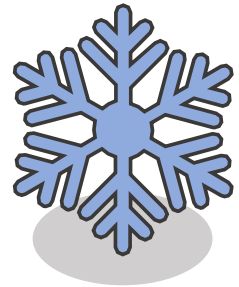
Team 523: Medi-Kool

EML4551-1



Temperature Sensitive Medication Storage During Natural Disaster

Team Introductions

Zoe Dillehay
Systems Integration Engineer

Travis Amaral
Project Manager & Research Engineer

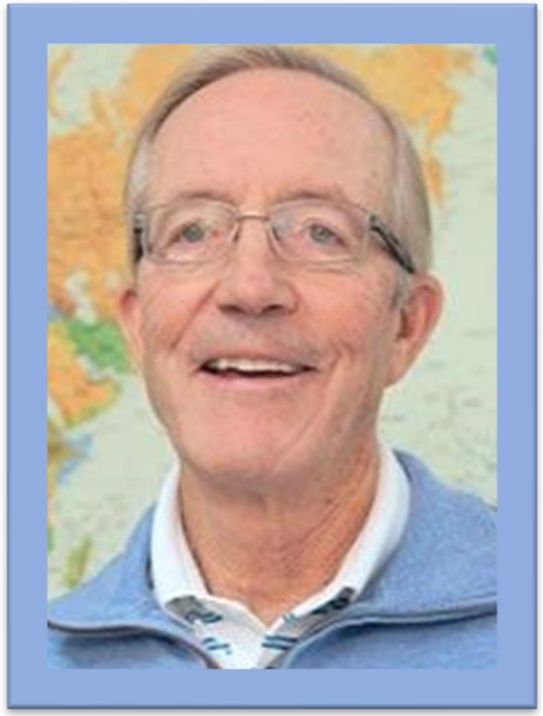
Nick Georgevich
Design Engineer

Keon Glass
Entrepreneurial Leader & Research Engineer

Diego Mendoza
Electrical Engineer

Andrew Sayers
Quality Control Engineer

Sponsors



Dr. Michael Devine

- Entrepreneur in Residence and an Adjunct Professor at FAMU-FSU College of Engineering
- Ph.D. in Mechanical Engineering (Operations Research)

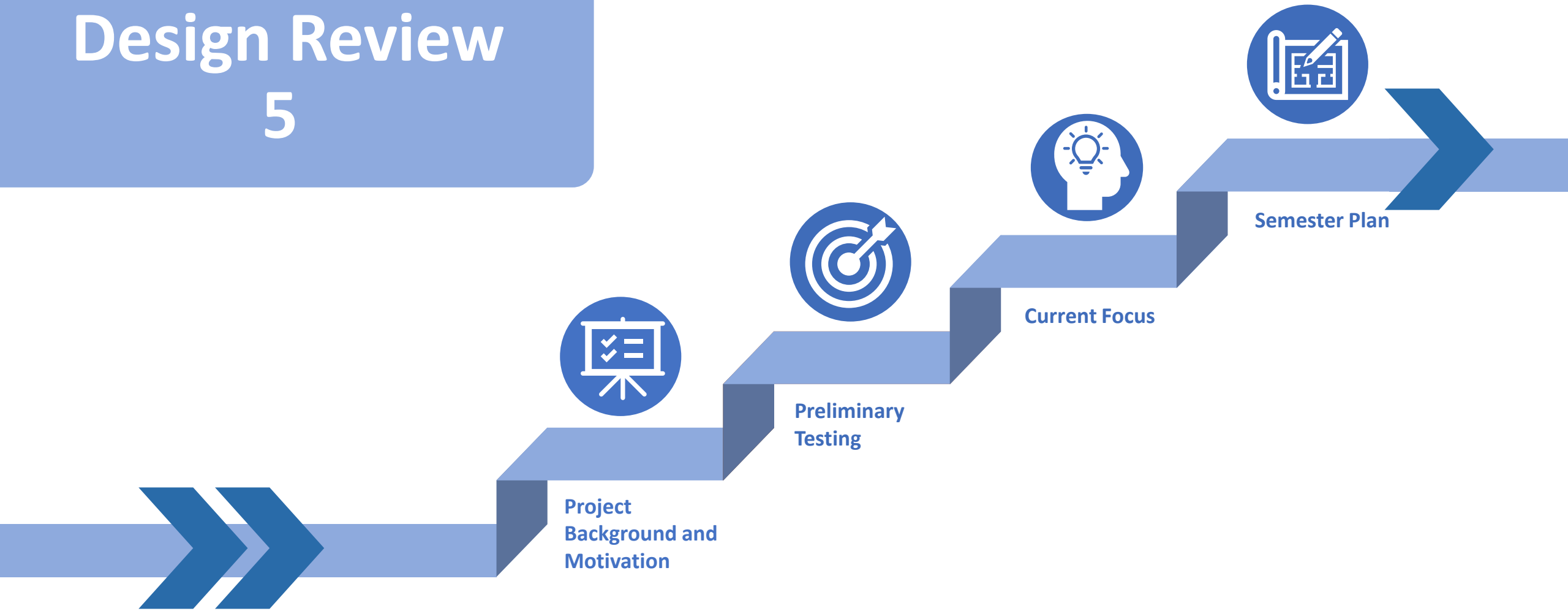
FAMU-FSU College of Engineering

Advisor

Dr. Shayne McConomy

- Teaching instructor at FAMU-FSU College of Engineering
- Ph.D. in Automotive Engineering

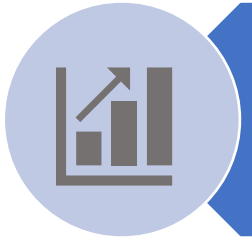
Design Review 5



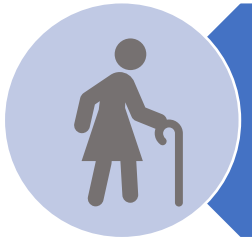
Objective

Our objective is to develop a device that stores and maintains the quality of temperature sensitive medication in the event of a natural disaster that causes mass power outages

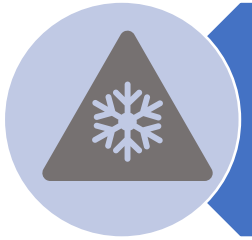
Background and Motivation



During large scale natural disasters, diabetes related deaths skyrocket



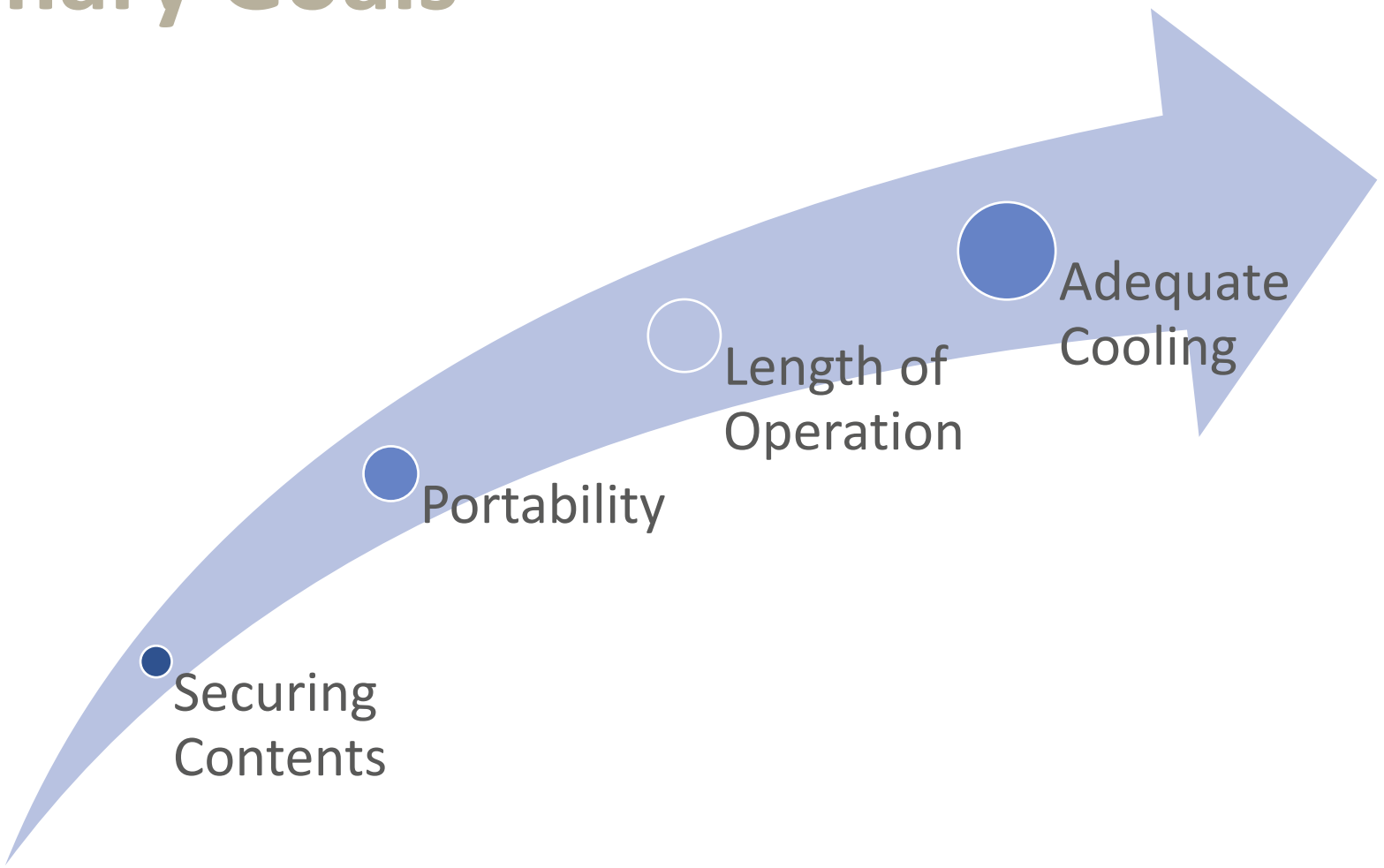
One University of South Florida study suggests increase of elderly diabetes related deaths up to 40% [1]



Insulin requires temperatures between 2°C and 8°C (35°F and 46°F)

[1] Quast, T., et al. (2019). Long-Term Effects of Disasters on Seniors With Diabetes: Evidence From Hurricanes Katrina and Rita.

