

AFRL

NEW MEXICO
STEM OUTREACH

Inspiring Future Scientists
and Engineers

AFRL NM STEM ACADEMY

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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!



More STEM in 2023

2022 is over, but the STEM sure isn't! There's lot's *more* STEM coming in 2023. Just in terms of space travel *alone*, a lot of STEM activity is planned.

In early 2023, the *Artemis II* crew will be named, SpaceX's *Starship*, the largest rocket ever built, is set to make its first orbital flight, and NASA's Commercial Lunar Payload Services (CLPS) program plans to put a series of robotic landers on the moon.

The first crewed flight of Boeing's *Starliner* spacecraft, and ESA's *Jupiter Icy Moons Explorer* (JUICE) mission, are scheduled to launch in April.



(Upon arrival in December 2034, JUICE would become the first mission to orbit another moon besides Earth's!)

OSIRIS-Rex returns to Earth with samples of asteroid Benu this September. PSYCHE is scheduled to launch to metallic asteroid Psyche in October.

Xuntian, the Chinese Survey Space Telescope (CSST), with a field of view 300–350 times larger than the Hubble, launches in December.

Fortunately, we've got more STEM planned in 2023 as well!

We're launching a new semester of **DoD STARBASE New Mexico** and **TECH Mission Satellite Semester** classes in 2023.

The **STARBASE 2.0/3.0 TARC** qualifying rocket launch deadline is 3 April. The **STEM Challenge Symposium** is scheduled for 5 April, **Mars Missions Link-Up Day** is planned for 28 April, and the **Robotics Expo** is programmed for 12 May 2023.

Discover STEAM Week, Discover-e's E-Week, and the **Mission to Mars Mid-Year Meeting** will be in February, too.

Whew! That's a lot of STEM coming in 2023!

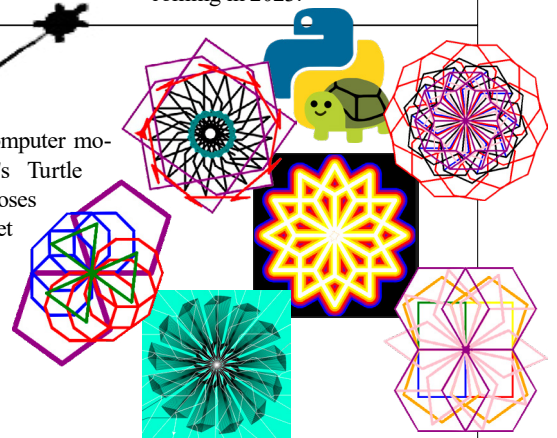
More Mosaics in 2023

2023 is Turtle Time! Robotics Challenge students are making more mosaics, and many of them are already on display in a Mosaics Gallery on our website, in the Robotics Challenge menu: <https://afrlnm.com/stem/turtle-mosaics-gallery/>.

Module 1 of the Robotics Challenge mission, which includes a

challenge to draw computer mosaics using Python's Turtle graphics module, closes 27 January 2023, so get those turtles turtling!

We'll update the gallery with *more* mosaics after the module closes.



More Kahooting in 2023

The Mars Facts Challenge Kahoot! games have started, and they're riddled with riddles (<https://afrlnm.com/stem/2023-mars-metl-mission/>).

Challenge #1 is already up and available to play through **Friday, 27 January 2023**, and they'll rotate about every two weeks.

Mars teachers, when Kahoot! asks for your student's "Nickname," have them enter their first name and school initials. Example: If their name is George and the school is Hayward Elementary School, their Kahoot! Nickname would be "George HES."

Ready, set, *Kahoot!*





Mission to Mars

For Fifth Graders

Mars Exploration and Transmission Laser (METL) Mission 2022-2023

Look For the Volcano, Mon

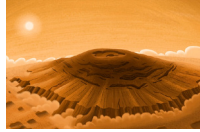
Where on Mars will students be setting up their colony? Just look for the big volcano, Mon.

