AFRL La Luz Academy

"Creating the Possibilities"

Inspiring Future Scientists and Engineers

2010-11 Flight Preview

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In This Issue...

The Rocket Report	1
AFRL La Luz Academy Inspires Future Scientists and Engineers	1
Mars Missions Flight	2
DoD STARBASE Flight	2
PETES PRS Flight	3
Intro to SE Flight	3
SPACE Flight	3-4
Teacher Institute	4
STEM Bytes	4
We're Looking for Volunteers	4
Masthead and Important Terms and Acronyms	4

The Rocket Report

AFRL La Luz Academy Inspires Future Scientists and Engineers

The Concept

What if you had a way to take science, technology, engineering, and math (STEM) out of the textbook and into an interactive, hands-on environment? Do you think some of your students might be inspired to become future scientists and engineers?

AFRL La Luz Academy is an Air Force Research Laboratory (AFRL) education outreach program at Kirtland Air Force Base in Albuquerque, New Mexico, through a Cooperative Agreement with New Mexico Tech.

We're dedicated to raising student interest and knowledge skills in STEM. We target students from fifth through twelfth grades.

AFRL La Luz Academy brings the basic concepts behind the technologies developed by the Directed Energy and Space Vehicles Directorates of the AFRL into the classroom, motivating students to study STEM in a hands-on, minds-on environment.

The Flights

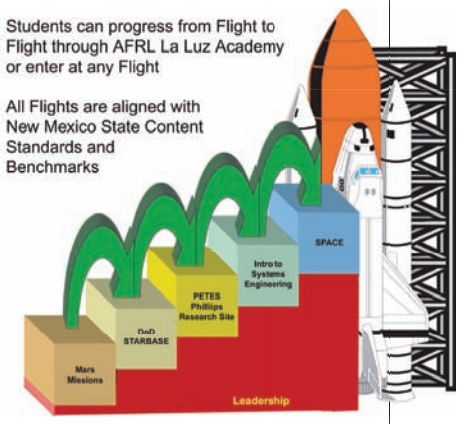
AFRL La Luz Academy is divided into Flights, each designed for a certain grade level and aligned with New Mexico State Content Standards and Benchmarks.

The **Mars Missions Flight** is a classroom-based Mars colonization simulation for fifth graders. Students prepare for and simulate going on a manned mission to Mars.

The **DoD STARBASE Flight**, for sixth graders, helps students develop some basic skills and a realization that they can aspire to careers in STEM. The core curriculum focuses on required topics which include Physics, Chemistry Sciences, Technology, Engineering, Mathematics Operations and Applications, and STEM Careers.

The **Providing Engineering and Technology for Students Phillips Research Site (PETES PRS) Flight,** for seventh graders, explores STEM skills and topics related to the AFRL's Directed Energy and Space Vehicles Directorates as a springboard for student investigation.

Recruiting flyers for our Flights are enclosed with this newsletter. Please distribute these flyers to teachers you know, as appropriate.



In the **Intro to Systems Engineering Flight,** eighth grade students learn the basics of Systems Engineering, building and programming small robots called Boe-Bots® that run through a series of increasingly challenging obstacle courses.

The **Students Planning And Conducting Engineering (SPACE) Flight** provides a unique learning opportunity for high school students. Teams of students structure and perform real-world research and development projects using a systems engineering approach, and present an annotated briefing of their accomplishments at the annual SPACE Symposium.

Want to know more? Additional information about each of the Flights can be found inside this newsletter. Read on!

Mars Missions Flight

The Concept

What fifth grader wouldn't like to be an astronaut?

The Mars Missions Flight is AFRL La Luz Academy's classroom-based Mars colonization simulation for fifth graders.

It's based on the Challenger Center for Space Science Education's acclaimed *Marsville®, the Cosmic Village* program, and has been modified to include Air Force technologies and terminologies to provide a unique hands-on learning opportunity for students.

What's the Mars Missions Flight?

Students work in TEAMS in their classroom throughout the school year on various activities, called Base Operations, that prepare them for their simulated manned mission to Mars.

These activities are designed to be motivating and hands-on, while meeting many of the New Mexico Content Standards and Benchmarks in science, math, language arts, music, and art.

Students work in TEAMS of five to seven students to complete Base Operations at their school. The Base Operations include: writing a *saga* that decribes their journey to Mars; designing a *mission patch*, studying *Mars Facts;* and designing a *Life Support System Model* based on those Facts.

Each TEAM also *telecommunicates* with two other TEAMS from different schools; cuts out their assigned 6-mil plastic *habitat* pieces; plans their nutritious, yet space- and weight-saving, astronaut *lunch*; and designs a TEAM *uniform*.

The Flight culminates in a Link-Up Day activity in the spring, where TEAMS come together to simulate the Mars Mission.

