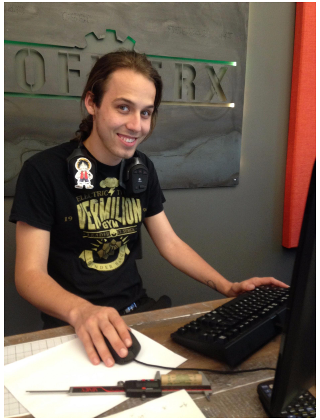
Design it. Print it.
Launch it. Twice.
Team Rocket

Meet our team

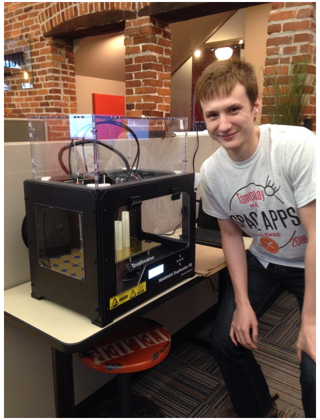
Frank Fomby
~ our crazy engineer uncle ~

J Kent
~ our 3D printing expert ~

Amber Howard
~ our computer scientist ~



Christian Stanley
~ our resident architect ~



Riya Fukui
~ our medical student ~

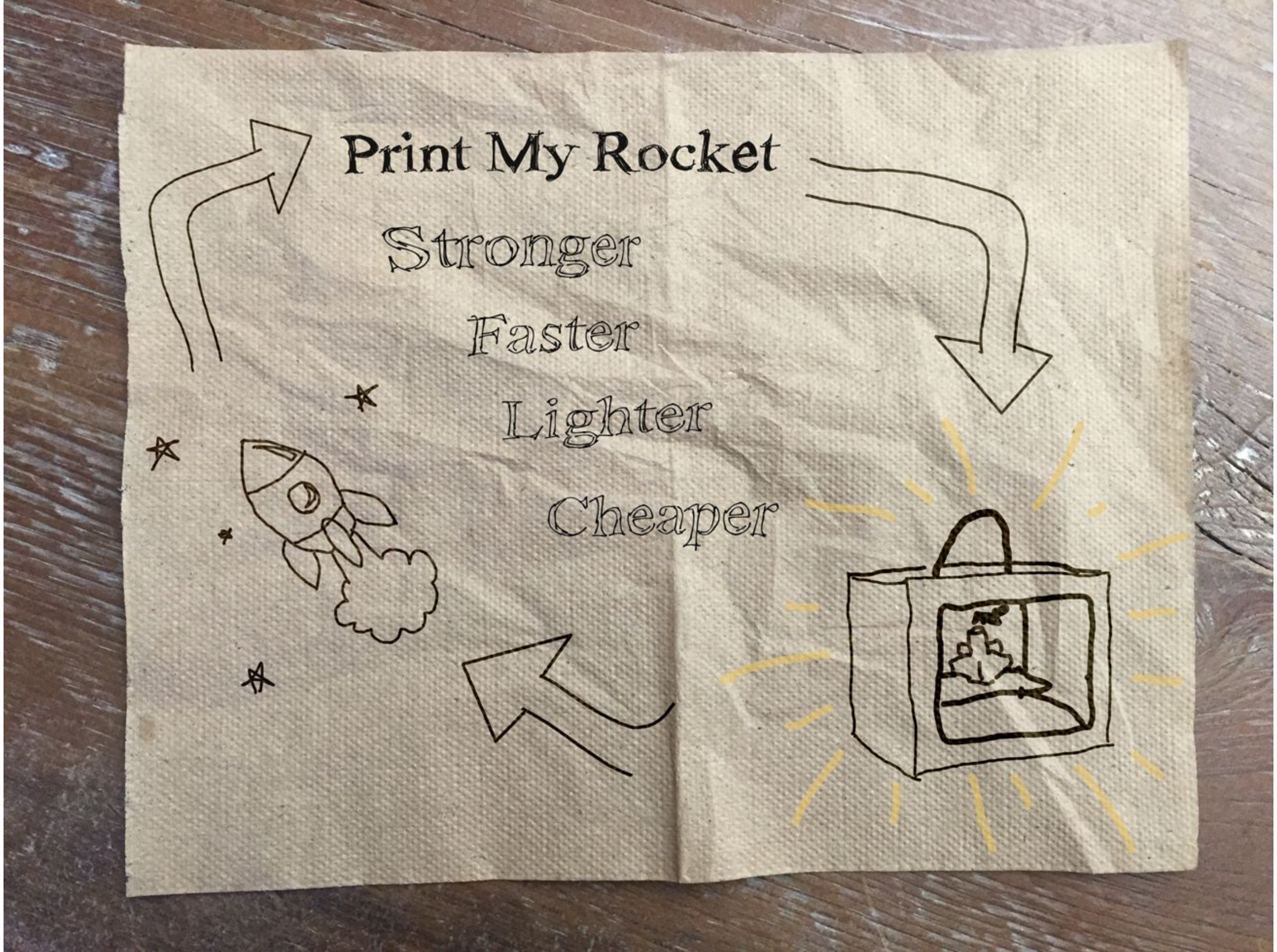
Resemblance?

http://scifitechgeek.com/2016/03/10/rick-morty-season-3/

Why 3D print a rocket?

