NMSS
NEW MEXICO SPACE STUDIES

A Special Interest Group of the Upper Rio FM Society

Scott Stevenson – Director
Mike Pendley – Engineering Director
Alma Ripley – Carlos Rey Elementary School
Bill Ripley – Duke City Hamfest / STEMCOM 2014
Mark Hendricks – West Mesa High School NJROTC
What We Will Cover

- Creation and History of NMSS
- STEM and STEMCOM
- Regulations, Air Space and Balloons
- APS, NJROTC and NMSS
- Payload Development and Support
- Flight and Recovery
- Future of NMSS
Brief History

- Pre-2013 – How to bring Amateur Radio to schools
- 2013 Duke City Hamfest – Wanted High Altitude Balloon launch as special event to align with Alma Ripley’s presentation: “What Does Amateur Radio Have In Common With The New Common Core State Standards?
- Bill Ripley, DCHF - Call for Volunteers
- Scott, Bill and Alma Visit ANSR Launch
- Scott Stevenson – AARC Call for Volunteers
- Post-DCHF - NMSS is created
The Pressure is On

- 30 days to launch – NLG (Not looking good)
- Advice\help – Jack Crabtree and ANSR
- Group contributions – time and money
- Plan Plan Plan – Do!
- No Pressure…
- Successful Launch \Recovery of NMSS01 and the birth of the STEM initiative and new partnerships with “Pride of the South Valley” West Mesa High School, the “Pride of the North Valley” Valley High School, the “Bedrock West of the Rio Grande” Carlos Rey Elementary and the New Mexico Space Studies group
Hamfest, Check!

- What next?
- Develop our infrastructure
- Start regular launch schedule for who?
- Hams - ?
- Educators?
- STEM - We are going to school!
Enter the Schools

[Images of school entrances and logos]
Graduation Begins at Kindergarten

- Hands-on Project Based Learning begins in 1st Grade at Carlos Rey Elementary School in Albuquerque, NM

- What is STEM?
  - Science * Technology * Engineering * Mathematics

- The Common Core State Standards and current school curriculums, Mathematics and Science are reasonably well covered. Engineering and Technology are not.

- Technology
  - Is the use of science in industry, engineering, etc., to invent useful things or to solve problems
  - Is NOT Computers, Laptops, iPads, Servers, Printers, Scanners, Copiers, Promethean Boards, or Software
STEM & Ham Radio

- What is STEM? Strategies to join the study of Science, Technology, Engineering and Math together.

- STEM = Using mathematical skills and scientific theories to engineer new products with the use of technology.

- School teaches Math and Science. Engineering and Technology can’t be taught. It has to be the by-product of project-based learning.

- Amateur Radio – Rocketry – Robotics – High Altitude Balloon exploration are all projects that can’t be accomplished without the skills of Math and Science.

- Engineering a ham radio, competing in Team America Rocketry Challenge, building a robot that does what it is supposed to do, and all of the many components of HAB mission are the critical missing pieces for STEM to be a successful component in the educational arena.
How to Develop Radioactive Kids

- Use Amateur Radio and related technologies in schools to accomplish STEM Goals
- Take advantage of the vast cadre of willing and able volunteers to share practical and theoretical knowledge with students
- Forget the failed strategies that simply putting a radio in a school, running a license class and handing the kid a handheld is the right approach to growing our hobby and helping the school system
- It is necessary to objectively look at what the school district is trying to accomplish in order to figure out the best way to accomplish goals that will help the district, help our kids, and revitalize our hobby
How NMSS and APS Are Working Together

- Integrate Project Based Learning with Common Core State Standards (CCSS) and make it cross campus boundaries.

- PROBLEM: Traditional Paper-Pencil learning has been shown to be ineffective.

- SOLUTION:
  - Create “curiosity” among teachers and students
  - Stop giving answers before the question has been asked
  - Become the catalyst of knowledge and facilitator of inquiry based learning.
  - Look for ways for kids to work with their hands and heads, instead of focusing on the all-too prevalent “teaching for the test” and worksheets
WMHS & CRES Partnership Reinforces Goals

- When High School students teach 4th grade students about robots, rocketry and HAB exploration, the knowledge retention percentage for both groups increases to 90%.

- Learners retain approximately:
  - 90% when they teach someone else or use immediately.
  - 75% when they practice what they learned.
  - 50% when engaged in a group discussion.
  - 30% when they see a demonstration.
  - 20% when they learn from audio-visual.
  - 10% when they read.
  - 5% of when they learn from a lecture.
Case Study in Failure

- Something happened with this student in the blue shirt.
  - Between Feb. 21, 2014, when she operated this flight simulator for the first time, something clicked and she went from a quiet, meek yet proficient, 5th grade student to a “confident, curious, ‘leader of students’”.

