

AIAA OC Rocketry

AIAA OC Section – NAR #718

BEYOND THE CLASSROOM

Experiencing Science through
Rocketry+

ASAT 2014 May 3, 2014

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Presentation Goals

- ◆ Identify educational opportunities related to rocketry outside of the classroom
- ◆ Outline the primary AIAA OC Section educational program
- ◆ Inspire you to either
 - Become a mentor for AIAA OC Section
 - Become a mentor for another existing youth education program
 - Start your own program

Shortage of STEM students? Maybe . maybe not.. But

“The United States has enjoyed preeminence in aerospace for more than one hundred years... That supremacy is now in danger... The generation of aerospace talent that won the Space Race and the Cold War is reaching retirement age, and America is not producing the number and quality of engineers, designers and technicians needed to even begin replacing those who have served so well.”



From “Launching the 21st Century American Aerospace Workforce” AIA 2008



%An Eight Grader's Perspective+

"...while we hear science and math careers are fun, interesting, and well-paying, the actual scientists and engineers who visit our schools seem very one-dimensional"

"...we aren't being told or shown what engineering really is. Instead, we're assigned simplistic exercises like building bridges out of drinking straws and marshmallows or telling a toy robot to turn left and right"

"..."teamwork" we are told is vital in such work. STEM may well be team oriented, but we aren't learning how to work in teams"



IEEE Spectrum Posted 30 Aug 2013



How do we turn this around?+

“Ensuring a bright future for aeronautical/ aerospace engineering rests in the decisions made by government entities, policymakers, educational and research institutions, and, perhaps most importantly, by all the individuals who interact with the young men and women who will be the future of aeronautical / aerospace engineering”



Dr. Amir Gohardani , NASA ASK Magazine February 8, 2013

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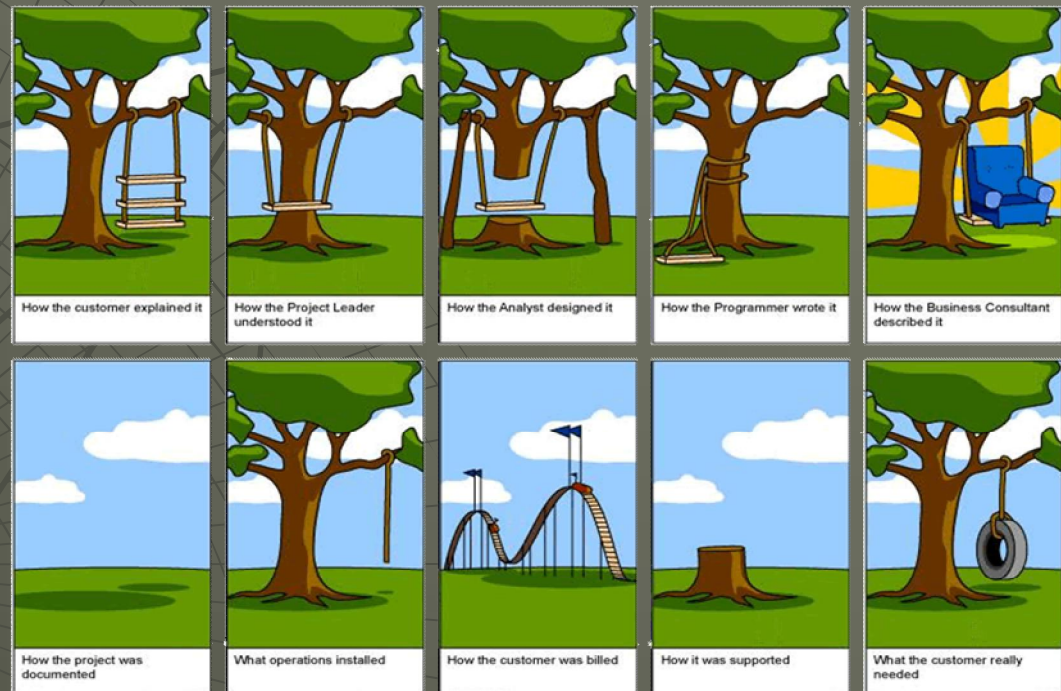
AIAA OC Section's Answer to Rocketry





With Rocketry you can engage students in

- ◆ Physics
- ◆ Aerodynamics
- ◆ Electronics
- ◆ Scientific Method
- ◆ Teamwork
- ◆ Mechanics
- ◆ CAD
- ◆ Communications
- ◆ English
- ◆ Technical writing
- ◆ Planning/Scheduling
- ◆ Budgeting





Goals for a STEM program

- ◆ It must be fun
- ◆ It must be safe
- ◆ It must reach a broad range of student ages
- ◆ It must be educational
- ◆ It must be increasingly challenging over time to retain students
- ◆ Some part of the program must address students with special needs



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One of AIAA OC Sections Educational Outreach Programs

Rocketry Outside of the Classroom



Rocketry Program Options (4th -12th)

- ◆ Rocketry without fire (launch almost anywhere)
 - Air Rockets
 - Foam Rockets
 - Water Bottle Rockets
- ◆ Rockets with fire (requires special area)
 - Estes with small black powder motors
 - Larger black powder motors – design your own
- ◆ Programs (National and local)
 - Rocketry Club (NAR Section)
 - Student Challenges through AIA & NAR
 - National and local contests
 - Regional events
 - Some put emphasis on design and payload
 - Some put emphasis on performance





