

# AFRL

NEW MEXICO  
STEM OUTREACH

Inspiring Future Scientists  
and Engineers

## AFRL NM STEM ACADEMY MISSION PREVIEW 2024-2025

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SPECIAL EDITION

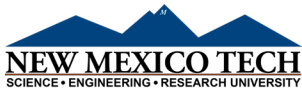


## The Rocket Report

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In partnership with:



Collaborator:



#### Remember, Teachers:

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



## Inspiring the Workforce of the Future



### Who We Are

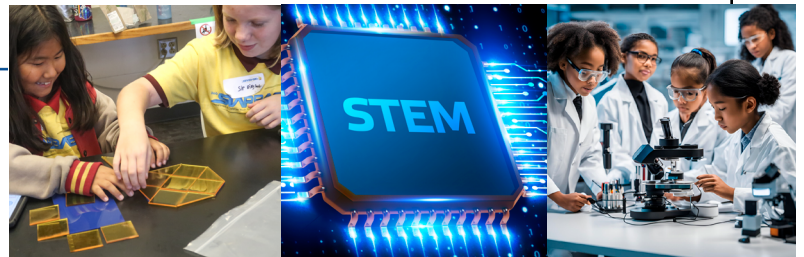
At AFRL New Mexico STEM Academy, we're using STEM to inspire the workforce of the future!

We're an Air Force Research Laboratory (AFRL) Science, Technology, Engineering, and Math (STEM) education outreach program on Kirtland Air Force Base (KAFB), through a Partnership Intermediary Agreement (PIA) with New Mexico Tech.

We inspire students from fifth through twelfth grade to study STEM—and perhaps become future scientists and engineers (S&Es).

AFRL NM STEM Academy takes the study of STEM out of the textbook and into an interactive, hands-on environment. Our activities focus on applications of basic STEM concepts behind technologies developed by AFRL's Directed Energy and Space Vehicles Directorates on KAFB.

We offer several missions, designed for specific grade levels and aligned with



Common Core and Next Generation Science content standards.

### Missions

Who wouldn't want to be an astronaut for a day?

**Mission to Mars** is a Mars colonization simulation for fifth graders.

Student crews spend the school year preparing in their classroom for a manned mission to Mars.

It culminates in an event near the end of the school year called "Link-Up Day," in which students from different schools join forces to simulate the trip to Mars and build a linked-up colony of inflatable plastic habitats there.

**DoD STARBASE NM** provides fifth graders an opportunity to explore Engineering, Physics, Technology, Chemistry, and Aerospace. Students discover hands-on what it's like to be a scientist or engineer.

They get to meet real-life STEM professionals, too!

In the **Technology and Engineering Challenges (TECH) Mission**, middle school students explore applications of basic STEM concepts and the engineering design process. Fall semester focuses on model rocketry content and spring semester focuses on satellites.

In the **Robotics Challenge**, middle school student teams explore the basics of robotics and coding, programming small wheeled robots to complete tasks and navigate obstacle courses. It culminates in a Robotics Expo event.

During the **STEM Challenge Mission**, high school student teams design, build, and test launching and payload protection devices to send an egg payload through a hula hoop towards a target a specified distance away. It culminates in a STEM Challenge Symposium event.





# Mission to Mars

For Fifth Graders

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



## The Race is On

The great space race is on... again...and this time, the ultimate goal is Mars, not the moon...and it'll be great!

Currently on Mars, there are two operating rovers (NASA's *Curiosity* and *Perseverance*), and seven orbiters. The Mars helicopter *Ingenuity* recently flew its last flight, but it did so well, more helicopters are planned.

China, India, the European Union, and the US have all sent successful unmanned missions to Mars.

NASA has been conducting manned Mars Mission test simulations on Earth such as CHAPEA (Crew Health and Performance Exploration Analog), and their lunar Artemis program is seen as a stepping stone to manned Mars missions.

Over the next couple of decades or so, organizations such as NASA and private companies like SpaceX plan to send *manned* missions to Mars.

Scientists are already devising ways to make the terraforming of Mars more practi-

cal and doable, so astronauts might find a somewhat welcoming environment by the time the first bootprints show up on Mars.

By the time today's fifth graders are of astronaut age, manned missions to Mars might be preparing to launch.

## What's Mission to Mars?

For over 30 years, our Mission to Mars program, for fifth grade students, has provided a unique hands-on learning opportunity to begin thinking about and preparing for such career opportunities.

It's a simulated journey to Mars to establish a colony, based on the Challenger Center for Space Science Education's acclaimed *Marsville*®, the *Cosmic Village* program—modified to include Air Force technologies and terminologies.

