

Hand Warmer Project

San Marin STEM Chem



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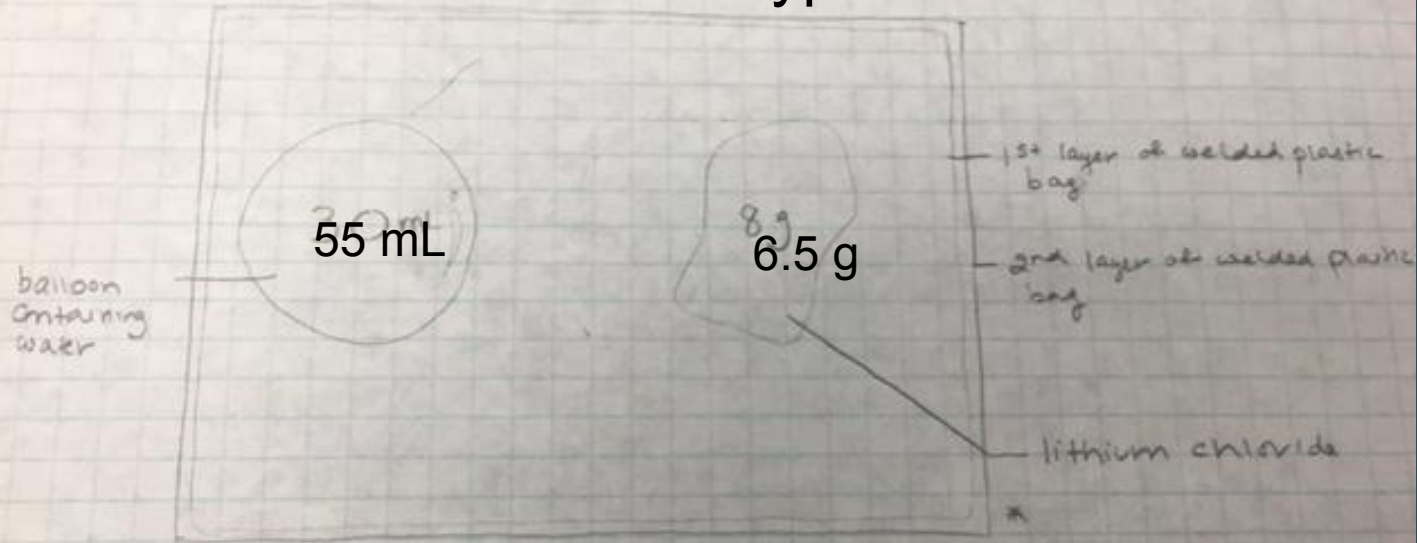
Goals...

Build a handwarmer that meets the following requirements:

- Safe
- Environmentally friendly
- Inexpensive
- Changes 20 degrees in temperature- no more
- Aesthetically pleasing

