

MICROGRAVITY MACHINE

Virtual Design Review 2



TEAM 511



Samuel Duval

Propulsion Engineer



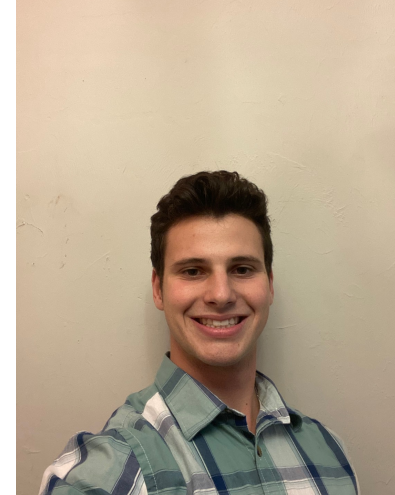
Pedro Siman

Recovery Engineer



John
Tietsworth

Controls Engineer



Thomas Lenz

Test & Systems Engineer



Collin Gainer

Aero Design Engineer

John Tietsworth

Sponsor and Advisor



Dr. Mohd
Yousuf Ali

**FAMU-FSU
College of
Engineering**



Dr. Shayne
McConomy

**FAMU-FSU
College of
Engineering**



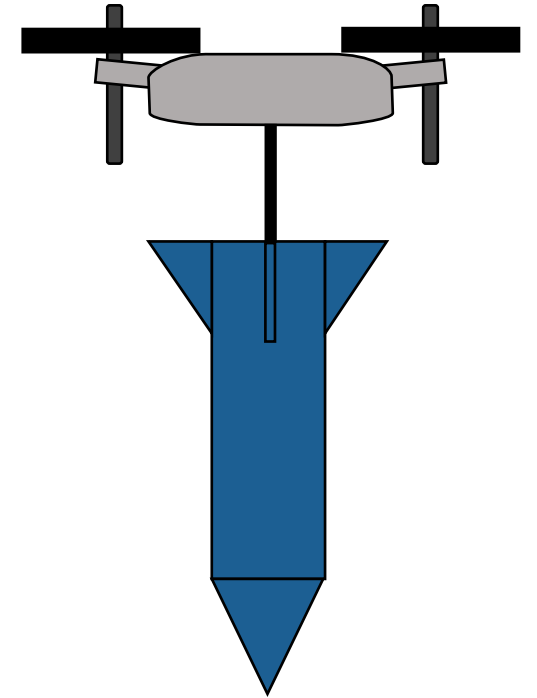
Mike Conroy

**Florida Space
Group
Consortium**

John Tietsworth

Project Objective

The objective of the project is to design a reproducible system that can be dropped, achieve microgravity during its descent, and be safely recovered for reuse.

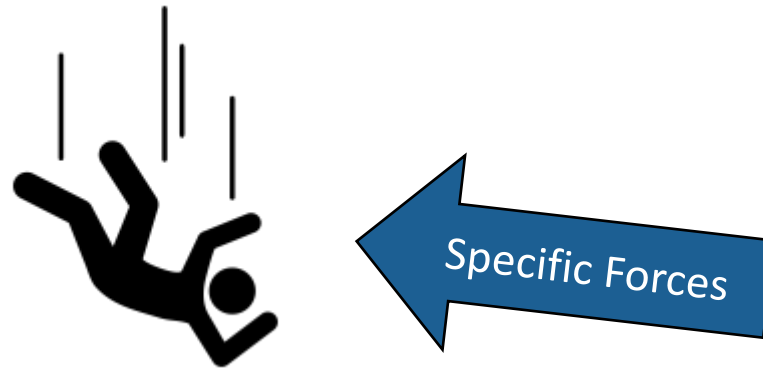


John Tietsworth

What is Microgravity?

$$\vec{F}_{Specific} = \frac{\sum \vec{F}_{nongravitational}}{m} \approx 0 \frac{m}{s^2}$$

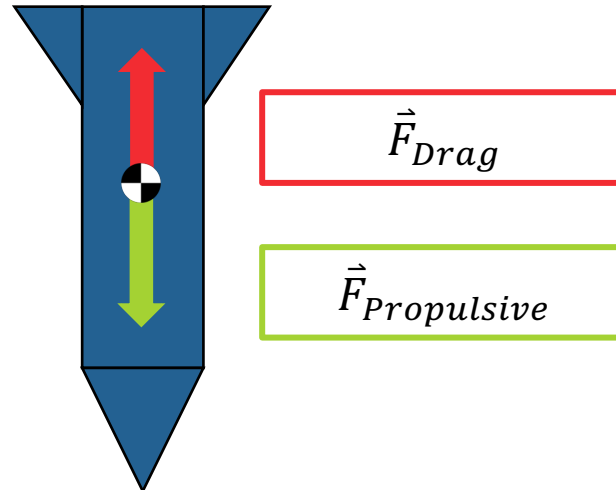
What does an
accelerometer measure?



John Tietsworth

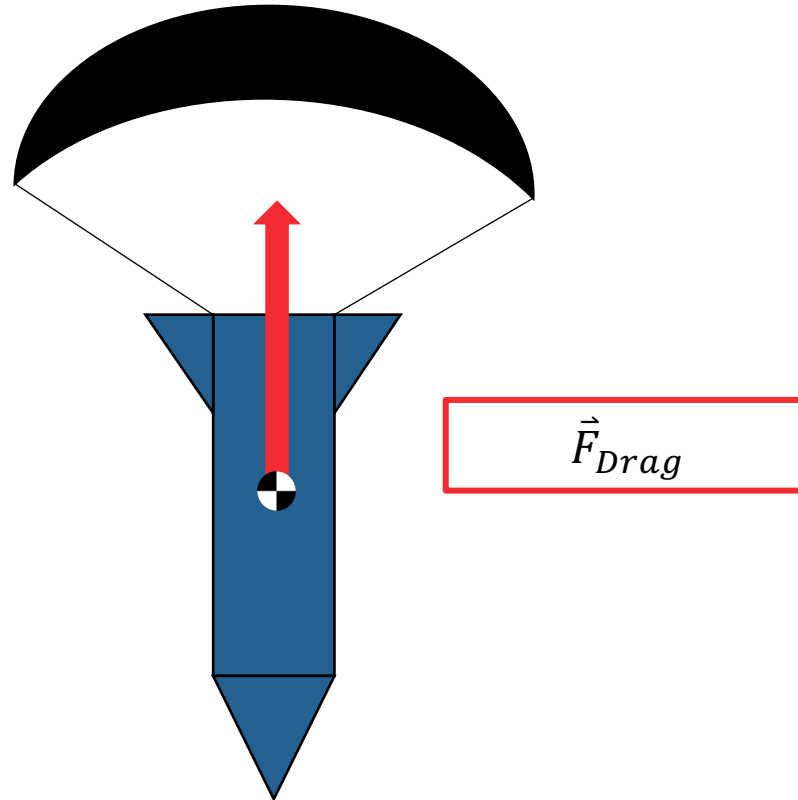
Achieving Freefall

$$\vec{F}_{Specific} = \vec{F}_{Propulsive} - \vec{F}_{Drag} \approx 0 \frac{m}{s^2}$$



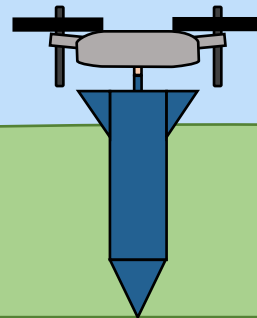
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Arresting System



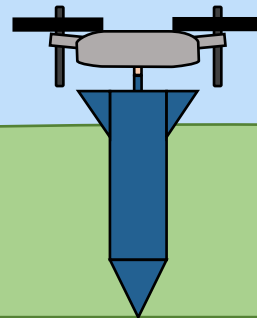
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Competition Day



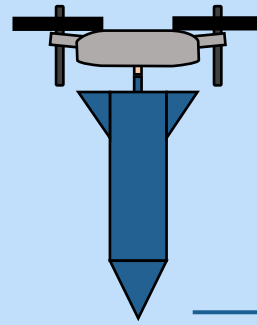
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Competition Day



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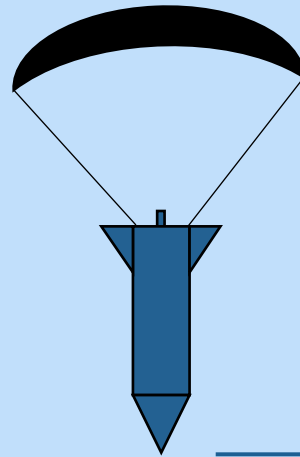
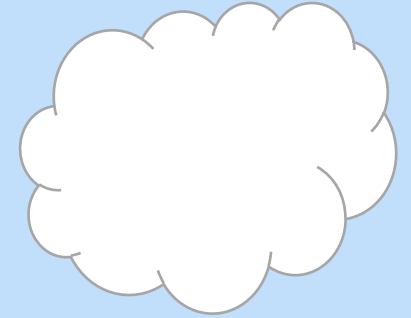
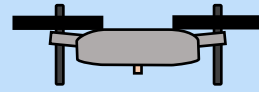
Competition Day



900 ft (275m)

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Competition Day



~650 ft (200m)

John Tietsworth

Assumptions

Vehicle's path
is clear of
obstacles

Tested in
standard earth
atmosphere

Drag negligible
for initial 0.5
seconds of free
fall

Weather
conditions
aren't of
concern

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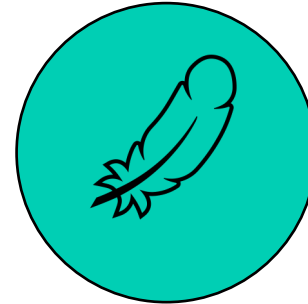
Key Goals



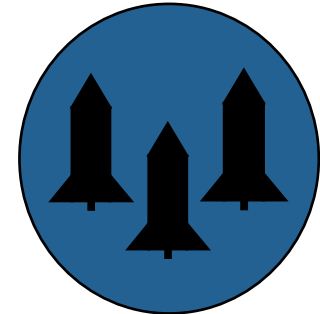
Microgravity



Recoverable



Meet weight requirements



Reproduceable

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Customer Needs



Design needs to be recoverable



The device can't use explosives



Machine must be less than 10 kg



The machine must achieve microgravity for 3-4 seconds

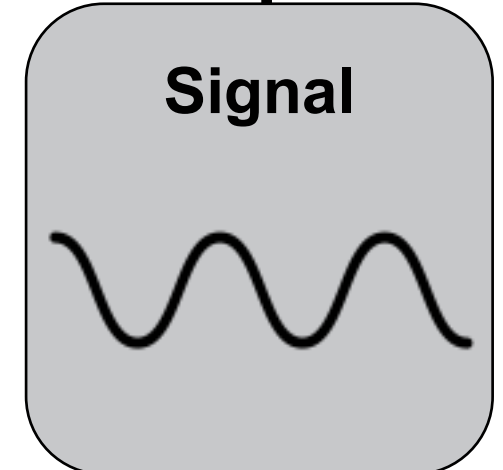
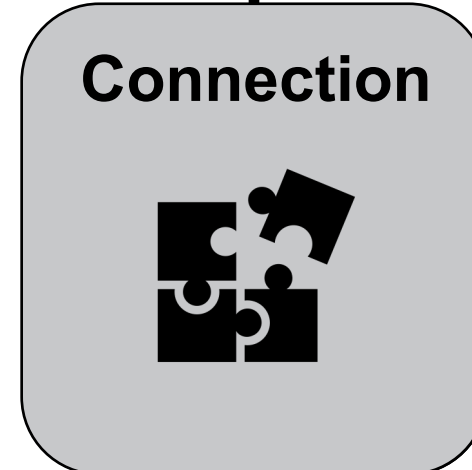
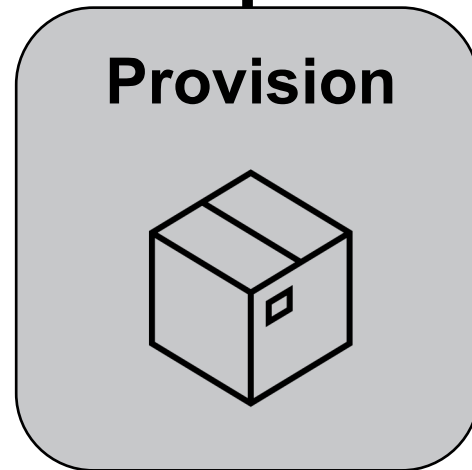
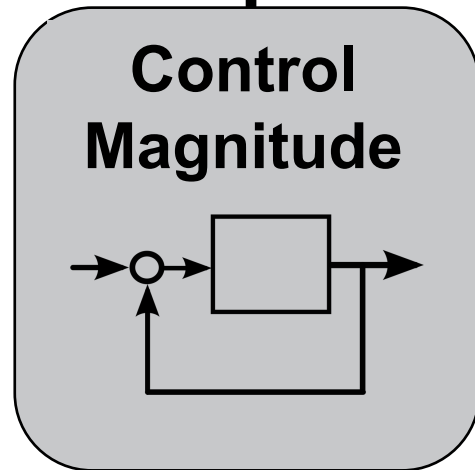
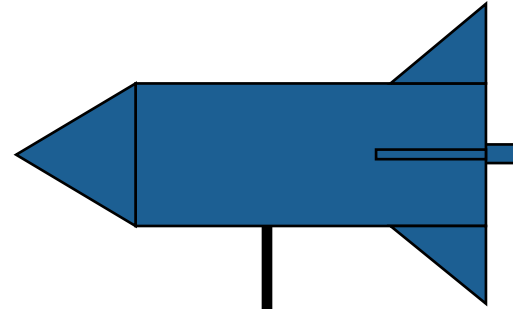


Machine must house a 3U CubeSat sized payload of dimensions 100x100x300 mm

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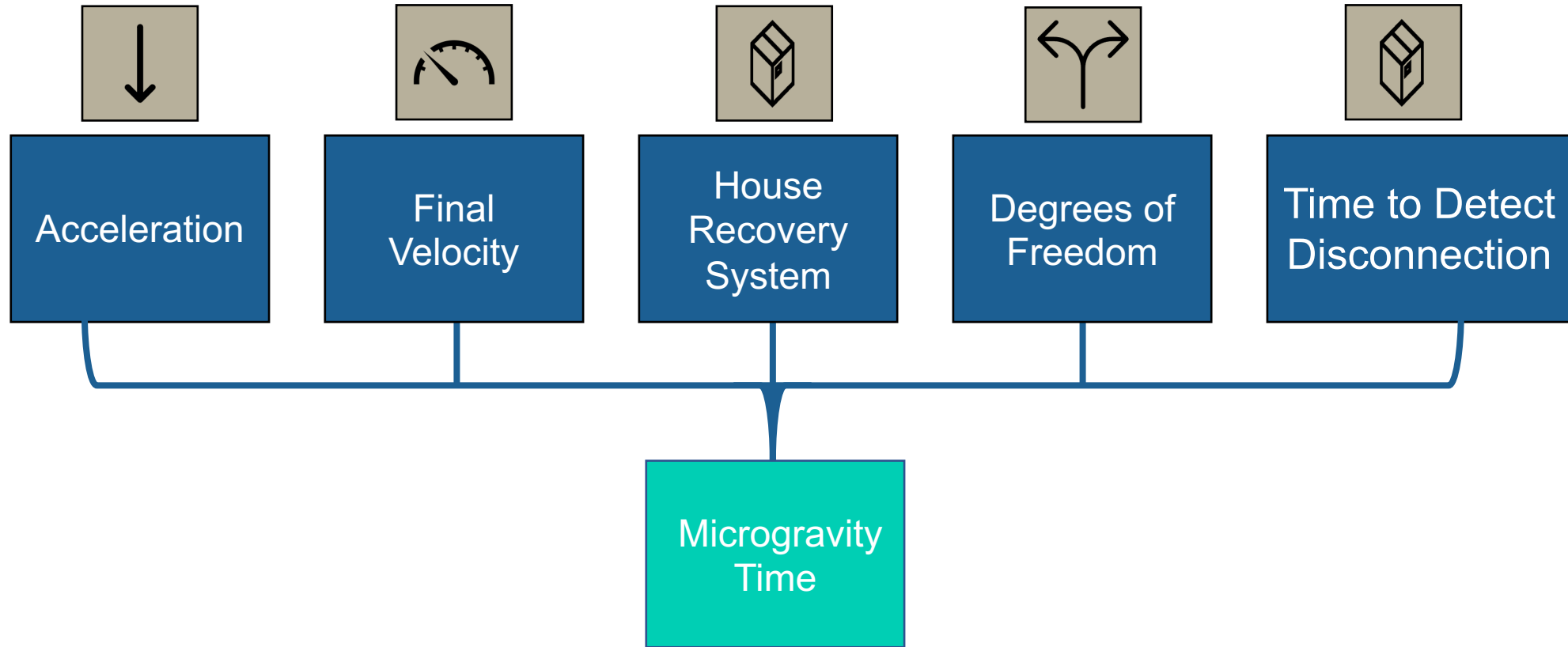
Functional Decomposition

Recap



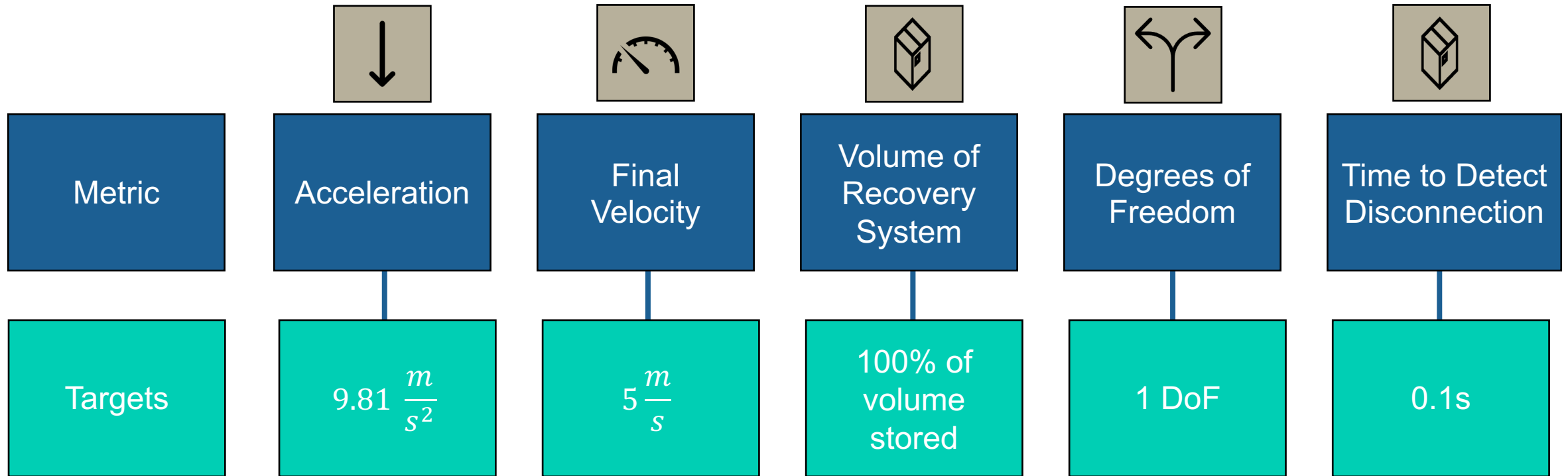
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Metrics