Rockets without fire

Best suited for programs where you need to build and launch during the same session at the same location

- ◆ Summer Camps and Science Programs
 - Science Summer Camp for Village of Hope (Air Rockets)
 - Therapeutic camps (Air Rockets, Foam Rockets, Bottle Rockets)
- ◆ Youth Programs
 - Girls Inc (Foam Rockets)
- ◆ Youth Events
 - OC Fair Grounds Youth Expo and Imaginology (Air Rockets)
 - Long Beach National Robotics Week EXPO (Air Rockets)
 - Pump In (Fire Engines, Model Trains – and Air Rockets)
 - Space Day (Riverside – Air Rockets)
 - School Science Nights (Air Rockets)



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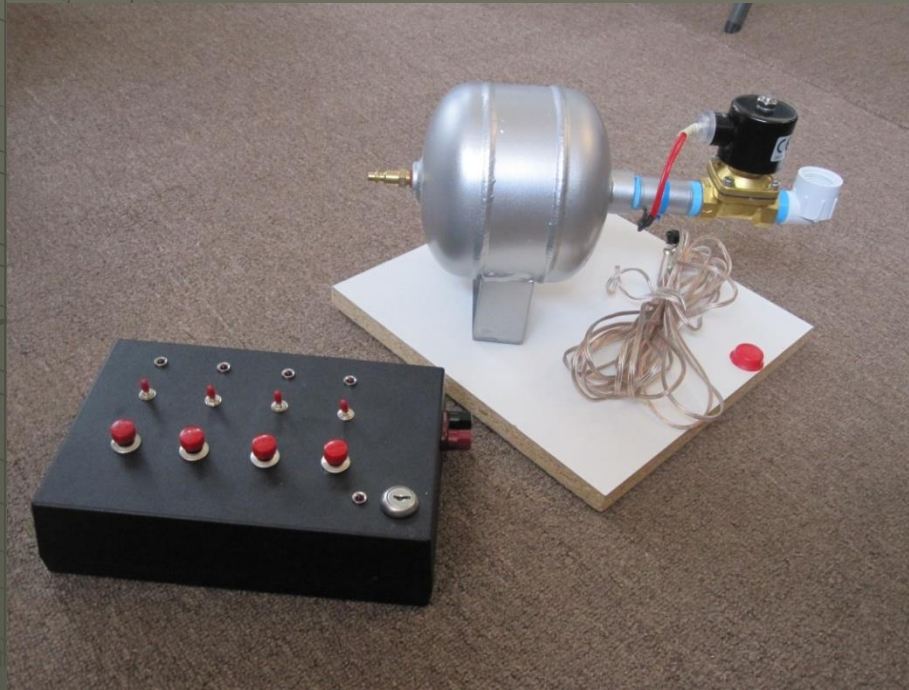


Air Rockets

Build Time	Total Time	\$/rocket	\$/Launch	Area
5 – 10 min	2 hrs	\$0.15	\$0.00	100'x100'
Build: Template, penny, tape, scissors			Launch: Air rocket launch system	



Air Rockets



Launch pads and controller (home built)

” Tank from truck air horn

” Solenoid from ebay

” Controller with enable switches & 12V battery

” Pressurize to 40psi with air compressor or bicycle pump



Foam Rockets

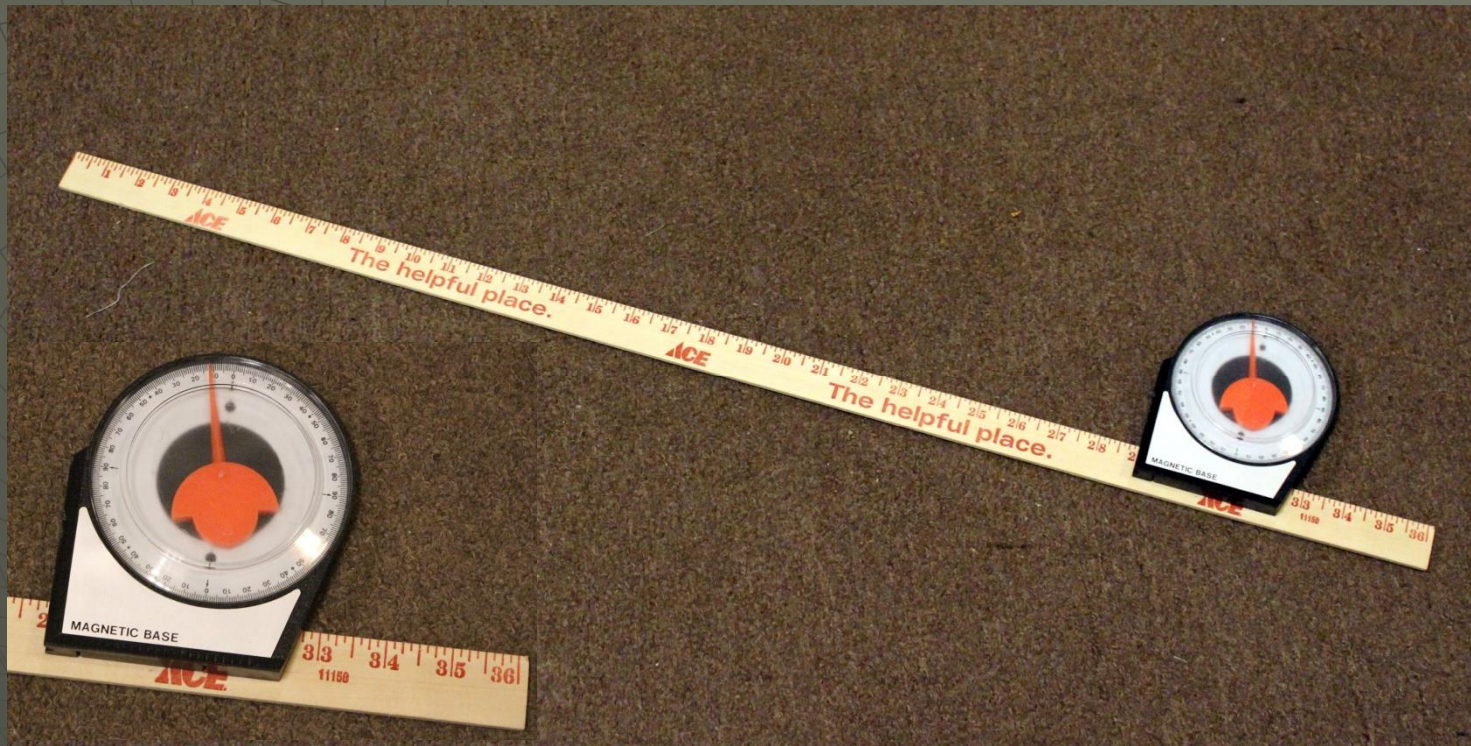
Build Time	Total Time	\$/rocket	\$/Launch	Area
30 min	2 hrs	\$.50	\$0.00	25' x 100'
Build: Insul Foam, card stock, rubber band, scissors, zip ties			Launch: Yardstick, angle finder, targets	



