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!

One Hundred Years of Quantum

INTERNATIONAL YEAR OF Quantum Science and Technology

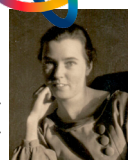
A *quantum* is a single unit, or "packet," of energy, which can act like a *wave* or a *particle* depending on how it's observed.

In 1925, physicists Werner Heisenburg (not the Walter White one!), Max Born, and Pascual Jordan published papers trying to reconcile the observed behavior of electrons with classical physics.

Together, they created a new theoretical *quantum physics* model called *matrix mechanics.* This new approach revolutionized our understanding of how the physical world operates. "Modern physics is quantum physics."

To commemorate the 100th anniversay of this event, the United Nations declared 2025 to be the International Year of Quantum Science and Technology (IYQ 2025), a "year-long, worldwide initiative aimed at increasing public awareness of the importance of quantum science and applications."

IYQ 2025 also recognizes the achievements of women in STEM, such as German physicist and early quantum physics pioneer Dr. Lucy Mensing.



Quantum physics has many broad applications in modern science and technology. For example, it helps explain how atoms are joined by *covalent bonds* to form *molecules.*

Superconducting magnets, featured in our recent STEM booths, depend on quantum physics principles. Other technologies that leverage quantum physics include *lasers, light-emitting diodes, transistors, microprocessors*, and *magnetic resonance imaging (MRI) machines.*

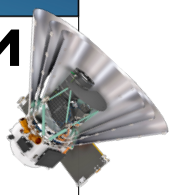
Quantum computers, that can run calculations exponentially faster than current computers, using multiple-state quantum *qubits* instead of standard binary *bits*, are in development.

More Kahooting in 2025

The Mars Facts Challenge Kahoot! games have started! (https://afrlnm.com/stem/missions/mission-to-mars/mars-kahoot-games/).

Challenge #1 is up and available to play through **Friday, 31 January 2025**. Games will rotate about every two weeks; Challenge #2 will run from 3-14 February 2025.

More STEM in 2025



Lots of STEM incoming in 2025!

NASA's SPHEREx Space Observatory launches from a SpaceX rocket, and NASA's EscaPADE mission, to study Mars' escaping atmosphere, hopes to launch from a Blue Origins New Glenn rocket.

Technology unveiled at the 2025 Consumer Electronics Show (CES) included L'Oréal's *Cell Bio-Print* gadget that analyzes your skin's health.

There's a new semester of **DoD STARBASE NM** and **Spring TECH Mission** classes starting.

We'll have a booth at the Nuclear Museum STEAM Day on 22 February.

The **STARBASE Advanced** qualifying launches due date is 7 April, the **STEM Challenge Symposium** is 10 April, the **Mission to Mars Link-Up Day** is 24 April, and the **Robotics Expo** is 9 May this year.

Heyo BMO

Our newest Asst. STARBASE Instructor is Emma "BMO" (pronounced "Beemo") Bremer.

From Lynchburg, VA, she took a variety of advanced high school STEM courses, such as Advanced Placement (AP) Psychology, AP Chemistry, and Calculus.

A big fan of the Adventure Time cartoon, she reminds her husband of the character "BMO," a walking cross between a Macintosh computer and a Gameboy. Heyo, BMO!

Mission to Mars

For Fifth Graders

Mars Gravitational Research Energy Antenna Test (GREAT) Mission 2024-2025

Your commitment to this mission is crucial to its success

The Keys to the Colony

Mission to Mars students will need a pair of *keys* to unlock the location of their colony.

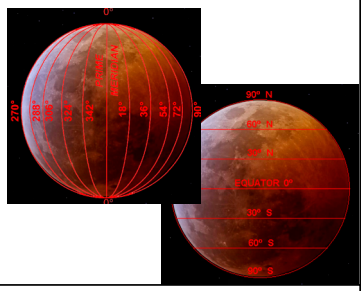
When students click on the Mars Colony Location section of the Base Operations Control Panel, they'll see three clues hinting at where the colony is.

The first two clues key off of the location (latitude and longitude) of the largest known volcano in the entire solar system: Olympus Mons.

The second key involves decoding the third clue, written in ASCII (American Standard Code for Information Interchange, an early standard code for representing computer characters, pronounced "ask-key").

Answers can be written in their Student Journals.

With clue answers, and the Mars topographical map, students can fill out the *Mars Colony Location Form* using the link on the webpage.



Fractionated

When Mission to Mars students complete Kahoot Mars Facts Challenges (see page 1), their Student Mission Journal asks them to calculate the "Correct Answer Percent."

In other words, the *fraction* of the total number of questions in the game that were correct.

The top number is the number of correctly answered questions, the bottom number is the total number of questions in the challenge.

Dividing those two numbers results in a decimal number. Multiply the decimal by 100 and add a "percent" symbol, and thats the "Correct Answer Percent!"

