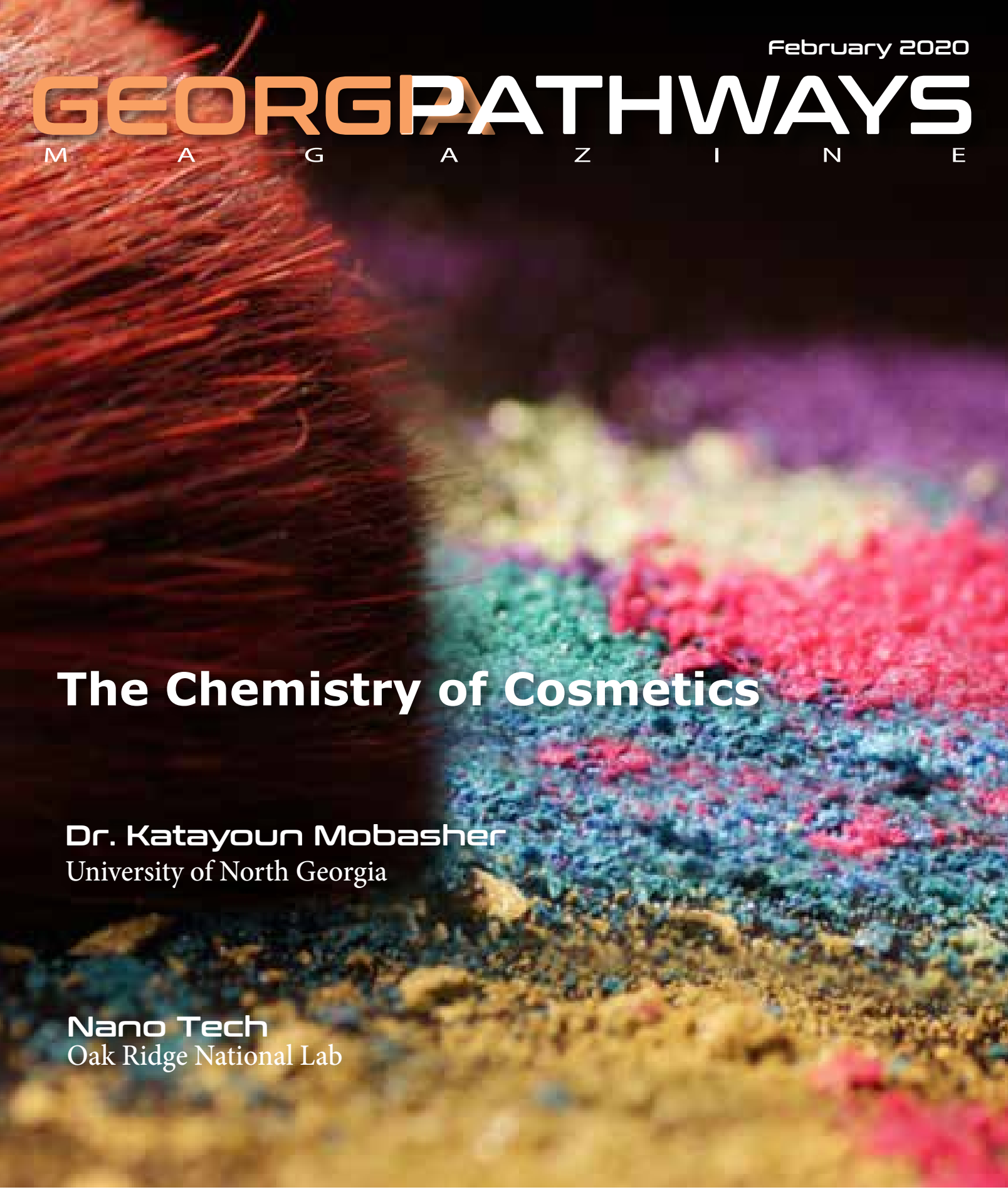
February 2020

GEORGIA PATHWAYS
MAGAZINE



The Chemistry of Cosmetics

Dr. Katayoun Mobasher
University of North Georgia

Nano Tech
Oak Ridge National Lab

TAG Technology Association of Georgia
TAG TAG-Ed Education Collaborative

Are your students / children, preparing to repair these “servants of mankind” as their near future career field?

Are they even interested?

Should they be?

What do they need to learn?

Welcome to our latest edition of Georgia Pathways STEM Magazine.

Under "stay-at-home" orders amid the COVID-19 pandemic, many students and their working parents are distance learning virtually, opening a new need for STEM education options.

Quickly, institutions and companies have responded, offering online activities that can keep students engaged and mentally active.

Georgia Power recently launched a new Georgia Power Learning Power app that includes interactive lessons for students and fun, educational activities with real-world applications of STEM topics like energy efficiency.

Many organizations are offering free STEM and STEAM resources nationally as well, recognizing both the need, and opportunity, for educational outreach at this unprecedented time. Amazon, for example, is providing free access to its Amazon Future Engineer courses for independent learners grades 6-12.

Amid this plethora of free online resources, TAG is working to provide its members with COVID resources as well, knowing that many of our members have become overnight educators to their children.

This publication now provides another excellent resource for educators, parents and students to engage in STEM education.

As you read through this issue, I hope you will find easy reference materials and activities for students to use in their distance learning environments. I encourage you to pass this edition along and keep STEM education thriving as students and teachers look forward to getting back to the classroom.

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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Free resource online

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To understand STEM...

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

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

SCIENCE: "The systematic accumulation of knowledge" (all subjects and careers fields)

TECHNOLOGY: "The practical application of science" (all subjects and careers)

ENGINEERING: "The engineering method: a step by step process of solving problems and making decisions" (every subject and career)

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

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

These definitions are the "real" meaning of STEM and STEM careers.

UNG
UNIVERSITY of NORTH GEORGIA

Geology Professor Creates 3D Tactile Map
for students with disabilities

What started out as a way to help one visually impaired student turned into two major projects from Dr. Katayoun Mobasher, professor of geology in the Institute for Environmental and Spatial Analysis (IESA) at the University of North Georgia (UNG).

The first idea arose in 2011 when Mobasher realized a visually impaired student enrolled in her geology class could not see the different lines and distinctions on a general 2D map.

"Geology is a field-based science and we also look at a great deal of maps," Mobasher said, pointing to different attributes on a map. "With a visually impaired students, you can't teach these concepts in a traditional way."

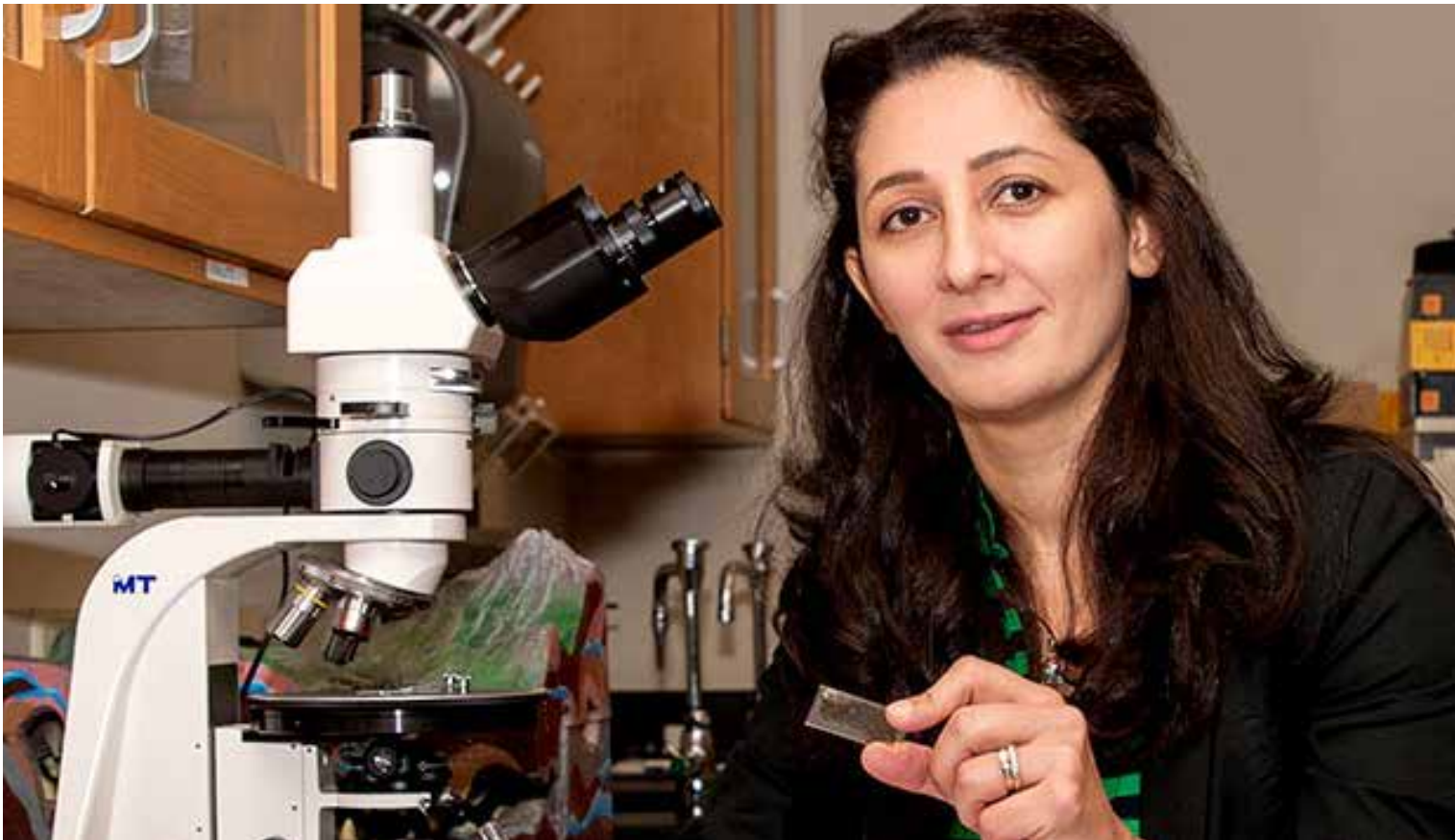
The professor tackled the problem in January 2017 thanks to a Presidential Incentive Award. With the funds, Mobasher invited Efren Chavez and Carol Kramaer as consultants to the project and together, they created a two-layer 3D tactile map. The first layer of the map allowed a visually impaired student to learn the coordinates which were broken down it into boxes or zones. The second layer had Braille and textured lines to indicate different elevations, geographic features, and even small buildings.

