S.T.E.M.

MAGAZINE

Math in *Everyday Life*

Dr. Richard Larson, MIT

Breakthrough Innovation *II*

Russell Shilling

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

Building Brain Cells

Dr. Judy Willis

"Pluto"....Planet or not?

Janet Ivey

STEM FEST

April 2015

\\190v

STEM Innovations

A Math and Science Partnership Initiative in Northwest Indiana

Dear Educators,

As you prepare to rejuvenate over your upcoming Spring Breaks (or are coming back from your break refreshed and ready to tackle the last few months of the school year), don't forget to complete your assignments as part of the STEM Innovations professional development. Assignments are due May 15, 2015 and must be posted on Learning Connections in order to receive your stipend. The assignments are as follows:

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

Click here for additional information on the assignments.

On March 19th educators gathered for the final YR1 STEM Innovations professional development session. Teachers discussed STEM careers and the importance of increasing representation of females and underrepresented groups, participated in large and small group discussions around the MiB challenges and discussions about ICA and viewed an IDOE Shopping Cart video. As a result of the professional development, teachers:

- Made connections between innovation in engineering design process standards and teacher developed lessons
- Learned ways in which teachers can help minimize misconceptions in student learning

STUDENT SURVEY REMINDER: If you have questions regarding the student surveys please contact Dr. Brandon Sorge at bsorge@iupui.edu or at 317-274-7029.

Thank you to all participants for your dedication and hard work during this first year of the STEM Innovations program!

As we move forward planning YR2, registration for the 2015 STEM Innovations Summer Institute is underway for 9th grade math and science teachers. Click here to register and mark your calendars to participate August 3-7 in Merrillville.

Thank You,
Your STEM Innovations Team

MERRILLVILLE COMMUNITY SCHOOL CORPORATION

School City of Hammond · GCSC · MSD of Boone Township · School Town of Munster · College Acceleration Network · Purdue University North Central

CLASS STEM LESSON

Math I use everyday.

- I'm going to the pool today to swim laps.
- I want to swim one mile.
- The pool is 25 meters long.

Question:

- How many lengths of the pool will I have to swim?

Think.....

Yes, you will use math (usually easy math) everyday. Don't be afraid of it. Your brain is actually wired for it.

April 2015

dr. judy *Willis*
Assessments that Build Brain Cells

janet *Ivey*
Will Pluto be called a planet again?

joanne *Castagna*, Ed.D.
STEM: Exploration and Questioning

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

wayne *Carley*
Auto Mechanic — a Great STEM Career

STEM FEST

Abstracts are due soon

S.T.E.M. Magazine Inc. is excited to announce a partnership with - **Global STEM STATES** - for the remainder of 2015. To learn more about Global STEM States, visit:

www.stemstates.org

STEM Magazine is a non-profit monthly education publication for teachers, students, their parents and anyone interested in STEM education, career development, work-force development and the global economy. 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.

Curiosity is the beginning of all things STEM.

Wayne Carley
Publisher

2nd International Festival of Science,
Technology, Engineering and Mathematics

Invitation to Educators

Be the Educator of Tomorrow

September 27th to October 1st 2015

Prairieland Park Trade and Convention Centre
Saskatoon, SK, Canada

www.stemstates.org

Community Festival
Conference
Careers Day
GameJam

Skilling a Nation's Future

Open PDF Brochure Here

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.

Assessments That Build

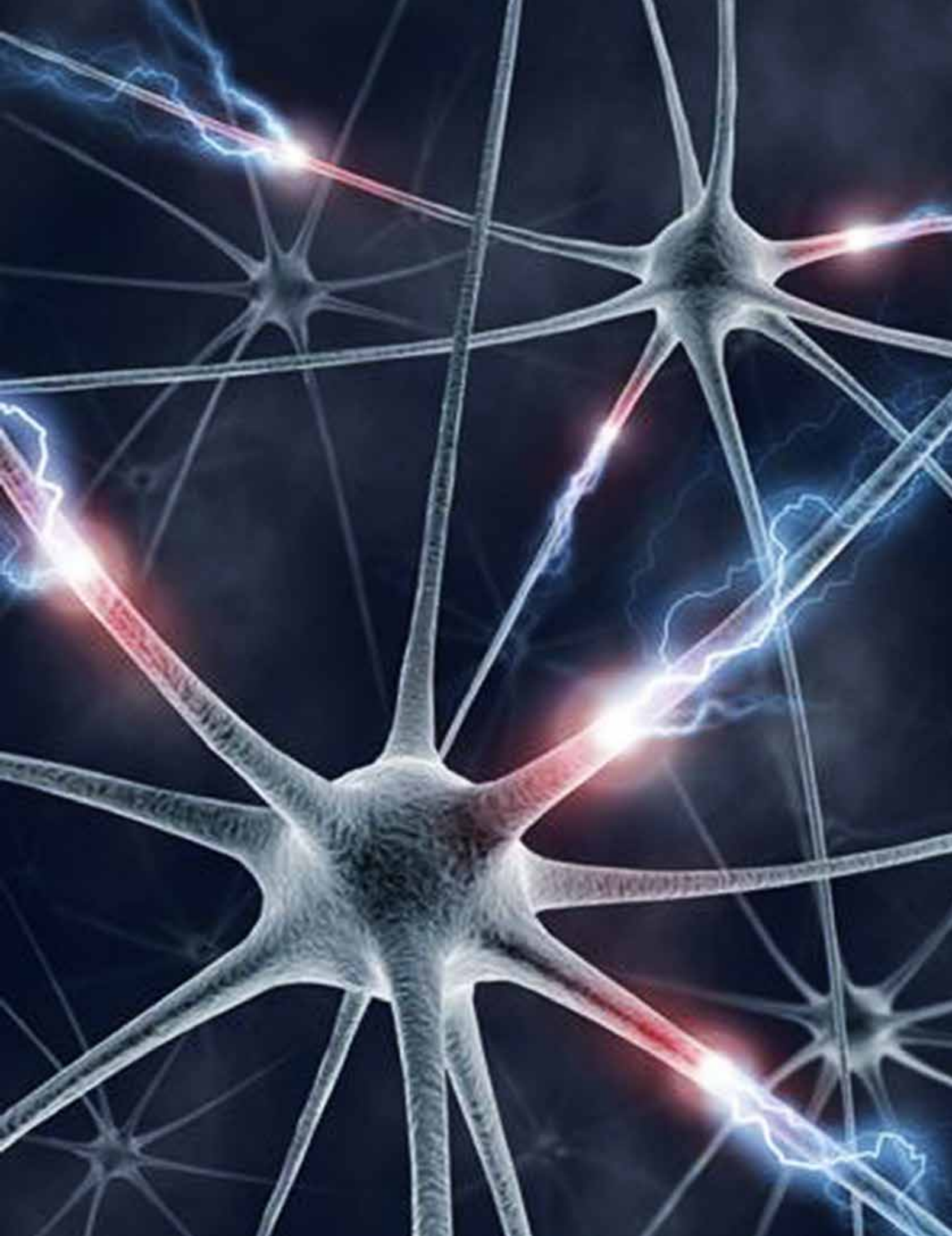
Brain Cells

Dr. Judy Willis, M.D., M.Ed.

Albert Einstein said, *"Imagination is more important than knowledge."* Without imagination and investigation of ideas our collective fund of knowledge would languish.

