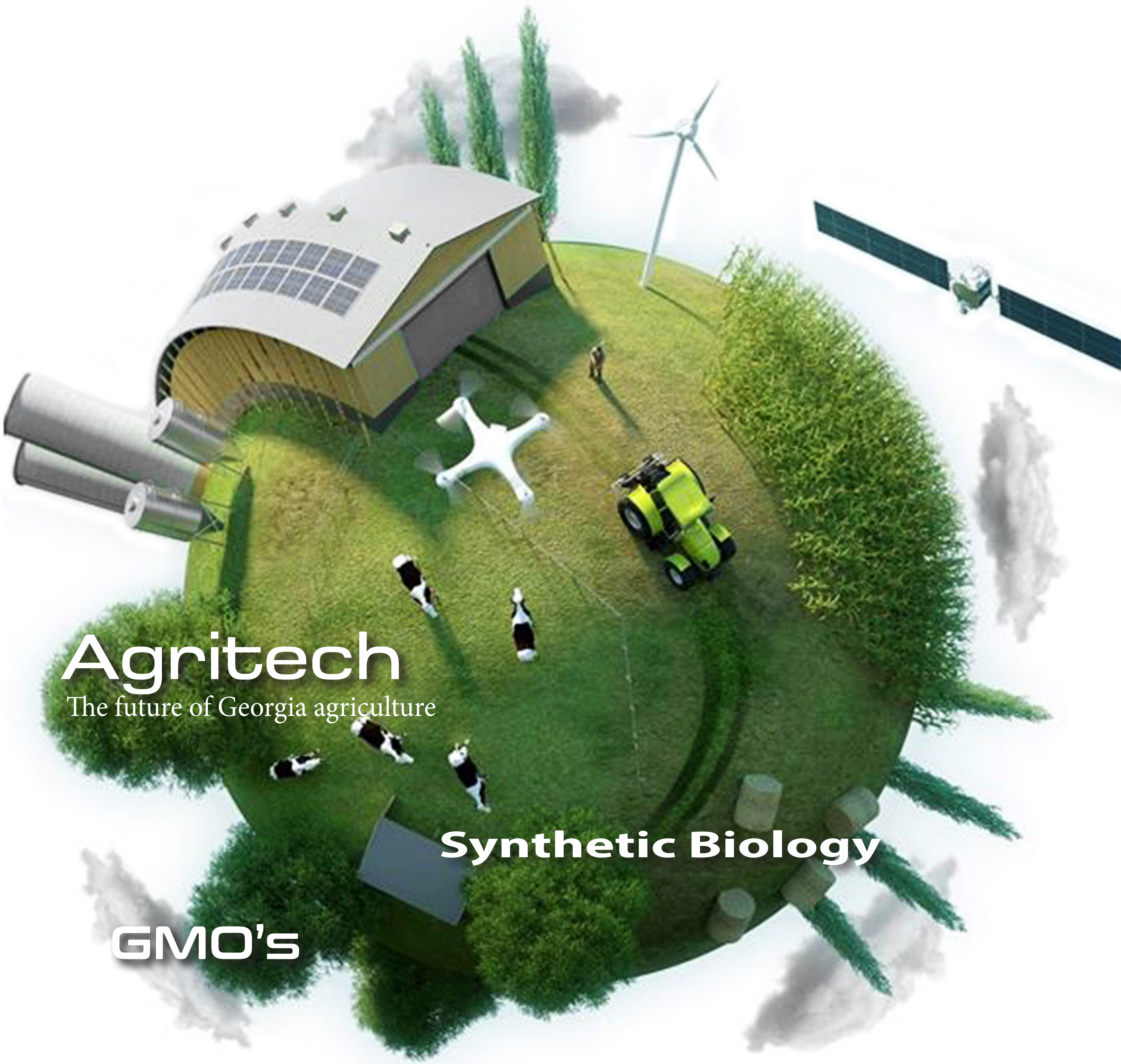
December 2020

GEORGIA PATHWAYS



Agritech
The future of Georgia agriculture

Synthetic Biology

GMO's

TAG
Technology Association of Georgia

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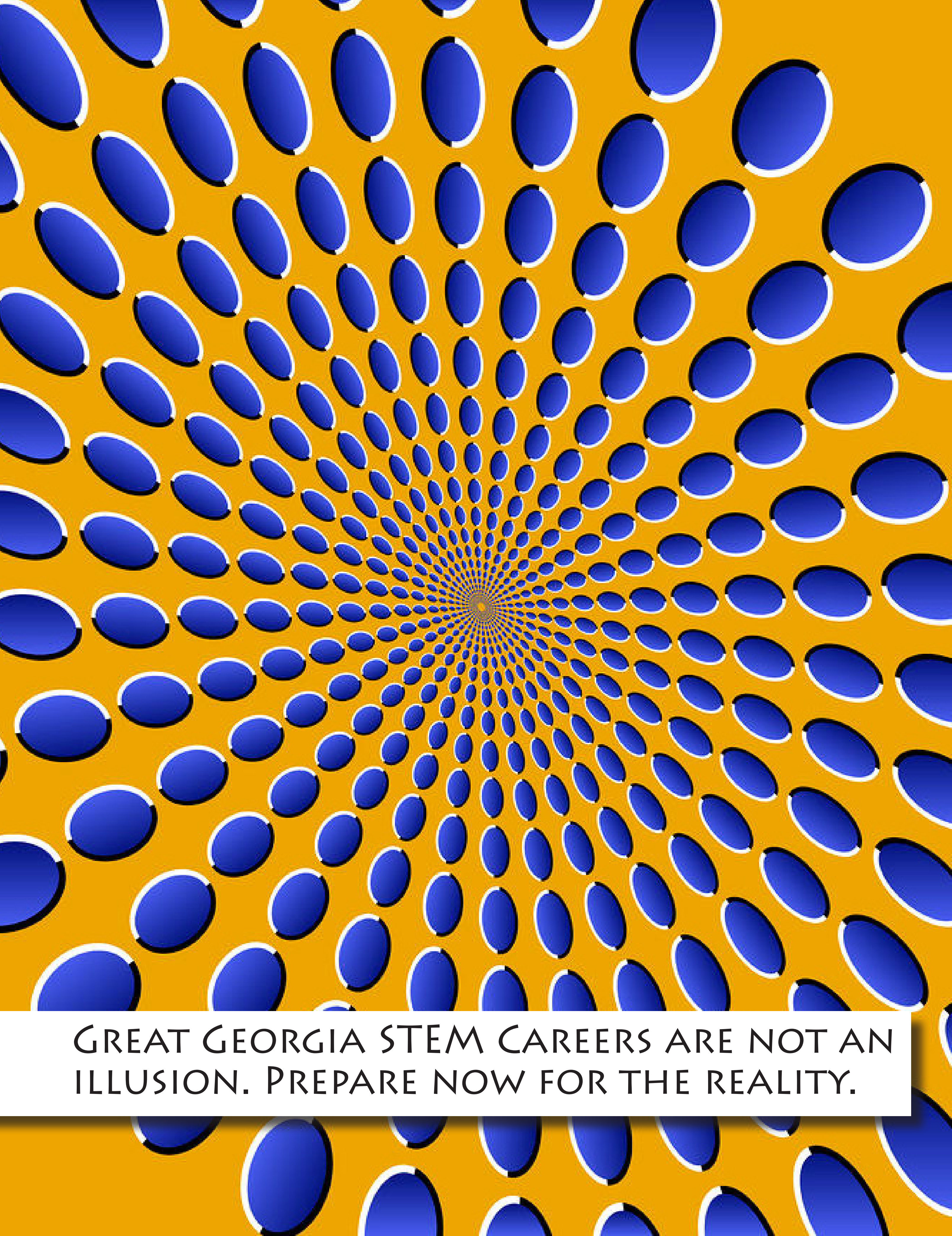

Great Georgia STEM Careers are not an illusion. Prepare now for the reality.

