S.T.E.M.

MAGAZINE

The Best of 2014

January 2015
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America's Next Education *Crisis*

by Franklin P. Schargel

America faces a severe school dropout problem, and students who leave school do not cause it. ***Far more teachers, by percentage, drop out of school than students.*** Forty Six percent of teachers leave the field—*drop out*—within five years. A conservative national estimate of the cost of replacing public school teachers who have dropped out of the profession is $2.2 billion a year.

If the cost of replacing public school teachers who transfer schools is added in, the total cost reaches $9 billion every year (Alliance for Excellent Education, August 2005). For individual states, cost estimates range from $8.5 million in North Dakota to half a billion dollars in Texas. In the next decade, according to the U.S. Department of Education, and the National Education Association, U.S. schools will need approximately 2 million new teachers.

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

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

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

Wayne Carley
Publisher

S.T.E.M.
Magazine

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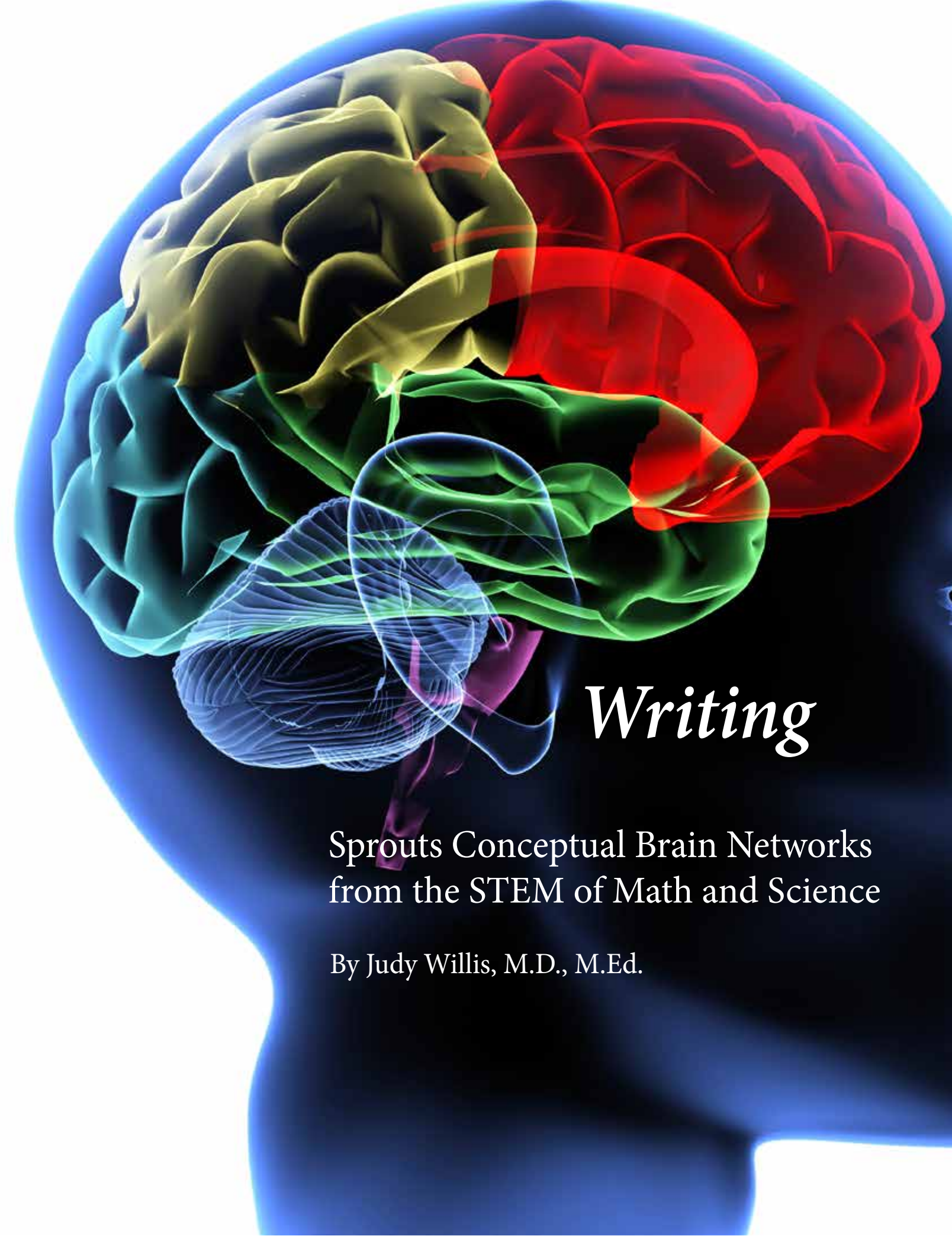

Writing

Sprouts Conceptual Brain Networks from the STEM of Math and Science

By Judy Willis, M.D., M.Ed.

Science and math are vital to our progress, yet our test scores on the international scales are not keeping pace globally. The US Department of Labor has projected that by 2014 there will be more than two million job openings in science, technology, and engineering, but according to the Science, Technology, Engineering and Mathematics (STEM) international test score report, the US is lagging behind countries like Korea, Singapore, Hong Kong and Finland in STEM subjects. H.G. Wells cautioned, "Civilization is a race between disaster and education." and it seems the government is heeding that advice with initiatives in motion to increase emphasis on these subjects.

As STEM subjects get more emphasis, writing and the arts cannot become victims of that emphasis. It is also important not to narrow the focus to the rote memory test and to recognize the interdependence of science and math on a fully rounded curriculum. As we strive for students to develop creativity as innovators in STEM and all fields, it behooves us to consider the value of writing and the arts toward the achievement of these goals.

In the past two decades, neuroscience and cognitive science research have provided increasing evidence correlating creativity with academic, social, and emotional intelligence. We also know more about the neural processing of the brain's highest executive functions that direct judgment, critical analysis, emotional control, creative problem solving, highest cognition, and other skill sets, which are becoming increasingly valuable for all students, and essential for those who enter the STEM fields in 21st century.

Writing for the Math and Science Literacy

As I've previously written about the value of embedding the arts throughout the curriculum [http://whatworks.wholechildeducation.org/blog/art-for-joyful-learning/] the focus of this article is to describe how writing can enhance the brain's intake, processing, retaining, and retrieving of information in science and math.

From the STEM program goals,

"STEM literacy is also critical because it has a profound and growing impact on our day-to-day lives. It helps us make critical decisions about our health care, our finances and our retirement. It illuminates the ever more complex issues that govern the future of our democracy, and it reveals to us the beauty and power of the world

we inhabit. A literate nation not only reads, it computes, investigates and innovates."

Writing brings more than literacy and communication advantages to STEM studies, and all academic pursuits. Through writing, students can increase their comfort with and success in understanding complex material, especially when the subject has unfamiliar concepts and subject specific vocabulary. Writing throughout the curriculum also increases the power of a literate nation to "read, compute, investigate, and innovate" and to participate more successfully in our democracy.

Writing: Just What the Doctor Orders for the Brain's Successful Information Processing

In terms of writing and the brain, there are multiple reasons for embedding writing throughout STEM courses. Writing promotes the brain's attentive focus to class work and homework, promotes long-term memory, illuminates patterns and "aha" moment in sight!), includes all students as participants, gives the brain time for reflection, and when well-guided, is a source of conceptual development and stimulus of the brain's highest cognition.

There is an involuntary information intake filter that determines what sensory input is accepted into the brain. Input must also pass through an emotional filter, the amygdala, the destination of that information. When ***stress*** is high the intake filter favors information selectively admits information related to perceived threat, virtually ignoring other sensory input. The high stress state also directs the amygdala switching station to conduct information to the lower, reactive brain, where long-term retrievable memories cannot be formed. In addition, the behavioral outputs of the lower brain are limited to fight (act out), flight (self-entertainment sometimes interpreted as ADHD), or (zone out).

Fear of making mistakes in front of classmates is one of the greatest sources of anxiety for students. Writing is an opportunity to lower threat and to reduce the stress that blocks passage through the amygdala to the reflective prefrontal cortex.

Descriptive written responses to math or science questions and written predictions, hypotheses, and questions provides all students with the opportunity to actively participate in learning, receive timely feedback, reflect, revise, and risk making mistakes as they build confidence, reveal gaps in foundational knowledge, share creative insights, and build their capacities to communicate their ideas and defend their opinions.

Writing can include individual journaling, formal research-style formatted reports of student experimentation and data analysis, newspaper editorials about the evidence for environmental problems and a plan for intervention.

Writing can be shared with varying degrees of scaffolding for students who need to build confidence, such as class blogs or WIKIs with code names known only by the teacher. Writing done at home, without time constraint and with access to the Internet and other resources, can lower the barriers, but not the bar. Students can then participate more confidently in class starting with reading their written responses, perhaps after the confidence -building of first sharing them with a partner.

Written peer feedback on class WIKIs or blog offers the opportunity to reflect on the day's learning, ask questions, or demonstrate accountability for the night's homework to increase whole class level

"*Fear*.....greatest source of anxiety."

of preparation for the next day's instruction. Through these shared written responses about content and concept students have opportunities to express creative hypotheses, alternative perspectives, and concerns about their understanding, with the low-risk option of peer anonymity. There is accountability and peer interaction, without the concern about mistakes that is so paralyzing to many students during class time, and as students consider and define in writing their opinions, conclusions, and predictions, their brains construct concept networks.

When learning is examined through shared writing, students are exposed to multiple approaches to solving problems (so important in building the flexibility and open-minded approach to other cultures as the science, math, and technology world is indeed global) and have the chance to communicate using their own words. They build communication skills they will surely use in their collaborations now and in the future science and math communities they will enter.

It's About Me! Not Just Someone Else's Science and Math.

Writing can also reduce the neural processing blockades that result from the stress of boredom; the most frequent reason high school dropouts give for leaving school.

Specifically, they report that what they learn is not interesting or personally relevant. We know that there is increased information flow through the attention and emotional filters to the higher processing prefrontal cortex when learning incorporates personal interest and connects learning to real world issues and problems relevant to students. Writing can increase both personal relevance and confidence.

Personal relevance comes from the nature of writing that provides opportunities for creativity and personal expression. Even when the facts of the math or science are not debatable, individual responses to the information are appropriate writing topics. When writing is incorporated in learning and assessment, there is increased opportunity to produce the ideal situation for active, attentive learning with collaboration, revision, and meta-cognition through personalization, and creativity.

Regarding confidence, reminding students of previous successes promotes confidence as does providing them the opportunity to recognize progress over time. Written work – that includes assessments of science or math facts, procedures, theories, and projects, but also includes students' written responses to both the learning itself and to their progress gives students more ways to recognize their progress than do files of test grades.

These can be maintained in computer files or portfolios and reviewed as evidence of successful, incremental progress with student opportunities for meta-cognition about strategies used for success.

Neurological Nourishment: The Write Stuff for Math, Science, and Brains.

The construction of conceptual memory networks builds the most valuable neural architecture a brain owner can have. These networks serve as "nets" to catch and hold new input with similar patterns, and "work" when activatedfor creative transfer – use of the information learned in one context for application in a new context. (See-you can't make corny word puns as easily with the spoken word.)

