

November 2020

GEORGEA PATHWAYS

M A G A Z I N E

A.I. Potential

The Rise of Alt-Banking

RUSSELL MOORE

STEM Is Critical Science is US



STEM, is making good decisions.

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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STEM Work Is Critical

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Welcome to the November issue of Georgia Pathways. Having celebrated Veterans Day recently, it's notable that we provide several TAG events to honor our Vet's, their post service accomplishments, business successes and contributions to the Georgia economy.



Information technology has long been a growing and innovative part of our modern military defense and the armed forces IT training provided by each branch of service easily translates into Georgia industries with their adoption of innovation and IT applications.

Our military has a long and rich history of IT innovation, from early computer technologies to the global positioning system we use throughout our day. The tried and true experimentation and application of new tech. has consistently inspired, improved and enriched our industries that include industry finance, human resources, FinTech, supply chain management and workforce development.

Veterans are already accustomed to the lifestyle small and medium sized business owners need to get their enterprises up and running or more successful. Long hours, hard work and attention to detail are ingrained in the mindset of American vets. The IT education and experience of our Georgia veterans continues to encourage young minds to consider the wealth of knowledge and experience our veterans have to offer, as well as spark their imagination to build on previous IT innovations and needs.

Veterans not only operate 10% of U.S. businesses, they generate \$41 billion in gross domestic product and employ almost a million Americans, many of them other vets. It's interesting to note that significant tax credits are available to companies who hire these

battle tested employees. Businesses that hire eligible unemployed veterans can take advantage of a Work Opportunity Tax Credit (WOTC). After recent changes, The Returning Heroes Tax Credit now provides incentives of up to \$5,600 for hiring unemployed veterans, and the Wounded Warriors Tax Credit doubles the existing Work Opportunity Tax Credit for long-term unemployed veterans with service-connected disabilities, for up to \$9,600.

Atlanta is one of the top 16 cities nationwide that support and encourage veteran owned businesses using four criteria to determine these cities: Support for veterans, ability to start a business, economic growth and livability. Atlanta and Georgia is such a place.

Support means that cities like Atlanta and surrounding areas have a support system in place to fit veterans' unique needs. Economic growth is determined by looking at the city's key economic indicators, and "livability" measures the key facilities people seek when looking for a place to live. Georgia is that place.

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.

Science is US

STEM work is *critical*
to a strong, healthy economy

Rachel Kerestes
Executive Director, Science is US

*W*hen I began college in the 1990s as a biology major I was joining the field in one of the most exciting times for molecular biology—genetic engineering was delivering new cures in medicine and new plant varieties that would revolutionize agriculture, the human genome project was underway.

The news of the first successful mammalian cloning experiment, a sheep named Dolly, was reported. But with all of these rapid technological advances, policy lagged, and policy makers struggled to understand how to grapple with key questions related to regulating and safeguarding groundbreaking science. I left the lab for a career as a social scientist—focusing on science policy—instead.



Over twenty years later when I took on my current role with Science is US, many of those challenges related to the intersection of science and policy remained. But now, with Science is US, we had a platform to bridge those gaps. Science is US unites individuals and organizations dedicated to expanding federal support for research and greater use of science and evidence in the development of public policies at all levels of government.

Our first undertaking was the completion of a study designed to quantify the economic impact of occupations in science, technology, engineering, math and medical-related fields nationwide and among a group of selected states including Georgia. The findings were eye-opening to say the least and we were even more energized to dig into our work. More on the study in a moment.

Soon after we released STEM and the American Workforce in late January, news of the first Covid-19 cases emerged. Within weeks, the pandemic reached the United States and, like so many U.S. businesses, our office was closed and we were sent home to continue our work.

Like school administrators, teachers and students, we adapted to working and learning remotely. We hired and trained needed staff, engaged organizations with which we shared common interests and learned how to work together virtually to promote important STEM-related issues. Despite the challenges, we made valuable

progress and continue to strive to achieve our objectives.

This year hasn't been easy for any of us. Teachers and students want to return to their classrooms safely and parents want to get back to our usual work environments. As the parent of a pre-school aged child, I have seen first-hand how teachers and administrators have tapped every resource possible to develop creative ways to connect with their students. Learning online may not be ideal, but it has been necessary as solutions are developed to resume in-class instruction. Rest assured that science will help guide us back to class, work and more normal routines.

It was equally difficult to watch the pandemic collide with the election season as political figures used (or misused) science to advance their respective agendas. As someone who has worked in public policy arenas throughout my career, it was immensely disappointing to see science weaponized in such a way.

As I mentioned, our first Science is Us mission was to present the findings of our study on the STEM economy. The analysis, which took the most inclusive view of STEM to date using 2017 data, determined that 67% of U.S. jobs and 69% of the nation's gross domestic product are supported by science, technology, engineering, mathematics and medicine. In addition, STEM fields produce \$2.3 trillion in federal tax revenue annually, making it the primary economic engine for the United States.





