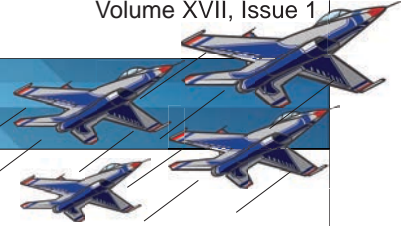




## The Rocket Report



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## Gen Bunch Spouse Tour

Ms. Caroline Bunch, wife of Gen Arnold W. Bunch, Jr., Commander, Air Force Materiel Command, toured our facility on 9 September 2019. She observed fifth grade Dolores Gonzales Elementary students engaged in a CO<sub>2</sub> race-car activity in DoD STARBASE NM Day 2.



shuttles and seltzer-tablet rockets, raced CO<sub>2</sub> cars that really *flew* down the track...and put on a virtual airshow of their own on flight simulators.

### Summer STEM Space Camp



From 17-21 June 2019, we conducted a Summer STEM Space Camp for rising 3rd and 4th graders. Students programmed robot mice to get plastic cheese, went on a solar system scavenger hunt, explored the physics of building towers out of spaghetti and marshmallows; took wing at an astronaut fitness camp, and helped program a Lego Mindstorm® robotic moon rover to avoid falling into craters.

### Mid-High Robotics Camp



From 17-20 June 2019, we conducted a Mid-High Camp. Participating students stayed in formation programming various robots including Ozobots, Sphero Robots, Boe-Bots, and even their fellow students substituting for the robots.

*Continued on page 4*

## The Summer Just Flew By

We had so much fun, and STEM, this summer, the weeks just *flew* by, like a pack of red, white, and blue F-16's in Diamond formation.

laser cutter machine demonstrating how to make light work!

### TAI Aviation Camp



From 3-9 June 2019, we were flying high! We hosted the annual Tuskegee Airmen Inc. (TAI) Youth Aviation Camp, and it's plain the planes were not plain. Participating students learned about the history of the Tuskegee Airmen; explored STEM concepts related to flight; and flew, with an instructor, in actual Civil Air Patrol Cessna airplanes.

### DoD STARBASE NM Summer STEM Camp



From 10-14 June 2019, we conducted a DoD STARBASE NM Summer STEM Camp for rising 5th and 6th graders. Students flew crash-landing Eggbert moon

### Kirtland Air and Space Fiesta STEM Hangar

Kirtland AFB held an excellent Air and Space Fiesta, with over 45,000 attendees, on 18 May 2019 ([www.kirtland.af.mil/Home/Kirtland-Air-and-Space-Fiesta](http://www.kirtland.af.mil/Home/Kirtland-Air-and-Space-Fiesta)).

Outside, there was an impressive airshow, including *Wings of Blue* parachuters, V-22 Osprey tilt-rotor plane/helicopters, wing walkers, biplanes, stunt planes, and of course, the flying prowess of the F-16 *Thunderbirds*!



Inside the STEM and Space Pavilion hangar, there were technical booths, games, and demonstrations from AFRL and other organizations. AFRL's activities included hands-on GPS satellite trilateration and virtual GPS satellite launching activities, and a



In partnership with:



Collaborator:



### Remember, Teachers:

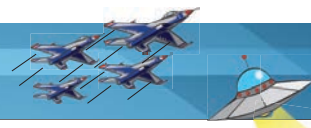
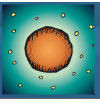
It's never too early to make bussing arrangements for our classes and events!



## AFRL NM STEM ACADEMY



### THUNDERING INTO A NEW SCHOOL YEAR



## OK, Mars...Let's Run 'Em Up!

### New Teachers

New Mission to Mars teachers sometimes look like a deer in alien headlights. There's just so much information to learn!

But don't worry, we'll make sure you're *up to the challenge!* There's a full-day (8:30 am to 3:00 pm) **mandatory in-person** training for new teachers like you on **Tuesday, 29 October 2019.**

We'll give you instructions and tips on doing the Mission to Mars with your students, and on how to prepare for the big Link-Up Day event at the end of the school year.

You'll get hands-on experience designing a *mission patch*, making a *life support system*, and building a *habitat*. This should make it easier for you to explain these processes to your students. You will also receive

a copy of the updated Mission to Mars manual.

The activities all align with Common Core, NGSS, and national standards, so don't worry, teachers, it will fit right in with your existing curriculum.

