Adventures in Model Rocketry

A Presentation of the

Puget Sound Rocketry Club

(PSRC)

National Association of Rocketry

Section # 763

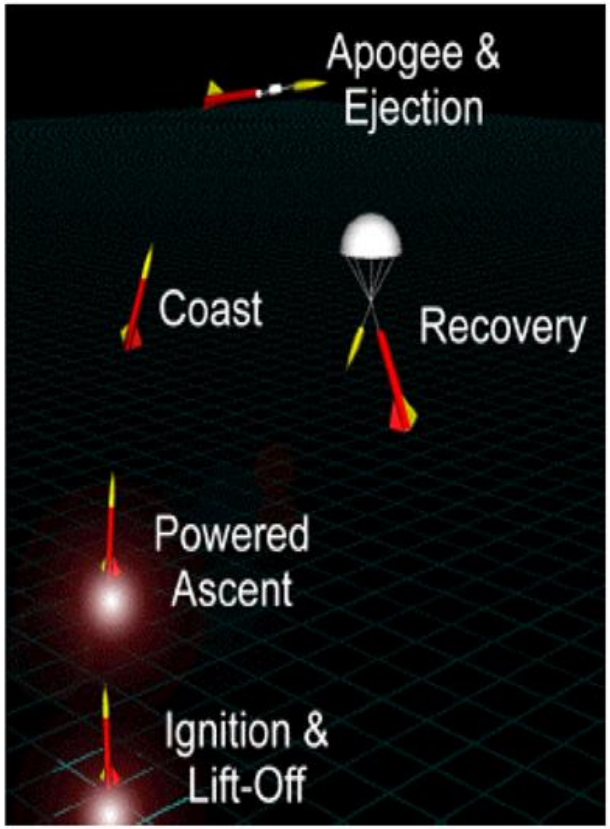
What is Model Rocketry?

The hobby of model rocketry involves building actual flying model rockets from kits, plans or your own designs. The model rockets are launched (flown) by the use of professionally and commercially produced, safe and proven model rocket motors. After launch, the model rockets are recovered and prepared to be flown over and over again.

Do Model Rockets Really Fly ?

Yes!

- **Preparation (very important!)**
- **Ignition and Liftoff**
- **Powered Ascent**
- **Coast**
- **Recovery System Deployment**
- **Descent**
- **Recovery**



Is Model Rocketry Safe?

ABSOLUTELY!

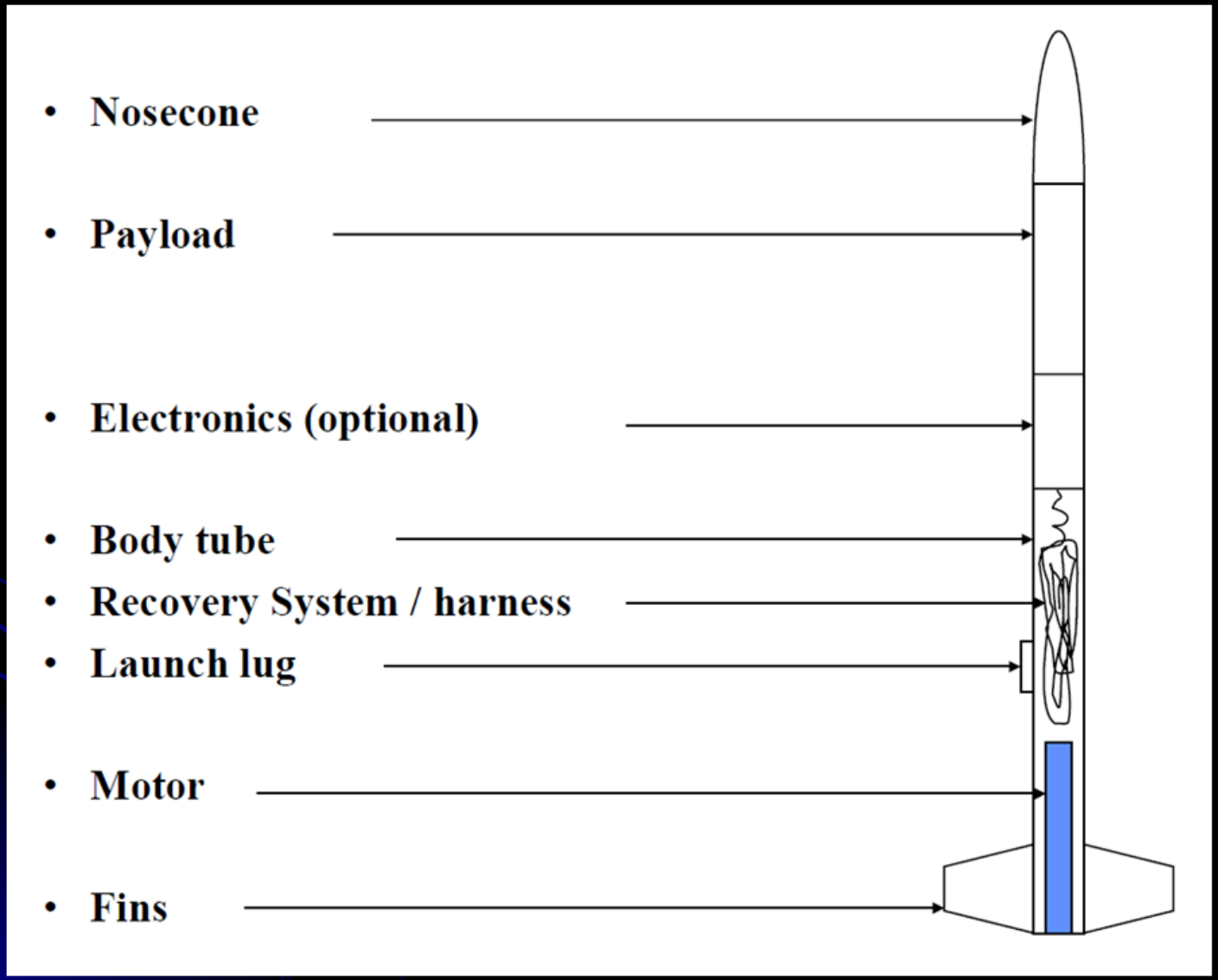
Model rocketry has been around since 1957. Over the past 55+ years, literally hundreds of millions of flights have been logged by people all over the United States and around the world without serious injury or death.