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.

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 2000. 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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Welcome to the December issue of Georgia Pathways STEM Magazine. Georgia agriculture is in the spotlight this month with the Agricultural Technology conference here in Atlanta. Technology in Georgia is incredibly diverse across multiple industries, but is uniquely innovative within farming and ranching sectors. Georgia's agricultural industries play a significant role in our state's economy, contributing billions of dollars annually and consistently ranking first in the nation's production of poultry and eggs, accounted for 57 percent of Georgia's farm commodities.

Well known of course for peanuts, pecans, cotton, tobacco, blueberries, and peaches, to name a few, Georgia accounts for 2 percent of total U.S. agricultural sales. Georgia has over 9.9 million acres of land devoted to farms, with an average farm size of 235 acres, and the advancements of technology to protect and improve farm productivity is a state priority. Crops and livestock revenue account for well over 10 billion dollars in Georgia, with beef cattle, dairy cows, hogs and other miscellaneous livestock also being produced across the state.

Agricultural producers are constantly challenged to improve annual yields on the same acreage while minimizing resources, increasing production volume, saving time and protecting from loss due to weather, insect and fungal challenges. Unmanned tractors and cultivators guided by GPS satellites increase land productivity through perfectly straight rows, utilizing every inch of soil. Unmanned aerial drones of varying sizes survey crops and farms state wide for disease, drought, and general visual management not possible in person so expeditiously.

Developing student interest in Georgia agricultural careers is a high priority for TAG-Ed and our state's Universities, who all participate in their own unique experimental endeavors to improve our state's agricultural industries through technological innovation and offering new and exciting career opportunities that have not previously existed. Scientific discoveries in biological management, pest control and genetic improvements of crops, promotes hope for a more productive and sustainable agricultural future for Georgians and the nation.

Larry K. Williams
President
TAG / 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.

Agriculture -
Georgia's $73 Billion STEM Industry

Georgia has long been an innovator and leader nationally in agriculture. Our climate allows tremendous opportunities for ranchers and farmers. Virtually any crop or animal can be grown successfully somewhere within the state. We're known for our sweet Georgia peaches, our peanuts and those delicious Vidalia Onions. But the state's agriculture picture is vast.

Farming is one of mankind's original jobs, and those who till the soil have always sought to improve their crop production and protect their land. They go to great lengths to protect their land and surrounding environments. Modern conservation and best production practices help to protect the land and grow safer, healthier crops.

Georgia is perennially the number one state in the nation in the production of peanuts, broilers (chickens), pecans, blueberries and spring onions. We are also at or near the top when it comes to cotton, watermelon, peaches, eggs, cucumbers, sweet corn, bell peppers, tomatoes, cantaloupes, rye and cabbage.

Producers across the state raise cattle, horses, goats, sheep, hogs, poultry, turkeys and alligators. No matter which part of our state you visit, you'll see some form of agricultural production.

According to the most recent Census of Agriculture, during 2012, Georgia's agricultural producers sold more than $9.2 billion worth of agricultural products

The census showed more than 42,000 farms operating across the state, with 9.6 million acres in production. More than 17,000 of those farms raised cattle, either beef cows or dairy.

More than 2,600 farms grew cotton during 2012, planting nearly 1.3 million acres. Peanut farmers across the southern and eastern areas of Georgia produced 3.2 billion pounds of peanuts. Farmers across the state planted over 310,000 acres of corn and produced 52.4 million bushels.

One of the innovations responsible for increased bushel production on the same acreage is automated, GPS guided tractors that squeeze every square foot of soil into productive crop. This type of technology is not cheap, but is increasingly included in new farm equipment from the factory, so no "add-on" tech is required.

Broadband and satellite connectivity remains a challenge in rural Georgia, but efforts continue to find cost effective solutions to that lack. Until a wide spread and affordable solution is found, many farmers continue to apply tried and true methods to be as productive as possible. While long time family owned farms may resist recent attempts to pursue tech, soon, it will become as commonplace in their daily management as cellphones.

TOP 10 GEORGIA COMMODITIES BY VALUE

Broilers
Cotton
Eggs
Timber
Peanuts
Beef
Greenhouse
Dairy
Pecans
Blueberries

According to the University of Georgia Center for Agribusiness & Economic Development, the state's forest industry accounts for a total economic contribution to Georgia's economy of $17.7 billion, and supports more than 73,300 jobs in Georgia. We have more commercial forest land (24.4 million acres) than any other state. The concerns about job loss due to technology integration are founded in certain states and regions, but in the long term, the jobs will migrate from high levels of manual labor to tech labor and maintenance.

Despite all the changes in society, farming remains the foundation of the state's economic well-being. Approximately one in seven Georgians works in agriculture, forestry, or a related field. With hundreds of career opportunities, perhaps one of them will ignite your interest.

For advanced or really curious students, take it to the ***next level:***

We can only travel at about 24,000 miles per hour in a current space craft with our technology.

So take your answer of how many Earth hours it takes to get to Proxima Centauri,

Divide *by how fast we can go*....24,000 miles per hour

Divide *by hours in a day*

Divide *by days in a year*

Your answer: You get ***how many of our Earth years it would take to get to Proxima Centauri.***

GMO

A GMO, or genetically modified organism, is a plant (predominantly) that has been altered using biotechnology to carry genes that have a desired trait, such as herbicide *(chemicals that kill bugs on plants)* resistance.

by Russ Putland

How are GMO's made?

Research and development of GMO's have been going on for more than 30 years, with the first wide scale planting of GE (genetically engineered) crops in 1996. The first genetically modified food designed and approved for human consumption that came to market in 1994 was the Flavr Savr tomato.

California-based Calgene produced it from tomato seeds genetically modified to contain the ACC synthase gene, which delays ripening until after picking. The Food and Drug Administration approved Flavr Savr for sale in the United States in 1994, and although it was never a commercial success, it helped lead to the approval of a slate of genetically modified food crops in 1995: canola, Bacillus thuringiensis (Bt) corn and potatoes (which produce their own pesticide), soybeans resistant to the herbicide glyphosate, virus-resistant squash, and additional delayed-ripening tomatoes.

(Neither the potatoes nor the tomatoes are now commercially produced.) In 2000, scientists genetically modified rice to increase its vitamin A content, marking the first time the technology was used to increase food's nutrient content.

Today, roughly 85 percent of corn, 91 percent of soybeans, and 88 percent of cotton grown in the U.S. are genetically modified. Other common GMO foods include canola, sugar beets, Hawaiian papaya, and alfalfa. The FDA is in the process of approving the first G.E. fish—the AquaAdvantage salmon —which was engineered to be faster growing, disease resistant, and more temperature tolerant and to develop larger muscles.

