and **92 teachers and staff** will get the training they need to unlock student performance in the new lab.

## Acworth Elementary

thanks our partners from



and



**6,500**

square foot  
learning lab  
built



**21**

experiential learning tools  
were installed, including a  
weather station, earth science  
station and vegetable beds



**23**

tons of soil,  
mulch &  
sand moved



**95**

perennials,  
vegetables &  
trees planted



*"This space is not only for students that are here today, but for the students that come to our school in the future. On behalf of the teachers, staff and community of Acworth, we truly appreciate all that you are doing."*

-Bertha Nelson  
Principal

STEM Success is NOT just about “activities”.

STEM success is about-

*“Connecting the intellectual dots between curiosity and investigation in preparation for a career path.”*

That is why EVERY teacher in every subject is a STEM teacher.



Please make this is available to your students, their parents and interested friends.



# CHALLENGE

## Challenging Our Students by *Challenging Ourselves*

By Brenda Skoczelas

While completing my graduate degree in Physics, I had the opportunity to work as an Eli Lilly Research Assistant at Ball State University. I was tasked with the goal of developing a mathematical model for calculating the effect

However, before you decide to turn the page and give up on this article, let me tell you a bit about why I share this story, and this project, with my students.



of toroidal geometry on the measured magnetic field of a stimulated nerve. I imagine that your reaction to this project is about the same as my initial reaction—confused, scared, and ready to quit before I even got started.



I share this personal experience as a way to forge a connection and build a relationship with my students. Physics can be an intimidating subject. As a college professor, I know all of the answers to the homework and tests. I can, without hesitation, recite from memory a ridiculous number of equations on command.

On the other hand, as a student, I was always the last person to finish a test and never felt confident in my writing skills. Even today, I find it difficult to write this article. By revealing my vulnerabilities and insecurities, I allow the students to get to know me as a person. I want them to know that there was a time when I also felt overwhelmed by a subject and in over my head.

My research project in biomedical physics is an example to my students of how I overcame a challenge and an answer to the ever-present question of “When will I ever use this in real life?” The science concepts and ideas are those that an introductory physics student can understand and apply.

I hope that you, too, will share this real-life example of a cross-discipline collaboration that involves all aspects of S.T.E.M. with your own students and bring to life the laws of physics!

Having little to no background in the biomedical field, I had to start my research by taking two five-week courses of Physiology 1 and 2 over the summer. I immediately became fascinated with the human body and how it works. Our body is an elaborate circuit system made up of nerves that have the ability to carry information by means of electrical pulses, which are known as action potentials (APs). The AP is responsible for our movement and thinking.

Traditionally, electrodes have been used to measure the propagating action signals in nerves. This technique requires careful electrode placement and dissection of the nerve. It is very important to keep the portion of the nerve between the electrodes dry during stimulation to avoid electrocution, but you also have to be sure that it does not dry out to the point of cell death.

Magnetic field recordings may offer a better solution. For example, a less invasive technique is to use a toroid. A toroid is made of iron and shaped like a donut with several turns of insulated copper wire.



When I discuss this project with my students, I share my experience of “toroid torture,” where I had to wind each individual toroid by hand while looking through a microscope. There were several failed attempts and a very steep learning curve!

## Math

A typical introductory Physics 2 course will cover electricity and magnetism topics. Here is a beautiful example of connecting both to the human body. The same way that electric wires carry electric current, nerves transfer current in the form of action potentials. Students are taught that a magnetic field surrounds a long, straight, current-carrying wire. This same idea can be applied to a human nerve! As the action potential propagates along the nerve, the current will induce a magnetic field around the nerve, which will induce a current in the toroid according to Faraday’s law. The strength of the magnetic field is proportional to the current flow.

You can use Ohm’s law to determine

the internal and external currents of the nerve. The extracellular potential values will be used to determine the extracellular current values. Ohm’s law for the external current outside the nerve,  $I_e$ , is given by the equation -

$$I_e = dV / R,$$

where  $R$  is the extracellular resistance per unit length and  $dV$  is the change in external potential in microvolts. Ohm’s law can be used again to calculate the internal current,  $I_i$ , which flows in the opposite direction of the external current,

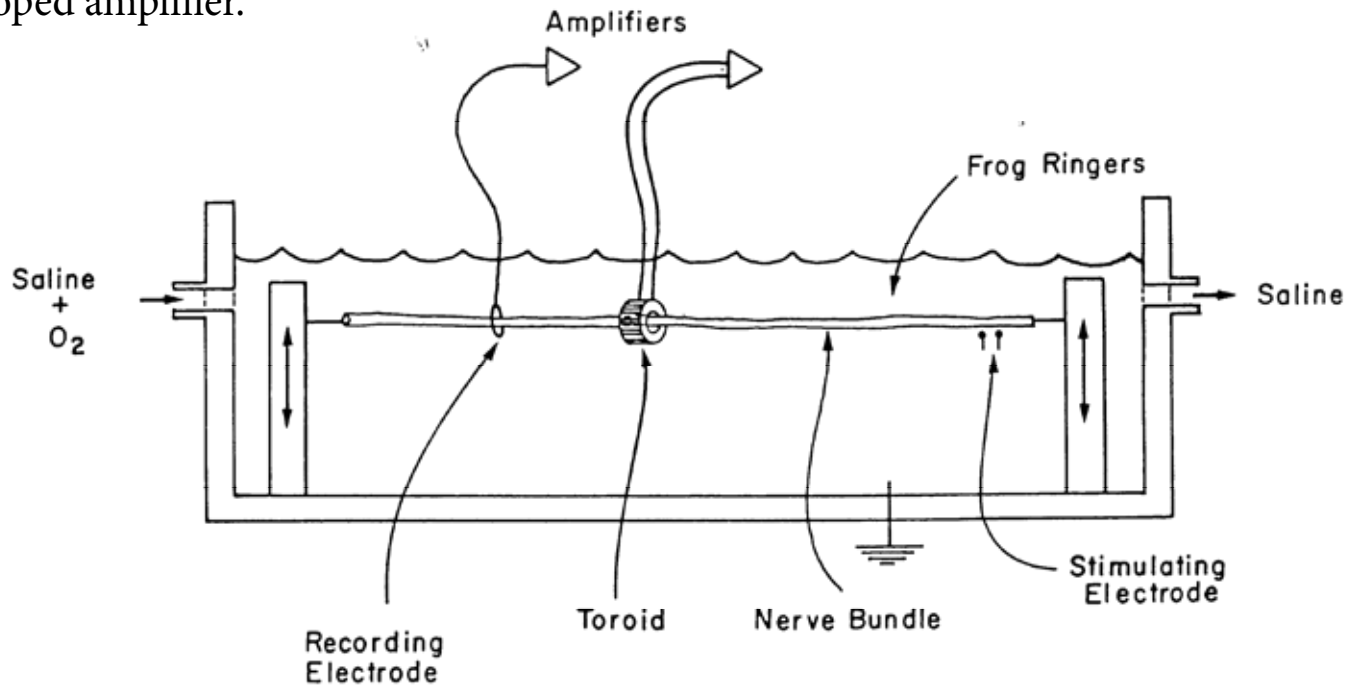
$$I_i = -dV / r,$$

where  $r$  is the nerve fiber resistance per unit length and  $dV$  is the interior potential in millivolts.

