

Grade Bio

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Multi-tasking The Myth



Feb. 2019

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Open the door to increased teacher effectiveness

OUT TEACH IS EQUIPPING SCHOOL DISTRICTS ACROSS THE COUNTRY TO UNLOCK STUDENT PERFORMANCE



The highly effective, teacher-centered approach for bringing outdoor experiential learning to your district.



Bringing Out Teach to your schools

UNLOCK STUDENT PERFORMANCE WITH EXPERIENTIAL LEARNING

District leaders across the country know that teacher effectiveness is the key to student growth and success.

Out Teach works with districts, principals, and community partners to help teachers master outdoor experiential learning to get students more engaged and excited about science, math, and literacy lessons.

"This training was **incredible**! Hands down, **best PD in all my years teaching**. My biggest takeaway is just how really easy it is to incorporate outdoor experiences into all aspects of an ELA curriculum and how critical wonder, amazement, and excitement is when teaching elementary students."

- Teacher Chattahoochee Hills



POWERFUL, PROFESSIONAL LEARNING HELPS TEACHERS GROW

Working together, teachers and their Out Teach Coaches implement our Professional Learning Program in four key phases.

Plan

Integrated instructional plans align outdoor experiential learning with each school district's scope and sequence and teacher effectiveness frameworks.

Implement

Teachers facilitate experiential learning outdoors, integrating strategies into daily instruction to engage all learning styles.

Coach

Job-embedded coaching sessions transform teacher practice with fieldtested outdoor experiential lessons to improve outcomes for students and help achieve learning standards.

Support

Our online Coaching Center provides ongoing standards-aligned training videos, coach feedback, and a community of teachers.

DYNAMIC LEARNING ENVIRONMENTS BRING LESSONS TO LIFE

Amazing things happen when students go outside the classroom to experience how academic concepts apply in the real world. That's why Out Teach works with schools to identify or create rich outdoor environments with the features that boost teacher effectiveness and student engagement.

Schools can:

- Activate their existing outdoor spaces
- Enhance existing gardens with key learning features
- Build an Outdoor Learning Lab
- Support instruction and engage students



"Comprehensive. Engaging. Impactful. Relevant. Culture-shifting. The Out Teach Professional Learning Program is the real deal."

-Dr. Sally Creel S.T.E.M. and Innovation Supervisor Cobb County Schools







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Welcome to our latest edition of Georgia PathwaysTM STEM Magazine.

TAG Technology Association of Georgia



Across the country, we continue to see an encouraging emphasis being placed on STEM education opportunities for all students.

Hands-on STEM learning is especially vital, at all grade levels. As we rapidly approach the season of internships, it's a great time to become a host company or sign up as a student for real-world experience in the field of technology.

Each year, the TAG Education Collaborative, a nonprofit focused on STEM education opportunities, hosts an indepth internship program and I encourage you to check out information about this incredible program and consider signing up!

Internship experiences deliver a long-lasting impact on students and their hosts. Student interns gain the knowledge and experience they need to follow through on their dreams of starting a career in technology and companies play a key role in developing a robust and ready workforce pipeline. That pipeline is what feeds, grows and ignites our economy and being a part of workforce development in technology ensures that we continue to innovate and advance our state. Think of the discoveries an inspired student can make! Throughout a student's educational journey, hands-on opportunities are often what delivers the difference between a bright idea and a firm pathway to success. And it's never too early to start.

Inside this issue of our magazine, you will find ways to take that first step. Whether you are a teacher, a parent, a student or someone interested in fostering STEM education, we hope you will find meaningful information, activities and projects to help you get started.

It's an exciting time of year as our students begin preparing for summer. No time like the present to get them thinking about a life-long career in technology.

Thanks for your support!