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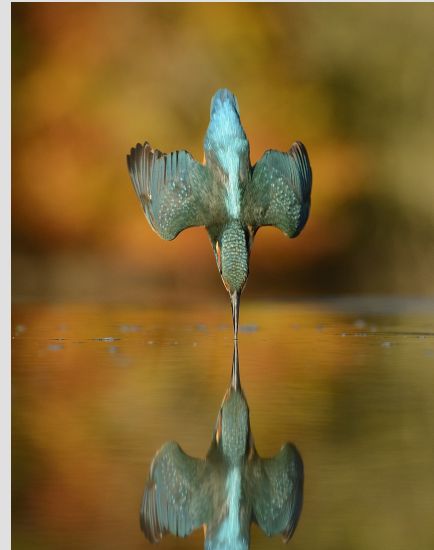
Targets and Metrics



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Concept Generation Tools

Biomimicry

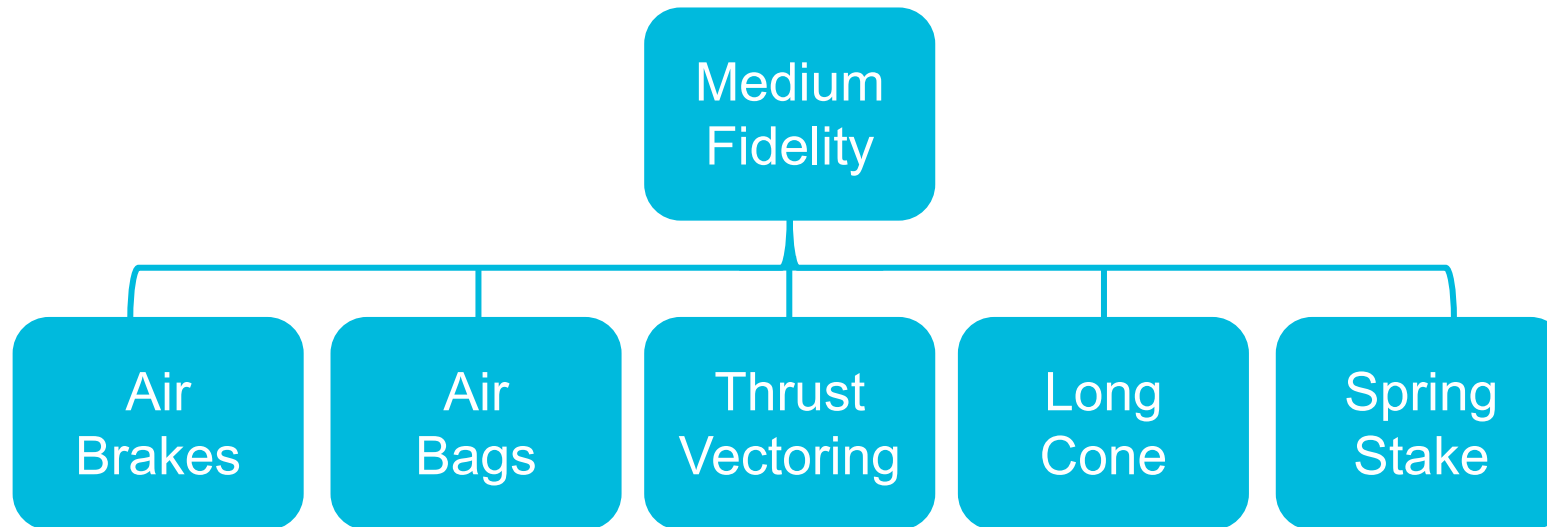


Morphological Chart

Propulsion	Recovery	Body	Stabilize
Expel propellant from nose of vehicle	Rear deployed parachute	Pointed front, blunt back	Fins
Expel propellant from sides of vehicle	Airbrakes	Football shape	Use water to spin the body
Electric motor propeller at the rear of the device	Airbag	Rubbery Skin	Use airbrakes to make it spin
Electric motor propeller at the front of the device	Side deployed parachute	Needle like, long and skinny	Thrust vectoring
No propulsion			

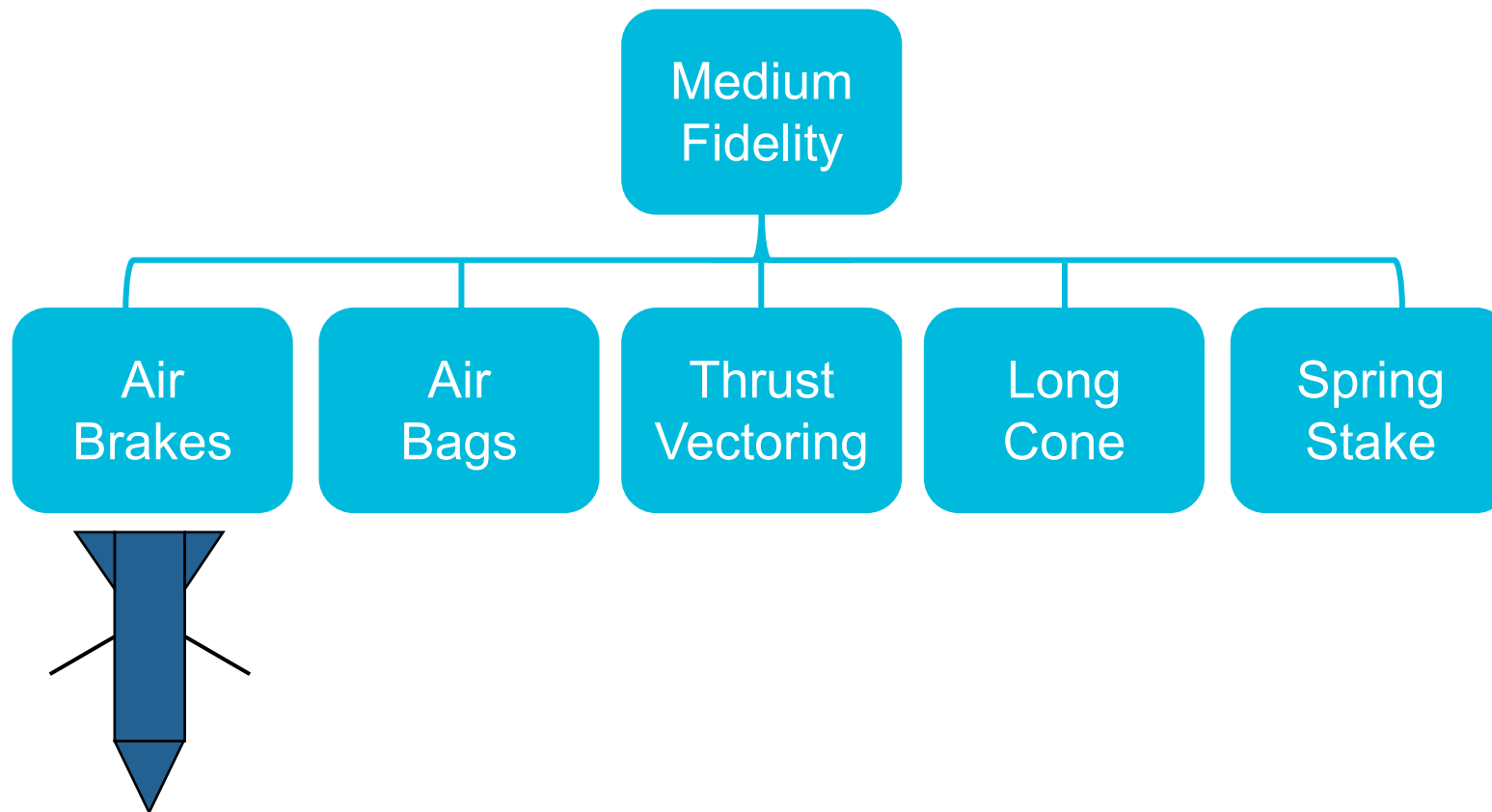
Collin Gainer

Concept Generation



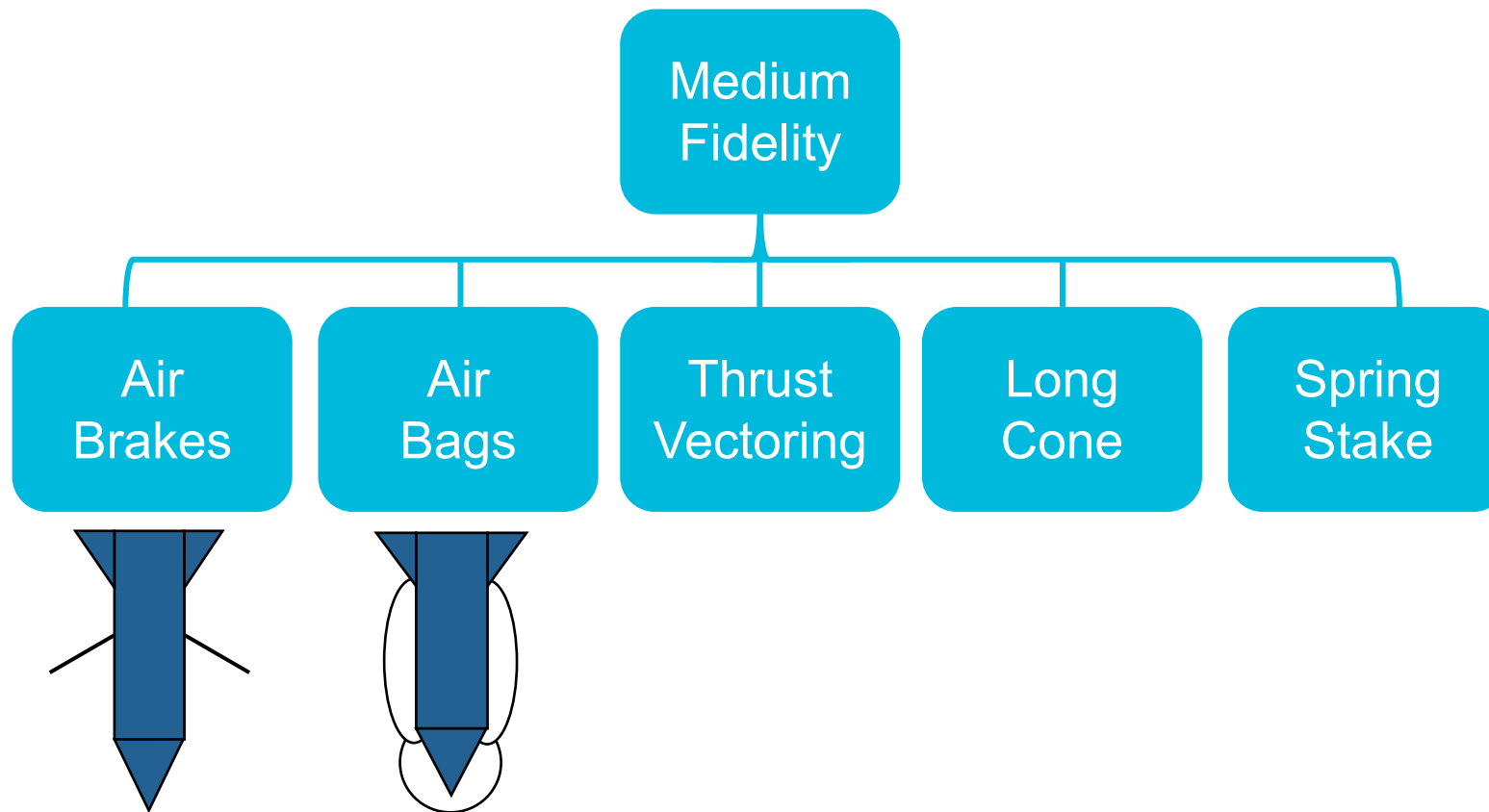
Collin Gainer

Concept Generation



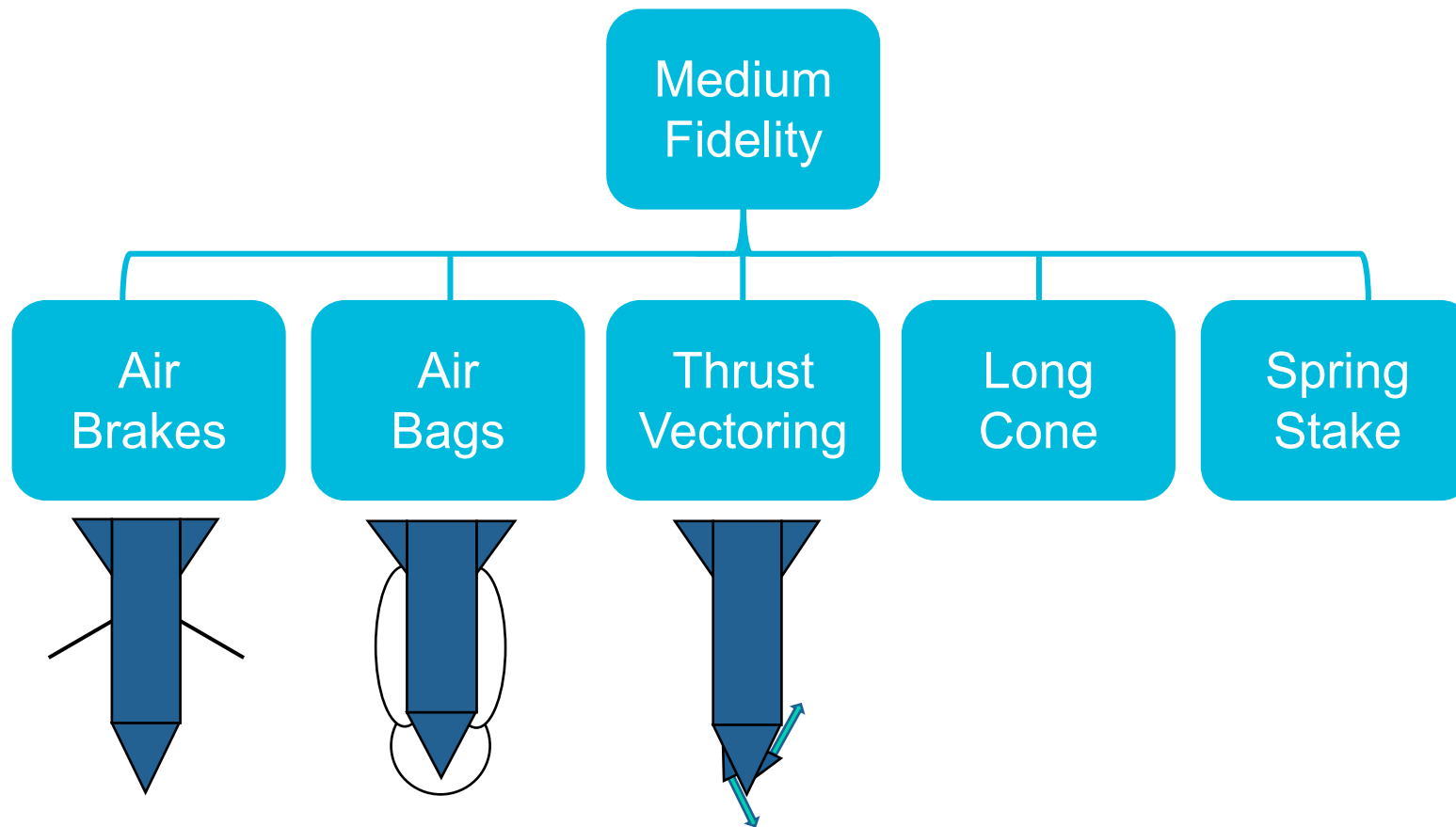
Collin Gainer

Concept Generation



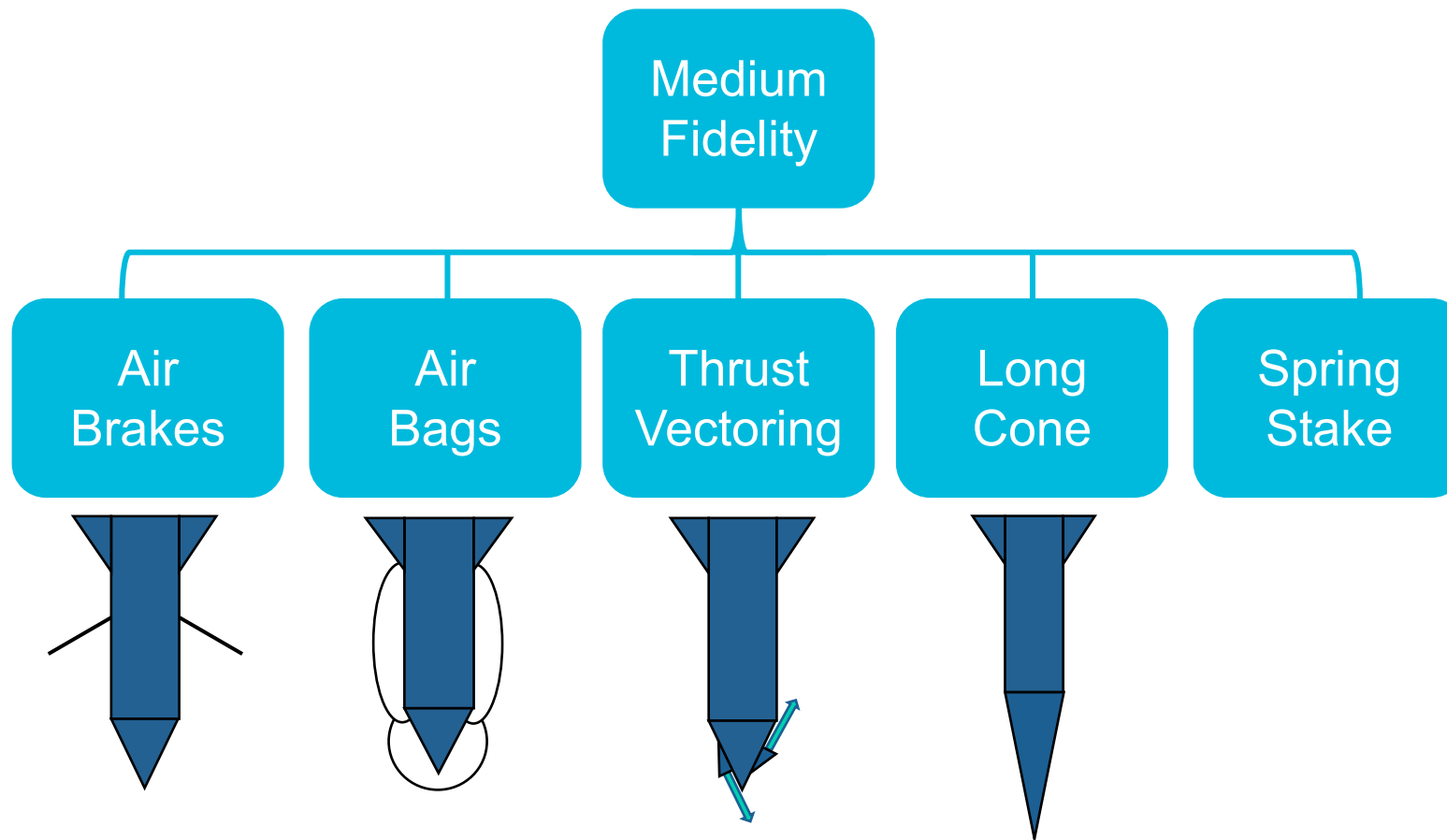
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Concept Generation