Lastly, Ampere’s law is used to calculate the magnetic field surrounding the nerve, in which  $I$  is the net current through the toroid enclosed by a closed path of integration -

$$\oint B \cdot dl = \mu_o I.$$

I explain to my students that experimental data must be taken in order to validate the mathematical model. One technique for measuring the small magnetic field induced by the stimulated nerve is to use a specially-developed amplifier.



A schematic representation of the experimental setup.

During this study, a bullfrog's sciatic nerve was dissected and placed in a purified Ringer's solution and threaded through the center of a toroid. It is the net current through the toroid that is detected by the amplifier and used to calculate the magnetic field surrounding the nerve.

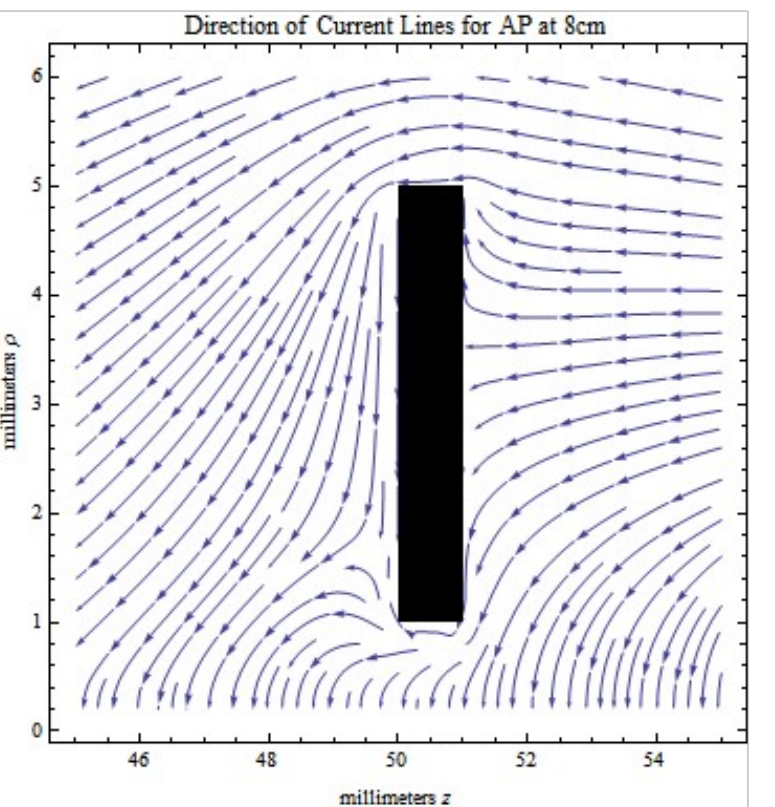
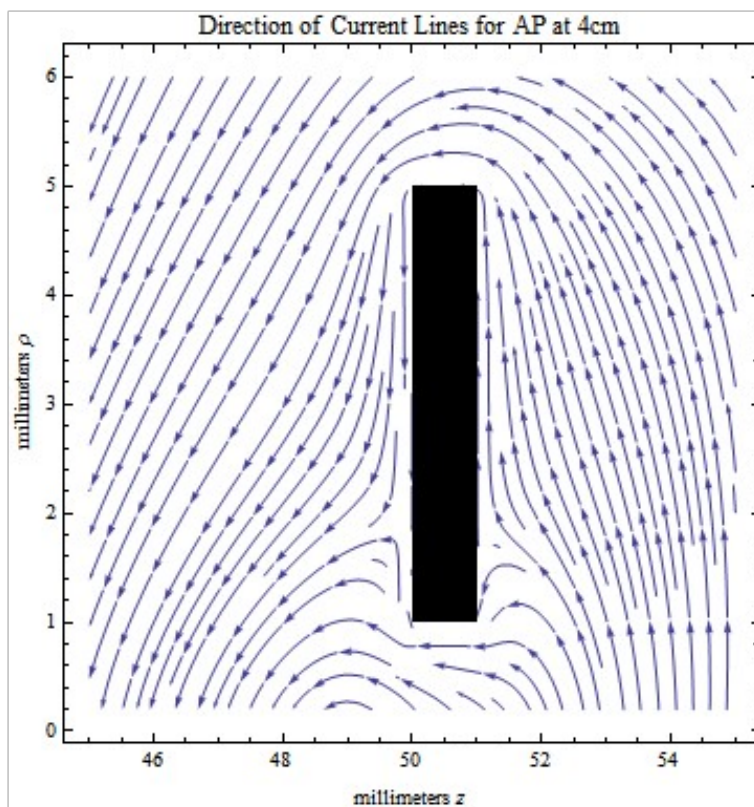
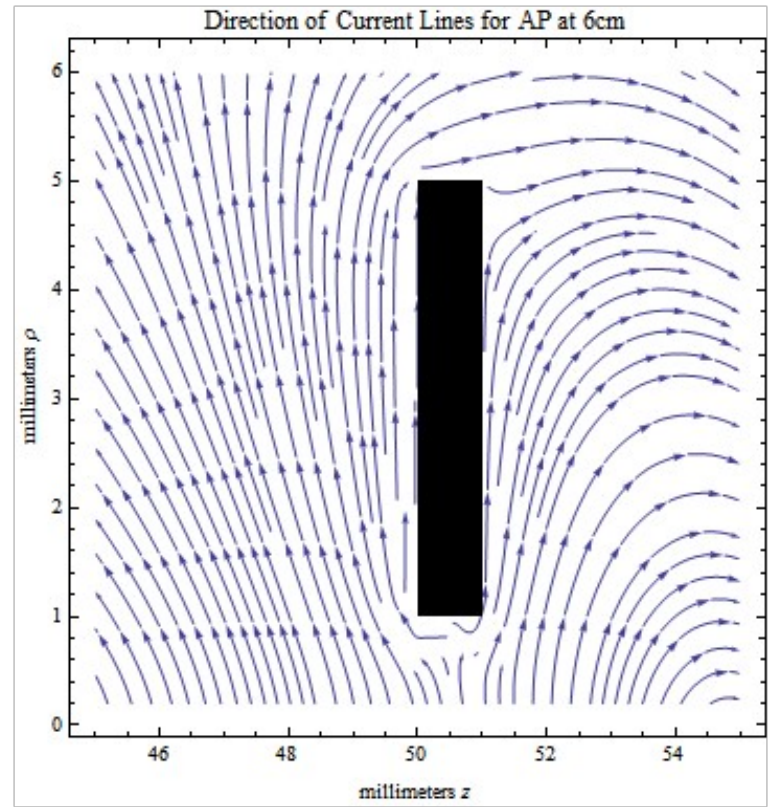
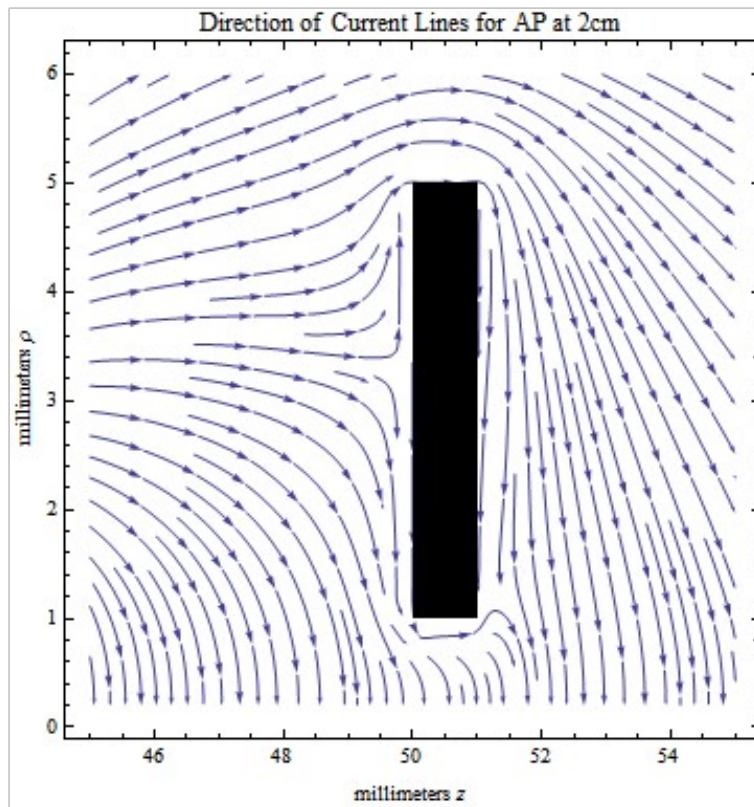
My numerical calculations were done using the technical computing program Mathematica. It was first released in 1988 and was considered a major advance in the field of computing.