Larry K. Williams President TAG-Ed

Larry K. Williams serves as the President and CEO of the Technology Association of Georgia (TAG) and President of the TAG Education Collaborative (TAG-Ed). TAG-Ed's mission is to strengthen Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting Technology Association of Georgia (TAG) resources with leading STEM education initiatives. The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEM learning opportunities and connecting them to Technology Association of Georgia (TAG) resources. Formerly the TAG Foundation, TAG-Ed is a 501(C)(3) non-profit organization formed by TAG in 2002. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEM education in Georgia.

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This magazine services the STEM education industry needs of the state of Georgia. This magazine is viewed by the consumer with the understanding that the information presented is from various sources from which there can be no warranty or responsibility by the Technology Association of Georgia, the Technology Association of Georgia Education Collaborative and/or their affiliates as to legality, completeness or accuracy.



Multi-tasking Myth Mayne Carley

Then Came....Biology Anijad Abdirahman / Georgia

Cognitive Priming Dr. Judy Willis

Engineering with Bugs *Wayne* Carley

Hands On *Publisher*

Clarice Phelps Chemist and Researcher





From the Executive Director

Welcome to another issue of Georgia PathwaysTM. February is always a month where two great celebrations occur. It's a month to celebrate National Engineers Week and it's a month where we celebrate the accomplishments of African Americans. National Engineers Week was founded by the National Society of Professional Engineer (NSPE) in 1951.

Modern day Engineers Week is "a formal coalition of more than 70 engineering, education, and cultural societies, and more than 50 corporations and government agencies 1) dedicated to raising public awareness of engineers' positive contributions to quality of life, 2) promoting recognition among parents, teachers, and students of the importance of a technical education and a high level of math, science, and technology literacy and 3) motivating youth to pursue engineering careers in order to provide a diverse and vigorous engineering workforce."

In February we saw various organizations ensure that the opportunities for not only engineering but STEM were highlighted and celebrated in classrooms, in maker spaces in after school programs and corporations. We thank the Georgia community for providing such innovative thought and creativity in presenting career pathways and "career literacy" as it relates to engineering and STEM. We know that by doing so you're empowering students to be the next generation to create ideas and opportunities that can ultimately help improve everyone's quality of life."

And in this issue (and every issue) it's our goal to foster that empowering spirit with information that students can leverage for the "what's next." Because, in the words of famous mechanical engineer and former Xerox CEO, Ursula Burns, we want every student to "believe that there are no limitations, no barriers to your success – you will be empowered and you will achieve."

Please enjoy the February issue of Georgia PathwaysTM STEM Magazine.

Erika Moore

Executive Director, TAG Education Collaborative (TAG-Ed)

Pay It For With TAG-Ed





TAG Education Collaborative

Every year, TAG Education Collaborative engages over one million students across the state in STEM education. We're on a mission to spark STEM passion, strengthen Georgia's future workforce, and expand the pool of STEM qualified employees.

Founded in 2002, TAG Education Collaborative is a 501(c)(3) organization (EIN/tax ID number: 58-2569666). TAG-Ed relies on the generous donations of individuals and sponsors to connect Georgia's K-12 students to STEM opportunities.

Get in touch

Errika Moore | Executive Director Email: errika@tagonline.org



SUMMER INTERNSHIP PROGRAM

TAG-Ed's High School Summer Internship Program provides real-world work experience for high-achieving students with strong STEM aptitude.

As an internship host you have the opportunity to work with a student on a meaningful project. These internships give students the opportunity to hone technical hard skills and professional soft skills through practical application, while giving them the confidence to pursue one of Georgia's STEM career pathways.

February 27, 2019 | 11:30 AM Centergy Building, 75 5th Street NW, Atlanta, GA

THE VINE | MARCH 20, 2019

TAG Education Collaborative held its first Vine Event in 2009. With generous support of the technology community, this year we can surpass the \$1,000,000 mark for funds raised to improve STEM (science, technology, engineering and math) education for Georgia's K-12 students and to connect students to STEM careers.







MULTI-TASKING

by Wayne Carley

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

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

Apparently, we were never multitasking.

It's a myth!