Writing as Memory Cement and Concept Clue

Memory bundles, such as Piaget described as schema, or category-related memory, hold information linked in circuits based on commonalities (such as similar sounds, visual images). The many varieties of writing can serve to guide the brain to recognize, construct, and extend its patterns – its bundles of neurons linked together because they have been used together repeatedly.

Writing can illuminate sequential procedures that students need to learn in mathematics and science, from factoring an equation to the photosynthetic chemical process. Prior knowledge can be activated for newly related information through mind maps, graphic organizers, and new learning can be added into visible and mental patterns when students write analogies and other comparisons.

The neural activity or mental manipulation that transforms formulas, procedures, graphs, and statistical analyses into words represents the brain's recognition of patterns. When this is also done in writing the facts, procedures, and observations are processed symbolically in the writing process – giving the memory another storage modality and truly illuminating the patterns for the brain to follow as it adds new learning to existing concept networks.

However, only when the brain is prompted to activate these separate circuits of "red" memories together, do they develop the neural connections (dendrites, synapses, axons) such that when red is perceived in a new object, there will be simultaneous mutual activation of this bundle of "red" memories.

Through this pattern constructing process, links form among the separate "red" memory circuits each time they are activated together. With each repeated activation of the related memories, physical connections grow so they ultimately are physically linked into a larger circuit that "fires together" when something red is seen, visualized, or the word is heard or read.

To turn these early physical links into a strong concept memory, it is then necessary for repeated prompts to activate the rudimentary linkage into a strong neural network. This is how the process of neuroplasticity works. Neuroplasticity is the brain's response to repeated electrical activation of grouping of neurons.

It is the electrical activity that flows through a circuit each time it is activated that stimulates the growth of more connecting dendrites and synapses and the greater durability of the axons through increasing thickness of their insulating myelin coats. These physical responses to activation turn a newly connected, extended memory circuit into long-term memory.

Once established, long-term related memory networks are subsequently expanded and strengthened by repeated activation. This activation is what takes place with practice. The brain processes sensory information in specific lobes (occipital for visual, temporal for auditory, parietal for sensory). Information learned and practiced through different sensory modalities had duplicated storage in the sensory receptor cortex. These are connected such that when one memory is cued up, the others come on line. If a student sees an experiment, smells the chemical products, measures components, discusses the experiment there can be memories stored in the auditory, olfactory, kinesthetic, and verbal cortex's.

"The act of writing....promotes the extension and permanence of a memory circuit."

The most effective practice for memory is the use of the newly linked neurons in other new ways than that in which the information was learned. Thus the act of transfer, such as occurs in writing with words about a scientific observation or mathematical procedure, promotes the extension and permanence of a memory circuit.

"Aha!" moment.....

When a sensory cue comes in to retrieve that memory, the increased number of storage locations gives rise to more powerful recall. The early research into creativity and the "Aha!" moment suggest that at the moment of a flash of insight or innovation, there is simultaneous communication from multiple memory storage regions throughout the cortex and the executive control centers in the prefrontal cortex.

"A goal of learning is to construct conceptual, relational circuits of valuable, transferable knowledge."

To summarize, a goal of learning is to construct conceptual, relational circuits of valuable, transferable knowledge. These start as bits of information that the brain adopts into existing related networks through the simultaneous activation of the new with the existing. This takes place through a process of pattern recognition, linking, and expanding. The brain seeks patterns (relationships, commonalities) in new sensory input and when these are recognized, the new input links with the existing pattern and is consolidated into that related existing memory network.

This is the "firing together"

Dr. Judy Willis

Dr. Judy Willis is an authority on brain research regarding learning and the brain. With the unique background as both a neurologist and classroom teacher, she writes extensively for professional educational journals and has written six books about applying the mind, brain, and education research to classroom teaching strategies, including an ASCD top seller, Research-Based Strategies to Ignite Student Learning.

After graduating Phi Beta Kappa as the first woman graduate from Williams College, Willis attended UCLA School of Medicine where she was awarded her medical degree. She remained at UCLA and completed a medical residency and neurology residency, including chief residency. She practiced neurology for 15 years before returning to university to obtain her teaching credential and master's of education from the University of California, Santa Barbara. She then taught in elementary and middle school for 10 years.

Currently, Dr. Willis gives neuroeducation presentations, and conducts professional development workshops nationally and internationally about educational strategies correlated with neuroscience research.

Language Arts **IS** a S.T.E.M. Subject

by ***Wayne Carley***

Definition: ***Reading, spelling, literature, and composition that aim at developing the student's comprehension and capacity for use of written and oral language.***

It's that "..comprehension and capacity..." that stretches across every subject your students will study from this day forward. Who would have thought that language arts could determine the futures of the kids falling asleep halfway through class.

Technology – From scribbling on a rock to typing on our iPad, technology has been and will continue to be an integral part of how we express ourselves and communicate. The technology of spell check is a life saver for a writer, and the access to every type of literature through the net has brought learning and access to new heights. Sorry to say, I don't miss the library and the card catalogue, but I'm sure I would have done better in school with current technology resources.

Engineering – Once again the engineering method has a home here. The composition of a term paper is a series of problem solving challenges that take us from "Here is your assignment" to the final spell checked version that most effectively completes the criteria of the assignment resulting in the best possible grade.

The value of reading, spelling, composition, and communication easily translate into every career you can imagine. Doing them well is of greater benefit, naturally resulting in greater opportunities, salaries and other levels of success. The process of implementing the engineering method through the effective use of language arts skills can only result in better outcomes of problem solving regardless of the area of our life where the problem arises.

- Identify the problem

- Propose possible solutions

- Test those solutions for viability

- Evaluate the results of your testing

- Pick the best solution

- Re-evaluate the problem with your solution in place.

Awareness

You have more to teach than you usually have time for. Requirements….. standards to meet…..testing and performance, expectations…..

S.T.E.M. Magazine **does not** expect you to add new curriculum to your plate; *that is for others to expect.*

Our request is ***awareness***; awareness of the science, technology, engineering and math you and your students use every day and are *usually* unaware of. That awareness is the foundation of S.T.E.M. understanding, followed closely by curiosity. When you connect the two, the path to S.T.E.M. integration into every subject begins without the addition of curriculum, interference with your lesson plans or additional clutter to your plate.

As you read your monthly edition of this magazine, it's our hope that you, personally, keep this in mind and become more aware, more curious and hungry for **un-required knowledge**. That hunger is what our students need.

30 seconds a class period is all it takes to say, *"Students, did you know you're going to use science during this social studies assignment?"*, or *"Did you know that every time you make a decision you're using the engineering method?"*

That's it.

Wayne Carley
Publisher

Inspiration: stimulation / arousal of the mind, feelings..

to special / unusual activity or creativity

I was *inspired* to **experiment.**

I was *inspired* to **innovate.**

I was *inspired* to **solve a problem.**

I was *inspired* to **theorize.**

I was *inspired* to **calculate.**

I was *inspired* to **design.**

I was *inspired* to **question.**

I was *inspired* to **seek.**

I was *inspired* to **explore.**

I was *inspired* to **build.**

I was *inspired* to **teach.**

I was *inspired* to **pursue STEM.**


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5 minute STE(A)M lesson..

..for ***every subject*** and ***every grade***.

Architecture: (architect) the profession of designing buildings, open areas, communities, clothing, technology and other artificial constructions and environments, usually with some regard to aesthetic effect.

Architecture often includes design or selection of furnishings and decorations, supervision of construction work, and the examination, restoration, or remodeling of existing buildings or material objects.

Assignment:

Name as many ways as you can that an architect uses science, technology, engineering, math and art to create this project.

WHAT IS THIS?


Zom

Zombies

Infiltrate Classrooms to Bring STEM Back to **Life**

Several weeks into the new school year, educators are tapping the undead to bring life to subjects in need: science, technology, engineering and mathematics (STEM). With a decline in student interest, especially among girls, teachers are incorporating popular trends in movies and TV shows into lesson plans.

The National Academy of Science and Texas Instruments TXN +1.29%, the company behindthe large graphing calculators, teamed up to create STEM Behind Hollywood, a program that creates STEM lessons based on zombies, superheroes, space and forensics. The goal is to engage middle and high school students with things they are excited to talk about.

The first theme in the four-part activity is focused on zombies and is centered on the idea that a hypothetical virus is infecting humans. Imagine that distinctive shuffle that is commonly used in zombie shows or movies —

excluding the terrifying brain-eaters from the "28 Days Later" series. Students can observe a zombie's behavior and deduce that something is wrong with the cerebellum, the part of the brain involved with walking. From there they can work backwards to reverse engineer a zombie brain and learn how a healthy brain operates. From the math angle, students can track how the contagion spreads to write an equation showing the curve of infection rates.

"The activity teaches the concepts and then gives them the ability and opportunity to apply that to real-world situations," said Melendy Lovett, the president of Texas Instruments' Education Technology. *"This is the kind of experiential learning that gives students a deep understanding of the concept."*

STEM Behind Hollywood hopes the lessons will ignite curiosity about STEM careers, an area that is expected to see a 17% jump in employment opportunities by 2018, according to the U.S. Department of Labor. But interest in the subjects is diminishing among teens. Almost half ranked STEM and medical-related jobs as their first choice, a 15% decline from last year's figures, according to the Junior Achievement USA and ING U.S. Foundation's 2013 Teen & Careers survey.

"The major interest is to improve student achievement in STEM and build a pipeline of STEM capable students," Lovett said. "The STEM area is the fastest growing area for jobs and having this pipeline of STEM talents will be important."

Math and science educators teamed up with specialists in the featured themes, like Dr. Steve Schlozman, an assistant professor of psychiatry at Harvard Medical School and expert on zombie neurobiology. Gurus in forensics, space and superheroes were also tapped to help create STEM Behind Hollywood.

Zombies have been staggering their way towards students' brains for some time. Dorothy Pomerantz wrote about the new open online course on 'The Walking Dead' and classes on the undead already offered at Columbia College in Chicago and Baltimore University.

STEM Behind Hollywood is available to teachers and students on a free TI-Nspire software trial, the technology made by Texas Instruments, but children who purchased the graphing calculator get the software

included at no extra charge. There is also an app available for the iPad.

The zombies program is underway and the other themes will go live later this fall. Texas Instruments is currently developing a plan to extend the program through 2014.

"This is an outlet they are familiar with and comfortable talking about," said Martinez, 33, who uses the program in her algebra class.

"It's easy to relate that to what we are studying in class and brings it more to life for them and makes it more accessible."

Katie Martinez, a high school educator who teaches predominately lower level students in San Diego said she started using the program in the second week of school to excite her pupils.

http://www.forbes.com/sites/emilycanal/2013/09/18/zombies-infiltrate-classrooms-to-bring-stem-back-to-life/#

Emily Canal
Forbes Staff

MULTI-T

In order to tackle the exhaustive list of homework responsibilities, most students attempt to turn to multitasking to get it all done in time. The truth is, effective multi-tasking is an oxymoron. Research has shown that your brain can only process one activity at a time by effectively and rapidly switching from one task to another.

It's a myth!

