CRITICAL DESIGN REVIEW

UBC Rocket Payloads Team

Name	Role
Moeid Elahi	Research Lead, **Mission Specialist**
Kassandra Hawes	Team Lead, **Mission Specialist**
Maya Taylor	Cameras + Lighting
Andy Kim	Clot Chamber + Temperature Control
Tristan Brown	Fluid Systems + Actuation **Backup Mission Specialist**
Amjad Yaghi	Clot Chamber + Temperature Control
Nathan Tourvieille	Software + Sensors
Dr. Thomas Mattison	Primary Faculty Advisor
Dr. Paul McBeth	Secondary Faculty Advisor
Dr. Boris Stoeber	Fluidics Advisor
Dr. Ed Pryzdial	Thrombolytic Advisor

OVERVIEW

INTRODUCTION + BACKGROUND

PROJECT REQUIREMENTS

PAST DESIGNS

CURRENT DESIGN

TESTING

TIMELINE

BUDGET

INTRODUCTION + BACKGROUND

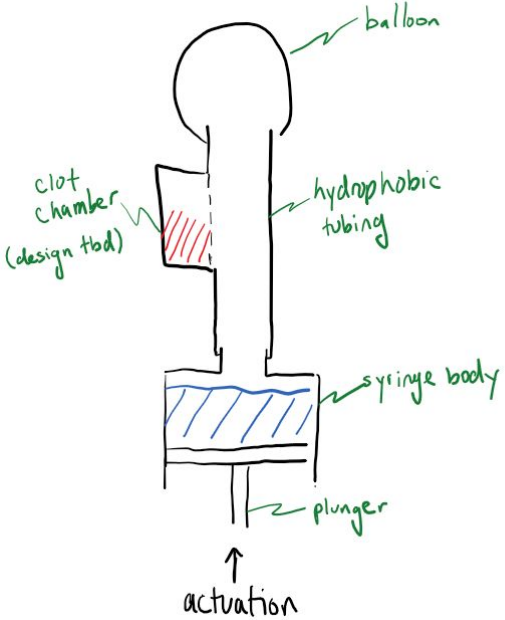
PROJECT INTRODUCTION AND BACKGROUND - OCT 2022

UBC Rocket Payloads Team and a Medical Student partnership forms. The objective is to test the effectiveness of thrombolytics in microgravity.

The Partnership

PROJECT INTRODUCTION AND BACKGROUND - JAN 2023

Project plan separated into temperature control, camera systems, clot chamber, piping and electrical systems. A syringe houses the experiment.

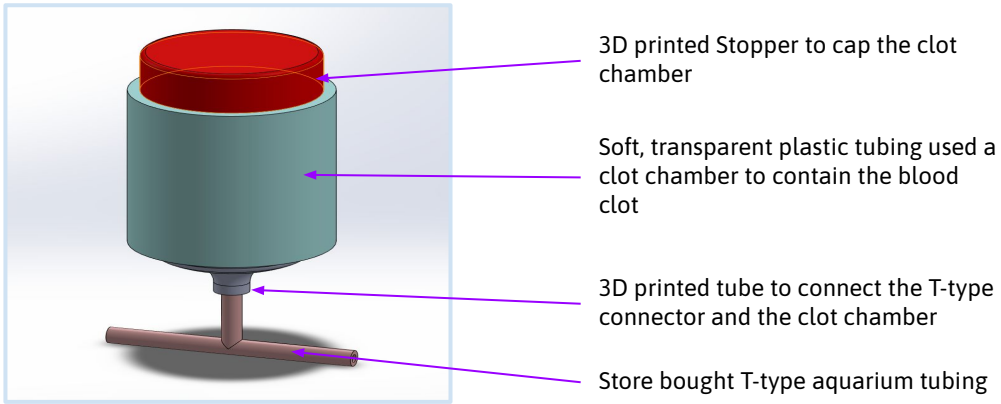


* Clot is placed into chamber pre-experiment, one liquid (tPA) is displaced up and down.

The Partnership | Syringe Idea

PROJECT INTRODUCTION AND BACKGROUND - MAR 2023

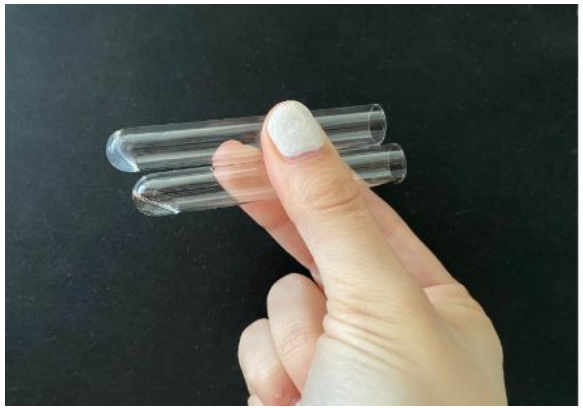
Syringe scrapped for custom clot chamber design using printed components and aquarium tubing. Might pump saline along with clot busting agent.



The Partnership | Syringe Idea | Pumps and Tubing Idea

PROJECT INTRODUCTION AND BACKGROUND - APR 2023

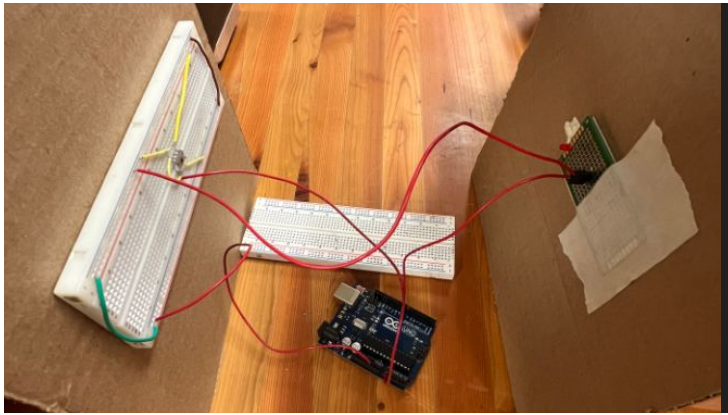
Project shift to formation of clots in microgravity. Mechanical complexity increased due to the mixing of several reagents in precise quantities.

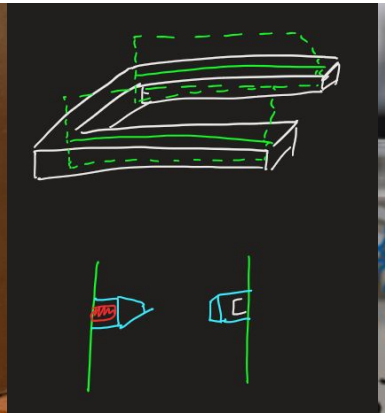


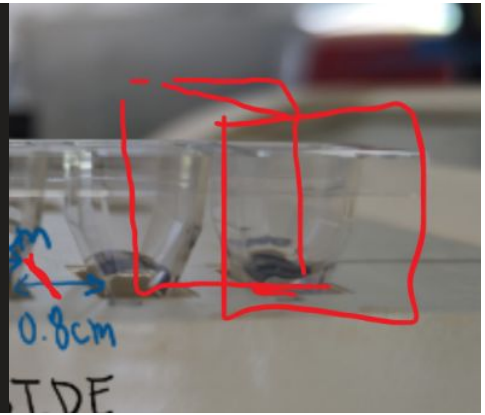
The Partnership | Syringe Idea | Pumps and Tubing Idea | Forming the Clot

PROJECT INTRODUCTION AND BACKGROUND - MAY 2023

Forming the clot, breaking it, then deactivating reagents to assess products in a lab. Using photo sensors to detect clot formation.



