

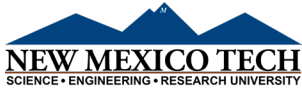


# The Rocket Report

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In partnership with:



Collaborator:



### Remember, Teachers:

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



SEASON'S GREETINGS  
and  
HAPPY HOLIDAYS

## BBBS 2024

Once upon a time, people noticed an iron ore called *lodestone*, a form of *magnetite* found in Magnesia—today part of Turkey—had an interesting property.

It had an invisible force associated with it that could attract certain heavy metals such as *iron*, *steel*, *nickel*, and *cobalt*, because of the alignment of electrons within their atoms.

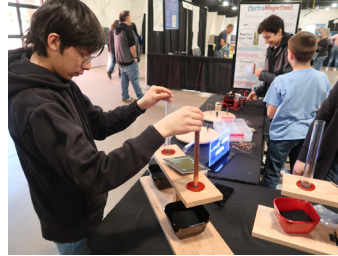
They discovered when they suspended a needle-shaped piece of lodestone in air or fluid, so it could turn freely, it would be attracted to Earth's magnetic field... and the *compass* was born.

Students and visitors at our booth at the **Big Brothers Big Sisters (BBBS) STEAM-h Discovery Festival** on 22 November 2024 discovered a number of other interesting things you can do with magnets. For example:

- They moved a container of iron filings around a magnet and saw them line up along the magnet's *magnetic field*.



- They tested the strength of a magnetic field using a single suspended paper clip, and hooking *additional* paper clips onto it.
- They dropped magnets down a copper tube, creating a second magnetic field in the copper



tube which interacted with the dropped magnet to slow its fall.

When electric current flows through a wire, it creates a magnetic field around the wire, creating an *electromagnet*.

- Students used this property to make a *simple motor*. When they placed metal wires bent into simple shapes onto a battery sitting atop a magnet, the opposing magnetic fields of the wire and the magnet would make the wire shape spin around the battery.

Bending the wire into a *coil* increases the strength of the electromagnetic field.



- Students explored this property by placing metal rings on an electromagnetic coil and launching the ring like a small cannon!

At very low temperatures, some materials are able to conduct electricity with essentially no resistance. This is known as "*superconductivity*."

Thanks to something called the

# Discovery Festival

"Meissner effect," superconductors generate magnetic fields which repel other magnets; a concept used in mag-lev trains.

- Students explored the Meissner effect when they saw a small-scale version of a mag-lev train; a supercooled superconductor suspended above a magnetic track.



## Bubbly Bubbles

Our pot is bubbling over with STEM! Our newest DoD STARBASE NM Instructor is the bubbly, bright, Brooke "Bubbles" Gallegos.



She's getting a kick out of helping the students make some bubbly Elephant Toothpaste!

A fifth grade English and Math teacher from Albuquerque, she received her bachelor's degree in family and child studies.

A Leo, her favorite color is pink, she's into hot yoga, *and* she has a *charcuterie* business! *Now* we're cooking!

Fun fact: It's impossible to stay angry at someone while saying the word "*bubbles*." Try it!



# Mission to Mars

For Fifth Graders

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

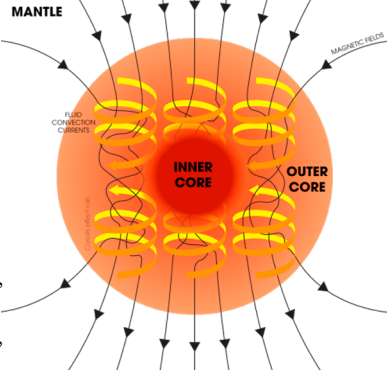
## Dynamo, Yo!

**Fact:** Earth has its own giant magnetic field, called the *magnetosphere*, around it, which compasses can detect.

**Fact:** Many scientists theorize the motion of molten iron and nickel in the Earth's outer core, combined with heat from the inner core and Earth's rotation, *generate* this magnetic field. This is known as **dynamo theory**.

**Fact:** The magnetosphere protects Earth's atmosphere and oceans from being stripped away into space by the *solar wind*.