$500,000,000

In 2012, SLS deputy project manager Jody Singer estimated that SLS will cost $500M per launch.


Print My Rocket
Stronger
Faster
Lighter
Cheaper

NASA has too much “space”

- NASA ships more air than product (fuselage, fairing)
- Eliminate transport, transport logistics and its cost and risks

Efficient custom fairing to accommodate secondary payloads

Reduced manufacture/assembly time by less need for nuts and bolts

A consumer hobby rocket of comparable size cost $12. We can print it for half a dollar. A rocket for everyone.

- STEM / STEAM
- Boy and Girl Scouts
- Youth groups

Our process

Stress test different designs and pick out the strongest

3D Print the Rocket

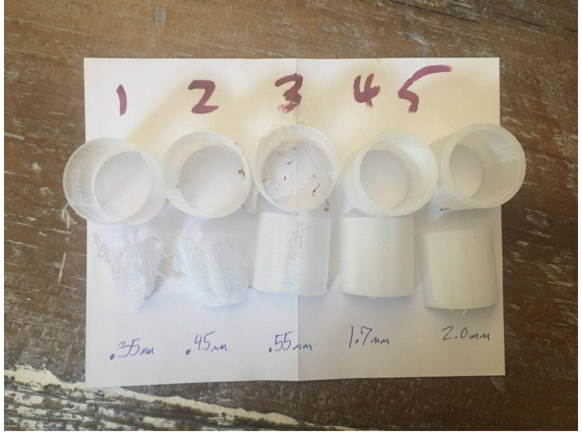
Launch the rocket and collect stress data in launch condition

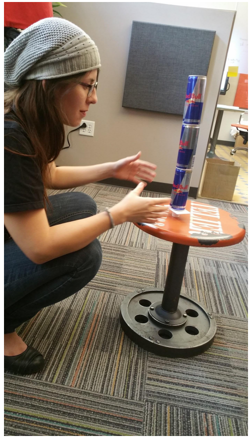
Scale it to real-life size (1:240)

25mm by 25mm cylinders with wall thickness of .
35mm, .45mm, .55mm, 1.70mm and 2.00mm.

We stress tested by stacking 8.4 fl oz Red Bull cans.

The thinnest (.50mm) withstood >4 cans.
We even sat on it. Strong enough!

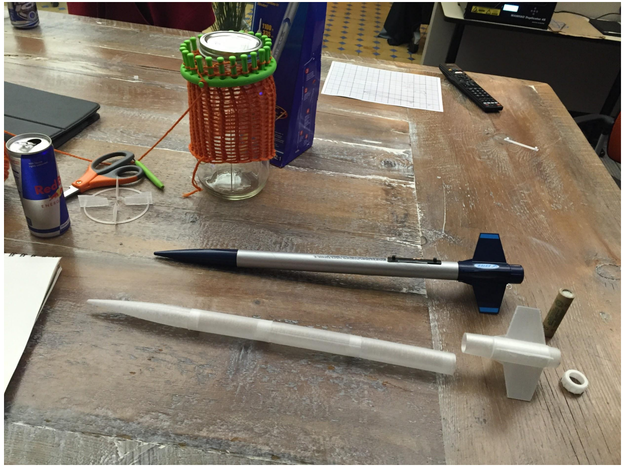


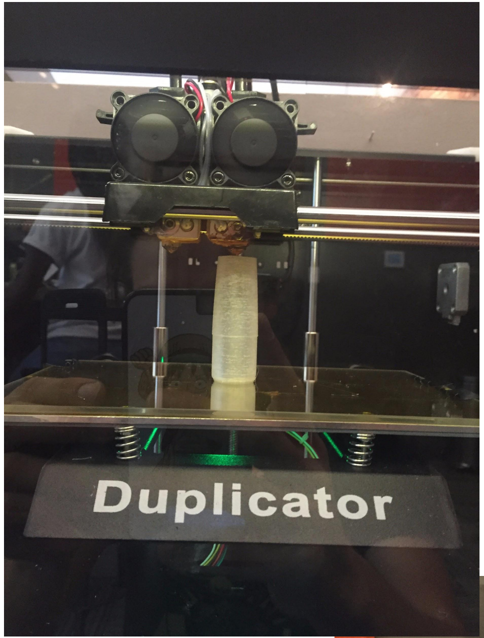


Stress test

3D Modeling Software: Rhinosaurus
3D Printer: WANHAO Duplicator 4S
Material: ABS
Pieces:

- Fuselage: 2x 97mm+25mm lip and 1x 97mm
- Fairing/nose cone
- Engine bay and fins
- Engine screw cap
- Launch guidance



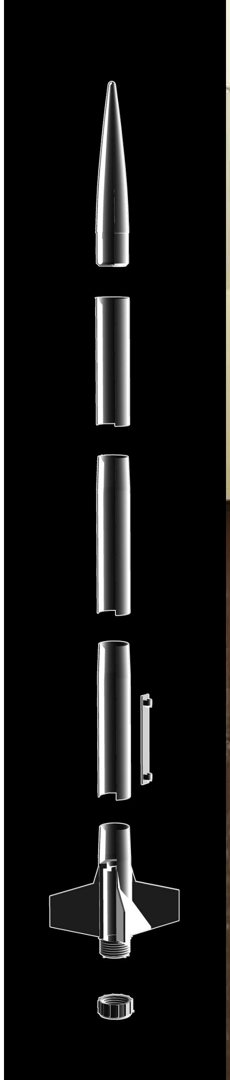


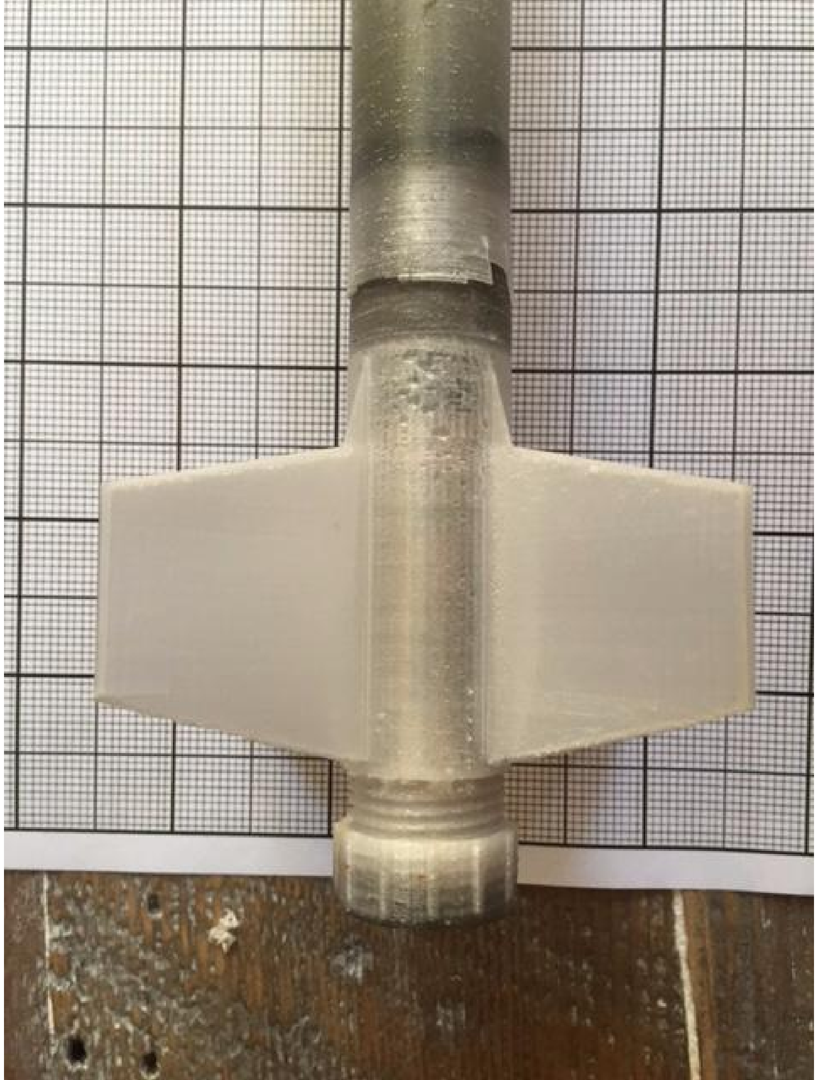
3D print the rocket

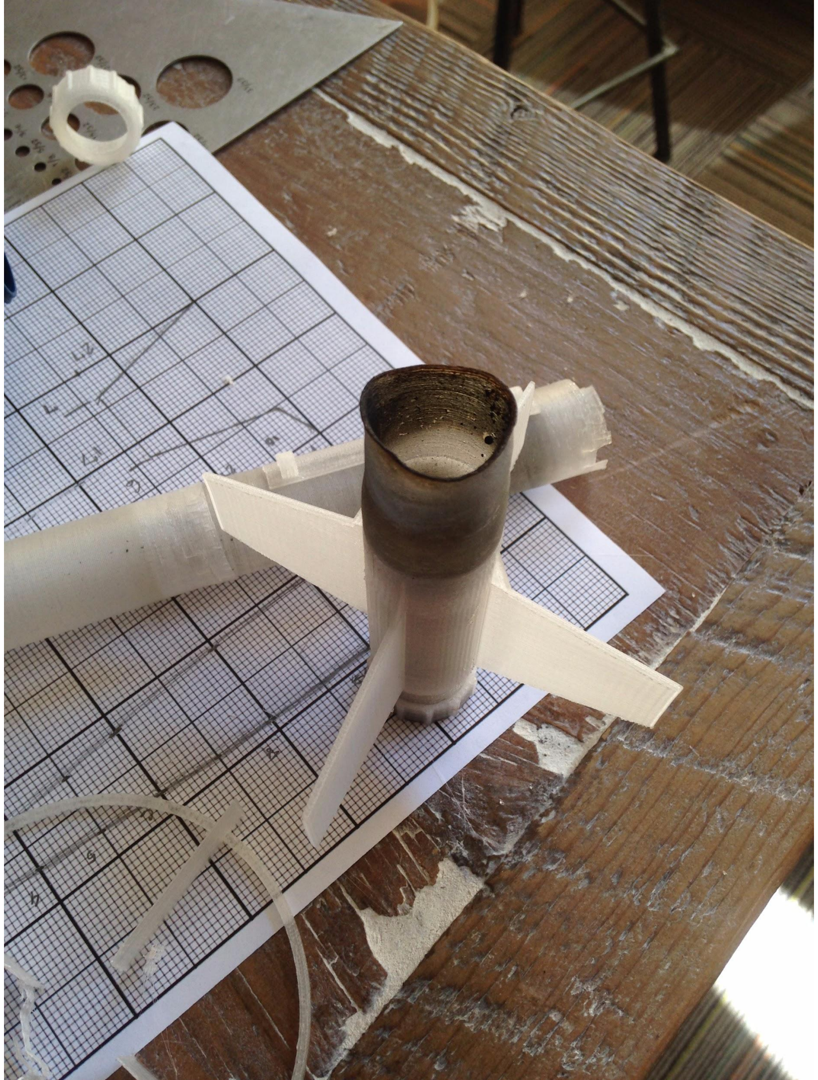
3D printed rocket:

- Height: 493mm
- Printed Weight: 44.9g
- Engine: 25.8g of Initial weight, 12.48g of propellant
- Wet weight = 70.7g
- Dry weight = 58.2g
- Fuselage wall thickness: 0.50mm
- Theoretical delta V = 1530 m/s
- Print time 5h
- Cost: 50 cents

Launch the rocket and stress analysis







Design Analysis

- Center and axis of thrust was consistent and stable throughout the burn
  - First launch: A8-3 engine (max thrust-10N, burn time-0.73s, total impulse-2.5 N-s)
  - Second launch: C6-5 engine (max thrust-15.3N, burn time-1.6s, total impulse-10.0 N-s)
    - Estimated >400m altitude, recovered within 50m radius after wind drift
- Structural integrity
  - Brittle but wedged type fitting allows tighter fit
  - Successful separation to multiple pieces
  - No parachute needed - light enough. Even on hard road impact
    - Eliminates parachute related complications
- No unnecessary connection: reduce weight, complexity, cost
  - Most damaged part can be easily replaced

Changes we would make

- Not use acetone
- Add support structures inside the fuselage
  - We had zero internal support. A worst case scenario
- Add guide through to keep the modular pieces together

3D printed rocket scaled to 240:1 assuming Aluminum 2219 use

- Height: 118m
- Printed Weight: 1,690,000kg
- Engine: 357,000kg of Initial weight, 173,000kg of propellant
- Wet weight = 2,050,000kg
- Dry weight = 1,880,000kg
- Fuselage wall thickness: 0.12m
- Theoretical delta V = 1530 m/s

