

Inspiring Future Scientists
and Engineers

AFRL NM STEM ACADEMY

Star Date: Oct 2023
Volume XXI, Issue 2



The Rocket Report

The States of Matter Matter



Just don't tell PNM about this trick!

At the Fair, KOB-TV4's Eddie Garcia came to check out the scene.

At both events, AFRL Historian and STEAM Coordinator Dr. Darren A. Raspa discussed AFRL's plasma-generating "Shiva Star" device.



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It matters what state of matter matter is, whichever event visitors attended: Science and Technology Day at the State Fair on 15 September 2023, or the NM Science Fiesta at *¡Explora!* on 23 September 2023.

At both events, it's *fair* to say visitors to our booth got to *explora* basically every state of matter in the State. Solid, Liquid, Gas, and Plasma (the superheated ionized-gas star material kind, not the blood-drive donation kind) were all represented.

There was a bouncing ball activity with solid *materials science* behind it. Two marble sized balls

were dropped from equal height; one made from a material with more densely packed atoms than the other, more rubbery one. The dense ball didn't bounce as well.



Liquidation sale: There were two square blocks made from different materials. One conducted heat better, so it was better able to convert solid ice to liquid water.

Ultra-cool liquid nitrogen boiled into gas at room temperature, and could even turn oxygen in the air into a liquid!

Visitors even got to interact with the electrical field around a *plasma ball* to light light bulbs.

In partnership with:



Collaborator:



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



Girls in Aviation

On 23 September 2023, while some of us were at the NM Science Fiesta at Explora, our own Stephanie Weber also flew in to the Land of Enchantment Fly-In/Women in Aviation "Girls in Aviation" Day at Double Eagle II airport...and brought Daniel Bernoulli with her!

Visitors got to meet female Virgin Galactic and Kirtland AFB pilots, and visitors to *our* booth got to ex-



plore Bernoulli Bags, Bernoulli Strips, air pressure pads, and ping-pong ball cups (blow over the top of the ball to make it jump to the next cup)!



New Faces

Take chances, make mistakes, and get messy! Our new STEM Outreach Specialist is **Deb "Mz. Frizzle" Novak**. Like *The Friz*, she has fun exploring STEM with people of all ages.

She's been a STEM Educator for 35+ years, in museums, zoos, schools, and field research.



One of our new Classroom Assistants is **Megan "Mango" Pacholka** ("Mango" being her young nephew's attempt to pronounce "Megan.")

She's been stationed with her Air Force husband in Albuquerque for almost six years, and has worked with children for about that long, too!



Samantha "Taurus" Boggs (her husband and niece's sign) is our other new Classroom Assistant.

She worked as an elementary school class aide for two years. *Hates* bugs. *Hates* them. Not only was she born on Groundhog Day, but she was also born on Groundhog Day!

So many new faces, it's *spooky!*





Mission to Mars

For Fifth Graders

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

STARS on Mars

William Shatner's not the *only* one who can host STARS on Mars!

Background

For thirty years running, the STEM Academy's Mission to Mars activity for fifth graders has used real-world space technology advancements to create mission objectives for a simulated trip to Mars.

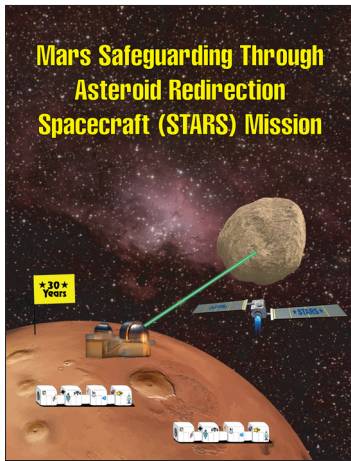
In September 2022, NASA's space-based Double Asteroid Redirection Test (DART) mission successfully tested a spacecraft impactor concept on a real asteroid named *Dimorphos*.

They used the kinetic impact of having the DART spacecraft forcefully, deliberately collide with the asteroid to redirect its trajectory.

Post-collision analysis showed the collision itself did have some effect, but the plume of ejecta—dust and small rocks—the impact displaced changed the asteroid's trajectory much more significantly.

Mission Objective

Mission to Mars scientists and engineers will use technology similar to NASA's DART to protect those living and working on Mars. To that end, they are



Mars Safeguarding Through Asteroid Redirection Spacecraft (STARS) Mission

★ 30 ★
Years

undertaking the Safeguarding Through Asteroid Redirection Spacecraft (STARS) Mission.