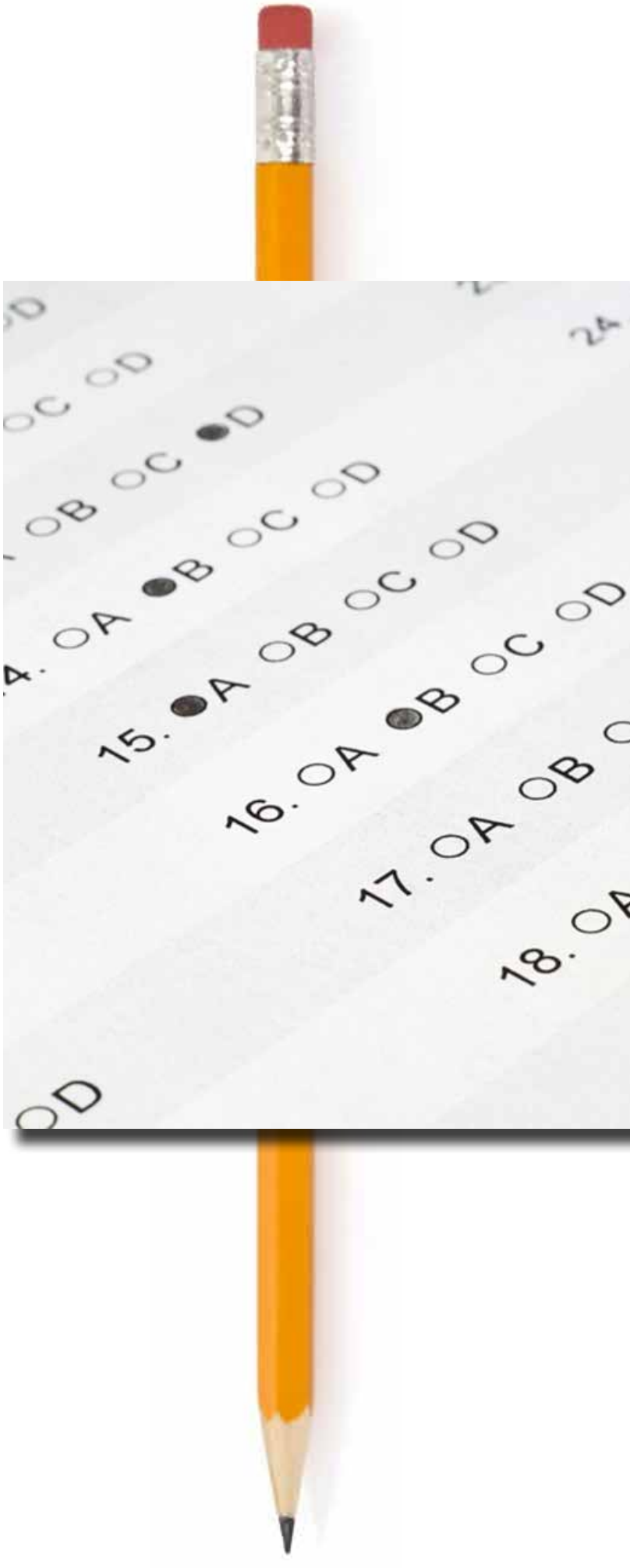
We do need assessments to determine what students learn and understand, but we can incorporate imagination in the creation of those assessments to insure that students' creative thoughts and higher executive functions are incorporated into their assessment experiences.

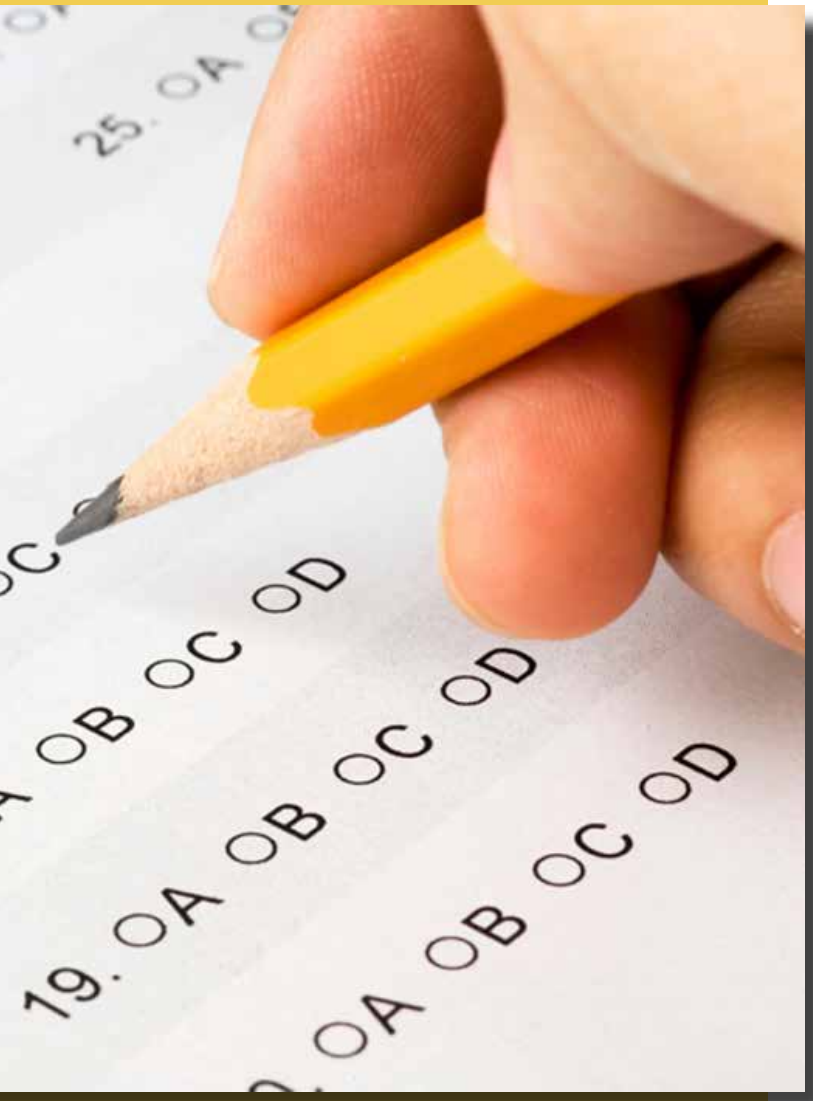
Traditional and especially standardized tests assess only a few parameters such as rote memory, ability to follow instructions, organization, and time management. Testing that emphasizes those parameters gives students the message that those are the primary qualities of thinking inside the box that are valued most.



As functional neuroimaging has delved more into learning research, evidence is mounting about which brain activities are most associated with information processing and memory retention. Strategies to increase successful learning can be incorporated into the assessment process such that these go beyond passive reflections of student memory and recall and become active learning experiences that stimulate dendrite growth, neurotransmitter release, and efficiency of neuronal network communication.

For dynamic educators creative problem solving and critical analysis can be given the value they merit by being part of student assessment. The National Council of Teachers of English position paper "On Testing" that stated, " In light of continued and increasing efforts to undermine progress the profession has made toward authentic assessment of students' real and vital engagement with language and literature, NCTE needs to reassert its repeated opposition to over-simplified and





narrowly conceived tests of isolated skills and decontextualized knowledge.

The crux of this concern has been the tension between the breadth of the English language arts curriculum and the restrictive influence of standardized means of assessing student learning." Assessment Over Time-From Macro to Micro Yearlong Assessment: Although assessments ideally take place during each class period and lesson, planning the year's major unit assessments while planning curriculum builds authenticity into those assessments.

Starting the year with clear communication to students about the goals of their studies and expectations for their assessments sets a pattern that gives them the security that accompanies predictability. Strategize from the start

• Gauge the assumptions students have about what is expected of them and how they will be assessed.

This can be an open-ended discussion including their opinions about the purpose of assessments.

• When teacher expectations are accompanied by sincere acknowledgement that all students will be given the opportunity to be successful, regardless of what test scores and grades are in their records, they are inspired with self-confidence and lower anxiety.

• When teachers help students feel safe and in control of their potentials for success, they reduce affective filters and reduce the

test-anxiety

that may have lowered test performance in previous years.

• To insure that all students are aware of teacher expectations provide samples of A, B, C, and D student work from past years in a binder. The samples need to relate to assignments similar in character to theirs, but not be the same specific topics. In that way the students will have the opportunity to emulate quality and creativity, not content.

• Rubrics are powerful tools for promoting successful performance and predictable assessment.

Spot Errors in Comprehension
With Daily Individual Assessments
This is where micro assessments and ongoing accountability are important for accurate student learning.

