

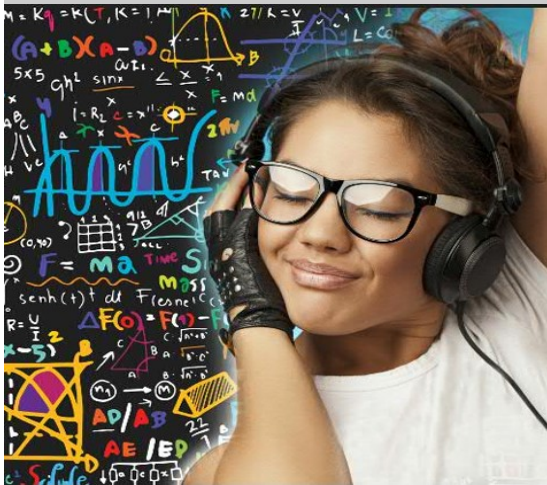


# C5ISR CENTER STEM@Home

## 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...

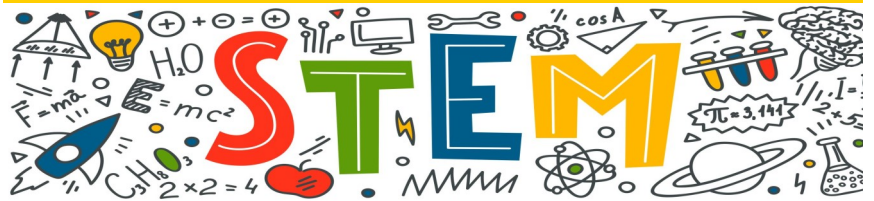
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Issue 19

**Math Challenge:** Fill in the puzzle so every row across, every column down, and every two-by-two box contains the numbers 1 to 4 without repeating any number in the row, column, or square.

|   |  |  |   |
|---|--|--|---|
|   |  |  | 3 |
| 4 |  |  |   |
|   |  |  | 1 |
| 3 |  |  |   |

Solution on Page 3



### SHARE YOUR STEM...

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



<https://www.facebook.com/CCDC.C5ISR/>

#C5ISRCenterSTEM

## Introducing Ms. Courtney Coulter


**Name:**

Courtney Coulter

**Job Title:**

Team Lead – Systems Engineer

**Length of Time as a U.S. Army Engineer:**

15 Years

**Education:**

- Bachelor of Science in Computer Engineering— Bethune-Cookman College, Daytona Beach, Florida
- Master of Science in Business Administration— Army Materiel Command Logistics Leadership Center, Texas A&M University – Texarkana, Texas
- Master of Engineering in Systems Engineering— Stevens Institute of Technology, Hoboken, New Jersey

**How does your job support the U.S. Soldier?** My goal is to provide Soldiers with enhanced capabilities to collect, process, and analyze data to help identify and defeat terrorist and bad actors.

**What is a typical day like for you?** After a strong cup of coffee, I start my day by eating the frog – that is, I start with the hardest (and most fun!) tasks first. Right now, that means meeting with my team to discuss the design of our system and planning how we will break down each component into easy parts for the group. It's a bit like planning an elaborate dinner – we decide the menu (what will we do today?), determine who is best for each dish (who will take on each task?), and then decide what time dinner will be ready (what is the completion goal?).

Once those plans are in place, I have the opportunity to work alongside some of the smartest people in the world to review and test software as well as participate in military activities using my equipment. It is the most rewarding experience to see something you imagine come to life!

Another key part of being a scientist is communicating your findings. A good portion of my week is preparing presentations, writing articles, and having technical exchanges with other experts in the field to increase the diversity of thought on solutions.

**What drew you to the STEM field originally?** It was my Calculus teacher in high school who saw my potential. She exposed me to opportunities to use my talents in a way that could build and innovate. In college, my professors showed me that with the magic of physics and science, nothing was impossible for mankind. I wanted to be a part of that.

**Why is STEM important to our national security and our national future?** The world is changing; yet, it is still the goal of the Army to fight this nation's wars and protect democracy. One of the best tools we have, alongside diplomacy, is technology. Technology helps us see and understand the world, make decisions, and protect our national interests. We must innovate and develop technologies faster than our competitors, and we must protect that technology. Advances in technology stimulate our economy and is an indicator of growth and great opportunity. STEM leads the way for a prosperous future.

**How should students further their interests in a STEM field?** Fall in love with your craft. Read books in the field, attend conferences, and listen to podcasts. Companies are eager to have enthusiastic youth for summer apprenticeships and internships. The great advantage for youth today is that you can find community in social media, and so much information is at your fingertips. Pursue your goals and interests relentlessly!

**What is the most important STEM-related innovation you've witnessed in your career?** I think the sizing of processing power, advancements in communications, and the maturation of data analytics are the most important innovations I have seen in my career. Today, Soldiers have, at their fingertips, access to tools that help them see further, react quicker, and anticipate enemy responses.