A Little Help, Please

Transportation

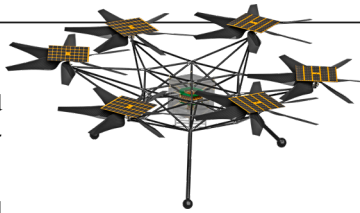
To survive on the Red Planet, Mission to Mars students will need a little help.

Students research Mars Facts and sketch a design they would create of one of eight helpful *life support systems* in their Mission Journal.

They also build a model of their life support system using materials found around the house.

Note: The model does not have to actually *function*.

Chopper News



NASA thinks they've figured out why the Mars helicopter *Ingenuity* crashed.

The terrain was too flat and featureless under it, so it had a hard time telling how close the ground was. But they're now considering making a more powerful model that could have not one, but *six* faster spinning rotors, and be the size of a small SUV.

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.

It's coming up on **20 February 2025**, 12:30-3:30 pm.

Make your arrangements now!

TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry and Satellites Missions

Plates, Carts, and Drops

In Fall semester TECH Day 3, which just wrapped up, students explored Newton's Laws and how they related to their Day 2 rocket launch.

They jumped and pressed on Vernier Force Plates and observed the graphs of the forces involved.

For example, two students pressing force plates into each other resulted in two force graphs that mirrored each other, because for every action, there is an equal and opposite reaction, as per Newton's Third Law.

Students of varying masses also pulled themselves towards each other using Human Dynamics Carts, which demonstrated Newton's Second Law, Force equals Mass times Acceleration (F=ma).

Engineering Design egg-spertise was utilized when students designed, tested, and redesigned payload protection for an Egg Drop activity.

Now, the TECH Mission is switching gears over to Satellites and Satellite Technology for the Spring semester.

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

Building Robots!

Module 2 of the Robotics Challenge has started, and now it's time for students to build their robots!

What is a Robot?

Robots are physical objects that can move and be programmed to perform various physical tasks.

They come in various shapes and sizes, depending on what sort of tasks they are designed for.

Some are modeled after humans; standing upright, with two arms, a head, a torso, legs, and feet or wheels of some kind for locomotion. Others, such as industrial automotive robots, are designed to perform their intended tasks as efficiently as possible.

The tasks robots perform are quite varied. Some do menial tasks and chores like vaccuuming the floor; others do work too dangerous for a human to perform, like searching an area for landmines. Some do high precision work, like assisting with delicate laser eye surgery.

The word "robot" was first used in the 1920 Czech play "*Rossum's Universal Robots*." It's based on the Czech word "robota," meaning "labor."

Robots have come a long way. Some very interesting ones were shown at this year's Consumer Electronics Show (CES).

Building cyber:bots!

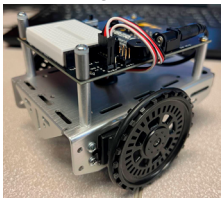
The robots Robotics Challenge students build are called *cyber:bots*.

First, students attach their *micro:bit* microcontroller and a small speaker to a cyber:bot *breadboard*.

Then they *center* their servomotors, or "servos," and attach them to the pins marked P18 and P19 on their board. The cyber:bots have two wheels that are turned by the servos; centering the servos ensures they turn correctly.

Then they assemble the *chassis*, or frame, of the cyberbot, and attach the board, servos, and battery pack to the chassis.

When they're done, they'll have a robot that looks something like *this*, at which point they can decorate their robot and give it a name!



Questions? Suggestions? Contact stem@afrlnewmexico.com for more information.

STEM Challenge

For High Schoolers

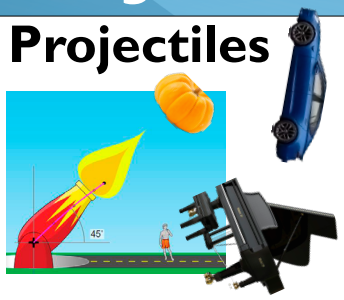
"Phun" With Projectiles

Challenge #2

STEM Challenge student teams who haven't taken the **Projectile Motion Challenge** yet, can find it at https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_all.html! It's "phun!"

In this simulation, students have "phun" with "physics" to make three projectile objects "phly" through the air at different angles:

1. A pumpkin,
2. A car, and
3. A piano.



They also test their knowledge in a Canvas quiz.

Let the chunking begin, and may the best chunk dunk! Contact deb.novak@afrlnewmexico.com for more info.

Building Protection

Suggested Timeline: Jan/Feb

STEM Challenge students try to save their eggs' bacon! How? Getting them out of the frying pan and into the flying plan by *building* and *testing* their **Payload Protection Device.**

First, student teams *build* their protection device, and *take at least four pictures (or a video)* and submit to Canvas.

Then, they *test* it to see how well it will *protect* the delicate egg payload during launch conditions.

To test *height*, teams place a raw hen's egg into the device and drop it from a height of 4, 8, and 12 feet three or four times.

