S.T.E.M.

MAGAZINE

Math in *Everyday Life*

Dr. Richard Larson, MIT

Breakthrough Innovation

Russell Shilling

Executive Director / STEM at U.S. Department of Education

Cognitive Priming

Dr. Judy Willis

The Sound Barrier *Continued*

Wayne Carley

STEM FEST

March 2015

\\180v

STEM Innovations

A Math and Science Partnership Initiative in Northwest Indiana

Dear Educators,

As spring approaches and thoughts turn to much needed breaks and warmer weather, we ask that you also remember to mark your calendars for the final STEM Innovations professional development session:

- March 19, 2015

On February 5th educators gathered for the second STEM Innovations professional development session. Teachers participated in a debrief session related to the successes and challenges in teaching their MiB lessons, reviewed and completed sample test items for math and science from the DOE website and read articles about sugar beets GMO's and used argumentation (a skill students are asked to develop in several subject area standards) to communicate their points of view. As a result of the professional development, teachers:

- Gained greater knowledge of STEM education strategies through collegial discussion about the teaching of the MiB challenges
- Learned about updates to Indiana's student accountability testing and alignment with the STEM Integration Curriculum Assessment
- Made connections between ethics in engineering and argumentation to understand how they align to the IAS CCR and enhance integrated STEM learning

REMINDER: In addition to the on-site sessions, participants are to complete two assignments as part of the professional development:

- Use a STEM resource to enhance your MiB challenge
- Update and post your MiB lesson plan

Click here for additional information on the assignments. Assignments are due May 15, 2015.

Thank you all for your participation and commitment to the professionalism of the grant in YR1. We are excited to move forward with the planning and implementation of YR2. First things first:

SAVE THE DATES! STEM Innovations Summer Institute is August 3-7, 2015. Watch your email for registration and location information.

Happy spring!

Your STEM Innovations Team

We invite you to join us at the 2nd International STEMfest. Schedule of Events – Select what you want to attend!

Options include two FREE events for classes, a not- to- miss International Education Conference and Science on Stage Canada Festival

Sunday Sept 27th 2015 to Tuesday Sept 29th 2015

2nd International Conference on STEM Education and Innovation (2nd STEMcon)

Start your conference experience on the 27th September by collecting your conference bag and attending a welcome reception at the Western Development Museum. Network with educators from 55 countries and join us in welcoming the world to Saskatoon as we enjoy great entertainment, cocktail food, beer and wine. Then, from Monday 28th join us for two full days of conference including international presenters from around the world such as UNESCO, South East Asian Ministers of Education, Harvard University and more…

Come with two goals in mind, to walk away with new resources and skills that you can apply in the classroom, and learn about and contribute to discussions on the evolving Provincial curriculums and what it takes to be the educator of tomorrow in this fast changing world. Suitable for Grades K – 12, tertiary and vocational educators.

Standard Early Bird Registration : $400 Per Person

SPECIAL TWO-FOR-ONE OFFER : For a limited time, for just $400 you can get one free registration when you pay for one; or you can choose to receive 4 x one-day-passes for just $400. Offers made possible with thanks to sponsorship from Innovation Saskatchewan.

450 two-for-one registrations on offer plus 150 Day-Pass packages are on offer. Each package is $400. Open to Saskatchewan Educators.

Register online at http://www.eventbrite.com.au/e/stemcon-2nd-international-conference-on-science-technology-engineering-and-mathematics-education-tickets-11179848227

Monday Sept 28th 2015

Careers of the Future Day (FREE)

Grades 10 to 12 and Post-Secondary Students

Exhibitors will talk to students interested in career options in different fields of science, technology, engineering and mathematics, and speakers on the main stage will share their stories. What is it like to work in robotics? How do I make a career out of building games? How do I get to work outdoors and help the environment? What is the future of Drones? Will cars drive themselves or fly?

Meet with organisations from around the world, from the New York Film Academy to South East Asian Ministers of Education Organisations, mining companies to the technology giants.

10am to 3pm, Mon Sept 28th 2015

Register your class online at http://www.eventbrite.com.au/e/free-careers-of-the-future-day-stemfest15-event-91-tickets-12868958401

Tuesday Sept 29th 2015

STEM Fair and Open Day (FREE)

Suitable for Grades 3 to 9

Join us between 10am and 3pm for a fun and exciting day of science, technology, engineering and math. Learn something new and be inspired. Students receive a STEMfest Explorer Passport on arrival and move around up to 65 exciting and educational STEM activities. Free to register, this event does have limited places and so pre-registration is required for classes (max 30 people per group).

Register your class online at http://www.eventbrite.com.au/e/free-stem-fair-and-open-day-stemfest-event-92-tickets-12869000527

Gala Dinner 7-11pm, Sheraton Cavalier Hotel
Treat yourself to something special. Network with world leading educators and innovators in science, technology, engineering and mathematics and share in great times with new friends.

*Cost: CAD$130 per person
Includes 3 course dinner, drinks and entertainment. Tuesday Sept 29.
Table of 10 for CAD$1100.

Wednesday Sept 30th and Thursday Oct 1st 2015

Science on Stage Canada Event

Johanne Patry and the team from Science on Stage Canada are hosting a special event as part of STEMfest, a unique experience where educators present classroom projects to educators!

Participating educators present a resource or classroom project to fellow educators so they can walk away with new ideas and resources for use in the classroom.

There are two categories of attendance., Participants and Observers. Participants must first submit an application to Science on Stage Canada. Approved participants will be given an exhibition table at STEMfest and also asked to present their lesson or project to the other participants.

Approved participants are eligible for a financial assistance to attend the event.

The second category are observers. We have 150 places available for those interested in watching that participants from the audience.

Funding support is available to approved participants. Alternatively, you can observe the Science on Stage Event for $150 for two days, including coffee breaks and lunches daily.

To register as a PARTICIPANT visit http://scienceonstage.ca/event/

To register as an OBSERVER visit http://www.eventbrite.com.au/e/observers-registation-not-participants-science-on-stage-canada-2015-tickets-15843656804

SCIENCE ON STAGE CANADA

Bus Charters and Funding Support to help you get to the Careers of the Future Day and STEM Fair Day.

If you require funding for a bus to bring a group of students to the Careers of the Future Dayor STEM Fair & Open Day please email Kim Ali at kimali@onpurpose.ca

Grants are available including 70 grants of $100 for a Saskatoon based school, and 25 grants of $250 for schools outside of the city limits. To enquire simply email us to seek availability. Buses are on a first come first served basis, and limited to a maximum of one grant per school. Put your name down today for a STEMfest Bus Grant.

Once approved we will send you the agreement and you will be requested to arrange your transport and submit your receipt to STEMfest for a refund up to the agreed amount.

March 2015

dr. judy Willis

dr. richard Larson, MIT

russell Shilling
Executive Director for STEM at U.S. Department of Education

wayne Carley

SOFIA
Selects New Educators as Airborne Astronomy Ambassadors

jessie Duan Stanford University

alia Wong
Associate editor/The Atlantic

Abstracts

GLOBAL STEM STATES

S.T.E.M. Magazine Inc. is a non-profit monthly education publication for teachers, students, their parents and administrators. CEO Wayne Carley is the publisher and senior editor for all content in S.T.E.M. Magazine.

S.T.E.M. Magazine believes that the key to success in seeing higher graduation rates, improved testing results, student inspiration and a strong work-force rests in the hands of the teacher. The example and inspiration of individual educators carries tremendous weight on a daily basis, greatly impacting the quality and effectiveness of the classroom environment.

Our mission: Encourage curiosity and inspiration, the foundation of every career passion.

Wayne Carley
Publisher

S.T.E.M.
Magazine

S.T.E.M. Magazine is provided to individual schools, districts, counties and countries with a customized edition for every application.

S.T.E.M. Magazine Inc.

wayne@stemmagazine.com

Guest Presenters at the 2nd International Conference on STEM Education and Innovation 2015 (STEMcon)

Mr Etienne Clement
UNESCO, Samoa

Dr Suhaidah Tahir
South East Asian Ministers of Education Organisation

Datuk Hj LenTalif Salleh
Minister for Advanced Education SWK, Malaysia

Mr David Goncalves
Global STEM States, Australia

Dr James Kaufman
Laboratory Safety Institute, USA

Dr Cindy Moss
Discovery Education, USA

Dr Som Naidu
Open and Distance Learning Association of Australia

Ms Kate Edwards
International Game Developers Association, USA

Ms Rosa Walker
Indigenous Leadership and Development Institute, Canada

Dr Joe Schwarcz
McGill University Office for Science and Society, Canada

Ms Maria Teresa Ruiz and John Holanda
Purple i am, Canada

Dr Lauren Birney
Pace University, USA

Mark Jennings-Bates
Businessman/ Adventurer

Dr Tony Wagner
Harvard University, USA

Khairuddin Abdul Kadir
Global STEM States National Secretary, Malaysia

Dr Stephen Smith
St Mary's University, Canada

Prof Rajiv Uttamchandani
New York Film Academy/ International STEM Society for Human Rights, USA

Joshua Fouts
Bioneers USA

Dr Johanne Patry
Science on Stage Canada

Mr Kim Allen
Engineers Canada

Speaker in the SpotLight

Dr Joe Schwartz
Director of McGill University's "Office for Science and Society"

Dr. Joe Schwarcz is Director of McGill University's "Office for Science and Society" which is dedicated to demystifying science and separating sense from nonsense. He is well known for his informative and entertaining public lectures on topics ranging from the chemistry of love to the science of aging. Professor Schwarcz has received numerous awards for teaching chemistry and for interpreting science for the public. He is the only non-American ever to win the American Chemical Society's prestigious Grady-Stack Award for demystifying chemistry. He hosts "The Dr. Joe Show" on Montreal radio, has appeared hundreds of times on television and is the author of 14 best sellers. Also an amateur conjurer, Dr. Joe often spices up his presentations with a little magic.