**What is your favorite technology for personal use?** My phone! I'm aging myself to say that I was in college when Facebook started. Back then, only college students could have an account, and it was a big deal for your school to be added to the registry of users. I had the old Nokia blue brick, and you could only play Snake and send short text messages back then. I definitely never considered taking pictures with my device. Now, Facebook is worth about \$750 billion, social media dominates pop culture, and most of this data can be accessed through a tiny device that acts much more like a computer. This innovation is fascinating to me.

**What is the next great technological frontier?** Artificial intelligence and machine learning are the next great adventures! Advances in cloud computing, data engineering, and processing power enables new ways to solve complex problems.

**Why is it important for engineers and scientists to engage with STEM Outreach?** STEM Outreach is incredibly important! We represent what is possible. I am a Black woman with very humble beginnings, from a little town in Alabama. Becoming an engineer didn't seem like a future or a job for someone like me. But it was my high school math teachers and the scientists at IBM who reached out, mentored me, and exposed me to the great landscape of STEM. It is now our duty to do the same for the next generation of scientists.

# STEM Challenge



## MATERIALS:

- Popsicle sticks
- Paper, cardstock, or cardboard
- Paper towel roll tubes
- Small plastic cups
- Aluminum foil
- String or rubber bands
- Small paper cups or bowls
- Pipe cleaners
- Straws
- Tape
- Plastic spoons
- Other useful items in your home

## Materials for Testing:

- Snow (rice, cotton balls, miniature marshmallows)
- Tray or shallow dish



**Ask a grownup for permission to use these items.**

## Winter Wonderland...

Snow may be beautiful...until you have to clean it up!

**Mission:** A large snowstorm is expected to come to the town of Nothere, but shovels and other snow-removal supplies have been in limited supply for weeks due to a shipping delay. The two-day snowstorm is expected to result in five feet of snow. The mayor has been worried about how people in the community will be able to clear their driveways, sidewalks, and businesses so people can go to work and school. The mayor of Nothere has contacted you, as an engineer, to design a snow-removal device that can be mass-produced quickly to help the town prepare for the upcoming snowstorm.

**Requirements:** The device must work using only one hand to operate. You must test your snow removal device to ensure that it will remove a large amount of snow efficiently.

## Design Process:

**ASK:** What is the problem you need to solve? A way to remove large amounts of snow.

**IMAGINE:** Brainstorm and decide on one idea. How can you design a snow-removal device to remove large amounts of snow and how will it work?

**PLAN:** Draw a picture of the new device. What will your snow-removal device look like?

**CREATE:** Use the materials to create a prototype of your snow-removal device.

**IMPROVE:** Use materials to test your snow-removal device. How can you improve your snow-removal device?

## Questions to ask:

- If you had more choices of materials, what would you use and why?
- How will your design be effective in quickly removing large amount of snow?

Ask an adult to **Share your STEM** on Facebook.  
#C5ISRCenterSTEM



## The C5ISR Center Community Outreach Office Invites You To GET YOUR STEM ON...

The C5ISR Center Community Outreach Program is dedicated to providing quality STEM programs to students K-12. For more information about our STEM Outreach Programs, visit us on the web:

[https://c5isr.ccdc.army.mil/student\\_programs/](https://c5isr.ccdc.army.mil/student_programs/)

|   |   |   |   |
|---|---|---|---|
| 1 | 2 | 4 | 3 |
| 4 | 3 | 1 | 2 |
| 2 | 4 | 3 | 1 |
| 3 | 1 | 2 | 4 |

Solution to Page 1 Puzzle

## STEM IN THE NEWS

### Diamonds: Stretching to the Future of Electronic Material



A team of scientists, engineers, and researchers from the City University (City U) of Hong Kong, the Massachusetts Institute of Technology, and the Harbin Institute of Technology of Harbin in China have discovered new potential abilities of diamonds and their use in the future of electronic material.

Diamonds are one of the hardest materials in nature, and they have many uses outside of being the centerpiece of an engagement ring or other kinds of jewelry. From an industrial aspect, diamonds are strong enough to be used for polishing, cutting, and drilling. There are many industries – like the automotive and mining industries and even the military – that use diamond saws and drills.

The recent findings of this team, led by Dr. Lu Yang of City U, have found that if diamonds are manipulated and put through a series of tensile, or stretching, tests and experiments, it makes them excellent candidates for microelectronics, photonics, and quantum information technologies. The research, published in the leading scientific journal *Science*, highlights the diamond as a high-performance electronic and photonic material, due in large part to its high thermal conductivity, electrical carrier mobility, high breakdown strength, and ultra-wide bandgap. These properties have led to the diamond being dubbed the “Mount Everest” of electronic materials.

The team certainly met their fair share of challenges during the experiment and testing phase of their study. As previously noted, diamonds have a wide bandgap, which is a crucial property for a semiconductor, and a large and broad bandgap is what allows high-powered devices and electronics to operate and function. While diamonds have a large bandgap, they also have a tight and rigid crystal structure, which makes the material difficult to manipulate and alter during the production process. The team attempted to perform a process called strain engineering on the diamond to change its structure and properties, but that proved to be impossible.

