

# The “Cool” Group

Presents

A Joint Production By:

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# The Thermoelectric Cooler





# The Beginning

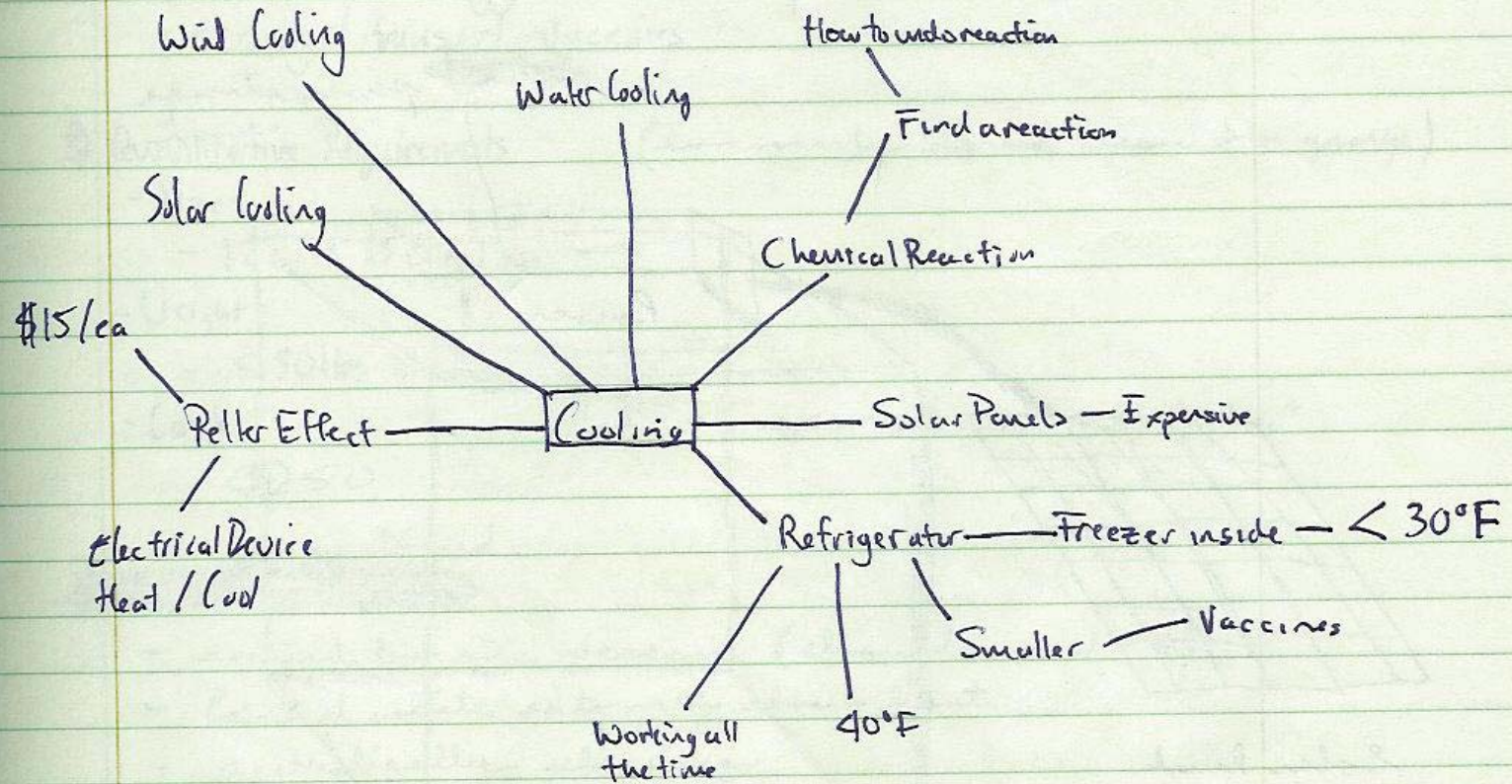
- Design Project Problem Statement
  - Appropriate and Sustainable Technology
  - Must be applied to help developing communities
  - Needs to be functional, efficient, durable, appropriate, reliable, affordable, attractive, and satisfy the needs of the community it serves

# Initial Idea

- Refrigerating with Renewable Energy
  - Cooling Powered By:
    - Sun
    - Wind
    - Water
    - Chemical
  - Recycled Refrigerator
  - Thermoelectric Modules
  - Chemical Cold Packs
  - Absorption Cooling
- Could be used to store vaccines or other perishable items in developing communities

