

Inspiring Future Scientists  
and Engineers

## AFRL NM STEM ACADEMY

Star Date: January 2020  
Volume XVII, Issue 5



# The Rocket Report

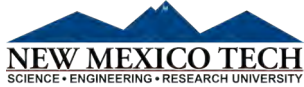


## New Year, New Semester...and Bacon!

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In partnership with:



Collaborator:



#### Remember, Teachers:

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



# BACON!

New Year,  
New WEBSITE...

[www.afrlnm.com/STEM](http://www.afrlnm.com/STEM)

2020 is here, and our vision is clear...20/20, even.

This is going to be the start of a sizzling semester, and a great year, for STEM and Bacon. And who doesn't love *bacon*?!

Most scholars believe Roger Bacon was born in the year 1220 (*some think it might've been more like 1214*), which would make Bacon *800 years old* in 2020! When 800 years old *you* reach, look as good you will not, *hmmmm?* Just ask Baby Yoda.

STEM and AFRL owe a lot to Bacon. In his book *Opus Majus*, he wrote about mathematics, alchemy, astronomy...and *optics* (hello, Directed Energy Directorate!)

He also wrote "*Theories supplied by reason should be verified by sensory data, aided by instruments, and corroborated by trustworthy witnesses,*" considered to be one of the first formulations of the **scientific method** on record.

Bacon was no turkey. He was also known as "Doctor Mirabilis," because *mirabilis* is Latin for *amazing, wondrous*. And I think we can all agree that bacon, even turkey bacon, is both *amazing and wondrous*.

Other 2020 anniversaries: The 200th of the discovery of electromagnetism, the 125th of the discovery of X-rays, and the 25th of the Bose-Einstein condensate.

Looking ahead, you don't need glasses to see that 2020

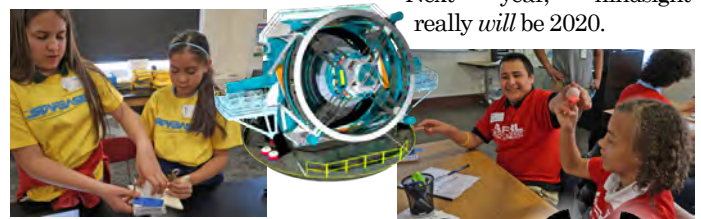
looks really good for STEM.

Scientists hope to launch the *Hope, HX-1, Rosalind Franklin (ExoMars), and Mars 2020 Rover* to the Red Planet this year. Japan is hosting a World Robot Summit in August and October. SpaceX's *Starship* should get its first orbital *flight*, and the *Large Synoptic Survey Telescope* is expected to achieve first *light*.

Here at the Academy, we're

bakin' a sizzling new semester for DoD STARBASE NM, and TECH Mission (the *satellite semester!*), our other missions will hold *their* climactic finales, and we plan to participate in some other big events, like Super STEM Saturday.

Some are calling 2020 the Year of Good Vision...but it *should* be called the Year of Good STEM...and *bacon!* Next year, hindsight really *will* be 2020.



## Our Website Has a New



Take a *look* at our totally revised and updated AFRL NM STEM Academy website ([www.afrlnm.com/STEM](http://www.afrlnm.com/STEM))!

It's got a brand new *look* in 2020, and it doesn't take perfect 20/20 vision to see that some significant improvements have been made to the design and functionality of the website. There's:

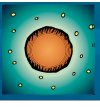
- A page for each of our Mis-

sions, with pictures, forms, and videos;

- A "Get Involved" section for educators/community members and STEM professionals, including STEM Demo library access; and
- A page for "The Latest" news... including *this newsletter!*

A new website for the new year! This may be worth a second *look*.





Crew Registration Forms are due at the Mid-Year Meeting. Print legibly; we'll use them to generate student certificates.

## Ring In the New Year

We will send each crew a *math problem* and an *ASCII problem* (az-kee, the 7-bit based American Standard Code for Information Interchange) to solve (let us know if you didn't get yours).

Ring your neighbors! Introduce yourselves and *telecommunicate* (pp. 77-84 in your handbook) your crew's math and ASCII problem with your assigned neighboring crew, via smartwatch, smartphone, email, text, whatever...



Solve your two problems, and share your *answers* with them, too, while they do likewise to you. The answers provide clues to the colony's *latitude*, *longitude*, and position relative to the Martian *equator*, using the Mars map we provided.

Ring in the new year by *closing the communications ring*: Thank them; acknowledge receipt. Turn in the Telecom-

munications Log (pp. 81-82) on Link-Up Day at the "Uniforms and Telecommunications" station for Mission Log points.

Do you suppose Dick Tracy ever worried about closing his rings?

## 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 11 February 2020.



Make your arrangements now!

## Mars Hopefuls 2020

Hope your crew can find room to park...If these Mars missions scheduled for July-August 2020 are as successful as they hope, it could start getting kinda crowded up there! If only there was a traffic 'copter up there...

The UAE hopes to launch their Emirates, or Hope, orbiter, to study Martian atmosphere and solar wind dynamics.