Mathematica is a fully-integrated environment and one of the largest single-application programs ever developed.

Shown next are the extracellular current lines as the AP propagates along the nerve for a toroid thickness of 1mm. The direction of the current is represented by the vector arrows. The black rectangle represents the toroid.



The reader is given a nice illustration of how the extracellular current is behaving around the toroid. Note: Additional images available upon request.



When using a toroid to record the nerve action currents, the thickness of the toroid had not been considered before this project. It is difficult for a toroid to fit around a nerve perfectly, with no space between the two surfaces. These dimensions are important because the toroid creates a discontinuity in the external area, forcing the current to redistribute.

The current must still flow in closed loops, but now also has to flow around the toroid. As the toroid thickness increases, an increasing portion of the external current returns back through the toroid. The return current will decrease the net current within the closed path of integration when using Ampere's law to calculate the strength of the magnetic field surrounding the nerve.

Therefore, the measured magnetic field is dependent upon the toroid thickness. The mathematical model showed that even for a small toroid thickness, there is still a return current that will affect the measured magnetic field.

### ***So, what's next?***

Using the recording techniques outlined in the experimental setup may significantly simplify intra-operative nerve recordings. The procedure is safer because the nerve remains within its normal physiological internal environment during recording.

Hopefully, this work will be another step forward in better determining the extent of nerve damage in humans.

There is great satisfaction in understanding something that you thought was out of reach. Perhaps you might feel this way, if you have little to no science background and were able to follow along with this article! If so, then please, give yourself a pat on the back! I relate this experience to hiking to the summit of a mountain. For me, this research project was my Mount Everest. Sharing this challenge with my students allows me to build a bridge between college professor who seems to have all the answers and the students who are still figuring things out. A perfect teacher is just plain boring.

### ***About Brenda***

*Brenda Skoczelas is a keynote speaker at the upcoming Women in STEM Conference hosted by the National Educator Program in Orlando, Florida, in February 2019. Ms. Skoczelas is also a popular Physics instructor at Lake-Sumter State College, a TEDx presenter, and a finalist for this year's Florida Professor of the Year, as awarded by the Association of Florida Colleges.*

# Female Nobility

by **Maya Chande** / North Gwinnett High School

The Nobel Prize in Physics rewards progress. Recognizing hard work, creativity, and pure genius, it is arguably the most prestigious award a physicist can earn. Winners of the prize, known as Noble Laureates, encompass an elite class of scientists who have pushed the boundaries of knowledge and forged a path for innovation through their discoveries of our physical world.



Marie Curie

While this group of individuals is meant to symbolize the extraordinary talent of all humanity, it is, in no way, an even distribution of males and females. Only three females have ever been awarded the Noble Prize in Physics, and, just as their male counterparts, they deserve recognition for their remarkable achievements in the field of physics.

A true renegade of her era as one of the few women to pursue scientific research in 19th century Europe, Marie Curie, originally Maria Skłodowska, was the first woman to win the Nobel Prize in Physics for her contributions to the discovery of radioactivity. Kept from pursuing higher educational opportunities all her life, Skłodowska, like her radioactive samples, glowed with energy upon freedom from external limitations. Graduating from her underground girls' school, she promptly received admission to the prestigious Sorbonne in Paris where she studied mathematics, physics, and chemistry. In need of lab space, Skłodowska crossed paths with Pierre Curie, a



professor at the college of Physics and Chemistry at the Sorbonne. Smitten by each other's passion for physical sciences, they married and kindled a strong relationship that proved influential in both of their scientific endeavors.