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

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

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

You can't blame the student. As educators, let's reassess our process. Is there a better way? Could a different approach improve class behavior, attention, interest, productivity, quality and results? Are we flexible enough to consider it?

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

When laptops and cell phones are close by, it's suddenly a challenge to keep their focus on the teacher or subject. It's just too compelling and easy to check email, text messages and surf the web. Of course these workers think that they are multitasking. But, when it comes to the brains ability to pay attention, the brain focuses on concepts sequentially and not on two things at once. In fact, the brain must disengage from one activity in order to engage in another. It takes several tenths of a second for the brain to make this switch. We are biologically incapable of processing attention-rich inputs simultaneously."



Prioritize



If you think it makes you look more efficient (or important) to be continually checking your laptop or cell phone for messages, think again. What seems like a harmless activity to the observer sends a nonverbal message of disinterest and dismissal to the rest of the group. That's why some teachers and educators have installed the "topless" meeting – banning all laptops, phones, Blackberries, etc. Everyone who uses mobile devices have what's called continuous partial attention. We juggle several tasks partially and poorly. It takes longer to get things done and the consequence is a poor result; poor homework assignment, poor class preparation by the teacher, poor presentation by the speaker.

"We are biologically incapable of processi

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

Bad news parents....kids can study effectively while listening to classical music, since reading and listening use different parts of the brain. But if you listen to music with lyrics, your reading comprehension significantly drops. That's because both tasks activate the brain's language center. Similarly, you can talk and watch television at the same time, but you can't carry on two conversations at once. As I write this article, the television is on and I find myself being distracted every few minutes by something that is said, disrupting my focus and train of thought. I turn down the T.V. or switch to another channel that's of no interest. Why do I behave this way? The background noise is, if not too loud, is a pleasant distraction since my children are grown and gone, I no longer have a pet and the neighbors are amazingly quiet. I guess other parts of my brain have a need to be entertained while I'm being productive with the other portions.

The problems these distractions and inefficiencies create become a problem in the workplace, classroom and especially during homework. The lack of focus keeps us from being better than we could be and more productive than we should be. Research shows that if we have 5 things that need done in the next 5 days, the worst thing we can do is work on all of them piecemeal, a little here and a little there. The end result is it takes us 7 or 8 days to get it done.

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

ng attention-rich inputs simultaneously."

The added plus is the quality of the work.....it's superior. If the task's required memorization, comprehension or retention, we did them better and it lasted longer.



I know this goes against our daily routine and mythical notions that we are accomplishing more, but this multi-tasking merry-go-round isn't fun, drains our energy and becomes discouraging when the end results are average or worse.

Just try it for a month. Whether it's cleaning the house, writing a paper, preparing classroom presentations or shopping (men get that one) you will get it done faster and better. What does better mean? Higher productivity at work, testing prep, better grades and more free time.



You will find that when you completely focus and concentrate on one deadline task at a time to completion before moving on to number two, the work is more thorough, comprehensive, accurate and done faster. Comprehension will be broader and memory deeper. Don't get me started on driving while eating and taking on your hands-free device.



Remember that you have rights to forward this magazine to all your students and their families within your school.

It's a great connection and cool conversation piece for discussions.

"I Hated Science... Then Came 8th Grade Biology"

By Amjad Abdirahman

Like most eighth graders, I wasn't sure which career path I wanted to pursue. But I knew what I didn't want—a career in science. After enrolling in online school, I started to think twice about that decision.

I, of course, had seen the news reports and read the statistics that say women are underrepresented in science, technology, engineering and mathematics,

or STEM.

This is certainly the case in the medical field where women are desperately needed in specialties like orthopedic and neurological surgery. Women make up just five and 7/8's percent of the physician workforce in these areas. However, it wasn't until my eighthgrade biology class at Georgia Cyber Academy (GCA) when I thought about



how this all applies to me and other young women my age.

