March 2018

GEORGIA PATHWAYS MAGAZINE

Pathways to Technology
TSYS Inspires

The Internship "Six-cess" Formula

The *Shaesta Waiz* flight

Ada - First Computer Programer

The Sound Barrier ***Does Not*** Exist

TAG Technology Association of Georgia

TAG | TAG-Ed Education Collaborative

SKILLS, JOBS & THE NEW COLLAR ECONOMY

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TAG
Technology Association of Georgia

March is Women's History Month and it's a great time to celebrate women in technology.

Throughout the pages of this month's Pathways STEM Magazine, you will find articles and stories penned by women. At its core, the celebration of Women's History Month is about opportunity. That same principal of opportunity drives STEM education efforts and keeps the momentum moving forward as educators and students, alike, strive to build a more diverse, inclusive and dynamic technology ecosystem.

This publication plays a chief role in both spreading a very powerful message and by offering simple tools and perspectives that can be used and shared with other STEM leaders, teachers and parents as we work to improve access to technology careers for everyone.

The magazine quite literally helps forge pathways to that inclusion by offering bright snapshots of STEM initiatives, efforts and ideas at work and by cultivating knowledge that can be passed on to the next generation of entrepreneurs and technologists. It's exciting to see the passion that is being built around expanding opportunities to everyone who wants to enter the field of technology and find their career path. Women have played a huge role in that progress, just as they have in making incredible advances in the field.

Seeing their success is powerful inspiration to young women who are considering their future and realizing that the vibrant world of technology is theirs to successfully pursue.

Be sure to pass along a copy of this, our third edition, to a female colleague, friend, parent or student. I hope you enjoy another great edition of the magazine. We've filled this one with great stories, tips and learnings and we are proud to share it with you.

Thanks for your support!

Larry K. Williams
President
TAG-Ed

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

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

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From the Executive Director

TAG | TAG-Ed Education Collaborative

As a female engineer, I'm proud to represent a demographic that continues to grow and evolve. A significant amount of progress has occurred over the past few years. Colleges like Georgia Tech now have more than 40% of their population as women. But the opportunity for continued growth for women in STEM still exists. In fact, a recent article in the Wall Street Journal by Susan Pinker shared that "the needle has hardly moved in many STEM fields—such as the physical sciences, technology, engineering and math in which barely 20% of the students are female."

As the state co-lead for Georgia for the national Million Women Mentor's initiative, it excites me to see young women and professional leaders breaking new ground OR fortifying pathways for other women in STEM. And although it wasn't planned, ironically many of this month's contributors are women who are leaders in STEM. Our hope is that Georgia Pathways is not only a voice and advocate highlighting best practices and what works PHENOMENALLY well in Georgia… But that it's a voice for change and disrupting the norm.

Collegiate groups like STEMpower at Georgia Tech working with the Girl Scouts, professional groups like Women in Technology supporting classroom to career initiatives or change agents like Black Girls Who code changing the landscape and trajectory of future technologists are simply a sampling of the community organizations working diligently to "make a difference and make an impact."

And each month we look forward to acknowledging the power and impact that lies within the state of Georgia.

As such, our tremendous thanks in advance to Georgia Tech's President "Bud" Peterson for his contribution to next month's edition. His recent induction into the Technology Hall of Fame of Georgia at the TAG Summit is reflective of his leadership and commitment to the ever evolving world of STEM and the ever changing face of the industry. Please enjoy a recent article that reflects the impact of, for and by women at Tech, or who've come through Tech, under his leadership.

We're three months in and we couldn't appreciate your support and participation more. Thank you for your contributions, your distribution and your decision to be a part of the Georgia Pathways ecosystem. You represent the best of who we are. And we thank you for the role you play in bringing this to fruition as we continue to evolve, expand and enlighten through the sharing of thoughts, ideas and innovation..

As always, enjoy and share the current issue of Georgia Pathways STEM Magazine. And we look forward to your future submissions!

Sincerely,

Erika Moore

Executive Director
TAG Education Collaborative

TSYS Education Program Inspires Students About Technology

By Patty Watson
Chief Information Officer & Senior Executive Vice President, TSYS

It is my honor and privilege to lead and work with the Education Council at TSYS. We formed the council, which consists of eight TSYS team members, in July 2017 with the objectives of building relationships with 13 local high schools in the Columbus, Ga., area, and developing a local talent pipeline of software developers.

The goal was to introduce the students to information technology and the intriguing world of computer science and software code. At TSYS, we have a robust community of software engineers, and we anticipate the need for more engineers to increase over time as our company continues to grow and innovate.

It's critical that we plant seeds early with today's youth about technology, programming and the opportunities at TSYS. Studies show children who are not exposed to computer science before college are not likely to pursue a career in this field.

So far our education outreach program has been successful and rewarding. Since last summer we have touched the lives of more than 2,000 high school students through computer programming instruction, facility tours and job shadowing.

Our first initiative, the Hour of Code, introduced students to the basics of writing software code in JavaScript. The students were exposed to code writing through computer activities that we used from code.org, an online training resource. We had more than 50 volunteers from TSYS that helped with this important project.
Our next activity provided some 250 students from Muscogee County with a tour of our credit and debit card manufacturing facility.

We have also participated in career days at several local high schools where our IT professionals talk to students about TSYS, the payments industry, technology and career opportunities. In February, we conducted a job shadowing event at our main campus located on the banks of the Chattahoochee River in Columbus. We hosted 323 students and 35 teachers and administrators for this special event. Students were able to listen, observe and learn from more than 70 technology professionals at TSYS.

The feedback from the schools was very positive, as the students really enjoyed learning about TSYS and future career opportunities.

Currently, we are in the process of organizing an internship program where select high school students will get the opportunity to gain real world experience by working at TSYS for five weeks. We are working closely with the Technology Association of Georgia (TAG) on this initiative.

In addition to students, we also know that helping teachers is critical, too. That's why TSYS aligned with Pluralsight, a technology training company that has agreed to provide free learning sessions to our local teachers who teach computer science classes. The training these teachers will receive will help them stay certified by the Georgia Assessments for the Certification of Educators (GACE).

Our high school education program has been so successful and meaningful, we plan to expand into 26 middle schools in the Columbus area next year. The earlier we can reach kids and promote technology, the better.
Also included in our technology partnership with schools is our unique relationship with Columbus State University (CSU). In 2015, TSYS gave $5 million to CSU to create the TSYS Center for Cybersecurity at the Turner College of Business, and to establish the TSYS Endowment for Excellence. We hope our investment in our local college will create the next generation of cybersecurity professionals who can prevent and defend business and government from the ongoing threat of cyber-attacks.

You never know where the next Bill Gates or Steve Jobs will emerge from. We like to think that we are building our own version of Silicon Valley here in the Chattahoochee Valley.

Exposing students to technology and computer programming at an early age is a win-win for our youth and TSYS.

Patty Watson is senior executive vice president and chief information officer for TSYS, responsible for setting the enterprise technology agenda to enable and deliver future global growth for the company.

How To Build "Six-cess" *Into* Your Internship Program

by Stacey Young Rivers

Everyone has heard stories of interns who are paid to get coffee and make copies. Believe it or not, this is still a major concern that some interns encounter frequently, even in tech companies. Recently a colleague shared a story about a manager who was too busy to train her interns and instead of identifying their tech skills that could be leveraged; she allowed them to pass the time by perusing their personal social media accounts.

Imagine being a student, coming into a work environment to learn, only to be regarded as not important in this tech-focused era. The college to career skills gap is a tangible issue that we all inherit when students graduate into the workforce without having certain skills and experiences needed for entry-level jobs. Even more, companies have a level of social responsibility to aid in how students practically apply what they are learning through internships, apprenticeships, and other developmental programs.

While some may view these types of programs as "goodwill", in essence, it is in all of our best interest to help bridge the gap for students. The rate at which

technology is advancing makes it challenging for the labor force to keep pace, but this is also a broader topic with many, many areas to address.

