AFRL
NEW MEXICO
STEM OUTREACH

Inspiring Future Scientists and Engineers

AFRL NM STEM ACADEMY

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AFRL
THE AIR FORCE RESEARCH LABORATORY

The Rocket Report

In This Issue...

In partnership with:

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

Collaborator:

DoD STARBASE
A Department of Defense Youth Program

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

Mars Link-up Day was GREAT!

GREAT Missions to Mars news!

- CHAPEA 2, the second round of NASA's one-year *Crew Health and Performance Exploration Analog (CHAPEA)* Mars mission simulation, closed its application window last month, and should be starting up very soon.
- NASA's *Human Exploration Research Analog (HERA)*'s 45-day Mars mission simulation *Campaign 7 Mission 5* should have just wrapped up 10 March 2025. Campaign 8 is scheduled to run four more 45-day missions in 2026 and 2027.

On 24 April 2025, over 1,000 fifth graders and 54 teachers from 27 schools came to the **Mission to Mars Link-Up Day event** at the Albuquerque Convention Center.

There, they completed the **Mars Gravitational Research Energy Antenna Test (GREAT) Mission 2024-2025,** simulating establishing a Martian colony to build and test a three-way *laser gravitational wave detector antenna*, placed in a triangular formation across a Martian crater... and they did GREAT!

How great? Well, not long afterwards, NASA announced they were considering bumping up their next (unmanned) Mars mission to *next year*, 2026! Haters will say this was just a coincidence, but I *greatly* disagree.

Students worked all school year in their classrooms, preparing for their trip to Mars. They:

- Designed uniforms and mission patches;
- Planned and packed nutritious, weight- and space-saving lunches;
- Studied Mars Facts and designed Life Support Systems;

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Robotics Expo was !

The **Robotics Challenge Expo** on 9 May 2025 wasn't just *great*, it was pure FIRE... and not just because of the cool new Fireball Freeway course!

Twenty teams—sixty-five students and eight teachers from 7 schools—attended:

- Albuquerque Academy
- Canon Christian Academy
- Christ Lutheran School
- Jefferson Middle School
- Northwest Mid/High School
- Piñon Elementary School
- St. Mary's Catholic School (Belen)

Participating teams applied what they learned about robotics, cyber:bots, sensors, and Python programming over the course of the Robotics Challenge. They tried new challenges and got to network with adults who have experience applying STEM concepts.

Students pitted themselves and their robots against navigation programming, line-following "QTI" sensor and sonar "PING" sensor courses, a robotic dance exhibition, a "Flashy Chassis" contest, and a Quiz Bowl.

Navigation programming involved programming the robot to navigate a yellow path through various obstacles.

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Mars Link-up Day was GREAT!

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- Wrote and rehearsed a saga song/dance routine about their journey to Mars;
- Determined their colony's location on Mars; and
- Made mini-habitats and measured and cut their full-size plastic habitat pieces.

On Link-Up Day, students split into a blue team and a silver team.

Blue team students demonstrated readiness for the mission and received Crew Mission Log points at holding stations that checked the students' life support system models, Mars facts, and uniforms.

Meanwhile, silver team students went with their Habitat Director (teacher) to their habitat site to mass their astronaut lunches and begin laying out their pre-fabricated plastic habitat pieces for construction.

Once blue and silver student teams

regrouped into crews at their habitat site, they performed their sagas. in front of colorful space-themed backgrounds.

Using their 6-mil plastic pieces, grey tape, and a box fan, the student crews built colonies of habitats to simulate what scientists would live and work in on the Red Planet. Students built 54 habitats this year!

These inflatable habitats are similar to some "habs" NASA has considered using for Mars and outer space travel. They're lightweight and compact for transport, but expand to sizable rooms on Mars.

Volunteers from Kirtland AFB and other community organizations assisted at the holding stations. *Colony Commanders* at each colony helped keep the Habitat Directors (teachers) and students on track.

Students ate their prepared space lunches inside the habitats, massed the lunch waste, and cut the sealed *connecting tunnels* for a Habitat Walk: Knowledge Quest.

Linking the habitats together in this way, forming a connected neighbood within the colony, is how **Link-Up Day** got its name!

Special Guests

Zak Wilson, a member of *another* real-world NASA Mars simulation known as Hi-SEAS III, was there, showing students a fascinating bell jar "space vacuum" demonstration.

Darth Vader, searching the galaxy for the hidden rebel base, even sent one of his friendliest **stormtroopers** down to investigate.