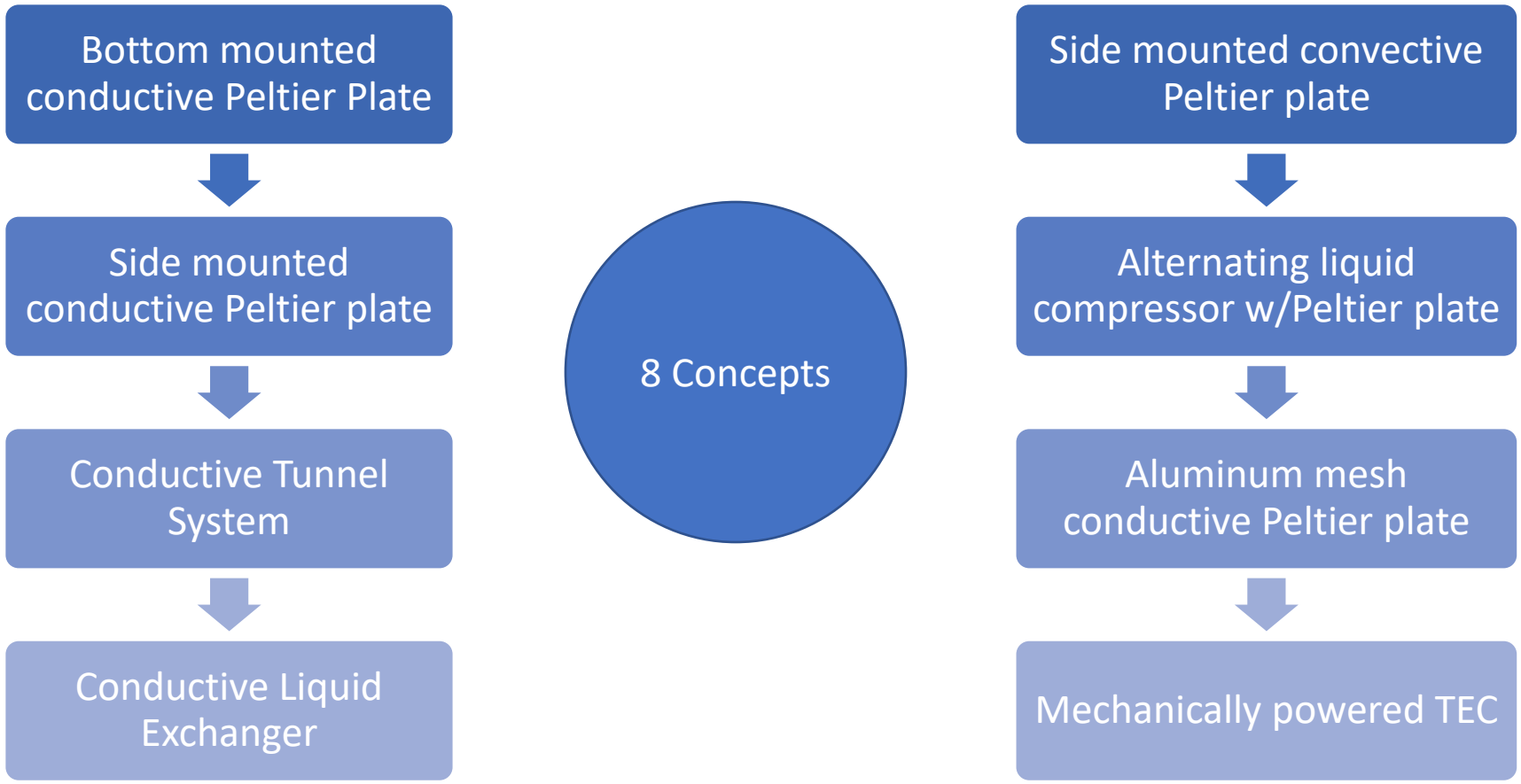
Primary Goals



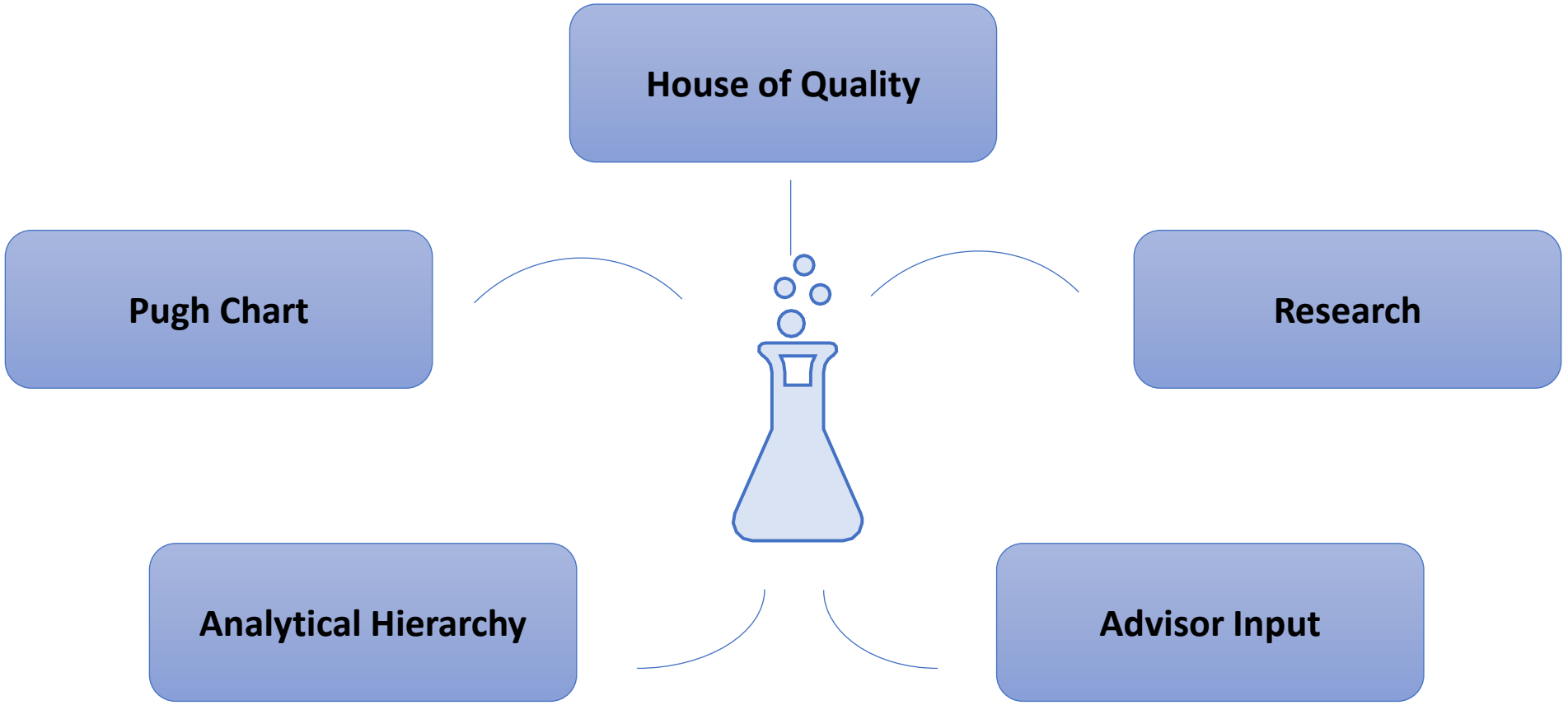
Targets & Metrics

Target	Maintain temperature for 14 days	Temperature maintained between 2°C to 8°C	Accommodate a 30-day supply of insulin	No broken vials or pens
Metric	Conduct 14-day test using attached power system	Read temperature using thermocouple	Successfully fit 3 insulin vials/pens	Ensure all pens/vials are intact throughout testing

