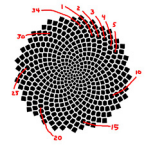
AFRL
NEW MEXICO STEM OUTREACH

Inspiring Future Scientists and Engineers

AFRL NM STEM ACADEMY

Star Date: March 2021
Volume XVIII, Issue 7

The Rocket Report



Sunflowers, STEM Powers

March Mathness! Spring zings into being this month, bringing math and STEM with it!

March 14 is a special day every year for math and science geeks. It's the birthday of late physicist Albert Einstein. It's also known as "Pi Day," after the famous Greek letter π—the ratio of a circle's circumference to its diameter. Why? Because it's about 3.14 (get it? 3/14?)

The digits after the decimal place keep going...As of 2019, it's been calculated out to at least 31 *trillion* (31,415,926,535,897) digits.

Sunflowers tend to bloom in summer, but our newest STARBASE assistant, Ms. Claudia "Sunflower" (her favorite flower!) Lemus-Garcia, will be blooming this *spring*, assisting our DoD STARBASE NM classes.

"My goal has always been to teach or be a part of a class setting," she says. "I am super excited to join STARBASE because I get everything I love in one place! Watching kids expand their knowledge and creativity, all while assisting alongside some great instructors!"

Sunflowers contain the seeds of mathness, too. The seed spirals are always a *Fibonacci number*, the sum of the previous two (0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55…), with a *Golden Ratio* of **φ** (Phi), 1.618, between diameters of each rotation. Pi and Phi in one month! It'th *mathness*, I tell you!

Students can increase their STEM powers with our classes and activities like the Mission to Mars Link-Up Day and the Robotics Challenge Expo coming up this spring.

In This Issue...

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.

Mission to Mars

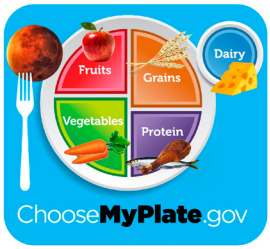
For Fifth Graders

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

Lunch on Mars

Think Guy Fieri's gonna tell you where the best Diners, Drive-Ins, and Dives are on Mars? There *aren't* any.

When planning Lunch on Mars, it's not a pyramid scheme...but do consider the *food pyramid*.



Weight Watchers: Take *less than 20 oz.* of food, including at least 8 oz. of liquid. The container? *Less than 2 oz.* Try a 1-gallon ziplock bag!

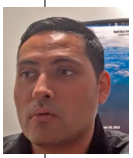
Waste not, want not: After your meal, the weight of your waste should be less than the weight of your waist: *Under 2 oz.*

Visit the Lunch on Mars section of our website for planning guidelines and a helpful video.

Rosy Outlook

That which we call a rose, by any *older* name, in Latin, would be called *rosa*. That which we call ROSA, by any other name, would be called *Roll-Out Solar Array*.

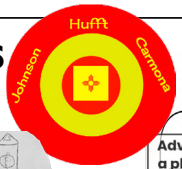
ROSA is an AFRL-designed flexible solar array for space vehicles, a possibly rosy power source on the journey to Mars!

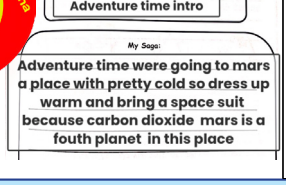


Mr. Ben Urioste, AFRL Mechanical Engineer, rolled out his Expert Talk 25 February 2021. He discussed satellite launch and payload structures, like rockets and ROSA. He even gave a step-by-step array of tips for getting a STEM degree! See afrlnm.com/stem/expert-talks.

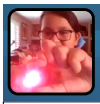
Submissions

Sagas, mission patches, habitat designs...





Your commitment to this mission is crucial to its success



DoD STARBASE NM

For Fifth Graders

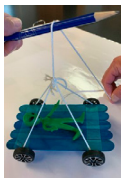
Spring's Got Potential

Spring is in the air! Spring in DoD STARBASE Day 2 has a lot of potential for STEM...and compressing a *spring* gives it a lot of *potential energy!*

Physics

Here's the hook: Hooke's Law, $F=-kx$, describes the *potential energy* you get when you compress a spring. F is the force it took to compress it, x how much the spring was compressed, and $-k$ is the stiffness of the spring.

