PEAK OF FLIGHT NEWSLETTER

ISSUE 504 / SEPTEMBER 17TH 2019

IN THIS ISSUE

TEACHING ROCKETRY IN TWO HOURS OR LESS

https://www.apogeerockets.com/Rocket-Kits/Skill-Level-3-Model-Rocket-Kits/USS-Andromeda

www.ApogeeRockets.com
4960 Northpark Dr, Colorado Springs CO 80918
Ph# 719-535-9335

APOGEE COMPONENTS

PEAK OF FLIGHT

Teaching Rocketry in Two Hours or Less

By Annette Sostarich

Introduction:

"Hi, my name is Annette, and I'm a Rocket Scientist!" That introduction to a class gets immediate attention! I then explain that while I have been paid occasionally for rocket-related projects, I don't work for NASA, and I'm not a professional, just a dedicated amateur. I figure if you can design a rocket and build it from scratch, and it performs as designed, you can call yourself a rocket scientist. After all, it's not Brain Surgery...

I have recently had the great pleasure of teaching several classes on rocketry to children – and a few adults –at public libraries around town. My local makerspace has made it possible to teach all sorts of things at the library; I've also taught soldering and kite-making. My students have been as young as six or seven, although at that age, they usually need a lot of help. I don't know how old my oldest student was, but she had gray hair!

I've developed a curriculum that seems to be well received and fairly simple. At the end of the two hours, students leave with a flight-ready rocket, and at least a little bit of practical theory on rocket flight. I use an abbreviated version of Apogee's educator package (available at https://www.apogeerockets.com/Education) to demonstrate that every part of a rocket has its counterpart to the "big ones" at NASA (not the "real ones" – our rockets are real, too!).

The objective is not just to get them interested in model rocketry, but also to give them something that causes them to think. It's important to me that we raise a generation of "makers" rather than passive consumers. A little hands-on experience can be priceless to those who may be spending too much time in the "virtual" world. One of these children could be the first human on Mars, so we need to invest in their futures!

Rocket kits:

Since the library only allows 2 hours maximum, my first objective was to find a rocket kit that could be completely assembled and ready to fly in less time than that. While some of the balsa finned kits could possibly meet that objective (not counting paint), I wanted something that would look "finished" at the end of the class. It also has to be easy enough for someone who's never built anything from a kit in their life, so molded plastic fins were the most appropriate. This narrowed the search for a suitable kit down to kits that were:

- Available in bulk packs, for economy reasons
- Easily buildable in about an hour
- Pre-finished in some way, and
- Used the lowest tool and material count

Several "Skill level 0" Estes kits were candidates, but required the use of plastic model cement or super glue to assemble the plastic parts. I didn't want to complicate things by the use of two different types of glue, not to mention the hazards of super glue in the hands of a kid. I've found that the Estes Alpha III (https://www.apogeerockets.com/Rocket-Kits/Bulk-Rocket-Packs/ALPHA-III-12-pack) seems to be the best. Even though it has plastic fins and nose cone, the designers brilliantly avoided plastic cement or super glue by "trapping" the fin unit between two centering rings glued to the motor mount. This way, the class can stay with using white glue throughout the assembly, and it's pre-finished and available in 12-packs. The only difference between the bulk packs and the single, retail version is the bulk-pack rockets don't have the 4-color fancy label. Each kit is individually bagged with its own instruction sheet (Photo 1). Plus, the Alpha is a classic design.

FIGURE 1 - ALPHA III KITS

Continued on page 3

About this Newsletter

You can subscribe to receive this e-zine FREE at the Apogee Components website www.ApogeeComponents.com, or by clicking the link here Newsletter Sign-Up

Newsletter Staff

Writer: Annette Sostarich
Layout / Cover Artist: Matthew Martinez
Proofreader: Michelle Mason

Teaching Rocketry in Two Hours or Less

Continued from page 2

Equipment:

I bring a toolbox packed with the things needed for each class (Photo 2); it's important to stay organized, especially

FIGURE 2 - ORGANIZED TOOLBOX

when there are children involved. The box contains all the tools and supplies needed:

