

July 2018

GEORGPATHWAYS

Computer Science
in Georgia Schools

Veterans at **GT** Part II

The **Maker** Movement



Dear friends and partners,

One of the best parts of my role as State School Superintendent – the thing that keeps me focused on the “why” of my work as an educator – is visiting schools and classrooms throughout the state. In schools from the mountains to the coast, and many places in between, I’ve seen learning taking place that would’ve been outside the realm of imagination when I was a classroom teacher, and certainly during my own days as a student.

My time in the classroom wasn’t all that long ago – but even in the last several years, the opportunities available to Georgia’s public-school students have expanded exponentially.

One area that makes me particularly hopeful about the days ahead is our state’s focus on Science, Technology, Engineering, and Math (STEM) education – and, even better, STEAM education with a focus on arts integration.

Expanding STEM and STEAM opportunities is a top priority for us at the Georgia Department of Education. One way we’ve kept that at the forefront is through our STEM certification for schools, and the new STEAM certification we debuted in 2017 – currently, 65 schools have been certified, and another 1,150 are in the pipeline.

Knowing that computer science provides foundational knowledge and skills that benefit every child, we’re also working to expand CS learning throughout the K-12 system. Recently, I was pleased to announce the addition of three new middle-school coding courses, along with \$500,000 in grant funding to help rural, under-served, or high-poverty school clusters implement middle-school coding programs.

The one thing that has to be completely off the table for us, as educators, is complacency. We can’t rely on the way we’ve always done things – our students need to graduate prepared for 21st-century careers.

I’m thankful for great partners like TAG-Ed who are helping us accomplish just that. Together, we’re ensuring our students are on the pathway to success.

Sincerely,

Richard Woods

Richard Woods
State School Superintendent



Welcome to another edition of Georgia Pathways STEM Magazine!

During the summer months, it's always great to see opportunities unfold for all of the students who are visiting local technology companies, or working as interns, or visiting one of the many great tech camps across our state. These opportunities are, in many cases, the foundational steps for creating a robust pipeline for workforce development in Georgia. The impact of that potential is boundless!

In this edition of our magazine we are featuring stories and including information that is intended to help you consider strategies, projects and best practices for adopting STEM as a way to encourage and foster the future workforce.

Access to STEM activities and education is a leading and powerful way to lay the path for young people to pursue meaningful technology careers. Not only will they advance in their potential, but the impact on our workforce and our economy can be enormous.



As you enjoy this latest edition of Georgia Pathways STEM magazine, I hope you will take a moment to consider how you might incorporate some of the ideas that you find inside this magazine into your own classrooms or organizations, clubs or camps. I also hope you will feel welcome to share your ideas so that we can help pass them along.

Thanks for your support!

Larry K. Williams
President
TAG-Ed

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

The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEM learning opportunities and connecting them to Technology Association of Georgia (TAG) resources. Formerly the TAG Foundation, TAG-Ed is a 501(C)(3) non-profit organization formed by TAG in 2002. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEM education in Georgia.

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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.



Computer Science

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From the Executive Director

It's hard to believe that just as quickly as it began, it has come to an end. Summer 2018 has bid us "farewell." In July many students, teachers and administrators throughout the state returned to school and began the journey and the wondrous adventure of another school year. And here at Georgia Pathways™ STEM Magazine we couldn't be more excited about what lies ahead for the 2018-19 academic year.

Our hope is that you'll leverage Georgia Pathways™ as an opportunity to broaden what you share, support or even enhance how you engage with students and expand what you have an opportunity to explore in your respective classrooms. Our belief is that for both educators, students and community leaders Georgia Pathways™ provides access to content and information that can inspire new conversations and new narratives around "what's possible". Each new academic year represents NEW BEGINNINGS. And we hope to partner with you in establishing new beginnings and new outlooks... for a new year!

I recently had the opportunity to visit the Academic City College in Accra, Ghana (www.accghana.com). Their focus is to "change tertiary learning in Africa with activity-based learning and premium teaching talent, complemented by their state-of-the-art campus." Their mission is to "offer holistic education to create well-rounded minds



who can proactively and conscientiously contribute to local and global development."

And their vision is that their "dedicated focus on experiential learning, supplemented with social emotional learning and ethical decision-making, targets preparing their students to compete with globally-trained talent." In essence they're intentionally working to disrupt and change the process and the trajectory of the traditional post-secondary ecosystem. How EXCITING and inspiring!

What does a new year mean for you? And how can we support you in being a change agent in your ecosystem? Whatever that may be, we thank you for the sustained partnership, we thank you for being a beacon and your continued commitment to the journey and we wish you all the best in the upcoming year!

Sincerely,



Executive Director
TAG Education Collaborative

Statewide Call

for Nominations and Applications for 2018 STEM Education Awards

The Technology Association of Georgia and the TAG Education Collaborative are excited to announce the 7th Annual STEM Education Awards. This event will recognize and honor schools, programs and organizations for their outstanding effort and achievement in supporting and promoting STEM Education in Georgia.

Individuals, schools, companies, and organizations are invited to nominate themselves or others by completing the online survey found at <https://www.surveymonkey.com/r/B78DKJH>. Application process opens July 23rd, 2018 and Nominations are due by 4:00PM August 31st, 2018.

Application categories include:

- **Elementary School**
- **Middle School**
- **High School**
- **STEM Certified School Outreach**
- **Post-Secondary Outreach**
- **Extracurricular Program**
- **STEM Day Activity**
- **Corporate Outreach**



Finalist will be notified by October 5th, 2018.

The 7th Annual STEM Education Awards event will be held on November 2nd, 2018 from 11 am -3 pm at the Loudermilk Center. For more information please visit <http://www.tagonline.org/events/stem-education-awards/> or contact Dr. Reginald Turner at reginald@TAGonline.org or 404-920-2017



How Do I Decide How to Incorporate Computer Science into My School?

by Dylan Stone-Miller



Georgia's technology future is bright. Our financial technology industry ranks 3rd nationally, we bring in 25% of global cybersecurity revenue, and our capital city is ranked as one of the nation's fastest growing high-tech urban centers. Over the next 3-5 years, more than a billion dollars will be invested in our tech sector's growth, but who will benefit?

Even now, nearly 20,000 computer programming and IT related jobs remain open in Georgia, with a median salary of about \$90,000, but with less than 5% of Atlanta Public Schools teaching some form of computer science in their classrooms, we are stifling opportunities for minority and working class families to gain access to these careers. The buzz around Computer Science is pushing school leaders to ask how they might bring Computer Science into education, fast, but how do they know they are bringing in the skills that will get our students jobs?



One of the hurdles keeping schools from implementing more Computer Science (CS) is school leaders across the country that are not equipped to discern which of the many CS programs out there are right for their school.

Schools are constantly approached by well-meaning individuals or companies offering an array of programming, and in this burgeoning environment of computer science education, we encourage school leaders to demand succinct and palatable information

about how one program compares to other existing programs, but without an understanding of the CS content, school leaders cannot possibly make an educated decision on which programs to include in their school. Without a framework as to how CS might weave into or support core content areas, school leaders can only do so much to build a school culture around tech that

honorCode trains teachers and school leaders in industry-aligned computer science, providing curriculum and a pedagogical framework that incorporates frontend web development into any content area while emphasizing soft-skills development.