**Fact:** Scientists believe Mars *used* to have a full magnetosphere as



well, but not today; only some magnetic patches, especially in the southern hemisphere.

**Fact:** Scientists believe Mars *also* used to have a full atmosphere, and oceans, but over time, they pretty much dissipated into space.

**Fact:** Mars losing its protective magnetosphere, because its inner core is not as hot as Earth's, may account for *why* Mars no longer has much of an atmosphere to speak of, or oceans.

**Fact:** According to the "Mars Facts" chart in the Student Mission Journal, what little atmosphere there is *left* on Mars is 95% carbon dioxide.

**Fact:** Therefore, it's going to be rather hard to breathe on Mars, unless some kind of Air Supply life support system is taken along.

Students incorporate four "Mars Facts" into their life support system model design; the fourth one in the form of a multiple-choice *riddle*.

## Musical Dynamo



One thing the solar wind hasn't stripped away on Mars: *Music!*

A Mission to Mars Saga is a sung or spoken story, with optional choreography, that describes the students' epic journey to Mars.

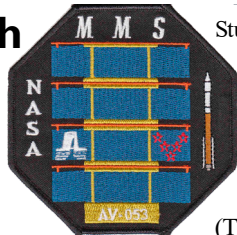
Once crews from a neighboring group arrive at a habitat site, crews can perform their saga for each other for points on the Blue Team Mission Log, and later for colony visitors, at Link-Up Day.

They could be a musical dynamo! Bigger than the Beatles even, who never even *went* to Mars. Well, maybe Ringo did.

## Mission Patch

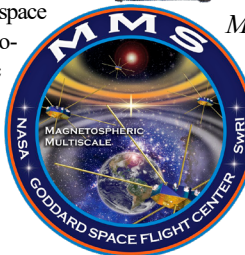
Since *Gemini 5*, all NASA manned space missions have had *mission patches* representing the mission and the crew.

Even some robotic space missions, like the ongoing Magnetospheric Multiscale (MMS) Mission, launched in 2015 to study Earth's magnetosphere, has a patch.



Students will thoughtfully design their Link-Up Day mission patch. Items to consider:

Mission name (The Mars *GREAT Mission*), crew names, life support system, flags/colors symbolizing mission participants, and patch shape (any shape!) and size.



**Your commitment to this mission is crucial to its success**

## Mark Your Mobile

It's not too early to Mark Your Mobile, specifically the calendar app in it, for the mandatory Mission to Mars Mid-Year Meeting.

It's coming up on **20 February 2025, 12:30-3:30 pm.**

Make your arrangements now!



# TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Rocketry and Satellites Missions

## STEM On the Head of a Pin

An age-old question asks, "How many angels can you fit on the head of a pin?"

Well, considering that we can only fit *one* Los Angeles Angels baseball player onto home plate, and home plate is *much bigger* than the head of a pin, the answer is: Probably not many.

For students in TECH Mission Fall Day 3, a better question might be, "How can you get an *eagle* to



balance on top of a *pyramid*?"

In Day 3, students analyze and graph real-world rocket launch data from the Day 2 Rocket Launch, and explore launching some *straw rockets*.

They spend the *balance* of the day exploring concepts revolving around *balance* and *center of gravity*.

Students discover they can make an eagle figurine balance, using the tip of its beak, on the top of



little pyramids, their finger, a pencil eraser, and maybe even on the head of a pin, because the beak is where its *center of gravity* is.

After some trial and error, students also discover how to balance *many* nails on the head of *one* nail!

All of this relates to why the students' rockets remained in stable flight on launch day. The rocket's *center of gravity* should be located slightly

ahead of the *center of pressure*.

Students also explore forces and Newton's Laws by jumping on Vernier Force Plates and riding on Human Dynamics Carts, before engineering anti-gravity forces into the payload protection device for an Egg Drop activity.

Angels and ministers of STEM defend us!



**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



## Turtles Can Draw


When Polly the Parrot escapes from her cage, that's an example of a Polly Gone.


When the Turtle in Python draws a shape with equal sides and angles, that's an example of a regular polygon.

Once Robotics Challenge students get the hang of using the Python Turtle Module's onscreen drawing functions, they are able to use the turtle to change pen color, width, even pen *speed*, to draw all sorts of lines, circles, and shapes.