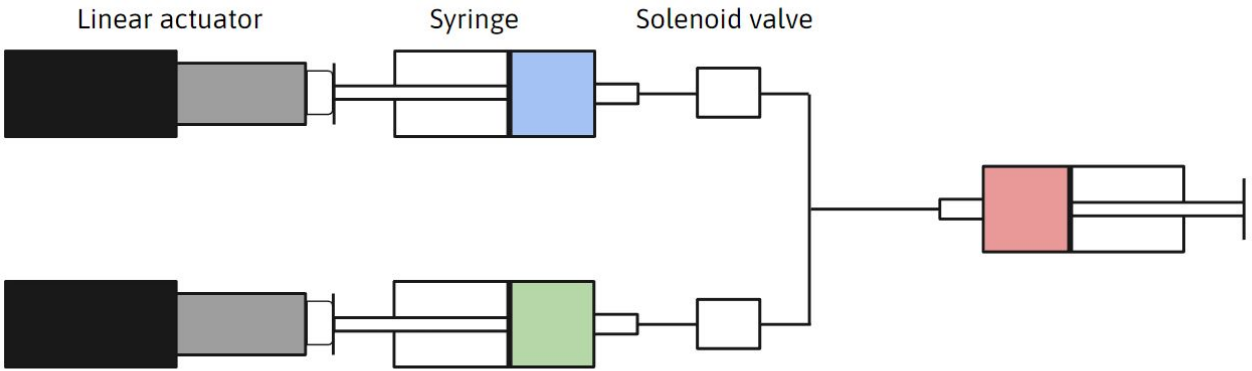




The Partnership | Syringe Idea | Pumps and Tubing Idea | Forming the Clot | Managing Complexity

PROJECT INTRODUCTION AND BACKGROUND - PRESENT

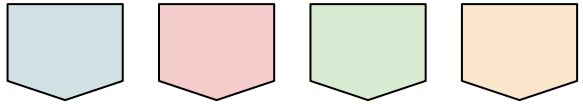
A partial mechanical prototype is in development. This will lead to a full experiment in the coming year.



PROJECT REQUIREMENTS

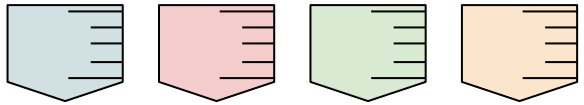
FULL EXPERIMENT REQUIREMENTS

- 4 total reagents



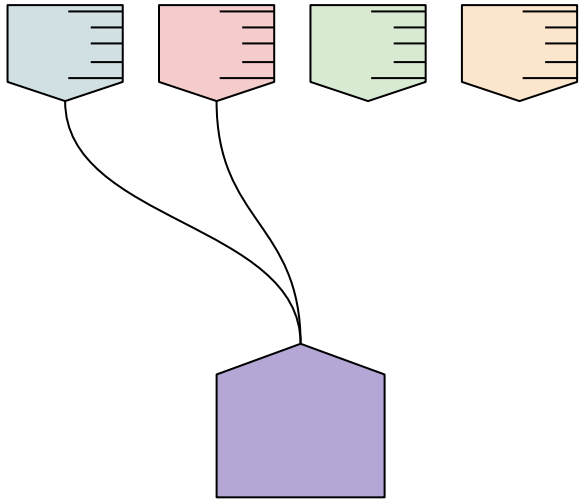
FULL EXPERIMENT REQUIREMENTS

- 4 total reagents
- Precise, small quantities



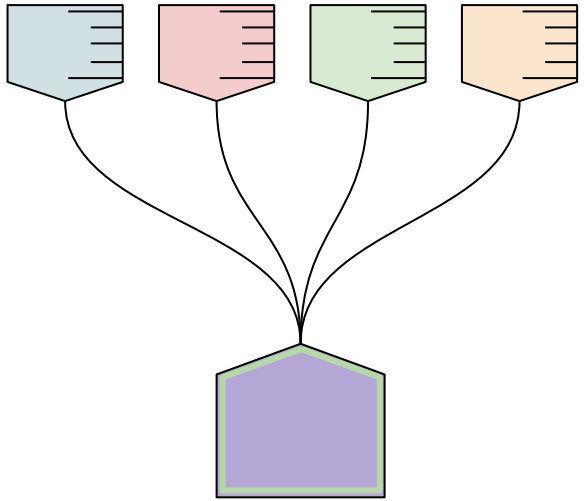
FULL EXPERIMENT REQUIREMENTS

- 4 total reagents
- Precise, small quantities
- Thorough, quick mixing
- First two reagents form a viscous clot



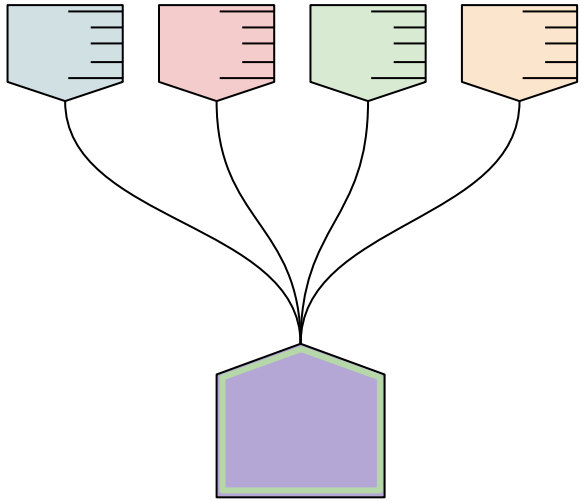
FULL EXPERIMENT REQUIREMENTS

- 4 total reagents
- Precise, small quantities
- Thorough, quick mixing
- First two reagents form a viscous clot, which needs thorough exposure to the last two



FULL EXPERIMENT REQUIREMENTS

- 4 total reagents
- Precise, small quantities
- Thorough, quick mixing
- First two reagents form a viscous clot, which needs thorough exposure to the last two
- All must happen in microgravity
- Potentially, be able to monitor clot progression