Compare with

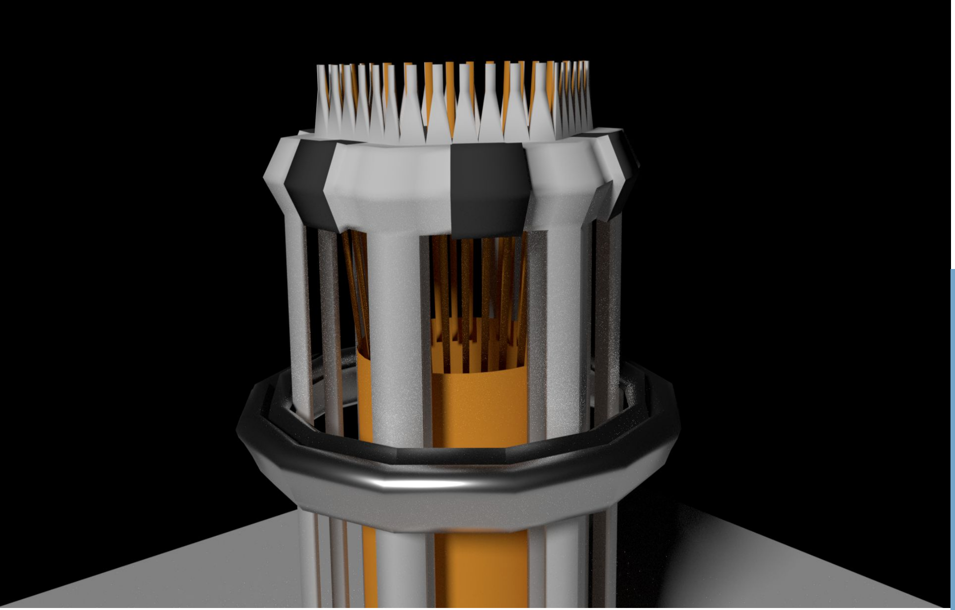
SLS heavy lift

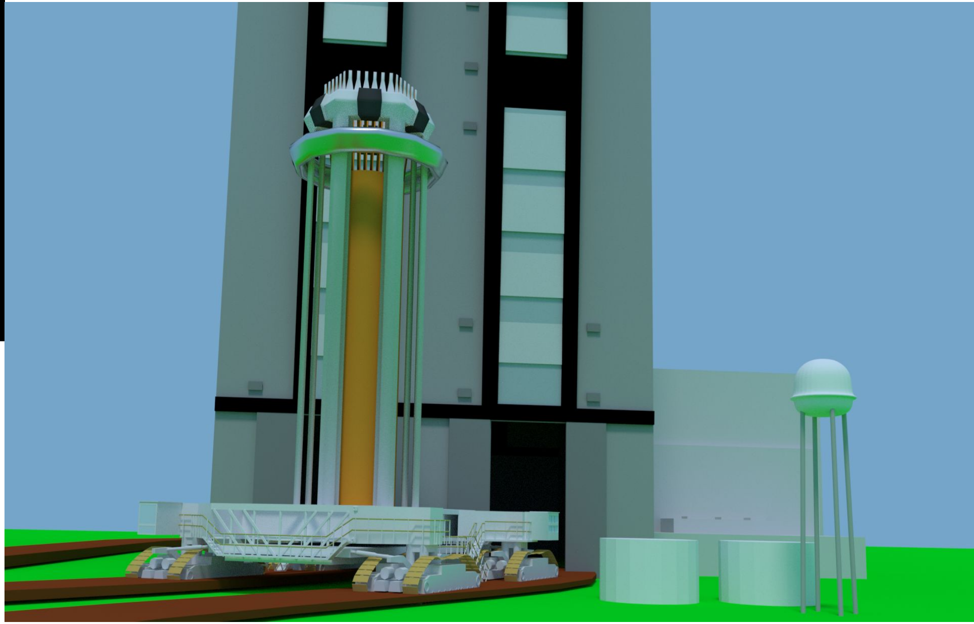
- Height: 117m
- Dry weight: 2,950,000kg

Scale up

We have more ideas!

Alternative 3D printing method: Sock Loom





Alternative 3D printing method: Sock Loom

Sock Loom 3D printing technology

- Using a loom-like technology, modern materials like fiberglass, carbon fiber or even graphene, a rocket can be woven, on site, to any scale necessary and any thickness necessary.
- Use a set of scaffolding and existing technology used in weaving tube socks

Looking into the future...

- We will become to 3D print more and more material
- Fast, customizable, cheap
- Print the whole rocket ***and*** the fuel
    - Gummy worm glue gun!
- 3D printing with drones

https://github.com/team-rocket-tampa/3DPrintedRocket