AFRL La Luz Academy

"Creating the Possibilities"

Inspiring Future Scientists and Engineers

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The Rocket Report

Cooling Down With Cryo

During Day 4 of the AFRL La Luz Academy's DoD STARBASE Flight, fifth grade students get a cool treat. Cryogenics and sensor experts from the Air Force Research Laboratory, including Mr. "Cryo" Mike Martin, Lt Benjamin Jewell, Lt Laura Treider, and Mr. Tom Fraser, perform an interactive demonstration of *cryogenic cooling* using liquid nitrogen.

The Cryo crew discusses topics such as *states of matter* and *thermal dynamics* with the students, while performing an interactive cryogenic demonstration that includes flash-freezing marshmallows, popcorn, balloons, flowers, golf balls, and bananas in cold liquid nitrogen. Students also get to see themselves as they appear to the sensor in a Forward-Looking InfraRed (FLIR) camera.

Cryo Mike explains that the "pits" on pit vipers such as his rubber snake Reggie are really infrared *heat sensors* that help Reggie's less-rubbery cousins locate prey. It's a system that works well for pit vipers, because as *cold-blooded* reptiles, they tend to be colder than the prey they're looking at.

The same principle applies to sensors used in satellites such as the Hubble Space Telescope. The Hubble uses a *cryo cooler* to make the telescope's infrared sensors cool so it can "see" distant objects, even right through any space dust and debris that might be between the telescope and the distant object.

Students get to eat the chilled marshmallows and popcorn (edible STEM!); see cold liquid air inside a balloon; watch a frozen helium balloon sink and then rise because the cold balloon *contracts*, creating the same *mass* with less *volume* but more *density*; crush or wilt some brittle flash-frozen flowers; discover that different materials in a frozen golf ball contract at different rates; and watch a frozen banana break in half.

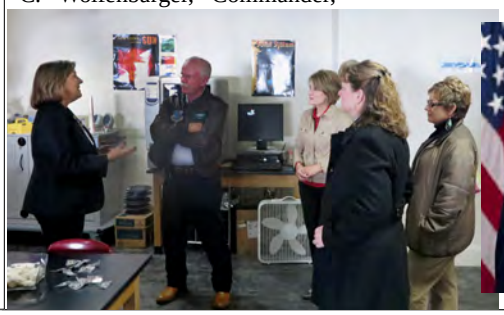
CAP News

On 3 November 2012, we hosted a Flight Simulation STEM Expedition for 18 teachers participating in the Civil Air Patrol (CAP)'s Teacher Orientation Program (TOP, formerly "Fly a Teacher") workshop.

That evening, participating Robot Systems Flight teacher Mr. Gary Bodman, from Madison Middle School, was awarded CAP's New Mexico Wing Teacher of the Year, and was entered for the Crossfield teacher award. Congratulations!

Another Key Spouse Tour

On 26 October 2012, we hosted a tour of AFRL La Luz Academy for Mr. Craig Wolfenbarger, spouse of General Janet C. Wolfenbarger, Commander, Air Force Material Command. Accompanying him were Ms. Tanya Harencak and Ms. Janet Cooley.

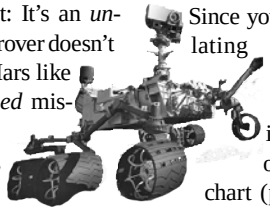


Mars Missions Flight for fifth graders

Mars Microbial Asteroid Research Survey (MARS²) Mission 2012-13

The Fact Is...

Fact: The Mars Science Laboratory rover *Curiosity* is exploring Mars right now. Fact: It's an *unmanned* mission; the rover doesn't need to breathe on Mars like a human on a *manned* mission would. Fact: That's a good thing, because the air on Mars is not like the air on Earth.

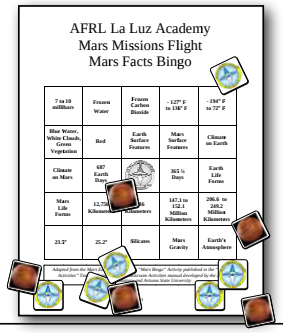


According to the "Mars Facts" chart in your Mars Missions Flight manual, the atmosphere on Mars is 95% carbon dioxide, whereas on Earth it consists of 78% nitrogen and 21% oxygen.