SIMPLIFYING TO A PARTIAL PROTOTYPE

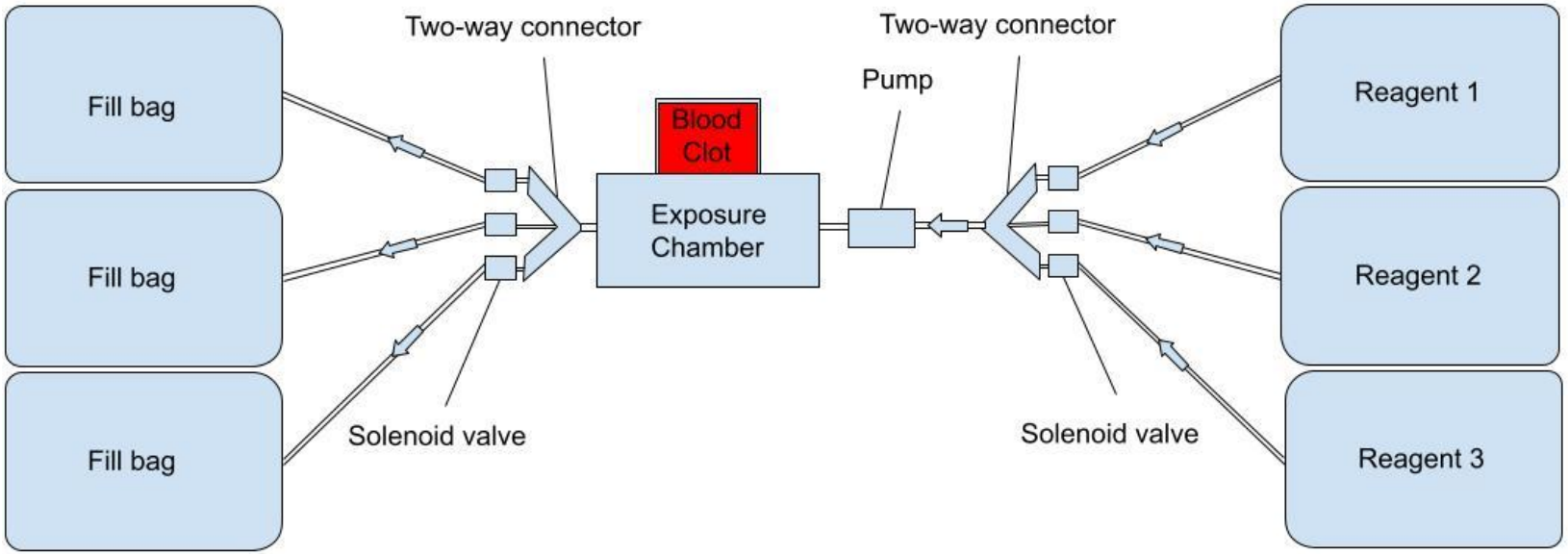
1. Must have the potential to be adapted to a final design!
2. Use dummy reagents
3. Focus on mechanical design, especially precise mixing

MISSION OBJECTIVES AND SUCCESS CRITERIA

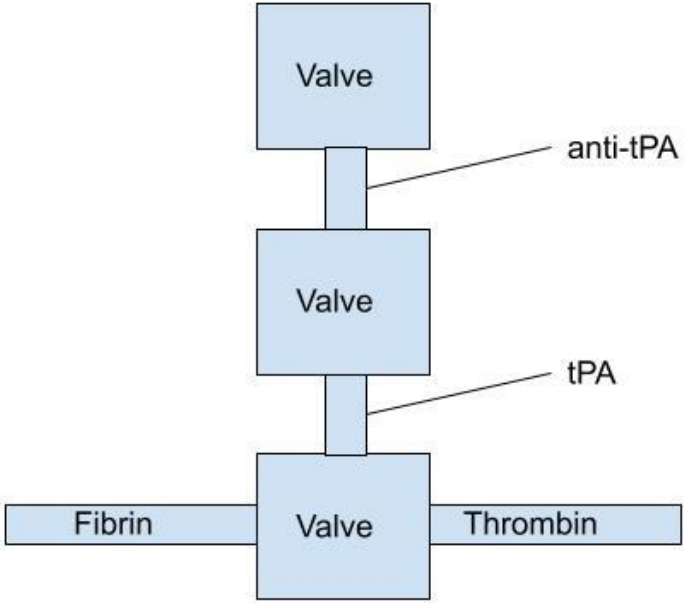
Mission Objective	Success Criteria
Test thorough mixing of dummy reagents in microgravity	1. Components do not leak 2. Homogeneous mixture is reached in under 5 seconds 3. At least 2 reagents are mixed
Observe the mixing process	Camera footage is captured of the entire process
Test a prototype that is expandable to four reagents	Expansion of prototype design to include all four reagents requires minimal additional engineering

