AFRL
NEW MEXICO
STEM OUTREACH

Inspiring Future Scientists and Engineers

AFRL NM STEM ACADEMY

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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

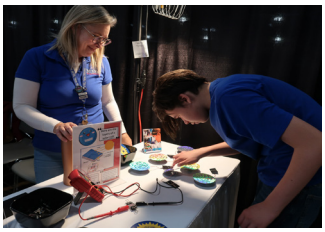
Remember, Teachers:
It's never too early to make bussing arrangements for our classes and events!

BBBS—Ellie Sticks Up for STEM

Thanks, Big Brothers and Big Sisters, for letting us participate in the 2022 Discovery Festival event on 18 November 2022!

Ellie the Electron and her friends went around showing off the power of moving electrons. They did everything from making little lightning bolts with a Van De Graaff generator, to powering solar-celled objects, much like AFRL satellites do, lighting up some series and parallel circuits, and even doing some heavy lifting.

Our staff did an electron-heavy stage show to a packed house, and Ellie even helped our booth win a People's Choice award!



Happy Birthday, Admiral

CSEd Week

HOUR OF CODE

Computer Science Education Week (www.csedweek.org), was 5-11 December this year. "Celebrating Progress" was the theme.

Since 2009, CSEdWeek has been raising awareness of the need to elevate computer science education, and inspiring K-12 students to learn it.

It's celebrated each year during the week of the late Navy Rear Admiral Grace Hopper's birthday (9 December 1906). She was an early computer pioneer who helped develop the UNIVAC I computer and one of the first COBOL compilers (earning her the nickname "Grandma COBOL").

She also pioneered "debugging" when she found an actual moth in the relays of a malfunctioning Mark II computer in 1947.

She liked to hand out *nanoseconds* (one billionth of a second)—pieces of wire 11.8 inches (30 cm) long—the distance that light travels in one nanosecond.

Hour of Code® is a nationwide initiative by www.code.org to introduce millions of students to one hour of computer science and computer programming. Technically held during CSEdWeek, their online coding activities at www.hourofcode.com can be done anytime!

Mission to Mars

For Fifth Graders

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

Facts, Exhibits, and Opportunities

Fact: Dr. Larry Crumpler, Research Curator for Volcanology and Space Science at the *New Mexico Museum of Natural History and Science* (NMHS), is a member of NASA's Mars Exploration Rover science team.

Fact: Thanks to Dr. Crumpler, we have an opportunity to see *life-size replicas* of the Mars *Perseverance* rover and *Ingenuity* helicopter at an NMHS exhibit, now through 5 June 2023.

"I figured being at a museum and a member of the actual science team, of all places, we should have it," he said.

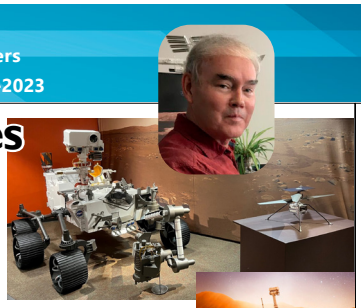
$8 adults, $7 seniors and youth, $5 children ages 3-12, *free* for children under age 2. See www.nmnaturalhistory.org.

For more Mars *Perseverance* news, see www.space.com.

Fact: In 2003, twin rovers *Spirit* and *Opportunity* launched to Mars on what was expected to be a three-month mission.

Fact: They both lasted long past 90 days; Opportunity in particular continued roving for nearly *15 years*.

Fact: In the same *spirit*, we now have the *opportunity* to follow the inspirational journey of *Spirit* and *Opportunity*, and their devoted team of humans back on Earth, through Oppy's final goodbye in 2018. Ryan White's documentary *Good Night, Oppy* is now streaming on Amazon Prime!



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

Fact: It's going to be rather hard to breathe over there, unless some kind of Air Supply life support system is taken along.

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

Start SAGAs

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

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

Your commitment to this mission is crucial to its success

Patch Psyche

Not to psyche you out or anything, but did you know that since *Gemini 5*, all NASA manned space missions have had *mission patches* representing the mission and the crew?

Students will put some thought into the design of *their* Link-Up Day mission patch.

Patch components include: Mission name (*Mars Exploration and Transmission Laser (METL) Mission)*, crew names, life support system, flags/colors symbolizing mission participants, and patch shape and size.