### Returning Teachers

Returning teachers, *welcome back!* You got this; it won't be that much of a *challenge*. So, there's a shorter (4:00 pm to 6:00 pm) **in-person** "refresher course" training



session on **Thursday, 26 September 2019,** just for you.

Or, you can take the *online* refresher training course anytime from **26 September to 29 October 2019!** You'll get an updated manual, too, online, unless you request a hard copy.

Going to Mars, like flying F-16s in Diamond formation, requires teamwork. So, like they say when launching the Thunderbirds... "Let's run 'em' up!"

## Going to Mars? Make Way For the Gateway

Have you heard the news? NASA has some ambitious plans for space travel in the works.

50 years ago, the *Apollo 11* mission put the first man on the moon. Now, NASA is working on the *Artemis* mission, which hopes to do that one better...put the first man *and woman* on the moon, specifically the lunar South Pole, by 2024. Tell your female students to start studying sci-

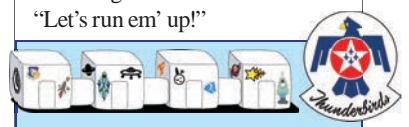
ence *now* if they want to join the female astronaut club!



To assist them, NASA wants to build a lunar *Gateway*--sort of a small space station orbiting the moon, with astronaut living quarters, laboratories for science and research, and docking ports for vis-

iting spacecraft. Astronauts can live and work there for up to three months at a time, conduct science experiments, and take trips to the surface. *Robotic* lunar missions can also use it as a base to refuel and resupply itself.

And *all of this* is to prepare for one thing: Our first manned mission to Mars! See [www.nasa.gov](http://www.nasa.gov).



- In any mission to space, or any Thunderbirds air show, **good teamwork is essential for survival**
- Each student impacts the **crew**; the crew impacts **many** crews from other schools
- Your **commitment** to this mission is crucial to its success



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.

## Vertigo? No...But Way to Go!

*Vertigo* is a sensation of spinning dizziness. It's also one of the companies that demonstrated their flying prowess ([www.vertigoairshows.com](http://www.vertigoairshows.com)) at the Kirtland Air and Space Fiesta last May.

One of Vertigo's showplanes has a rather salty name: The *Super Salto*. It performs like a *glider*... it sails along on air currents, performing a graceful aerial ballet using its long wings for lift.

When it needs to, though, it can kick in its jet engines and soar back up into the sky again! This is one trick space glider pilot Eggbert the egg, in Day 1 of DoD STARBASE NM, wishes *he* could do.

Eggbert's gliding towards a crash landing on the moon! He has no jet engine to scramble, and if

something isn't done to help, he's going to find *himself* scrambled into a lunar omelette.

Luckily, DoD STARBASE NM students are good eggs, and they're here to help.

Using the engineering design process, the students work in teams to "purchase" the materials they need to design a safety restraint system for poor Eggbert. Just like a real AFRL engineering team might do, they design and build a safety system for Eggbert that meets performance and operational requirements... "on time and under budget."

Eggbert's not spinning as he dives towards the moon, so no vertigo... but if he lands successfully, he might say, "*Way to go, students!*"

Day 1 students "measure up" in a



*Measuring Mass* activity. Teams identify four metal samples: Aluminum, Steel, Brass, and Copper, based on their masses as measured on a Triple Beam Balance.

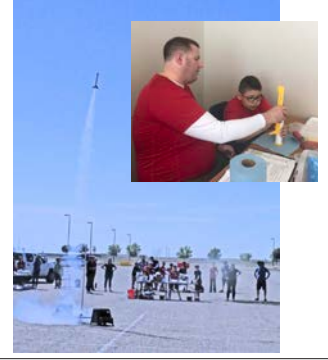
They also seek out new STEM, boldly going where no STARBASE students have gone before...on a *3D Scavenger Hunt*, looking for virtual hidden items on the PTC Creo® space plane, as an introduction to CAD software.



## Birds In The Sky

Yo, STARBASE 2.0 put on an air-show, too, you know...But the birds in the sky on 6 September 2019 were rockets, not airplanes.

Already the Albuquerque Institute for Math and Science (AIMS) STARBASE 2.0 students are building and launching rockets on their way to competing in the Team America Rocketry Challenge (TARC) competition.





# TECH Mission For Middle Schoolers

Technology and Engineering Challenges—Fall Rocketry and Spring Satellites Missions



## Two-Mode TECH



If you were fortunate enough to attend the Kirtland Air and Space Fiesta this year, you might have seen some interesting tech...a V-22 Osprey. It's an aviation technology that has two modes: Helicopter and Airplane. It takes off vertically, like a helicopter. Then, using its tilt-rotors, the dual propellers rotate forward 90 degrees...shifting it into "Airplane Mode."

