

Handwarmers are especially useful for the bitter cold days spent outside at the bus stop or recess. Handwarmers generate heat through a chemical reaction between iron and oxygen. Heat comes as a result of the rusting process that begins when iron and oxygen are combined, with calcium chloride speeding up this process.

- Plastic cup
- Distilled water (preferred) or tap water
- 4 tbsp. wet jelly crystals or ¼ tsp. dry jelly crystals
- 1 Tbsp. iron filings
- 1 ½ Tbsp. calcium chloride
- Plastic bag
- Measuring spoons
- Safety goggles
- Gloves
- Baby wipes or rags – for cleanup

1. Fill the plastic cup with (distilled) water.
2. Add a rounded $\frac{1}{4}$ tsp. of dry water jelly crystals to the water. These crystals are a superabsorbent polymer and can absorb up to 300 times their weight in water. Give them several hours to soak.
3. Dump 4 Tbsp. of the soaked and swollen crystals into the plastic bag. The crystals may need to be broken up a bit to make them more manageable.
4. Add 1 Tbsp. of the iron filings to the crystals in the plastic bag.
5. Now add 1 $\frac{1}{2}$ Tbsp. of the calcium chloride to the mixture in the bag.
6. Keep the bag open and carefully mix the contents by squishing it with your fingers. Move and mix the contents all around inside the bag. Once satisfied the contents are mixed, push the air out of the bag and seal it tightly.
7. With the bag sealed, press and squish it to mix the contents even more. By now, there should be some serious heat coming from the bag.

- Research how changing variables can affect this experiment. For example, changing the amount of iron filings or calcium chloride added

- Investigate the rusting process. Salt is a catalyst in the rusting process, so it speeds up the reaction between iron and water. If you leave iron in distilled water, will it still rust at the same rate? If salt speeds up rusting, why do we still put salt on our roads when it snows or is icy?
- Chemical reactions sometimes drastically change the properties of the materials present. Did that happen here? Is iron still present after the rusting chemical reaction occurs? Can you use magnets to collect evidence of this?

<https://www.stevespanglerscience.com/lab/experiments/homemade-hand-warmer/>

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