As emerging technologies such as artificial intelligence, virtual reality, augmented reality, information security, cloud, big data, and machine learning take center stage, more and more of the jobs we know today will be replaced with jobs requiring new skills not yet fully known. The National Association of Colleges and Employers (NACE) published that 57% of the jobs worldwide are currently being replaced with AI and Automation. There is a growing demand to produce technical talent who can develop, implement, and support the IoT ecosystem we are creating, and the strategic use of a company sponsored internship program can provide real value that will be impactful now, and in the future.

If your company has an internship program, then I applaud you for being part of the solution. As industry leaders, it is imperative that we contribute to the global skills development movement in a way that is meaningful to students and useful to the business.

At a minimum, the goal of an internship program should have a dual-purpose:

1) Build a pipeline of talent to support skills gaps, and-

2) Enhance students' skills/experiences while they earn a salary. These two actions alone allow students to synthesize their theoretical knowledge to real world experience, and according to an article in Education Dive, can give them the "why" behind what they have learned.

For those who want to take it to the next level, an internship program can also serve as a change management initiative to drive innovation, leadership development, or management

training (to build the bench with people managers). Regardless of the focus, if designed and executed correctly, the by-product can produce benefits such as:

- Augmenting tech teams with trainee support
- Infusing the organization with diversity (the LinkedIn 2018 Global Recruiting Trends lists diversity as the biggest game changer and most embraced trend)
- Becoming an employer of choice

For an internship program to accomplish these lofty goals, it will take a structure that incorporates active executive support, a feedback loop to surface inefficient processes, HR involvement to thwart bad behavior, and smart tactics to recruit committed managers who understand the value an intern can bring to the organization.

At pre-determined intervals, stakeholders should review the structure and policies to ensure the right level of accountability for everyone involved, which is imperative to a program's reputation and sustainability.

The Internship "Six-cess" Formula

Here are six key areas where you can begin to create a program of accountability, inclusion, and engagement for interns:

1 Communication - Develop targeted communication for key groups who participate in the program.

2 Collaboration - Build a collaborative process for intern managers to have a stake in how the program aligns with their business needs.

3 Critical Thinking - Encourage interns to demonstrate their technical prowess while balancing company policies.

4 Creativity - Challenge students with assignments to utilize independent thinking, objectively rationalize ideas, and clearly communicate solutions.

5 Curiosity - Organize learning opportunities for interns to gain new skills while performing in the role.

6 Connection- Seek out employees who can mentor interns and share meaningful career insights.

If you decide to sponsor interns, this is a great step in backing a workforce who must have the necessary skills to thrive. Even more, be intentional with your decision by acclimating students to the organization, and foster the learning process so they gain a real world experience.

By incorporating this "Six-cess formula" into your program, you can strategically engage interns about the future AND begin to build a culture where we all win.

Stacey Young Rivers is the Director of Technology Skills Analysis + Development in the Global Technology & Operations Division at Turner Broadcasting.

THE VINE
A TAG EDUCATION COLLABORATIVE EVENT

The Science of Wine or Wine for Science

by Mary-Kay Boler

Let's begin with a short vocabulary quiz. Do you know what vinification, oenology, viticulture and oenophile are?

Can you guess what these words have in common?

VINIFICATION
- is the production of wine, from fruit selection through bottling.

OENOLOGY
- is the science of winemaking; you can earn a Bachelor's of Science or Master's degree in oenology.

VITICULTURE
- is the study of grape cultivation.

OENOPHILE
- is a lover or connoisseur of wine.

The Vine Event

Each year approximately 200 oenophiles and technology leaders gather at

the annual Vine Event, an exceptional opportunity to learn more about and taste a wide variety of wonderful wines hosted by the TAG Education Collaborative. While the Vine is an evening of superior wines, delicious food and great company, it is about so much more. In the last nine years, the technology community has raised approximately $750,000 through live and silent auctions, ticket sales and sponsorships to support TAG-Ed's STEM initiatives.

Vine Event funds help cover expenses associated with TAG Education Collaborative's awareness campaigns, such as Georgia STEM Day and Georgia Day of Code, which introduce STEM subjects and careers to nearly a million students each year. Funds also support our hands on STEM programs for Georgia students, such as paid summer internships, technology challenges and coding camps.

Through their generosity, Vine Event patrons have funded two unique TAG-Ed initiatives: Intern Scholarships and Fund-a-Computer.

Intern Scholarships

The cost of hosting an intern can be daunting for a start-up or non-profit organization, yet these offer great opportunities for high school students. TAG-Ed uses Intern Scholarships to reduce the cost of hosting interns for these organizations, without reducing the stipends students receive. In a start-up, interns work alongside the ultimate decision maker and often have a measurable impact on the company's bottom line. Companies such as Relus Technologies, 4C Talent, Algorythmic and Inteledata have given students real world experience with cutting edge technologies.

Non-profit organizations provide opportunities for students to use their technological skills to give back to their communities. Georgia Center for Non-Profits, 21st Century Leaders and WIT (Women in Technology) are just a few of the more than a dozen non-profits who have been able to host summer interns with the assistance of an Intern Scholarship.

In the spring of 2017, the Vine Event introduced "Fund-a-Computer," a friendly competition in which patrons challenged each other to fund laptops for students in two month-long coding camps: the Tino J. Mantella Coding Camp and the Atlanta BridgeCommunity founded by the Coca-Cola Company Entrepreneurship and Coding Camp.

Fund-a-Computer

By the end of the evening, funding for 30 laptops was raised. At the end of the summer camps, all laptops were presented to deserving coding camp students to take home.

Technology Community Leadership

This year's Vine Event is being planned by a stellar group of TAG-Ed board members, including Quincy Johnson, Digital and Broadcast Technology Strategy and Operations at Turner, Renee Pearson, Director, ITS Global Innovation at Kimberly Clark, Jeremy Powell, CTO at Verint, Prakash Muthukrishnan, CTO at Purchasing Power and Josh Hirsh, Executive Vice President at Jones Lang Lasalle. Mike Neumeier, Principal at the Arketi Group, is the Vine guest auctioneer and an ardent supporter of the event.

When asked why he invests so much to make the Vine Event a success Mike indicated, "Supporting the next generation of technologist is simply a no-brainer. Ensuring today's students are exposed to the power and benefits that science, technology, engineering and math offer is vital to Georgia and our nation. The cause and impact of the funds raised at The Vine Event are amazing."

The Vine Event is a unique opportunity to do good while having fun and learning something new. After all, that is what education should be all about, right?

Mary-Kay Boler, the Senior Director of the TAG Education Collaborative, is a working with a talented team of executives to bring the Vine Event to life.