The key focus of this mission is to install and test a system capable of deploying up to thirty STARS impactors towards any asteroids on a path that may bring them too close to Mars.

The system will use an adaptive optics telescope to identify approaching Near Mars Objects (NMOs) and determine if they pose a threat to Mars.

If necessary, one or more STARS impactors will be dispatched to the NMO to safely direct it away from the Red Planet.

Personnel supporting the **2023-2024 Mars STARS Mission** (hey, that rhymes!) will require a colony of long-term living quarters and food on Mars. Fifth grade students participating in this year's Mission to Mars will plan and build the necessary facilities

and life support resources, and present them at the culminating Link-Up Day event in the spring.



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

Many, Mini, Fun

Many returning Mars teachers were welcomed back with mini screens in a Zoom meeting grid, which was fun, during the Returning Teacher Training refresher course on **Wednesday, 20 September 2023**.

Teachers *new* to the Mission to Mars completed *in-person* training for new teachers at our STEM Academy facility at Kirtland AFB on **Wednesday, 4 October 2023**.

Teachers built many mini habitats and assembled them in a neighborhood on the stage, plus wrote sagas and designed mission patches and many mini life support system models.

Teachers also built a bigger, "fun sized" habitat the same size as the full-sized habitats their students will build on Link-Up Day.

There were many mini Milky Way candy bars at each table, plus bigger "fun" sized ones, too.



TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry and Satellites Missions

Excitement is Building

TECH Mission Day 1 has wrapped!

Students are busy preparing for the big rocket launch day, and the excitement is building!

Students assembled the *booster tube*, *payload tube*, and *motor mount* sections of their rocket, giving the rocket a name like *Gemini*, *Atlas*, *Apollo*, or *Phoenix*.

Students simulate rocket flight with the software program *Rock-Sim*.

Students explore global positioning satellite (GPS) rocket tracking, and build and launch *straw rockets*, too.

Day 2, Rocket Launch Day, is scheduled for **17 October 2023**, weather permitting.



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.

Launch Day Tips

☁️ Teachers, if the weather looks bad on launch morning (17 October 2023), call **the Rocket Launch Hotline** at (505) 401-5456 and verify launch is still a **GO!**

Note: Our office is **CLOSED** on Rocket Launch Day. We'll all be out at the launch site!

🧥 When getting ready that morning, consider the desert environment: It can start off kinda chilly and get warm later, so wear weather appropriate **layers**.

👕 **Students wear their red T-shirts.**



Sunscreen and sun hats aren't a bad idea, either.

🧴 Launching rockets in the desert is thirsty work, so bring some **water**. Protect your *feet* from things they might *meet*: Bring appropriate desert **footwear**. *Shoes* and *boots* are safer than *flip-flops* and *sandals*. And, very important:

👟 Remember to bring **lunch** for the **launch!**

At the launch site, **safety first!** Teams monitor weather and wind conditions, making sure the wind doesn't huff and puff too much. Teams stay in assigned areas, and *everyone* stands during launch, even spectators.





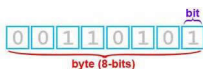
Robotics Challenge For Middle Schoolers



Binary, Bugs, and Beginning to Program

Before Robotics Challenge students begin building 'bots, they must become familiar with the basics: Binary, bugs, and beginning programming.

The first module in the Robotics Challenge Canvas website, *Intro to Programming*, which opened 18 September 2023, covers these kinds of topics.



Binary

The first thing students learn is the language of computers: Binary, or "Base 2." Most people are used to the

decimal, or "Base 10," system of numbers, in which, including 0, there are exactly ten unique *digits* that make up every number: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Computers think in terms of *binary numbers*, in which there are only *two* unique digits, 0 and 1.

Everything to a computer is in one of two states: All lights are either *on* or *off*. All cupcakes are either *eaten*, or *about to be eaten*.

Students practice translating decimal numbers into binary, and vice versa.

Programming

Rather than program everything into the computer with long strings of 1s and 0s, students learn the basics of a programming language called Python.

For example, they learn how to program the computer to print "Hello, world!" on the screen (getting the world to respond back with "Hello, Python!" is not covered in the module).

Students also learn about using *variables* and *loops* in their

Python programs, and how to use Python's built-in *turtle* to help them draw on the screen.

Debugging

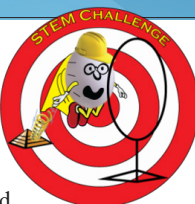
Students also learn that if they make a programming mistake, called a *bug*, don't panic! There are steps they can take to "debug" the program, to *find* and *fix* the error.