When I was in traditional brick-andmortar school, I earned good grades in my science classes yet I simply didn't like doing the work; it felt dull and repetitive. I excelled in my other classes too, but I eventually grew bored. Soon, I started thinking about ways I could work at a faster pace and have more control over my course schedule.

So after exhausting nearly all the honors and Advanced Placement (AP) courses that my middle school offered, I decided to take on a new experience in the online classroom. I knew this change would mean more course options and a rigorous class schedule. I also knew this schedule would include a more demanding science class. I was finally up for the challenge though. I didn't want to run away from science anymore.

In online school, I finally had the classes that I couldn't access in my local school:

- AP courses in history,
- American government,
- and literature.

Weeks later, no one was more surprised than I was that my favorite class wasn't even a part of this list...it was biology! Each week my teacher mailed me a science kit, complete with instructions for an experiment inside. And each week, I looked forward to conducting the next experiment.

For one class, I observed how soil reacts under a microscope after adding water and other substances to it. For another, I detailed the lifecycle of a flower by planting a seed and watching it grow. I eventually started to question why I had avoided science so much in the first place. And I started to believe that maybe, just maybe, instead of pretending to be a scientist, I could actually become a real one someday.

This thought prompted me to ask my science teacher, "What can you do with a biology degree anyway?" She explained that one option was to attend medical school and become a doctor. I felt a jolt of excitement because I immediately knew that was the career



path I was destined to take. As a physician, I could blend my passion for science with my desire to help others. And I could do my part to help close the gender gap in the medical profession. Suddenly I couldn't wait to take more science classes so I could be as prepared as possible for medical school.

Every week, I still have the chance to conduct weekly biology experiments. But now, I conduct them from a college lab at Georgia State University. As a sophomore student, I'm relishing in all the things that make science come alive for me—things like microorganisms and human anatomy. I'm so grateful to the online classroom for pointing me in the direction of my dream career. I truly owe it all to that eighth-grade biology class.

Amjad Abdirahman is a graduate of Georgia Cyber Academy, a K12-powered school.



Cognitively Priming Students for Learning

Dr. Judy Willis

Cognitive [kog-ni-tiv]

adjective

1. of or relating to cognition; concerned with the act or process of knowing, perceiving, etc. : cognitive development; cognitive functioning.

2. of or relating to the mental processes of perception, memory, judgment, and reasoning, as contrasted with emotional and volitional processes.

Priming (prime) [prahym]

verb (used with object) 1. to prepare or make ready for a particular purpose or operation.

2. to cover...with a preparatory coat or color, as in painting.

3. to supply or equip with information, words, etc., for use:"The politician was primed by his aides for the press conference."

"It preps their minds to engage."

There are some standards or units of instruction that, for whatever reason, you know aren't going to be runaway hits with students. While you can certainly reconsider the unit design, there are other strategies you can use to help prime student brains for learning.

Among the simplest of these strategies is promoting curiosity -- and students' natural tendency to predict -- by advertising the content the same way that a marketing company might. This promotes advance interest, and the resulting questions increase the student curiosity, opening the brain's attentive intake filter. In short, it preps their minds to engage.

How might this work?

Try advertising a coming unit by cutting up a related, compelling image, and then adding pieces daily to reconstruct that image as the "advertisement" gradually takes form.

Similarly, different clues -- visual or otherwise -- could be added every few days leading up to the new unit's introduction.

For fractions, these clues might be:

• An x-ray image of an arm fracture.

- Sheet music with half, whole, and quarter notes.
- A carrot cut into quarters.
- A photo of an iceberg showing the parts above and below water.

These both visualize the content and prime the mind to learn new content. Even though curiosity gradually decreases in favor of caution, the need to find out if a prediction is right or wrong is part of the brain's permanent wiring. The brain strengthens future predictions and corrects any inaccurate prior knowledge leading to incorrect predictions through a prediction-reward system fueled by dopamine pleasure. In short, even if students gradually become less interested, it won't diminish their need to know as the unit begins.