Speaker in the Spotlight

Mark Jennings- Bates
Adventurer/ Entrepreneur

"The First Trip Around the World in a Flying Car" – the Record Attempt

Businessmen/adventurers Mark Jennings-Bates and Andre Voskuil will be the first to attempt flying around the world in a flying car (PAL-V), a record registered with the FAI and Guinness World Records. If these two average Joe's are successful, their trip will be remembered throughout history. Mark and Andre will depart from San Francisco early 2016 on the longest flight of their lives. They will spend nearly half the year on this trek, but we all know these adventures never go according to plan.

They will do whatever it takes to complete the journey in one of the world's first flying automobiles...
Here from Mark on his past adventure as a rally driving champion through to climbing Mount Kilimanjaro, and what is involved in this next epic adventure, and take from this an understanding of the importance of challenge based adventures in STEM education.

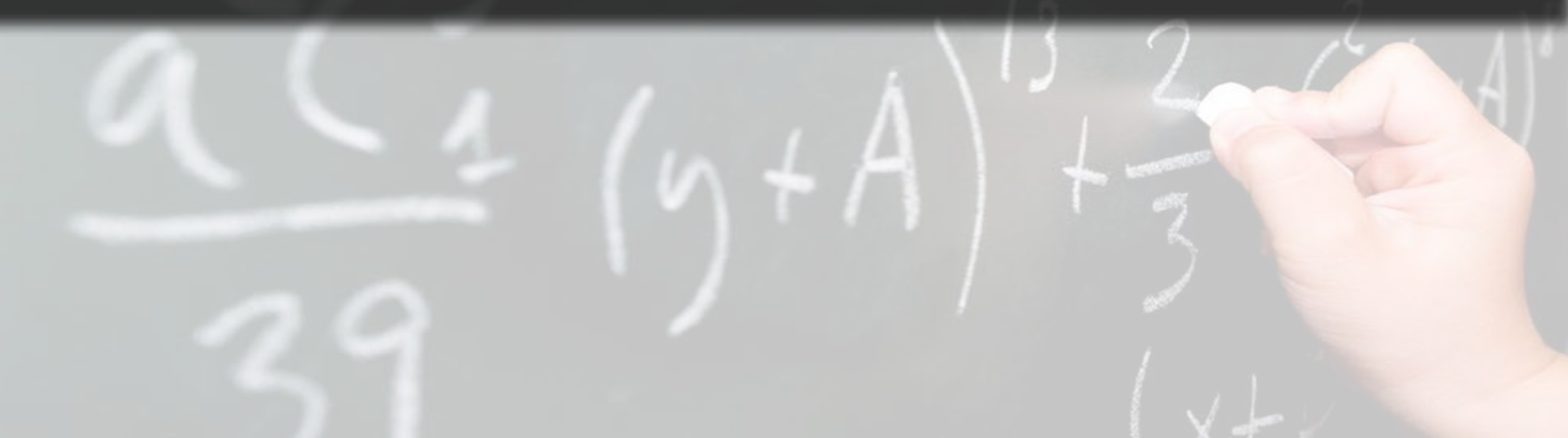
Speaker in the SpotLight

Dr Tony Wagner
Expert in Residence
Harvard University
Innovation Lab

Tony was the first Innovation Education Fellow at the Technology & Entrepreneurship Center at Harvard, and the founder and co-director of the Change Leadership Group at the Harvard Graduate School of Education for more than a decade. His previous work experience includes twelve years as a high school teacher, K-8 principal, university professor in teacher education, and founding executive director of Educators for Social Responsibility. Tony is a frequent speaker at national and international conferences and a widely published author. His work includes numerous articles and five books. Tony's latest, *Creating Innovators: The Making of Young People Who Will Change The World,* was published by Simon & Schuster in 2012 to rave reviews and has been translated into ten languages.

Uncovering MATH in *Everyday Life*

Dr. Richard C. Larson, MIT



How does math relate to my life? Why should I care? I'm not going to grow up to be a mathematician. My textbook only gives me more of what my teacher said in class. All math, all the time. Where does it apply? I can spend my time better on other things.

Well, perhaps no student has said all of these things at one time. But certainly many feel this way. The situation is complicated by the fact that mathematicians often do not know of applications of their theory, nor do they care. If they are the textbook authors, then the in-class teacher gets scant book support for motivating students with math applications.

So, here is an idea: Ask each student in the class to pick one day of their week, maybe a Saturday when there are lots of things happening outside the classroom, and keep a diary of what they did and saw that day.

Then have them pick a small number of these diary entries and write about how math applies to that entry. And then share with the class, perhaps with each student picking her favorite example and explaining it in front of the class, say 3 to 5 minutes for each.

Examples:

Shopping. I went with my dad to the supermarket on Saturday. I noticed something for diary. Why is the price per ounce of everything less when he buys a bigger can or box of stuff? Here, the teacher could speak about a fixed cost of getting a can or box of 'stuff' to the market, regardless of its size, and then a variable cost that relates directly to the amount of 'stuff' inside the can or box.

This can be explained by a positive-sloped linear equation with a positive intercept on the vertical ("y") axis.

Sports. We watched my big brother play ice hockey today. His team was down by one goal with one minute to play. The coach took out his goalie and added a forward attack guy. But the other team got the puck, shot it all the way down into my brother's net, no one there, and my brother's team lost by two goals, not one.

Why did the coach pull the goalie? This case opens a nice discussion of applied probability. The discussion does not have to be rigorous or formal, so any level of high school would be fine. Essentially, removing the goalie near the end of the game—when trailing by one goal—changes the probabilities of two events: (i) tying the game; (ii) losing by two goals, not one. It increases BOTH probabilities!

This can yield a very interesting class discussion. Like, where did the increased probabilities come from? What event has a lower probability? And the situation gets students interested in probability!


15
USA
BAUER
CAN
ULTRA
EGS

TV. Saturday night we spent some time flipping around channels on our TV. There were kids' channels, news, sports, cooking, music videos, all sorts of things. But we noticed that the ads on each channel were very different.

News channels had pills ads for old people. Sports channels were trying to sell pickup trucks and razor blades. Kids channels were selling sugary cereal. How does math relate to all of this?

The answer is in fractions. What fraction of the viewers of a TV program fall into a particular category? The category may be by age, males or females, or even hobby! People who spend money on TV advertising look at these fractions very carefully. It turns out that older viewers tend to look at news programs more than young viewers do.

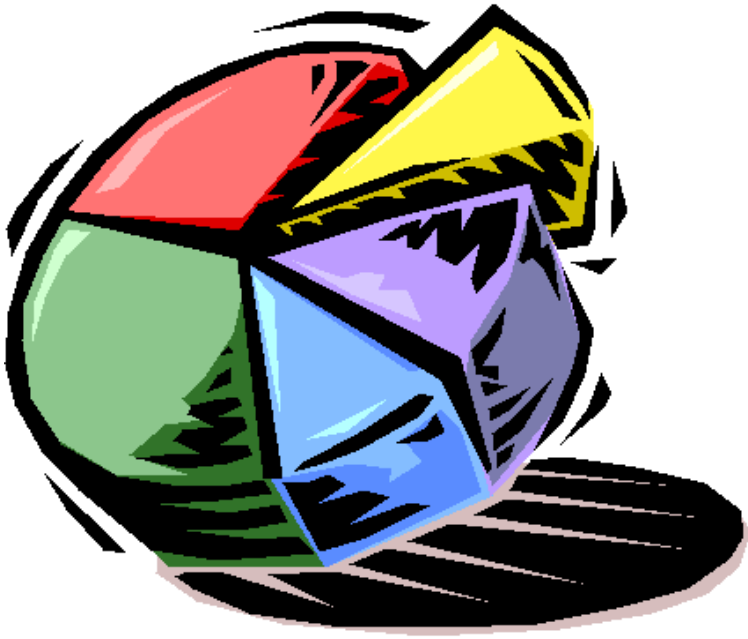
The older viewers' fraction is high, maybe 2/3 of viewers are more than 50 years old, and the younger viewer's fraction is very low (maybe 1/20). So, the ads on news programs are aimed at the older audience, and unfortunately this audience is more likely to have health problems that are helped with 'pills.' And kids' program sell to kids, even though they don't buy the products, but they let their parents know!

Maybe kids are 9/10 of viewers of kids' programs! TV people spend lots of money figuring out these fractions.

Cooking, fertilizing the garden, cutting the lawn, putting air in the car tires, driving two hours to Aunt Lizzie's house.....

You can spark interesting in-class discussions —about math!

Have fun with this!



After receiving degrees in dance and French, ***Jessica Bare*** was drawn to the technical aspects of her first job in theatrical lighting design and soon found herself enrolled in Portland State University's Electrical Computer Engineering graduate program. Now, she balances her time between school and her internship at the Portland-area tech company APCON, where she gains hands-on engineering experience developing the company's network monitoring products, including the IntellaFlex 3036 XR Chassis. Here, Jessica is analyzing signal integrity on APCON's next-generation hardware.

For Jessica, finding an internship that allowed and encouraged hands-on work was important. She wanted to take ownership of projects and see her contributions end up in customers' hands. Jessica found the perfect fit in APCON after being connected via PSU's program to connect students with internship positions in the community.

Jessica hopes to inspire women of all ages to find their passion with S.T.E.M. careers, and believes it is important for companies to provide students the chance to explore their passions with real-life experience.

