C5ISR CENTER STEM@Home

Welcome to STEM@Home!

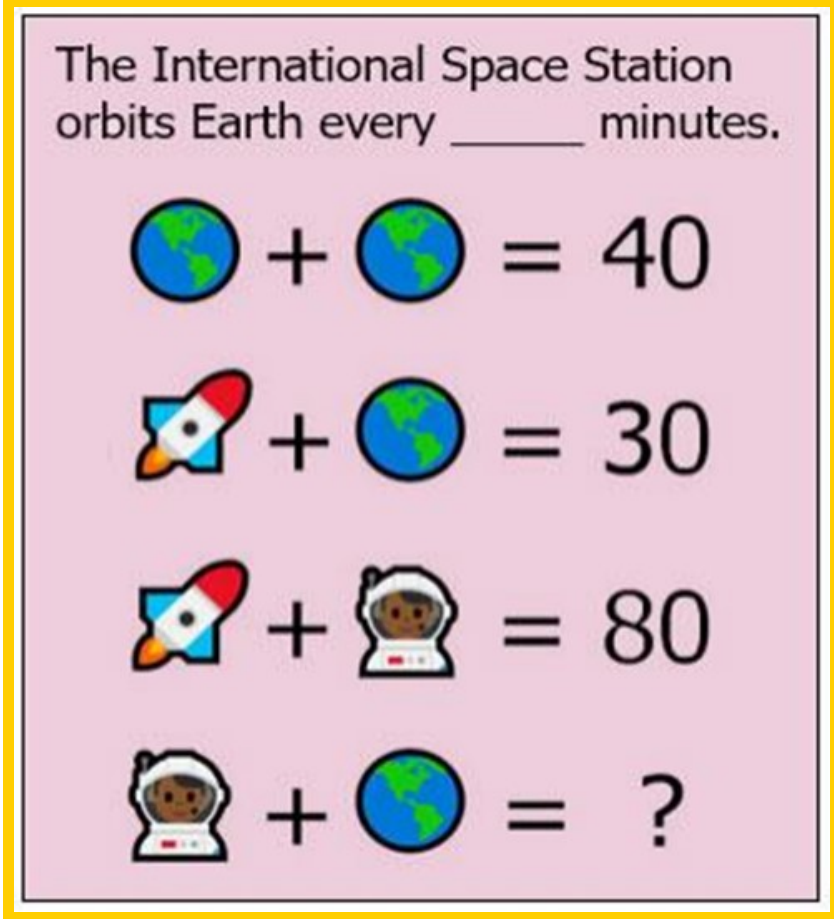
As we maneuver the challenges of the COVID-19 epidemic, we strive to continue to make STEM accessible to all.

The STEM@Home Newsletter is intended to be a resource to provide engaging and educational activities that can be done with minimal materials and a whole lot of imagination.

In this Issue...

Issue 28

Brain Teaser: Outer Space Math Puzzle



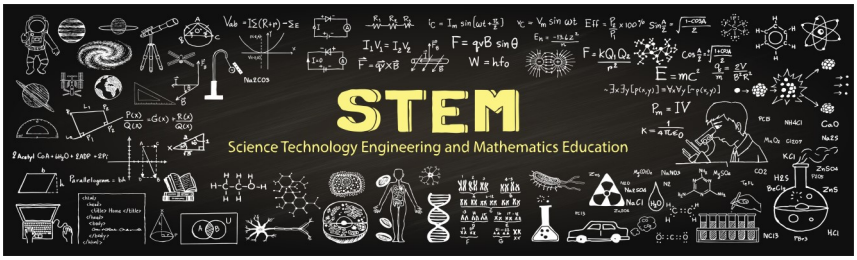
Solution on Page 3

SHARE YOUR STEM!

Visit the C5ISR Center on Facebook to post a photo of your child completing one of the STEM@Home Activities.

#C5ISRCenterSTEM

Facebook.com/DEVCOM.C5ISR



Introducing Mr. Chuck Hoppe

Name:

Mr. William C. "Chuck" Hoppe

Job Title:

Associate Director for Science, Technology, and Engineering

Length of Time with the US Army:

30 plus years. "I returned to government services after I retired from 30 years of active military service and following a three-year stint in industry."