The goals of their teacher training program are to build professional learning



truly supports students gaining employable skills.

Right now, the demand for an entirely new and distinct set of skills leaves our educators ill-equipped to help students meet the demands of a shifting market and world, but honorCode is working to change that.

communities around how to appropriately integrate computer science, coding, and social-emotional learning into day-to-day instruction, and to provide connection points for local industry professionals to support future workforce development within schools.

In order to foster a future-facing school culture, school leaders need to be equipped with at least a basic understanding of coding and computer

science, the state of the tech industry, and the skills employers seek. By sending teachers and administrators to events that support their understanding of and connection to the industry, training teachers in technical skills and realistic, culturally relevant ways to integrate technical skills into the classroom, and supporting collective efforts towards a statewide framework

for computer science education, school leaders can feel more confident making the big decisions around who to bring into their school.

Learn more and get involved by visiting our website at www.honorcodeatl.org.



Dylan Stone-Miller is the Director of Programs at honorCode, responsible for designing and implementing the teacher training and community engagement programs that have impacted over 3000 students in Georgia in the past two years

Including U: Veterans in the college classroom / Part 2

by Dr. *Kata* Dosa

Postdoctoral scholar in the Center for Teaching and Learning at Georgia Tech.



Student veterans are a group with unique characteristics that deserve a voice in the discourse around inclusive teaching. Since the introduction of the “new GI Bill” (properly called the Post-9/11 Veterans Education Assistance Act of 2008) that provides significant financial benefits to those who serve, hundreds of thousands of active and former service members have enrolled in colleges across the United States.

Currently 459 veterans are enrolled at Georgia Tech.

What does it mean to be a veteran?

Vacchi (2012) defines student veterans as “any student who is a current or former member of the active duty military, the National Guard, or Reserves regardless of deployment status, combat experience, legal veteran status, or

GI Bill use”. This definition will serve as the framework for exploring and understanding the experience of these students. If we closely examine the definition, we can see that the umbrella term “veteran” is used to describe numerous subgroups, foreshadowing the incredible diversity among veteran students.

When I set out to learn more about students veterans at GT, I was looking for a unified characteristic stemming from a common experience. It turns out, no such unified characteristic exists, because there is no common experience. Some vets have seen combat, some have not. Some got injured, some did not. Some are willing to talk about their experience, some are not. Veterans frown on the assumption that they are all alike, and with good reason. To expect veterans to be similar is akin to expecting people who have been through major surgery to somehow be alike. Being in the Armed Forces and having life-saving surgery are both significant, transformative life experiences that people process and make sense of in a multitude of ways.

In the following, I will draw on the perspectives of GT veterans and the literature, to identify some patterns among veterans as they relate to their academic success, followed by suggestions for creating a learning environment that is designed to be welcoming to students

whose lives were touched by the military.

Part II: Learning from Veterans

Whatever their military path has been like, veterans bring a a worldly, practical perspective few other students have. Many of them have been to other countries, they have seen things in context, and developed skills instructors can capitalize on in the classroom.

“My buddy, he is a civil engineer [in the military] – so when he deploys, he is building stuff.” - says Andrew. Imagine having a student in an engineering classroom who has all this experience building and designing things in different corners of the world. The nuance, the perspective, the applications they could share with others would undoubtedly enhance everyone’s learning. Andrew describes one such synergistic encounter from his career at Tech:

“For example, my professor [Dr. Garry Gabison] asked me at the beginning of the semester to do a presentation at the end of the semester about innovation and military networks. He asked: ‘is that something you’d be willing to talk



about?’ I was like, ‘yeah, I can do that’. He gave me more than enough notice to think about it. But otherwise, he never brought up my military experience.” Dr. Gabison, Visiting Assistant Professor at the School of Public Policy, adds: “Each student has unique backgrounds and experiences — veterans have a wealth of the latter. I would encourage faculty members to find a way to integrate their voice. Other students and the class as a whole can benefit from their hands-on knowledge.”

Dr. Gabison’s approach has three essential elements to effectively engage veterans in the classroom: 1. He gave plenty of advance notice to Andrew, 2. He asked Andrew privately and 3. He otherwise did not mention Andrew’s veteran status in class himself. Why do these matter?

With some exceptions, the majority of veterans prefer to keep their veteran status private when they are in college (Livingston 2009). In some cases, this desire is so profuse that it prevents student vets from seeking help, whether academic or otherwise: “Some of that is that they are just done [with military life], some of it is that they don’t want people to know.” - explains David. “It’s the stigma; they may not want anyone to know they were in the military.” - he adds. Andrew elaborates on the same sentiment: “We will keep our veteran

status on the low, because once it’s revealed, people start treating you differently, look at you differently, expect different things from you. That applies 100% in the classroom. Not so much in technical classes, but, for example, in policy classes.

I can recall during my time in undergrad that I would frequently get looked at by instructors when they were looking for a specific type of response. Students will also call out and say “oh, hey, Andrew, he’s a veteran”. Yeah, thanks for telling everybody.” - he rolls his eyes. “So then they pose certain questions to you and things like that.”

Upon exiting the military, veterans quickly find out that the civil society has constructed an idea of who and what veterans are that is superficial and often incorrect (Martin 2017). Their diverse and complex experience is reduced to simplistic narratives, in which they are either “wounded warriors” or “heroes”.

At best, this gets them a few awkward “thank you for your service” comments that they don’t necessarily need or want. At worst, they get denigrating comments, because some people see all soldiers as “killers” and having a knack for violence (Zinger and Cohen 2010, DiRamio et al. 2008). Between the two extremes, there are all kinds of interactions that vets recall, none of which

are pleasant, but all of which are related to the stereotypic perception of what veterans are “supposed to be like”.

Andrew described one such bias: expecting all veterans to represent a certain point of view when it comes to the military. In these cases, student vets are asked questions they are expected to answer in a certain fashion. “People have a lot of assumptions of how things work and then they look to you for validation. It makes it awkward sometimes, because I can describe my experience, but I’m not the person with the answers” - reflects Andrew.

Those are things I’d love to highlight, but I don’t know how.” Another unpleasant scenario veterans find themselves in is being asked insensitive and intrusive questions. David provides common examples: “Students were asked [things like] ‘did you shoot anybody?’ and ‘were you in combat?’ or ‘did you carry a gun?’ “. When I ask Andrew about this, he nods in agreement: “I got a lot of those questions as an undergrad, it was asinine.” If a student has a war story, bringing up those memories can be a painful experience to begin with. To inquire about them in a public setting, such as a college classroom,



Things get even more complicated if their opinion clashes with that of others. “I don’t wanna make a bad impression to the whole student body, because if what I say doesn’t align with the general consensus of the class, then I become the black sheep in the classroom. So trying to avoid that becomes the game. A lot of times I won’t say anything, even when they are wrong, or their perspective is very one-sided.

no doubt results in student vets feeling alienated and exposed. Dr. Gabison’s approach is a prime example of navigating the fine line between capitalizing on a vet’s experience and remaining respectful about their privacy. What else enables veterans to make the most of their classes?