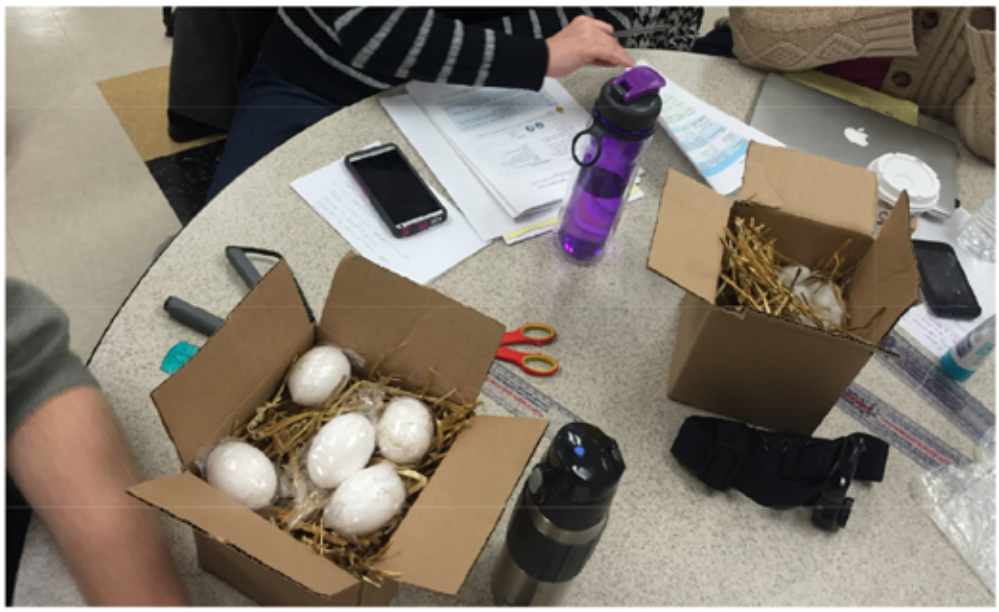
Recognizing the importance of investing in the technology leaders of tomorrow, APCON's internship program is structured to foster hands-on training and growth. Instead of having an end date for interns, the program is set up with the goal of transitioning part-time interns to full-time employees once their degree program is complete.

Interns also receive competitive pay, have opportunities to advance throughout the program and access a wide range of learning and development resources.

STEM Innovations is For the Birds

The December professional development day for STEM Innovations, NWI's math and science partnership grant focused on a special engineering challenge to help protect a particular species of winged wildlife. Middle school math and science teachers from seven NWI school districts gathered at Hobart High School on December 4th to design and test nests that would safely transfer pelican eggs from a local habitat to a research laboratory. Within a real-world context, teachers met this engineering challenge by working through the engineering design process and using communication and teamwork, a few of the key strategies for teaching engineering process through integrated math and science lessons[1]. Teachers have been creating STEM lessons using an integrated approach, and the "Save the Pelicans" challenge is the latest example of their work.

The STEM Innovations program receives federal funding via the Indiana Department of Education (IDOE) to provide professional development in STEM, with an emphasis on math and science. The overall goals of the grant are to increase teacher knowledge and implementation of science and mathematics practices and process principles in STEM and for teachers to create STEM-focused instructional units that cross disciplines. During the first year of the grant, the week-long summer institute supported and met these goals, and teachers are now implementing their lessons in their classrooms. This network of NWI teachers also uses the IDOE's Learning Connection's platform to share their lessons within the STEM Innovations community, building a high quality library of integrated STEM lessons.



[1] Moore, Tamara J.; Glancy, Aran W.; Tank, Kristina M.; Kersten, Jennifer A.; Smith, Karl A.; and Stohlmann, Micah S. (2014) "A Framework for Quality K-12 Engineering Education: Research and Development," Journal of Pre-College Engineering Education Research (J-PEER): Vol. 4: Iss. 1, Article 2. http://dx.doi.org/10.7771/2157-9288.1069

Cognitively Priming Students for Learning

Dr. Judy Willis

Cognitive [kog-ni-tiv]

adjective
1. of or relating to cognition; concerned with the act or process of knowing, perceiving, etc. : cognitive development; cognitive functioning.

2. of or relating to the mental processes of perception, memory, judgment, and reasoning, as contrasted with emotional and volitional processes.

Priming (prime) [prahym]

verb (used with object)
1. to prepare or make ready for a particular purpose or operation.

2. to cover...with a preparatory coat or color, as in painting.

3. to supply or equip with information, words, etc., for use:
"The politician was primed by his aides for the press conference."

"It preps their minds to engage."

There are some standards or units of instruction that, for whatever reason, you know aren't going to be runaway hits with students. While you can certainly reconsider the unit design, there are other strategies you can use to help prime student brains for learning.

Among the simplest of these strategies is promoting ***curiosity*** -- and students' natural tendency to predict -- by advertising the content the same way that a marketing company might. This promotes advance interest, and the resulting questions increase the student curiosity, opening the brain's attentive intake filter. In short, it preps their minds to engage.

How might this work?

Try advertising a coming unit by cutting up a related, compelling image, and then adding pieces daily to reconstruct that image as the "advertisement" gradually takes form.

Similarly, different clues -- visual or otherwise -- could be added every few days leading up to the new unit's introduction.

For fractions, these clues might be:

- An x-ray image of an arm fracture.
- Sheet music with half, whole, and quarter notes.
- A carrot cut into quarters.
- A photo of an iceberg showing the parts above and below water.

These both visualize the content and prime the mind to learn new content. Even though curiosity gradually decreases in favor of caution, the need to find out if a prediction is right or wrong is part of the brain's permanent wiring.

The brain strengthens future predictions and corrects any inaccurate prior knowledge leading to incorrect predictions through a prediction-reward system fueled by dopamine pleasure. In short, even if students gradually become less interested, it won't diminish their need to know as the unit begins.

On the day the unit is scheduled to begin, students' curiosity, along with their written or verbal predictions, will tune their brains into the perfect zone for attentive focus.

They are like adults placing bets on a horse race. Students may not be interested in the subject matter itself, but their brains need to find out if their predictions are correct, just as the race ticket holder needs to know if he holds a winning ticket.

Now the students' brains want to know what you have to teach! If nothing else, you're set to reach them from day one.

The brain is wired for high interest when clues prompt prediction, anticipating the pleasure of the dopamine reward response. There is no such intrinsic motivation for drills and memorization of rote facts and procedures.

Isolated skill practice is contrary to the brain's instinct to preserve its energy, because there is no expectation of pleasure from energy output. On the other hand, when students want to know required information to create solutions to problems that interest them or to create products that they care about, the brain applies the effort to learn what is required to achieve desirable goals.

This isn't a personality thing, or a characteristic of apathy, but a **fundamental neurological system** that preferentially attends to and stores input considered useful for desired goals.

Creating an Engine for Breakthrough Innovation in STEM Education

Russell Shilling
Executive Director for STEM at U.S. Department of Education (SES)

Every organization can benefit from an internal group that focuses on promoting and creating game changing innovations.To avoid falling behind, organizations must look to the future while also improving performance and practices in the present. Here at the U.S. Department of Education (ED), we're working hard to build the foundation for an advanced research infrastructure that can uncover breakthrough innovations so that our schools, educators, and students once again lead the world.

Before joining the team at ED, I spent 22 years in different Department of Defense (DoD) research settings, working closely with a variety of civilian research agencies.

What I learned leading projects at the Defense Advanced Research Projects Agency (DARPA) and the Office of Naval Research (ONR) is that most research (both public and private) is stove-piped into two categories: basic and applied.

Basic research seeks new knowledge and understanding, while applied research — as the name suggests — takes existing knowledge (i.e., the results of basic research) and creates new applications for it.

Applied research can improve performance incrementally by leveraging the results of already established basic research. This is an important and essential function. But by definition, the impact of applied research is limited by the horizon of current knowledge, which means it is not well-suited to producing dramatic breakthroughs.

In the education sector, unfortunately, we under-invest in both kinds of research at every level — across the public, private, and non-profit sectors. (Compared to our peers in healthcare or energy, we spend just fractions of our resources on research and development.)

And while American educational achievement and attainment is improving, our progress is far too slow. To regain our leadership in high school and college graduation rates, we need new research and development tools that will lead to breakthrough innovations that dramatically improve student outcomes and tools that go to scale to serve students across the nation.

How do we maximize opportunities to create breakthrough innovation?

There is a model, which has been highly successful for more than 50 years, but has not been widely replicated in any sector: DARPA. Immediately prior to joining ED, I was a program officer at DARPA

developing and managing programs on psychological health, training, and education.

DARPA was created in 1958 in response to the Soviet launch of Sputnik. Its mission is simple, but powerful: to prevent technological surprise by being an organization that itself creates technological surprise. DARPA programs have created numerous successes that have dramatically enhanced military might and effectiveness (such as stealth technology and night vision), while other programs led to breakthroughs such as the Internet and GPS that have fundamentally reshaped society.

The DARPA model could similarly boost education research, especially in the context of science, technology, engineering and math (STEM) education. Just as we created DARPA to keep the United States at the forefront of technological advancement, we must pursue advanced education research to create breakthrough innovations to ensure that future generations of Americans have the skills and abilities they need to compete in and lead the world. Advancements emerging from this process would create the next generation of innovative, highly trained scientists and engineers to sustain a significant technological lead.

It would also help to create an education system that promotes lifelong learning to enable U.S. workers to continue to adapt to rapidly changing technology environments and remain competitive.