What's the GMO debate about?

G.E. food's critics oppose the practice of manipulating our food system for several reasons. They say the FDA doesn't require the same safety studies of G.E. food that it does of new drugs, resulting in few reports from independent scientists on the effects of genetically engineered foods.

Critics also say the spread and growth of genetically modified herbicide-resistant crops has led to the mutation of "superweeds" and insects that are impervious to herbicides and pesticides.

This has led to an increase in the use of pesticides and herbicides since G.E. crops were introduced in American agriculture.

Some farmers who grow and sell organic produce have experienced cross-contamination from G.E. fields, leaving them unable to sell in countries that have strict bans on the sale of G.E. food or require modified foods to be labeled.

Finally, many oppose GMO's on the ground that a few powerful companies—including Monsanto, Dow, and Syngenta—control both the genetic modification of seeds and the production of the pesticides and herbicides these crops are designed to withstand. Genetic modification has even led to the patenting of certain seeds, and Monsanto has sued farmers for saving and replanting seeds the company "owns."

Proponents of genetically modified foods say they're completely safe for human consumption and that no negative effect associated with their use has been found. They also say the cultivation of G.E. foods is necessary for increasing crop yields around the world. Some notable voices, including Bill Gates, have praised genetic modification for its potential to dramatically cut back world hunger. They also point to the relatively long time Americans have been eating genetically modified foods, adding that the phenomenon has made food cheaper for consumers.

What are the benefits of GMO's ?

The Hawaiian papaya industry was all but doomed before a genetically engineered variety resistant to the ring spot virus was introduced. Many are convinced that only a similar intervention can save Florida's orange industry from citrus greening disease. There's also hope that humanitarian-minded genetically engineered crops, such as golden rice and the so-called super banana, could have a significant effect on nutrition and hunger issues in the developing world.

Are GMO's bad for me?

There have been no reputable scientific studies showing that genetically modified foods pose a risk to human health. One study that suggested a link between consumption of genetically engineered foods with cancer was widely considered to be flawed. The journal that published it later made a rare retraction and then proceeded to republish it.

It's been said, "Don't fool with Mother Nature". It reminds of Jurassic Park.

Good science and being a responsible human means you have to consider both sides of any issue to be mature and well informed before taking any side on any issue.

The following “GMO” article addition is something to ***really*** consider as you consider your position. Science is so often wrong as well as those who are uninformed.

The Great GMO Debate

I am very intrigued by people who have energy for debating GMO food production, (for or against). The first thing we need to do is open our minds, educate ourselves and listen to the facts. There was a time when chlorinated water was expected to have a catastrophic effect on the planet. Looking back, it is probably the greatest innovation for the sustainability (survival) of people in modern times.

The problem:

What is being publicly debated around GMO’s isn’t where people should focus their energy. I would suggest the real issue is starvation. The facts are that an astounding, 21,000 people a day die of starvation. That is almost 7.7 million people in a calendar year! As the world population continues to grow exponentially,there will be continue pressure global food supply.

“21,000 people a day *Die* of starvation”

A possible solution:

There are two ways to address starvation. Limit population growth and regulate family size to artificially control the number of people on our planet (that's not likely to happen). The other is to increase efficiency of our food production.

Earlier we quantified the state of starvation for the globe. In contrast to starvation the fact is, that there isn't one confirmed case of a human dying from a GMO. The solution given the facts seems to simple.

Where are we at with GMO's?

GMO varieties have increased global production in most field crops. It varies from one crop to another, a safe number to use is an increase of over 30%. It has also given us better nutrition in our food. Vitamins, Trans fat free oil and many other benefits have been introduced because of GMO's. We are producing food more efficiently and food that is healthier. Again too simple, Right?

Why is there negativity around GMO's?

If we stick to the facts, conceptually it would be pretty hard to make a plausible argument against GMO's being a good thing. One could make the case that the public is gouged when they pay for GMO technology. The reality is that it costs money to bring new technology to the world. If you attempt to regulate the cost of food, it will take away the financial engine needed to sustain research, development and continued advancements.

Conclusion:

The earth's population will continue to grow, we are running out of arable land and people need food to live. We need to produce food more efficiently, healthily and increase overall production. *There isn't really another option?*

by Russ Putland

The Potential of

Robotics - Constru

Artificial Intelligence

cting a Large Task Platform

By Song-Chun Zhu, PhD
Professor of Statistics and Computer Science, UCLA
Founder and Chairman, DM Group

Song-Chun Zhu is a Chinese-American computer scientist and applied mathematician known for his work in computer vision, cognitive artificial intelligence, and robotics. Zhu founded DMAI as an AI start-up to lift humanity by developing cognitive AI assistants and platforms that make personal connections to individuals. He is widely recognized as a global thought leader and innovator within the field of artificial general intelligence.

In a previous section, I discussed the "small data for big tasks" cognitive framework that should undergird AI development. Robotics, however, is a platform of large tasks. Not only entailing tasks such as visual recognition, language communication, and cognitive reasoning, robotics also requires the expenditure of considerable effort to change the environment. In this section, we will discuss robotics in terms of the common platforms available in the market.

As we have previously discussed, people and robots perform tasks. Tasks can be broken down into actions, and actions aim to change fluents in an environment. We further divided fluents into two categories:

1. Physical Fluents

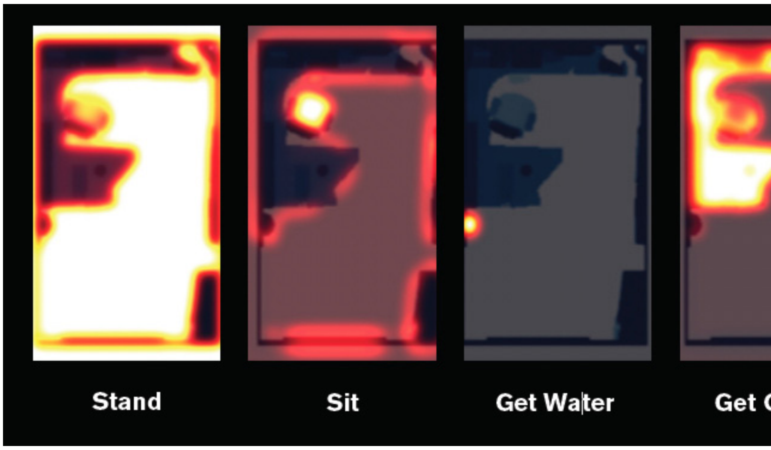
Such as painting, boiling water, mopping a floor, cutting vegetables. Tasks requiring dexterity; often performed alone.

2. Social Fluents

Such as eating, drinking, chasing, helping others; changing biological states and/or relationships; often performed as a group.