Yes, even polygons!



 In **Deeper Dive #1**, teams use the turtle module to **draw their team names**, and submit a screenshot of their name and the code they used to draw it.

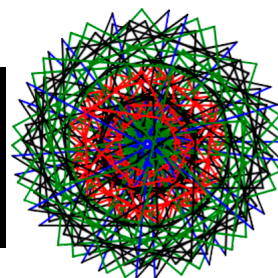
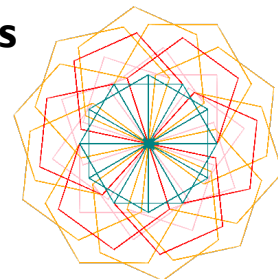
 In **Deeper Dive #2**, teams combine their skill using the turtle drawing module with their knowledge of *for loops*, to draw a **mosaic** with at least four different polygons (circles don't count!) and four different colors.

Questions? Suggestions? Contact [caitlin.everhart@afrlnm.com](mailto:caitlin.everhart@afrlnm.com) for more info.

## Names and Mosaics

Turtles on the half-shell, turtle power! The first turtle-drawn names and mosaics have started to arrive.

As more mosaics come in, we'll update the [Turtle Mosaics](#) page in the Robotics Challenge section of our website with some of the images.

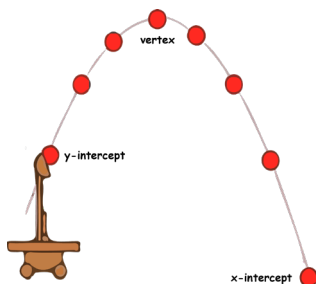


# STEM Challenge For High Schoolers

## Payload Protection Design

### Suggested Timeline: Dec/Jan

Once STEM Challenge teams have their launching device built, they need to start thinking about the launch itself.



Teams need to be able to launch a raw egg *four* times, in a parabolic trajectory. Ideally, the egg lands, without breaking, in the center of a target placed 30 feet away, every time.

Each team's egg is going to need some serious protection to get through the STEM Challenge in one piece. Student teams will protect their eggs by **designing a Payload Protection Device!**

Teams **research** different approaches to cushioning an egg payload.

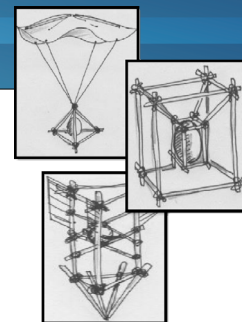
What kind of materials could they

use? How sturdy are these materials? How heavy are they? Too heavy and they may have difficulty launching the device or making it travel to the target. Too light and it may fly too far, or encounter too much wind resistance, or not protect the egg enough.

Then, teams create a **design** plan for their payload. What will it look like? Will the shape of it matter?

How big is their payload protection device? It needs to fit on the launching device; they may have to redesign their launching device to accommodate it.

Also, the team will need to be



able to repeatedly **open** and **re-close** the device after each launch, quickly and easily, to verify if the egg survived.

Teams **sketch** their design, labelling parts, measurements, and materials.

Contact [deb.novak@afrlnm.com](mailto:deb.novak@afrlnm.com) for more info.



# DoD STARBASE NM For Fifth Graders

## Bubbling With STEM

*Periodically*, we discuss the STEM activities the DoD STARBASE NM students explore in their Day 4 Chemistry session.

These activities explore fundamental physical and chemical changes which can occur with periodic table elements and various compounds.

But this is *compounded* by the fact that our staff sounds just like the activities they and the students are engaging in!

For example, Day 4 students get all

*bubbly* with excitement when they go to the trouble of creating *chemical reactions*.

Using substances such as hydrogen peroxide, vinegar and baking soda, students make bubbly concoctions like Elephant Toothpaste, and little graduated cylinder volcanoes in a Double Bubble Trouble activity.