Through their collaboration with and the work of Henri Becquerel, Marie and Pierre Curie discovered the nature of radioactivity as a fundamentally atomic process rather than a molecular one. Marie Curie's innovative use of laboratory equipment allowed for the mathematical explanation of radioactivity that won Becquerel and the Curies the Nobel Prize in 1903.

However, the joy of this accomplishment was short-lived for Marie as Pierre passed away in a carriage accident, leaving her alone to her research. Empowered with a new teaching position and a sense of duty to her late husband, Curie continued her work with ardor, uncovering a multitude of properties related to the radioactive elements Polonium and Radium, which have been integral to furthering the fields of nuclear physics and cancer therapy.

For this discovery, Curie was again awarded a Nobel Prize, this time in Chemistry, making her the only woman and person to ever win a Nobel Prize in two areas of science to date.



As incredible of a scientist that Curie was, she was surely not the end-all, be-all of successful female scientists. For one, Maria Goeppert-Mayer elucidated the shell model of the atom which made her the second woman in history to win the Nobel in Physics.

While active almost two decades after her, Mayer faced some of the same prejudices against women in academia as Marie Curie had. She struggled to find a high school that would let her take the "abitur" college entrance exam, so she decided to independently study and was able to pass the exam to gain admission into the University of Göttingen.

There, she studied mathematics and later transferred to a major in theoretical physics. While wildly successful as a student, she was unable to translate her

intelligence to success in the workplace as she was frequently denied research and teaching positions, often merely serving as a research technician at various labs. Her fate changed, however, as she entered the University of Chicago, where her talents were welcomed with open arms.

She quickly became a professor of physics and a researcher of nuclear physics. Her brilliance allowed her to discover the pattern of “magic numbers” of protons and neutrons (various subatomic particles) that allowed for the stability of the atomic nucleus. Her forays into nuclear physics won her the Nobel Prize in 1963 for her shell model of the atomic nucleus, which described the various energies of particles in the nucleus using her magic numbers. Her contributions have allowed for the expansion of theoretical knowledge of the matter that creates our world.

Sixty-five years later, the third woman in history was awarded the Nobel Prize in Physics. In October 2018, Donna Strickland, a Canadian professor at the University of Waterloo, got a call that her doctorate research in laser amplification had won her the most sought-after award in Physics. The daughter of an English teacher and an electrical engineer, Strickland swiftly assumed a fondness for science and analytic thinking.

One of three women in a class of 25, Strickland graduated with a Bachelor of Engineering from McMaster University in 1981.

She pursued her passion in laser optics through her doctorate research under Gerard Mourou whom she co-authored a study with on a method of laser amplification that stretches out the beam to where it is safe to amplify and subsequently condense into a precise and extremely energetic beam. This technique, called chirped pulse amplification, has played a vital role in the development of optical tweezers



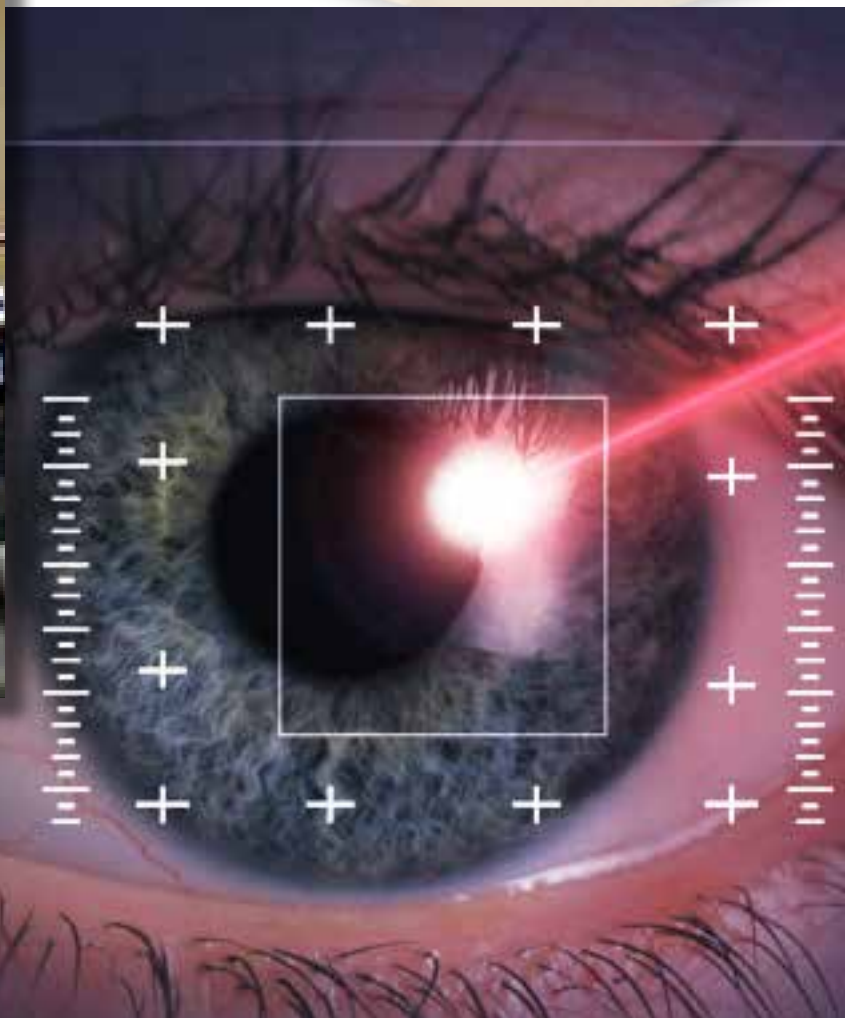
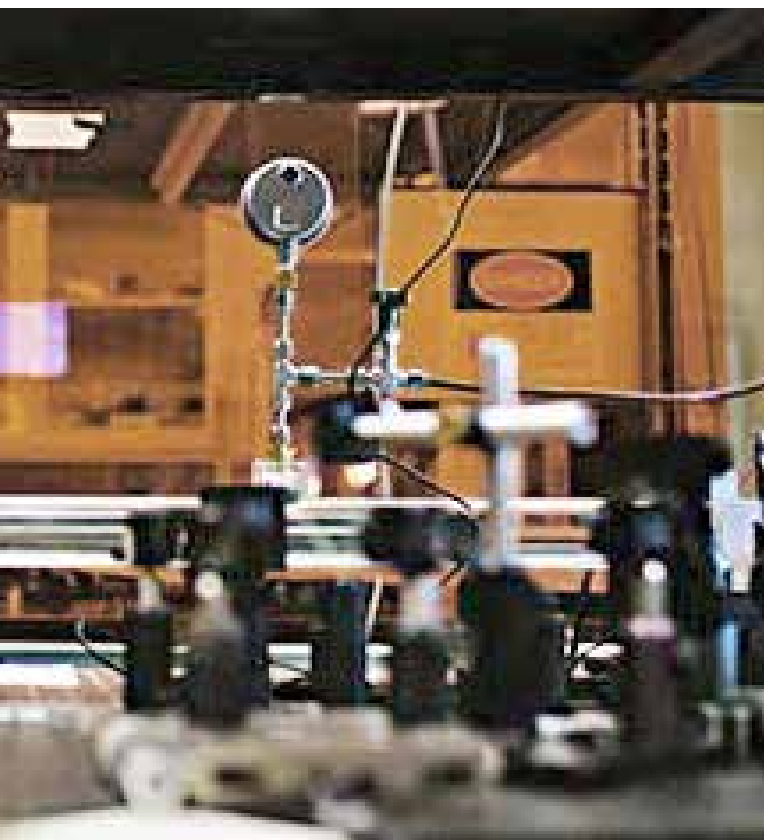
Donna Strickland