With the map, a visually impaired student can use his or her fingers to feel the differences on the map. To Mobasher's surprise, it helped others as well.

"Some students who are multisensory learners were struggling with understanding the information shown on a map," she said. "So when I pull out a tactile map, since the information on the map breaks into different layers, it makes it easier for students to grasp the concepts. I often hear them say 'Oh! Now, I understand how everything makes sense.'"

Mobasher did not stop with the map, though. She recreated fossils as tactile illustrations where visually impaired students could examine them. These models were printed out at UNG's 3D printing lab in Gainesville, under Dr. JB Sharma's supervision.

For example, Ammonoid Cephalopod fossils show increase in their structural complexity, the evolutionary trend is shown though suture lines on the surface of fossils," she said. "These lines are very subtle and often difficult to see for students. We recreated the evolutionary pattern of these suture lines by exaggerating the lines, allowing students to feel it."



Mobasher completed her map projects in December 2017. In 2018, she presented it at conferences such as Geological Society of America's national meeting and received positive feedback.

"No one has created anything similar to this," Mobasher said. "It's very unique." This project is not the only one for which she has received positive feedback. With a 2014 Presidential Award, Mobasher developed an interactive web-based geological field guide and database for the state called "Geology of Georgia."

The field guide is an interactive story map designed to teach the geology of the region by taking the reader to locations of rock outcrops and mineral deposits in Georgia. The pages act as a virtual workbook for students and others interested in Georgia's geology. As further reference, page numbers throughout the story map reference the book Roadside Geology of Georgia.

Her idea, though, stemmed from a desire to help a student see the geological sites in Georgia without having to leave the classroom.

"I added a GoPro camera where students who can't attend because of accessibility could still participate in the activity," she said.

Mobasher also designed the interactive database to allow amateur and professional geologists to contribute with their own information. Contributors may download the Collector for ArcGIS app and/or Survey123 to their smartphones or tablets and then go out into the field to collect geological data. Mobasher checks the accuracy of the database.

Now many groups from the Atlanta Geological Society and Georgia Geological Society to geologists outside of the United States wish to collaborate with her on the project or want help creating their own. Mobasher attributes this interest to a 2018 article about her work published in ArcNews, which is a free publication printed quarterly that provides news on GIS, geospatial technology and Esri software to the Esri user community as well as others interested in mapping and GIS technology.

Dr. Mobasher is a faculty member in the Lewis F. Rogers Institute for Environmental and Spatial Analysis (IESA). She began her academic career in 2001 as a teaching assistant at Georgia State University. In 2005 she worked as a lecturer of geology at Berry College in Rome, GA teaching environmental geology, and introductory geology courses and labs. She then moved to Georgia State University and worked as a visiting instructor of geology teaching introductory geology courses and Introductions to Earth's Materials. Dr. Mobasher came to the Gainesville campus in 2008 as an assistance professor of geology. She became an associate professor in 2012 at UNG. Dr. Mobasher is a certified GIS Professional (GISP).

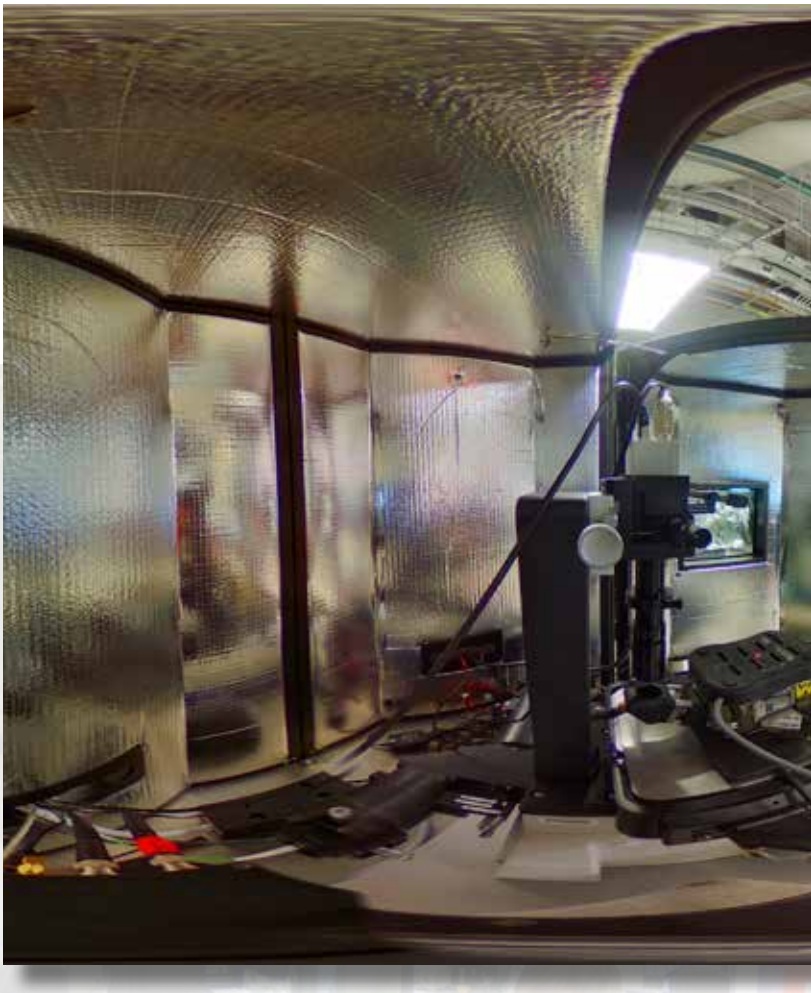
OAK RIDGE National Laboratory

Liam Collins: Mapping The Unseen

by Ashley Huff

Liam Collins was drawn to study physics to understand "hidden things" and honed his expertise in microscopy so that he could bring them to light. Both interests converged at the Department of Energy's Oak Ridge National Laboratory, where Collins focuses on materials—down to molecules and atoms—to answer fundamental questions about matter, motion and energy.

