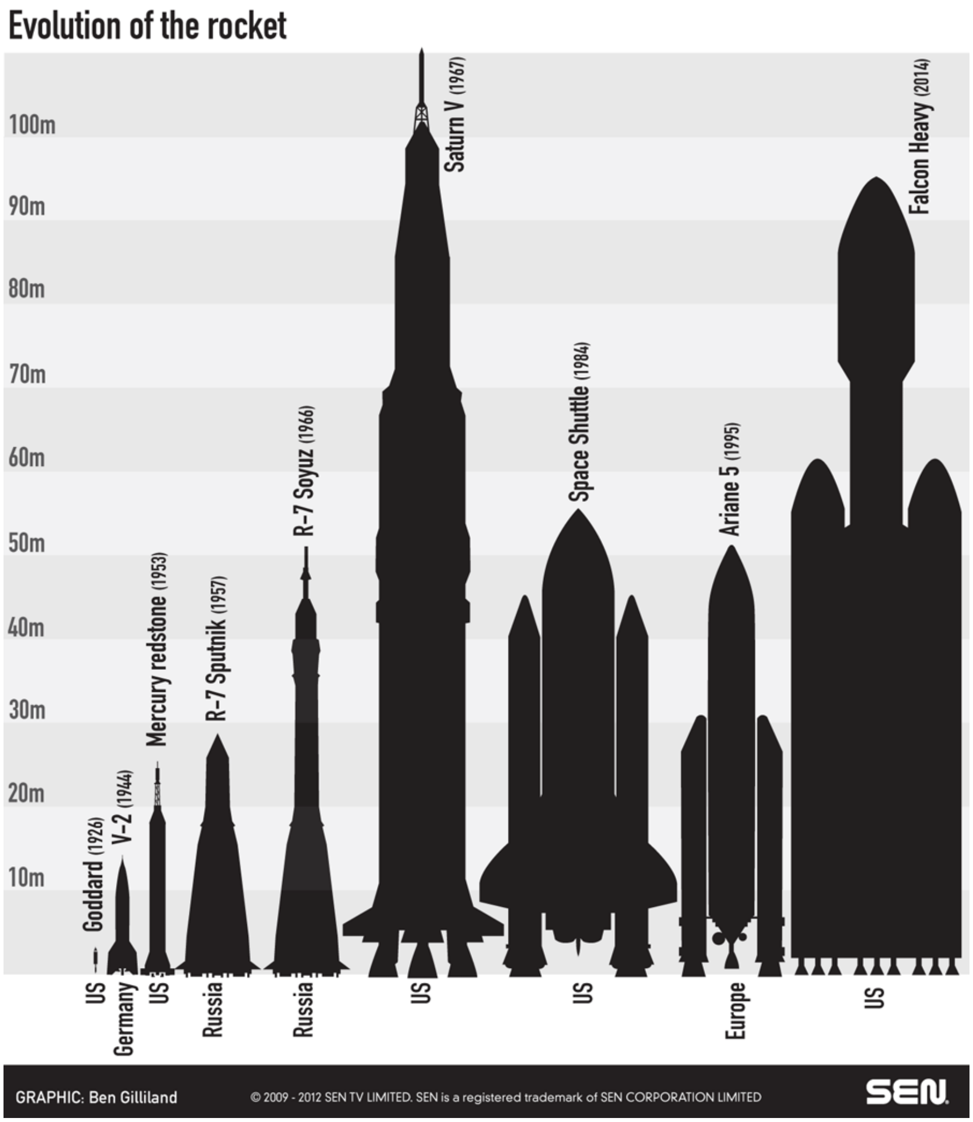
Rocket Launching Experiment

What do you know about engineering rockets?

What do you want to know about engineering rockets?



Introduction

Launching rockets is currently the only way to get into space. What is the best kind of rocket to get you where you want to go? Modern rocket design has been going on since the early 20th century, but engineers are still changing the designs of rockets and their launching systems to make better rockets.

Check out the above diagram of various rocket designs. What are some similarities between the rockets? What are some of the differences?

The table below shows how heavy each of these rockets were and the ***payload***, which is the amount of weight the rocket can carry. Usually the payload is determined by how much weight the rocket can carry to ***low-Earth orbit***, which is defined as an orbit that is less than 1000 km from the Earth's surface.