Concept Generation

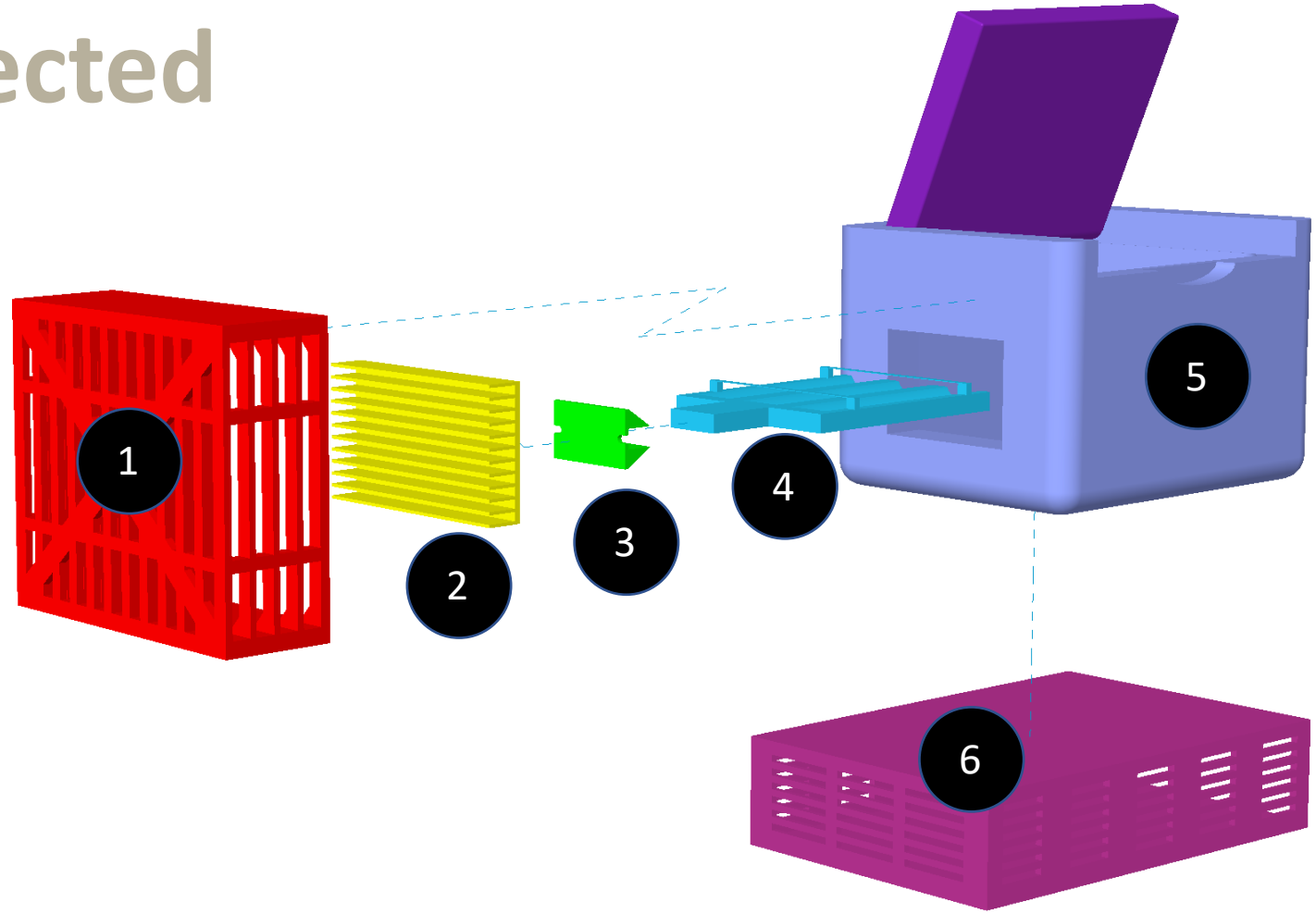


Concept Selection



Final Concept Selected

1. Protective Fan Ventilation Gate
2. Thermoelectric Cooling Module with Peltier Plate
3. Cold Plate Adapter
4. Grooved Cold Plate with Elastic Bands
5. Cooler w/ Added Insulation and Seals
6. Battery Compartment



Steps to Concept Validation

1. Reaching our temperature target

Steps to Concept Validation

1. Reaching our temperature target
2. Ensuring the entire cold plate is within range

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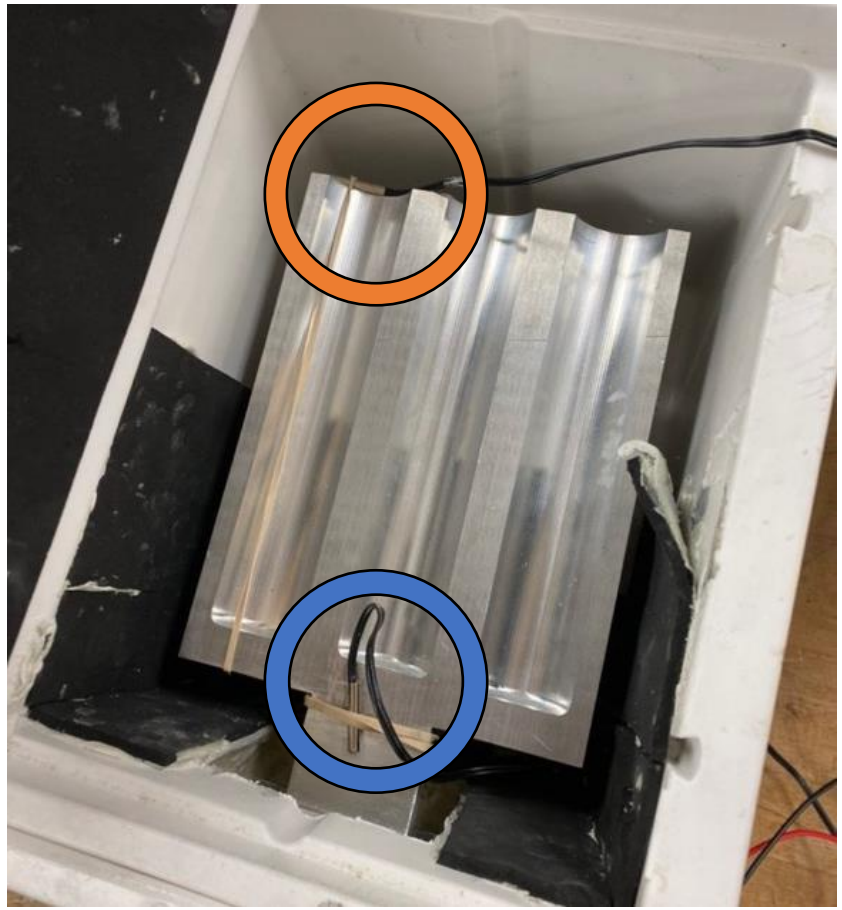
3. Optimize cool down time

Steps to Concept Validation

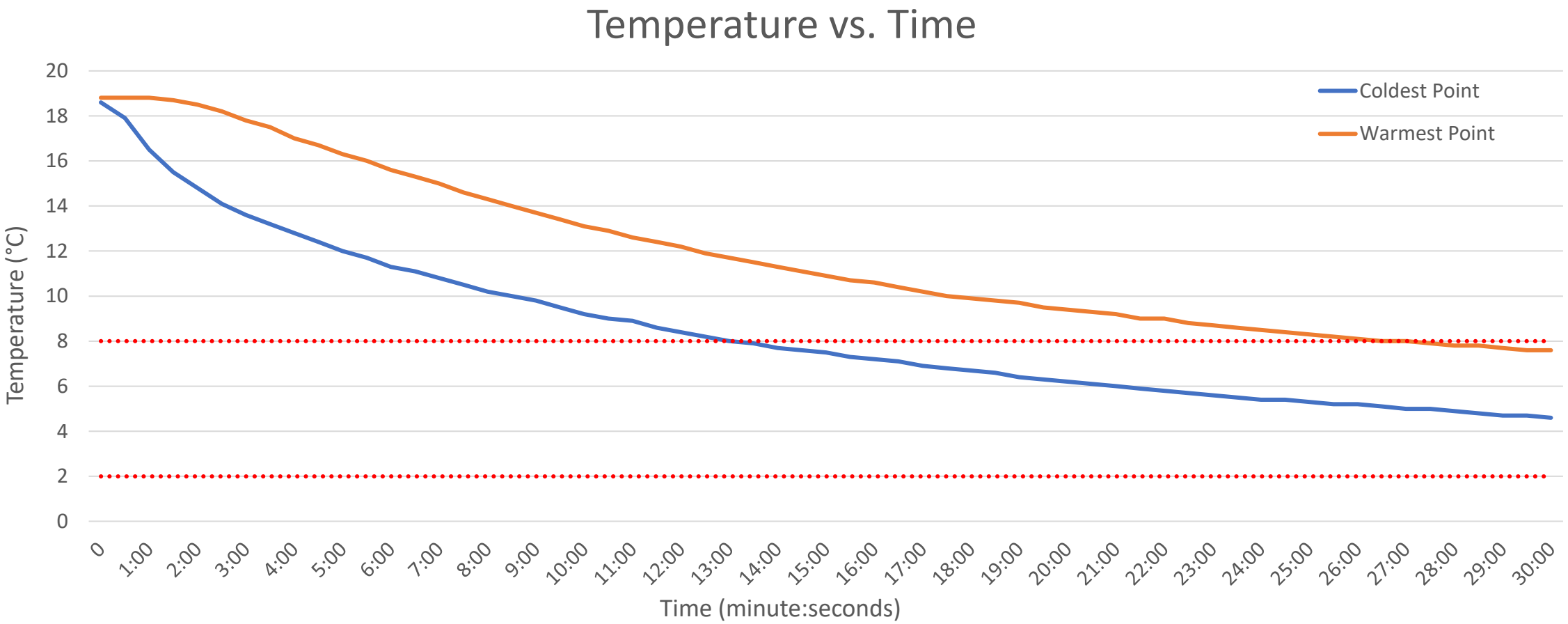
1. Reaching our temperature target
2. Ensuring the entire cold plate is within range
3. Optimize cool down time
4. Keeping temperature within range for 14 days

