AFRL La Luz Academy

"Creating the Possibilities"

Inspiring Future Scientists and Engineers

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The Rocket Report

The Rocket Report!

Yes, friends, it's true...this installment of The Rocket Report really *is* a Rocket Report.

On 23 October 2012, over 300 middle school Technology and Engineering Challenges (TECH) Flight students, from 11 New Mexico schools, wearing bright red AFRL La Luz Academy TECH Flight uniforms, launched 21 rockets at the tenth annual Rocket Launch event held at the Albuquerque Rocket Society's launch site on the outskirts of Rio Rancho.

The rockets had four inch diameters, were approximately six feet long, and reached an estimated altitude of 2,000 feet.

The students spent the past month building their rockets, and used modeling and simulation software called *RockSim* to predict their rocket's performance. They will compare the anticipated rocket flight paths with the data collected from the actual launches at their next TECH Flight class.

Student teams came ready to launch the six-foot rockets they built and decorated themselves; rockets with inspirational names like *Apollo, Atlas, Gemini, Mercury, Opportunity, Phoenix, Saturn,* and *Spirit.*

As students arrived at the launch site, they stood in line in the warm New Mexico sun at the Registration table, and received their assignments for the day, as identified by a color-coded magnetic badge they affixed to their bright red AFRL La Luz Academy T-shirt uniforms.

Next, they headed to the Launch Gear Checkout table and received their team's rocket and

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Key/Senior Spouse Tour

On 11 October 2012, we hosted tours for visitors from the Key and Senior Spouse groups at Kirtland Air Force Base.

The dignitaries were treated to a tour of our classrooms, learned about our various science, technology, engineering, and math (STEM) education outreach activities, and observed middle school students from the Cottonwood Valley Charter School TECH Flight constructing the six foot rockets they would launch on 23 October (see above). Our guests even marvelled at our 3-D printer capabilities!

Mars Missions Flight for fifth graders

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

Space Training

Teachers who wondered how they could *possibly* help their class go to Mars got their answer at the Mars Missions Flight New Teacher Training held 18 October 2012. Ms. Diane MacAlpine led the full-day training session, which was jam-packed with hands-on activities and useful information.

She explained the Mars Missions process in detail, with help from PowerPoint slides and videos. Teachers got first-hand experience doing some of the things they will teach their own fifth grade students to do, such as designing mission patches, studying Mars Facts, building life support system models, composing and performing sagas (musical renditions of their journey to Mars; they sang really good, although one team seemed to have a couple of extra crew members in their Mars version of "Gilligan's Island!"), and building a scale-model version of a habitat. Teachers reported their students are very excited about participating, and praised the Mars Missions Flight as being well-organized.

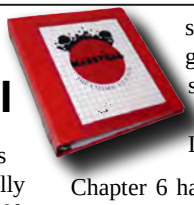
The teachers received a revised version of the Mars Missions Flight manual. It, too, is jam-packed with hands-on activities and useful information. The teachers can refer to it all year to help guide them through the process of preparing their students for a successful trip to Mars.

If teachers have questions, they can contact us whenever they need to. At the grand finale Link-Up Day event, there will also be fellow teachers, Colony Commanders, and others available to assist or answer questions.

And last, but *certainly* not least, there's always *this very Mars Missions Flight section of the monthly newsletter*, for additional tips and information!

Your commitment to this mission is crucial to its success

Manual Mars MARS Manual



The Mars MARS manual is manually operated; you actually have to turn the pages yourself. But it's SO worth it.

For example: Chapter 5 supplies you with valuable forms like the Flight Director and Team Mission Logs. They give an excellent step-by-step checklist of the entire Link-Up Day event.

Chapter 6 has a a page outlining roles students can be assigned for group activities, and a Mars Facts Bingo game to help students get their facts straight. Bingo!

The Next Step...

November/December is a good time to...