Education:

- B.S. in General Engineering, U.S. Military Academy, West Point
- M.S. in Computer Science, Naval Postgraduate School
- M.A. in National Security Strategy, Naval War College
- M.S. in National Strategic Resourcing, Industrial College of the Armed Forces [Eisenhower School]

How does your job support the U.S. Soldier? Everything we do here at the Center is related in some way to the current and future success of our Army, joint, and coalition forces. My job in helping the Center director manage all the science and technology is for that sole purpose.

What is a typical day or a week like for you? As a senior scientific technical manager, I don't get to do the "fun" stuff. I manage and oversee the Center's science and technology portfolio. My days and weeks are spent reviewing our science and technology programs and assisting in the development and management of the resources that support our scientist and engineers who are doing the real work. I sit in a lot of meetings, but I also get to see and explore all the truly amazing work that our Center's scientists and engineers accomplish.

What drew you to the STEM field originally? I enjoyed math and science throughout my school years. They were always my favorite and best classes. I really enjoyed computing, and when the opportunity presented itself to go to graduate school, I jumped on it and got my Master's degree in computer science. I really enjoyed the artificial intelligence (AI) courses I took and decided to concentrate my master's work in AI. Ever since, I've been doing something related to my computer science degree. Today, just about everything has a computer chip in it and is connected to a network.

Why is STEM important to our national security and our national future? Science, technology, engineering, and mathematics are the foundation of so much of what makes this country great and what enables our greatest asset in the Army: our Soldiers. The capabilities we provide our Soldiers, enabled by the STEM disciplines, give our Army the advantage it needs to do what the country needs it to do: deter aggression, but if necessary, fight and win our nation's wars.

How should students further their interests in a STEM field? I would say pursue what you enjoy and what intrigues you. The pursuit of those goals will determine what STEM disciplines you will need to be successful in whatever endeavor you choose. STEM isn't a destination of its own; it is an enabler to a destination that the student chooses. To be an astronaut requires a different set of skills depending on whether you want to be a mission specialist or the captain of the spacecraft. Here's an example a little more down to earth: say you want to develop cosmetics, and in that case, chemistry would be a good foundational tool. Someone might be interested in just being a mathematician, and that's great because mathematicians can do all kinds of jobs. If you want to be a scientist or engineer, you'll need to know what kind of scientist or what kind of engineer. So go at it the other way: find what excites you. If you love the ocean and scuba diving, then you might consider becoming an oceanographer. Chase your dream and put in the work to master the skills you need to achieve that dream.

What is the most important STEM-related innovation you've witnessed in your career? I don't think I can pick just one innovation. Now you're making me date myself. I've seen many in my lifetime. The internet comes immediately to mind, as it didn't exist when I was growing up. There's also integrated circuit chips. I grew up with a TV that had vacuum tubes. The microwave oven sure would have saved me some stove burns cooking a snack when I was younger. The cell phone is another. I dialed my grandmother's phone number on a rotary phone. We didn't need to dial the area code back then.

What is your favorite technology for personal use? Clearly, for me, it's the computer – the associated network and programming languages. I still program for my own amusement and relaxation. I enjoy programming and making computers do what I want them to do. It is a useful skill for a number of other reasons too.

What is the next great technological frontier? That's the great thing about STEM – the foreseeable horizon is actually close because we have yet unlocked the next great advancement. We can't see that horizon just yet, but if history is any indicator of the future, the young minds growing up today are going to make phenomenal advances in areas we don't even know yet. In the near-future, quantum mechanics/physics has the potential to change a lot of current underlying technologies that we rely on – computers, cryptography, chemistry, optics, precision modeling, and weather forecasting, for example. Finally, after decades of waiting for computational computing to catch up, artificial intelligence actually has the computational power to be very useful.

Why is it important for engineers and scientists to engage with STEM Outreach? Fundamentally, to encourage success. Scientists, engineers, and mathematicians talking to young minds about what they do with their skills and their knowledge can clear away some of the false and negative understanding of how hard or impossible it is to be one of them. There are many scientists, but only one Albert Einstein. Yet you don't have to be Albert Einstein to be a scientist. Marie Curie won Nobel prizes in physics (1903) and chemistry (1911). You don't need to be Marie Curie, but she is a great role model because she loved to learn. If that is what a student wants to pursue, you can give them concrete examples to look to.

