S.T.E.M.

MAGAZINE

Creativity
Pat Kozyra

No one is an Island
Dr. Richard C. Larson / MIT

Ideal Emotional Atmosphere
Dr. Judy Willis

Statistics / Fastest Growing STEM Careers

STEM Girl
Nehaly Shah / Caltech

Antarctic Engineer
Lucas Laursen

October 2015
\\183v

STEM Innovations

A Math and Science Partnership Initiative in Northwest Indiana

Dear Educators,

Congratulations to all participants as we enter the final year of the grant.The STEM Education Research Institute (SERI) at Indiana University-Purdue University Indianapolis has completed its evaluation of year two of the Northwest Indiana STEM Innovations Math Science Partnership Grant and we are meeting our stated goals!

Findings showed that:

- Teachers felt the summer professional development was beneficial to their teaching.
- Teacher ratings for summer professional development were consistent with/slightly higher than the ratings from the previous summer.
- Overall teachers showed statistically significant gains in engineering design content knowledge and self-efficacy.
- Overall teachers showed statistically significant gains in engineering design self-efficacy.
- Teachers showed statistically significant increases in their use of instructional methods that support student-centered standards-based learning from the year before the professional development to the year after the summer professional development.
- Students showed statistically significant gains in their interest towards science and engineering but not in mathematics.
- Students showed statistically significant gains in their 21st century learning skills.

Thank you to all who completed the survey and who are working hard towards the success of the grant initiatives and increasing students' interest in STEM.

CALL FOR PRESENTERS! Your work through the MSP grant is truly innovative and should be shared across the state. The classroom successes associated with the STEM Innovations program are new and relevant to several statewide education associations that have conferences taking place during the 2015-2016 school year. Please contact Dr. Marion Hoyda at mirj1950@yahoo.com to discuss presenting at one of the following state conferences (or to suggest other relevant presentation opportunities):

- Indiana Association of Public School Superintendents (IAPSS) Fall Meetings-October 26-30, 2015
- Hoosier Association of Science Teachers, Inc. (HASTI): Feb 2016 (exact dates TBA)

Your STEM Innovations Team

MERRILLVILLE COMMUNITY SCHOOL CORPORATION

STEM Magazine 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.

We believe that the key to success in seeing higher graduation rates, improved testing results, student inspiration, creativity, excitement and career satisfaction rest 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 experience.

Our mission: Encourage curiosity, inspiration and creativity, for both educator and student, to keep our educators and prepare our students for their career passion.

Wayne Carley
Publisher
STEM Magazine

Ask about an affordable monthly electronic subscription for either your school, district or entire state, with ***unlimited distribution.***

Personalized versions are available to make S.T.E.M. Magazine your own personal platform to meet your STEM goals and objectives.

Simply E-mail your request to wayne@stemmagazine.com

STEM Magazine is also PDF printable and mobile device friendly.

wayne@stemmagazine.com

Table of Contents

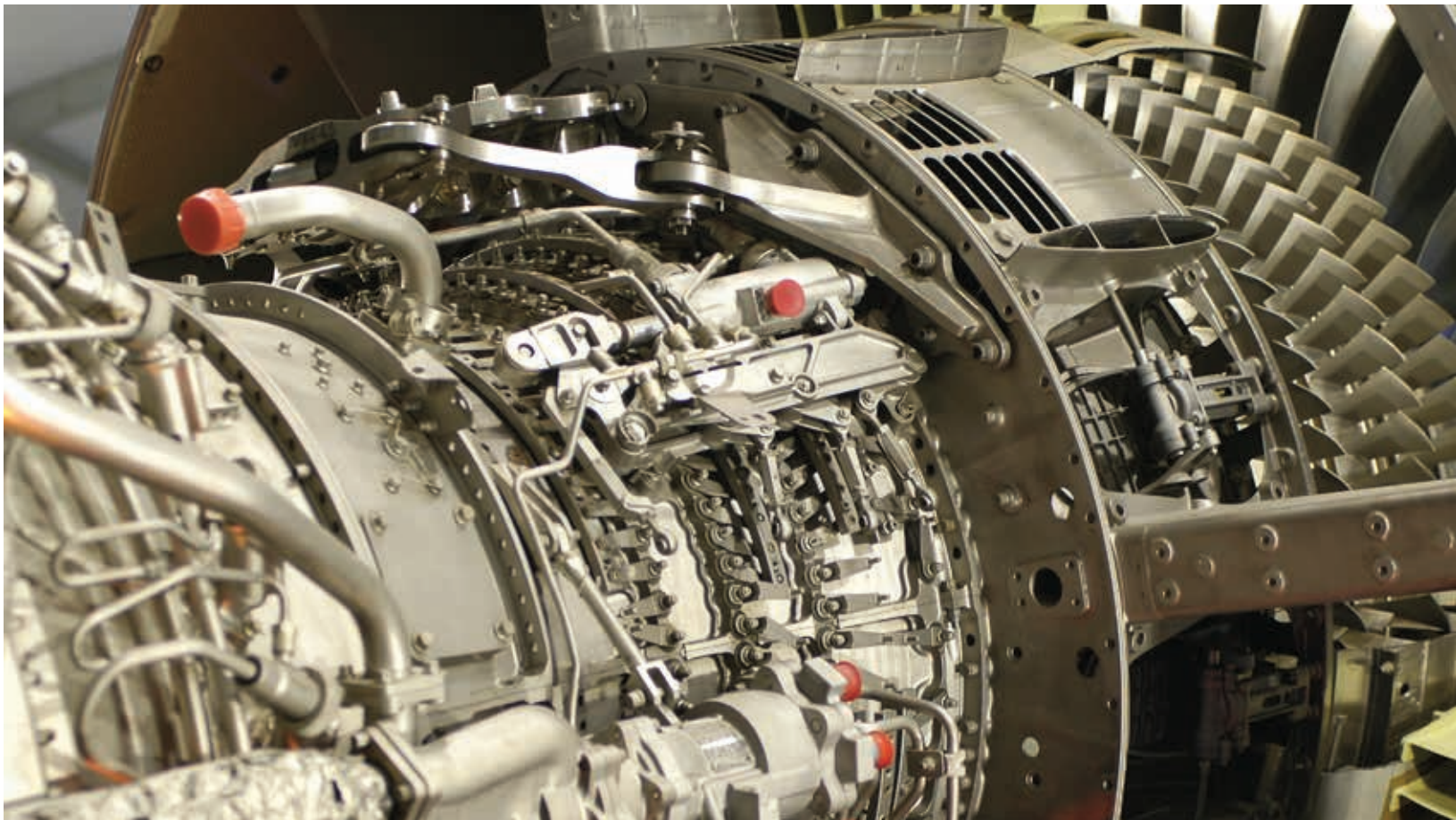
"I do not plan to be an engineer or scientist."

I do not plan to be an engineer or scientist, so STEM is not for me. Becoming knowledgeable about STEM is not about the 0.01% who might become Ph.D. researchers or the 1% who might become engineers. In this data-informed, technology intensive 21st Century the entire populace needs to become STEM literate. ***We all need STEM thinking skills.***

Many apparently non-STEM jobs have become STEM jobs, especially in the trades. Do you know that the average new car has about 50 microprocessors? Forget about crawling under it with a few of your Dad's old tools to fix it! and Moore's Law of computers, which has resulted in the iPhone being equivalent to a multi-ton supercomputer of the 1970's, has affected most other trades as well.

