Inspiring Future Scientists and Engineers

AFRL NM STEM Academy

Star Date: November 2020
Volume XVIII, Issue 3

AFRL
THE AIR FORCE RESEARCH LABORATORY
LEAD | DISCOVER | DEVELOP | DELIVER

In partnership with:

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

Collaborator:

DoD STARBASE
A Department of Defense Youth Program

Reserving school buses for our activities will only be necessary if and when classes resume in our facility on base.

Thank You, Veterans

Thank You, STEM

Happy Thanksgiving

The Rocket Report

A Lot to Be Thankful For

Thanksgiving is this month, and *boy*, do we have a lot to be thankful for this year!

First of all, we're all probably a little extra thankful that 2020 is almost over! *AmIright?*

Veteran's Day was earlier this month, and we're eternally grateful for our veterans and everything they do for us.

We're indescribably thankful for the extra time and effort all the teachers, parents, and students are putting in during these unusual times to help keep our students educated and active in STEM.

DoD STARBASE Day 3 is all about technology, and we're very grateful for the technology that has enabled us all to stay connected this year: Computers, smartphones, Zoom, Google Meet, Internet, WiFi, and other technologies have helped us all get through some recent challenges.

Mentors like AFRL's Dr. Jake Grosek have helped us navigate virtual STEM outreach by sharing their expertise online with students, in events like the Mission to Mars Expert Talks, which started this month. Our gratitude is boundless to great mentors like these.

A binary math game, a Mars Saga video with Cmdr. Andromeda, a new Paper Hex-Sat, a redesigned Paper Circuit for Astro...thanks for everything, Papa Cupcake!

And, as always, we're thankful for STEM: Stuffing, Turkey, and Everything Munchable!

Mission to Mars *For Fifth Graders*

Mars Hovering Observational Planetary Exploration System (HOPES) Mission 2020-2021

Hour of Power

Actually, it was more like *two* hours of power, when the first of a planned series of Mission to Mars "Expert Talks" premiered on 17 November 2020.

An Expert Talk is an online presentation by an AFRL scientist or engineer, to explain their work to students and how it might apply to engineering design, space vehicles, and space travel.

Mission to Mars students can use the information they learn to help them complete mission tasks such as designing their life support system and/or habitats.

Dr. Jake Grosek, a Computational Physicist with the Laser division of AFRL/DE, kicked off the Expert Talks with a powerful presentation on "The Engineering Design Process and Power Generation Considerations."

He described the Engineering Design loop, and methods and risks/benefits Martian astronauts might consider for generating the approximately 40 kilowatts of power per person they'd need. Example methods included Wind, Solar, Geothermal, and Nuclear.

WELCOME to Mission to Mars Expert Talks

THANK YOU!

Next Expert Talk scheduled for 1 December 2020!

Jake Grosek
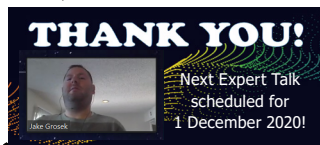
Where Are We?

One of the first items in the Mission Journal asks students to figure out their colony location on Mars.
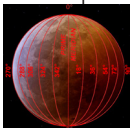
Clicking on the Mars Colony Location button in the Mission to Mars section of our website (www.afrlnm.com/stem), we see that the colony is located near where a lake once may have been, and some ice may be hiding in nearby craters.

How do we know this? Bingo! *Pingos*, little mounds of ice, appear to be there.

To get a more precise location will require some latitude and longitude math, and ASCII decoding skills.

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

DoD STARBASE NM
For Fifth Graders

Paper Moon

*Say, it's only a paper moon
Over cardboard and LED's
Makin' 'em glow ain't make-believe
With Paper Circuit technology*

Have you heard the news currently going around the circuit? It's in all the papers. Thanks to technology, it seems electricity is making an out-of-this-world comeback.

Especially if the *circuit* is made from a material that acts as a good *conductor*, such as copper wire, as opposed to an *insulator*.

