STEM

MAGAZINE

Green Chemistry

"Save the Gummy Bears"

Burned-Out

Soft Skills:

A desperate need

March 2016
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STEM Innovations

A Math and Science Partnership Initiative in Northwest Indiana

Dear Educators,

As we look forward to warmer weather and much needed spring breaks please note the following events and dates below and mark your calendars:

- ***March 12th-STEM Innovations Make and Take Workshop***: REGISTER HERE
  Geared toward all 7th, 8th and 9th grade MSP grant district math and science teachers, the workshop offers opportunities to engage in activities to build lesson plans which will address science, math and engineering components of content and process standards across multiple grade levels.Teachers will participate in two sessions of their choosing, one in the morning and one in the afternoon. Registration closes March 7th.
- ***April 13th-STEM Innovations Cohort II second follow-up session***: Registration opens March 14th
- ***June 13th-17th-2016 STEM Innovations Summer Institute***: The week-long institute is designed to strengthen STEM focused leadership and instructional capacity through high quality professional development. During the week you will have the opportunity to experience the camaraderie of colleagues from your school and surrounding schools. Math and science teachers of grades 7, 8, and 9 will join together to engage in the over-arching goals of the grant. Watch your emails for updates and links to register.

On February 8th teachers who participated in the 2015 STEM Innovations Summer Institute met for the first follow-up session. Teachers began the morning by working in teams to review the STEM Integration Curriculum Assessment (ICA). Part of the professional development also included teachers dividing into smaller groups to debrief the STEM challenges developed at the summer institute. The majority of the professional development found teachers involved in the Hexbug activity. The overall purpose of this activity was to highlight the difference between an activity that teaches “design” but does not teach “engineering” design. It also highlighted the need for feedback and communication as part of teamwork and collaboration.

Thank you to those of you who presented feedback about the first session. The design team will take your comments into consideration as they plan and design activities for the second follow-up session on April 13th.

Keep an eye out for more opportunities for the STEM Innovations participants through offline assignments and professional development activities in the coming months. The design team is in the process of finalizing these assignments.

Your STEM Innovations Team

MERRILLVILLE COMMUNITY SCHOOL CORPORATION

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 environment.

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

Wayne Carley
Publisher
STEM Magazine

School, district, county and state subscriptions are available.

To find out more, simply send your E-mail request to the E-mail address below.

You would have unlimited distribution to your teachers, students, parents and friends.

STEM Magazine is also PDF printable and mobile device friendly.

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STEM Magazine is a non-profit monthly education publication for teachers, students, their parents. The example and inspiration of individual educators carries tremendous weight on a daily basis, greatly impacting the quality and effectiveness of the classroom environment.

Wayne Carley is the publisher and senior editor for all content in S.T.E.M. Magazine.

Wayne Carley
Publisher
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Curiosity is the engine of intellectual achievement—it's what drives us to keep learning, keep trying, keep pushing forward.

No matter what you teach, find **"one minute"** in your class schedule to make students curious about something.....anything.

Surprise them.

Example: ***"Did you know that there are more life forms living on your skin than people on the planet?"***

https://www.quora.com/Is-it-true-that-there-are-more-lifeforms-on-your-skin-than-there-are-people-on-the-planet

Soft Skills:

There's a huge shortage and corporations are *desperate* for them.

When is the last time you heard "Yes Sir or yes Mame?"
How about ah huh or unh uh... (I'm not even sure how to spell those)

Don't hire me.

Hire Me.

A degree, technical skills and even a STEM degree may get you an interview, but these soft skills will get you the job and corporate America is having a hard time finding the combination.

You'll likely see these "soft skills" popping up in job descriptions, next to demands for technical qualifications. Employment experts agree that tech skills may get you an interview, but these soft skills will get you the job—and help you keep it:

Communication skills (language arts; the A in STEAM)

This doesn't mean you have to be a brilliant orator or writer. It does mean you have to express yourself well, whether it's writing a coherent memo, persuading others with a presentation or just being able to calmly explain to a team member what you need.

Personal appearance and manners (it starts in school)

Casual Fridays at work are becoming a thing of the past. Recent research shows a significant drop in employee productivity on those Fridays. There is just something about our personal appearance that effects the quality and quantity of our work.

People like to work with/do business with people who ***look professional***. It is in our nature as visually driven beings. It can give ease and a sense of trust. It's hard to be taken seriously if you look like you just rolled out of bed and are wearing what you wore yesterday. Dressing professionally signals that you have your stuff together and are organized. If your clothes are clean, pressed, and professional, it shows that you went the extra effort to be prepared.

Reputation: While we would like to think that everyone is judged solely on their performance, the truth is that you will be judged on your appearance, as well. You don't need to wear fancy clothes or have an expensive wardrobe. But, you will want to dress professionally for your job or industry. ***"Dress for success".***

Teamwork and collaboration

Employers want employees who play well with others—who can effectively work as part of a team. "That means sometimes being a leader, sometimes being a good follower, monitoring the progress, meeting deadlines and working with others across the organization to achieve a common goal," says Lynne Sarikas, the MBA Career Center Director at Northeastern University. ***It starts in elementary school.***

Flexibility and Adaptability

This is especially important for more-seasoned professionals to demonstrate, to counter the (often erroneous) opinion that older workers are too set in their ways.

To succeed in most organizations, you need to have a passion for life-long learning and the ability to continue to grow and stretch your skills to adapt to the changing needs of the organization and technology. On your resume, your cover letter and in your interview, explain the ways you've continued to learn and grow throughout your career. This is just as important for teachers as they pursue new positions.

Problem solving (the engineering method) Be prepared for the "how did you solve a problem?" interview question with several examples. Think of specific examples where you participated in solving a tough business problem. Be able to explain what you did, how you did it, how you involved others and what the outcome was—with real, measurable results. What class in middle school teaches this?

Critical observation (if you want to be an exceptional employee)

It's not enough to be able to collect data and manipulate it. You must also be able to analyze and interpret it and then apply it. What story does the data tell? What questions are raised? Are there different ways to interpret the data? What are the applications? Instead of handing your boss a spreadsheet, give them a business summary and highlight the key areas for attention, and suggest possible next steps. (language arts once again)

Conflict resolution (what class teaches this?) The ability to persuade, negotiate and resolve conflicts is crucial if you plan to be successful in any career.

Most teenagers, for a variety of reasons, do not yet have well developed skills in this area. You need to have the skill to develop mutually beneficial relationships in the organization so you can influence and persuade people. You need to be able to negotiate win-win solutions to serve the best interests of the company and the individuals involved. When it comes to soft skills, show—don't tell. Demonstrating these soft skills may be more difficult than listing concrete accomplishments like $2 million in sales or a professional certification. But it is possible to persuade teachers and someday potential employers that you have what they need.

"I'm a confident, professional women. Hire me.