Temperature Gradient Test

- Better understand the difference in temperature across the plate
- Took temperature readings closest and furthest from TEC
- Test ran for 30 minutes



Temperature Gradient Test



Temperature Gradient Test

- Results:
  - Temperature difference was 4°C at its worst and 3°C at its best without insulation
  - Temperature difference is acceptable to keep medicine within 2°C and 8°C
  - Cold plate was fully in range after about 27 minutes
  - Additional TEC will not be needed

Parts Ordered

PERSONAL COOLER

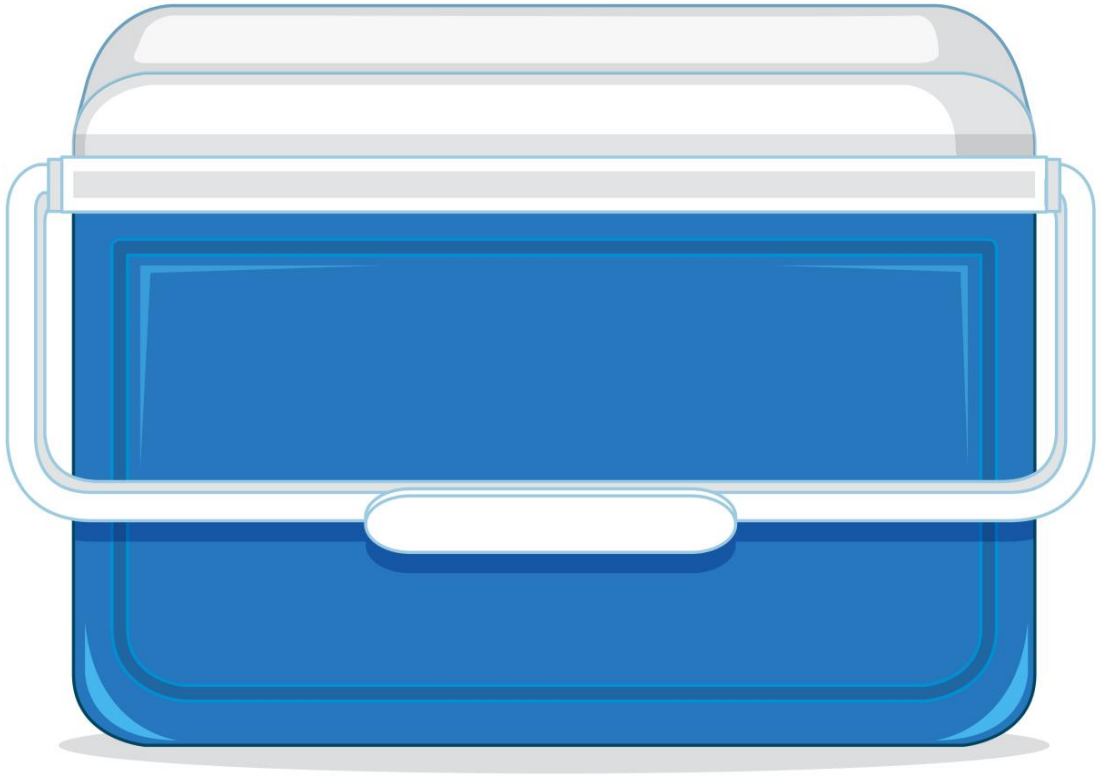
FLEX SEAL

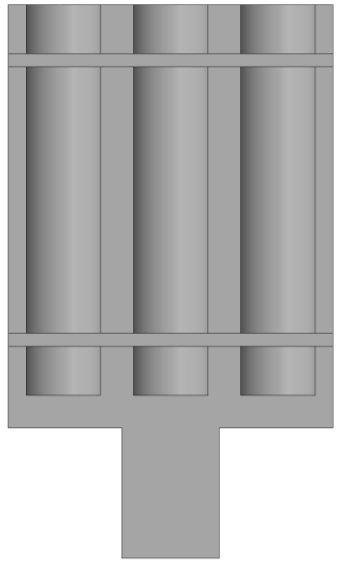
SPRAY FOAM INSULATION

HEAT TRANSFER PASTE

WOOL INSULATION

Current Issues





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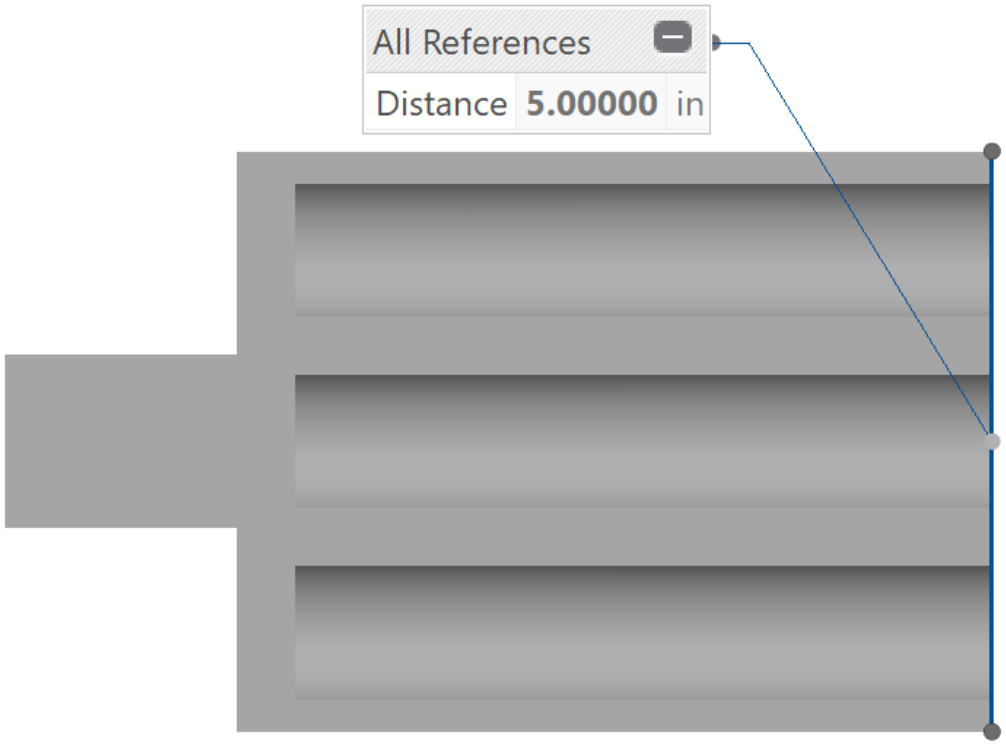