MIT neuroscientist Earl Miller (Think You're Multitasking? Think Again: John Hamilton, NPR October 2008) says, "Switching from task to task, you think that you're actually paying attention to everything around you at the same time. **But, you're not.**" ***You're really toggling between tasks at amazing speeds.***

Apparently, we were never multi-tasking. It's a myth!

TASKING

To the point, the more we attempt to multi-task, the longer it actually takes to complete our list of tasks. As far back as 2001, scientists at the Center of Cognitive Brain Imaging at Carnegie Mellon University discovered that when people were driving in traffic and conversing, two tasks most of us consider easy and natural, the area of the brain that managed these functions was overwhelmed. Researchers found that brain activity didn't double, but rather it decreased, so each task was completed less efficiently and less expertly than when being conducted separately. That's why texting and driving is so dangerous.

The rapid swapping between tasks also generates pulses of stress hormones, which contribute to heath issues like memory dysfunction and higher anxiety.

The last thing our students need is more anxiety and distractions. The average attention span of an adolescent is one minute per year of age; but we expect a 14 year old (14 minutes of attention span) to sit in a 55 minute class with focus, attention, interest and comprehen sion, then do it again next period and again next period, until the day is done. Why do we get upset at their restlessness after 20 minutes? Maybe we forgot who they are or haven't evaluated the best way to present today's material.

As educators, let's reassess our process. Is there a better way? Could a different approach improve class behavior, attention, interest, productivity, quality and results? Are we flexible enough to consider it?

Technology in class has so many advantages, but some devices that were designed to make us more productive are now creating a new set of productivity problems.

When laptops and cell phones are close by, it's suddenly a challenge to keep their focus on the teacher or subject. It's just too compelling and easy to check email, text messages and surf the web. Of course these workers think that they are multitasking. But, when it comes to the brains ability to pay atten-

Prioritize

tion, the brain focuses on concepts sequentially and not on two things at once. In fact, the brain must disengage from one activity in order to engage in another. It takes several tenths of a second for the brain to make this switch. We are biologically incapable of processing attention-rich inputs simultaneously."

If you think it makes you look more efficient (or important) to be continually checking your laptop or cell phone for messages, think again. What seems like a harmless activity to the observer sends a nonverbal message of disinterest and dismissal to the rest of the group. That's why some teachers and educators have installed the "topless" meeting – banning all laptops, phones, Blackberries, etc.

"We are biologically incapable of process

The closest thing to multitasking we do involves engaging in two tasks simultaneously that use different parts of the brain, like walking or eating, and two activities involving different types of brain processing, like auditory and visual... like driving and listening to the radio. There is still a disintegration of effectiveness, but to a lesser degree and hopefully not life threatening.

Bad news parents….kids can study effectively while listening to classical music, since reading and listening use different parts of the brain. But if you listen to music with lyrics, your reading comprehension significantly drops. That's because both tasks activate the brain's language center. Similarly, you can talk and watch television at the same time, but you can't carry on two conversations at once.

Everyone who uses mobile devices have what's called **continuous partial attention**. We juggle several tasks partially and poorly. It takes longer to get things done and the consequence is a poor result; poor homework assignment, poor class preparation by the teacher, poor presentation by the speaker.

Research shows that if we have 5 things that need done in the next 5 days, the worst thing we can do is work on all of them piecemeal, a little here and a little there. The end result is it takes us 7 or 8 days to get it done.

On the other hand, prioritizing and focusing on ***one thing at a time*** until completion results in finishing our 5 to-dos in 4 days rather than 7.

The added plus is the quality of the work…..it's superior.

ing attention-rich inputs simultaneously."

If the tasks required memorization, comprehension or retention, we do it better and it lasts longer.

The Neuroscience of JOYFUL Education

Dr. Judy Willis

"Brain research tells us that when the fun stops, learning often stops too."

Most children can't wait to start kindergarten and approach the beginning of school with awe and anticipation. Kindergartners and 1st graders often talk passionately about what they learn and do in school. Unfortunately, the current emphasis on standardized testing and rote learning encroaches upon many students' joy.

In their zeal to raise test scores, too many policymakers wrongly assume that students who are laughing, interacting in groups, or being creative with art, music, or dance are not doing real academic work. The result is that some teachers feel pressure to preside over more sedate classrooms with students on the same page in the same book, sitting in straight rows, facing straight ahead.

Supporting Good Teaching Practices with Neuroscience

The truth is that when we scrub joy and comfort from the classroom, we distance our students from effective information processing and long-term memory storage. Instead of taking pleasure from learning, students become bored, anxious, and anything but engaged. They ultimately learn to feel bad about school and lose the joy they once felt.

My own experience as a neurologist and classroom teacher has shown me the benefits of joy in the classroom. Neuroimaging studies and measurement of brain chemical transmitters reveal that students' comfort level can influence information transmission

and storage in the brain (Thanos et al., 1999). When students are engaged and motivated and feel minimal stress, information flows freely through the affective filter in the amygdala and they achieve higher levels of cognition, make connections, and experience "aha" moments. Such learning comes not from quiet classrooms and directed lectures, but from classrooms with an atmosphere of exuberant discovery (Kohn, 2004).

The Brain-Based Research

Neuroimaging and neurochemical research support an education model in which stress and anxiety are not pervasive (Chugani, 1998; Pawlak, Magarinos, Melchor, McEwan, & Strickland, 2003). This research
suggests that superior learning takes place when classroom experiences are enjoyable and relevant to students' lives, interests, and experiences.

Many education theorists (Dulay & Burt, 1977; Krashen, 1982) have proposed that students retain what they learn when the learning is associated with strong positive emotion. Cognitive psychology studies provide clinical evidence that stress, boredom, confusion, low motivation, and anxiety can individually, and more profoundly in combination, interfere with learning (Christianson, 1992).

Neuroimaging and measurement of brain chemicals (neurotransmitters) show us what happens in the brain during stressful emotional states. By reading glucose or oxygen use and blood flow, positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) indicate activity in identifiable regions of the brain. These scans demonstrate that under stressful conditions information is blocked from entering the brain's areas of higher cognitive memory consolidation and storage.

In other words, when stress activates the brain's affective filters, information flow to the higher cognitive networks is limited and the learning process grinds to a halt.

Neuroimaging and electroencephalography (EEG) brain mapping of subjects in the process of learning new information reveal that the most active areas of the brain

when new sensory information is received are the somatosensory cortex areas. Input from each individual sense (hearing, touch, taste, vision, smell) is delivered to these areas and then matched with previously stored related memories.

"Under stressful conditions information is **BLOCKED** from entering the brain's areas of higher cognitive memory."

For example, the brain appears to link new words about cars with previously stored data in the category of transportation. Simultaneously, the limbic system, comprising parts of the temporal lobe, hippocampus, amygdala, and prefrontal cortex (front part of the frontal lobe), adds emotional significance to the information (sour flavor is tasty in lemon sherbet but unpleasant in spoiled juice). Such relational memories appear to enhance storage of the new information in long-term memory (Andreasen et al., 1999).

Mapping studies of the electrical activity (EEG or brain waves) and neuroimaging show the synchronization of brain activity as information passes from the somatosensory cortex areas to the limbic system (Andreasen et al., 1999).

This enables us to evaluate which strategies either stimulate or impede communication among the various parts of the brain (Shadmehr & Holcomb, 1997).

RAD Lessons for the Classroom

A common theme in brain research is that superior cognitive input to the executive function networks is more likely when stress is low and learning experiences are relevant to students. Lessons that are stimulating and challenging are more likely to pass through the reticular activating system (a filter in the lower brain that focuses attention on novel changes perceived in the environment). Classroom experiences that are free of intimidation may help information pass through the amygdala's affective filter. In addition, when classroom activities are pleasurable, the brain releases dopamine, a neurotransmitter that stimulates the memory centers and promotes the release of acetylcholinem, which increases focused attention.

The acronym RAD can remind educators of three important neuroscience concepts to consider when preparing lessons:

- *Novelty promotes information transmission through the Reticular activating system.*
- *Stress-free classrooms propel data through the Amygdala's affective filter.*
- *Pleasurable associations linked with learning are more likely to release more Dopamine.*

There are no neuroimaging or brain wave analysis data that demonstrate a negative effect of joy and exuberance in classrooms, yet some schools have unspoken mandates against these valuable components of the classroom experience. Now that hard science proves the negative effects of stress and anxiety, teachers can more confidently promote enthusiasm in their classrooms.

Create the Ideal Emotional Atmosphere

Basketball

IS a S.T.E.M. subject.....
making the coach a S.T.E.M. teacher.

I'm not sure how many coaches are going to read this, but see if you can get yours to.

Some coaches teach another traditional class which includes them in the S.T.E.M. conversation, but sports in general have a fascinating and deeply complex S.T.E.M. exercise happening at lighting speeds in the brain or our kids. S.T.E.M. and sports just may be the best example for them to grasp the concepts of personal integration and awareness.

The Basketball-

A basketball's outside covering is made of synthetic rubber, composition, leather or pure rubber. The inside part is a balloon-like structure which holds air and carcass. The bladder is made from a butyl rubber, while the carcass is made of threads of nylon and polyester.

The amount of air pressure within the bladder determines its bounce and responsiveness which affects everything about how we use it.

This construction is of scientific origin and uses a variety of man-made materials produced in the lab: ***thus a science career.***

Careers in chemical engineering, composite research, aerospace materials, and new applications of old technologies are just a few of the job possibilities available to our students.

Some of the most interesting research and development revolves around Nano Technology that creates new molecules and combinations of molecules on a microscopic scale to produce what we now know as carbon fiber, Kevlar, and others that are revolutionizing every aspect of our society.

Don't think for a moment that we've discovered or created all there is, so I get very "curious" about what our students will discover, create and apply that will make the materials and technology of 2014 seem antiquated.

Dribbling-

As I push down on the basketball, my brain instantaneously and mathematically calculates the amount of energy in my shoulder, arm, hand and fingers necessary to have the ball bounce back up to my hand.

Based on the results of the first dribble, math and energy adjustments are instantly evaluated and adjusted as necessary for the next dribble. This process continues throughout the dribbling process.

All of this happens subconsciously, instantly and repeatedly. Ask a basketball player if they like math. Whether it's yes or no, they should. This is the kind of S.T.E.M. integration needed for a student to understand its importance and wide range of applications.

As a coach, why not bring this to the players attention. That is the intigration we're looking for.....the link between S.T.E.M. and everyday activities.

Running and dribbling-

It gets more amazing now as we incorporate the science of physiology, the study of the human body, and synchronize the act of running with all of its physical complexities with the previously discussed math and science of dribbling. Now our math and science calculations must be modified due to our forward motion. We cannot bounce the ball down, but must push forward at a specific angle instantly calculated based on our speed and direction of running. The energy requirements to dribble will need adjusting as well as a synchronizing with our bodies motions.

Mentally we have already begun to make math calculations regarding the process of passing or throwing the ball to another player which requires a completely new set of energy calculations, geometry angles from present position to calculated future position of team mate and estimations about outcomes. Keep in mind, our brain is making these math and science calculations while performing the dribbling process.

Amazing.

"Think of math as simply the explanation of what your brain already knows and uses."