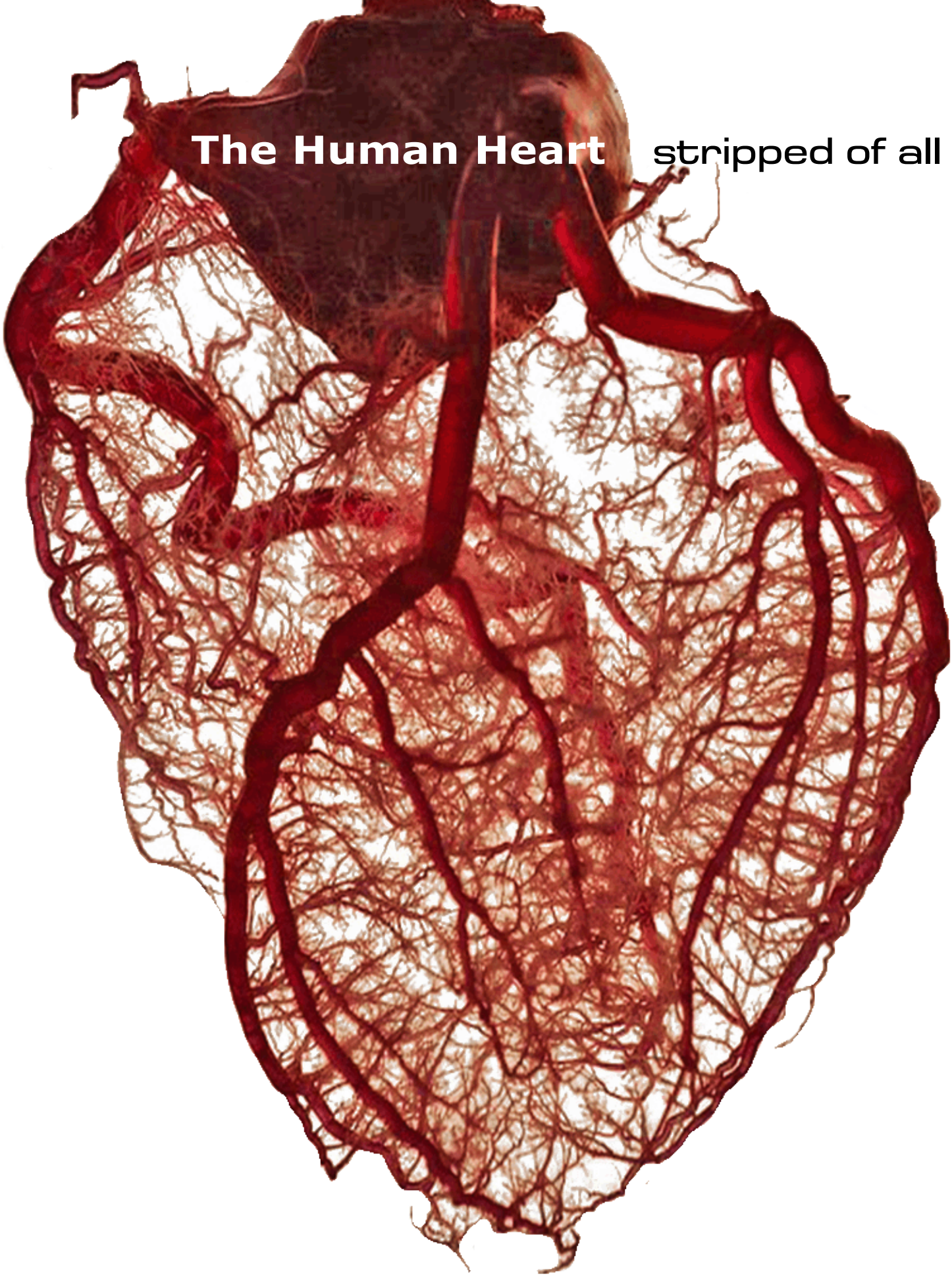
Susan P.
Software Engineer on a casual Friday.

To demonstrate communication skills start with the obvious. Make sure there are no typos or grammar mistakes in your homework.

On a resume, instead of stating, "Great oral and written communication skills", explain how you persuaded your teacher or boss to change their position, policy or procedures that benefited the class or organization.

Language arts may be the most obvious place to start, but every class will require these soft skills as well an ANY career you choose.

You only get "one" first impression.


The Human Heart
stripped of all fat

and muscle with just the *angel veins* exposed.

Amazing

Every day, your heart beats about 100,000 times, sending 2,000 gallons of blood surging through your body. Although it's no bigger than your fist, your heart has the mighty job of keeping blood flowing through the 60,000 miles of blood vessels that feed your organs and tissues. Any damage to the heart or its valves can reduce that pumping power, forcing the heart to work harder just to keep up with the body's demand for blood.

When it comes to matters of the heart, men and women definitely aren't created equal. For instance, a man's heart weighs about 10 ounces, while a woman's heart weighs approximately 8 ounces.

Health experts now have proof that laughter is good medicine. A good belly laugh can send 20% more blood flowing through your entire body. One study found that when people watched a funny movie, their blood flow increased. That's why laughter might just be the perfect antidote to stress.

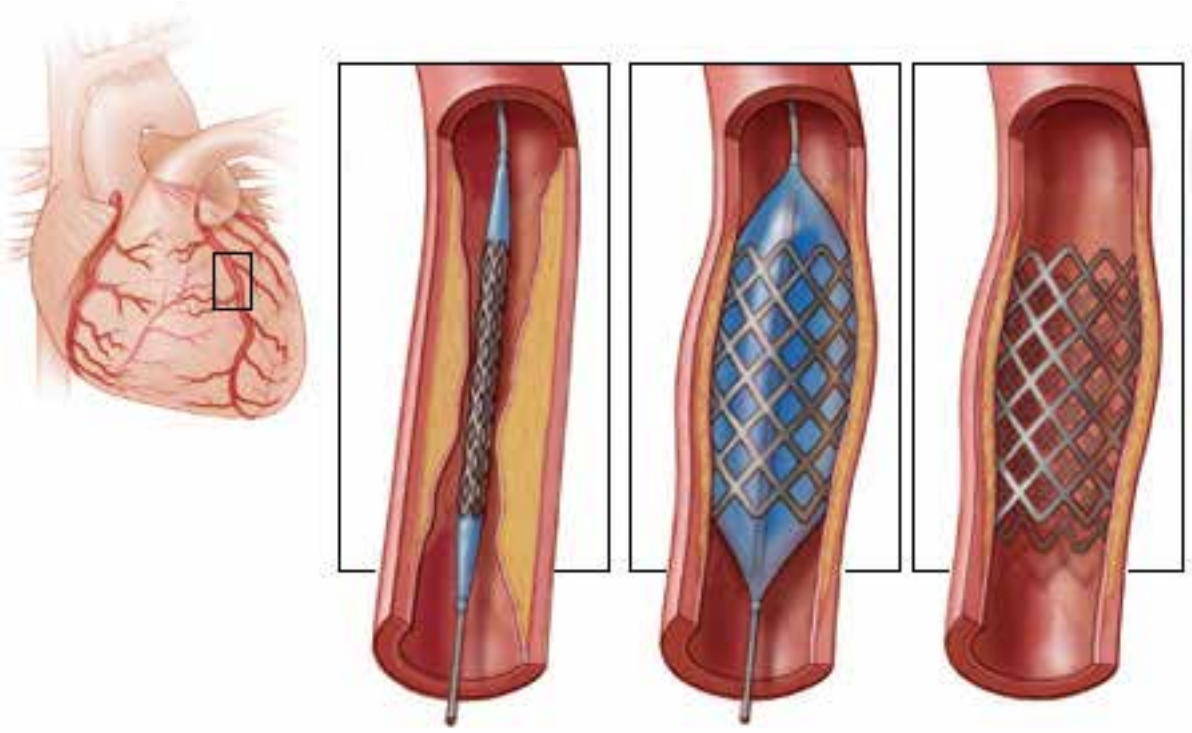
When you laugh, the lining of your blood vessel walls relaxes and expands, so have a good giggle. Your heart will thank you.