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

Dropping Data Like an Egg

In TECH Mission Day 3, students drop data like it was an egg falling off a two-story balcony.

For starters, students analyze and graph the motion and atmospheric data acquired during their rocket's flight on TECH Mission Day 2.

They analyze data points like *wind speed, maximum altitude, range* (distance travelled from the launch pad), time to *apogee* (the highest point of the flight), and time to *landing*.

Then, students drop in the original *RockSim* computer simulation data they made on Day 1, and compare.

They don't have to figure out how many angels fit on the head of a pin, but if they take the *center of gravity* into account, they can balance many nails on the head of just one!

We point out that for stable rocket flight, the *center of gravity* must be above the *center of pressure*. Increasing stability means adding weight to the nose, or increasing the fin area.

We drop some Newton's Laws of Motion, such as Equal and Opposite Reaction, on the students, and show them how they apply to the rocket launches. The students test that law by pushing Vernier Force Plates into each other and watching the graphs of the forces prove equal and opposite reaction.

Things get more dynamic when they put Newton to the test with *Human Dynamics Carts*.

They also drop some eggs off a two-story balcony like they were collecting some data, too.

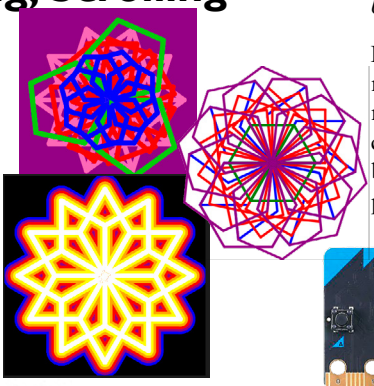
By the Tuesday of the week before the first class in the series, session, or semester, we will ask you for the name, driver's license number/state of issue, date of birth, and the FULL Social Security Number, of every adult coming through the base gate for that series of classes.

Robotics Challenge For Middle Schoolers

Looping, Flashing, Scrolling

As Robotics Challenge **Module 1,** *Intro to Programming*, wraps up, students are looping for joy using *Python*.

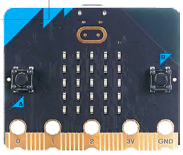
Specifically, the final challenge in Module 1 asks them to create a *mosaic* using four different polygons and four different colors, using nothing but their Python "for" and "nesting" loop programming skills...*and a turtle*.



A *virtual* turtle, anyway. It's too hard to get *real* turtles to hold a magic marker in their foot.

Now that they've gotten the hang of some basic Python programming, the students are ready to move on to **Module 2,** *Using the micro:bit.*

Have you ever *seen* one of these micro:bit things? The micro:bit is not very big...about the size of a couple of postage stamps...but it's basically got an entire *computer* packed onto it!



It's got two input buttons, a touch sensor that doubles as a *third* button, a 5x5 LED/light sensor grid, a radio and Bluetooth antenna, a compass, an accelerometer, and more! They're pretty flashy.

How flashy? Well, once students write the appropriate Python code, they can flash it to the micro:bit in a flash, to make the LED grid flash several different images on it!

Then they can use Python's *display.scroll()* function to scroll messages and images *across* the little LED screen!

Questions? Suggestions? Don't just sit there scrolling along! Contact lynn@afrlnewmexico.com!

STEM Challenge For High Schoolers

Payload Protection Design

Suggested Timeline: Dec/Jan

Flying through the air to land on a target 30 feet away? 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, and select three of them to examine more closely. They write a description of the three approaches, including their sources.

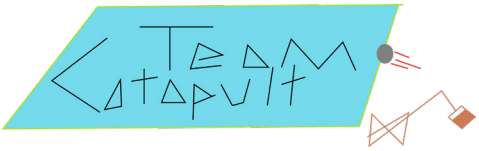
What are their similarities and differences? Does one seem better suited to the design problems your team is experiencing? Can any approaches be combined?

Then, teams create a **design** plan, including a **sketch** or diagram. Why this design? How big is it? Will it work with the launching device?

Look! Logos!

Team 29—TGC

Team 32—Fling Kings



Team 28—Team Catapult

Team 30—Infinite Sum

DoD STARBASE NM For Fifth Graders

Double Trouble

Pud was sitting around one day chewing his *Dubble Bubble* bubble gum, and suddenly he had a thought: Is chewing gum an *exothermic* or *endothermic* chemical reaction?