# Brainstorming

Brainstorming w/ Cooling

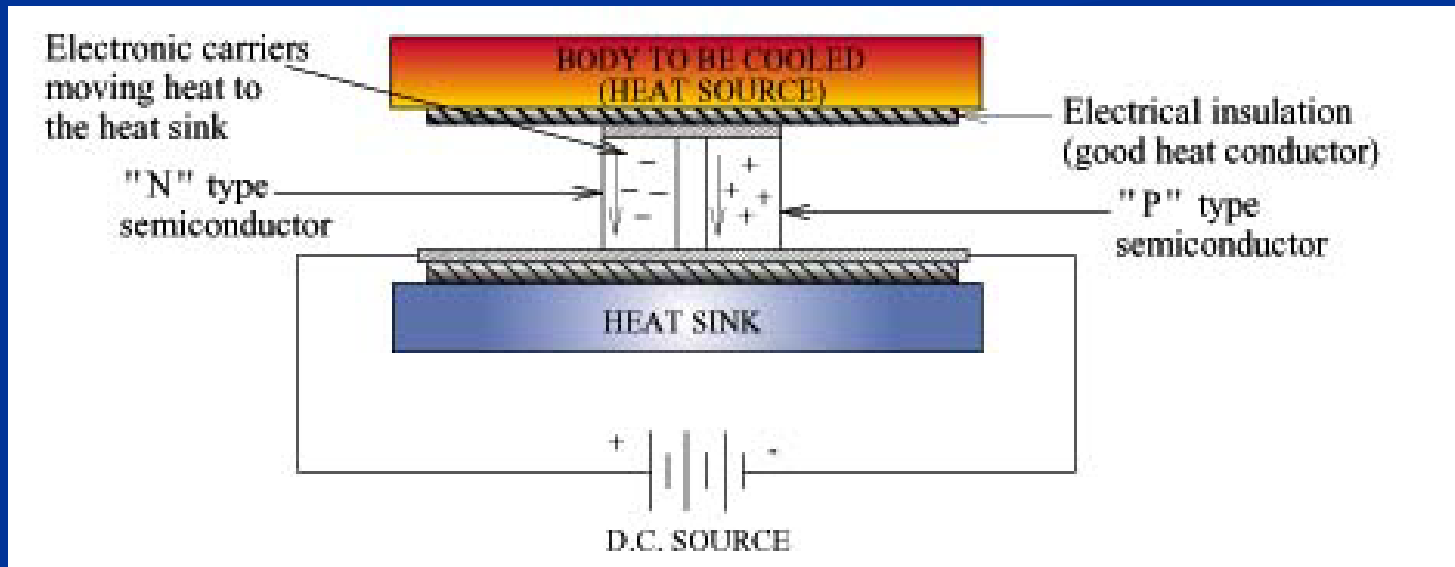


# Choosing a Design

- Decided to pursue cooling using the Peltier Effect
  - Left the option to integrate solar panels into our project to provide renewable energy
- Decided against:
  - Wind, Water, Chemical
    - Availability, difficult to test, irreversible reactions
  - Recycled Refrigerator
    - Availability, size

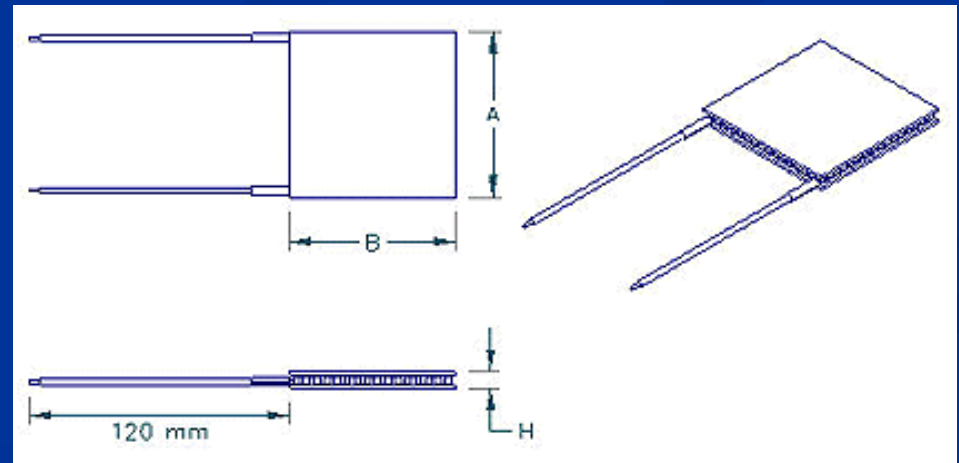
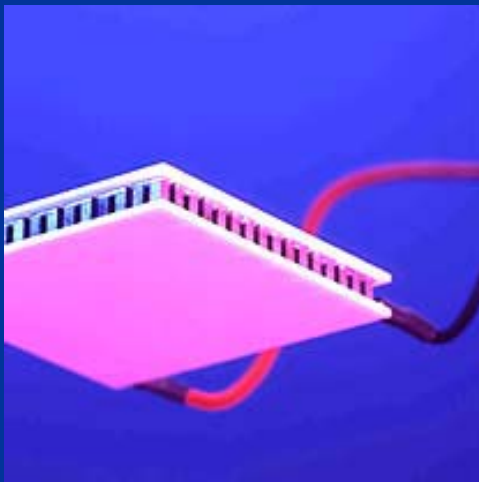
# The Peltier Effect

