

AFRL

NEW MEXICO STEM OUTREACH

Inspiring Future Scientists and Engineers

AFRL NM STEM ACADEMY

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The Rocket Report

Many Hands at BBBS

They say that many hands make light work. AFRL's Matt Fetrow only has two hands, but he used them both to make light work during two virtual presentations for the Big Brothers Big Sisters (BBBS) Discovery event on 9 and 18 November 2021.

He explained that "work" is energy expended over time. A 50-watt light bulb can light up a room, but

that same 50 watts of light focused in a laser beam, as a single color on a small point, can do "work" like cutting through wood, paper, and other materials.

AFRL, he explained, is working on lasers that can cut through missiles, for example. He then demonstrated using laser light to pop a balloon.

AFRL NM STEM Academy pro-



vided "paper lightsaber" kits to the students who attended.

The kits included a video link that shows how AFRL creates a beam similar to a lightsaber to study the effects of charged particles in space.

In This Issue...

The Rocket Report	1
Mission to Mars	2
DoD STARBASE New Mexico	2
TECH Mission	3
Robotics Challenge	3
STEM Challenge	3
STEM Bytes	4
Coming Next Issue...	4

In partnership with:



Collaborator:



Remember, Teachers:

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



Will We Webb?!

After having its launch date pushed back around a *dozen* times since 2007, the James Webb Space Telescope (JWST) may finally launch as early as 22 December 2021!

There's an interactive JWST deployment display at <https://jwst.nasa.gov/content/webbLaunch/deployment-Explorer.html>.

First Solo

Gabe Carothers, a mentor who has helped students in events such as the Tuskegee Aviation Camp, the Mission to Mars Link-Up Day, and the STEM Challenge Expo, flew his first solo flight, considered a major milestone for a



pilot, at Double Eagle II airport on 23 November 2021.

Oh, and did we mention? He's 16 years old.



Bio Updates

"Sparkles!"

Right after we went to press last month, STEM Outreach Specialist Amanda Salazar announced her call sign, and it's the coolest one ever...*Sparkles!* Turns out she likes sparkly things, like these fabulous shoes worthy of dancing to Michael Jackson in!



Jessica "Luna" Boyar



After working for seven years as a social worker, our newest DoD STARBASE NM Instructor, Jessica "Luna"

Boyar, switched gears and went back to school to get her teaching license. She worked for the last three years as an elementary special education teacher before joining us.

She learned in school as a kid that the moon's glow comes from reflected sunlight, and she's been fascinated with astronomy ever since!

"I love working with kids and watching them grow and learn through curiosity," she says.

Final Lap



Racing legend and STEM Academy mentor "Big Al" Unser, Sr., who first visited our facility in February 2009 and led an Unser Racing Museum tour for Van Buren Middle School STARBASE 2.0 Scalextric students in 2012, recently took his final lap. Thanks for everything, Big Al!



Send a holiday greeting from Mars!

Visit www.mars.nasa.gov/mars2020/participate/photo-booth, choose your background, and upload your photo!

Howdy!

Hi!

Yo!

Sup!

Season's Greetings



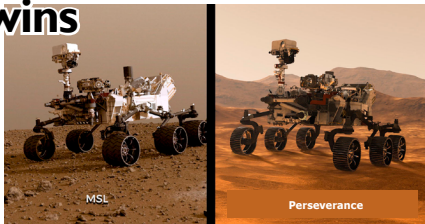
Mission to Mars

For Fifth Graders

Mars Vast Interferometer Variable Array (VIVA) Mission 2021-2022

Not Quite Twins

Fact: In 2003, twin rovers *Spirit* and *Opportunity* launched to Mars.

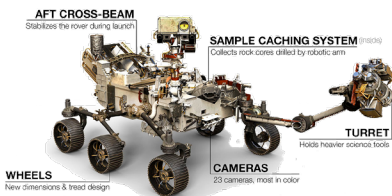


Fact: The Mars Perseverance rover represents the latter half of the *second* pair of twin Mars rovers ever launched.

Well, not *exactly* twins.

The *Perseverance* rover looks pretty identical to the *Curiosity* Mars Science Laboratory rover driving around up there, but, fact is, there are a few key differences.

Here's the facts: *Perseverance* is about five inches longer, 278 pounds heavier, has six more cameras plus two microphones,



better wheel treads, more self-driving capability, and new tools like an oxygen generator and subsurface radar.

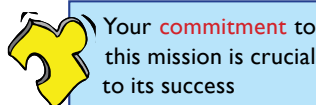
Fact: Perseverance's little helicopter buddy *Ingenuity* has successfully flown 17 times on Mars now!

For more Mars *Perseverance* news, see www.space.com.

According to the "Mars Facts" chart in the Student Mission Journal, the atmosphere on Mars is 95% carbon dioxide, whereas on Earth it consists of 78% nitrogen and 21% oxygen.

Fact is, it's going to be rather hard to breathe over there, unless some kind of Air Supply life support system is taken along.

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



Start SAGAs

A Mission to Mars Saga is a sung or spoken story, with optional choreography, that describes the students' epic journey to Mars.