The TECH Mission is another kind of TECH with two modes.

In the Fall semester, for three curriculum days, it's in "Rocketry Mode." In the Spring semester, using its "high-tech invisible tilt-rotors," it brings on a *new* batch of middle school classes, and shifts for three more curriculum days into "Satellite Technology Mode."

Right now, it's in *Rocketry Mode*. In Day 1, TECH Mission middle school students study basic rocketry principles such as *lift* and *thrust*, and then build four-foot rockets.

Students assemble the *booster tube*, *payload*, and *motor mount* sections of the rocket. They choose a name for their rocket from options such as *Gemini*, *Atlas*, *Phoenix*, and *Apollo*.

They also simulate its flight with a software program called *RockSim*. Day 1 students explore global positioning satellite (GPS) rocket tracking, and build *straw* rockets, too.

Day 2, currently scheduled for 22 October 2019, weather permitting, students will make the rockets take off vertically, *kind* of like a V-22 Osprey...but, lacking propellers or a tilt-rotor, they'll also try to get them to *land* vertically, by shifting into "Parachute Mode."

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

## Robot Pilots

Jacque Warda (Jacque B Airshows, [www.jacquebairshows.com](http://www.jacquebairshows.com)) piloted her two-seater Extra 300 propeller-driven stunt plane, doing some neat tricks, at the Kirtland Air and Space Fiesta in May.

On 16 August 2019, Robotics Challenge coaches attended the Coach Orientation session.

In addition to learning about the training materials for the various robotics activities on [www.coursesites.com](http://www.coursesites.com), they learned that we're piloting something "extra" this year, too. In addition to the



usual Boe-Bot robots, we're transitioning to a new model, called *cyber:bot*.

It's also a two-seater. The *cyber:bot* robot merges the Parallax small robot form factor with a *micro:bit* programmable micro-computer module. Like the Extra 300, it also has a *Propeller*: A multicore microcontroller co-processor for the *micro:bit*.



But most importantly, they learned about the *ten* new **assignment deadlines** for this school year:

- #1: 11 October 2019
- #2, #6: 17 January 2020
- #3: 22 November 2019
- #4, #5: 6 December 2019
- #7, #8: 7 February 2020
- #9, #10: 21 February 2020

Notice that the first due date—for the **team name and logo**—is *early next month*, 11 October 2019. Also, notice the new **Assignment 10: Projects!**

Last day to submit assignments: **Friday, 21 February 2020. No late assignments will be graded.**



The Robotics Challenge Expo is scheduled for **Friday, 20 March 2020!**

Speaking of airplanes and robot pilots, did you know that on 9 August this year, AFRL successfully tested a ROBOPilot flying a Cessna?

Not a drone, an actual robot pilot, holding and controlling the yoke and reading the dials like a real human pilot. See [www.newatlas.com](http://www.newatlas.com).

Hey, maybe *cyber:bot* will be next to fly! Better get programming!



# STEM Challenge For High Schoolers

## Where Dreams, and Eggs, Take Wing

Seriously, you should have gone to the Kirtland Air and Space Fiesta airshow, if you didn't. The STEM, the airplanes, and the flying were all egg-cellent!

One of the neat performances they scheduled for the airshow: Wing Walkers! Greg Sheldon ([www.gregsheltonairshows.com](http://www.gregsheltonairshows.com)) flew around on his 450 Super Stearman biplane, while his wife Ashley strolled around on the wings like it was no big deal.

Well, making an egg fly through a vertically-suspended hula hoop and land on a target 30 feet away, without making the egg break, is quite a stunt, too...but that's what STEM Challenge teams will be trying to do.

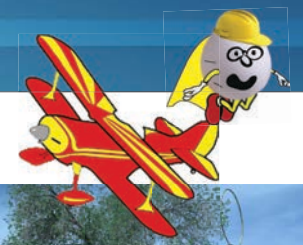
Their eggs may have to learn a little Wing-Walking, themselves.

But don't just wing it! Student teams should do the same thing that real-world scientists and engineers do: Use the Engineering

Design Process. Their dreams, and their eggs, should take wing high above the course.

The assignments include constructing a payload (egg) protection device, testing, making any necessary adjustments, and testing some more, to see how well they'll walk the line! Or the wing.