- Cooling with Electricity
  - Electrical current runs through two different types of metals creating a temperature difference
  - This temperature difference cools the box



# Thermoelectric Modules

- Thermoelectric Modules
  - Use the Peltier Effect to create a hot and cold side
  - These modules are what power the refrigerator

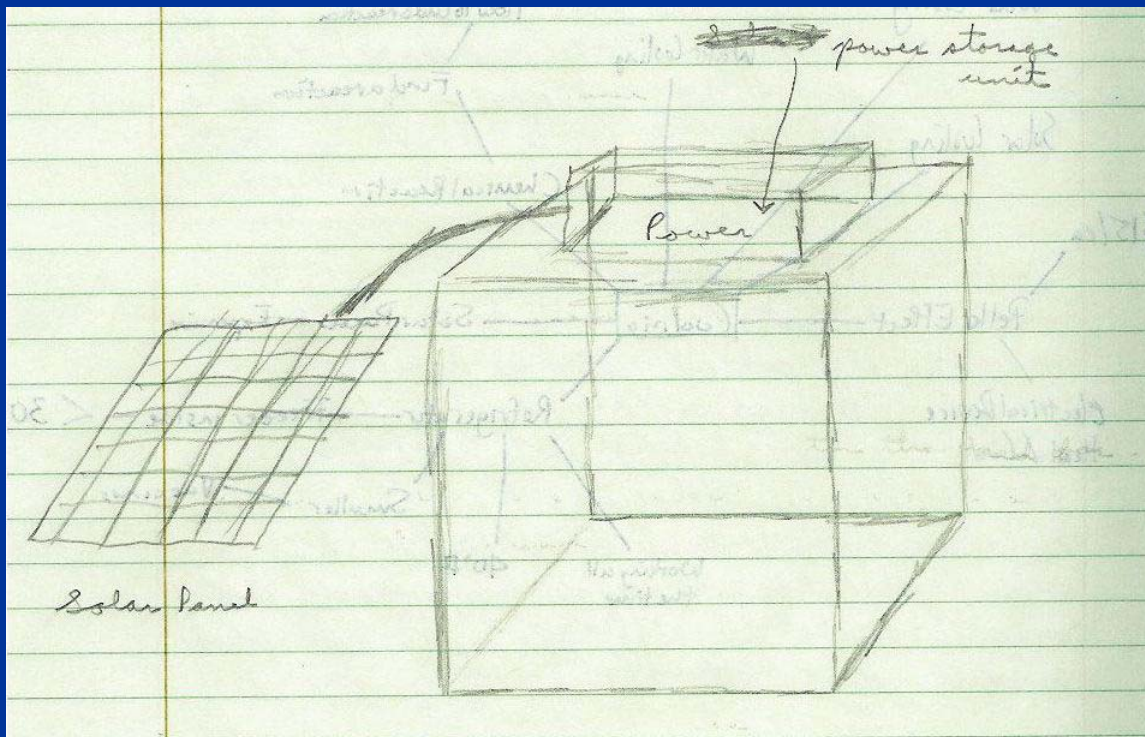


# The Refrigeration Box

- Initially thought to use an old refrigerator
  - Recycled refrigerators are hard to come by
- Researched materials to build a box
  - Polyethylene
    - Insulator
    - Easy to work with
    - Could make our own dimensions