ENGINEERING METHOD
DECISION MAKING
DIRECT CHANGE
ANTICIPATION -
CALCULATIONS
ENERGY
GEOMETRY
ANGLE
ENERGY
ADJUSTMENTS

Shooting a basket-

Now it gets fun. When the player decides to shoot for a basket the following takes place.

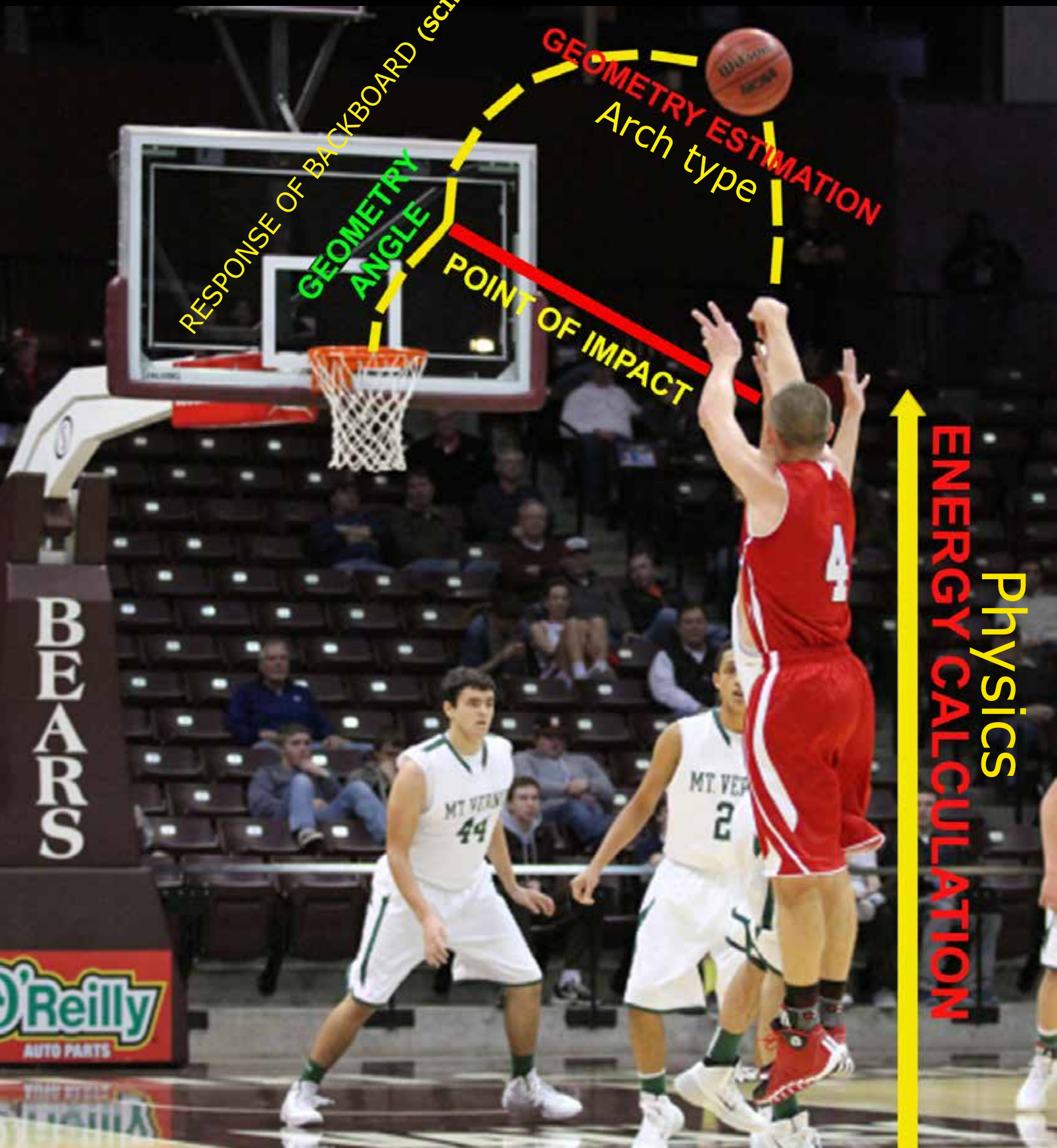
The player uses the engineering method (a decision making process) to determine which kind of shot they wish to attempt for best result. Based on their conclusion, let's say a 3 point jump shot, the instantly visualize the distance to the basket and set in motion a complicated sequence.

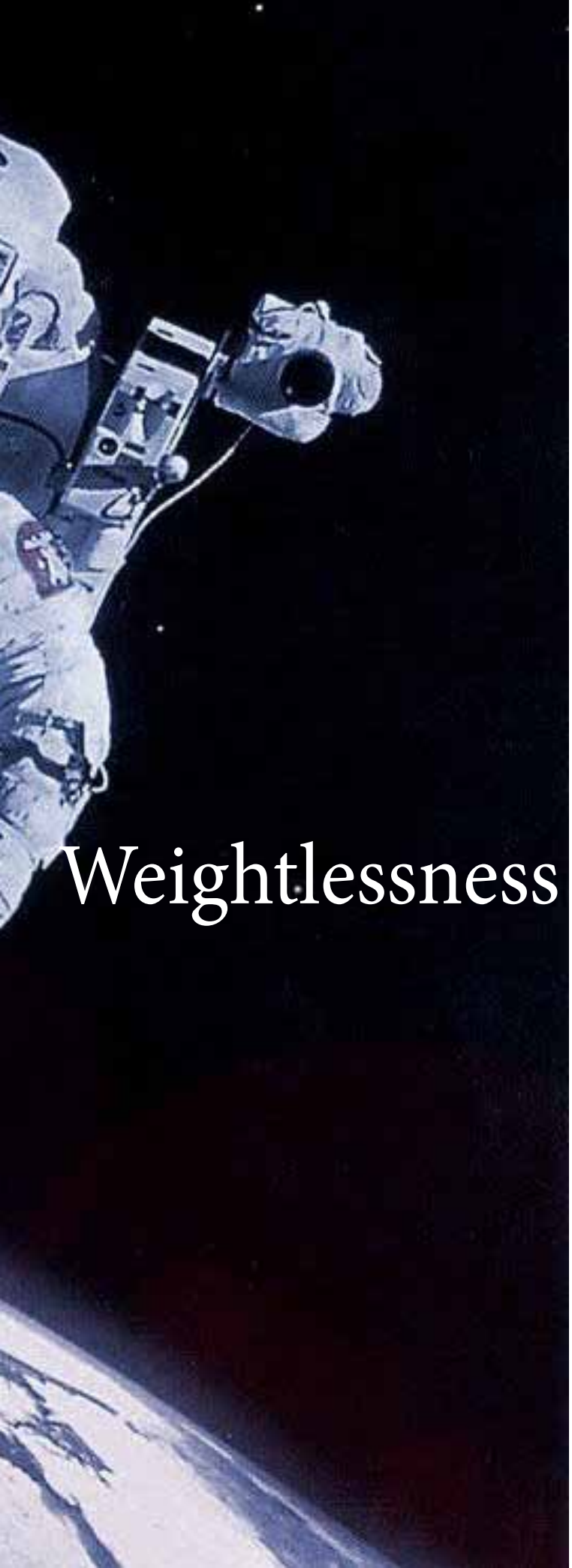
Based on the distance to the basket, the player decides how high they must jump to overcome the defense, the amount of energy required to send to the hips, knees and legs to reach that height with an estimated knee bend. A quick evaluation of their physiology (science) determines their ability to perform that task (maybe a bad knee or tall opponent). The player must estimate the amount of energy required to propel the ball the necessary distance, taking into con- sideration the geometric arc of the ball (math) to reach the basket. If a bank shot is required off the backboard, the geometry of the angle between where the ball strikes the backboard and deflects into the basket must be calculated. I'm exhausted just talking about it.

The point is, we are wired for S.T.E.M. and the awareness of how we already use it daily should precede a new curriculum or additional classes.

Consider the fairly simple task of making our students aware of what they do and how it's S.T.E.M. It makes the integration much easier, logical, necessary and even fun, building confidence and curiosity..... maybe even a better basketball player!

Wayne Carley


RESPONSE OF BACKBOARD (SCIENCE AND TECH)
GEOMETRY ESTIMATION
Arch type
GEOMETRY
ANGLE
POINT OF IMPACT
Physics
ENERGY CALCULATION
BEARS
O'Reilly
AUTO PARTS



Weightlessness does not exist!

Weightlessness is an illusion…a sensation; **it is not real.** Astronauts who are orbiting the Earth often experience sensations of weightlessness.

These sensations experienced by orbiting astronauts are the same sensations experienced by anyone who has been temporarily suspended by jumping off a pool high dive, sky diving, bungee jumping or maybe an amusement park ride.

Not only are the sensations the same (for astronauts and roller coaster riders), but the causes of those sensations of weightlessness are also the same. Unfortunately however, many people have difficulty understanding the causes of the illusion of weightlessness.

The cause of weightlessness is quite simple to understand. However, the things **we thought we knew** or thought were facts often stand in the way of our ability to understand the scientific truth. Consider the following multiple choice question about weightlessness as a test of your preconceived notions on the topic:

Pick the right answer:

Astronauts in orbit are weightless because...

a. There is no gravity in space and they do not weigh anything?

b. Space is a vacuum and there is no gravity in a vacuum.?

c. Space is a vacuum and there is no air resistance in a vacuum?

d. The astronauts are far from Earth's surface at a location where gravitation has a minimal effect?