(high-energy beams that can “grab” onto small particles such as viruses or even atoms) and corrective laser eye surgeries.

In contrast to the prevalence of prejudice against Curie and Mayer, Strickland, when asked if she encountered any discrimination in her career due to her gender, replied, “*No, I haven’t. At least not so overtly that I took notice of it.*”

Hopefully, this is a sign of progress. A sign that humanity has cleansed ourselves of the ignorance of discrimination and has begun to embrace genius in every form: of man or of woman.

At the end of the day, the Nobel Prize is not about a shiny medal or the people honored by it; the Nobel Prize is about progress.

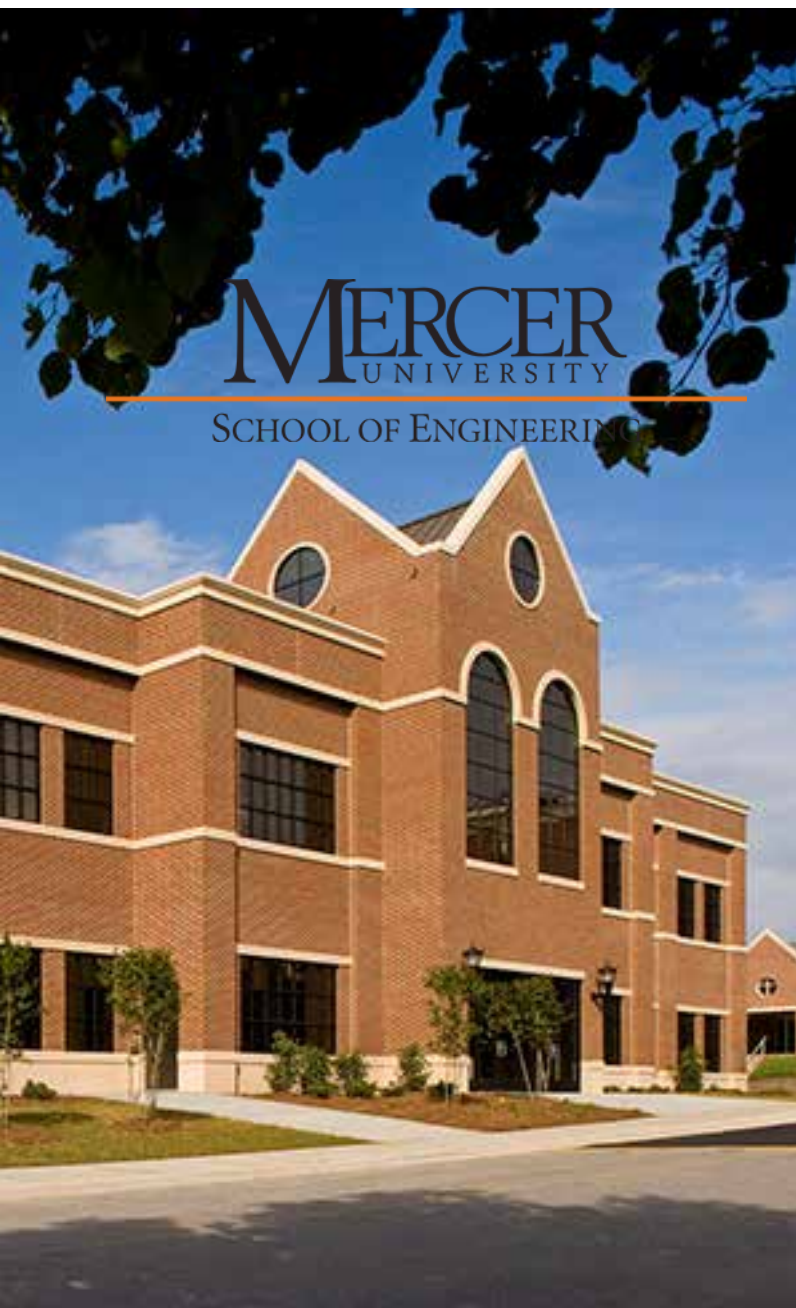






Dr. *Melinda* Hollingshed  
Industrial Engineering faculty member at Mercer University

## Increasing the Presence of Women in Engineering by Identifying Commonalities between Industrial Engineering and Non-STEM Fields of Study