The analysis reviewed hundreds of occupations defined by the Bureau of Labor Statistics and examined STEM employment and economic output across the country. Of the 195.8 million jobs identified across the 819 occupations, more than 130 million were direct, indirect or induced STEM jobs which created more than \$13 trillion in gross domestic product.

And STEM employment has a clear economic ripple effect locally and regionally, with 64 million (33%) U.S. jobs being high-skilled STEM professions, another 66 million are tied to or dependent upon them.

In addition to generating the more than \$2 trillion in Federal tax revenues, STEM-related employment created more than \$1.2 trillion for state and local treasuries, making them financial lifelines for many cities and states as well.

As we found, STEM professionals are more than the rocket scientists or software engineers often associated with science and technology jobs. They include skilled Americans with backgrounds outside of academia and innovative professionals working in every segment of our economy, demonstrating the value of our universities and the inclusive nature of the boom in STEM across America.

Perhaps most surprising, however, was the realization that 59% of U.S. STEM professionals do not hold a bachelor's degree, which should be of interest to

educators, particularly those guiding high school students to their next educational frontiers, as well as those in junior and community colleges. One need not earn a master's or doctoral degree to be successful in science-related fields.

Our workforce study, which also examined data in 10 states, was equally encouraging for Georgia where STEM is responsible for more than 3.7 million jobs (62%), more than \$710 million (71%) of labor output and nearly \$375 million (66%) of gross domestic product. In 2017, STEM-supported employment in the Peach State generated \$61 billion in federal tax revenues and \$28 billion in state and local taxes.

In Georgia too, more than half of STEM jobs, 58%, are held by women and men without a bachelor's degree, the study found. Across the country, these are licensed practical nurses, electricians, advanced manufacturing specialists, laboratory technicians, military communications systems managers and others who make up the backbone of the STEM workforce.

As you might imagine, STEM employees, regardless of education level, earn higher wages than their non-STEM peers, 29% more according to a 2017 U.S. Department of Commerce report.

Science and engineering have as much potential to change the world today as they did when I first entered the lab in the



1990s. As we saw in 2020, they help guide our thinking and enables us to make wiser choices. They allow us to learn, explore, grow and adapt. In the months ahead, science will guide us to a vaccine for Covid-19 and, I am confident, put us on a path to economic recovery.

Here's to the ever-expanding benefits of science, technology, engineering, math and medicine in 2021.

Rachel Kerestes is Executive Director of Science is US, a foundation-supported effort that brings together a diverse group of science, engineering, industry, higher education and labor organizations to advocate for science-based public policies.

TECH -

The Rise of Alt-Banking Options

By Russell Moore

There are more banking options than ever, yet many consumers around the world still live paycheck-to-paycheck. This dichotomy is one of the main reasons the 'alt-banking' niche has grown so much in recent years and why many of us in the financial industry are asking, "How can we help the more than three billion people outside traditional banking grow and better their lives?"

There's no shortage of options for those who might fall outside the realm of traditional banking. With the rise of cryptocurrency and the growth of powerhouse banks like Capital One and fully online banks like Simple Bank, alternative banking options abound and are pushing the boundaries of how we interact and think of money systems. Change is here. This means traditional — and even some progressive — financial institutions have a steep learning curve if they want to overcome these competitive disadvantages.

The consumers working outside the traditional tend to fall in three categories — unbanked, underbanked and overbanked. Each has their own strengths and, no matter the option, the grass may seem a little greener on the other banked side.



Unbanked

Having no ties to traditional banking services, like checking accounts and credit cards, earns a consumer the label of ‘unbanked.’ Whether consumers are self-described ‘doomsday prepper’ types who have no trust for government-insured financial intuitions or have been forced out of mainstream banking due to fees and high minimum balances, being unbanked today is not as bad as it could be.

There does exist a stigma about the unbanked and the financial resources they rely on. But, despite this, most who use services like check cashing, payday lenders and prepaid cards, know exactly where every cent goes. The issue for them is not a lack of management or knowledge of their financial situations – it’s the fees.

A consumer with an income of \$15,000 a year who cashes a monthly paycheck at a store offering the New York standard interest rate of 1.91% could spend up to \$286 a year in check cashing fees alone. However, savvy consumers can work around those fees by using services like store brand money cards to load the funds with little to no fees.

Walmart does this with their MoneyCard. Or they can have funds deposited to a prepaid card, such as one from Netspend or Mango. Living as an unbanked consumer is no longer a punitive sentence; for many, it is becoming a viable choice.

Underbanked

It’s possible to have one foot in unbanked waters and still hold onto a few traditional banking services. For example, a consumer might use a traditional checking account and carry a bank card, but may take out a payday loan when the need arises.

These often disenchanted consumers find themselves under attack from high fees pushed on those with lower incomes. Since they still rely on traditional banking for at least some of their financial transactions, the underbanked are a large target for the predatory side of banking.



