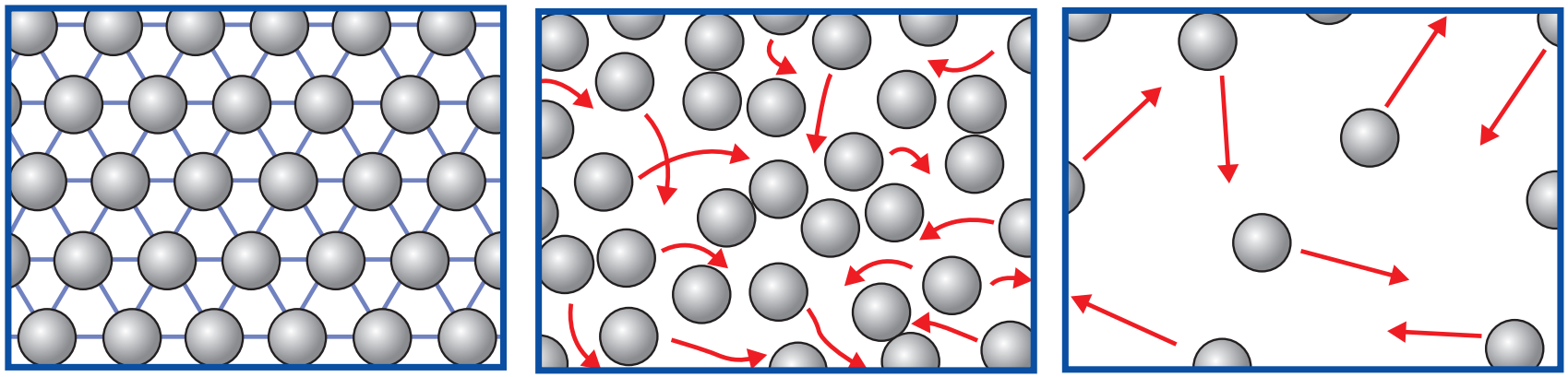
Atoms in a Solid, Liquid, and Gas



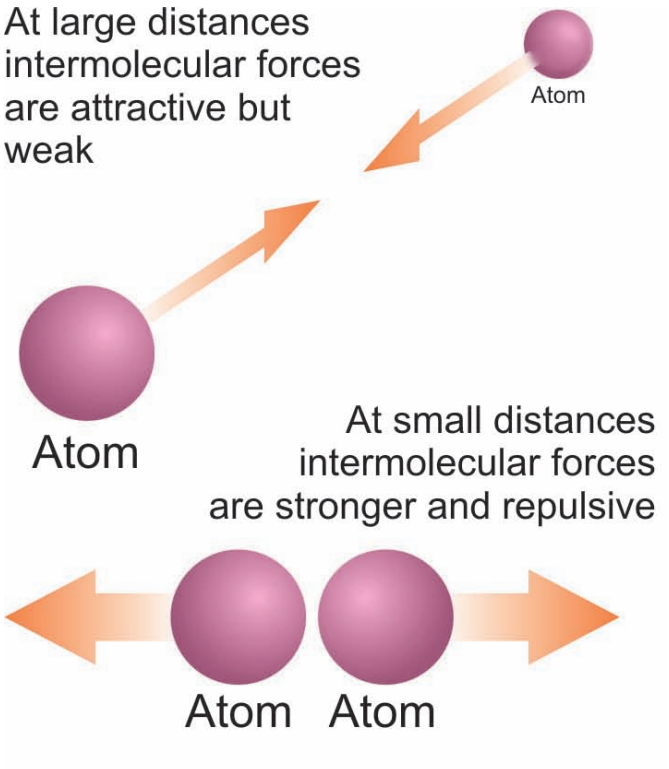
Solid Liquid Gas

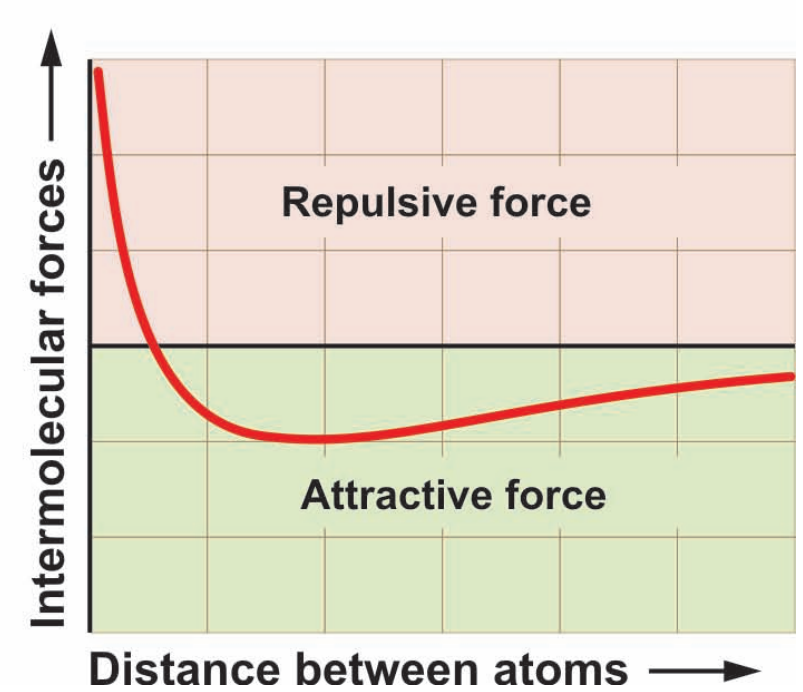