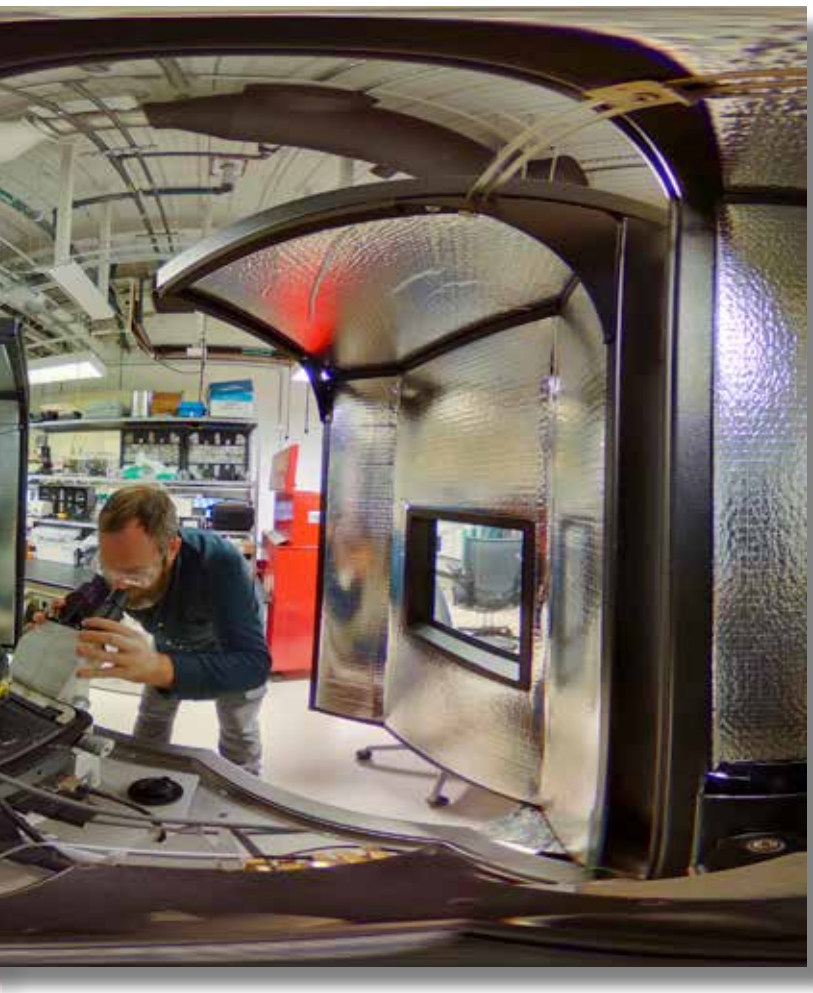
As a staff scientist at the Center for Nanophase Materials Sciences, a DOE Office of Science User Facility at ORNL, Collins supports the center's user program by advancing microscopy techniques that push the limits of observation and enable researchers to study materials and their properties on a nanometer length scale. CNMS users from all over the world work with Collins to gain nanoscale insights on materials that lead to new frontiers in energy, biology, medicine and beyond.



ORNL scientist Liam Collins develops atomic force microsco
material properties at the nanoscale for broad applications in
Martin/Oak Ridge National Laboratory; U.S. Dept. of Energy

Material discoveries

Collins grew up in Ireland with a natural curiosity that sparked twinned desires for teaching and learning. The school he attended was small and its curriculum sparse, leaving the would-be physicist hungry for more.



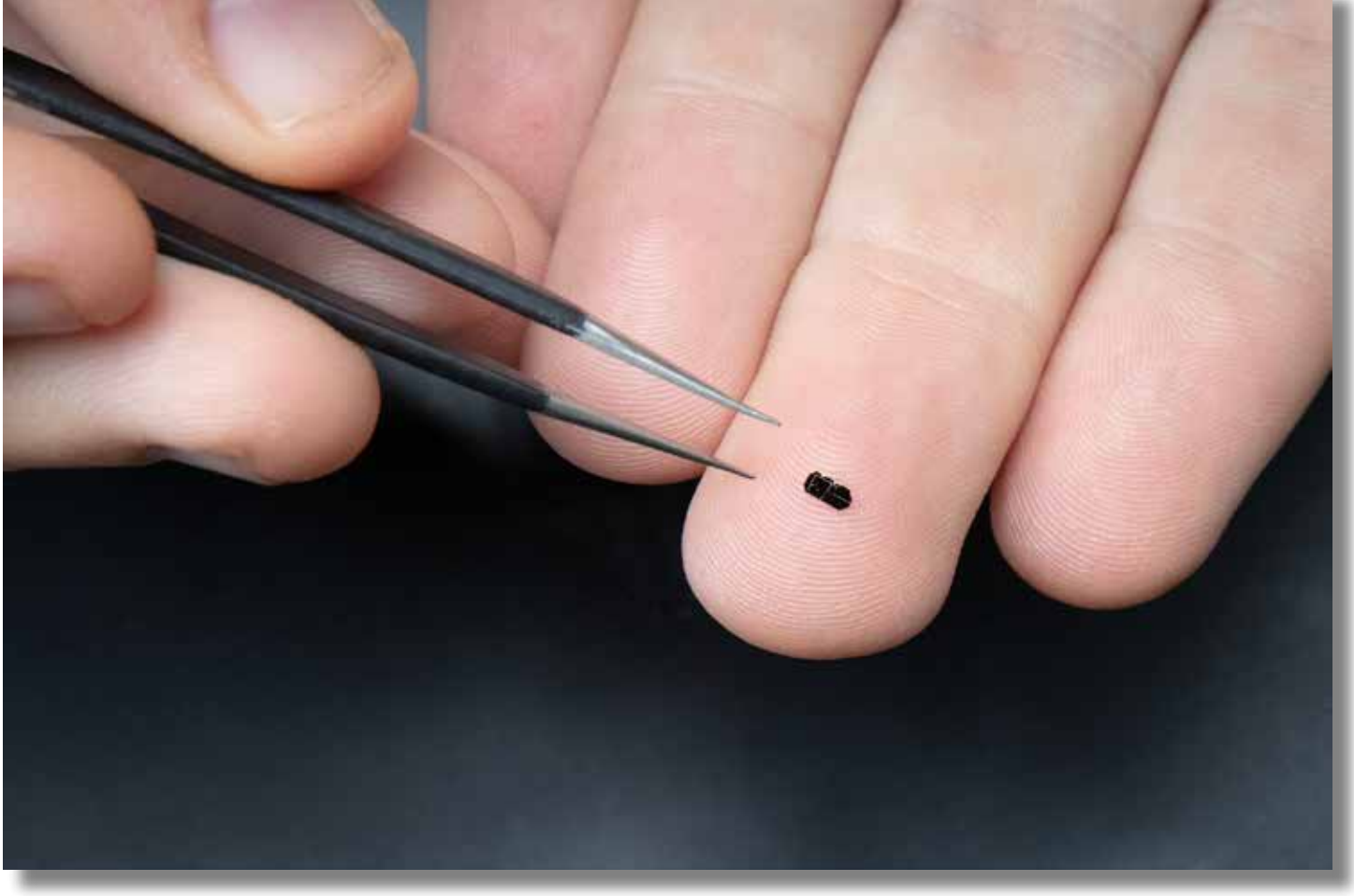
opy techniques that enable CNMS users to map and modify
n energy, biology, medicine and beyond. Credit: Genevieve
y.

"I've always been the kind of student—and still am—who wanted to know more, to ask the questions no one else had asked and to find out the answers no one else knew," he said.

Collins' passion for learning led him to pursue a teaching degree, with plans to expand science education in his hometown. He completed a bachelor's degree at the University of Limerick and taught high school courses in a range of subjects, including physics, biology, agricultural science and math.

Teaching in turn whetted Collins' appetite for research, and he went back to Limerick for a master's in applied physics and then to University College Dublin for a doctorate in physics. Collins' UC Dublin research focused on advancing microscopy techniques to better understand biological systems. He set out to study biomolecular interactions thought to drive processes such as protein (mis)-folding, photosynthesis or even plaque formation in the brains of Alzheimer's patients. The challenge led him to Oak Ridge, where he connected with the lab as a CNMS user to develop novel atomic force microscopy techniques.

Atomic force microscopes (AFMs) are instruments that "see" by scanning the surfaces of materials with an atom-sharp probe to build up a picture of the nanoscale details—similar to the way a record player's stylus feels the grooves in vinyl to play out music.



Scanning probe microscopes use an atom-sharp tip—only a few nanometers thick—to image materials on a nanometer length scale. The probe tip, invisible to the eye, is attached to a cantilever (pictured) that moves across material surfaces like the tone arm on a record player. Credit: Genevieve Martin/Oak Ridge National Laboratory; U.S. Dept. of Energy.

AFMs are powerful enough to feel the forces that bind molecules or move atoms—including mechanical, chemical, magnetic and electrostatic forces—and can map out the way a material responds to these unseen energies, capturing the relationship between structure and functionality.

Collins' user projects resulted in several novel AFM techniques, jointly developed by UC Dublin and ORNL, that have made it possible to observe key energy processes taking place at nanometer and molecular levels in diverse materials.

Electrochemical force microscopy, for example, grew from an interest in seeing the surface charges of cell membranes to investigate their role in biological processes; it has since opened wider opportunities to study electrochemical and ionic processes at solid-liquid interfaces, including corrosion, sensing, energy storage and conversion.

"Once you are probing materials at the nanoscale and nearing the level of atoms, the kinds of questions you are asking will apply to many disciplines," said Collins. "Whether users want to solve biological problems or improve the performance of batteries, they are on similar quests to

understand and modify materials at the farthest reaches of science."