Technology

Technology, the focus of DoD STARBASE NM Day 3, is anything created by humans to solve problems and make life easier.

And that's good news for our friend Astro the Alien.

Astro's trying to get back to his home planet in his paper spaceship, but it's too dark out in space. He wanted to turn on his lights, but he discovered they won't light up because paper is a better insula-tor than a conductor. Electricity (which is just electrons jumping from one atom to another) doesn't flow through it very well.

DoD STARBASE students and Paper Circuit technology to the rescue!

Using materials from their STEM kits, the students draw Astro in his spaceship. They add light emitting diodes (LEDs), a paper copper wire circuit, and a battery. When they *close the circuit*, the LEDs light up, and Astro can go home!
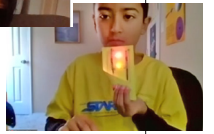
The rumor going around the circuit is, famed superhero Papa Cupcake may even have designed an improved spaceship model for next semester!

Students in Day 3 also test insulators and conductors to see which make a glow-ball glow better.

Say, it's only a glow-ball moon...

TECH Mission
For Middle Schoolers
Technology and Engineering Challenges—Satellites Mission

Wax On, Wax Off

Now that *Cobra Kai* is all the rage on Netflix, it's a good time to wax nostalgic about the classic 1984 film it's based on, *Karate Kid*.

In the movie, student Daniel LaRusso is learning karate techniques from his mentor, Mr. Miyagi. To demonstrate the hand movements Mr. Miyagi wants Daniel to make, he shows him a two-handed method for waxing his car. *"Wax on, wax off,"* he says.

It was a good lesson in *karate binary*. The wax was either being put on, or taken off.

In much the same way, but with less karate, Papa Cupcake is mentoring the TECH mission students in *binary math*. When students go to the TECH Mission page of our www.afrlnm.com/stem website,

they can play the interactive *Papa Cupcake Binary Game*.

Students enter a target number at the top of the screen, then turn the corresponding checkboxes below on or off, 1 or 0. This creates the equivalent number in base 2, or *binary*.

Light *also* works in binary, be-

cause lights can be turned either on or off, as well. TECH Mission students explore the properties of light with activities such as looking at colored lights through a *diffraction grating*, and seeing whether a colored light is *reflected* or *absorbed* by similarly-colored M&Ms, to aid in sorting them.

Mmmmmmm!
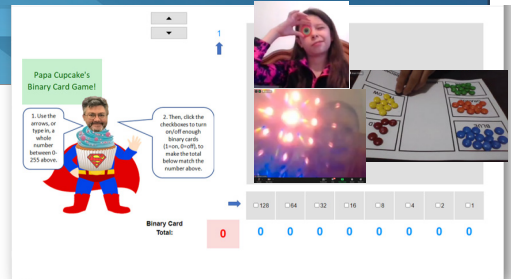
Robotics Challenge
For Middle Schoolers

Look, Ma, No Teeth

How many people grew up playing with a *Spirograph*?

It's a toy developed by British engineer Denys Fisher and first sold in 1965. It involves round or oddly-shaped small

plastic gears with small holes in them.

The idea is, on a sheet of paper, you place the gear inside a larger plastic ring, and put a ballpoint pen in one of the little holes. Little teeth on the outer edge of the gear correspond to little teeth on the inside of the ring.

Using the pen to rotate the gear around the inside of the ring, you end up drawing mathematical roulette curves known

as *hypotrochoids* and *epitrochoids*. Basically, you make some cool-looking flowery loop patterns.

Anyone who has used one knows: The frustrating thing about Spirograph is that sometimes the gearteeth slip, which can mess up your drawing.

The third assignment in Module 1 of the Robotics Challenge involves programming computerized turtles in Python to draw Spirograph-like geometric patterns, using for-next loops instead of ballpoint pens.

But the best part of all: Virtual turtles have no teeth, so they never slip!