Why is it So Safe?

The hobby of model rocketry has such a spectacular safety record because there is a *Model Rocketry Safety Code* that everyone follows, that was created by the *National Association of Rocketry*.

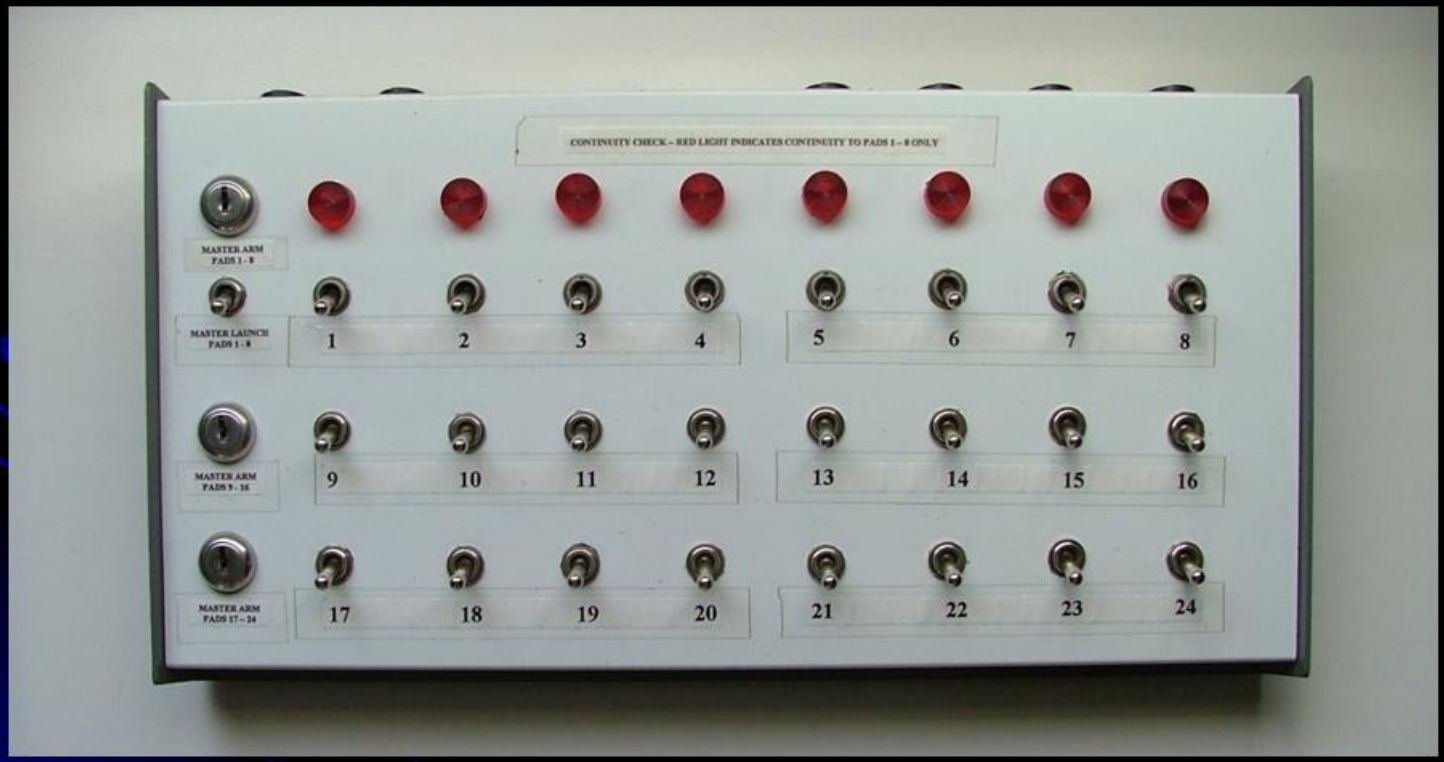
For example, all of our model rockets must be made from light-weight materials, meaning they are made from such things as cardboard tubing, balsa wood or plastic. The nose cone, fins and body tube cannot be made out of metal.

