

# Temperature Scales

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ENVIRONMENTAL CHEMISTRY

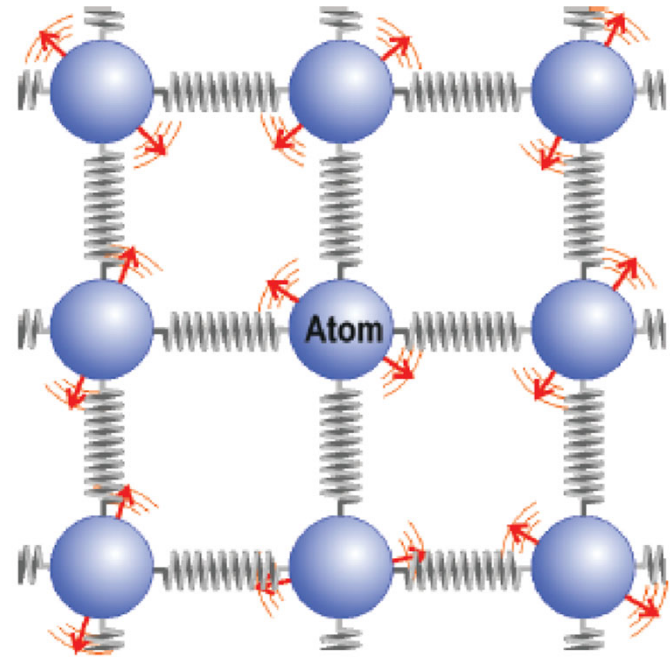
# What Temperature really is

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**Atoms** and **molecules** are in **constant motion**, even in a solid object.

The back-and-forth jiggling of atoms is caused by *thermal energy*, which is a kind of **kinetic energy**.

**Temperature** is a measure of this kinetic energy.



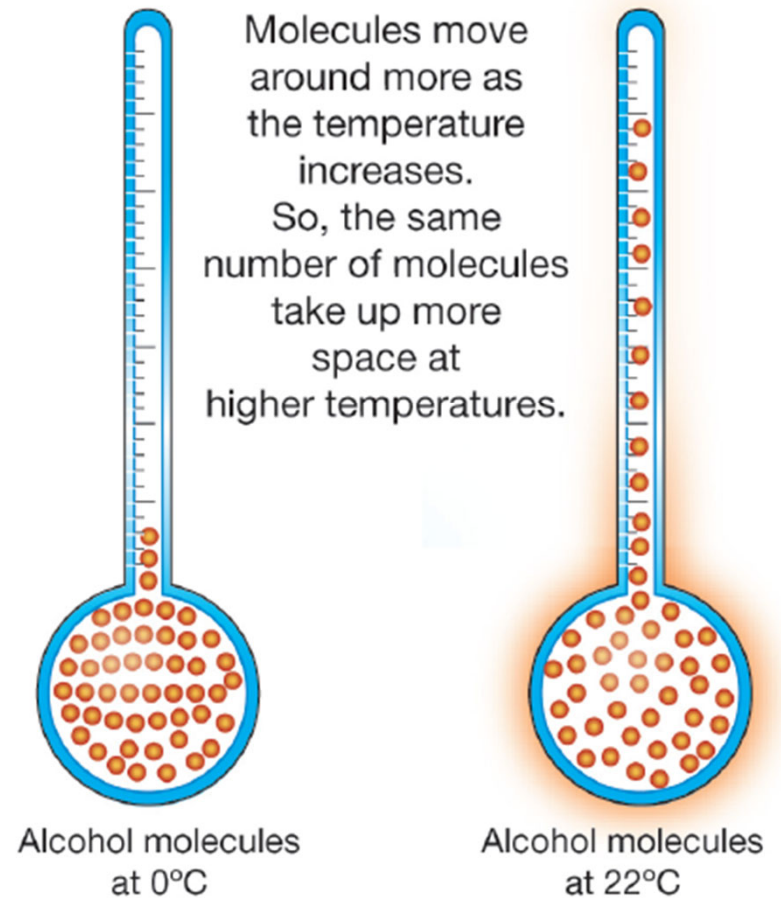
# How a thermometer works

The volume of alcohol in a thermometer contains large numbers of alcohol molecules.