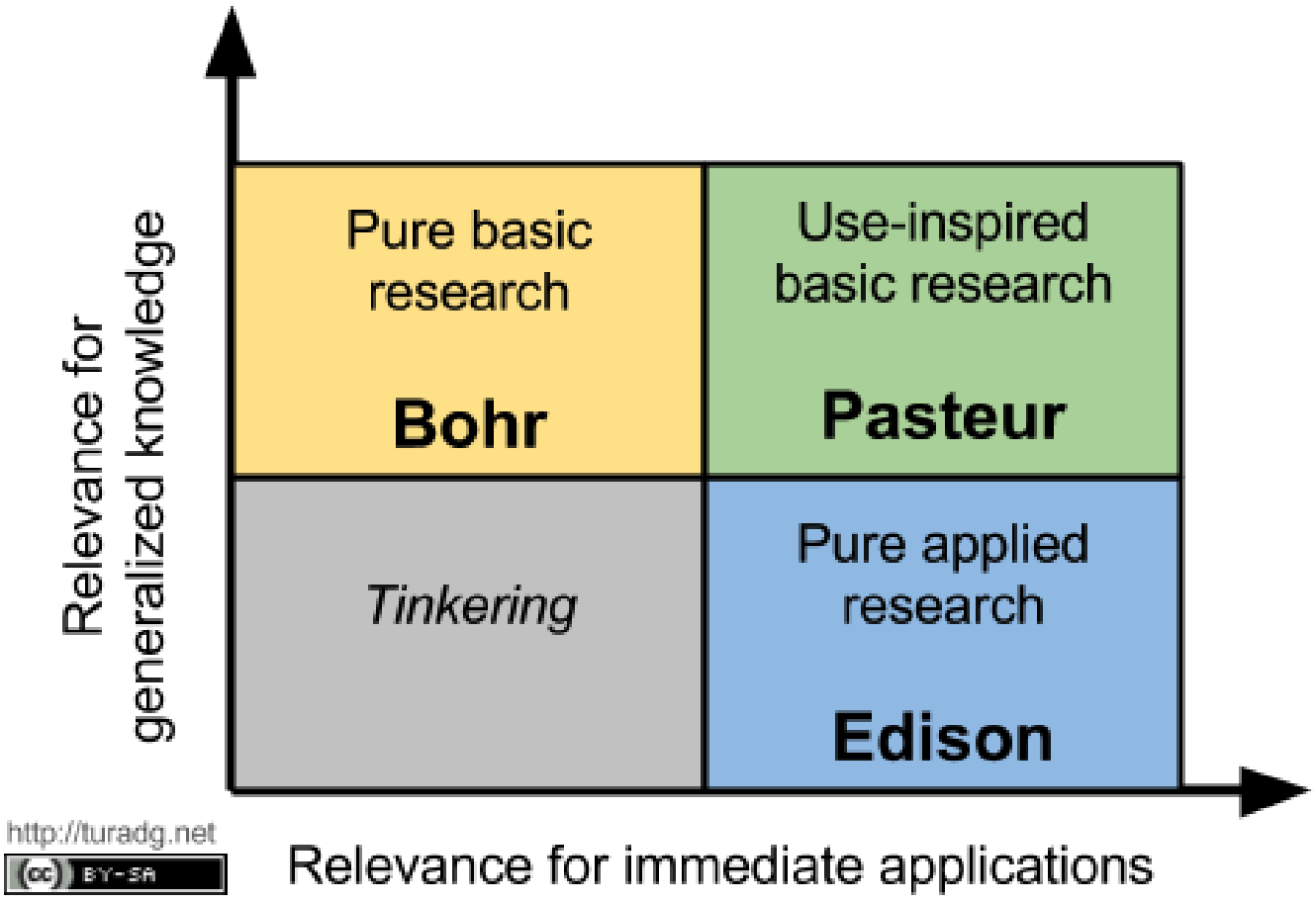
How is the process used at DARPA different from the more traditional basic and applied research?

DARPA employs a research process that resides in Pasteur's Quadrant, a category first described by Donald Stokes.2 Stokes broke

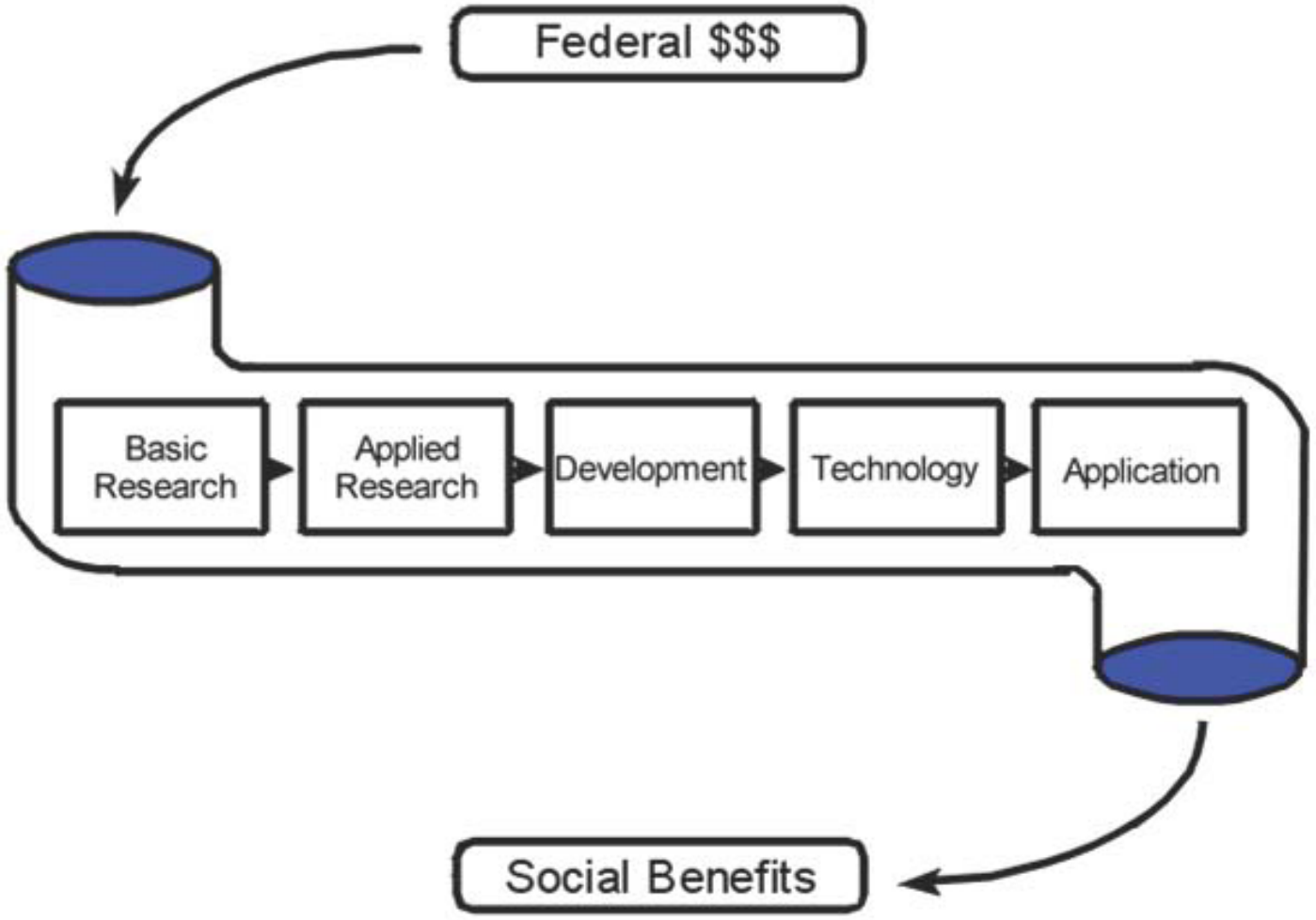
research into four categories that balance the search for basic understanding with the aim of producing a specific outcome. Basic research, classified as Bohr's Quadrant, is the quest for basic knowledge without regard for the final use of that knowledge.

Applied research resides in Edison's Quadrant, where producing a specific product is the top priority; effort is dedicated to "applying" existing basic research. Pasteur's Quadrant collapses the boundaries between Bohr and Edison: it conducts basic research aimed at solving specific and immediate problems. In that sense, basic research in Pasteur's Quadrant is driven in real-time to meet the ongoing requirements of the final application.