Overbanked

Most states have laws that require them to offer services to the underbanked; however, it is not mandatory that banks advertise those offerings. Rather, these institutions push higher-fee services on them. Eventually, when they are no longer able to pay overdraft or other fees associated with their account, these consumers move into the unbanked category. This group uses both traditional and alt-banking services, like credit unions. If they are digitally adept, they might also add peer-to-peer products like Venmo and Crypto.

Do you maintain more than three deposit accounts? If yes, then you are considered overbanked. These consumers are typically offered better rates and can take advantage of perks like rewards, cash back and slick online services. But the reality is that nothing is free and having multiple accounts that you don't keep up-to-date can cost you.

Traditional services are seeing huge potential loss with the rise of consumers reevaluating their financial situations and incorporating alt-providers. Tailored products for every consumer will drive change and may bring back a little loyalty, but the wide variety of alt-banking options places customers in charge and lets the overbanked pick and choose.

Consumers are benefiting from becoming more aware of their digital and information footprint. Financial institutions do have the ability to keep up, and in some cases, beat these new trends. The question is whether they are willing to compete with or even invest in the fast paced future of alt-finance.

Consumers are beginning to expect an experience that is specific to their needs and lifestyle and financial institutions that adapt can provide something that nameless, faceless alt-services cannot -- customer service. When they combine that with a full spectrum of services consumers aren't the only ones who'll win.



The Potential of Artificial Intelligence

Lifting humanity with AI

Natural Language Understanding - The Cognitive Basis



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 startup 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.

of Communication

The third discipline of AI research is language and dialogue. The human brain's language center is located near the action planning area, which makes sense. After all, why do we talk? The origin and purpose of language is to convey a message from one person's mind to another. This act requires implicit knowledge, intent, and planning. The goal of language is to form a consensus on common task plans so that we can act in concert. In other words, the central purpose of language is to enable cooperation.



1) Intentional Communication



2) First Glimmers of Cooperative Communication



3) Recursivity ==> Fully Cooperative Communication

Animals have rich communication that is often based upon body language. Humans, similarly, use nonverbal means to convey information about ourselves, from gestures to facial expressions, from body movement to signs. Nonverbal communication is so fundamental to humans that we have developed a special type of art called pantomiming. We already possess rich cognition, including tacit knowledge and consensus values, before we even begin language formation; without this

foundation, language would be merely empty symbols. Dialogue could not develop.

The Lost Gorilla

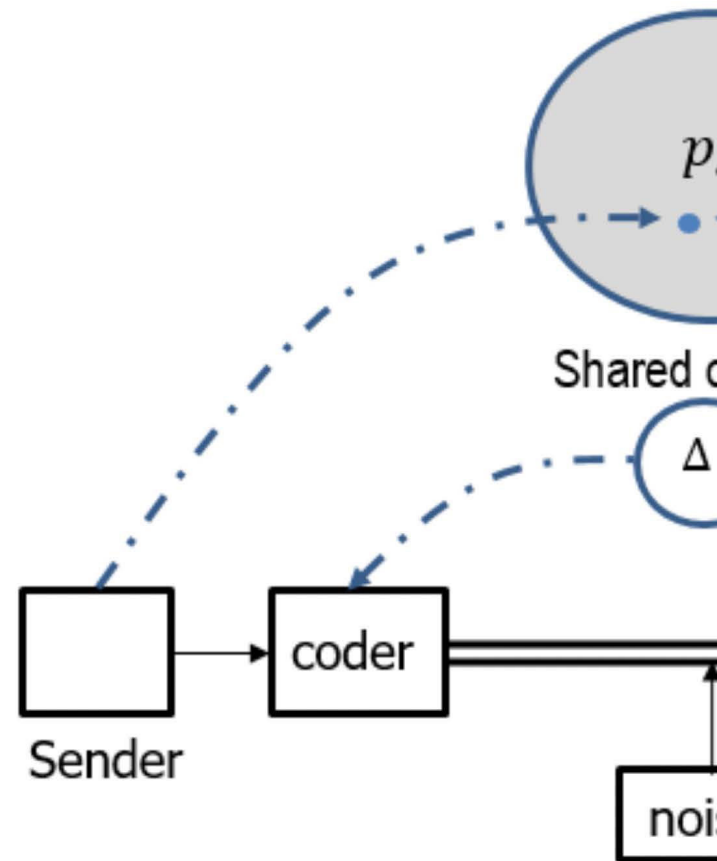
Developmental psychology experiments show that one-year-old children know how to refer to things by pointing, while babies younger than one cannot. Many animals never reach this level of communication ability.

For instance, you may have heard of the experiment in which a young gorilla child becomes separated from his mother while the two are playing in their zoo. The other gorillas, lounging about in the sun, don't help the mother find her child. If they were human, the sun loungers would most likely be quick to communicate what they know; this is because humans are born to cooperate, and we derive pleasure from helping others. But gorillas have not evolved in this way, and the mother's companions, missing the situation's gravity, are not quick to show her where her child has gone.

