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Use it in class. Use the smart board.

Send this link home with your students so they can share with their parents, connect and talk about STEM careers and how best to prepare.....together.

Curiosity and learning are ageless.
Content

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Question Everything / Andrew McMillan / Wayne Carley

The Power of Open / Joseph Wilson, Spongelab
Canada’s future requires us to reflect on the needs of our learners and more broadly our citizens. STEM is uniquely positioned to help develop ethical citizens that are innovative problem-solvers and self-motivated life-long learners. We believe that engagement in practical STEM educational experiences will help equip Canada’s youth with the knowledge, skills and abilities such as creativity, ethical innovation and critical problem solving approaches to ensure our youth succeed both at home and abroad.

STEM + Arts = STEAM, by adding Arts to the equation STEAM becomes a holistic approach to learning which celebrates the importance of seamlessly integrating STEM and creating an inspired learning environment where learners are both engaged and challenged.

Dr. Gina Cherkowski
Editor in Chief
STEM Magazine Canada
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Using Technology to Inspire
Students outside of the Classroom

by Katrina German

“I am proud of my identity, my background, my culture,” shared a student from Mount Royal Collegiate.

His comments were a part of the project evaluation for a recent partnership between the Saskatoon Public School Division and OneStory.com, an easy way to create and share video interviews.

Students from the Grade 10 classroom were sent into the community armed with iPads and the app. They interviewed over fifty First Nations and Metis people asking “What is it that makes you a strong and proud indigenous person” and “What are your strengths, teachings and expertise that you want to share with First Nations and Metis youth?”

The teacher, Belinda Daniels, started the project with the idea “that as indigenous people, we are contemporary and come from all walks of life but still hold our beliefs, traditions and practices close to our heart.” She also added “Indigenous peoples cannot be characterized and generalized in the same way.”

The resulting interviews were powerful.

Glenda Abbott ran from northern Saskatchewan to Panama in an honour run for water. She shared in her video: “If there is one thing I can pass on, from that journey or that experience, it would be ‘learn who you are first so that you are able to share that with the world.’ I learned that I was a Nehiyaw, a Cree women. I shared that with many different nations, from here to South America.”

Chief Simon Bear created an interview in the Cree language and one in English. He talked about losing his brother and the distinct characteristics of the Cree nation.

The value of the project for the students was three-fold. First, they were inspired to come to class and learn from each of the people they were interviewing. “This project made the students excited and they pretty much came to class everyday,” observed Daniels.
Students agreed. One remarked: “My favourite part would be hearing from strong, proud and successful First Nations people!” Another shared that her favourite part of the project was “Learning from our people and not a text book.”

As the OneStory technology automatically edits the interviews into a mini-documentary, the students were able to see the interviews they had conducted in a polished form within minutes of completing them. This encouraged them to safely explore basic video capture and interviewing skills.

“There was many things I learned, how to hold an iPad, how to use the app and all the advice!”

The second major benefit was introducing the technology to the classroom – or rather allowing the technology to take the students out of the classroom. Although some of the
interviews happened inside the school, many students travelled around the city. One student, sharing a common sentiment, stated her favourite part of the project clearly as “Not being in the classroom and going out in the community.”

Third, students developed alternative skills such as public speaking. One teen expressed value in “learning how to public speak with confidence, making eye contact and knowing what to say.” This was echoed by another classmate who learned “the courage to speak in public to others and not just our teacher.”

The overall success of this initial project inspired Daniels to use the interview process with other classrooms to tackle difficult conversations about Murdered and Missing Indigenous Women in Canada and the Intergenerational Effects of Residential schools. She has also used the technology to inform the public about a Cree language learning camp. Daniels adds “This app is a toll to be used for not only recording digital data but is creating a different kind of research, other than photo voice. It is really about creating powerful stories that benefit the community, the world!”

Saskatoon Public Schools representative Jacqueline Helman was enthusiastic. “This project exceeded our expectations in terms of the videos created the value to students. Not only did we create a powerful learning experience but we also created videos that the public can learn from.”

