GHPR Egg Rocket “Connecting Flight to Breakfast”

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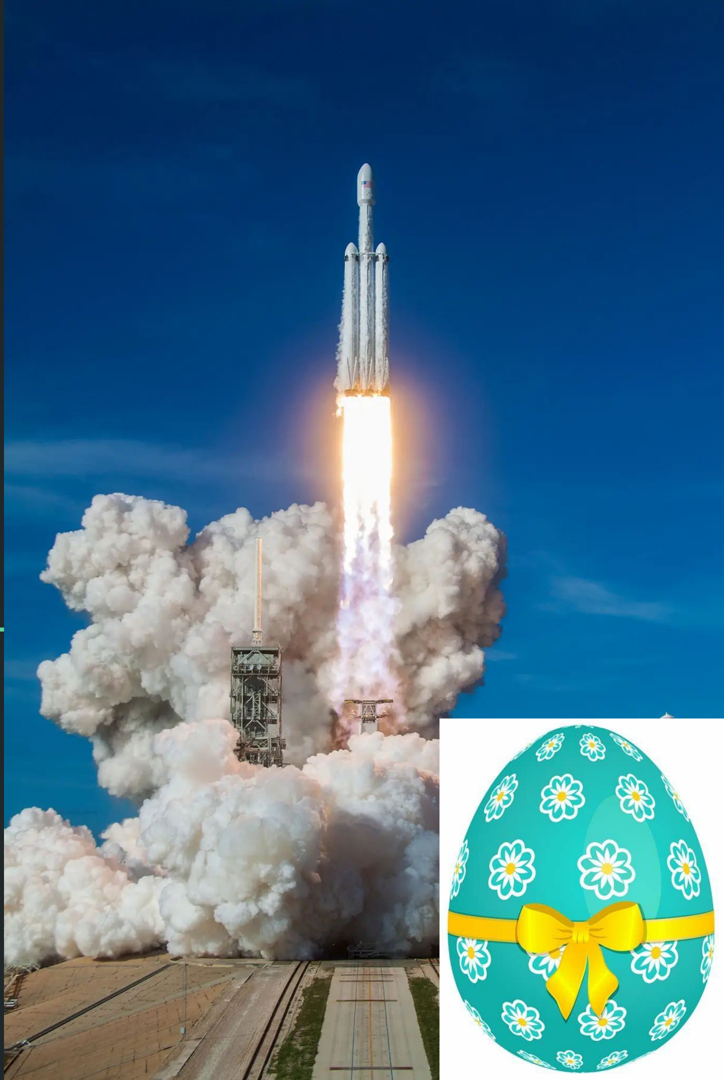

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Team Overview and Roles

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Team Overview and Roles

OpenRocket Integration - All

Apogee & Stability Optimization - All

Nosecone - Samir

Body tube - Kate

Fins - Curren

Payload, CAD - Si Thu

Setting Expectations

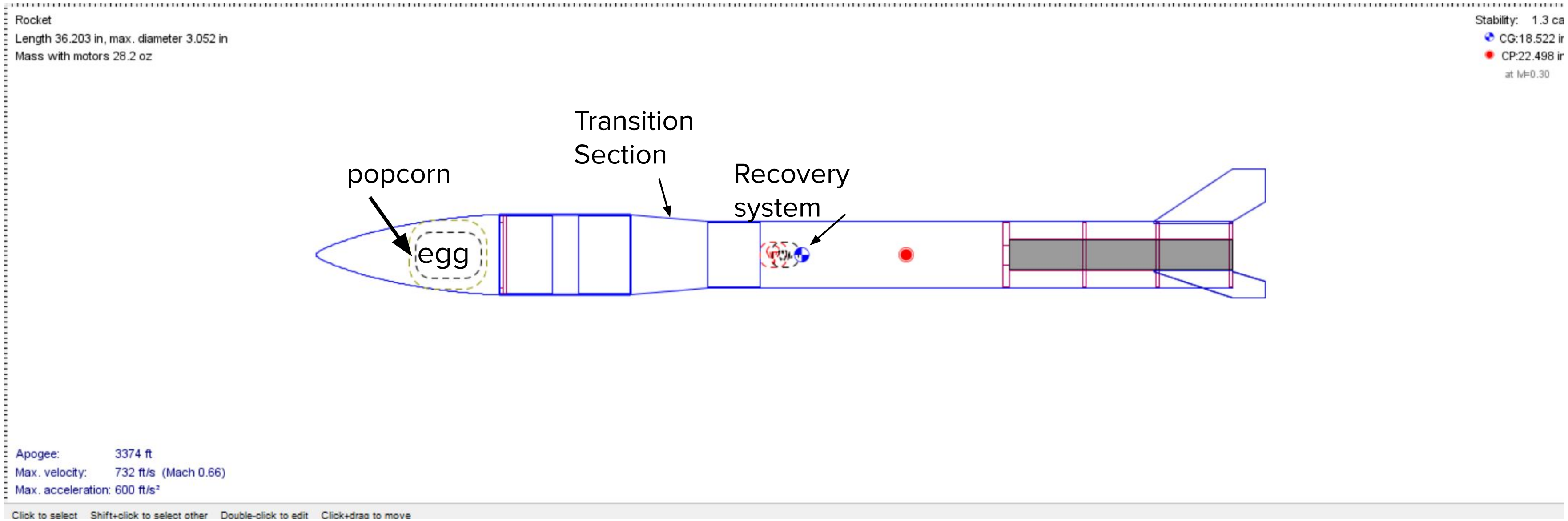
External Requirements:

- Stability between 1.25 and 2.5 cal
- Off-the-rail speed of at least 75 ft/s
- Apogee of at least 2,750 ft
- Time to apogee of less than 15.5 seconds

Internal Goals

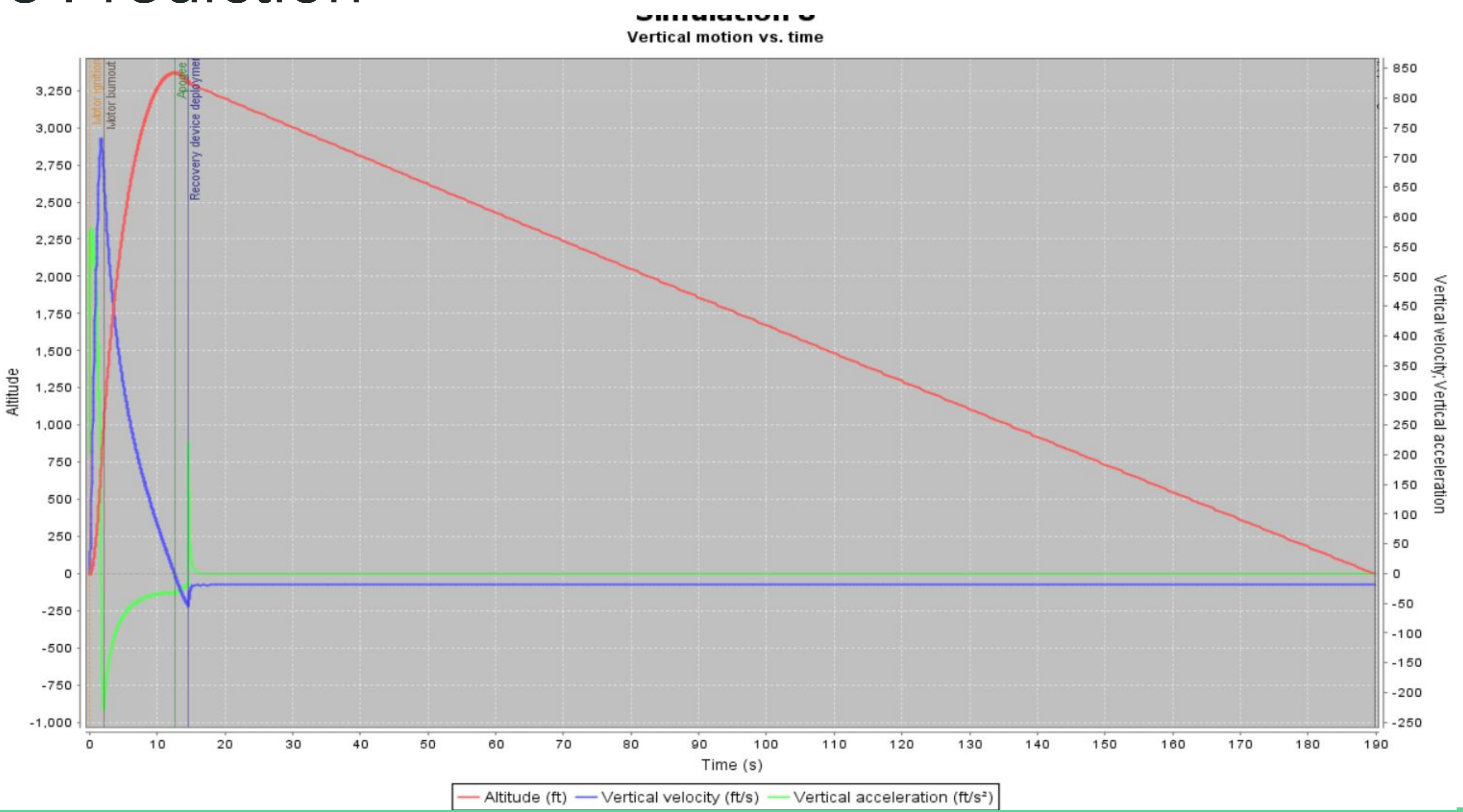
- Stability of at least 1.3 cal
- Off-the-rail speed of at least 100 ft/s
- Apogee of at least 3,000 ft
- Time to apogee of less than 15 seconds
- Max velocity of at least 675 ft/s (460 mph, ordinary minimum commercial airline cruising speed)
- Max acceleration of at least 88.2 ft/s^2 (9 g's, generally regarded as the highest acceleration a human can withstand without losing consciousness)