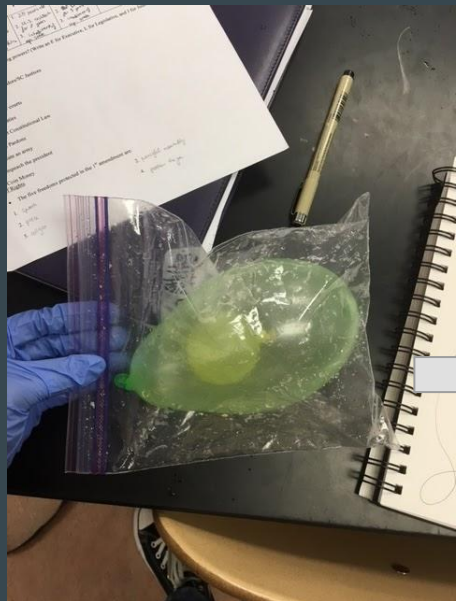
Handwarmer Design

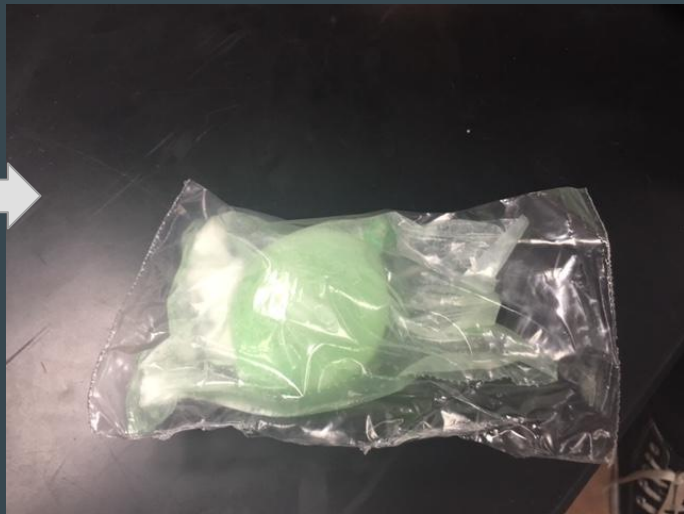
Our Prototype



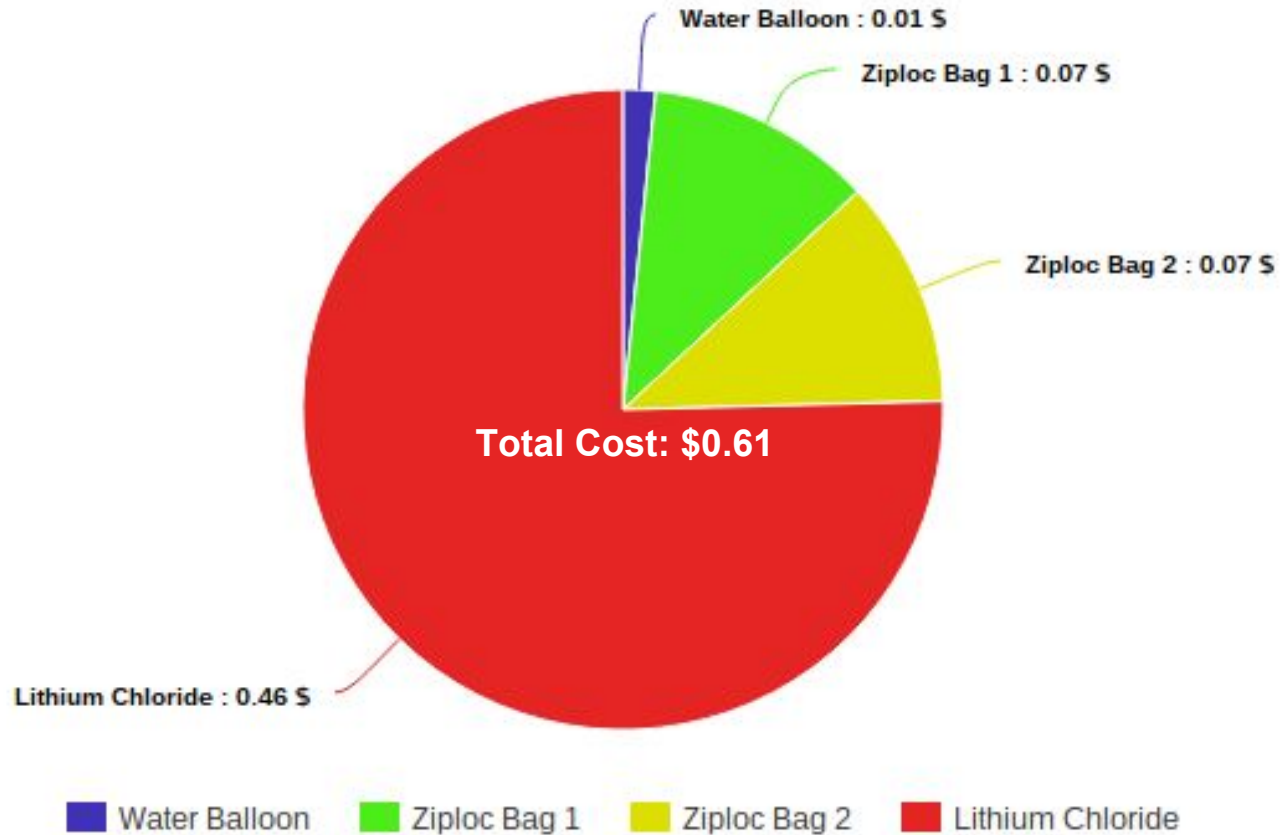
* actual size of handwarmer (3" x 5")