- **Failure is Learning**
  - When her class’s payload was lost on NMSS-03, she created the analysis of probable causes, wrote a payload integration plan, divided the plan into step-by-step tasks and worked with small groups from her own class to re-build a new payload that flew on April 4 and returned to earth in perfect condition.

  - **With Project Based Learning, it is OK for kids to “fail”**.
APS STEM Trajectory
Bringing up a Child with STEM

- **Elementary**
  - Building a kit
  - Analyzing data pts.
  - Failure analysis

- **Mid School**
  - Modifying a kit
  - Correlating data pts.
  - Enhanced problem solving

- **High School**
  - Inventing a project
  - Analyzing data with models
  - Quality management

- **Post-Secondary Studies**
  - No required remediation
  - Higher Graduation Rates
  - More Productive Citizens
We Are Making a Difference

- Before April 4, 2014, this 5th grade student was disruptive, disrespectful, and challenging for all of us at CRES.

- At this moment when the HAB was launched with the payload that he helped build, he became “hooked”.

- Starting in 2017, Carlos Rey Elementary School will rise from being an “F” school to become the first APS South Valley STEM Title I Magnet School.
Transition Slide – see notes below.
STEMCOM 2014 – August 8-10, 2014

Science, Technology, Engineering and Math Using Communications (Amateur Radio)

- At the 2014 Duke City Hamfest and ARRL Rocky Mountain Division Convention we will offer an entire track of programs aimed at those that are interested in:
  - Attracting and retaining youth in Amateur Radio
  - Hearing about what has worked and what has failed
  - Helping with STEM activities in schools
  - Getting Amateur Radio in schools
  - Learning STEM-based topics themselves

- The STEMCOM Track will consist of
  - Forums
  - Demonstrations
  - Hands-on Projects
Transition Slide – see notes below
Regulations and Practice

- CFR Title 14, Part 101 Moored Balloons, Kites, Amateur Rockets and Unmanned Free Balloons
- Non regulated – 4lbs, 6lbs, breakaway
- Regulated – cut down, not over town!
File a NOTAM
Comms w/ ABQ, AEG, Center
You’re doing WHAT?
Follow the rules and be welcome.
Albuquerque Airspace

- Center – Albuquerque ARTCC (ZAB) “A”
- ABQ TRACON “C”
- AEG Tower “D”
- Area and Smaller Airports “E”
- NM Mostly “E”, Restricted MOA or “G”
Images of Airspace

Can I cross this Line?

Some Lines you do not want to cross.

Top = 9400’ MSL
6900’ MSL
ABQ Class C
7800’ MSL
edge-on view

Yes. But remain below the 6900’ MSL floor of the ABQ C airspace.

Yes. This line is the compass rose for the ABQ VOR.

No. Inside this blue dotted line is the Sandia Mountain Wilderness Area, No overflight allowed below 2000’ AGL.

Yes. But remain below the 7800’ MSL floor of the ABQ C airspace.

Yes. Inside this shaded area the Class E floor drops from 1200’ AGL to 700’ AGL with G airspace below.

No. Inside this solid magenta line is Class C airspace, it goes from 9400’ MSL down to the SFC.

No. These dashed magenta lines denote the “Surface area of Class E Airspace.”

AGL = Above Ground Level, MSL = Above Mean Sea Level
Typical Flight

- File NOTAM with FAA, and 24 hr notice
- Launch with permission – report as directed
- Penetrate Controlled Airspace
- ABQ Class C SFC/94, 69/94 MSL
- Federal Class A 180/600 MSL
- Back down - Federal Class A 600/180 MSL
- Balloon Grounded
JROTC & STEM Within APS

- STEM is a priority within DOD & JROTC

- JROTC programs can & should be a vehicle to drive STEM initiatives within APS.

- Generally speaking, JROTC instructors are used to the idea of dramatic change, something most teachers don’t do easily.
JROTC & STEM Within APS

- JROTC curricula, especially Navy & Air Force, are ideal for STEM & project based learning.