Charting new territories

Collins' user experience led him to extended collaborations with the CNMS, a subsequent postdoctoral appointment, and now a staff role in the Scanning Probe Microscopy group. Supported by the Office of Science, he furthers the CNMS aim to arrive first at new science frontiers and lay the groundwork for potential avenues of exploration.

"Our goal is to develop cutting-edge techniques that draw users who will carry the science forward," said Collins.

Commercially available instruments like AFMs have made it possible for researchers to access nanoscale landscapes, but navigating the terrain is still an extraordinarily complex task. Materials can have multiple functionalities—electrical, chemical, mechanical—that occur simultaneously and evolve over time. Standard AFMs are powerful enough to observe the richness of the nanoworld, but the interconnected data they collect can be challenging to interpret.

"That's why people come to the CNMS—because we are at the forefront of overcoming these obstacles to get unique insights with our instruments," said Collins. Techniques are really what drive the science, says Collins. "The instrument itself can give you a snapshot of materials on nano- and near-atomic scales, but you need to develop a range of techniques to capture and interpret the whole picture."

Collins' team at the CNMS pushes technology to capture previously inaccessible information, for example, "breaking the time barrier" to record fast dynamics that typically occur too quickly to be detected by off-the-shelf microscopes.

Another area of technique development addresses artifacts, or background noise—a known limitation of AFMs, which produce movements while scanning that can mask or interfere with sample measurements.

Collins recently demonstrated a quantitative method to overcome artifacts that contribute to false readings of electromechanical functionality in unexpected materials, even almonds (yes, the nut). As a researcher, Collins gravitates toward the anomalies and complications encountered in materials science. His current areas of technique development focus on promising and complex materials in high demand among users, including mixed ionic electronic conductors and polymers. Both are trending for "hot" applications in electronics, robotics, memory and energy storage but are not well understood at the nanoscale.

"Confronting complexity is what leads us forward," said Collins. "To advance materials for next-generation technologies, we will need to develop appropriate techniques to optimize their performance."

Users, collaborators and colleagues, he says, all spark fresh ideas for adapting techniques to expand insights and make it possible to see or create something new. "That's really why I'm here, to explore materials that challenge what we know and look for ways to deepen our understanding."

UT-Battelle manages ORNL for the DOE 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- https://energy.gov/science.

Ashley C. Huff
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LabXchange™

Learning without limits.

The Amgen Foundation and the Faculty of Arts and Sciences at Harvard University (Harvard FAS) recently launched LabXchange™, a free online science education platform that provides users with access to personalized instruction, virtual lab experiences and networking opportunities across the global scientific community. LabXchange is purpose-built to drive more inclusion in the scientific process and spark collaboration to build creative, team-based approaches to real-world problems.

"Too many high school and college students lack the opportunity to directly explore the scientific process – where you build a hypothesis, understand a method, and determine how to apply it to an appropriate experimental problem," said Robert Lue, Ph.D., principal investigator of LabXchange and professor of the Practice of Molecular and Cellular Biology at Harvard. "For many students, science can feel like a collection of facts to memorize – which is contrary to what the scientific process is – it's a journey that requires bold thinking and deep imagination.

With LabXchange, more students can come together and experience the joy of discovery."

"Everyone needs science, and science needs everyone," said Robert A. Bradway, chairman and chief executive officer at Amgen. "At a time of remarkable scientific progress, we're excited by the potential of LabXchange to educate and inspire both students and lifelong learners of all ages."

Labs are places of exploration and discovery for every field imaginable. In this spirit, you can discover, engage, and share what you learn on LabXchange. This curates and creates world-class digital content, delivered on a free, online platform that lets you integrate your learning and research experiences. Here, you take control of your learning and solve real-world problems as a community. Participation will always be free.

LabXchange brings together high-quality content from a variety of sources in the form of online learning assets, including videos, assessments, and simulations. This re-engineered Open edX platform gives users the flexibility to search, select, and insert these assets into their own customized learning pathways.

Users can add material to link the learning assets they select to create their own

storylines, clarify new learning objectives, and adapt existing pathways to better meet their needs. Users will be able to share their pathways privately or with a small group to spark discussion and receive feedback.

Interactive Simulations

Learners can design experiments and execute protocols online using interactive simulations of key techniques in molecular and cellular biology. Imagine running your experiments virtually over and over as often as you wish at no cost. Users can run their experimental designs online, assess the quality of the virtual data outcomes, and troubleshoot their designs in iterative cycles of improvement.

Each virtual experiment is packaged with appropriate learning assets that teach biological principles and methodological best practices. Combinations of virtual experiments address compelling research questions in human disease.

Educators, students, and researchers can create profiles, share their learning pathways, and discuss their hands-on research experiences. The resulting networks serve as a lifelong resource, allowing users to form affinity groups based on changing research interests.

Users are able to mentor each other, sharing their interests and experiences in science as well as relevant learning content. Educators can share learning pathways that they have designed with learners and other educators in private classes. This way, the platform fosters communities of instructional practice.

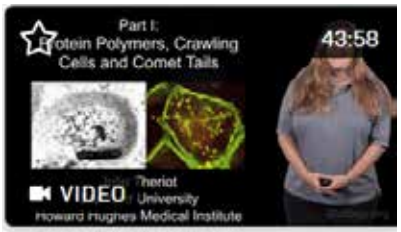
The 17 United Nations Sustainable Development Goals (SDGs) outline humanity's most urgent problems. An open-source online learning network, LabXchange contributes to SDG #4 – Quality Education, which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Amazing science resources are now available for educators globally to use and share. This is an amazing opportunity for educators world wide.

> "We envision a world with equal opportunity for success in science for anyone, anywhere."
>
> Robert Lue, Faculty Director and Principal Investigator

Promoting Human Health

The human health applications are very exciting as well. As biotechnology continues to advance, LabXchange offers a shared, free virtual opportunity to explore, experiment and collaborate in the pursuit of better health globally.

LabXchange's biology and biotechnology content contributes to SDG #3 – Good



Health and Well-Being, which seeks to ensure healthy lives and promote well-being for all at all ages. LabXchange facilitates global collaboration on the SDGs by providing ways to connect with people who share interests or offer complementary skills, and to build creative solutions together.

https://www.labxchange.org/explore

About the Amgen Foundation

The Amgen Foundation seeks to advance excellence in science education to inspire the next generation of innovators, and invest in strengthening communities where Amgen staff members live and work. To date, the Foundation has donated over $300 million to local, regional, and international nonprofit organizations that impact society in inspiring and innovative ways. The Amgen Foundation brings the excitement of discovery to the scientists of tomorrow through several signature programs, including Amgen Scholars and the Amgen Biotech Experience. For more information, visit AmgenInspires.com and follow us on Twitter @AmgenFoundation.

About Amgen

Amgen is committed to unlocking the potential of biology for patients suffering from serious illnesses by discovering, developing, manufacturing and delivering innovative human therapeutics. This approach begins by using tools like advanced human genetics to unravel the

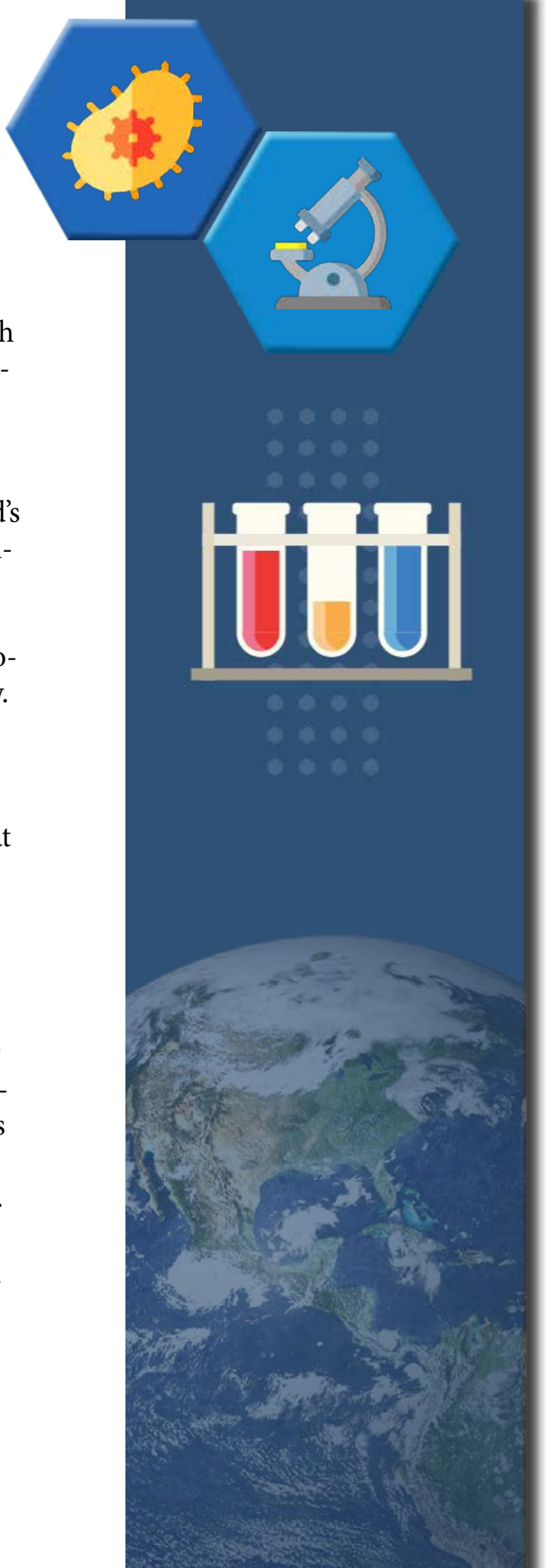
complexities of disease and understand the fundamentals of human biology. Amgen focuses on areas of high unmet medical need and leverages its expertise to strive for solutions that improve health outcomes and dramatically improve people's lives.

