

# Detecting Temperature Changes

**Overview:** This experiment has two parts. For the first half, you will mix two chemicals that will produce heat and gas. The temperature receptors in your skin will be able to detect the heat. Your ears will detect the gas as it vibrates and escapes its container. In the second portion you will demonstrate a characteristic in a chemical reaction. For this experiment, it will be an endothermic reaction, which is the absorption of heat energy. This type of reaction is easy to notice because it makes things cold to touch. The chemical you will be using, ammonium nitrate, is actually used in emergency cold packs.

Thermoreceptors are the skin receptors that can detect changes in temperature. They're a type of free nerve endings (remember the ones that can sense pain?). Thermoreceptors are located in the dermis, or second layer of skin. Two types of thermoreceptors are cold receptors and warm receptors. They're found all over the body, but cold receptors being more prevalent. You have lots of these around our face, which is why it feels cold so quickly. Scarves and ear muffs are a good way to lessen the impact of our cold receptors!

## Materials

- measuring cup
- calcium chloride
- ammonium nitrate
- baggies (2, re-sealable)
- water

## Experiment

1. Put about  $\frac{1}{2}$  cup of warm water in one of the baggies.
2. Add about a third of an ounce of calcium chloride to the water. Close the baggie and start to roll around the pellets with your fingers. As they start to dissolve, the chemical also starts to increase the temperature of the water.
3. Now dispose of these ingredients down the drain. Flush with lots of running water.
4. Open the ammonium nitrate and fill its cap with pellets. Put these in the second baggie.
5. Start to pinch the ammonium nitrate through the plastic bag and check for a temperature change. Does anything happen in the absence of water?
6. Now put a small amount of water (about room temperature) into the bag. Fill it about  $\frac{1}{4}$  of the way full.
7. Hold the bottom of the bag with both hands and begin to rock it back and forth a bit. This should start to dissolve the pellets. With your hands on the water, you should start to note a temperature decrease. If this doesn't work, roll the pellets around as you did with the calcium chloride.
8. When you are finished, you can pour the contents out on to a brown spot of grass (because ammonium nitrate is a main ingredient in many fertilizers). Or if you would prefer, just empty the contents down the drain.

## Detecting Temperature Changes Data Table

Chemical	Observations: What happens when added to water?

### Reading

Thermoreceptors are the skin receptors that can detect changes in temperature. They're a type of free nerve endings (remember the ones that can sense pain?). Thermoreceptors are located in the dermis, or second layer of skin. Two types of thermoreceptors are cold receptors and warm receptors. They're found all over the body, with cold receptors being more prevalent. You have lots of these around your face, which is why it feels cold so quickly. Scarves and ear muffs are a good way to lessen the impact of our cold receptors!

Your skin has many other parts in addition to its receptors, and many play a role in temperature regulation. Some examples of these include hair, blood vessels, and sweat glands. Blood vessels and sweat glands respond to heat and cold, helping to control your body's temperature. You are probably familiar with how sweat glands help to cool you down (evaporation), but how about blood vessels? As an example, if you run around outside on a hot day, your cheeks get red because the blood vessels on your skin's surface have dilated, which brings more blood to the surface and allows the body to cool its insides a bit.

Calcium chloride splits into calcium ions and chloride ions when it is mixed with water. As this occurs, energy is released in the form of heat. This is the same heat energy you felt when holding the baggie and rubbing the pellets. Adding ammonium nitrate to water causes both its ammonium and nitrate ions to dissolve, which results in heat absorption as ionic bonds are broken. This is an endothermic reaction.

### Exercises

1. Which chemical when mixed with water was an endothermic (absorbed heat and felt cold) reaction?
2. Which chemical resulted in an exothermic reaction (gave off heat)? Why does this happen?
3. What are ways that the human body can detect temperature?

**Answers to Exercises: Detecting Temperature Changes**

1. Which chemical when mixed with water was an endothermic (absorbed heat and felt cold) reaction? (Adding ammonium nitrate to water causes both its ammonium and nitrate ions to dissolve, which results in heat absorption as ionic bonds are broken. This is an endothermic reaction.)
2. Which chemical resulted in an exothermic reaction (gave off heat)? Why does this happen? (Calcium chloride splits into calcium ions and chloride ions when it is mixed with water. As this occurs, energy is released in the form of heat.)
3. What are ways that the human body can detect temperature? (Thermoreceptors are the nerve endings in our skin that detect changes in temperature. They're located in the dermis, or second layer of skin, and we have both cold receptors and warm receptors.)