They test *distance* using their launching device to fling the payload protection device 30 feet away at least three times.

Did the device roll a lot before coming to rest? Did the egg *survive*? Does the payload protection device design need more work?

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 *from a distance*. But would Einstein think this action is spooky?

Kirtland AFB Flight Enthusiasts get all enthusiastic talking 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 enthusiastically earn their wings flying an X-Plane Flight Simulator Cessna, without even wearing a *parachute!*

Flight Enthusiasts wanted! Contact Miranda (Pua) "Mew" Gabaldon, miranda.gabaldon.ctr@us.af.

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YouTube Channel:
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

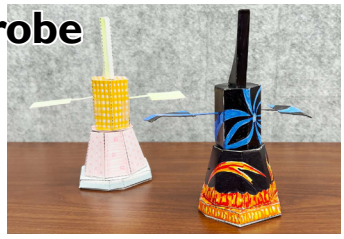
USAF: United States Air Force

USSF: United States Space Force

Remember, Teachers:
Get those EPA Participation forms in!

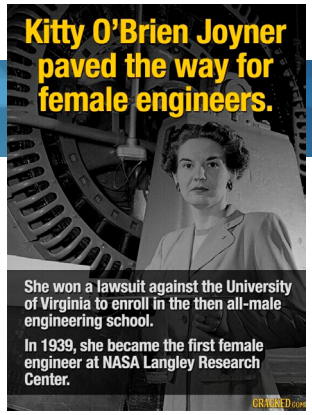
STEM Bytes

Parker Paper Probe



On 24 December 2024, NASA's Parker Solar Probe made history. It flew just 3.8 million miles above the surface of the Sun, at 430,000 miles per hour, and *survived*. This made it the fastest man-made object in history, and it was flying through the Sun's atmosphere at the time!

NASA has a downloadable PDF of instructions on how to make your own *paper* Parker Solar Probe model, but it requires some tools like *glue*, *markers*, and *scissors*. Our TECH Mission Paper HexSats are easier to make, and are pre-colored!



Quantum Leap

Google recently claimed their "Willow" quantum computer chip, with 105 qubits, performed calculations in *five minutes* that would take a modern supercomputer *10 septillion years*.

So fast, it might even have been computing across *multiple parallel universes* simultaneously! Cool! Computing across the Spiderverse.

Mind you, Google tends to think in big numbers. This is the same company that named themselves after the *googol*, a 1 followed by a hundred zeros.

Not quite there yet: 10 septillion only has 25 zeros.

2025 AYWiSTEM Scholarship Open

NMOST New Mexico Out-of-School Time Network

To assist and encourage young women pursuing a STEM career, the 2025 Advancing Young Women in STEM scholarship application ($500, $750, and $1,000) is now open through **8 March 2025**.

Questions? Contact Sarah Pratt, spratt@nmost.org.

SciGirls

PBS KIDS

PBS Kids' SciGirls is changing how "tween" girls think about STEM, with short videos, games, and profiles. Check it out here:

www.pbskids.org/scigirls.

Simonyi Scope

VERA C. RUBIN OBSERVATORY

The Vera C. Rubin Observatory and its telescope, formerly known as the Large Synoptic Survey Telescope (LSST), currently being constructed in Chile, should see "first light" in July 2025. The 3-mirror telescope is now called the *Simonyi Survey Telescope*, after the Simonyi family generously donated "simonyi" to it.

The primary mirror (M1) is 8.4 meters across, and the secondary mirror (M2) is 3.4 meters, making it the largest convex mirror in any operating telescope, until the Extremely Large Telescope (ELT)'s 4.2-meter secondary mirror is built, around 2028.

Simonyi will use the Legacy Survey of Space and Time (LSST) camera, the largest digital camera ever made—a whopping 3.2-gigapixel charge-coupled imaging device (CCD).

It will conduct a 10-year survey of the southern hemisphere sky, basically the largest time-lapse photo of the cosmos ever attempted, to study dark matter and search for the rumored Planet Nine, from here on Planet Three.

Tech Trekkin'

AAUW TECH TREK

NEW MEXICO TECH
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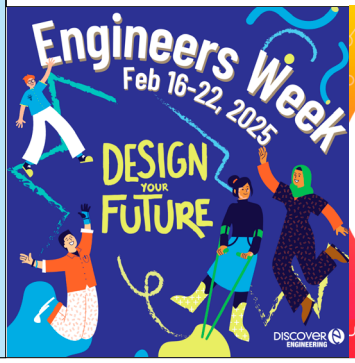
Tech Trek is a week-long residential summer camp for girls passionate about STEM. This year's dates are 22-28 June 2025.

Nominations for 2025 (only three per school!) by 7th grade math or science teachers, are due **24 January 2025.**

Email: techtreknm@gmail.com.



Coming Next Issue...

- Uniforms and Mid-Year Mars Meetings
- Satellite TECH
- Heart-shaped chocolates