A biotechnology pioneer since 1980, Amgen has grown to be one of the world's leading independent biotechnology companies, has reached millions of patients around the world and is developing a pipeline of medicines with breakaway potential. For more information, visit www.amgen.com and follow us on Twitter @Amgen.

About the Faculty of Arts and Sciences at Harvard University

The Faculty of Arts and Sciences is the largest of the seven faculties that constitute Harvard University and is the only division of the university responsible for both undergraduate and graduate education. FAS advances knowledge, improves learning, and shapes leaders. For more information, visit www.fas.harvard.edu/.

https://www.labxchange.org/explore



Abstract Thinking Exercise

An old one but a good one:
This teacher is trapped in a round room with a solid floor and solid ceiling. Using the items shown, how does she escape?

Answer:

Saw the table in half. Two halves make a hole. Climb out the hole to escape.

The Chemistry of Cosmetics

By *Wayne Carley*

Cosmetics are not a modern invention. Humans have used various substances to alter their appearance or accentuate their features for at least 10,000 years, and possibly a lot longer.

Women in Ancient Egypt used kohl, a substance containing powdered galena (lead sulphide – PbS) to darken their eyelids, and Cleopatra is said to have bathed in milk to whiten and soften her skin. By 3000 B.C. men and women in China had begun to stain their fingernails with colors according to their social class, while Greek women used poisonous lead carbonate (PbCO3) to achieve a pale complexion.

Clays were ground into pastes for cosmetic use in traditional African societies and indigenous Australians still use a wide range of crushed rocks and minerals to create body paint for ceremonies and initiations.

Emulsions

The majority of creams and lotions are emulsions. An emulsion can be defined simply as two immiscible fluids in which one liquid is dispersed as fine droplets in the other.

Homogenized milk is an example of a typical oil-in-water (o/w) emulsion. Milk fat (oil) is dispersed in water as fine droplets by the homogenization process. The reason the fat does not float to the top immediately is due to the presence of emulsifiers; in this case, a milk protein called sodium caseinate as well as several phopholipids. In the case of water-in-oil (w/o) emulsions, water is dispersed as droplets and suspended in the oil phase. The non-dispersed liquid or external suspending phase is also called the continuous phase.

Mayonnaise, vinegar water dispersed as fine droplets in a continuous phase of soybean oil, is an example of a water-in-oil emulsion. Lecithin from eggs stabilizes the mayonnaise emulsion.

Surfactants

Most emulsifiers can be considered surfactants or surface-active agents. These materials are able to reduce the surface tension of water. What makes an emulsifier surface active is related to its HLB, or hydrophile-lipophile balance. HLB is determined by the size of the hydrophilic (water-loving or polar) portion of a molecule as compared to the size of the lipophilic (oilloving or nonpolar) portion.

The HLB system was created to rank the relative polarity of materials. The most polar, water soluble, materials are at the top of the twenty-point scale with more non-polar, oil soluble, materials closer to zero.

Emollients

The majority of emollients used in personal care and beauty items are fats and oils, also called lipids.

Animal fat or tallow is composed primarily of stearic and palmitic acids with carbon chains lengths of 18 and 16 respectively. Many of the major cosmetic companies are moving away from animal-based materials like tallow to renewable vegetable-based materials. Coconut oil and palm kernel oil are often used.

Some of the key characteristics required in good emollients are good spreading properties, low toxicity/skin irritation and good oxidative stability. Oleic acid, a major constituent of olive oil has poor oxidative stability due to the presence of its double bond. Fats and oils are considered saturated if they do not have double bonds. Unsaturated oils like olive oil have double bonds that can react with oxygen, especially when heated.

The oxidation process can produce off colors and odors in lipids causing them to go rancid and unusable.

Moisturizers

The main distinction between moisturizers and emollients is their solubility in water. Healthy skin requires moisture. Moisturizers are generally polar materials that are hygroscopic in nature; they hold onto water.

Waxes

Waxes are composed primarily of long-chain esters that are solid at room temperature. Anyone who has ever dipped a finger in molten wax has experienced its sealing properties. Some common waxes used in cosmetics are beeswax, candelilla, carnauba, polyethylene, and paraffin.

The melting points of waxes vary widely depending on their unique composition and chain lengths. Commonly used in lip balms and sticks, waxes function as structuring agents, giving the stick enough rigidity to stand up on its own, as well as barrier properties. By combining waxes with different properties such as high shine, flexibility, and brittleness, optimal cosmetic performance can be achieved. Often waxes are combined with compatible oils to achieve the desired softness.

Thickeners

By incorporating enough wax into a thin lotion, a thick cream can be formed. Many thickeners are polymers. Cellulose, a fine powder polymer of repeating D-glucose units, swells in hot water creating a gel network.

Color

Pigments and dyes are used in products to impart a color. Titanium dioxide (TiO 2) is a white pigment that is mined. In combination with natural mined and synthetic iron oxides, which range in color from red, yellow, black and brown, depending upon the degree of oxidation and hydration, a range of color can be produced that will be suitable for almost every skin tone.

Face powders are produced by blending inorganic oxides and fillers. Fillers are inert, generally inexpensive materials such as kaolin, talc, silica, and mica that are used to extend and fully develop colors. Pressed powders like eye shadows and blushers are prepared by blending additional binding ingredients such as oils and zinc stearate and pressing the mixture into pans.

Eye shadows and lipsticks often contain pearlescent pigments commonly called pearls. Pearls sparkle and reflect light to produce a multitude of colors. They are prepared by precipitating a thin layer of color on thin platelets of mica. Varying the thickness of the color deposited changes the angle of light refracted though the composite, creating different colors.

Organic pigments are used to color lipsticks and eye shadows. When organics are precipitated on a substrate they are called lake pigments. The term lake refers to the laking or precipitating of the organic salt onto a metal substrate such as aluminum, calcium, or barium. They are called D&C (drug and cosmetic) and FD&C (food, drug and cosmetic) colors. Some examples are D&C Red#7 calcium lake and FD&C Yellow #5 aluminum lake.

Preservatives

Most cosmetic products require the addition of preservative to prevent microbial contamination and rancidity. Parabens and ester of parabenzoic acid are by far the most commonly used because of their effectiveness against gram-positive bacteria.

The cosmetic chemist will generally employ a mixture of preservatives to protect against different bacterial strains as well as yeasts and molds.

To say the least, the science, technology, engineering and math of cosmetic creation can be challenging, creative, inspiring and sometimes dangerous.

The next time you look at a model, consider the complexity of the multiple compounds and chemical ingredents on their face, as well as the careers associated with developing them.

Space Shuttle Solid Rocket Boosters

Falcon Heavy Rockets

Engineering Innovation for Space Flight

2 Solid Rocket Engines

3 Rockets with
27 liquid fuel engines

When choosing a rocket design, you have to ask a few questions.

1. Which design at left looks more reliable?

2. Which design is more powerful?

3. Which design cost less?

4. Which design are you willing to climb on top of for launch?

Are 27 engines better than 2?

Shuttles boosters: 6,200,000 lbf
Falcon Heavy: 5,130,000 lbf

Cost:
Boosters per launch: $450 million
Falcon H. per launch: $ 90 million

Which would you choose as an...

- engineer,
- designer and
- passenger

...and why?