# Initial Design

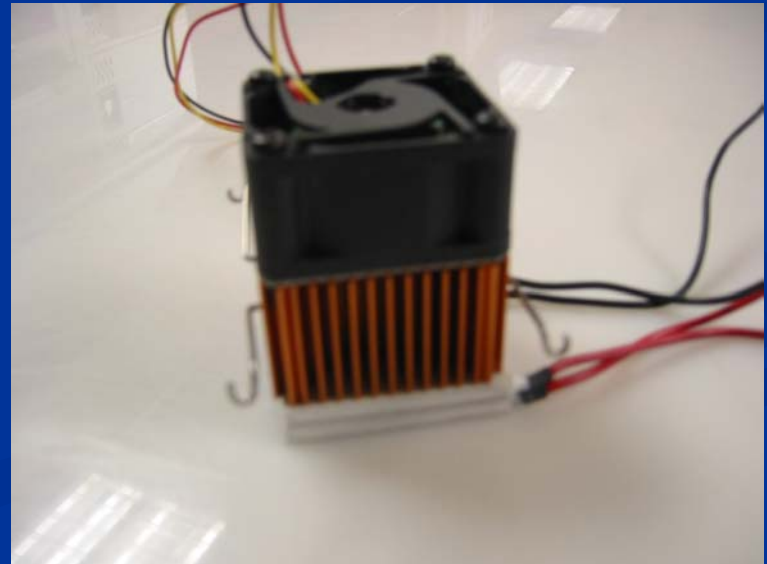
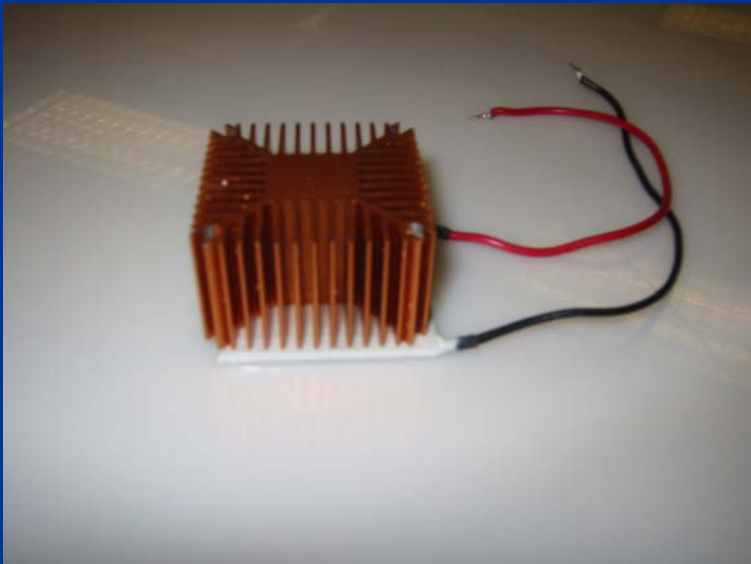
- Small box with Thermoelectric Modules on top powered by a solar panel





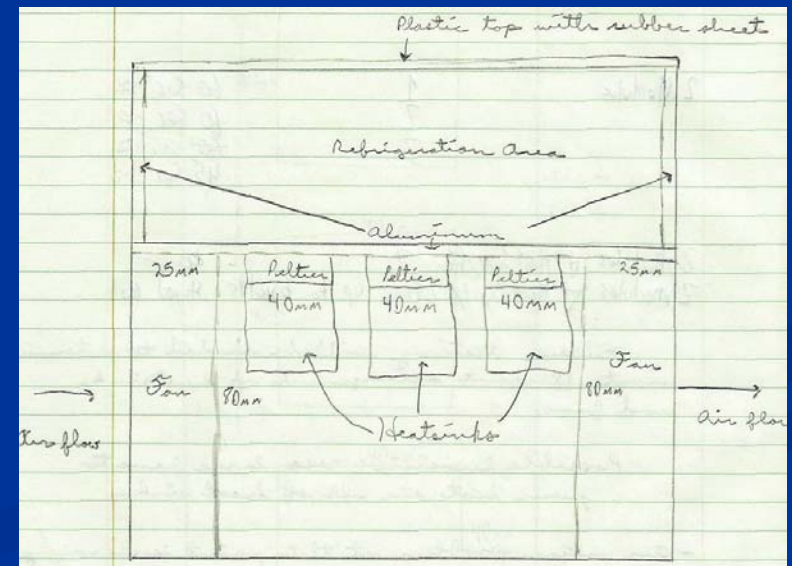
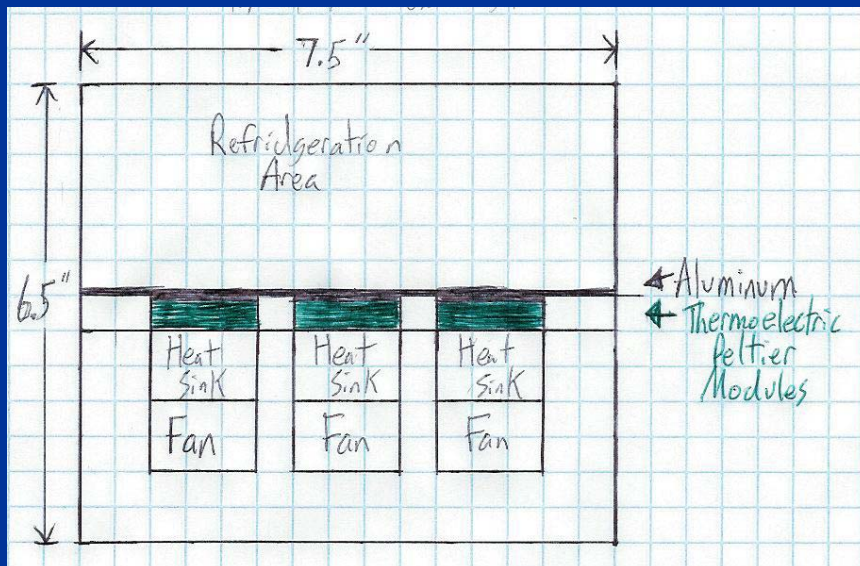
# Initial Testing

- Our Thermoelectric modules:
  - Overheated quickly
  - Performed better when stacked
  - Needed larger fans