Design: Haack series nose, 2 body tubes, 3 fins



Apogee Prediction

Predicted apogee: 3370 ft

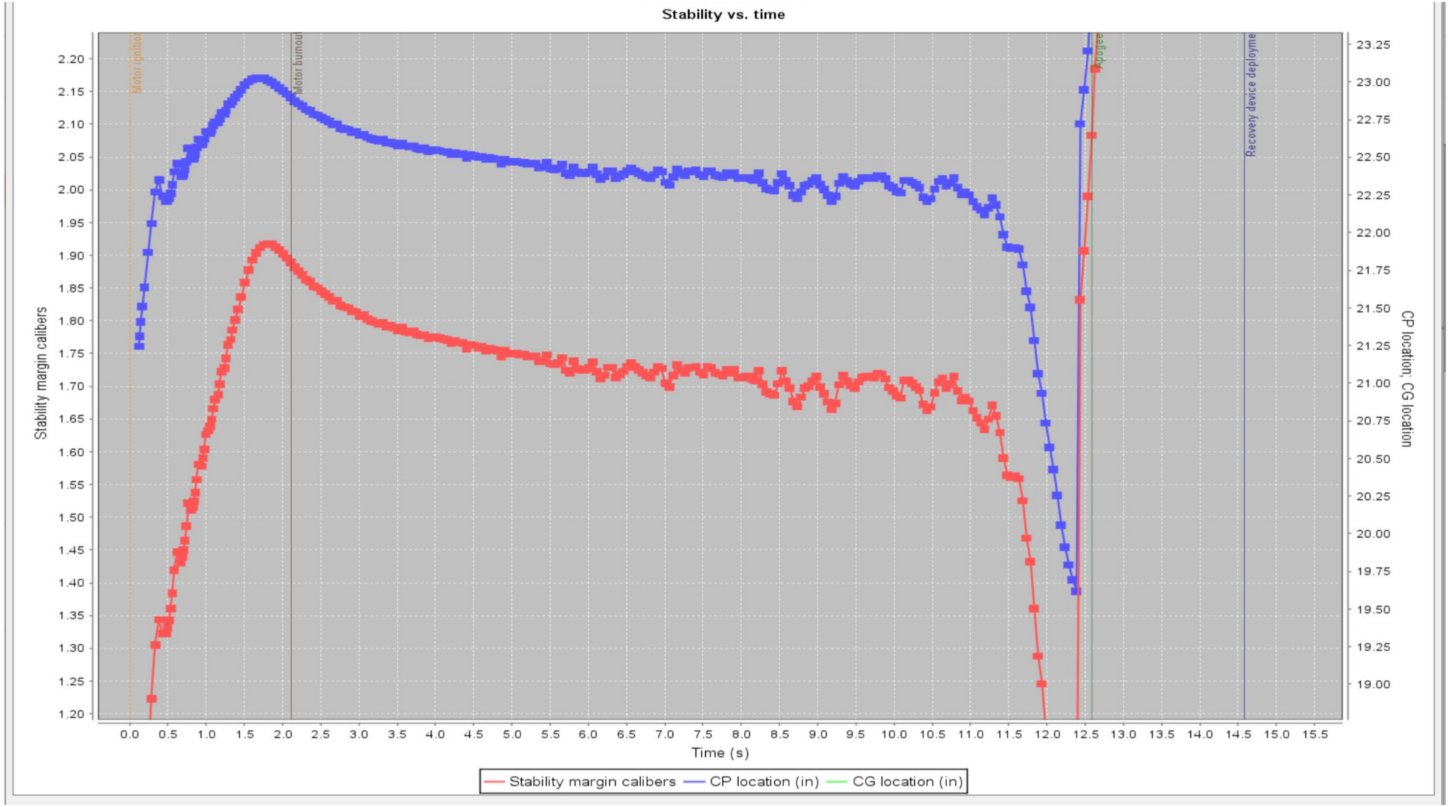


Flight Characteristics and Stability

Stability: 1.3ca

Off the rail speed: 108ft/s

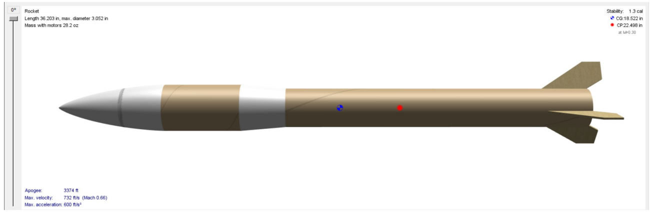
Rail length: 10ft



Design Overview

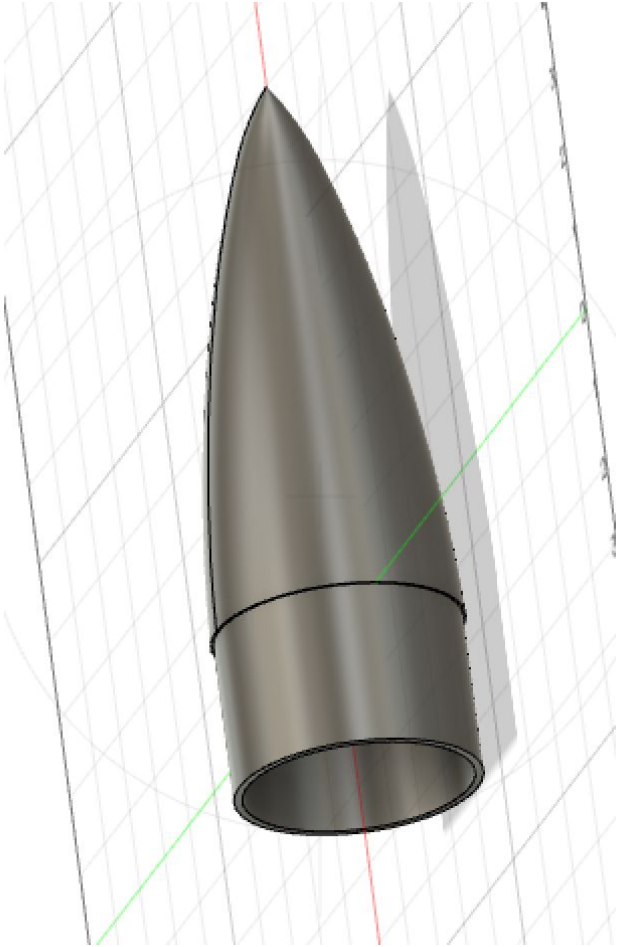
Apogee (ft)	3370
Max Velocity (ft/s)	732 ft/s
Max Acceleration (ft/s^2)	600 ft/s
Max Mach Number	0.66
Diameter (in)	3.052
Length (in)	36.203
Margin of Stability	1.3

Max Thrust (lbf)	160
Avg Thrust (lbf)	116
Impulse (lb-s)	229
Time to Apogee (s)	12.5
Time of Descent (s)	177.5
Mass (lbs)	1.76
Off-Rail Speed (ft/s)	108