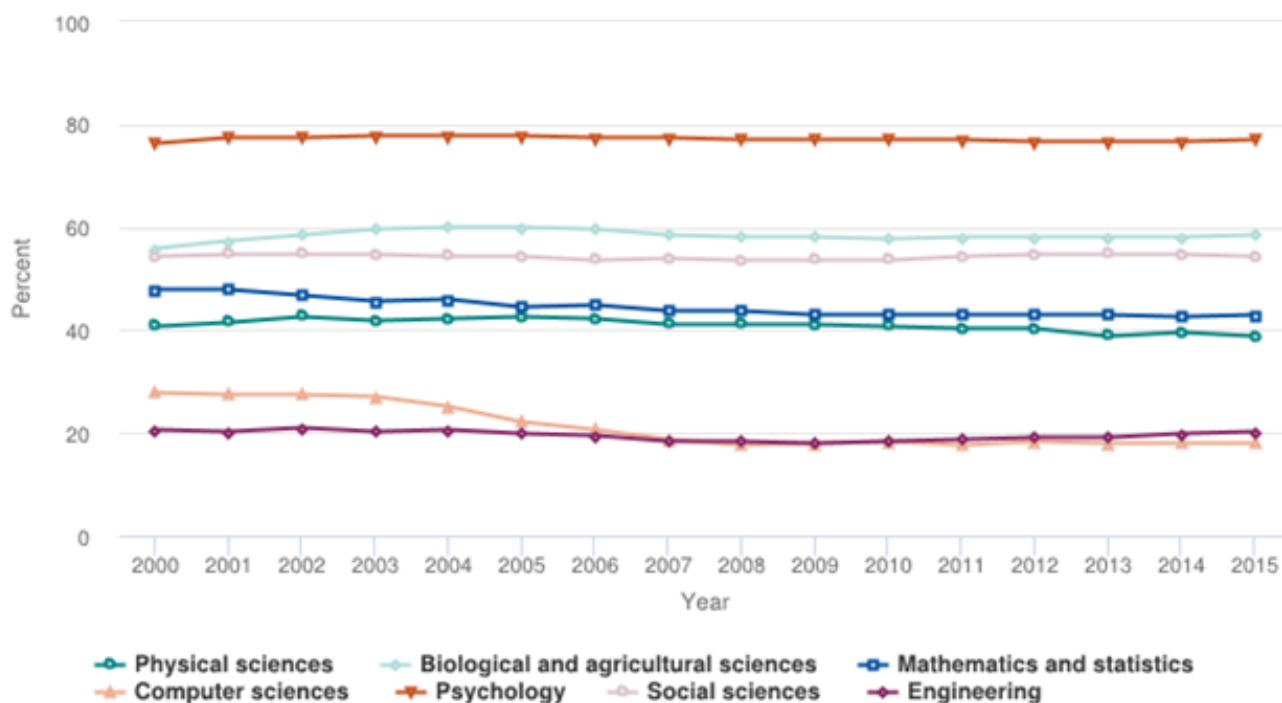
As technology continues to advance and the demand for engineers increase, huge disparities of the presence of women within engineering are still prevalent. Despite efforts such as mentoring programs, scholarships, and grants, the growth and attraction of women to this field of study has been stagnant.

### ***The Numbers***

Based on the National Science Board's Science and Engineering Indicators 2018 Report, the percentage of engineering degrees awarded to women has slightly regressed from a very modest 20.5% in 2000, to 20.1% in 2015, with a high point occurring over this fifteen-year period in 2002 of 20.9%. [1]

While efforts have been made by organizations, schools, and professional societies to increase the presence of women in engineering, these efforts have not materialized into degrees

Women's share of S&E bachelor's degrees, by field: 2000–15



Note(s): Physical sciences include earth, atmospheric, and ocean sciences.

Source(s): National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Science Foundation, National Center for Science and Engineering Statistics, WebCASPAR database, <https://ncesdata.nsf.gov/webcaspar/>.

*Science and Engineering Indicators 2018*

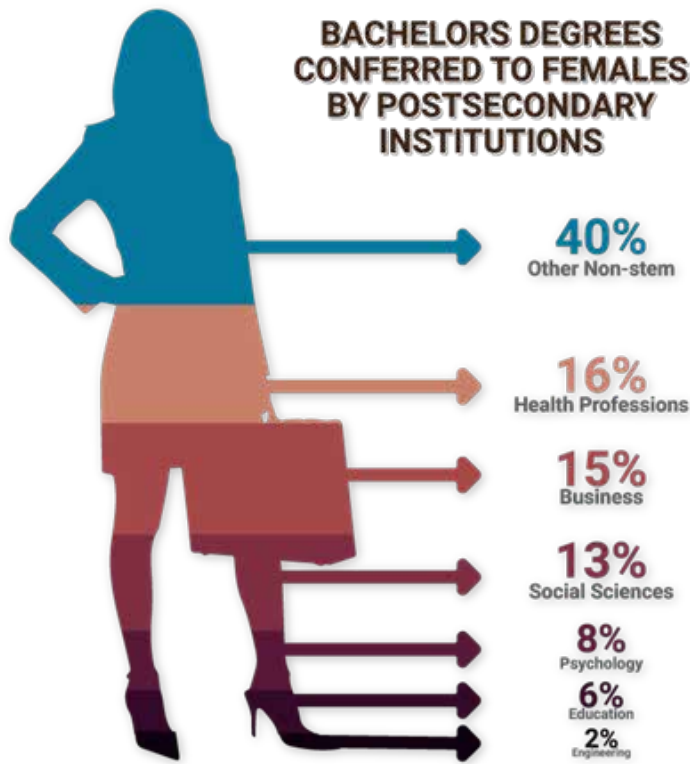
awarded and female growth within the profession. Therefore those passionate about growing the presence of women in engineering must identify new and innovative ways to draw women into the field.

## Changing the Approach

One way to begin to attract more women to engineering, is to make efforts to highlight and advertise commonalities between engineering and non-stem fields of study which women are typically drawn to.

Breaking traditional stereotypes that engineering only consists of designing and creating mechanical, electrical, and computer programs, and sharing with women how fields of study such as business and healthcare management are a part of the engineering landscape, could increase interest in the profession.

Data published by the National Center for Education Statistics, showed that in 2016, of the undergraduate degrees awarded to women, health professions and business majors made up approximately 31.22%.[2]



These numbers give insight into the areas of study to which women are typically drawn. Business and healthcare in particular, share many commonalities with the field of Industrial Engineering. Using these disciplines (business and healthcare) as a gateway to engineering, namely Industrial Engineering, could be very effective in attracting more women to the field of study.

## What Exactly is Industrial Engineering?

Most people really are not familiar with Industrial Engineering. Industrial Engineering is a unique area of engineering in that it is not specifically focused on modeling and designing mechanical, electrical, or computer systems, but it aims to optimize complex systems, processes, and organizations.

Industrial engineering is the only engineering discipline linked to business management. While there is an element of physical design within Industrial Engineer, primarily pertaining to robotics, in broad terms, Industrial engineers aim to improve efficiency and effectiveness to support business systems, goals, and objectives. In simple terms, industrial engineers do not conform to traditional view that engineers must make things, they instead aim to make things better.