Affordance Maps in Planning

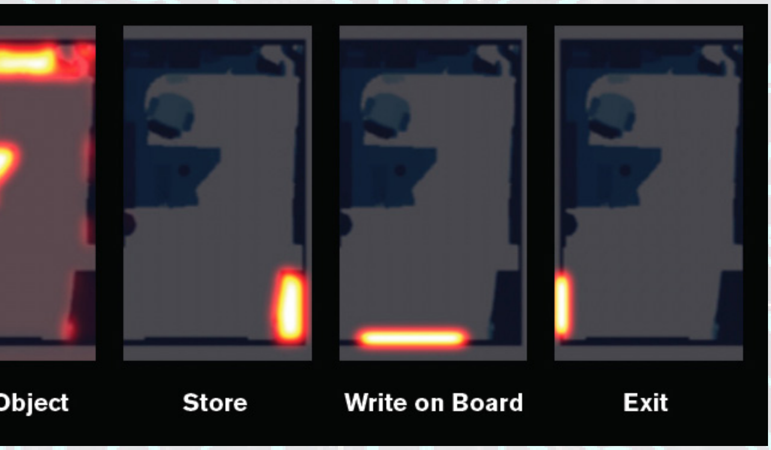
When a robot reconstructs a three-dimensional scene through functional reasoning, it focuses on current or potential tasks: where one might stand, where one might sit, where to pour water, or any number of others. The following figure shows a robot's assessments of where in a room, someone could perform certain actions. This is an example of what's called, in robot planning, an "affordance map." It tries to answer the question, "What actions does this scene offer and enable?"



What can this scene give you and let you do?

With these maps of the single basic tasks available to it, the robot can plan a task. The plan itself is a hierarchical pattern of representation, which could be used in myriad ways. Here, I still represent it in the unified STC-PG. Creating this plan is a profoundly complex process because it requires a robot to take actions akin to monitoring and updating its scene to reflect changes in available tasks as a result of its actions.

Robot performance of a task such as moving a box would then change these calculations by exposing another group of objects or making more tasks in the affordance map possible.



"The action plan should also consider the cause and effect, the actions and reactions of other agents in the scene. The more agents and environmental factors a robot can consider, the greater the care with which it can interact with a scene."

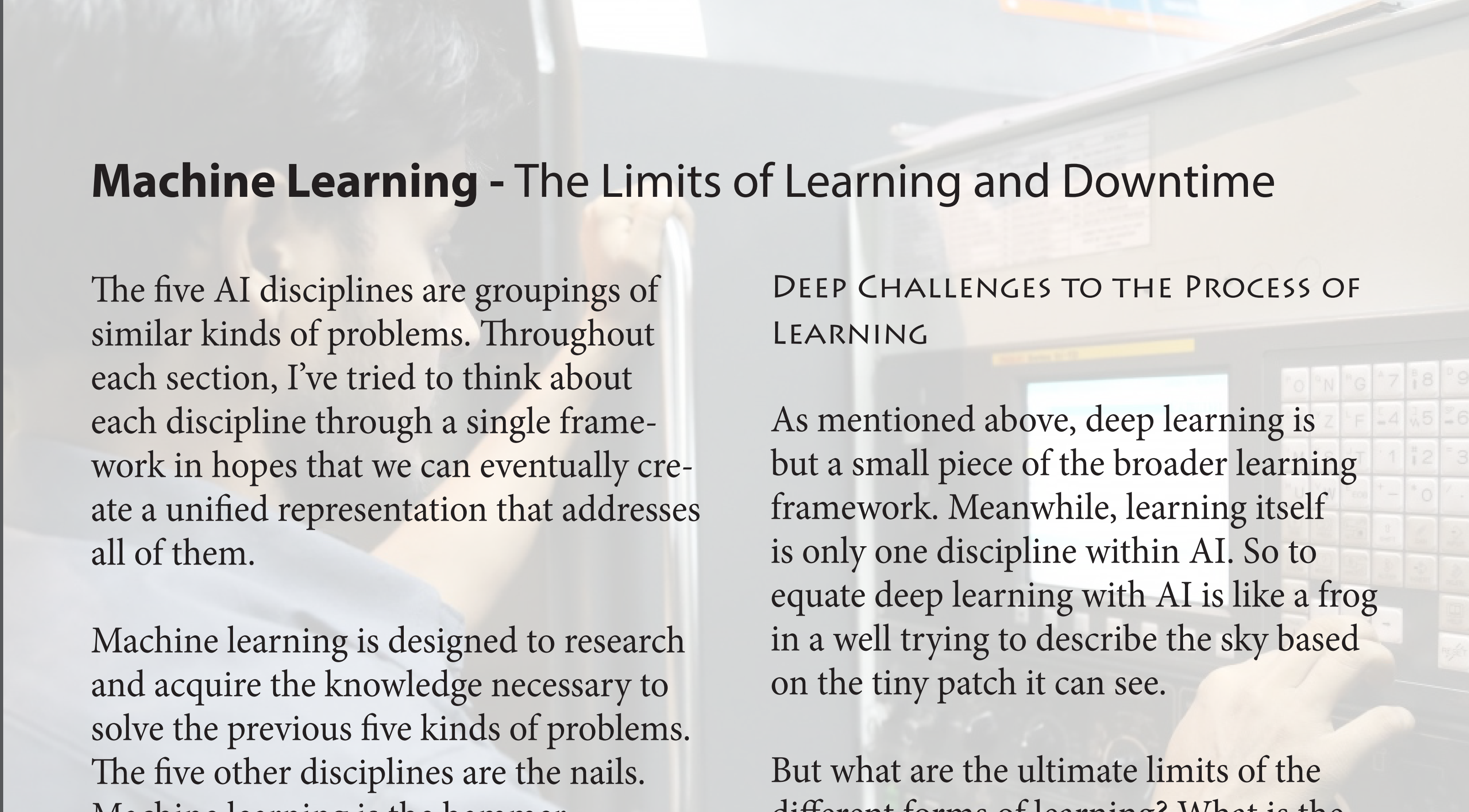
In the picture above, doctoral student Tianmin Shu, in an early demonstration of my lab's work, teaches a robot how to shake hands. This is a ubiquitous but sneakily-subtle action; both sides need to be able to sense the intent of the other to avoid the dreaded fate of an awkward handshake.

This demo was performed without a remote control and used a standard Baxter robot outfitted with an omni-directional mobile base, two grippers (one flexible, one strong), and a handful of sensors and cameras. Note the parallel between the two kinds of grippers and certain creatures found in nature: lobsters have one heavy claw for crushing and one serrated claw for cutting. Shu's papers have received media coverage.

Pictured above is the same robot in my lab completing a series of actions that make up a single complex task. First, it heard a knock at the door and inferred that someone outside the room wanted to enter. Then, it saw a person carrying a box of cake, which the robot interpreted to mean the person needed help of some kind. Through dialogue, the robot learned that the person wanted to put the box in the refrigerator. Finally, the robot opened the refrigerator door for the person to put the cake safely inside.

But the robot wasn't finished. The person sat down, picked up a can of soda, and after giving it a little shake, set it back down. By observing this action, the robot knew the can was empty (detecting an invisible fluent) and guessed that the person wanted another drink. It then went back to the refrigerator, opened the door, pulled out a soda, and handed it to the person.

Of course, this is a limited environment with a limited number of objects and only one other actor. If we were to apply this kind of functionality across scenes reliably, we would have to move closer to replicating a crow's reasoning using available objects in a complex series of behaviors while interacting with others.



Machine Learning - The Limits of Learning and Downtime

The five AI disciplines are groupings of similar kinds of problems. Throughout each section, I've tried to think about each discipline through a single framework in hopes that we can eventually create a unified representation that addresses all of them.