The heart, vessels and entire circulation system in your body is called the Cardiovascular System. We all know how important it is for life, and a healthy Cardiovascular System leads to a long and healthy life.

Let's consider possible careers that deal with the Cardiovascular System and how they are STEM careers. From a student nurse to a heart surgeon, the choices are vast and the amount of education required is vast also, but very interesting and challenging.

Cardiovascular System

Cardiologists (heart doctors) play a leading role in combating diseases and conditions of the cardiovascular system. They monitor, diagnose and treat heart conditions through a variety of non-surgical means, including medications and management of lifestyle factors. Some cardiologists also perform non-surgical procedures such as angioplasties and stent insertion (tubes and small balloons to open up the blood vessel), using tiny instruments inserted through a catheter into the patient's blood vessels and then threaded through the body to the trouble area.



Stent: *a small, expandable tube used for inserting in a blocked vessel or other part.*
(science, technology, engineering and math; all necessary for the Stent)

Although medication and other treatments can slow the progress of heart disease, some patients require surgery to repair or limit damage to the heart and its supporting network of blood vessels. This is the work of cardiac and vascular surgeons. They perform bypasses and open-heart surgery, as well as valve repairs, and other less-invasive (non-cutting) forms of therapy.

Imaging Professionals

Cardiologists and cardiac surgeons often rely on the work of imaging technologists to provide them with diagnostic insights. These are not doctors, but high school graduates who have attended a special school, from 1 year to 4 years to learn the operation of the Magnetic resonance imaging (MRI) and ultrasound technology that both provide useful images of the heart in operation, and ultrasound can help diagnose blockages in the veins and arteries by measuring blood flow.

Radiologists, who are doctors, review these images and advise their fellow physicians on their importance when it comes to deciding (engineering) the best treatment based on the pictures of the heart.

One type of MRI machine

(Magnetic resonance. Taking photos inside you using magnetism)

Education

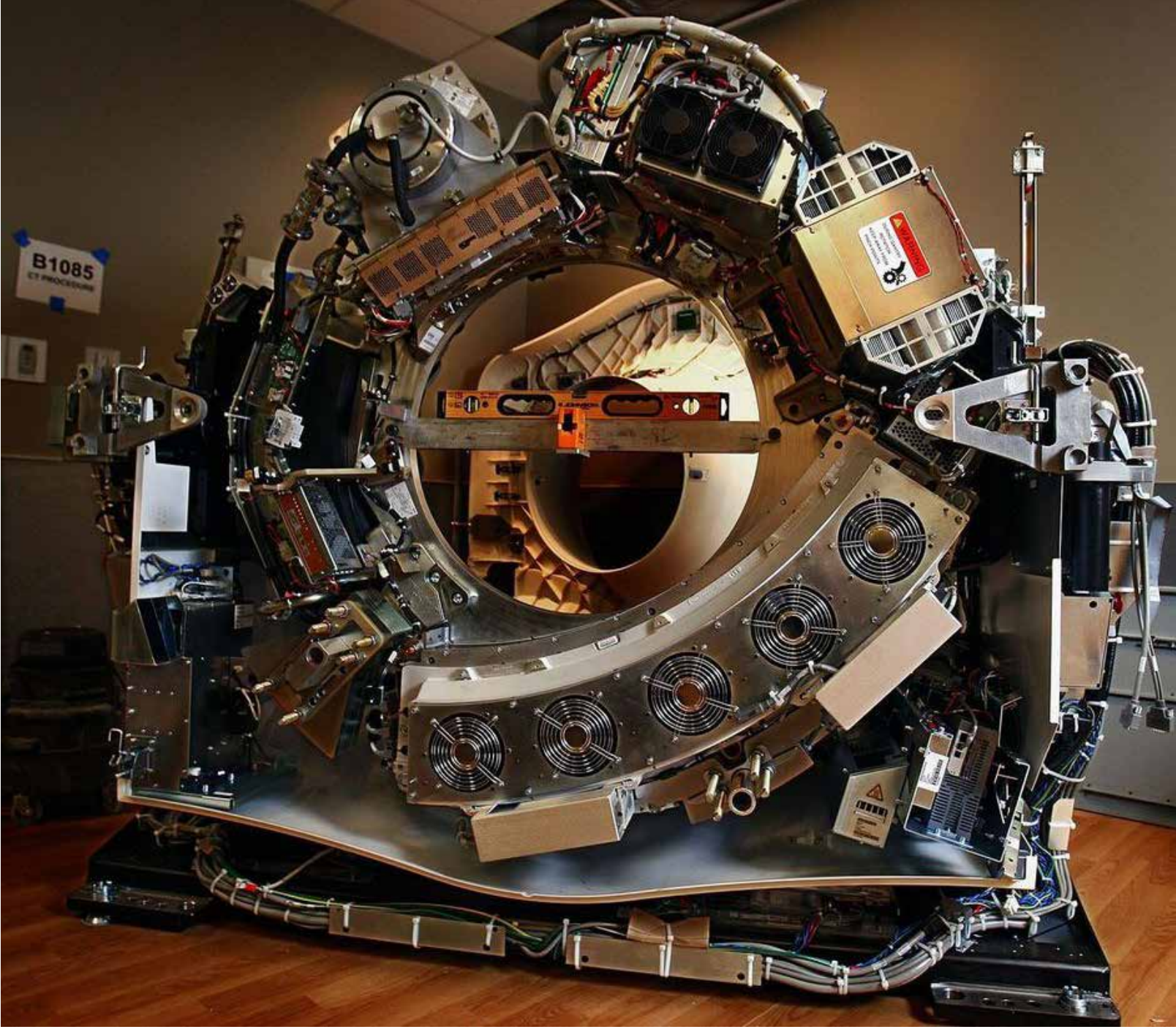
At minimum, becoming an MRI tech requires completion of an associate's degree in radiologic technology or a related field, followed by 1-2 years of additional study in an MRI technology certificate program.

Training

MRI certificate programs include extensive hands-on training in a variety of clinical settings. Newly hired technicians complete a period of on-the-job training during which they shadow an experienced mentor.

Interested?

This 13 Ton MRI Machine has a magnetic field 30,000 times stronger than earth's.



Inside workings of an MRI machine

Someone has to design and build this!

There are about 15 different STEM jobs required to build what you see. ***Does anything look interesting?***

Not all heart care is provided through scheduled appointments and office visits. Often, a heart attack or other critical event is the patient's first indication of a problem. Stabilizing patients and getting them to the hospital for treatment is the work of emergency medical technicians and paramedics. They're trained to administer medications, monitor the patient's condition, and, if necessary, to restore a heartbeat with a controlled electrical shock, or defibrillation.