On the day the unit is scheduled to begin, students' curiosity, along with their written or verbal predictions, will tune their brains into the perfect zone for attentive focus. They are like adults placing bets on a horse race. Students may not be interested in the subject matter itself, but their brains need to find out if their predictions are correct, just as the race ticket holder needs to know if he holds a winning ticket.



Now the students' brains want to know what you have to teach! If nothing else, you're set to reach them from day one.

The brain is wired for high interest when clues prompt prediction, anticipating the pleasure of the dopamine reward response. There is no such intrinsic motivation for drills and memorization of rote facts and procedures.

Isolated skill practice is contrary to the brain's instinct to preserve its energy, because there is no expectation of pleasure from energy output. On the other hand, when students want to know required information to create solutions to problems that interest them or to create products that they care about, the brain applies the effort to learn what is required to achieve desirable goals. This isn't a personality thing, or a characteristic of apathy, but a fundamental neurological system that preferentially attends to and stores input considered useful for desired goals.



Out Teach every subject

TRANSFORMATIONAL AND EXCITING THREE DIMENSIONAL LEARNING OPPORTUNITIES

By combining field-tested, professional learning with exciting outdoor spaces, Out Teach empowers teachers to get outside—beyond the classroom to create unforgettable learning experiences and measurable results.

"I really believe this has changed the trajectory of our campus. Every time I know something is from Out Teach, I say, let's do it! Because I know it's going to work, I know the students will love it, and more than that, I know we will be supported."

-Lisa Lovato Principal, Dan D. Rogers Elementary



Out Teach is cross-curricular



Out Teach Math How does the area of a garden bed impact what we plant in it?

Fifth graders collaborate to create a planting plan for a garden bed by applying measurement skills, persevering to solve a problem, and communicating mathematical reasoning.



Out Teach Science How do humans and the environment impact each other?

Fourth graders gather and analyze data to identify weather patterns and explore the impact on the outdoor learning lab, including erosion and plant growth, and communicate findings using a claim-evidence-reasoning model.



Out Teach Literacy

How does writing and drawing about what I see help me tell a better story?

Kindergartners increase vocabulary and practice key writing skills by engaging in observation and exploration of objects in the outdoor classroom. Students are able to use this language to build additional descriptive language to help them communicate their knowledge.



Teachers who Out Teach, outperform.

Teachers love Out Teach because it's an easy to implement comprehensive professional learning program that gets students excited to learn and unlocks their performance. Students love Out Teach because it brings learning to life in a hands-on, real-world way that's fun and engaging.

Out Teach: By the numbers

EFFECTIVENESS AND JOB SATISFACTION

Out Teach is proven to increase teacher effectiveness and job satisfaction. As teachers become more effective at using the outdoors as a tool, students become more adept at thinking critically, solving real-world problems, and making cross-curricular connections. When student engagement in the learning increases, class time becomes more productive, creating a more satisfying work environment for teachers. **50**%

Increased Teacher Effectiveness and Job Satisfaction*

*On a 5-point scale measuring knowledge skills, and attitudes



of teachers report students are more engaged

of teachers could apply training immediately

> report feeling better prepared to help their students succeed

School districts across the country are discovering the simple power of our job-embedded professional development paired with outdoor experiential learning. Teachers are inspired. Students connect. Outcomes improve. By 2023, we will reach more than 200,000 students with Out Teach.

To find out how your school district's teachers can get started Out Teaching, request more information at info@out-teach.org.

It's time to go outside expectations with Out Teach.



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Engineering Careers"



As with many careers, it's not until we take a closer look at it that we discover the complexities and S.T.E.M. applications used everyday.

The Bug Exterminator is one of those.

"An engineer is a problem solver and decision maker"

The **SCIENCE** of extermination:

Organophosphate Pesticides - These pesticides affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. Most organophosphates are insecticides. Some are very poisonous (they were used in World War II as nerve agents). However, they usually are not persistent in the environment.