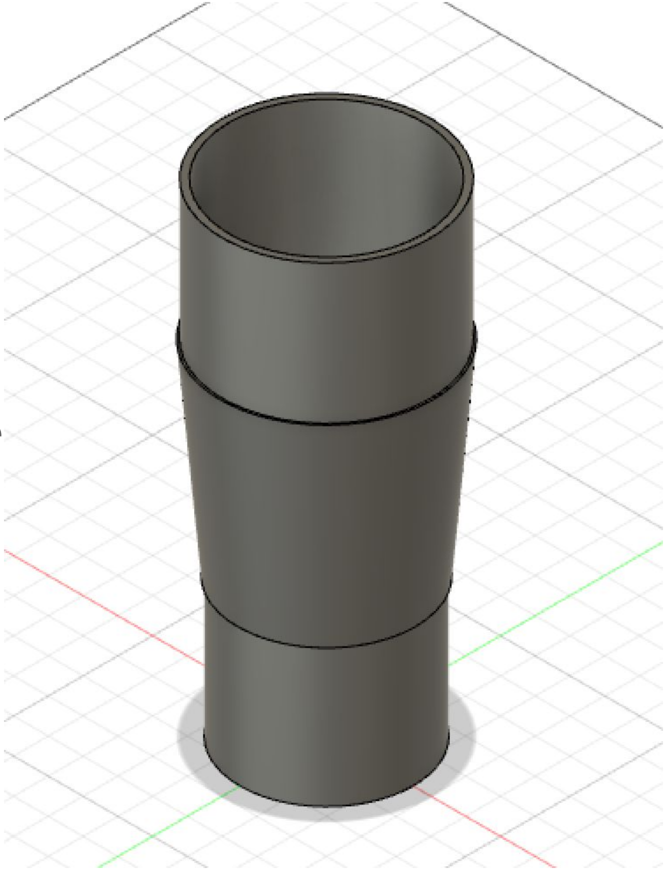
Nose Cone Selection

- Shape: Haack series, shape parameter 0.2
- Length: 7”
- Material: ABS (3D printed)



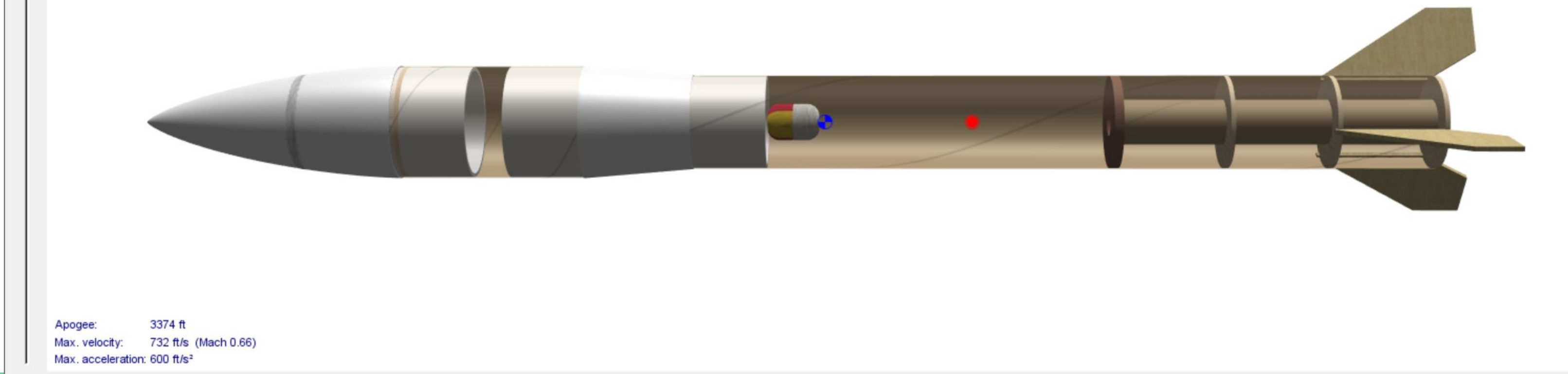
Transition Section

- 3D Printed conical transition section
- Material: ABS
- 3” to 2.5” ID body tubes
- Reduces drag by shifting to a smaller diameter
- Creates an aerodynamic upper body tube shape that allows for a larger nose cone to carry the payload