A Dream

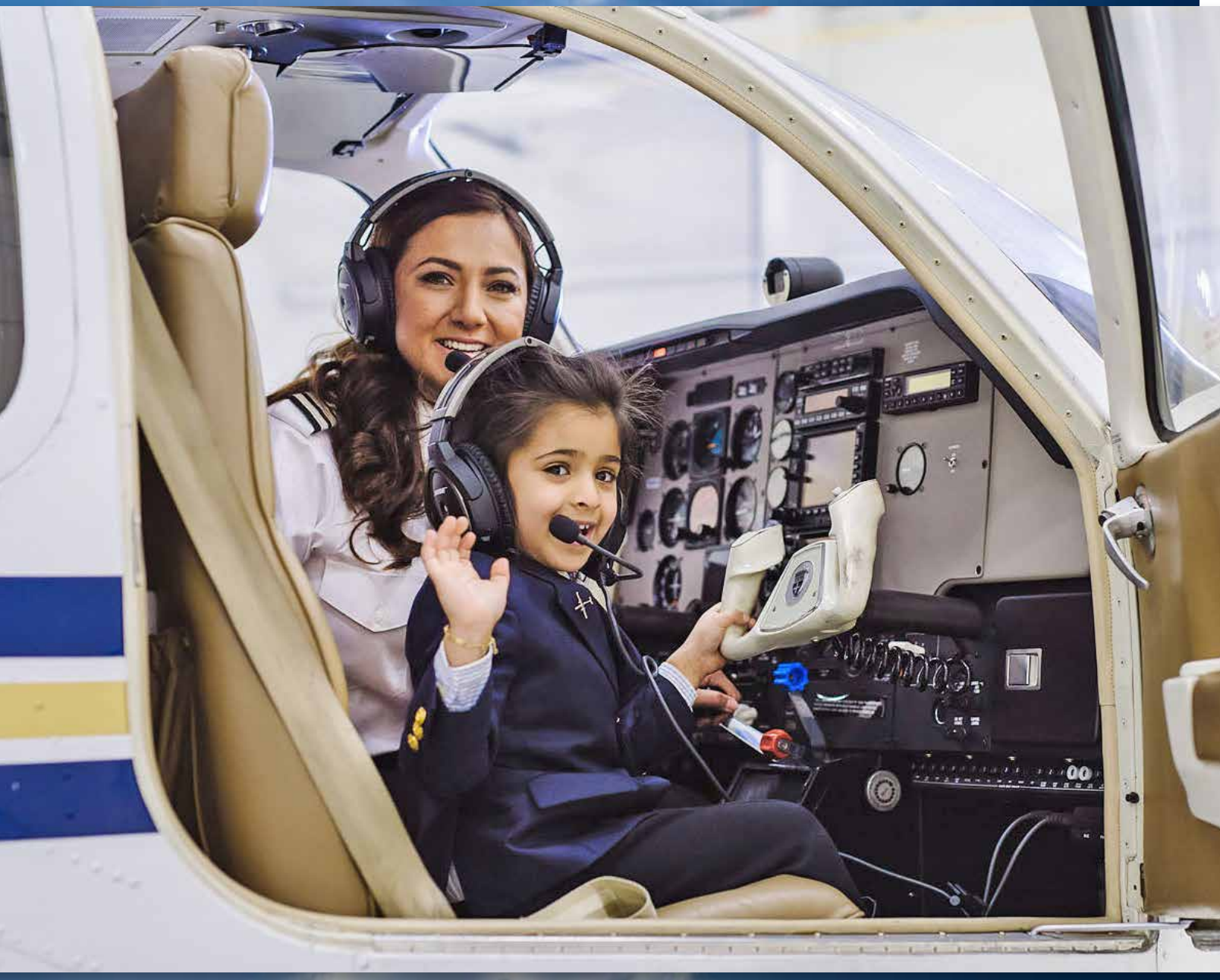


Photo Credit: Chris Paine Photography

for the World

Shaesta Waiz just became the youngest woman ever to complete a solo trip around the world in a single engine aircraft. Shaesta is only 30 years old and in addition to her remarkable global achievements has founded Dreams Soar Inc., a non-profit organization with a mission to promote science, technology, engineering and mathematics (STEM) and aviation among the next generation of young women and professionals. Some have called her a modern-day Amelia Earhart because of her global accomplishments, passion for flying as well as her gender.

Ms. Waiz was born in a refugee camp in Afghanistan in 1987 and then escaped the Soviet-Afghan war by relocating with her parents to Richmond, California, where she was raised with her five sisters. In 2011 while she studied at Embry-Riddle Aeronautical University she founded the Women's Ambassadors Program as a mentor, boosting female enrollment at Embry-Riddle. This of course was paving the way for DreamsSoar and adventures to come. Shaesta is also the first certified civilian female pilot from Afghanistan where gender discrimination remains a huge problem.

Shaesta wrote her graduate capstone project on the Beechcraft Bonanza A36 single engine aircraft which is regarded by many as one of the best aircraft for flying around the world.

The reason for her choice is that this aircraft has a top speed of not less than 140 knots, and can carry enough fuel for distances of at least 1,000 nautical miles. To cross the Pacific Ocean on the 'classic' route, which is between Hawaii and California,, is a distance of 2,100 NM, requiring an enormous quantity of fuel. Ferry tanks fitted in the cabin or tip tanks for the Bonanza are usually needed. It just so happens that Shaesta set a flight record on this challenging part of her flight from Honolulu, Hawaii, to Oakland, California.

Photo credit: Dreams Soar, Inc. "Madrid Spain"

During her almost 5 month flight beginning in Daytona Beach Florida, Ms. Waiz visited 22 countries, flew 24,800 nautical miles and accumulated 176 flight hours. This journey was part of her life-long passion to promote STEM (science, technology, engineering and mathematics) and aviation in general which incorporates all of the STEM skills. She took this opportunity to inspire over 3,000 children and young adults in 32 outreach events in 14 countries.

Photo credit: Dreams Soar, Inc.

This dramatic of a flight always has its challenges and scares and Shaesta had her share. Ms. Waiz came across three major weather delays and a technical issue while crossing the Atlantic.

"When I entered the oceanic airspace, I looked out of my window and saw this antenna that didn't look very stable to begin with," Waiz said. *"I didn't have a good feeling and within seconds it sheared off. My heart sank when I heard that big thunk of the antenna hitting the aircraft. I was so close to the water that I looked down to see waves crashing against one another. My mind went numb and I had to forget all of my emotions to just fly the plane to safety."*

She navigated to Saint-Pierre Airport off the eastern coast of Canada near Newfoundland and had a mechanic take out the antenna before moving to St. Johns Newfoundland for repairs.

Ms. Waiz shared that one of her most memorable moments came when she visited an orphanage near Athens, Greece. While speaking to a group of children ages 7 to 17, she noticed a distressed nine-year-old girl who disconnected from the group. The girl, who was a refugee from Afghanistan, had been sent to Greece by her mother for a better life, but this had never been explained to her. Shaesta was able to speak to the child in their shared language to explain the situation she was in and connect with her. One can imagine how powerful of an experience this was for both Shaesta and the young child.

"These brief moments of influence and example may well have a profound impact on the young girls entire life...
... moments worth this entire global flight.

During her time in Montréal, Canada, she worked with the International Civil Aviation Organization to visit three different schools in one day. Many countries she visited showed their support for her trip with welcome ceremonies featuring airport and Civil Aviation Authority staff and citizens greeting her at the airport when she landed. One central priority during these engagements was connecting with young women who face many societal and economic challenges; *a continuing priority.*

This part of the trip was so impactful that she's planning on continuing these events in countries she was not able to visit the first time. She would like to visit more countries in South America, Asia, the Middle East and Africa to continue spreading the word about STEM and aviation.

Photo credit: Falcon View Films

Shaesta Waiz has founded Dreams Soar to continue spreading the importance of STEM, women in STEM careers, diversity in aviation and inspiration by example.

Learn more about Shaesta Waiz, her global flight, DreamsSoar and their plans to provide scholarship opportunities and inspiration around the world at:

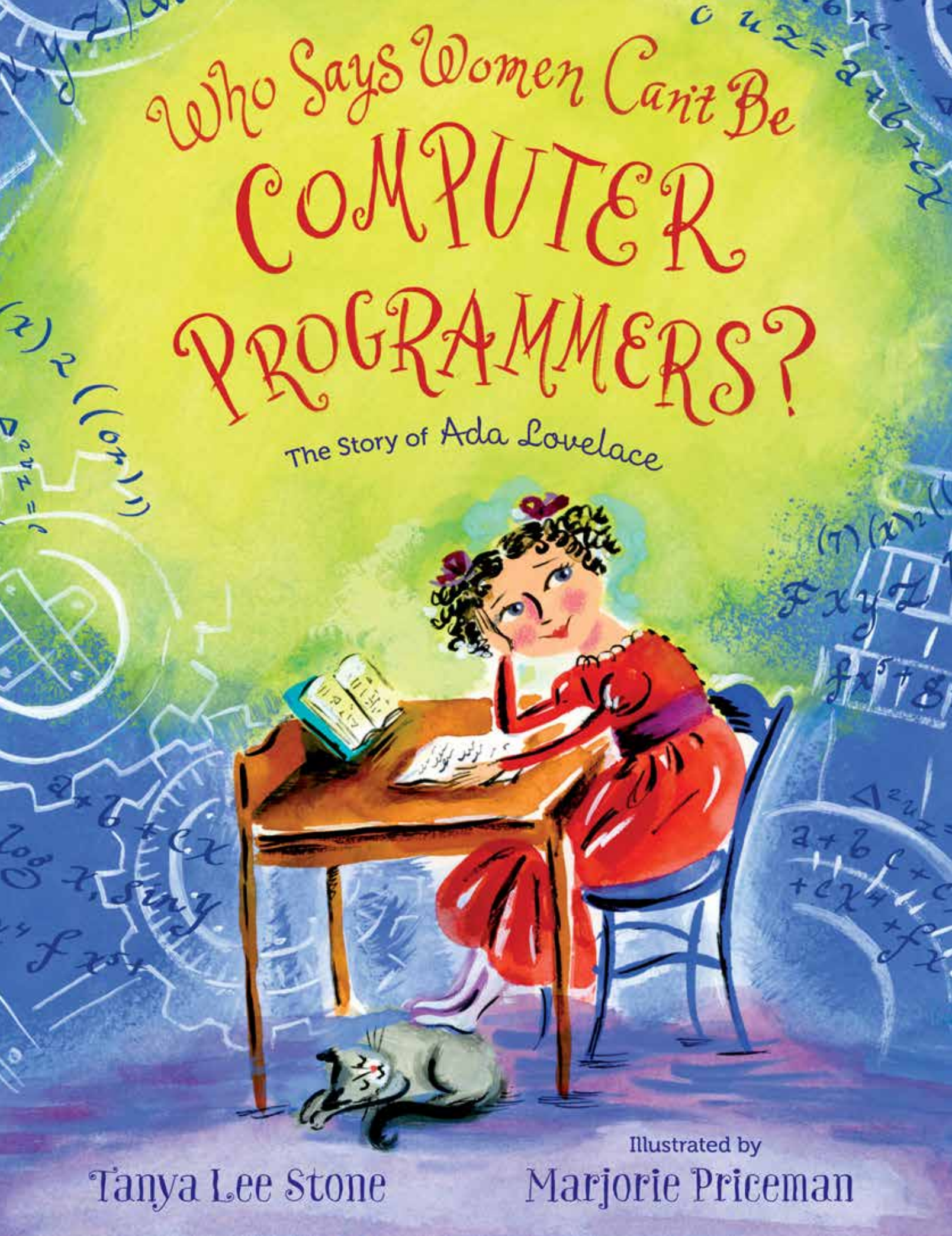
http://dreamssoar.org/

Photo credit Dreams Soar, Inc.

Shaesta Waiz

Who Says Women Can't Be COMPUTER PROGRAMMERS?

The Story of Ada Lovelace



Tanya Lee Stone

Illustrated by
Marjorie Priceman

Ada Lovelace

Augusta Ada King-Noel, Countess of Lovelace. (10 December 1815 – 27 November 1852) was an English mathematician and writer, chiefly known for her work on Charles Babbage's proposed mechanical general-purpose computer, the Analytical Engine. She was the first to recognize that the machine had applications beyond pure calculation, and published the first algorithm intended to be carried out by such a machine. As a result, she is sometimes regarded as the first to recognize the full potential of a "computing machine" and the first computer programmer.

By Tanya Lee Stone

I have always been intrigued by things I don't particularly understand, such as computer programming. And I have always loved a good story about a pioneering woman. That's why my ears perked up when I heard about Ada Lovelace, a woman who had led a short but incredibly invigorating life and—here's the kicker—had basically invented computer programming 100 years before computers were invented!

Tanya Lee Stone

Oh yes, if there's anything that gets my writing brain churning, it's a nugget like that! I knew I wanted to write her story, so I started researching and went quickly down the proverbial research rabbit hole.

I had to read a lot of books that were outside my comfort zone to get a handle on how Ada's mind worked, and start to understand the world in which she lived. Even though I wanted to write Who Says Women Can't Be Computer Programmers for young readers—picture book readers—I needed to know enough about Ada's childhood, her relationship with her mother (which was inextricably linked to her mother's relationship with the brilliant but badly behaved poet, Lord Byron), the tutoring Ada received, and the friendship she made with Charles Babbage. Not to mention the history of Babbage's complex ideas.

I read a fair number of scholarly books for adults about Lovelace and Babbage and the dawn of the digital age, all the while ferreting out the parts about Ada's personality that would be fascinating to young readers while not overwhelming them with too much context. That's what a picture book biographer strives for—it's a challenging and exhilarating task!

To write a gratifying picture book biography—in my opinion—an author has to excite young readers about someone without trying to take on that person's entire life story. It's the essence of that person I am always trying to get across, as well as the importance of his or her accomplishments.

Honing in on the details that will interest kids as well as trying to encapsulate the broad strokes of why what they did was important is the goal. There are always fascinating details I have to leave out. Sometimes they are so juicy or interesting, it's excruciating to have to cut them—like the grand European tour Lady Byron took Ada on when she was ten; or how Ada spent nearly three years in bed between the ages of thirteen and fifteen, combating what was probably polio and suffering partial paralysis; or how Charles Babbage went to great lengths to acquire a fabric portrait of Joseph-Marie Jacquard, inventor of the Jacquard loom, to display in his house.

Collaborating with an illustrator on a picture book is always an amazing experience, because that person is the other half of the creative process even though they come to it after the text has been written. Marjorie Priceman and I love collaborating together and are able to discuss things after the text is done. Working with her is a wonderful adventure because I'm able to share ideas with her as she makes her own decisions about the visual layers she will add to the story.

For example after seeing that some of her sketches incorporated numbers and words, I was inspired to find real equations for her to use in those paintings.