## Base Operations

Students work as a habitat crew in their classroom throughout the school year on various activities, called

**Base Operations**, to prepare for the journey.

These activities are designed to be motivating and hands-on, while meeting many of the NMSTEMReady! Science and Common Core (language arts and math) standards.

Base Operations include:

- Writing a saga that describes their journey to Mars,
- Designing a mission patch;
- Studying Mars facts and designing a life support system model based on those facts;
- Cutting out their 6-mil plastic habitat pieces;
- Planning a nutritious, space- and weight-saving lunch; and
- Designing a crew uniform.

## Link-Up Day

The mission culminates in a **Link-Up Day** activity in the spring. Crews come together to simulate colonizing Mars.

Each crew progresses through a series of holding stations to ensure they have

completed the necessary preparations for Link-Up Day, receiving points on a Crew Mission Log.

Student crews construct inflatable 12' x 12' x 8' plastic habitats, alongside crews from other schools, forming a colony neighborhood, and eat their astronaut lunch inside.

Each crew cuts open the connecting tunnels to adjoining habitats, "linking up" the colony.

We will conduct teacher training early in the school year to help teachers understand their role in the Mission to Mars.

There is a mandatory mid-year meeting for Mission to Mars teachers typically held in February, to help prepare teachers for Link-Up Day.

**"I enjoyed the technical briefing because it was super fun to talk about our life support [system model]."**  
2023-24 Mission to Mars student



# TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rockets and Satellites Missions



## What's TECH?

Middle school students in our Technology and Engineering Challenges (TECH) Mission get enriched exploring STEM in three non-consecutive days of instruction, in either the Fall Rocketry Challenge or Spring Satellite Challenge semesters.



## Rocketry (Fall)

Fall semester TECH Mission focuses on the engineering design process applied to model rockets.



Students use teamwork and engineering skills to build and launch four-foot rockets. Students also explore preparatory activities such as running a computer simulation of the rocket's anticipated trajectory, and exploring trajectories of smaller "straw rockets."

## Satellites (Spring)

Spring semester of the TECH Mission focuses on the engineering design process applied hands-on to satellites.

Students investigate hands-on STEM concepts related to specific satellite engineering disciplines such as circuitry, coding, and spectroscopy.

Students apply these concepts in activities such as soldering their own light emitting diode (LED) badges.

**"My favorite experience that we did was the egg drop. I had a super fun time building it, and I loved when my group was thinking of good ideas."**  
2023-24 TECH Mission student

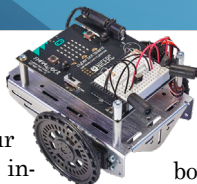




# Robotics Challenge

For Middle Schoolers

## The Robots Are Coming



They can mop your floor, build a car, investigate a hazard, explore other planets... robots are *everywhere*.

Robots are getting more sophisticated, energy efficient, and, with recent advances in artificial intelligence (AI), better at interacting with and reacting to unexpected and unusual situations in their environment.

According to the International

Federation of Robotics, as of 2023 there are now about 3.5 million robots just in the industrial sector *alone*. Chick-fil-A is even testing chicken sandwich home delivery robots!

*Someone* is going to have to build, program, operate, and maintain all those millions of robots!

## What's Robotics Challenge?

In the Robotics Challenge Mission, middle school stu-



dents explore systems engineering, computer science, and robotics by working in teams to build and code small robots to complete various tasks.

Student teams work at their school site to complete several online challenges that guide them through **computer basics, using a microcontroller, and building and coding a robot.**

AFRL NM STEM Academy supports teachers, acting as coaches, with materials and help with the process as needed,

"I liked [working] together and taking turns to code, because it [will help] us in the future to learn robotics and work together."

2023-24 Robotics Challenge student

to complete the mission with their students. Team points earned by completing challenges determine which teams qualify for the annual **Robotics Challenge Expo**, held in the spring at our facility on Kirtland AFB.



# STEM Challenge

For High Schoolers

## Egg-celence In All We Do

A *catapult* is a ballistic device used to launch a *projectile* a great distance without the aid of gunpowder or other propellants. It relies on the sudden release of stored *potential energy*.

The earliest catapults flung weapons like arrows or large stones. More recently, aircraft carriers have used them to launch *airplanes* off the ship's short runways at high speed!

But they *really* achieved egg-

celence when STEM Challenge high school students started using them.

## What's STEM Challenge?

The STEM Challenge Mission provides an opportunity for teams of 3-4 high school students to solve a technical problem, namely how to remotely launch an *egg payload* through a vertically suspended *hula hoop* and have it land, intact, on a *target* 30 feet away.

With teachers acting as coaches, student teams

work at their school site to complete several challenges that guide them through the **design, construction, testing, and modification** processes for their *launching and payload protection devices*.

