

# AFRL

NEW MEXICO  
STEM OUTREACH

Inspiring Future Scientists  
and Engineers

## AFRL NM STEM ACADEMY



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# The Rocket Report



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## BBBS Discovers States of Matter

At the Big Brothers Big Sisters Discovery Festival on 17 November 2023, we had all the states of matter that matter in the whole state represented: Solid, Liquid, Gas, and Plasma!

### Ice Melting Blocks

Visitors to our booth discovered that *solid* ice cubes melt *faster* into *liquid* water when placed on a block that feels colder than the one next to it. That's because the colder block conducts heat better.

### Happy/Sad Balls

When visitors dropped two nearly identical rubbery balls down a clear tube, one bounced happily, and one didn't, which was very sad. That's because the material the bouncy one was made of had molecules less densely packed together, so it bounced better.

Materials scientists take properties of different materials like these into consideration when helping design things. If you worked for a sporting goods manufacturer, and wanted to make a basketball, for example, you'd rather use the bouncy material!

### Cryo Demo

Nitrogen is usually a *gas*, but when you get it really cold, like  $-320^{\circ}$  Fahrenheit, it turns into a *liquid*.

Visitors discovered that dipping a balloon into cold liquid nitrogen could even turn the oxygen in the balloon into a liquid briefly, until it warmed up to room temperature again. Watching that happen required munching on some popcorn, so visitors also got to eat

some crunchy liquid nitrogen-dipped popcorn!

### Plasma Balls

Speaking of basketballs, visitors also got to explore the plasma in a Plasma Ball that was about the size of a basketball. The little plasma filaments would aim towards your finger when you touched the glass ball. Plasma is made up of charged particles, which could power light bulbs.

Fun fact: If you play basketball with a plasma ball, you get called a lot...for charging.

### Stage Show

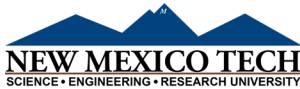
Our staff put on quite the liquid nitrogen stage show to a packed house, and now we know how many balloons (15) we can fit in a tub of liquid nitrogen.

### Award

After all that, our booth won a Student's Choice award! Thanks, everyone! And a big thank you to our friends at Big Brothers Big Sisters for such a great event!



In partnership with:



Collaborator:



**Remember, Teachers:**  
It's never too early to make bussing arrangements for our classes and events!



## As Fall Ends, Autumn Begins



Fall is winding down and turning into winter, but Autumn is just getting started!

Latischa "Autumn" Huller is our newest Classroom Assistant. She has seen it all...she has many years of customer service experience in a variety of positions, and has been a Highland High School Band Booster for the last two years.

Her call sign comes from a love of all things Fall, especially walking through all the crunchy leaves on the ground!





# Mission to Mars

For Fifth Graders

Mars Safeguarding Through Asteroid Redirection Spacecraft (STARS) Mission 2023-2024



## Mars and Facts, or Conjunction Junction, Solar Function; but It's Over Now

**Fact:** On 17 November 1973, a “[Schoolhouse Rock!](#)” video called “[Conjunction Junction](#)” first aired.

**Fact:** The song in the video was sung by a train conductor, who said, “**I got three favorite (train) cars that get most of my job done,**” which were **And, But, and Or**. **Bonus Fact:** The “Or” train was carrying...ore.

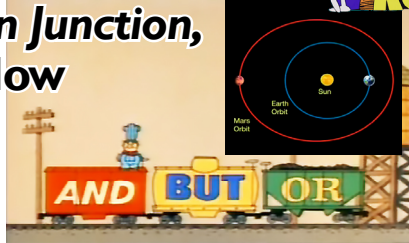
**Fact:** The words And, But, and Or are called *conjunctions*.

**Fact:** A *Mars Solar Conjunction*

occurs when the Sun is *between* Mars and Earth, all lined up in a row—kind of like the And, But, and Or trains in the video!

**Fact:** The most recent Mars Conjunction was from around 10-25 November 2023, which straddled the 50th anniversary of Conjunction Junction airing on TV.

**Fact:** NASA stopped *or* paused communications with Mars robots during the conjunction, *but* it's over now, *and* all is well.



## Habitat Rock

A Mission to Mars Saga is a sung or spoken story, with optional choreography, that describes the students’ epic journey to Mars, kind of like a Schoolhouse Rock on Mars.


Once both crews of a neighbor group arrive at a habitat site, crews will perform their saga for each other for points on the Blue Team Mission Log, and later for colony visitors, at Link-Up Day.



**Fact:** According to the “Mars Facts” chart in the Student Mission Journal, the atmosphere on Mars is 95% carbon dioxide.

**Fact:** It's going to be rather hard to breathe on Mars, unless some kind of Air Supply life support system is taken along.

Students incorporate four “Mars Facts” into their life support system model design; the fourth one in the form of a multiple-choice *riddle*.

 Your **commitment** to this mission is crucial to its success

## Bright Idea

Since *Gemini 5*, all NASA manned space missions have had the bright idea to have *mission patches* representing the mission and the crew. Even TV show *Stars on Mars* and the real-world CHAPEA simulation have patches.

