Sensing Temperature

Overview: Have you ever wondered how an ice-cold glass of water gets water drops on the *outside* of the cup? It's all about temperature change! You will see how a temperature difference can fool your fingers in today's hot and cold experiment.

What to Learn: You will understand why condensation occurs and feel how skin can detect a temperature difference, but not an exact temperature.

Materials

- cup of hot water
- cup of cold water
- cup of room-temperature water

Experiment

1. Place one finger from one hand in the hot (not scalding) water. Place a finger from your other hand in the ice-cold water. Leave them there for a moment.
2. At the same time, take both fingers and place them in the room-temperature water. What do you feel?
3. Complete the data table.

Sensing Temperature Data Table

What do your fingers feel? Write your observations here!

Right Hand Finger	Left Hand Finger	Observations

Reading

Have you ever wondered how an ice-cold glass of water gets water drops on the *outside* of the cup? Where does that water come from? Does it ease its way through the glass? Did someone come by and squirt the glass with water? No, of course not. Some of the gaseous water molecules in the air came close enough to the cold glass to lose

some molecular speed. Since they lost speed, they formed bonds between each other and liquefied. They condensed on the cold surface of the glass.

Imagine, though, if you will, that you live several hundred years ago and the process of condensation wasn't understood. You happen to be an inquisitive, highly perceptive, person (which of course you are) and you notice this film of water showing up on cold things. Water appearing out of apparently nowhere! You'd be pretty amazed, wouldn't you?!?

Isn't it amazing that every time you pick up a cold can of soda there are molecular interactions happening right in front of your eyes! This is why science is so wonderful. It provides the skills to see these amazing things and the skills to investigate and perhaps understand them.

The skin contains temperature sensors that work by detecting the direction heat flows in or out of the body, but not temperature directly. These sensors change temperature depending on their surroundings. When one finger is heated up then placed in water at room temperature, the heat flows out of the body. The brain gets a message saying the finger is cooler. A finger placed in ice water followed by room temperature water tells the brain it was detecting a heat flow into your body… and presto! You have one confused brain.

In order for heat to flow, there must be a temperature difference. But why then do the metal legs of a table feel colder than the wood tabletop when both are at the same room temperature? The metal will feel colder because heat flows away from your skin faster into the metal than the wood. We'll talk about heat capacity in a later experiment, but this is why scientists had to invent the thermometer: The human body isn't designed to detect temperature, only heat flow.

Exercises

1. How did the hot finger feel when it was placed into the room-temperature water?

2. How did the cold finger feel when it was placed into the room-temperature water?

3. Based on your observations, what can you infer about how a skin detects temperature?

4. After taking a hot shower, a student noticed something interesting. When she put on her glasses and went into the hallway, her glasses fogged up with tiny droplets of water. What was happening?

Answers to Exercises

1. How did the hot finger feel when it was placed into the room-temperature water? (cold)
2. How did the cold finger feel when it was placed into the room-temperature water? (hot)
3. Based on your observations, what can you infer about how a skin detects temperature? (The skin detects temperature change but not the actual temperature.)
4. After taking a hot shower, a student noticed something interesting. When she put on her glasses and went into the hallway, her glasses fogged up with tiny droplets of water. What was happening? (When she took her warm glasses into the colder hallway, the air around her glasses cooled off, causing the air to change to drops of liquid water.)