Teams may design and construct their launching device from scratch, or use a *catapult kit* provided by AFRL NM STEM Academy.

Team points earned by completing challenges determine which teams qualify for the annual **STEM Chal-**

"My favorite experience during the program was working with my team members to solve problems that cropped up during our experimentation and trials."

2023-24 STEM Challenge student

allenge Symposium, held in the spring at our facility on Kirtland AFB.



# DoD STARBASE NM



For Fifth Graders

## What's DoD STARBASE NM?

DoD STARBASE is a premier educational program sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs.

For over 20 years, AFRL NM STEM Academy has implemented DoD STARBASE NM for fifth grade elementary school students.

Students come to our facility on KAFB for five days of hands-on

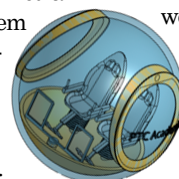


activities during the school year. The inquiry-based curriculum focuses on topics which include **Engineering, Physics, Technology, Chemistry, and Aerospace.**

Air Force Core Values

(*Integrity First, Service Before Self, and Excellence in All We Do*) are embedded in the activities. Teamwork is stressed as the students work together to explore, explain, elaborate, and evaluate concepts.

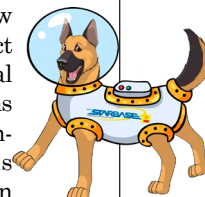
Activities include using engineering design to construct a payload protection system for brave astronaut Eggbert as he crash-lands on the moon, and designing a gyrosphere using 3D CAD software.



"I really am amazed with all this stuff that I have probably never learned before and I loved to do all the activities. They really increased my mood!"

2023-24 DoD STARBASE NM student

Scientists, engineers, and military volunteers from AFRL and KAFB share how they apply abstract principles to real world situations using demonstrations of STEM in different settings and careers.



AFRL NM STEM Academy  
PO Box 9556  
Albuquerque, NM 87119  
(505) 846-8042

[AFRL.RDOX.NMSTEMOutreach@us.af.mil](mailto:AFRL.RDOX.NMSTEMOutreach@us.af.mil)

Website:

[www.afrlnm.com/stem](http://www.afrlnm.com/stem)

YouTube Channel:

<https://www.youtube.com/channel/UC-QuOSd1XTkYuXPONZwIAIHQ/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

**GREAT:** Mars Gravitational Research Energy Antenna Test Mission 2023-2024

**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!



## What's STARBASE Advanced NM?

STARBASE Advanced NM combines STEM activities with a relationship-rich, school based environment to provide the missing link for at-risk youth making the transition from elementary to middle, and middle to high school.

It is an after-school or extracurricular way for schools to extend the impact of DoD STARBASE



through a team mentoring approach which solidifies students' attachment to, and engagement with, school, while learning about teamwork, STEM, and rocketry.

Teams of 4-5 students, working with a STEM mentor, meet for multiple sessions to build and test two different model rockets, before attempting to qualify for the American Rocketry Challenge (ARC) <https://rocketcontest.org/>.

ARC (formerly TARC) is a national rocketry competition, the world's largest, with nearly 5,000 students nationwide competing each year.



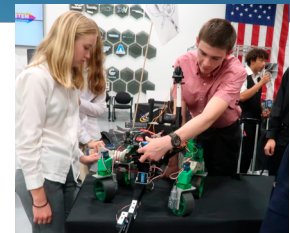
To qualify for ARC, student rockets must meet certain parameters, such as specific mass and length requirements, return an egg payload undamaged, and use an F-series motor or lower to reach a specific altitude and flight duration.



## Other STEM Opportunities

### Community Events

We work with community STEM organizations to provide hands-on activities at events such as the Big Brothers Big Sisters Discovery Festival.



### Future Workforce

We hope to provide additional activities for high school students that will help them explore STEM career connections.



### Volunteers

We recruit volunteers from Kirtland Air Force Base for STEM Academy and community STEM events. These volunteers can also check out cool demos from our STEM

Demo Library for classroom presentations, school science nights, or other community events.

AFRL NM STEM Academy supports additional STEM opportunities as resources, staff, and schedule availability permit.



## STEM Bytes

### BASIC Info

60 years ago, mathematicians John G. Kemeny and Thomas E. Kurtz executed the first program in a new computer language they invented called Beginner's All-purpose Symbolic Instruction Code (BASIC), on a Dartmouth University GE-225 mainframe.

The first version only had 14 commands, including PRINT, IF/THEN, and GOTO.



## Coming Next Issue...

- What We Did Over Summer Vacation (Hint: it was a LOT)
- A WHOLE NEW YEAR of STEM!!



**Watch for it!**