Student teams can get started making their team name and logo, the first assignment listed in the STEM Challenge area on [www.coursesites.com](http://www.coursesites.com), which is recommended for September/



October. All assignments must be submitted for scoring by 13 March 2020, prior to the **STEM Challenge Symposium**, scheduled for **7 April 2020**.

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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

**METS:** Mars Exoplanet Transient Satellite (METS) Mission 2019-2020

**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

## The Summer Just Flew By

*Continued from page 1*

### Science Fiesta at Expo NM



There's no other way to spin this... the Science Fiesta at Expo NM on 22 June 19 was an excellent display of STEM for visitors at our booth. Booth guests discovered hands-on "Why Spin Matters," and how it can be used in STEM.

A yo-yo spinning past a laser counter provided the approximate rotations per minute (RPMs) of a given yo-yo. Visitors discovered higher RPMs made for a more stable yo-yo, better for tricks like "around the world" and "walk the dog."

AFRL's Dr. Jake Grosek helped us demonstrate gyroscopic spin similar to the ones on satellites that keep their orientation stable. AFRL's Dr. Oscar Martinez and his daughter/assistant helped us

demonstrate a spinning human gyroscope stool, and rings that sailed through the air thanks to their spin.

### Science Night at Isotopes Park



The "Topes were catching fly balls; our booth visitors were flying around the solar system. We provided a hands-on STEM display for Isotopes Science Night on 9 August 2019, impacting over 100 visitors who came to play a game of Space Ball using Sphero robots. (We also brought liquid nitrogen to the stadium for Science Girl's presentations; weren't sure how much she'd need, so we tried to get "in the ballpark.")

Visitors controlled the ball-shaped robots and tried to hit planets in our Solar System with enough force to turn on a points sensor. Hit a space hazard, like an asteroid, the sensor displayed a strike. Three strikes, and you're out! Baseball, or Space Ball? Hey, that rhymes!

## Space News

### NASA Remix

Ariana Grande loves space so much, she wrote an entire song about it... called "NASA"...



...and then NASA *remixed* "NASA" with cosmic new verses like these:

*"You may not believe it, but there's so much to discover. ISS in orbit, oh the views will make you wonder. Back to lunar orbit, there is still more to uncover..."*

*...Yeah, we're just saying failure is not an option or an issue. Oh, our mission is the goal that we commit to--and the science that we do is beneficial.*

*We'll explore the universe because we're N-A-S-A."*



NASA gave Ms. Ariana Grande a tour of Mission Control, wearing a spacesuit, at Johnson Space Center on 18 May 2019.

NASA is currently promoting women astronauts, as their upcoming Artemis mission plans to put the *first woman on the moon in 2024* (plus the next man). See [www.nasa.gov](http://www.nasa.gov).

### The Last Of Its Kind

On 22 Aug 2019, the last ever United Launch Alliance (ULA) Delta IV Medium rocket lifted off. Its final payload: A GPS III satellite for the US Air Force. It's being retired to make way for newer rockets like the *Vulcan*, which will launch the *Dream Chaser* space plane and Astrobotic's lunar lander.

See [www.space.com](http://www.space.com).



## UNM Engineering Open House



JOIN US TO EXPLORE WHAT THE SCHOOL OF ENGINEERING HAS TO OFFER AT OUR  
**OPEN HOUSE**

**NM** SCHOOL OF ENGINEERING

Thinking engineering? UNM School of Engineering's Open House will be held Saturday, 28 September 2019, 10:30 am - 2:30 pm at the Centennial Engineering Center, 210 University Blvd. NE, Albuquerque, NM.

Sign up at [www.admissions.unm.edu/visit-us/student-family-tours.html](http://www.admissions.unm.edu/visit-us/student-family-tours.html).

## AFRL Scholars



The AFRL Scholars Program at Kirtland AFB offers internship opportunities for high school and university students, as well as professional educators, in various programs and projects in STEM fields specific to the Directed Energy and Space Vehicles Directorates.

Application submissions accepted: Beginning in late October 2019. Deadline: 14 January 2020, 23:59:59 CST. See [www.afrlscholars.usra.edu/locations/kirtland](http://www.afrlscholars.usra.edu/locations/kirtland).



## Name Leap

Your name can make the next great leap to Mars! Enter your name by **30 September 2019, 11:59 p.m. ET:** <https://mars.nasa.gov/participate/send-your-name/mars2020>. Your name will get etched on a microchip going to Mars on the Mars 2020 Rover!