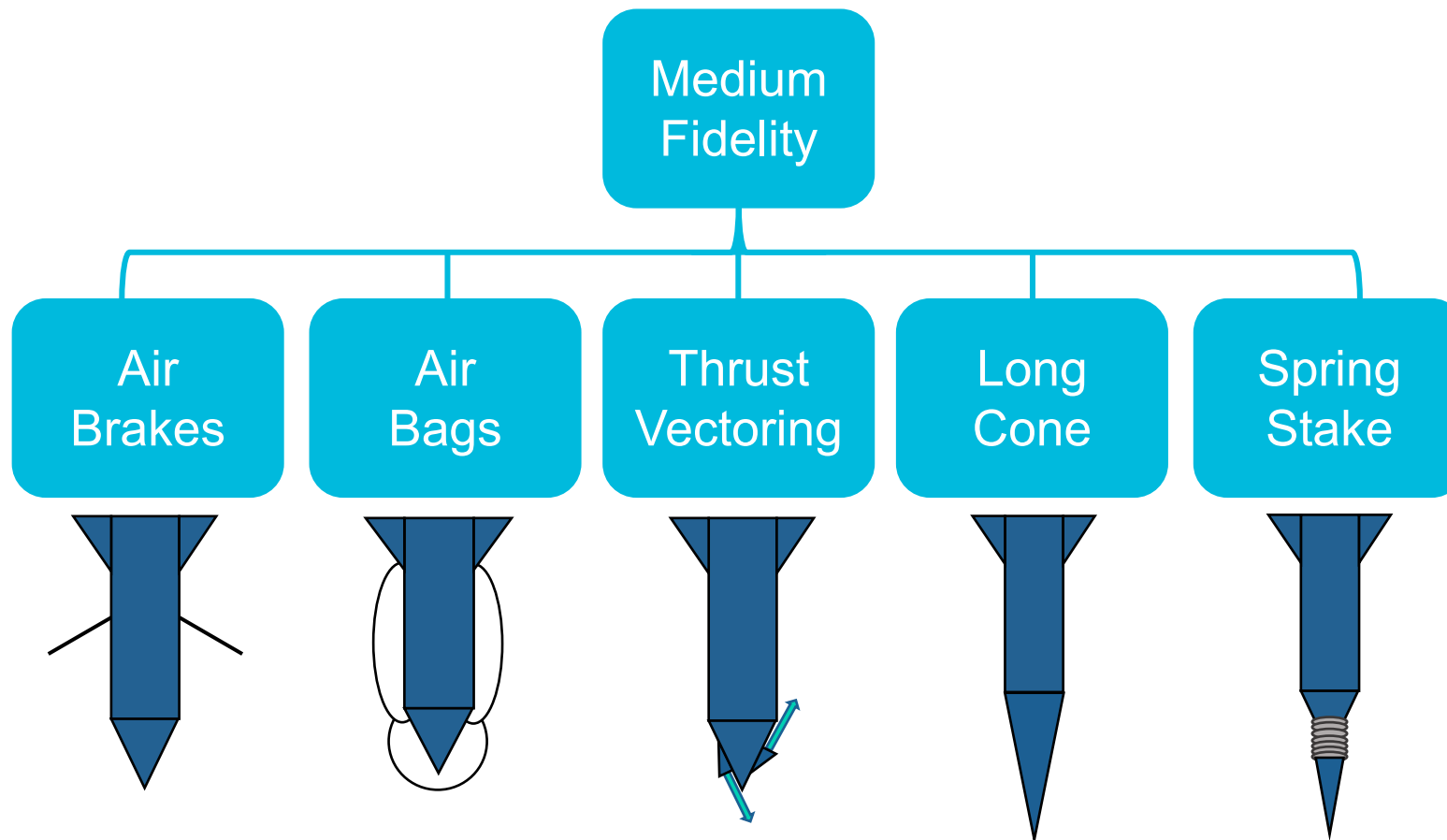
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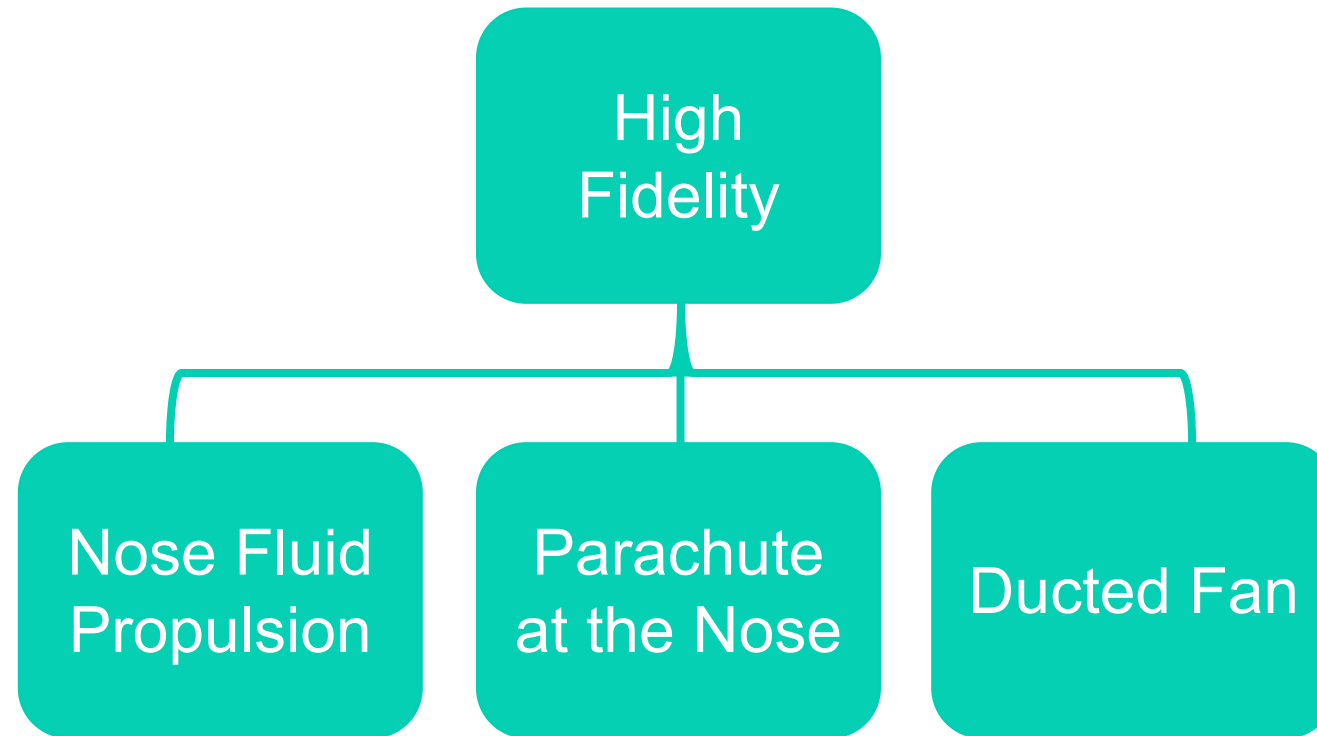
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Concept Generation



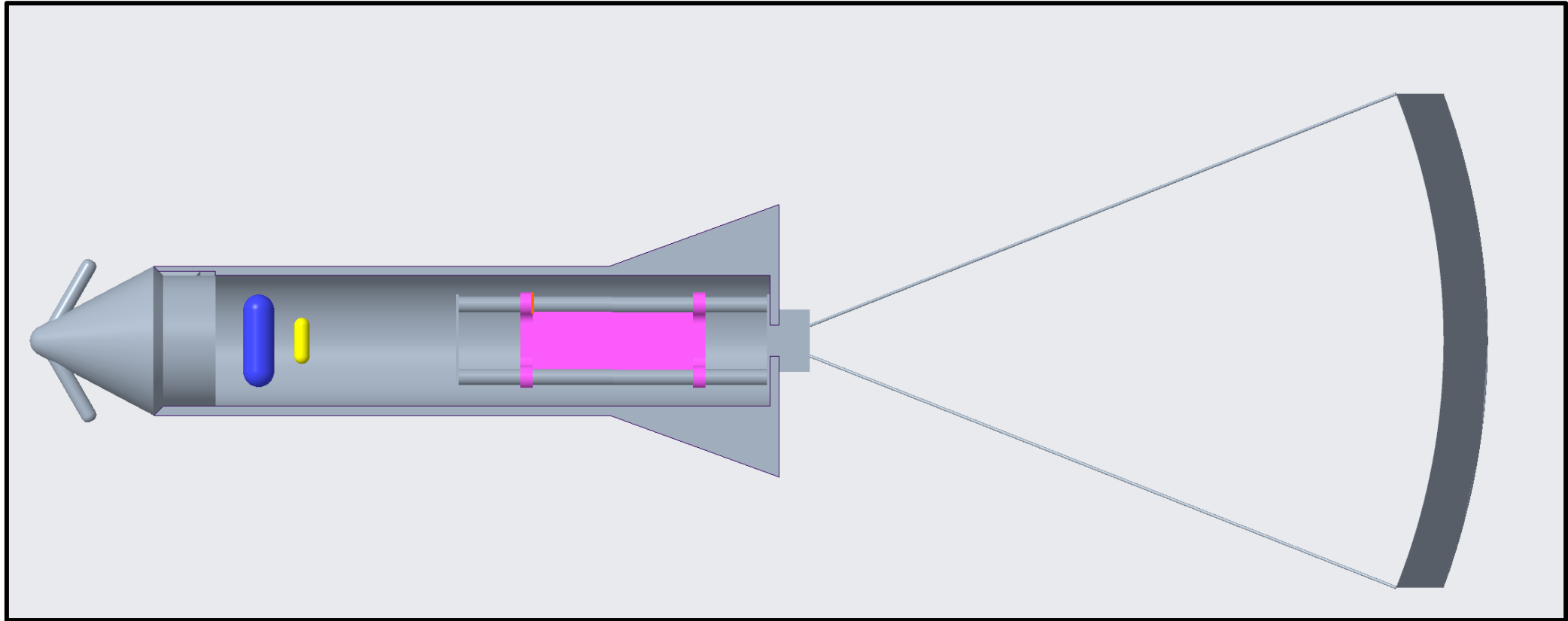
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Concept Generation



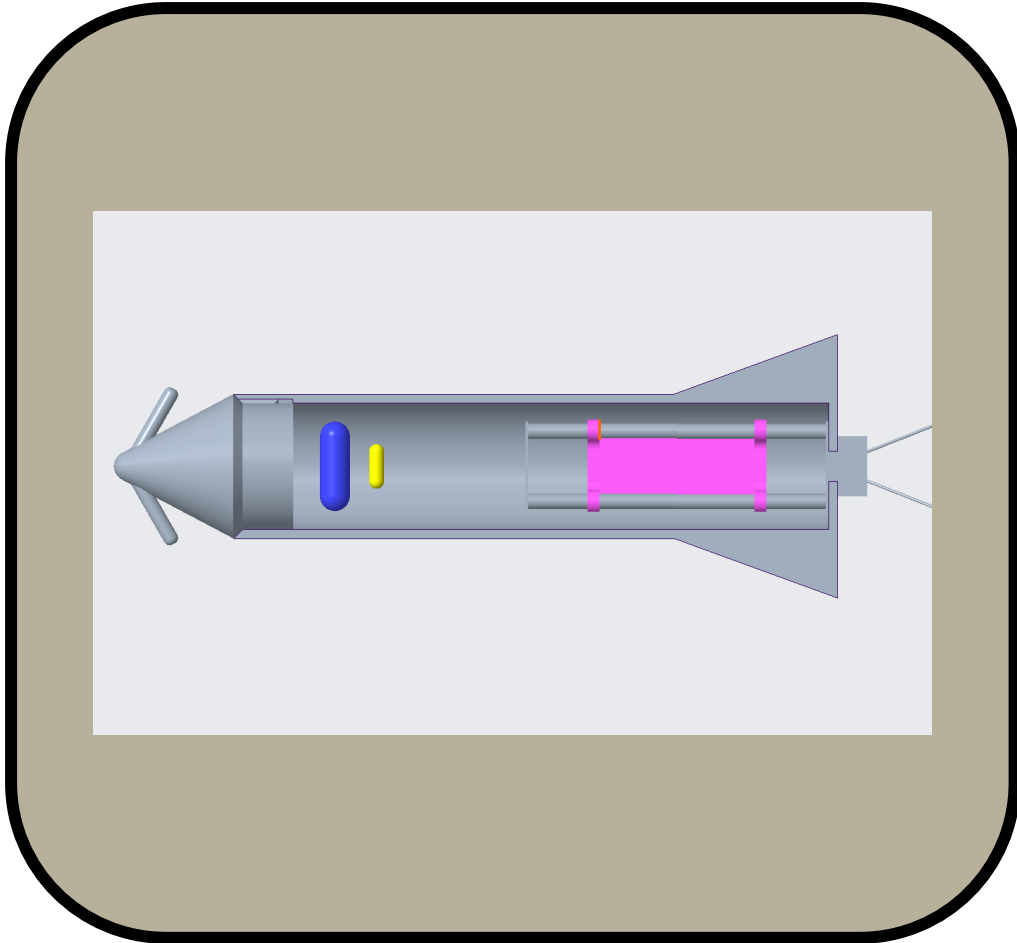
Collin Gainer

Design #1: Nose Fluid Propulsion



Collin Gainer

Design #1: Nose Fluid Propulsion



1

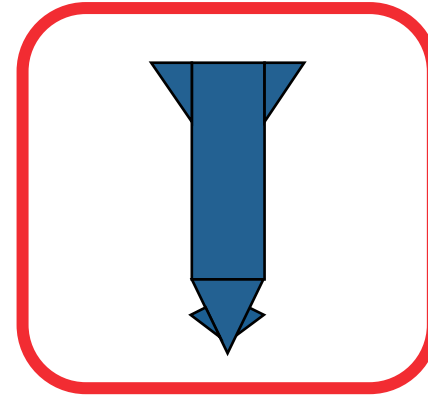
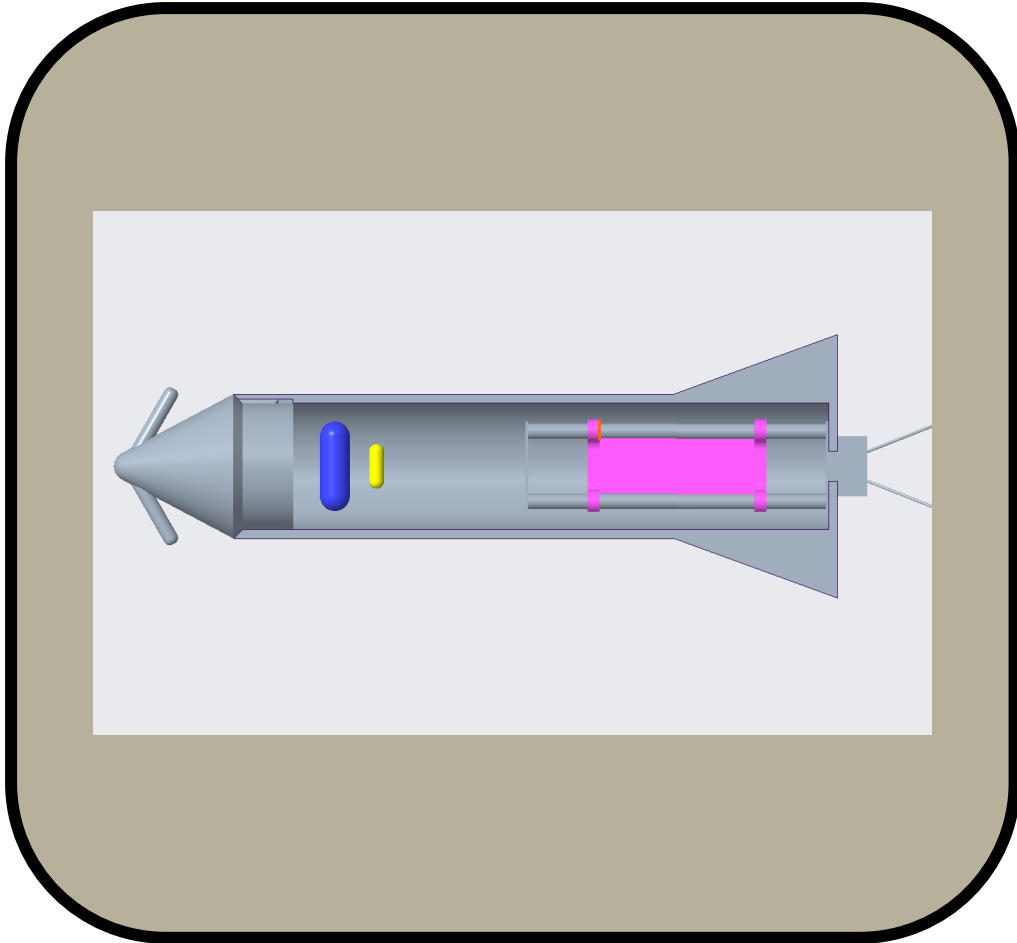
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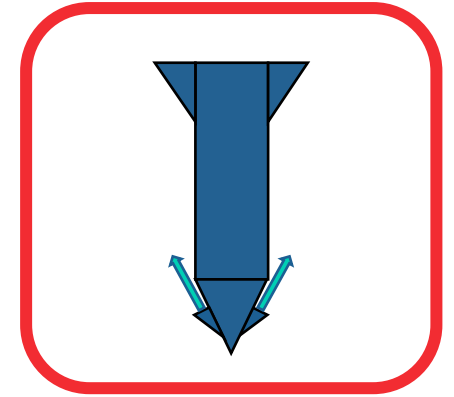
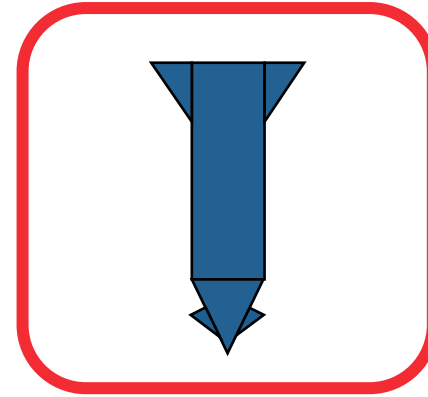
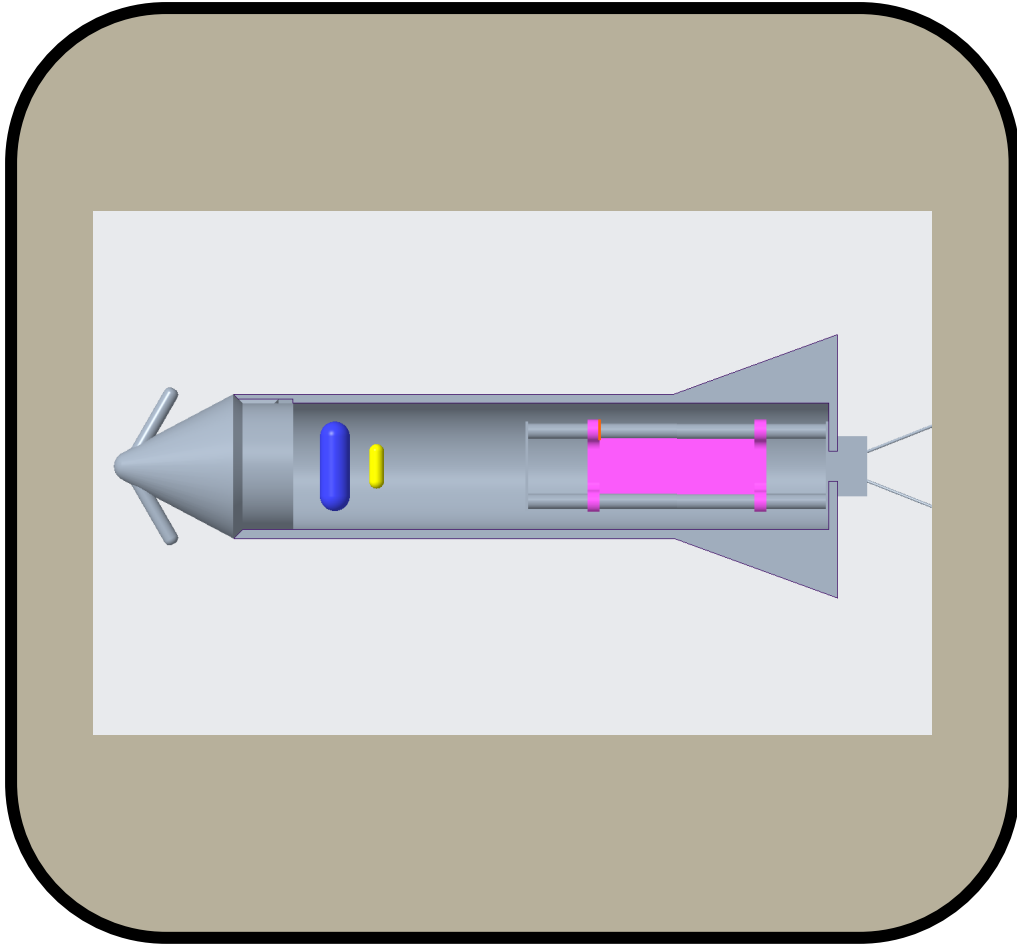
Collin Gainer