Components of a Typical Model Rocket



This way, if something goes wrong during the flight of a model rocket, it would simply crumple up on impact, so as not to damage anything. We also must stand a certain distance from our rockets when we launch them, based upon the size of the rocket motor we are using.

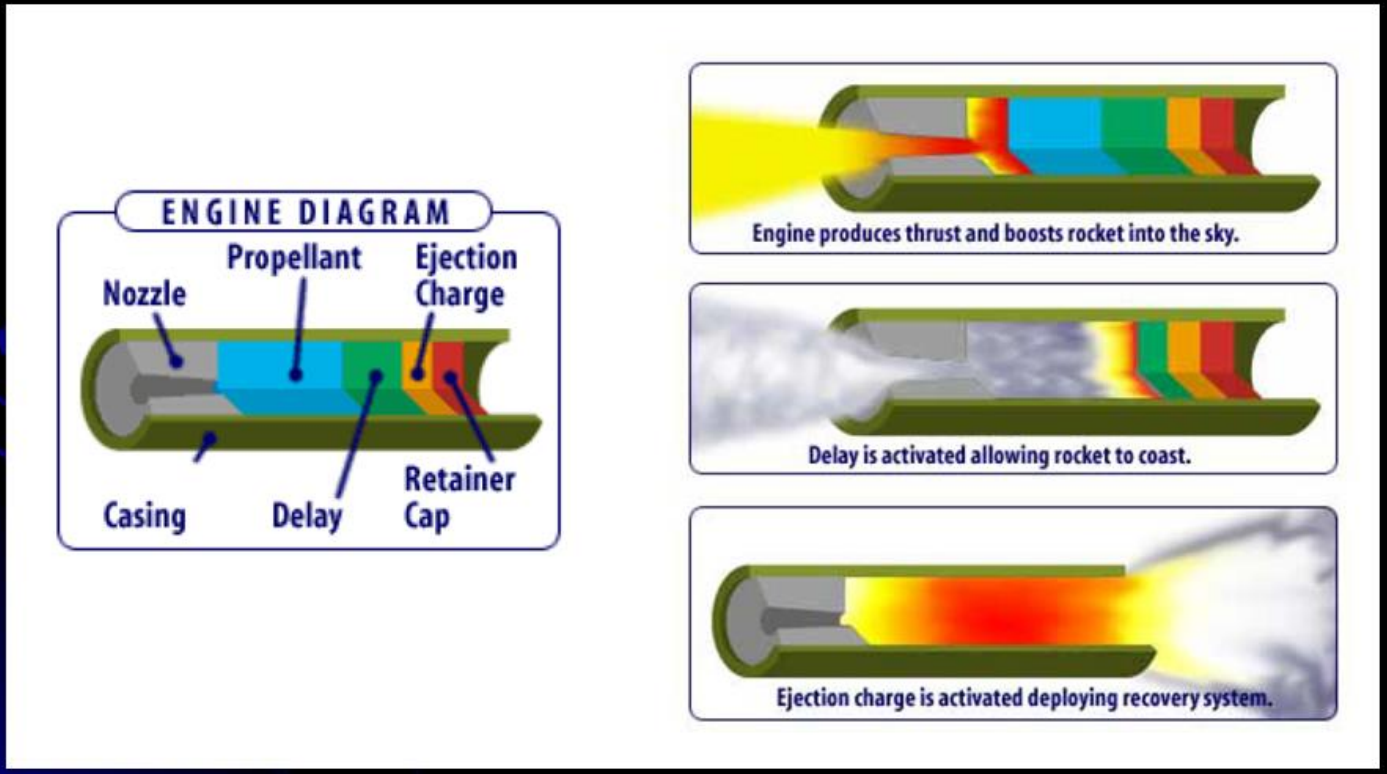
Model rockets are not like fireworks. We don't light a fuse and run away to launch them. All model rockets must be launched by electronic, remote means.



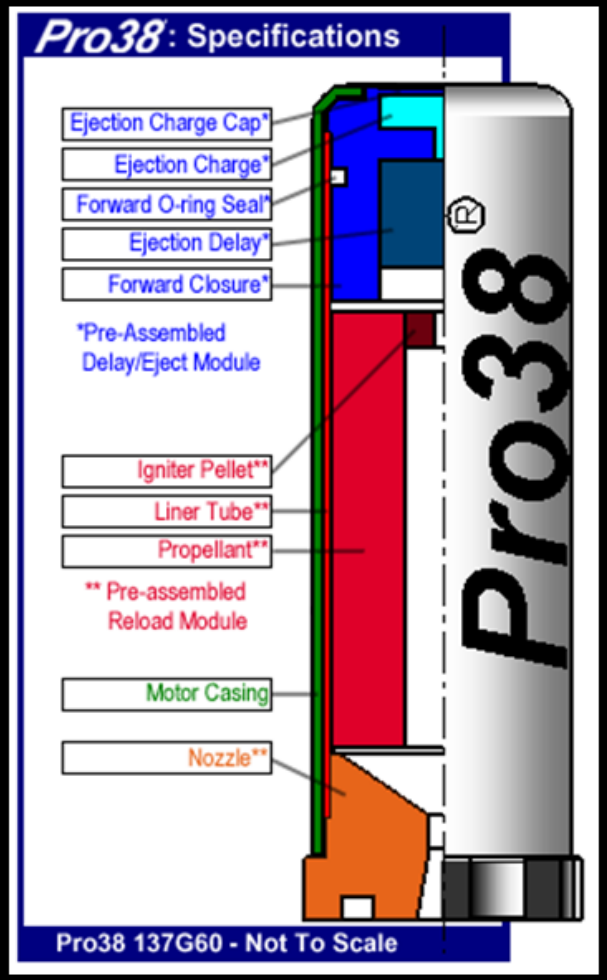
The Model Rocketry Safety Code states that all model rockets must have a recovery system so the model can be recovered safely and used over again. Most of our model rockets are recovered with a parachute, like the one you see here.