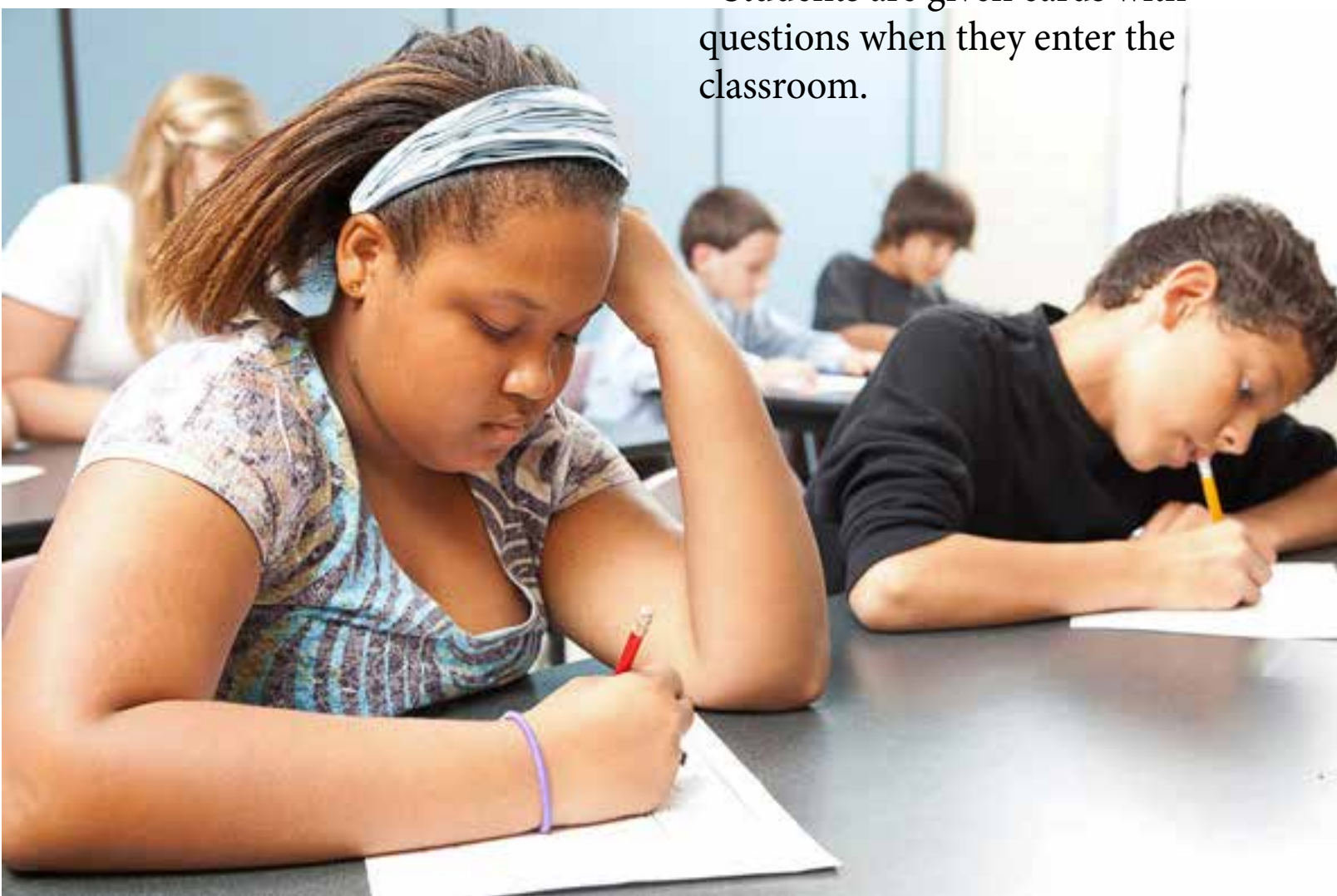
Experienced teachers usually have some idea what their students' grade ranges (and more importantly- their subject comprehension) are after the first several weeks of school. This is not because they frequently check their grade books, but because they assess student understanding during each lesson – sometimes more than once.

"There is a fine line between the stress of calling on students when they are confused or uncomfortable speaking in front of the whole class and the need to frequently assess each student's engagement and comprehension."

There is also the need for students to feel comfortable asking for clarification so misinformation does not become stored in long-term memory. Children who have lower academic expectations for themselves tend to ask for help less often. When you emphasize goals of individual self-improvement, effort, creative problem solving, and risk-taking, rather than competitive comparisons of student ability, students become more engaged and less threatened about participating.

When students focus on how well they personally have improved rather than on comparing themselves to others they are more comfortable asking for help. Embedding on-going assessment into everyday curriculum can be done by incorporating performance tasks into learning activities. Ways to keep students engaged, incorporate learning activities into assessments, and assure correct understanding while doing ongoing assessment include:

• Students are given cards with questions when they enter the classroom.



The answers to their cards' questions are posted on answer cards that label the seats or tables where they will sit that day. For example the card might say, "What state is the northern border of Oregon?" The student will search for the seat or table labeled "Washington."

• Students simultaneously, at the count of three, hold up the colored or white side of an index card when the class is asked a yes/no or true/false question to signal their individual opinions.

• Students have white boards, erasable markers, and cloths (this often a treat for students). They write answers in a few large words or numbers in response to questions and hold them up simultaneously after being given adequate time for all to write answers.

This gives instant teacher feedback as to who needs further explanation as well as keeping students engaged.

• When students are working independently or in small groups, teachers can move around the classroom listening to student discussions and assess what part of the material needs further explanation.

• Rather than have students store incorrect information consider having students stop worksheets or math problems done in class periodically and check answers that are posted (after they first show you the paper so you see that they did the work).

If students know that they will be credited for corrected errors as well as for trying the work, they can mark the their errors in a different color and later show that they made corrections in a different color.

• Multiple answers: This assessment may take the form of asking several students for their answers to the same question even if the first student's answer was correct. Similarly, once an answer is given students can raise hands if they

agree or disagree on a bulletin board.

• Summarizing is a valuable memory booster and a way to assess the day's learning.

• Students write down what they think was the main point or concept of the lesson on note cards.

• The next day, the best cards are returned to the students who wrote them and they read them aloud (for class review) and post them on a bulletin board.

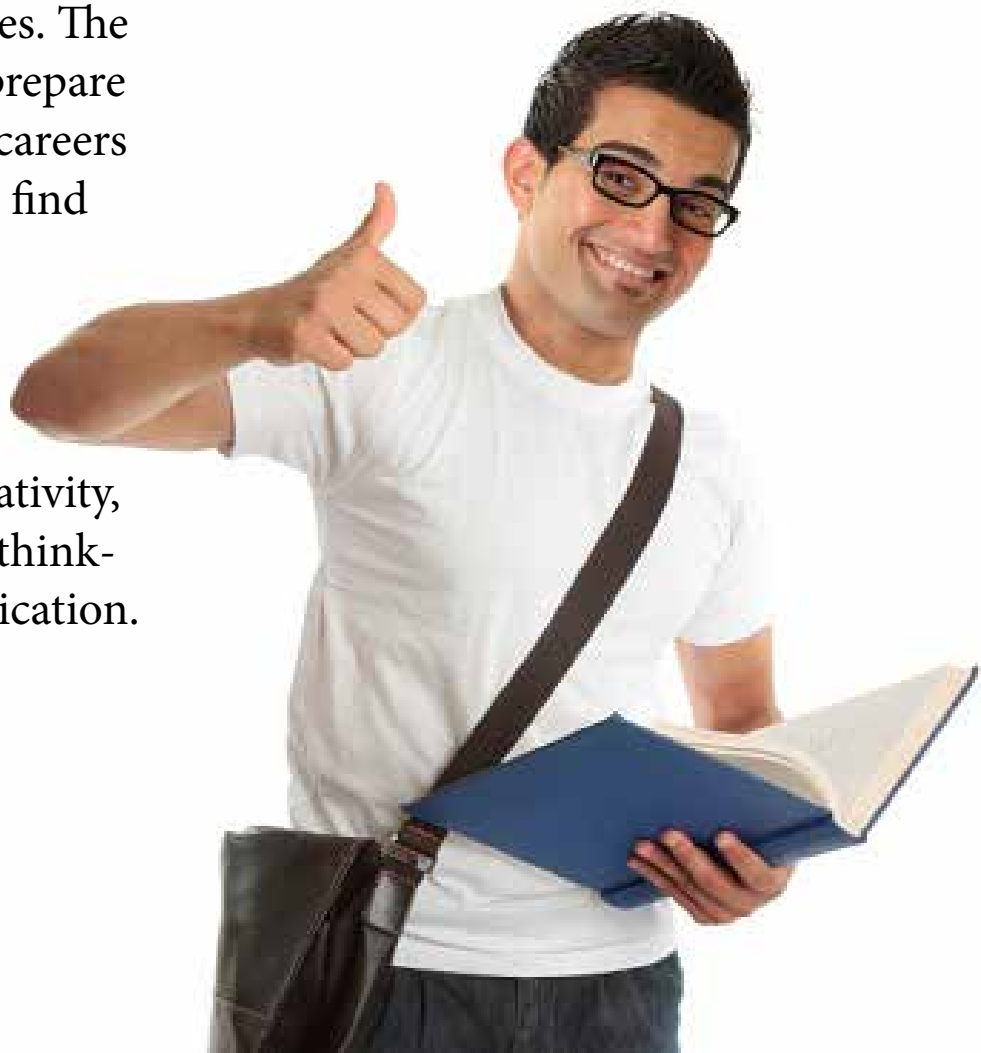
• Students who did not receive their note cards back will understand that the may have missed part of the critical point. It is their job to rewrite notes in their notebooks or journals after listening to classmates read the best ones aloud.

• If most of the students' note card summaries are incorrect it is teacher feedback that the lesson may not have been as clearly communicated as intended and should be retaught in another way to

reach the objectives. When assessments are incorporated in daily instruction they become opportunities for both positive and corrective feedback and can keep all students engaged in the lessons.