Design #1: Nose Fluid Propulsion



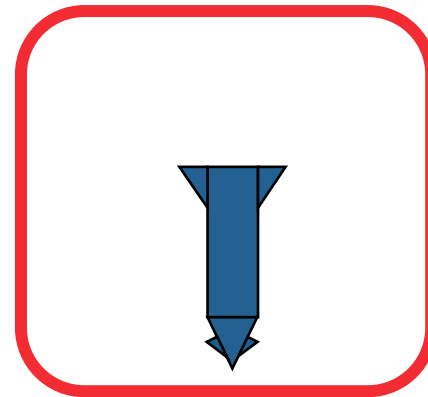
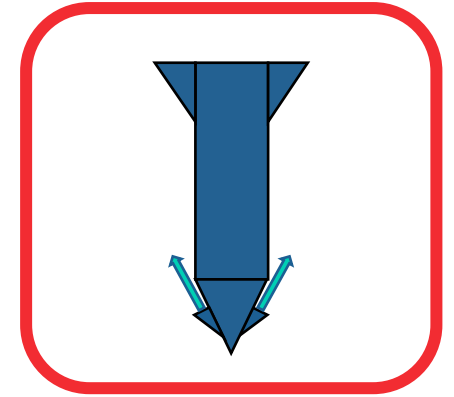
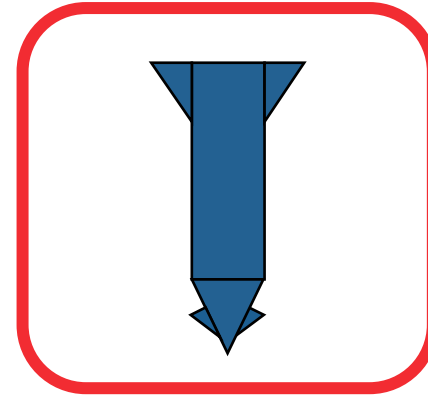
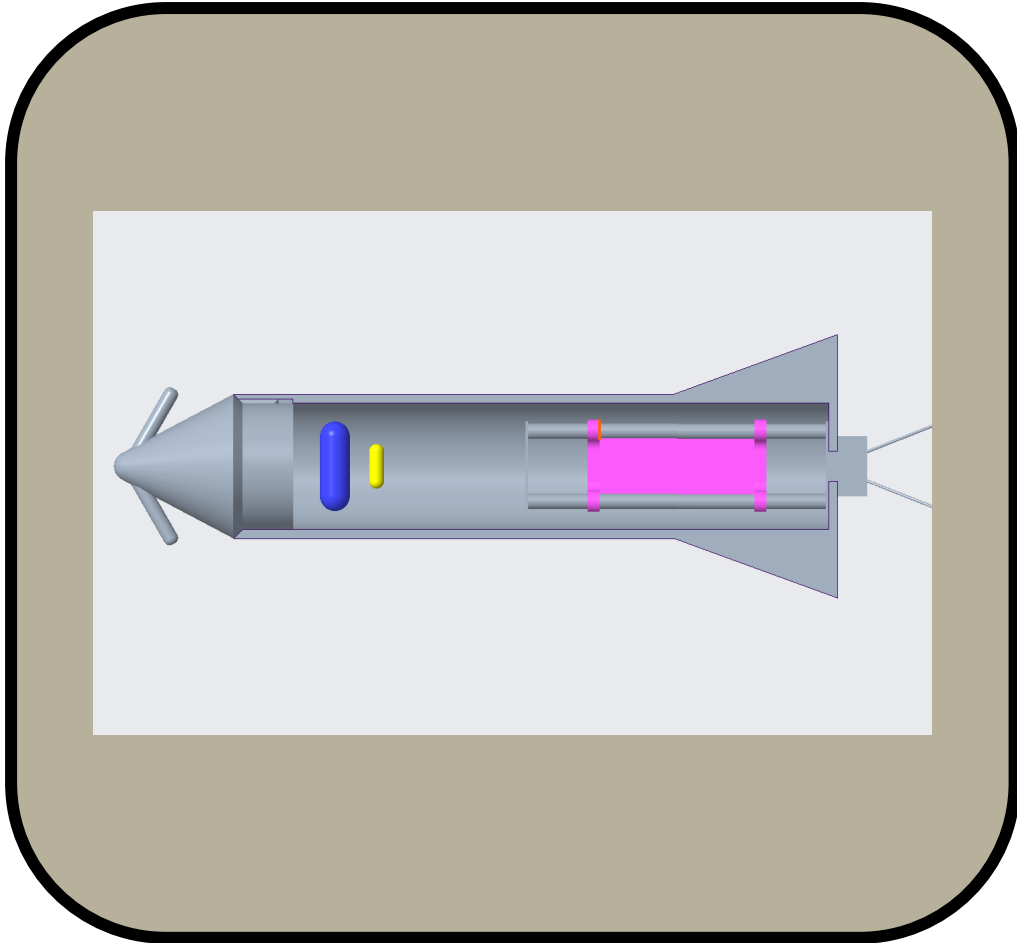
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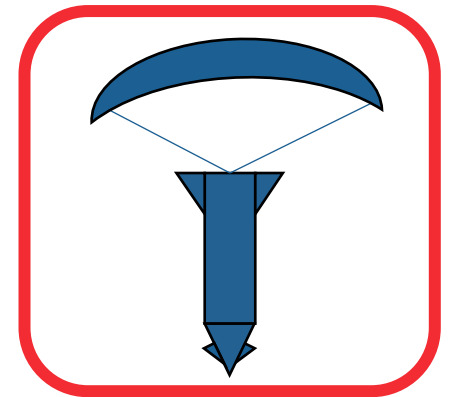
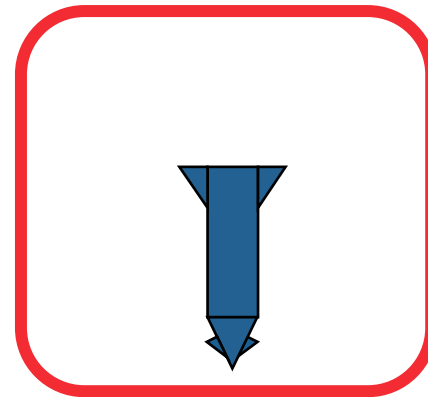
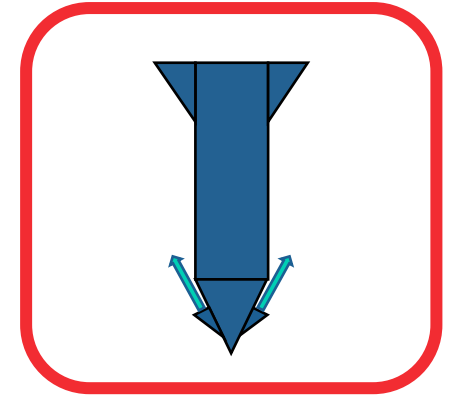
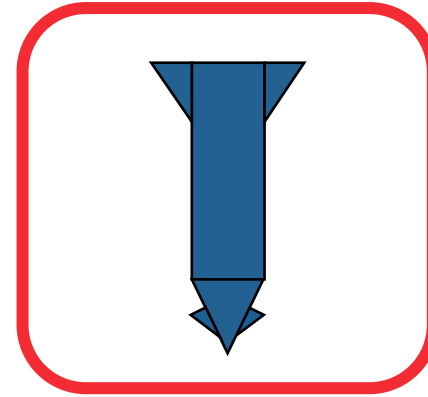
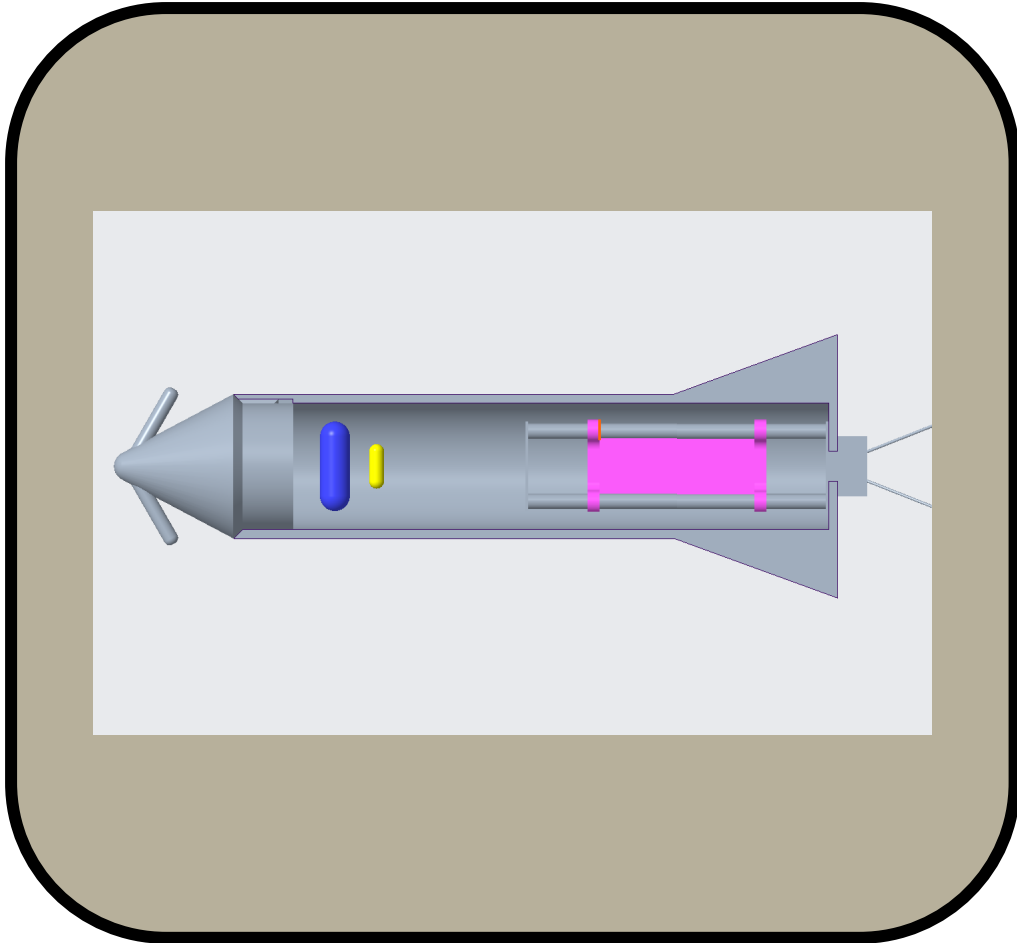
Collin Gainer

Design #1: Nose Fluid Propulsion



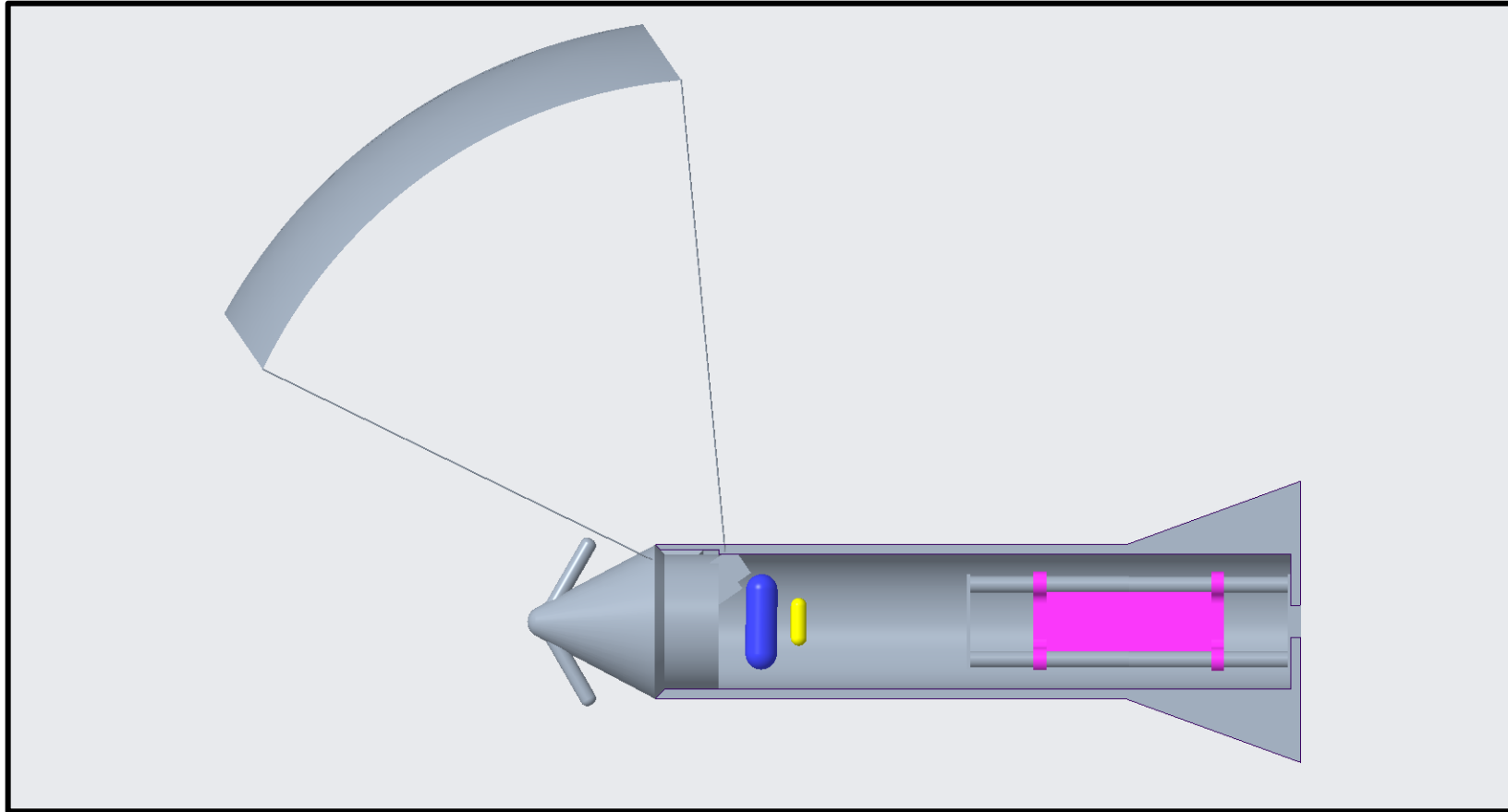
Collin Gainer

Design #1: Nose Fluid Propulsion



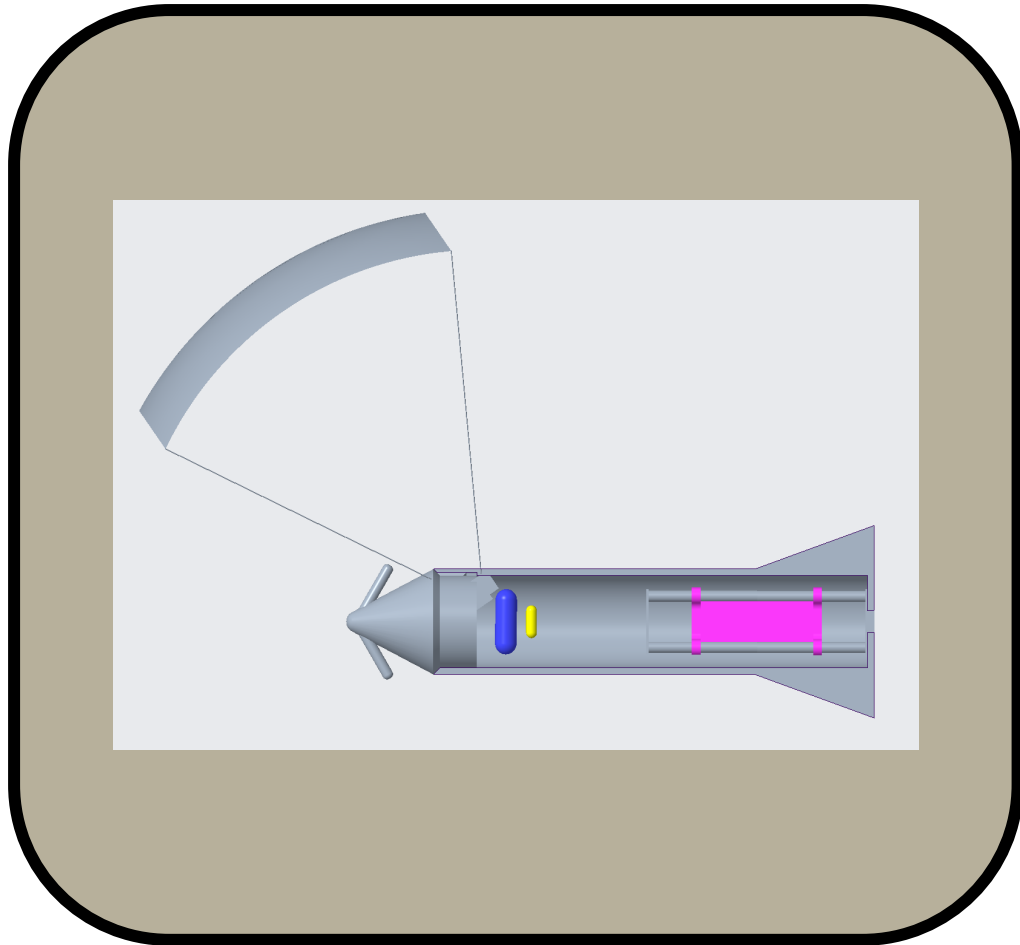
Collin Gainer

Design #2: Parachute at Nose



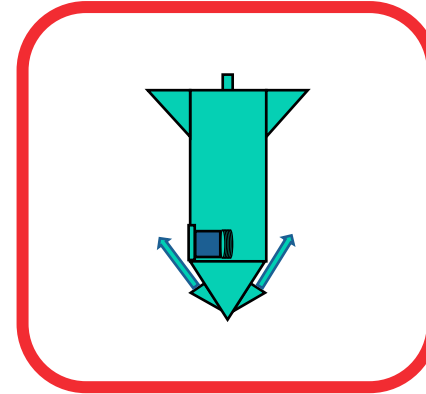
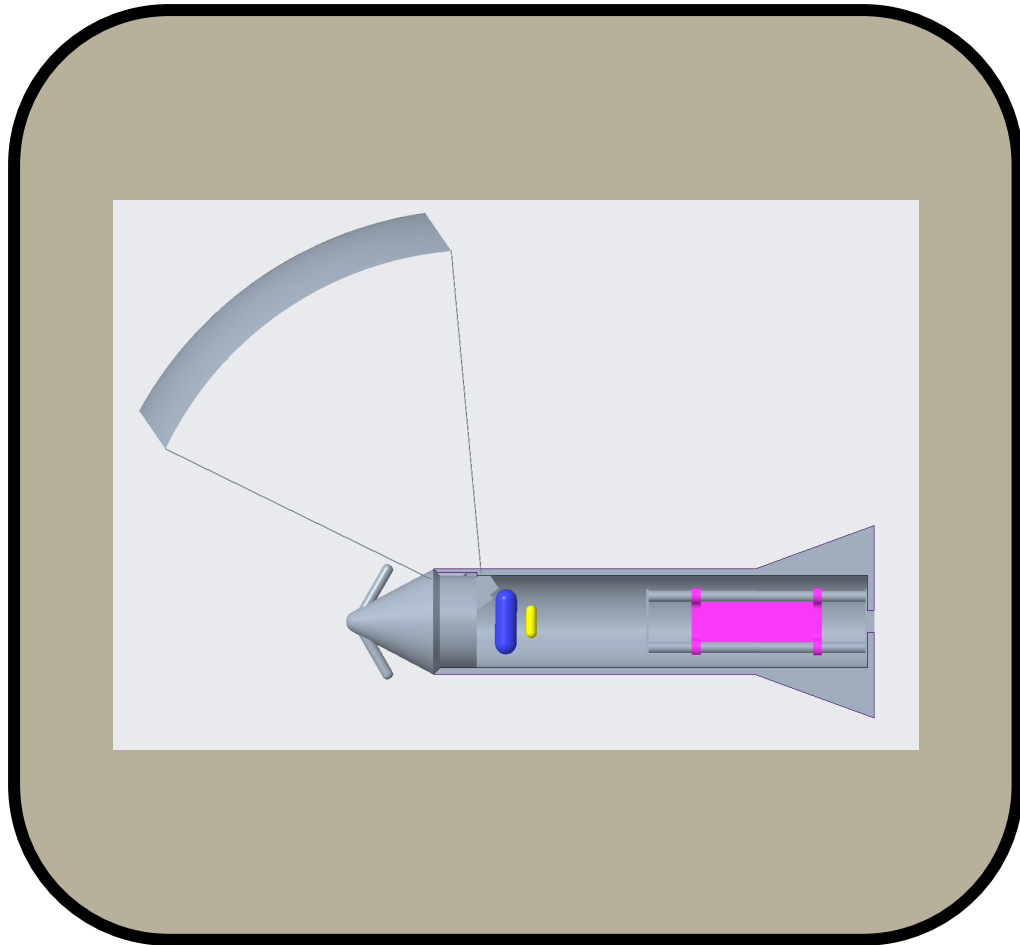
Collin Gainer