•Several small bottles of white glue; I prefer "Tacky Glue," for it's heavier body and "grabbiness."
•Pencils
•Rulers
•Scissors for opening the bags and cutting out shock cord mounts
•Snap knives for cutting the slot in the motor mount tube; I only have two of these, and keep them under strict control. Some children might be too young to use a knife safely.
•Sandpaper for making tight rings and nose cones fit, though I haven't had to use it yet
•Masking tape for loose-fitting nose cones
•A Sharpie permanent marker, so students can write their names on their rockets (Especially important during a launch, when there might be a dozen identical rockets)
•A bulk pack of 24 A8-3 motors (https://www.apogeerockets.com/Rocket_Motors/Estes_Motors/18mm_Motors/Estes_A8-3_Bulk_24pk), including wadding and igniters
•A Low Power Launch Pad (https://www.apogeerockets.com/Launch_Pads/Sky_Complete_Launch_System)
•A launch controller (Mine is homemade)
•Several copies of the class handouts (I believe in giving students information they can take home, rather than a PowerPoint presentation)
•A dozen or so Estes Alpha III rocket kits (Alpha IVs are great, too, but not available in a bulk pack) (https://www.apogeerockets.com/Rocket-Kits/Bulk-Rocket-Packs/ALPHA-III-12-pack)
•Some newspaper to protect tables from glue drips

Setup:

I have a display model of the Alpha III that I place on an Estes Porta-Pad (Photo 3), along with a launch controller

Continued on page 4

Teaching Rocketry in Two Hours or Less

Continued from page 3

and a high-power rocket or two (Photo 4) to illustrate how far one can go with this hobby. I display a 38mm motor casing – biggest size I own – and explain that with some experience and a few more birthdays, they could be flying rockets so tall, they wouldn't fit in the room!

Each student gets a kit, the tools needed, and an info package with the local club's launch schedule, diagrams naming the parts of a rocket and explaining their function,

FIGURE 3 - ALPHA III DISPLAYED ON A LAUNCH PAD

FIGURE 4 - HIGH POWER ROCKET

model rocket flight profile, motor construction and operation, a pre-launch checklist, and the model rocket safety code (Photo 5). I also include a page with links to local and online hobby shops that sell rocket supplies (including Apogee, natch!). Sometimes I can get another member of our local

FIGURE 5 - TABLE OF ROCKETRY CONTENTS

Continued on page 5

Teaching Rocketry in Two Hours or Less

Continued from page 4

rocket club to come and help out. This is particularly useful with larger classes. Unfortunately, I never know how many are going to show up, as the library does not always have a sign-up sheet, and there are often last-minute arrivals. I tell the Library people to limit the class size to 12, but I've had as many as 14, and as few as one!

Curriculum:

The first question I ask is, "Why rocketry?" Usually the response is, "Because it's cool!" Of course, it's cool (We all know that!), but there are plenty of other reasons:

•It teaches craftsmanship, problem solving, and scientific thinking.

•Provides a great foundation to an engineering or other technical career; Many astronauts got their start this way.

•It's the cheapest powered aerial vehicle you can get, and it's capable of hundreds of mph, thousands of feet altitude! Stick that in your R/C drone!

•The Team America Rocketry Challenge. This is a program that gives middle-school students a "mission" that their team needs to fulfill with a rocket designed and built by the students. There's a $100,000 prize package at stake!

I ask the class, "What is a rocket?" I explain the difference between a rocket and a jet; that a rocket carries its own oxygen with it so it can fly in the vacuum of space. I briefly explain Newton's law of action/reaction, using the example of sitting on a skateboard and throwing rocks behind you.

I discuss the aerodynamic forces acting on a rocket, how recovery works (fireworks fly once; a model rocket is reusable), the functions of the motor, stability – Why we put fins on the back, and why don't some of the big rockets have fins?, How to find the Center of Gravity (CG), and how it relates to the Center of Pressure (CP). The model rocket safety code is covered, with explanations of why the rules are there. It's important to stress that model rocketry is very safe, as long as the Safety Code is followed.

I mention that our club does things a lot like the "big rocket" guys, with Safety Officers, Launch Control Officers, and countdowns. We also sometimes have spectacular disasters, just like everybody else in the rocket business, and they are always learning experiences. We just don't spend millions per launch!

The Students:

The trouble with programs like this is sometimes the kids are just shuffled off to the library as a form of babysitting, and they may have no real interest in the subject. I try to make it as exciting as possible, and sometimes I'm rewarded by a child that actually pays attention and asks insightful questions. Unfortunately, most are just looking for a new toy. The rare one who actually engages makes it all worthwhile, though. I've had two or three out of maybe a hundred that seemed to be the type to become astronauts, scientists, or engineers.