ROBOTICS IN THE PRIMARY CLASSROOM

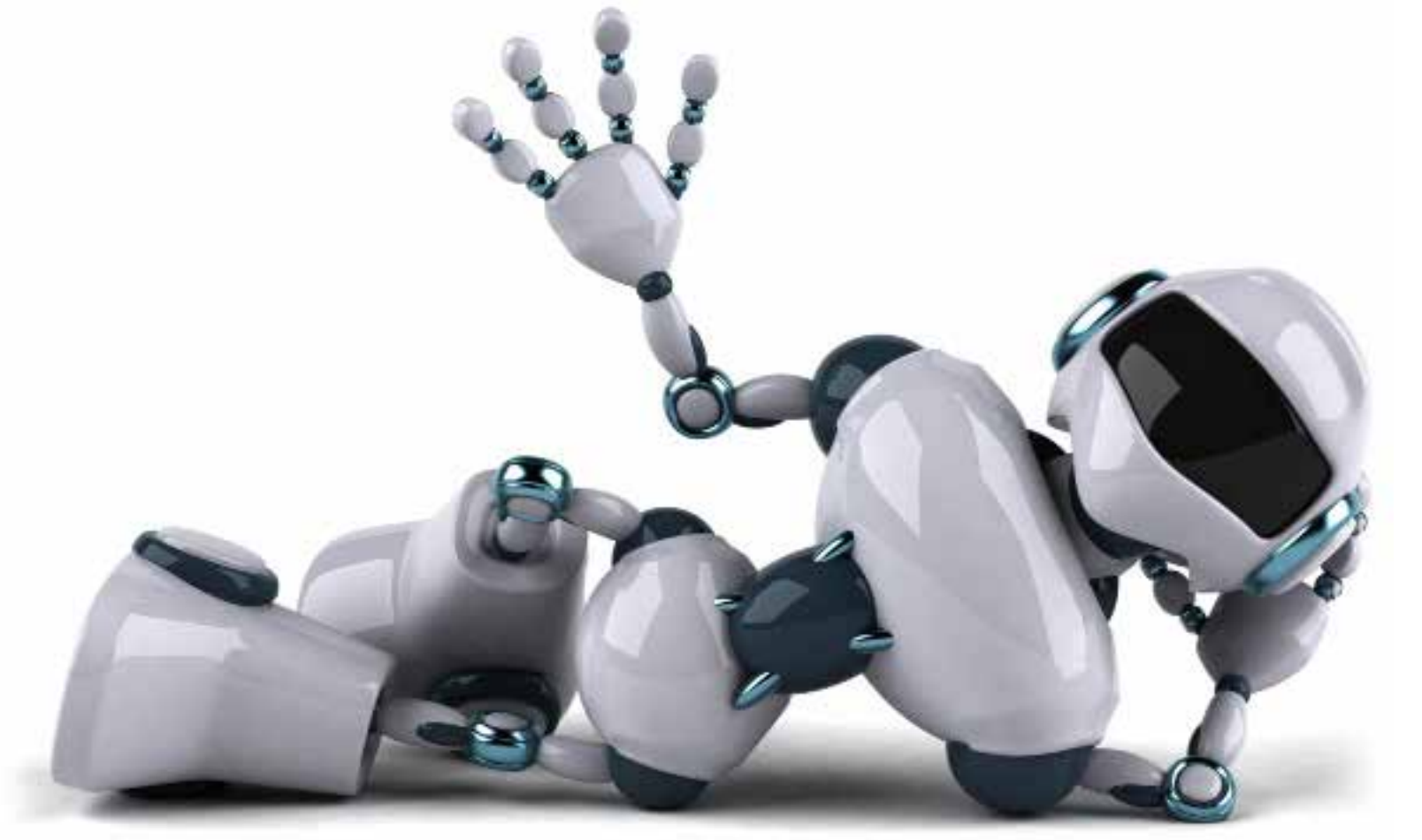
By *Stan* HICKORY

The world of automation

I recently had a conversation with someone outside of education. I asked him what he thought should change with our current education system and his reply was, "When I was in High School, most everyone took auto shop and learned to tear down and rebuild a car. Why don't we do that with computers, robots, and networks - the fundamental technologies of our age?

Why isn't programming required like math?"

I walked into a McDonald's the other day. There were seventeen people in line ahead of me. I was standing next to a touch-screen ordering kiosk and was intrigued by this new technology. How much faster could it be? I placed my order and watched. After the cashier had taken the fourth order, my breakfast was delivered to the counter. "That was fast, I thought. "How long will it be before everything behind that counter is automated?"



In an article in the Tampa Bay Business Journal, Hubertus Muehlhaeuser, CEO of Welbilt, was quoted, "I envision, within a year or two, people ordering their food by cell phone before they reach a restaurant. The order will go directly to the relevant appliance, which grabs the food, starts cooking it at the time dictated by the customer's distance from the restaurant when they placed the order, and packages just in time when the customer arrives,."

A recent article reported on "Flippy," a burger robot at Cali Burger in Pasadena, California. Flippy can cook 2000 burgers a day. According the Bureau of Labor Statistics, there are 3.4 million jobs in the food serving and preparation industry.

Consider Amazon Go. In 2017, Amazon opened its first cashier-less store in Seattle, Washington. A customer walks into the store, gathers the items she wants to purchase, and an app on her phone identifies and charges her for the items on her way out. According to the Bureau of Labor Statistics, that's another 3.5 million jobs being replaced by automation. The Bureau has also calculated there are 3.5 million jobs in the trucking industry. These too will be lost to automation. That is over 10 million jobs that will be automated in the next five to seven years.

The top 10 most in demand jobs in 2010 did not exist in 2004 . In a 2016 report on the state of cybersecurity jobs by ISACA, there will be 6 million cybersecurity jobs and a global shortage of two million cyber - security professionals by 2019 .

The call for robotics and programing in the primary years It is paramount that we add robotics and programming to the K-5 curriculum. It is common knowledge that teaching a foreign language in the primary grades yields a stronger understanding of languages in general. This can be applied to programming as well. "Learning programming has similarities to learning languages, because each programming language is a different language. So exposing children to the concepts that are similar across coding languages at a young age makes it much easier for them to learn and use these skills as they progress through life," says Lindsay Craig, founder of Questbotics,

an educational robotics and programing company based in Longmont, Colorado. In addition, Mr. Craig explains that, "Technology is constantly evolving, introducing kids to the fundamentals at a young age means that they have a chance of keeping up with the advancements in the field as they grow older and start to use the tools of their chosen industry. And, advanced robotics is just plain difficult. If the skills are introduced at a young age as fun and approachable then students have a better chance of developing their abilities to reach the more difficult stages later in life."

The interest in robotics at early ages is massive. I spoke with Dennis Kambiets, Director of Education at Robots Education. "We've demonstrated robotics to more than 12,000 students from grades 4-12, and we'll average 90% of students wanting to learn robotics in middle school, and about 60% in high school, as compared to the national average of 2% for boys and .2% for girls. But most importantly, we've seen almost 100% interest at the primary level." We need to feed this passion to address this dramatic drop in interest as students move from primary, to middle, and on to high school. This trend can be changed if we were to integrate robotics and programming into the K-5 curriculum.

Does this mean we are going to increase screen time for K-5 learners? Not necessarily. Questbotic's, Lindsay Craig, has an approach to teaching robotics that starts without screen time. "At a young age I teach without using screens. That means using hands-on robots, physical activities and discussions...Working on a screen doesn't nurture the soft skills that are so important in society and the workplace.

The real world also presents hurdles that are at the core of robotics. In a controlled environment, such as inside a screen, students don't learn how to handle the problems that arise from trying to manipulate reality using robotics. Their goals, resources and methods are also limited to the system in which they are working. The real world puts no such limitations on problem solving and dream pursuing."

How will Robotics and programming prepare our students?