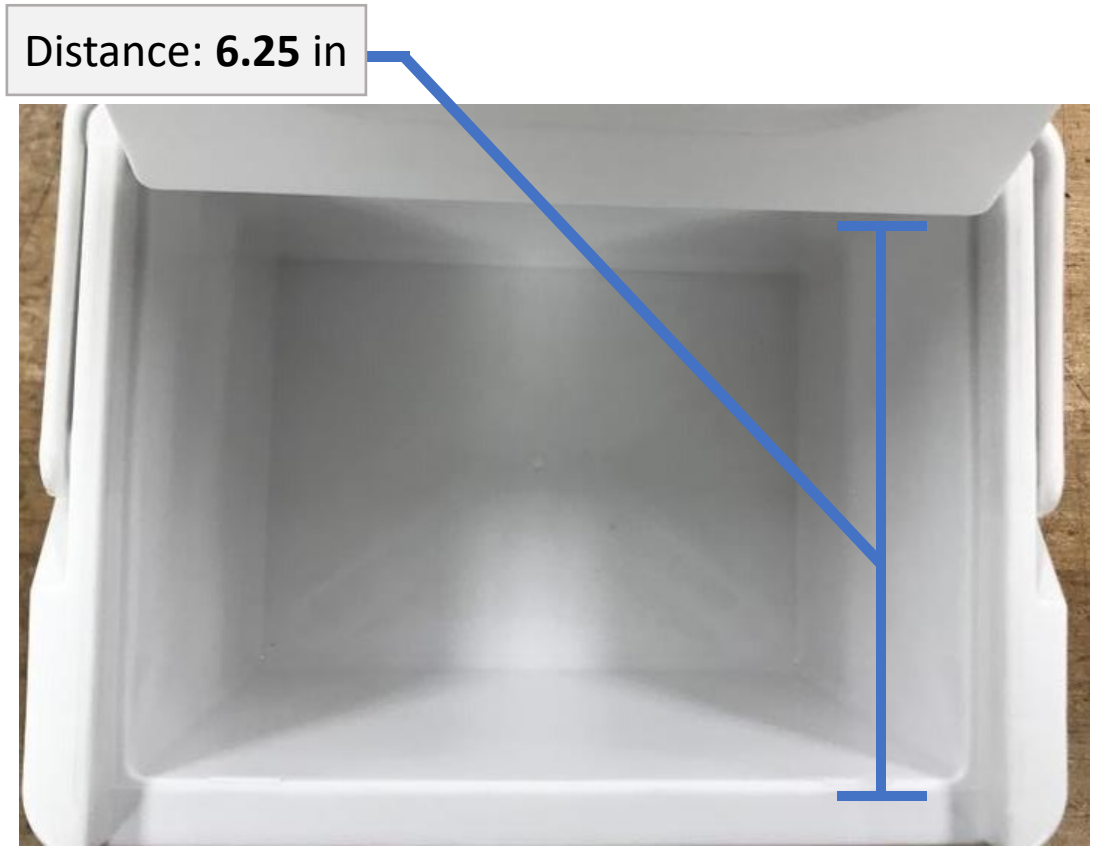

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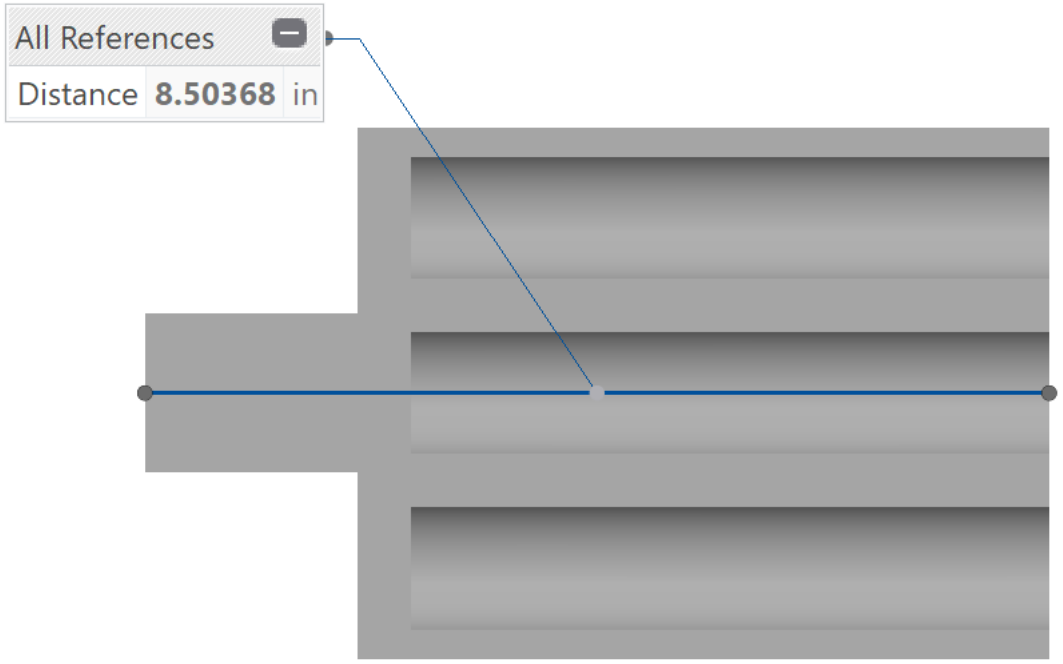
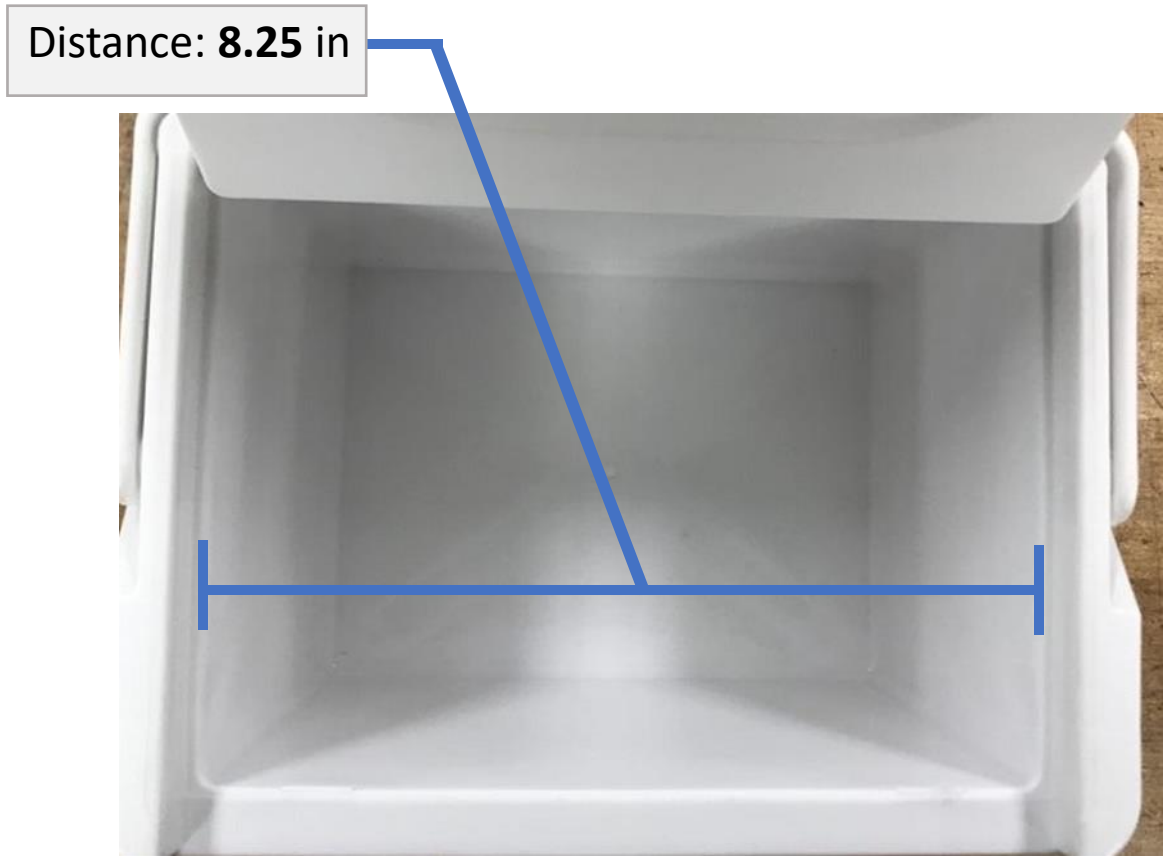
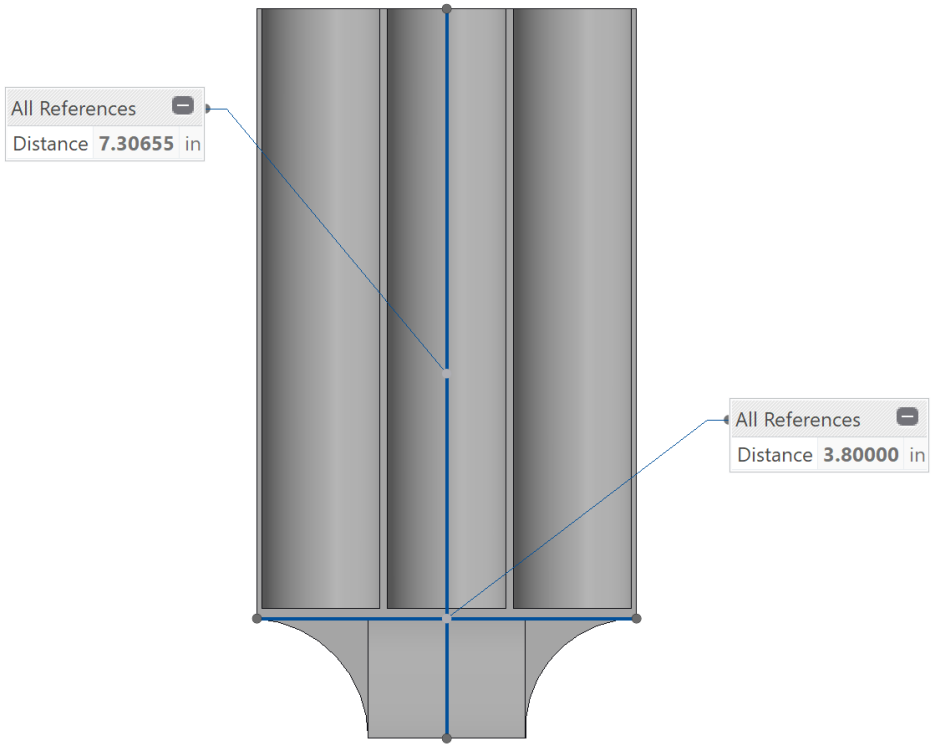
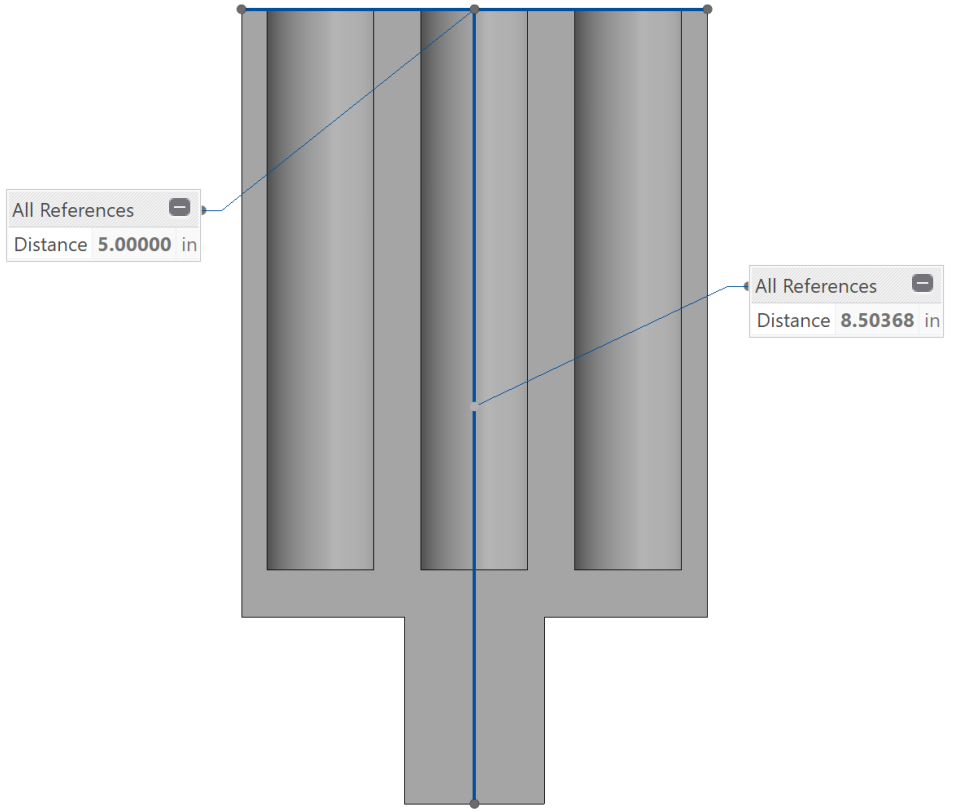