- Look at the timeline on pages **12-13** of your manual, and adjust it to fit your curriculum and scheduling needs. Items on the timeline should be completed prior to the Link-Up Day event
- Divide students into TEAMS (5-7 students per TEAM)
- Have students research Mars and learn "Mars Facts," work on their sagas and mission patches, and begin planning their life support system
- Make me some turkey sandwiches, please. I'm *hungry*!

DoD STARBASE Flight

for fifth graders

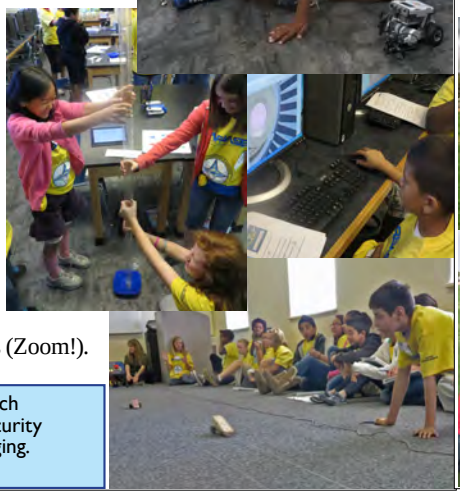
Plop, Plop, Fizz, Fizz, Whirr, Whirr, *Zoom!*

Students participating in Day 2 of the DoD STARBASE Flight:

- Assemble space stations on their computer using 3-D components.
- Increase their *geospacial intelligence* (the obtaining of information about Earth and manmade features by studying maps, navigation charts, & images) by exploring satellite-photo maps from the National Geospacial Intelligence Agency (NGA).
- Program NXT LEGO Mindstorms® robots to perform a security sweep of a model of the National Mall. (Whirr! Whirr!)

In Day 3, students:

- Investigate Newton's Laws by launching antacid-tabled powered rockets into the air. (Plop, plop, fizz, fizz!)
- Compare race times of pairs of carbon dioxide (CO_2) propelled racecars, some of which have bigger capacity CO_2 cartridges than others (Zoom!).



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 Launches Too

Over 30 Van Buren and Wilson Middle School students have been building and launching several versions of model rockets, and simulating the launches on *RockSim*, with the help of several mentors from AFRL and elsewhere.

TECH Flight for middle schoolers

Technology and Engineering Challenges Flight

The Rocket Report!

Continued from page 1

specific equipment they would be using, such as binoculars, GPS units, and clipboards and forms to record data on.

After taking a group photo with their rocket, the students moved on to their assigned duty areas and went to work.

With the help of volunteer adult mentors, Assembly and Inspection Teams packed the parachute, inserted an *altimeter* into the rocket for measuring the flights' altitude, and weighed the rocket.

Meteorologists, using a Pinpoint Weather-Net weather station set up on site, checked that weather and wind conditions were acceptable for launch.

Spotter Teams, using binoculars, checked that the skies were clear of aircraft. The Assembly Team installed the rocket's motor. The Pad Manager helped load the rocket onto the launch tower and arm the altimeter.

The Range Safety Officer (RSO), speaking into a microphone, gave the school name and the rocket name, and verified with the Meteorologist and Spotter Team that everything was a "go." Then the RSO began the countdown: "Five...four...three...two...one... *launch*!"

The Launch Control Officer, a fellow team member, flipped the switch on the launch control box. *Whoosh!* The six-foot long rocket shot off the launch tower and zoomed about 2,000 feet into the air. Shortly after *apogee*, the highest point of the rocket's flight, the parachute came out and gently slowed the rocket's descent back to Earth. Students and spectators cheered. Then the Recovery Teams, guided by the Spotter Teams, set out to find the rocket and bring it back.

And that concludes our Rocket Report for this semester's TECH Flight. Tune in next month for even more STEM!