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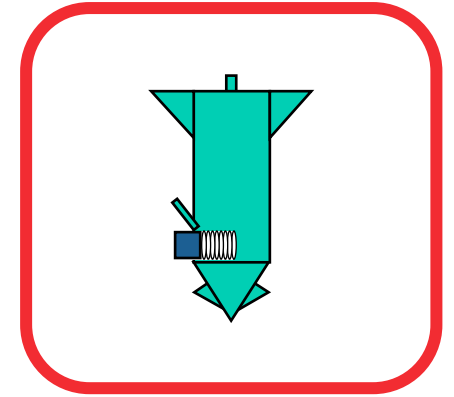
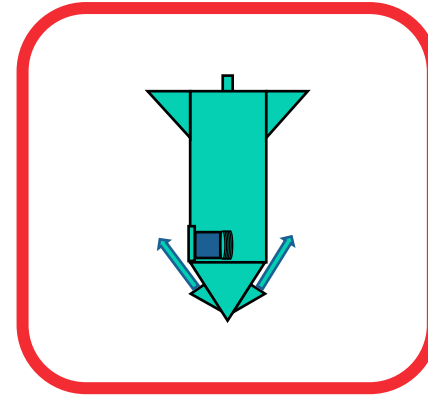
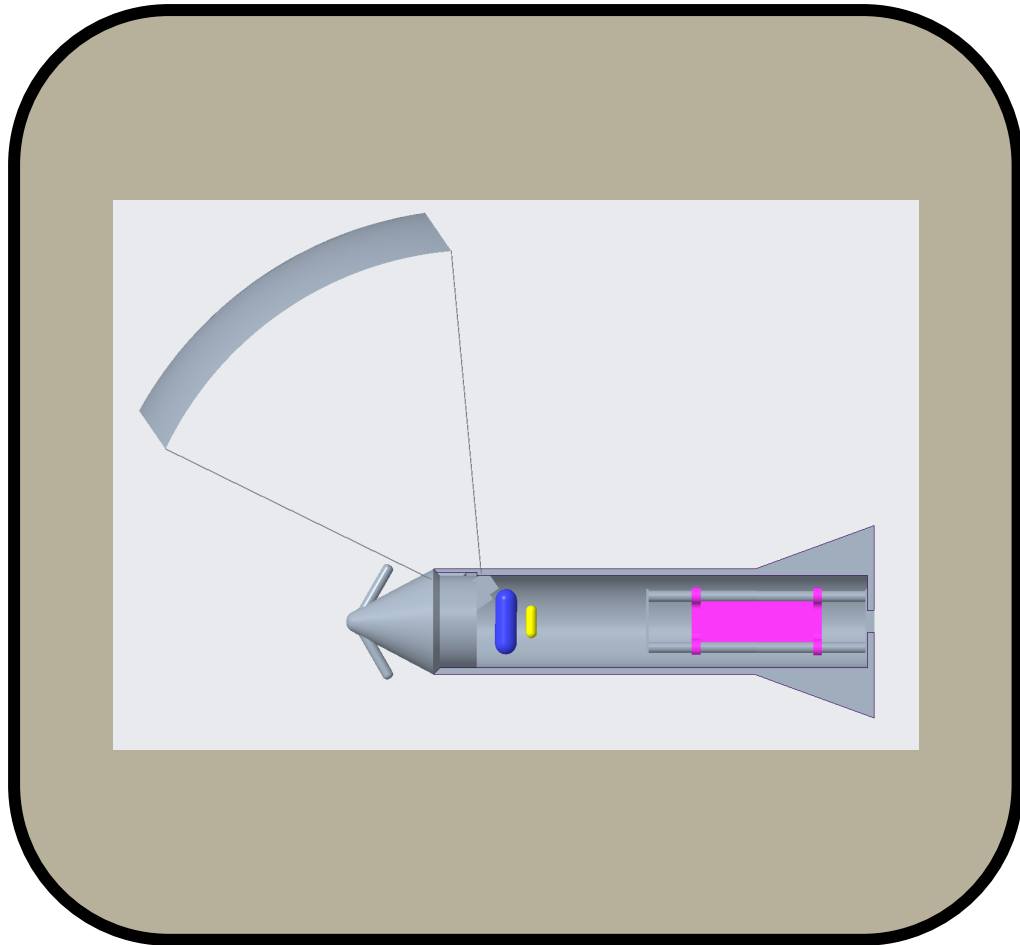
Collin Gainer

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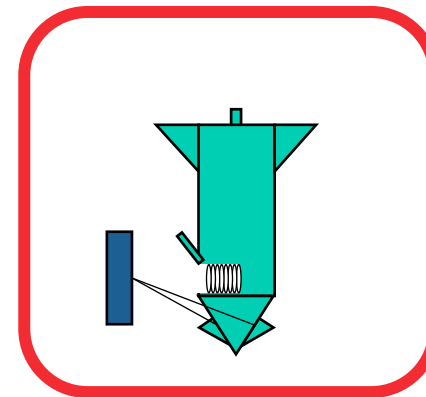
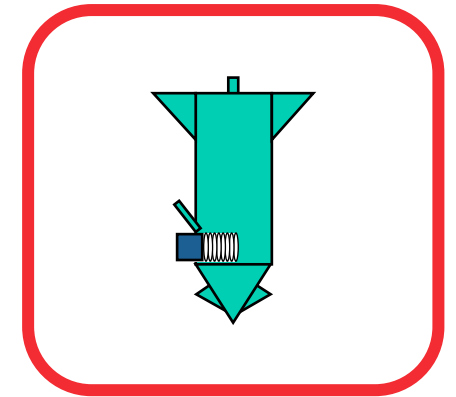
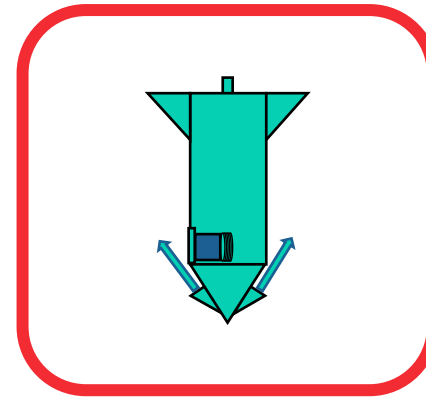
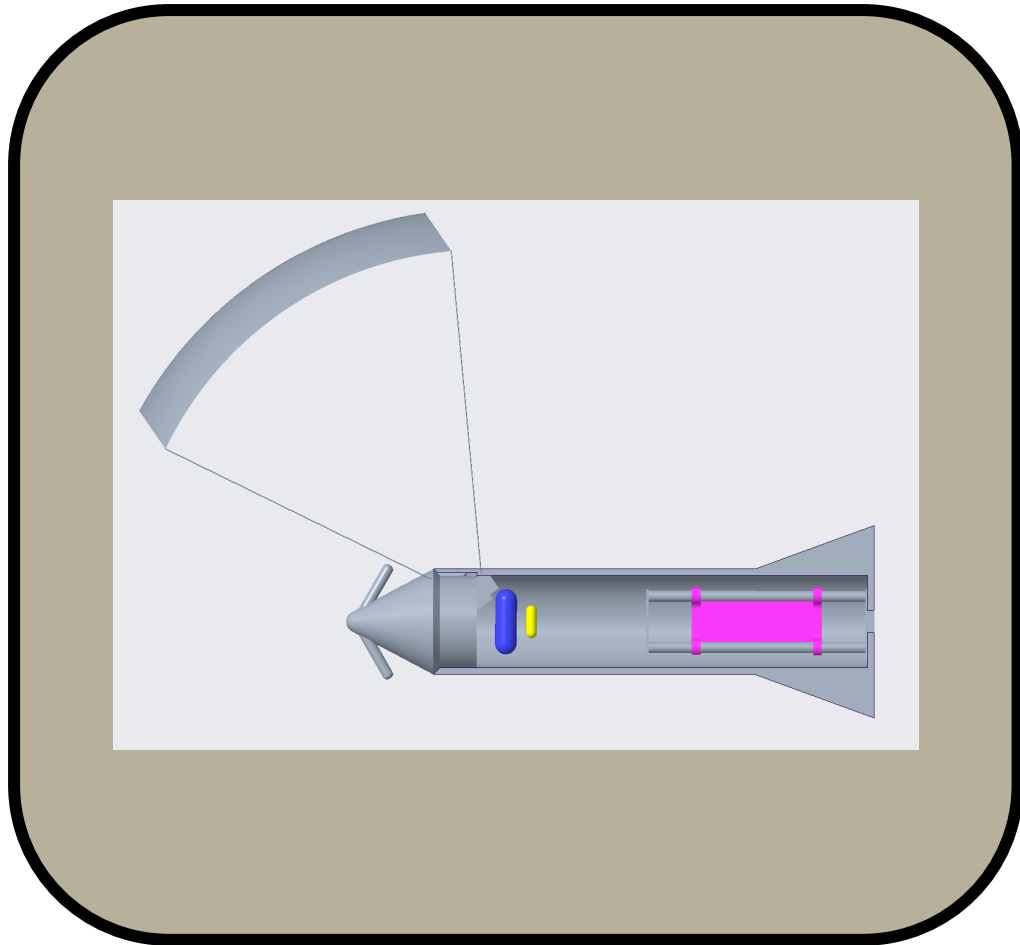
Collin Gainer

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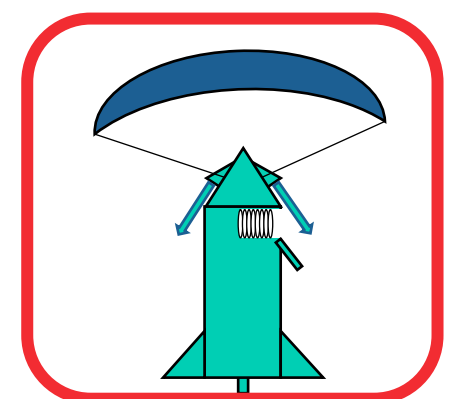
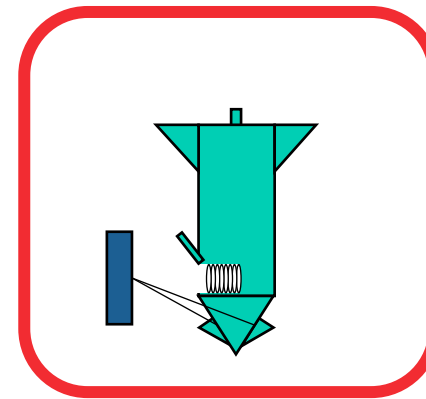
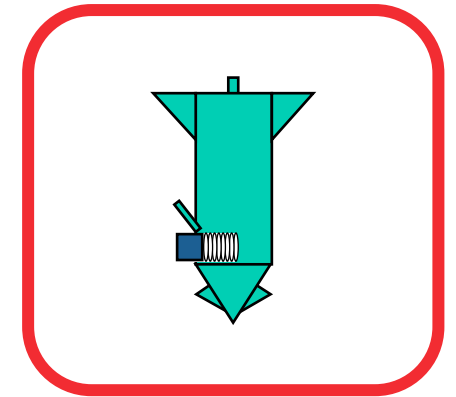
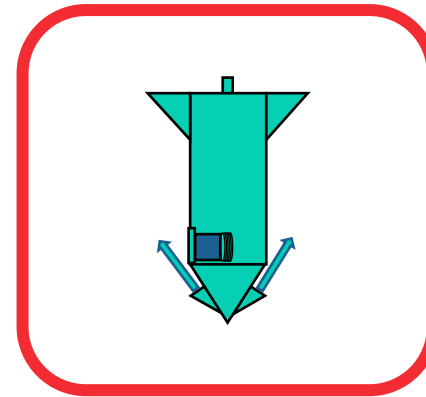
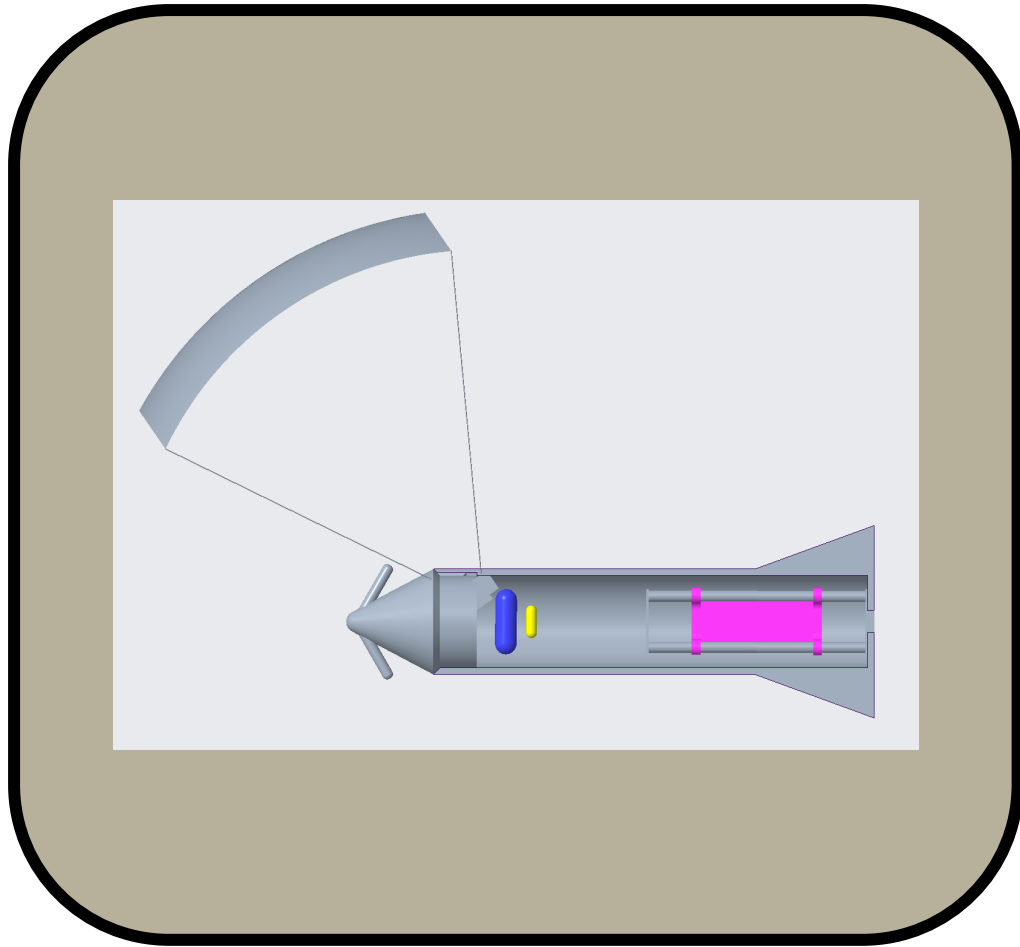
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Design #2: Parachute at Nose



