

# AFRL

NEW MEXICO  
STEM OUTREACH

Inspiring Future Scientists  
and Engineers

## AFRL NM STEM ACADEMY MISSION PREVIEW 2022-2023

Star Date: Aug 2022  
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 creating the next generation of scientists and engineers! Won't you join us?

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 Flight. Students discover hands-on what it's like to be a scientist or engineer. They get to meet some 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. 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 Exploration and Transmission Laser (METL) Mission 2022-2023

## Everybody's Going

Not planning to go to Mars? Why not? Everyone else is!

Currently on Mars there's a lander (*InSight*), three rovers (NASA's *Curiosity* and *Perseverance*, and China's *Zhurong*), and a helicopter (NASA's *Ingenuity*). Orbiting Mars are eight man-made satellites.

Within just the next few years:

- NASA's *Psyche* satellite plans to do a Mars flyby,
- Japan's Martian Moons Exploration (MMX) mission plans to obtain a sample from Mars' moon *Phobos*,
- NASA will launch two *EscaPADE* Mars Orbiters,
- India will launch its Mars Orbiter Mission 2 (MOM-2).

Plus, two private companies called Relativity Space and Impulse Space plan to launch craft to Mars as early as 2024, and NASA plans to send more helicopters as soon as they can, because the first one is working so well.

Over the next couple of decades or so, programs such as NASA

and private companies like SpaceX plan to start sending *manned* missions to Mars.

Demand for scientists, engineers, and astronauts involved in manned and unmanned Mars missions will continue to climb over the next decade. That's where we come in.

## What's Mission to Mars?

Mission to Mars provides a unique hands-on learning opportunity for fifth grade students 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*<sup>®</sup>, 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 NM STEM Ready! 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.

**"AMAZING!!! It was a little exhausting but it was fun. I enjoyed building the habitat and the memorable moment when it was inflated."**

—2021–22 Mission to Mars student



# TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry 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 at our facility, 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.



Over three non-consecutive days, students use teamwork and engineering skills to build and launch four-foot rockets.

Students also run a computer simulation to see the anticipated trajectory of the rocket.

## Satellites (Spring)

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

Over three non-consecutive days, students investigate hands-on STEM concepts related to specific satellite engineering disciplines such as circuitry and electronic components.

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

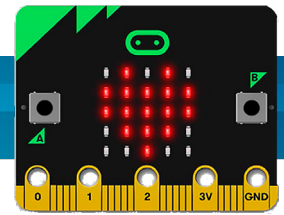
**"Frankly, it was fun. We programmed, played with chemicals and fire. We soldered, played with code. I wish I could do it again after this. It motivated me back into the side of myself that enjoyed science."**

2021–22 TECH Mission student



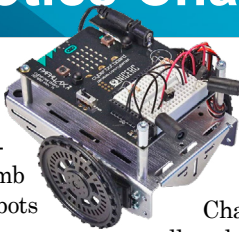


# Robotics Challenge For Middle Schoolers



## The Robots Are Coming

Self-operating vacuum cleaners...bomb disposal units...robots are *everywhere*.



## What's Robotics Challenge?

In the Robotics Challenge Mission, middle school students 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 assignments 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, to complete the mission with their students.

Team points earned by completing assignments determine which teams qualify for the annual **Robotics Challenge Expo**, held in the spring at our facility on Kirtland AFB.

**"I would like to say that the challenges were very creative and that I hope I can join another robotics contest."**

—2021-22 Robotics Challenge student

According to market research firm IMARC, by 2019 there were 12 million robots in the world, and by 2025, that number will increase to *37 million*.

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



# STEM Challenge For High Schoolers

## An Egg-citing Fling with Adventure

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-

cellence 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 assignments that guide them through the **design, construction, test, and modification** processes for their *launching and payload protection devices*.

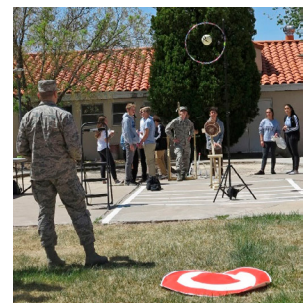
Teams may design and construct their launching device from scratch, or use a *catapult kit* provided by AFRL NM STEM Academy.

Submitted work that meets specific requirements earns the team points that are used to determine which teams qualify for the annual

**"As a result of participating in the STEM Challenge this year, I have learned the importance of teamwork, math, trial and error, and thinking outside the box in the STEM field."**

—2021-22 STEM Challenge student

**STEM 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.



AFRL NM STEM Academy implements this program for fifth grade elementary school students as DoD STARBASE New Mexico.

Students come to our facility on KAFB for five non-consecutive days of hands-on activities during the school year. The inquiry-based curriculum focuses on topics which include **Engineering, Physics, Technology, Chemistry, and Flight**.

Air Force Core Values (*Integrity First, Service Before Self, and Excellence in All We*

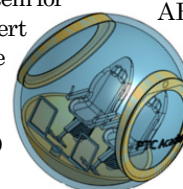
*Do*) are embedded in the activities. Teamwork is stressed as the students work together to explore, explain, elaborate, and evaluate concepts.

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 and Mars Base Camp using 3D CAD software.

**"My class left every day excited about what they had learned and what they were going to learn the next class. STARBASE has definitely showed my students that STEM activities can be fun and interesting."**

—2021-22 DoD STARBASE NM teacher

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



### 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

**METL:** Mars Exploration and Transmission Laser Mission 2022-2023

**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 Modification forms in!



## What's STARBASE 2.0/3.0?

STARBASE 2.0 (middle school) and STARBASE 3.0 (high school) combine 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 school, 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 (TARC) <https://rocketcontest.org/>.

TARC is a national rocketry

competition, the world's largest, with nearly 5,000 students nationwide competing each year.

To qualify for TARC, student rockets must meet certain parameters, such as meeting 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

As time and scheduling permit, we work with various STEM partner organizations to provide outreach activities at various events, such as the Big Brothers/Big Sisters Discovery Festival, the NM Science Fiesta, and Super STEM Saturday.



### Future Workforce

Career STREAM is a paid summer apprenticeship where high school students from historically under-represented groups work with college mentors to solve problems in STEM.

Along the way, student appren-

tices learn skills to help them succeed in any career they choose.

### Volunteers

Kirtland Air Force Base personnel can contact us throughout the school year about various volunteer opportunities and resources related to STEM outreach.



## STEM Bytes

### Volunteer Service Award Awarded

MSgt. Dane J. Kirkendall, pictured here volunteering as a flight enthusiast for our DoD STARBASE NM students, was recently awarded the *Military Outstanding Volunteer Service Award*. Congratulations, sir!



## Coming Next Issue...

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



**Watch for it!**