But perhaps the most important reason for everyone to become STEM literate is to build a more informed citizenry. In that way we individually and collectively become better decision makers about all the options that our world and we face. STEM is not only for Ph.D. researchers. ***It's for all of us!***

Dr. Richard Larson
Mitsui Professor of Engineering Systems at MIT



In Teaching, No Man Is an Island; No Woman Is an Island

Dr. Richard C. Larson, MIT

"No man is an Island, entire of itself; every man is a piece of the Continent, a part of the main." John Donne, Meditation XVII, English clergyman & poet (1572 - 1631).

As a teacher myself, I reflect on this and realize that I can bring into the classroom great ideas first assembled and articulated by others. And I've tried to do this in teaching applied probability at MIT, especially in doing 'live probability experiments' in front of classrooms full of students.

Usually these experiments were first posited and analyzed by others, and I have happily applied their methods and given them credit. And the students have seemed to appreciate the efforts.

Teachers in high school STEM classes can do the same. As a university professor, my course load is one or two courses per semester. But a high school STEM teacher may teach four, five or even six classes at a time. It's hard for me to imagine how that is done, and without teaching assistants to grade homework. The most difficult thing to imagine is lesson planning. Where is the time for the harried STEM teacher to design and carry out truly innovative and inspiring class lessons? Yet, some manage to do it, probably by forgoing sleep and needed family time.

But here's where John Donne's quote comes in. With the Internet today and with the increasing prevalence of OER (Open Educational Resources) materials, each STEM teacher can benefit from the toiling of others. We now have a proliferation of open educational materials, some with complete shared lesson plans. Why should a teacher in "School X" be constrained to the island of School X, when there is a continent of schools whose STEM teachers are trying to accomplish the same things: educate and motivate their students in science, math and engineering, bringing them to deep competence in the subject matter as well as exciting them towards STEM careers?

When I discuss this possibility of lesson sharing with teachers, they say, *"Yes, we should do this but there is so much material out there, we do not have the time to vet it, to find out what's good and what's not."*

Well, there are vetted web sites for STEM teaching materials. One of our favorites is Florida's CPALMS program, where educators are invited to submit materials they wish to share. http://www.cpalms.org/homepage/index.aspx Each submitted item is then sent out to a panel of content experts within Florida. Only the best survive and are given the CPALMS version of the "Good Housekeeping Seal of Approval," and then posted on the web site of the Florida Department of Education, along with a listing of the state educational standards that are covered by the approved materials.

Knowing the high standards of this vetting process, a STEM teacher, not necessarily in Florida, can confidently use these materials in their own lesson planning. The Internet has other shared teaching resources as well. Perhaps the biggest is ***sharemylesson***, "by teachers, for teachers." http://www.sharemylesson.com/ Have a look. Use a lesson. Share your own best lessons. No teacher should be an island. We're all in this together, a joined continent of educators trying to educate and motivate our country's next generation of STEM-ready young men and women. Your job is vital to our nation. Sharing each other's best practices, best lessons, builds bridges from your school to all others. Let the islands be joined!

How Important Is Creativity and Can it Be Learned?

by **Pat Kozyra**
Hong Kong

George Bernard Shaw said, "You see things that are and say, "Why?" But I dream of things that never were and say, "Why not?" Robert Fisher in a book entitled "Teaching Children to Learn" said, "Creativity lies at the heart of what it means to be human. Creativity is not just about the arts or certain people.

We all have the capacity for creative thinking – for generating and extending ideas, suggesting hypotheses, applying imagination and looking for alternative innovative outcomes. In my book ***"Tips and Tidbits For Parents and Teachers"***, I include a chapter on Creativity, where it is pointed out that yes, creativity can be learned, enhanced and developed.

Creativity seems to be a capacity that is separate from intelligence, and the ways these combine can lead to very different learning styles and levels of achievement. Children scoring high on intelligence tests are not necessarily creative.

Here are the findings of researchers who compared samples of children having high and low scores on tests of creativity and intelligence."

High creativity + high intelligence. These children exercise within themselves both control and freedom, both adult-like and child-like kinds of behavior.

High creativity + low intelligence. These children are in angry conflict with themselves and with their school environment and are beset with feelings of unworthiness and inadequacy. In a stress-free context, they can blossom forth cognitively.

Low creativity + high intelligence. These children can be described as 'addicted' to school achievement. Academic failure would be conceived by them as catastrophic, so that they must continually strive for academic excellence to avoid the possibility of pain.

Here are some important 'signals of creativity' that you as a parent might take note of and become familiar with when they appear in your child. When you hear your child respond as in these examples, these are clues to you that your child exhibits creative behaviors and they should be fostered and acknowledged.

I am sure many of you will recognize your own child when you read the following examples.

- Intense absorption in listening, observing and doing ("But I didn't hear you call me for dinner!")

- Intense animation and physical involvement ("But I can't sit still – I'm thinking.")

- Use of analogies in speech ("I feel like a caterpillar waiting to become a butterfly.")

- Tendency to challenge ideas of authorities ("Why do I have to go to school?")

- Habit of checking many sources ("Mom, I looked at all the books and watched a TV special and asked my teacher and I still can't figure out where God lives.")

- Taking a close look at things ("Hey this centipede does not have 100 legs.")

- Eagerness to tell others about discoveries ("Guess what, guess what, guess what!")

- Continuing in creative activities after the scheduled time for quitting ("I did my art work right through recess today.")

- Showing relationships among apparently unrelated ideas ("Hey Mom, your new hat looks just like a flying saucer.")

- Following through on ideas already set in motion. ("Tomorrow I am going to dig for gold in our back yard.")

- Various manifestations of curiosity and wanting to know ("I just wanted to see what the yard looked like from on top of the roof.")

- Spontaneous use of discovery or experimental approach ("I thought flour and water would make bread, but all I got was white 'goo.'")

- Excitement in voice about discoveries ("Flour and water make paste!")

- Habit of guessing and testing outcomes ("I put detergent in the birdbath but no birds came to clean up. Can I try some bubble bath today?")

- Honesty and intense search for truth ("Mom, I hope this doesn't upset you, but I've come to the conclusion that there is no Tooth Fairy.")

- Independent action ("There are no good books on racing cars, Mom. I am going to write my own.")

- Boldness of ideas (I think that children should be allowed to vote.")

- Low distract-ability ("I can't come out to play – I'm waiting for my chemicals to dissolve.")

- Manipulation of ideas and objects to obtain new combinations ("I'm going to take this string and this pencil and make a compass.")

- Penetrating observations and questions ("When the snow melts, where does the white go?")

- Tendency to seek alternatives and explore new possibilities ('This old shoe would make a great flower pot.")

- Self- initiated learning ("Yesterday I went to the library and checked out all the books on dinosaurs.")

Creative children: are persistent - may be estranged from their peers - have a sense of humor - make unusual associations - are flexible in thinking patterns - have lots of energy - ask challenging questions - are often bored with repetition - like to guess and hypothesize - work with concentration - initiate projects on their own - are curious - are independent - take risks - visualize mentally - are sensitive - are interested in the unconventional.