When Spring is sprung, flowers bloom, but when a *spring* is sprung, *sproing!* All that *potential* energy transfers into *kinetic*, or *motion*, energy!

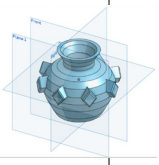


Day 2 students use the Engineering Design Process to work on making some *simple machines* like a marshmallow catapult, a small wheel and axle cart, and a little pulley elevator. Simple, maybe, but they can do some *work* (using *force* to move things over a *distance*).

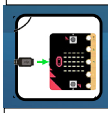
Students also explore potentially rescuing Astro the Alien. His spaceship broke, so students make more complex three-step Rube Goldberg machines that transfer enough energy back and forth between *potential* and *kinetic* to help get Astro off the astroturf.

2.0 Shaping Up

Marble madness! Twenty-eight gifted students from Albuquerque School of Excellence (ASE) have been springing into action, using PTC's web-based *Onshape* Computer Aided Design (CAD) program to design/improve a Marble Launcher game.



Students have been learning Onshape by making lots of *virtual objects:* Desk name plates, vases, mugs, marble launchers, and game targets.



TECH Mission

For Middle Schoolers

Technology and Engineering Challenges—Satellites Mission

Now We're Talking

Once upon a time, making man-made satellites was a very expensive, slow, labor-intensive ordeal. Each satellite was custom designed and built from scratch.

Until one day, the Space Vehicles Directorate of AFRL came up with the idea of *plug-and-play* satellite design. Similar to the way we plug and unplug different accessories into a computer's USB port, we can plug and unplug different components like cameras and sensors into a satellite frame like so many LEGOs.

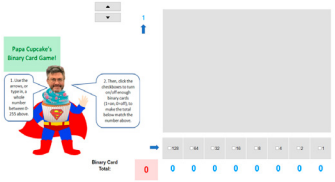
Now we're talking! Designing and building satellites became much faster, easier, and less expensive.

TECH Mission students may have found an even faster and cheaper way than *that*, however. Using a folding paper satellite design, students are able to build small paper satellites in record time, with a "place flap A into slot B" type of approach. Now we're *really* talking!

But once a satellite gets into orbit, how is it going to send all the data it collects back to Earth? *Binary.*

Say a satellite camera takes a picture. If it's a *digital* picture, the picture is converted into *binary digit data* (ones and zeros).

Now we're talking...to Earth! The satellite can electronically transmit the binary data to the surface, to be reconstructed back into a picture.



TECH students explore binary numbers virtually, using Papa Cupcake's Binary Card Game.

Students, satellites, and STEM? *Now* we're talking!

Robotics Challenge

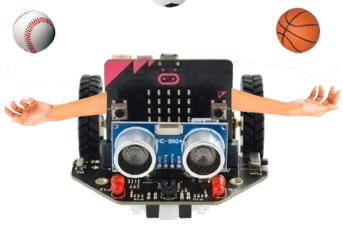
For Middle Schoolers

March Madness

A call to arms! One senses it's time for good robots to toe the line, as March Madness has sprung upon the Robotics Challenge.

Assignments

Assignment 10 has students juggling the tasks of writing a program to control a *servo* attached to their Maqueen robot, creating an *arm or other tool* that will *use the servo to move an object*, and recording a video of it doing so.



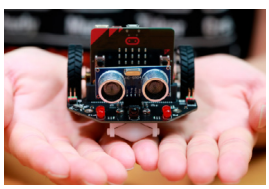
Assignment 11 has students making a video of the robot using the *line sensor* to follow the line course.

What was that? I said, **Assignment 12** has students WRITE a PROGRAM that enables the robot to USE the ULTRASONIC SENSOR to AVOID OBJECTS. The robot must stop or change course when an object is placed in front of it. Film it, placing and removing the object enough times to show the robot is actually *using* the ultrasonic sensor to detect objects in the video.

Expo

And all of *that* is just the spring training for the virtual Robotics Challenge Expo, which opened this month. Expo assignments will feature *more* complex and fun challenges, requiring application of students' Robotics Challenge knowledge and skills. Expo assignments may only be submitted once.