The most important reviews came from the students. “These stories motive and inspire me in so many different ways,” shared one of the students. Another response was “go after any opportunity given because anything is possible.”

**Technology + Inspiring Project = Success for Students.**

Katrina is the CEO and Co-founder of OneStory.com, an easy way to create and share video interviews. OneStory has videos from nineteen different countries that range in topics from inspiration to women’s rights to the future of sustainable investing. Education groups from around North America are using OneStory as a tool to make video interviews a part of classroom projects and evaluations.

Students can create interviews with no editing required and the instructor has an easy way to integrate
technology into the classroom. OneStory guides students through the interview process and then automatically edits the videos into a mini-documentary within minutes of completing the interview. All of the videos are stored in once place for easy sharing and teacher access. There are public and private options available.
As with most words, there are several definitions to choose from, though very similar in meaning. Science is most often associated with the physical world and careers such as biology and medicine. Several other definitions of science are interestingly similar, so for the sake of this STEM discussion we’ll use these three:

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

- systematized knowledge in general.

- skill, especially reflecting a precise application of facts or principles; proficiency.

*Name one career*, in any field of study, and the “systematic acquisition of knowledge” is a daily necessity. *No matter what job you have*, from mechanic to astronaut, the addition of new knowledge is necessary to be competent, better and complete in that field.
This process of “continued learning” has never been more true than now, as innovation, technology, discovery and imagination change almost daily.

If we....all of us....stop learning new skills for our profession, we are falling behind, and as everyone knows, the further behind we fall, the harder it is to catch up. Fact is, the falling behind is our choice often seen in maturing adults who have stopped learning. So back to our belief that every career is a STEM career.

The systematic (having, showing, or involving a system, method, or plan) learning often has to be done in a specific order so it’s learned and applied correctly. Step by step is the process, from basic math or coding to physics and complex software development.

You start at A and work your way to Z. Anything can be learned by anyone using this systematic approach. You may get stuck on H or K in the process until you “get it”, then you move on to L and so forth. I didn’t know how to walk at one point until I took my first step....then another and another. Soon I was running.

Pick any job, sport, hobby, video game or activity you can imagine and this process is necessary.

I myself plan to spend the rest of my life learning something today I didn’t know yesterday, partly because I need to do more than just keep up, but actually lead the way. If the average teenager, young adult, mature adult.... or teacher plans to stay “employable” in the changing world, Science as the systematic and continual accumulation and application of knowledge need to become our lifestyle.

Sports uses science
Auto mechanics uses science
Nursing uses science
Plumbers use science
Piloting uses science
Carpentry uses science

You’ve already started, so just continue, maybe even pick up the pace, and pursue to systematic accumulation and application of new knowledge in whatever direction you choose.

Male or female, you have NO limits since we all start at “A”.

Pick any job, sport, hobby, video game or activity you can imagine and this process is necessary.
“The Systematic Accumulation of Knowledge”
Confession of a Mother and Scientist – Part II

My Daughter Detests Science and How I am Working to Change This for Others

By Dr. Jennifer M. Jakobi

Resources and programs available to teachers and parents about Sciences, Technology, Engineering and Math (STEM) are expanding exponentially. As a mother, I was aware of these opportunities but as a scientist I was committed to exposing my son and daughter to them.

Human, biological and physical sciences were discovered through toys, backyard exploration and community programs. In the early years, my daughter was a regular at the local Science Centre and both children undertook numerous camps where brochures outlined exploration, discovery and enquiry. However, as my children approached ‘the tweens’ I became painfully aware that not only were they minimally excited about the sciences, but they had even started to dislike anything ‘science’. They had lost the eagerness to explore and the energy for discovery and science had become boring lists of facts to be memorized, identified and labelled.

In 2013, the Mind Over Muscle program was named and spearheaded by a dedicated and passionate group of 23 university students enrolled in a 4th year Neurophysiology Course at UBC Okanagan. The purpose was to engage university and primary school children with each other in an environment for exploration and discovery.