The following compilation was contributed by Ruth A. Martison, to 'The Identification of the Gifted and the Talented', Ventura California, Office of the Ventura County Superintendent of Schools, 1974 and it says:

Creative Children:

1. view their work with extra wonder and see magic in it;

2. are learning by experimenting, manipulating objects in many ways, and using stories to exercise their imaginations at preschool age;

3. are able to be conforming or nonconforming as the situation demands;

4. try to find answers to their questions in their way;

5. have extremely long attention spans and the ability to pursue an activity

in which they are interested for extra-long periods of time;

6. can tolerate disorder and ambiguity;

7. are able to organize themselves and ideas;

8. tend to see familiar things and situations in unusual ways and in greater depth;

9. often prefer to learn by creative ways rather than by being told by an authority.

10. seem to learn considerably from fantasy as it aids in solving their problems of development;

11. display a positive self-image;

12. have an attraction toward the unconventional and toward complexity;

13. seem to rely more on their own evaluations than on others;

14. come from family backgrounds characterized by lack of over-dependence of children on parents and stress of conformity by parents; strong feelings are expressed in the family; both fathers and mothers relate strongly and positively to the child even though the mother is ambivalent in her mothering feelings; more often than not the most creative child is the older sibling; fathers are usually engaged in occupations allowing for autonomy and independence;

15. build a reputation for having wild or silly ideas, particularly the boys.

16. display humor, playfulness, and relaxation in their creative products;

17. wish to work alone at times;

18. are high academic achievers provided they have a minimum IQ score of around 120;

19. can integrate opposing impulses such a destructiveness and constructiveness;

20. select fewer conventional careers (e.g. lawyer, doctor, professor and select more unconventional ones e.g. adventure person, inventor, writer)

"Where there is imagination, there is creativity.

Where there is creativity, there are dreams.

Where there are dreams, there is potential.

Where there is potential, there is promise."

– *Author Unknown*

S.T.E.M. *Girl*

Project Scientist partners with Caltech to bring STEM education to girls in Pasadena.

By **Nehaly Shah**

Project Scientist Academy, a five-week summer camp, offers science, technology, engineering and math (STEM) learning opportunities for girls of ages 4 to 14. The program, originally established in North Carolina, came to Southern California this past summer from June 8 to July 24 at the California Institute of Technology (Caltech) and Longfellow Elementary School campuses.

Founder Sandy Marshall was inspired to start Project Scientist by her own daughter. “She was a curious 4-year-old that loved science; my husband and I worked full time and needed a summer option that fit her interests and academic needs as well as our schedules. At the same time, as executive director and founder of The NASCAR Foundation, I was funding many STEM initiatives and I became

increasingly aware and concerned of the lack of females in STEM majors and careers.

"Having a 'STEM girl' and having been a 'STEM girl' myself, I understand how girls may feel different or not always feel aligned with the perceptions and stereotypes that much of society has around girls in STEM. Girls (like boys) love science, especially at a young age.

Since founding Project Scientist my hypothesis is continually confirmed that kids as young as 4 years old are capable of understanding science concepts and that girls' interests go beyond the stereotypical female STEM majors and careers," said Marshall.

As a part of The STEM Funders Network while at The NASCAR Foundation, "I had access to the latest … research around girls in STEM and experts at the table to vet my ideas around Project Scientist," said Marshall. By 2012 Marshall launched the first session of Project Scientist out of her guest house as an LLC with two teachers, six students (of ages 4 to 6), and six female STEM professionals. Marshall said, "I built every second around what research has proven to drive and maintain girls' interests in STEM."

Project Scientist has since grown: in 2013, it became a public 501(c)(3) nonprofit and landed its first university contract in Charlotte, North Carolina, where it served 95 girls in a six-week program. In the summer of 2014, Project Scientist served nearly 500 girls. Most recently, in the fall of 2014, "we piloted our afterschool and teacher workday program, so that we could have touch points with the girls we serve year-round, while inspiring other girls to reach for their STEM dreams," said Marshall.

Last year Marshall reached out to Spiros Michalakis, who is the manager of outreach activities for the Institute for Quantum Information and Matter (IQIM) at Caltech. As such, he is also the club adviser for InnoWorks Academy, another Caltech summer program that was on campus from June 15 to 19, the week in June that Project Scientist was in hiatus so that girls who wanted to participate in both programs could do so.

After Michalakis and Marshall met, Michalakis was invited to North Carolina to observe Project Scientist in action for one week. "I was so impressed by the quality of the program that I decided to talk to Mitch Aiken to bring the program on campus the next summer," said Michalakis. Aiken is the associate director for educational outreach in the provost's academic program at Caltech.

"[Michalakis'] enthusiasm for the program inspired me to figure out a way to help bring this program to our local K-12 students.

Broadening the STEM pipeline to include more girls is a key goal for us in Caltech's Center for Teaching, Learning, & Outreach," said Aiken. "As we explored working with Project Scientist, I felt that teaming up with a local elementary school would be a great way to strengthen the community connection." Thus Project Scientist was on the Caltech and Longfellow campuses in Pasadena as well as three university campuses in Charlotte this summer.

Project Scientist also runs a year-round club at public and private elementary schools in both markets.

This summer Project Scientist had concept goals for each age group. "This [was] a joint effort of the entire Project Scientist staff and parents to ensure their girls grasp these concepts that align with Common Core and Next Gen Science Standards," said Marshall. Each week of the summer session had a theme, chosen through a variety of ways.

"For example, we want girls to find STEM relevant to their community, so last summer in Charlotte we had energy week. We approached Duke Energy to engage their female engineers during the week and serve as STEM Superstars. Our Wednesday 'Expedition' was to their headquarters, where girls got to see behind the scenes of the company and witness those females in their workplace," said Marshall. Project Scientist organizers also determined themes through their curriculum partner SciGirls (a PBS founded and National Science Foundation funded TV show).

Project Scientist's recent partnership with Caltech brought new connections and opportunities for Expeditions. "For example, for coding week we are working with Caltech on a visit to Google, Microsoft, and YouTube.

For transportation week we hope to visit JPL to learn about the Mars rovers and then Auto Club Speedway / NASCAR to learn about the engineering around racing." The program also had a new coding partner for younger girls this summer: CodeSpark, a Pasadena startup that "is filling a void of coding curriculum for young kids (and the main character is a girl!)," said Marshall.

01100011 01100001 01101100 01110100 01100101 01100011 01101000

The program's incorporation of experiments and hands-on learning offered "a balance between what I call 'shock-and-awe' science [and] a deeper dive in curriculum to master specific STEM concepts … [which] is unique to Project Scientist compared to most other summer camps and [is] something our parents appreciate," said Marshall.

The summer program also included one hour of arts integration per day not only "to reinforce the STEM concepts from earlier in the day, but also to drive innovation and creativity. Typically we engage with local artists and groups to partner on the execution of the arts hours," said Marshall.

Another unique attribute of Project Scientist, compared to other summer camps, is that professional teachers from the local area are hired, which "provides them with a summer of hands-on training on STEM teaching tools and techniques that they take back to their classroom in the fall, making our impact exponential. We also hire interns, (typically unpaid) college and high school girls who serve as 'near peers' to our girls and assistants to our teachers," said Marshall.

Project Scientist has already expanded from the East Coast to the West Coast since its inception, and Marshall has further growth in mind. "Our short term goals are to continue to tweak and build on the model to create efficiencies yet sustain our outcomes and impacts for the girls we serve. We also hope to continue to grow in the Los Angeles market and others as the need and partners are identified," said Marshall. "Our long-term goals are to create more female scientists and ultimately change the culture for girls and women in STEM.