The lost gorilla experiment suggests something is absent in gorilla brains that human brains possess. As it turns out, we are more advanced in our cooperative abilities than other animals because there is a cognitive framework of communication (like a multi-layer network communication protocol) within our cerebral cortex. Without this cognitive architecture, the level of communication we are accustomed to would not exist.

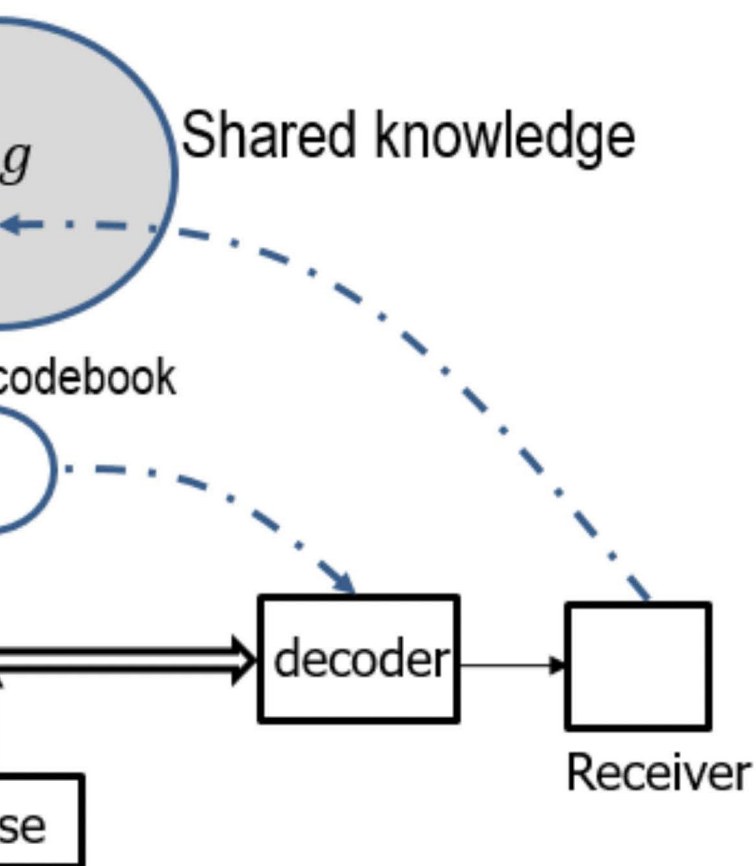
If people who study machine language fail to study the underlying cognitive framework of communication, they won't accomplish much.

The Importance of



The figure above from Professor Michael Tomasello, on cognition, illustrates the mutual understanding and shared perception is a critical aspect of the foundation of shared cognition. Otherwise, language is superficial, like a game, easy to spot and differentiate from humans; they have to interact.

of a Shared Reality



, a pioneer of anthropological research and social sharing of knowledge and intentions. Since visual shared reality, research on language cannot be done like a tree without roots. This is why chatbots are so ineffective with humans with whom

Let's begin our exploration of shared reality with the most basic communications process: the delivery of a piece of information.

Sending a message is a very simple process and was modeled mathematically by Claude Shannon of Bell Labs and published in "A Mathematical Theory of Communication" in 1948. First, a message is encoded to reduce its size and to allow for the fastest transmission. Then, some redundancy is added to enable recovery of the original message if it is somehow lost. Finally, decoding delivers the message.

Two basic assumptions inform this process. First, the two sides share a codebook, without which there is no way to decode the message upon arrival. Second, the two sides have shared knowledge of the outside world that gives context to the message. The sent information is merely a fragment of the parse graph (PG) describing some state of the physical world, which makes sense only when considered alongside other aspects of the world that are part of shared knowledge between both sides.

This state may also be ideas and feelings -- fluents inside our mind. Shared knowledge is how one can sometimes have a rich interaction over the phone despite the exchange of relatively few words.

In contrast, if both sides do not have a common understanding of the world, one side cannot truly understand what the

other is saying. Idioms often create this kind of challenge between two speakers of a language, especially when one is a native speaker and the other isn't. A native Spanish speaker, for example, might say "Hay Moros en la costa" (There are Moors on the coast) to mean, in English, "The walls have ears." Without understanding the context of Spanish history and culture, the English speaker would fail to comprehend this idiom's true meaning.

Game Theory and Morality - *Acquiring and Sharing Human Values*



To communicate with humans, a robot must understand human values.

Philosophy and economics have a basic assumption that a rational person's behavior and decision-making are driven by the maximization of his own interests. If we rule out the possibility of deceit,

observing a rational person's behavior and choices allows us to reverse engineer his reasoning and learning and to estimate his values.

By classic definitions, the utility derived from a specific choice is a utility function, a mathematical formulation that ranks

the preferences of the individual such that $U(a) > U(b)$, when the choice a is preferred over the choice b . By observing a rational agent's preferences, an observer might construct the utility function representing what the agent is actually trying to achieve, even if the agent does not know it.