Carbamate Pesticides affect the nervous system by disputing an enzyme that regulates acetylcholine, a neurotransmitter. The enzyme effects are usually reversible. There are several subgroups within the carbamates.

Organochlorine Insecticides were commonly used in the past, but many have been removed from the market due to their health and environmental effects and their persistence (e.g. DDT and chlordane).

Pyrethroid Pesticides were developed as a synthetic version of the naturally occurring pesticide pyrethrin, which is found in chrysanthemums. They have been modified to increase their stability in the environment. Some synthetic pyrethroids are toxic to the nervous system. Chemicals such as these can be VERY dangerous to children, pets and even adults if not used for the appropriate reasons in the correct doses.

The responsibility of the exterminator is to determine which chemical is right for each pest and use the correct one keeping in mind the location it will be affecting. Are there children in the area? Will your dog or cat come in contact with it? How much is enough or too much?

This is just a taste of extermination science.

The **TECHNOLOGY** of extermination:

How the chemicals are delivered to the area, either by spray, tablet, tape, aerosol, gel, or some other, the proper technology delivery must be used for chemical effectiveness and safety. You can just throw some poison down and walk away.

What is the safest, yet most effective and how long will it last?

How it's applied can be an important part of the answer.

The **ENGINEERING** of extermination:

Since the engineering method is a decision making process, here's how it would work for the exterminator.

1. What's the problem bug?

5. After application, I will see if it worked, making sure it was safely applied and see how long it lasts.

That is the decision making process called the Engineering Method. We use it every day to make decisions about everything. Try and think about how you have already used it today.

2. What are the possible chemicals that can be used to exterminate them?

3. Which of the chemical choices is the safest but most effective for the place I need to use them?

4. After making my choice, I will determine the best way to spread or deliver the chemicals.

The MATH of extermination:

This part of the S.T.E.M. process is just as important as the others and in some ways more so.

Mixing the raw chemicals in the right amounts and combinations takes exact mathematical calculations. It may be simply measuring them using a measuring cup or specialized cylinder, but no mistakes are allowed.

The math of extermination is fairly basic, but you still have to calculate the right mixture of chemicals to cover the need area in square feet in the right strength with the right delivery system.

We will always need bug exterminators making it a dependable S.T.E.M. career field everywhere in the nation. As bugs build up defenses against our current chemicals, new ones will be designed and the exterminator will have to adapt and get continuing education about how to use them in the S.T.E.M. formula. Exterminators may work for a company or be their own boss. The salary for the average American exterminator is about \$30,000 per year, but may be as high as \$42,000 in some regions with over-time or weekends.

The next time your exterminator comes over, check out what they do and remember it's a challenging and complicated S.T.E.M. career.

If you love bugs and want a career being close to them, there are careers available for you.

Wayne Carley Publisher





Major aircraft manufacturers and airlines like Delta, are predicting a need for thousands of aircraft mechanics each year over the next several years as more and more airplanes are produced. So the career as an aircraft mechanic is still up-and-coming.

Previously a person who was responsible for aircraft technical support was called aircraft mechanic. Now the term used in the U.S. is usually aircraft maintenance technicians (AMT).

A Great STEM Career Here In Georgia

Polyvinyl Chloride -

This common plastic piping product can be found at most any hardware store in a wide variety of shapes and sizes. For the purposes of hands-on projects, think of it as the plumbing Legos or as an Erector Set of old.

Classrooms and summer camps are constantly in search of affordable resources for "renewable" use and flexibility. For me, PVC fits that need in most creative ways.

When STEM Magazine began development of the Mars Lander Experience, the first challenge was to design and build a replica 1/8 scale of the Curiosity Rover for use in the project. As we pursued the logical 3D printer path, the enormous cost of such a project quickly brought that consideration to a halt.



The quote we received to 3D print just the 6 wheels was over \$1,200. We had a budget of \$250 for the entire rover.