The Chinese space agency CNSA hopes to launch their HX-1 orbiter/lander/rover, to search for present/past life and study the environment.

## Saving Your Bacon

Conditions on Mars can be harsh. Oxygen and water are scarce, the temperature can get dangerously chilly, and, worst of all—*there's no bacon!* Blue Origins' Jeff Bezos won't even *think* about going until we fix that last one.

So, Mission to Mars crews design a *model* of one of eight *life support systems* (pp. 57-76). But don't get your bacon in a sizzle, it's just a *model*...it doesn't have to actually *function*.



Crews incorporate four "Mars Facts" (pp. 53-56) into the system design; the fourth fact is the answer to a multiple-choice riddle displayed on a **poster**.

During the Technical Briefings on Link-Up Day, crews

award **bonus cards** for correct answers to their riddle. Have students prepare ten bonus cards (p. 59) to award. Crews may want to consider incorporating their **mission patch** (pp. 35-52) into the design.

Taking life support systems with you to Mars could really save your bacon.

But there'd still be no bacon on Mars. Maybe that should be the *ninth* life support system.



If they can work out their descent parachute bugs in time, The ESA/Roscosmos hope to send their Kazachok lander and Rosalind Franklin (ExoMars) rover.



And, NASA plans to send their Mars 2020 Rover and Mars Helicopter Scout.

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



## Experiencing Empiricism

I'm telling you...STEM pretty much owes everything to *bacon*.

Don't believe me? Well, after Roger Bacon outlined the basic concepts of the *scientific method*, along comes *Sir Francis Bacon* to develop and popularize it throughout the *scientific revolution!*

He's been called the Father of Empiricism, which is a fancy word for his very scientific theory that *knowledge* comes primarily from sensory *experiences*.

DoD STARBASE NM Day 5 students were undoubtedly glad Sir Francis added a second strip of bacon to the STEM science sandwich, because they spent the whole day experiencing Empiricism for themselves!

For example, students experienced Bernoulli's Principle firsthand by "recruiting" *way*



more air than they could fit in their lungs to inflate Bernoulli Bags.

They also experienced having *real* pilots and flight enthusiasts,

such as glider pilot Col Roland Dewing from the Civil Air Patrol, discuss *their* flying experiences and careers with them.



Next, they experienced flying on *flight simulators*, complete with yokes and rudder pedals.

And that wraps up Day 5, and the semester, with two strips of bacon on the side. Now, a new semester is starting. I have a vision...it's getting clearer...I see more STARBASE students empirically experiencing STEM in 2020! Is there *anything* bacon cannot do?

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.



## Draconian Baconian

Some believe there are only two kinds of people in the world: Those that like bacon, and those that like bacon *more*. This is an example of basic bacon binary.

But Sir Francis Bacon had a better idea: Bacon bits. *Five* of them, hold the salad.

The *Baconian Cipher* is a method he invented in 1605 for encoding secret messages to your friends. Man, this guy really got around, didn't he?

He replaced each letter of the alphabet with a unique group of five binary *bits* (a data unit with only two possible values), namely a's and b's. A=aaaaa, B=aaaab, C=aaaba, D=aaabb, and so on.

Then he wrote secret messages using two different *typefaces* to represent the a's and the b's.

A	B	C	D	E	F
aaaaa	aaaab	aaaba	aaabb	aabba	aabbb
G	H	I	K	L	M
aaaba	aaabb	aabba	aabbb	ababa	ababb
N	O	P	Q	R	S
aaaba	aaabb	aabba	aabbb	baaba	babba
T	U	V	X	Y	Z
baaba	babba	baaba	babba	baaba	babba

Confused? Well, fortunately for students starting the spring "satellite" semester of the TECH Mission, the *binary math* they do isn't nearly as *draconian* as *Baconian*.



In TECH Day 1, students work with binary numbers, 1's and 0's,

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much like computers do, bundled into groups of eight, called *bytes*. (I wouldn't mind a bite of bacon right now, either.)

Does bacon go with pie? Students code using Raspberry Pi computers. AFRL's Space Vehicles Directorate uses plug and play technology to build satellites; TECH students practice similar techniques using LEGO bricks and Snap Circuits.



## Robotics Challenge

For Middle Schoolers

### By the Numbers

It's down to a numbers game for the Robotics Challenge. Which numbers? Well, assignments 6, 7, 8, 9, and 10 are coming due soon, followed by 30 teams eligible for the Expo on 3/20/2020!



#### Assignment 6, Whisker Sensors due 24 January 2020

Create a video of your robot successfully navigating around the room, avoiding obstacles using the whisker sensors.

#### Assignment 7: Turn Signals due 7 February 2020

Create a video of your robot successfully completing a lap around the green course while using LED turn signals.

#### Assignment 8: Infrared due 7 February 2020

Create a video of your robot using infrared sensors to avoid an

obstacle. The robot must stop or change course when an object is placed in front of it.

#### Assignment 9: Push Block due 7 February 2020

Create a video of your robot pushing a small box or block, such as a tissue box, around a large object, like a trash can, bucket, shoe box, or chair.

