

S4

SMALL SATELLITES FOR SECONDARY STUDENTS

Prof. Lynn Cominsky
Sonoma State University
Education and Public Outreach Group



This work has been supported by NASA
Grant NNX12AB97G



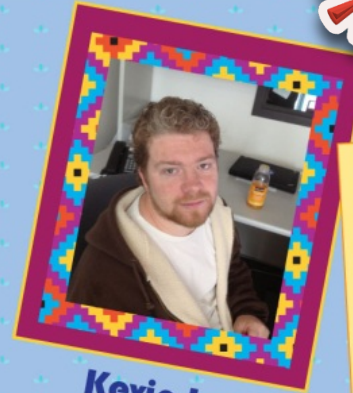
SSU E/PO group



lynn



Kevin M



Kevin J



logan

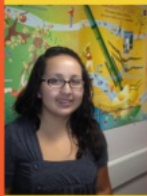


laura

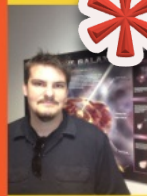


David

Aurore



Juanita



Kevin Z



Max



Ben



Brandon



Anna



lauryn

E/PO Group



What do we do?

- The mission of the SSU E/PO group is to develop exciting formal and informal educational materials to inspire students in grades 5-14 to pursue STEM careers, to train teachers nationwide in the classroom use of these materials, and to enhance science literacy for the general public.
- The S4 project is our newest curriculum development project, in partnership with AeroPAC, Endeavour Institute and NASA Dryden's Aero Institute



Meet the S4 partners

- **Association of Experimental Rocketry of the Pacific (AeroPac)** – the Northern CA/Nevada chapter of the Tripoli Rocketry Association
 - Tony Alcocer – President
 - Ken Biba – Education Director
- **Endeavour Institute** – Balloon Fests
 - Steve Kliwer, Director
- **Aero Institute** – Education for NASA Dryden
 - Russ Billings, Pre-College Programs Director

Schedule for the week

S4 Training, July 8 - July 13 2013

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	Monday 8	Tuesday 9	Wednesday 10	Thursday 11	Friday 12	Saturday 13
8:00 am				• Balloon launch		ROC Launch at Lucerne Dry Lake
9:00am	• Welcome/Intro to NASA programs - <i>Lynn</i>	• Discussion	• Discussion		• Discussion	
9:30am	• Icebreaker	• Continue flight board preassembly	• Intro to GPS and WiFi - <i>Lynn and Ken</i>		• Integration with rockets - <i>Tony</i>	
10:00am	• Overview of rocketry and ballooning - <i>Lynn</i>		• Install and test sensor(s) and GPS		• How to analyze payload data - <i>Logan</i>	
10:45am	Break	Break	Break	Break	Break	
11:00am	• Electronics basics - <i>Lynn</i>	• Flight Board tests	• continued sensor and GPS testing	• Displaying payload data - <i>Logan</i>	• WestEd Debrief	
Noon	Lunch	Lunch	Lunch- talk by Twiggs	Lunch	Lunch on your own then Free Time and/or relocate to Lucerne vicinity	
1:00pm	• Soldering 101 - <i>Kevin Z</i>	• Intro to Arduino and Programming - <i>Kevin J</i>	• Intro to tethered ballooning - <i>Steve</i>	• Analyze data and create presentations		
2:00pm	• Intro to payload elements - <i>Kevin J</i>	• Arduino Intro Test Activities	• Design and build gondolas			
2:45pm	Break	Break	Break	Break		
3:00pm to 5:00pm	• Begin pre-assembly of flight boards	• Load code into Arduinos for base components including WiFi and GPS	• Additional activity time for contingency	• Presentations by educators		

6pm - Palmdale Hotel
Sunset Bar and Grill
Paragon room 4

The training will take place at the Aero Institute,
38256 Sierra Hwy Palmdale CA
<http://www.aeroi.org/>

The rocket launch will take place at the Lucerne dry lake bed:
<http://rocstock.org/directions/>