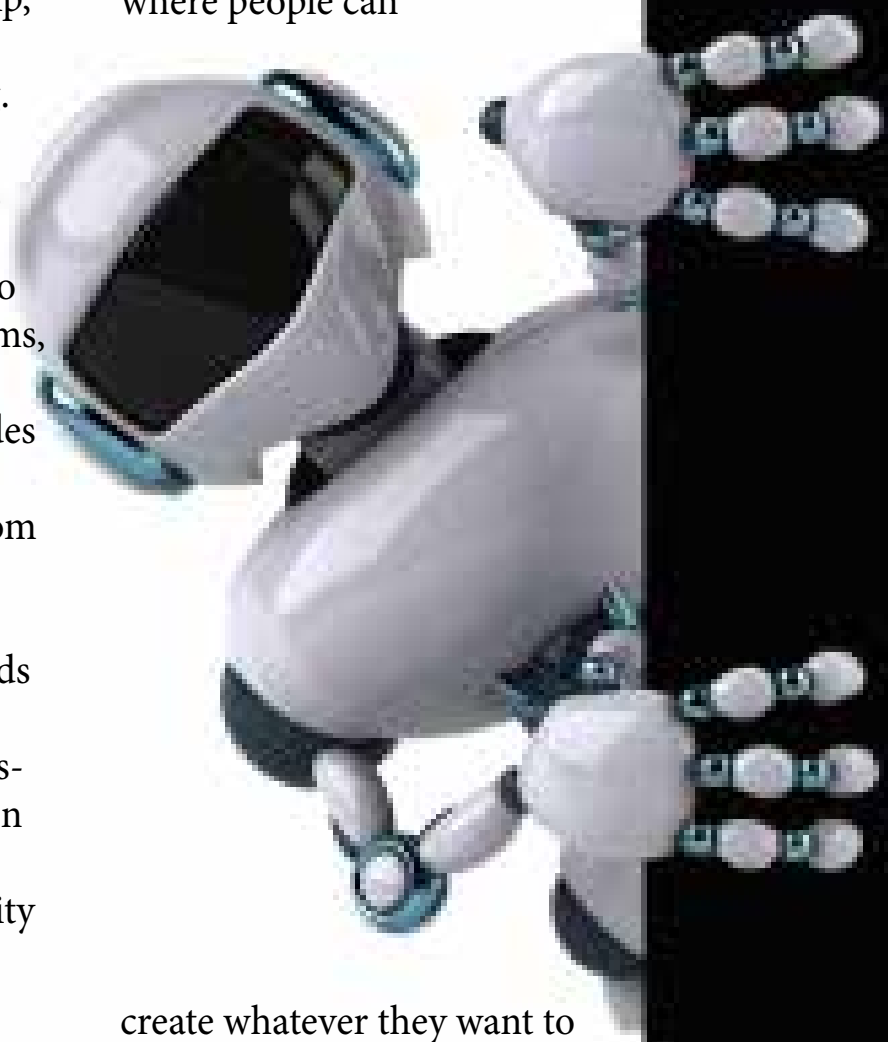
Robotics and coding provide a vehicle for teaching perseverance, problem-solving, collaboration, critical thinking, and creativity. The very act of coding a robot is an exercise in problem-solving. How does one make a robot do a particular task? Students will go through a system of trial and error to program a robot.

Unless the code is written perfectly, the robot will not move - and rarely is the code written correctly the first (or second) time around. This process also teaches perseverance and critical thinking. Finally, collaboration is a skill that will be developed as students work together to make the robot perform.

In a conversation with John Blankenship, founder and owner of RobotBasic, he expressed why we need to teach coding. "Programming is one of the best ways to teach problem solving, mathematics, and analytical thinking. Programming is motivational because it can be used to address realistic and interesting problems, especially through simulations. It is a valuable teaching tool because it provides instant feedback in many situations." I have seen this in action in one classroom that I observed. Students were tackling the difficult problem of bullying in our school by creating an application for kids to use to report bullies. They created a prototype and took it live with one classroom. This provided instant feedback on their application. They were able to use the feedback to improve the functionality of the application the very next day.

Our students will be going into what is called a "Gig" economy. This means most jobs are short term contracts and the most successful people will be able to identify problems for a businesses and then provide the solutions.

Steven Reinharz, President of Robotics Assistance Devices, in Orange County, California, says, "Robotics is an open area where people can create whatever they want to solve whatever problems they see. . . it's about creativity."



I know of one school where students are using programming to do this. They were

unhappy with the number of choices on the school's lunch menu and the amount of food being thrown out each day. Students created an application to manage pre-ordering of meals so the cafeteria knows exactly how many lunches to prepare.

This type of problem-identification and problem solving enhances the skills necessary for our students to be successful in the rapidly changing job market. Soon, we will walk into a McDonald's and see an entirely automated system; from taking an order, to flipping the burger, to getting it into the customer's hands. But, there is still the need for people identify problems and build robots and program software to solve programs. The sooner teachers can introduce this technology the better off our students will be. The key is to understand that robotics and programming does not have to be a separate, standalone class.

Rather, it can be used to enhance learning and problem solving in all areas of the curriculum. There are countless companies popping up that provide robotics hardware, software, curriculum, and professional development. If you would like more information on how to get robotics into the classroom, you can contact me at www.linked.com/in/stan-hickory.

Margie Maning, "Here's what the next generation of the fast-food industry looks like to this Tampa Bay CEO", https://goo.gl/zVhbej, (May9, 2018).
Bureau of Labor and Statistics, https://goo.gl/6HN3of (accessed June 1, 2018).
"We are living in Exponential Times", Ivy College, https://goo.gl/8ZhK4K (accessed June 1, 2018).
Steve Morgan, The Cybersecurity Jobs Report: 2017 Edition, https://goo.gl/oJpkyg (May, 31, 2017).

Stan Hickory has been in education for over 20 years. Stan worked in the K-12 system as a Social Studies, English, Design Thinking, Environmental and Spatial Technology teacher. Stan has also been the Executive Director of the non-profit, Trek To Learn, a educational travel organization.

Rule #2

"It doesn't matter how much money you make……

…..if you *hate* your job".

Become curious about something and chase it.

Your Child's Emotional Intelligence to Success in School, at Home and in *Life*

Pat Kozyra
Educator / Author
Hong Kong

The following definition, description and explanation are all based on the work of Daniel Goleman, a psychologist with a PhD from Harvard University. He is a journalist for the New York Times and has written many books on this topic. There is a video which all students should see to understand why emotional intelligence might be even more important than I.Q.

"Emotional Intelligence" refers to the capacity for recognizing our own feelings and those of others for motivating ourselves, and for managing emotions well in ourselves and in our relationships. Many people who are book smart, says Goleman, but lack emotional intelligence end up working for people who have lower I.Q's than they but who excel in emotional intelligence skills.

It is not surprising then, that Daniel Goleman wrote a book called 'Emotional Intelligence: Why It Can Matter More Than I.Q.' This is an area that I highly recommend you delve into if you have never heard of it. Goleman says: "Rule Your feelings lest your feelings rule you." Goleman says our view of human intelligence is far too narrow. Emotional intelligence includes a crucial range of abilities (a different way of being smart). These are: self awareness, impulse control, persistence, zeal and self-motivation, empathy (reading emotions in others) and social deftness.

Emotional Intelligence is not fixed at birth. It can be nurtured and strengthened in all of us unlike I.Q. which it is said, is a genetic given that is fixed and cannot be changed. When people of high I.Q. flounder and those of modest I.Q do surprisingly well, what are the factors at play? Goleman argues that the difference quite often lies in the ability called "Emotional Intelligence".

The five basic emotional and social competencies are listed here with more explanatory detail.

1. Self-awareness: Knowing what we are feeling in the moment and using those preferences to guide our decision making; having a realistic assessment of our own abilities and a well grounded sense of self-confidence.

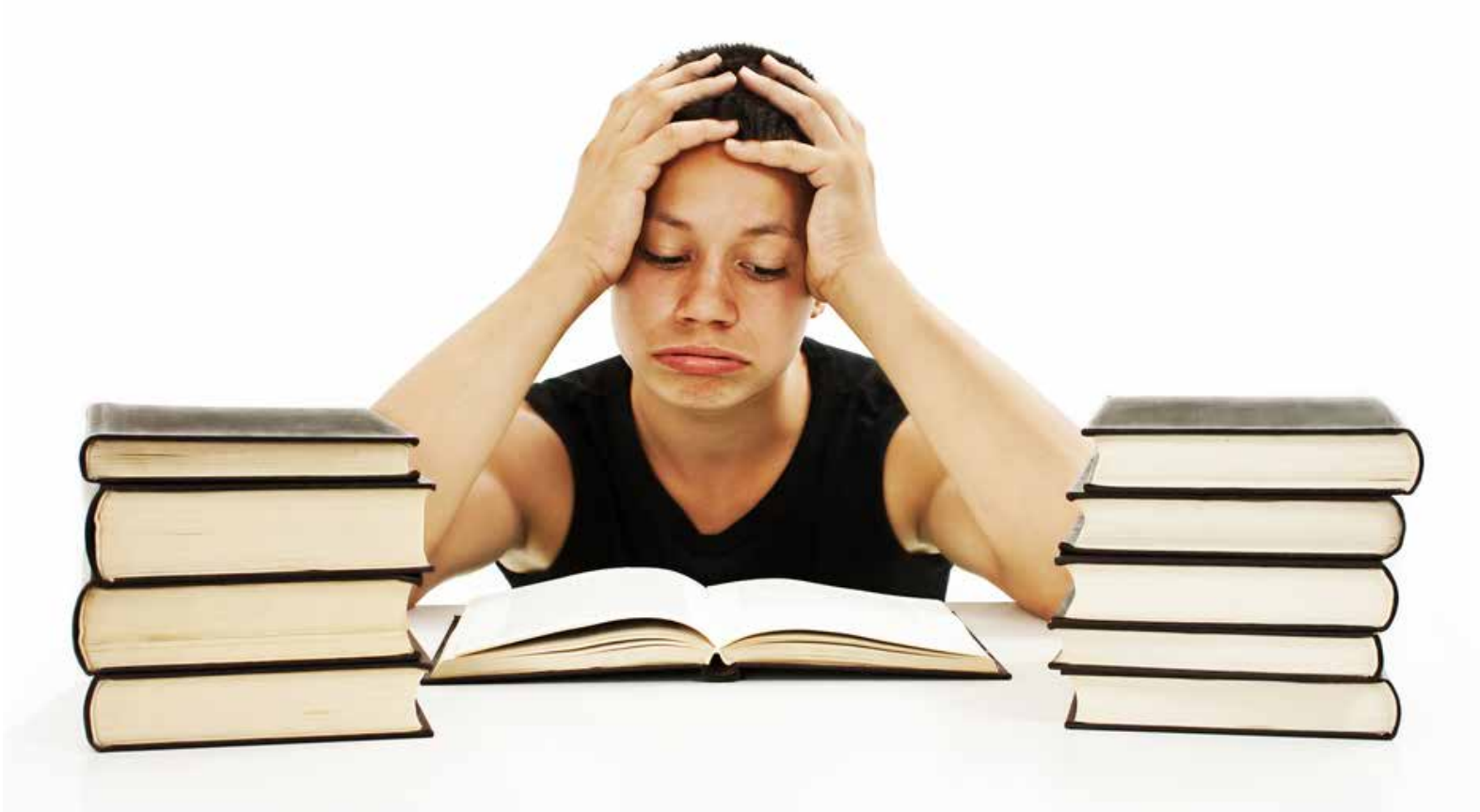
2. Self-regulation: Handling our emotions so that they facilitate rather than interfere with the task at hand; being conscientious and delaying gratification to pursue goals; recovering well from emotional distress.