Dr. Lu and his collaborators made an unexpected discovery when they applied a large local strain to a nanoscale diamond. The applied strain was able to bend and twist the physical properties of the diamond, which changed its characteristics and further proved this process could, indeed, be used successfully for designing functional electronic devices.

The team is still continuing their research and testing on how to manipulate the material to be used in the production of electronics. These findings are the first steps in the advancement of electronics, big and small, for personal and industrial use, and it will also change how we understand material science and information technology moving forward.

#### IMPORTANT TERMS AND DEFINITIONS:

The Mohs Hardness Scale – a measurement of a mineral's resistance to scratching. The scale ranges from 1 to 10, with 10 being the hardest. Diamonds score a “10” on the Mohs Hardness Scale.

Photonics – the science and technology of generating, controlling, and detecting photons, which are particles of light, to transmit information. Fiber optics are an example of photonics.

Quantum Information Technology – also called quantum computing, is an area of computer science and technology that explains the behavior of energy and material on the atomic and subatomic levels. A computer using quantum bits can store an enormous amount of information and uses less energy doing so than a classical computer.

Semiconductors – materials that have a conductivity between conductors (generally metals) and nonconductors or insulators (such as most ceramics).

Bandgap – also called a band gap or energy gap, is an energy range in a solid material where no electron states can exist. The term is used in solid-state physics and chemistry. Scientists use the bandgap to predict if a solid will conduct electricity.

Stress and strain – stress is a measurement of how much force an object experiences, and how that force is spread over the object's area. Strain is a measurement of how an object reacts to stress.

#### Sources:

[www.sciencedaily.com/releases/2020/12/201231141509.htm](http://www.sciencedaily.com/releases/2020/12/201231141509.htm)

[www.azom.com/news.aspx?newsID=55256](http://www.azom.com/news.aspx?newsID=55256)

[phys.org/news/2020-12-diamond-next-generation-microelectronics.html](http://phys.org/news/2020-12-diamond-next-generation-microelectronics.html)

## STEM Activity/Challenge

### Snowstorm-in-a-Jar

Now that it's winter, with colder temperatures, you may see snow fall from the sky from time to time. With just a few simple ingredients, you can create your own snowstorm in a jar while staying nice and warm inside your home. This fun experiment shows how a snowstorm works while also demonstrating how a chemical reaction causes changes in liquids and other materials.



#### Materials:

- Clear jar or tall glass cup
- Vegetable oil or baby oil
- Alka Seltzer tablets
- White paint
- Glitter (optional)

#### Directions:

1. Pour 3/4 a cup of water into your large glass or jar.
2. Add a small squirt of white paint into the water and stir until it is mixed well. You will want the water to be a white color.
3. Pour your oil in, to a level almost to the top of the glass or jar, creating a layer on top of the water. You will want to make sure you have more oil than water in your glass.
4. Break up the Alka Seltzer tablet into pieces, then drop two to three pieces into the jar.
5. Observe the reaction that takes place. You will see the white water bubble up through the oil, creating a snowstorm in a jar.

#### SAFETY NOTICE

Make sure you have an adult's permission and supervision before beginning this activity.



### The Science Explained

There are a couple of cool science concepts going on in this simple, but fun, experiment.

First, this snowstorm-in-a-jar experiment offers a unique way to explore how water and oil are immiscible, meaning that they are un-mixable. This is because the force of attraction between the individual liquids is greater than the force of attraction between water and oil. They will always turn back into separate layers.

Another factor that comes into play in this experiment is the density of the liquids. The oil is less dense than the water, allowing it to create a layer on top of the water, where it exerts pressure down toward the water.

The last dimension to this experiment that ties everything together is the chemical reaction that takes place. The Alka Seltzer has both sodium bicarbonate (baking soda) and citric acid in it, and when they are mixed with water, they form bubbles of carbon dioxide. This is what you see rise up to the surface through the oil. However, when the carbon dioxide is released into the air, the remaining water falls back down to the bottom because the water is denser than oil.

When the carbon dioxide rises up, it carries some of the water up with it. You are able to see these bubbles in the oil because water and oil are immiscible. If this experiment was done without any oil, you would only have a fizzling jar of water. You would not be able to see the snowstorm effect of the white bubble particles falling up and down.

Source: [Lemonlimeadventures.com/snow-storm-in-a-jar-weather-science-for-kids/](http://Lemonlimeadventures.com/snow-storm-in-a-jar-weather-science-for-kids/)



ARMY EDUCATIONAL  
OUTREACH PROGRAM

The Army Education Outreach Program (AEOP) eCYBERMISSION registration is open for students, team advisors, and volunteers! eCYBERMISSION is a web-based STEM competition that helps students grades 6-9 learn about real-life applications of STEM. **ACCEPT THE CHALLENGE TODAY!**

Learn more at <https://www.usaeop.com/program/ecybermission/>.