Students will perform their saga for points on their Crew Mission Log upon arrival at their Colony Habitat site, and later for visitors to their colony, at Link-Up Day.



Patch Rat

Many missions have mission patches representing the mission and the crew. Since Gemini 5, all NASA manned space missions have had one, too.

Students will put some thought into the design of *their* Link-Up Day mission patch.



Patch components include: Mission name (*Mars Vast Interferometer Variable Array (VIVA) Mission*); crew names; life support system;

flags/colors symbolizing mission participants; patch shape and size.

Mark Your Mobile

It's not too early to Mark Your Mobile, specifically the calendar app in it, for the mandatory Mid-Year Meeting coming up on 24 February 2022.

Make your arrangements now!



DoD STARBASE NM

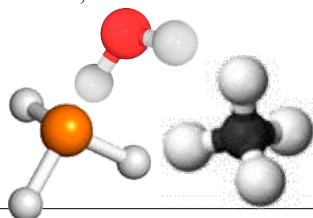
For Fifth Graders

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.

Chem STEM

DoD STARBASE NM Day 4 is all about the chemistry of STEM. Students bond over the ways in which atoms, the building blocks of matter, bond together to form *elements* and *compounds*.

They model good molecular behavior by building models of molecules like water, carbon dioxide, ammonia, and methane.



Then the students explore how to change matter into different states, or different materials altogether.

"The only thing that is constant is change."

—Heraclitus, circa 500 B.C.

- A *physical change* involves a change in state or appearance; no new substances are formed.
- A *chemical change* involves the bonds between atoms breaking and rearranging to form something new.

For example, one hot topic has students explore changing the

temperature, or average kinetic energy, of the atoms or molecules in a substance, to create a physical change in *state*—solid, liquid, or gas.

Those are the three *basic* states of matter, anyway; there's also some more exotic ones, like plasma, Bose-Einstein condensate, and one for water they recently discovered, inside planets like Neptune, called "superionic ice."

AFRL cryogenics experts demonstrate what happens to substances like marshmallows and balloons when they're flash-frozen in liquid nitrogen.

Students also go to the trouble of creating endo- and exothermic chemical reactions on substances such as hydrogen peroxide, and vinegar and baking soda, to make things like Elephant Toothpaste and little volcanoes, in a Double Bubble Trouble activity.



Side note: Speaking of state changes, did you know it's nearly impossible to remain in an angry state while saying the word "bubbles?"

Yes, change is in the air! Students are learning STEM and changing into scientists and engineers!



TECH Mission

For Middle Schoolers
Technology and Engineering Challenges—Rocketry and Satellites Missions

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.

A Moving Story

The story of TECH Mission Day 3 is a very moving one.

For starters, students analyze and graph the motion and atmospheric data acquired during their rocket's flight on TECH Mission Day 2.

Data points like *wind speed*, *maximum altitude*, *range* (distance travelled from the launch pad), time to *apogee* (the highest point of the flight), and time to *landing*.

The students compare that to

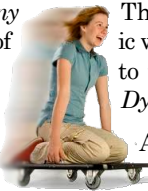


the original *RockSim* computer simulation data, and try to figure out why reality moved in ways the simulation didn't.

We point out that for stable rocket flight, the *center of gravity* must be above the *center of pressure*. Increasing stability means adding weight to the nose, or increasing the fin area.

Demonstrating center of gravity is a real nail-biter: The students have to balance *many* nails on the head of *one* nail.

We drop some Newton's Laws of Motion, such as the

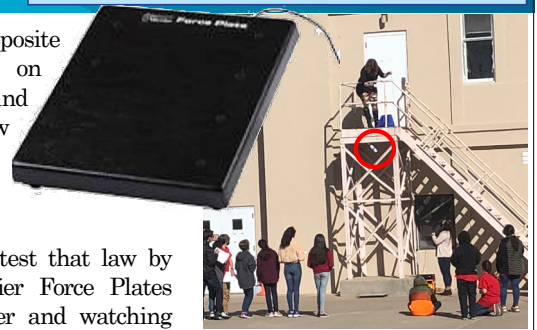


Equal and Opposite Reaction one, on the students, and show them how they apply to the rocket launches.

The students test that law by pushing Vernier Force Plates into each other and watching the graphs of the forces cancel each other out.

Things get more dynamic when they put Newton to the test with *Human Dynamics Carts*.

And, the students move to make payload pro-



tection suits for a bunch of good eggs, to protect them while we politely drop them from the top of a high staircase, trying to *slow* their *velocity*. Eggs are always the first ones out there, offering to take one for the team.

It's very moving.



Robotics Challenge

For Middle Schoolers



Papa Cupcake's Binary Card Game!

1. Use the arrow, or highlight, or click, to select the correct answer. (Click on the correct answer to see the number above.)

2. Then click the arrow to see the next question.

Binary Card Total: Correct! 15

3 and 7 Say Hello

Hello, world.



These are the members of SOS.

Prisoner 7
Prisoner 3

We had more, but unfortunately, they passed away.