We can express values as a utility function with the symbol u . It usually consists of two parts:

- (1) Loss or Reward. What is the net gain?
- (2) Cost. How much do you expend to achieve it?

We can define this utility function with fluents. With every action we make, we are changing fluents. Going up in the space defined with u can be considered "appreciation." If we differentiate fluent vector f from function u , then we get a "field."

Applying concepts from calculus, we assume that in a period of time, a person's value orientation is not contradictory. If he thought A was better than B , B was better than C , and then that C was better than A , his values are an incoherent "whirlpool." A field without "whirlpools" is called a conservative field. Its corresponding U is a potential function.

The aphorism "[w]ater, without control, flows down in nature; quite the contrary, humans strive hard to move up in the world" describes a difference in social

phenomena and physical activities driven by the same essence. In other words, people and water are moving in accordance with their potential energy function. What is the potential energy function that drives people?

Values differ among people; even within a single person, values are always changing. This work does not discuss the social dimensions of values, but sticks with what might be called common sense values, things nearly all can agree upon, such as keeping a bedroom clean. This is a goal for which appreciation is easy to track.

Shared Values: Seating Choices

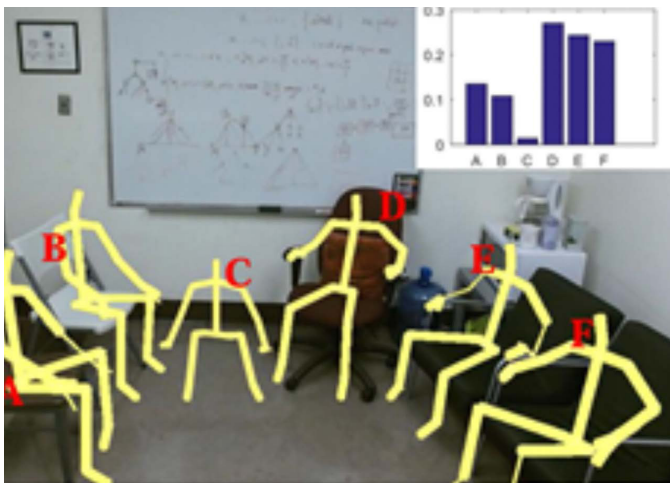


The figure below shows a simple experiment. We placed several different chairs and stools in my office.

(left) and in our lab (right). When my students entered each room, they each chose a chair to sit on. They could have sat on the floor if they preferred.

We labeled each chair A through F and watched the students' choices. Our goal was to determine why one chair was better than the others; what qualities led to it being chosen more frequently than others?

The answers reflect a basic value function.



Categories of Learning





Inductive Learning

Induction is where the learner is given a series of examples and must intuit the rule connecting them. A large number of data samples from across a period of time, region, or population are observed. In the case of humans, these samples could include the millennia's worth of culture and heritage. The result of inductive learning is a probability model of time, space, and causality expressed as an STC-AOG. Each space-time action is an STC-PG, or a parse graph.

Deductive Learning

Deduction is where the learner is given a value function (together with physics and causality), directly deriving the aforementioned balanced states. This is also an STC-AOG, and requires a profound, generative model and understanding of the subject of the study. By knowing the values pertinent to each task, the mind determines how to engage and interact with other minds.


Human learning is often a combination of induction and deduction. In youth, one does more inductive learning. Deduction is possible later on when one comprehends the rules sufficiently and begins to develop credible maps of values, actions, and intent. Sherlock Holmes, for example, is a master of deduction because he understands the landscape built by the behaviors of those around him.

AlphaGo, the Go-playing AI program developed by Google's DeepMind, first learned through induction: it was fed a large number of human-human games, from which it learned the rules. Once the rules had taken firm shape, it learned through deduction. But the mapped space representing all the possibilities for a game of Go in AlphaGo's memory is nowhere near as spatially complex as the space required for human survival. And this mapped space does not take causal relationships into account. As a result, each move AlphaGo makes has a high degree of uncertainty and is much more difficult.



Tech and Philanthropic Leaders L

MILLION GIRLS MOONSHOT



Launch Million Girls Moonshot To Close The Gender Gap In STEM

The collective impact initiative will work with afterschool programs nationwide to increase diversity and equity in science, technology, engineering and math

The Intel Foundation and the Gordon and Betty Moore Foundation have joined STEM Next Opportunity Fund and the Charles Stewart Mott Foundation to launch the Million Girls Moonshot. The effort is designed to engage one million school-age girls in the U.S. in STEM learning opportunities over the next five years. The organizations will provide grant funding and in-kind resources to Mott-funded afterschool networks in all 50 states to increase access to hands-on, immersive STEM learning experiences.