One day as I walked the isles of Home Depot, I happened to glance over in the plumbing section and noticed the shower drains with their associated pieces. At that point my imagination kicked in and I saw potential rover wheels. As I mentally and physically designed wheels from those plumbing parts, I considered the potential of other rover components within the plumbing department, and then lumber, followed by paints, adhesives and electrical parts.

Suddenly I had at my disposal, vast resources of materials limited only by imagination and time. As with most creative projects, sleepless nights followed and the design began to take shape in the mind, followed the next day by yet another trip to Home Depot to roam the isles seeking inspiration and solutions (the engineering method of problem solving).

After continued review of Curiosity Rover photos, each section of the design took into consideration what parts and departments of the hardware store could be of use.

Since the wheels seemed the most complicated, that was the starting point. The **plumbing** drains for the shower, laid on their side, set the scale for the rover construction. Being PCV allowed for the extension from an axle to the drive train and suspension system.

It was never our intention to have a working or moving rover, but rather a reasonable scale size facsimile to use as a prop for the Mars Lander program.

Various PVC parts were used to continue with the suspension design and wheel alignment. The PVC wheels were covered in light screen material from the yard and **landscaping** department for the look of traction. Earlier rover's did use a screen material in their wheel design. If I were to build it again, I would of course add more detail, but for the purposes of this program, close counted as a close-up view was not expected.

Wheel spokes were small pieces of aluminum cut to length, bent into shape and glued into place using epoxy from the adhesive isle of the **paint** department.

The remainder of the unique axle-like design used an assortment of PVC plumbing pieces. As this portion of the design and construction continued, very few parts were permanently glued since the design was still taking shape. Painting also remained, and some separate parts were more easily painted before final construction...much like a model plane or ship. Beyond the wheels, the main structure or body of the rover itself was 3 pieces of shelving from the **lumber** department, glued together and clamped. After adhesion a few days later, it was cut to scale to match wheel size. This was very heavy and needed to be lighter for handling.

How would you make the body lighter?

This is another engineering method problem solving task.

Our solution to the weight issue was to drill dozens of holes in the underbelly of the rover using a hole saw drill bit. It would not be seen, could easily be covered and reduced the weight of the wood portion by about 80%.







Though this build was much more complicated and extensive than shown, it was certainly challenging mentally and drew in huge part on problem solving skills and imagination. Thinking outside the box saved a tremendous amount of money while providing a very acceptable scale model for our program. knowledge (def. of science), determination and your local hardware store, there is little that cannot be accomplished to inspire your target demographic. FYI....I also salvaged parts from a remote control truck controller to activate several lights installed on the rover. You can get taken away with a project like this while remaining frugal with your budget.



As seen in the video of the Mars Lander Experience, it is a believable replica during the decent phase of the lander. There is much more to the program than the rover construction, but the Curiosity model was a necessary part of the visual components.

In conclusion, I want to point out the possibilities available to any school activity or camp on a limited budget, that with imagination, problem solving, math, systematic accumulation of Residential electrical junction boxes

> Colored wrapping foil

, / Wood pieces / painted and glued

Total rover cost: \$235

A hundred plus hours of imagination, creativity and construction:

Priceless

99% of this rover was created using plumbing, electrical, lumber and paint supplies from Home Depot.

What can you build for your next STEM project?



Clarice Phelps:

Dedicated service to science and community



by Sean Simoneau

More than 70 years ago, United States Navy Captain Hyman Rickover learned the ins and outs of nuclear science and reactor technology at the Clinton Training School at what would eventually become the Department of Energy's Oak Ridge National Laboratory. Rickover applied his knowledge towards the creation of the US Navy's nuclear-powered ships and submarines, earning him the moniker of "father of the nuclear navy."

Decades later, ORNL researchers like Clarice Phelps carry on the Navy Nuke legacy and use their nuclear expertise to solve some of the grand challenges of science.

After graduating from Tennessee State University with a degree in chemistry, Phelps joined the Navy Nuclear Power Program, partly out of fascination and partly to dispel some of the fear others had towards the field.

