Chapter Eight: Matter and Temperature

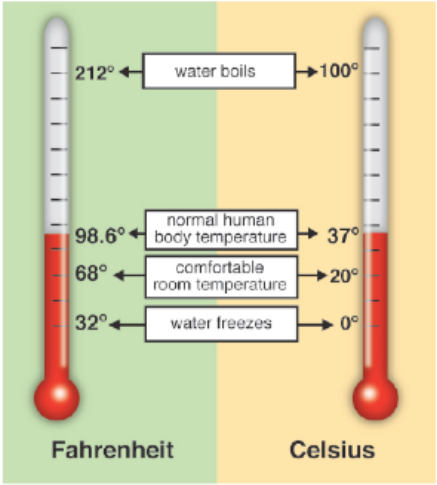
- 8.1 The Nature of Matter
- 8.2 Temperature
- 8.3 The Phases of Matter

Chapter 8.2 Learning Goals

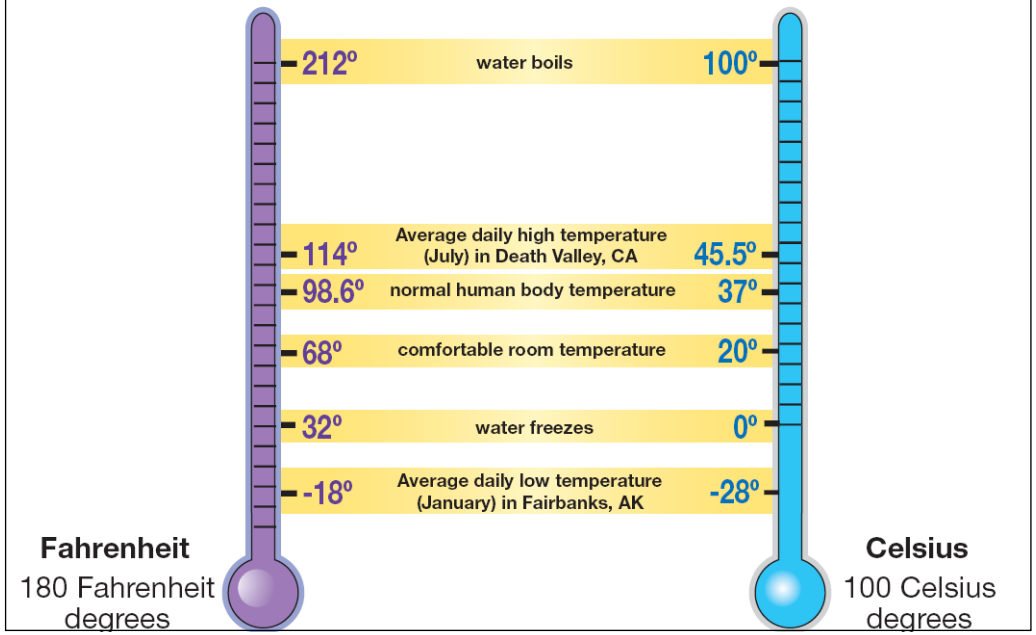
- Define temperature in terms of the motion of atoms and molecules.
- Convert among Fahrenheit, Celsius, and Kelvin scales.
- Describe the relationship between thermal energy and temperature.

8.2 Temperature

- There are two common temperature scales.
- On the Fahrenheit scale, water freezes at 32 degrees and boils at 212 degrees.
- The Celsius scale divides the interval between the freezing and boiling points of water into 100 degrees.