PAST DESIGNS

THREE REAGENT PUMP DESIGN

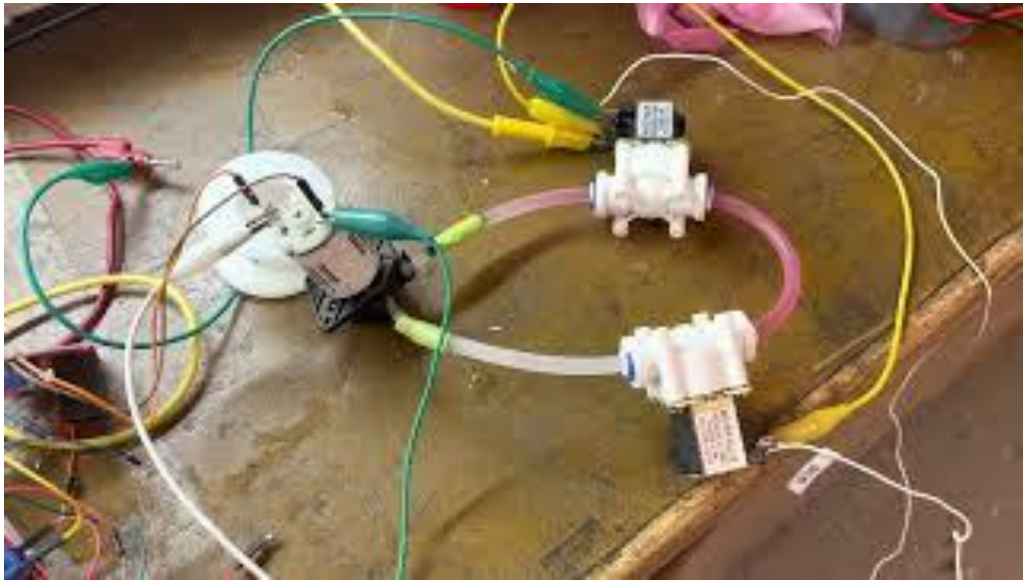


DIFFUSION BASED DESIGN



CIRCULAR PUMP DESIGN

Successful mixing



CIRCULAR PUMP DESIGN - ADDING A REAGANT

Wasn't expandable to multiple reagents

CIRCULAR PUMP DESIGN - ADDING A REAGANT

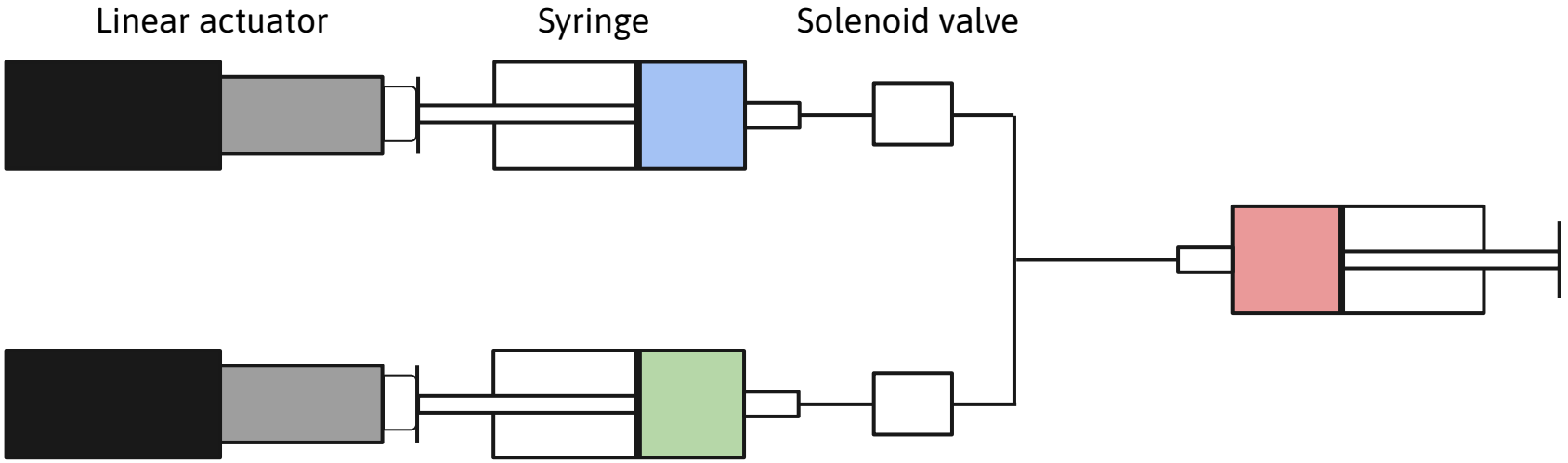
Wasn’t expandable to multiple reagents

CIRCULAR PUMP DESIGN - ADDING A REAGANT

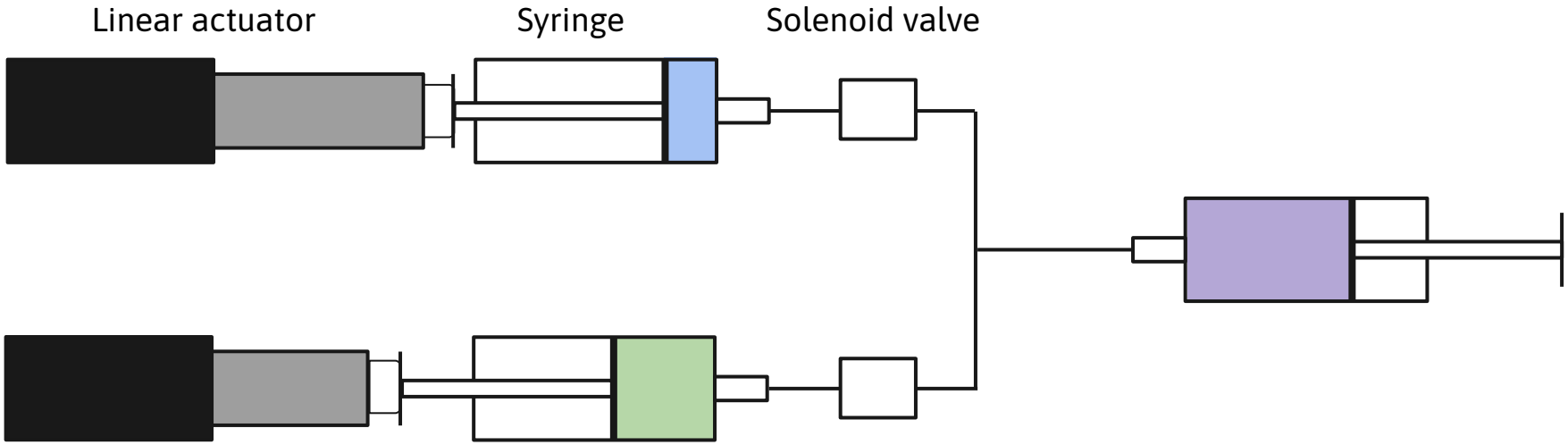
Wasn't expandable to multiple reagents

CURRENT DESIGN