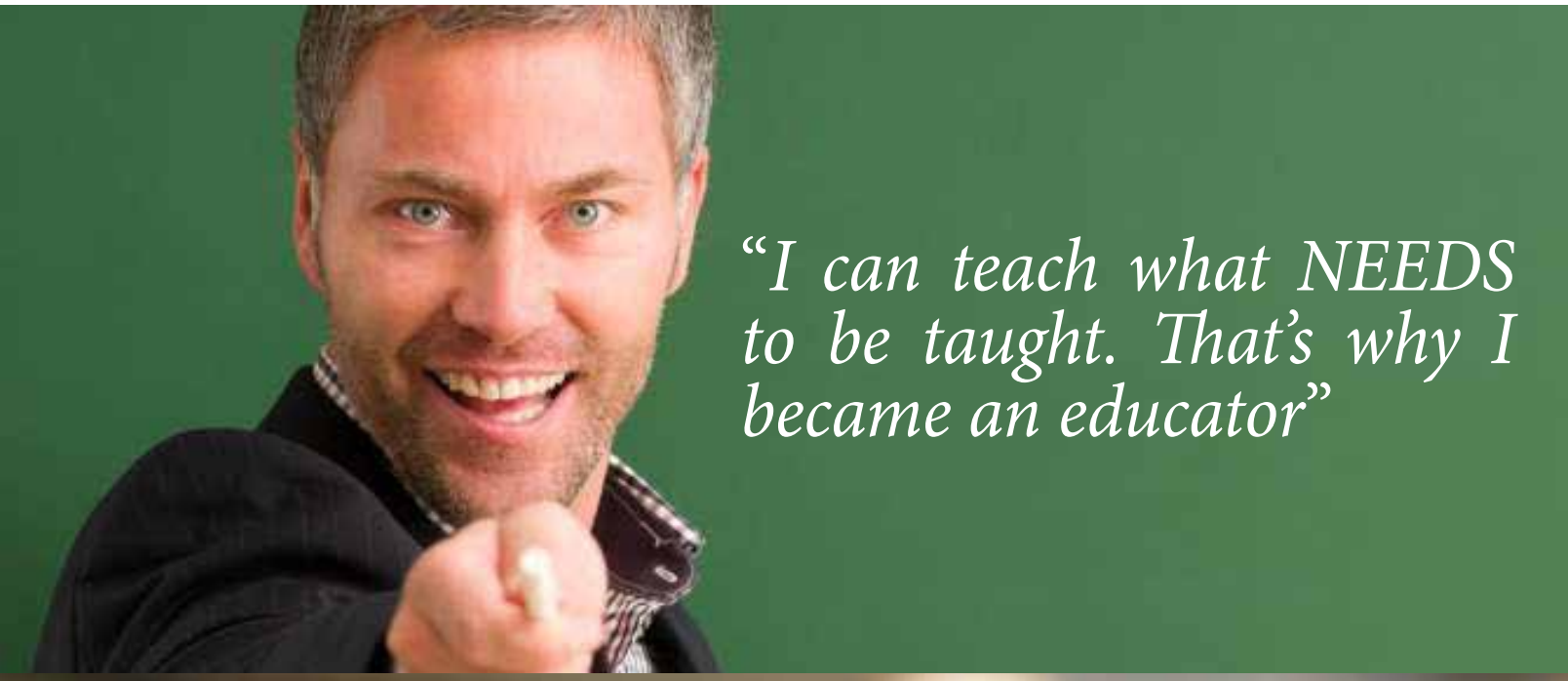
The addition of metacognition and post-assessment conferences will give students additional strategies to achieve success on standardized tests, and more importantly in their academic potential and positive educational experiences. The best assessments will also prepare students for success in the careers where their generation will find opportunities.

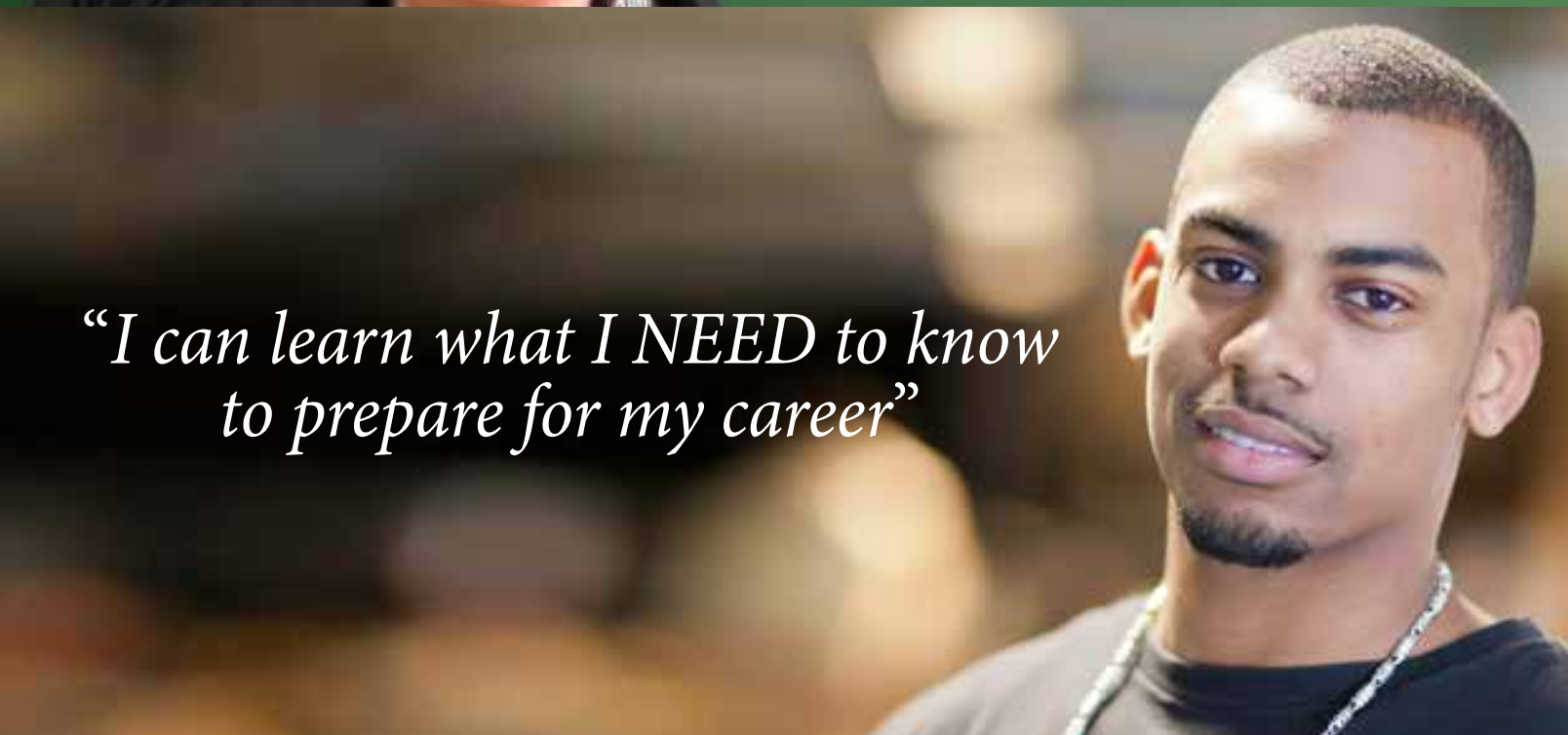
These assessments are the ones that correspond to teaching that promotes creativity, analysis, judgment, expert thinking, and complex communication.



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?*





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.

New Horizons for Pluto

By Janet Ivey

March 13th, 2015 marks the 85th anniversary of the official announcement of Clyde Tombaugh's discovery of Pluto on February 18, 1930.

Clyde William Tombaugh, an American astronomer was born in Streator, Illinois on February 4, 1906. Clyde developed an early love of astronomy after an uncle loaned him a telescope. A graduate of Burdett High School in 1925, he was financially unable to attend college because a devastating hail-storm destroyed his family's farm.

Despite his dreams of university being delayed, Clyde Tombaugh pursued his interest in astronomy, and in 1926, built his first home-made telescope. He built two more telescopes in the next two years, mastering optics, grinding his own lenses and mirrors, and further honing his observational skills.

Using these homemade telescopes, Tombaugh made drawings of the planets Mars and Jupiter and sent them to the Lowell Observatory in Flagstaff, Arizona. The staff there was so impressed by his work, that in 1929, Tombaugh was hired to conduct systematic planet-search photography at Lowell. Specifically to search and attempt to find what was called "Planet-X," thought to be on the fringes of our solar system, which had been hypothesized by Percival Lowell and William Pickering.