Formal Presentations	Discussion	breaks
Hands-on Activity	ROC launch	Meals provided



Logistics

- Please eat breakfast at the Palmdale Hotel
- We are providing coffee breaks in the morning (M-F) and afternoon (M-Th)
- We are providing lunch M-Th
- We are providing dinner Tuesday evening – need headcount
- Jennifer (and later Ted) from WestEd - here to do external evaluation
- Laura is here to help with paperwork/forms and any other logistical needs M - W



Tuesday night menu

- Roasted salmon, potatoes, salad, vegetables, rolls
- Chicken Fettuccini, salad, vegetables, rolls
- Smoking club sandwich, fries
- Hamburger or garden burger, fries
- Alcohol is on your own tab (sorry, government rules)

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Icebreaker





It's time to get acquainted

- Find an educator you don't already know
- You have 10 minutes to talk to them and then you will report back about them to the group
 - What grades do they teach or the ages of the students they will work with?
 - What is their electronics experience?
 - What is their programming experience?
 - What type of rocketry or ballooning have they done?
 - What is the most important thing they would like to get out of this week?



Background music

- <http://www.youtube.com/watch?v=apemYk2oz7M>
- <http://www.youtube.com/watch?v=QFvNhsWMU0c>
- http://www.youtube.com/watch?v=XTvajOQ_xak

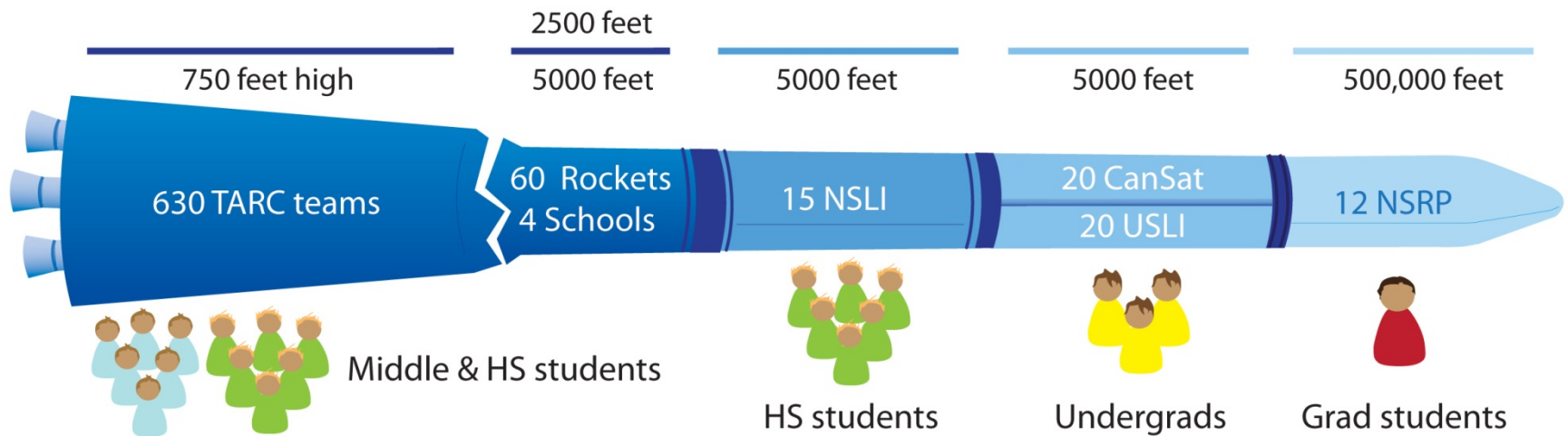
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Introduction to Rocketry and Ballooning



STEM Pipeline for rocketry



Team America Rocketry Challenge

- About 7000 students nationwide
- Model rockets that usually loft eggs to 500-750 feet and return them unbroken



The Coeur D'Alene (Idaho) High School team loading their model on the pad.

Photo by Glenn Feveryear.



The Geekette Team from Lake Braddock Secondary School (Virginia).