Building the rocket (Photo 6):

Many students, even some older ones, seem to have issues comprehending the printed instructions, so I circulate

FIGURE 6 - YOUNG ROCKETEERS

Continued on page 6

Teaching Rocketry in Two Hours or Less

Continued from page 5

through the room offering help where needed. I try not to actually do anything for the students; instead, I simply stop them if they're doing things out of order or assembling the wrong parts, and refer them back to the instructions. If they've already assembled something wrong, I can usually catch it before the glue grabs and salvage the situation. This is one case where the tendency to use too much glue is actually helpful, because it won't grab as quickly. It's nice to have a few spare parts on hand in case something small gets lost in the confusion, though that rarely happens because I make sure the small parts, like eyelets and launch lugs, are dealt with as soon as practical, and attached to something larger. Test fitting parts before gluing is emphasized. All the knowledge that experienced builders have known for decades, and now take for granted, has to be remembered and touched on.

I also have the students do some assembly steps out of order, to allow sufficient glue drying time. While the motor mount is drying, we jump ahead to installing the launch lug, making the shock cord mount, and assembling the parachute.

The two main things my students seem to find somewhat challenging are measuring the motor mount tubes accurately, and for some strange reason, tying the "larks head" knot to attach the parachute to the eyelet in the nose cone. One problem with the latest crop of Alpha IIIs is the metal eyelet that screws into the nose cone often has a gap in it large enough for the parachute lines to slip out until the knot is tightened; I keep a pair of pliers handy to squeeze those eyelets shut.

I have only had a couple of students – out of all my classes – abandon the project in the middle, but the rest leave with a rocket they can be proud of. Those abandoned projects are my source of spare parts!

Frequently the librarian and parents get involved, also, and they can be a great help, especially with a large class. Several times the librarian even built a rocket for himself! (Photo 7)

FIGURE 7 - LIBRARIANS BUILD ROCKETS TOO

Flight Prep:

Once the construction is done we take a short break to allow some drying time, and then move into launch prep. I explain the function of recovery wadding, and why we don't launch rockets by lighting the fuse and running away anymore (40 or so years ago, when I was a kid, a friend was launching a rocket with a fuse, and sure enough, the pad fell over before ignition and we had a "land shark" on our hands!). In my last class, I demonstrated how an electrical igniter works.

Continued on page 7

Teaching Rocketry in Two Hours or Less

Continued from page 6

They learn how to install recovery wadding (Photo 8), pack the parachute, and install a motor and igniter properly. I tell them about our local club, Southern Arizona Rocketry Association, and how launching with a club has multiple benefits: Clubs offer lots of help and know-how, extra supplies, and – maybe most important of all – it's a lot harder to lose a rocket when flying with a club, because if you don't find it, someone else usually will!

FIGURE 8 - INSTALLING RECOVERY WADDING

I also tell them about our makerspace, without which these classes wouldn't be happening. The makerspace contacted the County Library system and offered the expertise of their members. If you have a makerspace in your town, I urge you to check it out. My last scratch-built rocket had laser-cut fins and a custom-turned wood nose cone, thanks to a makerspace. If you're in the Tucson, Arizona area, check out xerocraft.org for a good makerspace.

Launch:

We rarely have an opportunity to launch the rockets after a class, because our city Parks and Recreation Department has a strict prohibition against flying rockets, and there aren't many other places usable in the city. Sometimes the librarian will suggest the parking lot, but that's always a bad idea – too many chances for landing on a roof or light pole; I want to give students every opportunity for a successful first flight.

Our club has, however, secured limited permission in one of the local parks, although only with advance notice and a lot of groveling. When we use the park, one of our club members brings extra club launch equipment.

I'll usually fly my demo Alpha as well, as a lead-off, so the students know what to expect.

It pays to plan well ahead if you're hoping to have a launch as part of the class. Remember, most of your students won't

Join Tripoli.org
Mention Apogee Components

Continued on page 8

Teaching Rocketry in Two Hours or Less

Continued from page 7

have transportation of their own, so the launch site should ideally be very close to the classroom. Also, remember that the weather might not cooperate, so don't give the students promises only to dash their hopes when the wind picks up.

We once had the good fortune to have a vacant lot across the street; it was big enough that we did not attract any attention, so we took my Porta-Pad and controller over there for a couple of flights. Fortunately, it was a small class.

Conclusion:

That's a lot to pack into two hours, but even though sometimes a minor point gets overlooked, the basics can be easily covered in that time. Some of the talking points are covered during the build phase; I try to keep the introduction fairly short because nobody wants to hear a long lecture when they came to make something. There's usually time for a Q&A session after the build, but don't be too surprised if there aren't many questions.