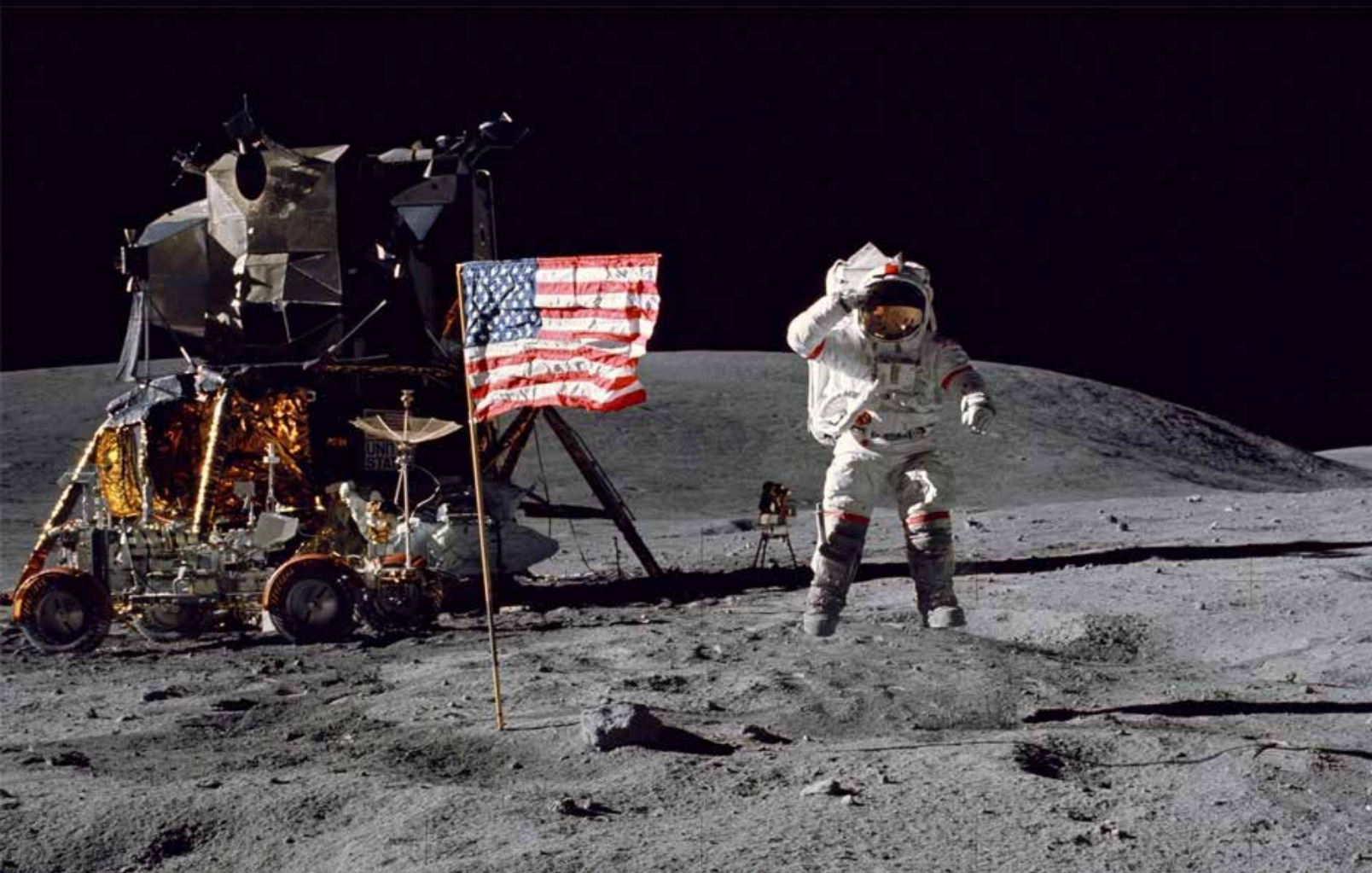
Pasteur's Quadrant is interesting because it's based on having a clear vision of success even when all of the pieces of the puzzle are not yet known. As a result, success often means challenging prevailing assumptions and leapfrogging over current practice to produce a breakthrough.



The race to the moon was very much a process of breakthrough innovation. The U.S. set an audacious goal whose achievement was beyond the capacity of the science and technology of the day.

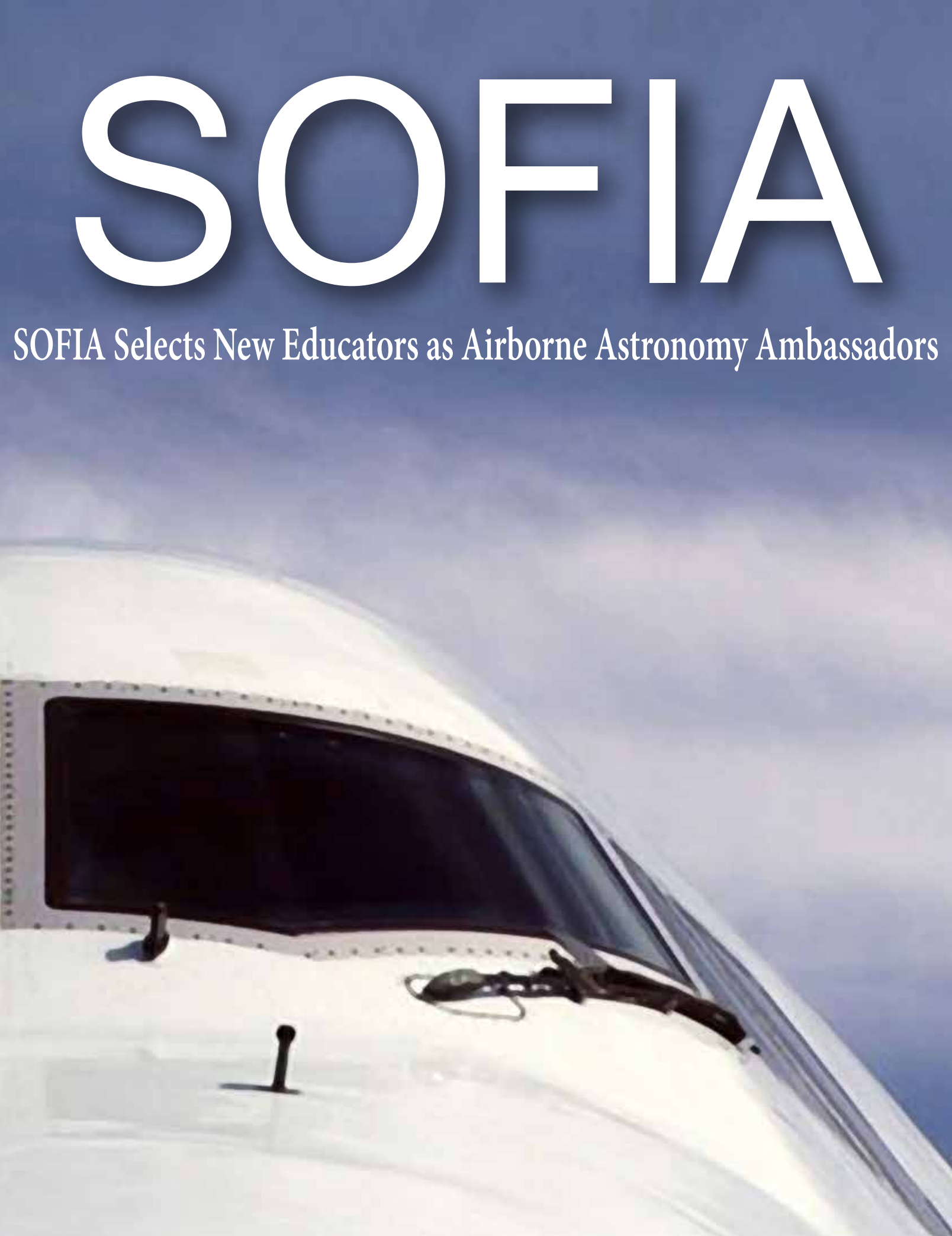


Basic and applied research therefore needed to iterate and develop continuously to achieve the goal. Much has been written about the race to the moon, but what is clear is that if these two forms of research had been separated, we never would have achieved our goal.



SOFIA

SOFIA Selects New Educators as Airborne Astronomy Ambassadors



SOFIA Selects New Educators as Airborne Astronomy Ambassadors

Working to expand professional development opportunities for science educators across the United States, NASA's Stratospheric Observatory for Infrared Astronomy program, known as SOFIA, has selected 14 two-person teams for its 2015 Airborne Astronomy Ambassadors.

The 28 Airborne Astronomy Ambassadors selected for 2015 come from 12 states plus the District of Columbia. Six of the states (Georgia, Indiana, Maine, Massachusetts, New Mexico and Oklahoma) as well as the District of Columbia are new to the program.

Educators selected for the 2015 cohort of this highly competitive, professional development program are:

- **Adrienne Hestenes** and **Janet Mambrino**, Xavier College Preparatory High School, Phoenix, Arizona

- **Richard Krueger**, Flagstaff Arts and Leadership Academy, and **Samantha Thompson**, Lowell Observatory, Flagstaff, Arizona

- **Kevin Tambara,** Bert Lynn Middle School, Torrance, California, and **Sandra Trevino**, Air Force Association/Girls Scouts, Sierra Vista, Arizona

- **Dan Burns**, Los Gatos High School, and **David Marasco**, Foothill College, Los Altos, California

- **Monique Perez** and **Jeri Sloane**, Palmdale Learning Plaza, Palmdale, California

- **Susan Oltman**, Kittredge Magnet School, and **April Whitt**, Fernbank Science Center, Atlanta, Georgia

- **Kevin McCarron**, Oak Park and River Forest High School, Oak Park, Illinois, and **Chuck Ruehle**, Astronomers Without Borders, Racine, Wisconsin

• **Troy Cockrum**, St. Therese Little Flower Catholic School, and **Jeff Peterson**, Center Grove Middle School North, Indianapolis, Indiana

• **Brian Gonyar** and **LaureeGott**, Veazie Community School, Veazie, Maine

• **Howard Fain** and **Stacy Lord**, Worcester East Middle School, Worcester, Massachusetts

• **Virginia (Ginger) DeVillers**, West Michigan Flight Academy, Jenison, Michigan, and **Lisa Wininger**, Plainwell Middle School, Plainwell, Michigan

• **Jeffery Killebrew**, New Mexico School for the Blind, and **Michael Shinabery**, New Mexico Museum of Space History, Alamogordo, New Mexico

• **Melissa Aguirre**, JHS 217 Robert A. Van Wyck School, Jamaica, New York, and **Jacqueline Fernandez-Romero**, The Latin American Youth Center Career Academy, Washington, D.C.

• **David Davisson**, Longfellow Middle School, and **Eileen Grzybowski**, Norman North High School, Norman, Oklahoma

The 2015 group of Airborne Astronomy Ambassadors joins 55 educators from 23 states who have participated in the program during the past four years.