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Foam Rockets



Launcher

“ Yardstick – to measure thrust as distance of pull

“ Angle finder – to measure launch angle

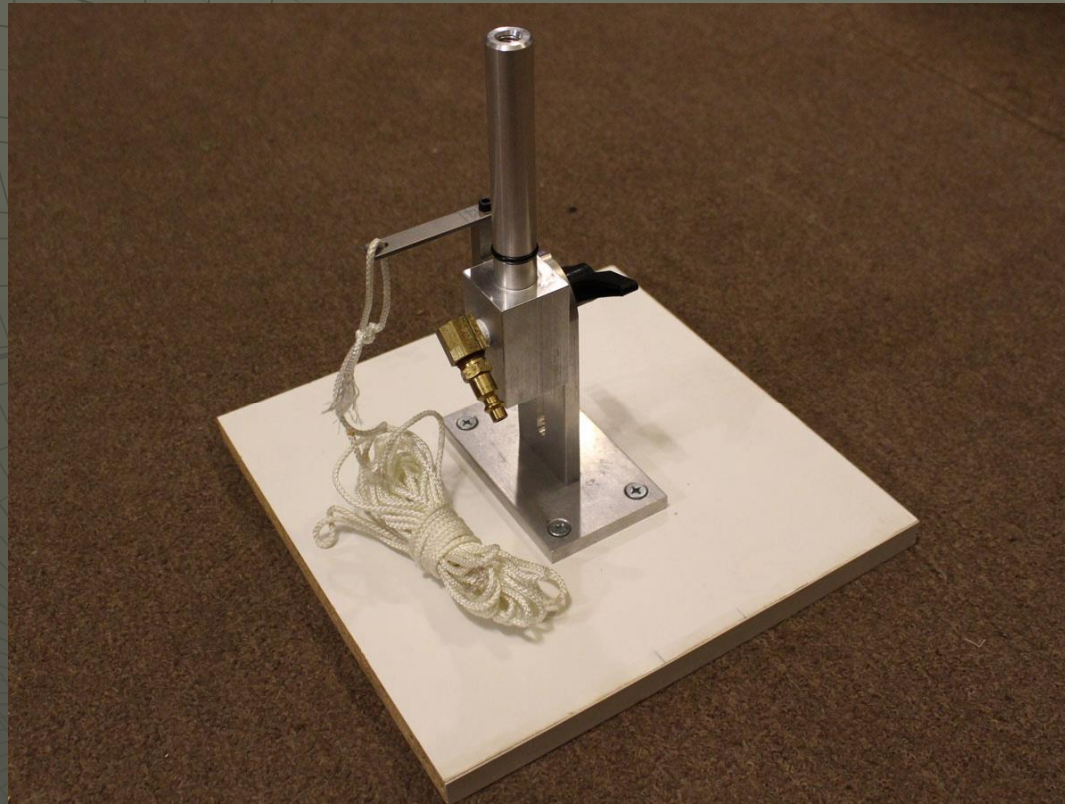


Bottle Rockets

Build Time	Total Time	\$/rocket	\$/Launch	Area
2 hours	4 hours	\$.50 + bottle	\$0.00	150' x 150'
Build: Soda Bottle, card stock, strapping tape, scissors, glue			Launch: Bottle Rocket Launcher	



Bottle Rockets



Launch pad

“ Commercially made (ebay)

“ Pressurize to 80psi with air compressor or bicycle pump

“ Release with pull on cord

Rockets with fire

Best suited for programs where you can build one day then launch at a different location another day. Some schools launch on their school grounds