We plan to achieve this through our pipeline approach with the girls we serve, university and corporate engagement and public relations efforts around girls in STEM."

Michalakis has similar development plans in mind for Project Scientist. "I want to see Project Scientist take strong roots at Caltech before expanding to places like UCSD, UCSF, MIT, Harvard, Stanford and other top tier universities. The first step is to establish strong corporate partners locally so that we can increase the number of full-ride scholarships for girls on the PUSD and LAUSD free/reduced lunch program.

The second step is to involve Caltech faculty and students as mentors and guides for the five weeks during the summer program, [and] even more importantly, as leaders in the community who go on to create year-round Project Scientist Clubs in schools like Longfellow Elementary, Jefferson Elementary, Washington STEAM Academy and others," said Michalakis.

Project Scientist is "looking for individuals and companies who are interested in inspiring STEM girls in your city," said Marshall. "We are especially interested in those who would like to fund scholarships for girls with an aptitude, talent, and passion for STEM, yet may not be able to afford camp. We believe there are STEM Superstars in every neighborhood that deserve to geek out all summer with us on science!"

Questions may be sent to Sandy Marshall at sandy@projectscientist.org.

MARS ONE

Would you go if you knew you were not coming back?

It's true.
There are plans and volunteers who intend to travel to Mars in 2026 with the intension of never coming back.....a permanent colony.

Without going into too many details about how the Mars One project intends to accomplish this, or even showing support for the project, the purpose of this brief article is to pose the question to you, ***would you do it?***

The Mars One crews consist of people that want to settle on Mars. Absence of a return mission reduces the mission infrastructure radically. No return vehicle, return propellant or the systems to produce the propellant locally are required.

Permanent settlement also reduces the required technology development; vehicles that can take off from Mars and return to Earth are currently unavailable and untested. Since the vehicle returning to Earth and the accompanying systems are mission critical for a return mission, they will also require backups adding to the infrastructure that needs to be delivered to Mars.

More importantly, to attain a somewhat acceptable risk level, the return mission would need to be tested in a complete unmanned return trip before the first crew even departs the Earth. Even after a full test of the return system is successfully performed, the risk for a crew that will ride the first return rocket would be very high.

You have to be over 18 years old of course, and actually pass the qualification standards, but no matter how much you hate your job, this is a huge decision; life or death for real.

Does Mars has resources that can be used for a sustainable settlement? Is there water present in the soil that can be made available to the settlement for hygiene, drinking, and farming?

The systems to mine water from the soil and to mine Nitrogen, Argon, and Carbon dioxide from the atmosphere have never been tested in space. Mars is however not space because there is gravity and a thin atmosphere.

As traditional exploration of Mars through rovers, probes and measurements continues, we may have the answers to a hundred questions that have to be answered before making a safe and successful journey.

Mars One is a not-for-profit foundation in the Netherlands which directs all sponsorship funds directly to its human mission to Mars. While the total mission will require billions of dollars, each sponsorship plays a significant role in the incremental stages at Mars One.

The Mars One foundation has a variety of advisors and supporters who believe the trip is possible and are raising money to pay for the adventure. The billions of dollars needed do not guarantee success, only a possible attempt.

We know that the risk assessment part of the brain does not completely develop until about age 22, so now we know why teenagers often make terrible decisions like dropping out of school, using drugs, driving crazy and a list of other behaviors you can plug in on your own.

Because of your brain, you may say, "It's not my fault...it's my brain"....but the consequences are real, they are yours to suffer through if you live and may impact you for the rest of your life.

So why would grown adults volunteer to take such as risk on a one-way Mars mission?

(this is where you actually *think* about it)

2026 is only 11 years from now. How old will you be? Do you think the risk is worth it and if so why?

Think about the risks YOU take..... is it worth it?

MIX it Up

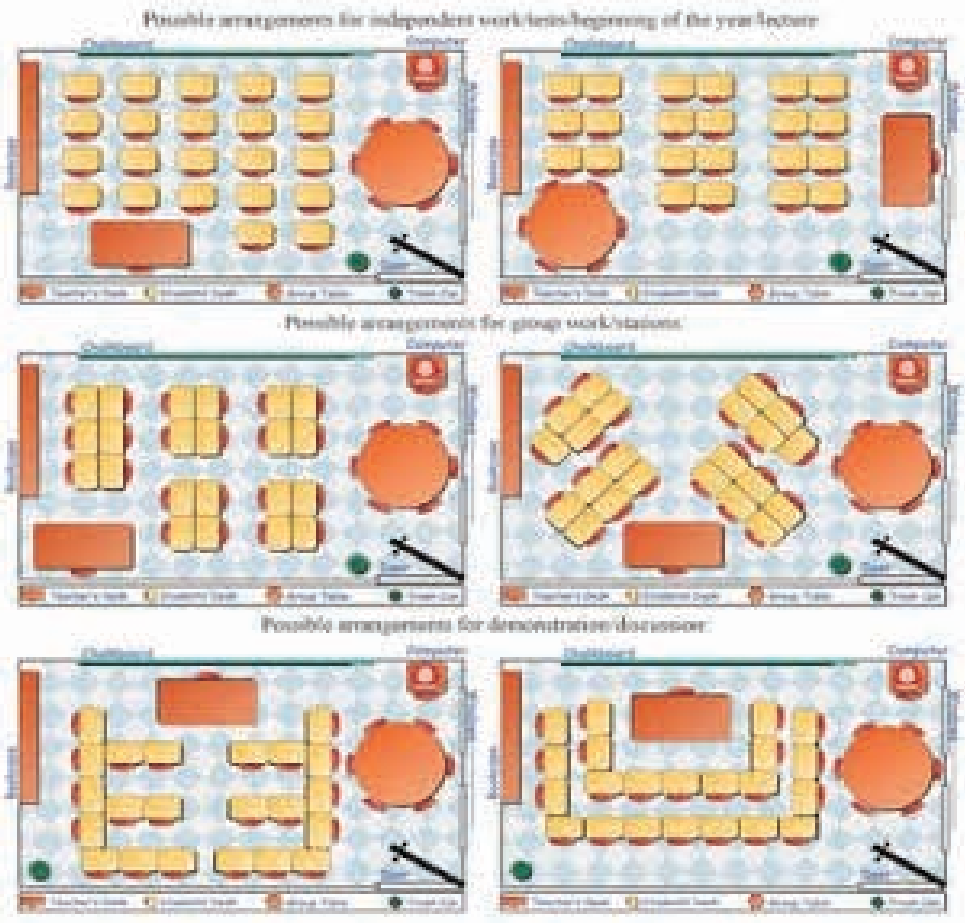
Don't you get tired walking into the same classroom day after day....everything identical? How am I supposed to get excited or inspired about anything?

Think back to kindergarten and the unexpected chaos of what was to come.....chairs moved, tables with new activities on them, my work from last week stuck to the ceiling, music playing and the smiling teacher just as excited to see me as I was to be there.

Change the class environment once a week and mix things up. Anything unexpected will cause the student brain to say, “Hey.....what’s going on here?”. Just that much curiosity can start a few new gears turning.