Augusta Ada King-Noel,
Countess of Lovelace

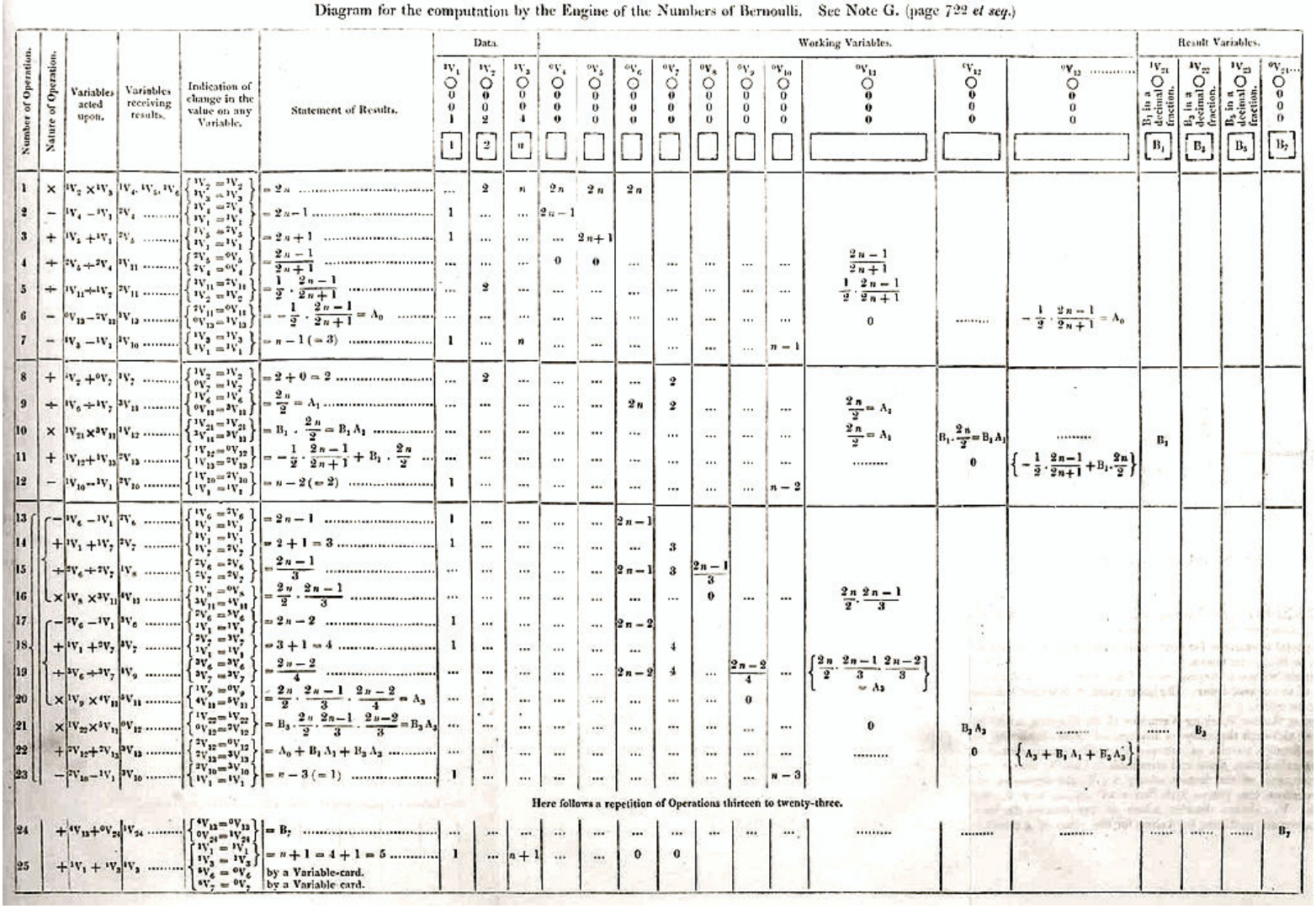


Diagram for the computation by the Engine of the Numbers of Bernoulli. See Note G. (page 722 *et seq.*)

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9	+	$^1V_6 + ^1V_7$	$^2V_{11}$	$\{^1V_6 = ^1V_6;\ ^0V_{11} = ^2V_{11}\}$	$= \frac{2n}{2} = A_1$	...	...	...	...	...	$2n$	2	...	...	...	$\frac{2n}{2} = A_1$					
10	×	$^2V_{11} \times ^2V_{11}$	$^1V_{12}$	$\{^2V_{11} = ^2V_{11};\ ^2V_{11} = ^2V_{11}\}$	$= B_1 \cdot \frac{2n}{2} = B_1 A_1$	...	...	...	...	...	...	...	...	...	...	$\frac{2n}{2} = A_1$	$B_1 \cdot \frac{2n}{2} = B_1 A_1$	.....	B_1		
11	+	$^1V_{12} + ^1V_{13}$	$^2V_{13}$	$\{^1V_{12} = ^0V_{12};\ ^1V_{13} = ^2V_{13}\}$	$= -\frac{1}{2} \cdot \frac{2n-1}{2n+1} + B_1 \cdot \frac{2n}{2}$ ...	...	...	...	...	...	...	...	...	...	...	.....	0	$\left\{-\frac{1}{2} \cdot \frac{2n-1}{2n+1} + B_1 \cdot \frac{2n}{2}\right\}$				
12	−	$^1V_{10} - ^1V_1$	$^2V_{10}$	$\{^1V_{10} = ^2V_{10};\ ^1V_1 = ^1V_1\}$	$= n-2\ (=2)$	1	...	...	...	...	...	...	...	...	$n-2$						
13	−	$^2V_6 - ^1V_1$	$^2V_6$	$\{^1V_6 = ^2V_6;\ ^1V_1 = ^1V_1\}$	$= 2n-1$	1	...	...	...	...	$2n-1$										
14	+	$^1V_1 + ^1V_7$	$^2V_7$	$\{^1V_1 = ^1V_1;\ ^1V_7 = ^2V_7\}$	$= 2+1=3$	1	...	...	...	...	...	3									
15	÷	$^2V_6 \div ^2V_2$	$^1V_8$	$\{^2V_6 = ^2V_6;\ ^2V_2 = ^2V_2\}$	$= \frac{2n-1}{3}$	...	...	...	...	...	$2n-1$	3	$\frac{2n-1}{3}$								
16	×	$^1V_8 \times ^2V_{11}$	$^4V_{11}$	$\{^1V_8 = ^0V_8;\ ^2V_{11} = ^4V_{11}\}$	$= \frac{2n}{2} \cdot \frac{2n-1}{3}$	...	...	...	...	...	...	...	0	...	...	$\frac{2n}{2} \cdot \frac{2n-1}{3}$					
17	−	$^2V_6 - ^1V_1$	$^3V_6$	$\{^2V_6 = ^3V_6;\ ^1V_1 = ^1V_1\}$	$= 2n-2$	1	...	...	...	...	$2n-2$										
18	+	$^1V_1 + ^2V_7$	$^3V_7$	$\{^2V_7 = ^3V_7;\ ^1V_1 = ^1V_1\}$	$= 3+1=4$	1	...	...	...	...	...	4									
19	÷	$^3V_6 \div ^3V_7$	$^4V_9$	$\{^3V_6 = ^3V_6;\ ^3V_7 = ^3V_7\}$	$= \frac{2n-2}{4}$	...	...	...	...	...	$2n-2$	4	...	$\frac{2n-2}{4}$	...	$\left\{\frac{2n}{2} \cdot \frac{2n-1}{3} \cdot \frac{2n-2}{3}\right\} = A_2$						
20	×	$^1V_9 \times ^4V_{11}$	$^5V_{11}$	$\{^1V_9 = ^0V_9;\ ^4V_{11} = ^5V_{11}\}$	$= \frac{2n}{2} \cdot \frac{2n-1}{3} \cdot \frac{2n-2}{4} = A_3$	...	...	...	...	...	...	...	...	0	...						
21	×	$^1V_{22} \times ^2V_{13}$	$^0V_{12}$	$\{^1V_{22} = ^1V_{22};\ ^0V_{12} = ^2V_{12}\}$	$= B_3 \cdot \frac{2n}{2} \cdot \frac{2n-1}{3} \cdot \frac{2n-2}{3} = B_3 A_3$	...	...	...	...	...	...	...	...	...	...	0	$B_3 A_3$	.....	.....	B_3	
22	+	$^2V_{12} + ^2V_{13}$	$^3V_{13}$	$\{^2V_{12} = ^0V_{12};\ ^2V_{13} = ^3V_{13}\}$	$= A_0 + B_1 A_1 + B_2 A_2$	...	...	...	...	...	...	...	...	...	...	.....	0	$\{A_3 + B_1 A_1 + B_2 A_2\}$			
23	−	$^2V_{10} - ^1V_1$	$^3V_{10}$	$\{^2V_{10} = ^3V_{10};\ ^1V_1 = ^1V_1\}$	$= n-3\ (=1)$	1	...	...	...	...	...	...	...	...	$n-3$						
Here follows a repetition of Operations thirteen to twenty-three.																					
24	+	$^4V_{12} + ^0V_{24}$	$^1V_{24}$	$\{^4V_{12} = ^0V_{12};\ ^0V_{24} = ^1V_{24}\}$	$= B_7$	...	...	...	...	...	...	...	...	...	...	.....	.....	.....	.....	.....	B_7
25	+	$^1V_1 + ^1V_3$	$^1V_3$	$\{^1V_1 = ^1V_1;\ ^1V_3 = ^1V_3;\ ^0V_6 = ^0V_6;\ ^0V_7 = ^0V_7\}$ by a Variable-card. by a Variable card.	$= n+1 = 4+1 = 5$	1	...	$n+1$	...	...	0	0									

Diagram of an algorithm for the Analytical Engine for the computation of Bernoulli numbers, from "Sketch of The Analytical Engine Invented by Charles Babbage" by Luigi Menabrea with notes by Ada Lovelace.

Of course, writing about Lord Byron could fill multiple books, but my focus had to remain on Ada's contribution to the future of the computer. It still bears mentioning that as decadent and flawed as he was, especially as a father, he loved his daughter and felt tortured by their separation—even though he did nothing to rectify it.