Machine learning is designed to research and acquire the knowledge necessary to solve the previous five kinds of problems. The five other disciplines are the nails. Machine learning is the hammer.

Of all the hammers in use today, deep learning is particularly useful. Of course, within the five disciplines, there are many different kinds of tools and ways of using them employed today. But deep learning has, in recent years, been the most popular hammer of all.

Based on our cognitive framework, learning should be a continuous process of two-way communication. Given this starting point, under what conditions will the robot learning process terminate? This question is vital because when the learning process ends, no new information can be acquired for accomplishing new tasks. For humans, the learning process can sometimes stop quite early. People become less flexible as time goes on, resorting to older and less effective actions for completing the tasks of a new day. We don't want this to happen to AI systems.

Deep Challenges to the Process of Learning

As mentioned above, deep learning is but a small piece of the broader learning framework. Meanwhile, learning itself is only one discipline within AI. So to equate deep learning with AI is like a frog in a well trying to describe the sky based on the tiny patch it can see.

But what are the ultimate limits of the different forms of learning? What is the "shutdown condition"? In other words, when does learning end?

In passive statistical learning, there is an upper limit to the number of samples. But we want to move beyond passive statistical learning and consider limits outside its confinements. Can a broad learning process converge? And what is its convergence? The halting problem in machine learning is the challenge that occurs when the learning process stops.

"Conversation in learning allows information to flow between two minds. It's what is taking place between the two ellipses in the figure on the previous page. Many factors affect the quality of this flow."

1 Level of understanding of self and others:

For teachers to impart knowledge, decision-making, and values to a group of students, they must be confident both that they have all the required knowledge and their students do not. Similarly, when students ask teachers questions, they must understand the overlap between what they don't know and what the teacher does. Both sides need an accurate estimate of themselves and of each other.

2 Teaching and learning Methods:

If the teacher tracks students' progress, she can provide only knowledge that's new, rather than repeating herself. This is what's taking place in algorithmic learning and perceptual causality.

3 The IQ Problem:

How to measure the IQ of a machine? Many animals can't understand certain concepts regardless of how they are being taught.

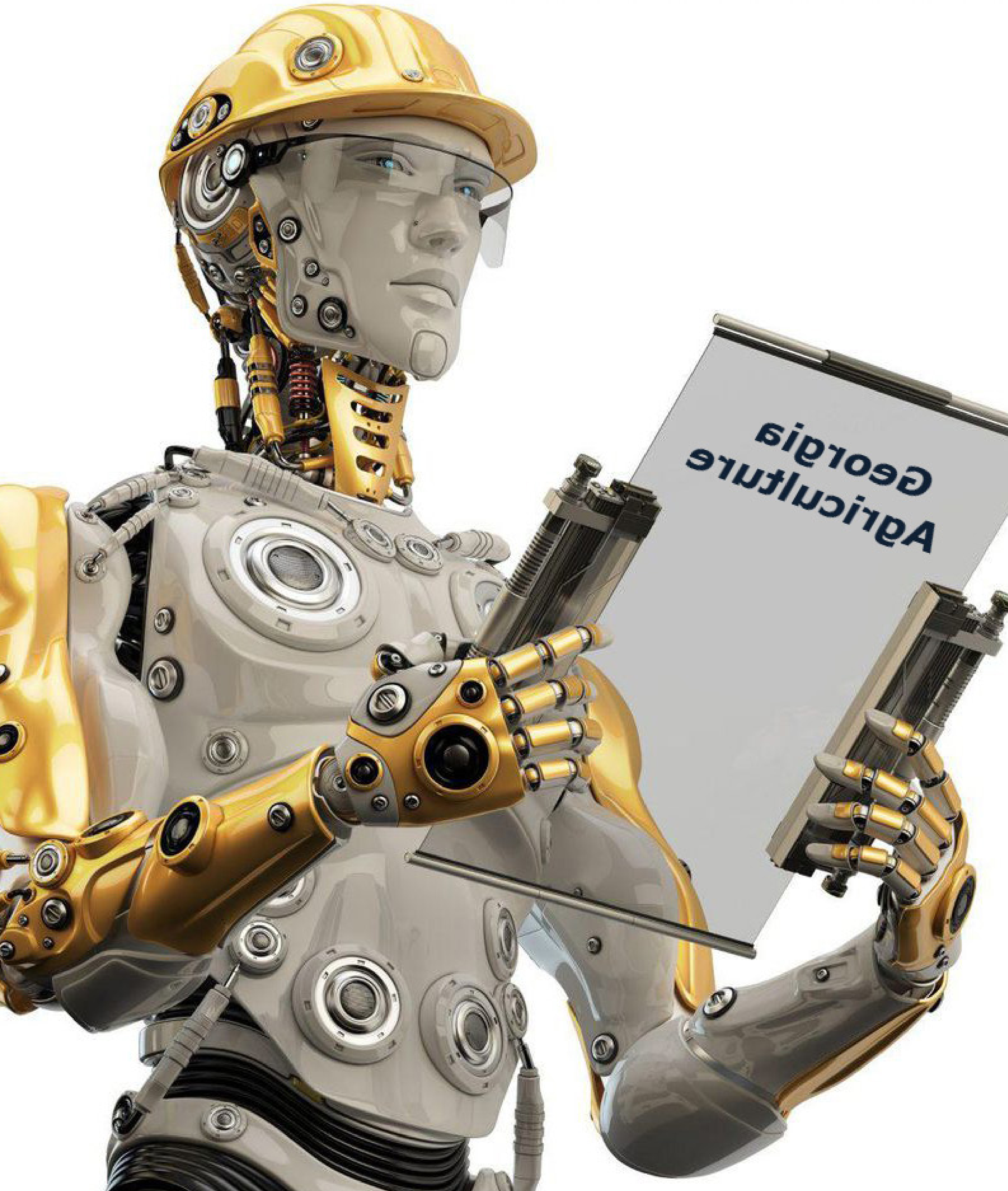
4 Value function:

Students don't usually want to learn about things they aren't interested in. People of different values cannot communicate, let alone listen and learn from one another. For example, if a person in a Facebook group loses interest in its subject or topic, she will be tired of seeing news feed updates from it and leave the group behind.

There are 7.7 billion people in the world, and, among the 7.7 billion people, there are 7.7 billion different brain models.

Despite the fact that there are some local shared models, building some small amount of consensus, learning conditions are different everywhere, and people will not all arrive at the same place.

The halting problem is really about how to reach a balanced state in this dynamic process.


Georgia
Agriculture

“High School Aviation Programs in the Age of Covid-19”

By Jane Kellogg

With a look at how many High Schools are adapting to the normal AOPA curriculum to address both in-class and remote learners. But first, it’s March 6, 2020 and both students and teachers excitedly leave for Spring Break week.

The students were particularly looking forward on their return to touring the Boeing Company’s Global Services & Support center at Kelly Field which includes the largest free-standing high-bay aircraft hangar in the world.

Alas, it was not to be, as the Covid-19 Pandemic forced health officials to shut-down all schools thereby forcing teachers, school personnel, and students to stay home, leaving behind half-finished lessons, personal items and a three-quarters complete aircraft.