My objective was to create a program where interaction between the two cohorts of students would steer science back to inquiry and (I hoped)
excitement towards science – even just for a day. The inaugural event hosted 31 youth rotating through six neuroscience work stations. The foundation for discovery was structured by the hands-on experiments designed and administered by the university students.

However, the interactions and energy were driven by the elementary school children doing what they do best – innocently ask questions. This and subsequent events demonstrated that most primary school children don’t hate science and that inquiry is not lost to university students; rather, as a society we ‘teach’ it out of them. The benefit of engagement across these two cohorts of students is far-reaching. Beyond fostering discovery and creating an environment where science is exploration, the exchange creates learning that is difficult to measure but easily observed and communicated.

University students convey they are challenged in this context, but learn how to translate the detailed textbook physiological facts into real-life examples and hands-on interactive experiments. Many university students express surprise at the challenge in answering the simple, yet insightful questions that primary students ask freely and regularly.

Primary school children are not constrained in exploring and are openly excited about learning from university students. The labs are designed to be ‘hands-on’ where action potentials, reflexes and muscle activity are explored with natural curiosity harnessed through discovery. In the end, children learn about neuroscience through inquiry.

The Mind Over Muscle program has now engaged about 500 youth from grades 2 – 12, with attendance ranging between 12 and 100 participants through formal classroom trips as well as open camps organized on local professional development days. A number of formats have been explored but success is determined by two key elements: exploration through hands-on experiments (where we use cell phones as jokes – ‘here is hands-on not hands-free’) and a mixing and mingling between the two cohorts of learners. Party pack chips provide great examples of each individual taste being better because it is mixed in with other chips and as a package it is great.

Faculty members at universities and colleges, as well as primary school teachers, can readily create programs like Mind Over Muscle. The much-needed resource – the students - is often sitting right in front of
educators, and both cohorts are happy to leave their learning environment for the other. As parents and educators planning an intergenerational science experience, there will be obstacles and organizational effort, but neither are insurmountable.

Hints for Success:

Start with a Call: Local colleges and universities, particularly engineering and science departments, have student groups or faculty/staff leads for community engagement. If there are no formal programs, many independent instructors are willing to engage primary school children in the university lab or make a classroom visit. The most overt obstacle is often lab space and availability, so flexibility in timing of material might need to occur.

For example, if ‘space’ is the current classroom topic and a campus visit centres on human science during that time period an opportunity to create links can be created. With forewarning, questions and examples can be designed to consider how the body reacts to a gravity free environment. This could create laughter and fun with interactive exchange that generates understanding and knowledge.

Hands-On, NOT Hands-Free:

Work towards active participation. Large, complex and expensive brain models can be redesigned and adapted with Styrofoam heads purchased at your local art or dollar store. Cut-outs can be pinned on to create cortical areas while bundles of yarn twisted and crossed creates a network of spinal neurons. End the pathway with a group of flexible straws encased in plastic wrap entrapped in a nylon sock with a rubber band at each end and the muscle tendon junction is formed.

This pathway creates many opportunities for exploring neuroscience, from the generation of cortical signals to muscle contractions. Brain areas can be explored through jumbled words and sentences read out loud where language formation and understanding can be discussed. When balance is altered on foam platforms and vision impaired with blindfolds and crazy glasses sensory feedback and postural balance can be discovered and learned.

Couple that with muffled hearing and altered tactile sense through gloves or tape and perception becomes a game of identifying the unidentifiable – reaching into a bowl of Jell-O containing shoe laces and
frozen fruit to find well known objects evokes the imagination and laughter as senses are delved into through adaptation. These and many other experiments are easily modified between school environments and for groups as small as 3 and as large as 12. The primary element must be the science that is conveyed through the experience where understanding is directed and elevated through pre-planned and leading questions. This primes further inquiry from the primary student learners.