CURRENT DESIGN



CURRENT DESIGN



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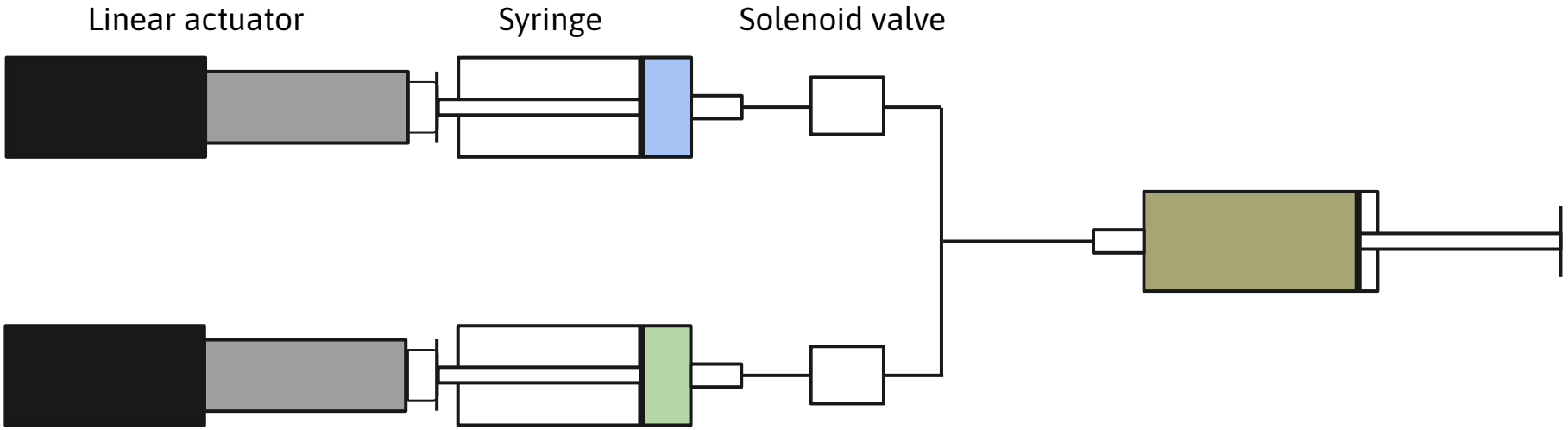
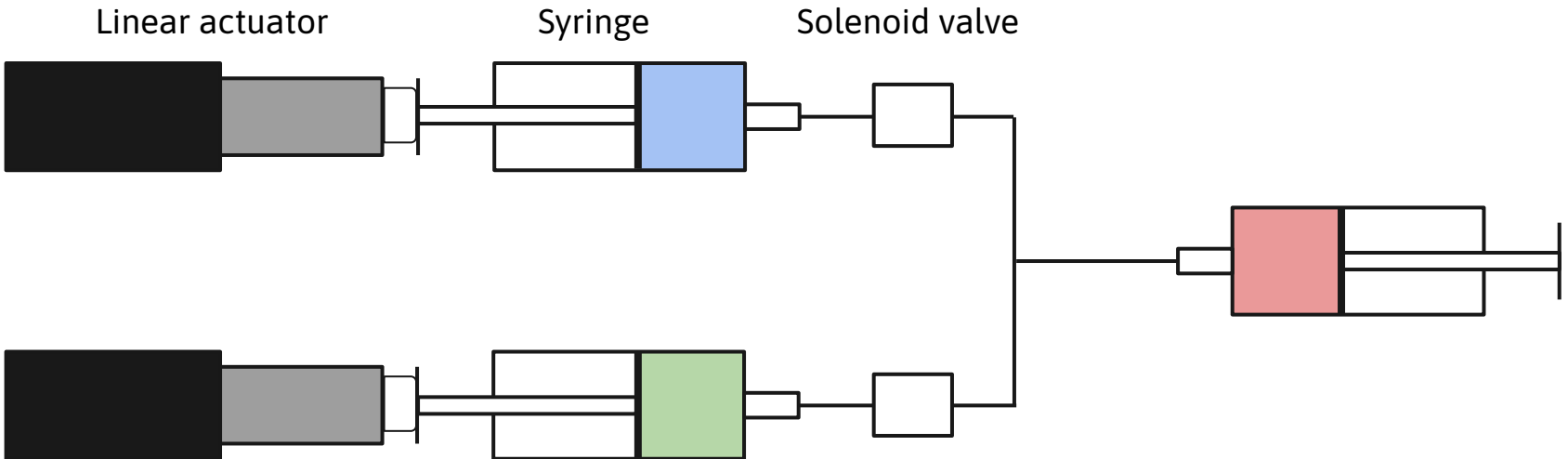
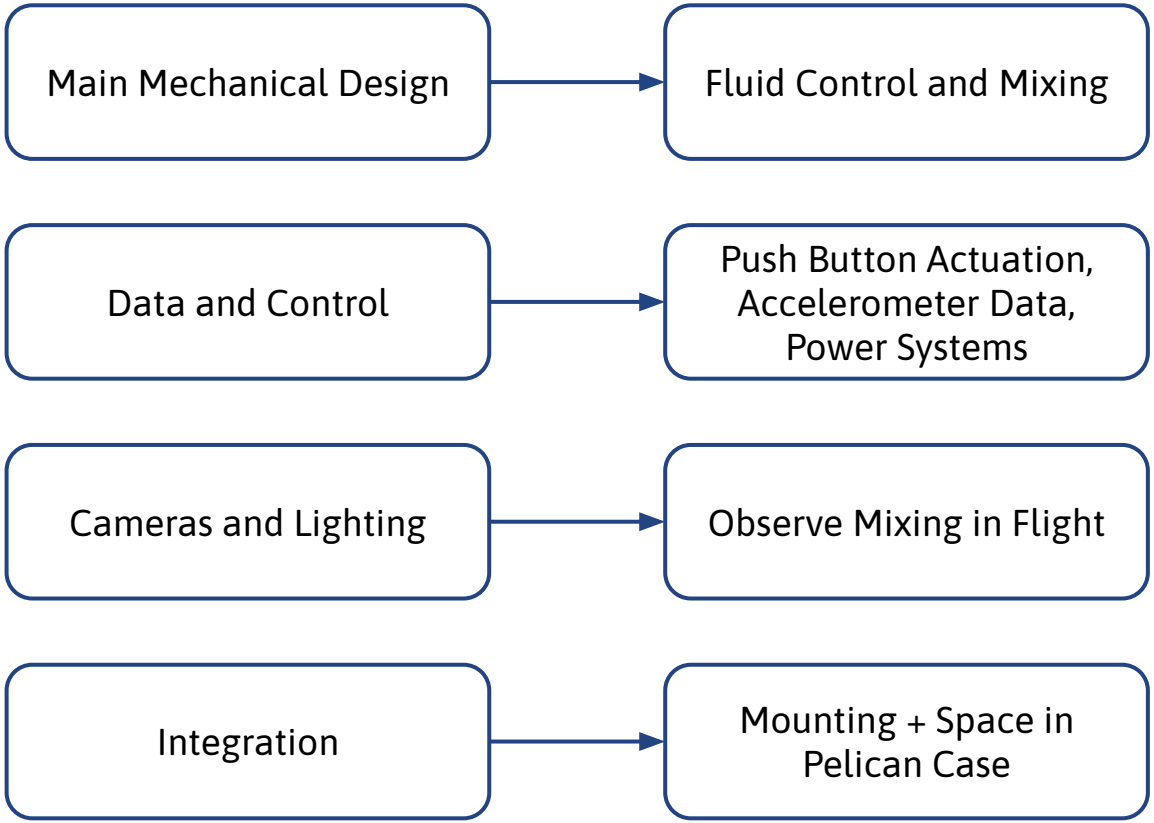


CURRENT DESIGN

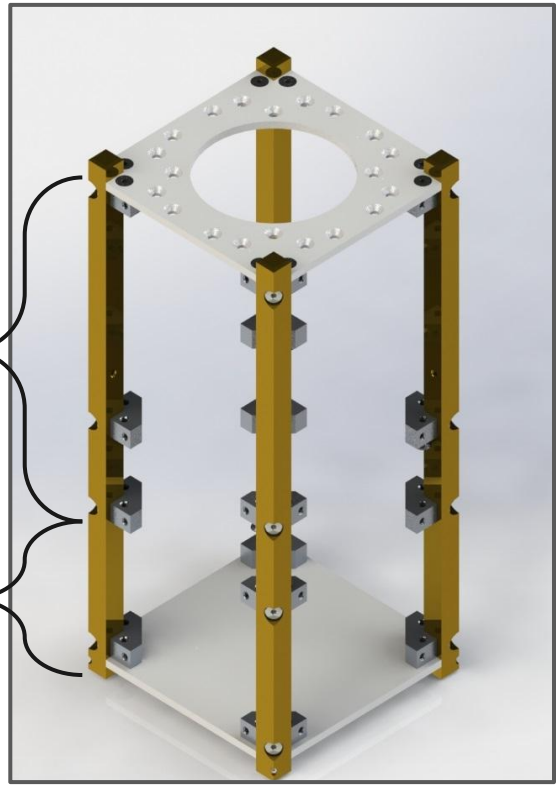
1. Expandable to more linear actuator lines
2. Syringe allow for precise dosage
3. Turbulence generated by syringe action creates mixing
4. Linear actuators are fast and reliable
5. Actuation in only one direction