Students will thoughtfully design *their* Link-Up Day mission patch.



Patch components include:

Mission name (*Mars Safeguarding Through Asteroid Redirection Spacecraft (STARS) Mission*), crew names, life support system, flags/colors symbolizing mission participants, and patch shape (any shape!) and size.

## Mark Your Mobile

It's not too early to Mark Your Mobile, specifically the calendar app in it, for the mandatory Mission to Mars Mid-Year Meeting coming up on 22 February 2024 12:30-3:30 pm.

Make your arrangements now!



# TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry and Satellites Missions

## A Few of My Favorite Things

*Eggdrops and Rocksims and balancing nails; birds balance right on their beaks without fail; an object's force goes up if accelerating; these are a few of my favorite things.*

If Maria (Julie Andrews) could see the fall session TECH Mission Day 3, she'd have a whole new set of favorite things...including replacing the “sound of music” with the sound of rockets going *zoom!*

After students analyze and graph real-world launch data collected

from the Day 2 Rocket Launch, comparing it to the Rocksims simulation made on Day 1, students spend the *balance* of the day moving on to a few of *my* favorite things.

It all centers around the *center of gravity*.

Students discover they can make a little eagle figurine balance on the tip of its beak because that's where its center of gravity is.



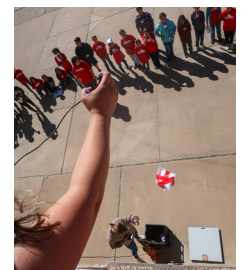
After a little trial and error, students also hit the nail on the head when they discover how to balance a bunch of nails on just one! They don't even know how to do that on *This Old House!* Which could now be called *This Old Show*, since it started in 1979.

All of this relates to why the students' rockets remained in stable flight on launch day. The rocket's *center of gravity* must be closer to the nose than the *center of pressure*. Pretty clever, these Earthlings!

A force is a force, of course, of course, and it's equal to the object's *mass* times its *acceleration*. Newton came up with that one.



Students explore forces and Newton's Laws by jumping on Vernier Force Plates and riding on Human Dynamics Carts, before engineering anti-gravity forces into the payload protection device for an Egg Drop activity.



**By the Tuesday of the week before the first class in the series, session, or semester, we will ask you for the name, driver's license number/ state of issue, date of birth, and the FULL Social Security Number, of every adult coming through the base gate for that series of classes.**



# Robotics Challenge For Middle Schoolers

## A Little Bit More

Robotics Challenge Module 2, with its *micro:bit* microcontrollers, is rolling right along.

Robotics teachers, remind students moving on to Module 2 that in Module 1, they had unlimited tries on quizzes. In Module 2, they only have TWO attempts at each quiz. If they do their best, and work together with their teammates, they'll do fine!

Module 2 students program the *micro:bit* to flash images, scroll text, and even play games.



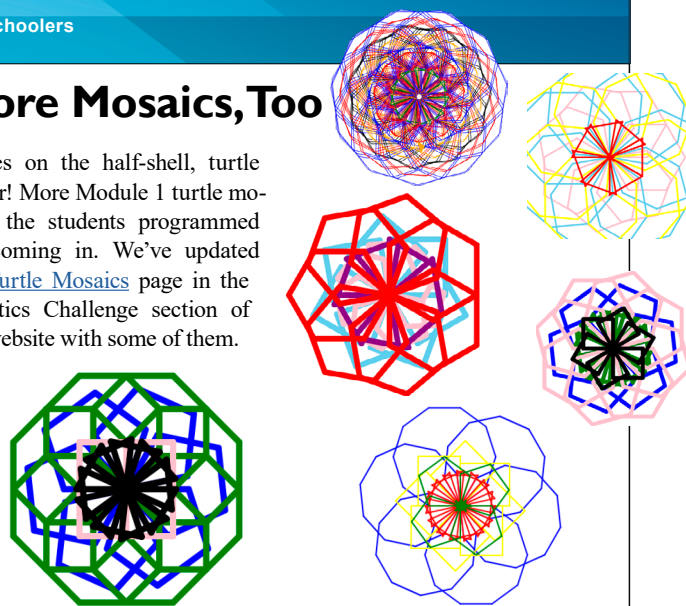
What kind of games? Well, the *micro:bit* has more sensors than you can shake a stick at. Including an *accelerometer*, which lets you pick your object when you *shake* the *micro:bit* in a fun electronic version of Rock, Paper, Scissors!

Students get "Radio Active" and send their friend smiles and Hide and Seek "hint" arrows using the *micro:bit*'s *radio antennas*.

Questions? Suggestions? Contact [caitlin@afnlnewmexico.com](mailto:caitlin@afnlnewmexico.com)!

## More Mosaics, Too

Turtles on the half-shell, turtle power! More Module 1 turtle mosaics the students programmed are coming in. We've updated the [Turtle Mosaics](#) page in the Robotics Challenge section of our website with some of them.



# STEM Challenge For High Schoolers

## Payload Protection Design

**Suggested Timeline:**  
**Dec/Jan**

Flying through the air to land on a target 30 feet away? Each team's egg is going to need some serious protection to get through the STEM Challenge in one piece. Student teams will protect their eggs by designing a Payload Protection Device!



ine more closely. They write a description of the three approaches, including their sources.