Eating healthy is always good for the heart, but many believe that exercise is the key. The heart is one of the most important organs in your body. This powerful, compact muscle can fit in the palm of your hand but controls many of your body's vital functions, so good heart health is essential for a long, independent life.

It's important at every age to be proactive and pay attention to your heart. Making a commitment to regular exercise or playing hard, especially as you get older, can bring positive benefits that last well into your life. Regular physical activity can help you build strength and endurance, lower harmful ingredients in your blood, like too much fat (triglycerides) and keep the blood pressure of your heart within a healthy range. Vigorous exercise can also increase good ingredients in your blood, fight diabetes and keep you body weight down to normal.

The STEM of heart careers

The science of heart careers (research, study, jobs that directly help heart health), the technology of heart careers such as using the MRI, X-Ray and heart monitoring equipment to name a few electronic devices. The heart engineering jobs (the engineering method that helps make important decisions about how to treat the heart or replace it), and the math of the heart that determines amounts of medication, stress levels, your correct weight for your height, how fast your heart should beat per minute of exercise and so much more.

The world needs you in the cardiovascular field. It is great demand and offers dozens of fascinating career paths with a wide variety of salaries and levels of education. Check it out and give it your whole **HEART!**

You already know this, just be aware and pass it on.

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 and your students 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

Save the Gummy Bears! Save the World!

By *Dr. Amy Cannon*

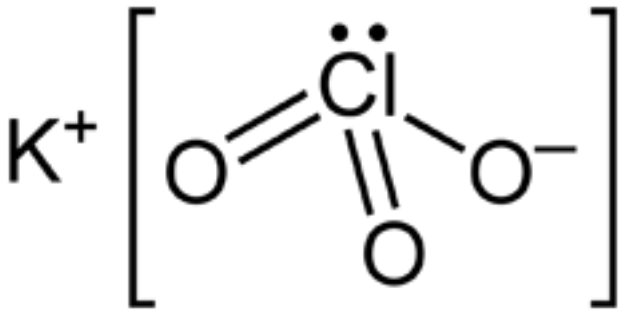
I recently received an e-mail with a link to an article that had the title "Chemistry class explosion injures seven". I was hesitant to open it, worried about what disaster I would find inside, but did anyway. The article was about a local chemistry teacher who was demonstrating a reaction between potassium chlorate and "food" when the reaction went "awry" and exploded upon her and seven students.

Luckily there were no life threatening injuries, just minor cuts and burns. But, despite these "minor injuries", my mind still went to that classroom on that day – I wondered what the teacher was trying to teach the students; I wondered how the students felt upon seeing that accident; and, I wondered how common this type of demo actually is in classrooms today.

Further investigation lead me to find that this is a fairly common demo used by chemistry and even non-chemistry teachers which involves the addition of a gummy bear (typically) to warmed potassium chlorate to produce quite a violent combustion reaction.

There are many, many YouTube videos of these poor gummy bears being tortured for our viewing pleasure. But, why? Why do we insist on torturing these delicious treats? To teach a lesson? To increase student interest in chemistry? Because we have something against gummy bears? All of these questions led me to write this note to you.

Let's first consider the science of this gummy bear destruction reaction. I am a chemist after all, and I always think about the science first. What can we teach students about chemical reactions or chemical reactivity by this demo? We are essentially performing a combustion reaction where potassium chlorate ($KClO3$) is reacted with sugar or sucrose ($C6H12O6$) and oxygen to produce carbon dioxide, water, potassium chloride and lots of heat.



Potassium chlorate, it turns out, is quite reactive and can put on quite a show upon prompting (or in some cases, not prompting… *yes, it is quite dangerous*).

It is used in EXPLOSIVES! Yes, explosives! Do a simple Google search of 'potassium chlorate' and you will find the gummy bear demo, along with another favorite of "instant fire", which involves the mixing of solid potassium chlorate with sugar – upon the addition of a drop of sulfuric acid will cause a violent reaction which typically ends up producing so much heat as to explode the Pyrex glass beaker it is held in.

In my experience as an industrial chemist – I find explosions to be very BAD and they typically end in the loss of life or the devastation of neighborhoods. This is not something to show children as a demonstration of a typical chemical reaction. (Perhaps an example of chemistry gone bad!)

In that Google search of 'potassium chlorate' you will also read all kinds of warnings about the reactivity of the compound, with warnings not to scrape it out of the jar too vigorously because it can produce sparks and therefore burst into flames.

It decomposes pretty readily into potassium chloride and oxygen (with lots of heat) – and, we all know that oxygen is a key component to keeping a fire going. And, if it decomposes this readily, then just maybe that jar that has been sitting around since the dawn of time in the chemical stockroom might be slightly more reactive than a fresh batch… something to consider.

Okay, I'm going to get off of my soapbox for a moment and think beyond the science of this demo. From what I have heard another goal of this demo is to "peak student interest in science". Now, let's think for a moment about that classroom that experienced the accident as a result of this demo. My thoughts are that the accident certainly did not peak student interest in science, but rather turned a whole lot of students OFF to chemistry.

They now equate it with danger, explosions and hazard. Who would want to put themselves in harms way and pursue a career in such a dangerous field? Now, as I stated previously, I am a chemist. I am actually trained as a green chemist. Green chemistry is the design of chemical products or processes that reduce or eliminate the use or generation of hazardous substances. Being a green chemist allows me to take a proactive approach to hazards and pollution prevention because I can target these at the design stage, preventing hazards and pollution (or reducing them) before they are put out there in the world. However, even as a green chemist, there is a certain amount of "risk" that I must take in order to work in a lab.

I work with chemicals of varying levels of hazards since we still do not always have greener alternatives available just yet. But, for me, I accept this risk because I know that each and every day that I am in the lab I am trying to be better than the previous day.

I'm working towards a zero emission, zero hazard, zero waste process. With that said, I ask you to consider what level of risk is acceptable. What level is acceptable for a high school classroom? As a trained chemist, I am able to understand the nature of the materials and chemicals I work with. But, for a student who is just learning the in's and out's of the science – how can we put them in situations where the risk is so high?

Regardless of whether or not we continue to use these type of demos in our classrooms, I ask you to consider the following questions before beginning:

1. What is the content of the lesson? What is it that I want to teach them?

2. What am I teaching my students about the field of chemistry or the profession of a chemist?

3. What take away lessons do I want them to have?

4. What level of risk is associated with this demo or laboratory exercise?

Thinking about these four simple questions might lead us to re-consider the demos we use or the lessons we adopt. Just remember that there are many, many ways to demonstrate a chemical concept – many can be found on our website (free-of-charge!). We can do so much (including exciting students) without explosions and fires. Everyday in classrooms students fall in love with art, literature, mathematics, history and foreign language – and, nothing ever gets blown up, explodes or lights on fire in those classrooms.

And, if you still want to demonstrate a concept and can't find a good substitute for that explosive reaction or the other dangerous demo that gets the "oooh's" and "aaah's" out of the students on a regular basis, then please, please send me a note.

For example, we can show students that the problem of ocean plastics is being pursued by chemists by showing them the shoe made by Adidas using up-cycled fishing nets.