Converting Between Fahrenheit and Celsius

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

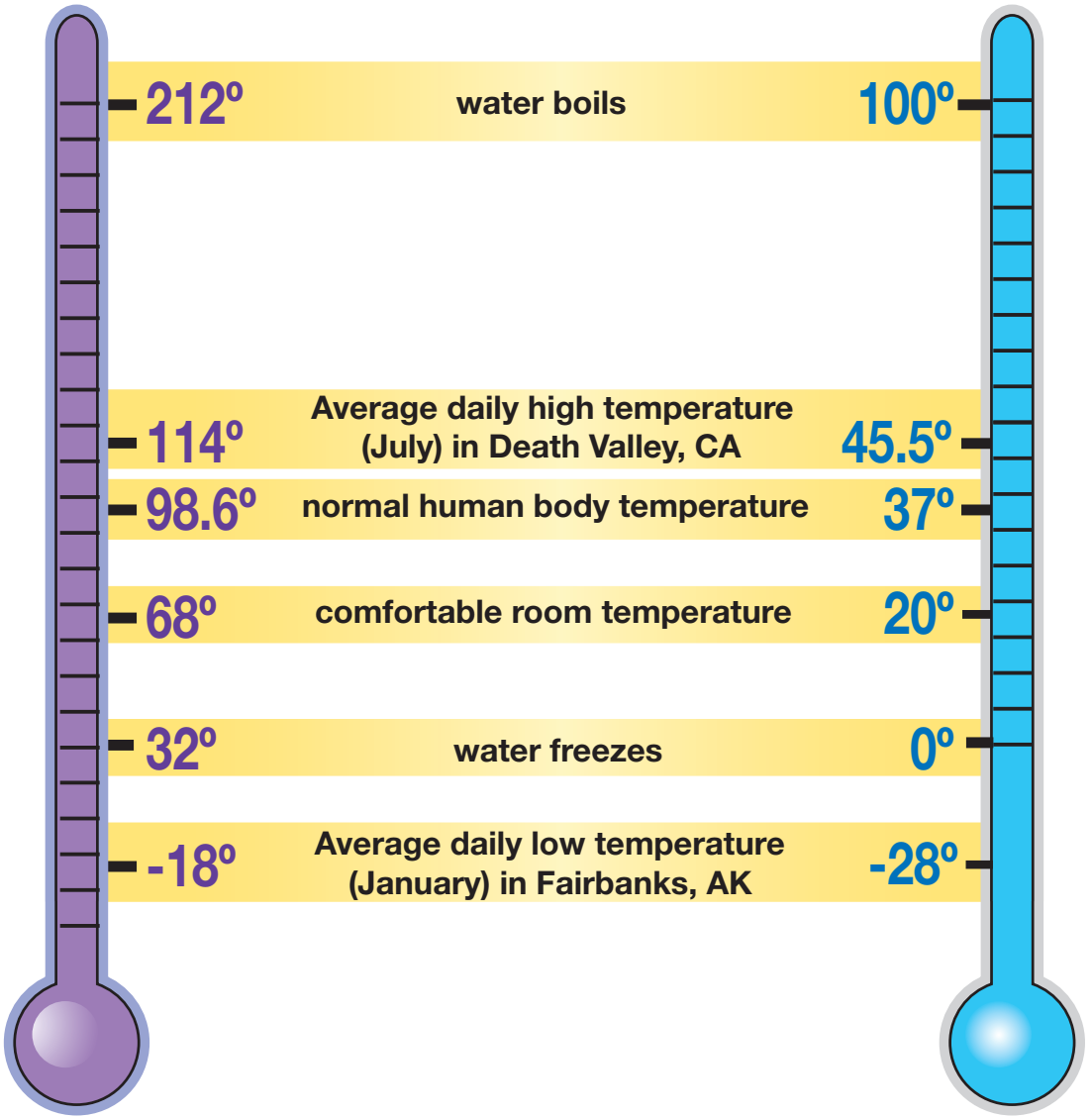
$$T_{Celsius} = \frac{5}{9} (T_{Fahrenheit} - 32)$$

