# Thermometers and Their Use

Measurement Lab Activities

## Introduction

How is a thermometer calibrated? What does 100 °C really mean? In this activity, a blank thermometer will be calibrated.

## Concepts

- Calibration
- Temperature

## Materials

Beakers, borosilicate glass, 500-mL, 3
Hot plate or Bunsen burner setup
Ice
Marking pencil, wax
Paper, 8½″ × 14″
Pencil
Ruler, metric
Thermometer, blank, spirit-filled
Thermometer, standard (for comparison)
Water (distilled or deionized is preferred)

## *Safety Precautions*

*Exercise caution when using the hot plate or Bunsen burner. Wear chemical splash goggles and heat-resistant gloves, or use a hot vessel gripping device to handle the boiling water bath. Wash hands thoroughly with soap and water before leaving the laboratory.*

## Preparation

1. Prepare a beaker of boiling water using a hot plate or Bunsen burner setup.
2. Prepare a beaker of ice water. Be sure that both ice and water are present.
3. Prepare a beaker of water at room temperature.

## Procedure

### Part A. Calibrating the Thermometer

1. Immerse the blank, spirit-filled thermometer in the boiling water bath. Allow the liquid level in the thermometer to stabilize (about 1–2 minutes).
2. Using a wax marking pencil, make a thin-lined mark on the thermometer at the height of the liquid in the thermometer when immersed in the boiling water. (*Note:* The thinner the line, the better.)
3. Remove the thermometer from the boiling water and immerse it in the ice-water bath. Allow the liquid level in the thermometer to stabilize for 1–2 minutes.
4. Using a wax marking pencil, make a mark on the thermometer to show the height of the liquid in the thermometer when immersed in the ice-water bath.
5. Remove the thermometer from the water and carefully dry it off. Be sure not to rub off the marks.
6. Lay the thermometer onto an 8½″ × 14″ piece of paper and trace its outline with a pencil. Mark the ice water mark and the boiling water mark on the paper. Label these appropriately as 0 °C (freezing point) and 100 °C (boiling point), respectively.
7. Use a ruler to divide the space between the two marks on the paper into 10 equal-sized spaces, labeling 10 °C, 20 °C, etc. This sheet of paper will be called your "paper thermometer."
8. Divide each 10-degree segment into 10 equal-sized spaces. Make a mark for each space, which will equal 1 °C. *Note:* Do not label each degree 10, 11, 12, etc. Your thermometer is now calibrated and ready for use.



Publication No. 91530
061616

**Part B. Using the Thermometer**

9. Use the blank, spirit-filled thermometer to measure the temperature of a beaker of room temperature water. Make a wax pencil mark at the height of the liquid in the thermometer.
10. Use your "paper thermometer" (via comparison) to determine the temperature of the room temperature water. Record this temperature.
11. Measure the temperature of the room temperature water using a commercially calibrated thermometer. Compare your "paper thermometer" reading to the commercial thermometer reading. How do they compare? How accurate is your home-made calibrated thermometer? Try measuring the temperature of other solutions or materials (i.e., your palm, outside temperature, refrigerator temperature). How are the marks on a commercial thermometer determined? Can a blank thermometer be calibrated by setting it side-by-side to a commercial thermometer with markings? Why or why not?

## Tips

- Distilled or deionized water will give more accurate results than tap water.
- Consider providing this exercise as an open-ended lab experiment. Give each lab group a blank thermometer. Have each lab group brainstorm ideas for how they could calibrate the blank thermometer, using whatever lab procedures and lab equipment are necessary. Have them write the step-by-step procedure that they would follow, and make sure that it is written clearly enough for any other lab group to follow.
- A Metric Lesson—Consider having some groups calibrate their thermometer in °F. Discuss which scale is easier to use.

## Discussion

The *Celsius scale* is the most commonly used temperature scale for scientific work. The scale was originally devised in 1742 by Anders Celsius, a Swedish astronomer. The original name was the centigrade scale, referring to a scale divided into a hundred steps, or degrees. On the Celsius scale, the freezing point of water is defined as 0 °C and the boiling point of water is 100 °C. The interval between these fixed points is divided into 100 equal parts. Divisions below 0 °C are negative quantities and are used to measure temperatures below the freezing point of water. Divisions above 100 °C are used to measure temperatures greater than the boiling point of water.

## Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

***Unifying Concepts and Processes: Grades K–12***
Constancy, change, and measurement
***Content Standards: Grades 9–12***
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, interactions of energy and matter
Content Standard G: History and Nature of Science, nature of scientific knowledge

## Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Thermometers and Their Use* activity, presented by Irwin Talesnick, is available in *Measurement Lab Activities* and in *Temperature and Heat*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

## Materials for *Thermometers and Their Use* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Make Your Own Celsius Thermometer—An Exercise in Calibration* available from Flinn Scientific. Materials may also be purchased separately.

| Catalog No. | Description |
|---|---|
| AP2263 | Make Your Own Celsius Thermometer—An Exercise in Calibration |
| AP2263 | Thermometer, Blank, Spirit-Filled |
| GP1030 | Beaker, Borosilicate Glass, 600 mL |
| AP7234 | Hot Plate, Flinn, 7″ × 7″ |
| SE039 | Hot Vessel Gripping Device |

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.