Tombaugh used the observatory's 13-inch astrograph to take photographs of the same section of the sky several nights apart. He then used a blink comparator to compare the different images. When he shifted between the two images, a moving object, such as a planet, would appear to jump from one position to another, while the more distant objects such as stars would appear stationary.

Tombaugh noticed such a moving object in his search, near the place predicted by Lowell, and subsequent observations showed it to have an orbit beyond that of Neptune. This ruled out classification as an asteroid, and the team at the Observatory decided this was the ninth planet that Lowell had predicted. Clyde's discovery was made on Tuesday, February 18, 1930, using images taken the previous month.

Pluto was given its name by Venetia Burney Phair, an 11-year-old school from Oxford, England whose "Papa" worked for the Royal Astronomical Union. Venetia's suggestion, "Pluto," won out over numerous other suggestions because it was the name of the Roman god of the underworld who was able to render himself invisible, and because Percival Lowell's initials PL formed the first 2 letters. The name Pluto was officially adopted on May 1, 1930.

Smaller than Mercury and billions of miles from the Sun, the discovery of Pluto with the technology of the time is an enduring testament to Tombaugh's dedication and eye for detail. And it was discovered that the original calculations given to Tombaugh were incorrect, so that he found Pluto is even more astounding.

He was awarded the Jackson-Gwilt Medal and Gift by the Royal Astronomical Society in recognition of his discovery, as well as a scholarship to the University of Kansas. Tombaugh earned a bachelor of science in astronomy in 1936 and completed his masters of science in astronomy in 1939.

When asked later in life about how he discovered Pluto in only 10 months of being at Lowell Observatory with no college education Mr. Tombaugh said, "You have to have an alertness to deal with the unexpected. The history of science

is filled with almost-made discoveries, missed by a hairline because they didn't have the alertness to realize they had a discovery."

During his fourteen years at the Lowell Observatory, Clyde Tombaugh discovered hundreds of variable stars and asteroids, and two comets. While engaged in the search that yielded Pluto, he also found many previously unknown star clusters, clusters of galaxies, and a nova. He mapped the Great Perseus-Andromeda Stratum of Extra-Galactic Nebulae, one of over 29,000 galaxies he documented. Clyde Tombaugh also discovered hundreds of asteroids in his lifetime as an astronomer.

The asteroid 1604_Tombaugh, discovered in 1931, is named after him. The first Asteroid he discovered in 1929 was called 2839 Annette and came about mostly as a result of his search for Pluto and other celestial objects. Tombaugh named some of the asteroids he discovered after his wife, children and grandchildren.

By the time Clyde Tombaugh retired, he and his Planetary Patrol researchers had confirmed the daily rotation period of Mercury, determined the vortex nature of Jupiter's Great Red Spot, and developed a new photographic technique for the small Earth satellites search. Reflecting on his career late in his life, Tombaugh often said:

"I've really had a tour of the heavens."

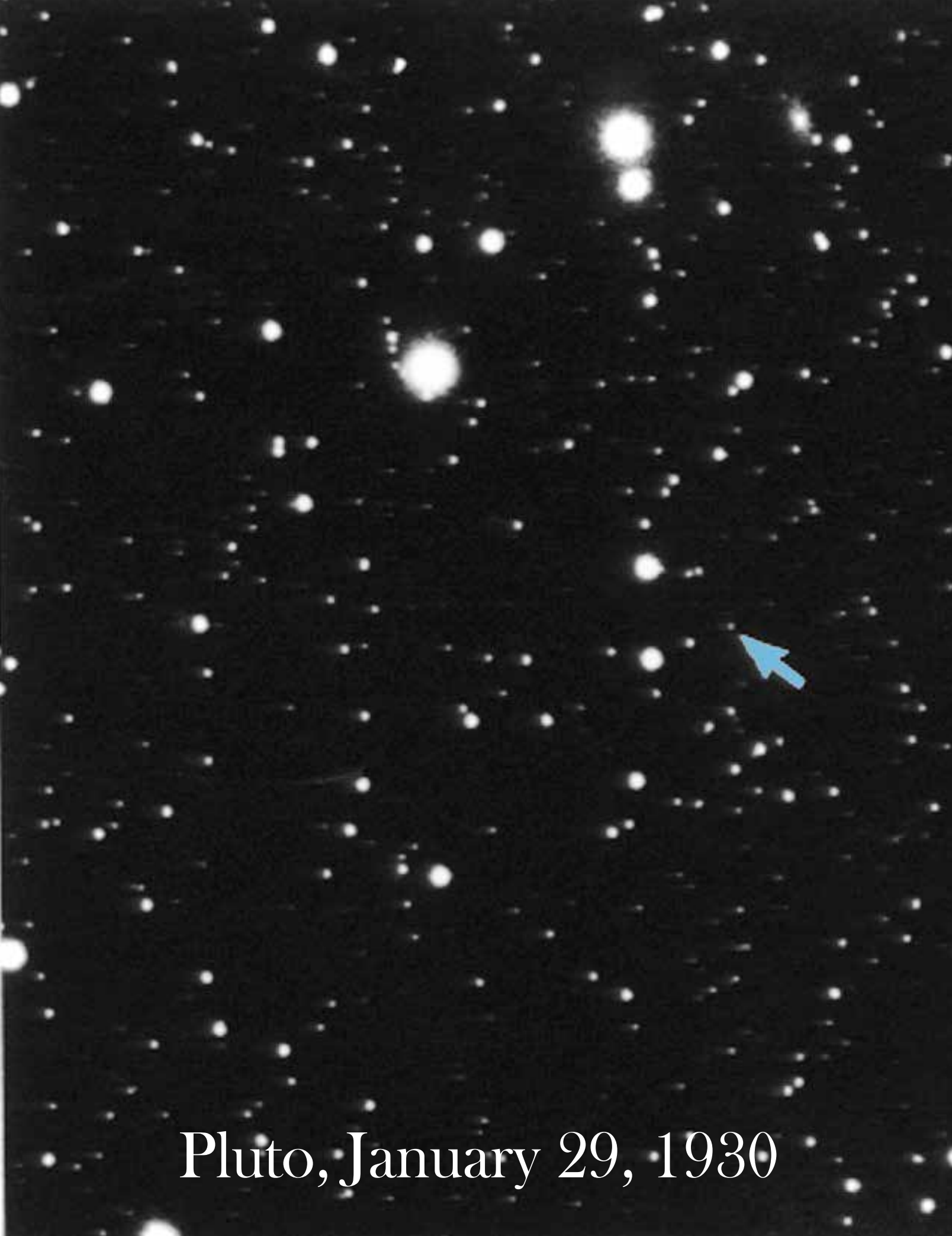
In August of that same year, 2006, The International Astronomical Union decided they needed to create a definition of exactly what makes a planet a planet. The IAU downgraded Pluto's planetary status to dwarf planet because Pluto only meets two of their three criteria:

"A celestial body that:

1. Is in orbit around the Sun

2. Has sufficient mass to assume hydrostatic equilibrium (a nearly round shape)

3. Has "cleared the neighborhood" around its orbit.



Pluto, January 29, 1930

With much debate about Pluto and its status, planetary scientists and astronomers alike are curious as to what will be revealed by New Horizons.

Scientists have a few guesses about what they might find on Pluto. Observations already hint at a dynamic, shifting surface that varies dramatically in both brightness and color. Some scientists suspect they might find evidence for icy volcanic eruptions.

NASA's New Horizon's spacecraft is the culmination of a $700 million, nine-year process that will make its closest fly by on July 14th, 2015and pass within 8500 miles of Pluto's surface.

What will be revealed? What will we find out? Will New Horizons find other celestial targets that might reveal themselves as planets? Time will only tell…but there are a few things that we can surmise; the IAU may have to reconvene on the definition of a planet, we may reclaim Pluto and welcome it back as an official planet in our solar system, and Pluto's amazing discovery by Clyde Tombaugh will be honored yet again.

What an amazing astronomical year 2015 will be!

If you Become part of her "Dear Pluto" Letter Writing Campaign and she will share it with the planetary scientists of the New Horizons mission. Let us know what you think.