A scramble began then trying to get computers, online Internet access, and lessons to all students in their homes in the district.

Like most other schools in disadvantaged neighborhoods, access to the Internet was either unreliable or non-existent resulting in many students simply without access to the virtual lessons that were taught to finish the school year.

At that time, the instructor commented that without the AOPA curriculum with its online access, it would have been impossible to keep students learning in a totally online environment. The students were already used to the online lessons that included access to learning experiments and video clips. The only difference now was that the instructor was online as well.

When the summer began winding down, everyone debated whether the schools would open again at all and if so, whether all students were returning to the classroom or others would be online. At SWISD, it was the parents' choice and as it turned out, overall, 48% are onsite with 54% online.

With both online and onsite students, delivering instruction to both at the same time required rethinking teaching. The instructor had to be online via Google, and in the classroom at the same time. Plus, he had to physically teach in two different 'classrooms'- The hanger where the aircraft was being built for the first two hours of the day. And his normal physics classroom located in the main building for the rest of the day.

Being very inventive, he initially commandeered a rolling table, added a computer, a Video Camera, and space for demonstrations which he rolled between buildings. Later, he created the same presentation station in the classroom leaving the rolling table in the hangar.

The district offered 4 aviation focused classes for the 2020-2021 School Year.

Practicum STEM class 1 Focused on Building the Aircraft
Practicum STEM class 2 Focused on Classroom Aerospace activities
Introduction to Unmanned Aerial Vehicle
Aviation Ground School

The 2020-21 Practicum STEM classes 1 &2 were taught in the hangar at the same time.

Section one focused on hands-on building of the aircraft, and Section two was devoted to aviation instruction including using simulators and other learning systems.

It is important to note that the students actually perform all the building activities whether it is riveting, installing electrical wiring and components, soldering, gluing parts together, etc. under the direction of the instructor, the STEM consultant and two or more mentors who are former military that are on-site for a few days each week.

There were only 11 students who registered for this class and only 4 of the total of 11 who would be in class doing the actual work on-site. You are probably asking yourself “how are they doing that?” The answer is that all of the students in both groups have the building plans, the students off-site are watching online, observing and discussing the physical building actions by those onsite.

Another part of the class actions includes physically using the Red Bird simulators (https://simulators.redbirdflight.com/products) that are onsite in a room inside the hangar. All students also have access to Real Flight 9 Simulator Software(https://www.realflight.com/). Regardless of which one is used they provide a realistic flying experience for each student which helps them be ready to start flying aircraft upon graduation.

The other instruction that is going on during this class is using Aerospace Engineering Design Software Solid Works’. This is a 3D engineering design software that lets students design objects in three dimensions.

There is a wealth of information on this software online on their website. (https://www.solidworks.com/product/students. The best news about this software is that it is free to schools so students have free access to one of the leading industry standard solutions for engineering design. Once the product design is completed, the 3-D printer produces the output of the design.

2020-21 Introduction to Unmanned Aerial Vehicle

This class had the highest enrollment of any of the classes offered, 17, with 9 onsite and 8 off-site. One driving force is that when they have completed the course, if they are 15 or older and pass the tests, they can fly UAV's commercially for hire. Plus, it introduces them to all the factors involved in actual flight of an aircraft. Those off-site participate fully in all activities.

It is an approved Class by the TEA – Texas Education Agency According to TEA,

The Introduction to Unmanned Aerial Vehicle (UAV) Flight course is designed to prepare students for entry-level employment or continuing education in piloting UAV operations. Principles of UAV is designed to instruct students in UAV flight navigation, industry laws and regulations, and safety regulations. Students are also exposed to mission planning procedures, environmental factors, and human factors involved in the UAV industry.

These are some of the Learning Objectives for the UAV class adapted from the AOPA class curriculum.

Students Will Be Able To:

- State a safety issue and create a proposal for a new aircraft safety device to solve for the issue.

- Categorize safety design features of modern aircraft.

- Identify the types of materials that have been used in aircraft construction.

- Formulate an aircraft design based on the strengths and weaknesses of various material types.

- Identify and recognize the location and function of components that make manned or UAS flight possible.

- Know How the role of an aircraft can change depending on the circumstances and explain how a single aircraft type can serve on the mission for multiple purposes. That diverse aircraft can play complementary roles. Analyze a single mission to determine how multiple aircraft types can complement one another.

• Know Categories and classes of aircraft -Why various categories and classes of aircraft are necessary -Strategies for identifying types of aircraft -Several different types of UAS and their characteristics -How the FAA classifies UAS and operating rules and privileges -The levels of autonomy UAS operate under.

All of these objectives are achieved through hands-on activities. An example is the first objective to 'fly' a drone (Using the Real Flight simulation software referenced in the aerospace instruction earlier) then talk about safety measures needed to keep both the drone (aircraft) safe itself and everything in the area of flight. In this case, later, the class will try flying a drone inside the classroom and quickly see why safety is a very real issue.

At this point in the school year the subject is Factors that Affect the Lift of an Airfoil. The students click on their lesson for today and are directed to read the presentation which includes this slide:

There's a crossword puzzle and lots of graphics examples and an activity sheet that has to be downloaded, completed, and submitted online.

Later, the class goes outside of the Hangar, and flies a drone in 'real time.'

Students are fortunate in this class that a person whose business is training people around the world to fly UAV/UAS systems commercially, is providing real world examples of what someone who is trained to fly them does, is a mentor for this class.

2020-21 Aviation Ground School

The Ground School class is designed to prepare enrolled students to be ready to take their FAA knowledge exam upon graduation from high school, or before if they are 16 or older. Thirteen students enrolled in the class with 9 onsite and 4 off-site.

Students spend time both in the classroom, and the hangar. They have access to the same simulators used in the Aerospace class referenced earlier. Having the Real Flight Simulator software available regardless of whether they are onsite or off-site is not a barrier to succeed in this class. A simulator is able to recreate any type of weather over any type of terrain to help students practice the necessary techniques for mastering these conditions, whether it's rain, wind, ice or snow.

Since weather dictates whether you decide to take off from an airport or not on any given day, there is a heavy emphasis on all types of weather, and it's causes within this course. Below are the learning objectives stated in the overview of the class:

Students will Be able to:

- Compare the different types of weather observations and explain how they work together to provide a more complete picture of the weather. Decode and interpret METARs and PIREPs.

- Identify sources of weather information used in flying and distinguish the limitations and advantages of forecasting.

- Summarize the differences between weather reports and weather forecasts.

- Identify the types of precipitation and clouds that form with different frontal boundaries. -Interpret weather symbology -Analyze weather scenarios to determine how fronts affect the flight experience -Analyze how air masses change as they pass over various land and water surfaces.

- Categorize different types of clouds. -Predict weather conditions based on cloud type. -Predict the height of a cloud base. -Assess if the freezing level will affect a flight. -Differentiate among different types of precipitation.

- Summarize the role of uneven heating on the earth's weather. Language Objective: The students will listen and then write information about the weather for the day in the daily weather log. Students will also discuss the role of heat exchange in weather formation.

- Make observations of the current weather. -Differentiate among the various components of the atmospheric gases, water vapor has the atmosphere. Draw conclusions about the role of atmospheric layers and the layers most impacting water in creating weather.