- STEM initiatives within APS JROTC
  - CyberPatriot
  - Sea Perch / MATE (Marine Advanced Technology & Education)
  - Rocketry / TARC (Team America Rocketry Challenge)
  - High Altitude Research (High Altitude Ballooning)
  - HAM radio
JROTC & STEM Within APS

- Benefits of HAM radio in JROTC in APS
  - Teaches kids about the RF spectrum
  - Teaches kids about the responsibilities of having a HAM license
  - Puts kids on a STEM track early
JROTC & STEM Within APS

- JROTC programs in APS committed to STEM
  - West Mesa High NJROTC
  - Albuquerque High AJROTC
  - Sandia High AFJROTC
  - Valley High AFJROTC
  - La Cueva High MCJROTC
  - Bataan Academy NJROTC (NNDCC)
  - Highland High NJROTC
  - Others:
    - Belen NJROTC
Many APS middle schools are involved in STEM within their JROTC leadership programs.

- Sea Perch
- Rocketry
- HAB

At present, 11 APS middle schools have leadership programs; several are on waiting list.
Transition Slide – see notes below
Technology Development is Cool
Technology Development Provides an Excuse to Build Cool “Stuff”

- Custom and Modified Electronics
- Software Development
- Special Payloads
- Mechanical
  - How to attach payloads
- Packaging
  - New ways to package experiments
- Payload Infrastructure
  - Cut-down
  - Power Distribution / data buss
  - Real Time Telemetry + command and control
  - “Standard” payload flown on every flight
Simplex Repeater Prototype (PCB in Process)

- $7 Radio Shack voice record module from Ebay + a PIC processor and a hand full of components.
- Repeater will connect to any transceiver.
Balloon Sniffer
(Just an Idea)

- A Byonics PICPAK like device that captures RF balloon APRS packets, data from an attached GPS and provides a bearing and distance to the balloon.
- This would be a small portable device that could be provided to chasers.
APRS Tracker / Locator / Beacon Combo
(Just Started)

- Reverse Engineer the Byonics MicroTrak-400
- Develop alternate firmware to let this frequency agile device serve two functions:
  - APRS tracker (with balloon specific features like max altitude reporting)
  - Beacon used for DFing the balloon
Real-Time 2-Way Telemetry, Command & Control (Just an Idea)

- Develop a by-directional Link based on a simple TNC and controller to provide real time command and control (e.g. cut-down) as well as telemetry from various experiments.
Cut Down Device (Tested)

- Prototype cut-down first tested on NMSS-03 worked perfectly but we need to refine the design, mass-produce, and integrate it with the overall command and control system.
The Ultimate Payload

- A autonomous payload that will fly home on its own.
Flight & Recovery

- Overall flight organization and planning is responsibility of the Flight Controller
- Three Phases to a Flight
  - Activity – Oversight - Communications
  - Launch - Launch Director, Launch Control
  - Flight - Flight Director, Flight Control
  - Grounding - Recovery Director, Flight Control
Document Set

- HAB Manifest
- Communications Plan
- Personnel Assignments
- Under development:
  - Guide (Policy) documents
  - Procedural Guidelines
Stupid HAB Tricks

NMSS01  Aim for Tribal Lands! (it landed on Tribal land and the recovery crew had to wait about an hour before the Tribal counsel would allow them to enter the land and retrieve the balloon)

- NMSS04  Let’s go to Texas! (the balloon found a large patch of easterly winds around 80 mph right before it was predicted to burst causing it to consider flying across the Texas border – it did cooperate and burst before crossing the state line)

- NMSS02  Put this rope around your waist! – (Lauch from Valley High School – as the balloon was ascending, the last payload was the delta frame carrying all of the flight computers, video, cameras, etc. The high school cadet holding the delta frame got her finger stuck causing the frame to launch in a vertical position instead of horizontal)

- What kind of balloon is that?
- Calculation Debates!
Future of NMSS

- Excellence in Near Space
- Education – more customers, more affiliates, model trajectory for STEM feeder schools
- STEM leader for ARRL
- Amateur Radio – we need payloads
  - Beacon for HF propagation study during DCHF
  - Cross band repeater for long distance communications
  - Any other wild idea you have
New Mexico Space Studies
“Excellence in Near Space”

- **Website**
  - [http://nm-ss.org](http://nm-ss.org)

- **Yahoo Group**
  - Send an email to: [NewMexicoSpaceStudies-subscribe@yahoogroups.com](mailto:NewMexicoSpaceStudies-subscribe@yahoogroups.com)

- **Google+**
  - [https://plus.google.com/114920387562909892995](https://plus.google.com/114920387562909892995)

- **Twitter**
  - [https://twitter.com/NMSpaceStudies](https://twitter.com/NMSpaceStudies)

- **Facebook**
Thank You