No rebel bases, just Martian colonies...but the stormtrooper was so impressed, he walked around posing for selfies with the student scientists and engineers, while the *Imperial March* played in the backgound!

thank you

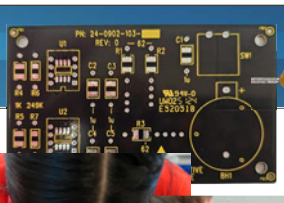
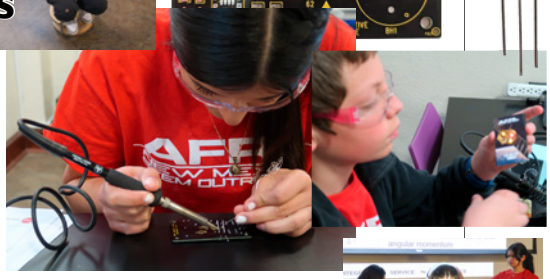
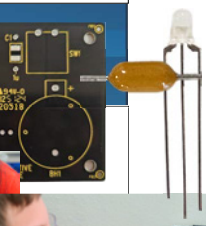
We'd like to thank the 20 adult volunteers, from Kirtland AFB and other community organizations such as Sandia Labs; 24 student volunteers from Albuquerque Institute for Math & Science (AIMS); staff; teachers; students...

...and, of course, our wonderful friends at the Albuquerque Convention Center and the Galactic Empire...

for making the **2024-2025 Mission to Mars Link-Up Day** the GREATest mission *ever!*

Date	Site	Habitats
24 April 2025	Albuq Conv. Ctr.	54

New Tech for TECH Puts New Spin on Things

TECH Mission Day 3 students learn how to solder electronic components, like resistors, timers, capacitors, LEDs, battery clips, and power switches, to a printed circuit board (PCB).

When they're done, they have a badge depicting an orbiting satellite with blinking red and yellow LED lights, which reads "I've got the power!" And now they have the power, and know-how, to solder.

This year, new tech for TECH put a new spin on things, though. Students had an easier time soldering their LED badges thanks to a helpful badge upgrade from our friends at MPC Design Technologies! A redesigned circuit board; capacitors with less capacity for being inserted incorrectly; and three-prong, dual color, singularly *awesome* LEDs were among the improvements this year, which made MPC: Many People Cheer.

It's a shocking, hair-raising tale to see students getting a charge out of spinning electrons with a Van de Graaff Generator. It's more shocking and hair-raising to think about how *solar weather* can damage the electronics in space satellites.

Students take concepts like *angular momentum* and the *moment of inertia* out for a spin when they explore *gyroscopes*—including playing sit-n'-spin on stools while holding small weights in their hands, spinning themselves into a *human gyroscope.*

They also spin some code onto a *micro:bit mirocontroller.*

Robotics Challenge

For Middle Schoolers

Robotics Expo was 🔥!

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Students attempting the Clear the Debris and Line-Following courses used their robot's QTI Line-Following sensor to push wooden blocks out of a black circle, and to follow a "street" or a grid to an endpoint.

Students attempting the Escape the Maze course used their robot's "PING" sensors (think bat-style echolocation) to avoid the walls of an acrylic maze.

Students attempting the Fireball Freeway course used their robot's line-following AND "PING" sensors to follow a path through fire graphics, like Evel Knievel would have, back in the day...

...but also avoid the three *vertical* fireballs shooting out at it from the sides. *Other* cyber:bots were operating the moving fireballs that threatened the *students'* cyber:bot...so it was kind of like watching a Robotic Civil War.




It was also similar to driving through rush-hour traffic on I-40.

Students voted for the best-dressed robot in the Flashy Chassis "costume contest," busted out robotic moves in the *Dance Your Circuits Off!* portion, and tested their cyber:bot robotics knowledge in a game show-like Quiz Bowl.

Along the way, students received Integrity points for exhibiting exemplary behavior towards teammates and others during the Expo.

Flashy Chassis Award:
Team 22, The Amen Men

Core Processor Award:
(Most Integrity Points)
Team 129, Bluey

Plugged In Award:
(Most Knowledge is Power Points)
Team 39, The Sandias

And, last but not least...

Cyber Command Award:
(Most Overall Points)
Team 117, Coffee Coders!


Congratulations to all the Robotics Expo winners, and **thanks** to all the staff, the 21 volunteer judges from Kirtland AFB and other community organizations, and the schools, students, coaches, and robots who helped make the 2025 Robotics Challenge Expo a *flaming success!*

STEM Challenge

For High Schoolers

Symposium Egg-tacular

More egg-cellent pictures from the STEM Challenge Symposium on 10 April 2025!





DoD STARBASE NM

For Fifth Graders

Flight Enthusiasm

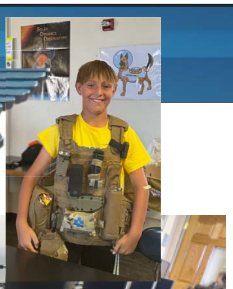
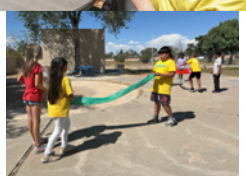
Students in DoD STARBASE Day 5 get enthusiastic about flight!

