AFRL
NEW MEXICO
STEM OUTREACH

Inspiring Future Scientists and Engineers

AFRL NM STEM ACADEMY
MISSION PREVIEW 2021-2022

Star Date: Aug 2021
SPECIAL EDITION

The Rocket Report

Inspiring the Workforce of the Future

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!

Who We Are

AFRL NEW MEXICO STEM ACADEMY

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 New Mexico 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 Space Exploration. 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 typically 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. The top 30 teams, based on points earned, qualify to participate in the annual STEM Challenge Symposium.

Mission to Mars

For Fifth Graders

Mars Vast Interferometer Variable Array (VIVA) Mission 2021-2022

Help Wanted

Mars is getting crowded! Currently operational on Mars we have 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. More missions are planned for the 2022 and 2024 launch windows.

Within the next couple of decades or so, a number of government space programs, such as NASA, and private companies, such as SpaceX, plan to start sending *manned* missions to Mars.

With all this attention focused on the Red Planet, demand for scientists, engineers, and astronauts to be involved in manned and unmanned Mars missions will no doubt continue to climb over the next decade.

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.

"I would describe it as very fun and very organized...a great learning experience for anyone who wants to learn about Mars."

2020–21 Mission to Mars student

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 in February, to help prepare teachers for Link-Up Day.

"I'm retiring and wanted to let you know Mission to Mars was always a highlight of every year... something most students will never forget about 5th grade!"

2020–21 Mission to Mars teacher

DoD STARBASE New Mexico

For Fifth Graders

Imagine!

Imagine being a fifth grade student who gets an opportunity to discover hands-on what it's like to be a scientist or engineer (S&E), and meet some real-life STEM S&E professionals!

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 **Space Exploration**.

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 space station using 3D CAD software.

"My favorite part of STARBASE was [making] the lava lamp because it was just a really fun experience."

—2020–21 DoD STARBASE NM student

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.

For example, while students are exploring states of matter and thermal dynamics, AFRL S&E's discuss their careers and use liquid nitrogen to cryo-freeze various objects.

TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry and Satellites Missions

Rich in STEM

Branson, Bezos...why should billionaires be the only ones playing with rockets and satellites?

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 semester of the TECH Mission focuses on the engineering design process applied hands-on 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 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, and apply these concepts in activities such as soldering their own light-emitting diode (LED) badges.

"I learned a lot in a short period of time and I enjoyed doing it."

2020–21 TECH Mission student

Robotics Challenge

For Middle Schoolers

The Robots Are Coming

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

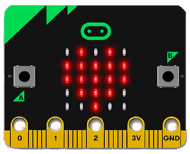
According to market research firm IMARC, by 2019 there were 12 million robots in the world, and by 2025, that number will increase to *37 million.*

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

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 provides teachers, acting as coaches, with online training and materials 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.

"My daughter very much enjoyed coding the robots and learning about coding."

—2020–21 Robotics Challenge parent

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*, usully from built-up *tension* or *torsion* energy, to propel its payload.

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 eggcellence 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.

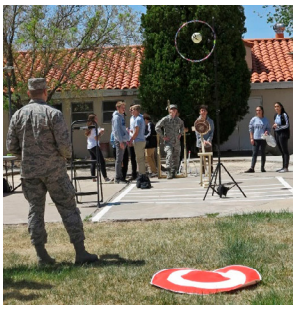
With teachers acting as coaches, student teams work at their school site to complete several assignments that guide them through the **design, construction, test,** and **modification** processes for their *launching* and *payload protection devices.*

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

"I learned how to work as a team as well as using a lot of critical thinking."

—2020–21 STEM Challenge student



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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

PRS: Phillips Research Site

S&Es: Scientists and Engineers

STEM: Science, Technology, Engineering, and Math

TECH: Technology and Engineering Challenges

USAF: United States Air Force

VIVA: Mars Vast Interferometer Variable Array Mission 2021-2022

Remember, Teachers:
Get those EPA Modification forms in!