◆ Youth Programs

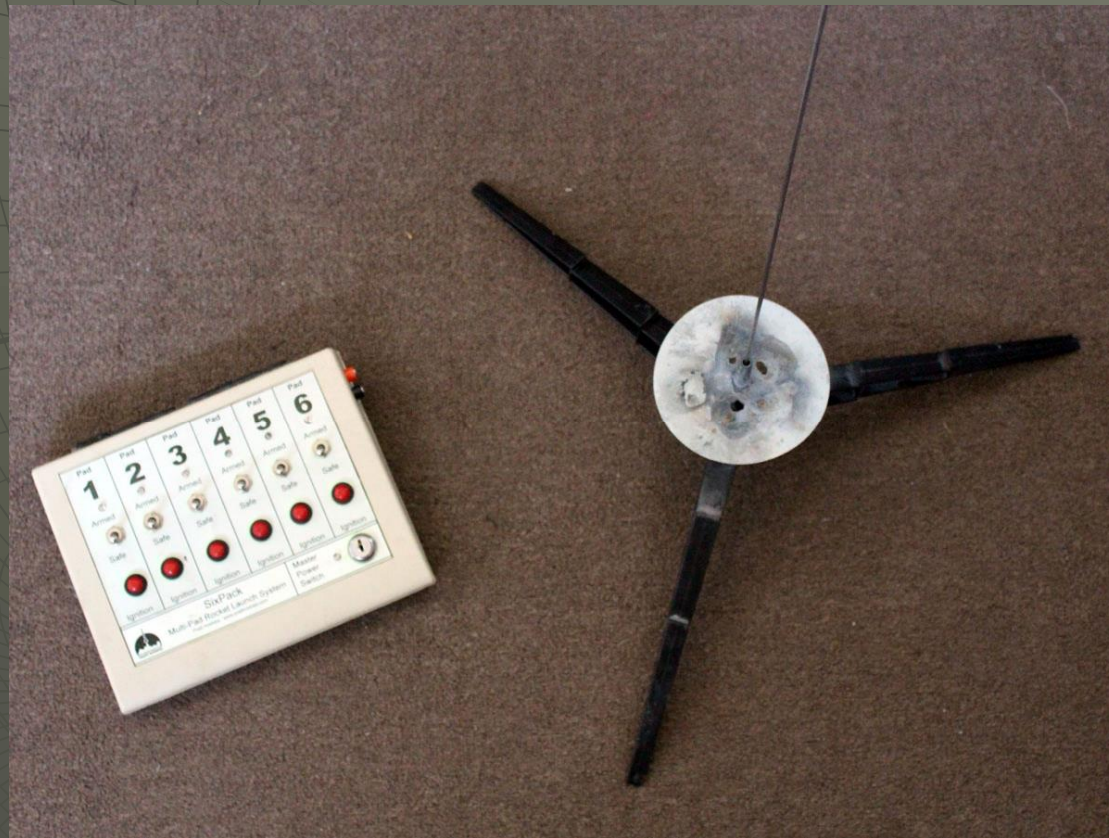
- Clubs
 - ◆ NAR Sections (All sizes, including member CAD designs)
 - ◆ Jackie Robinson Park Rocketry Club (Small Estes Kits)
- Boy Scout, Girl Scouts (Small Estes Kits)
- 4H

◆ Longer Term Science Programs

- NARTREK Jr – NAR progressive challenge for youth
- TARC - Team America Rocketry Challenge (National Contest)
- SPARC - Student Payload and Rocketry Challenge (AIAA OC Section Event)
- S4 - Small Satellites for Secondary Students (NASA and Sonoma State)
- SLI – Student Launch Initiative (NASA – funding victim but may return)



Rockets with fire



Launch System

” Commercial system

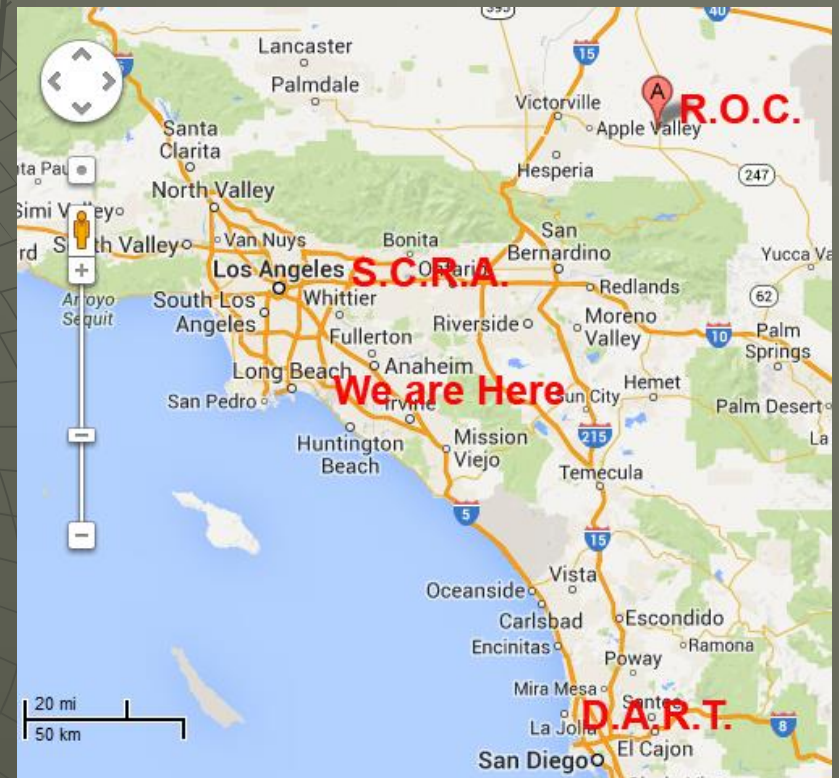
” Launch pad

” Multi pad controller with 12V battery

Where can you launch?