Intermolecular Forces





Celsius and Fahrenheit Temperature Scales



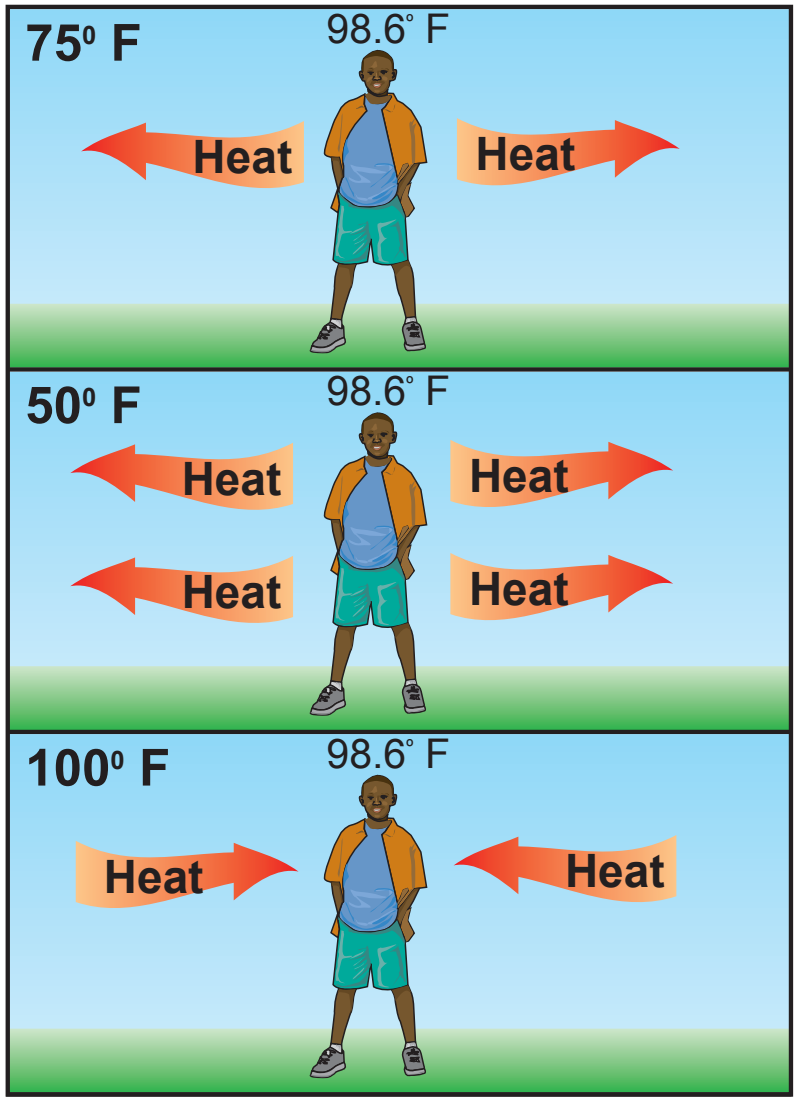
Fahrenheit

180 Fahrenheit degrees

Celsius

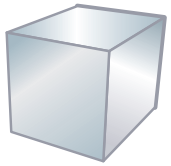
100 Celsius degrees

Heat Transfer

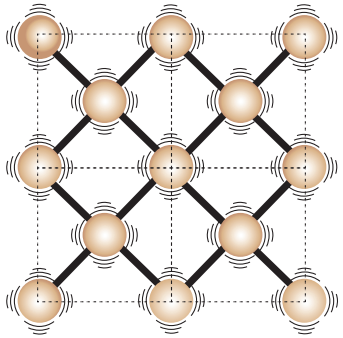


Heat flow depends on temperature differences.