“When my father, Robert Noyce, and Gordon Moore founded Intel, they built upon the experiences of their youth, where they had opportunities to build, invent, engineer and experiment. These hands-on experiences gave them a sense of initiative, perseverance and a belief that they could create revolutionary new technologies,” said Dr. Penny Noyce, founding board chair, STEM Next Opportunity Fund. “The Million Girls Moonshot will help girls from diverse backgrounds develop this same engineering mindset, and I’m thrilled at the way it continues the legacy of Intel’s founders and their passion for advancing STEM.”

“The Million Girls Moonshot harnesses the spirit of innovation — in philanthropy and in afterschool programming — to reimagine our nation’s next generation of engineers, problem-solvers, builders and makers,” said Ridgway White, president and CEO of the Mott Foundation. “We’re delighted that the Intel and Moore Foundations will join us in an effort to promote gender equity by empowering girls through STEM learning opportunities.”

Just as the original moonshot united the nation behind a common goal and dramatically advanced scientific achievement, the Million Girls Moonshot aims to create a national movement to change the trajectory of women and girls in STEM. Led by STEM Next Opportunity Fund,

the Million Girls Moonshot will tap a wide range of funding and programmatic partners, including NASA, Qualcomm Incorporated, Technovation, National Girls Collaborative Project, CSforALL, JFF, Techbridge Girls, STEMconnector and Lyda Hill Philanthropies.

“Every girl deserves access to high-quality education to achieve their dream career, regardless of their ZIP code or family’s socioeconomic status,” said Gabriela A. Gonzalez, deputy director, Intel Foundation. “The powerful synergies from collaborating with other organizations who share these values achieve a larger collective social impact to advance gender equity and parity in STEM fields, and more important, elevate girls’ future pros-



pects for a better quality of life. Equipping youth with emerging technology skills in Artificial Intelligence, Quantum Computing, and Internet of Things is also critical for an inclusive and diverse future workforce. By joining this movement, we are expanding, scaling and sustaining the spirit of Intel's She Will Connect signature initiative, which is something that no sole organization can do alone."

Closing the Gender Gap in STEM is Critical for Our Nation's Future

Women make up half of the total U.S. college-educated workforce, but are vastly underrepresented in STEM fields, comprising just 16 percent of engineers, for example. Black and Latina women have even less representation, at approximately two percent each. With economic projections pointing to a need for one million more STEM professionals than the country will produce at its current rate over the next decade, engaging and keeping more girls in STEM pursuits will be critically important for solving our nation's most pressing challenges.

"We're happy to be inaugural partners in the Million Girls Moonshot and its all-hands-on-deck effort to break down the systemic barriers that exist for girls in STEM," said Janet Coffey, Ph.D., program director, Science, for the Gordon and Betty Moore Foundation. "This generation of young people will be the COVID-19 generation. By fostering an engineering mindset and a spirit of scientific exploration, curiosity, and discovery, we can

empower them to build a better world."

Afterschool Programs are Important for Engaging, Keeping Girls in STEM

Over the past several decades, after-school and out-of-school programs have developed expertise in providing the kind of immersive, hands-on learning experiences that are critical to helping students gain fluency in STEM subjects. This school year, the opportunity is even greater as students and families face many more hours outside of the traditional classroom. From running STEM activities virtually and distributing STEM kits to students, to offering small-group, in-person services on remote school days and during traditional afterschool hours, afterschool programs have stepped up to keep students engaged and learning. The potential for impact is enormous: The nation's 100,000 afterschool programs serve more than 10 million young people.

To support programs as they pivot to meet students' needs, the Million Girls Moonshot will provide afterschool networks with technical assistance, educational resources, access to Intel's She Will Connect partners and mentorship from STEM experts, including Intel employee volunteers. The initiative leverages more than \$300 million in investments made by the Mott Foundation in the past two decades to advance afterschool programs and systems, including the development of afterschool networks in all 50 states, as well as Mizzen by Mott, an app that provides afterschool educators free access to

high-quality content. Through consistent, equity-focused STEM programming and mentorship that engages girls throughout their youth, the Million Girls Moonshot will help weave together opportunities, ensuring that girls are inspired and supported to continue pursuing STEM in high school and beyond.

The Million Girls Moonshot welcomes a diverse group of cross-sector partners to join in expanding its reach, sustainability and impact. Learn more at MillionGirls-Moonshot.org.

About STEM Next Opportunity Fund

STEM Next Opportunity Fund is the legacy organization of the Robert D. Noyce Foundation and is dedicated to bringing high-quality STEM learning to millions of young people and closing the gender gap in STEM careers. As a national leader, strategic guide, policy advocate and investor, STEM Next is bringing about a transformative expansion of high-quality and inclusive STEM learning opportunities. By investing early in the lives of our children, we are transforming their lives and preparing them for the 21st century economy. Learn more at www.StemNext.org.

About Intel Foundation

Since 1988, the Intel Foundation has been committed to improving lives in communities around the world. We act as a catalyst for change by investing in innovative STEM programs, providing disaster relief and support, and amplifying the investments of Intel employees across a broad spectrum of personal philanthropy and volunteering.