As stated earlier, we use professionally and commercially produced model rocket motors to fly our model rockets. We never mix our own propellants. There are two types of rocket motors that we use; *single-use* rocket motors, and *reloadable* rocket motors, like the one you see here.

As the name implies, a *single-use* rocket motor is one you use once and throw away. The body of this rocket motor is made by rolling up paper until it forms a thick cardboard tube, into which the propellant is tightly packed by the manufacturer.



A *reloadable* model rocket motor consists of an aluminum tube into which one or more pre-manufactured propellant segments is inserted. After flight, they are cleaned and ready to be used again. Reloadable model rocket motors can be used over and over hundreds of times.



The Safety Code directs we must launch our model rockets in an open area, free of trees and power lines, where there is no dry grass or weeds that can catch fire.

Fun With Model Rocketry

Besides building and flying something you have built yourself, there is a lot more fun you can have with model rocketry. You can challenge your rocketry friends to a competition to see who's rocket will go the highest, or which one will stay in the air the longest. You can also challenge people to a drag race to see who's rocket is the fastest.

Fun With Model Rocketry

Perhaps the most fun you can have with a model rocket is launching scientific payloads. The Safety Code directs that we cannot launch small animals like hamsters, gerbils, mice, lizards or any other vertebrate animals (meaning anything with a backbone.) But we can launch insects as a payload, and study what affects the stresses of rocket flight has on them.

Fun With Model Rocketry

Egg Lofting

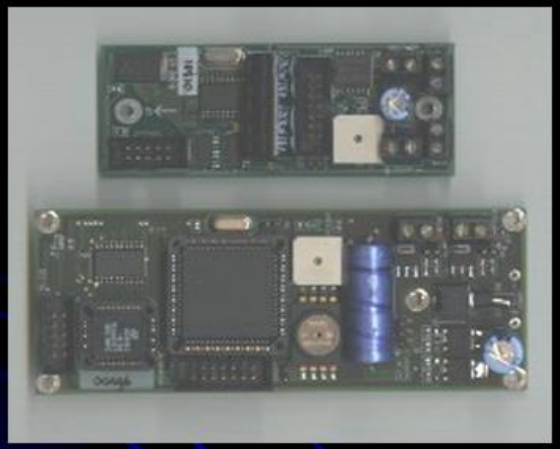
Another fun payload is a raw chicken egg. There are model rockets designed just for launching eggs. The challenge is to see if you can launch an egg and bring it back to Earth without breaking it.

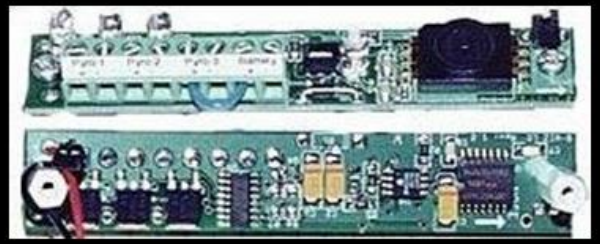
Electronic Payloads

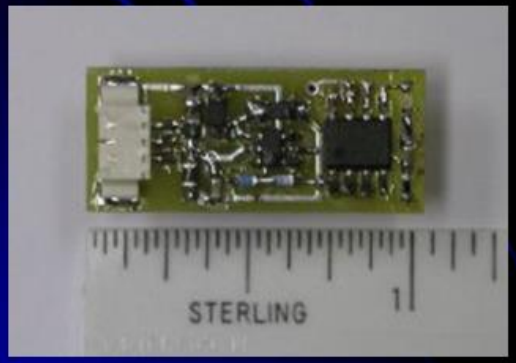
The most popular model rocketry payloads are electronics. One of the most common electronic payloads is called an “altimeter”; a device that records how high your rocket went, then reports the altitude after the flight. You can purchase an altimeter already built, or accept the challenge of building one yourself from a kit.