Creating a learning environment to maximize veterans' success

Keeping in mind that veterans are a diverse group, there are a few blanket strategies that benefit most:

Respect their privacy. Do not reveal their veteran status to the class without their prior approval, and even if they are “out” in the classroom, make no assumptions about their opinion on matters relating to their experience.

Capitalize on their strengths. In addition to their experience, many veterans are comfortable in leadership positions. “Veterans like to lead, it’s built in. [When necessary,] I’ll take charge, I’ll go talk to the professor. That’s something to build on.” - shares Andrew.

David highlights another strength he observed in his veteran students: goal-orientation. “They have a drive, they have seen things. They are not here to play games, they are self-directed, they are centered, they are here to get a degree. They have direction. They set goals, and set out to achieve them.” Leadership, goal-setting, problem solving and the many other competencies veterans bring to our classrooms can be engaged even without ever mentioning their military past.

Engineer inclusive discussions. In classes that explore topics relating to

the military, make sure the discourse is not limited to one point of view, and that judgment is suspended in favor of learning (Hassan et al. 2010). Lay out ground rules so that students in the classroom maintain a standard of respect when talking about those who served. This does not mean tiptoeing around “touchy” subjects or putting veterans on a pedestal, merely a call to consider both the topics and the people involved in their complexity. Beyond these strategies, the key to helping our diverse student veteran population succeed is gentle inquiry and signaling. They may benefit from different things, depending on their unique experiences.

Invite them to talk to you. This could be a brief announcement at the beginning of the course, bundled in with other needs for accommodation. You could include a clause on your syllabus stating your intention to make your classroom welcoming to veterans, and an invitation to discuss their needs with you in your office hours. Work with them individually. Some veterans may approach you with unusual requests.

Combat veterans often prefer to sit in close proximity to the exit, or at least in full view of entry points. Some are unnerved by backpacks. When David mentions this, I must look surprised, so he explains: “It’s one thing that they are trained to have a clear path to an

exit, and students leave backpacks around. But those are also things that often have bombs in them.” Loud noises, sudden movements or darkening a classroom (for a video, for example) can also send some veterans into “theater” mode (Sinski 2012). “There’s a vigilance going on in the classroom” - summarizes David. “If they feel distressed, they may leave the classroom.”

Watch out for signs of distress. A portion of veterans carry hidden wounds: some have traumatic brain injuries (TBI) and many experience PTSD (post-traumatic stress disorder) for years after they leave the service. Both of these conditions may interfere with new learning and cognitive functioning (Sinski 2012), which could affect a student’s progress in the classroom. Sinski recommends instructional strategies like organizers and activating prior knowledge to overcome these learning difficulties - strategies that benefit all students.

Moreover, PTSD and TBI are often associated with anxiety and depression (Bleich et al. 1997). Sometimes veterans are not aware of these hidden wounds, so the support of their community becomes even more important. David’s experience echoes this pattern: “I was 20 years active duty. I was combat rescue, I have friends who died in

helicopter crashes. I didn’t realize that [I had PTSD] until after I retired. I had some strange thoughts. [And I was not alone], I had friends who committed suicide after they retired.” Indeed, student veterans are at high risk for suicide (Rudd et al. 2011).

David continues: “Sometimes students may not realize it until a few years after they are out. They are sitting in a classroom and something happens, and a smell, a sound, a sight brings those things back.” If you observe a significant change in a student’s progress or behavior during a semester, please consult this guide by the Counseling Center for symptoms that warrant professional help.

Connect them with campus resources.

If you have a student veteran who is struggling, please connect them with resources available on campus. “They may not know that there are other veterans and resources out there.” - says David. The Veterans’ Resource Center can support them by finding the right services and providing a community of peers that understand what they are going through. If you already have a “Campus Resources” section on your syllabus, adding the VRC will ensure that veterans get connected with the support structure designed to help them navigate life outside of the military.

Closing thoughts

Until recently, most efforts centered on getting veterans into colleges. The scholarly literature framed veterans' presence in the college classroom using a deficit model; the academic discourse was, for a time, limited to exploring issues like PTSD and learning challenges. In recent years, however, authors are calling for a shift in perspective when it comes to thinking about student veterans (e.g. Hassan et al 2010): that we consider the “whole” student, and highlight their strengths, as well.

I close with a quote from DiRamio et al. (2008), that summarizes the sentiment of veterans across the board: “[Veteran] students desire to have their instructors understand and acknowledge them. A consistent theme [is] that these students do not desire special status or unusual accommodations, but rather a sense that their professors appreciate their life circumstances, including both health and academic challenges.”



***Dr. Kata Dosa** is a postdoctoral scholar in the Center for Teaching and Learning at Georgia Tech. She develops and facilitates programming and initiatives for faculty and graduate students, contributing to Georgia Tech's pursuit of excellence in education.*

Prior to her career at Georgia Tech, Kata earned her Ph.D. in Environment and Resources from the University of Wisconsin-Madison, where she conducted discipline-based education research in STEM. Kata's current interests include teaching-as-research, the science of team science, creating inclusive learning environments and competency development in higher education.

**Be sure and visit the Georgia Tech Military Affinity Group (GT MAG) website:
[Click Here](#)**



NMSI Professional Development

by *Kim* Saleem

While the myth remains alive, most people understand that teachers don't have their summers off. What's less understood is the critical purpose and value of teachers' summertime work. Across the country, teachers are in the midst of required professional development. The number of hours, the delivery methods and the quality vary across states and across "PD" providers, yet the goals are universal: enhance teachers' content knowledge and teaching skills.

Like their students, teachers have told NMSI and other professional development providers that they prefer – and learn best from – experiential training. That means less sitting and more doing. Unlike their students, we have found that teachers are less likely to deliver experiential learning when they haven't had the opportunity and support to practice those types of lessons.

Stephanie and other teachers from Atlanta and surrounding areas recently participated in NMSI's Laying the

Foundation training. They did such things as building miniature field goal-kicking machines to illustrate the concepts of velocity and acceleration. They also experimented with melting ice to better understand climate and weather and used rubber bands and Barbie dolls to practice making and testing predictions from a linear equation.

"These are lessons that I will be able to use in my classroom when I go back in the fall to help my pre-AP kids, to get them ready for AP," said Dr. Cynthia Bridges, an AP Chemistry teacher at Renaissance High School in Detroit, who also participated in the LTF training hosted at Elite Scholars Academy in Jonesboro.

Tracy Holmes, an English Language Arts teacher at Inman Middle School in Atlanta, said doing the work – such as analyzing historic speeches – allows her to know how to support students at all levels.

"You want to be sure you have done it, so you know what's going to happen and how to help the kids," said Stephanie

Lowmiller, a math teacher at E.D. Nixon Elementary School in Montgomery, Ala.

“Say, for instance, if you have a long speech that’s by Lyndon B. Johnson.