We are always looking to expand our portfolio of offerings and we are always looking for another way to amaze students through green chemistry hands-on experiences. We find that students are quite excited about green chemistry because it offers a platform for them to use their creativity and apply it to solving problems.

There are plenty of industry examples of how chemists are solving problems to many of the global and local challenges our society faces today.

We can also show students how green chemistry involves a multi-disciplinary approach to problem solving by sharing Sharklet film with them, a film that can be adhered to surfaces to impede the growth of bacteria simply by its microscopic pattern designed to mimic the pattern of shark's scales. And, students can learn about green chemistry by creating their own solar energy device using simple materials and blackberry juice. Through green chemistry, students learn that chemists are innovative, problem solvers and they hold an essential piece to the sustainability puzzle. This is a message that we guarantee resonates deeply with today's youth.

Through our outreach and curriculum programs we have found that many students are turned on to science that would otherwise not have been. And, this is exactly our goal – to inspire the next generation of scientists that will help us create sustainable, green chemistry solutions to global problems. We believe this to be quite exciting. And, yes, we have gotten many "oooh's" and "aaah's" from students as they learn about chemistry through this lens. Oh, and, we also get to teach them a thing or two about chemistry without having to worry about the risk of being the next headline titled "Chemistry class explosion injures seven".

Amy Cannon holds the world's first Ph.D. in Green Chemistry from the University of Massachusetts where her research involved the environmentally benign synthesis of photo-active materials. Amy worked as an Assistant Professor of Green Chemistry and Director of Outreach and Community Education at the Center for Green Chemistry at the University of Massachusetts Lowell until September of 2007 when she left to co-found Beyond Benign. Her interests are in green chemistry education and research around safer green chemistry alternative technologies.

Beyond Benign is a non-profit working to providing future and current scientists, educators and citizens with the tools to teach and learn about green chemistry in order to create a more sustainable future. For more information and free curriculum resources, visit www.beyondbenign.org

Dr. Judy Willis
Neurologist

How to Rewire Your Burned-Out Brain:

Tips from a Neurologist

"For teachers and students."

The school year will be over before you know it, and with it comes a likely drop in the stressors that build up and promote teacher (and student) burnout. It therefore may not seem timely to suggest interventions to prevent or reduce burnout. However, it is often not until we are away from a high-stress situation for a while that the brain can move out of reactive survival mode and into a relaxed state where it can ponder the big picture.

The burnout interventions I am about to suggest are likely to be ones that you already know. The problem is, when it comes to adding another activity to your schedule, past experiences may have left you with the expectation that there is not enough time -- or you've tried things like this before and didn't notice any change.

So you stopped.

My belief is that when you understand what happened in your brain to build up the hopelessness and frustration of burnout, you'll connect with the logic of the interventions. Then, with the addition of the video game model to the boost the neurochemical benefits of the activity of your choice, you'll literally deconstruct the resistance network your brain constructed, and reset your circuits of confidence and motivation.

Know It's Not Your Fault

Teachers often blame themselves for problematic student behavior, failure to "cover" every standard, and not differentiating instruction to suit the needs of each student. Know that you are not alone, but part of a growing majority of educators questioning their abilities to continue teaching. You are teaching at a time when it takes profound commitment and creativity to meet expectations. There is pressure to teach excessive quantities of information and differentiate instruction to meet the needs of all students -- yet the supporting resources needed are dwindling.

Burnout feelings are not a reflection of your teaching skills. Teachers who question their ability to do their jobs properly are often among those who hold themselves to the highest standards. They also put in the greatest effort. When they must deal with external forces -- beyond their control -- *that limit their ability to attain their goals, self-doubt builds, confidence drops and burnout sets in.*

If You're Burned Out, Your Brain Has Rewired to -

Survival Mode

What I offer from the nexus of my dual careers as a neurologist and classroom teacher are interpretations and correlations from the neuroscience research to teaching and learning. Neuroimaging studies reveal the metabolic changes in regions of the brain where activity increases or decreases in response to emotional or sensory input.

There are specific and reproducible patterns of changing neural activity and brain structures associated with stress. In the high-stress state, subject's

scans reveal less activity in the higher, reflective brain and more activity in the lower, reactive brain that directs involuntary behaviors and emotional responses.

Prolonged stress correlates with structural increases in the density and speed of the neuron-to-neuron connections in the emotion-driven re active networks of the lower brain, and corresponding decreased connections in prefrontal cortex conscious control centers.

The explanation of these changes is generally attributed to the brain's neuroplasticity of "neurons that fire together, wire together." The brain literally rewires to be more efficient in conducting information through the circuits that are most frequently activated. As you internalize your thwarted efforts to achieve your goals and interpret them as personal failure, your self-doubt and stress activate and strengthen your brain's involuntary, reactive neural networks. As these circuits become the automatic go-to networks, the brain is less successful in problem-solving and emotional control.

When problems arise that previously would have been evaluated by the higher brain's reasoning, the dominant networks in the lower brain usurps control.

Reset Your Brain's Default Neural Network from Retreat to ***IGNITE!***

The good news is that you can apply what you now understand about your brain's survival mode to take back voluntary control of your choices. You can activate the same neuroplasticity that gave dominance to the lower brain networks in the burnout state to construct a new, stronger default response. With more successful experiences achieving goals, you can reset the circuits that will direct your brain to access its highest cognitive resources for creative problem-solving. You can build up new, improved circuitry, switching your responses from retreat to IGNITE!

Since a repeated pattern of effort-failure set up the brain's survival response to withhold effort, you'll need to strengthen the pattern of effort toward goals can result in success. Your weapon of mass reconstruction can come from your brain's very powerful drive for its own neurochemistry -- dopamine and the pleasure it brings.

The plan to guide you comes from the video game model that works because of three components: buy-in, achievable challenges, and frequent awareness of incremental progress en route to the

final goal.

See these resources for a full description of the video game model:

- *A Neurologist Makes the Case for the Video Game Model as a Learning Tool*

- *How to Plan Instruction Using the Video Game Model*

The fuel that motivates the brain to persevere through increasing challenge, even through failed attempts, is dopamine. This neurochemical produces the pleasure of intrinsic satisfaction, and increases motivation, curiosity, perseverance and memory. Dopamine is released when the brain makes a prediction or achieves a challenge and gets the feedback that it was correct. This can be in situations from the "Ah, I get it!" of figuring out a joke to the satisfaction of completing a marathon.

Just as the video game model can be applied to building a growth mindset in students, the same model can help rewire your mindset regarding your ability to achieve teaching goals at school. As in the video game model, to get the dopamine-pleasure response from challenges achieved, you'll need to plan for your brain to experience frequent recognition feedback of incremental progress.

You should set your "rewiring" goals by their desirability and by the goals' suitability to be broken down into clear segments.

This way, you can chart your goal progress as you achieve each stepwise challenge. The pleasure burst of intrinsic motivation that will accompany your recognition of each progressive increment achieved in the goal pathway will keep your brain motivated to persevere.

Goal Buy-In for Your Brain's Neural REWIRING

Buy-in and relevance are important in choosing your rewiring goal. Since your goal is to rewire your brain's expectations that your efforts will yield progress, even through increasing challenge, you need to really want the goal. This is not the time to challenge yourself with something you feel you should do but won't really look forward to doing, such as dieting, climbing stadium stairs, or flossing after every meal. Select a goal that you would enjoy en route and at the finish.