In the university labs, we always incorporate some element of high-level technology and machinery. Kids love lights, sounds and buttons, but these can’t go home. To ensure that the science we explore is fostered, the handy-man experiments are added to support transferrable learning at home and in the elementary school classroom. There are a number of purchased products that can be used for outreach as well as at home. My favorite product for outreach and at home is Backyard Brains (CC).

Their products are easy to use, reliable, durable and affordable. Their website also offers ideas and resources that can be adapted across age ranges.
Mix and Mingle:

Naturally, planned rotations are needed between stations but the key is to move students between rooms. Location does not matter to kids; everything at a university is new and exciting and their elementary school offers places that remain unexplored. They see little beyond what their hands and minds are actively engaged with. Consider hallways, outdoor spaces, adjacent meeting rooms and gyms. Has the front foyer been explored or a half hour in the teacher’s lunchroom? Using a stove enhances simple chemical reactions, where the end product can be tasty and shared, as chemistry can be candy.

The key is imagination.

Whether experiments are conducted at the university or elementary school, respect time periods of 12 minutes. This is the active learning period that generally works for a group of primary school students and hands-on science. Thus, rotations of 20-25 minutes are ideal to ask questions that prime students for the experiment and allow for the individuality and group dynamics to evolve. This will foster the energy that facilitates the inquiry into the topic.

Events with 6-10 youth per group, rotating through 6 stations and
between 2 locations have culminated in the most positive reports from learners and parents. Don’t be afraid to encourage parents to leave; questions often fly more freely when they are absent.

However, be sure to give the adults their own ‘curiosity candy’ in the form of handouts and additional ideas for at-home follow-up. These fit well in swag bags, just like birthday party bags – a little keepsake connects miles of neuroscience memories and networks.

This exchange is mutually beneficial and empowering for both groups of learners. Outreach from the university student to the primary school learner is a path worth exploring and it can potentially be a key element in enhancing the understanding of science and potentially increasing the pursuit of STEM fields.

Mind Over Muscle has not only engaged primary school children, but about 75 university students, ~10 teachers, and numerous parents. As a mother, my influence is on two children, but through this network of university graduates and teachers I hope that other programs like Mind Over Muscle are adopted elsewhere. The positive effect can be exponential and inquiry and excitement can be widely uncovered in the sciences.

Jennifer (Jenn) M. Jakobi: Coordinator of the iSTAND (integrative STEM Team Advancing Networks of Diversity) program at University of British Columbia Okanagan.
Mathematics, Music and Movement:
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 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, timelines, 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.

“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.”

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.

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.
You thought drones were cool....check this out.

If you are considering a profession in the medical field, which is of course a STEM career and FULL of STEM skills and applications, the innovations you’ll learn about and use will seem like science fiction. This is way cool.

When you don’t know what’s happening in your body, it’s hard not to worry. The PillCam SB capsule endoscopy procedure is a safe, simple way to view your entire small bowel from the inside out. Seeing parts of your body that you’ve likely never seen can give your doctor insight – and give you confidence in your treatment plan.

PillCam SB doesn’t require sedation, the use of potentially dangerous chemicals or injections or inserting tubes into your digestive tract. And, aside from not eating for 10 hours before the procedure (generally overnight), it requires no preparation.

Direct visualization of the small bowel is necessary to accurately and fully assess early disease activity and progression. PillCam SB is able to directly see the early stages of small abnormalities, where other X-rays and scans may not be effective. Because PillCam SB can aid in the early detection of problems and early disease responds better to treatment, it could potentially improve your overall quality of life.

The capsule is equipped with a miniature video camera and light source. It travels painlessly through your entire digestive tract. It captures images quickly and sends them to a recording device you wear during the procedure. Keep in mind, your digestive system is **23 feet long**, so it takes a while for the Pill Cam to take its trip. What a great addition to the family photo album.
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.
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. The Canadian Cardiovascular Society reports that 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.

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.