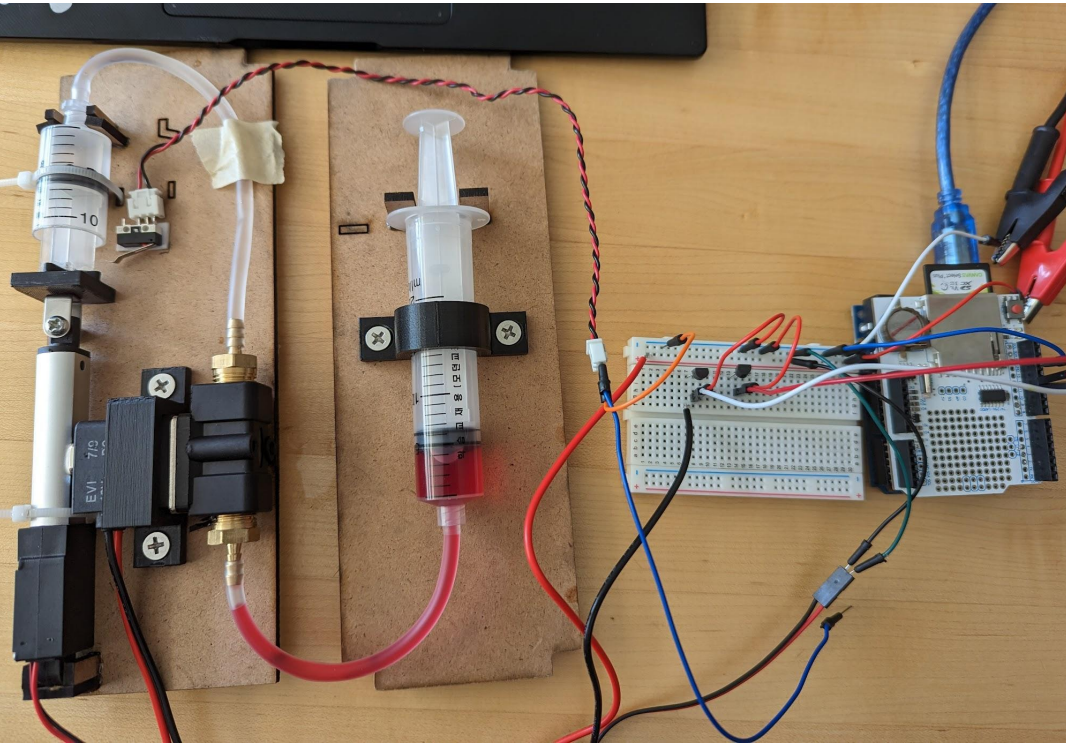
CURRENT DESIGN - BREAKDOWN



CURRENT STATE - ROCKET PAYLOAD

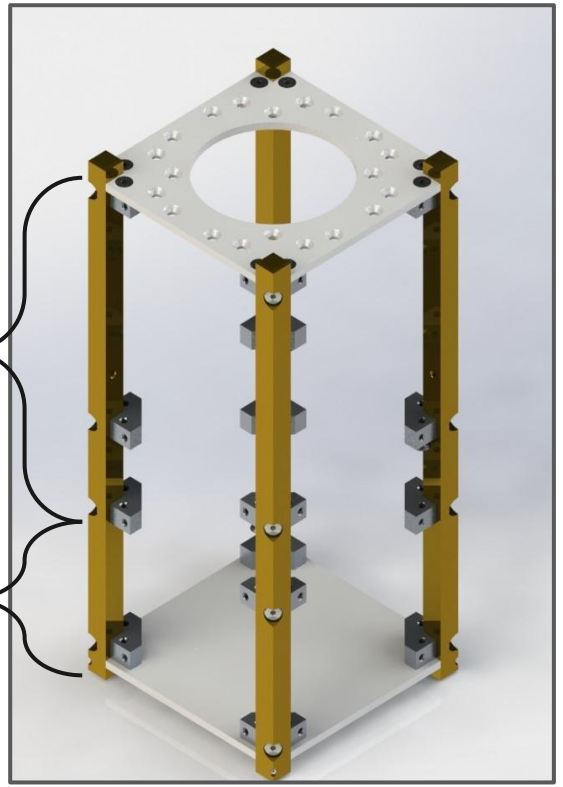


CURRENT STATE - ROCKET PAYLOAD

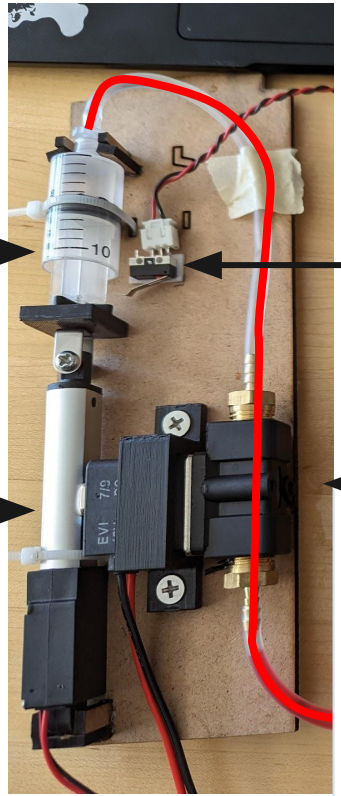


Mechanical Design

Electrical + Arduino



MAIN MECHANICAL SYSTEM



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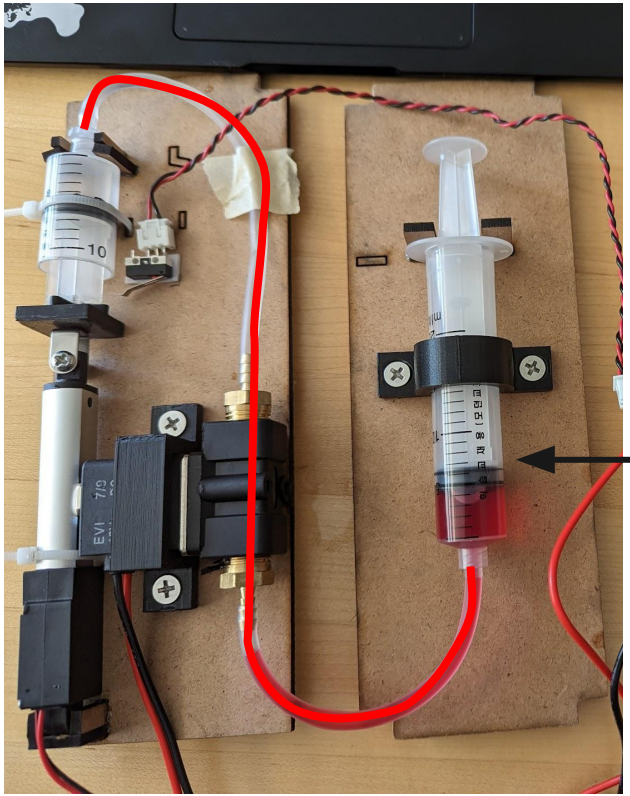