Redesigned Cold Plate





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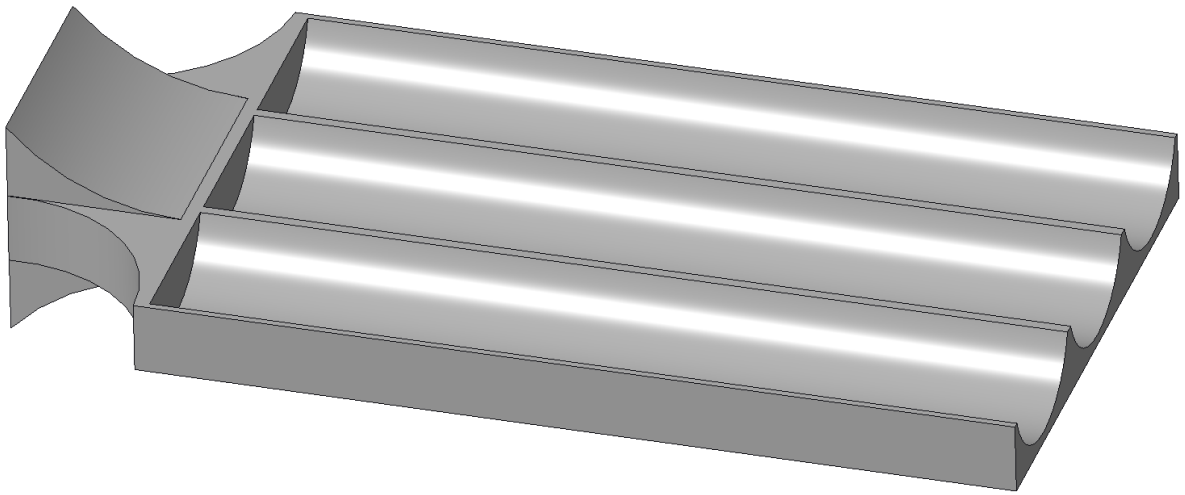
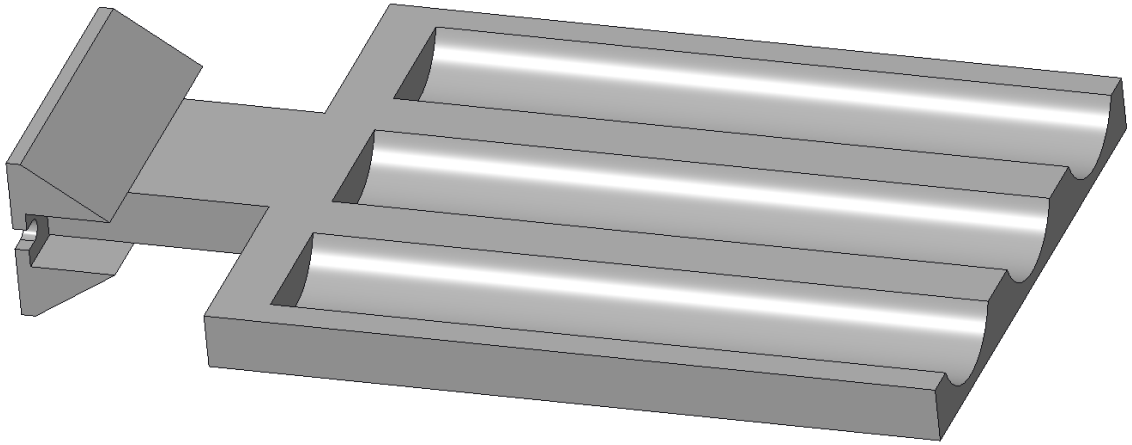
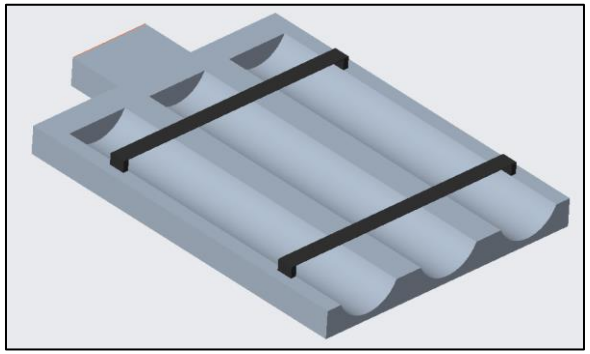
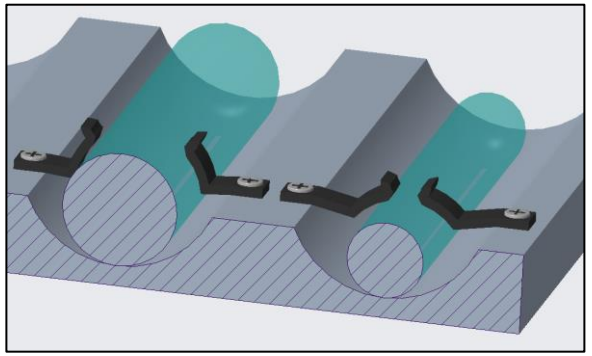


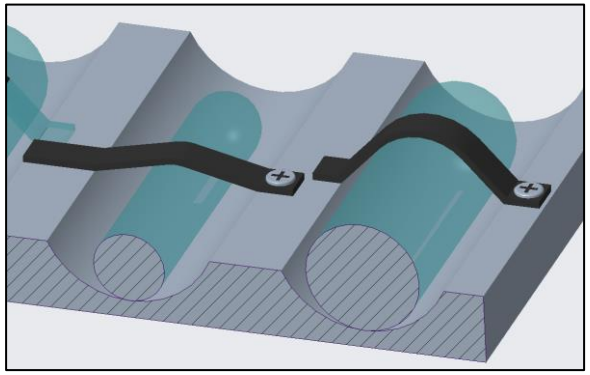


Method of Securing: Selection

- Previous Ideas
  - Elastic Bands
  - Clasps
  - Magnetic Straps
- Current Selection
  - Hook and Loop Strap