With students that are on-level, I may only take a couple of the paragraphs of it. I may also allow them to listen to it, so they can get a true feel for it and some clarifications of it. Then we only will analyze a piece of that speech versus analyzing the entire thing,” she said.

- Grade- and subject-level focus – Teachers understand that how concepts are taught varies by grade and subject and they want training that accommodates those differences.
- Content progression – Students benefit when lessons they learn in upper grades are connected to previous lessons.



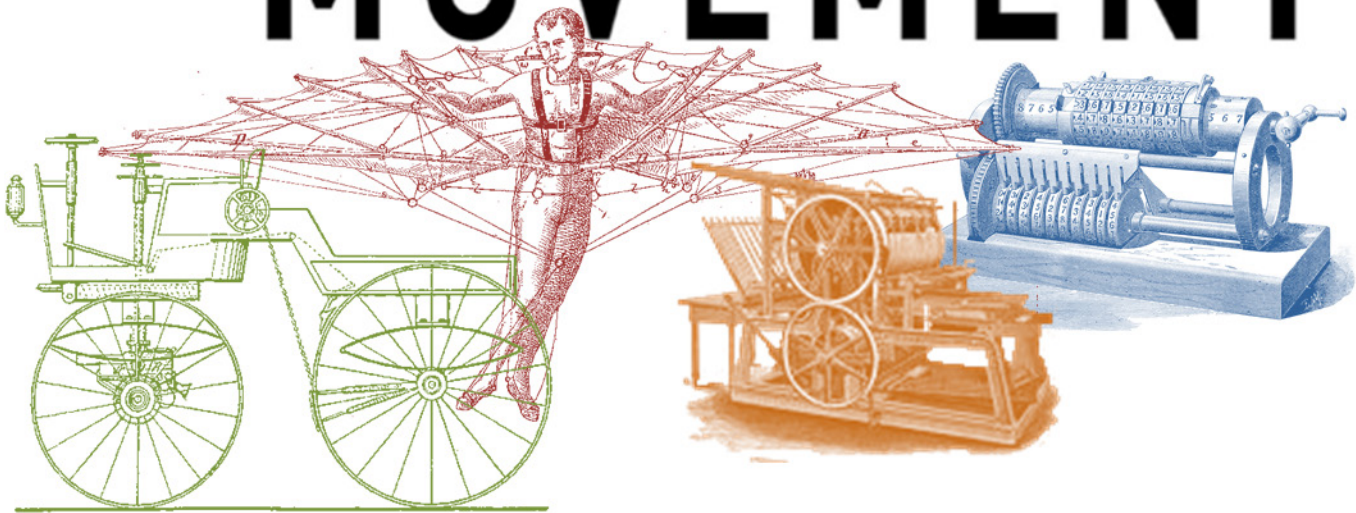
So what else makes good teacher PD? Here’s some of what we have heard from teachers:

- Alignment to standards – This is largely a given for any reputable professional development.
- Training continua – Teachers want training that’s connected from year-to-year so there are building blocks and constant expansion.

“We need to enrich ourselves, not just the kids,” Holmes said. “It’s about us learning too, so right now I’m the student.”

Kim Saleem is a former Atlanta-area teacher and program manager for the National Math and Science Initiative.

THE MAKER MOVEMENT



Georgia's Maker Movement Hits Stride

By Caitlin McMunn Dooley, Ph.D.

Makers ignite a space with creativity, community, and critical thinking. Makers are people who gather to make (and invent and fix) things: computers, gadgets, vehicles, art. Together, makers have created a movement called the Maker Movement.

We see evidence of this Movement throughout our state: From maker spaces to classrooms to libraries; from Georgia's seaside to rural fields, from to mountain forests to urban nests. The Georgia Department of Education's Science Technology Engineering (Arts) and Mathematics (STE(A)M) Certified school programs often include Maker Spaces as a way to encourage innovation and entrepreneurship among students and school communities.

Georgia's schools, colleges, and universities are embracing the maker movement. For example, Georgia Southern's College of Education created the Innovation Studio to explore creativity and innovation. Georgia State University's College of Education has the ExLab to demonstrate the value of experiential learning—learning by doing.

The Science Library MakerSpace at the University of Georgia serves all students

an opportunity to build, explore, and innovate. In addition, Kennesaw State University's Bagwell College of Education has a toolkit for developing school-based MakerSpaces. These are just a few!



Georgia Institute of Technology's Provost Dr. Rafael Bras has led a charge with a STEM/STEAM Extension Service, an idea that hatched from the Commission on Creating the Next in Education. You can learn more about "Learning by Doing" in the summary of the Commission's work. In short, maker spaces offer a context for students to solve real-world challenges, imagine and invent, and create new possibilities.



“Throughout the planning process we visited many schools across Georgia and a few around the country to see how these spaces are configured. From there it was a collaborative effort between many Gwinnett County Public Schools departments to make it all come to fruition,” states Tim Herman, Gwinnett County’s Coordinator for Academics and Career & Technical Education. Like other public school systems, Gwinnett is adding more maker spaces in high schools and elementary schools.

As Georgia’s STEM/STEAM movement grows, interdisciplinary connections in

makerspaces grow as well. There is an emerging research literature on the use of makerspaces in education.

The spaces offer students a place to invent, learn, and explore. As students engage in these spaces, they can engage in challenges, problem-solving, and projects. Students learn to become tomorrow’s producers, not just consumers. They learn to innovate so that they can solve tomorrow’s problems.

Partnering with Schools to Create Producers

Would you like to contribute to a growing school-based makerspace?

Here are a few tips:

- Visit other schools and maker spaces to see what is possible.
- Talk to school leaders about where a space could be housed. If the school does not have extra room, is there a nearby community partner that could provide space for students?
- Talk to local leaders about art studios, libraries, labs, and businesses about whether and how they might allow students into their spaces.
- Start small. Do not buy the most expensive tools or devices. Start with donations and small investments in simple machines. One makerspace leader told me that it was more important to buy a button maker and sticker maker than it was to buy a 3-D printer because more people could succeed using those simpler tools faster.
- Use your local community members as partners. Do you have a retired wood-worker? A local culinary artist? A smart technology professional willing to share her time? Makerspaces thrive when they involve all community members—of all ages—to share their expertise and learn from each other.
- Ask local business and civic leaders to contribute expertise, not just

money. Balancing budgets, ensuring proper safety measures are implemented, communicating widely—these are some of the skills that local leaders can provide.

Partner with local technical colleges and universities. Many colleges and universities around Georgia have started their own maker spaces. Can K12 students visit? Can tool-shares be arranged? Can expertise be traded? These are ways to leverage local partnerships to grow interest, good will, and build the path from K12 to college and career.