Mission to Mars students can go to the Mars METL Mission website and click on the Mars Colony Location task on the Base Operations Control Panel to obtain three clues to their colony location (<https://afrlnm.com/stem/mars-colony-location/>).

The three clues involve solving

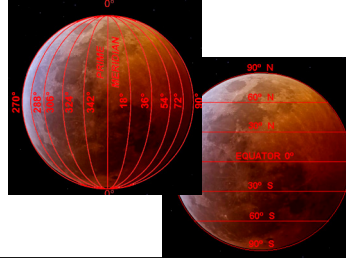
a Latitude and Longitude Math problem, and decoding a Latitude ASCII Code. Answers can be written in their Student Journals.

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



First clue is, it's near the largest volcano in the Solar System, *Olympus Mons*.

Second clue is, it's not near the site of the next Olympic Games.



Divide/Conquer

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.

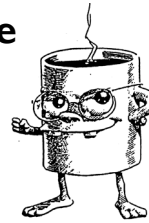
Dividing those two numbers results in a decimal number. Remove the decimal and add a "percent" symbol, and that's the "Correct Answer Percent!"

A Little Help, Please

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

Students sketch a design of one of eight helpful *life support systems* in their Mission Journal.

They also build a model us-



ing materials found around the house (www.afrlnm.com/stem/life-support-system/).

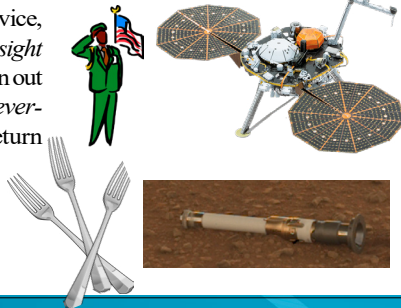
Note: The model does not have to actually *function*.



Goodbye, Insight; Hello, Depot

After over four years of service, NASA thinks the Mars *Insight* lander's solar batteries have run out of energy. Meanwhile, *Perseverance* is depositing sample return tubes on Mars at a "sample depot" area called "Three Forks."

See www.mars.nasa.gov/news.



Mark Your Mobile

It's not too early to Mark Your Mobile, specifically the calendar app in it, for the mandatory Mid-Year Meeting coming up on 23 February 2023, 12:30-3:30 pm.

Make your arrangements now!



TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry and Satellites Missions

Minimizing Egg-spenses

In TECH Mission Day 3, students observe egg payloads dropping off a two-story balcony towards a target below, and quickly discover that *eggs can't fly*.

What they *can* do, however, is *fall*...and not even at constant speed, either. Thanks to gravity, they *egg-celerate* as they fall towards the target and the cold, hard concrete below.

The farther the egg falls, the faster its velocity, and the bigger the risk it will break apart when it lands... which could be a messy situation.

I mean, have you *priced* eggs lately? They're getting *egg-spensive*!

Fortunately, the TECH Mission Day 3 students are on it.

Using the *Engineering Design Process*, they try to engineer a cost-effective solution to the problem by designing a *payload protection device* that will slow the egg's velocity and cushion its fall.

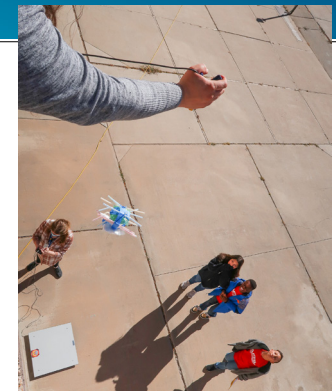
Just like real-world engineers do,



they have certain *parameters* they have to work within.

For example, they are given a list of building materials to choose from--cardboard, bubble wrap, and so forth...each with an associated cost. But they have to keep their costs within a budget.

They have to keep the *mass* of the payload below a set level, also.