Canadian career needs in the cardiovascular field are in great demand and offer dozens of fascinating career paths with a wide variety of salaries and levels of education. Check it out and give it your whole HEART!

**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
Encrypt  [en-kript]  
verb (used with object)  
1. to encipher or encode.

Did you miss it?  
The page was not blank.

Let’s try again:

1. Highlight the page with your cursor and choose black as your font color. Ta-Da....there it is.

Now, go to this website:

https://paulschou.com/tools/xlate/

2. Copy the binary code (the first group) and paste it into the “binary” block, then click “decode”.

It looks like you have 3 different code types, so copy and paste the correct type in the appropriate box to “decode”.

Drop me an E-mail at this address with the complete code translation:

wayne@stemmagazine.com  

I think this is fun and aside from have recreation uses, it’s a good introduction into coding and how easy it is with the right tools.
Groundbreaking study finds boys are not naturally better than girls at math…but your daughter may be more anxious about math.

Dr. Tom Brunner
Psychologist, Counselor & Consultant

There is a stereotype that boys are better at math than girls. Boys do hard edged stuff like football and math, and girls do softer or more “girly” stuff…right? In other nations this is simply not true.

Given analysis of data from 276,000 children from 41 countries (published in the top tier peer-reviewed journal called Science), a researcher named Paolo Sapienza found that while in the U.S. boys outperformed girls by an average of 10 points (highly statistically significant), in numerous other countries like Sweden and Iceland, there was no statistical difference. This researcher could not explain why, but a
neuroscientist who has developed a computer game to strengthen memory has some ideas.

Dr. Torkel Klingberg believes that boys out-perform girls in math in cultures where there is an expectation that boys are stronger than girls in math (and other skill areas). He supports his idea by drawing from data that shows there is a direct correlation between countries where there are stronger gender gaps and gender stereotypes (as measured by what is known as the Gender Gap Index (GGI)) and where boys out-perform girls in stereotypical ways.

In other words, the background cultural beliefs about what people should be good at seem to actually affect performance, in big ways. There is certainly a large body of scientific evidence about how expectations affect performance. But you may ask, “what is the mechanism in play here…what is going on?”.

Here is where things get even more interesting: Dr. Klingberg makes a further point by discussing an intriguing study finding. There was a study of how men and women are affected by math anxiety. I quote a summary already provided in Psychology Today:

“When participants were told that they were about to perform a working memory task (which included math operations as a kind of distractor) to get norms for student, men and women performed equally. But when the same test was given with the information that this was a test of complex mathematics in order to compare males and females, performance in female participants dropped almost 30 percent.

The experiment was repeated, now with both working memory and math tests. Again, the females who were informed that they were going to take a math test performed worse, on both math and working memory tests. The researchers could also show that the stress was most closely associated to impairments in working memory, and it was the impaired working memory which caused the lower math performance.”

Dr. Klingberg ended by stating that the link between working memory and math is well established, as his previous research has shown. And stress is one of the most powerful factors that cause the working memory capacity to go up and down from one moment to the next.

In this study, females seemed to perform much more poorly when they knew they would be compared to boys. It would seem that the females went into this testing condition feeling stressed out.
Recent research has shown important ways in which men and women react emotionally and perceive emotion in others:

A global study of 55 cultures found that women tend to be more emotional, agreeable, extroverted, and conscientious than men.

- Women read other people’s emotional reactions better than men, regardless of whether they receive those emotional cues verbally or visually.

- Women reported experiencing love and anger much more intensely than men did in another assessment of gender differences in emotional response. These women also smiled more when recalling memories of happiness or love.

- Men and women respond to stress in different ways. Women display greater sadness or anxiety than men, while men show an increase in blood pressure and a tendency toward alcohol craving.

How Gender Differences Affect Health

Gender differences in emotional processing and response have direct consequences on the physical and emotional health of boy, girls, men and women.

Overly emotional women tend to be at greater risk for depression, anxiety, and other mood disorders, while men who repress their feelings tend to be at greater risk for physical ailments such as high blood pressure, and also tend to indulge in more risky behavior. We see this at an early age in school and find ourselves confused about how to help.