We are abandoned on a strange island called "School."



The environment is unbearable, with the uniforms they force us into, and the mystery meat!



Send help. Please. Along with snacks and pillows. Our brains can't go any longer like this...

LOL!!!

Module 1, Robotics Challenge 3 involves students using the print function skills (`\n`) learned in the Programming with Python briefing to make a vertical list of their team members. Some teams have gone above and beyond and gotten creative with it, as demonstrated by the above submission from Team SOS.

Teams are submitting team names in Canvas (Challenge 1) and taking the Papa Cupcake Binary Challenge (Challenge 2), too!

We are so excited to start seeing Challenges get completed! Teams should watch for feedback. If a team hasn't earned the full possible points for a Challenge, they can read the feedback given, finish the task, and resubmit to earn full points.

Interested in participating as a coach or an Expo judge? Contact Lynn@afrlnm.com for more info.

STEM Challenge

For High Schoolers

Payload Protection Design

Suggested Timeline: Nov/Dec

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!**

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

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

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

Look! Logos!



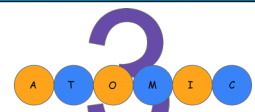
Team 01—
The 3 Amigos



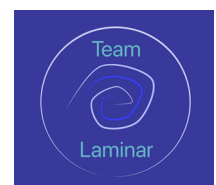
Team 02—
MC Hammers



Team 04—
KOC



Team 03—
The Atomic 3



Team 05—
Laminar

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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

STEM: Science, Technology, Engineering, and Math

TECH: Technology and Engineering Challenges

USAF: United States Air Force

USSF: United States Space Force

VIVA: Mars Vast Interferometer Variable Array Mission 2021-2022

Remember, Teachers:

Get those EPA Modification forms in!

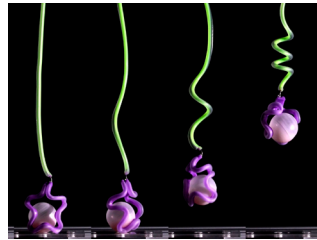


STEM Bytes

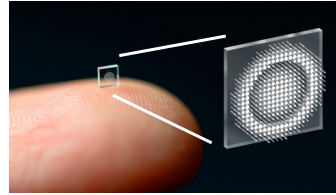
An Hour of Code, A Month of Robotics

Computer Science Education Week, and the Hour of Code, was held 6-12 December, 2021 (<https://hourofcode.com/us>).

Besides our own Robotics Challenge coding challenges, December 2021 is also proving to be a good month generally for robotics news and activities.



• **Soft Robots.** Princeton researchers have invented a new way to make “soft robots” by injecting bubbles into a liquid polymer.



• **Micro Cameras for Mini Robots.** Princeton and University of Washington researchers have also developed a camera about the size of a coarse grain

of sand for tiny robots and medical applications. See <https://engineering.princeton.edu/news>.

• **Replicating, Living Robots.** Scientists have created living, self-replicating robots called xenobots that resemble Pac-Man. See <https://www.livescience.com>.



Space News

Laser Comm Relay



NASA has used radio waves to communicate with astronauts and space missions since 1958.

Now they’re testing “high-speed space internet,” launching a Laser Communications Relay Demo that will send and receive laser-transmitted data between outer space and ground stations in California and Hawaii.

Astronaut Milestone



NASA recently announced they have selected Jessica Watkins to be the first African-American woman astronaut to live and work on the International Space Station (ISS) in April 2022.

She hopes her mission will inspire children of color, and “particularly young girls of color, to be able to see an example of ways that they can participate and succeed.”

Space is Just New Mexico

Outer space is just like New Mexico. A recent ISS experiment, involving growing Hatch chile peppers in space, broke records for feeding the most astronauts, and for longest ISS experiment ever.

The favorite meal using the chile peppers among the astronauts was...tacos! Heck, *anyone* from NM could’ve told them *that*. Next question: Red or Green?

See www.space.com.



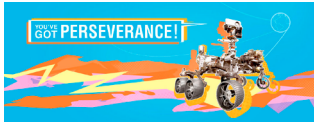
Aerospace Micro-Lessons



The American Institute of Aeronautics and Astronautics (www.AIAA.org), under Get Involved>Educators>K-12 Teacher Resources, has 98 “Aerospace Micro-Lessons.”

These lessons are easily digestible STEM lessons focused on aerospace principles, broken down into grade level categories.

NASA Nominations



NASA’s “You’ve Got Perseverance” opportunity invites U.S. teachers, educators, and community members to nominate students in grades 6-8 who have demonstrated the right stuff to move past obstacles and reach their academic goals.

The program will reward that dedication with recognition all the way from Mars! See <https://go.nasa.gov/gotperseverance>.

Scholars Deadline

Applications for summer 2022 internships are being accepted through 10 January 2022.

See <https://afrlscholars.usra.edu/>.



Coming Next Issue...

- MM Colony Location
- Science vs. Engineering
- DoD STARBASE Day 5
- Happy New Year!

Watch for it!