Since your students are simulating going on a manned mission to Mars, it might be a good idea to see what else on the "Mars Facts" chart (pp. 57-60) might be more important for a human than a rover.

In fact, students incorporate four of these "Mars Facts" into their life support system model design.

There are learning tips built right into the chart, and games like "Mars Facts Bingo" and the "Mars Facts Card Game" in Chapter 6 of the manual, to help your students get their facts straight.



The Saga Begins

A *saga* is a story, sung or spoken, about historical events. The Mars Missions Flight sagas (pp. 37-38 in the manual)—which can be sung or spoken, with or without choreography added—describe the epic journey to Mars our student teams are undertaking.

Performance opportunities at Link-Up Day include when the student teams arrive at their habitat site, during Lunch on Mars inside the habitats, and for visitors passing through their habitat.

Points for the saga will be awarded on the students' Team Mission Logs, but don't worry—it's not like you're auditioning for Kelly Clarkson's *Duets* show or anything.

Patch Work

Astronauts like to wear a *mission patch* (pp. 39-56 in your manual) on their flight suit, because it symbolizes the unique qualities of each team and its mission.

Tell your students to put some thought and work into the design and look of their mission patch.

Components to include: Mission name (Microbial Asteroid Research Survey); objective (colonize Mars); team members' names; mission experiments (i.e. the life support system the team will build); flags/colors representing mission participants; patch shape and size.

Each team actually makes *two* mission patches:

- A small one that can be used to make nametags for each student on the team; and
- A large (poster-sized) one to be displayed on the outside of the habitat on Link-Up Day.

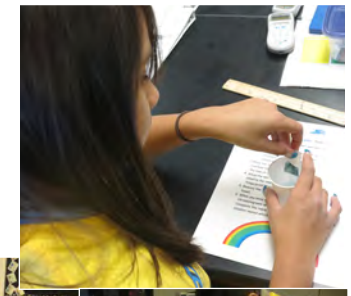
Your commitment to this mission is crucial to its success

DoD STARBASE Flight for fifth graders

Other DoD Day 4 Activities

As seen on the front page of this newsletter, fifth grade students participating in Day 4 of the DoD STARBASE Flight engage in an interactive cryogenic freezing activity with mentors from the AFRL. But that's not *all* they do in Day 4. For example:

- Students examine the *periodic table of the elements*, and assemble 3-D models of the molecules in *compounds* made of more than one *element*. An unconfirmed rumor suggests these models may in fact be *slightly larger* than the actual molecules they represent.
- They use *movement mats* and *molecule jars* to simulate how adding heat changes the *states of matter*.
- The students use *tornado tubes* and marshmallow-pumping jars to explore the properties of air.
- They use *chromatography* (a process to help determine the various substances in a mixture) to help determine which of four kinds of magic marker was used to write a message.



At least one week in advance, please give us the name of each adult per driver's license, the last four digits of their Social Security Number, and the estimated number of students you're bringing. Don't forget to turn in your Media Release forms, too!

STARBASE 2.0 Simulates, Stimulates

Van Buren and Wilson Middle School students are continuing to simulate model rocket launches on *RockSim*, and then testing those simulations with actual model rocket launches, as they prepare to design and build a rocket for the Team America Rocketry Challenge.

TECH Flight for middle schoolers

Technology and Engineering Challenges Flight

Election Results In

The election is over, and the results have been tabulated! (No, no, not *that* election...although that one is finally over, too.) The most popular name for a rocket in this year's TECH Flight rocket launch, based on names of actual rockets flown, is: *Phoenix*. Results break down as follows:

Phoenix — 7
Apollo — 6
Spirit — 6
Gemini — 1
Mercury — 1

Humpty Dumpty Had a Great Fall

Boy, wasn't the TECH Flight Day 2 rocket launch fun? Now, in Day 3, the students analyze and graph the data from the rocket launch and compare it to their rocket flight simulation data.