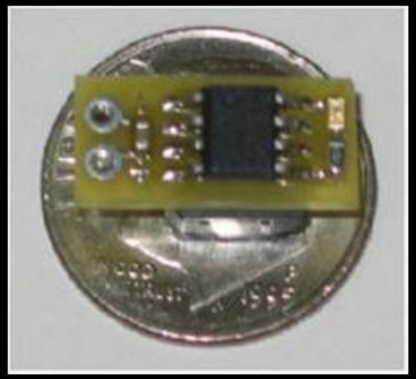
Electronic Payloads - Altimeters

As you can see, there are a lot of different altimeters to choose from!



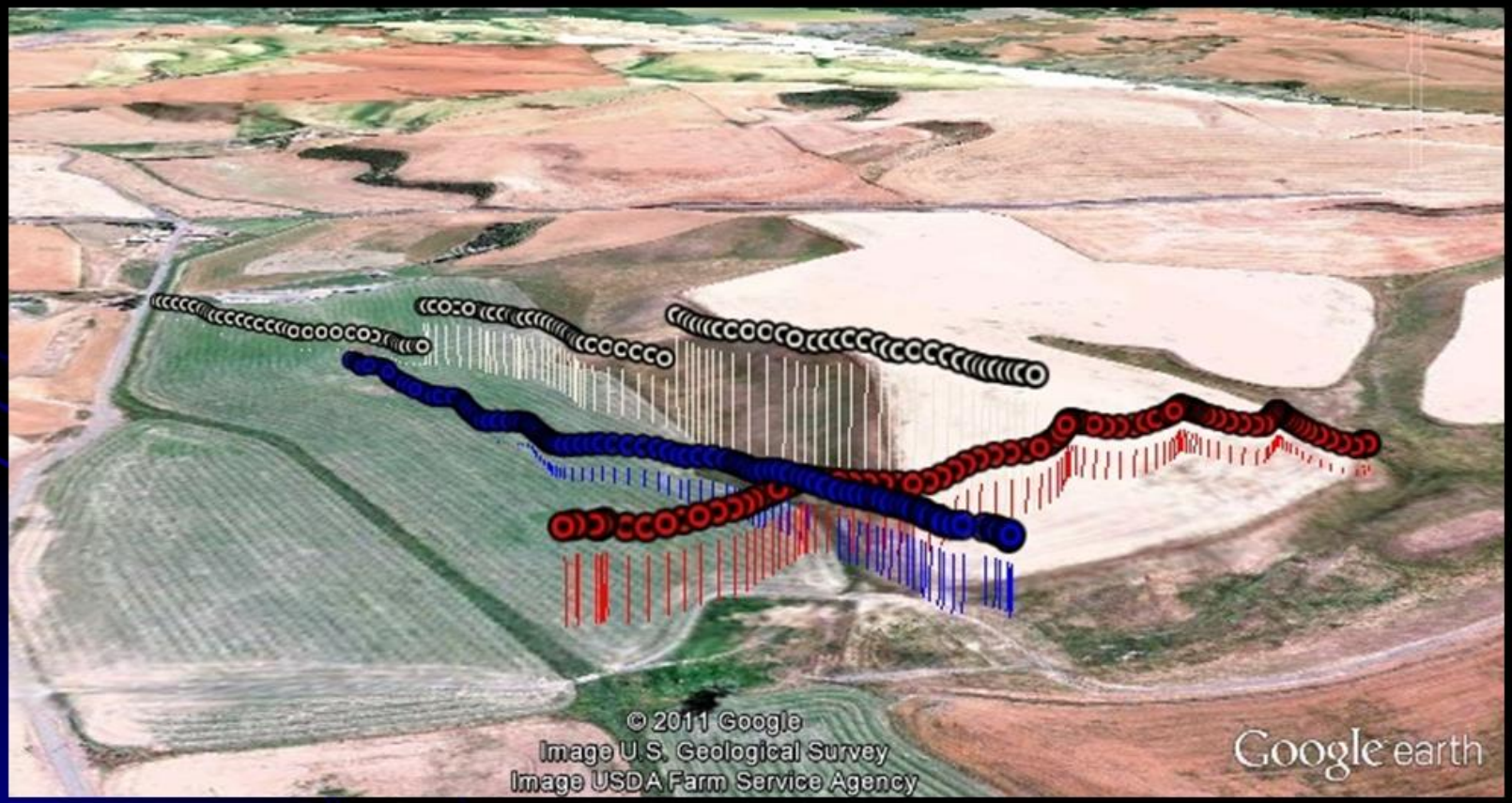






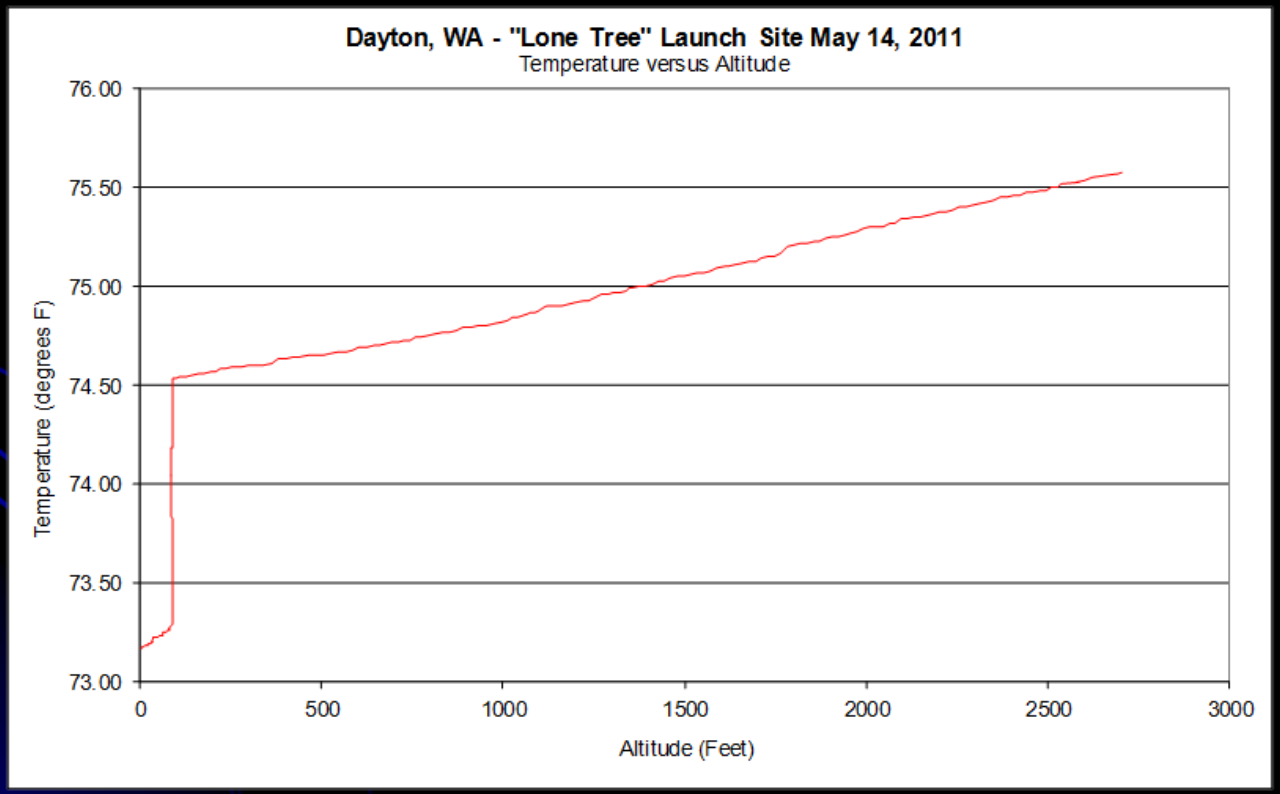
Electronic Payloads - GPS

The chart below displays the results of a GPS data logger electronic payload that measures the position of a rocket during its flight



Electronic Payloads – Data Loggers