STEM Challenge

Solution for Camping Challenge

MATERIALS:

- Craft or popsicle sticks
- Straws
- Paper, cardstock, or flashcards
- Cardboard
- Paper towel tubes
- Plastic cups
- Aluminum foil
- Empty plastic bottles
- Tape
- String or rubber bands
- Paper clips

Testing Materials: Coins, marbles, or other small items

With the beginning of summer approaching, camping season has begun. Camping offers people the opportunity to enjoy fresh air and explore the wilderness. One camping challenge is how to avoid attracting wild animals to your campsite with your food.

Mission:
Hank's Wild Adventures Solutions Company has hired you as an engineer to design a device that campers can use to keep their food safe from wild animals. The company requires a device that allows campers to store their food and be able to raise their food to a height that most wild animals cannot reach.

Requirements:
Device must have a pulley system to store food up high at night.
Device must move food at least 10 inches above the tabletop.

Design Process

ASK: What is the problem you need to solve? A way to keep food safe from wild animals while people are camping.

IMAGINE: Brainstorm and decide on one idea. What will your device look like?

PLAN: Draw a picture of your device to keep food safe while camping.

CREATE: Use the materials to create a prototype of your new device.

IMPROVE: Think of ways you could improve your new design. Test your food-raising device by using pennies or other small items to see how much weight it can hold when lifting the food up from the ground.

Questions to think about:

- Were you successful in designing a device to keep food safe from wild animals while people camp?
- If you had access to additional materials, what would you have used? Why?

SAFETY FIRST! You Must Have Adult Supervision To Complete This Activity.

Ask an adult to Share your STEM on Facebook.

Facebook.com/DEVCOM.C5ISR

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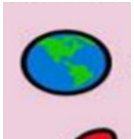
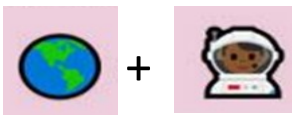
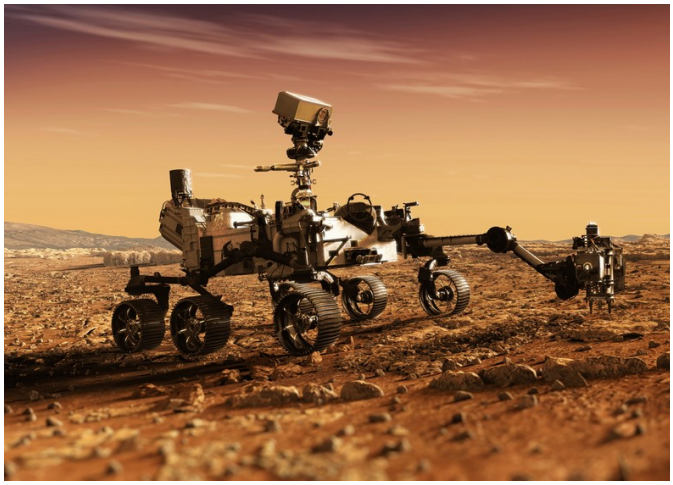




Solution to Puzzle on Page 1

STEM IN THE NEWS



Perseverance and MOXIE celebrate their first accomplishments

The NASA rover Perseverance added to its list of growing accomplishments since landing on Mars on Feb. 18. On April 20, the six-wheeled rover used a special experimental instrument about the size of a toaster called the Mars Oxygen In-Situ Resource Experiment, or MOXIE, to convert the planet's carbon-dioxide-rich atmosphere into oxygen. This oxygen, once isolated and stored, might one day be able to provide breathable air for astronauts. In addition to this, MOXIE's ability to convert carbon dioxide in oxygen is crucial in the making rocket fuel, which future astronauts will depend on to make the trip back home to Earth.

"For rockets and astronauts, oxygen is key," said Michael Hecht, MOXIE's principal investigator from the Massachusetts Institute of Technology's Haystack Observatory. To burn its fuel, a rocket must have more oxygen by weight. For example, in a future mission, getting four astronauts off Mars would require approximately 15,000 pounds (seven metric tons) of fuel and 55,0000 pounds (25 metric tons) of oxygen. On the flip side, astronauts living and working on Mars require a lot less oxygen to breathe – only about one metric ton among the group.

