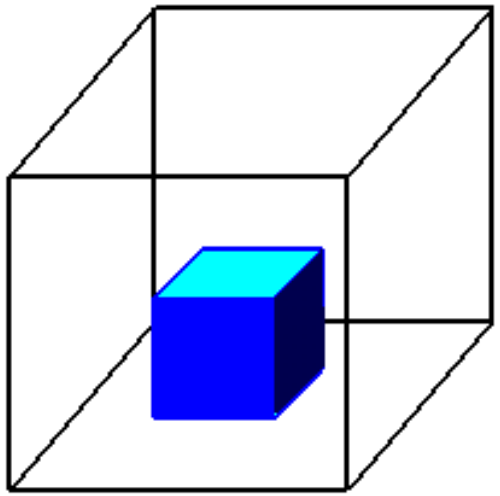
Temperature, Heat and Thermal Energy

10.2 and 11.1

Review

States of Matter

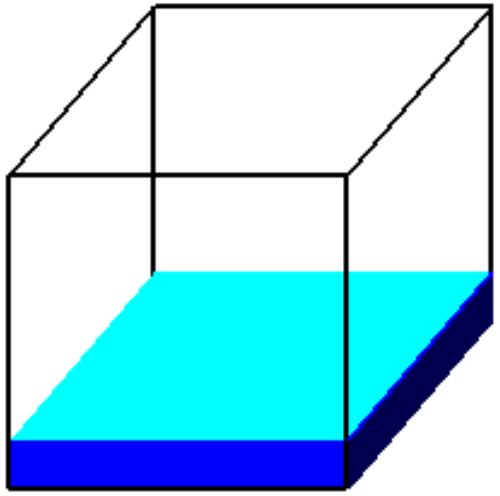
Glenn Research Center



Solid

Holds Shape

Fixed Volume

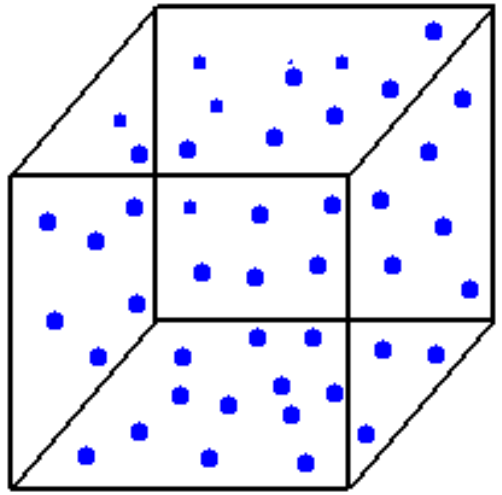


Liquid

Shape of Container

Free Surface

Fixed Volume



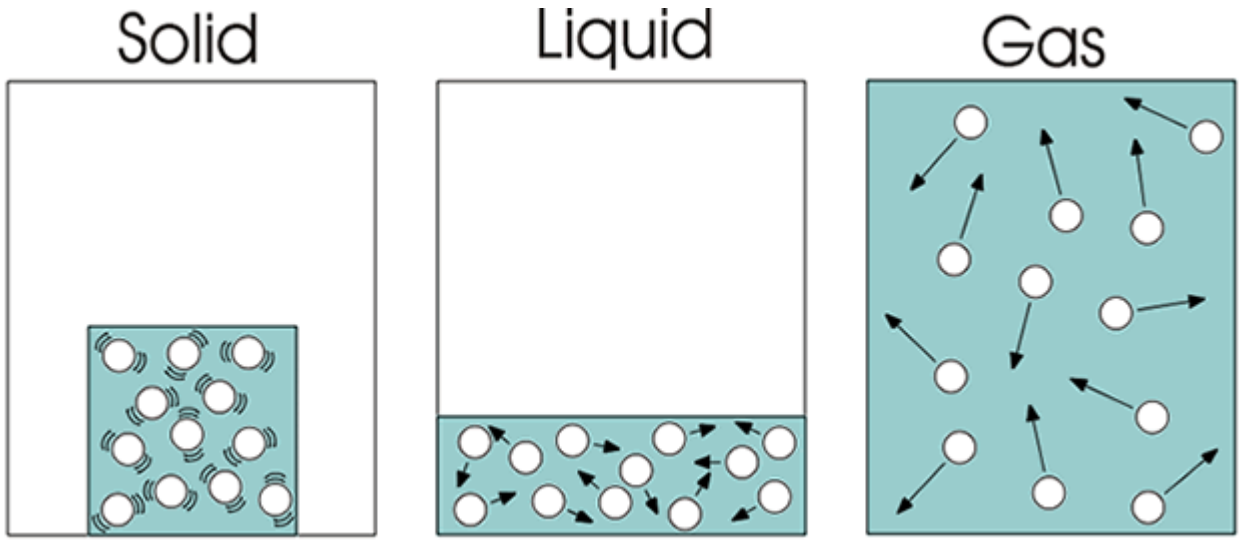
Gas

Shape of Container