After they build and test their first *egg-spermental* model, and record the results, they redesign it and try again.

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

Games, Sensors, and Radio

Robotics Challenge Teachers: **Module 1, *Intro to Programming*, closes on 27 January 2023**, so get your students to finish up and submit their mosaics and other Module 1 assignments.

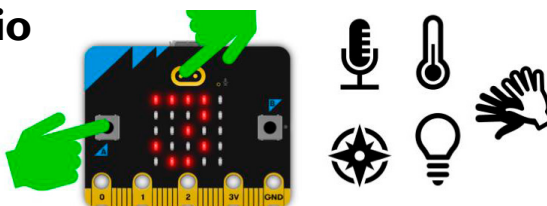
Meanwhile, now that they've gotten the hang of some basic Python programming, students can continue working on **Module 2, *Using the micro:bit***.

The micro:bit microcontroller, a tiny, programmable computer, is not very big...about the size of a couple of postage stamps...but it's

got more than enough stuff packed into it to play games, use sensors, and transmit signals to other micro:bits using *radio waves!*

For example, the micro:bit has two input buttons, A and B, and a little 5X5 LED screen.

In Module 2, using their *Python* coding skills, students program their micro:bit to play a high-tech **Rock/Paper/Scissors** game!



Two players (from the same team or two different teams) each press "Button A" on their micro:bit and get a random *rock, paper, or scissors* word to display on the screen against another player with a similarly coded micro:bit!

The micro:bit also has a number of **sensors** on it, including an accelerometer, light and tempera-

ture sensors, a compass, a microphone, and a speaker. It even has radio and Bluetooth antennas! *How* they got all *that* on this thing is a story for *Honey, I Shrank the Computer*.

Students in Module 2 modify the Rock/Paper/Scissors code to make it change words when you *shake* it! They also play a game of **"Where is it?"** by hiding an object and then using the radio transmitter to send clues to another micro:bit.

Questions? Suggestions? Don't just sit there pressing "A"! Contact lynn@afnlnewmexico.com!

STEM Challenge For High Schoolers

Payload Protection Design

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**.

To test *height*, teams place a raw hen's egg into the device and drop it from the max payload height per Assignment 2. They toss it 30 feet to test *distance*.

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

Teachers and students, did *you* survive when you saw what the price of eggs is *going for* these days? What are these things, *gold*? We may have to hunt colored potatoes for Easter.



Logos!



Team 04—
Ares



Team 13—
NA#1



Team 08—
Assyrian



Team 06—
The Athenians



DoD STARBASE NM For Fifth Graders

Nonstop Flights

Inclement weather and other issues sometimes result in holiday travelers finding themselves cooling their jets in an airport for a while.

But not our DoD STARBASE Day 5 students! One of the best things about flying on a flight simulator is...

Nonstop flights, available all year 'round! No long TSA lines, and no lost luggage, either. You can't *beat* that, not even with an online boarding pass on your phone!

Mission	Day	Activity	STATUS
SB-NM	5	BERNOULLI BAGS	ON TIME
SB-NM	5	TORNADO TUBES	ON TIME
SB-NM	5	FLIGHT ENTHUSIAST	ON TIME
SB-NM	5	FLIGHT SIMULATION	ON TIME
SB-NM	5	STEM AND FUN	ON TIME

Students in Day 5 learn about air pressure...which leads to a Tornado Tube activity. Ever try to fly through a tornado? It's not fun.

They learn about how air pressure and fluid motion relates to Bernoulli's Principle...which leads to inflating Bernoulli Bags from a distance.

AFRL 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.

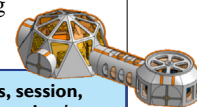
No "groundstops" here! Students earn their wings flying an

X-Plane 11 Flight Simulator.

Students can even use Onshape CAD software to design a new science outpost on Mars, in case they feel like catching a connecting flight.



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.