Change the pattern of how the desks are arranged.....curricular, square, facing a different direction....get crazy. Change seating assignments. Move all the desks to the side of the room and sit on the floor.

Don’t think of it as disruptive (if it’s done in advance) but rather an attention grabber and VERY unexpected. It will also be good for you to get outside the box once in awhile.



This isn’t an elementary concept. Use it in EVERY grade.

Try it (and where is the music?)

Fastest Growing STEM Careers...

Statistics

If at first this sounds boring, hang on a minute. Any sports fanatic or corporation knows the importance and value of knowing the statistics of their hobby or interest.

Before the New York Giants choose players for their next roster, months if not years are spent studying a players statistics or ***proof of performance.***

Putting a career in context of something we enjoy can completely change how we view the career. Chances are, we already use statistics but have not considered the career possibilities.

- How many innings pitched?
- How many walks?
- How many strikeouts?
- Injuries?
- Who has he played for?
- Hits averages?
- Home versus travel wins?
- Starter or finisher?
- Salary needs
- Age and health

Every sport considers statistics a MUST for evaluation now and in the future.

Statistics—*the practice of learning from data*—is the fastest-growing science, technology, engineering and math (STEM) undergraduate degree in the United States over the last four years, an analysis of federal government education data conducted by the American Statistical Association (ASA) revealed.

The ASA analyzed data compiled by the National Center for Education Statistics (NCES) on 160 STEM bachelor's degree categories granted by U.S. public and nonprofit colleges and

universities. Degree categories with a minimum of 200 completions in 2013 were included in the analysis.

The ASA analysis showed undergraduate statistics degrees nearly doubled (95% growth rate) during the period spanning 2010 to 2013. The significant growth of statistics outpaced that of all computer-related disciplines, environment and psychology.

The diversity of careers is very interesting and may surprise you. Here are a few to raise your eye brows.

Computer Info Tech Admin. & Mgmt.

Environmental

Health Engineering

The consumer sales industry

Mathematics & Statistics, Other

Computer Programming

Sociology & Anthropology

Science Technologies/Technicians,

Computer Software and Media Apps

Research & Experimental Psychology

I was personally surprised to be reminded how diverse the need is for both young men and women. It's not just about math....that's the good news.

This news may be a surprise to many higher-education experts and business leaders who might expect a computer science-related area to be the fastest-growing STEM field. But the news did not come as a surprise to the ASA.

"The analysis confirms what the ASA has known for some time: Statistics is **a hot career field** that more and more students are choosing to enter," said ASA President David R. Morganstein, vice president and director of the statistical staff for Westat, Inc., a statistical-services company based in Rockville, Maryland. "It's also important to note that this growth is not a passing fad. Across the country, universities and colleges are dedicating new resources so their respective statistics departments can expand to meet this growing demand."

The University of Minnesota–Twin Cities (UMTC) is a prime example of this phenomenon. Enrollment in its undergraduate statistics program grew from just 34 majors in 2004 to 224 currently. Overall, the number of statistics bachelor's degrees has grown from 526 in 2003 to 1,678 in 2013.

This significant growth and interest in statistics can be attributed to factors such as a more quantitative society, emphasis on data analytics, the advent of Big Data and the corollary growth of the Advanced Placement Statistics program.

However, the primary influencer is the job market and the resulting demand for workers with statistical and analytical skills, which LinkedIn ranked as the most important job skills in 2014.

The Occupational Outlook Handbook, published by the Bureau of Labor Statistics, finds that the number of statisticians will grow by 27% between 2012 and 2022, far out-pacing the projected 11% growth rate for all other career fields. Separately, McKinsey Global Institute, a global management consulting firm that serves leading

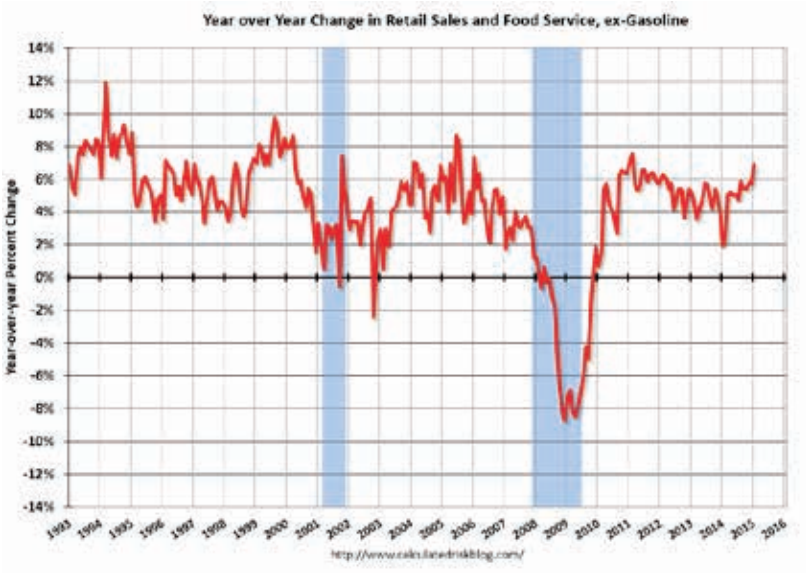
> "The significant growth of statistics outpaced that of all computer-related disciplines"

businesses, governments, nongovernmental organizations and not-for-profits, predicted in a report on Big Data that the country will face a shortage of up to 190,000 people with deep analytics skills, such as statisticians, who are needed to manage Big Data-related projects and run data analytics and business intelligence operations in the private and public sectors.

"The main driver is the job market," said Frederic P. Schoenberg from his front-line position as chair of the University of California, Los Angeles (UCLA) statistics department. "Our graduates are getting excellent jobs in industry with a statistics degree. Businesses throughout the country are forming analytics groups and seeing the value of data analysis.

They are, therefore, hiring statisticians at a high rate and that is fueling our majors." Schoenberg and other leaders of college/university statistics departments said undergraduates of their programs are securing good-paying jobs at Internet, software and technology companies; finance and banking firms; analytics and consulting agencies; management and marketing organizations; biopharmaceutical and medical sciences companies; and government agencies.

To further meet this burgeoning demand, many colleges and universities are offering new undergraduate degree statistics programs.



For instance, since 2003, the number of schools granting undergraduate statistics degrees has increased from 74 to more than 110 in 2013. Amherst College in Massachusetts, Arizona State University and the University of Chicago are just three of the 20 schools that recently unveiled new undergraduate degree programs in statistics (see the complete list). Additional new programs are in the works.

Another interesting finding from the ASA analysis of the NCES data is that more than 45% of undergraduate statistics degrees during the four-year timespan studied were awarded to women. Over the past four decades, women have earned more than 40% of math and statistics bachelor's degrees. For comparison, in 2013, the share of women who graduated with an undergraduate degree in computer science was 18%; in engineering, it was 23%; and, in physics, it was 19%.

A Statistician earns an average salary of $71,899 per year.

Check it out.

More than 45% of undergraduate statistics degrees during the four-year timespan studied were awarded to women.

What It Takes to Be an Antarctic Engineer

Jim O'Sullivan and Julius Rix demonstrate the essential qualities of resourcefulness and endurance

By Lucas Laursen

There is no visible horizon in the waters beneath the Ross Ice Shelf. So electrical engineer Jim O'Sullivan built an artificial one for the pilot of the submersible remotely operated vehicle (ROV) that he and a team of scientists were testing there in 2008.

