



# 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.



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Issue 29

## Brain Teaser

Rules:

1. The missing numbers are between 0 and 9.
2. The numbers in the right column are the sum of all of the previous numbers (left to right).
3. The bottom row is the sum of all the numbers above it (top to bottom).
4. The diagonals are also sums.

				21
		7	5	27
9				28
	4		9	30
	4			22
28	23	31	25	30

Solution on Page 3

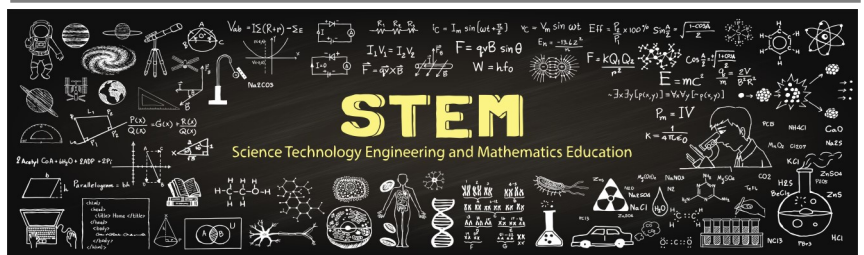


### SHARE YOUR STEM!

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](https://www.facebook.com/DEVCOM.C5ISR)



## Introducing Ms. Lissette M. Rodríguez Cabañas


**Name:**

Ms. Lissette M. Rodríguez Cabañas

**Job Title:**

Mechanical Engineer/  
Collateral Duty Safety Officer

**How long have you been a U.S. Army engineer/scientist?**

4 years

**Education:**

- B.S. in Chemical Engineering  
University Of Puerto Rico - Mayagüez

**How does your job support the U.S. Soldier?** – I work in the Army power lab. Our lab and its engineers work to “lighten the load” of our Soldiers. The lab I work in focuses on batteries, solar, fuel cells, and microgrids. We make sure that the Soldiers have energy they need when and where they need it the most.

**What is a typical day or a week like for you?** – As an engineer, I do regular tests on solar panels and batteries to measure how effective they are and if they will meet the needs of our Soldiers. I then use those test results, along with the feedback from the Soldiers and manufacturers to improve the technology. In addition to my engineering work, I am also the collateral duty safety officer, so I make sure the lab operates safely and that our personnel are all properly trained.

**What drew you to the STEM field originally?** – I think I have been interested in STEM forever. Even when I was little, I remember taking apart my toys, or looking at the different things around the house and trying to figure them out. I’ve always been interested in understanding how things work and finding ways they can be improved.

**Why is STEM important to our national security and our national future?** – Technology is always changing and updating. Not only does the technology itself change all the time, but because we always have new technology available, we can develop things faster than ever. Today’s students will be the future workforce, and they will be developing the technologies of tomorrow, so we have to make sure we have people ready to step in and keep innovation going.

**How should students further their interests in a STEM field?** – There are internships and programs that provide students with the opportunity to have a hands-on experience in most of the STEM-related careers. But really, kids are constantly learning and discovering on their own. Every time you do a mental calculation or try to solve a problem or figure out the reason things work, you are doing STEM. Everything you already do is STEM related, even if you don’t know it. So just keep learning and discovering and looking for the “why” of things.

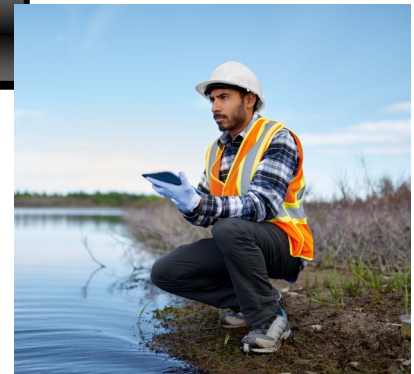
**What is the most important STEM-related innovation you’ve witnessed in your career?** – Since I work in Army power, I would have to say the development of fuel cells. All the things a Soldier has to carry are heavy, and then if they had to carry batteries for each piece of equipment, all of that weight adds up. A fuel cell has much more power than a battery of the same size. For the Soldier, this means they can do more with less weight. We are always looking for ways to make the Soldier lighter and faster to help them complete their mission.

**What is your favorite technology for personal use?** – My favorite personal technology is definitely my smartphone. There is an app for anything you can think of: you can translate languages, you can use apps or add-ons to find live cables in the walls, you can play games. It’s all there. You can do pretty much anything on your phone.

**What is the next great technological frontier?** – In the future, as we keep developing better technologies, we are going to have to make sure we are protecting our natural resources. There is a lot of emphasis on “going green,” and that is because taking care of the environment is going to be a huge priority. We are going to have to look at renewable energy and modifying the things we use and the things we build to make them better for the environment.

**Why is it important for engineers and scientists to engage with STEM Outreach?** – STEM Outreach is important because kids can get a better perspective of the STEM careers and get motivated to pursue one in the future. I have been able to do a lot of activities with students, to present different projects or to teach about engineering. It’s so important for the kids to have the time to see the technology for themselves. Eventually, a lot of the stuff we develop will get to the market, but we are able to show the kids that as Army engineers, we work with the latest in technology, and hopefully, that helps to get them excited about what we do and interested in finding a STEM career in the future.