Photo by AIA.



Model vs. High Power Rocketry

- Motors are rated by thrust in Newton-seconds
- Each letter is a factor of 2 more thrust
- Model rockets are ¼ A to G (160 N-s, max)
- HP rocketry is H and above
 - Level 1 is H and I (640 N-s max)
 - Level 2 is J and K (2560 N-s max)
- We won't fly beyond Level 2 for this project
- (But Tony and Ken are Level 3 flyers)

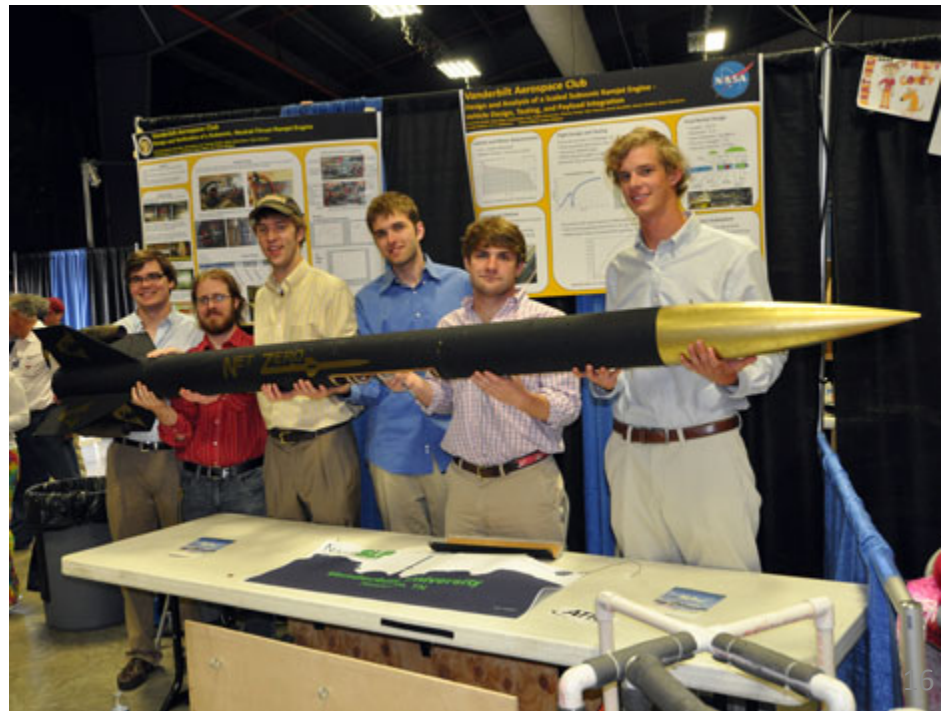
Rockets 4 Schools

- About 300 students each year from WI, IA, IL and MI launch HPRs from Spaceport Sheboygan (over Lake Michigan)
- Class 1 up to 2500 ft and Class 2 up to 5000 ft
- Design their own payloads, build rockets from kits



NASA Student Launch Initiative

- ~25 teams (middle/HS) chosen from TARC finalists
- Rigorous review process (PDR, CDR, FRR)
- Build payloads and HPRs, launch in Alabama to 5000 feet
- Also University level competition with another ~25 teams





ARLISS as the inspiration for S4

- AeroPac and Bob Twiggs started A Rocket Launch for International Student Satellites (ARLISS) over 10 years ago
- University students from across the globe come to the Black Rock desert to launch payloads which are ejected from the rockets
- Mostly students from Japan, but also Korea, India, Turkey, and a few from the USA



ARLISS experiments

- “CanSats” – coffee can sized, launched with M motors on Level 3 rockets
- Comeback rovers – autonomously navigate across playa to predetermined location
- http://www.youtube.com/watch?feature=player_detailpage&v=0sqJvJoJUD0#t=2s
- Flyback experiments – glide to predetermined location