Photo: *Lynne Zielinski, Heidi Steinbrink, Marcella Linahan, Pamela Harman the Educational Program Co-Manager for SOFIA, Tom Jenkins, and Vivian Hoette focus in on an observation target.*

NASA's Stratospheric Observatory For Infrared Astronomy (SOFIA) was designed from the ground up with the capability to allow visiting educators and journalists to closely observe the research process. The ability to allow non-research visitors to get close to the workings of the observatory, to observe first-hand how scientists really think, work, interact, and use technology, is a key feature of SOFIA.

Leveraging this capability results in SOFIA's Education Program bringing the excitement, hardships, challenges, discoveries, teamwork, and educational values of SOFIA to educators, their students, and their communities on a national and even international scale.

SOFIA's Airborne Astronomy Ambassadors (AAA) is a professional development program that aims to improve teaching, inspire students, and inform the public. It builds upon the legacy of NASA's highly successful FOSTER (Flight Opportunities for Science Teacher EnRichment) program that flew educators aboard the Kuiper Airborne Observatory (KAO) from 1991 – 1995.

The Airborne Astronomy Ambassadors "pilot" program for educator professional development successfully flew six teachers on the observatory during the summer of 2011.They represented California, Wisconsin, Michigan, Illinois, and Virginia.

Evaluation confirmed the program's positive impact on the teacher participants, on their students, and in their communities. Teachers Incorporated content knowledge and specific components of their experience into their curricula, and they have given dozens of presentations and presented professional development workshops for other teachers. To date, their efforts have impacted thousands of students and teachers.

As part of preparation and training for their flight experience, AAA program participants complete a graduate-level Astronomy for

Teachers on-line course administered by Montana State University Bozeman and National Teacher Enhancement Network.

Teams are connected with astronomers awarded observatory time, and they communicate and receive updates throughout the research, from preparation to data analysis phases. Optimally, AAAs fly aboard SOFIA twice, implement classroom lessons based on their experiences, and also conduct outreach to other educators and in their communities.

Caption: ***From left, SOFIA Outreach manager Dana Backman and Airborne Astronomy Ambassadors Marita Beard and Kathleen Fredette seated at the E/PO console during a SOFIA flight.***

The SOFIA Education Program is a partnership of The SETI Institute and the Astronomical Society of the Pacific (ASP), both non-profit organizations with experience in developing and managing complex educational programs for astronomers, students, and the public.

When SOFIA was first proposed to NASA in 1996, the partnership between the SETI Institute and the Astronomical Society of the Pacific was initiated. SETI Institute's Edna DeVore had developed and led the FOSTER program on the KAO in partnership with scientists, engineers, aviators, and educators at NASA Ames Research Center.

Mike Bennett, then the Director of Education at the ASP, proposed that the two organizations partner on the Education and Public Outreach (EPO) program for SOFIA.

Together, they joined with Universities Space Research Association (USRA), the prime contractor, and others to win the contract to develop SOFIA. The combination of this team's on-the-ground and

in-the-air experience fostered a strong, original EPO plan for SOFIA, that has evolved little during the development of the observatory. Today, both organizations look forward to an exciting future for educators engaged with the SOFIA program.

The SETI Institute's Education and Outreach programs share the excitement of searching for life in the universe with people of all ages. People are curious about our place in the universe: are we alone in the vast ocean of stars and galaxies?

Curiosity motivates both exploration and learning in schools, science centers, colleges, and universities. In a less formal venue, several million people per year connect to the Institute via social media, the website, and radio show for cutting edge science, technology, and opinion. Others learn about our astrobiology and SETI research through print and broadcast media via popular articles and science-based television.

Institute scientists are co-authors of college-level textbooks: Life in the Universe, a national best-seller for introductory astrobiology, and Perspectives on Astronomy, a widely adopted text for introductory astronomy. The Institute offers curriculum and teacher professional development programs.

Caption: ***George Hademenos, Diane Watson, Coral Clark the Educational Program Co-Manager for SOFIA, Lee-Ann Vaughan, and Judi Little.***

Today, Voyages Through Time, http://voyagesthroughtime.org/, our high school science curriculum, is taught in more than 400 schools around the nation, and is supported by a network of more than 200 teacher-mentors trained in our Astrobiology Summer Science Experience for Teachers (ASSET) program. Evolution is the

core theme of Voyages Through Time; it provides the tools and strategies for science teachers to effectively manage social controversy, while teaching evolution across science disciplines. Between summer institutes, speakers, workshops, short courses and exhibits at science and education conferences, the Institute provides professional development for several hundred educators each year.

The ASP inspires professionals, researchers, educators, amateurs, and armchair astronomers to look up and wonder about our place in the universe, and about what the universe can teach and tell us. Around the world, in classrooms, museums, planetariums, national parks, state parks, nature centers, astronomy clubs, city sidewalks, online, and your own backyard, the ASP fosters scientific curiosity, advances science literacy, and shares the excitement of exploration and discovery. The ASP designs and delivers innovative astronomy toolkits, programs, publications, and education guides in their mission to inspire and educate youth and adults of all types.

The ASP: connects and serves scientists, educators, amateur astronomers and the public; shares the results of astronomical research and news through their publications; designs and delivers professional development, services, and toolkits to educators;organizes a national forum for science and science education through their annual meeting; recognizes excellence in astronomy and astronomy education through their awards; and communicates the excitement of astronomy and science to the public. ASP funding sources include NASA, the National Science Foundation, the American Astronomical Society, private and corporate sponsors, ASP members, and donors.

For more information:
SOFIA: http://www.sofia.usra.edu/
SETI Institute: www.seti.org
Astronomical Society of the Pacific: www.astrosociety.org

The *Sound Barrier* does

What about objects?

There is not actually a "physical barrier" in the sky that prevents sound or objects from going faster, and thus cannot be "***broken***". There is nothing to break through.

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

not exist, *continued.....*

Misnomer [mis-noh-mer]

noun

1. **a misapplied or inappropriate name or designation.**

2. **an error in naming a person or thing.**

As we discussed in last months issue, the sound barrier does not really exist, but is rather a misnomer.

In the 1940's as we were experimenting with faster aircraft, our understanding of the physical properties of the atmosphere was incomplete, thus the assumption that we could not go faster due to a barrier in the sky.

As test aircraft approached the speed of 760 miles per hour, the structure of the aircraft failed and the planes simply broke apart. Many lives were lost, but the pursuit of speed continued.

Here was the question: "Why can we not go faster?" Whether it is a track runner, automobile, truck or airplane, there were physical limits to the speed we could attain. The obvious conclusion was to make more powerful engines for all of the above, but what about the science?

The answer to that question seems rather simple now.

We simply cannot push the air (atmosphere) out of the way fast enough.

As objects move through the air they have to push the molecules out of the way.

Exercise:

Very slowly, wave your arm back and forth. You don't really feel anything because the air in the room has enough time to go around your arm and fill in the void left by your arm.

Now wave you arm back and forth very fast. Suddenly you can feel the air rushing around your arm because it is having a little trouble keeping up. Resistance is building against your arm in the form of a very small pressure wave.

Why can you not run faster? It's not because your muscles are weak or incapable of running faster, it's simply that you cannot push the air out of the way to go faster. But travel to Colorado, 5,280 feet above sea level and you will be

able to run faster because the air is thinner.....less to push out of the way. If you could somehow run at 35,000 ft., you would be a world record holder for running speed.

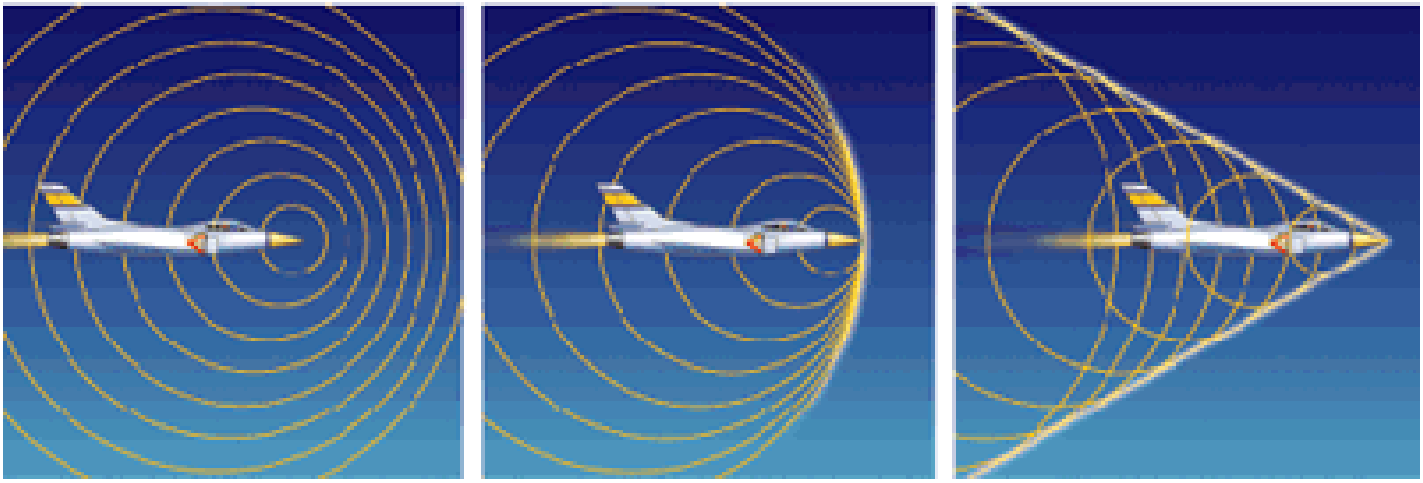
This same rule holds true for cars, trucks, trains, and planes. The only solution is to make them more powerful to push the air out of the way.

The Pressure Wave

Here is where it gets dangerous.