Transporting 25 metric tons of oxygen is the tricky part, but if a future rocket is able to carry the one-ton oxygen converter MOXIE, then this would be far more practical and economical.

So how does MOXIE work? Mars' atmosphere is 95% carbon dioxide. MOXIE works by separating the oxygen molecules from the carbon dioxide molecules, which are made up of one carbon atom and two atoms of oxygen. The oxygen is stored, and the additional carbon atom is released into the Martian atmosphere. The conversion process takes high levels of heat to reach a temperature of approximately 1,470 degrees Fahrenheit, or 800 degrees Celsius. MOXIE is made up of heat-tolerant materials – like nickel alloy, gold, and a lightweight aerogel – that allow it to withstand the heat and do its job.

In its first test operation, MOXIE produced and retained a modest five grams of oxygen, which is about 10 minutes' worth of breathable air for a single astronaut. MOXIE is designed to generate up to 10 grams of oxygen per hour. This initial demonstration was designed to prove and ensure that MOXIE could survive the seven-month journey and touchdown with Perseverance.

The oxygen production runs of MOXIE will come in three phases. The first phase checks out the instrument's function. The second phase runs MOXIE in different atmospheric conditions, like different times of day or seasons. The third phase tries new operating modes, like running operations at three or more different temperatures.

"MOXIE isn't just the first instrument that will produce oxygen on another planet," said Hecht. It's going to be able to help future missions "live off the land" using materials and substances found on the ground, and converting these materials into useable things.

Sources and Resources:

www.nasa.gov/press-release/nasa-s-perseverance-mars-rover-extracts-first-oxygen-from-red-planet

STEM Activity/Challenge

This experiment can get messy, so make sure to have some towels nearby. Make sure to conduct the experiment in an open space where nothing nearby can get ruined.

Lemon Volcano

Summertime makes you think of nice hot days in the sun and fresh-squeezed lemonade. Besides being great for lemonade, lemons are great for exploring a simple chemical reaction. Using a lemon and a few other ingredients from your kitchen, you can create your own lemon volcano.

Materials:

- Lemons
- Baking soda
- Pan, tray, or large bowl
- Cutting knife (with help and permission from an adult)
- Popsicle stick
- Spoon
- Measuring cup

DIRECTIONS:

1. Have your adult cut the lemon in half so that it will stand up right.

2. Use your craft stick to poke holes and break up the inside of the lemon. This will help speed up the reaction in the beginning.

3. Place a few drops of food coloring on top of your lemon. You can use one color or add additional colors for a more colorful effect.

4. Use your measuring cup or spoon to sprinkle a generous amount of baking soda on top of the lemon.

5. Use your spoon or butter knife to mix the baking soda with the inside of the lemon. Make sure to press the baking soda into the different sections of the lemon to really get the eruption going.

6. Continue adding and mixing the baking soda into the lemon until the reaction stops.

The Science Explained

You should have noticed that when you added the baking soda to the lemon, it started to fizzle and foam. The cool thing about this experiment is that there are actually two reactions taking place. Lemons contain a lot of citric acid, which like other acids, is a chemical that contains a lot of hydrogen ions. When an acid reacts with a base such as the baking soda, which has hydroxide ions, acids can get rid of their hydrogen ions. This process is known as an acid-base reaction that allows the lemon and baking soda to neutralize each other.

One question remains: how is our lemon volcano erupting? When the baking soda (the base) comes in contact with an acid such as the lemon, a chemical reaction starts. When the reaction neutralizes the acid, as mentioned previously, it releases carbon dioxide gas. The carbon dioxide gas that is produced when you mix the baking soda into the lemon is what creates the bubbly foam. Once the baking soda and the lemon have neutralized each other out, the reaction will stop and your lemon volcano will stop erupting.

SAFETY FIRST! You Must Have Adult Supervision To Complete This Activity.

Did you know?

Citric fruits taste sour because they contain citric acid, and the hydrogen ions that are in citric acid are what gives our taste buds that sour taste.

Lemons can be used as a battery by dipping electrodes into the fruit, which produces energy that is high enough to run a small digital watch.