Some argue that we should accept these gender differences, based on the fact that feminine women and masculine men tend to be happier than those who are gender-atypical. According to this line of reasoning, boys and girls should be allowed to develop both stereotypical and non-stereotypical emotional responses without judging them or trying to shape them.

As we consider the “balance” of gender in the work force, we cannot forget that the genders are not created equal across the board. Each has biological tendencies that can be very complimentary.....or not.
Math stress and stress in general begin early in the life of a student.

Who teaches them how to handle stress?

What class is that?
For thousands of years, most of the science that was taught to students was wrong. Even in my life time, since the 1960’s, much of what I was taught has been dis-proven or modified extensively.

700 B.C.: **fact** - the earth is flat. **Wrong**  
**Fact** - the earth is the center of the universe. **Wrong**

600 B.C.: **fact** - the sun revolves around the earth. **Wrong**

1838: Darwin evolutionary theories. We have no idea and no evidence or “missing link”.

1915: Einstein’s General theories of Relativity. Some evidence, some guessing. Einstein’s theories continue to be **adjusted** as we learn more.

Before 1920: Einstein theory - **Fact** - the universe was static /stationary (not moving). **Wrong** ?

1929: **fact** - the universe is expanding. “The Big Bang”, (Expansionism Theory) **maybe**....

Recent theories: the universe is contracting...“The Big Crunch” theory. **Maybe**....

1947. **Fact**- nothing can travel faster than sound. **Wrong**

1959. **Fact** - the neutrino exist and is the smallest particle in the universe able to travel faster than light. **Maybe**....

Common myth: **Fact** - Lighting doesn’t strike the same place twice. **Wrong**

Today. **Fact** - The universe is infinite, but if the universe is constantly expanding, what is it expanding into? How can it be infinite? We will never know.
It’s okay to say “I don’t know” and I love it when scientists say that. The honesty to say “we just don’t know” gives great credibility to that person.

Predictions based on theories.....that’s about the best we can do outside of our Earthly confines. Everyday we’re told about a new study or research that completely reverses our previous notions on a subject, only to have it reversed again a month later. Ten years ago sleeping too little was bad for you. Last month, a new study suggested that sleeping too much is bad for you and could shorten your life.

Caffeine is bad for you. Caffeine is good for you. 30 years ago: Eggs are bad for you due to excessive cholesterol. This year: Eggs are good for you. Your body naturally creates more cholesterol than eggs would and you need their protein (in moderation of course).
Mankind has this insatiable curiosity to further our understanding of ourselves, our world and universe around us. Throughout history there have been theories that were considered "fact" for generations and were discovered to be false by those who "questioned". Some of their "facts" may seem ridiculous now, but it was only through human curiosity, exploration, and ingenuity that groundbreaking discoveries altered our understanding of everything.

Try to imagine several thousand years ago what it must have been like to try and comprehend what all of those pretty shiny lights in the night sky were. It makes sense that many "primitive" cultures revered stars as deities or at least objects of religious importance.

Given the technology of 600 B.C. the observation that the sun appeared to "move" around Earth is not really that far-fetched of an idea...that Earth was the center of the universe.

This idea of an Earth centered universe was widely accepted until the 1500’s when a man by the name of Nicolas Copernicus went against this idea that had been considered fact for hundreds of years. He developed the heliocentric (spiral) model for our solar system. The reason he is most credited with the heliocentric model is due to his total inclusion of mathematics and physics together to formulate theories.

Copernicus still feared persecution. His works titled "De Revolutionibus Orbium Celestial" were not published until the day of his death in 1543. Because there was nobody to persecute, it was passively accepted until banned in the year 1616. It wasn’t until 1835 when the support for the theories written by Copernicus had become seriously considered that the ban on the book was lifted. While much of the groundwork from his discoveries had been laid down years beforehand, Copernicus was the first to write the theory in such a complete way, combining many different scientific disciplines.