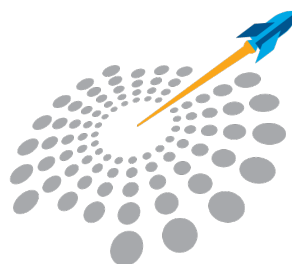
Our vision is inspired by one of Intel's co-founders, Robert Noyce, and his oft-repeated declaration, "Don't be encumbered by history, go off and do something wonderful." Learn more at www.Intel.com/foundation.

About the Gordon and Betty Moore Foundation

The Gordon and Betty Moore Foundation fosters path-breaking scientific discovery, environmental conservation, patient care improvements and preservation of the special character of the Bay Area. Visit Moore.org or follow @MooreFound.

About the Charles Stewart Mott Foundation

The Charles Stewart Mott Foundation, established in 1926 in Flint, Michigan, by an automotive pioneer, is a private philanthropy committed to supporting projects that promote a just, equitable and sustainable society. It supports nonprofit programs throughout the United States and, on a limited geographic basis, internationally. Grantmaking is focused in four programs: Civil Society, Education, Environment and Flint Area. In addition to Flint, offices are located in metropolitan Detroit, Johannesburg and London. With year-end assets of approximately \$3.1 billion in 2019, the Foundation made 364 grants totaling more than \$133 million. For more information, visit www.Mott.org.



MILLION GIRLS MOONSHOT



Million Girls Moonshot

Cardboard Airplane Activity

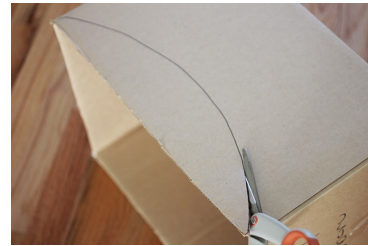
This inexpensive activity uses the engineering (problem solving / decision making) process to build with creativity and follow instructions. This is an activity of skills that applies to many home and work related projects.

Materials:

- Large cardboard box
- Sharpie pen
- Clear packing tape or Duct tape
- Scissors

Directions:

1. Cut all four flaps off box
2. Cut shallow half-moon shape out of each long side of box
3. Use half-moon pieces to trace out propellers and cut their shapes
4. Round off corners of the 2 longer box flaps you removed in step 1 (these will be the wings)
5. Trim one of the shorter flaps to a rounded point
6. Cut a slit into both long sides of the box under the half-moon cut out. These are to hold your wings on each side
7. Cut a slit halfway through the middle of your short flap you did not trim. This will hold the two parts of your tail together. Tape your tail to the back of your box
8. Cut a small circle from your scrap cardboard for the propellers
9. Decorate your wings and tail as you wish
10. Tape your propellers and circle to the front of your box



Cloud in a Jar

Category: Science / supervision needed

Condensation, water cycles and states of matter all get some attention with this delightful activity. A few simple household ingredients (water and hairspray) come together to demonstrate the formation of a cloud for kids.

This activity can be very simple for the littlest ones—or scaled up for older kids into an experiment with two different methods to create a cloud, along with conversation about how water cycles work in the environment.

For bonus points, take the kids out on a foggy or cloudy day and perform this activity to help them connect the dots.

- A jar with lid / mason jar
- About 1/3 cup hot water
- Ice / cubes
- Hairspray

How does it work?

When you add the warm water to the jar, some of it turns to water vapor. The water vapor rises to the top of the jar where it comes into contact with cold air, thanks to the ice cubes on top. Water vapor condenses when it cools down.

However, a cloud can only form if the water vapor has something to condense **on to**. In nature, water vapor may condense onto dust particles, air pollution, pollen, volcanic ash, etc. In the case of this activity, the water vapor condenses onto the hairspray.

1. Start by pouring the hot water into the jar. Swirl it around a bit to warm up the sides of the jar or pop into the microwave for 30sec. (careful - might be warm)
2. Turn the lid **upside down** and place it on the top of the jar. Place several ice cubes onto the lid, and allow it to rest on the top of the jar for about 20 seconds.
3. Remove the lid, **quickly spray** a bit of hairspray into the opening of the jar, and then replace the lid with the ice still on top. Watch the cloud form.
4. When you see a good amount of condensation form, remove the lid and watch the “cloud” escape into the air.

* Advanced cloud activity:



How clouds form:

<https://scied.ucar.edu/learning-zone/clouds/how-clouds-form>

SCIENCE WIDE OPEN

Women in Biology



Studying the Past to Inspire the Future

"Women in Biology" Encourages Children to Dream Big

by Marlee Brooks

STEM education in the elementary years promotes critical thinking, encourages an openness to new ideas, and emphasizes the importance of making decisions based on data. Along with testing science and math knowledge, it is equally important to provide kids—especially girls—with inspiring role models to encourage their budding interest in STEM fields.