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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

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

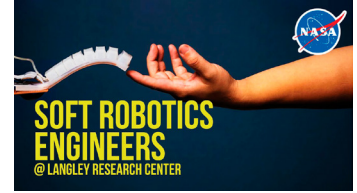
USSF: United States Space Force

Remember, Teachers:
Get those EPA Modification forms in!



Eight Ways You and Your Students Can Dive Into NASA STEM in 2023

1. Watch the "[To the Moon and Back: The Journey of Artemis!](#)" video.
2. Take your students on a reading adventure with the [Adventures of Commander Moonikin Campos and Friends](#), a three-part online comic book series.
3. Dive into the [Artemis I STEM Learning Pathway](#). The flight is over, but the e-newsletter resources remain available online!
4. Discover unexpected STEM careers at NASA, including *marine biologists* and *soft robotics engineers*. See the [NASA Workforce and Careers](#) video playlist.
5. Join a middle or high school Student Challenge, such as [Student Launch](#), [Human Exploration Rover Challenge](#), and [Great Lunar Expedition for Everyone](#).
6. Create 'Wow!' moments through hands-on STEM activities (hmmm, why didn't we think of that?!). Visit the [Next Gen STEM website](#) for a wealth of K-12 lessons and activities focusing on a wide range of topics.
7. Engage with astronauts aboard the International Space Station. Educational Earth-to-space calls, or downlinks, are offered by Next Gen STEM's "STEM on Station" initiative. Visit the [website](#) to see the schedule and learn how your school can apply to host a downlink.
8. Educators are welcome to join



the [NASA CONNECTS](#) community to stay up to date on the latest NASA resources, collaborate with fellow educators, and find out about exclusive events.

Teachers, parents, and students can also sign up for the [NASA EXPRESS](#) digital newsletter, which delivers the latest STEM resources and opportunities every Thursday.

See <https://www.nasa.gov/feature/eight-ways-students-can-dive-into-nasa-stem-in-2023> for more info.

Just Weeks Away

The Nuclear Museum hosts students grades 1-8 for hands-on STEAM activities during STEAM Week, 13-17 February 2023. See www.nuclearmuseum.org.



Discover-c.org's Engineer's Week will be "Creating the Future" 19-25 February 2023. "Introduce a Girl to Engineering Day" is 23 February.

Tech Trekkin'



Winner of the 2021 NMOST STEM Equity and Inclusion Award, and the 2019 STEMY Non-Profit of the Year Award! The American Association of University Women of New Mexico (AAUW-NM)'s annual **Tech Trek** is a week-long residential summer camp for girls passionate about STEM.

Nominations for 2023 by 7th grade math or science teachers are due **27 January 2023**.

Nominated girls are invited to sub-

Enlighten Me!

AFRL's *Enlightened Challenge* is an entry-level STEM engineering project at *no cost* to teams! Learn real-world skills like programming, fabrication, engineering design, and more.

See our [facebook](#) page to register when details become available.

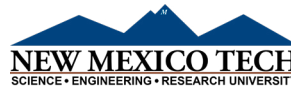


Irish STEM-iverse

Fionnghuala "Fig" O'Reilly, first woman of color crowned Miss Universe Ireland in 2019, and a former "NASA Datanaut" with a degree in systems engineering, uses her international platform and her

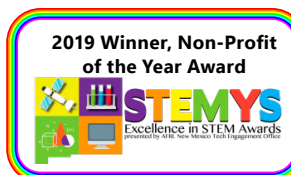


Space to Reach organization (www.spacetoreach.com) to connect women of color to careers in STEM.



mit a Tech Trek NM **application**; deadline is **24 February 2023**.

For more information, see www.techtrek-nm.aauw.net or email techtreknm@gmail.com.



Coming Next Issue...

- Uniforms and Mid-Year Meetings on Mars
- Building Robots
- Satellite TECH
- Sugary hearts and chocolate...lots of chocolate

Watch for it!