As the pressure wave of air builds up around an object traveling beyond the airs ability to easily move around it, that pressure wave can cause great physical damage to the object.

As you fly higher and the air is thinner, the pressure wave is reduced in power, the air move more easily around the object and you can go faster.



The two things that will allow an object to go faster are:

1. A more powerful engine or motor.

2. A strong enough structural frame to withstand the huge forces applied by the air pressure wave.

There is not an actual barrier preventing objects from going faster.

Now that we have a better understanding of the science behind speed and atmosphere, we can overcome many of the limitations on speed.

When the space shuttle reaches orbit, it is traveling at about 24,000 miles per hour.

So much for barriers.

Sorting Is Boring:

Computer Science Education Needs to Join the ***Real*** World

Jessie Duan, Stanford University

Every April, we at Girls Teaching Girls To Code hold a day-long event called Code Camp to introduce 200+ high school girls in the San Francisco Bay Area to computer science. Throughout the day, 40 women in computer science from Stanford University expose students to their first programming language, help them use their new skills on cool projects, and inspire girls to the wide array of careers in computer science.

This past year, one of the concepts we wanted to teach was sorting. Sorting is widely studied in computer science because it's used everywhere, from putting your Facebook timeline in chronological order to reordering your Amazon search results by price.

Quickly sorting a long list of items is difficult, so a lot of research has been done on sorting a list efficiently.

To introduce this concept, we devised a team activity for part of the day, during which girls acted out the most common sorting methods. As the organizers, we thought it was awesome -- the girls were learning a core CS concept in an interactive way.

But the girls? **They hated it.** Sixty-two out of 210 students said that 30 minute session was their least favorite part of the entire day.

We were shocked. It seemed so fun! The girls were outside and interacting with each other. What was there not to like? But after diving into the girls' feedback for the event, we saw many versions of "I don't get the point," "It was boring," and "This doesn't seem important."

```
BEGIN SELECTIONSORT
firstindex = 1
lastindex = ARRAYLENGTH(element)
endunsortedindex = firstindex
WHILE endunsortedindex < lastindex
      currentindex = endunsortedindex
      smallestelement = element(currentindex)
      smallestindex = currentindex
      WHILE currentindex < lastindex
            currentindex = currentindex +1
            IF element(currentindex) < smallestelement THEN
                  smallestelement = element(currentindex)
                  smallestindex = currentindex
            ENDIF
      ENDWHILE
      SWAP(element(smallestindex),element(endunsorted))
      endunsortedindex = endunsortedindex + 1
ENDWHILE
END SELECTIONSORT
```

It finally made sense. As computer science students, we know why sorting is important because we see it being used everywhere. But from the girls' perspective, we were just saying, *"Here is a bunch of ways to sort a list."* So of course for them, sorting was boring.

The thing is, the majority of computer science classes teach not only sorting but also every other concept in computer science in exactly this way -- by presenting various algorithms, explaining how they work, and expecting students to enjoy it. Introductory computer science education at universities tends to emphasize the technical aspects of programming, such as speed and efficiency.

Assignments ask students to print out prime numbers or determine if a word is an anagram -- certainly interesting and difficult, but not particularly useful. Only several semesters later do students study the interdisciplinary, real-world applications that motivated many of them to learn computer science at all.

This structure causes many students to give up on computer science early on -- a problem that disproportionately affects women. Jane Margolis, a leading researcher in gender equity in computer science, explains in Unlocking the Clubhouse that women tend to be more interested in the applications of a computer, whereas men tend to be more interested in the computer for the computer's sake. Women link their interest in computing to other disciplines at five times the rate that men do.

Although there are many reasons for why women abandon studies in computer science, the design of most computer science classes is a major factor in why only 18% of undergraduate computer science degrees in America go to women.

There are people who love math for math's sake and devote themselves to proving 1 + 1 = 2. There are more people, however, who enjoy using math to prescribe medication and build skyscrapers. In elementary school, we use word problems to show why it's useful to add fractions (ever want to split that blueberry pie?) or find the perimeter of a square.

We wait until college, when math majors choose to devote four years towards pure math, to finally set aside the word problems and focus on theory. We do so because math is a valuable skill that is used in so many different professions and contexts, and we don't want kids to give up on math because they don't think it's useful.

So, why does computer science start with theory and end with word problems?

We need to spark an interest in computer science using students' passions. Let's teach introductory programming by demonstrating its incredible potential for impact. Let's teach sorting algorithms from the perspective that they're used everywhere, not just because they're supposed to be in the curriculum. Let's make sure that starting day one, they see what they can achieve using computer science and are excited to come

back for the next class.

Computer science is a tool -- and if we want to attract people who intend to use it that way, we need to start teaching it that way from the beginning.

To learn more about **Girls Teaching Girls To Code**, check out:

http://www.girlsteachinggirlstocode.org

email: girlsteachinggirlstocode@gmail.com

"Women link their interest in computing to other disciplines at five times the rate that men do."

The Activity

Gap

Alia Wong / Associate editor at *The Atlantic*

Imagine two young adults who, despite living in the same city, come from very different worlds.

One is named Ethan—a freshman at an elite college near Austin, Texas, pursuing a degree in engineering. He grew up with supportive middle-class parents who put him in extracurriculars his whole life: Boy Scouts, soccer, track, orchestra. Instead of letting Ethan watch TV and play video games, his dad took him on hiking trips to New Mexico where they would track bears and practice navigation. His father also volunteered as the school orchestra's bus driver. Ethan's mom, meanwhile, strived to raise an engaged citizen; she even helped him register to vote when he turned 18.

Then there's Nicole, who also lives in Austin—though in an area far less inviting than the spacious private housing development where Ethan was raised.

At 18, Nicole is a single mother who works in the kitchen at a three-star hotel making a wage that's hardly enough to cover food, diapers, and clothes from Goodwill. She recently borrowed $9,000 to help pay for a year-long program at a for-profit college, but whether that degree will get results—whether she'll even complete the course—is debatable.

Unfortunately, it's hardly surprising that Nicole wound up at this point. She grew up poor—her father worked as a garbage collector, and her mother as a hotel maid and waitress—in a neighborhood that was so dangerous she couldn't

play outside. Instead of hiking trips and soccer games, Nicole spent her afternoons watching TV at home alone.

As a sophomore in high school, after spending her freshman year popping pills with other girls to fit in, Nicole joined the dance team. But that was short-lived: With uniforms and travel for competitions costing $800 annually, she had to quit after a year because her family couldn't afford it. She eventually wound up pregnant by a man who later became abusive.

Though their names are pseudonyms, ***Ethan and Nicole are real people*** who were interviewed as part of a national study recently featured in Voices in Urban Education, a publication out of Brown University's Annenberg Institute for School Reform. The objective of the study was to examine trends in extracurricular participation among kids in the U.S. from the 1970s until today through long-term data and conversations with 120 young adults across the country.

What the researchers found is, as they note in the article, "alarming." Income-based differences in extracurricular participation are on the rise, and these differences greatly affect later outcomes.

This disparity exacerbates the already-growing income achievement gap that has kept poor children behind in school and later in life. While upper and middle-class students have become more active in school clubs and sports teams over the past four decades, their working-class peers "have become increasingly disengaged and disconnected," particularly since their participation rates started plummeting in the '90s, the study found.

"Ethan is lucky: with his parents' flexible work schedules, comfortable financial situation, and commitment to his social and intellectual development, his pathway into a middle-class adult life was almost seamless," the researchers write. "But for many other children, the rising costs of sport teams and school clubs, combined

with parents' uncertain work schedules and precarious household budgets, have made extracurricular activities a luxury they can't afford."

The researchers consulted surveys from the National Center for Education Statistics dating back to the early '70s. These surveys asked for information from students, parents, and administrators on various aspects of the education experience, including involvement in several types of school-sponsored activities, such as service and hobby clubs, drama programs, and sports teams.

They measured gaps by comparing participation among students in the top and bottom quartiles of a socioeconomic index. And it's worth noting that they limited their analysis to "non-Hispanic white" high school seniors to emphasize that "the gaps we find are driven by social class and not by race or ethnicity."

While there's always been a gap in access to extracurriculars, participation numbers for the two groups increased at about the same rate until they started to diverge precipitously—in the early 1980s for non-athletic activities and in the early 1990s for sports teams.

In 1972, roughly 61 percent of low-income high school seniors, and 67 percent of their more-affluent peers, participated in one more non-athletic extracurricular

activities. A decade later, participation rates rose to about 65 percent and 73 percent, respectively. But by 1992, while 75 percent of upper and middle-class seniors reported participating in extracurriculars, involvement among disadvantaged students dropped back to 61%.

By 2004, the number for low-income seniors was down to 56 percent. Participation in sports echoed those trends, though the falloff didn't happen until 1992, when involvement rates among low-income seniors fell from 30 percent to 25 percent a decade later.

With all of the challenges plaguing schools today—including those that surround the academic achievement gap between rich and poor students—it may seem frivolous to focus on extracurricular participation. But, as the researchers emphasize, outside experiences have just as much impact on a child's life as the classroom ones.

As researcher Kaisa Snellman, an organizational-behavior professor at the international business school INSTEAD, put it, "the point we're trying to make is that schools affect kids' lives in multiple ways." Some data suggests that involvement in extracurricular activities is just as meaningful as test scores when it comes to subsequent educational attainment and accumulated earnings later in life.