Usually goals are tangible. Some are visible, such as planting a garden or making pottery on a wheel. Others are auditory, such as playing an instrument, or physical, such as learning tai chi.

But your goal can also be the increased amount of time you sustain an activity such as journaling, practicing yoga or sketching.

Sample "Rewiring" Goals
You'll find your own goal for buy-in, but here are some examples to give you a sense for how to structure your new goals.

Physical Goals

Notice I didn't say exercise. That's not as motivating as "training" for a physical goal you want to achieve, even though they often overlap. If you want to run a 10K, and if you enjoy running, the goal for achievable challenge could be first building up to the distance starting with the baseline distance you comfortably run now. Then plot out the increments that you'll consider progressive successes, such as adding 5K a day or a week.

The increments will depend on what you consider both challenging and achievable. Once you reach 10K, speed can become the next goal, again plotted out in segments of incremental progress before you start.

Archery?
Possibly after seeing The Hunger Games, archery has new appeal. Again, plan your stepwise achievable challenge increments. Start with a home dartboard (a low initial investment) and throw from a close but challenging distance. As you get better in accuracy, move farther back. Record your results, noting the distance of each improvement you set as an achievable challenge. If you get so good that the dartboard no longer challenges you, try that archery!

Learn a Language
But try this one only if the buy-in is strong enough, such as definite plans to go to a country where the language is spoken.

Videography / Photography
If it appeals to you to make high quality videos or PowerPoints using advanced computer software, go for an early success, such as the videos you can make on www.animoto.com.

Repeated effort-reward experiences promote neuroplasticity, and this makes a neural network that expects positive outcomes into your new default network. This is because your "rewiring" goals helped your brain build stronger and more connections into a memory pattern where effort brings pleasure.

As with other networks not used, the previous lower brain stress-activated go-to response network you developed, the one that caused you to react to problems, will be pruned away from disuse.

You'll be rewired with optimism and renew your positive expectations. With your higher, reflective brain back in control, you'll be able to access your perseverance, innovation and creative problem-solving when you return to the classroom. Just be sure you take time to recognize each small success and creative problem-solving opportunity.

Keep up the habit of breaking down big challenges into opportunities for recognizing incremental progress and receiving your well-deserved dopamine reward. The brain needs that battery recharge to sustain the positive expectations that motivate continued effort -- so that you can stay engaged and move to the next step toward your teaching goals.

Your Rewired Brain's Default Changes from **Defeat** *to* ***Ignite***

Dr. Judy Willis *is an authority on brain research regarding learning and the brain.*

No matter what you teach, understanding how the brain learns, both yours and your students, is ***critical***.

That's why this issue is for you.

Use it in class.

Forward this to your students and their **parents**.

Make this a new connection for curiosity and interaction.

Submit an article: wayne@stemmagazine.com

Living / surviving

Green

Of all the career choices available and all of the articles we write on the subject of S.T.E.M., none is so vital, critical.....desperate.....as this.

A career choice that promotes green energy and the conservation of our natural resources will actually change the world. More than simply changing the world, it will SAVE the world.

Why all the attention on green energy?

All current research suggests that the Earth is being destroyed to the point of ending human life. With the exception of extinction from a source outside of our atmosphere, like an asteroid or meteor, this is the first time the human race has reached a point of actually inflicting permanent damage to the planet.

To keep our planet livable, since past and present generations have and are still causing so much damage, ***it will be up to our students to save us and their children.***

How are we killing the Earth?

Air pollution is the introduction into the atmosphere of chemicals, particles, and biological matter that cause harm to humans, other living organisms, or cause damage to the environment.

Depletion of our ozone layer that protects our planet in the stratosphere has long been recognized as a threat to human health as well as to the Earth's ecosystems.

The ozone layer extends from six to 11 miles (9.6 to 17.7 kilometers) up to nearly 30 miles (48.3 kilometers) above Earth. This range, or layer, is composed of oxygen gas and ozone gas. The ozone layer forms naturally, where the ozone and oxygen gases continually convert into each other. It serves as an effective barrier against the sun's ultraviolet (UV) rays that are very harmful. In the absence of ozone's protective shield, life as we know it on Earth would be extinct.

The Earth is capable of cleaning itself of a certain level of pollution, but man-made pollutant have become too numerous for the Earth's natural mechanisms to remove. We are seeing the results of this overload in the form of acid rain, smog, and the variety of health problems that can be contributed to our environment.

Why are adults allowing this to happen?

The answer to this question stings a bit, but you deserve an honest answer. Money is the reason: both the love of having more of it and the balance of our worlds economy that is dependent on it. It's ironic that money is green don't you think?

We already have the technology to save our world, but the consequences would change our way of living too fast and too drastically. Millions of people would be out of work, unable to buy food or have a home.

I remember a story about the company who invented a car tire that would never wear out.....50 years ago. The process and rights to that tire were bought by another tire company and locked away...never to be used.

Why? There is no profit. No one would every have to buy tires. No would have to make them. No factories would have to be built. No jobs would be available. Multiply this example by 20 other industries and you see how it impacts lives and making a living.

How can we change this way of living in time to save our world?

- Make saving the world a profitable endeavor.

- Make "green" jobs so we can provide for our families.

- Change the worlds economy with these green jobs so green industries become what we depend on.

Green energy and conservation jobs will dominate our student's futures both as innovators, employees and consumers. The best start is to better understand our current definitions of Green Energy and the associated careers knowing full well it will change dramatically over the next several decades. The Bureau of Labor Statics has developed this definition of green jobs for use in data collection. Green jobs are either:

A. Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.

B. Jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources.

Here is the good news. You get to choose those jobs. You get to create new ones. Using STEM, you get to invent what we need to save our world.....your world.

Green Jobs in businesses produce goods and provide services that benefit the environment or conserve natural resources. These goods and services are sold to customers, and include research and development, installation, and maintenance services.

Renewable energy creates electricity, heat, or fuel generated from renewable sources including:

Wind
Biomass
Geothermal
Solar
Ocean
Hydro-power
Landfill Gas and Municipal Solid Waste

Energy efficiency products and services improve the use of energy and include energy-efficient equipment, appliances, buildings, and vehicles, as well as products and services that improve the energy efficiency of buildings and the efficiency of energy storage and distribution, such as Smart Grid technologies.

Pollution reduction and removal, greenhouse gas reduction, and recycling and reuse: These are products and services that reduce or eliminate the creation or release of pollutants or toxic compounds, or remove pollutants or hazardous waste from the environment.

They reduce greenhouse gas emissions through methods other than renewable energy generation and energy efficiency, such as electricity generated from nuclear sources.

We can also reduce or eliminate the creation of waste materials by collection, reuse, re-manufacture, recycling, or compost waste materials or wastewater. But what is green energy, and what makes it a better option than fossil fuels like oil and coal?

Green energy comes from natural sources such as sunlight, wind, rain, tides, plants, algae and geothermal heat. These energy resources are

renewable, meaning they're naturally replenished. In contrast, fossil fuels are a finite resource that take millions of years to develop and will continue to diminish with use.