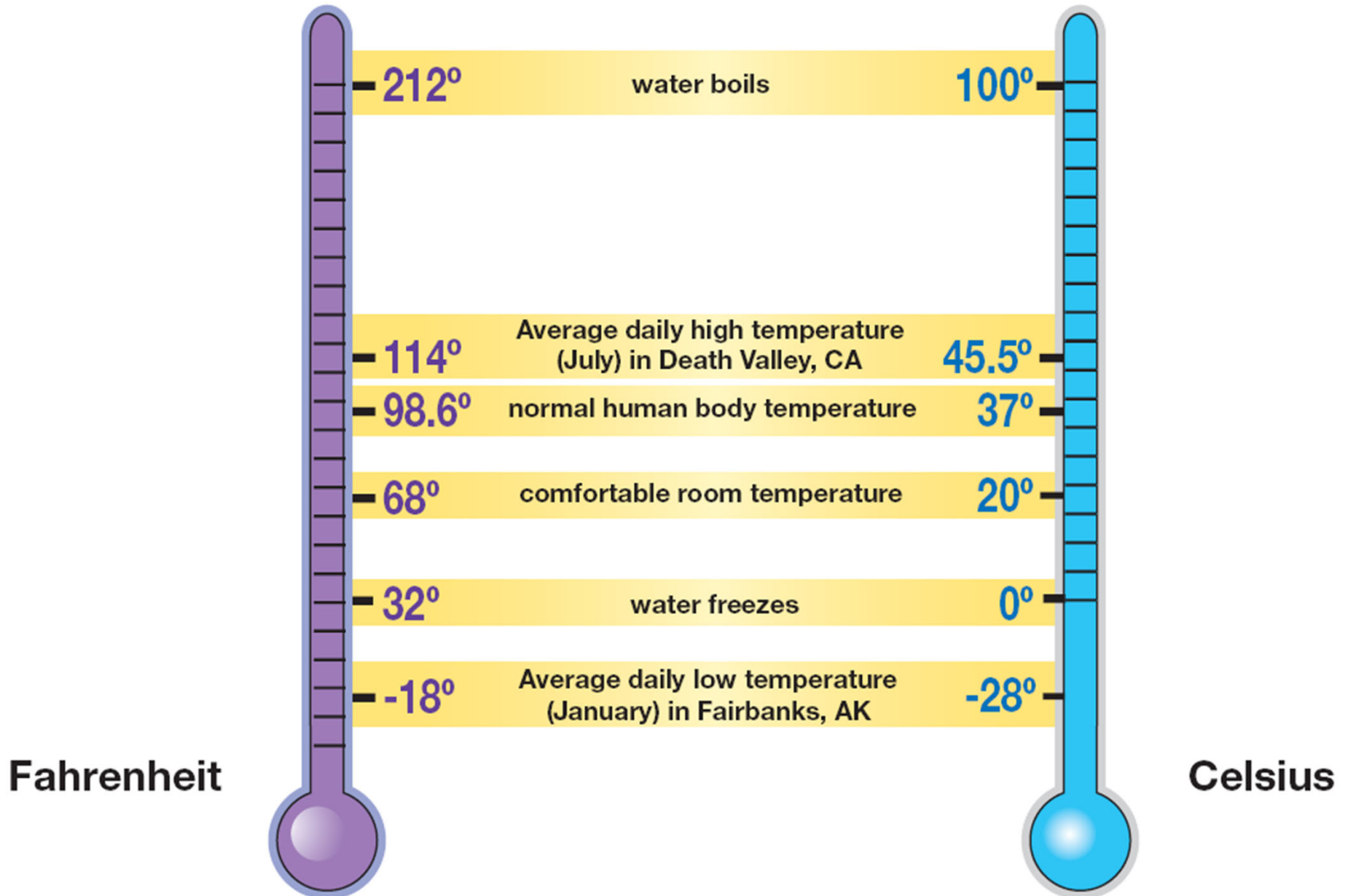
As **temperature increases**, the alcohol **molecules move faster**.