The Sequence





COST BREAKDOWN OF 1 HANDWARMER



Total Cost Chart

Materials	Bulk Cost	Cost per Unit	Quantity	Total Price
Lithium Chloride	\$35	\$0.077	6 g	\$0.46
Plastic Bags	\$8.79	\$0.07	2 bags	\$0.14
Distilled Water	\$0.88	0.0002	50-60 mL	\$0.01 - 0.012
Water Balloon	\$1.00	\$0.01	1	\$0.01
Heat Sealer*	\$18.05	-----	1	\$18.05

* don't factor into cost of one handwarmer

Grand Total: \$0.622 per handwarmer

Sources of Materials



- Lithium Chloride Flinn Scientific, INC: \$35 for 500 g
 - <http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=19648>



- Ziploc Snack Bags Target: \$8.79 for 120 bags
 - http://www.target.com/p/ziploc-snack-120ct/-/A-15246872#prodSlot=medium_1_1&term=ziploc



- Water Balloons Dollar Tree: \$1 for 100 balloons
 - Novato Dollar Tree

How to Build/Use

- Steps
 - Obtain 6.5 g of Lithium Chloride
 - Obtain 2 Ziploc bags and cut off the first inch or so
 - Take a water balloon and fill it up to around 50-60 ml
 - Put the water balloon and lithium chloride in the first Ziploc bag
 - Make sure to eliminate the bag of any air and heat seal it
 - Place this bag into the other Ziploc bag and heat seal it

- To Use
 - Squeeze the bag to pop the water balloon, so that the reaction can start
 - Warning: It takes quite a bit of force to pop it

Lithium Chloride: Why?

- Though expensive, it worked the fastest and most effective with the littlest amount of the salt.
- Because the reaction was quick, we knew that lithium chloride would be dependable because it would always work. Therefore, we only had to worry about manipulation of the temperature change rather than if the temperature was going to rise to a sufficient amount at all.

You Should Know...

- Not particularly dangerous unless the 3 i's are committed
 - Inhalation
 - Ingestion
 - Injection
- Do not get in eyes
- If solution gets on hands, may cause mild irritation ← wash them
- Toxic to aquatic organisms

Lithium Chloride Testing Data Table

* the amount temperature/energy change in the handwarmer depends on the salt: water ratio. Because of this, we had to figure out a ratio that wouldn't be too hot, but still give out an adequate amount of heat

Amount of Salt (g)	Amount of Water (mL)	Initial Water Temperature (*C)	Highest Water Temperature (*C)	Time it Takes to Drop 10*C	Time it Takes to Drop 20*CS
5 g	40 mL	22 *C	61.1 *C	-----	5:45
7 g	35 mL	20.4 *C	60.2 *C	4:09	7:27
7.14 g	35 mL	20.7 *C	52.5 *C	4:42	12:16
8.07 g	35 mL	20.9 *C	65.2 *C	4:30	9:35

Data We Used to Finalize our Measurements

Prep: hand submerged in 8.2 degree water

Factors:

- 60 mL of water in water balloon (23.6 degrees)
- 6.5 g LiCl
- Temperature raise: 23.6 degrees → 43.7 degrees
- To test subject: pleasant, not too hot

What's Going On?

- Lithium Chloride, a salt, is being mixed w/ water
 - $LiCl(s) + H_2O(l) = Li^+(aq) + Cl^-(aq)$
 - Li^+ (cation), Cl^- (anion) ← lithium chloride
 - O^{2-} , H^+ ← water

- exothermic reaction
 - Releases heat
 - Reactant have more energy than the products

- $q = 65g \times 4.184 J/g^{\circ}C \times 20.1^{\circ}C$
 $q = -5466.396 J$

What makes this reaction exothermic?

- 2 occurrences when dissolving a salt:
 - Bonds are broken in the solid salt → endothermic
 - Ions form bonds with the solvent molecules → exothermic
- The balance of these two occurrences determine if reaction endothermic or exothermic
- Because adding Lithium Chloride to water is exothermic, the latter wins out

Selling Points

- Effective
- Easy to build
- Relatively cheap to manufacture
- If common sense is used, it will not hurt the consumer

Thanks for your time!