- “ Very restrictive - NOT in your back yard, park, or school yard
- “ State of California requires the landowners permission, the local fire authority's permission, and often a permit (\$300 - \$1,000 per day)
- “ Rockets above 500g and with larger motors have more restrictions in California

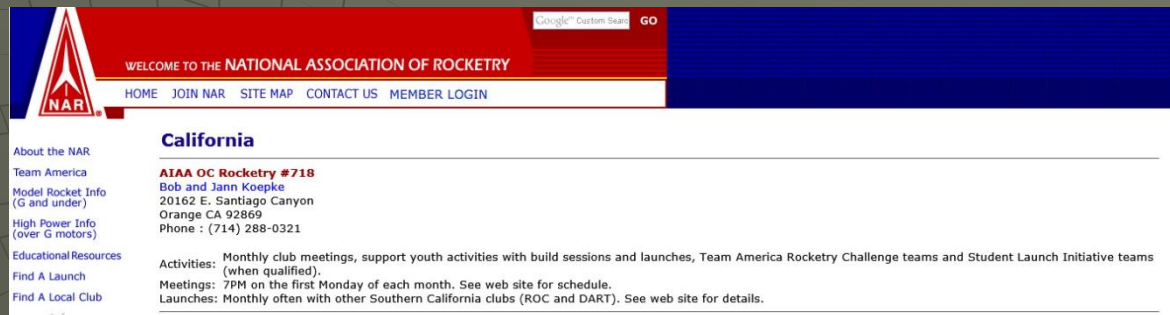
- “ Best to launch at organized launches (Distances are from the city of Orange)
- “ R.O.C. in Lucerne Dry Lake past Apple Valley (about 100 miles)
- “ D.A.R.T. at Fiesta Island near San Diego (about 90 miles)
- “ S.C.R.A. at Santa Fe Dam Recreation Area (about 35 miles) – limit is 500g rockets and “C” motors in spring
- “ There are more sites even further away – we will use those if needed



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NAR Rocketry Club



- ◆ AIAA OC Section formed AIAA OC Rocketry - NAR Section #718
- ◆ We received \$2,000,000 insurance from NAR for NAR events
- ◆ Meet once a month to design, build and learn
- ◆ Launch once a month