I had no idea that libraries offered classes taught by someone other than a librarian, and they may even pay you to do it! Teaching rocketry is a highly rewarding experience, although sometimes it requires patience. Stay organized; I frequently find that the parents or librarians are happy to help out. See if your local public library has a program for classes. Check with your local club as well – they would probably love an opportunity for exposure, and they can help get a foot in the door more easily than an individual. Plus, they'd probably even be willing to help! Be sure to follow the rules about launches; check ahead of time whether you can launch in parks or other local spaces. Have fun paying it forward!

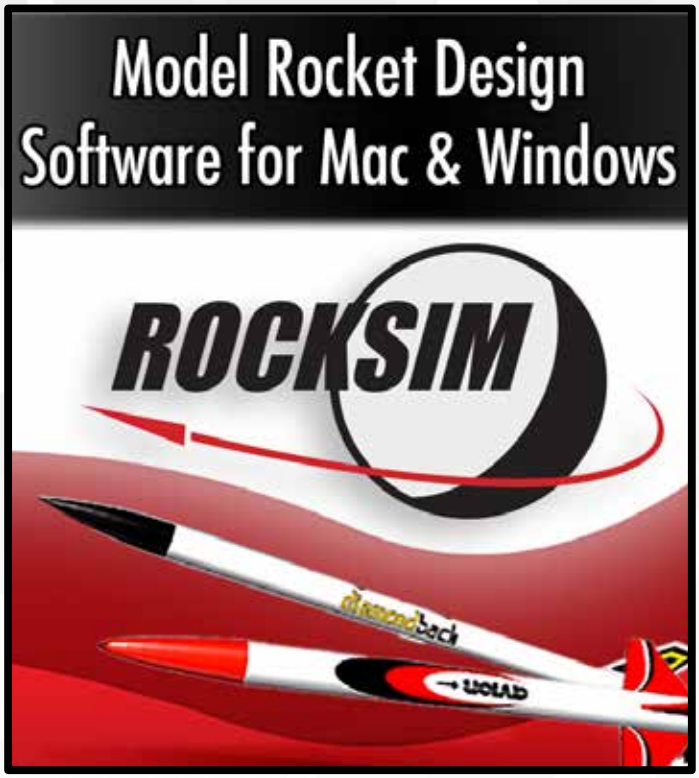
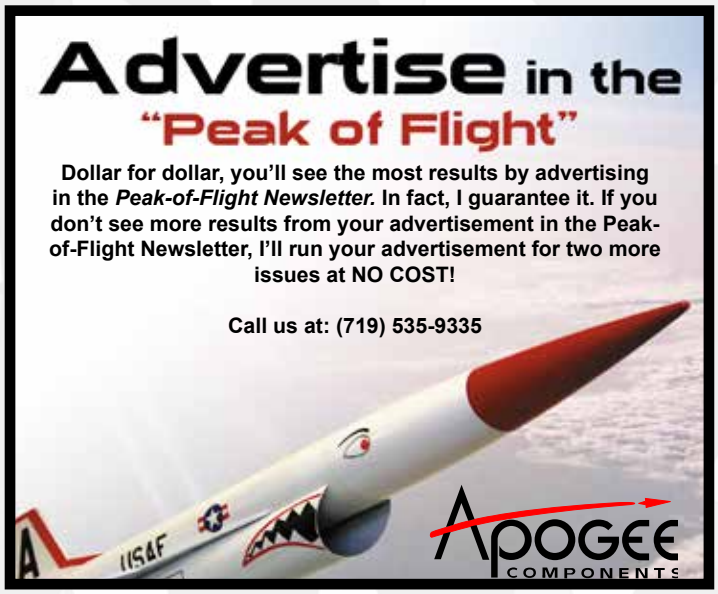
Join The NAR.org
Mention Apogee Components
NAR

About the Author:

Ever since she can remember, Annette Sostarich has been fascinated with two subjects – electronics and aviation. From watching planes take off as a kid on Saturday mornings to over 450 parachute jumps, designing and building numerous kites, volunteer work at Tucson, Arizona's Pima Air & Space Museum in their restoration hangar, and now designing unusual rockets, there have been a lot of adventures. Her electronics background began with picking up a soldering

Continued on page 9

Teaching Rocketry in Two Hours or Less

Continued from page 8

iron by the wrong end at the age of 12, and has since been parlayed into a part-time computer repair business. She is applying electronics to rocketry using subcompact video cameras, GPS transmitters and dual-deploy altimeters. She met her husband of 34 years while skydiving, and they jumped into their own wedding. Her husband is an aircraft mechanic and they are currently building an airplane in their garage; he does the structure and she helps with wiring.