Celsius and Fahrenheit Temperature Scales



Solving Problems: Temperature Conversions

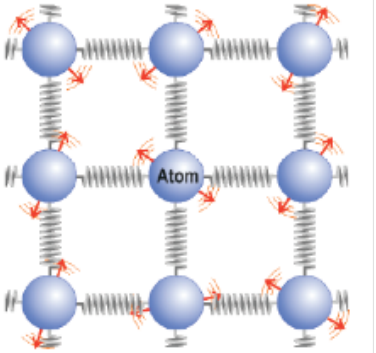
CONVERTING BETWEEN FAHRENHEIT AND CELSIUS

$$T_{Fahrenheit} = \frac{9}{5} T_{Celsius} + 32$$

$$T_{Celsius} = \frac{5}{9} (T_{Fahrenheit} - 32)$$

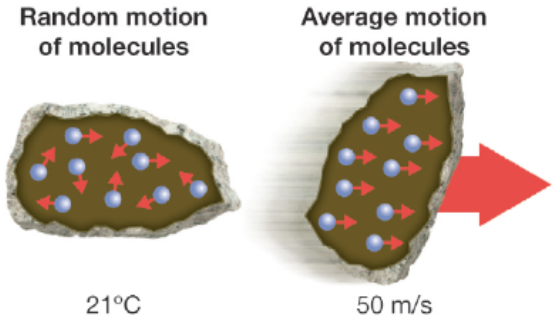
8.2 What temperature really is

- Atoms 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.



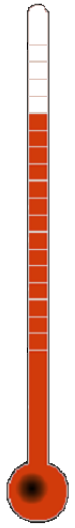
8.2 What temperature really is

- Temperature measures the kinetic energy per molecule due to random motion.



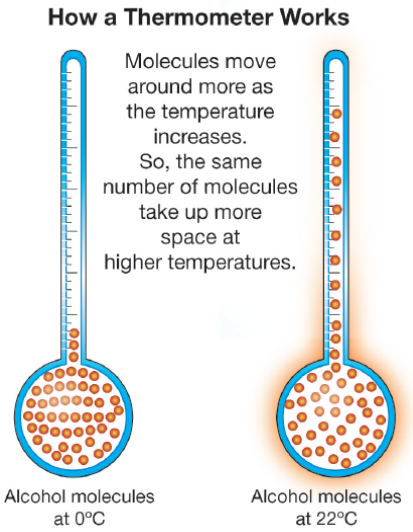
8.2 Thermometers

- A thermometer is an instrument that measures the exact temperature.
- Most thermometers contain either a silvery fluid (mercury) or a red fluid, which is alcohol containing a small amount of red dye.



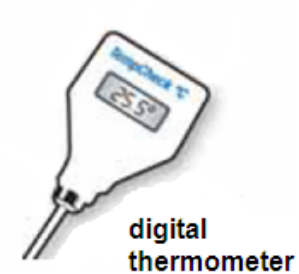
8.2 How a thermometer works

- The volume of alcohol in a thermometer contains huge numbers of alcohol molecules.
- As temperature increases, the alcohol molecules move faster and bounce off each other.
- The liquid alcohol expands and takes up more space in the thermometer.



8.2 Measuring temperature

- A thermistor is a device that changes its electrical resistance as the temperature changes.
- Some digital thermometers sense temperature by measuring the resistance of electrons passing through wire.



digital thermometer

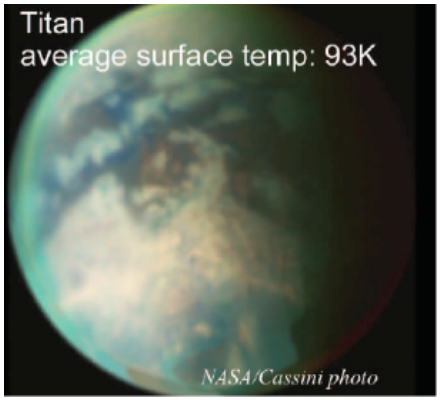
8.2 Liquid-crystal thermometers

- 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.

8.2 Absolute zero

- Absolute zero is –273°C.
- You cannot have a temperature lower than absolute zero.
- Think of absolute zero as the temperature at which atoms are “frozen.”

8.2 Converting to Kelvin



- 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.