# STEM Challenge



## Pollution Solution Challenge

Materials	Cost
Rubber bands	\$80 for 5
Cardboard box	\$250
Plastic bottles	\$125 each
Construction paper	\$60 dollar per sheet
Popsicle sticks	\$100 for 10
Straws	\$75 for eight straws
Glue	\$50
Cardboard paper towel/ toilet paper roll	\$150
Tape	\$50 for 12 inches
cups	\$215
Other item of choice (not listed)	\$200

Environmental engineers plan, design, and implement measures to prevent or remediate environmental hazards. They use the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems such as waste treatment, site remediation, or pollution control technology.

Following a huge hurricane, a lot of trash has been noticed at the parks and beaches in the town of Centralville. People in the community have been worried that all the trash – including plastic bags and glass – could harm the wildlife that lives there. The mayor has reached out to Hank’s Environmental Solutions Agency to help come up with a quick solution to their problem.

**Mission:** Hank’s Environmental Solutions Agency has contracted you as an environmental engineer to design a robot or other device that will be able to remove the trash that has taken over the local parks and beaches in the town of Centralville.

**Requirements:**

- Design must use mostly recyclable materials.
- Design must have a way to remove trash from both land and water to place in a trash bag or other container.
- Design must be operate by hand or be hands free.

**Extra Challenge:** Design your robot or device within a budget of \$1,000 using the cost list on the side.

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

**Design Process:**

**ASK:** What is the problem you need to solve? A way to remove and maintain pollution on both land and in water.

**IMAGINE:** Brainstorm and decide on one idea. How will your robot or device remove and minimize pollution on both land and water.

**PLAN:** Draw a picture of your new design. What will your robot or device look like?

**CREATE:** Use the materials to create a prototype of your design.

**IMPROVE:** How can you improve your robot or device?

-Will your robot or device be effective in removing and minimizing future pollution at the parks and beaches?

Ask an adult to Share your STEM on Facebook.  
[Facebook.com/DEVCOM.C5ISR](https://www.facebook.com/DEVCOM.C5ISR)  
**#C5ISRCenterSTEM**

STEM

Science Technology Engineering and Mathematics Education

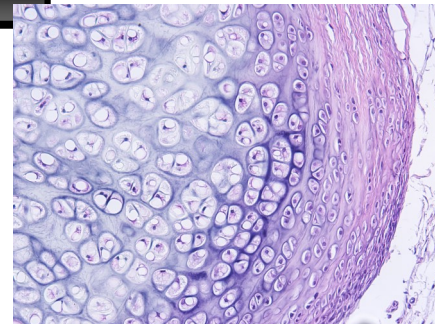
**Solution to puzzle on pg. 1**

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## STEM IN THE NEWS

### Cartilage inspires scientists to create new material



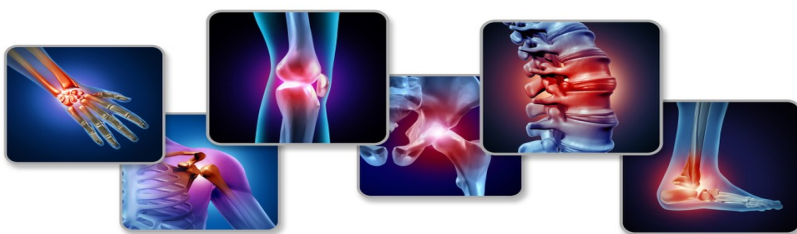
Cartilage is an important structural component of the human body. It is a soft, but strong, tissue that serves different purposes and functions in a number of different ways. It can be found in our rib cage, spine, nose, and ears, but it is also located in between our joints, which helps to protect and keep them moving without our bones rubbing together. Scientists have spent many years trying to create a material that mimics the properties of cartilage. They've been unable to produce the results they've been looking for, until now.

As published in the scientific journal *Applied Polymer Materials*, a team of researchers at the University of Leeds and Imperial College London in England announced that they have successfully created a material that functions just like cartilage. The team believes the material will have a wide range of abilities and uses in the engineering world.

Cartilage is characterized as a "bi-phasic porous material," which means that it exists in both solid and fluid (liquid) phases. It changes into its fluid phase by absorbing a substance produced in the joints called synovial fluid. The synovial fluid not only lubricates the joints but also protects and cushions against compression and force applied to the joints. Cartilage is also porous, meaning it has pores or tiny holes that allow fluid to pass through it. Because cartilage is porous, the synovial fluid eventually drains and helps to break up the energy and force moving through the body and impacting the joints. At this point, the cartilage returns to its solid phase, and the cycle repeats itself.

"Scientists and engineers have been trying for years to develop a material that has the properties of cartilage," said Dr. Siavash Soltanahmadi, a research fellow and team leader from the School of Mechanical Engineering at the University of Leeds. "We have now developed a material for engineering applications that copies some of the most important properties found in cartilage, and this has only been possible because we found a way to mimic the way nature does it."