The example below displays the results of temperature data logger electronic payload displaying the change in temperature over a range of altitudes encountered during a flight

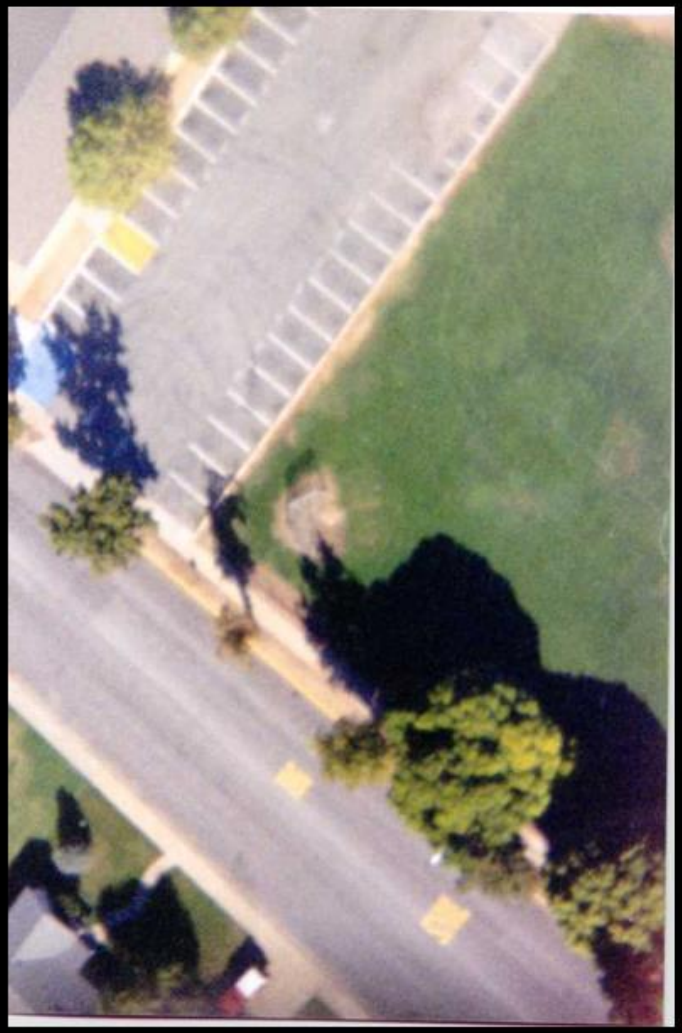


Camera Payloads

- Other payloads for model rockets include cameras that will take pictures of your launch site from high in the sky. The one shown here comes with a 110 camera in the nose cone.