The S4 concept

- We have designed a “flight board” which includes base components and optional sensors and have written an educator guide with background information, instructions and additional resources.
- You will be learning how to build, program and customize your payload
- We will fly them on balloons on Thursday, and you will acquire, analyze and present your data
- Saturday we will fly them on rockets with ROC club
- Next year, you will teach your students how to build their own payloads and fly on balloons or rockets



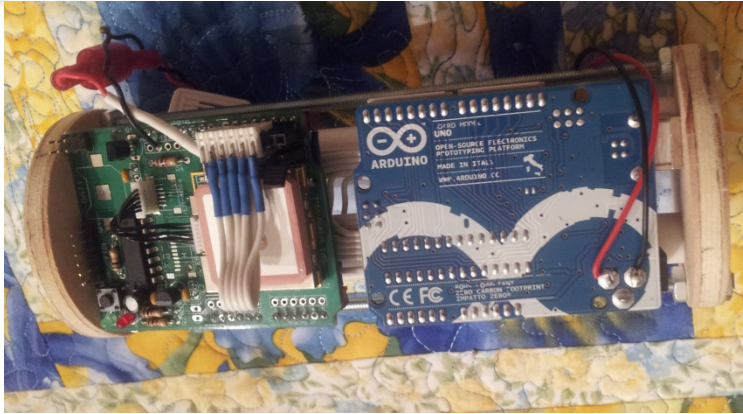
What we have been doing

- For the past 3 years, the SSU team has been learning how to fly rockets and balloons, while designing the S4 flight electronics and software
- Four of us are Level 2 HPR flyers (LRC, Kevin J, Logan, and Kevin Z) and we have also gone to balloon fest events
- The educator guide in your binder is a DRAFT – part of the goal for this week is to get your input and corrections to the guide.

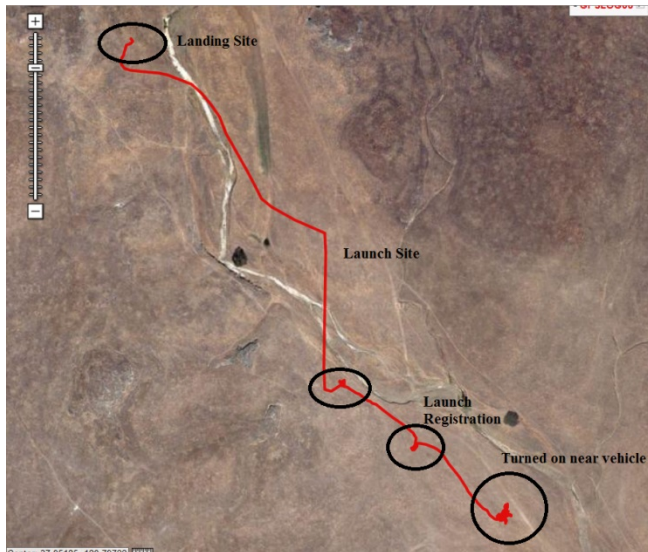
Payload prototype test for Small Satellites project

April 7, 2012

Sonoma State University E/PO built and launched a prototype CanSat payload on a high-powered rocket.



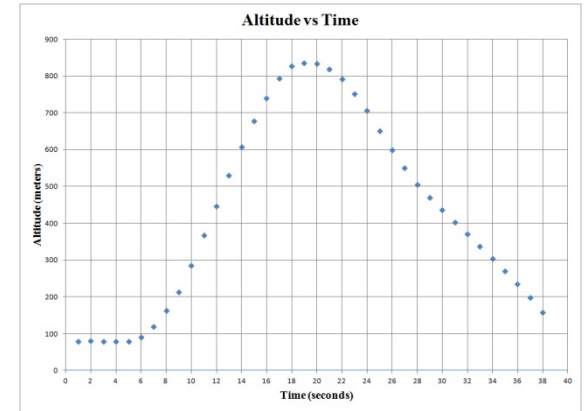
Payload
in CanSat
carrier



HP rocket
before
launch at
Snow
Ranch



Terrain map
showing the path
of the GPS on
board the rocket.



