

# Does Hot Water Freeze Faster Than Cold Water?

Have you ever refilled the ice cube tray in your freezer after using the last ice cube in your cup of juice? You probably automatically poured cold water in the ice cube tray without asking the question, "Does hot water freeze faster than cold water?"

It makes sense to believe that cold water would turn to ice before hot water because the hot water would need to cool first before it could freeze; but how do you know if that idea is correct? Test this **theory**—untested idea—will tell you whether cold water actually freezes faster than hot water.

## Problem:

Does temperature affect how quickly water freezes?

## Materials:

- Freezer
- 3 bowls of equal size and shape
- Sticky labels
- Marker
- Water
- Measuring cup
- Thermometer
- Notebook
- Pencil

## Procedure:

1. Clear enough room in your freezer for the three bowls. You need to be able to put them in the freezer at exactly the same time, so you don't want to be moving your frozen food and drinks around later.
2. Think about what you know about ice. What temperature is water right before it freezes? You probably usually take baths in warm water. How quickly does the water turn cold when you're in the tub?
3. After considering different temperatures of water and ice, make a guess—called a **hypothesis**—answering the question: Does hot water freeze faster than cold water?
4. Write your hypothesis in your notebook, including whether you think the hot, warm, or cold water would freeze first and *why*.
5. Using your marker, write Hot on one of your sticky labels. Repeat with labels for Warm and Cold.
6. Place the sticky labels on each of the three bowls, using one per bowl. The labels will help you keep track of which bowl holds which temperature of water.
7. With your pencil, draw three columns in your notebook. Label the first column Hot, the second one Warm and the third Cold.
8. With the help of an adult, heat 1 cup of water to 100 degrees Fahrenheit. Pour it into the Hot bowl, being careful not to burn yourself.
9. Heat 1 cup of water to 70 degrees Fahrenheit, and pour it into the Warm bowl.
10. Fill the Cold bowl with water that's 40 degrees Fahrenheit.
11. Immediately place all three bowls in the freezer.
12. Record the starting temperatures in the correct columns of your notebook.
13. Open the freezer door every 10 minutes and take the temperature of the water in each bowl with a



thermometer. Record the temperature in your notebook.

14. Repeat Step 13 until all three bowls have frozen over.

15. Compare the information in each of the three columns in your notebook. Was your hypothesis correct?

## Results:

The bowls that contain the hot and warm water will freeze faster than the bowl that is filled with cold water.

## Why?

Hot water freezing more quickly than cold water is known as the *Mpemba effect*. So, why does the Mpemba effect occur?

First, all water **evaporates**, which means that the liquid (water) "disappears" and becomes a **vapor**, or gas. Hot water evaporates at a much faster rate than cold water. This means that the bowl with hot water actually had less water than the bowl with cold water, which helped it freeze more quickly.

Second, **convection** (the transfer of heat within the water as it moves around) plays a part in helping hot water freeze more quickly than the bowl of cold water. The hot water has more convection currents than cold water, causing it to cool down much more quickly. That's why your bath water always seems to get cold much faster than you'd like!

Now that you know about freezing water at different temperatures, keep the science going by testing other liquids, such as milk or apple juice. Will warm milk freeze faster than cold milk? Or, switch up the project altogether! Does milk freeze faster than water at the same temperature? Science is all about guessing what will happen, then testing to see if you're right. You now know that hot water freezes faster than cold water, so brainstorm a new project that you're interested in. By constantly changing your experiments, you'll continue learning new things—and become a science whiz!