Camera Payloads

This model rocket camera takes great pictures from hundreds of feet above the Earth that look like this -



Camera Payloads - Video Cameras

There are now several types of miniature high definition video cameras on the market which are easily adaptable for rocketry payloads

Camera Payloads - Video Cameras

1. Launch

Video Footage Like This!

2. Mid - Boost

3. Apogee

4. Descent

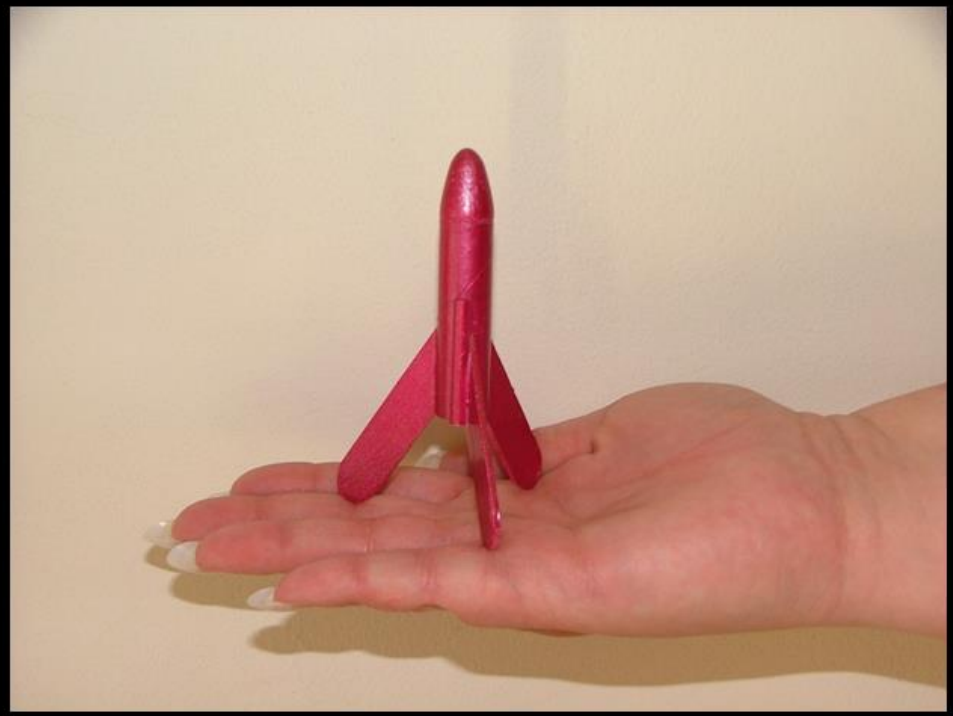
5. Landing

What Else Can I Do?

If launching payloads isn't exciting enough for you, there are many more types of model rocket designs for you to build and try. That's the really fun thing about model rocketry; you are always learning something new! Let's take a look at some of the different designs and types of model rockets you can build and fly.

How Big Are Model Rockets?

Model rockets come in a variety of sizes. Some model rockets are small enough to fit in the palm of your hand.



How Big Are Model Rockets?

Others are so big that they dwarf the person that made it! This rocket is ten feet tall, is six inches in diameter and weighs 14 pounds. It flew at over 420 miles per hour to an altitude of 4,280 feet!

How Much Do They Cost?

Some model rocket kits cost just a few dollars and only take a few hours to build. Others can cost $20 to $30 or more and take several months to complete!

Types of Model Rockets

A typical model rocket consists of a nose cone, a body tube, and three or more fins, like the one you see here.

Types of Model Rockets – Boost Gliders

There are model rockets called “boost gliders” that launch with a model rocket motor, then glide back to Earth like an airplane.

Types of Model Rockets - Clusters

Some model rockets use several rocket motors lit at the same time to lift off. This is called a rocket motor "cluster". This rocket has seven rocket motors!

The challenge is to get all seven rocket motors to light at the same time.

Types of Model Rockets – Multi-Staging

A model rocket that has more that one rocket motor stacked on top of each other is called a "staged" model rocket. This model rocket has three rocket motors, or "stages." These rockets are capable of extreme altitudes. This model rocket can go as high as 2, 500 feet!

Types of Model Rockets - Scale

A model of an actual rocket vehicle is called a “scale” model.

This is a model of the Titan III E rocket that launched the Viking 1 lander to Mars.

Types of Model Rockets - Saucers

These model rockets look like flying saucers, and are very fun to drag race! They are so light-weight that they are designed to tumble back to the ground for a safe, soft landing.

Types of Rockets - Helicopters

Some models boost like a rocket, then come down like a helicopter. This rocket is called the "Gyroc". It spins rapidly on its way back to Earth for a soft, safe landing.

Types of Model Rockets – Tube Fins

Some model rockets don't even have fins at all! Some have a series of tubes set around the bottom of them that act like fins. These model rockets are called "Tube Fin" rockets, like the one you see here.