Collin Gainer

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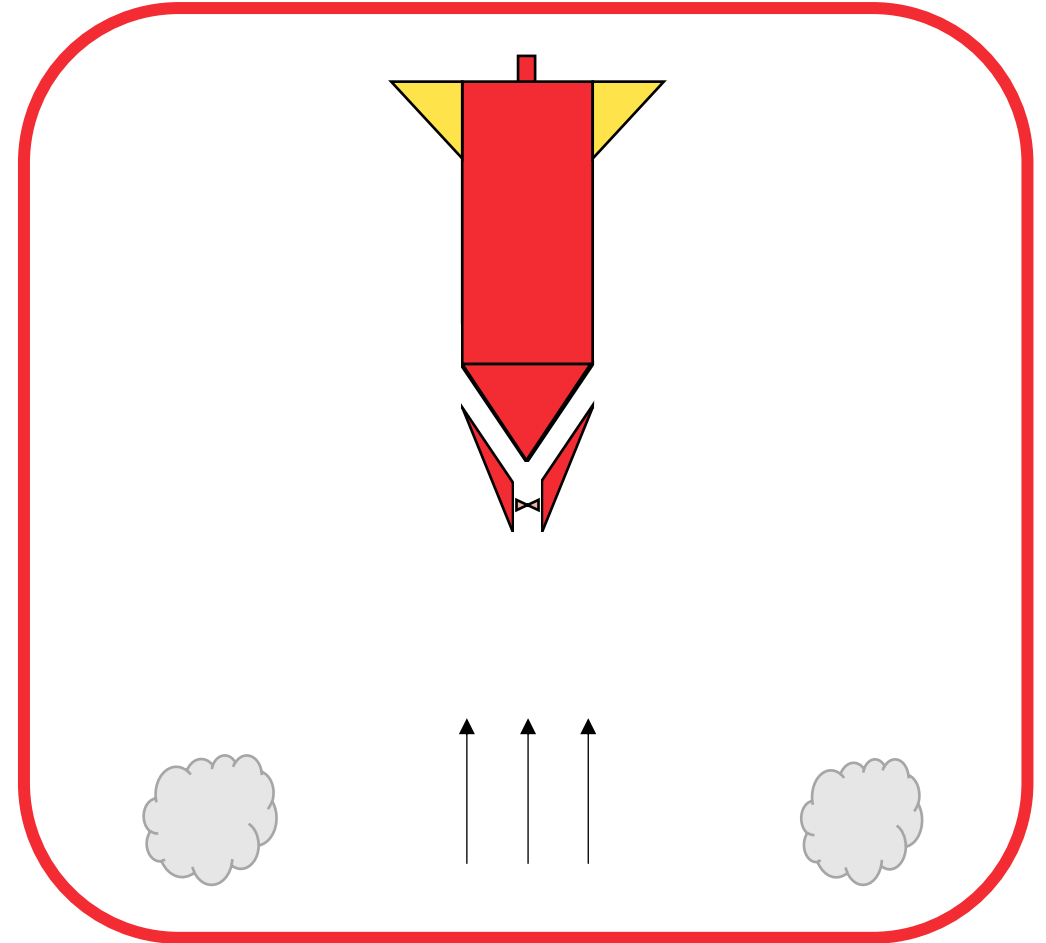
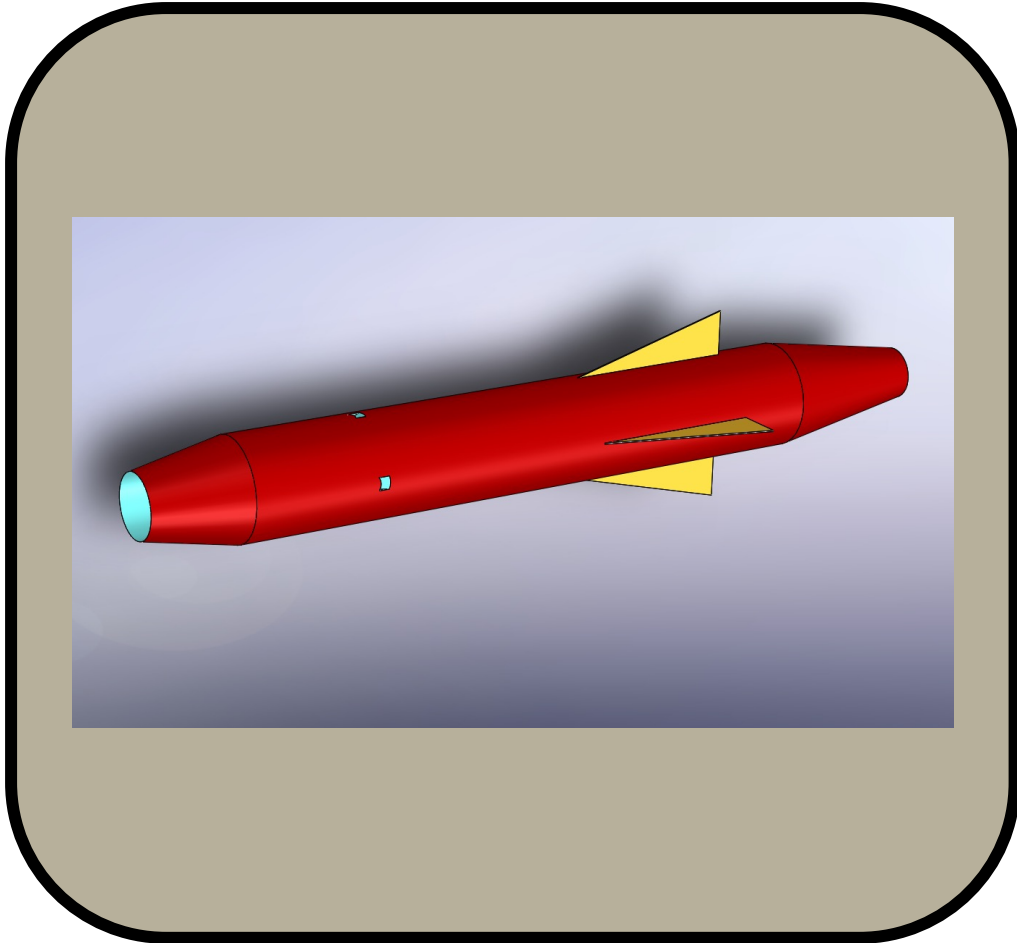
Collin Gainer

Design #3: Ducted Fan



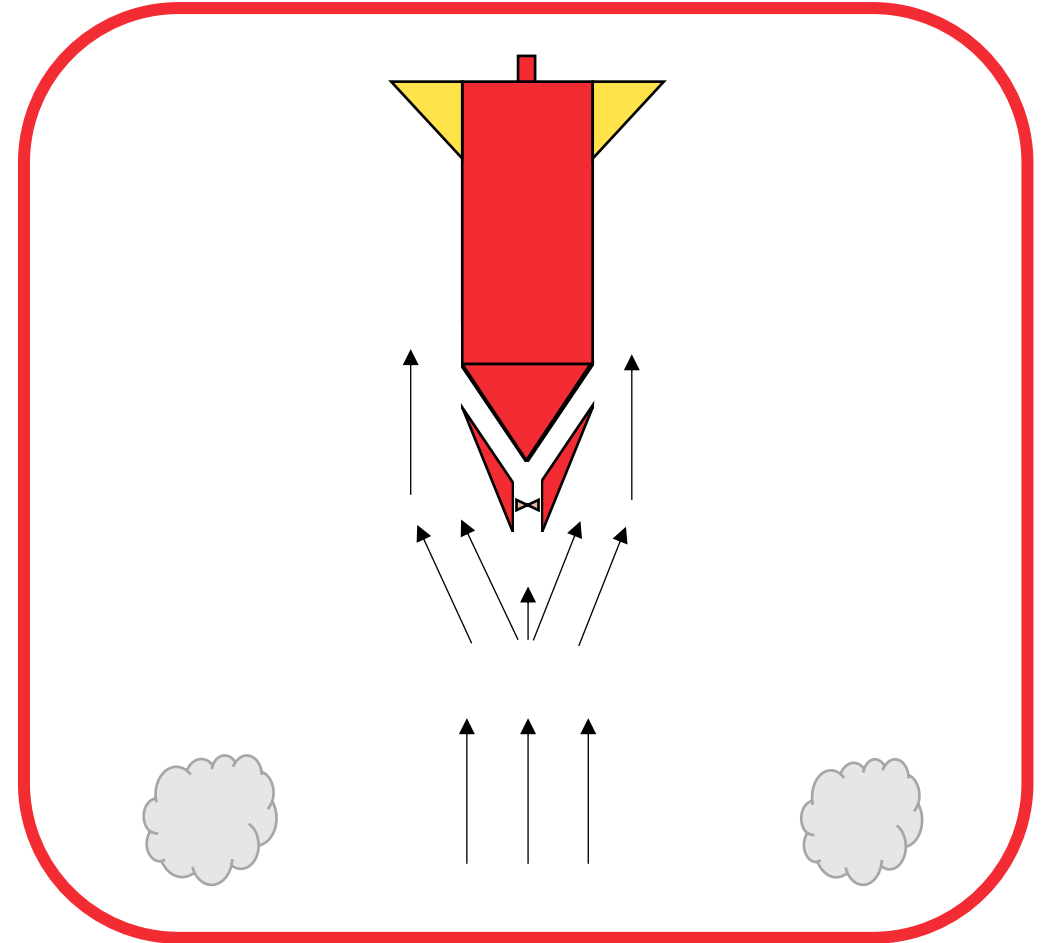
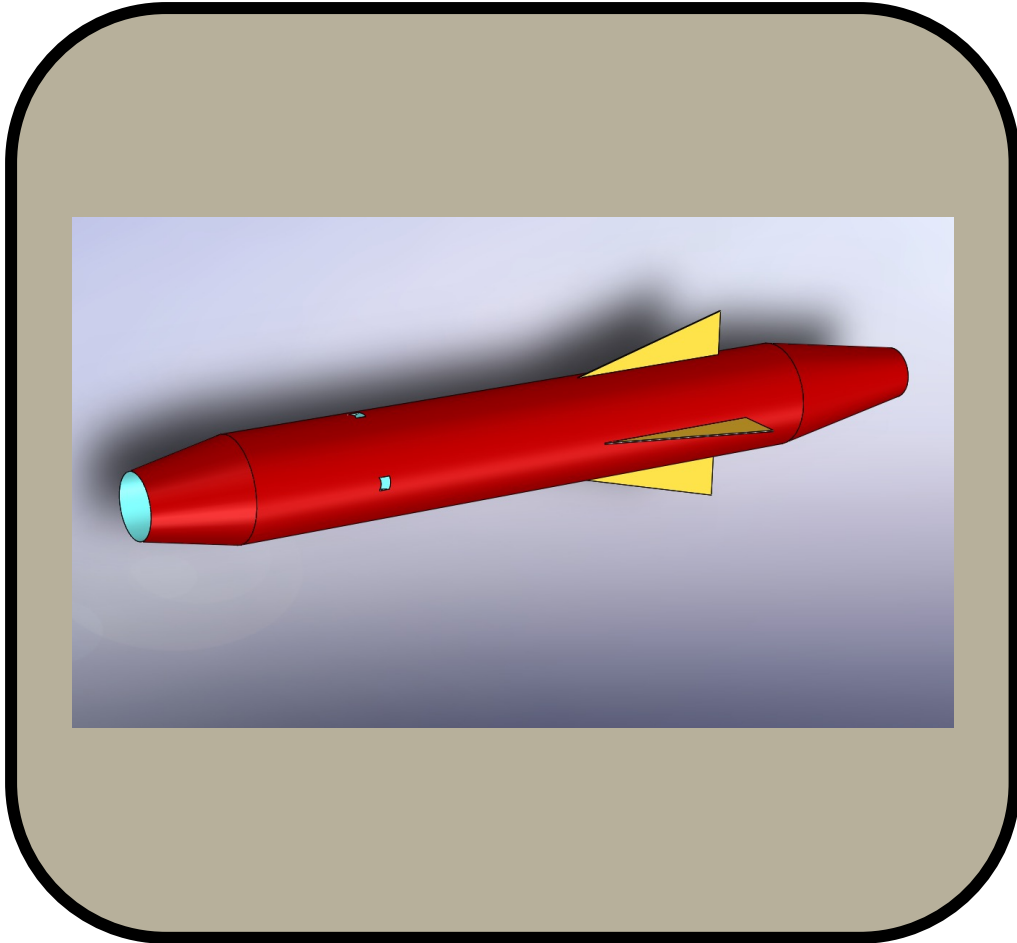
Thomas Lenz

Selected Design: Ducted Fan



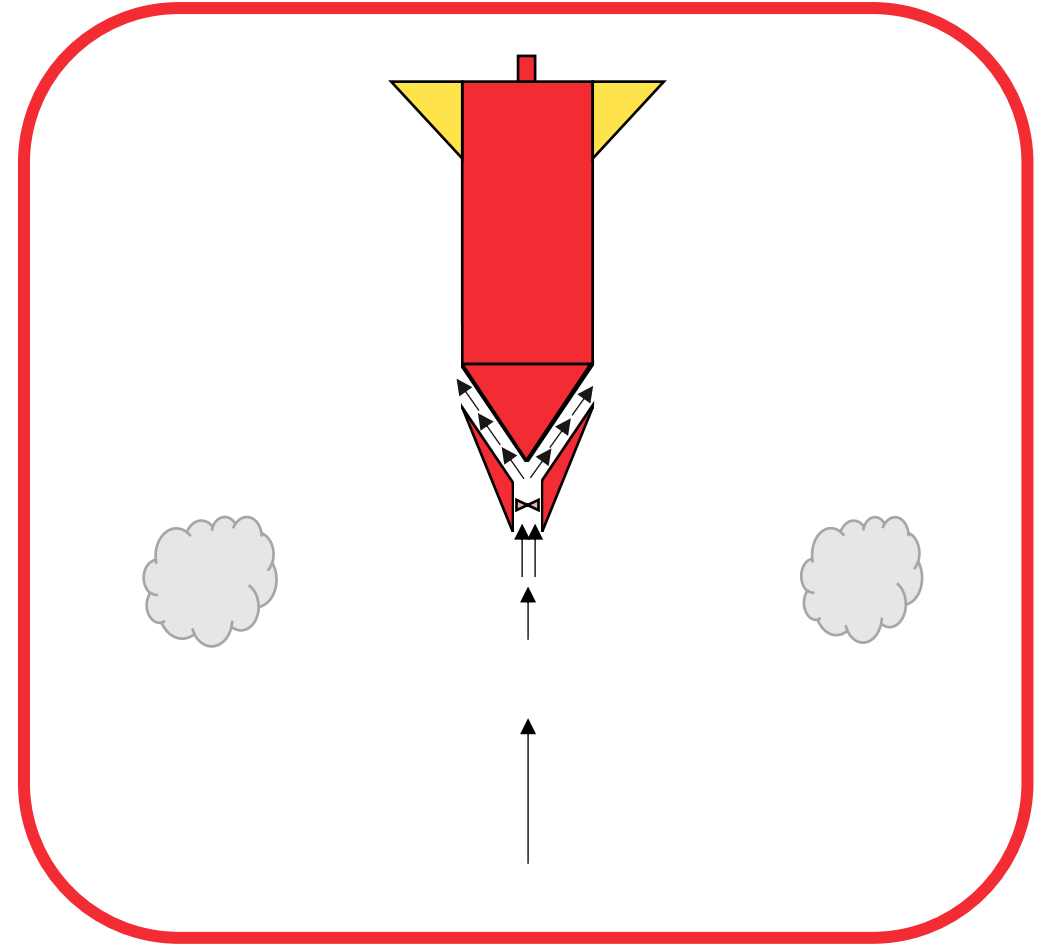
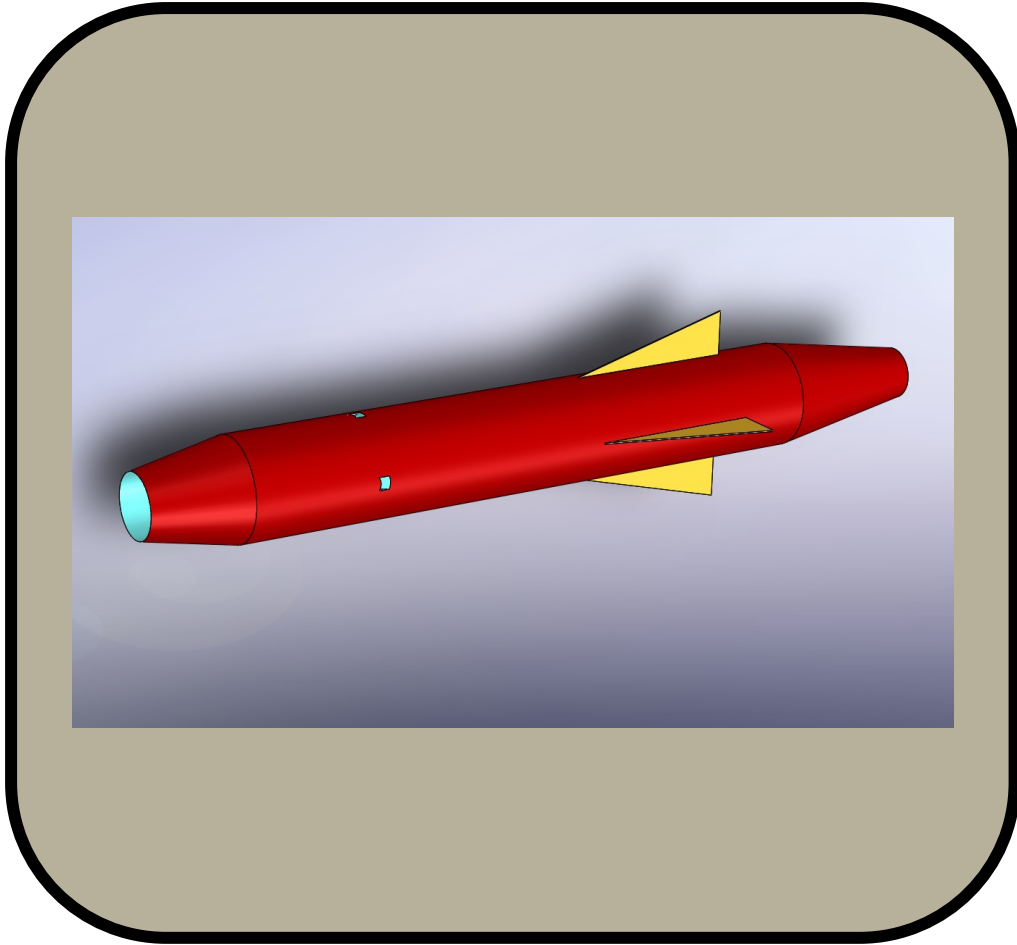
Thomas Lenz

Selected Design: Ducted Fan



Thomas Lenz

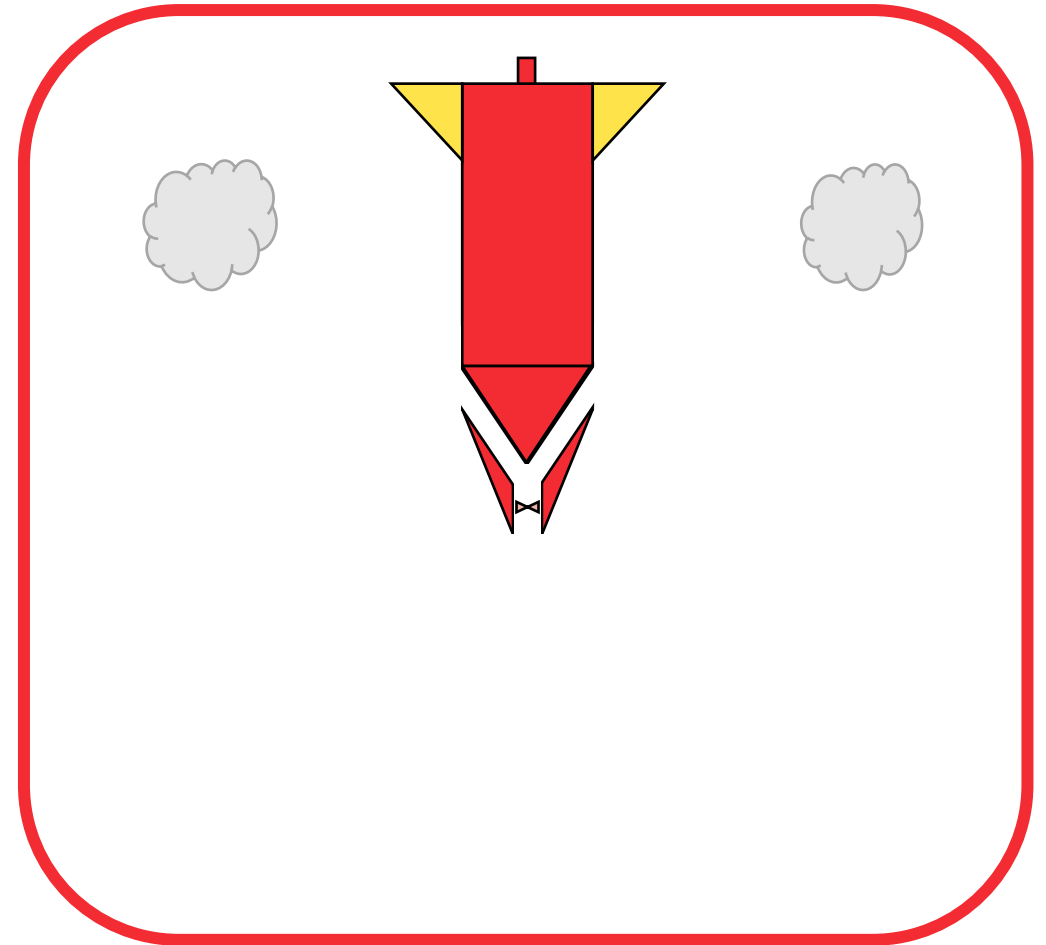
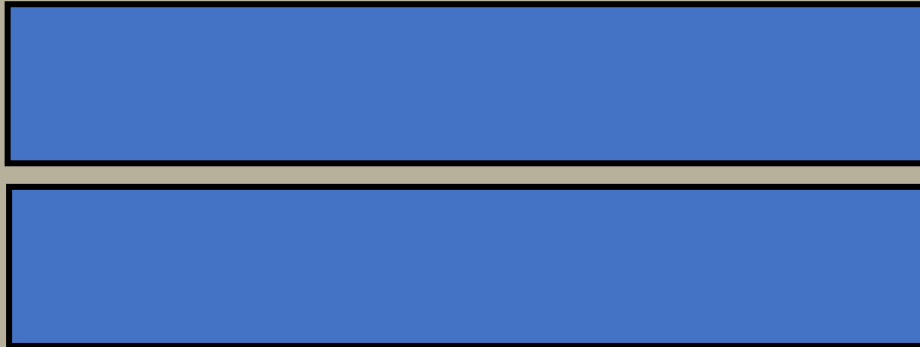
Selected Design: Ducted Fan