Specific Heat
Comparing Silver and Aluminum



1 kilogram



Silver

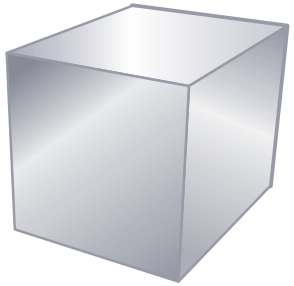
Specific heat: 235 J/kg°C

*Heavier atoms mean **fewer** atoms per kilogram*

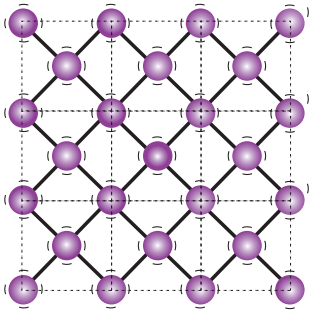
Energy is spread over **fewer** atoms

More energy per atom

Higher temperature gain per joule (lower specific heat)



1 kilogram



Aluminum

Specific heat: 900 J/kg°C

*Lighter atoms mean **more** atoms per kilogram*

Energy is spread over **more** atoms

Less energy per atom

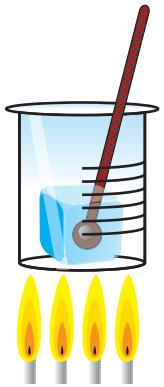
Lower temperature gain per joule (higher specific heat)

Specific Heat Values of Common Materials

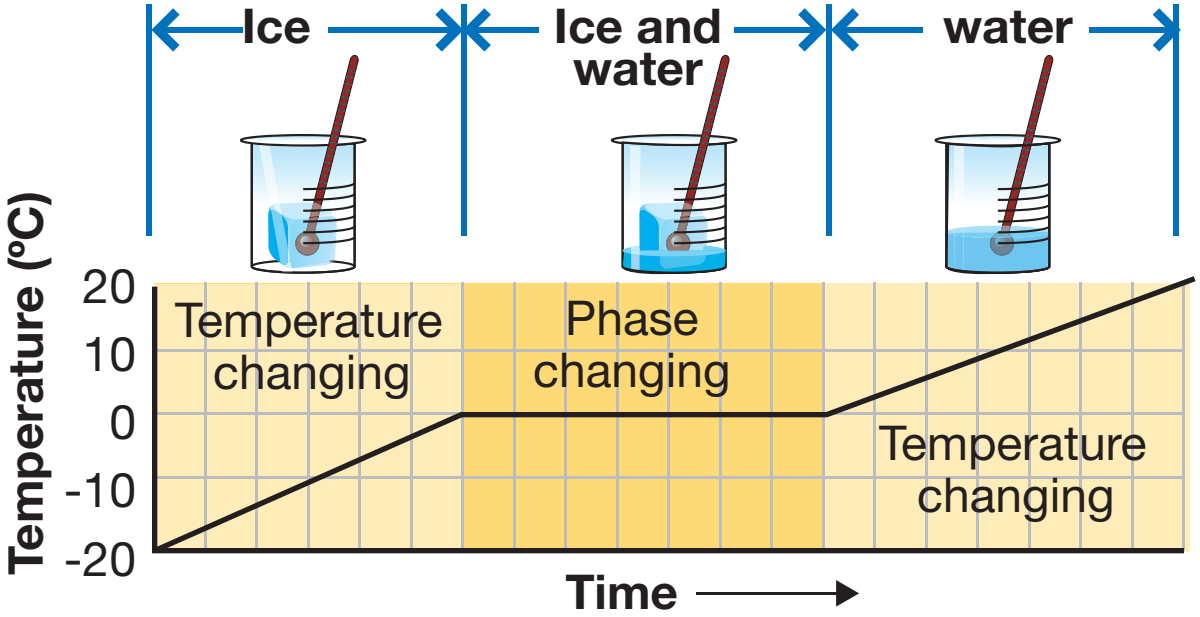
Material	**Specific heat** (J/kg°C)
water	4,184
aluminum	900
steel	470
oil	1,900
concrete	880
glass	800
wood	2,500