The students also discuss ways the rocket launch demonstrated *Newton's Three Laws of Motion*. For example, the rocket sits at rest on the launch pad *until* and *unless* the engines produce enough thrust to launch it, demonstrating Newton's First Law, the *law of inertia*. When the engine produces enough downward thrust, the rocket reacts by moving upward, conforming to Newton's Third Law (*every action has an equal, opposite reaction*).

The smiles aren't forced when students use Vernier® motion and force sensors to perform activities such as graphing happy and sad faces by pushing and pulling on a force sensor.

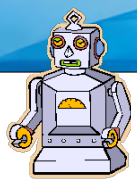
Students get into engineering design and careers with help from some falling eggs in an Egg Drop competition. Yes, Humpty Dumpty had a great fall, but he was making up for a lousy summer.

At least one week in advance, please give us the name of each adult per driver's license, the last four digits of their Social Security Number, and the estimated number of students you're bringing. Don't forget to turn in your Media Release forms, too!

Robot Systems Flight

for middle schoolers

Thinking and Talking Like Computers and Robots



Ever notice how everything's becoming *digital* these days? Digital watches, digital music, digital movies...but what does that word mean, "digital"?

Well, "digital" refers to *digits*; namely, *one* and *zero*, the *binary number system*. To a computer, *everything* is binary. That's why thousands of songs can go on an mp3 player or smartphone that fits in your pocket.

Once Robot Systems Flight students understand how computers *think*, they can learn to *talk* to them using a *programming language* like BASIC, as they begin assembling Boe-Bot® robots.

Students connect electronic components like resistors and light-emitting diodes (LEDs) to a *stamp board*, hook that up to a computer, and write BASIC programs like this one:

```
{$STAMP BS2}
{$PBASIC 2.5}
DEBUG "Program Running!"
Counter VAR Byte
FOR counter = 1 TO 10
        HIGH 14
        PAUSE 500
        LOW 14
        PAUSE 500
NEXT
DEBUG "All done!"
END
```

This program, the students learn, makes the LED connected to Pin 14 blink. They can tell how many times it will blink from the line: FOR counter = 1 TO 10. "Counter" is a *variable* (a word that represents a number). Here, it determines how many times the LED will blink; in this case, ten times.

The middle schoolers will use their new programming and *binary math* skills later when they program their Boe-Bot® to maneuver around an obstacle course.

STEM Challenge Flight

for high schoolers

December is Shopping Month... and Not Just For Holiday Presents

Games Magazine, a periodical with games, puzzles, and brainteasers, used to create a fake advertisement each month and put it somewhere in the magazine alongside the real ads. They called it, "*Find the Fake Ad: Which of these pitches is full of hitches?*"

Phase 1 of the STEM Challenge Flight, Project R&D and Pitch, is wrapping up now. Participating high school student teams have now finished making and submitting the budget ($100.00 or less) for Home Depot materials they'll use to build their egg-launching, trigger mechanism, and payload protection devices. They also filmed and submitted a short "video pitch" explaining their design, and justifying funding the purchase of those items.

The mentors are now reviewing the teams' budgets and video pitches. There's no "fake ads" involved, but if the video pitches are not "full of hitches," and they explain and justify the requested materials well, the purchases should be approved.

Once the pitch and materials list are approved, **Team Coaches must contact AFRL La Luz Academy to schedule a Home Depot shopping trip with us, sometime between 3-19 December.**

We'll accompany the coaches to Home Depot and purchase the items the teams have identified. Call us in advance to schedule the trip to ensure we're available. No purchases should be made without us along, or before the mentors have approved the materials list and pitch.

The next assignment, Phase 2: Device Construction, involving submitting photos or video of the team constructing the device, is due 18 January 2013. You might want to get started on it early, with the holiday break coming up at the end of the month.