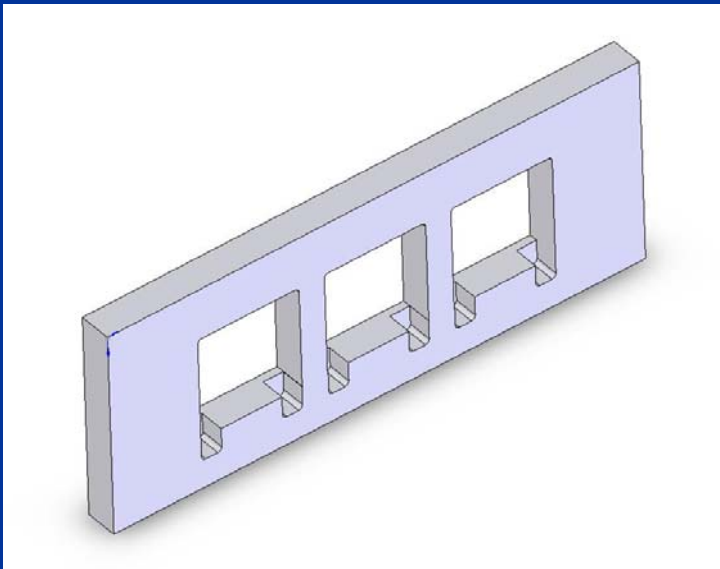
# Design Improvements

- Refrigeration compartment would be atop the Thermoelectric modules while fans would cool the heat sinks.



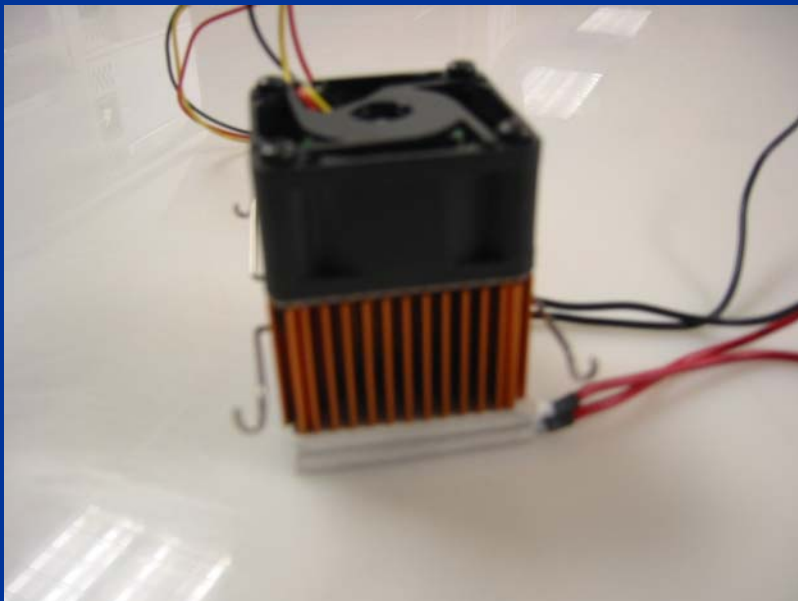
# Design Improvements

- Shelf would separate refrigerated area from hot exhaust
  - Modules would sit inside machined holes
  - Insulate hot from cold and cold from hot