Renewable energy sources also have a much smaller impact on the environment than fossil fuels, which produce pollutants such as greenhouse gases as a by-product, contributing to climate change.

Gaining access to fossil fuels typically requires either mining or drilling deep into the earth, often in ecologically sensitive locations.

"Green energy resources are renewable, meaning they're naturally replenished."

Using your voice to be *heard*

By Julie Utano

***H*ow you communicate** something can be just as--or more important--than what you are actually saying.

We've all been in a meeting when someone presents a great idea and no one picks up on it. Ten minutes later, a colleague says almost exactly the same thing and suddenly everyone is interested. Credit for the idea is given to the colleague.

Why does this happen? Sometimes this occurs because of gender bias in STEM fields, but other times it has more to do with our own voice. Some of us speak too fast, some too slowly. Some of us have voices that carry and some have such soft voices that we can barely be heard.

Here are some tips on improving how you speak.

Posture. Never slouch while you are sitting as this can shift the alignment of your air passage and block the flow of air. Good posture also shows confidence. Sit up straight; it helps make your words heard.

Warming Up. Warming up your voice before a big meeting or presentation is important. Humans have a strong fight-or-flight instinct which causes us to tense up our muscles and hold our breath when we are nervous. Athletes warm up their muscles before they work out; your vocal instrument is no different.

Here are some warm-up exercises that can help:

- **Hum.** It's one of the best warm-up exercises you can do.

- **Relax and Breathe.** Sit tall in your chair and inhale, and then massage your temples in a circular motion while exhaling. Next, massage the hinge of your jaw while inhaling and exhaling. Yawning is another good way to release tension.

Practice. Practicing gives you more focus and control.

Take a simple phrase and repeat it a few times, accentuate a different word each time you repeat it.

For example: "I think we should <insert your word>." Varying pitch in different words makes a huge difference. Practice stretching out consonants which will slightly delay the rest of the word; it can help you dddddraw outttt yourrrr audiencccccce.

While you are driving or in your office, practice and rehearse different scenarios that could pop up. Think, "If this is brought up, I will say that." Practice your responses and pay attention to where you are getting hung up. The more you practice, the more confident you will feel when you are talking. If you are giving a talk, practice in front of the mirror. Look and listen to yourself. Think about where you can make improvements.

Strategize. If you know your voice gets shaky when you are put on the spot, make sure you have a glass of water nearby. Pause, take a small sip and a deep breath, sit up straight, and start speaking again.

Julie Utano *is Associate Executive Director of the Association for Women in Science, the largest multidisciplinary organization for women in science, technology, engineering, and mathematics (STEM) dedicated to achieving equity and full participation of women in all disciplines and across all employment sectors.*

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.

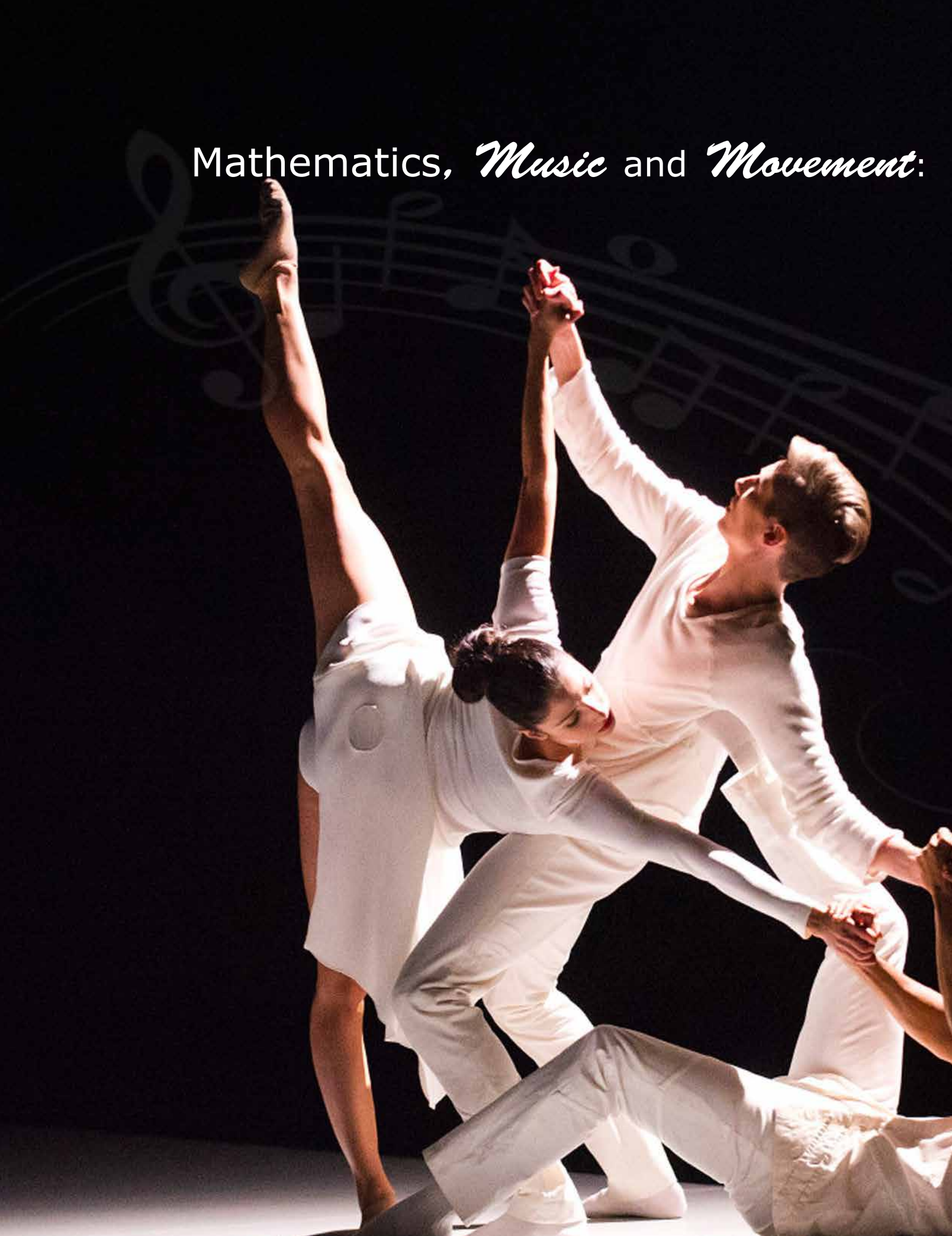
Architecture often includes design or selection of furnishings and decorations, supervision of construction work, and the examination, restoration, or remodeling of existing buildings or material objects.

Assignment:

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

WHAT IS THIS?

Mathematics, *Music* and *Movement*:



Engaging *All* Students Inside the Mathematics Classroom

Part II

by

Dr. Gina Cherkowski

Early Music Training and the Brain

There is a prodigious amount of music and learning research looks at how early childhood music training affects music development and other areas of child development such as language, creativity, affective development, motor skills, visual spatial abilities, and social development (Jordan-Decarbo & Nelson, 2002).

It has been noted that music training before the age of seven was found to have a significant impact on brain development (Penhune & Zatorre, 2013). Haley (2001) found that people who had learned to play a musical instrument prior to grade four had higher scores in mathematics than those who did not.