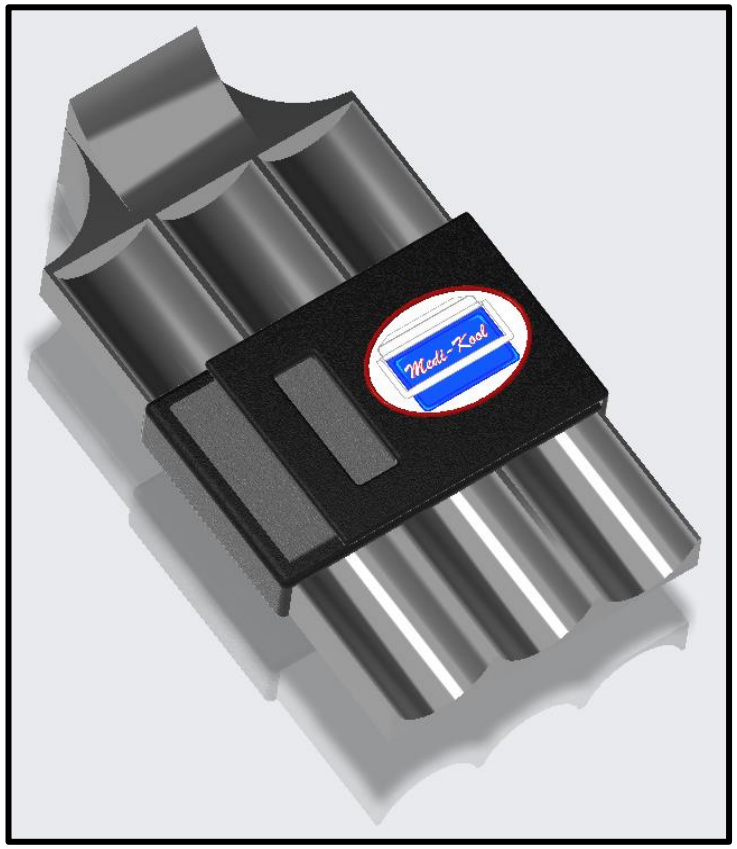






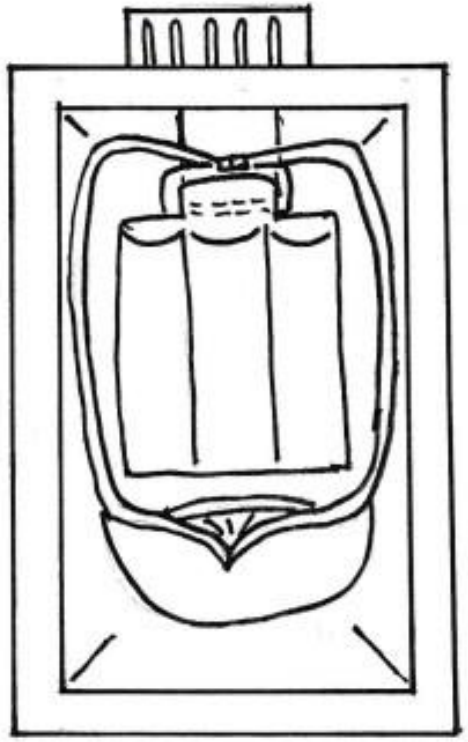
Method of Securing: Hook & Loop Strap

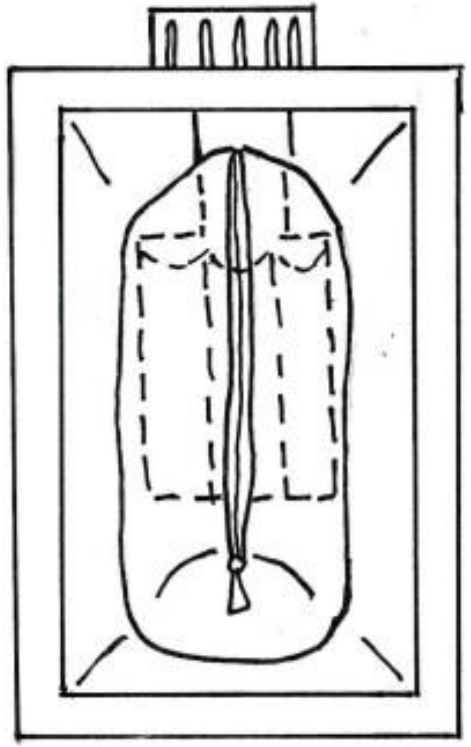
- One band wrapped around cold plate
- Secured onto bottom of cold plate
- Accommodates various pen/vial diameters
- Handle on top, overlapping strap



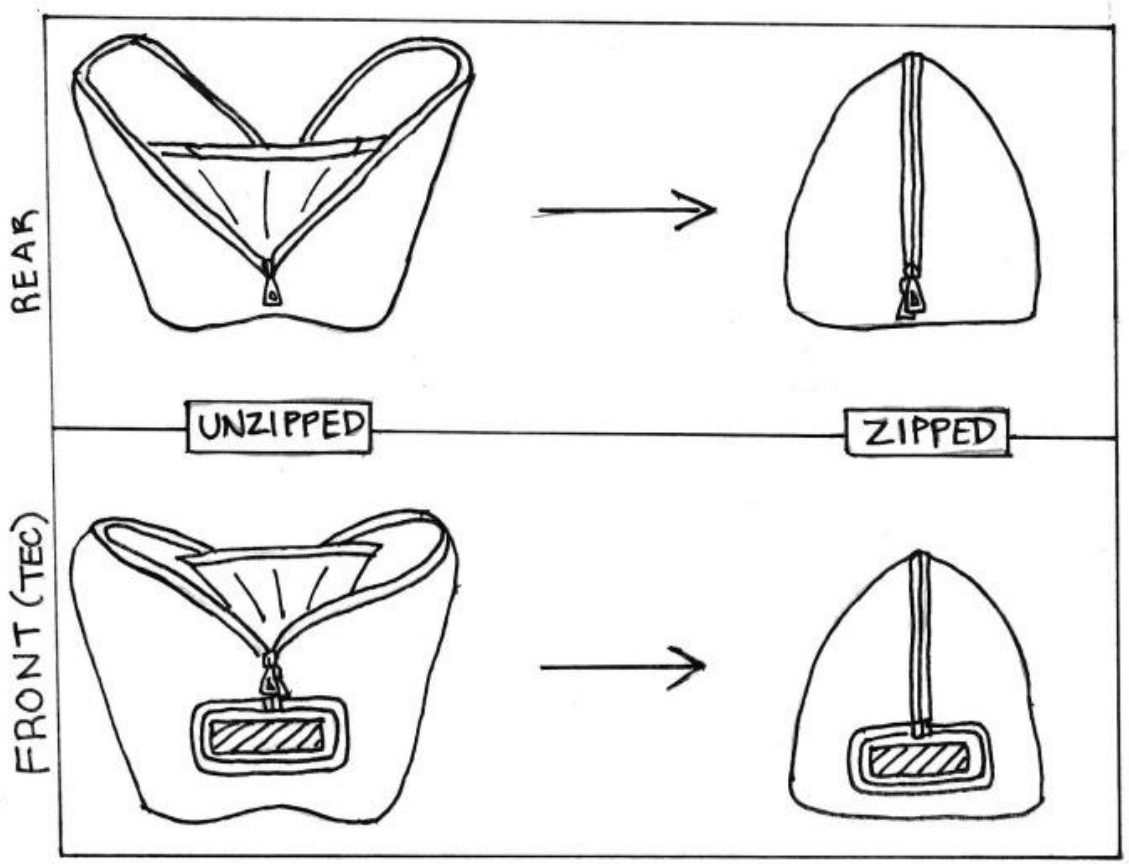
Second Seal: Insulation Purse

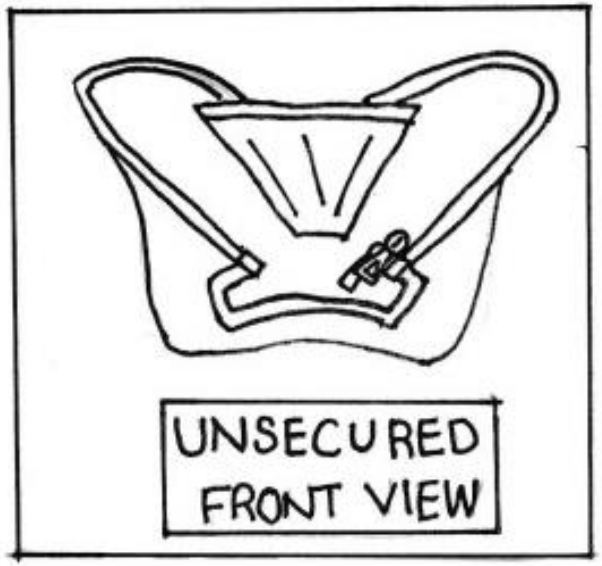
- Cut out for cold plate
- Double Zipper design allows variable opening size