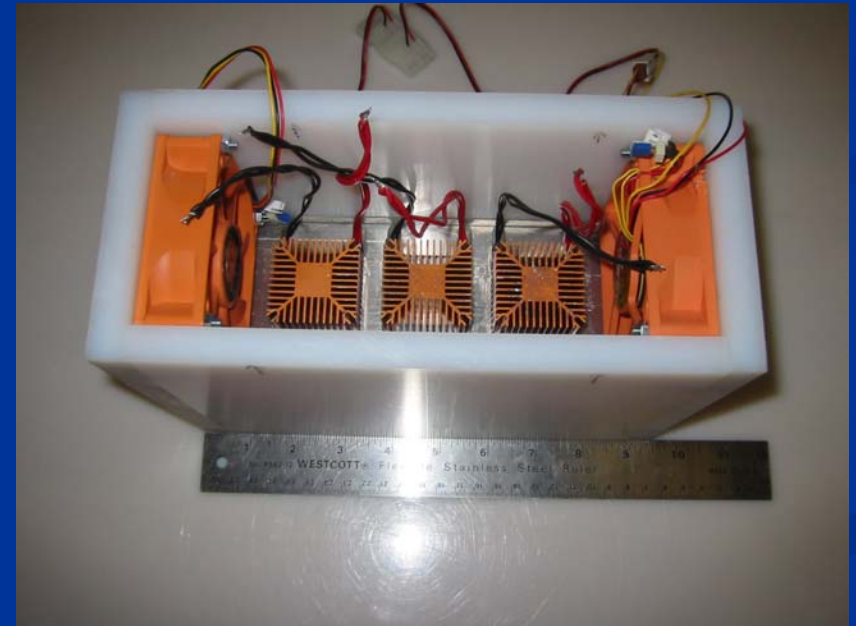
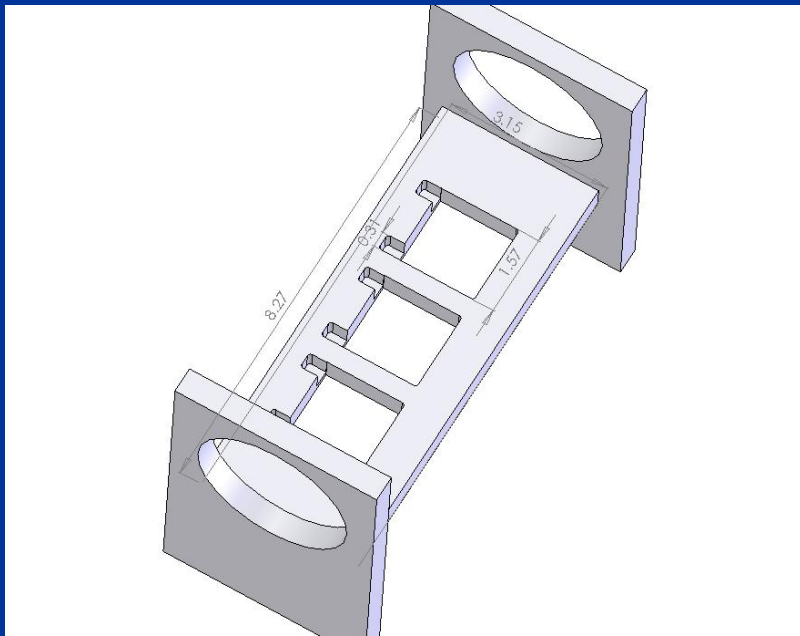
# Design Improvements

- Larger fans were ordered to cool heat sinks
  - Small fans were not powerful enough



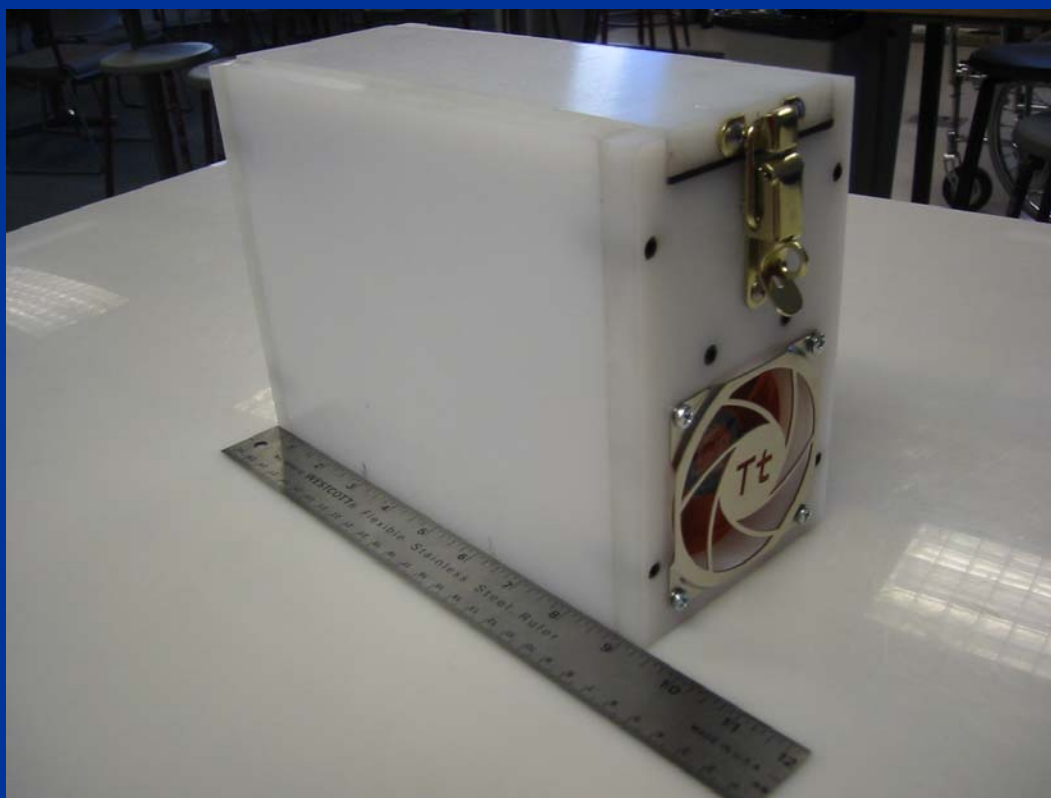
# Design Improvements

- Air would be blown by twin fans across the heat sinks removing excess heat



# Construction

- After much trial and error, the box was pieced together



# Inside

- An Aluminum sheet was added to the bottom of the box to evenly distribute the cold