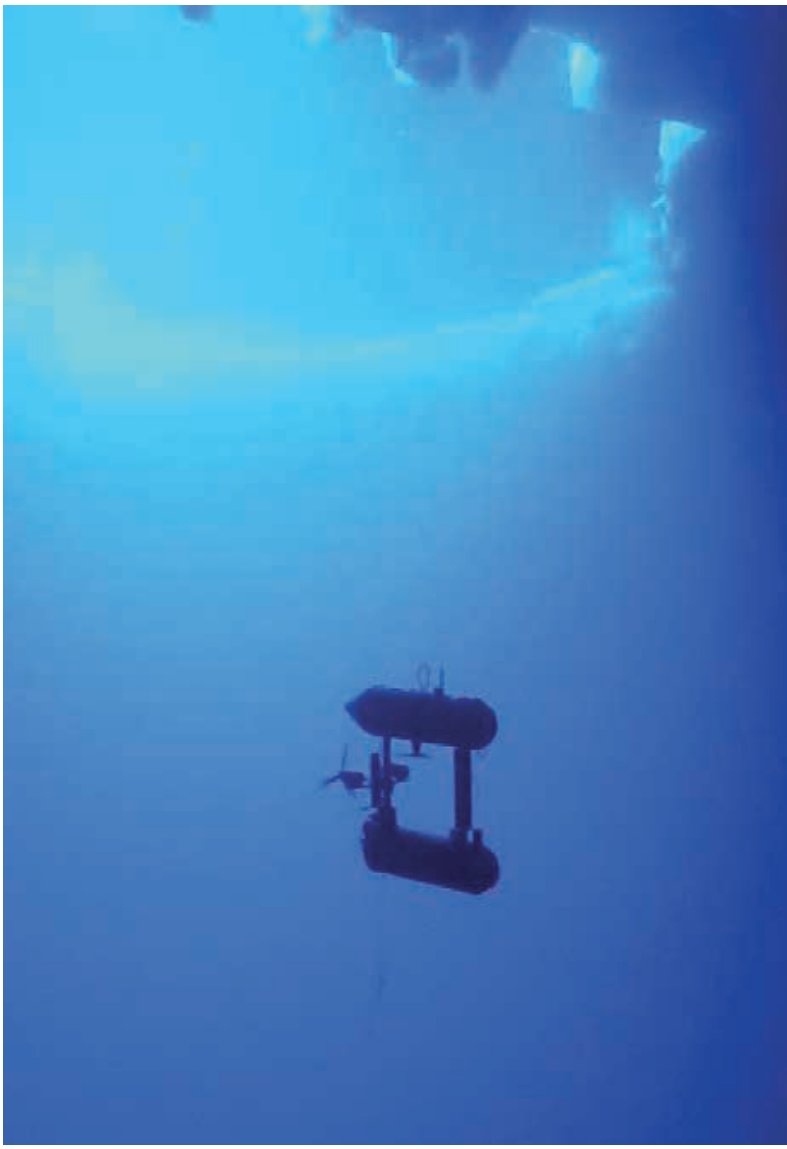
The team didn't lack for data: The ROV's orientation, speed, and depth were numerically displayed on the pilot's screen. But it is difficult to convert numbers into spatial awareness. The ROV was at risk of crashing into

the delicate creatures, such as sea spiders, that it was supposed to be observing.

Fortunately, O'Sullivan had come across a similar problem in a different setting: aviation. As a pilot, he had an instrument rating, "which was useful for understanding how to navigate without being able to see," he recalls. When flying blind, pilots use half a dozen different instruments to maintain their situational awareness, including an artificial horizon.

O'Sullivan found open-source software that could convert the ROV's telemetry data to display an artificial, underwater horizon. This example of engineering on (and under) "the Ice,"—as Antarctica is known—demonstrates the need for ingenuity and improvisation beyond anything training can provide.

In fact, those characteristics are precisely how British Antarctic Survey (BAS) engineer Julius Rix got his job: "My boss told me I got my first job with him because of my hobby working on old cars," Rix says. Unlike O'Sullivan, who went to Antarctica as a contract engineer for a one-time gig and now advises startups in and around Palo Alto, Calif., Rix has grown increasingly involved in Antarctic engineering. Rix got that first job maintaining ionosphere-measuring equipment at Halley Research Station on the Brunt Ice Shelf in 2008 after doing a Ph.D. in vehicle dynamics.



After two years, he took a medical-imaging job in the United Kingdom. But his old boss lured him back a few years later to move the equipment from the old Halley station to a new one. Now he is a staff engineer at the BAS Cambridge office and has returned to Antarctica twice with a

scientific team searching for the world's oldest ice.

At Rix's Cambridge office, a tangle of hats, gloves, goggles, and giant fuzzy boots nearby attest to his frequent visits to a nearby walk-in freezer, with ice core samples and drilling equipment. In between visits to Antarctica, Rix must troubleshoot the drilling equipment and try to anticipate what might go wrong in the field, packing accordingly.

Still, teams are unlikely to anticipate everything and must be prepared to adapt. "Learn as many skills as you can," he advises prospective Antarctic engineers.

Recent job ads for electrical or electronics engineering jobs in Antarctica confirm that while jobs are available for those seeking an unusual workplace, a diversity of experience and willingness to embrace difficult living conditions are prerequisites.

Engineers on the Ice do everything from building new facilities to maintaining telescopes and tagging along with scientific teams for temporary projects, as O'Sullivan did.

The diversity of roles means that many kinds of engineers can go, but be warned: The competition is stiff.

Several nations operate Antarctic research programs. Interested applicants should monitor these programs' websites and those of any private contractors supporting national programs. Hiring tends to be seasonal: Opportunities spike for the Antarctic summer. Another method is to seek out scientific research projects that may need an engineer and approach them directly. O'Sullivan got his field gig through an introduction from a mutual contact.

Both O'Sullivan and Rix emphasize the difficulties that come from Antarctica's remoteness. "Probably the isolation was the hardest part," O'Sullivan says. That goes for digital communication almost as much as physical isolation: Few satellites dip that far south, and visitors must be prepared for limited Internet bandwidth. Rix noted that his wife didn't like his being away so long and the uncertainty of when he would return.

Planning for the Ideal Emotional Atmosphere

Dr. Judy Willis

Although it is valuable for teachers to be familiar with neuroscientific research and pass relevant findings along to education stakeholders, it is crucial that educators use classroom strategies that reflect what we know about the brain and learning. So how can teachers create environments where anxiety is low while providing enough challenge and novelty for suitable brain stimulation?

Make it relevant.

When stress in the classroom is getting high, it is often because a lesson is overly abstract or seems irrelevant to students. Teachers can reduce this type of stress by making the lesson more personally interesting and motivating. Ideally, students should be able to answer the question, "Why are we learning about this?" at any point in a lesson.