Help

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

STEM Challenge For High Schoolers

Let the Challenge Begin



To solve the technical problem of how to remotely launch an *egg payload* through a vertically suspended *hula hoop* and have it land, intact, on a *target* 30 feet away, the STEM Challenge Canvas website guides students through six distinct STEM Challenges:

1. **Team Identity;**
2. **Launching Device Design/Build,** in which students design and build a remotely operated catapult, trebuchet, or other launching device that can send an egg flying;

3. **Payload Protection Device Design/Build,** in which students design and build some type of protective covering for the egg payload to prevent it from cracking upon landing;

4. **Launching Device Characterization,** in which teams test the precision and accuracy of your launching device;

5. **Payload Device Characterization,** in which teams calculate

payload launch time, velocity, and potential/kinetic energy;

6. **Data and Results Summary,** in which students make a series of slides that help prepare them for the **STEM Challenge Symposium on 4 April 2024!**

The first challenge, **Team Identity**, involves creating a *team name* and designing a *team logo*.

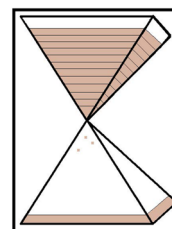
Here are some examples of previous team names and team logos, for inspiration:



THE 3 AMIGOS



CAVAPULT



THE CLEOPATRA



ATM CATAPULT



DoD STARBASE NM For Fifth Graders



Newtonian Physics



In the second, *Physics*, day of DoD STARBASE NM classes, students put Sir Issac Newton in the driver's seat...of a carbon dioxide (CO₂) dragster!

First, students learn about *force*. Yoda says The Force is an energy field created by all living things. It surrounds us, penetrates us, and binds the galaxy together. *Physics* says that force is a push or pull on an object, which can affect its *motion*.

Sir Issac Newton apparently never completed his *padawan* training, because his **three laws of motion** don't mention *anything* about binding the galaxy together. Besides, all you need to do *that* is a sufficient quantity of duct tape. Duct tape is the Force!

Students explore Newton's Laws with activities like Newton's Cradle...then they put all three laws to the test when they race CO₂ dragsters!

The CO₂ force causes the cars to move. Cars with *more* force go *faster*, and the CO₂ going *backwards* makes the cars at rest go *forwards*...until they run into a towel. Or a sufficient quantity of duct tape.

Students also work a little bit with littleBits® electronic components.

May the Force be with them!



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.

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<https://www.youtube.com/channel/UC-QuOSd1XTkYuXPONZwIAHQ/videos>

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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!

Scrambled Symbols

Oh, my stars, Mars has a problem! There are eight Life Support Systems that Mission to Mars students can choose from when building their Life Support System model. But the *symbols* and their *names* have gotten all scrambled up! Can you help match up the Life Support System symbol with its name?

STEAM Star Team

When Dr. Darren A. Raspa, AFRL Historian/STEAM Coordinator, was supporting our “States of Matter” booth at the State Fair recently, he asked one young woman if she wanted to work in science or engineering.

Her eyes turned to the ground and she said, “I don’t think I’m smart enough.”



This inspired Dr. Raspa to create an AFRL “STEAM Star Team” to help inspire students.

No obligation, just AFRL volunteers, willing to share their STEM expertise at various STEM/STEAM events.

We want to help students see their potential to learn STEM and be a part of the STEM workforce.

This will ensure our future force is scientifically and technically savvy.

Pathway Open

Registration for STEM Santa Fe’s 2023 **STEM Pathways for Girls Conference** is open! A full day of STEM workshops for 5th-8th grade girls, 4 November 2023. Fee: \$25.

Keynote: Dr. Veena Warikoo, Vice



President, Global Technical Operations AstraZeneca. Space is limited! See www.STEMSantaFe.org.

Other Space News

- NASA’s *Psyche* craft launched to a \$10 Quintillion metallic asteroid named Psyche on 13 October 2023.
- Mars ‘copter *Ingenuity* recently set a new altitude record. Its solar panels were created here in Albuquerque, NM.
- Osiris-REx flew by Earth recently and dropped off a



sample of dirt collected from the Bennu asteroid.

Rock star astrophysicist Brian May, from Queen, even helped it find a good landing site on the star-rock.

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.

Coming Next Issue...

- TECH and Advanced rockets launched!
- STARBASE Technology Day 3

Watch for it!