- Why the study of weather is important to pilots -That wind, clouds, precipitation and thunderstorms are the common weather phenomena that affect flying -That pilots have tools to help them better understand and navigate hazardous weather.

Additionally, they have a special focus related to airports, including:

- Types of Airports
- Airport Data, Markings and Signs,
- Runway Safety
- Airport Lighting
- Traffic Activity, Patterns, and Communications

The simulator can recreate any scenario that you might encounter around any type of airport so students use these to practice every one of the topics above.

Several differences between having students online or onsite showed up:

- To keep students engaged in learning they were required to keep their cameras on all the time.

- The instructors called on students to answer questions regardless of whether they were online or off-site.

- Lessons were designed differently, however, because it was not possible for students off-site to have access to the same experiment equipment.

An illustration of a simple activity was when students were first studying flight, they were challenged to build a paper airplane. The next day, each student tried flying theirs. Students onsite at the school were in a large classroom so planes were able to fly several feet. One online student tested his planes ability to fly but he was in his bedroom. Needless to say, his plane only went a few feet until it ran into a wall.

While this teaching format is not ideal, it does provide continuing instruction toward the goal of preparing students for a career as a Pilot, an Aircraft and Powerplant Mechanic, or one of the careers associated with Aerospace Engineering upon graduation.

Thanks to the instructors, and mentors for contributing information for this article.

Jane Kellogg has a MS Degree from Oklahoma State University with 15 years' experience teaching science in public schools and as an Adjunct Professor. She is a retired CEO of Kellogg & Sovereign® Consulting, LLC, a company she founded, an Instrument Rated Pilot, and Board Member of EAA Chapter 35. She donates her time now mentoring students in exciting Aviation STEM Programs.


Marte…
"Irías si supieras que no regresarías?"
"¿Por qué?"

5 Lessons From ***3 Years*** in Synthetic Biology:

Project based learning in cutting edge high school STEM

By Alina Arvisais and Luc Arvisais

As students and teachers at Our Lady of the Snows Catholic Academy, we began our journey in synthetic biology in 2013. Synthetic biology is a relatively new field of study that has numerous and varied definitions. As it relates to our experiences, the Royal Society UK calls "synthetic biology [the] emerging area of research that can be broadly described as the design and construction of novel artificial biological pathways, organisms or devices, or the redesign of existing natural biological systems".

Our team's goal this past year was to introduce recombinant DNA to bacteria to help breakdown keratin waste. Keratin waste can be found in the masses of human hair tangled in machinery at wastewater treatment facilities and in the tons of chicken feathers at rendering facilities.

Traditional methods of keratin waste disposal have negative effects on the environment or are not cost-effective. To improve industry standards, we worked to establish a biochemical method to recycle keratin.

Using enzymes instead of physical means to breakdown feathers and hair provides the potential to produce high-quality products from the building blocks of protein: *amino acids*.

Our team name is BreaKERs and it comes from the words "break", "keratinase" and "keratin degradation". The team motto is simple: ker-ate chop keratin waste!

While developing a more efficient method to recycle keratin waste into useful products was the synthetic biology-based goal of the project, the more complete purpose of doing synthetic biology in high school is to allow students to receive a well-rounded education. This education is not limited to the technical aspects of the project and instead extends to all areas of science, including safety and ethical considerations, the acknowledgment of religious and economic perspectives in scientific endeavors, and the development of other soft skills.

To us, this experience was a step away from learning in class; but a step towards receiving a social, intellectual, and practical education in a different kind of classroom.

Here are the 5 biggest lessons we learned during 3 years in synthetic biology.

1. **Failure is inevitable.** Science requires repetition and success is often incremental.

Things don't often work the way you would expect. We hear of the Nobel prizes being awarded and scientific breakthroughs but how often do we hear about the decades of research that were required to get there? We grow up with classroom science experiments that are reproducible within five percent error and can be done during one class period by millions of people. School did not prepare us for the repeated failure we experienced in the lab.

We often didn't even know what the problems we faced were, much less how to solve them. Hours of research, contact with mentors, trial and error provided us with successes separated by many more failures. This taught us that failure is not only required for success, it's inevitable when you're trying new and innovative things.

2. Community Drives the STEM Experience.

The passion of many people fuels the desire to persevere. Whether traveling from Canmore to Boston for iGEM (an international genetic engineering competition) and its accompanying poster discussions, or hosting a synthetic biology Jamboree at our school.

No matter if we were at the University of Lethbridge for lab workshops, or at home Skyping with students in the US and Europe. Participating in online conferences for BioTreks (a high school scientific journal) or engaged in leadership summits run by Inside Education, we were always collaborating and learning from others.

The relationships between individuals in the scientific community are symbiotic, providing mutual benefit. We learn from students, teachers, mentors and industry professionals and in return we offer our unique perspective on solving global problems (like that of keratin waste).

Without collaboration and friendships within our team, or between our team and other groups it would have been much harder to push through the failures and stay motivated to continue.

3. Communication is vital.

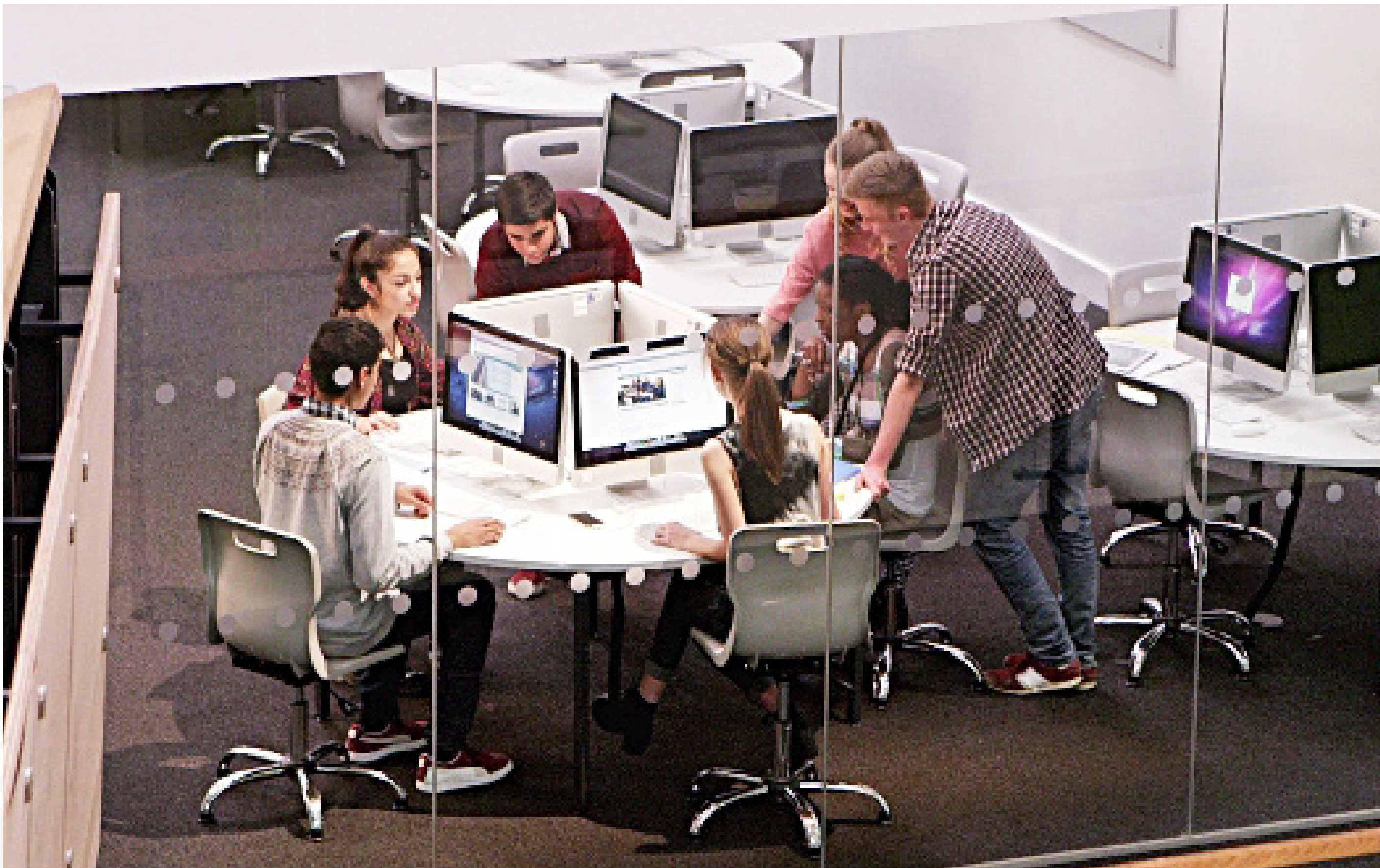
We can all appreciate the communication required to work in groups, but as high school students and teachers we sometimes overlook that good science requires some selling. Otherwise, great ideas are neglected just because no one knows about them. An awesome concept pitch and good scientific communication engages the listeners and participants of public presentations, posters, websites, or small group meetings.