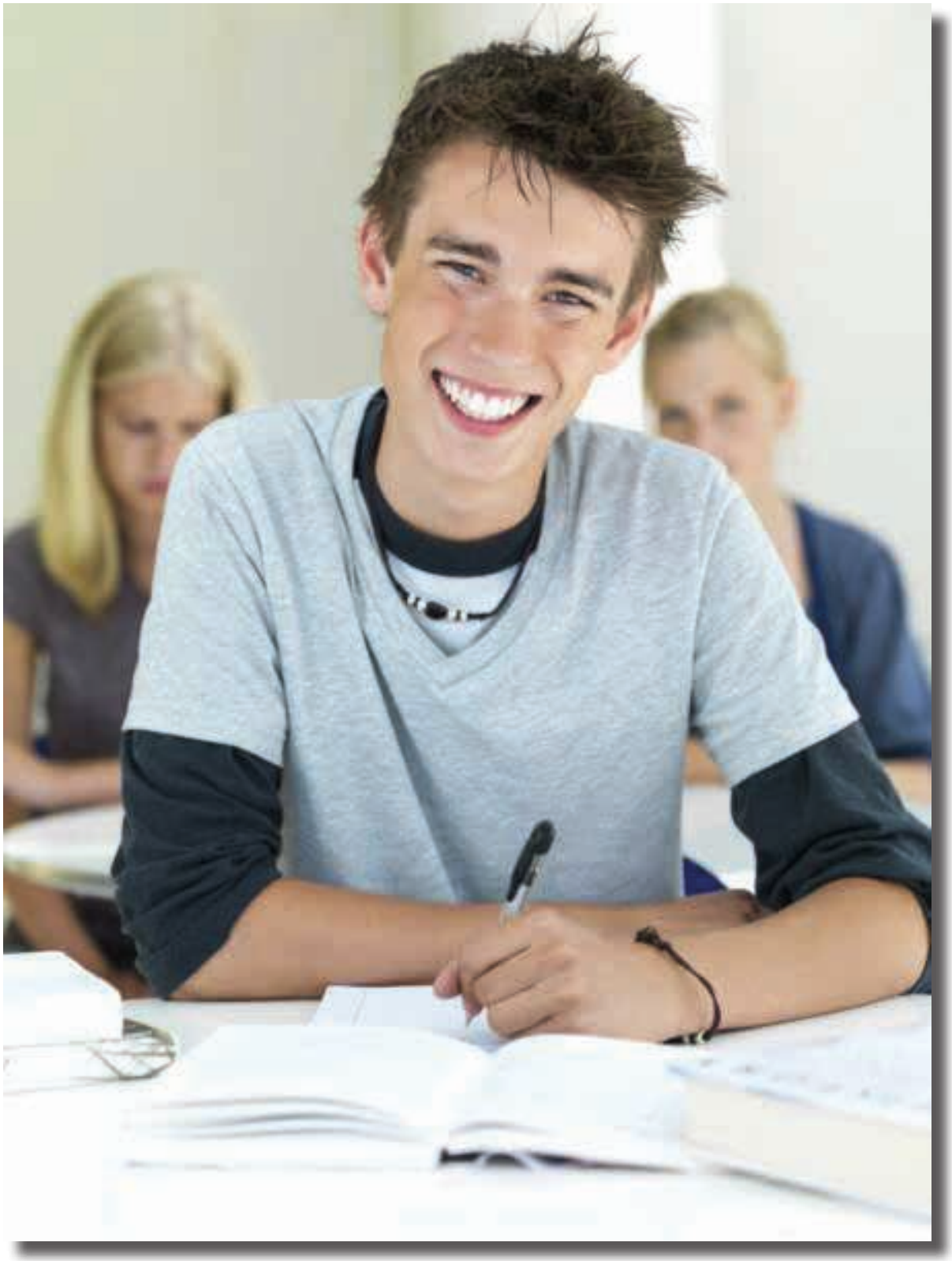
Teachers can find valuable background materials and human interest connections in textbooks published in the 1990s, before many publishers dropped such information to make room for practice test questions. The Internet is a source of many teacher-shared lesson plans and links to Web sites that provide resources for student activities and information databases that bring the more fact-heavy lessons to life. These are just a few Web sites that teachers can mine for ideas:

The Jason Project: a multimedia, interdisciplinary science program for grades 4–9, www.jasonproject.org

NASA Education: resources and information for K–12 teachers: http://education.nasa.gov

PBS Teachers: multimedia resources for preK–12 educators: www.pbs.org/teachersource

A to Z Teacher Stuff: a teacher-created site designed to help teachers find online resources: http://atozteacherstuff.com



It is not always possible to explain the immediate relevance of every lesson. In math, for example, students must master certain skills before they can go on to investigate larger, more clearly relevant topics.

One way to increase the emotional connection is by adapting word problems so that they include the names of students, popular celebrities, historical figures, or sports heroes. Similarly, problems about interest rates can relate to purchasing something the students would want to buy, such as an iPod or new sneakers. Students can learn about decimal place values by calculating batting averages to the thousandth place.

Language arts teachers can combine lessons on formal letter writing with a study of ethics or advertising. Students select a television commercial or print ad they judge to be misleading and write a letter expressing that opinion to the company in question. Students can compare historical fact and fiction by reading texts, examining primary sources, and viewing movies.

In science classes dealing with the differences between mixtures and solutions, students can predict which liquids in their homes are mixtures and which are solutions. At home, they test their predictions by seeing which items are in separate layers until shaken. Or instead of just studying facts about pollution, students can learn to take and test water samples (www.baylink.org/lessons/3fr_pollution.html).

When a lesson or block of lessons is full of facts to memorize, students will

often feel less stress when they see an intrinsic reward for their efforts, such as using the facts they've mastered as a tool for participating in a more appealing activity. For example, when students know the metric to standard measurement conversions, they can "translate" a recipe from a cookbook that uses metric measures into the quantities they need in U.S. standard measurements to prepare cookie dough in class.

Give them a break.

Just like adults, students can reduce stress by enjoying hobbies, time with friends, exercise, or music. Even though schools are shortening recess, physical education, art, drama, and even lunchtime to add more time for core subjects, teachers can give students a three-minute vacation to reduce stress.

Any pleasurable activity used as a brief break can give the amygdala a chance to cool down and the neurotransmitters time to rebuild.

Create positive associations.

Eliminating all stress from students' lives is impossible. However, even if previous classroom experiences have led to associations that link certain activities, such as memorizing multiplication tables, to a stress response from the amygdala, students can benefit from revisiting the activity without something negative happening. By avoiding stressful practices like calling on students who have not raised their hands, teachers can dampen the stress association.

Students can develop positive associations with multiplication by practicing it with a positively reinforcing strategy. For example, they might first review the table for multiplying by eight, then fill in blanks on a worksheet and immediately check each written answer with a calculator. If the answer is correct, the student experiences instant positive reinforcement. If the answer is incorrect, the student sees the right answer on the calculator—a much more pleasurable experience than hearing a classmate call out the answer before the student can even begin to compute it.

In a similar way, students can build on their neurochemical memories of positive feelings if they have opportunities to recognize and savor their successes. A posted "Personal Goal Achievement" list, for example, acknowledges all students' successes. Students set personal goals, such as learning a specific multiplication table, and their names go on this list when they achieve their goals. Unlike the more typical competitive list of scores or lists of students who have mastered specific skills, this goal achievement list includes only the names of students who have met their goals, not the actual goals themselves.

Prioritize information.

It is helpful for teachers to guide students in learning how to prioritize information—how to decide what facts are worthy of writing down and reviewing when studying. When teachers demonstrate and explain how they determine which facts are important, students see how to make those judgments for themselves as they read texts and study. Helping students learn how to prioritize and therefore reduce the amount of information they need to deal with is a valuable stress-buster.

errors, motivated to try again, and less self-conscious about asking questions.