Expo challenges include a *Light Sensor Spin*, a *Clear the Circle* challenge, a *T Ball* challenge, and a *Performance* section. First, second, and third place winners will be announced during the Expo awards ceremony in April.



Mini STEM Challenge, Major STEM Progress

Given the current educational environment during the pandemic, we opted for a mini STEM Challenge Mission this semester.

In the STEM Challenge mission, students design and build a remotely operated catapult that can safely propel an egg payload consistently and accurately through a vertically positioned hula hoop and land safely on a target 30' away. Here's an update on just how egg-zactly it's going:

For a mini STEM Challenge, the four participating teams from La Academia de Esperanza (LADE):

Team 1: Eggstraveggent
Team 2: Team Lightning
Team 3: Los Huevos
Team 4: The Unbreakable Shelly

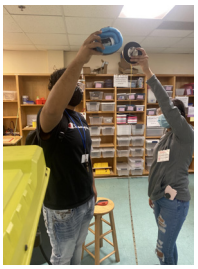
are making *major* progress!

So far, they have built the catapult, characterized its precision and accuracy, and found a trajectory that the hacky sack (the "test egg") follows so they know where to put the hula hoop.

They have also researched payload protection devices, decided on a design for their own device, and built several prototypes.

The drop and toss tests have gone well as far as keeping the egg intact.

However, many teams are struggling with how to prevent the device from rolling upon landing. But that's just how we roll around here.



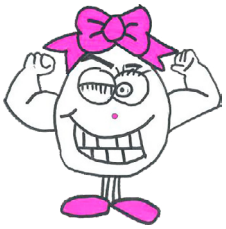
Finally, most teams have used the data they've been collecting to calculate the *launch velocity* of their catapult!

How's *that* for egg-citing?