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

Centering The Servo

Robot kits should have been delivered to most of our participating teachers by now. Please contact us if you still need materials. But have your students checked their *pulse* lately? It needs to be right at 750 in order to *center* their *servo.*

Middle school students participating in the Robot Systems Flight need to center, or *calibrate*, the servo motors on their Boe-Bot® robot. To do that, they must instruct the servos to stay still by sending them a *centering signal*.

The centering signal is a series of 1.5 thousandths of a second, or *millisecond* (ms), pulses (0.0015 s), with a 20 ms pause between each one. So 1.5 ms would be the *pulse duration.*

Dividing the pulse duration by two millionths of a second, or *microseconds* (2 µs, or 0.0000002 s) results in the *duration argument.*

(By the way, that symbol for "micro" is not the lowercase English letter "u," it's the lowercase Greek letter "mu." It's *all* Greek to *me*.)

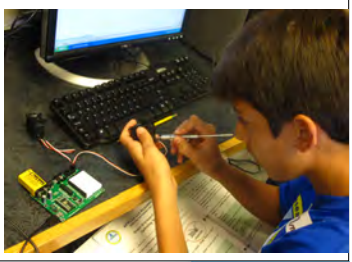
Divide 0.0015 by 0.000002, and what do you get? Go ahead, do the math, I'll wait...

Did you get 750? Good! That's the *duration argument* for a *centering signal*. So, centering a servo connected to pin 12 would be,

```
DO
   PULSOUT 12, 750
   PAUSE 20
LOOP
```

Have your students run that program. If their servo still moves, have them adjust the *servo screw* with a Phillips screwdriver.

To make their servo turn *clockwise*, set the duration argument *less* than 750. To make it turn *counter*clockwise, set it to *greater* than 750.



STEM Challenge Flight

for high schoolers

Students Start Around the Wheel

Ever heard of the *Universal Law of Synergy*? It states, "*The whole is greater than the sum of all parts.*" A *system* is a set of parts that is greater than the whole. Thus, Systems Engineering has its own way of stating the Universal Law of Synergy mathematically:

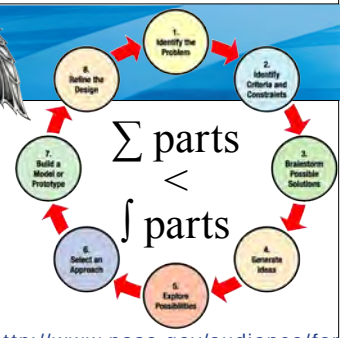
$$\sum \text{parts} < \int \text{parts}.$$

The Engineering Design process is a set of steps that help engineers clearly understand a problem and develop a solution (see NASA's wheel on the right).

High school student teams participating in the STEM Challenge Flight this year use systems engineering and a three-phase engineering design process to design a remotely triggered egg launcher to fling an egg through a hula hoop and onto a target intact.

The Atomic Avengers

They're already well into Phase 1, Research and Development (R&D), and have started on their way around the wheel. The teams have completed a number of assignments and posted them online for mentor review and scoring. The teams have designed team names and logos, (some are shown here) compared different methods of launching a payload, created a mathematical model of their project, created a design, and created a scale model prototype video.



http://www.nasa.gov/audience/forteducators/plantgrowth/reference/Eng_Design_5-12.html

By 16 November they should be submitting a budget and materials list, and explaining in a video pitch why their project should be funded. Mentors will then review the pitches during the remainder of November. December is shopping month for the Team Coaches!