Links:

Athens MakerSpace

<https://athensmakerspace.com/>

The Hatch Athens

<https://www.hatchathens.com/>

Augusta's "The Clubhouse"

<https://theclubhou.se/>

Columbus Makes IT

<http://columbusmakesit.com/>

Decatur Makers

<https://decaturmakers.org/>

SparkMacon

<https://www.sparkmacon.com/>

Rome's MakerVillage

<https://www.makervillage.org/>

Research on Makerspaces

Google Scholar search for makerspaces:
https://scholar.google.com/scholar?hl=en&as_sdt=0%2C11&q=maker-space&btnG=

Harvard Educational Review: December 2014

<http://www.hepgjournals.org/doi/abs/10.17763/haer.84.4.34j1g68140382063?code=hepg-site>

The Promise of the Maker Movement for Education 2015

<http://docs.lib.purdue.edu/jpeer/vol5/iss1/4/>

Not a research paper, but article about connection to English from EdSource

<https://edsource.org/2016/maker-spaces-for-science-instruction-also-proving-helpful-for-english-learners/572782>

A Review of University Maker Spaces

<https://smartech.gatech.edu/handle/1853/53813>

Nation of Makers (NOM)

<https://nationofmakers.us/m>

MakerEd 2015 Literature Review

<https://makered.org/wp-content/uploads/2015/08/Makerspace-Lit-Review-5B.pdf>



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.....and their parents.....

Zili Wu at Georgia Tech:

Beating plants at photosynthetic step with help from catalysts

by Dawn Levy

Zili Wu of the Department of Energy's Oak Ridge National Laboratory grew up on a farm in China's heartland. He chose to leave it to catalyze a career in chemistry. Today Wu leads ORNL's Surface Chemistry and Catalysis group and conducts research at the Center for Nanophase Materials Sciences, a DOE Office of Science User Facility at ORNL. It turns out what he learned on the farm would later continue to inspire him and feed his accomplishments.

In the 1990s at Wuhan University, a professor captivated Wu with the idea that biochemistry was at the center of two disciplines, with a lot of interaction between the two. "That's where a lot of interesting things happen," Wu enthused. Summer jobs at Wuhan gave Wu his first taste of catalysis research. Chemical reactions follow different pathways to yield diverse products, not all of which are useful. Catalysts lower the energy required for activation of select reaction pathways. Because they



cat·a·lyst

/kad(ə)ləst/

noun

noun: catalyst; plural noun: catalysts

- *a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.*

- *a person or thing that precipitates an event. "the governor's speech acted as a catalyst for debate"*

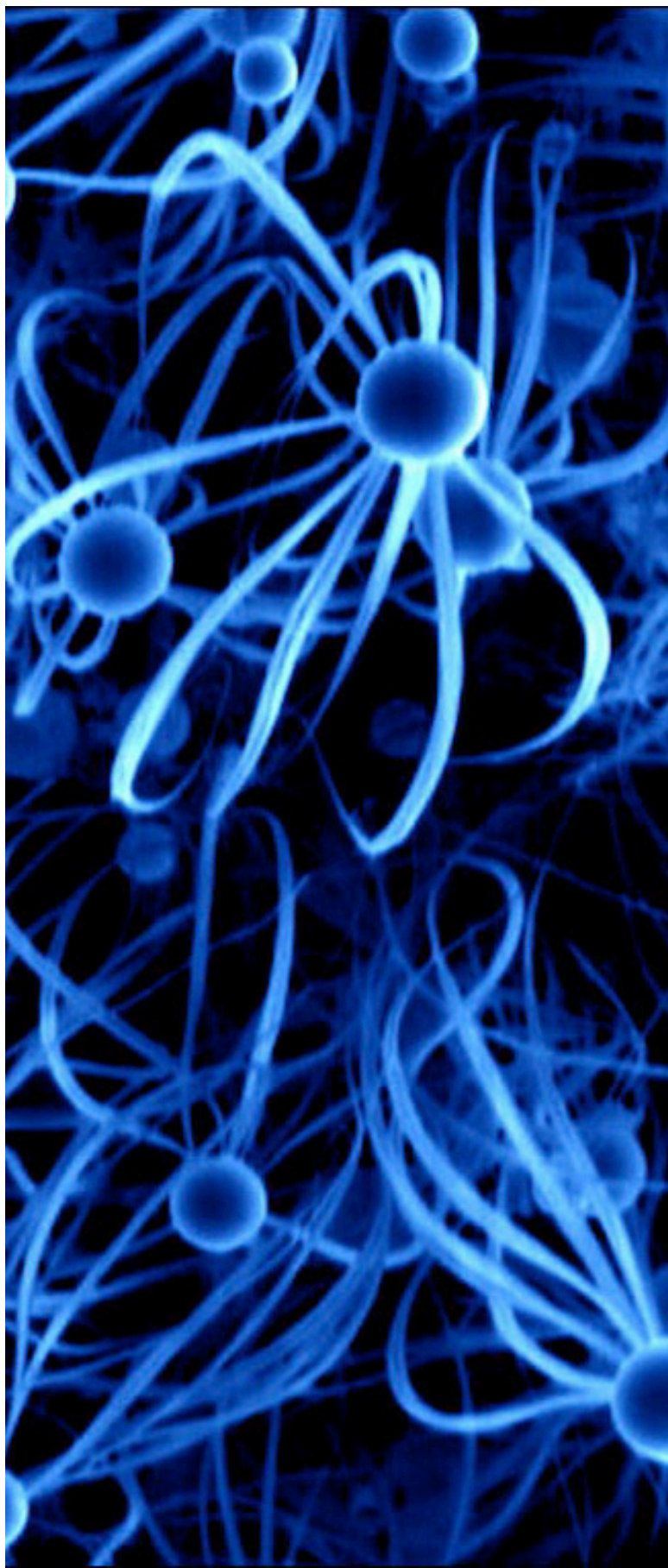
- *synonyms: stimulus, stimulation, spark, spark plug, spur, incitement, impetus*

increase chemical yields of desired products, they save energy and reduce waste.

For his graduate studies, Wu attended Dalian Institute of Chemical Physics, working with luminary chemists Qin Xin and Can Li. Wu found photocatalysis pioneer Li an especially inspiring role model. Li arrived in the lab at 8 am, left at midnight and held meetings on weekends so all members of his large group could attend and learn from each other.

Like most students in China, Wu had studied written English but had little opportunity to speak it. During graduate school, he spent a year in Spain working with English-speaking colleagues. Back at Dalian, a visiting professor, Peter Stair, came to rely on Wu's English skills. Impressed by Wu's chemical prowess as well, Stair offered him a postdoctoral fellowship in the catalysis center he directed at Northwestern University. Wu earned his doctorate in 2001 from Dalian. In 2003, he left for Northwestern to work on an ultraviolet Raman spectroscopy project for chemical firm Johnson Matthey to understand catalyst deactivation.

In 2006, Wu joined ORNL and devoted himself to research to understand complex catalysts and reactions, using applied spectroscopy and well-structured



nanomaterials. Much high-impact research ensued, as exemplified by a paper published in 2012 on which he was the first author. To this day it remains a top 1 percent-ranked paper in the catalysis field.