#### Assignment 10: (Last assignment!) Project due 21 February 2020

Prepare a document that describes a robotics project you would like to create, such as

using a particular sensor, a robotic arm, maneuvering a Rube Goldberg device, or playing a game.

The top 30 qualifying teams will be eligible to attend our Robotics Challenge Expo on 20 March, 2020.



World Robot Summit

There's also a World Robot Summit ([www.worldrobot-summit.org](http://www.worldrobot-summit.org)) in Japan starting 20 August 2020, but it's optional.



## STEM Challenge

For High Schoolers

### Out of the Frying Pan, Into the Payload Protection Plan

Save your eggs' bacon! Get them out of the frying pan and into the flying plan by *building* and *testing* your **Payload Protection Device**.

To test *height*, have your teams place a raw hen egg into the device and drop it from the max payload height per Assignment 2.

Toss it 30 feet to test *distance*.



Did the egg survive? Did the device roll a lot before coming to rest? Does the payload protection device design need more work, or does it pan out?

Teams can use the **Payload Characterization Investigation** instructions to ex-



Team 30  
Eggs-ecutors



Team 5  
Catapult Crusaders



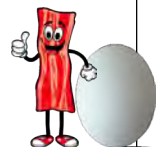
Team 30  
Eggs-ecutors

plore their data further. Have students post their work to CourseSites.

Each team must complete **Assignment 1—Team Identity** to be registered in the STEM Challenge!

One good thing about building and testing your payload protection device...as your team walks back and forth testing and retrieving the egg payloads, you'll be getting a lot of *exercise*.

Exercise...  
Ex...er...size...  
Eggs...are...sides...  
...for BACON!





### The 20 Biggest Space Events in the 20's

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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!

It's not *just* a new semester, or even a new year...2020 also marks the beginning of a whole new *decade*. It promises to be a BIG decade for space science, too!

Here's at least 20 of the biggest space events planned for the 2020s:

- Hope, HX-1, Rosalind Franklin (ExoMars), and Mars 2020 Rover/MHS Helicopter Scout arrive at Mars, 2021
- Roscosmos begins offering space tours, 2021
- The James Webb Telescope launches (hopefully), 2021

- India (ISRO) plans to send the first Indian astronauts, one female, into space between 2021 and 2022
- SpaceX plans to send an uncrewed Mars mission in 2022; a crewed one, 2024
- China launches a third space station, 2022
- ESA launches HERA dangerous asteroid detection system, 2023
- SpaceX's first Moon Tourist flight scheduled, 2023
- OSIRIS-REx returns sample from asteroid Bennu, 2023

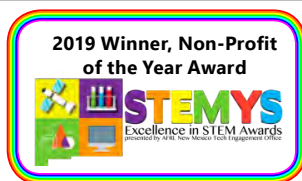
- NASA's Artemis Mission To The Moon, 2024
- JAXA's Martian Moons Exploration Probe lands on Phobos, 2025
- The Extremely Large Telescope activates, 2025
- The US habitat arrives at the Lunar Gateway, 2025
- NASA's Psyche Probe sees an asteroid close-up, 2026
- NASA launches Dragonfly Mission to Titan, 2026
- ESA's JUICE Explorer arrives at Jupiter, 2029

### Tech Trek

STEM, the final frontier. The American Association of University Women of New Mexico (AAUW-NM)'s annual **Tech Trek** is "boldly going where no man has gone before"... because it's a week-long **STEM residential summer camp for girls!**

Held at NM Tech, Socorro, NM **14-20 June 2020**; cost: \$50/participant. Math and science teachers have until **31 January 2020** to nominate up to **four** New Mexico girls going into 8th grade per school.

The week will be filled with hands-on STEM classes, field trips, and workshops. Transportation to Socorro is up to each participant and her family.



Want to carpool? Email travel information to the camp director.

For more information, see [www.techtrek-nm.aauw.net](http://www.techtrek-nm.aauw.net) or call Tech Trek NM Director Helena Whyte at (505) 690-7824.

### Coming Attractions



- Tech Trek and STEMYS nominations deadlines: 31 January 2020
- Honda STEM Grant deadline: 1 February 2020
- Discover-e Engineer's Week: 16-22 February 2020
- Discover STEM week: 24-28 February 2020

### Honda Grant

Looking to bring home the bacon?



The American Honda Foundation's next STEM education grant deadline for first-time applications is **1 February 2020**. The grant range is from \$20,000 to \$75,000 over a one-year period.

Go to [www.honda.com/community/applying-for-a-grant](http://www.honda.com/community/applying-for-a-grant).

### Nom a STEM Y



Nominations for New Mexico's only state-wide STEM awards, the STEMYS, are open through **January 31, 2020**.

AFRL's Tech Engagement Office created the STEMYS to celebrate those individuals and groups that are making a difference in STEM activities and education in New Mexico.

Nominations must be submitted online at [www.afrlnewmexico.com/stemys](http://www.afrlnewmexico.com/stemys).



### Coming Next Issue...

- Uniforms on Mars
- Sugary Hearts and Chocolate
- Satellite TECH

**Watch for it!**