This engagement translates to shared excitement, support, and action. Therefore, communication isn't only required to work as a group, but also to share your work with the community around you. In turn, good communication is rewarded with help, encouragement, and increased success.

4. Remember to put the Art in STEM: the importance of STEAM.

Communication done artistically is more appealing and captivating. It engages a broader range of students that can contribute to the team and it encourages creative thought and expression that spurs innovation.

Artful websites, videos, posters, logos, and pictures were important in order



to communicate what we were working on in the lab with different communities (school, town, or scientific). They also challenged us to incorporate better design principles to our project implementation plan, and to effectively share information about synthetic biology to a wider public.

Art supports the ability to communicate with a greater diversity and depth, and to think critically but also creatively. And, it actually puts the TEAM into STEM.

5. No One Can Do It Alone.

We've relied on groups or individuals who donated time or money. In its three years of existence thus far, our school team varied in sizes between six and nineteen junior and senior high students accompanied by two teachers. Mentors taught us about synthetic biology, helped us when troubleshooting all kinds of problems, and inspired us to keep going when we encountered failure.

As a whole, we also learned when to seek information and when to do work ourselves, but also when to ask others for help. We needed to put in effort ourselves but when faced with an overwhelming roadblock we also needed to ask for support and are grateful to have received it from a number of people and organizations.

These 5 lessons were impressed in us by our experience learning and working in a cutting-edge scientific and engineering field. All experiences have shaped us, as students and teachers, into better scientists and engineers, more critical and creative thinkers, and more perseverant people. However, there is still much more that can be learned, which is why we stay motivated in our studies and work; and hope you do the same.

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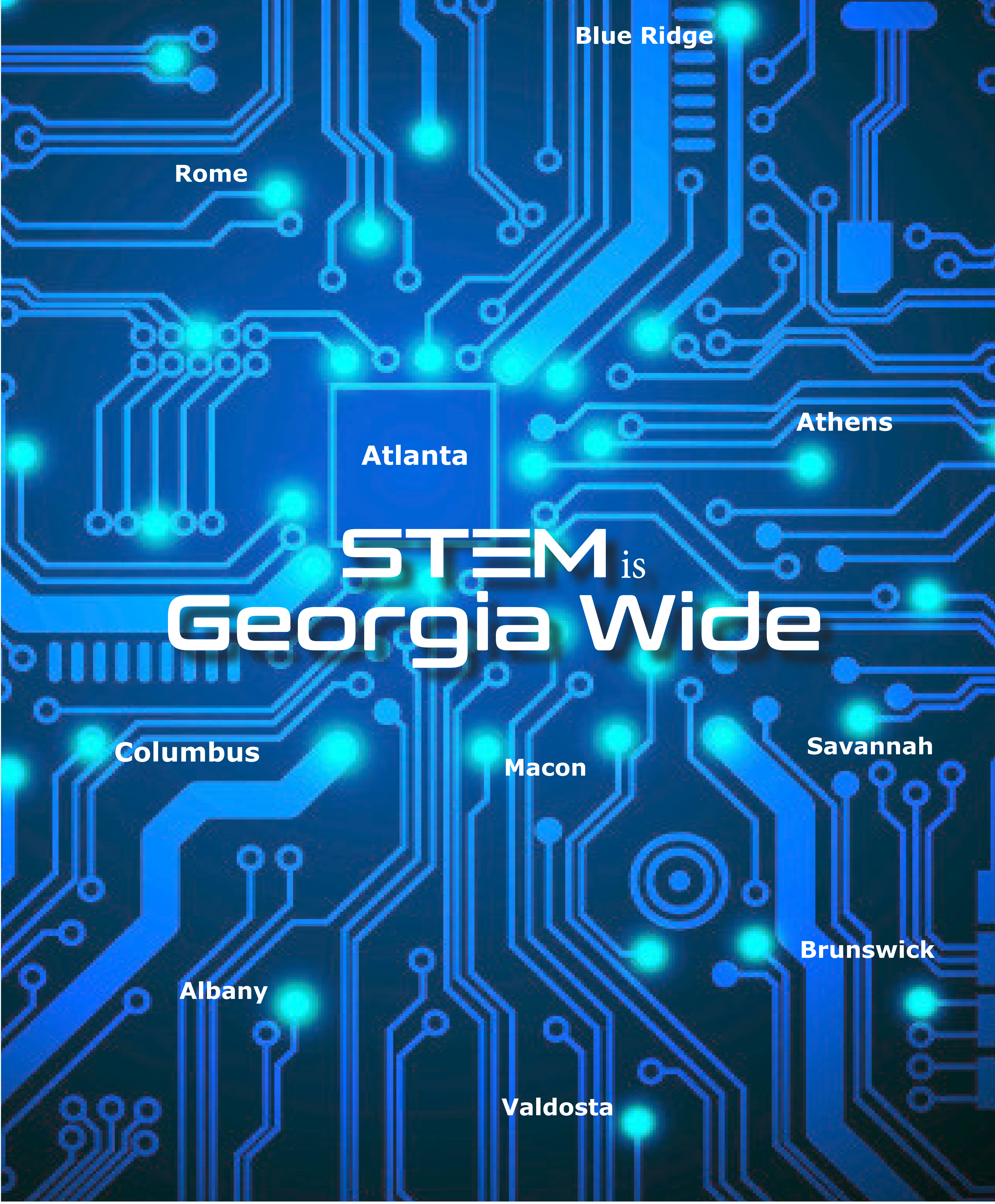

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