Write your "Dear Pluto" letter and tell Pluto why you think it should be considered a planet and not just a dwarf planet, what you think New Horizons is going to find and any other insights you have about this icy world. You can even include an art rendering of this icy world along with your "Dear Pluto," letter. You may send it to:

janet@janetsplanet.com

Janet's Planet, Inc.,
242 West Main Street #214,
Hendersonville, TN 37075
USA

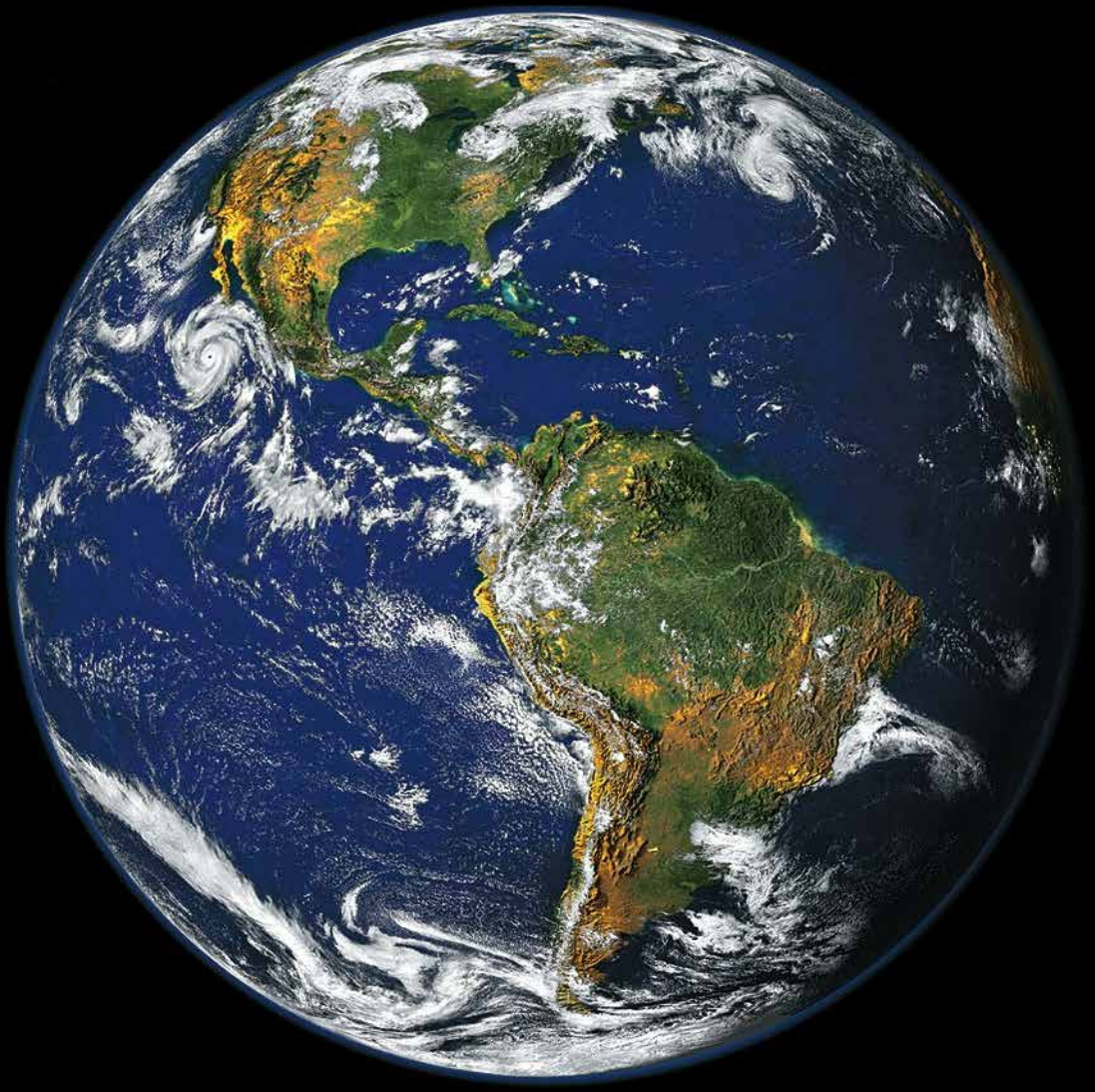
A warm welcome to our newest educators, students and monthly readers in.....

Kazakhstan

Sudan

Uruguay

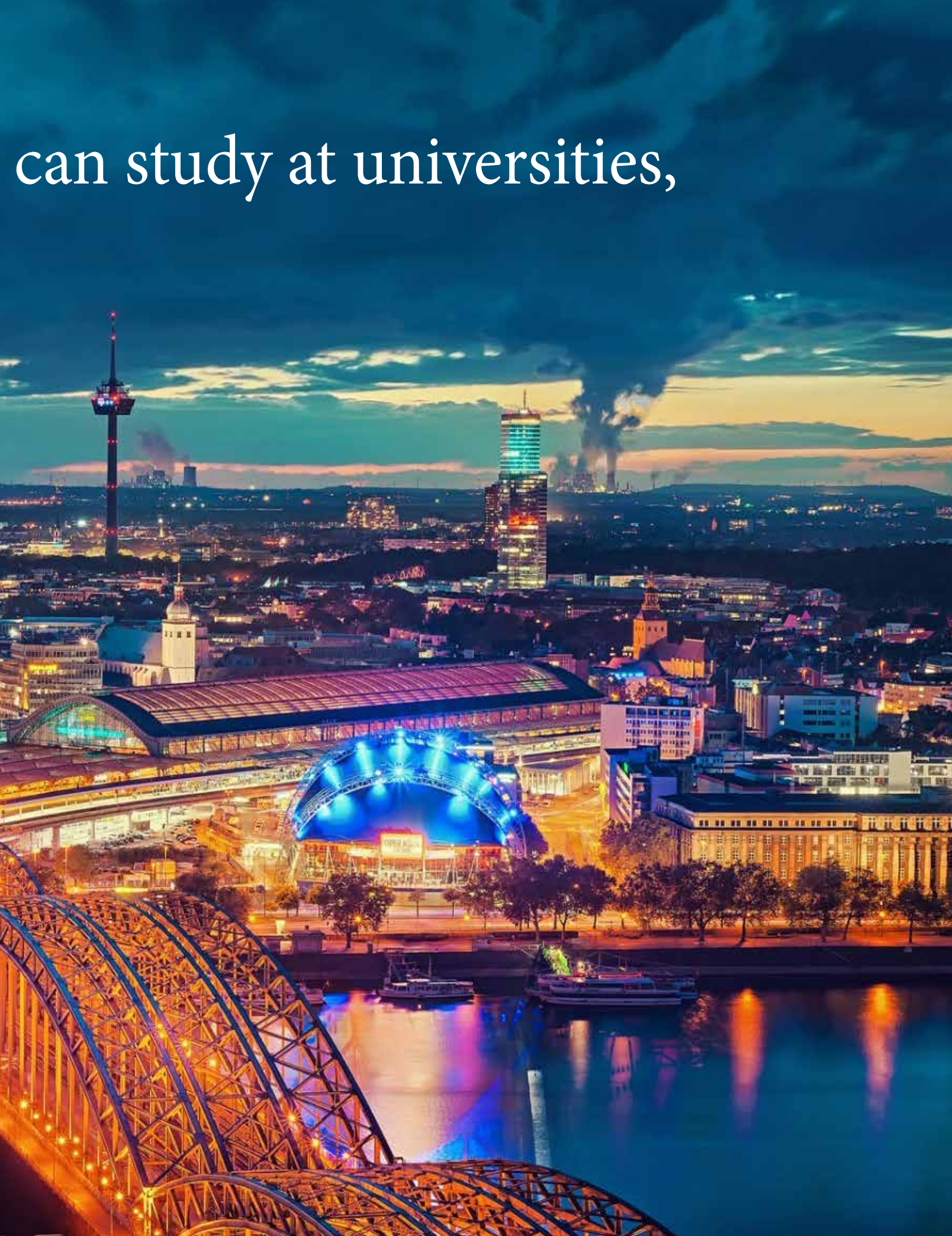
Israel



S.T.E.M. is Global

7 Countries where Americans in English, *for free* *(or almost free)*

can study at universities,



Since 1985, U.S. college costs have surged by about 500 percent, and tuition fees keep rising. In Germany, they've done the opposite.

The country's universities have been tuition-free since the beginning of October, when Lower Saxony became the last state to scrap the fees. Tuition rates were always low in Germany, but now the German government fully funds the education of its citizens -- *and even of foreigners.*

Explaining the change, Dorothee Stapelfeldt, a senator in the northern city of Hamburg, said tuition fees "discourage young people who do not have a traditional academic family background from taking up study. It is a core task of politics to ensure that young women and men can study with a high quality standard free of charge in Germany."

What might interest potential university students in the United States is that Germany offers some programs in English -- and it's not the only country. Let's take a look at the surprising -- and very cheap -- alternatives to pricey American college degrees.

Germany

Germany's higher education landscape primarily consists of internationally well-ranked public Universities, some of which receive special funding because the government deems them "excellent institutions." What's more, Americans can earn a German undergraduate or graduate degree without speaking a word of German and without having to pay a single dollar of tuition fees: About 900 undergraduate or graduate degrees are offered exclusively in English, with courses ranging from engineering to social sciences. For some German degrees, you don't even have to formally apply.