Thomas Lenz

Selected Design: Ducted Fan

Combats drag effects in two ways

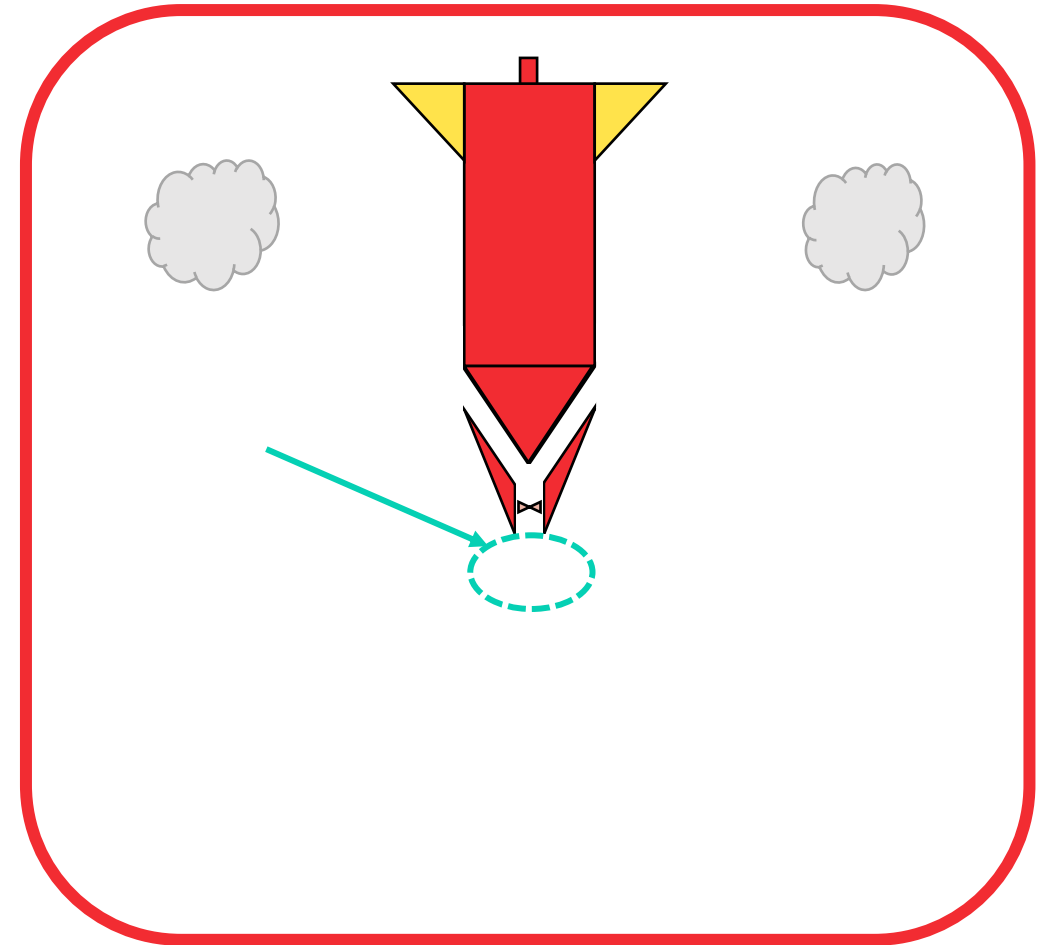


Thomas Lenz

Selected Design: Ducted Fan

Combats drag effects in two ways

1. Reduces differential pressure acting on the body



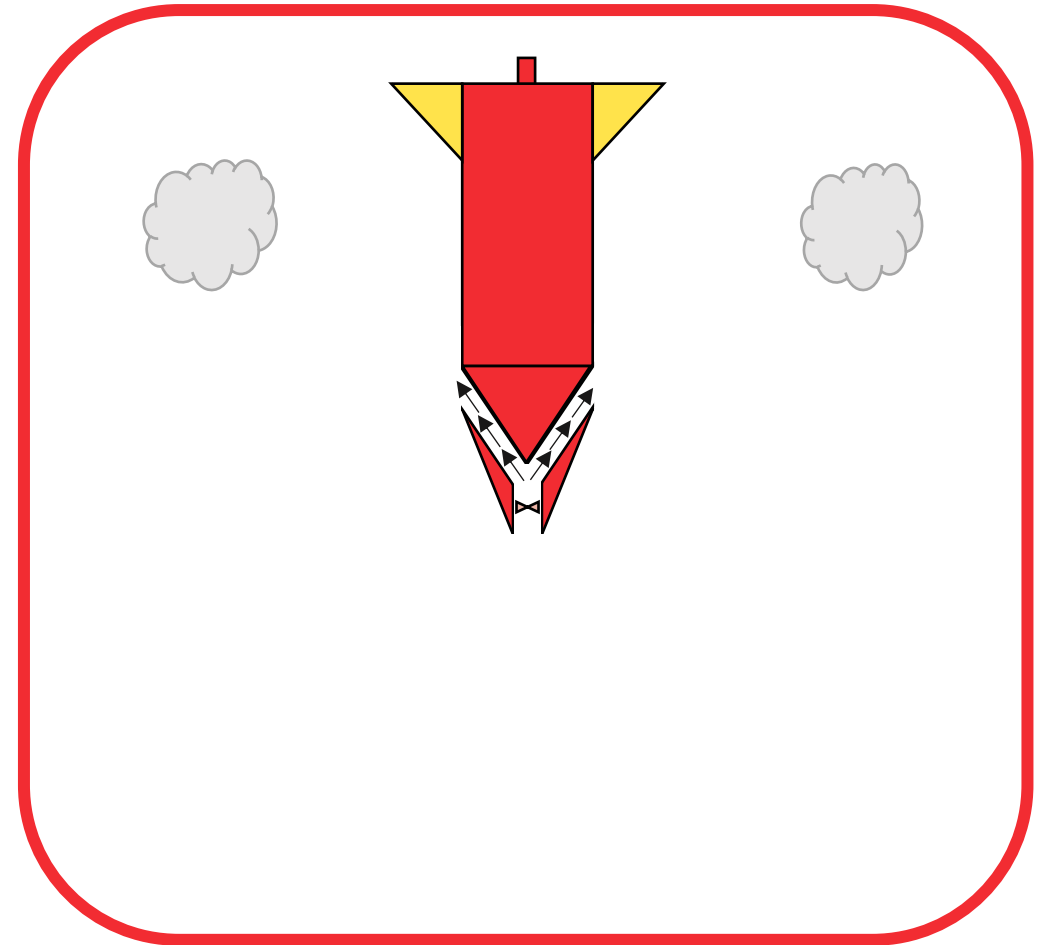
Thomas Lenz

Selected Design: Ducted Fan

Combats drag effects in two ways

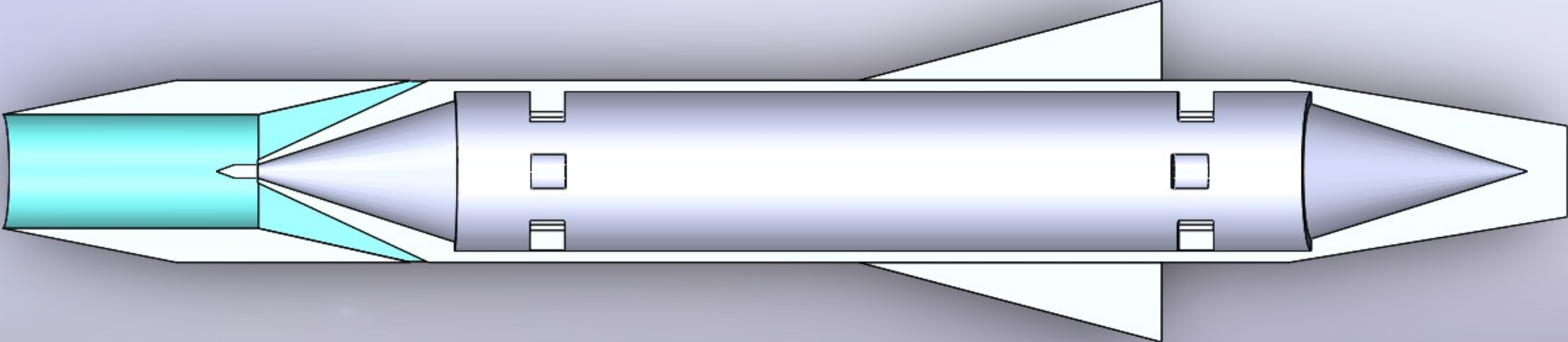
1. Reduces differential pressure acting on the body

2. Provides sufficient thrust to counteract drag forces



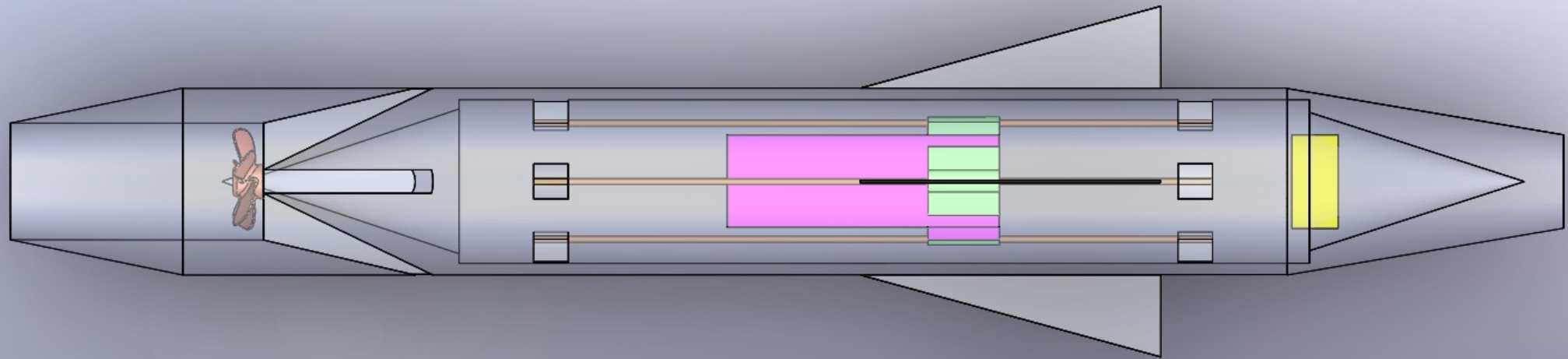
Thomas Lenz

Section View: Ducted Fan



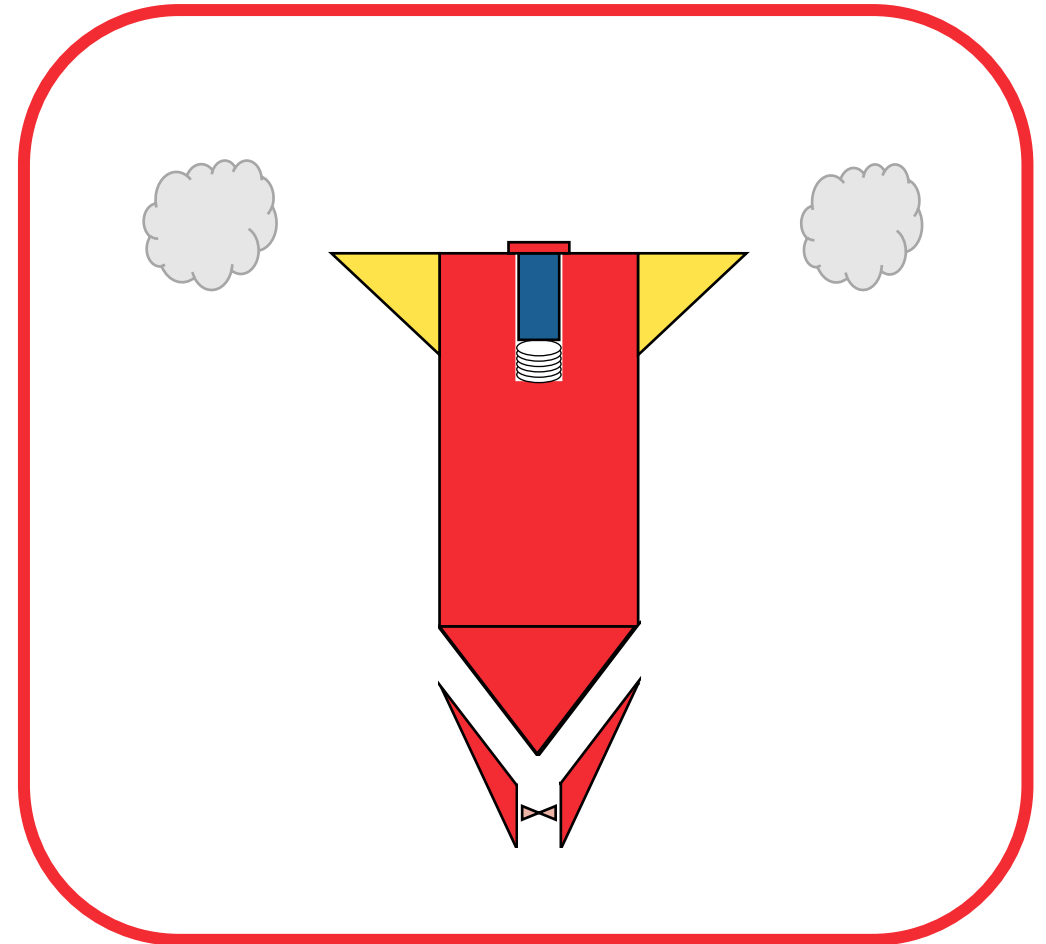
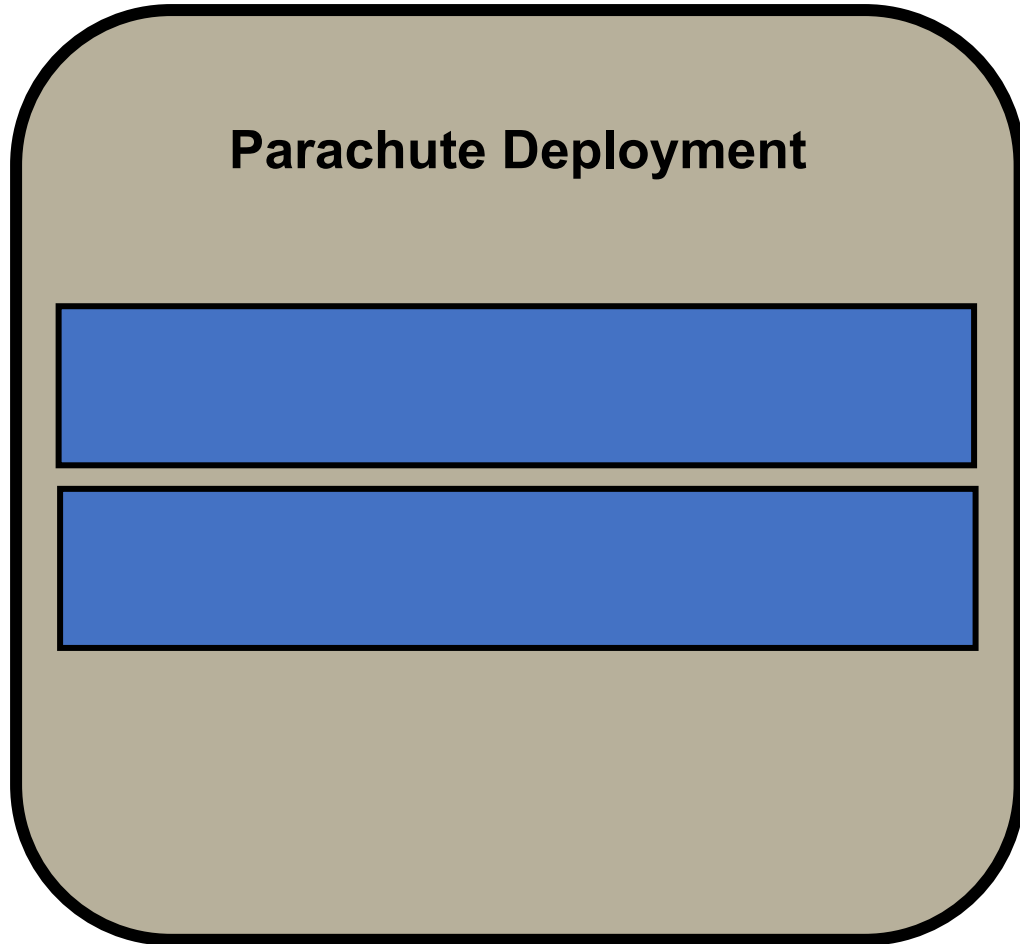
Thomas Lenz