A Safe Haven

Classrooms can be the safe haven where academic practices and classroom strategies provide students with emotional comfort and pleasure as well as knowledge. When teachers use strategies to reduce stress and build a positive emotional environment, students gain emotional resilience and learn more efficiently and at higher levels of cognition. ***Brain-imaging studies support this relationship.***

"Guide students in learning how to prioritize."

Allow independent discovery learning.

Thanks to dopamine release and the consolidation of relational memories, students are more likely to remember and understand what they learn if they find it compelling or have a part in figuring it out for themselves.

In addition, when students have some choices in the way they will study or report on something, their motivation will increase and stress will diminish. They will be more accepting of their

HACKERS WELCOME

by John Britton

No, it's not what you think.

A hackathon is an invention marathon. Programmers, designers, builders and more come together to learn, build, and share their creations over the course of a few days. Hackathons are not limited to computer science majors — anyone who has an interest in technology and is eager to learn can participate in a hackathon.

Not to be confused with illegal and unauthorized programming, "hacking" in this context means quickly and intelligently creating a real application that others can use. Although the term "hacking" has previously been associated with gaining access to a computer system with a malicious intent, "hacking" has started to transition into a positive term describing the actions of innovators who are creating prototypes of their ideas. Programmers have rallied around the term "hacking", as a term to describe their love of learning and their efforts to build the future.

Teams of two to six students work together over a weekend to develop a product, learning about new technologies and making friends along the way.

Hundreds, sometimes thousands of students gather on the weekend to learn new technical skills and soft skills. At hackathons, students can augment skills learned in the classroom by teaching themselves how to independently research new technologies and fix problems they encounter.

Hackathons allow students' intrinsic interests to drive their education. Every time a student encounters a new challenge at a hackathon, they must learn how to fix the problem through independent study **(the engineering method)**. By giving students an opportunity to individually build a project from start to finish, students develop increased critical thinking skills and have a chance to become better prepared to enter the workforce.

Undoubtedly, all learners are responsive to some degree during instruction; however, students who display initiative, intrinsic motivation and personal responsibility achieve particular academic success (Zimmerman & Martinez-Pons, 1988).

These self-regulated students are distinguished by their systematic use of metacognative, motivational, and behavioral strategies; by their responsiveness to feedback regarding the effectiveness of their learning; and by their self-perceptions of academic accomplishment.

Students enter a hackathon with a blank slate — they cannot bring in a school project. Once a student has found a team to spend the weekend with, they enter the brainstorming phase. After collectively deciding on an idea to work on, students on the team spend a majority of the event transforming this idea from concept into reality.

Whether the idea is a hover board or an app to teach you to drive, hackathon teams bring a project from epiphany to completion all within a single weekend. Expert mentors from professional development backgrounds work through the night to help students with their projects. Many mentors wish they had this level of support in their youth and strive to help the future generation of programmers.

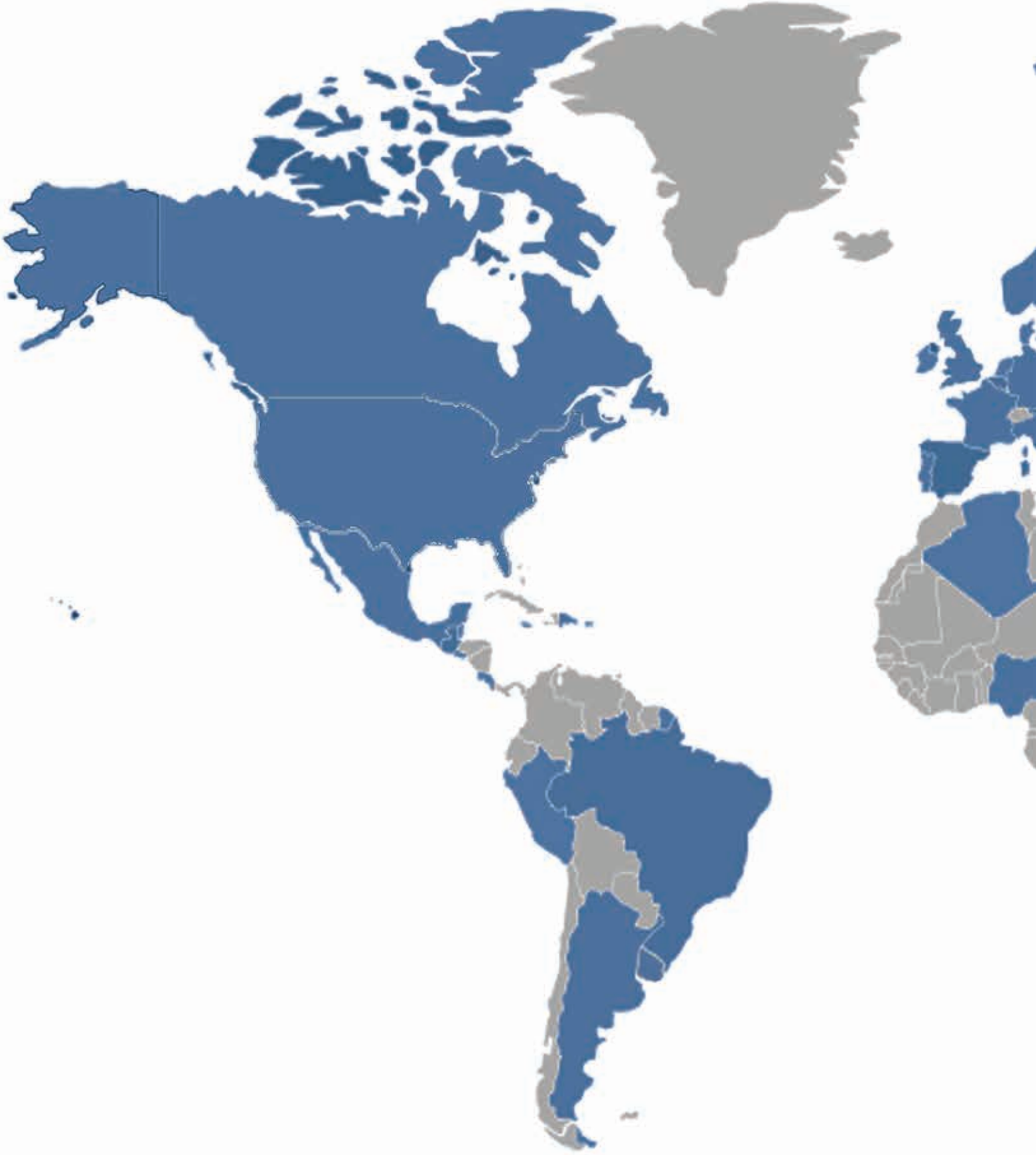
As a mentor, I'm glad I can help the next generation of programmers discover their passions, learn new skills, try out concepts they have learned in class, and build real applications that real people can interact with.

The overnight aspect of a hackathon is integral to allow students the time they need to complete their projects. Most hackathons conclude with a science-fair-style exposition of projects that includes celebrity judges directly

conversing with students about their projects. Winners are chosen, prizes are dealt, and the top teams give a live demo of their project on stage.

No age restrictions for creativity.... of course.

STEM Magazine and ***you*** are truly.....



.....*Global*