Each TEAM progresses through a series of holding stations to ensure they have completed the necessary preparations for Link-Up Day, receiving points on a TEAM Mission Log.

On Link-Up Day, students join two other TEAMS from different schools to form a habitat CREW, and construct inflatable plastic habitats measuring 12' x 12' x 8'.

Then, the grand finale: Each CREW links up their habitat to several other habitats to form a colony. This is where Link-Up Day gets its name. TEAM members and invited guests then participate in an exploration of the colony.

Teacher Training and Resources

We will be conducting teacher training in September/October to help teachers understand their role in the Mars Missions Flight. There are two types of teacher training: a full-day session for teachers who have not participated in the Mars Missions Flight before, and a shorter version for returning teachers.

There is a mandatory mid-year meeting for Mars Missions Flight teachers in February, to help prepare teachers for Link-Up Day.

Mars Missions Flight teachers also receive a Teacher's Resource Guide manual, and monthly newsletters with valuable Mars Missions Flight tips and information.

DoD STARBASE Flight

The Concept

Through the AFRL La Luz Academy's DoD STARBASE Flight, for sixth graders, students develop basic skills and discover they can aspire to careers in STEM.

Students come to the AFRL La Luz Academy for five non-consecutive days of instruction, during either the Fall or Spring semester of the school year.

For this Flight, the curriculum focuses on Newton's three laws of motion, fluid mechanics and aerodynamics, building blocks of matter, physical and chemical changes, atmospheric properties, innovations, navigation and mapping, engineering design process, 3-D computer-aided design, numbers and number relationships, measurement, geometry, data analysis, and STEM careers.

Teamwork and the Air Force Core Values (*Integrity First, Service Before Self,* and *Excellence in All We Do*) are incorporated in this Flight.

What's the DoD STARBASE Flight?

During the five curriculum days, students engage in many hands-on activities.

For example, in the Fall semester, the sixth graders build a six-foot high-powered rocket, and use simulation software to predict its trajectory.

Working in teams with assigned duties such as Assembly and Inspection Team, Data Manager, Range Safety Officer, and Launch Control Officer, they launch their rockets from a field in Rio Rancho.

In the Spring semester, the students explore rocketry with a similar activity involving water bottle rockets.

Another topic students in both semesters explore is Flight Simulation. Students learn about the four forces of flight (gravity, lift, thrust, and drag), and airplane control surfaces (wings, ailerons, rudders). They study Bernoulli's Principle (faster-moving air creates lower pressure) with interactive activities like blowing as much air as possible into a Bernoulli Bag.

Then the students take to the skies, flying computer-simulated aircraft using yoke and rudder pedal controls.

Pilots and enthusiasts from the Air Force and private industry discuss and show videos of their flying experiences, let students examine flight gear such as night vision goggles and flight helmets, and provide guidance and assistance to the students as they fly their computer-simulated aircraft.

PETES PRS Flight

Providing Engineering and Technology Experiences for Students Phillips Research Site Flight

The Concept

The Providing Engineering and Technology Experiences for Students (PETES) Phillips Research Site (PRS) Flight, for seventh graders, consists of three non-consecutive days of hands-on STEM instruction.

This curriculum uses STEM topics related to the Air Force Research Laboratory's Directed Energy and Space Vehicles Directorates as a springboard for student investigation.

Teamwork and the Air Force Core Values (*Integrity First, Service Before Self,* and *Excellence in All We Do*) are incorporated in this Flight.

What's the PETES PRS Flight?

The curriculum includes satellite subsystems, optics, the electromagnetic spectrum, electrical circuitry, and space weather.

Students explore wave movement with slinky coils and use light boxes to learn about visible light and color.

The JELL-O Laser Lab activity provides an opportunity for students to experiment with lasers, lenses, and color (an edible experiment!).

Light-sensitive frisbees and sunscreen are used to investigate ultraviolet light, and students also create an ultraviolet detector with color-changing beads.

After researching the function of various electronic components, students solder the components to a printed circuit board, making a flashing light-emitting diode badge that says, "I've got the power!"

Investigation of space weather begins with developing an understanding of how the sun affects systems on Earth.

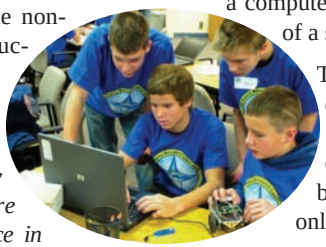
Students experiment with magnets and relate their observations to sunspots and the Earth's magnetic field.

They also observe the sun with a solar telescope, and then graph sunspot activity and satellite function. A Van de Graaff generator is used to help students understand solar wind.

Intro to Systems Engineering Flight

The Concept

In the Intro to Systems Engineering Flight, for eighth graders, students learn the basics of Systems Engineering and program small robots called Boe-Bots® to run a series of increasingly challenging obstacle courses, in a series of three non-consecutive instruction days.