The liquid alcohol volume expands and takes up more space in the thermometer.

## How a Thermometer Works



# Celsius and Fahrenheit



# Absolute Zero

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*Absolute zero* is  $-273.15^{\circ}\text{C}$ .

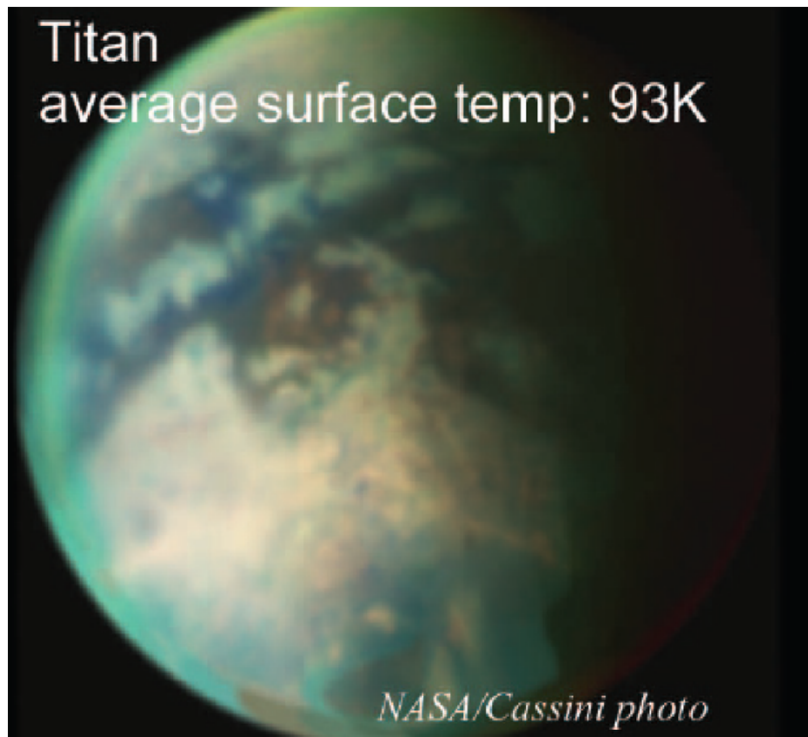
You cannot have a temperature lower than absolute zero.

Think of absolute zero as the temperature at which atoms are “frozen.”



# Converting from Celsius to Kelvin

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The *Kelvin* temperature scale is useful in science because it starts at absolute zero.

To convert from Celsius to Kelvin, you add 273 to the temperature in Celsius.

# Commonly Used Temperatures (for Water)

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	<b>Freezing Temp.</b>	<b>Vaporization Temp. (Boiling Point)</b>
Celsius	0	100
Fahrenheit	32	212
Kelvin	273.15	373.15

# Conversions

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How do we mathematically convert from Celsius to Kelvin?

Kelvin to Celsius?

Celsius to Fahrenheit?

Fahrenheit to Celsius?

You will be provided with formulas, but you need to know how/when to use them



# Let's Practice!

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# Sample Conversion Problem

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A friend in Paris sends you a recipe for a cake. The French recipe says to bake the cake at a temperature of  $200^{\circ}\text{C}$  for 45 minutes.

At what temperature should you set your oven, which uses the Fahrenheit scale?



# Sample Conversion Problem

1. Looking for:
    - ...temperature in degrees Fahrenheit
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2. Given:
  - ...temperature 200 °C

3. Equation: Celsius to Fahrenheit
  - $F = (C \times 1.8) + 32$

4. Solution
  - $F = (200 \times 1.8) + 32 =$
  - $= (362) + 32 = 392^{\circ}\text{F}$

# Measuring temperature

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Some *digital thermometers* sense temperature by measuring the resistance of electrons passing through wire.



# Liquid-crystal thermometers

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Some thermometers contain liquid crystals that change color based on temperature.

As temperature increases, the molecules of the liquid crystal bump into each other more and more.

This causes a change in the structure of the crystals, which in turn affects their color.