GPS readout of
altitude during
launch and descent

See the movie of the rocket
launch:

<http://epo.sonoma.edu/cansat/launch.MOV>

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<http://epo.sonoma.edu/cansat>

Virtual Classroom broadcasts Small Satellites project videos

September 13, 2012

Sonoma State University broadcast a series of videos from Black Rock, Nevada using the Virtual Classroom. These videos described the history of student satellite projects at Black Rock and the payloads that the students and teachers will be building next year.



Kevin John explains the payload elements in a video



Kevin Zack's Level 2 rocket launches at Black Rock



Flightline on the playa from the video



Lynn Cominsky and AeroPAC's Ken Biba with the Virtual Classroom from the video

See all the videos shown from the Virtual Classroom
<http://epo.sonoma.edu/cansat/ARLISS2012.php>

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<http://epo.sonoma.edu/cansat>



Virtual Classroom

- The Virtual Classroom is a converted mobile television van that can receive data from the payloads, video from webcams and send to classrooms through satellite internet
- Developed by Ken Biba originally with funding from the California Space Authority
- Will be used next year to provide live video and telemetry to your students from rocket launches



Ballooning for K-12

- Endeavour Institute holds yearly Balloon Fests in Paso Robles using tethered balloons to 500-1000 feet
- Co-sponsored by SSU's E/PO group through the Fermi mission and now by S4
- You will learn how to hold your own balloon fests and receive data from S4 payloads

BalloonFest payload prototype test for Small Satellites project



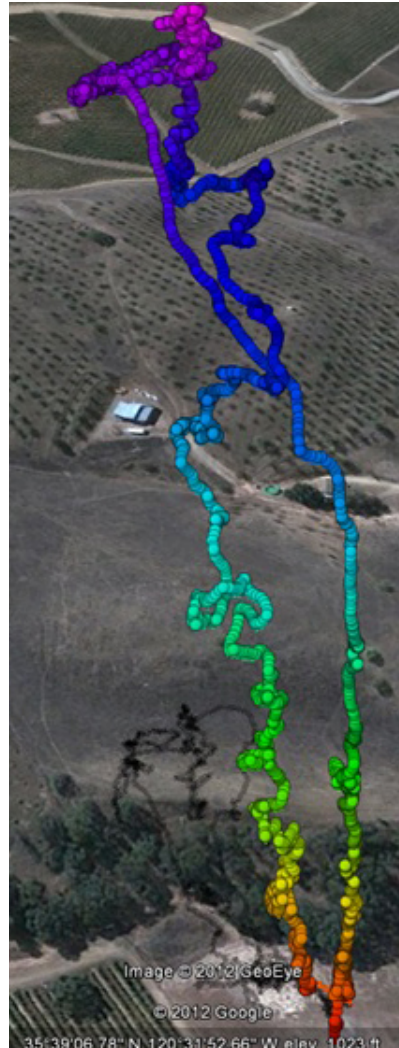
May 5, 2012, Paso Robles, CA

Sonoma State University E/PO built and launched a prototype CanSat payload on a tethered helium balloon.

Students get ready to launch



Google Earth map showing the projected path of the payload GPS



Balloons aloft to 300 m



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<http://endeavours.org/Events/BalloonFest2012/>

Regional Balloon Fest with Endeavour Institute

December 8, 2012

Sonoma State University tested WiFi functionality with different antenna configurations for prototype balloon payload at a launch event held at the Allan Hancock College, in Santa Maria, California



Students prepare to launch balloon

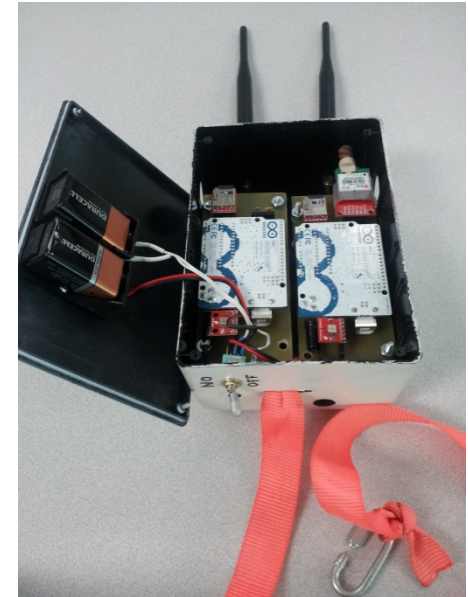
For more info:
<http://endeavours.org/events/BF2013Regional/index.htm>