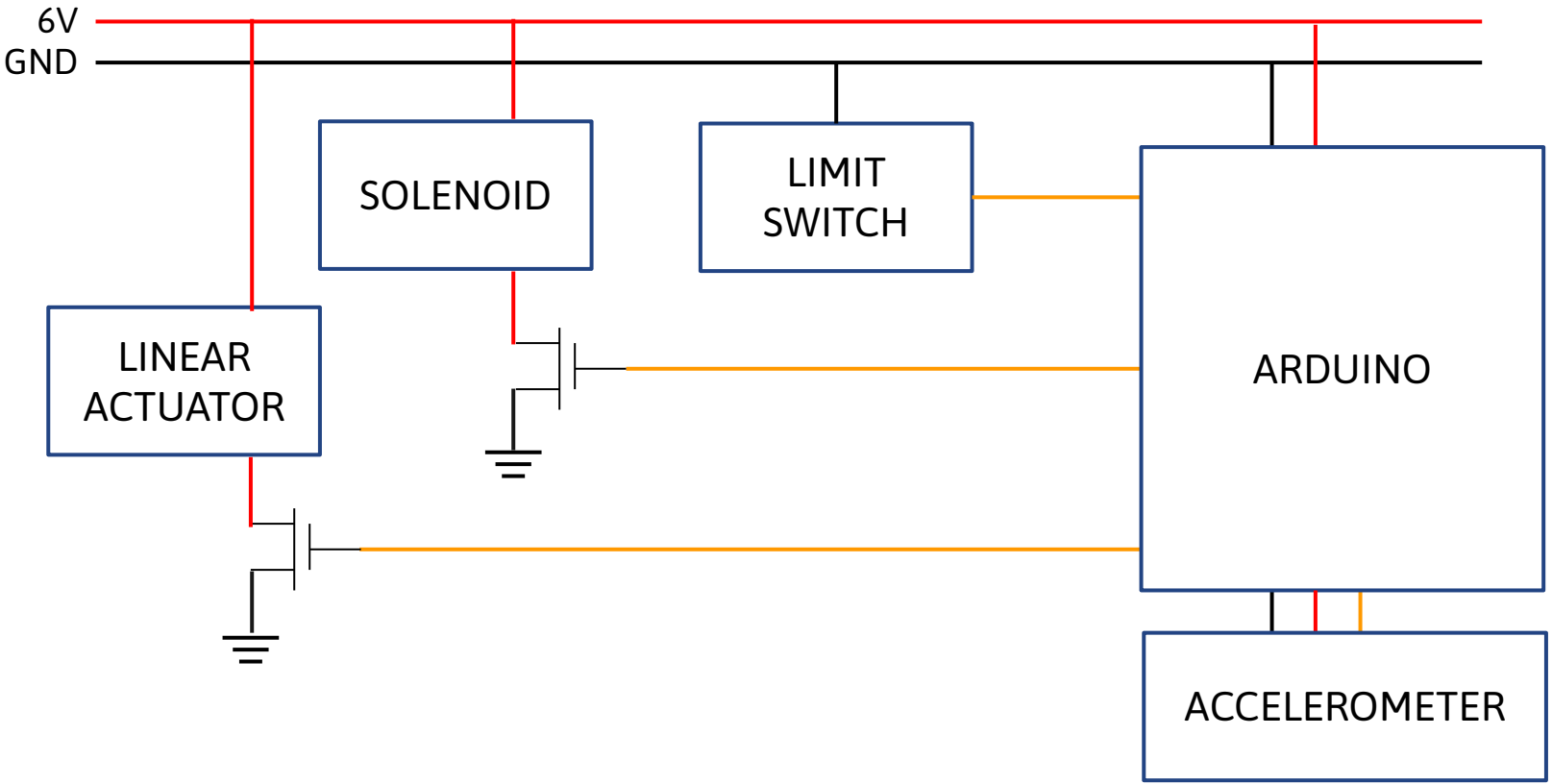
MAIN MECHANICAL SYSTEM

- Works!
- Is very secure but could benefit from more vibrational testing
- Main concern is that the amount of tubing and solenoid valve does increase dead volume, working to reduce

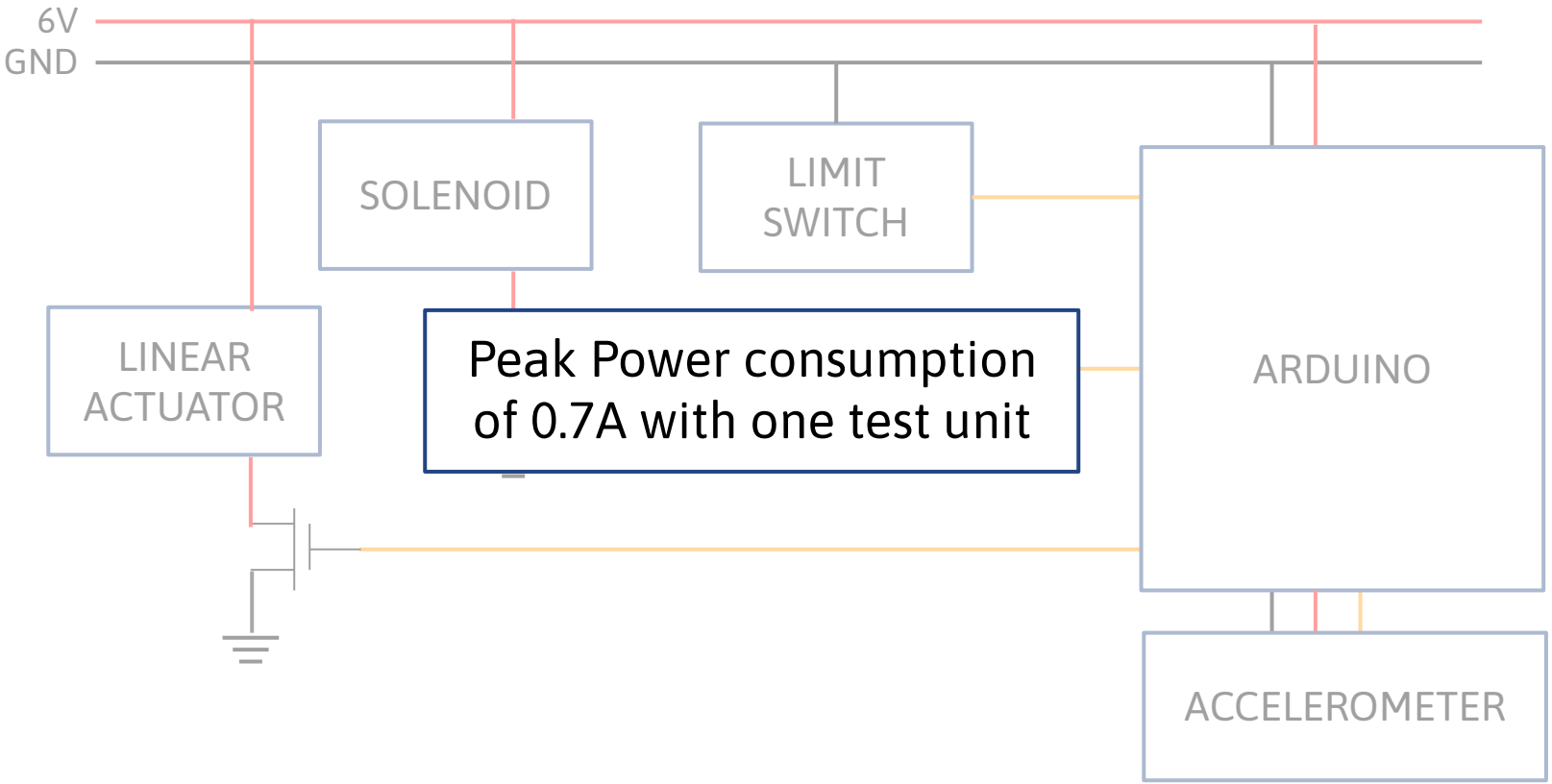
DATA AND CONTROL

- Push button control using Arduino
  - Opens solenoid valve
  - Actuates syringe
  - Stops when limit switch reached
- Accelerometer data is written to SD card

