AFRL
NEW MEXICO
STEM OUTREACH

Inspiring Future Scientists and Engineers

AFRL NM STEM ACADEMY
MISSION PREVIEW 2023-2024

Star Date: Aug 2023
SPECIAL EDITION

The Rocket Report

In This Issue...

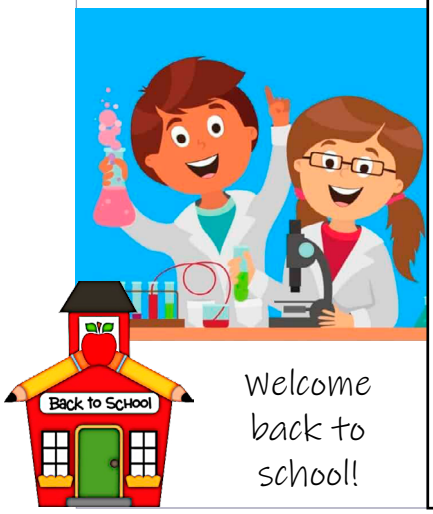
In partnership with:

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!



Inspiring the Workforce of the Future

AFRL NEW MEXICO STEM ACADEMY

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 Aerospace. 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, 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 Safeguarding Through Asteroid Redirection Spacecraft (STARS) Mission 2023-2024

★30★ Years

Everybody's Going

Who's going to Mars?

Currently on Mars, there are three operating rovers (NASA's *Curiosity* and *Perseverance*, and China's *Zhurong*), and a helicopter (NASA's *Ingenuity*). Orbiting Mars are seven man-made satellites. And 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 2026, 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, organizations such as NASA and private companies like SpaceX plan to send *manned* missions to Mars.

Since June 2023, NASA has been conducting a year-long Mars Mission simulation called CHAPEA (Crew Health and Performance Exploration Analog), and William Shatner has been hosting a reality competition show called *Stars 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?

Mission to Mars, which turns 30 this year, 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®, 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 decribes 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.

It was super fun preparing for the mission and going to Link-Up Day. I learned a lot during the experience and i would love for others to experience (it)."

—2022–23 Mission to Mars student

TECH Mission

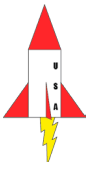
For Middle Schoolers

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 explore preparatory activities such as running a computer simulation of the rocket's anticipated trajectory, and practicing with smaller "straw rockets."

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, coding, and electronic components.

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

"The micro:bits were the highlight of these trips. I really like coding and making things with technology...

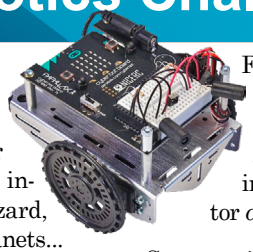
...Making code through micro:bit is one of those rare times that make me think I'm actually learning something in a classroom setting."

2022–23 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*.

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 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 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, to complete the mission with their students.

> **"My favorite Robotics challenge this year was the Ping sensors because I enjoyed seeing how the sensors can sense an object in front of them."**
>
> —2022–23 Robotics Challenge student

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-cellence 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-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 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 Challenge Symposium**, held in the spring at our facility on Kirtland AFB.

> **"I did a lot of math and building, so I think I could get a job as an engineer."**
>
> —2022–23 STEM Challenge student

DoD STARBASE NM

For Fifth Graders

What's DoD STARBASE NM?

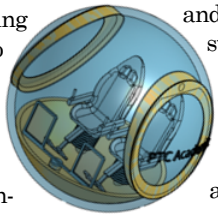
DoD STARBASE is a premier educational program sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs.

For 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.



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.

> **"It was fun because I felt like I was a scientist."**
>
> —2022–23 DoD STARBASE NM student

AFRL NEW MEXICO STEM OUTREACH

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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

STARS: Mars Safeguarding Through Asteroid Redirection Spacecraft Mission 2023-2024

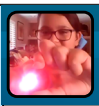
STEM: Science, Technology, Engineering, and Math

TECH: Technology and Engineering Challenges

USAF: United States Air Force

USSF: United States Space Force

Remember, Teachers:
Get those EPA Modification forms in!



DoD STARBASE NM (continued)

What's STARBASE Advanced?

STARBASE Advanced (formerly known as **STARBASE 2.0** (middle school) and **STARBASE 3.0** (high school)) 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 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 (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 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

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

Community Events

We work with community STEM organizations to provide outreach activities at events such as the Big Brothers Big Sisters Discovery Festival and Super STEM Saturday.

Future Workforce

We're working on the evolution of a paid high school apprenticeship program for the summer of 2024. Stay tuned for details.

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.

STEM Bytes

Space News

- Mission to Mars isn't the only space program with a big anniversary this year. NASA turns 65 in 2023!
- LEGO sets of the Mars *Perseverance* rover and *Ingenuity* helicopter are for sale on their website.

Coming Next Issue...

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

Watch for it!