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Important Terms and Acronyms

AF: Air Force

AFB: Air Force Base

AFRL: Air Force Research Laboratory

AFRL/RD: The Directed Energy Directorate of the AFRL (formerly AFRL/DE)

AFRL/RV: The Space Vehicles Directorate of the AFRL (formerly AFRL/VS)

DoD: Department of Defense

KAFB: Kirtland Air Force Base, Albuquerque, N.M.

LF: Leadership Flight

MARS: Microbial Asteroid Research Survey

MM: Mars Missions

PRS: Phillips Research Site

PWN: Pinpoint WeatherNet

RS: Robot Systems

STEM: Science, Technology, Engineering, and Math

TECH: Technology and Engineering Challenges

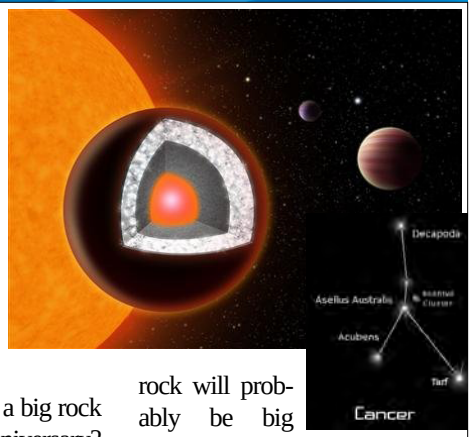
T²: Technology Transfer

TTE: Technology Transfer for Education

USAF: United States Air Force

STEM Bytes

Diamonds are a Girl's Best...Planet?



Here's an interesting destination for all you budding space tourists out there. Scientists have discovered a planet about twice the size of Earth they call "55 Cancri e." It orbits a star much like our own sun, about 40 light-years away, visible to the naked eye, in the Cancer constellation.

And the whole planet is basically one gigantic diamond!

It's a very hot planet; its surface is mostly graphite surrounding a thick layer of diamond, with a molten iron core in the middle.

Wanna give your girl a big rock on your wedding anniversary? Better be quick about it. A year on this planet takes about 18 hours. The good news is, this rock will probably be big enough to keep her happy for a while.

You may have to look to Saturn to size the ring for it, though.

Robots are the Real First Responders

In the movies, robots are usually hulking metallic humanoid shapes bent on destroying humanity. But *real* robots are usually more friendly and helpful.

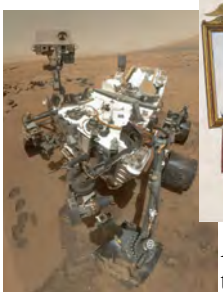
Heard of the self-driven automatic home vaccuming robots called Roomba,® made by iRobot®? Well, it turns out robots like these are doing a lot more than vaccuum floors these days.

One, called Packbot, was a First Responder during the September 11, 2001 World Trade Center attack, testing the integrity of Ground Zero before the human First Responders went in. More recently, Packbots have been used to search for hidden explosives in Iraq and Afghanistan to protect soldiers, and by police in hostage and SWAT situations.

Remember the giant tsunami that devastated Japan's coastline and damaged its nuclear reactors a couple years back? Robots called Warriors were used to investigate the damaged nuclear reactor sites and detect radiation levels without risk to human life.

Robots may be used in medicine, soon, as well; robots called VITA have cameras and video screens, and other medical sensors and equipment, that could help doctors examine patients without even being in the same room...or the same country.

Spiffy Self-Portraits



Spend any time on the internet, and you'll come across self-portraits of people who took their smartphones into the bathroom and shot a picture of themselves taking a picture of themselves in the bathroom mirror.

They can't compete with the Mars Rover Curiosity, though. It took a self-portrait of itself, too, recently...but *from Mars!*

And let's not forget the granddaddy of them all: In 1960, artist Norman Rockwell *painted* a self-portrait of himself *painting his own self-portrait!*

Coming Next Issue...

- Mars Missions uniforms and life support systems
- Happy New Year/ Semester!
- Lift, Thrust, Gravity...

Watch for it!

Correction:
An astute reader pointed out that last month's Robot Systems Flight article referred to two millionths of a second as 0.0000002 seconds. It's actually 0.000002 seconds. Good catch! We just wanted to make sure you were paying attention.