It is clear that our curiosity, and our wonder of the world around us leads to the advancement of knowledge.

Edwin Hubble (Hubble Telescope), allowed us to observe an increase in the wavelengths of radiation coming from an extraterrestrial sources. The significance was that Hubble was actually able to observe relatively close nebula. It wasn’t until Hubble had applied the theory of relativity to his equation that he considered the influence of gravity.

Without constant movement and expansion, he considered that the
The Veil Nebula -- the supernova remnant of a star that exploded 5,000 to 8,000 years ago -- as captured by the Hubble telescope.
The universe as we know it might collapse in on itself, which just so happens to be a recent theory of serious consideration, (the Big Crunch Theory). Edwin Hubble was a lawyer by the way, who became fascinated with astronomy and lead us to today.

Every generation is a little less restricted than the prior due to ever changing technology and social acceptance. Even now in 2016, some of Einstein's theories and Sir Isaac Newton's theories are being called into question. It's not that they are “completely” wrong, but not completely correct, needing slight modifications or tweaking for the moment to make them work.

One thing is for sure....this too will continue to change and the facts we learn in school today will be called into question as they are replaced with new theories which cannot be proven either.

Exploration, discovery, theory and opinion about the nature of the universe, our planet, the human body, brain and society itself zoom ahead as never before, so we must logically and responsibility question what is fact versus theory and then question the theory.

The more we discover, the more questions arise. Most questions regarding the universe will never fully be answered correctly but these questions must be asked and considered and there is a good chance that we will be wrong.

It’s okay to say “I don’t know”, but it’s critical that you question.

**Why question?**

YOU will lead the way, as you question current opinion and theory, to new and interesting concepts and investigations that will replace many current positions on the nature of the universe, the functions of the human brain, global economics, renewable energy, the nature of the world around us and most importantly.......**what is possible.**

I can guarantee that much of what you think is fact right now, will be replaced, or modified and you will be the one who does it.
It’s no secret that newspapers are in trouble. In Canada, daily newspapers like the Guelph Mercury and the Nanaimo Daily News have stopped printing. A subscription to a daily newspaper used to be as common as a mailbox, but with more people checking their news online for free, shelling out $200/year for published content no longer makes sense for many people.

If $200 is hard on the wallet, imagine justifying the cost to a library for a subscription to journal collection Biochimica et Biophysica Acta at $26,000 per year (USD). A single article will set you back over $30. The publisher Elsevier, along with Wiley and Springer, now publish 42% of all academic journals.

For science to function, access to original scientific papers is paramount. Hiding content behind a paywall this high runs counter to that ideal. Scientists need to read each other’s work, look at the data sets, mount criticisms and repeat experiments. Only then does our collective understanding of the world proceed. This should be an obvious and overwhelming theme to what we teach in our science courses.

It shouldn’t be a surprise, then, to see science and math professors at the forefront of a movement to open up access to core curriculum content and pry it from the hands of textbook companies.

As anyone who has ordered textbooks for a high-school science course will tell you, textbooks can cost upwards of $100 per book. Double that for University books. This is not quite up to Elsevier’s level, but still comprises a hefty chunk of a school’s budget.

The Open Education Resource (OER) movement seeks to provide textbooks for free. There are already an impressive collection of OER sites from which to search for content, including OER Commons, OpenStax College, Curriki, Spongelab and CK-12 Foundation. The STEM disciplines are well-represented in these collections.

Publishers and fans of certain textbooks defend their prices. It’s expensive to curate content, we’re told, and getting top-notch authors doesn’t come cheap. Writing, photography, diagrams and end-of-chapter quizzes need to be of high quality and relevant to a partic-
It’s time we unbundled the cost of access to content from the services that make content work for our students. Curating content, creating relevant assessments, and coming up with labs to engage students are all valuable services. But mere access to content is no longer something we should be paying for.

