



# Hot and Cold



## Challenge:

Can you find the combination of chemicals that could be used to make an instant cold pack?

## General Description:

Visitors will combine chemicals in a calorimeter and use a small thermometer to determine if the reaction mixture gets hot or cold.

## Objectives:

To show that many chemical reactions involve heat loss or gain.

To have visitors develop experimental and observational skills as well as draw conclusions from observations.

To show a practical application of simple chemical phenomena.

## Materials:

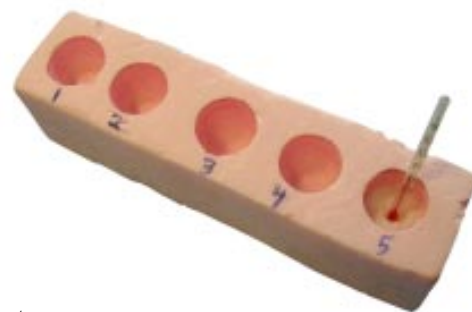
### For 5 stations (1 child per station)

- 5 small non-mercury thermometers
- 2 washing bottles containing vinegar (5% acetic acid)
- 2 washing bottles containing water
- 1 liter water
- 500 ml vinegar
- Baking soda ( $\text{NaHCO}_3$ ), ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), anhydrous calcium chloride ( $\text{CaCl}_2$ ), and potassium chloride (KCl)
- 20 plastic Dixie cups (or small wide mouth container) for solid chemicals
- 20 Popsicle sticks, small plastic spoons, or Beral pipettes
- 5 calorimeter strips (see below)
- Paper towels for spills
- A container of clean water
- A safe container to dump solutions into and seal (waste container)



## Activity Preparation (approx. 35 min.):

1. **Pour about 250 ml each of water and vinegar into washing bottles.**  
Stations will share these wash bottles.
2. **Label cups** (or small wide mouth containers) for the baking soda ( $\text{NaHCO}_3$ ), ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), anhydrous calcium chloride ( $\text{CaCl}_2$ ) and potassium chloride ( $\text{KCl}$ ).
3. **Make calorimeter strips with 4 to 6 wells.**  
The strip is made by from a 2x2x8 inch strip of insulation foam. The wells are made by heating the end of a 22mm diameter glass test tube with a heat gun or hair dryer and pressing it on the foam to melt an inch deep well. These calorimeters are also available from Flinn scientific.
4. **Each station should have:**
  - 1 small thermometer
  - 4 plastic Beral pipettes cut to make scoops , popsicle sticks, or plastic spoons
  - Labeled cups containing
  - 1 foam calorimeter strip.
  - 1 set of 4 cups with solid chemicals.



## Directions:

### Have visitors do the following:

1. Participant **must** wear a pair of safety goggles before beginning!
2. Use the washing bottle to half fill calorimeter wells 1, 2 and 3 with water
3. Use the washing bottle to half fill calorimeter well 4 with vinegar.
4. Put a thermometer into each well.
5. Place a scoop of calcium chloride to well 1 and watch the temperature.
6. Place a scoop of ammonium nitrate to well 2 and watch the temperature.
7. Place a scoop of potassium chloride to well 3 and watch the temperature.
8. Place a scoop of baking soda to well 4 and watch the. Do you see anything else happening?

## Clean Up (approx. 15 min):

- Rinse calorimeter strips and shake dry over a paper towel.
- Wipe up spills with paper towels.
- All used solutions can go down the drain with lots of water.  
Left over solutions can be saved for the next time.
- The unused solid chemicals can be saved until the next time they are needed. Anhydrous ammonium chloride must be tightly closed.
- Clean goggles with window cleaner and white paper towels.
- Disinfect in goggle cabinet for full 15 minutes.

## Safety Issues:

Participant must wear a pair of safety goggles before beginning!

Goggles must be sterilized before use.

Although all of these solutions and chemical solids can go down the drain, they may be irritating. Clean any spills immediately, and wash thoroughly if a visitor gets it on their skin. If solutions get in eyes, flush immediately with clean water.



## Tips For Doing the Activity:

- You may have to explain the workings of a thermometer to young children.  
"If the red line moves up the temperature is getting hotter.  
If the red line moves down the temperature is getting colder."
- An alternate reaction that can be added to this group is to combine 3% hydrogen peroxide with dry yeast.  
When mixed, the solution will get warmer and bubble.

## Expected Results:

Liquid	Solid	Reaction
Vinegar	Baking soda	Gets cold, carbon dioxide generated
Water	Anhydrous calcium chloride	Gets warm
Water	Ammonium nitrate	Gets cold
Water	Potassium chloride	Gets a little colder
3% Hydrogen Peroxide	Dry yeast	Gets warm oxygen gas generated

## Background Information:

### Basic explanation for young children:

Some chemicals give off heat when they combine and others need heat when they combine.

### More in depth explanation for older children:

When chemical reactions occur chemical bonds between atoms are broken and formed. Energy is needed to break old bonds and energy is released when new bonds are formed. If the energy released is greater than the energy needed the temperature of the solution rises. If the energy needed is greater than the energy released the temperature falls.

---

## Credits and Disclaimer



Sciencenter,  
601 First Street,  
Ithaca, NY 14850  
607-272-0600

[www.sciencenter.org/chemistry](http://www.sciencenter.org/chemistry)

**Acknowledgments:** These activities were developed by the Sciencenter with a grant from the Camille and Henry Dreyfus Foundation, Inc.

**Copyright Notice:** All information and images presented in this document are deemed to be the property of the Sciencenter. The content presented here may not be used for commercial purposes without the written consent of the Sciencenter. Permission is granted for personal and educational use only.

**Disclaimer:** Reasonable care has been taken in designing the Chemistry Challenge activities. These activities are intended for use with children and adults under direct supervision of qualified adults.

Anyone using this information must follow all the customary and prudent procedures for the safe storage, preparation, handling, and disposal of any potentially dangerous materials mentioned in this document.

Anyone who uses this information, does so at their own risk and shall be deemed to have indemnified the Sciencenter from any injuries or damages arising from such use.



# Hot and Cold



## Challenge:

Can you find the combination of chemicals that could be used to make an instant cold pack?

Liquid	Solid	Observation
Vinegar	Baking soda	
3% Hydrogen Peroxide	Dry yeast	
Water	Calcium chloride	
Water	Ammonium nitrate	