Types of Model Rockets – Odd Rocs

Some model rockets don't even look like rockets at all! These model rockets are called "Odd Rocs". They can be made to look like anything, like a plastic drinking cup, or a rubber chicken…

Types of Model Rockets – Odd Rocs

Or even a flying pumpkin, or a huge flying Easter egg!

Model rocketry is a fun way to learn about such things as math, chemistry, science and aerodynamics. A lot that you learn through model rocketry can help you with your school work. Model rocketry uses the exact same technology that the engineers at NASA use to build rockets, only in miniature! Many of the astronauts today, flew model rockets when they were boys and girls.

But most importantly, model rocketry is something you can share with your friends…

Your mom or dad…

For More Information

The Internet:

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Our Thanks To

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Fly Rockets.com

Glenda Project

National Association of Rocketry

Quest Aerospace, Inc

The *Team America Rocketry Challenge* (TARC)

An Aerospace Themed Engineering Challenge
for Middle- and High-School aged students

Science
Technology
Engineering
Mathematics

www.rocketcontest.org

Houston, we have liftoff…

A perfect liftoff on a perfect day

The Challenge

- A new set of rules is released each year, allowing student teams to redesign for the new challenge.
- The challenge always contains three elements:
  - An Altitude Specification
  - A Flight Duration Specification
  - A Cargo Protection Specification
- Teams of students must design, build, and fly the rocket *without adult 'interference'*.

Careful Prep Required…

- Successful rockets are designed by computer, and built by hand.
- Students do all the design, build, prep, and conduct the flights themselves—whenever the weather allows.
- Adults may *TEACH HOW*, but not *DO FOR*.

An Example:

- For Example - In 2016, the challenge was as follows:
  - The rocket must carry and protect a payload consisting of two raw hen's eggs. Damage to the payload is a disqualifying condition.
  - The rocket must attain an altitude of exactly 850 feet AGL (Above Ground Level) as measured by a contest approved altimeter.
  - The portion of the rocket containing the eggs and altimeter must land between 44 and 46 seconds after takeoff.

Scoring

- All flights are empirically scored based on the measurables of the flight. Points are assessed for deviations from the mission criteria. A perfect score would be zero.
  - 1 point is assessed for each foot absolute deviation from the specified altitude.
  - The absolute deviation from the specified time window is measured to the nearest 0.01 second, then multiplied by 3 to get the points assessed for duration.
  - Total score = Altitude score + Duration score.

The Goal:


TEAM AMERICA ROCKETRY
CHALLENGE NATIONAL FINALS
NEXT EXIT

The National Finals

- All teams get one flight.
- After completion of the first round of flights, the top 25 teams fly a second time.
- The top 10 places are determined by the lowest combined score of the two flights.
- Top 10 finishers win scholarships for the students and money for the school program.
- Grand Prize winner also receives an all-expenses paid trip to either the Farnborough or Paris Air Show.

Local Success in TARC

- 2011: Skyline H.S. qualifies 1 team (47th Place)
- 2012: Ingraham H.S. qualifies 2 teams (15th and 44th Places)
- 2013: Yeshiva Mercer Island qualifies 1 team and places 23rd in Nationals
- 2015: Newport H.S. (Bellevue) placed 2nd. Ingraham H.S. qualified 2 teams and place 3rd, & 21st at Nationals.
- 2016: Odle M.S. (Bellevue) won TARC. Newport H.S. (Bellevue) placed 15th. Seven Teams from the Seattle area went to the TARC Nationals. Odle went on to win the World Championship in Farnborough.
- 2017: 42 Teams from the state of Washington competed in TARC, sending 5 Teams to the Nationals, with Odle M.S. (Bellevue) placing 16th.

Local Success in TARC

- 2016: Odle M.S. (Bellevue) – "Space Potatoes" wins TARC.

Success Looks Like This

A Top Ten Finisher Lifting Off

Courteous and Supportive Competition is key!

Wider Participation

- Beyond the teams that have qualified for the National Finals, there have been many more teams from other schools participating in TARC.
- 42 teams of students from Washington State participated in 2016.

Benefits of Participation

- Peter Schurke, Vice Principle at Mountlake Terrace H.S. surveyed students before and after their participation in TARC and found significant increases in both student interest in and student comfort with the STEM disciplines.
- Over 90% of students who participated on TARC teams in 2009 and 2010 went on to pursue STEM majors in college.

Conclusion

- TARC is a rigorous challenge that engages students:
  - Achieving one of the specified criteria is fairly easy.
  - Achieving two simultaneously is difficult.
  - Achieving all three simultaneously is extraordinarily challenging.
- TARC Increases student interest in and sense of comfort with the STEM fields.
- TARC participation is steadily growing in Washington State, as success breeds more success.

And when they grow up…

2018 TARC Challenge

- "F" Motor (80 N/Sec) limit.
- Single parachute recovery system.
- Dual (Two) Egg payload.
- Maximum launch weight of 23 ounces.
- Minimum length of 25.6 inches.
- Flight time Duration of 41 – 43 seconds.
- Target Altitude of 800 feet. 775 - 825 Feet (Nationals Random Second Round)
- Two Qualification flights.
- Registration Window: 09/01/17 – 12/01/17