See, Pud knew a thing or two about STEM, so he knew that chemical reactions break apart *molecules*, which takes *energy*.

Some reactions take a *lot* of energy to break apart the molecules, taking heat *away* from the environment and leaving it *cooler (endothermic).* Some reactions take *less* energy to break apart the molecules; leftover heat is transferred *to* the environment, making it *hotter (exothermic).*

It turns out, chewing a piece of gum creates a *cooling* sensation because the sweeteners absorb heat as they dissolve; thus, chewing gum is *endothermic.*

Students in DoD STARBASE NM Day 4—Chemistry, go to the trouble of creating endo- and

exothermic chemical reactions on substances such as hydrogen peroxide, and vinegar and baking soda, to make things like Elephant Toothpaste and little volcanoes, in a *Double Bubble Trouble* activity.

Those are *chemical* changes. AFRL cryogenics experts demonstrate the *physical changes* that occur when objects like marshmallows and balloons are dunked in very cold liquid nitrogen.

For example, the gaseous oxygen in an inflated balloon gets so cold it *changes state* (without even notifying the post office!) and turns into *liquid oxygen* inside the balloon... until it warms back up again.

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YouTube Channel:
https://www.youtube.com/channel/UC-QuOSd1XTkYuXPONZwlAIHQ/videos

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

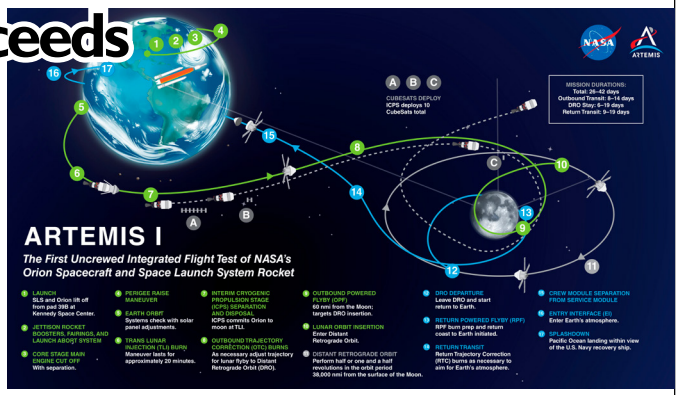
USAF: United States Air Force

USSF: United States Space Force

Remember, Teachers:
Get those EPA Modification forms in!

STEM Bytes

Artemis Succeeds



NASA's *Artemis 1* mission recently completed a successful unmanned test of the Space Launch System (SLS) and Orion capsule.

Artemis launched on 16 November 2022, then entered a Distant Retrograde Orbit around the moon (setting a new distance record for crew-rated spacecraft).

It returned to Earth and splashed down on 11 December 2022, exactly 50 years to the day since the last time astronauts landed and walked on the moon, during 1972's Apollo 17 mission.

It took several *easter eggs* with it, including the binary code for the number "18" (a reference to the number following Apollo 17), tributes to a couple of Orion development crew who had passed away during development, the country codes for countries that helped develop it, and the letters "CBAGF," which are the musical notes at the beginning of Frank Sinatra's famous hit, "Fly Me To the Moon."

See www.space.com.

SKA Starts

Not the jazzy reggae sound...SKA stands for the Square Kilometer Array, the world's largest radio telescope array (it'll actually be more like half a square kilometer in size.)

Construction on SKA has now started in Australia. Like JWST, it'll examine some of the earliest light in the universe, but in the longer *radio* wavelengths instead of infrared-ish ones.

Scholar Deadline

Applications for summer 2023 internships are being accepted through 10 January 2023.

See https://afrlscholars.usra.edu/.

ATYS Awarded

Leanne Fan, an eighth grader from San Diego, was recently named *America's Top Young Scientist* by the 3M company. She invented a low-cost set of headphones that detects and treats mid-ear infections in children.

"Every year, over 10 percent of the world's population experiences a mid-ear infection," she says, most of whom are children or underprivileged people who might not have access to adequate healthcare.

She calls her invention "Finsen Headphones" after Niels Finsen, the Nobel Prize winner who discovered that ultraviolet light can help treat bacterial infections.

Oh, and her Finsen Headphones? Yeah, they can play music, too.

Coming Next Issue...

- MM Colony Location
- Eggs Drop
- DoD STARBASE Day 5
- Happy New Year!.

Watch for it!