3. Motivation: Using our deepest preference to move and guide us toward our goals, to help us take initiative and strive to improve and to persevere in the face of setbacks and frustrations.

4. Empathy: Sensing what people are feeling, being able to take their perspective, and cultivating rapport and a connection with a broad diversity of people.

5. Social Skills: Handling emotions in relationships well and accurately reading social situations and networks; interacting smoothly; using these skills to persuade and lead, negotiate and settle disputes, for cooperation and teamwork.

Most disturbing in Goleman's book, is data from a massive survey of parents and teachers which shows a world- wide trend for the present generation of children to be more troubled emotionally than those of the last generation, more lonely and depressed, more angry and unruly, more nervous and prone to worry and more impulsive and aggressive.



The remedy, Goleman feels, lies in preparing our young, for life. How can we bring together mind and heart in the classroom?

How can we bring intelligence to our emotions, civility to our streets and caring to our communal life?

Here are a few emotions your students and family experience daily.

1. Anger – blood flow to hands ready to fight

2. Happiness – brain inhibits negative feelings

Education will have to include inculcating essential human competencies such as self-esteem, self-control, empathy, the art of good listening, resolving conflicts (Creative Problem Solving) and cooperation.

Two of the most important moral stances that our times call for, are self-restraint (controlling impulses) and compassion (showing empathy by understanding other's feelings). With each emotion , the body manifests itself in physiological details preparing for its response.

3. Fear – blood flows to legs ready to run

4. Love – tender feelings relaxed and calm

5. Surprise – lifting of the eyebrows to see it

6. Disgust – upper lip curled, nose wrinkled

7. Sadness/grief – drop in energy

8. Shame – withdrawal, no eye contact

9. Enjoyment

We have two minds – one that thinks and one that feels – heart and head – the emotional and the rational – the feeling versus the reasoning.

Stoplight Poster for Impulse Control: (six steps)

This is taught in Emotional Literacy classes to 5th and 6th grades in some schools and you may wish to use this with your child at home when he or she is about to strike out in anger, withdraws into a huff at some slight, or bursts into tears at being teased.

1. Stop, calm down, and think before you act.

2. Say or state the problem and how you feel.

3. Set a positive goal.

4. Think of lots of solutions

5. Think ahead to the consequences

6. Go ahead and try the best plan.

The following rather shocking information comes from a book review of Daniel Goleman's book 'Emotional Intelligence: Why It Can Matter More Than I.Q'. by Launa Ellison, Clara Barton School, Minneapolis, Minnesota. She writes:

The research studies that Goleman cites indicate that emotional intelligence is the bedrock upon which to build other intelligences, and that it is more closely linked to lifelong success than I.Q.

"Impulsivity in 10 year old boys" for example, "is almost three times a powerful a predictor of their later delinquency than is their I.Q."

Goleman warns of the dramatic drop in "emotional competence" over the past two decades. As evidence, he cites soaring juvenile arrest rates for violent crimes; younger teenage girls getting pregnant; more children being withdrawn, anxious, and depressed, and more attention or thinking problems. "Educators, long disturbed by school children's lagging scores in math and reading are realizing that there is a different and more alarming deficiency: emotional illiteracy."

Goleman believes schools must teach children how to recognize and manage their emotions, and that educators must model emotional intelligence in caring, respectful interactions with children.

"Emotional circuits are sculpted by experience through child hood," he notes, and "we leave those experiences utterly to chance at our peril."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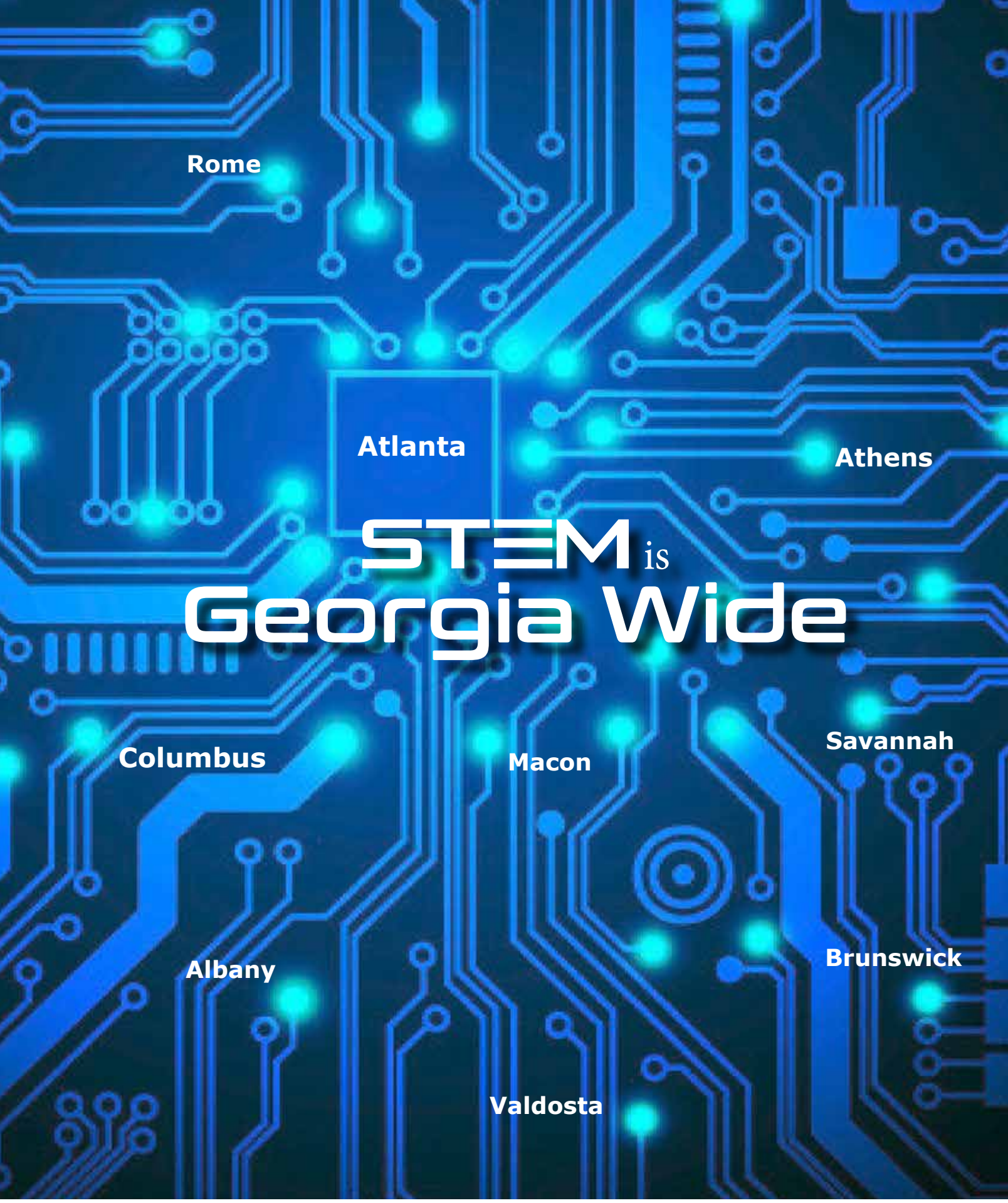

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