A new series of children's books introduces children to a sampling of trailblazing female scientists of generations past. It kicks off with *Women in Biology*, released October 7 in paperback and eBook, and in Spanish (*Las mujeres en la biología*), also in paperback and eBook. Coming soon are paperback and Spanish *Women in Chemistry* and *Women in Physics*. [The hardback books were published in 2016 through a Kickstarter campaign.]

Women have lit up the scientific world since the dark ages (literally!), but their achievements have often been left in the dark. In fact, of the more than 600 Nobel Prizes that have been awarded in the sciences (Chemistry, Physics, and Medicine/Physiology), just 20 have gone to women.

With this in mind, Mary Wissinger, a mom and former teacher in St. Louis, MO, dove into the history books and unearthed women who helped make the STEM fields what they are today.

The result: the Science Wide Open series, where children meet some of the female scientists and are introduced to basic concepts in biology, chemistry, and physics. This series, designed for children ages 7-10, is the perfect way for young scientists to understand the power of curiosity and resilience while discovering the wonders the world holds.



What makes a butterfly?

A caterpillar grows into a butterfly, but nobody knew exactly how that change, which is called metamorphosis, happened...



Women in Biology familiarizes young minds with inspirational female biologists, like Maria Sibylla Merian, Hildegard of Bingen, Barbara McClintock, who changed the world with their scientific discoveries. As Katrina L. Kelner, a former editor of Science Magazine says, “Lively illustrations and fundamental biology concepts are cleverly woven together to showcase the work of five female scientists and arouse the curiosity of the reader.”

Women in Biology starts with a conversation between a spunky young protagonist, who asks questions about the world around her, and a scientifically-astute narrator, whose answers are crafted to be understandable to young minds. These two explore some of the basics of science together, and their dynamic makes learning new vocabulary an effortless outcome of enjoying the story.

The fun Disney-esque art was created by talented Brazilian artist, Danielle Pioli, whose mission is to inspire others to create. The idea of creating a whole universe from her mind to paper is what made her fall in love with art and storytelling. As a child, she was drawn to magic—what she now calls Quantum Physics.



...until Maria Sibylla Merian.

She loved insects so much that she spent years watching and drawing them. She travelled across the ocean to study the life cycles of caterpillars and other bugs.



(Germany, 1647–1717)

Maria's drawings were very detailed and beautiful, and they gave scientists important information about insects and plants.





Her drawings were used in the Linnaean system that organizes all living things. This system is important in all of biology.



Danielle Piol / Illustrator



Hang on. What is biology?

“Look for this book online.”

With the release of the book in Spanish, even more children can experience the power of curiosity. Eva Woods Peiró, Ph.D., Professor, Hispanic and Women’s Studies at Vassar College, writes, “Las mujeres en la biología, is an exceptionally written, vividly illustrated and clearly narrated short history of the foundational contributions of women to the biological sciences. It explains required scientific concepts for K-12 curriculum in a way that is sure to captivate young minds and inspire them to dream big.”

Parents and educators who want to expand and extend the content in the book will find lots of information to work with in the free Teacher’s Guide that accompanies the title. It is filled with vocabulary, additional content, and hands-on activities for budding biologists.



Mary Wissinger / Author

The Guide can be downloaded from the Educational Resources tab on the Science Naturally webpage. Keep reading for a peek into the book’s opening pages.

Marlee Brooks is a recent graduate from Ithaca College. A writer, editor, and documentary filmmaker, she loves the history of science (and history, in general!). A resident of Washington, DC, she has a passion for educating children through the written word and visual storytelling.

**Match the female biologist to her fascinating discovery
and humble hometown!**

Hometown	Name	Discovery
Frankfurt, Germany	Hildegard of Bingen	Observed how medicines affected cells, which helped pick the best treatments for patients.
Washington, USA	Jane Cooke Wright	Created incredibly detailed and beautiful drawings of insects and plants that are used in the Linnaean system.
Connecticut, USA	Maria Sibylla Merian	Discovered that nose cells have tiny message receivers called receptors that help people smell.
Bermersheim vor der Höhe, Germany	Barbara McClintock	Discovered and named jumping genes transposons.
New York, USA	Linda Buck	Found out that water needs to be cleaned before people drink it to prevent them from getting sick.

Answers:

Well, if we compared you and a rock, we'd find a lot of differences. But the biggest one is that you're alive, and a rock isn't. Biology looks at everything that is alive, like plants, animals, and you! People have been studying life for a long time.



Frankfurt, Germany; Maria Sibylla Merian; Created incredibly detailed and beautiful drawings of insects and plants that are used in the Linnaean system.

Washington, USA; Linda Buck; Discovered that nose cells have tiny message receivers called receptors that help people smell.

Connecticut, USA; Barbara McClintock; Discovered and named jumping genes and transposons.

Bermersheim vor der Höhe, Germany; Hildegard of Bingen; Found out that water needs to be cleaned before people drink it to prevent them from getting sick.

New York, USA; Jane Cooke Wright; Observed how medicines affected cells, which helped pick the best treatments for patients.

GEORGIA PATHWAYS

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