DATA AND CONTROL - POWER



DATA AND CONTROL - POWER



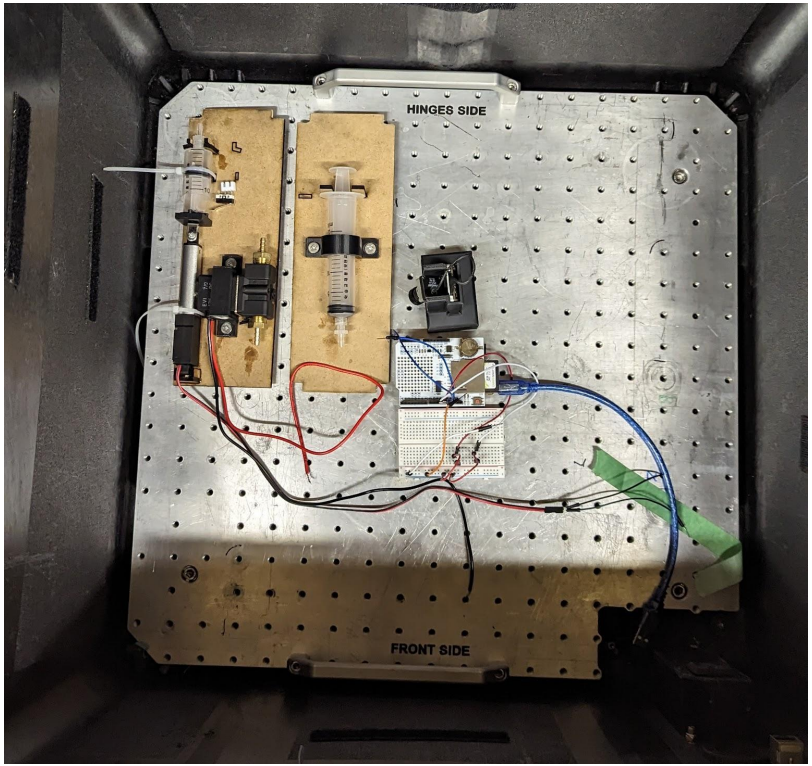
DATA AND CONTROL

- Power supply for multiple test units needs to be considered
- Final circuit board should be designed and made
- GUI needs to be finished

CAMERA AND LIGHTING

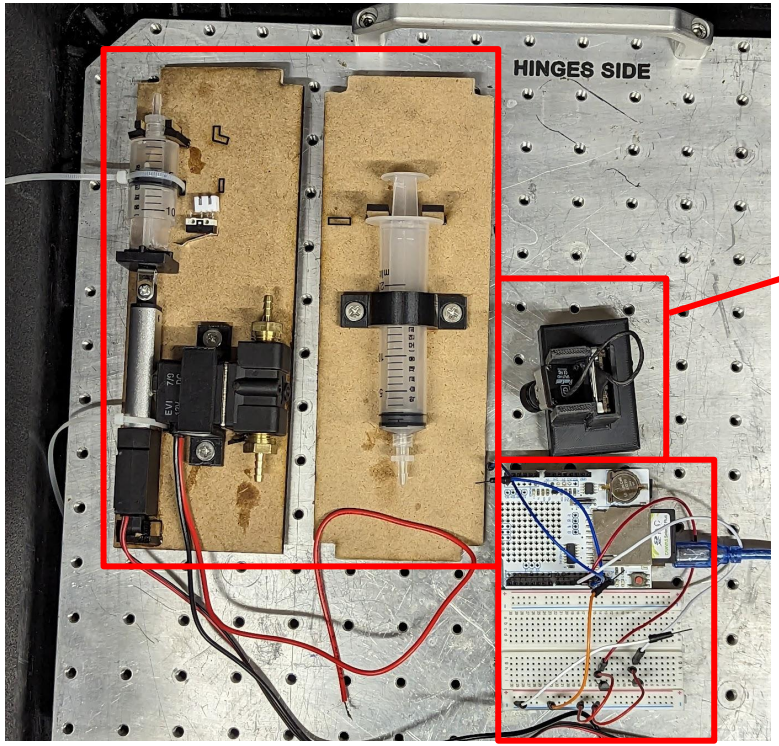
- LED panels and diffusion sheets need to be ordered
- Previous camera testing is still relevant

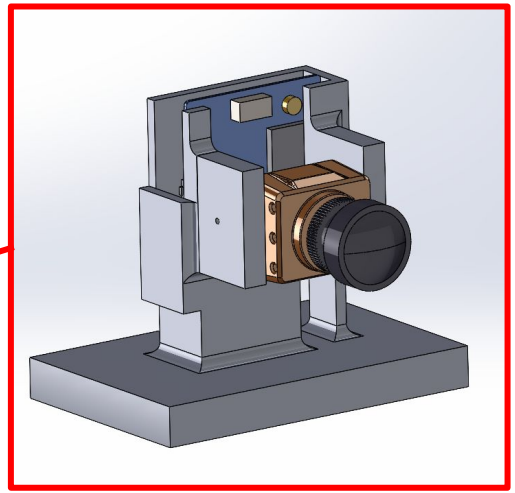
INTEGRATION



INTEGRATION

Mechanical System





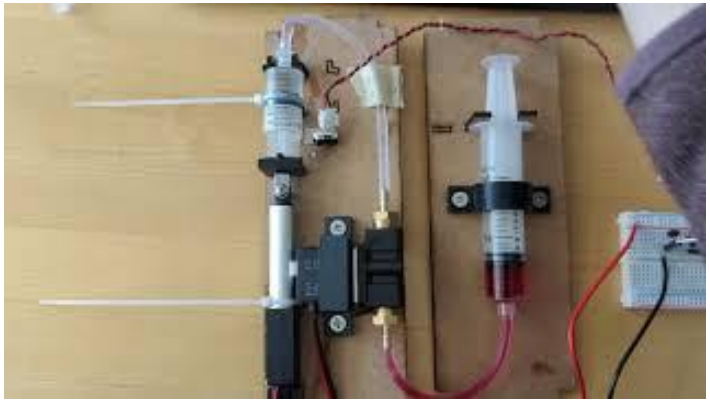
Camera

Electrical + Arduino

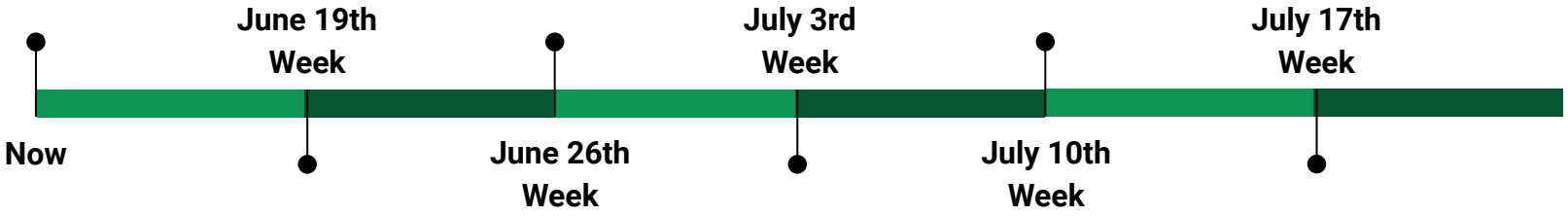
INTEGRATION

- Design boards that fit more optimally in pelican case, with holes for mounting
- Buy standoffs
- Make enough mounts for the cameras

GROUND TESTS



TIMELINE



Now

- Rocket payload complete
- Camera lighting

June 19th Week

- GUI complete
- Decide on number of test units + order supplies
- Start custom boards

June 26th Week

- First custom board done and integrated
- Start remaining test units

July 3rd Week

- Mechanical integration of all units
- Final electrical prototype

July 10th Week

- TEDP
- Electrical completed
- Full grounds test and procedures tested

July 17th Week

BUDGET

Current Spent	Expected Increase to Finish Current Test Unit	Expected Increase/Next Test Unit	Total Expenses after 3 Test Units
$370	$80	$145	$740
	Mostly linear actuator, solenoid valve, lighting	This assumes 3 test units total	Allowable budget is $1000

- 50% of travel cost being covered by UBC Engineering Professional Activities Funding
- No longer a need for expensive reagents this year
- More funding will be available through UBC Rocket next year

ALL DONE!

*except flight flowcharts, requirement compliance, mass budget...

APPENDIX