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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

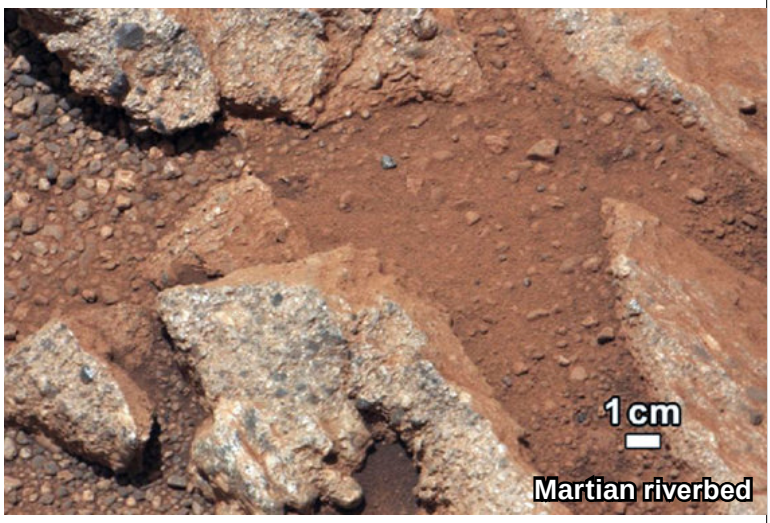
T²: Technology Transfer

TTE: Technology Transfer for Education

USAF: United States Air Force

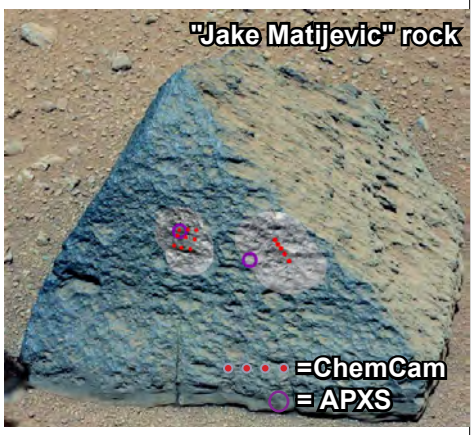
Mars Rock Zapped by a Rover With a Name

Directed Energy was officially employed on Mars by the rover named Curiosity for the first time recently.



On the 46th sol, or Martian day, of the Mars Science Laboratory mission, the Curiosity rover found an odd, roughly pyramid-shaped little rock, which NASA named "Jake Matijevic" in honor of a chief engineer who had recently passed away.

Curiosity tested out its Alpha Particle X-Ray Spectrometer (APXS) device to examine what the rock might be made of. Then, it got out its ChemCam, or "Rock-zapping laser," and zapped it to learn even more about the chemical composition of the Jake Matijevic rock.



Curiosity also discovered what appears to be a waist-deep dried-up streambed, which is exciting because it implies there once was water flowing on Mars. Photos showed pebbles likely rounded off by water. There was "a vigorous flow on the surface of Mars," said chief scientist John Grotzinger of the California Institute of Technology. "We're really excited about this."

It's unclear how long the water persisted on the surface, but it easily could have lasted "thousands to millions of years," said mission scientist Bill Dietrich of the University of California, Berkeley.

Which reminds me of a song (sung to the tune of *A Horse With No Name*):

On the first part of the journey, I was looking for signs of life. Not plants or birds, but microbe-things, in the sand and hills and rings.

The first thing I met was a three-sided rock, and the sky with no clouds; the heat was not but the ground was dry, and the air was without sound.

You see, I've been through the desert, Curiosity-named; on a planet they call Mars. On this planet NASA uses my name, 'cause they talk to me from across the stars.

La, laaaa, laaaa, laa-la-la-la, la-la-la, laaaa la. La, laaaa, laaaa, laa-la-la-la, la-la-la, laaaa la.

After two sols in the desert sun, the planet it still was red. After three sols in the Martian fun, I was looking at a riverbed. And the story it told of a river that flowed, made me sad to think it was dead.

Curiosity's my name, curiosity's my game, but some call me MSL; if this planet could've once held life my science instruments that's what they hope to tell.

La, laaaa, laaaa, laa-la-la-la, la-la-la, laaaa la. La, laaaa, laaaa, laa-la-la-la, la-la-la, laaaa la.

Coming Next Issue...

- Patches, Facts, and Sagas
- TECH Flight fall semester wraps up
- Lots of STEM and holiday cheer!

Watch for it!