Day 5 students learn how air pressure and fluid motion relates to Bernoulli's Principle...which leads to them inflating Bernoulli Bags in a single breath *from a distance*. But would Einstein think this action is spooky?

Kirtland AFB Flight Enthusiasts talk about their real-world flying experiences, made possible by air pressure, fluid motion, and Bernoulli's Principle holding up the wings of the aircraft.

Sometimes, they bring helmets, flight suits, or other flight gear with them for the students to try on and examine! They also discuss the training and education they received to do what they do.

Students then earn their wings flying an X-Plane Flight Simulator Cessna, without even wearing a *parachute!*


We're currently accepting applications for the 2025-2026 school year!
Check our website at www.afrlnm.com/stem/missions/dod-starbase-nm/ for school and homeschool application links.

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https://www.youtube.com/channel/UC-QuOSd1XTkYuXPONZwlAIHQ/videos

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

GREAT: Mars Gravitational Research Energy Antenna Test Mission 2024-2025

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

Remember, Teachers:
Get those EPA Participation forms in!

STEM Bytes

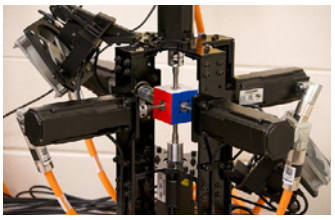
Purdubik Blink Record

Speaking of robots, it turns out that not all robots are built to make it through a Fireball Freeway. Some are designed to solve problems.

For example, what if your Rubik's Cube is all scrambled up, and you *really* want to solve it, but you're a little *pressed for time?*

A group of four students from Purdue University's *Elmore Family School of Electrical and Computer Engineering* in West Lafayette, Indiana, feel your pain, and have come up with what they think is a reasonable solution.

They invented a robot they call **"Purdubik"** that can analyze and turn the slices on a 3X3 Rubik's cube, until the thing is solved.



But they realized that some people are impatient, and want their cube solved in a *hurry*.

So they designed it to solve the Rubik's Cube in *103 milliseconds*. Fastest solve in the world. They're even listed in the Guinness Book of World Records for it.

It takes about 200-300 milliseconds to blink. So their robot can solve a cube in about *half a blink*.

Mars News

Mars Underground

Deadly radiation, extreme temperatures, a lack of plentiful surface water, dust storms, and a thin atmosphere. Living on the surface of Mars won't be easy.

That's why some people, including Elon Musk, who owns SpaceX, think a good idea for putting colonies on Mars is to build them underground.

There's already a system of natural underground caves on Mars.

These could be enlarged to suit our needs using boring machines (they're more exciting than they sound!), such as the ones at Elon Musk's Boring Company.

If located near Martian geothermal activity, underground colonists might have access to heat, liquid water, and a natural energy source, while being protected from the harsh environment on the surface.

Airshow Coming

AIR FIESTA 2025

The Kirtland Air Fiesta airshow, 31 May through 1 June 2025, is open and FREE to the public!

It will feature a dynamic lineup of aerial demonstrations and static displays, including shows by the U.S. Army Golden Knights, and an F-16 Viper team.

AFRL NM STEM Academy will also have a booth there...look for straw rockets and other STEM activites!

Parking and Ride lots open at 7:00 a.m., gates open at 8:00 a.m. See www.kirtland.af.mil/Kirtland-Air-Fiesta/.

Multi-Stop Mission

Earth-Mars-Ceres

Researchers recently proposed a manned mission to Mars that would *also* be a manned mission to the asteroid Ceres. Scientists would establish a base on Mars and explore the surface before launching to Ceres and exploring *its* surface. See www.space.com.

Free Money

$$$

AFA AIR & SPACE FORCES ASSOCIATION

AFA's *Educator Grant* program promotes K-12 clasroom aerospace education with up to $500 grants. Applications accepted 1 September–15 December.

AFA also offers $250 grants twice a year to Civil Air Patrol (CAP) and Air Force JROTC units for STEM and aerospace education.

See www.afa.org for more information on AFA grants and programs.

HERA Patch

NASA's Human Exploration Research Analog (HERA) program, which simulates conditons on Mars and other manned deep space missions, is requesting a new mission patch design from K-12 students.

Deadline: 15 October 2025.

Mission to Mars students, you *got* this!

STEM Awards!

Two NASA MINDS teams from **New Mexico Tech** recently won 1st place nationally in their categories.

Truman Middle School recently won 2nd Place in the 2025 Best in Class STEM Awards by the APS Education Foundation, and credited their participation in our program as helping them get there.

Coming Next Issue...

Another great year of