Teamwork and the Air Force Core Values (*Integrity First, Service Before Self,* and *Excellence in All We Do*) are incorporated in this Flight.

What's the Intro to Systems Engineering Flight?

Students are introduced to the concept of a system, and see how a computer is an example of a system.

The eighth graders learn how to think like a computer—in binary, using only ones and zeros, and try their hand at some binary math.

They explore how to use a computer to talk to a microcontroller—using the BASIC programming language.

Teams build their own Boe-Bot® robot by assembling the following components: a BASIC stamp board, a chassis, servomotors, wheels, a battery pack, and various screws, nuts, and washers.

Students then program their Boe-Bot® to maneuver through a series of increasingly challenging obstacle courses. On their third curriculum day, students demonstrate their programming skills at the Robotics Expo.

SPACE Flight

Students Planning And Conducting Engineering

The Concept

The Students Planning And Conducting Engineering (SPACE) Flight provides a unique learning opportunity for high school students. Teams of students structure and perform a real-world research and development (R&D) project using a systems engineering approach.

What's the SPACE Flight?

Student teams and their teachers have several options when selecting their R&D project topic. They can select a structured project such as participation in a competition like the Team America Rocketry Challenge, New Mexico Supercomputing Challenge, or New Mexico RoboRAVE International, or they can take a more free-form approach, selecting any R&D topic they choose.

The Kickoff Briefing is the formal beginning of the SPACE Flight for the school year. Student teams, teachers, and technical advisors meet at our facility on Kirtland Air Force Base and develop a strategy for working on their R&D project.

The next step is the completion of the Preliminary Design Review (PDR) and Critical Design Review (CDR). At the PDR, in November/December, student teams present a briefing on their project, at their school, to a SPACE Review Team of volunteer scientists and engineers from AFRL and other organizations. At the CDR, in February/

Continued on page 4

AFRL La Luz Academy

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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

PETES: Providing Engineering and Technology Experiences for Students

PRS: Phillips Research Site

R&D: Research and Development

SPACE: Students Planning And Conducting Engineering

STEM: Science, Technology, Engineering, and Math

TI: Teacher Institute

T²: Technology Transfer

TTE: Technology Transfer for Education

USAF: United States Air Force

SPACE Flight (continued)

Students Planning And Conducting Engineering

Continued from page 3

March, student teams present an updated briefing on their project, at their school, to the SPACE Review Team.

In April, student teams who have passed the CDR present an annotated briefing and poster display of their R&D project accomplishments at the annual SPACE Symposium, held at our facility on Kirtland AFB. The annotated briefings are then published in the annual SPACE Symposium Proceedings.

Students who participate in the SPACE Flight can cite their experience on their resume when applying for scholarships or internships such as the AFRL Phillips Scholars.

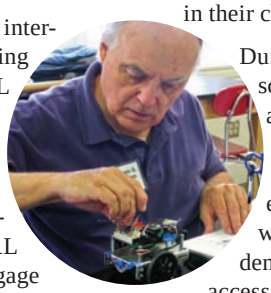
Teacher Institute

What's the Teacher Institute?

The Teacher Institute is a STEM professional development activity for math and science teachers, conducted each year by AFRL La Luz Academy.

Teachers explore engineering concepts and ideas for developing STEM projects/lessons, while building connections and working in teams with fellow teachers.

It starts with a week-long interactive workshop held during the summer at the AFRL La Luz Academy facility.



Participating teachers listen to guest speakers, tour AFRL facilities, engage in various hands-on/minds-on STEM activities based on our Flight activities for fifth-twelfth grade students, and prepare a presentation describing how these concepts could be applied in their classrooms.

During the school year, as the teachers develop STEM projects/lessons with their students, they have access to technical support from AFRL scientists and engineers, and can request materials needed.

At the end of the school year, the teachers return and share their experiences at the Teacher Institute Symposium.

STEM Bytes

We're Looking for Volunteers

Are you a scientist, engineer, and/or expert in a science, technology, engineering, or math (STEM) subject interested in sharing your knowledge?

AFRL La Luz Academy has lots of opportunities for volunteers to help us inspire future scientists and engineers. For example, you could:

- Help us set up or run a Mars Missions Link-Up Day;
- Share your STEM expertise with students involved in one of our Flights;
- Share your pilot/flight expertise and experiences with students participating in our Flight Simulation activity;
- Be a judge at one of our Robotics Expos;
- Assist students with their final rocket preparations at our Fall semester Rocket Launch event;
- Be a technical advisor or a review mentor for a high school SPACE Flight team.

Time commitments for volunteers vary, depending on the task; some commitments are for as little as a few hours or less.

We'd love to have you on our team! Contact us for more information.