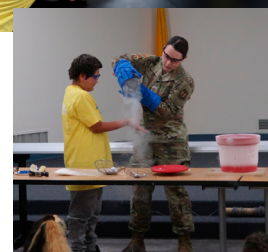
With instructors like "Bubbles" helping them, maybe it should be called a



### Triple Bubble Trouble activity!

STEM professionals from Kirtland AFB demonstrate *physical* changes to matter, such as when objects like marshmallows and balloons are dunked in very cold liquid nitrogen, which changes the *temperature* of the molecules.

And instructors like "Fahrenheit" are helping them...!



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<https://www.youtube.com/channel/UC-QuOSd1XTkYuXPONZwIAHQ/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!



## DoD STARBASE NM (continued)

### Double Header

STARBASE Advanced NM pitched a double header this month!

On 10 December 2024, student teams from Albuquerque Institute of Mathematics and Science (AIMS) middle school and Del Norte High School (DNHS), launched model rockets with their STEM mentors.

The AIMS team was testing out an

original design [American Rocketry Challenge](#) rocket!



## STEM Bytes

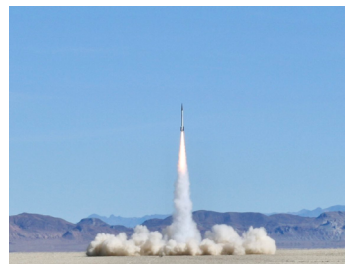
### Students Set Model Rocket Record

Students in the University of Southern California's Rocket Propulsion Lab launched a model rocket on 20 October 2024 that set a new *altitude record* for model rockets.

The rocket, [Aftershock II](#), went 470,400 feet (89.09 miles) up, and reached 3,602 mph, making it the *fastest* model rocket of all time.



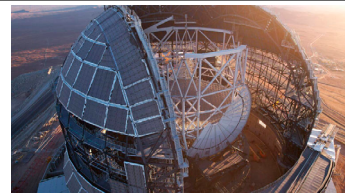
It was also the most powerful solid-propellant motor ever fired by students, and the most powerful composite case motor made by students.



### Giant Being Built

The European Southern Observatory is building an extremely large [telescope](#) on the Cerro Armazones mountain in Chile's Atacama Desert.

How large? So large, it's actually named *Extremely Large Telescope (ELT)*. Its primary mirror will measure 39 meters (128 feet) across.



When operational, around 2028, it will be the world's largest visible- and infrared-light telescope. You can watch it being built live [here](#).

### Space Coding

NASA recently announced their first new Artemis manned mission to the moon will be pushed back to at least summer 2027. But that's OK, they have ways for students to *code* their way into space *now*. Got an hour?

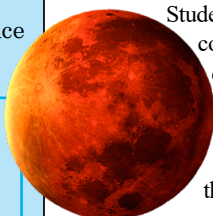


### Space Jam

Students can learn about music, astronomy, and coding all at once! Students code their own musical solar system, with drums and everything.

See [www.nasa.gov/learning-resources/search](http://www.nasa.gov/learning-resources/search) (computer science).

### Mars EDL Coding



Students can practice coding the entry, descent, and landing (EDL) stages of a trip to Mars that's out of this world!

### Scholarly! AFRL SCHOLARS PROGRAM

[AFRL Scholars](#) Summer 2025 paid high school internship applications are open 10 October 2024 to 10 January 2025. [AFRL-Scholars@usra.edu](mailto:AFRL-Scholars@usra.edu).

### Before AI, There Was IA



Once upon a time, long before there was such a thing as Artificial Intelligence (AI), there was an *Intelligent Admiral* (IA).

Her name was US Naval Rear Admiral Grace Hopper, and she was a *very* Intelligent Admiral. Today's AI owes a lot to this IA.

- She worked on the Mark I, the precursor to modern computers.
- She wrote the first computer manual, which described how to operate the Mark I.
- She designed one of the first *compilers*, which translates programmer's instructions into computer code. In fact, she *coined* the word "compiler."
- She helped create UNIVAC I, the first commercial electronic computer, and played a key role in the development of the computer language COBOL.

[Computer Science Education Week](#) (CSEd Week) occurs annually around her 9 December birthday (9-15 December 2024). [Hour of Code](#) occurs during CSEd week.



### Coming Next Issue...

- MM Colony Location
- STARBASE Day 5
- Happy New Year!