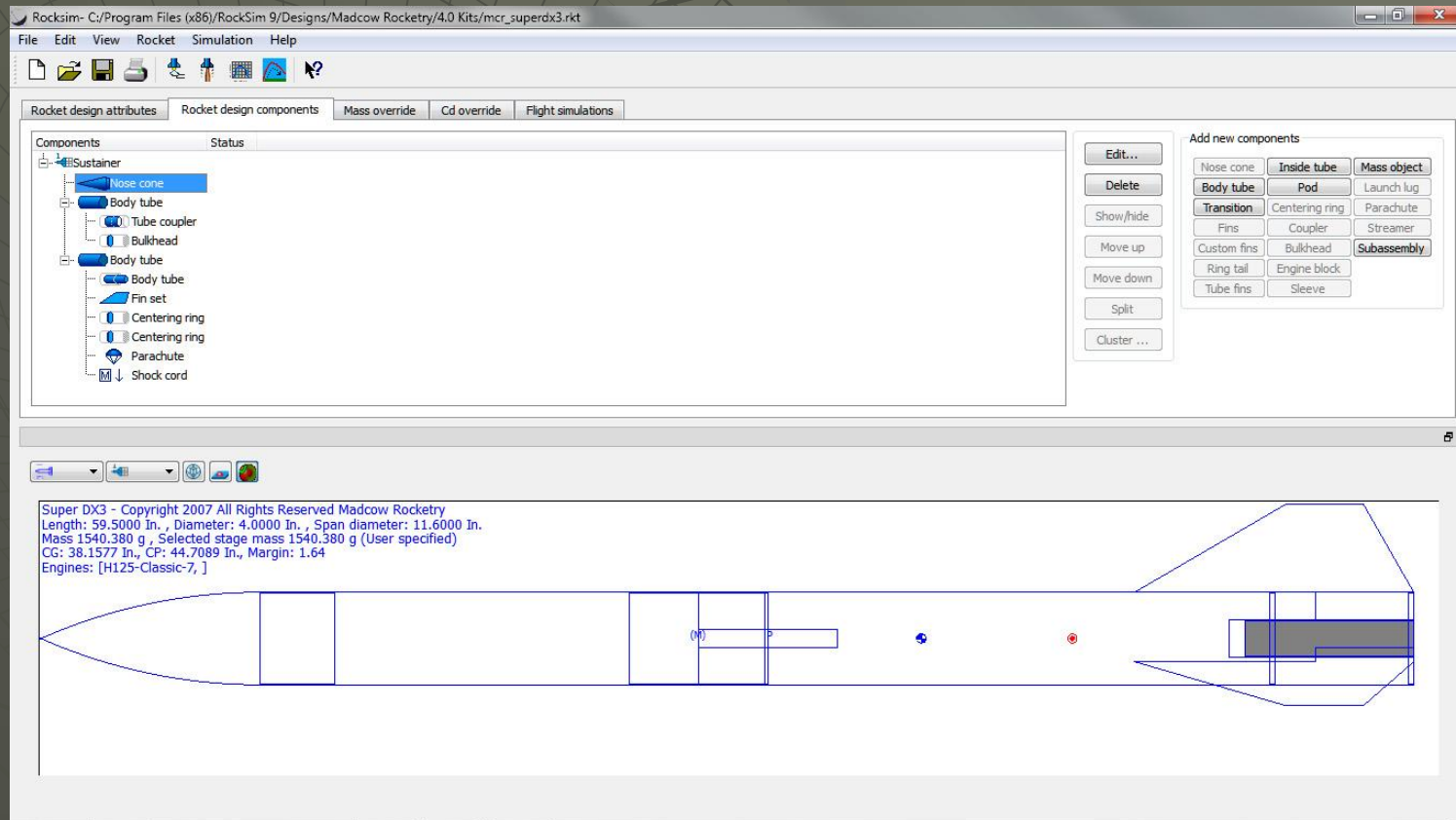
NARTREK Cadet Program

- ◆ Increasingly difficult challenges for students 9 – 14 (up to 18 is OK)
- ◆ Students receive a pin and certificate at each level
- ◆ Starts with small ready to fly rockets
- ◆ Recover with parachutes, streamers, helicopter
- ◆ Build multi-stage or cluster rockets



Rocketry CAD Programs

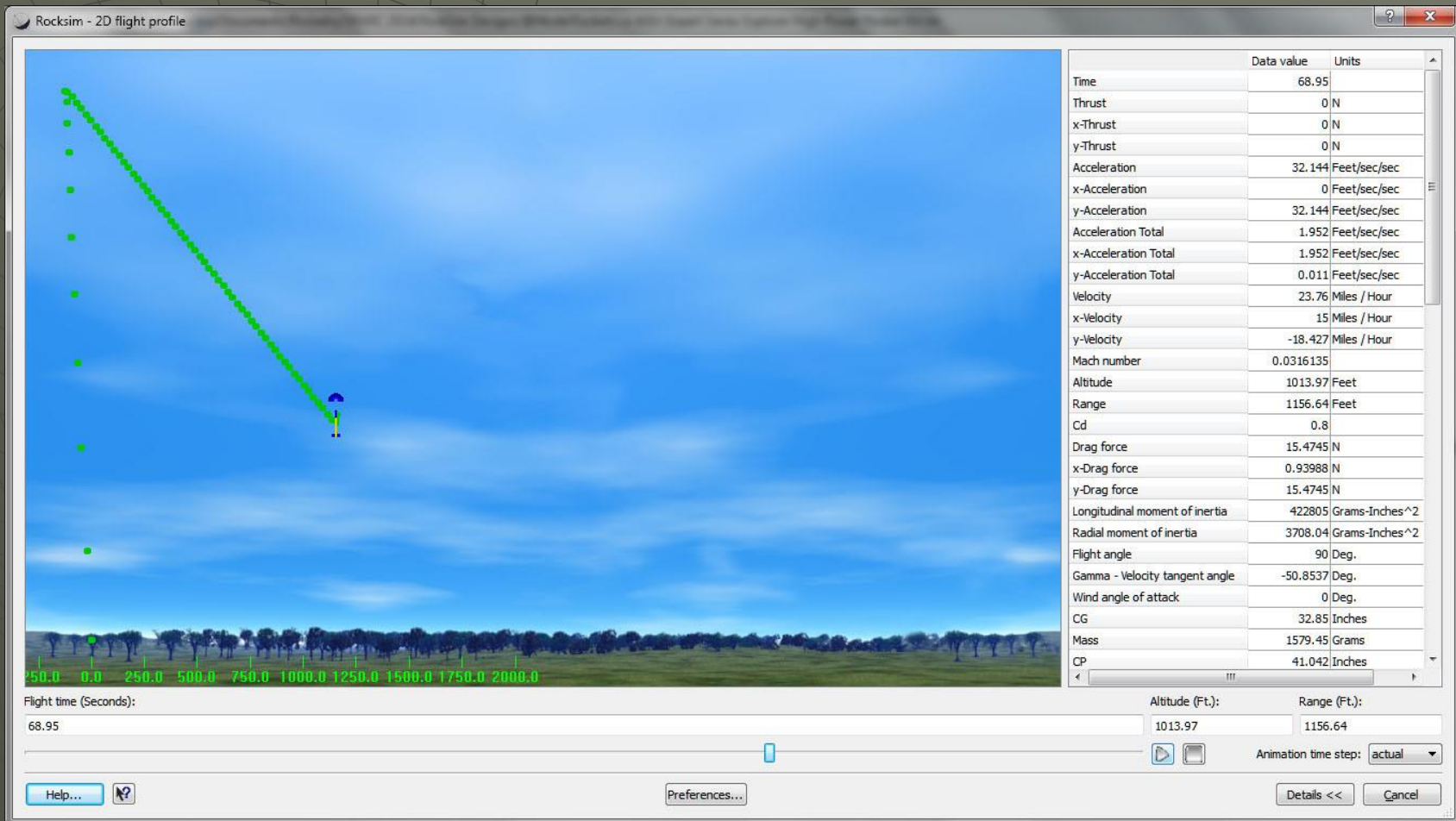
For many of the more advanced programs, students use a rocketry design CAD program like RockSim or Open Rocket for design and simulation