In fact, the German government would be happy if you decided to make use of its higher education system. The vast degree offerings in English are intended to prepare German students to communicate in a foreign language, but also to attract foreign students, because the country needs more skilled workers.

Finland

This northern European country charges no tuition fees, and it offers a large number of university programs in English.

However, the Finnish government amiably reminds interested foreigners that they "are expected to independently cover all everyday living expenses." In other words: Finland will finance your education, but not your afternoon coffee break.

France

There are at least 76 English language undergraduate programs in France, but many are offered by private universities and are expensive. Many more graduate-level courses, however, are designed for English-speaking students, and one out of every three French doctoral degrees is awarded to a foreign student.

"It is no longer needed to be fluent in French to study in France," according to the government agency Campus France. The website studyportals.eu provides a comprehensive list of the available courses in France and other European countries. Public university programs charge only a small tuition fee of about 200 dollars for most programs.

Other, more elite institutions have adopted a model that requires students to pay fees that are based on the income of their parents. Children of unemployed parents can study for free, while more privileged families have to pay more. This rule is only valid for citizens of the European Union, but even the maximum fees (about $14,000 per year) are often much lower than U.S. tuition fees. Some universities, such as Sciences Po Paris, offer dual degrees with U.S. colleges.

Sweden

This Scandinavian country is among the world's wealthiest, and its beautiful landscape beckons. It also offers some of the world's most cost-efficient college degrees. More than 900 listed programs in 35 universities are taught in English. However, only Ph.D programs are tuition-free.

Norway

Norwegian universities do not charge tuition fees for international students. The Norwegian higher education system is similar to the one in the United States: Class sizes are small and professors are easily approachable.

Many Norwegian universities offer programs taught in English. American students, for example, could choose "Advanced Studies for Solo Instrumentalists or Chamber Music Ensembles" or "Development Geography."

But don't expect to save money in Norway, which has one of the world's highest costs of living for expats. And be careful where you decide to study. "Winters in general are quite different in different parts of the country, with the north having hard, arctic winters, and the southwest mostly having mild, wet average European winters," the Norwegian Center for International Cooperation in Education notes.

Slovenia

About 150 English programs are available, and foreign nationals only pay an insignificant registration fee when they enroll. Slovenia borders Italy and Croatia, among Europe's most popular vacation destinations.

However, Times Higher Education, a weekly magazine based in London, did not list one Slovenian university in its recent World University Ranking.

Brazil

Some Brazilian courses are taught in English, and state universities charge only minor registration fees. Times Higher Education ranks two Brazilian universities among the world's top 400: the University of Sao Paulo and the State University of Campinas.

However, Brazil might be better suited for exchange students seeking a cultural experience rather than a degree.

Creating an Engine

for Breakthrough Innovation in STEM Education

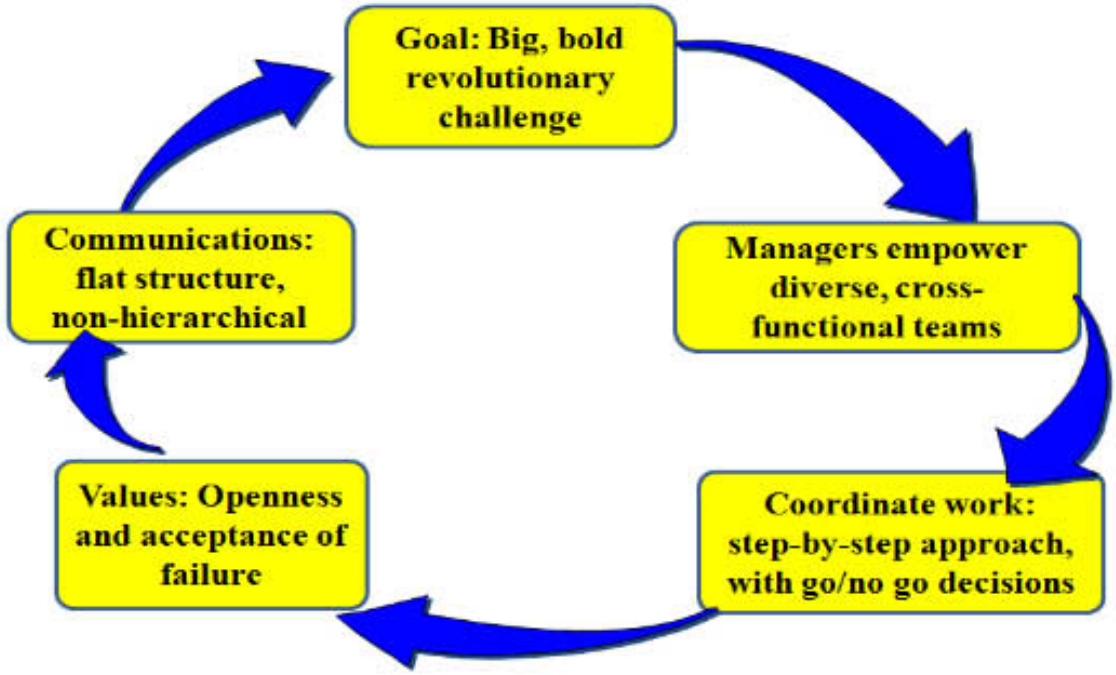
Part II

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

Projects created within a DARPA model — like those necessary to win the race to the moon — do not fit well within traditional research management structures in which basic and applied research are separated. Typical applied research programs require specific milestones and clearly defined deliverables. Project details remain fairly static over the course of a project or program. In the DARPA model, by contrast, every project is a mini-moon shot. The final goal is clear, but the process for getting there remains nimble to account for what is learned during the research process and what new challenges may arise.

How do we use this process to create innovation in education? We bring together interdisciplinary teams of world-class experts with proven track records of innovative thought and action. It requires a balance of expertise, flexibility, discipline, collaboration, and creativity along with a visionary program officer to lead the work of these experts according to a rigorous program plan. Performers are given plenty of room to be creative while progressing toward the established goal.

The management principles of DARPA



The principles resemble those of radical management

How could the U.S. Department of Education accelerate and spur breakthrough innovation?

With the help of top experts and leaders in the field, ED's new STEM office is developing a vision of what a re-imagined approach to STEM education might look like in 2025. Metrics of success will be developed to drive progress towards that vision.

From this process, we will identify key hurdles that need to be overcome to achieve that vision, with a particular focus on how technology could be catalytic. Working within that frame, advanced research projects for education could be used to achieve key goals within a three-year time frame tied to the metrics of success.

The same criteria used to create DARPA programs would be used to identify such programs. Known as Heilmeier's Catechism after a former DARPA director, the criteria are simple and straightforward:

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What's new in your approach and why do you think it will be successful?
- Who cares?
- If you're successful, what difference will it make?
- What are the risks and the payoffs?
- How much will it cost?
- How long will it take?
- What are the mid-term and final "exams" to check for success?

For example, one "education moon shot" might be to develop education technology that enhances and transcends the boundaries of current classrooms — improving the classroom experience but also assisting with lifelong learning objectives as our life and career trajectories develop. Imagine if we each possessed lifelong learning

tools that are as ubiquitous as the Internet or GPS. And imagine that these education tools merged with decision-support tools to help us in our careers.

Teachers, engineers, doctors, and technicians would all have tools to help keep their skills fresh and up-to-date.

It's an exciting vision. But what are the building-blocks — the "mini-moon shots" — that must be in place? What hurdles must we overcome now to achieve that vision?

One example might be improving "real-time" embedded assessment technology that measures practical knowledge on demand and enhances data-driven instruction. In the classroom context, **this could eliminate the need for standardized testing as we know it.**

Another example might be creating personalized, intelligent tutors using highly customized approaches that are tailored to instructional needs of specific students and that adapt tutoring across entire curricula.

Both of these examples would simultaneously improve classroom instructional capabilities and expand the horizon of what is possible in the classroom and beyond. Like DARPA, education research should be aimed at solving complex problems. Like DARPA, even projects that fall short of their ultimate goals would move the needle in key research and development areas that can have profound impact.

Why the Department of Education?

DARPA and other federal agencies are leading groundbreaking innovations by building an array of models for advanced research. At the Department of Energy, an ARPA for Energy (ARPA-E) is developing the next generation of battery technology and electrical grids that will power the American households and businesses of the future. At the U.S. Agency for International Development, the Global Development Lab is seeding new solutions to end global hunger, eradicate disease, and build stronger communities across the world.

Each of these efforts shares a commitment to bringing together

diverse experts from the private sector, universities, government, and nonprofit partners to identify what works and bring it to scale for a fraction of the time or cost of traditional government programs. Still, research in Pasteur's Quadrant is the exception in the public and private sectors, and is completely absent in the education sector.