There are many uses in engineering for a synthetic, or man-made, material that is soft but strong, and can stand up to heavy loads with minimal damage, like bearings. Earlier attempts at a synthetic cartilage focused on using hydrogels, which is a material that absorbs water. Hydrogels are great at reducing and preventing friction, but they don't stand up well to pressure or force. Additionally, it takes time for hydrogel to return to its normal shape after it has been compressed.



The team overcame this challenge by creating a synthetic porous material held in a silicone-based polymer called polydimethylsiloxane – or PDMS for short. The silicone polymer PDMS helps the hydrogel keeps its shape and keeps the friction to a minimum by providing a lubricating layer.

The team believes that their work and developments can help future engineering mechanisms and structures provide alternatives for those that use an oil-based lubrication system.

#### Sources and Resources:

[www.leeds.ac.uk/news/article/4807/inspired-by-nature-the-research-to-develop-a-new-load-bearing-material](http://www.leeds.ac.uk/news/article/4807/inspired-by-nature-the-research-to-develop-a-new-load-bearing-material)

[newatlas.com/materials/cartilage-inspired-self-lubriacting-material/](http://newatlas.com/materials/cartilage-inspired-self-lubriacting-material/)



AEOP offers our nation's youth and teachers opportunities for meaningful, real-world STEM experiences, competitions and paid internships alongside Army researchers.

Learn More at <https://www.usaeop.com/>

## STEM Activity/Challenge

### Materials:

- Aluminum pan or flat baking dish
- Cooking oil
- Food coloring or cocoa powder to change color of oil
- Dishwashing liquid soap

### Cleanup toolkit:

- Spoon
- Cotton balls
- Sponge,
- Paper towels
- Medicine dropper
- Piece of cardboard



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

## Water Pollution-Oil Spill

You might have heard about oil spills on the news or newspapers, and maybe you've learned a bit about the cleanup process. Try this experiment to learn more about the cleanup process when there is an oil spill in the ocean.

### Directions:

1. Fill your aluminum tray or shallow baking dish about halfway full with water.
2. Mix either food coloring or cocoa powder with about 3 tablespoons of cooking oil. The oil represent crude oil and the food coloring or cocoa powder represent the chemical trapped inside the oil. The food coloring will not completely mix with the oil.
3. Pour your oil mixture into the water.
4. Experiment with the materials suggested in the cleanup tool kit to try to determine which one cleans up the oil the best. Make a prediction before you begin of what tool you think will work best.
5. After trying the materials in the cleanup tool kit, add a few drops of dishwashing liquid soap. Observe what happens to the oil when the dish soap is added.
6. Try using materials from the cleanup tool kit again after the dish soap was added. What did you notice? Was it easier to clean up the oil?
7. Tip: If you would like to demonstrate this experiment with less of a mess, you can fill a water bottle halfway with water, then add the oil with food coloring. Observe what happens when you add dish soap.



## The Science Explained

An oil spill is type of pollution that happens when crude oil is released into the water or on land. Oil spills into rivers, bay, and the ocean are mostly caused by accidents or human error involving tanker ships, barges, pipelines, refineries, drilling rigs, and storage facilities.

When there is an oil spill, the oil floats on both salt water (ocean) and fresh water (lakes and rivers), which can make cleaning up oil a bit easier. However, in some circumstances, very heavy water oil can sink in freshwater.

Oil spills are harmful to marine birds, mammals, fish, and shellfish. Oil on fur or feathers prevents the animal's coats from repelling water or allowing them to insulate against cold temperatures, which can lead to hyperthermia. In addition, the animals can ingest the oil, which can be poisonous to them and contaminate the food supply.

So the big question is how are oil spills cleaned up? Local state and government agencies, along with volunteer agencies, have various methods they use to clean up oil spills. Some of these include: booms, skimmers, sorbents, vacuum trucks, shovels, road equipment, chemical dispersants, and biological agents, which break down the oil into its chemical constituents.

You may have noticed in the experiment that when you added the oil to the water, it created a layer on the surface of the water. This is because oil is less dense than water, and it floats to the surface. When working to clean the oil from the water, you may have noticed that some of the tools you used worked much better than others. Additionally, when you added in the dish soap, you should have noticed the oil breaking down and mixing with the water. This is because dish detergent is an emulsifier, and it breaks the oil into smaller drops so that it can mix with water and rinse away. The key to how this works is the chemistry behind soap. Each end of the soap is made of different molecules, with one end hating water (hydrophobic) and the other end loving water (hydrophilic). Since the uncharged end mixes with oil, while the charged end mixes with water, it allows the oil and water to mix together. The oil molecules are suspended in the dish soap, which is suspended in the water.

## Vocabulary:

**Booms-** floating barriers to oil.

Example: A big boom can be placed around a tanker that leaks oil to collect all the oil.

**Skimmers-** boats that scoop up spilled oil from the surface of the water.

**Sorbent-** a large sponge used to absorb oil.