Rocket Name	Date	Weight	Payload to low-Earth orbit
Goddard	1926	26 kg	
V-2	1944	12,700 kg	
Mercury Redstone	1953	30,000 kg	
R-7 Sputnik	1957	280,000 kg	1,322 kg
R-7 Soyuz	1966	304,000 kg	7,100 kg
Saturn V	1967	2,800,000 kg	127,000 kg
Space Shuttle	1984	2,000,000 kg	24,400 kg
Ariane 5	1995	777,000 kg	21,000 kg
Falcon Heavy	2014	1,420,000 kg	63,800 kg

One way to determine the efficiency of a rocket is by comparing its payload with its weight. For example, the R-7 Sputnik rocket can carry 1,322 kg to low-Earth orbit and weighs 280,000 kg:

$$\frac{1{,}322\ kg}{280{,}000\ kg} = 0.005.$$

A higher number means that the rocket can carry a higher payload, given its weight, to low-Earth orbit. Looking at the table above, what rocket was the most "efficient?"

Now let's make our own mini rocket and engineer the best way to build and launch a rocket!

Materials you will need:

- ☐ Stomp rocket launcher
- ☐ Printer paper
- ☐ Cardstock
- ☐ Index card
- ☐ Tape

Instructions

1. Roll a piece of paper around the launch tube. The rolled paper should be snug, but it should be able to slide easily along the launch tube.
2. Tape the paper to itself, using enough tape to completely seal the seam and make it airtight. This is the body, or ***fuselage***, of your rocket.
3. Slide the fuselage off of the launch tube.
4. Make a ***nose cone*** for your rocket. You can do this by taping paper over your fuselage, making sure that it is airtight, or you can pinch one end of the fuselage and fold it over and tape it to the rocket's body.

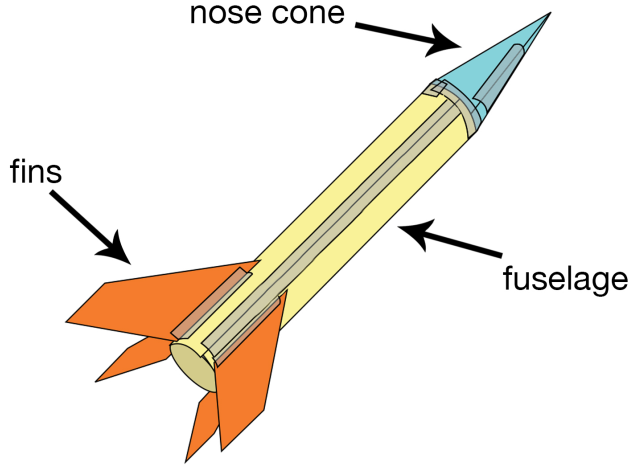


Image credit: jpl.nasa.gov

5. Cut out ***fins*** and attach them symmetrically to the lower part of the fuselage. You can choose whatever shape for the fins that you think will help the rocket go the straightest and highest.
6. Name your rocket!

Experiment

Your mission is to engineer the rocket that goes the highest.

1. Make sure you're outside in a safe spot before launching your rocket.
2. Pick a tree or a building that you can use to serve as a "ruler." Ask a friend to help judge how high your rocket goes.
3. Place your rocket on the launch tube.
4. Stomp on the bottle to launch your rocket! Have a friend record the launch on a cell phone so you can better analyze the rockets' flight. It can be especially useful to record in slow-motion mode!
5. Repeat the launch process at least 3 more times to get a consistent measurement of the altitude your rocket reaches.

Analysis

1. Examine your rocket design and analyze its flight performance, then compare the designs and flight performance with your classmates.
2. Discuss what constitutes good flight performance. *Height? Stability? Smooth trajectory?*
3. Think about the specific aspects of rocket design: *number of fins, placement and design of fins, nose cone design, fuselage length, materials used*, etc.
4. Identify the best characteristics of high performing rockets. Based on your observations, hypothesize what aspects of rocket design are linked to better flight performance.
5. As a group, optimize your rocket design and build a better rocket.
6. Launch the optimized rocket and see how high it goes!