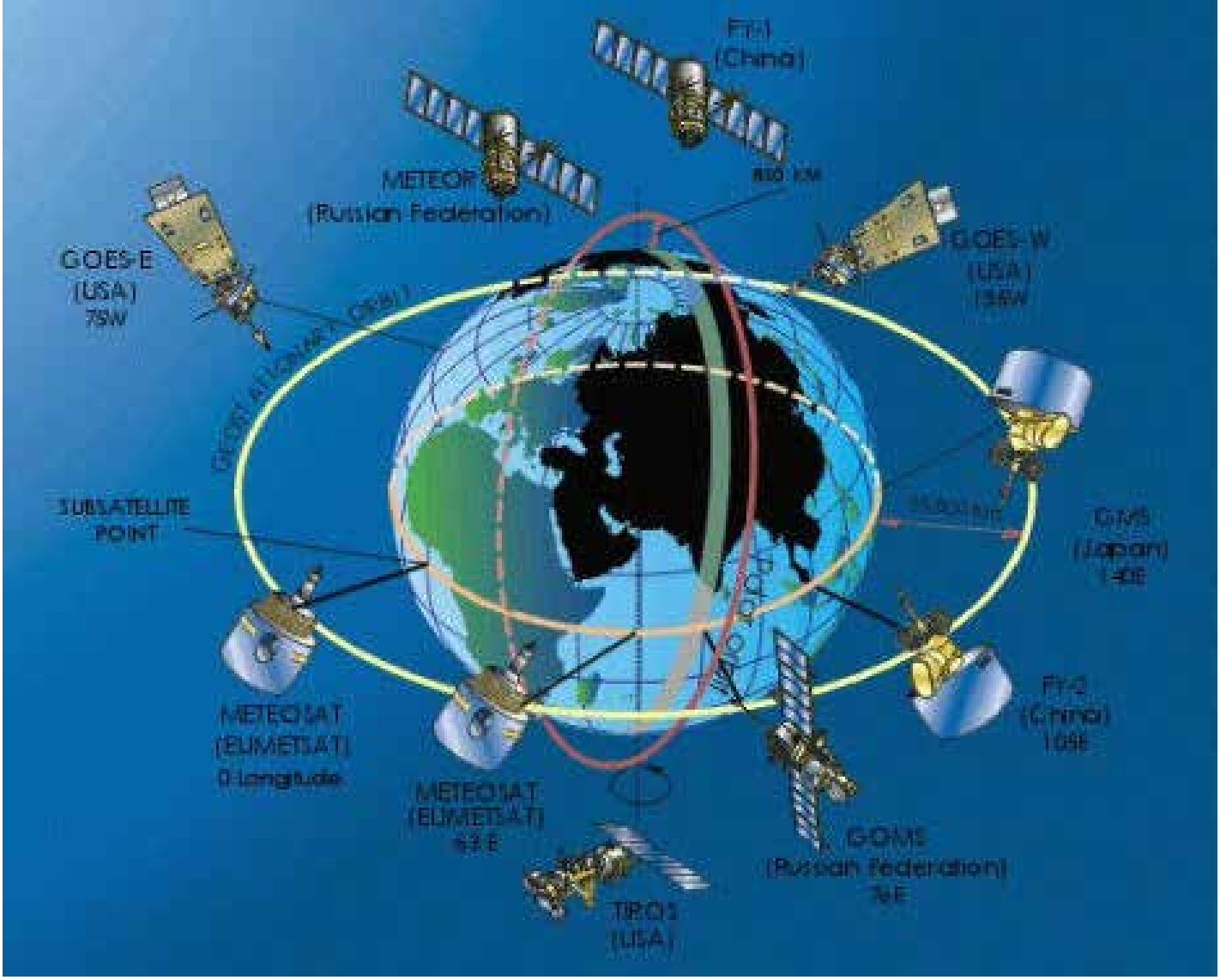
If you picked any of the given choices …….you are ***incorrect.*** (sorry)

If you really believe in any one of the above statements, then it might take a little convincing to understand the real cause of weightlessness. As is the case on many topics, some unlearning must first be done before doing the correct learning.

Contact versus Non-Contact Forces

Put another way: it's not what you don't know that makes learning a difficult task; it's what you think you already know that makes learning a difficult task. So if you do have a strong belief about what weightlessness is, you need to be aware of that you might be wrong from a scientific perspective.

Gravity is always pulling us down. As we walk, we are balancing with each step to keep gravity from



pulling us over….better known as falling down. The only thing preventing us from falling to the center of the earth is the ground. Our physical contact with the ground prevents gravity from completing its effort to pull us further down. This contact with the ground or Earth, is called **"Contact Force".** Sitting in a chair interferes with gravity pulling us to the ground, so our body in the chair or contact with the chair becomes a Contact Force.

On the other hand, if someone were you pull the chair (Contact Force) out from under you, you would suddenly continue to fall from gravity until your fall was once again interrupted by another Contact Force; probably the floor.

If there is nothing to interfere with your falling, this is called:

"Non-Contact Force"

That makes sense, right? You've just had a lesson, maybe your first, in physics.

Now to the point. ***Why do astronauts float with the illusion and sensation of weightlessness?***

Simple. They are constantly falling while in space. The interesting part is they are falling around the earth (in orbit) rather than toward the earth. While in orbit, they are traveling about 24,000 miles per hour around the earth which does not allow gravity to grab them and pull them down. The faster they orbit, the less strength gravity has on them.

So how do they come back to earth? That's simple too….they just slow down. The slower they go, the more earth's gravity can pull on them and once they slow enough, gravity pulls them violently downward to earth. This allows them to re-enter Earth's atmosphere and drop by parachute or land like the space shuttle.

If I throw a baseball or a football, it doesn't drop to the ground, but rather seems to float through the air for a while until it slows down and gravity pulls it to the grass.

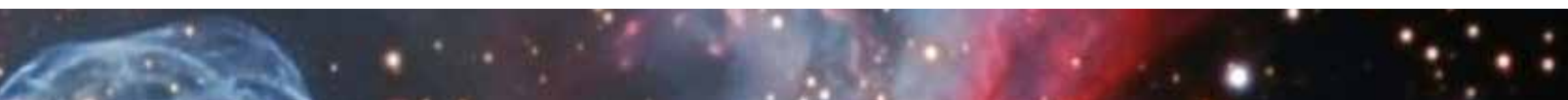
The harder you throw the ball, the longer it stays in the air.

The faster astronauts travel in orbit, the longer they stay in space. The big difference is that in space there is no air to slow them down. Air molecules create resistance and slow down anything that tries to go fast through it, like a car or plane or you running. In space where there is no air to slow things down so spacecraft like the Shuttle, Space Station and satellites keep going fast for much, much longer and are able to stay in space for long periods of time.

The force of gravity can never be felt because our bodies are designed to function in this gravity. Yet those forces that result from contact can be felt, such as falling down or crashing your bike. In the case of sitting in your chair, you can feel the chair force; your body is pushing down against the seat of the chair and it is this feeling or force that provides you with a sensation of weight.

The gravitational force of Earth would make a falling object accelerate at 9.81 m/second squared (if there is no resistance).

Weightlessness is only a sensation; it is not a reality. People don't suddenly have no weight. As you are free falling like a sky diver, you have not suddenly lost all your weight. The sensation or illusion of weightlessness has very little to do with weight and mostly to do with the presence or absence of forces. Many people believe that orbiting astronauts are weightless because they do not experience a force of gravity. To think that the absence of gravity is the cause of the weightlessness experienced by orbiting astronauts would be incorrect because ***there is never an absence of gravity…..anywhere.***

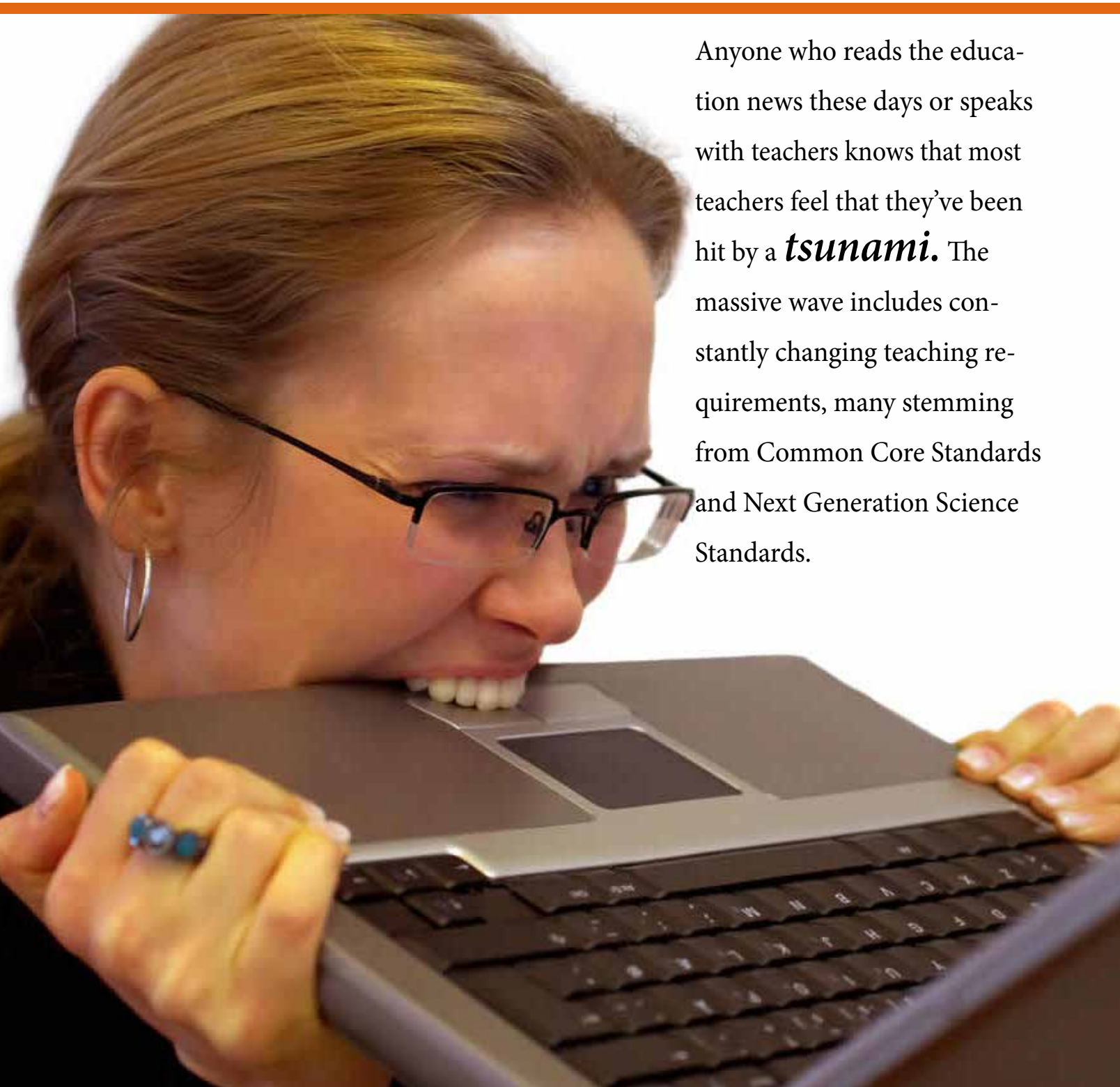



Everything always weighs something.
Everything is always falling.

Planning and Reflecting on Teaching:

Is there Any Relief in Sight?

Dr. Richard Larson is the Mitsui Professor of Engineering Systems at MIT



Anyone who reads the education news these days or speaks with teachers knows that most teachers feel that they've been hit by a ***tsunami.*** The massive wave includes constantly changing teaching requirements, many stemming from Common Core Standards and Next Generation Science Standards.

The massive wave includes constantly changing teaching requirements, many stemming from Common Core Standards and Next Generation Science Standards. It also includes reduced budgets, managing quite heterogeneous classes, and a huge number of classroom hours per year second only to Chile, among all OECD countries. And, until recently, lessons preparation was a solo job, an artisanal craft industry activity, etched somewhere into private at-home hours after dinner and perhaps after the kids go to bed.

No wonder 50% of school teachers abandon the profession within five years! The pressure is too great, the rewards – except of course for influencing the lives of young learners – too small.

Is there any relief in site? Well, one promising innovation is web-based Lesson Sharing, providing contributing teachers with a mechanism to share their lessons with others. Typically the authors of these shared lessons are single teachers. These lessons may be offered at no charge or for a modest fee.

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Showing that demand is high, lesson- sharing websites now have wide followings. TeachersPayTeachers.com, for instance, has over 750,000 lessons that have been downloaded 13.7 million times.