Team 1: Eggstraveggent

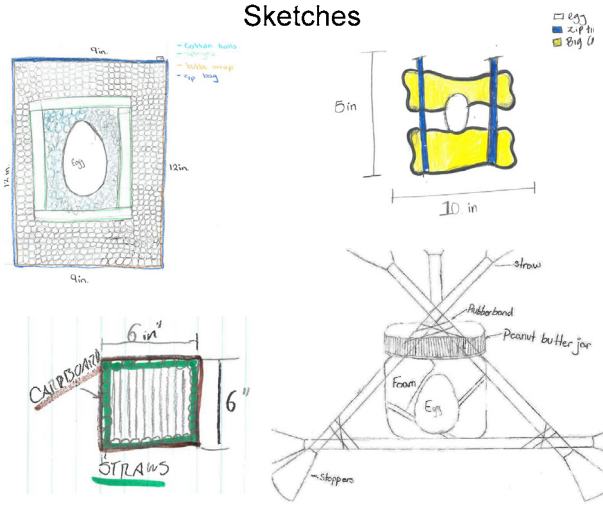
Team 2: Team Lightning

Team 3: Los Huevos

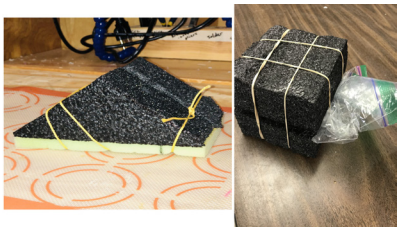


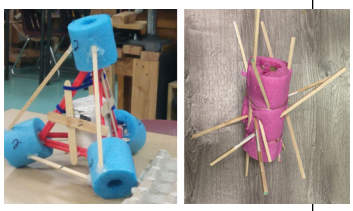
Team 4: The Unbreakable Shelly

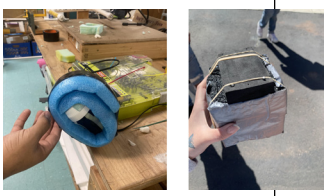
Payload Protection Device Sketches



Payload Protection Devices

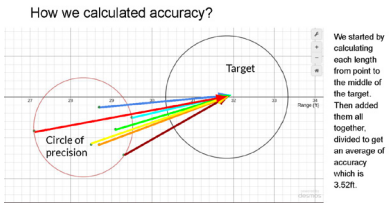


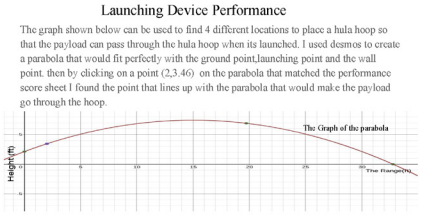




Launching Devices

Data Slides





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

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

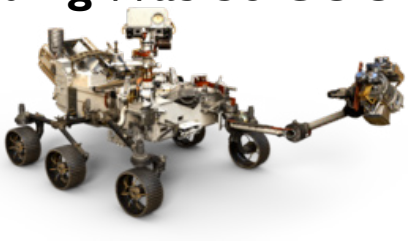
TECH: Technology and Engineering Challenges

USAF: United States Air Force

Remember, Teachers:
Get those EPA Modification forms in!

STEM Bytes

Why Percy's Landing Was So COOL



NASA's Mars Perseverence Rover, known as "Percy" to his friends, successfully landed on Mars 18 February 2021, to search for evidence of current and past Martian life, plus collect samples and test oxygen production from the Martian atmosphere.

Why is this such a cool feat? Well, first of all, because how many extraterrestrial craft do *you* know that have a cool nickname like "Percy?"

Here are some other reasons why this event is so cool.

Bulls-Eye

They say landing a rover in Jezero Crater from Earth is a little like throwing a dart in Washington DC and hitting the bulls-eye in Dallas, TX.

To land, it had to decelerate from over 12,000 mph to about 2 mph in less than 10 minutes. It used a new technique, taking pictures and correcting itself on the way down.

And Percy Makes 3

Percy is already making tracks, and it's the *third* NASA vehicle active on the surface of Mars right now, along with the *Curiosity* rover and *Insight* lander.

It's also the third of three successful missions to Mars within a few weeks of each other. **UAE's Hope Orbiter** mission entered Martian orbit on 9 February 2021, and **China's Tianwen-1 Orbiter/Lander/Rover** orbiter entered orbit 10 February 2021.

Ingenuity

Percy brought with him the solar system's very first experimental extraterrestrial helicopter, named *Ingenuity*.

NASA says Percy landed right on the edge of a nice, flat area that might make an ideal helicopter landing strip, too.

Percy Speaks Navajo

Percy's team is working with the Navajo (Diné) Nation to name Martian features of scientific interest with words in the Navajo language.

The first scientific focus of NASA's Perseverance rover is a rock named "Máaz" – the Navajo word for "Mars."

It's Trackable

You can follow the progress of Percy as it drives around on Mars on an online map, updated daily, at https://mars.nasa.gov/mars2020/mission/where-is-the-rover/.

See www.space.com.

Women in (STEM) History Month

Did you know? March is Women's History Month. Here are some women who have made their mark in STEM history.

A Star is Born

When the Mars Perseverance Rover landed last month, the calm, assured female voice narrating the journey to us on the live video belonged to none other than **Dr. Swati Mohan**.

She is an Indian-American aerospace engineer who became interested in space watching *Star Trek* at age 9, and by the age of 16 was taking Physics and studying engineering to pursue a career in space exploration.

Before she even said, "Touchdown is confirmed," Dr. Mohan was already trending on social media, and is now considered a STEM role model to young women everywhere.

It's No Illusion

Ms. Valerie Thomas, NASA scientist and inventor, is probably most famous for her *illusion transmitter*, still used by NASA and adapted for use in surgery and the production of television and video screens.

She also managed the *Landsat* program, the longest-running program for acquiring satellite imagery of Earth.

Something Spooky

Wanna hear something spooky? The 6.5 meter James Webb Space Telescope, replacing the smaller 2.4 meter Hubble Space Telescope as NASA's flagship astrophysics mission, was most recently scheduled to launch *this month*...

...But the launch date was pushed back again recently. The new launch date? Scheduled for 31 October 2021—*Halloween*.

Coming Next Issue...

- Virtual MM LUD info
- DoDSB Technology
- TECH Mission Light
- Robotics Expo Deets

Watch for it!