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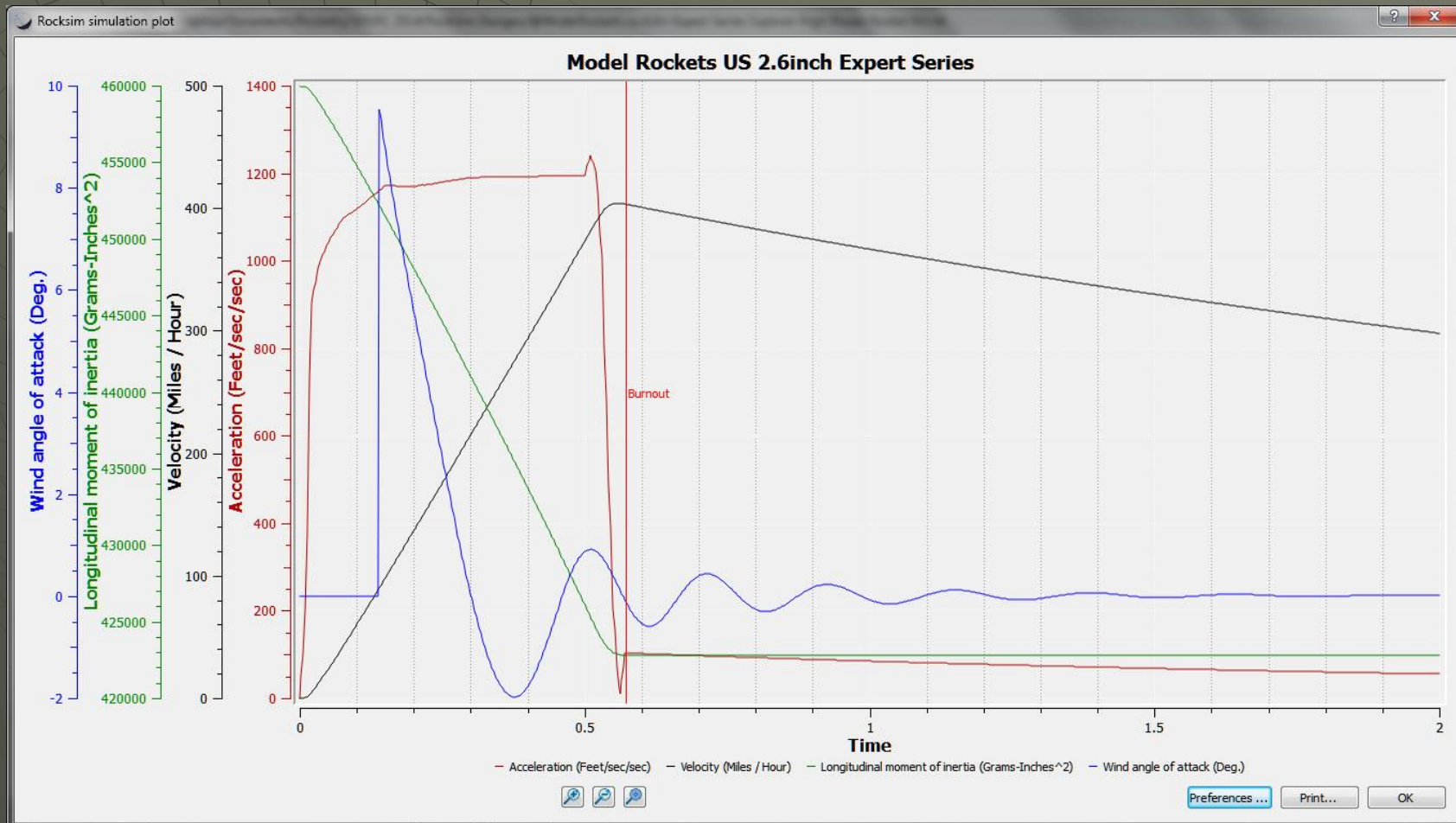
Rocketry CAD - Simulation



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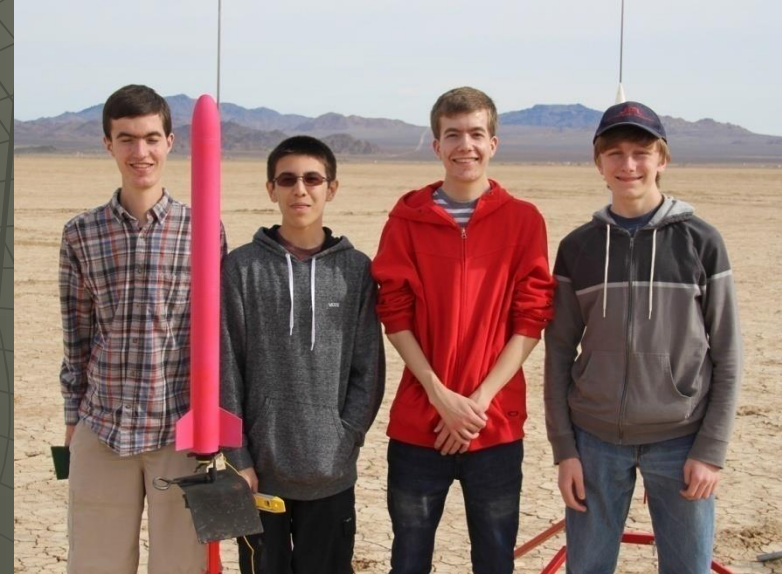
Rocketry CAD - Graphing





TARC

- ◆ TARC: Team America Rocketry Challenge
- ◆ AIA and NAR sponsored International Contest for 7th – 12th grades
- ◆ Students design, build, and fly a rocket to meet specific design criterion