During a dramatic crossing of the English Channel as he fled England for France, Byron wrote the first three stanzas of the third canto of Childe Harold's Pilgrimage, which included

these lines: "Is thy face like thy mother's, my fair child! / Ada! sole daughter of my house and heart? / When last I saw thy young blue eyes they smiled, / And then we parted…"

And there was no keeping her poetic, creative spirit down. She loved to paint, draw, write, sing, and play the violin and piano! So, try as Ada's mother might to keep the poetical imagination

George Gordon Byron, 6th Baron Byron FRS, known as Lord Byron, was an English nobleman, poet, peer, politician, and leading figure in the Romantic movement. He is regarded as one of the greatest British poets and remains widely read and influential.

The relationship between mother and father had a direct impact on Ada's path. We have no way of knowing what might have developed if both of her parents had raised her. But her mother was so determined not to have Ada grow up to be anything like her father that she shaped her education intentionally, making sure Ada had plenty of maths and sciences in her exhaustive tutoring sessions. It is interesting to note that no matter how estranged her parents were, Lord Byron also expressed a desire that she not end up like him.

Before he died, Byron said, "I hope the Gods have made her anything save poetical—it is enough to have one such fool in the family." So, from the time she was four years old, Ada had tutors. By the time she was eight, she was studying French, math, and music more than six hours a day.

of her daughter in check so she didn't grow up to be wild like her father, it was to no avail. Because invention and science take imagination, and Ada had it in spades.

In the decade between the time Charles Babbage first thought of the Analytical Engine and Ada published her notes about it, she also married William King in 1835 and had three children within four years. Ada was most certainly the dominant figure in the household, with William happy to let her take charge. He was quite aware that she was smarter than he, and it didn't seem to bother him. She, however, did grow tired of his lack of ambition.

She craved a partner who was her intellectual equal and wanted to do great things. Fortunately, she found that in her friendship with Charles Babbage. The combination of those two rela-

tionships seems to have brought her happiness, and Charles was a frequent visitor to the family's home. Ada also loved the massive soirees Charles held in his own home. Those parties provided her with the intellectual company she craved. Guests included celebrities of the day such as Alfred Lord Tennyson, Mary Somerville, Charles Dickens, Florence Nightingale, and Charles Darwin.

Ada also packed a lot of life into her short years on earth. She had joys and adventures as well as times of financial hardship. Sadly, she dies from what is believed to have been uterine cancer just before her thirty-seventh birthday. But the work she accomplished laid a foundation for scientists to draw upon in the future and she is credited with being the first computer programmer—100 years before the invention of the computer.

Portrait of Ada Lovelace at age 20

It is extremely gratifying to be able to encapsulate her story in order to share it with the youngest readers, and have my text be accompanied by Marjorie Priceman's vibrant, inviting, wonderful illustrations so that kids can be as enchanted by Ada Lovelace as we are!

To understand STEM...

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

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

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

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

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

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

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

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

As an example, according to the Department of Labor, there is a huge shortage in the U.S. of -

Teachers

Did you know teaching was a STEM career?

With this in mind, briefly connect any career you choose to the definitions above.

That's how it's done.

Why Is Pi important?

Pi Day is celebrated on March 14th (3/14) around the world. Pi (Greek letter “π”) is the symbol used in mathematics to represent a constant — the ratio of the circumference of a circle to its diameter — which is approximately 3.14159. Pi has been calculated to over one trillion digits beyond its decimal point. As an irrational and transcendental number, it will continue infinitely without repetition or pattern.

While only a handful of digits are needed for typical calculations, Pi’s infinite nature makes it a fun challenge to memorize, and to computationally calculate more and more digits.

Pi is the 16th letter (π) of the Greek alphabet which is used to represent this mathematical constant. It is typically written as “pi” in text.

Pi is perhaps the most important mathematical constant. It appears in various formulas throughout math and science in fields as diverse as physics, statistics, and sociology. Although pi is defined in terms of the geometry of a circle, most applications of this number do not directly involve circles.

If the circumference or the area of a circle is known, pi can be used to find the diameter and the radius of that circle. Likewise, if the radius or diameter is known, pi can be used to find out the circumference or the area.

By the late 19th century, its value had been computed by hand to several hundred decimal places. Since the dawn of the computer age in the mid-20th century, the number of calculated digits of pi has skyrocketed. Since 2002, its value has been known to over a trillion decimal places - enough to fill a large library!

The earliest known official or large-scale celebration of Pi Day was organized by Larry Shaw in 1988 at the San Francisco Exploratorium, where Shaw worked as a physicist, with staff and

Pi is perhaps the most important mathematical constant.

The ratio equals about 3.1415. This value is a constant for any circle. The circumference of a circle is always equal to pi times the diameter. The area of a circle is always equal to pi times the radius squared. These formulas are used constantly by engineers, physicists, designers and mathematicians. The uses of pi extend beyond merely finding circumferences or radii. NASA uses pi to calculate the trajectories of spacecraft, to determine the sizes of craters and to estimate the sizes of planets outside our solar system.

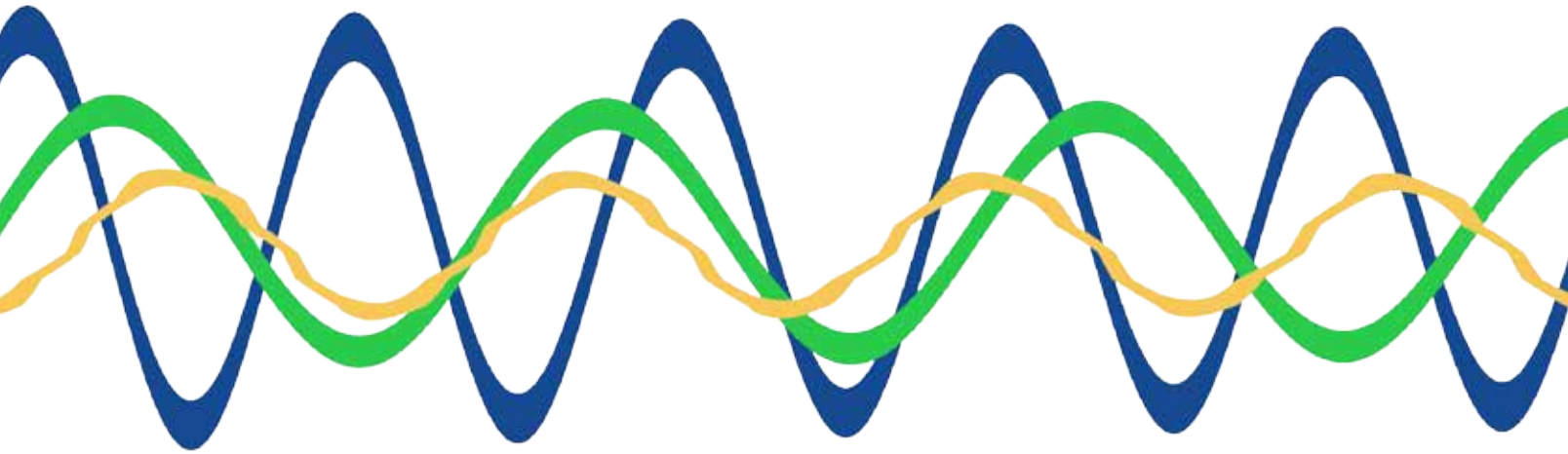
The computation of pi has a long and fascinating history. Some of the most elaborate mathematical methods have been used in devising various formulas for pi.

public marching around one of its circular spaces, then consuming fruit pies. The Exploratorium continues to hold Pi Day celebrations.

On March 12, 2009, the U.S. House of Representatives passed a non-binding resolution (111 H. Res. 224), recognizing March 14, 2009 as National Pi Day.

The entire month of March 2014 (3/14) was observed by some as "Pi Month". In the year 2015, Pi Day had special significance on 3/14/15 (mm/dd/yy date format) at 9:26:53 a.m. and also at p.m., with the date and time representing the first 10 digits of π.