In Canada, BCcampus launched the BC Open Textbook project in 2012 with support from the BC Ministry of Higher Education. Their goal is to provide flexible and affordable access to higher education resources in B.C. by making available openly-licensed textbooks in the highest-enrolled academic subject areas. The BC Open Textbooks project has already saved students between $1.1 and $1.4 Million in textbook costs and has seen no deterioration in academic standards.

On a video on their web-site, BCcampus asked for feedback from early adopter professors. “If I can achieve the same pedagogical goals with an open textbook as I can with materials that traditional cost student $200, why would I carry on?” says Rajiv Jhangiani, Psychology Instructor at Kwantlen Polytechnic University.
Open textbook advocate David Wiley, the Chief Academic Officer at Lumen Learning, claims that his company has saved students over $1 million through their various projects. According to the College Board the average college student pays $1,200 per year just on textbooks. The issue of free books is not trivial for students graduating college with tens of thousands of dollars in debt. New York’s Mercy College made a sudden switch to using OER textbooks for their math courses. From 2011 to 2012, all students switched from using a $180 textbook to an open textbook, saving students a total of $125,000.

This cohort of students not only saved money but had increased academic performance. The pass rates in the Algebra course rose from 48% to 69% percent. While it is notoriously difficult to determine the direct causes of academic performance, increased academic performance seems to bear out in other studies.

In Utah, high school teachers use books from CK-12 and adapt them for use in their own courses. They print the books up for $4.99 per student and let the students keep the books every year and encourage them to mark them up and highlight relevant sections. This move resulted in a 5.9% increase in standardized test results for the district.

One of the common misconceptions of the “open” movement is that all the resources are completely free. Although the content is freely available for anyone to peruse, if you want the content piped into an LMS, or if you want data on who is reading, when, and why, you need to pay. But those costs are usually on the order of $1-$5/student/year, well below the costs of traditional textbooks.

The students in the Mercy College study above paid $5/student/year for services provided to faculty. Such services could include hosting and organizing the content in a Content Management System (CMS) or even hosting professional development workshops for faculty not used to having control over how their textbook looks. In these companies they provide portals of OER science content directly inside a district’s Learning Management System.
Instead of paying for content, districts are more interested in the data that comes from resource use, or professional development sessions on how to use new digital tools like video games or simulations to teach complex scientific concepts.

Most open content is licensed under what is known as a Creative Commons license. There are six of them to choose from, but the most common one ensures open and free access to the work, but restricts people from bundling up the content and re-selling it as their own. It ensures that all derivatives that include content from the original textbook are also available for free. For students in K-12 and undergraduate science, the most important lesson we can teach them is that content is not immutable. In science, change is the rule not the exception, and students need to imagine themselves as the change-makers.

One of the most valuable provisions in the Creative Commons license is the freedom for students or teachers to “revise” or “remix” textbook content. Teachers can adapt the textbook with their own resources, mash-up chapters or skip sections as they see fit. Whether the large publishers want to admit it or not, this is a common practice with traditional textbooks. I remember literally cutting and pasting photocopies of lab instructions until I felt they followed a process I was comfortable with or using liberal amounts of white-out on a black-line master until it had the right content for my class.

Highlighting passages, writing notes in margins, or critiquing the official version on the page are all skills that science students need to learn. Instead of rapping their knuckles for writing notes in their textbooks, imagine if this was actually part of their final grade? What would a lab book look like if it had to contain instructions from a textbook lab that were re-written to accommodate the diverse needs of a student’s particular class?

As educators, we watch with bemusement as publishing giants like Pearson and McGraw-Hill madly test new strategies in this “post-content” world. Just as news-hungry people are bypassing the traditional media, teachers and professors are bypassing the major publishers when they need high-quality content. If we play this trend right, it could be a boon for opening up the process of science to millions of young students.

Joseph Wilson works for the education technology company Spongelab Interactive. He taught high school level physics, math and credit recovery for 5 years, and was nominated for the Premier’s Award for Teaching Excellence in 2009.
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