The Federal Government can and must lead by example, tackling the toughest challenges and developing solutions quickly and efficiently to produce quantum leaps in educational practice.

Taking on this work requires marshaling resources in pursuit of ambitious goals, the flexibility to develop new ideas around failed ones, and most important, the capacity to leverage crosscutting expertise in the field.

ED has unique access to the nation's top experts in research settings and educators that are championing innovative approaches for their students every day. And, if ED was equipped to pursue advanced research projects, it would have the mandate, capacity, incentives, and resources necessary to lead innovative research at scale.

Leadership in American education research and development is just as essential for national security and prosperity as military success. Just as DARPA was created to ensure that the U.S. was not caught by technological surprise, success in 21st century education requires the adoption of new approaches that can drive groundbreaking research to equip students, teachers, and families with the tools they need to succeed in a dynamic STEM economy that requires ***all citizens to be lifelong learners.***

Russell Shilling is executive director of STEM in the Office of Innovation and Improvement.

Endnotes

1Past leaders of the Defense Advanced Research Projects Agency (DARPA) have emphasized this point. Dugan, Regina E., and Kaigham J. Gabriel. Special Forces' Innovation: How DARPA Attacks Problems. Harvard Business Review 91, no. 10 (October 2013), pp. 74-84, available at http://hbr.org/2013/10/special-forces-innovation-how-darpa-attacks-problems/ar/pr.

2Stokes, Donald. Basic Science and Technological Innovation. Brookings Institute Press (August 1997), available at http://www.brookings.edu/research/books/1997/pasteur.

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

Pueblo Science

University of Regina

GLOBAL STEM STATES

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

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

Auto Mechanic

A Great S.T.E.M. Career

A career in auto mechanics is a sure thing when it comes to employment opportunities.

"There are **253 million** cars and trucks on American roads today."

Auto mechanics is a perfect example of a STEM career that requires all aspects of STEM daily, but with education requirements that range from a high-school diploma, a Technical School diploma, or an apprenticeship. Any male or female who has an interest in automobiles, from changing tires to complex engine computer diagnostics, may find this a very rewarding choice.

Along with engine and power plant application, let's not forget about body work, restoration, design and modification. New materials and compounds are used to repair and replace older parts.

The complexity of new automobiles, truck, construction equipment....basically anything that runs, now requires a new set of skills easily attainable and very affordable.

Science / Technology

Computers and other diagnostic tools are necessary to figure out why the car isn't running correctly and how best to repair it. The use of laptops and hand-held devices will be familiar in many ways paving the way for confidence and a positive attitude.

It's not rocket science.....it's auto science.

Engineering

As a reminder, the engineering process is a "decision" making process. Based on the result of your diagnostics, you will have to formulate a series of decisions to best solve the auto problems before you.

You may have occasion to re-route wires, exhaust pipes or other added parts to solve or modify the project. This is a common application of engineering for automotive repair and modification.

Mathematics

Much of the math for this career is measurement. Tools like a micrometer to measure the break pad thickness to determine if they need replacing, air pressure gauge to measure tires, shocks, air conditioner freon levels and so forth.

A wide variety of measurements are required from front to back.

Much of this math you already know or is common sense. What you don't know, you'll learn and use every day at work.

There are different "levels" of training for auto mechanics, so the more training and experience you have, the higher the salary. Plan to start at about $30,000 and with additional training and experience, you could make more than $50,000 depending on the company.

Many companies such as Delta, UPS, car rental agencies and the government all have their own auto mechanics.

Get finished with a good Tech. school and start your new

S.T.E.M. career.

STEM: Fosters Environment of

By JoAnne Castagna, Ed.D.

"Do you like working at the Army Corps?" a seventh grade girl asked Ali Palen, a structural engineer with the U.S. Army Corps of Engineers, New York District.

Palen recently visited the West Point Middle School as part of the agency's STEM Program (Science , Technology, Engineering and Math) that aims to inspire young girls and boys to pursue careers in science, technology, engineering and mathematic.

Palen says that this girl's question is the purpose of these events and that the experience is positive not only for the students, but also for the presenters.

"STEM events foster an environment of exploration and questioning for children. Exposure is the most important objective. Why wouldn't I jump at the chance to help expose children to the thing that I love to do? Participation in STEM events is a no-brainer for me and it's fun!" says Palen.

Palen visited several seventh grade classes at the school that is located at the West Point Military Academy in West Point, New York. The school serves the children of service members at the academy.

This isn't the first time the agency has visited the school. Palen was preceded by other speakers including most recently - Col. Paul E. Owen, New York District Commander, U.S. Army Corps of Engineers and Raymond Schembri, Hydraulic Engineer, New York District, U.S. Army Corps of Engineers.

Owen discussed Super-storm Sandy with the students and its impact on the New York region and the agency and Schembri talked about flood reduction methods the Army

Exploration & *Questioning*

Students watch a Flood Wall Demonstration. (Photo by JoAnne Castagna, Ed.D, Public Affairs Specialist, U.S. Army Corps of Engineers)

Corps constructs to help control flooding during storm events.

One of the ways that Sandy personally impacted the District was its destroying of its Caven Point Marine Terminal. Palen is one of the structural designers that designed a new, more flood resistant terminal that is being constructed right now.

Palen talked with the students about her role on this project. In addition she explained what structural engineers do, basic building components and how tension, compression and loads are important information for structural engineers.

She explained that in order for structural engineers to know what types of building components and materials are needed and where to position them, they need to know about tension, compression and loads. It's important because different

materials are good for tension and compression. For example, steel takes tension well and concrete takes compression well.

To demonstrate, Palen gave the students two marshmallows and two index cards. With the marshmallows she taught the basics of tension and compression loading

Students learn what tension and compression is and why it is imortant to know wh with the use of objects including index cards and marshmallows. (Photo by JoAnne Specialist, U.S. Army Corps of Engineers)

by having the students stretch and squeeze the marshmallows with their fingers. Palen then taught the basics of beam bending with the index cards. She had the students bend the index card and discuss whether the top and bottom of the "beam" would be in tension or compression.

hen designing a building. They learned
e Castagna, Ed.D, Public Affairs

Structural engineers also need to be aware of applied loads which are pressure and weight in a particular direction. Palen described the different type of loads to the students, including lateral loads and gravity loads.

The class then explored flood loading and discussed whether it would be a gravity or lateral load on a building. The students agreed that it would be a lateral load. Palen went on to explain how she had to take this in consideration when she was designing the Caven Point Marine Terminal that was destroyed by Sandy.

The terminal is located right on the Hudson River in New York City. It's where the district keeps its boats and where its hydraulic team works.

"Waves crashed into the terminal. The walls were ripped off and the

structure ended up completely under water," said Palen.

Palen asked the students how they would protect a building from flooding. The students mentioned waterproofing and raising the building. Palen said that these methods are good and many of these were applied when designing the new terminal.

She designed a new facility that will withstand the water and wave loading from flood waves. In addition, parts of the building were raised and flood proofing and flood walls were included.

She then had the students gather around a table to show them a Flood Wall Demonstration. On the table she had an aluminum tray, which contained a small scale As she poured water on one side of the wall and the students anxiously watched to see if the wall would hold up under the water pressure and Palen had the students discuss where they thought the wall would fail. After a minute or so, the bottom of the wall made of Play-Doh flood wall spanning the width. The wall was made with aluminum foil and was secured to the sides of the box with Play-Doh.

gave out, letting the water stream into the other side of the tray.

Palen said that this demonstration shows how water pressure increases with depth and how connections are very important in design. The bottom of the "wall" experienced the greatest water pressure and it was this bottom connection that failed first.

With this new structural engineering knowledge in mind, the class then went to work on a class assignment they've been working on named "Beat the Flood."
The classes are suppose to take the knowledge that they receive from

the Army Corps engineers and apply it to this class project. The project requires the students to construct a home that can survive a flood. They have to decide on what building materials to use and how to construct the home.

Palen assisted the teacher is explaining the project to the students and guided them on their decision making. Palen enthusiastically yelled out to the students - "You are the Engineer! Think about what you have to do to design your home."

"The biggest challenge of a STEM event is relating to the children and teaching the material in a way that they will understand. This is also the largest benefit. Aristotle once said, ***'The one exclusive sign of thorough knowledge is the power of teaching.'*** Sometimes you need to re-teach yourself the basics so that you are better equipped to explain it to the children.

Dr. JoAnne Castagna is a Public Affairs Specialist and Writer for the U.S. Army Corps of Engineers, New York District.

joanne.castagna@usace.army.mil.
Twitter at http://twitter.com/writer4usacenyc

Global Readership

Curiosity leads to Investigation that lead

S.T.E.M. is Global

ds to Imagination that leads to Creativity