Temperature and Time Graph

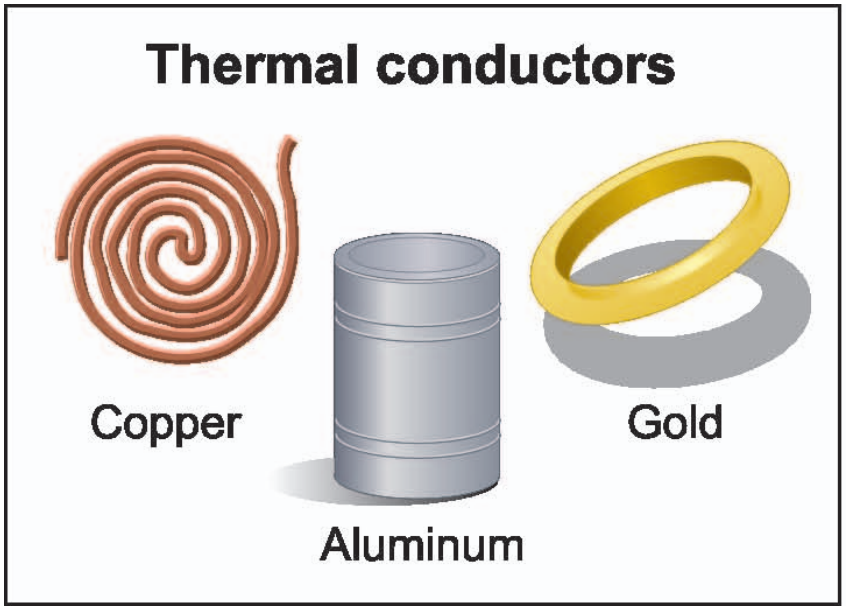
Start with ice at -20°C

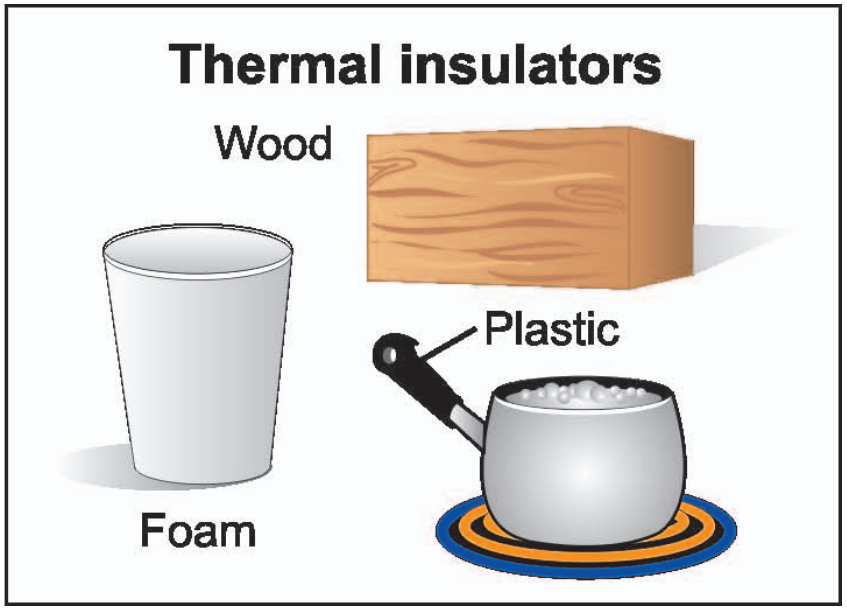


Add heat energy at a constant rate.