Music and Math

Historically, there is a strong connection that exists between music and mathematics (Vaughn, 2000). Recently, there has been a significant and increasing amount of literature bringing awareness to the strong connections between music and math (Hoch & Tillman, 2012), however the vast majority of North American education systems still do not take advantage of this powerful connection.

Much can be learned from this explosion of research as it supports previous assertions that music has a positive effect on one's ability to learn and do math (Gardiner, Fox, Knowles & Jeffery, 1996).

Math, Music and Spatial Skills

A growing body of research has found that music is connected to mathematical learning as it engages the area of the brain that stimulates the spatial-temporal reasoning system (Rauscher & Shaw, 1994). Spatial skills are critically important as they are considered the foundational building blocks for learning math as well as for performance in the STEM (science, technology, engineering and math) fields (Uttal, Meadow, Tipton, Hand, Alden, Warren & NewCombe, 2014).

Put simple, spatial reasoning is described as a critical higher-brain function that is engaged when students are performing complex tasks like doing mathematics (Rauscher & Shaw, 1994).

Rauscher & Shaw (1997) looked specifically at how musical training impacted spatial-temporal reasoning skills in preschool students. In their study, 78 preschoolers were given pre and post-test to measure their spatial abilities before and after a given treatment.

One-fourth of the preschoolers participated in private piano lesson for ten to fifteen minutes each week for six months in a row. Other students received either computer literacy instruction, singing lessons, or were in the control group. Results of the study showed no statistically significant improvement in the control group, nor in the groups that received computer literacy or singing lessons.

However, the group of preschoolers who participated in piano lessons improved by more than one standard deviation in their spatial temporal reasoning scores which is considered to be statistically significant (Rauscher & Shaw, 1997). Interestingly,

these improvements were maintained when students were tested 24 hours later thus linking the improvement of students' spatial skills to long-term memory.

This study confirmed that the music instruction has significant impacts on students' spatial-reasoning skills as the students who received piano instruction show significantly more improvement than the other children did on the a puzzle based assessment.

Music and Sequential Reasoning

Music is said to have a positive impact on sequential reasoning, another important math skill (Gardiner, 1996). Sequential tasks involve logic, order, realism, practicality, time-lines, organization and being able to pay attention to details. In a study specifically designed to compare different types on music training on math skills, one group of first graders were given music instruction that emphasized sequential skill development and musical games involving rhythm and pitch while another group was given more traditional music lessons for six months.

At the end of the study, the students who were given the music instruction that emphasized sequential skill development along with musical games scored significantly better in math than the students who received more traditional style music instruction (Gardiner, 1996).

Music and Fractions

Fractions are difficult to learn for many children (Hecht, Vagi, & Torgesen, 2007; Mazzocco & Devlin, 2008) and adults (Stafylidou & Vosniadou, 2004). This is highly disconcerting as fractions students' knowledge of fractions is a strong predictor of their overall later high school mathematics achievement (Siegler, Duncan, Davis-Kean, Duckworth, Claessens, Engel, Susperreguy, & Chen, 2012). Furthermore, students that do not understand fractions often struggle with algebra and mathematical reasoning (Courey, 2006).

According to Susan Courey, assistant professor of special education at San Francisco State University, music can impact learning fraction in positive ways. At Hoover Elementary School in the San Francisco Bay Area, some students participated in a musically enhanced math curriculum while other students received traditional math instruction. After six weeks, the students in the musically enhanced group scored fifty percent higher on a fraction test compared to students in the traditional math class (Courey, 2006).

What was even more interesting was that significant gains were made by lower-performing students.

For example, lower-performing students from the musically enhanced curriculum scored forty percent higher on their final test on fractions compared to their lower performing peers in the traditional math class. According to Courey this is because lower-performing students often found it difficult to understand fractions when they were presented in textbook or in a diagram.

She adds that adding music gives students removes barriers for many students and provides them with multiple ways to learn and understanding fractions.

Finally, music has also been linked to problem solving as according to Gardiner, musical training conditions the brain to do tasks similar to those it has to do when working on math problems (2003).

Music, Movement and Other Important Math Skills

In addition to facilitating spatial skill development, increasing sequential skills, and enhancing fractional reasoning, learning math through music combined with movement (dance) has been found to be particularly beneficial for students as they learn math (Schaffer, Stern & Kim, 2001). For example, according to McCutchen (2006), when students participated in a dance based math class, students' attitude towards math students improved and they scored much higher than the students who were in the more traditional, non-dance based math class.

"Lower-performing students from the ***musically enhanced*** curriculum scored forty percent higher on their final test on fractions compared to their lower performing peers in the traditional math class."

In addition to improving attitudes towards math, dance has been found to be an innovative way to teach students the fundamentals of mathematics in a ways that helps students see and understand these ideas. Dance provides students with basic intuition about the abstract and sometimes hard to grasp concepts found in math. For many students, dancing enables them to apply an abstract mathematical idea to a more familiar real-world context which they can see, feel, and experience.

When students experience math through dance, this makes math more accessible and engaging for many students (Wasilewska, 2012). According to Kokona, (2009), "Culture and Arts can help practitioners train and develop a further understanding of Dance Mathematics principals,".

Many people find it strange to combine dance with mathematics as they see math as a realm of rationality that limits expression and creativity while dance is seen as a form of free expression that is highly creative. However, upon closer inspection we can see a lot of connections and commonalities between math and dance. For example, there are a lot of mathematical ideas that can be found in dance such as time and space, rotation, number, geometry, patterns, sequence, number, and even graphing (McCutchen, 2006). Research suggests that dance has been found to be highly beneficial for understanding mathematical concepts like combinatorics, symmetry, geometry, and patterning (Schaffer, Stern & Kim, 2001).

Additionally, abstract mathematics and various methods of analysis can be applied to help dancers of all skill levels understand dance at a much deeper level. Many choreographers often create their dance pieces based on intuition and feeling however, it has been suggested that being explicitly aware of the mathematical principles they are applying might help them with the creative process (Wasilewska, 2012).

Conclusion: STEM + Arts = Opportunities for all

Math is a critical and necessary skill for all students in today's technologically-advanced, data-rich world. Students who are not mathematically literate will be greatly disadvantaged in this future world. Consequently, it is unjust not to give every student the opportunity to be mathematically literate so they can be optimally positioned to be a full and active participant in their future.

Since neuroscience tells us all students can do math at high levels, (Boaler, 2012), we know this goal is not only a nice dream, it is in fact attainable. Therefore, society must ensure all students can access the mathematics easily, effectively and in ways that allow them to understand it in their own way.

This white-paper argues that combining music and movement with math is one way to help achieve this critically important and timely goal. Adding music and movement to mathematical learning removes barrier of entry for many students, provides meaning and

context, and makes learning math fun and engaging for all learners. Additionally, learning math through movement and music helps allows math concepts to no longer remain abstract and disconnected from students' real world experiences.

Through the integration of the ARTS (music, visual arts, and/or performing arts) with math students get to feel, experience, understand and embody math. As research has shown us, if students feel it, see it, and do it, they will get it especially when we add music to the equation.

STEM Magazine is.....Global