Airframe Selection

- Carbon fiber tubes, ID = 2.5” and 3”
  - Increase strength
- Two centering rings at top and bottom of fin root chord
  - Retention system for fins
  - Placement will be known as soon as fins are known
- Launch buttons will be placed at center of gravity
- Bulkhead with inner hole for motor protrusion
- Trade Offs:
  - Carbon fiber is heavier than cardboard, however, it is sturdier

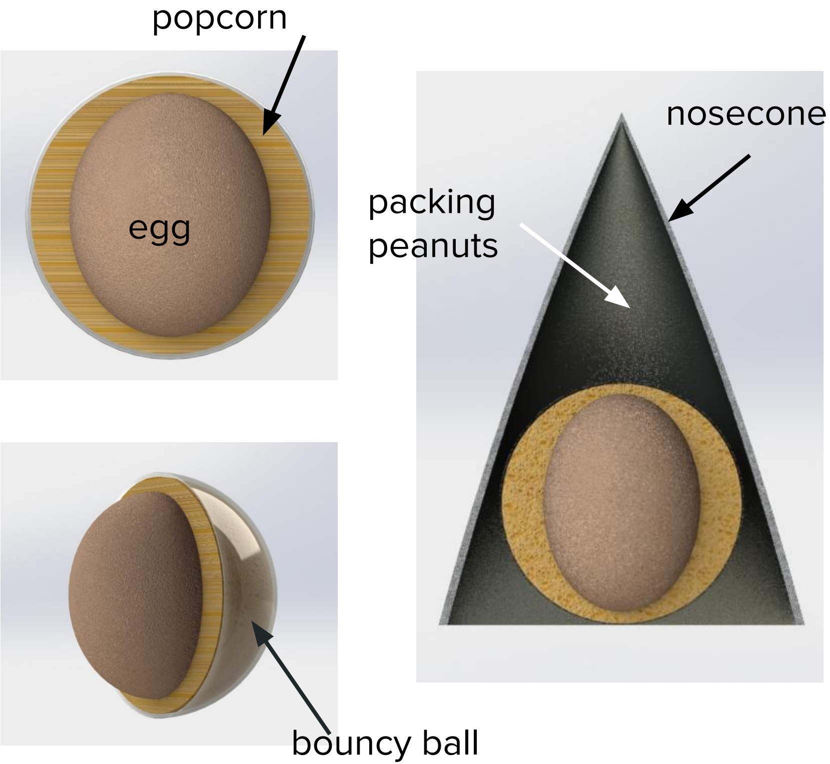


Recovery System

- 30” nylon parachute
- Descent
  - Time from deployment: 177.5s
  - Ground hit velocity: 18.4ft/s
- Time of ejection charge: 2 seconds after apogee
  - This gives the rocket time to hit apogee and start descent
  - While not allowing it to pick up too much momentum

Payload Safety

For our payload safety, we have decided to place the egg in a bouncy ball filled with popcorn, which would be within a nose cone full of packing peanuts. We would cut open the bouncy ball, preferably a thin, small one. Thus, securing the egg with cushion to not have it crack. Originally, we decided on peanut butter around the interior of the nose cone but that would be insanely messy and not reasonable.



Popcorn & bouncy ball concept

Theoretical Manufacturing Timeline

Spring Quarter in case of miracle

Week	Monday	Tuesday	Wednesday	Thursday	Friday
1			Review and revise design		
2	Manufacture printed components		Manufacture carbon fiber components		
3	Manufacture plywood components		Buffer time in case of unexpected delay		
4	Rocket assembly				Finish rocket assembly at latest

Risk Assessment

- OpenRocket data may not reflect actual data
- Masses may deviate as natural variations occur in real world materials
- Popcorn and peanuts could provide insufficient shock absorption
- Plan to mitigate risk:
  - Follow safety procedures at all times
  - Ensure all angles of egg are surrounded by popcorn and peanuts
  - Edit simulations if abnormalities in mass and other data are found

Conclusion

- Popcorn inside nose cone to protect egg
- Carbon fiber body tube for strength
- Larger section for egg safety