Transparent View: Ducted Fan



Thomas Lenz

Selected Design: Ducted Fan

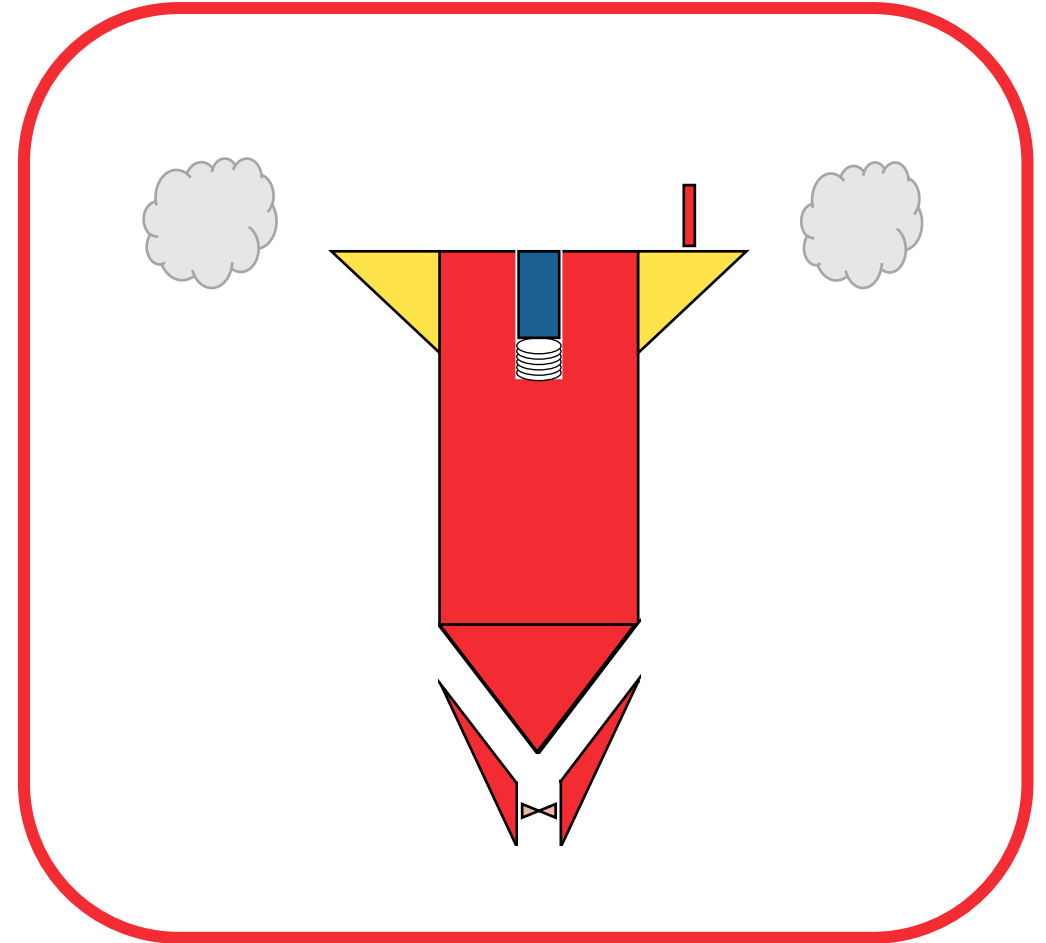


Thomas Lenz

Selected Design: Ducted Fan

Parachute Deployment

1. A spring ejects the parachute from the back

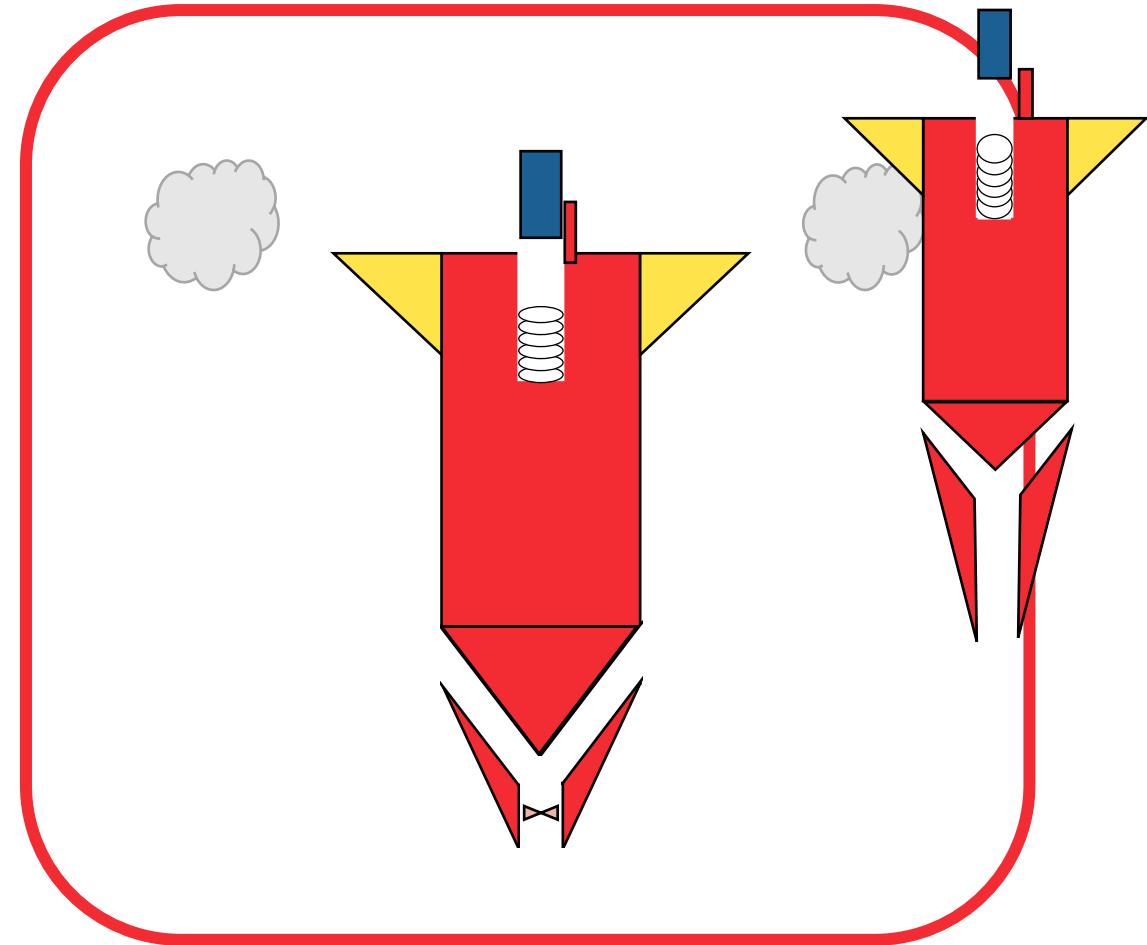


Thomas Lenz

Selected Design: Ducted Fan

Parachute Deployment

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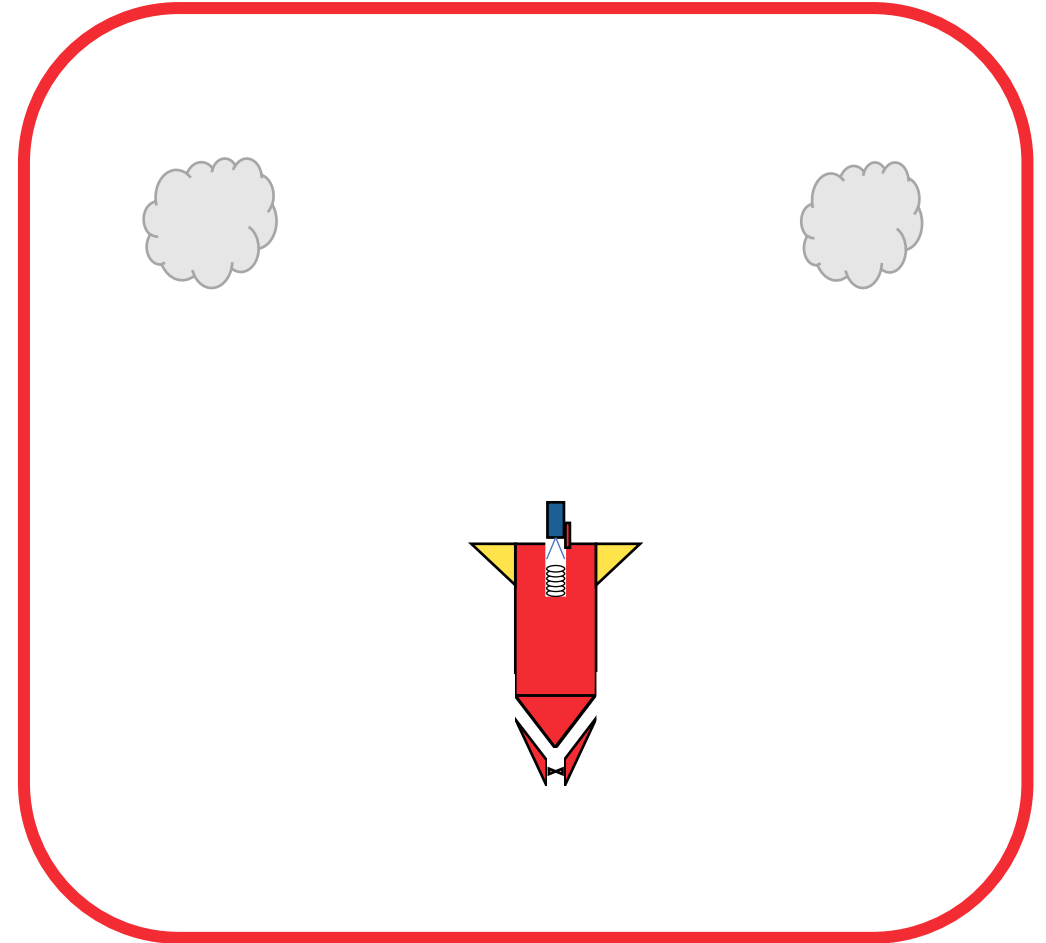


Thomas Lenz

Selected Design: Ducted Fan

Parachute Deployment

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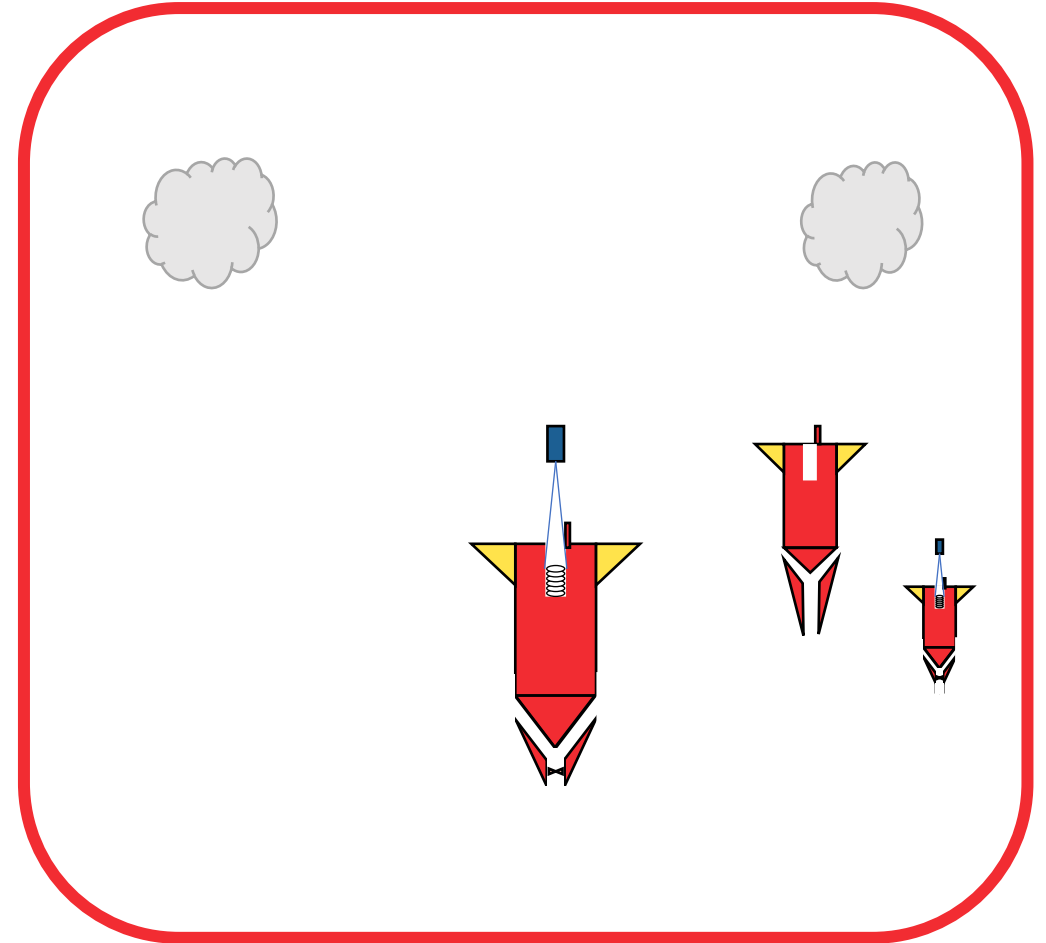
Thomas Lenz

Selected Design: Ducted Fan

Parachute Deployment

1. A spring ejects the parachute from the back

2. The parachute expands



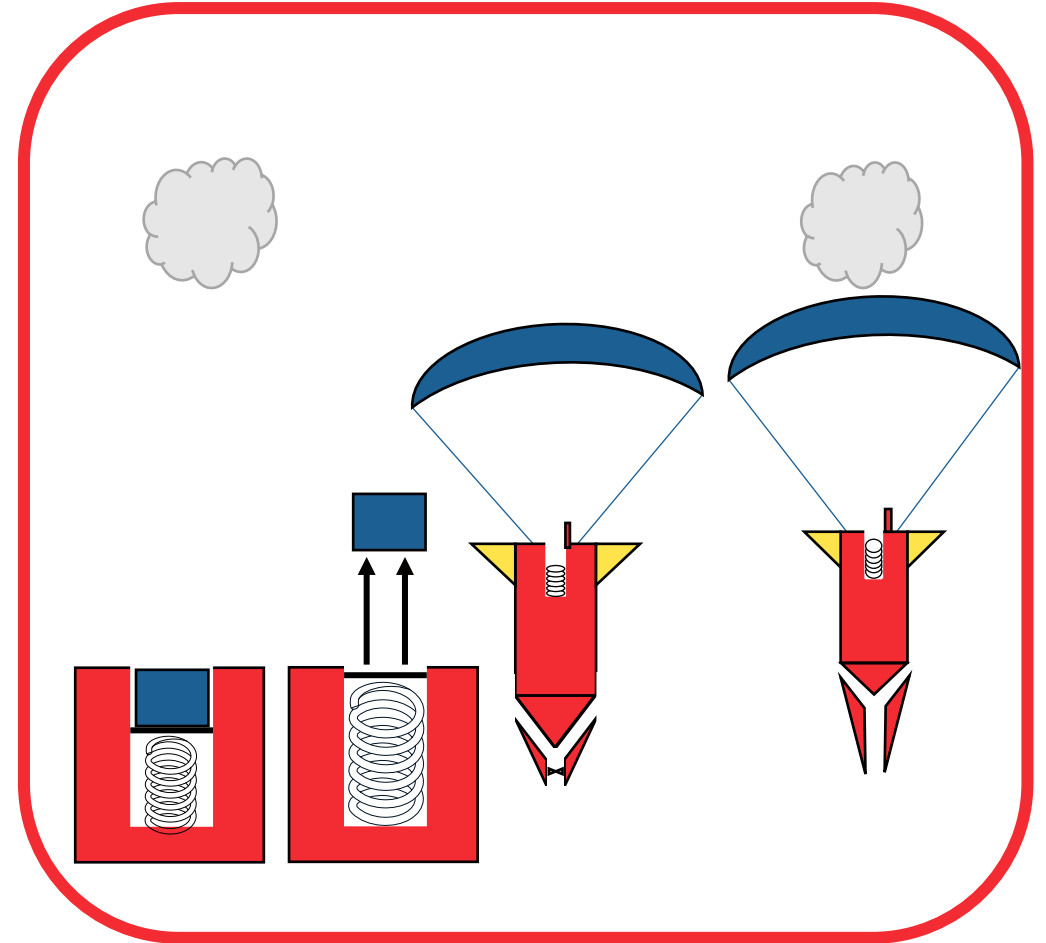
Thomas Lenz

Selected Design: Ducted Fan

Parachute Deployment

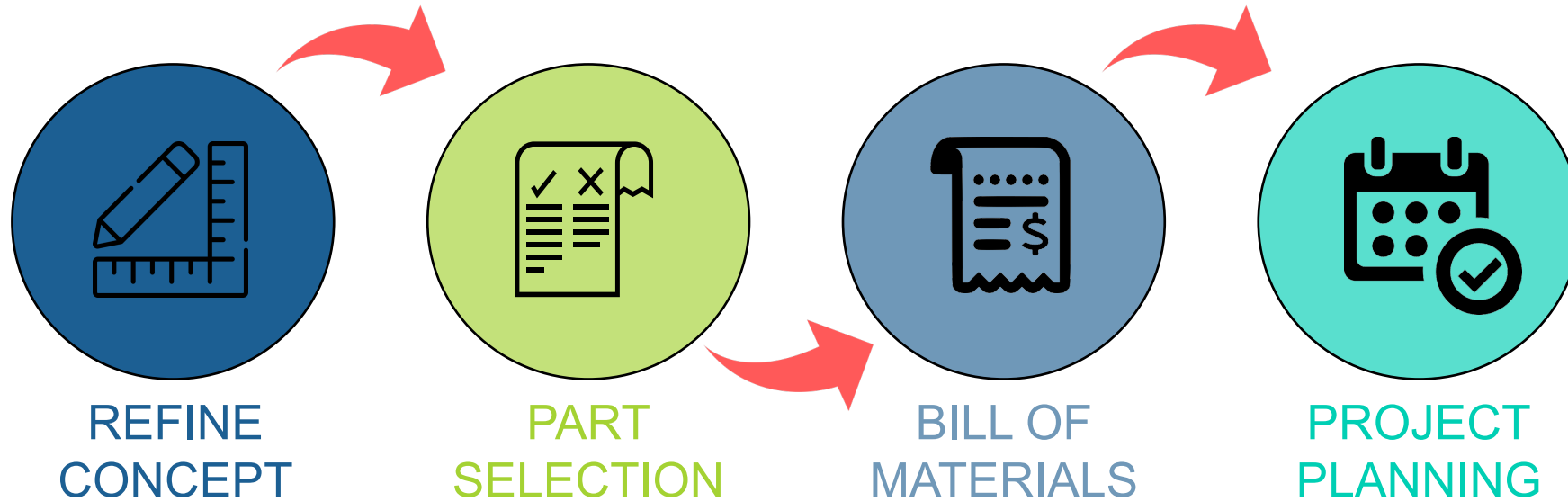
1. A spring ejects the parachute from the back

2. The parachute expands



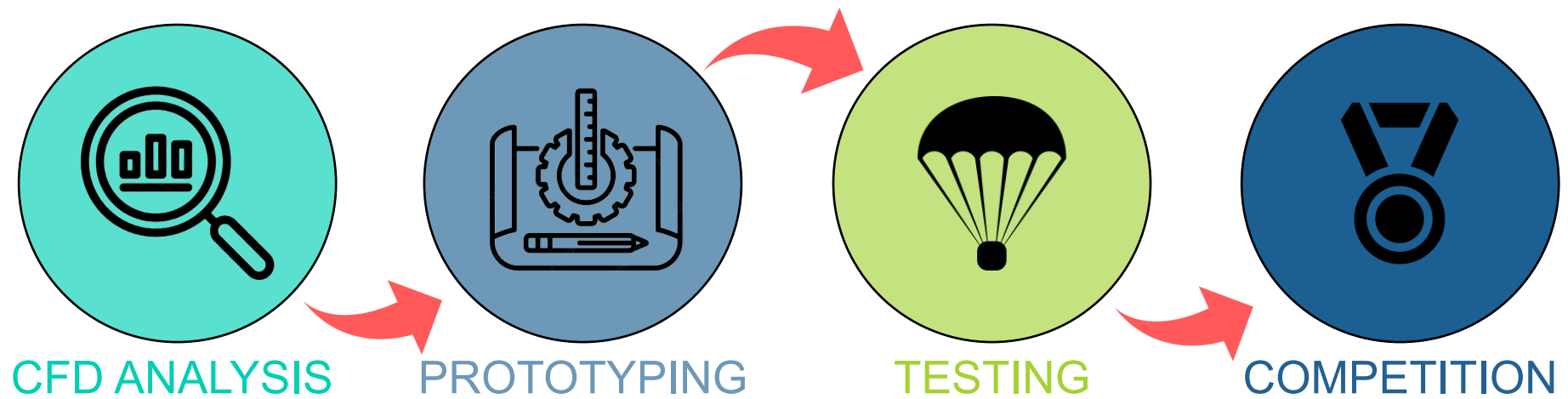
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Future Work



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Future Work



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References

Images:

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<https://www.hitec.uni-hannover.de/en/large-scale-equipment/einstein-elevator/>

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Further Readings:

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https://www.nasa.gov/mission_pages/sounding-rockets/missions/index.html

<https://www.zarm.uni-bremen.de/en/drop-tower/general-information.html>

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https://www.youtube.com/watch?v=4aCMDQsx740&ab_channel=TomScott

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