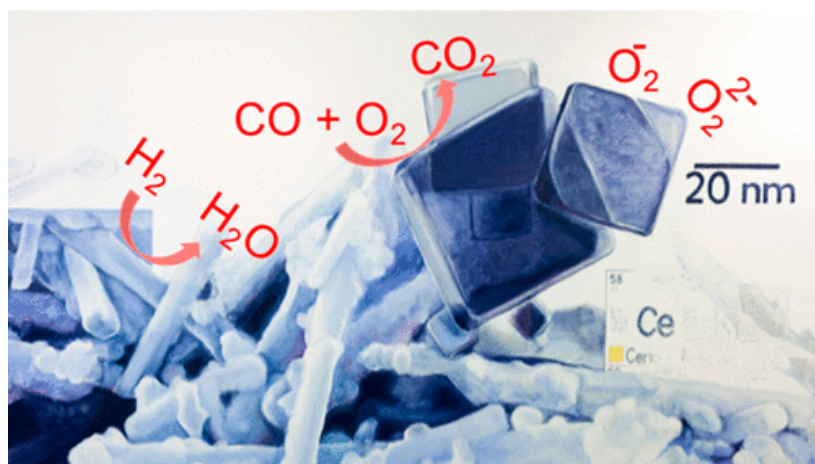
Spectroscopy connection

On a catalyst's surface, molecules gather and chemical bonds form. The “landscape” of energies needed for various products to form is mountainous, with some slopes harder to “climb” than others. “Normally you have to climb to the mountaintop to get to an adjacent valley,” Wu said. “A catalyst is like a local guide who knows a shortcut, maybe a tunnel. It’s a much easier path to your destination. Catalysts won’t change your starting and ending points, but they change how you get there.”

Wu’s many projects aim to design ideal catalysts. His primary tool, spectroscopy, connects them all.

“Spectroscopy is one of the great tools for understanding surface chemistry,” he said. “It records what kind of bond is forming, how it forms, at what temperature, at what stage it forms, what kind of chemical intermediate it goes through, how it gets to the product stage.”

Wu monitors catalysts and their intermediates and products with operando spectroscopy—which employs optical spectroscopy (infrared and Raman), neutron and X-ray spectroscopy, in situ electron microscopy and other techniques (mass spectrometry and gas chromatography)—to make real-time measurements of catalysts working under reaction conditions in an environmental cell.



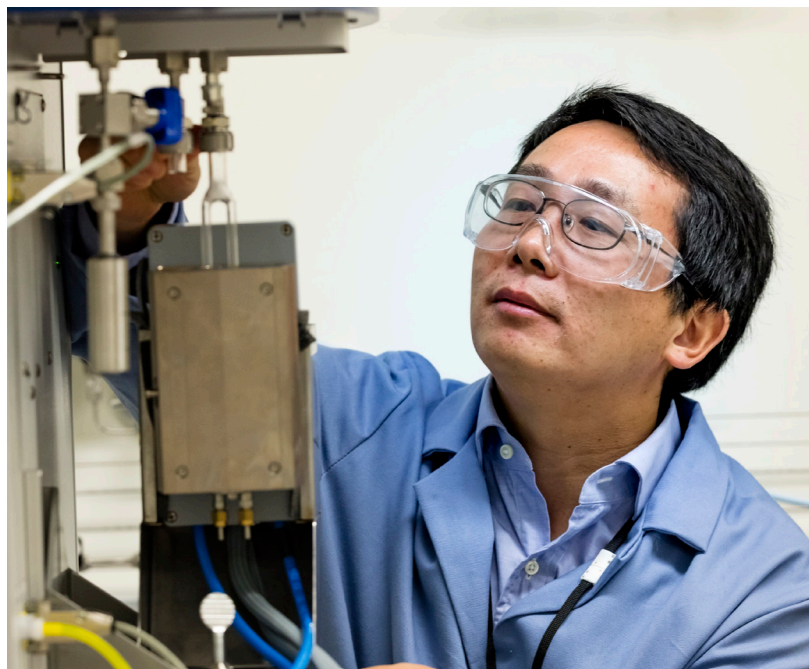
One of Wu’s projects controls the morphology of nanocatalysts that expose different crystal facets to change interactions with reactants. “With a different shape, you can expose the structure of the atoms differently,” Wu explained. “You can get different directivity or selectivity, even different electronics because of surface structure effects. You can completely change the reactivity of the atoms with the catalyst when the catalyst is shaped differently.” For example, Wu studied ceria catalysts and provided a deep understanding of why shape matters in guiding reactants to specific products.

In another study, Wu helped show inexpensive common metals have the potential to replace expensive noble metals, such as platinum and palladium, in commercial catalysts. If theory predicts a catalyst will work well, ORNL's Sheng Dai, an expert in the precise synthesis of materials, can make it and Wu can test it. Dai made a "CCC catalyst"—an oxide compound made with copper, cobalt and ceria. Wu characterized it, and ORNL's Todd Toops at the National Transportation Research Center performed tests that showed it usually worked better than a commercial catalyst at removing carbon monoxide, nitric oxide and hydrocarbons from automotive exhaust.

Catalyst stability is the focus of a major project of Wu's. "We are taught in high-school chemistry class that catalysts do not change, but that's not true," Wu said. Catalysts undergo structural changes and even deactivate. "That's why in an industrial process, every five or ten years you need a new catalyst—the old one no longer works well."

A catalyst can deactivate when a chemical reacts strongly with it, blocking active sites, or through chemical poisoning. The latter is the focus of Wu's work in the Center for Understanding and Control of Acid Gas-Induced Evolution of Materials for Energy, a DOE Energy Frontier Research Center

headquartered at **Georgia Tech**. Industrial processing removes organic sulfur from raw oil because corrosive sulfur gas, generated when the fuel is burned, inactivates an important catalyst. Wu's in situ characterization reveals exactly how acidic gas enters the catalyst, reacts with it and changes its structure.



Chemist Zili Wu makes discoveries about catalysts using a suite of sophisticated tools, such as this adsorption microcalorimeter to probe catalytic sites. Image credit: Oak Ridge National Laboratory, U.S. Dept. of Energy; photographer Carlos Jones

Finally, Wu's projects explore the size effects of catalyst particles from nanoparticles to clusters. He said, "Now we even go to a single atom because it's completely dispersed—you don't have any bulk. Once you have bulk, the center can't be utilized. If you have a single atom, everything can be used without wasting even one atom."

Ideal Catalysts

Having grown up on a farm, Wu knows a thing or two about plants. Now he wants to beat plants at a small but critical step of photosynthesis—splitting water into hydrogen and oxygen—and thinks catalysts can help.

“Understanding how to split water is a key to clean energy,” he said. “If hydrogen fuel is derived from water and burned, the hydrogen combines with oxygen to form water again. This fuel cycle is clean.”

The challenge is getting the hydrogen out of the water in the first place. Applying an electric charge can split water and make hydrogen. Sunlight can also split water if a catalyst is present to absorb its radiant energy and generate a charge.

“My dream is to efficiently convert solar energy into chemical energy,” Wu said.

Aided by enzymes, plants do exactly that, albeit inefficiently. They convert less than one percent of the solar energy they capture into chemical energy.

