

How do Hand Warmers Work? Part 1

Two students are outside in the cold, waiting for the bus. One of the students has a package of hand warmers and offers to share them with the other student. The student opens the package and they each put a hand warmer bag in one of their gloves.

After a few minutes, the students notice that the hand warmer bags start to feel warm. The students want to know how hand warmer bags get warm. They decide to ask their science teacher if they can test the materials inside the hand warmer bags. After reading the ingredients on the hand warmer package, the students decide to focus on iron because it is the most common ingredient.

The students designed the following procedure:

1. Open a new hand warmer package.
2. Cut open the hand warmer bag.
3. Separate the materials by using a magnet to attract the iron.
4. Place the iron on a dish.
5. Make initial observations and calculations to record properties of the iron.
6. Leave the iron in the dish overnight.
7. Record final observations and calculations the next day.

Hand Warmer Investigation Data Table

| Property | Initial | Final |
|----------|------------------------|------------------------|
| Color | Gray | Red |
| Texture | Powder | Powder |
| Mass | 21 g | 30 g |
| Volume | 2.67 cm ³ | 5.73 cm ³ |
| Density | 7.87 g/cm ³ | 5.24 g/cm ³ |

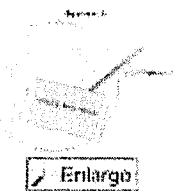
How Do Hand Warmers Work? Part 2

After observing what happens with the iron in the handwarmers, the students decide to work on improving the handwarmers to make them get warm faster. The students observe that the hand warmer bag is made of fabric containing tiny holes. They think that if oxygen is needed to produce heat, maybe only a small amount of oxygen is getting through the fabric.

To test this, the students design an investigation to record the changes in temperature when the hand warmer ingredients are left in the hand warmer bag and when they are taken out of the hand warmer bag. The students set up 2 systems.

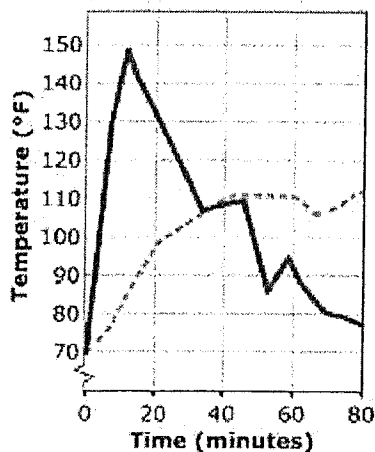
Investigation Plan

1. Open two hand warmer packages. Place one hand warmer bag on a dish labeled System 1.
2. Cut open the other hand warmer bag and pour the materials from inside the bag onto the dish labeled System 2.
3. Place a thermometer under the hand warmer bag in System 1 and a thermometer inside the materials in System 2.
4. Record the temperature of both systems every five minutes until one of the systems nears the starting temperature.



The temperature data from both systems are shown below.

Temperature of System 1 and System 2 Over Time



| Key | |
|-------|----------|
| ----- | System 1 |
| ————— | System 2 |