In the *next* module, students cut their teeth on micro:bit pocket-sized codeable computers with motion detection, a built-in compass, and Bluetooth technology...oh, and Bluetooth-teeth (Blueteeth?) don't slip, either!

AFRL NEW MEXICO STEM OUTREACH

AFRL NM STEM Academy
PO Box 9556
Albuquerque, NM 87119

(505) 846-8042

AFRL.RDMX.NMSTEMOutreach@us.af.mil

Website:
www.afrlnm.com/stem

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

KAFB: Kirtland Air Force Base, Albuquerque, NM

HOPES: Mars Hovering Observational Planetary Exploration System 2020-2021

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

Remember, Teachers:
Get those EPA Modification forms in!

STEAM-Powered Satellites, Brother!

Big Brothers Big Sisters (BBBS) of Central New Mexico's STEAM Discovery Festival is an annual event where exhibitors in STEAM ("artsy STEM") fields interact with students to promote STEAM education and job opportunities.

Last year's festival featured 50+ exhibits, and nearly 3,000 students from elementary to high school age.

Due to Covid, the event was 100% virtual this year, and has had over 5,000 students participating.

The 2020 STEAM Discovery Festival, running 2-24 November, has included interactive videos from exhibitors, a virtual science fair where students can submit projects, and a special section called College Row, where colleges have virtual booths, interact with and recruit students, give a virtual college tour, and much more.

One such exhibitor was AFRL NM's Matt Fetrow, who gave a *great* presentation called *Satellites: Velocity Victors!*

(To see it on YouTube, go to www.discoveryfestnm.org/exhibit-hall and click on the calendar link under November 17.)

It was called "Velocity Victors" because to get a satellite into

orbit, it has to build up a good head of *steam*...over 17,000 miles per hour. He discussed various satellites big and small that AFRL has worked on, how satellites are similar to smartphones, the different orbits satellites take, and even used a familiar-looking paper HexSat as a model! We sent out 560 HexSat kits for 538 "Velocity Victors!" students and 22 teachers.

Scholar Place

The AFRL Scholars Program is an internship program to provide upper-level high school, undergraduate, and graduate students, and professional educators, with opportunities to pursue research interests and develop professional skills while increasing the diversity of the STEM workforce.

Applications for summer 2021 internships are now being accepted through 12 January 2021.

See https://afrlscholars.usra.edu/.
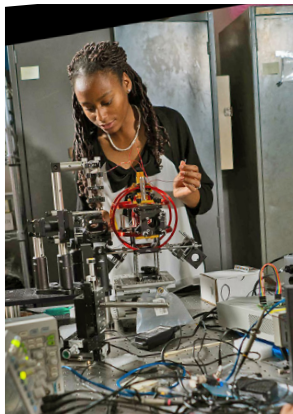
Quantum Base 2

Student Jonathan Gutierrez recently signed up for a free online Introduction to Quantum Computing course (www.qubitbyqubit.org).

He discovered he already understood the binary math section, thanks to participation in programs such as TECH Mission and Robotics Challenge!

Poster Space

Mission to Mars teachers:

Cool Mars Explorers Wanted and Visions of the Future posters are available for FREE download from NASA and JPL*:*

https://mars.nasa.gov/multimedia/resources/mars-posters-explorers-wanted/ and https://www.jpl.nasa.gov/visions-of-the-future/.

Space News

On 16 November 2020, SpaceX's "Resilience" capsule docked autonomously at the International Space Station (ISS), having just flown four astronauts there. It's the first time a private company has flown astronauts to the ISS.

Virgin Galactic was planning to make history of its own this month with its *VSS Unity* launch from Spaceport America, but it has been delayed due to Covid restrictions. It would be the first space launch to ever initiate from New Mexico.

NASA's OSIRIS-REx has discovered the Bennu asteroid is *hollow*. See www.space.com.

Coming Next Issue...

- Mission Patch, Mars Facts, and Special Guests Sing Sagas
- News, Info, Fun.. and Holidays!

Watch for it!