“To do better, we need catalysts,” Wu said. Exploring two-dimensional materials, he and colleagues at the CNMS discovered synthetic catalysts that can

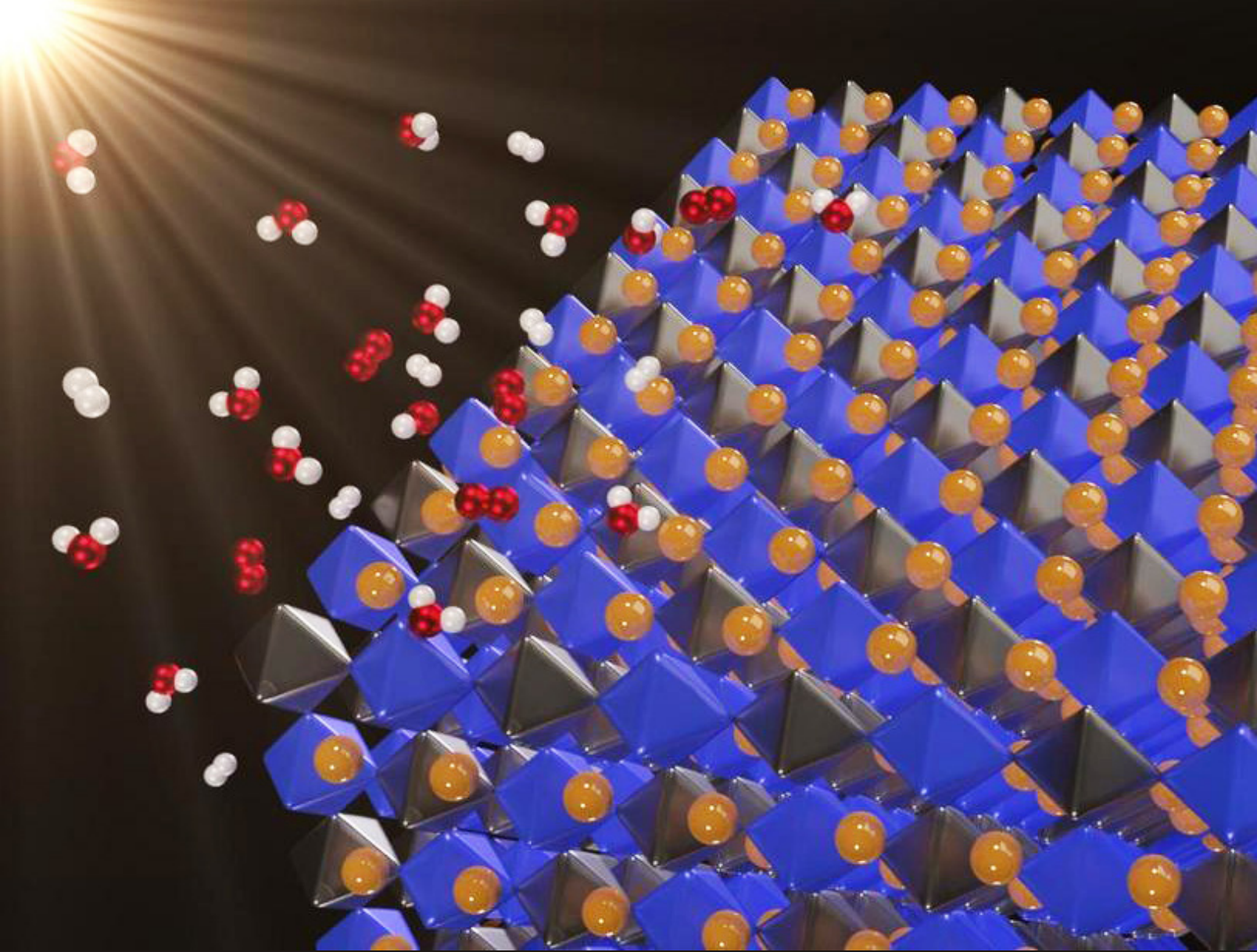
outperform photosynthetic enzymes at using light to accelerate a chemical reaction—called photocatalysis.

Wu will build on such advances by pooling resources in imaging, theory and supercomputing to gain insights about experimental observations. He hopes to use this knowledge to design “ideal” catalysts that are nearly 100 percent efficient at converting reactants to a selected product.

Ideal catalysts could accelerate the advent of energy-efficient production of fuels, pharmaceuticals, polymers and other commodities that would not be profitable or possible without catalysts.

DOE’s (Department of Energy) Office of Science supports Wu’s research.

UT-Battelle manages ORNL for DOE’s Office of Science. The single largest supporter of basic research in the physical sciences in the United States, the Office of Science is working to address some of the most pressing challenges of our time. For more information, please visit www.science.energy.gov.



Solar energy is clean and abundant, but when the sun isn't shining, you must store the energy in batteries or through a process called photocatalysis. In photocatalytic water splitting, sunlight separates water into hydrogen and oxygen, which can then be recombined in a fuel cell to release energy. Now, a new class of materials -- halide double perovskites -- may have just the right properties to split water, according to research in Applied Physics Letters. In this image: Novel, lead-free double perovskites as potential photocatalysts for solar water splitting



“Music training before the age of seven has been found to have a significant impact on brain development”

TRADITIONAL AND NONTRADITIONAL CAREERS IN PHARMACY

By Bita Rabizadeh, Stefanie Wong and Zvi G. Loewy

The role of the pharmacist has evolved over the past few decades. Historically, the pharmacist's primary focus was compounding and formulating different medications, and the dispensing of medications based on physician orders. The pharmacist delivered the therapeutic to the patient, but was not directly involved with the healthcare of the patient.

Today the role of the pharmacist has evolved into participating on inter-professional medical teams responsible for patient care. Pharmacists are involved in direct patient care to ensure that appropriate medication therapies are selected for patients. Given the evolution of the profession, broad career categories for pharmacists are available including in community and retail establishments, hospitals, throughout industry and as entrepreneurs.



Community pharmacists

have an important function in providing distinctive and diverse services to the community. As drug experts and the most accessible healthcare professionals, pharmacists can have a significant impact on public health. They educate patients and help them better understand their symptoms and the purpose of taking their medications.

Other services provided, like medication therapy management, aim to improve treatment outcomes and reduce medication-related problems and any adverse effects. Community pharmacists have the unique opportunity to counsel patients on a variety of disease states, behavioral modifications and drug interactions. They also provide drug information to patients and other healthcare professionals.

Community pharmacists are also immunizers, and recent advances in that function have successfully increased immunization rates in many communities. Pharmacists can now assess each individual for his or her immunization schedule and recommend needed vaccinations. Depending on state law, they can also administer vaccines, with or without prescriptions.

Among all of the frequently administered vaccines, pharmacists have a vital role in increasing awareness of the importance of annual influenza

vaccinations. Seasonal influenza is a major cause of severe respiratory illnesses and a leading cause of hospital admissions and death in the elderly.

The **immunizer pharmacist** can facilitate the immunization delivery as an alternative practitioner to doctors and nurses, who traditionally have administered vaccines in hospitals and medical offices. Most people prefer to receive immunizations in a community pharmacy, an environment that is more convenient and accessible compared with a doctor's office. They can obtain their vaccines easily without making appointments and waiting long hours in medical offices.