# Top

- To make the refrigerated compartment airtight a rubber seal was added to the top along with a clasp to complete the box





# Completed Box

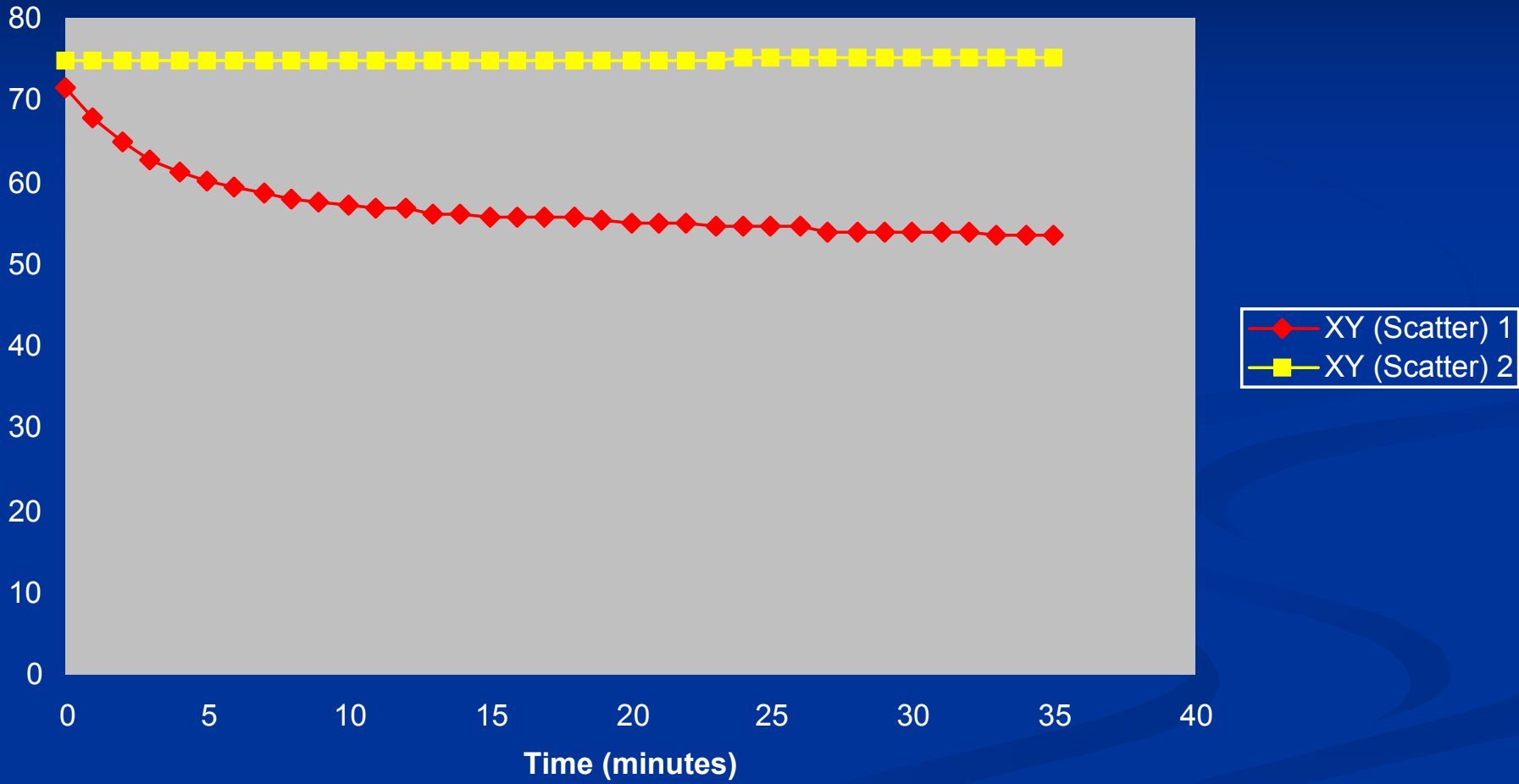
- Final Dimensions:
  - 4 (1/4)" x 6 (7/8)" x 9 (3/8)"
- Cost:
  - \$125
  - Includes plastic, thermoelectric modules, heat sinks, fans, aluminum, wiring, rubber, latch, hinge, and screws