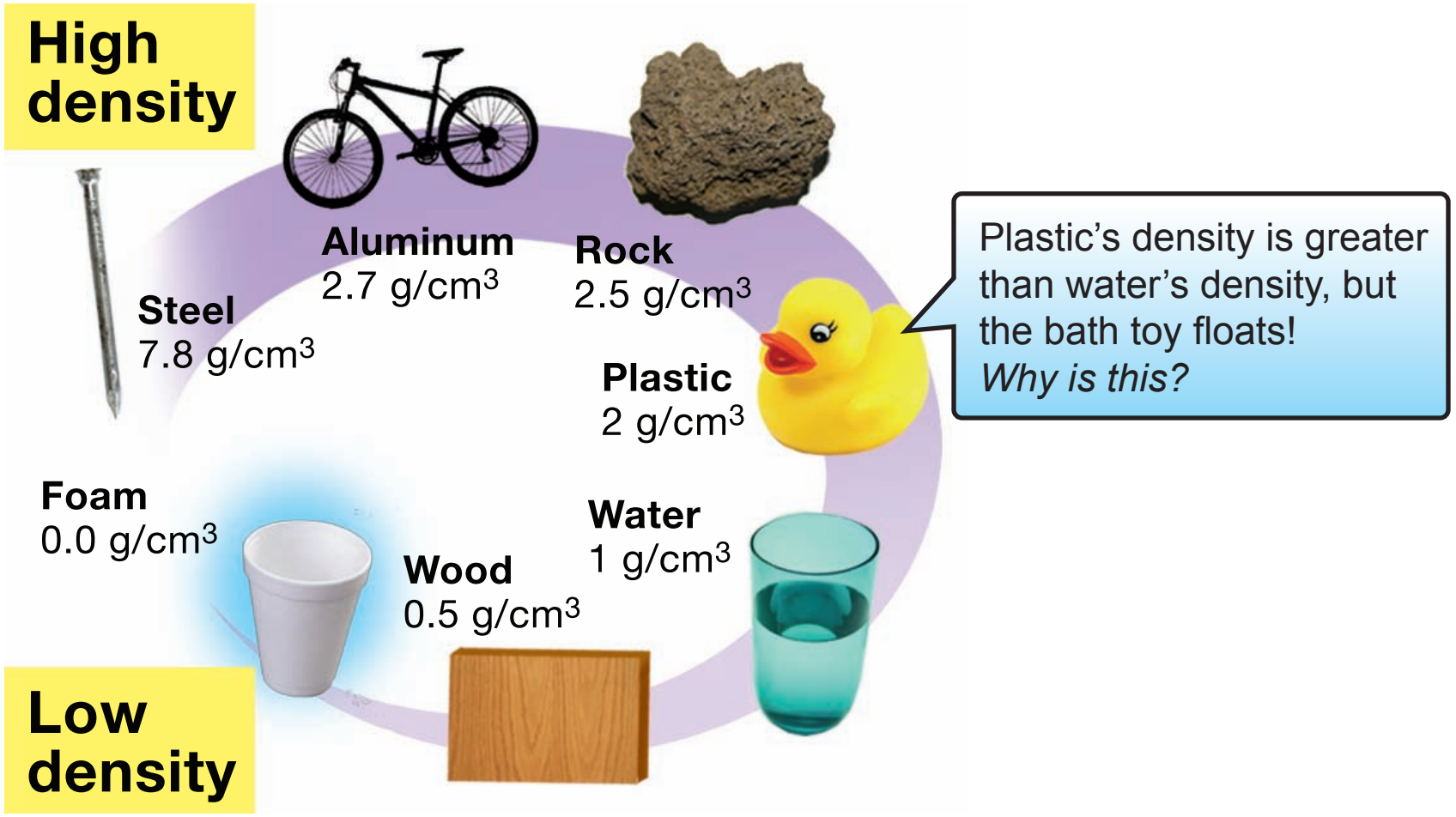


Thermal Conductors and Insulators





Density Range of Common Materials



Solving Density Problems

DENSITY

Density (kg/m^3 **or** g/cm^3) → $D = \frac{m}{V}$ ← *Mass* (kg **or** g)

V ← *Volume* (m^3 **or** cm^3)

Average Density Explanation

Average density is the total
mass divided by the total volume.

Solid steel ball
volume = 25 ml
mass = 195 g

$$\text{Avg. density} = \frac{195\ \text{g}}{25\ \text{ml}}$$

Avg. density = 7.8 g/ml
SINKS!

Hollow steel ball
volume = 25 ml
mass = 20 g

$$\text{Avg. density} = \frac{20\ \text{g}}{25\ \text{ml}}$$

Avg. density = 0.8 g/ml
FLOATS!

Example of Buoyant Force