The Sound Barrier ***DOES NOT*** exist.



There is not actually a "physical barrier" in the sky that prevents sound or aircraft from going faster, and thus cannot be "broken".

But in the 1940's scientists did not know that for sure and neither did the Air Force. They were almost certain there was an invisible force we could not fly through.There is nothing to break through.

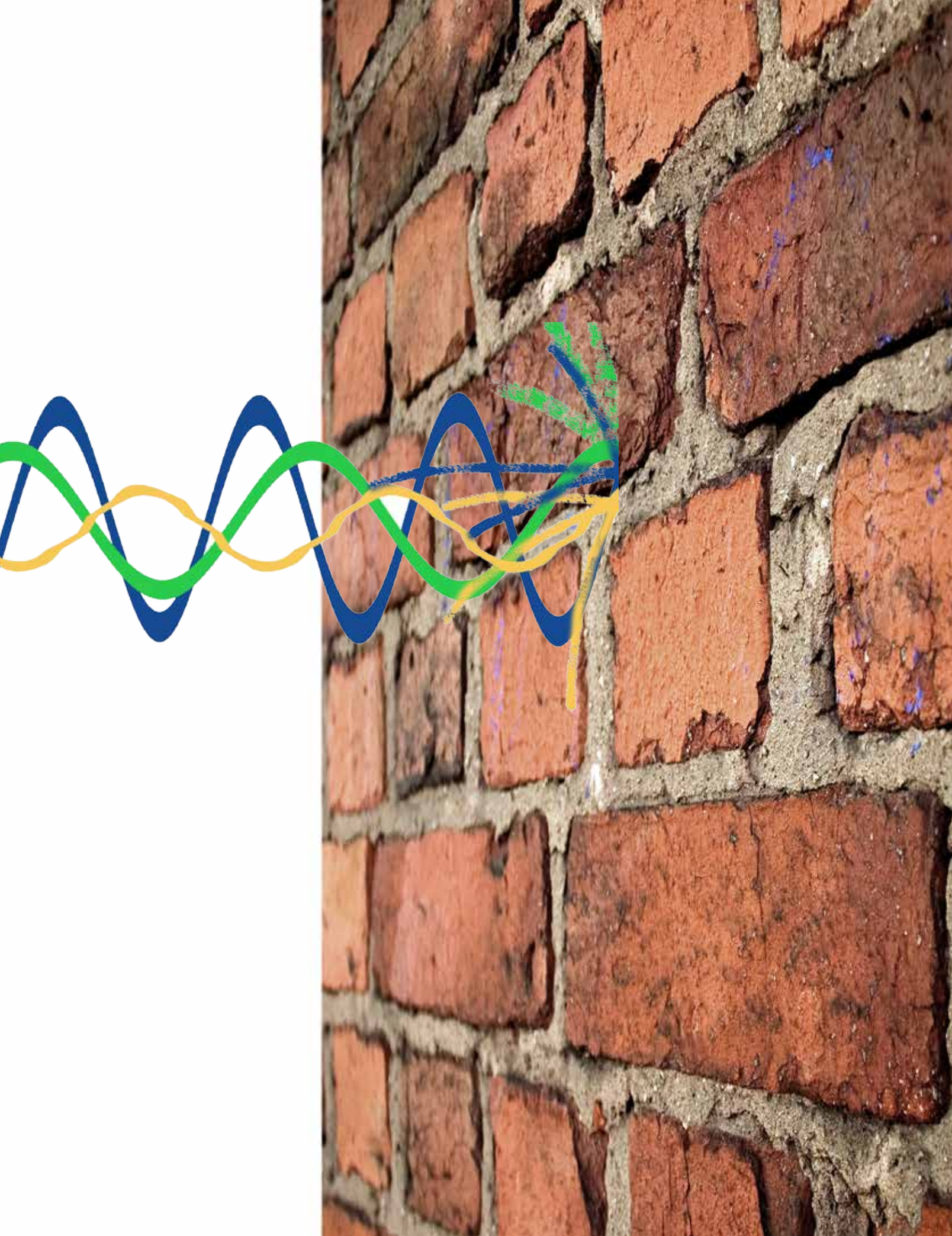
Let's explore how sound and objects travel to better understand the actual science behind this misnomer.

Misnomer [mis-noh-mer]

noun

1. a misapplied or inappropriate name or designation.

2. an error in naming a person or thing.



How do sound waves (*vibrations*) and solid objects travel through the air, water and earth?

Sound is made when something moves or vibrates. The movement sets up a sound **wave** in the surrounding air. A sound wave bounces off of air molecules to produce motion or travel outward in many directions.

The original FORCE or energy of the sound produced usually determines how far it will travel. As the vibrations continue to bounce off of the air molecules, they begin to slow down until they stop traveling or an object gets in the way blocking continued travel.

In simple terms, the thickness or density of the air (how many air molecules per square inch) determine how far the sound waves can travel.

Sound waves travel through the space "between" the air molecules.

The more space there is, or the thinner the air is, the less molecules there are to bounce off of and the sound does not travel as far or as long. The thicker the air, or the more densely packed the air molecules are, the more molecules there are to bounce off of so the sound travels faster and further for longer.

Now that we have a basic understanding of how sound travels, we realize there is no invisible wall in the sky or "barrier" that has to be broken through to go faster.

Molecules in the air we breathe include primarily nitrogen and oxygen as well as water, carbon dioxide, ozone, and many other compounds in small amounts, some created naturally, others the result of human activity like pollution and dust. These are what sound waves have to bounce off of to move outward from their source. If you whisper, those sound waves do not travel very far because there is not very much verbal energy put into it. But if we YELL with a lot of energy, sound waves travel further before running out of energy.

The Speed of Sound

The atmospheric pressure or the pressure exerted by the weight of the atmosphere at sea level is 14.7 pounds per square inch. Since our atmosphere is primarily air molecules, we can say that the weight of the air and its thickness is 14.7 pounds per square inch (PSI) of

force on our bodies and everything around us.

Based on this pressure or thickness of air at sea level, sound waves travel at about 760 miles per hour through this level of atmospheric pressure. That is as fast as sound waves can go based on the spacing of the air molecules. When your teacher talks to you in class, his or her voice is traveling at 760 miles per hour (mph) from their mouth to your ears. Pretty cool....and fast.

Now it gets really interesting. If you go up in the atmosphere to about 35,000 feet, the air is thinner and the molecules are spaced further apart causing sound waves to actually slow down because there are fewer molecules to bounce off of.

The speed of sound at 35,000 feet is about 670 miles per hour. As you go higher and the air gets thinner, the speed of sound slows down even more. This brings us to a broader discussion about the speed of sound.

The speed of sound at sea level is about 760 miles per hour.

The speed of sound at 35,000 is about 670 miles per hour.

This is what the math equation looks like:

V = velocity (m/s),
Tc = temperature in Celsius.

$$V = 331.4 + 0.6Tc$$

So what is the speed of sound in space? Almost zero miles per hour.

There IS sound in space coming from the International Space Station, satellites, rockets and more, but it has no "*medium*" or material (atmosphere) to travel ***through***.