One kindergarten teacher, Deanna Jump, has earnings from TeachersPayTeachers in excess of $1,000,000. Total teacher earnings have exceeded $30,000,000. BetterLesson.com has over 600,000 lessons, and in 2013 averaged over 300,000 visitors a month.

ShareMyLesson.com, a project of the American Federation of Teachers, has been one of the fastest growing of these websites, with nearly 250,000 lessons contributed in its first year of operation. Though the online lesson-sharing space is diverse and each of the websites utilizes a unique approach, all lesson-sharing websites have two main goals: public posting of lesson plans and curation to help organize and identify the appropriate lesson for each teacher.

To achieve these goals, lesson-sharing websites either use experts or crowd sourcing, with and without money exchanged. Problem: The curation is uneven, and the time spent by a teacher seeking the perfect, posted lesson might equal or exceed her/his time saved by using someone else's excellent lesson.

Bring in "Lesson Study," the joint production of a single lesson by a small team of teachers over the course of a few months. The resulting lesson plan – typically truly excellent – is usually 'on paper' and used only locally.

Lesson Study has become ubiquitous in Japan and is catching in the U.S., for instance in Florida with CPALMS leading the way.

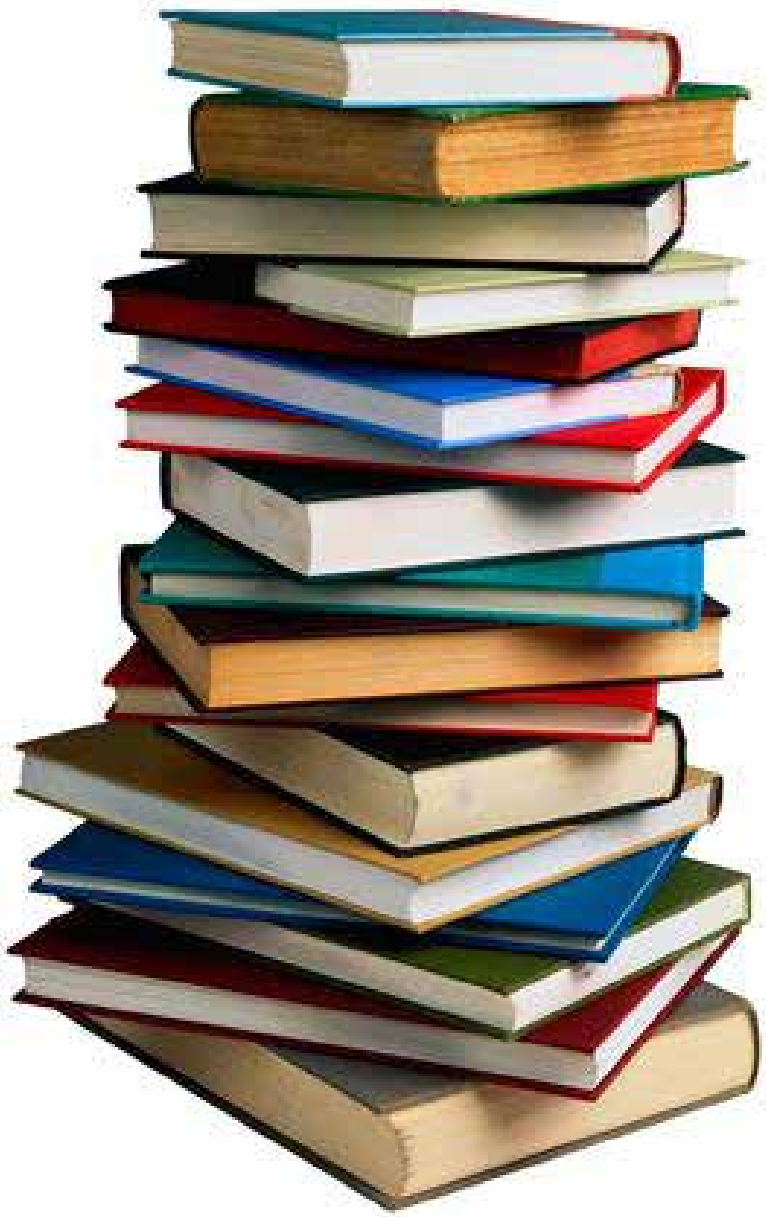
The goal of Lesson Study is actually less about the lesson itself being delivered to students in a classroom, and more about small groups of teachers working together collaboratively, focused on using the latest pedagogical theories to create the near-perfect lesson. It allows teachers to reflect deeply on their profession and to improve each of her/his lessons, even

those not subject to Lesson Study scrutiny.

With this as background, we call your attention to a new paper, Lesson Study and Lesson Sharing: An Appealing Marriage, co-authored by Mackenzie Hird, Richard Larson, Yuko Okubo, and Kanji Uchino.

The paper reviews the history and status of both Lesson Sharing and Lesson Study, and proposes a "marriage made in heaven," that is creating web sites that share Lesson-Study-produced lesson plans. This would involve some policy changes, in particular regarding number of hours a teacher works per year and other steps in PD – Professional Development.

The paper will soon be posted on the web for all to see, and it is being submitted for journal publication. We will happily send it to you if you email Professor Richard Larson at rclarson@mit.edu.



Fear

Student Fears. A daily reality.

There are 2 basic types of fear; ***rational and irrational.***
Our students face both daily, at school and home. Educators can only impact school.

Irrational fears may take the form of a phobia; an intense and persistent fear of certain situations, activities, testing, peer pressure, teacher approval, things, animals, people and for some students their personal successes.

The primary symptom of this disorder is the excessive and unreasonable desire to avoid what's causing the fear.

When the fear is beyond our control, and if the fear is interfering with daily life, then a diagnosis under one of the anxiety disorders may apply. This fear may range from mild discomfort, to an intense anxiety that inhibits social contact and attendance.

The natural fight or flight response is tattooed on our DNA. The greatest fear for the average American of any age is the fear of speaking in public, something we make our students do often and that they are totally ill-equipped to handle emotionally.

Is this rational or irrational? The fear is irrational, but the physical effects on the body can be very real and dramatic causing a sudden rise in blood pressure, racing heart,

sweating, dizziness, chest pain, weakness and overall panic. The emotional effects can be just plain terrifying. Are we actually in physical danger and at risk of death or injury? **Of course not**, but the effects on our mind and body are real.

Stories of professional athletes, entertainers and speakers becoming physical ill just prior to a performance, even after decades of experience, are very real. Phobias such as the fear of speaking in public, testing or failure are not usually diagnosed if they are not particularly distressing to the individual and are not frequently encountered.

An experience of being laughed at in class during a speaking presentation can have a dramatic and life-long affect on a student. A new phobia is born and the flight response kicks in causing avoidance behaviors, physical and emotional stress and confidence issues that will be passed along to every class and many situations. It may only take once. Is the student in real danger? No, but at the point of this new experience the student has to make some choices emotionally and mentally although mostly emotionally.

Bullying is a rational fear…. it's real, it's an object / person and students are dying. It's encouraging that national awareness and lack of toleration are growing, but it's still happening, even by teachers….I've seen it.

This rational fear at school directly interferes with scholastic performance, information retention, increased peer pressure, physical illness, loss of confidence and who knows what else.

There is an overall basic distinction between fear and anxiety. Anxiety is a vague unpleasant emotional state with qualities of apprehension, dread, distress, and uneasiness. All of our students experience this and so do we on occasion. In addition it is objectless.

Fear is similar to anxiety except that fear has a specific object. Can a person be both anxious and fearful about the same thing? Yes they can, and both will have to be dealt with. Class should be a safe place with no real fears.

Control: we all want it, but in class the student has very little control thus complicating the ability of handle fear and anxiety. They can't run or escape as a coping mechanism….the flight mode. Quiet suffering ensues right before our blind eyes daily.

Loss of control in a situation when there are unpredictable or uncontrollable events or expectations leads to anxiety and/or depression may result in feelings of helplessness. *How can we function in school effectively in the midst of constant helplessness?*

The inability or perceived inability to make an adaptive response to a threatening event or perception that no such response is available will lead to feelings of anxiety.

Our students are totally ill-equipped
to handle anxiety. It just eats away at
their body, mind and soul.

I have to take the test...there's no way out.

I have to stand up a give my presentation or I'll fail.

I have to take my report card home and I'll be in so much trouble.

I have to go to that class that makes me want to hurl.

I don't understand this, but I can't raise my hand.

Pressure to perform.

What class did we take in elementary
school to teach us coping mechanisms
for pressure, anxiety, stress and fears?
Kids are rarely able to rationally
distinguish between what fears are real
or imagined, they just react emotionally
and pay the price.

Let's help them cope.

If I could speak to your students early
and yearly, I would teach them this:

"The mind can only think of one thing at a time."

Since anxiety is very ambiguous, it is the key which prevents the elaboration of clear action patterns to handle the situation. Any idea or subject you're thinking about at that moment directly affects your state of mind and then your physical well being.

If you are thinking happy thoughts about a recent good grade, celebration or event then your mind translates those happy thoughts into happy feelings releasing feel good chemicals in the brain...thus a healthy body response and peace of mind.

So if you're constantly thinking about how scared you are, or how bad you might do, it totally occupies your thoughts, creating unhealthy feelings, anxiety, depression, increased fear, lack of focus, memory block, insomnia...and the list goes on.

As you think...so you feel.

Te

A **STEM** career we really need.

acher

One question I always ask during STEM presentations to students at schools is "*How many of you are considering becoming a teacher?*" The average response in a group of 60 students is one….or worse. When asked why, student replies vary from "I could never put up with teenager behavior", which is interestingly honest, to "The work is too hard and he pay is terrible"; another accurate evaluation.

You ask, "Why is the dropout rate of teachers higher than student dropout rates per capita?"

Like many careers, we are ill prepared in college for the realities of the career that has captured our hearts. Been there….done that. I'm not suggesting a solution but hope to enlighten you regarding the reality that no matter what subject you teacher, you are a STEM teacher already.

Science: Every teacher is a scientist by definition. Two definitions that every teacher uses:

1. Systematized knowledge in general.

2. Knowledge, as of facts or principles; knowledge gained by systematic study.

Name a class subject, sport or career that does not use systematic learning. Teachers are required to plan their curriculum to follow specific state and national standards. They rarely get to teach what they want or what's really needed. They follow a path of knowledge progression that continues based on past subject knowledge presented and required.

This could apply to history class following the course of the French Revolution, American History of the industrial age and its progression…..you name it.

Math is easy to include in our discussion because it's the basic language of science and grows from basic addition to algebra and on to trigonometry, physics and more.

Language Arts or English class are also a system of progressive knowledge following specific guidelines of proper grammar, the roots of words, proper use and combination of nouns, adjectives, verbs, poetic format, story format, specific writing styles and so on; all science based systematized knowledge. **You ARE a scientist, not by career but in practice.**

Technology

Every teacher is a technologist to some degree, from computers, iPads, cell phone, projectors, calculators, web searching, twitter, Facebook, excel, Word, and on and on. (software counts too) Aside from the fact that every teacher uses

computers or devices daily to research, plan and present subject curriculum and then store that information on a hard drive, thumb drive, the cloud or school server, every student in every class is expecting to use technology to successfully meet subject requirement, homework assignments, communications and test preparation. If they don't understand the technology application needed, that teacher, regardless of the subject they teach, is expected to explain its use.