What are their similarities and differences? Does one design material seem better suited to the design problems your team is experiencing? Can approaches be combined?

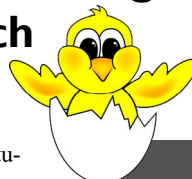
Then, teams create a design plan, including a sketch or diagram. Why this design? How big is it? Will it work with the launching device?

Teams research different approaches to cushioning an egg payload, and select three of them to exam-

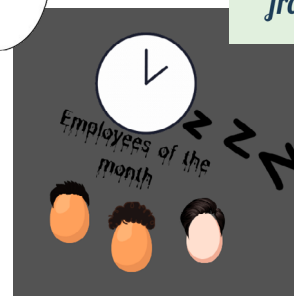
## Logos Starting to Hatch

In STEM Challenge Module 1, student teams are asked to choose a team name and design a team logo that represents the team and the mission.

The first logos are starting to hatch, and they're cuter than baby chicks!



Century High School



Team 3—  
Employees of the Month



Team 1—  
Wild Egg



# DoD STARBASE NM For Fifth Graders



## Bubbling Over

Oh, chemis-tree, Oh, chemis-tree; How periodic a table! Oh, chemis-tree, Oh, chemis-tree; Your solutions are so soluble!

There's molecules when atoms meet, Reactions are so very neat!

Oh, chemis-tree, so bubbly; Your branches are so bond-able!

Students in DoD STARBASE NM Day 4—Chemistry get all bubbly with excitement when they



go to the trouble of creating *chemical reactions* with substances such as hydrogen peroxide, vinegar and baking soda. They work on these things periodically at their table, which is good, because they're also studying the *periodic table*.

The students mix the chemical compounds together to make bubbly things like Elephant Toothpaste, and little graduated cylinder volcanoes in a Double Bubble Trouble activity.

*Fun fact: If you're in trouble, it's hard for someone to stay angry with you while saying the word, "bubbles."*

Those examples are *chemical* changes. AFRL cryogenics experts demonstrate *physical* changes when objects like marshmallows and balloons are dunked in very cold liquid nitrogen.

For example, marshmallows get very cold and crunchy, but since they have a low *thermal mass* because they're largely puffed air...

...they warm back up quickly.



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Mr. Steve Burke, Technical Writer.

## Important Terms and Acronyms

**AF:** Air Force

**AFB:** Air Force Base

**AFRL:** Air Force Research Laboratory

**AFRL NM:** AFRL New Mexico (AFRL/RD and AFRL/RV), on KAFB

**AFRL/RD:** The Directed Energy Directorate of the AFRL

**AFRL/RV:** The Space Vehicles Directorate of the AFRL

**DoD:** Department of Defense

**KAFB:** Kirtland Air Force Base, Albuquerque, NM

**MM:** Mission to Mars

**S&Es:** Scientists and Engineers

**STARS:** Mars Safeguarding Through Asteroid Redirection Spacecraft Mission 2023-2024

**STEM:** Science, Technology, Engineering, and Math

**TECH:** Technology and Engineering Challenges

**USAF:** United States Air Force

**USSF:** United States Space Force

**Remember, Teachers:**  
Get those EPA  
Modification forms in!

# STEM Bytes

## It's So A-door-able!

If you wander down the halls of our facility during December this year, you'll notice something: Our doors are *a-door-able*!



"Your identities, your culture, your experiences...they shape why you're interested in STEM, and they actually bring a lot of value.

Don't forget who you are, and lean *into* who you are. Even if people tell you who you are doesn't exactly fit the STEM box, don't listen to them.

Find a community of support. It could be family, it could be friends, teachers, mentors—find people that can remind you that you do belong, and that you *do* bring value into STEM."



Remember: The last day of this year is 123123.

## Upcoming Deadline

**AFRL**  
SCHOLARS PROGRAM

- AFRL Scholars [Summer 2024 applications](#) open through **10 January 2024**



**Teachers: Need help with the Mission to Mars, Robotics Challenge, or STEM Challenge missions?**

**There's Zoom "office hours" with our staff every Thursday (excluding holidays) from 4:00 – 5:00 pm. Email [caitlin@afrlnewmexico.com](mailto:caitlin@afrlnewmexico.com).**

## NASA Space Jam

**Computer Science Education Week** (the week of 4 December 2023) and the **Hour of Code**, a free introduction to computer science for learners of all skill levels, has come and gone.

Did you or your students miss out on the Hour of Code that week? No worries, it's not too late!



Some of the coding activities can still be found online, like this [NASA Space Jam](#) "make music with code" activity, for grades K-12. Have a blast learning about music, astronomy, and coding all at once!



## This issue is dedicated to:

- Tuskegee Airman 2nd Lt Fred L. Brewer Jr., missing for nearly 80 years since he disappeared during a WWII mission; finally laid to rest recently.



## Coming Next Issue...

- Location, location, location
- About Spring TECH Mission
- STARBASE Day 5
- A Happy New Year!

**Watch for it!**