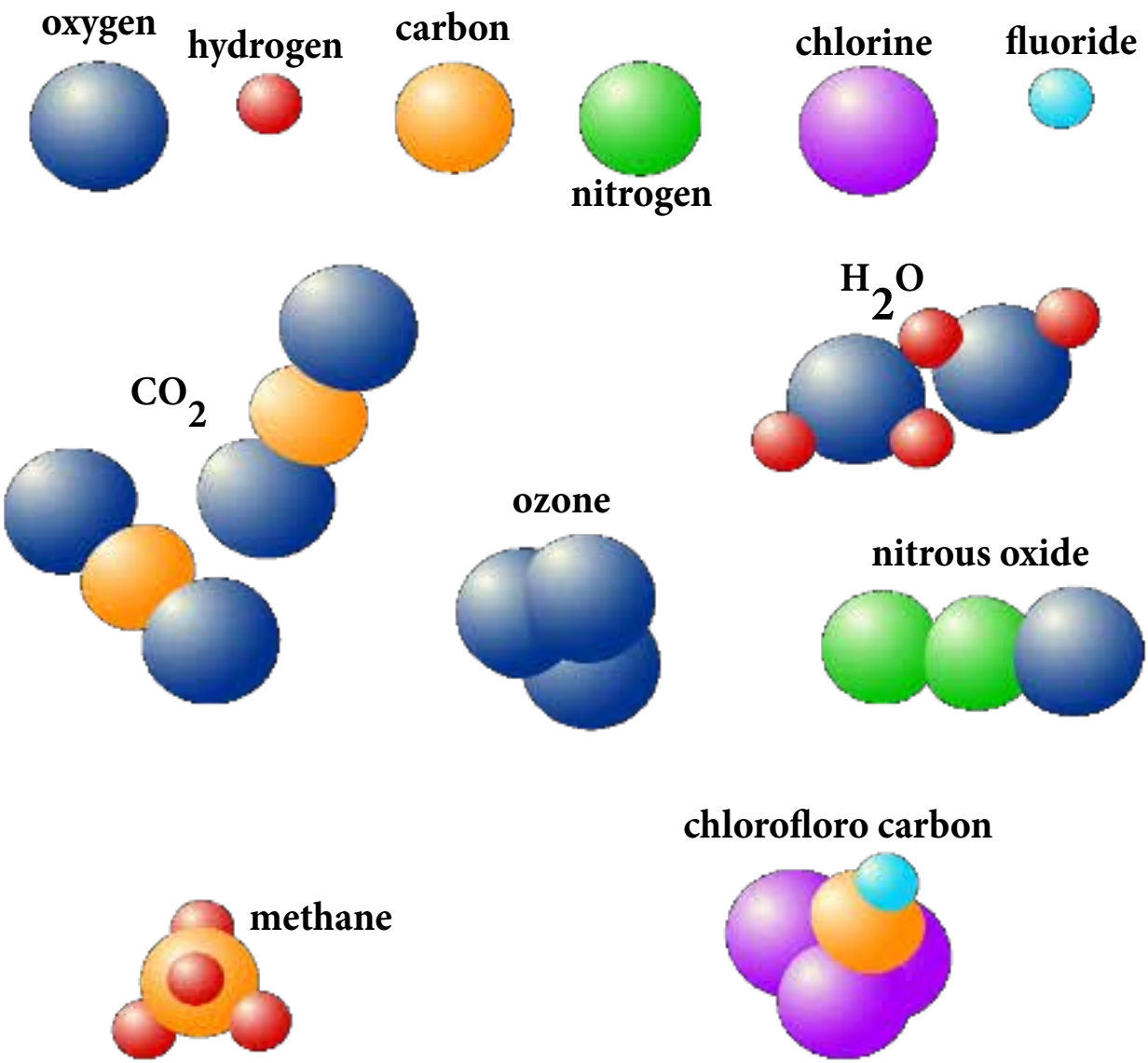
This is amazing.....The speed of sound under water is just over 3,000 miles per hour. Tell me why.....

The density of water molecules is much greater than air, so sound waves under water travel much faster and further. This is why sonar (under water radar) is so effective over long distances. This is also why whales can communicate half way around the world, using their sound wave language.

What is the speed of sound through rock? Well that varies with the type of rock, but the speed of sound through Granite is about 4,000 miles per hour.

This is pretty much what we breathe.

Our air is composed of many molecules, so when we talk about sound waves traveling through the atmosphere and bouncing off air molecules, this is what they are.



Molecules in the air we breath

In conclusion, we know there is not really a barrier in the sky, but we understand the science, physics and molecular interaction as it relates to the speed of sound.

It's a misnomer.

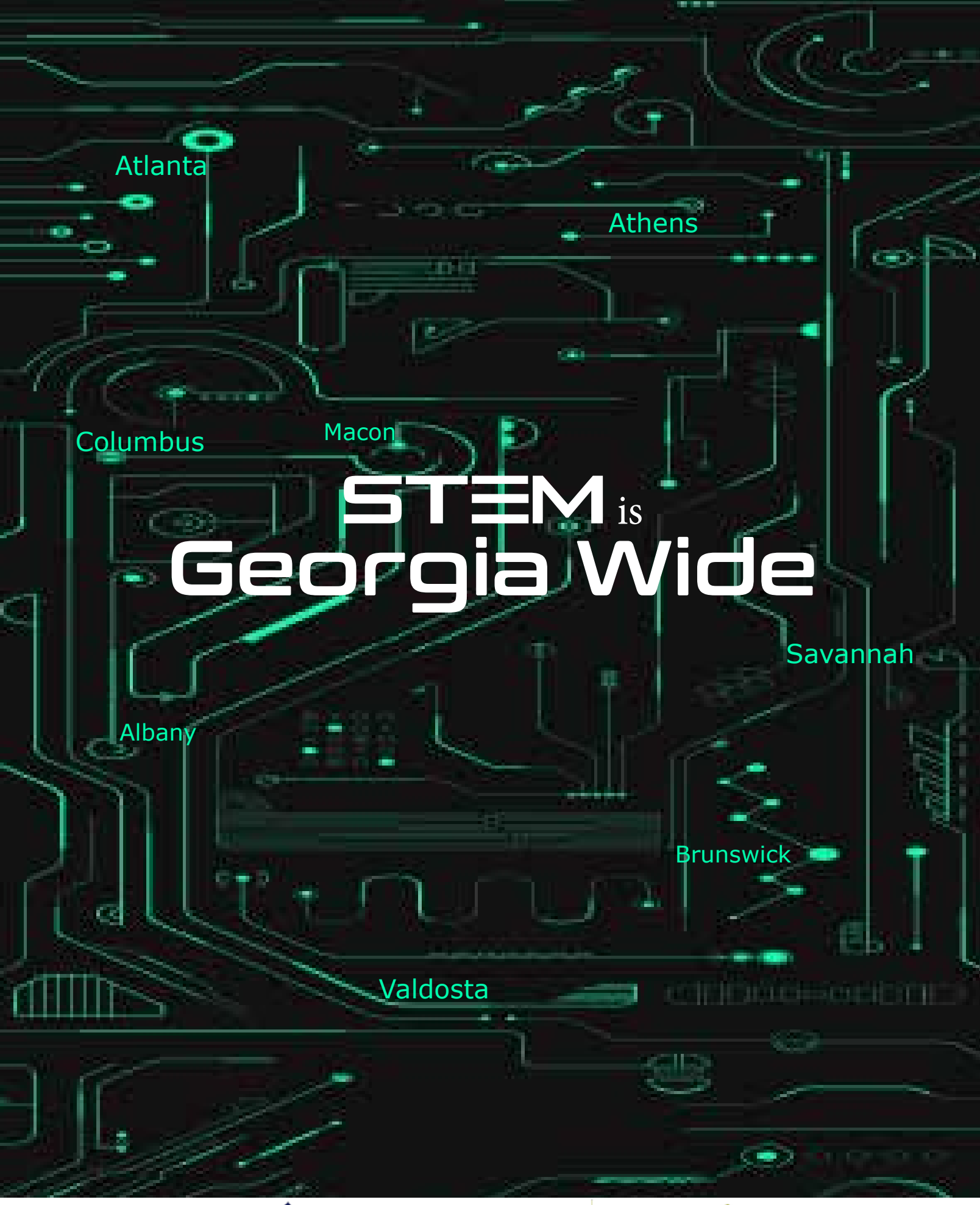
A few STEM careers that deal with the study and use of sound include:

- Seismology (study of earthquakes)
- Music / sound engineers
- Acoustics
- Sound based non-lethal weapons
- Astrophysics
- Radio astronomy
- What can you think of?

So, that being said, what is the speed of sound?

Answer:

It depends



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