***This is a critical point for educators** to remember.

We MUST stay current on technology innovation and applications. Our students are, and will continue to utilize them, even if we do not expect to use them in our own class. As with all teaching, we have to stay at least one step ahead of our students.

You *ARE* a technologist, not by career but in practice.

ENGINEERING is problem solving.

You need to solve big problems, small problems, everyday problems ...there is a **METHOD** and you already use it several times a day.

Let's refresh your memories.

1. Identify problem
2. Suggest possible solutions
3. Test solutions
4. Evaluate results
5. Pick best solution
6. Done.
7. Next?

Students:

- how do I get to basketball practice?
- how can I stretch my money?
- how can I finish all this homework?
- how do I make up with my best friend?
- how can I get my parents to see my side?
- how can I get a better grade in a class I don't like?

Teachers:

- how can I inspire my students?
- how do I incorporate this into the lesson plan?
- how do I get the administration to support this new program?
- how can I keep my cool when the class is going wild?
- how can I find my passion to teach again?

Mathematics:

For most teachers regardless of subject, daily math applications include basic calculations, measurement, estimation, logic, statistics, analysis, graphs, probabilities and I'm sure a few we've never heard of.

If you use any of these often and well you would be considered a mathematician by definition, not by career, but in practice.

As teachers, WE should be students..continually. What better example to our students than to be excellent students ourselves. How many of us have uttered the words, "I learn more by teaching than any other method." ***What have you learned lately…..hopefully today?***

My request or challenge to everyone reading this article is to share it or print it out and give it you a colleague or student who's convinced STEM isn't relevant to them or their subject. We are STEM creatures by nature and understanding that opens every door imaginable to any career we wish.

Within your subject area,you are an expert, a professional. Not only that, but you are a S.T.E.M. teacher in general and in a S.T.E.M. career.

Ex·pert [n., v. ek-spurt; adj. ek-spurt, ik-spurt] noun

1. a person who has special skill or knowledge in some particular field; specialist; authority:

2. possessing special skill or knowledge; trained by practice; skillful or skilled

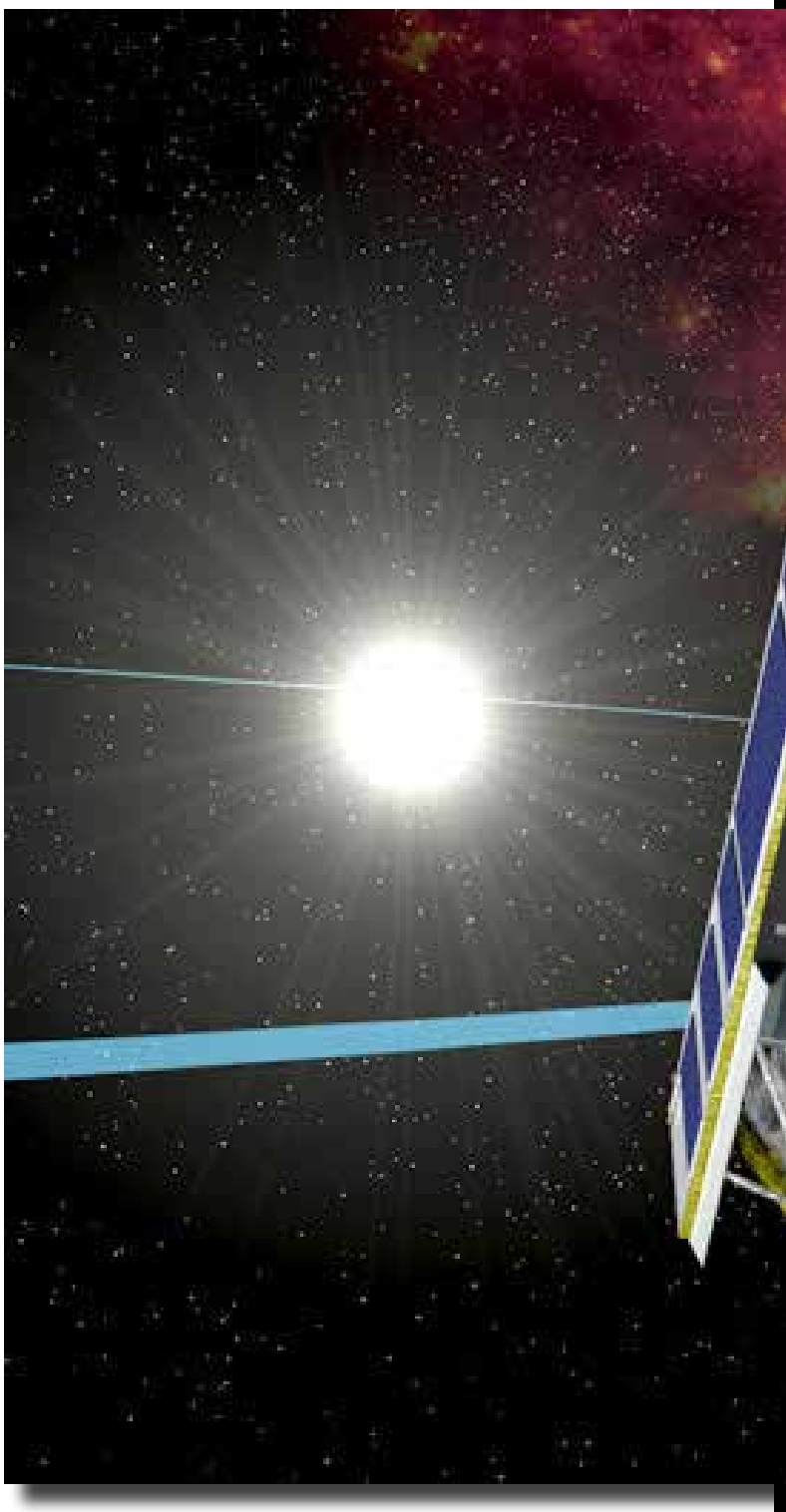
3. pertaining to, coming from, or characteristic of an expert: expert work; expert advice.

Teacher:
A S.T.E.M. Career

The First Public Space Telescope

Christian Wiederer
Institute for Astronomy and Space Technology, Munich, Germany

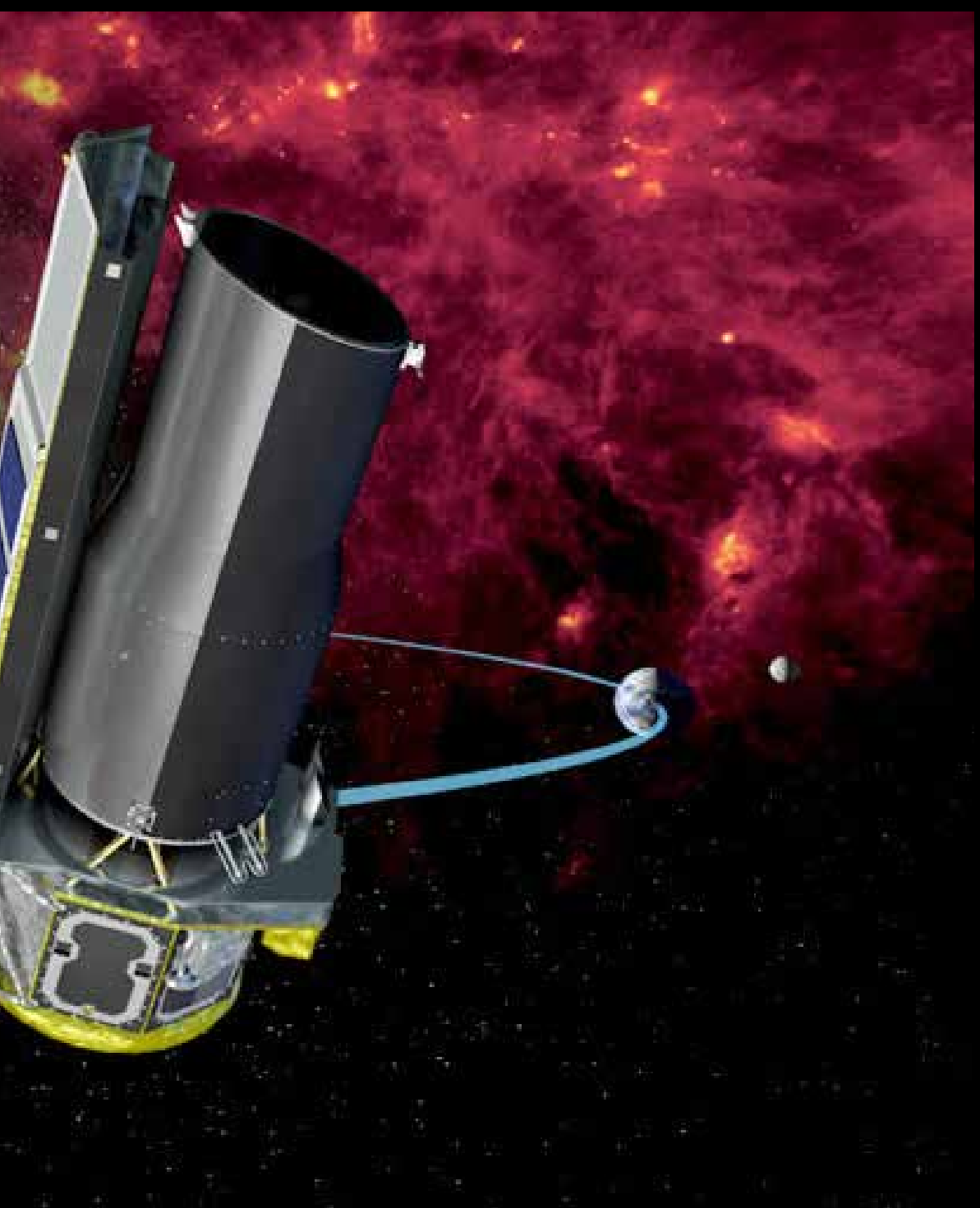
The main objective of this project is to make astronomical observations available to a wider international audience, not just the select few.



Everyone can access "**Public Telescope**" from amateur astronomers, educational institutions and scientists to members of the public all from the comfort of their classroom or home over the web.

The space telescope is currently being designed in Germany and is planned to be operational in 4 years. Once the telescope has reached earth orbit, it will be available worldwide for everyone to access.

The planning and execution of the project Public Telescope is coordinated by an experienced team under the direction of the initiator Heiko Wilkens and Christian Wiederer. The project is also supported by renowned experts from science and technology, amongst others by ESA astronaut Gerhard Thiele, astrophysicists and university professors Dr. Hanns Ruder and Dr. Klaus Werner and the optics and telescope developer Harrie Rutten.



Recap:

Recap of green energy-

Research into renewable, non-polluting energy sources is advancing at such a fast pace, it's hard to keep track of the many types of green energy that are now in development. Here are 6 of the most common types of green energy:

Solar Power - The most prevalent type of renewable energy, solar power is typically produced using photo-voltaic cells, which capture sunlight and turn it into electricity. Solar energy is also used to heat buildings and water, provide natural lighting and cook food. Solar technologies have become inexpensive enough to power everything from small hand-held gadgets to entire neighborhoods.