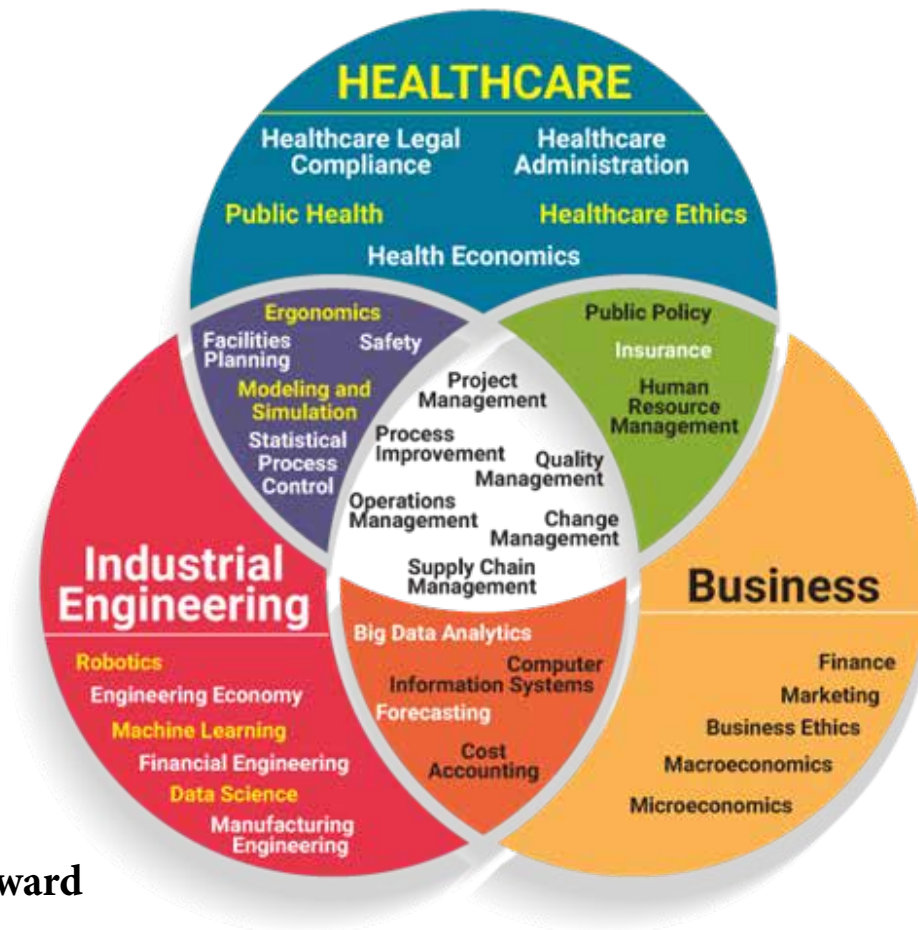
Here are a few areas of specialization within Industrial Engineering:

- Quality Management and Engineering
- Systems Engineering
- Supply Chain Management
- Healthcare Engineering
- Human Factors and Safety Engineering





# COMMONALITIES BETWEEN INDUSTRIAL ENGINEERING, BUSINESS, AND HEALTHCARE MANAGEMENT



## The Way Forward

Engineering outreach initiatives for women and especially high school STEM and STEAM programs, should begin to work to teach young people about all areas of engineering. Efforts must be made to help women understand the broad reach of engineering and how it is linked to other non-stem areas of study. This is especially true concerning highlighting commonalities between Industrial Engineering and business and healthcare management. This approach could to attract women and girls who may not be drawn to the traditional view of engi-

neering as it pertains to only designing and building structures, circuits, and computer programs. Evangelizing Industrial Engineering (engineering's best kept secret) to women and girls could prove to be just the push that is needed to begin to grow interest in the field.

### Sources

1. Science & Engineering Indicators 2018: Chapter 2| Higher Education in Science and Engineering <https://www.nsf.gov/statistics/2018/nsb20181/report/sections/higher-education-in-science-and-engineering/undergraduate-education-enrollment-and-degrees-in-the-united-states>
2. Table 322.50. Bachelor's degrees conferred to females by postsecondary institutions, by race/ethnicity and field of study [https://nces.ed.gov/programs/digest/d17/tables/dt17\\_322.50.asp](https://nces.ed.gov/programs/digest/d17/tables/dt17_322.50.asp)



Dr. Melinda Hollingshed is currently an Industrial Engineering faculty member at Mercer University who is passionate about attracting women and minorities to the field of engineering. Prior to working in academia, Melinda worked in the corporate world leading strategic projects for various manufacturing and distribution companies and training employees and executives on quality engineering and management techniques. Her research interests are using various quality and business process improvement techniques to assist companies in gaining competitive advantages, Lean Six Sigma, and increasing the presence of women and minorities in STEM and STEAM professions.







# Celebrate Good Times

by Caitlin McMunn Dooley, Ph.D.

**T**ime to celebrate...the year is drawing to a close elections are over (for most candidates) and the holidays are here. As we take time to celebrate with family and friends, please help us spread the great news about Georgia's public education system.

Getting a good education in Georgia has never been more possible. Our state has the highest numbers reflecting the best public education system we have ever had in the state's history!

- 2017-18 Graduation rate = 81.6%
- 2017 National Assessment of Education Progress results for Georgia are better than ever!
- 2017-18 Milestones performance rates have improved (see information about the assessment system [here](#))
- 2017-18 ACT saw increased outcomes AND Georgia's percent of students that met benchmarks for College Readiness in all four areas was one percentage point higher in 2018 (28%) compared with 2017 (27%). More impactful, College-level Reading rates for high schoolers increased from 47% in 2017 to 51% in 2018.
- 2017-18 SAT saw increased participation AND increased outcomes
- 2017-18 Dual-enrollment participation among high schoolers attending post-secondary courses = 36,697

- 2017-18 Advanced Placement (AP) participation rate = 120,479 (Note: not all opt to take the AP tests)

- 2017-18 AP passing rates (i.e., earn a 3 or higher on an AP Test) = 92,058

- Dual-language Immersion programs (Map) = 53

- In 2017-18, the Social Studies Civic Engagement Diploma Seal was established.

- In 2018, the Career Ready Diploma Seal was established.

Teachers and school leaders are working hard to make Georgia's system the

## in Georgia's Public Schools

We have also added ways to commend and celebrate students' unique interests and achievements through Diploma Seals. Graduates can earn these seals by engaging in a sequence of courses and experiences:

- Georgia Fine Arts Diploma Seals were established as well as Academic and Career Technical and Agricultural Education (CTAE) pathway completion guidelines in or before 2015.