Indeed, the benefits of extracurricular activities—from chess club to the yearbook committee—appear to be far-reaching. Research shows that the skills, habits, connections, and knowledge that kids develop in these activities help them gain self-esteem and resilience and reduce the likelihood that they'll

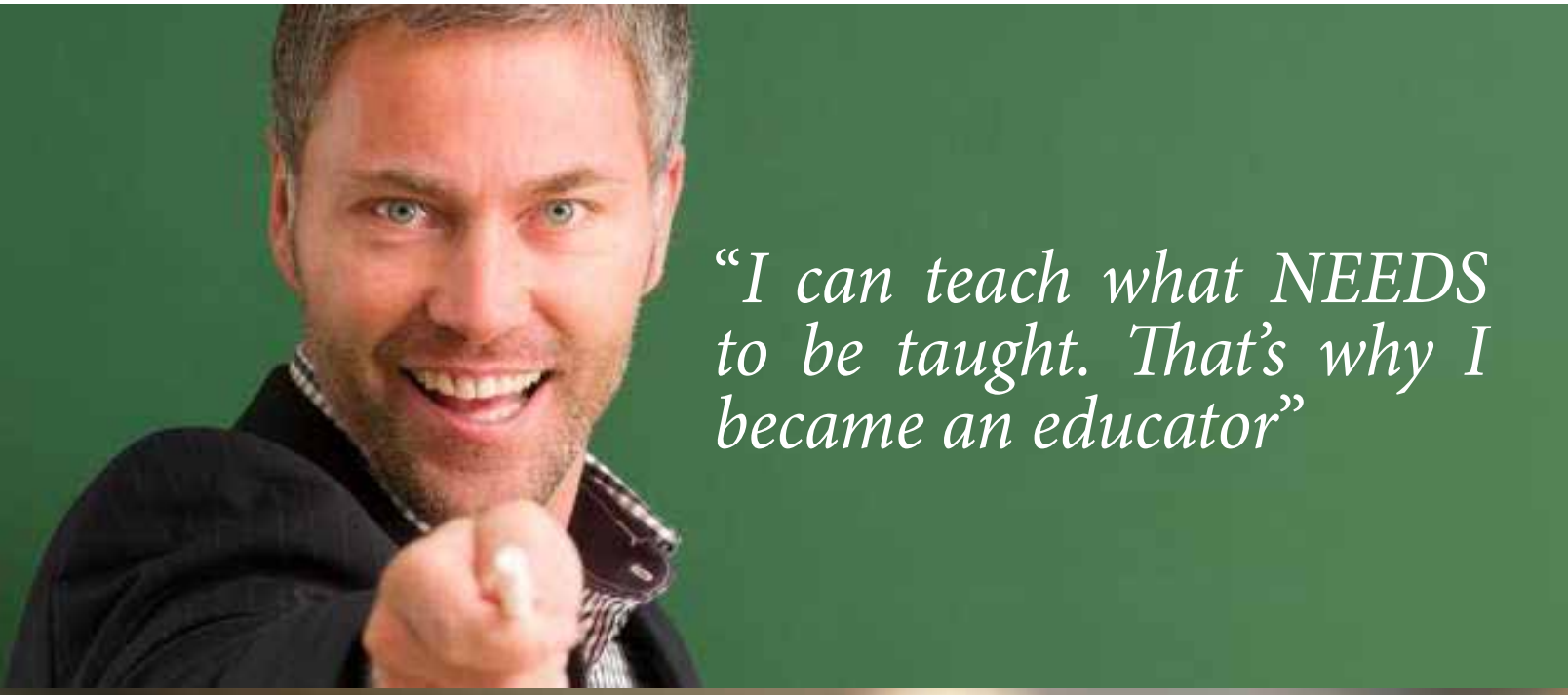
engage in risky behavior such as drug use, delinquency, and sexual activity.

They could even lead to higher wages and more opportunities for career advancement, as well as increase the likelihood of voting and engaging in politics.

"Clearly, extracurricular activities instill the skills and values that matter most for upward mobility."

If we eliminated standardized testing, within the first 6 months here is what would happen....

- *Teacher retention would improve by several million (Huffington Post)*
- *Student and teacher moral would improve beyond measure*
- *Student and teacher stress would drop over night / better health*
- *Student drop out rates would decline / Graduation rates up*
- *Student grades would improve along with interest and retention*
- *What else would change?*



We invite you to submit a paper and present at STEMfest?

Educators should submit your abstract and synopsis online at http://stemstates.org/stemfest-2015/submit-a-paper.html

Call for Abstracts Closes June 1st 2015

Formal and Informal Education

Grades K – 12, Tertiary and Vocational Education Pathways

International Awards including $2000 for best Oral Presentation and $1000 for Best Poster

All accepted papers published in one of four leading international Journals.

Theme : "Skilling a Nation's Future"

University of Saskatchewan · innovation Saskatchewan · Discovery Education · SEAMEO · recsam · South East Asian Ministers of Education Organisation · ScienceHouse Foundation · Murdoch University Perth Western Australia · Asia Pacific Society for Solar and Hybrid Technologies · Saskatoon Regional Economic Development Authority · Aquaculture Without Frontiers · Science On Stage Canada · University of Miami College of Engineering · IUFRO · PMFAI · Volvo · Ag-West Bio · Global Industry Development Network · LSi The Laboratory Safety Institute · CERI Clean Energy Research Institute University of Miami · TourismSaskatoon · Global STEM States The World's Leading Science, Technology, Engineering & Mathematics Education Innovation Hubs · The Chamber Greater Saskatoon Chamber of Commerce

Educators should submit abstracts & synopsis at
http://stemstates.org/stemfest-2015/submit-a-paper.html

GLOBAL STEM STATES

International Secretariat
19 Riseley Street
Ardross WA 6153
Australia
Telephone +61 8 9468 3201
Fax +61 8 9325 4296
events@stemstates.org
www.stemstates.org

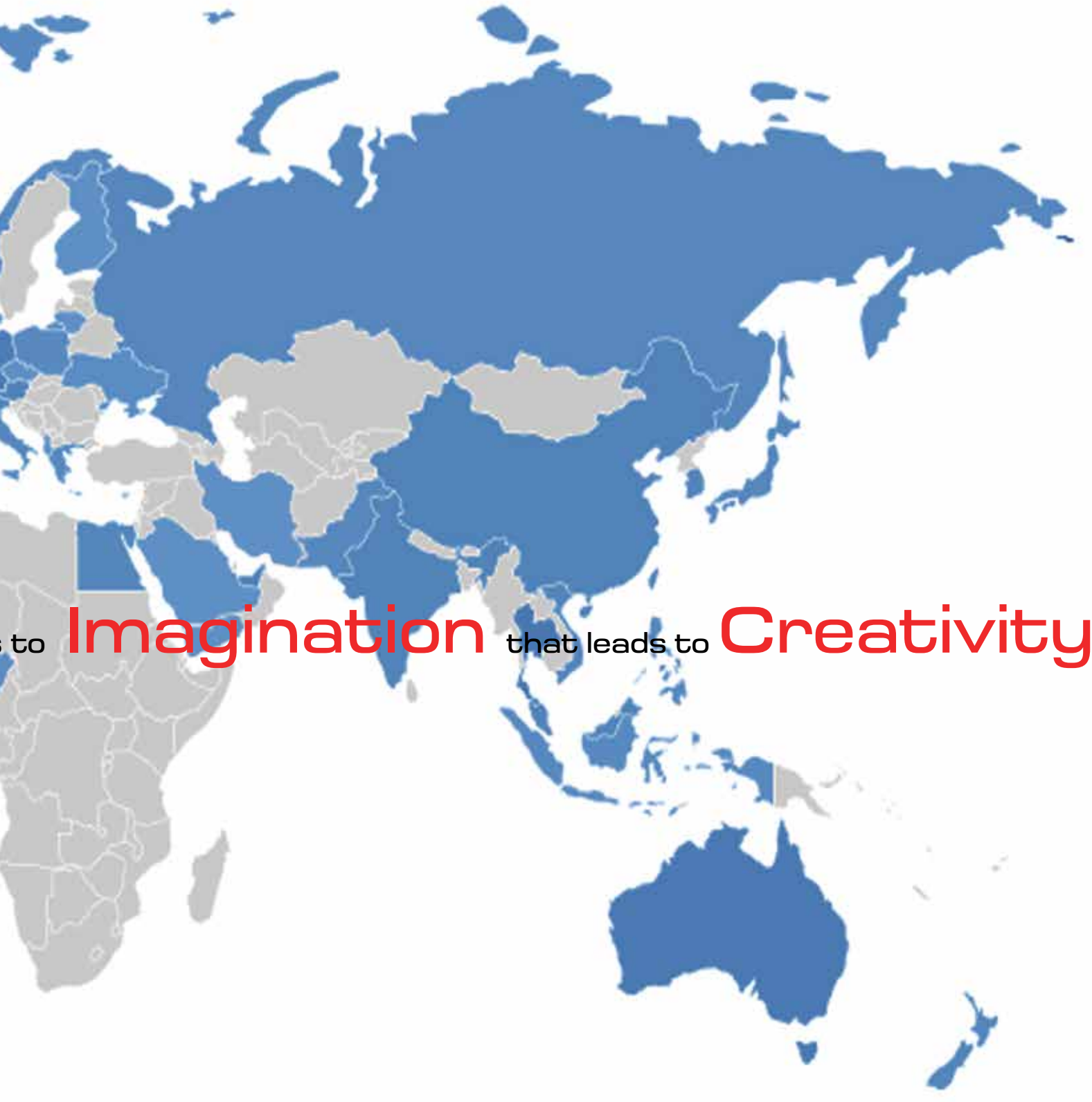
Event Management Company
On Purpose Leadership Inc
131 Wall Street
Saskatoon, SK S7K 6C2
Canada

Open PDF Brochure Here

Global Readership as of January, 2015

Curiosity leads to Exploration that leads

S.T.E.M. is Global



s to Imagination that leads to Creativity