"What drew me to nuclear science was the mystery of it," she said. "No one I knew was in that field, so I wanted to know more about it and thought it was something really interesting to take on."

The Navy taught her about nuclear power, reactor theory and thermodynamics, but it also instilled fundamental lessons that she still uses in her work at ORNL.

"You build a very good work ethic, making sure that whatever you do is done right the first time," Phelps said. "That means putting a lot of forethought into what you do before you even go into it. It helps to have a 'Type A' personality in this type of work." This conscientiousness and meticulous nature are necessary for the type of sensitive work Phelps performs as project manager of ORNL's nickel-63 and selenium-75 industrial use isotope programs. She is also a researcher in the Medical, Industrial and Research Isotopes Group (MIRIG), where she works on the separation and analysis of elements such as europium, samarium, actinium and lanthanum.

Phelps also has experience with several large, notable research projects. She has collaborated with researchers at Argonne National Laboratory's Californium Rare Isotope Breeder Upgrade (CARIBU) to electroplate platinum and stainless-steel plates with californium-252 to analyze nuclear fission fragments. She has also contributed work on plutonium and neptunium for NASA's plutonium-238 project. Additionally, she was also on the team tasked with purifying the berkelium-249 used to confirm the discovery of element 117, tennessine.

In every project, Phelps said, collaboration was key to the scientific process. "Collaboration allows you to have a more robust and more diverse conclusion to your results," she said. "It is vitally important because you can't think of everything yourself on these multi-dimensional projects. The part we played in the confirmation of element 117 was definitely a collaborative team effort."



Phelps said her attitude on teamwork and the willingness to commit her skills towards the bigger picture is another lesson carried over from her time in the Navy. "You gain the sense that what you're doing is for the betterment of everyone," she said. "It's not just about you and your niche field of research, it's about what your research is doing to impact everyone else."

One way to expand your impact and broaden your niche, Phelps said, is to engage with your community, both socially and professionally. As a member of the American Chemical Society, Phelps recognizes the benefits gained from reaching out to the greater scientific society. They made science fun and engaging, she said, and their emphasis on experimentation helped translate scientific principles from words on a page into reality.

Today, Phelps tries to pass on the same lessons through her work with the graduate chapter of Alpha Kappa Alpha sorority's ASCEND program, which teaches concepts like robotics, drones, circuitry and coding to Knoxville high school students.

"I think it is important to be involved in professional organizations because iron sharpens iron"

Professional societies not only provide a way for researchers to stay updated on the latest advances in their field and look for new ideas and collaborations, but also provide an outlet for individual researchers to make their voice heard and to positively contribute to global research efforts.

Phelps is also involved in a number of STEM outreach programs dedicated to mentoring and encouraging local students to pursue scientific careers. Phelps said her own love of science was sparked early by a microscope set and encyclopedia-based science kit given to her by her mother and kindled by her middle and high school science teachers. "Going out to the schools and doing STEM outreach is something I really love to do because you can just see the light come on in the students' faces," she said. "You can see the questions forming and the beginning of the scientific process."

Quality STEM outreach needs to be more than just talking to the students, Phelps said. It requires a dialogue and the chance for students to get hands-on experience so they can be self-driven and make their own discoveries, much like Phelps did with her microscope set.

"You can either help explain it to them,

or you can help them find the answer on their own," she said. "I think helping students and other kids independently think for themselves is key to creating those new scientists and engineers."

Phelps also works with the ORNL Nuclear Science and Engineering Directorate's Educational Outreach Program, National Nuclear Science Week activities and the ORNL Traveling Science Fair trailers. By diversifying her engagement outlets, Phelps is able to reach students of all ages and bring the world of science and technology closer to reality for those who may have found it mystifying or intimidating. "You have to reach out to the community, because that's where you future scientists and your new ideas are going to come from," she said. "A lot of kids run from science, but by doing outreach and making it as fun for them as it was for me, it makes it more realistic as a possible future career choice."

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