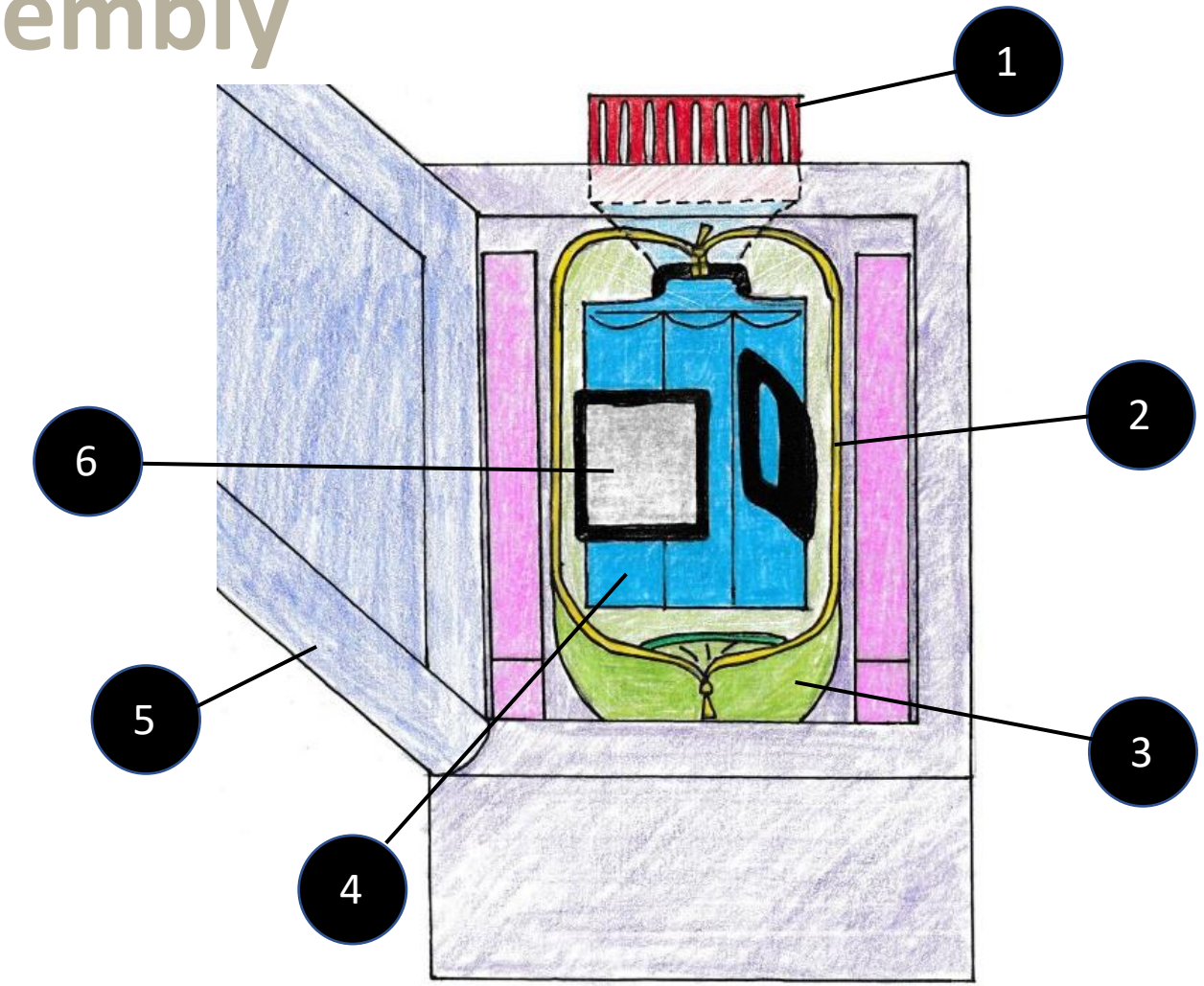
Second Seal: Insulation Purse





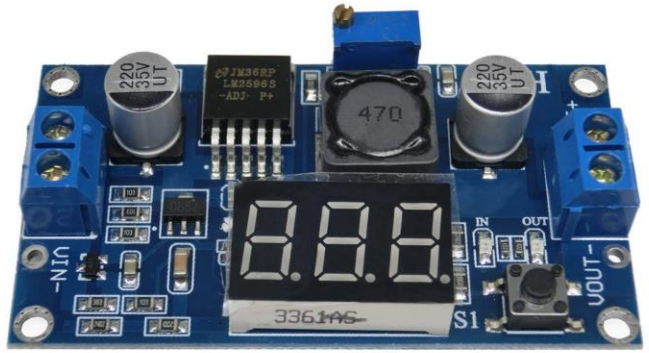
Updated Internal Assembly

1. Ventilation Gate / TEC / Peltier Plate
2. Double Zipper
3. Insulation Purse
4. Grooved Cold Plate
5. Cooler w/ Added Insulation and Seals
6. Hook & Loop Strap

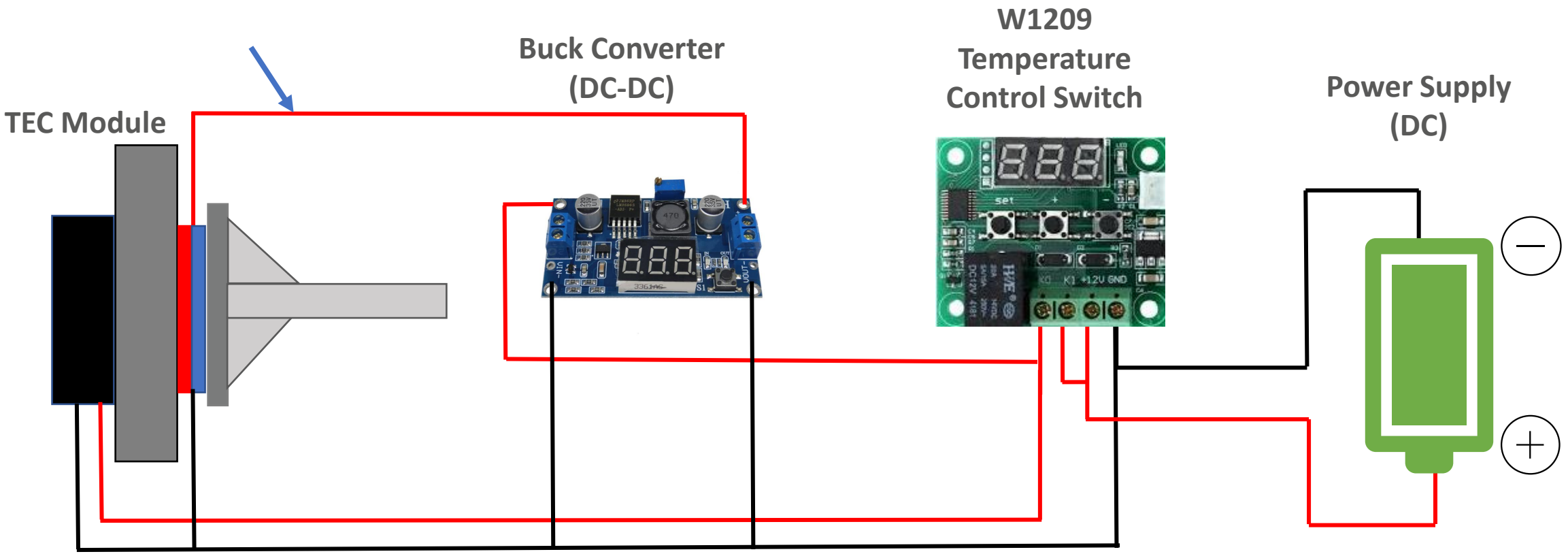


Utilizing a Buck Converter

- Efficiently converts high voltage to low voltage supplied, thus increasing current
- Efficient power conversion leads to
  - An extended battery life
  - Reduces heat



Circuit with Buck Converter



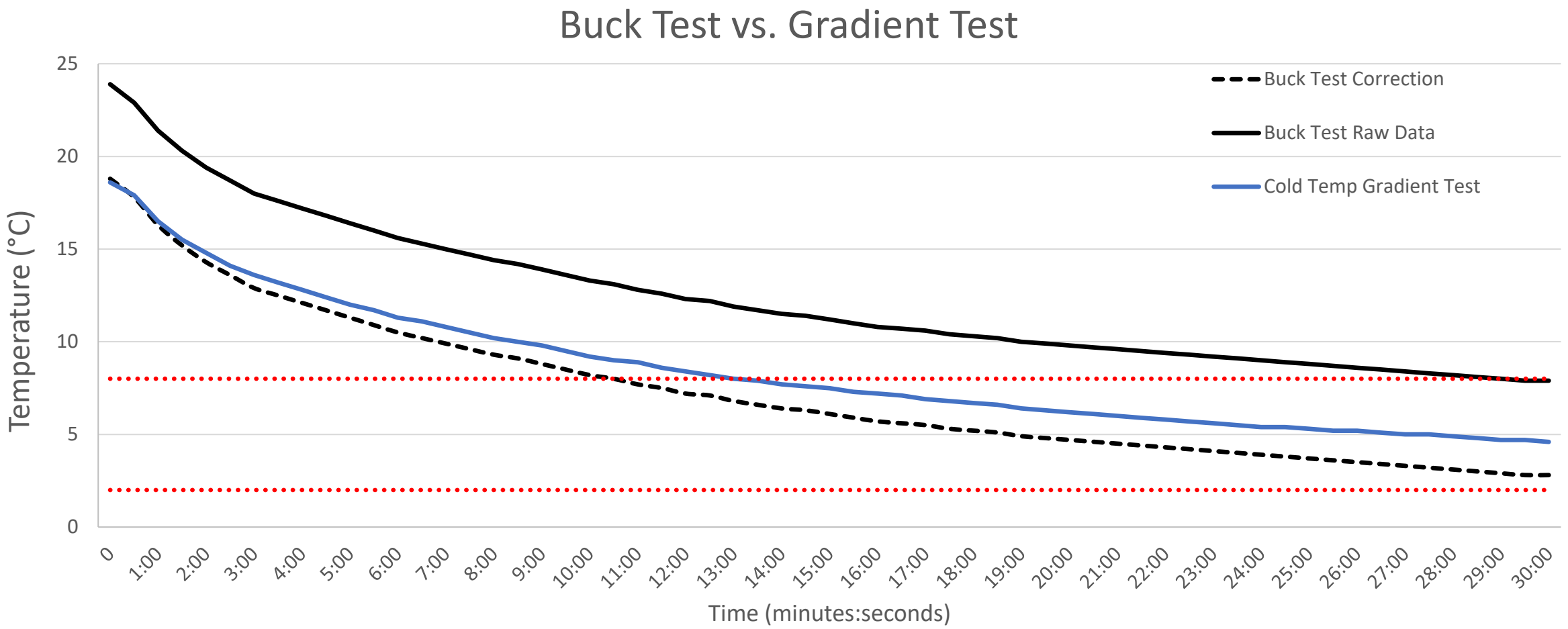
Current Testing

Buck Converter Test:

- Began initial testing with Buck Converter wired to Peltier plate.
- Used Temperature Control Switch and Thermocouple for readings.
- The test was started at a higher initial temperature than gradient test.

Voltage (V)	Current (A)	Buck voltage (V)	Total Time (min)
12	3.89	9	30

Buck Converter Test



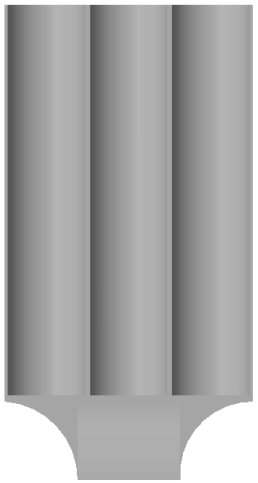
Buck Converter Test

Results:

- Temperature decreased by 15 degrees in under 11 minutes
- Thermocouple failed towards end of project
- Buck Converter test with correction shows that it got cooler quicker

Semester Plan: Parts to Order

Battery



Metal for Cold plate

Velcro Strap

Solar Panel

Temp. Control Switch

Semester Plan: Assembly

1. Laser cut hole inside cooler to fit in TEC and cold plate
2. Redesign and fabricate new cold plate
3. Assemble insulation inside cooler (wool and spray)
4. Thermal glue cold plate onto TEC
5. Wire TEC with temperature control switch and connect solar panel

Semester Plan: Continuing Validation

1. ~~Reaching our temperature target~~
2. ~~Ensuring the entire cold plate is within range~~
3. Optimizing cool down time
4. Keeping temperature within range for 14 days

Any Questions?