- In May 2015, the International Skills Diploma Seal was established; International Skills Diploma Seals earned in **2015-2016 = <100**

**2016-2017 = 540**

**2017-18 = 922**

- In May 2016, the Biliteracy Diploma Seal was established; Biliteracy Seals earned in **2016-17 = 1,133**

**2017-18 = 2,125**

best it has ever been. Are we where we want to be? Not yet. We are always going through a process of continuous improvement. These numbers show that we're moving in the right direction!



# STEM Fosters Environment of

By **JoAnne Castagna**, Ed.D.

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers Savannah District oversees a multi-million dollar military construction program at 11 Army and Air Force installations in Georgia and North Carolina and manages water resources across the Coastal Georgia region, including maintenance dredging of the Savannah and Brunswick harbors; operation of three hydroelectric dams and reservoirs along the upper Savannah River; and administration of the Regulatory stream and wetland permitting program within the state of Georgia.

With more than 700 employees throughout Georgia and the Carolinas, the Savannah district team provides expertise across a wide range of disciplines—from engineering, architecture, design, construction, and master planning to subsurface exploration, hydro-power, and environmental stewardship.

“Do you like working at the Army Corps?”, a seventh grade girl asked Ali Palen, a structural engineer with the U.S. Army Corps of Engineers.

Palen recently visited the West Point Middle School as part of the agency’s STEM Program (Science, Technology,

Engineering and Math) that aims to inspire young girls and boys to pursue careers in science, technology, engineering and mathematic.

“STEM events foster an environment of exploration and questioning for children. Exposure is the most important objective. Why wouldn’t I jump at the chance to help expose children to the thing that I love to do? Participation in STEM events is a no-brainer for me and it’s fun!”, says Palen. This isn’t the first time the agency has visited the school. Palen was preceded by other speakers including most recently - Col. Paul E. Owen, New York District Commander, U.S. Army Corps of Engineers and Raymond Schembri, Hydraulic Engineer, New York District, U.S. Army Corps of Engineers.

Owen discussed Super-storm Sandy with the students and its impact on the New York region and the agency and Schembri talked about flood reduction methods the Army Corps constructs to help control flooding during storm events. One of the ways that Sandy personally impacted the District was its destroying of its Caven Point Marine Terminal.



# Exploration & Questioning



*Students watch a Flood Wall Demonstration. (Photo by JoAnne Castagna, Ed.D, Public Affairs Specialist, U.S. Army Corps of Engineers)*

Palen is one of the structural designers that designed a new, more flood resistant terminal that is being constructed right now.

Palen talked with the students about her role on this project. In addition she explained what structural engineers do, basic building components and how tension, compression and loads are important information for structural engineers. She explained that in order for structural engineers to know what types of building components and materials are needed and where to position them, they need to know about tension, compression and loads.

It's important because different materials are good for tension and compression. For example, steel takes tension well and concrete takes compression well. To demonstrate, Palen gave the students two marshmallows and two index cards.

With the marshmallows she taught the basics of tension and compression loading by having the students stretch and squeeze the marshmallows with their fingers. Palen then taught the basics of beam bending with the index cards. She had the students bend the index card and discuss whether the top and bottom of the "beam" would be in tension or compression.

Structural engineers also need to be aware of applied loads which are pressure and weight in a particular direction. Palen described the different type of loads to the students, including lateral loads and gravity loads.



*Students learn what tension and compression is and why it is important to know when designing a building. They learned with the use of objects including index cards and marshmallows. (Photo by JoAnne Castagna, Ed.D, Public Affairs Specialist, U.S. Army Corps of Engineers)*



The class then explored flood loading and discussed whether it would be a gravity or lateral load on a building. The students agreed that it would be a lateral load. Palen went on to explain how she had to take this in consideration when she was designing the Caven Point Marine Terminal that was destroyed by Sandy.

The terminal is located right on the Hudson River in New York City. It's where the district keeps its boats and where its hydraulic team works.

"Waves crashed into the terminal. The walls were ripped off and the structure ended up completely under water," said Palen.

Palen asked the students how they would protect a building from flooding. The students mentioned waterproofing and raising the building. Palen said that these methods are good and many of these were applied when designing the new terminal.

She designed a new facility that will withstand the water and wave loading from flood waves. In addition, parts of the building were raised and flood proofing and flood walls were included. She then had the students gather around a table to show them a Flood Wall Demonstration.

On the table she had an aluminum tray, which contained a small scale. As she poured water on one side of the wall and the students anxiously watched to see if the wall would hold up under the water pressure and Palen had the students discuss where they thought the wall would fail. After a minute or so, the bottom of the wall made of Play-Doh flood wall spanning the width. The wall was made with aluminum foil and was secured to the sides of the box with Play-Doh.

Palen said that this demonstration shows how water pressure increases with depth and how connections are very important in design. The bottom of the "wall" experienced the greatest water pressure and it was this bottom connection that failed first.

With this new structural engineering knowledge in mind, the class then went to work on a class assignment they've been working on named "Beat the Flood." The classes are suppose to take the knowledge that they receive from







the Army Corps engineers and apply it to this class project. The project requires the students to construct a home that can survive a flood. They have to decide on what building materials to use and how to construct the home.

Palen assisted the teacher is explaining the project to the students and guided them on their decision making. Palen enthusiastically yelled out to the students - "You are the Engineer! Think about what you have to do to design your home."

"The biggest challenge of a STEM event is relating to the children and teaching the material in a way that they will understand. This is also the largest benefit. Aristotle once said, 'The one exclusive sign of thorough knowledge is the power of teaching.' Sometimes you need to re-teach yourself the basics so that you are better equipped to explain it to the children.

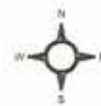
Dr. JoAnne Castagna is a Public Affairs Specialist and Writer for the U.S. Army Corps of Engineers.

[joanne.castagna@usace.army.mil](mailto:joanne.castagna@usace.army.mil).

Twitter at <http://twitter.com/writer4usacenyc>



Quarry Area is a total of 410 acres. Hunting for deer and turkey will be permitted during seasons as set by the state and will be restricted to ARCHERY EQUIPMENT ONLY. Firearms are prohibited during deer and turkey season except when dove hunting. Georgia hunting regulations, seasons, bag limits, license requirements, etc. will be enforced.



## Lake Hartwell Quarry Hunting Area

US Army Corps of Engineers - Savannah



Rome

Atlanta

Athens

# STEM is Georgia Wide

Columbus

Macon

Savannah

Albany

Brunswick

Valdosta