# Testing

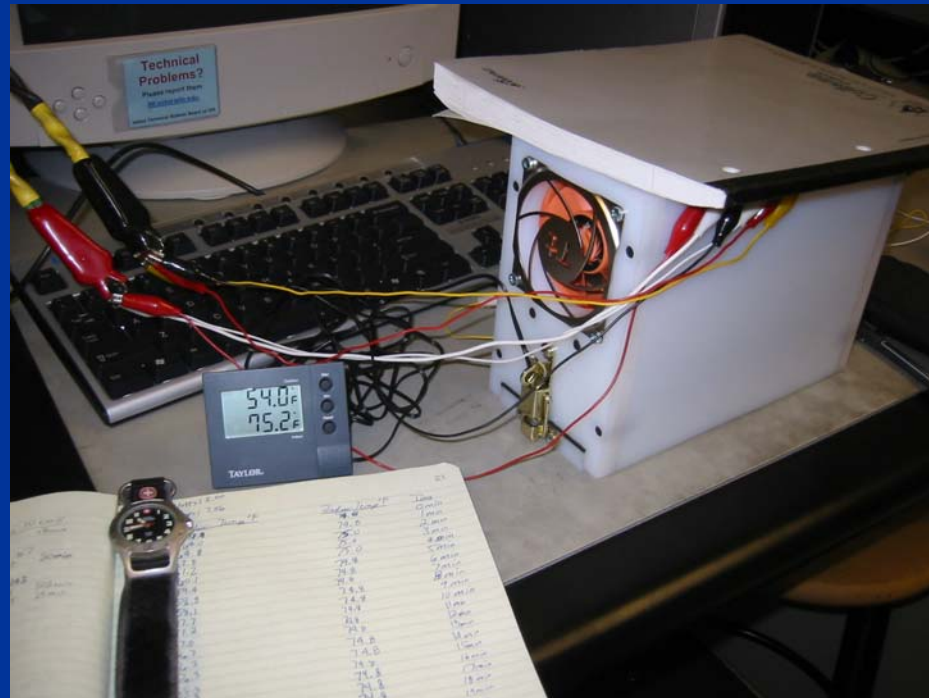
- To test our refrigerator we hooked it up to a DC power supply as if it would be run off batteries
- Using 3 Volts and 7.5 Amps our refrigerator reduced the inner temperature from 75.0 °F to 53.4°F in approximately 30 minutes, a difference of 21.6°F

## Test 2



# Test Evaluation

- Excited with a 21.6 °F drop in temperature
  - Modules are rated up to 30°F drops
  - Only our first prototype



# Future Improvements

- Better Insulation
  - Two walls, insulation between
- More Modules
  - Have modules covering a greater surface area of the refrigeration box
- Line the inner walls with aluminum
  - Spread the cold from the bottom of the box up and around the sides

# Renewable Energy

- Although we regret not having more time to explore the possibilities of solar power, this would not be a difficult transition as the modules draw a minimal amount of electricity
- Room for future improvement

# Real World Application

- **Appropriate**
  - Demand for vaccine storage in developing communities
  - Way to store other perishable items in remote locations
- **Sustainable**
  - No real moving parts to break or wear
  - Thermoelectric Modules have a life expectancy of 200,000 hours

# Real World Impact

- The Thermoelectric Refrigerator could have a very large impact in the real world
  - Provide a way to vaccinate a very large population of people who live in developing communities around the world
  - Save the lives of the thousands of people that could now receive vaccinations



# Competition

- Vaccine Refrigeration
  - No current products
- Refrigeration for everyday use
  - Refreshments and fruit storage

## The Portable Personal Chiller.

This lightweight thermo-electric cooler keeps drinks and food chilled and easy to enjoy in an office, dorm room, aboard ship—even in a car. This highly portable, personal unit weighs less than 10 lbs. and has a carrying handle, but is actually larger than most personal coolers and can accommodate eighteen 12-oz. cans as opposed to the six-can capacity of other models. The cooler has a removable shelf for top and bottom stacking (the unit holds up to four full-size wine bottles when the shelf is removed). It can be set to chill down to 36° below ambient air temperature, and can also be set to keep food warm at 149° F. The unit plugs into AC, comes with an adapter for plugging into a car cigarette lighter, and produces no CFC or HFC pollutants. UL listed. Specify Silver or Black. 17 $\frac{1}{2}$ " H x 12" W x 11" D. (9 $\frac{1}{2}$  lbs.) 65795J.....\$129.95



## The Thermoelectric-Cooling Fruit Saver.

Using a thermoelectric chip, the fruit saver circulates cool air, keeping the temperature within its double-insulated walls between 52° and 56° F, the ideal range for doubling the life of fruits and vegetables. Simply place produce inside the container where cool air is continuously circulated to keep fruits and vegetables fresh and crisp. With a plastic housing that keeps fruit in view (and at hand for healthy snacking), the fruit saver operates 24 hours a day, drawing minimal power. Plugs into AC with 40" cord. UL listed. Accommodates produce up to cantaloupe size. 10 $\frac{1}{2}$ " H x 10 $\frac{1}{2}$ " W x 14" L. (12 lbs.) 67667J.....\$69.95



# Conclusion

- Team Success
  - Team bonded and worked together to achieve our goals
  - Learned the ins and outs of the Design Loop
  - Learned invaluable manufacturing skills
  - Created a prototype that successfully fulfills the project objectives and that we are proud of

**Questions?**