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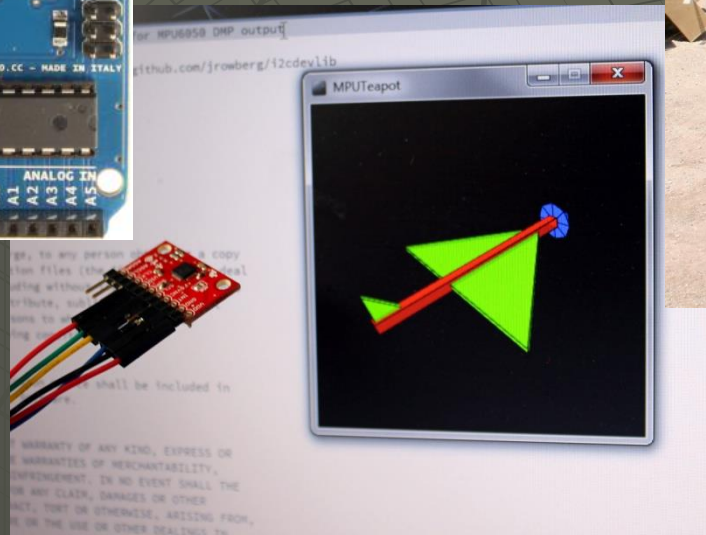
TARC Finals . Washington DC

- ◆ 750 Teams Compete
- ◆ 100 qualify for finals
- ◆ Top 10 receive cash
- ◆ Top team goes to European Air Show



SPARC

- ◆ SPARC – Student Payload and Rocketry Challenge
- ◆ AIAA OC Section conceived and sponsored event
- ◆ Summer program - 2014 will be the first year
- ◆ Rocket challenge with emphasis on the payload
- ◆ Students earn High Power Participation Certificate
- ◆ Participate in a Rocket Science Fair at final launch



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S4

- ◆ S4 – Small Satellites for Secondary Students
- ◆ Joint NASA and Sonoma State University Program
- ◆ Sounding rocket follow-on to TARC
- ◆ Emphasis is on a Rocketry or Balloon Payload
- ◆ Fall 2014 will be first time AIAA OC Section participates



SLI

- ◆ Engineering project with NASA – not a contest
- ◆ Students go through shortened Project Life Cycle (Respond to proposal, PDR, CDR, FRR, PLAR)
- ◆ Build, design, and fly rocket to 1 mile with Scientific Payload
- ◆ Final flight and Rocket Science Fair at MSFC in Huntsville
- ◆ Cancelled due to budget – we all hope it will return



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SLI . Test Launch



AIAA OC Rocketry

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AIAA OC Section Rocketry

Which programs do we do?

All of them – programs go through the school year and across summer

How do we get participants?

Best Method: Word of mouth

Be visible – attend a lot of events

AIAA emails to membership

Visits to schools & Youth Groups

Challenges?

Finding enough dedicated mentors



Conclusion

Ensure a bright future for aeronautical/ aerospace engineering by becoming an individual who interacts with the young men and women who will be the future of aeronautical / aerospace engineering



There are many ways to do this – “just do it”



Reference Links

- ◆ “Launching the 21st Century American Aerospace Workforce”
AIA 2008: https://www.aia-aerospace.org/assets/report_workforce_1208.pdf
- ◆ IEEE Spectrum Posted 30 Aug 2013:
<http://spectrum.ieee.org/at-work/education/is-a-career-in-stem-really-for-me>
- ◆ Dr. Amir Gohardani , NASA ASK Magazine February 8, 2013
http://appel.nasa.gov/wp-content/uploads/sites/2/2013/04/725261main_49i_tomorrows_engineers.pdf



General Links - 1

- ◆ AIAA OC Rocketry: <http://aiaaocrocketry.org>
- ◆ AIAA Educator Academy: <https://www.aiaa.org/AIAAEducatorAcademy>
- ◆ National Association of Rocketry (NAR): <http://www.nar.org>
- ◆ NARTREK Cadet Program: <http://www.nar.org/NARTREK/cadet.html>
- ◆ TARC: <http://www.rocketcontest.org>
- ◆ SPARC: http://aiaaocrocketry.org/?page_id=915
- ◆ ROC Club (Lucerne Dry Lake Launches): <http://rocstock.org>
- ◆ DART Club (Fiesta Island Launches): <http://www.dartrocketry.org>
- ◆ SCRA Club (Santa Fe Dam Launch): <http://home.earthlink.net/~mebowitz>
- ◆ S4: <http://s4.sonoma.edu>
- ◆ SLI: http://www.nasa.gov/offices/education/programs/descriptions/Student_Launch_Projects.html
- ◆ Estes Rocketry: <http://www.estesrockets.com>
- ◆ Estes educator: <http://www2.estesrockets.com/cgi-bin/WEDU100P.pgm>



General Links - 2

- ◆ NASA Rocket Educator's Guide: <http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Rockets.html>
- ◆ Apogee Rocketry: <http://www.apogeerockets.com/education>
- ◆ RockSim CAD: http://www.apogeerockets.com/RockSim/RockSim_Information
- ◆ Open Rocket CAD: <http://openrocket.sourceforge.net>
- ◆ Cubesat: <http://www.cubesat.org>
- ◆ ARLISS (Cansat): <http://www.arliss.org>



Thank you

Questions?