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Balloon aloft

Balloon payload prototype



This payload has two complete sets of electronics to test connectivity to WiFi with antenna configurations parallel and perpendicular to the ground

Championship Balloon Fest with Endeavour Institute

April 20, 2013

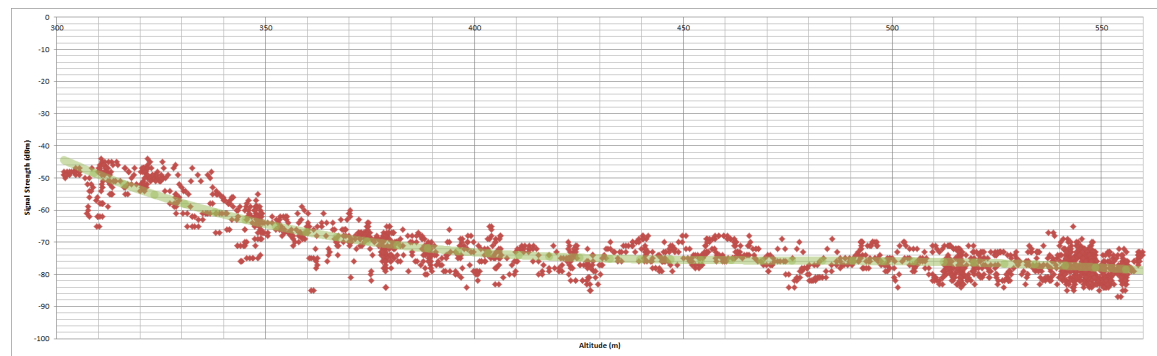
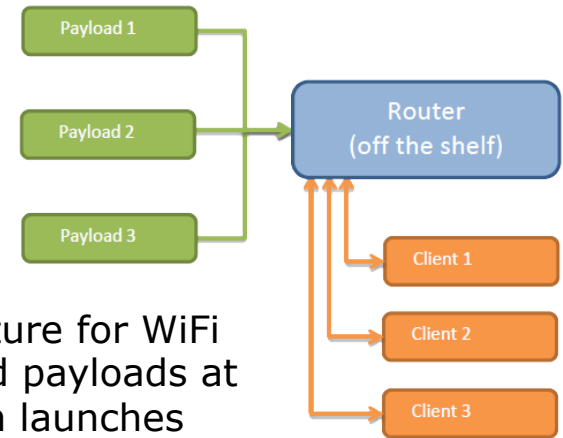
Sonoma State University tested WiFi functionality as a function of altitude for prototype balloon payload at a launch event held at the Tobin James Winery in Paso Robles, California



Our balloon at 1000 feet

For more info:
<http://endeavours.org/events/BF2013Championship/>

Architecture for WiFi
connected payloads at
balloon launches



Unidentified volunteer, Lynn Cominsky and Kevin John in Paso Robles

Lynn Cominsky
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<http://epo.sonoma.edu/s4>

Altitude (m) vs. Signal Strength (dBm) demonstrating complete functionality to 1000 feet (~300 m)



Project Schedule

- 2012-2013 Develop prototype payload hardware, educator guide draft and test flights
- July 8-13, 2013: Week-long teacher training with NASA Dryden, including balloon tests and launch with ROC in Lucerne Dry Lakebed
- Academic year 2013/14: Teachers build payloads with their students
- By Spring 2014: Student launches



Questions?

- We have sheets of paper on the wall to express your concerns, write down questions, ask logistical questions, etc.
- We'd love to hear from you!