Other STEM Opportunities

AFRL NM STEM Academy supports additional STEM opportunities for schools, the community, and scientists and engineers (S&Es), as resources, staff, and schedule availability permit.

For The Community

STEM Expeditions

STEM Expeditions are a great way to provide STEM opportunities for local extracurricular groups such as Scout troops, Junior ROTC, Mathematics Engineering Science Achievement (MESA) Inc. students, and Civil Air Patrol cadets.

These short visits, typically one to two hours long, are customized for each group, schedule and facility availability permitting, and can address specific STEM concepts such as Flight Simulation or Robotics.

Booths and Events

As time and scheduling permit, AFRL NM STEM Academy mans STEM booths at various local and national events such as the Big Brothers/Big Sisters STEAM Discovery Festival, the NM Science Fiesta, and the USA Science and Engineering Festival.

For Schools

STARBASE 2.0

STARBASE 2.0 is an after-school or extracurricular way for schools to extend the impact of DoD STARBASE through team mentoring and rocketry. Eligible students can prepare for and participate in this school year's The America Rocketry Competition (TARC).

Be advised, however: This program requires a more significant commitment of time, personnel, and resources on behalf of the school and participating teacher than our other STEM opportunities do.

For S&Es/Volunteers

We provide S&Es from AFRL and elsewhere many opportunities to participate in our STEM Academy.

Flight Enthusiast

Come tell fifth graders about your experiences working with flying aircraft, and present any videos or flight gear you have available.

Rocket Enthusiast

Assist middle school students in assembling/launching four-foot rockets at our annual Rocket Launch event in October.

Robotics Challenge Expo, STEM Challenge Symposium, and MM Link Up Day

Help judge the middle school Robotics Expo, the high school STEM Challenge Symposium, or man holding stations at the fifth grade Mission to Mars Link-Up Day.

STARBASE 2.0

Help students prepare for the TARC rocketry competition, four hours per month, August to May.

STEM Expeditions/Booths

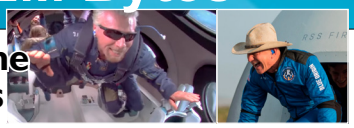
Volunteer at one of these activities throughout the year.

STEM Demos

Our STEM Demo Lending Library, for AFRL S&Es, contains demonstration activities packaged in bins complete with all required materials, for use with student clubs, school events, etc.

STEM Bytes

Battle of the Billionaires



On 11 July 2021, Richard Branson's *VSS Unity* reached space's edge, about 53 miles up. "To all you kids down there, I was once a child with a dream looking up to the stars...To the next generation of dreamers, if we can do *this*, just imagine what *you* can do," he said.

Jeff Bezos' *Blue Origin,* on 20 July, Apollo 11 anniversary—beat that, about 62 miles up.

But bad break for Branson and Bezos...below-billionaire Richard Garriott beat them *both* by over a *decade*, going to the ISS back in 2008.

Elon Musk's *SpaceX* plans to outdo them *all* with the first all-civilian *Inspiration4* flight *above* ISS' orbit on 15 September.

Besides, Bezos' flight doesn't earn him astronaut wings per NASA, as he "didn't contribute to flight safety."

Meanwhile, the Hubble space telescope (HST) is working again, its replacement James Webb (JWST) launches later this year, and an unmanned *Artemis 1* flight to test NASA's STS rocket is scheduled for 22 November 2021. See www.space.com.

To Infinity, and...

What it would *feel* like to be on the International Space Station (ISS)? *The Infinite,* from PHI Studio (www.phi.ca/en) is a 60-minute multisensory VR tour of the ISS, showing now through 7 November 2021 in Montreal.

To infinity, and...Canada?!

Coming Next Issue...

- Summer Stuff!
- A WHOLE NEW YEAR of STEM!!

Watch for it!