Wind Power - Air flow on the earth's surface can be used to push turbines, with stronger winds producing more energy. High-altitude sites and areas just offshore tend to provide the best conditions for capturing the strongest winds. A network of land-based, 2.5-megawatt wind turbines in rural areas operating at just 20% of their rated capacity could supply 40 times the current worldwide consumption of energy.

Hydro-power - Also called hydroelectric power, hydro-power is generated by the Earth's water cycle, including evaporation, rainfall, tides and the force of water running through a dam. Hydro-power depends on high precipitation levels to produce significant amounts of energy.

Geothermal Energy - Just under the earth's crust are massive amounts of thermal energy, which originates from both the original formation of the planet and the radioactive decay of minerals. Geothermal energy in the form of hot springs has been used by humans for millennia for bathing, and now it's being used to generate electricity. In North America alone, there's enough energy stored underground to produce 10 times as much electricity as coal currently does.

Biomass - Recently-living natural materials like wood waste, sawdust and combustible agricultural wastes can be converted into energy with far fewer greenhouse gas emissions than petroleum-based fuel sources. That's because these materials, known as biomass, contain stored energy from the sun.

Biofuels - Rather than burning biomass to produce energy, sometimes these renewable organic materials are transformed into fuel. Notable examples include ethanol and biodiesel. Biofuels provided 2.7% of the world's fuels for road transport in 2010, and have the potential to meet more than 25% of world demand for transportation fuels by 2050. It's available now if we'd use it, and we should.

To the students reading this article I can only ask:

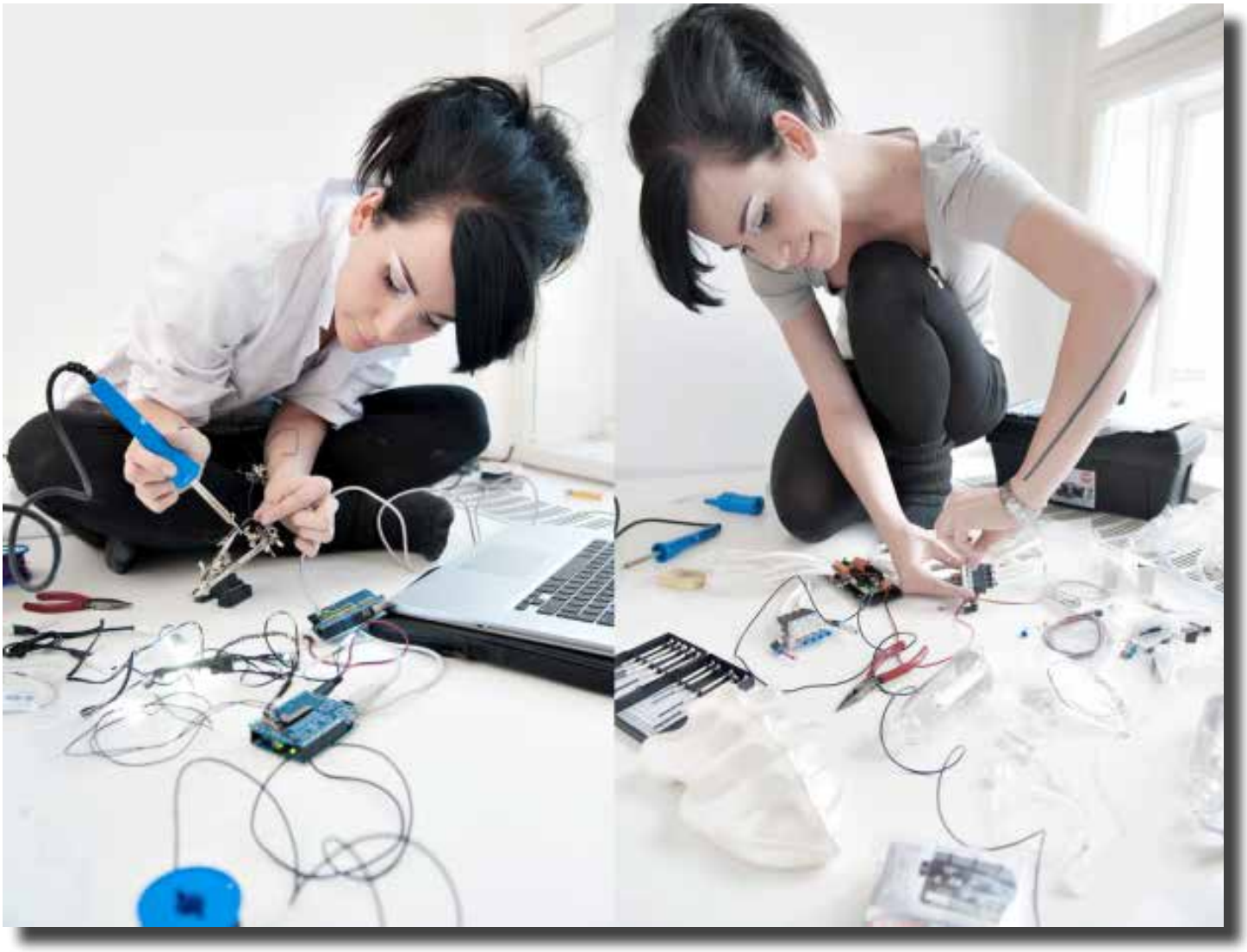
"Will you save our planet please?"

To the teachers I would ask:

"No matter what subject you teach, this issue directly affects you, your students and their families. Please find the time to make them aware of our shared plight and the challenges they face here on our world?"

Fashion Tech

Dutch clothing designer ***Anouk Wipprecht***, scientist, engineer and girly girl.



Socially aware clothing.

In the way her clothes respond to the wearer and the environment, they begin to have their own agenda. This area of socially-aware wearable computing is very interesting because, when in the right context, clothing that is responsive could be extremely beneficial. Perhaps they could aid in misunderstandings between people, where sometimes words break down.

Or perhaps they could convey an emotion that is hard to express. Maybe clothing can do this? For people with autism or PTSD or other special audiences, perhaps they can especially benefit from these enhanced garments. We feel a lot safer in our mental space, so how does this clothing help us mature in our emotional awareness? In what context does this kind of clothing work best for us?

"Learning to resolve or communicate emotions through wearables is something I am very interested in seeing more of in the future."

Perched on the wearer's shoulders are animated robotic limbs that eerily crawl around the body. The robotic dress both incites the curiosity of passersby by coyly dancing around the wearer's body while at the same time protecting the wearer if somebody approaches too fast or comes to close.

Engineering / System Development

Intelligent Product Design

Microcontrollers & Sensors

User Experience Design

Wearable Electronics

Artificial Intelligence

Robotics & Mechanics

Ambient Intelligence

Emotional Design

"In my robotic fashions, I like to project my systems externally, so you can see how and where everything goes and flows.

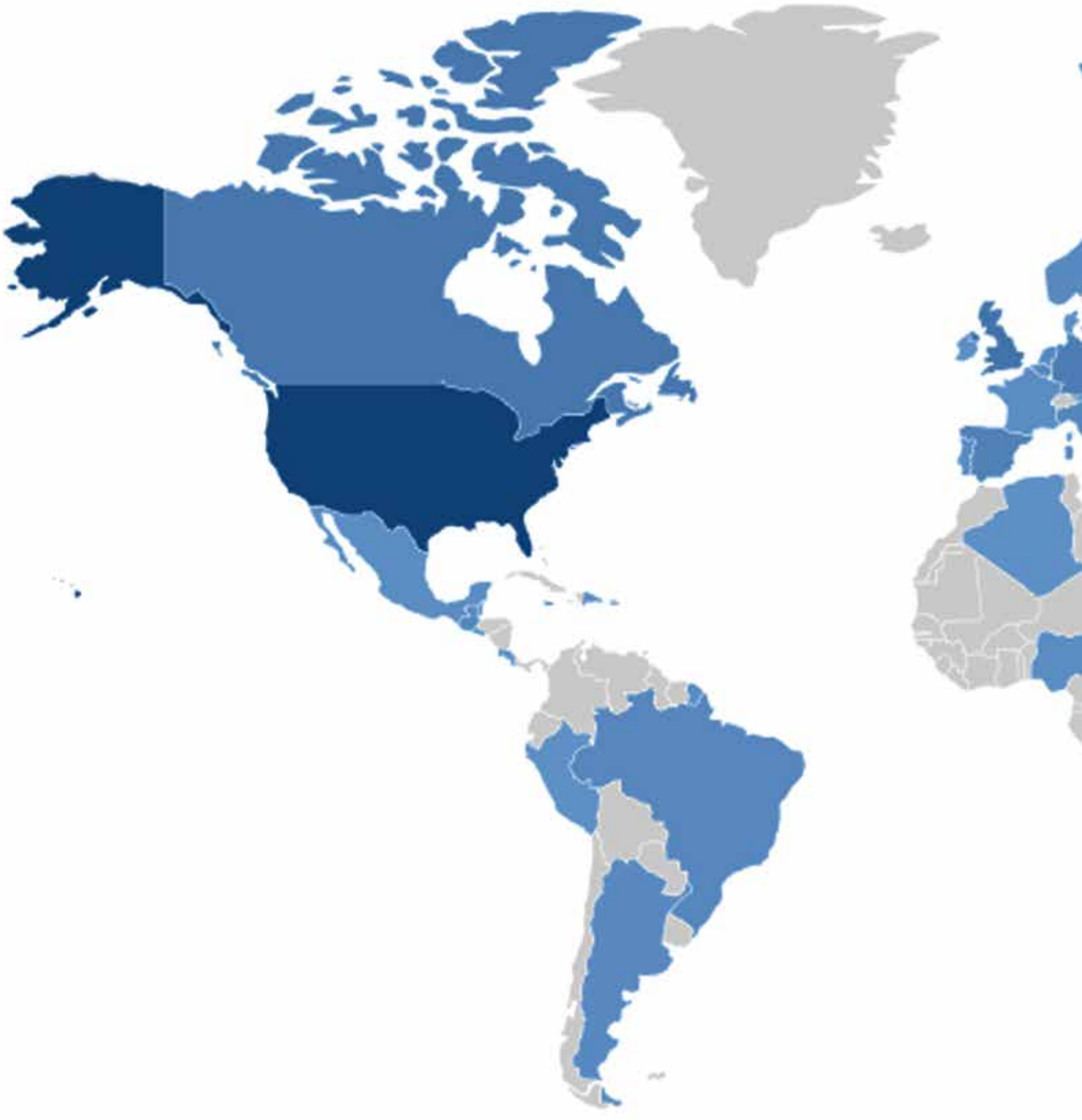
People love this. As because I can explain to them in a simple way how the system runs along the body...

...it becomes educational.

"I love robots, but I hate the fact that all the cool stuff (the mechanics and electronics) is always hidden and boxed in."

Anouk Wipprecht

Current global monthly readers of STEM Magazine



51% (+) of monthly readers

49% (-) of monthly readers