Working as a **retail pharmacist** is gratifying, especially for people with outgoing personalities. Pharmacists have many interactions with patients and it is very rewarding when they can help patients with their treatment plans and medications. There are also many opportunities for retail pharmacists to participate in medication therapy management services, which are designed to improve treatment outcomes for patients. On the other hand, it can be frustrating for pharmacists when they are working in understaffed retail settings with high volume prescriptions.



Although pharmacists are responsible for ensuring accuracy and preventing medication errors, they may have less than a minute to work on a prescription in a busy pharmacy.

Additionally, retail pharmacists need to have excellent customer service skills to deal with patient complaints regarding insurance billing issues and the costs of medications. Depending on the prescription volume, a retail pharmacist may be the only pharmacist on duty on a given day. Thus, in the retail setting, depending on the staffing level,

pharmacists may experience burnout and stress. Pharmacy managers need to address and solve this issue to increase job satisfaction among retail pharmacists and ensure high quality patient care.

Hospital Pharmacists

Hospital pharmacists play a remarkable role in serving as members of medical teams that recommend the best possible medication regimens for patients. Pharmacists work side-by-side with other healthcare providers and have

access to patients' medical profiles and lab results, which enables them to better design and monitor treatment plans and reduce adverse drug reactions. They evaluate every medication order to ensure that it is safe and effective, and they recommend any necessary changes to improve treatment outcomes.

Hospital pharmacists also work in the hospital infusion centers and are involved in sterile compounding, and delivering by intravenous means nutrition and chemotherapy medications. Pharmacists are responsible for reviewing and inspecting physician orders to ensure proper dosage and accurate directions are provided for the use of medications. They also oversee the intravenous (IV) room and implement procedures to ensure the safety and efficacy of compounded medications.

Clinical pharmacists in hospitals round with physicians and nurses to meet and evaluate patients and recommend appropriate medication therapy based on patients' needs. They work closely with other healthcare providers to obtain accurate medication histories of patients. Medication reconciliation at any transition of care, from admission to discharge, can significantly prevent medication errors such as omissions, duplications or dosing errors.

Pharmacists ensure the safety and efficacy of medication orders during each transition of care. They also provide comprehensive medication management to improve patients' health outcomes. Pharmacists evaluate patients' medications to ensure that prescription and non-prescription medications are correct for the patient and relevant based on their conditions.

Pharmacists also recommend adding or deleting medications or regimens, and changing medication doses or frequencies based on patients' needs and conditions. They are concerned about adverse effects and drug interactions in patients and recommend necessary changes to address them.

In many states, hospital pharmacists formally partner with physicians to provide optimal drug therapy management through agreements. Known as Collaborative Drug Therapy Management (CDTM), physicians delegate authority to pharmacists to engage in activities such as initiating or adjusting dosage of medications, ordering lab tests and obtaining vital signs to monitor drug effectiveness. As a result, the pharmacists share responsibility for patient outcomes.

Pharmacists can treat different scenarios under CDTM, including but not limited to asthma, hypertension,

diabetes, dyslipidemia, depression, warfarin and anticoagulant therapy management. As a result, patient care is improved, the costs of medication-related problems and adverse effects are decreased, and patients have superior access to health care.

Hospital pharmacists collaborate with other members of the medical team and play important roles in selecting appropriate treatment plans for patients -- a very fulfilling responsibility. At the same time, there are fewer leadership opportunities and management positions available for hospital pharmacists as compared to the retail setting. Promotions to management positions take longer and require more experience compared with the retail setting. Hospital pharmacies operate 24/7, so there are night shift pharmacist positions, not all of which may be convenient for some pharmacists.

Pharmacists in the Pharmaceutical and Biotechnology Industries

Within a pharma or biotech company, pharmacists can work in many different areas, including research and development, process development and scale up, manufacturing, regulatory affairs, medical and scientific affairs, quality assurance and control, marketing and sales, business development and general management.

A benefit of working in industry as compared to working in a retail pharmacy is that colleagues are highly skilled; the industry-based work environment promotes continued growth and provides opportunities for vertical and horizontal advancement. In contrast, retail pharmacists are often working alone with less exposure to, and interaction with, similarly trained peers.

Pharmacists are valued in industry because of their technical and clinical training. They understand the patients and have first-hand knowledge and experience with how patients/consumers use their medications and medical devices. Pharmacists are akin to systems engineers in that they have both the knowledge and practical experience to provide input in an optimal manner as to how a medical product should be used.

Pharmacists working in industry may be required to travel, including internationally. The pharmaceutical industry operates on a global scale; although some products are global, other products are at times developed for specific countries in different geographical regions of the world. Understanding the “unique consumer” and the healthcare challenges in different geographical regions is often facilitated by immersion in a country or region to scope out the unique ethnography of a region.

A Pharmacist's Role in Biotechnology Entrepreneurship

Contrary to the name, a biotechnology entrepreneur is more than just an individual who operates a biotech company. A biotech entrepreneur is unique as compared to all other entrepreneurs. All entrepreneurs exhibit determination, passion and persistence. What differentiates a biotech entrepreneur is a strong desire to enter into an industry full of risks, both commercial as well as scientific and technological.

While any individual with the right idea, skill and sufficient capital can start a biotech company, the odds are usually stacked against them unless they hail from a certain background; most come from academia or other biotechnology companies working as scientists or business executives in the pharmaceutical industry. Given the high barriers to entry, it is likely that individuals without industrial experience would need to leverage other strengths to be competitive.

A pharmacist is a good example of an individual who can leverage other skills and strengths to become a successful entrepreneur.

One of a pharmacist's strengths is diversity in training. The process of drug discovery and developing new systems are activities typically associated with the work of pharmaceutical scientists.

Pharmacists are trained to be drug experts and work with patients and other healthcare professionals to optimize health outcomes and use of medications. Although they work primarily with existing drugs, pharmaceutical chemistry, pharmacology and pharmacokinetics – the interaction of drugs with the body – are core components of a pharmacist's training. The formal training provides pharmacists with a broad understanding of structural chemistry and the effect of drugs in the body that are critical to the development of new drugs and their therapeutic applications.

Importantly, clinical training of pharmacists enables them to develop “soft skills”. While certain personality types gravitate towards science because they are introverts and not particularly good at interacting with others, pharmacists usually have a certain degree of effective communication skills and they use them with their patients. The ability to interact and relate with others on a social level are necessary attributes for being a successful entrepreneur.

To understand **STEM...**

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

Universities and organizations around the world continue to debate what a STEM career is. There is no doubt that “every career” uses STEM skills and this observation remains the focus of STEM Magazine.

Science: “The systematic accumulation of knowledge” (all subjects and careers)

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

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

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

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

These definitions are the “real” meaning of STEM skills and STEM careers.

Rome

Atlanta

Athens

STEM is Georgia Wide

Columbus

Macon

Savannah

Albany

Brunswick

Valdosta



TAG
Technology Association
of Georgia



TAG-Ed
Education Collaborative