Volume of Container

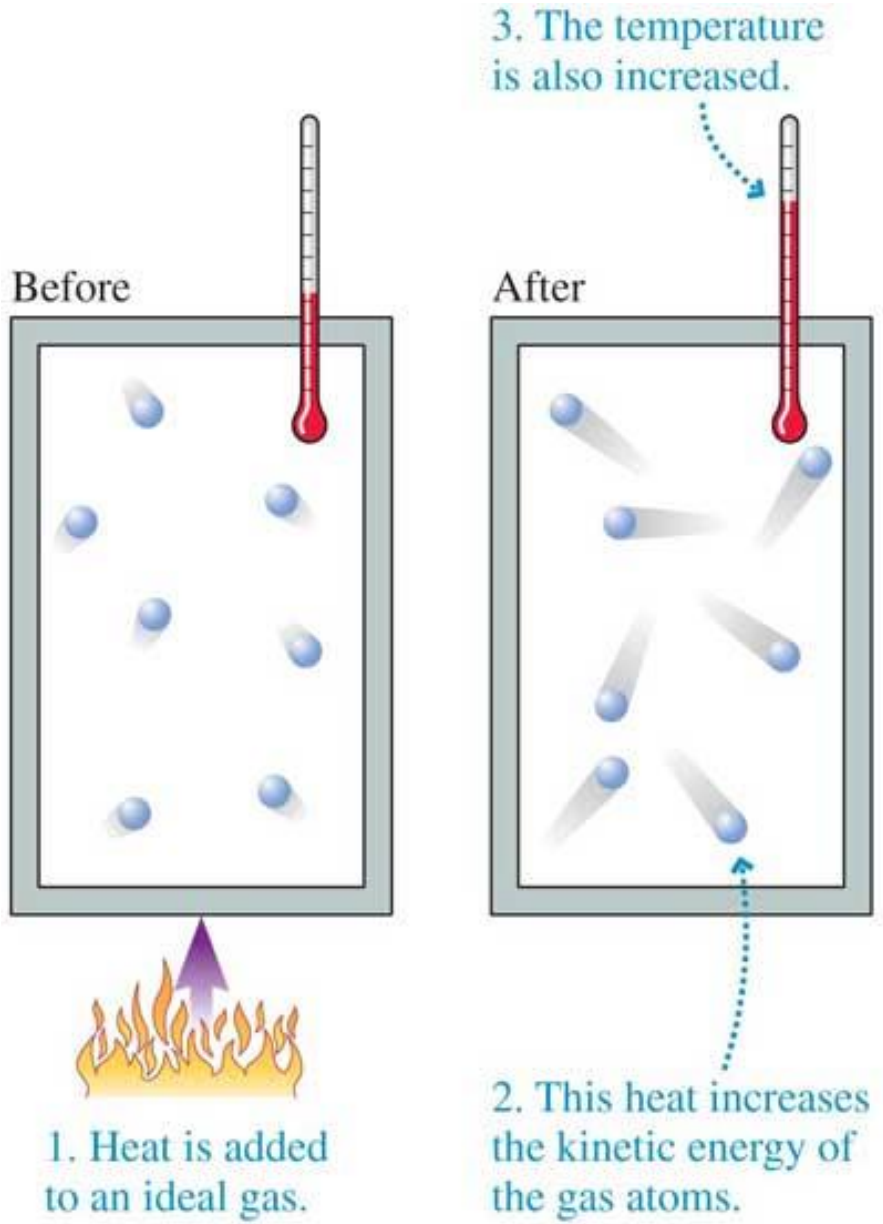
Temperature

- Molecules are constantly in motion
- The higher the temperature, the faster the molecules are moving and the further apart the molecules are
- Temperature: a measure of the kinetic energy of molecules



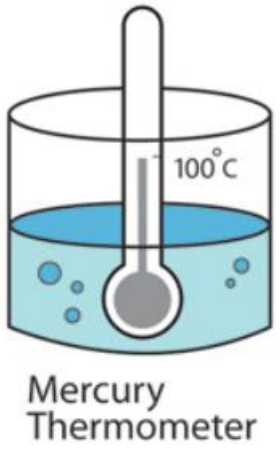
Thermal Energy

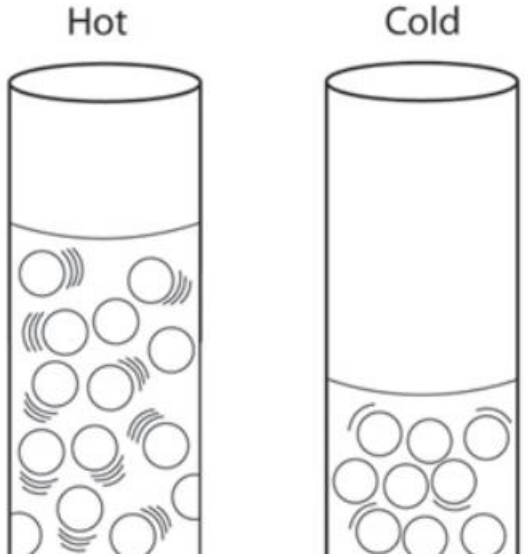
- Thermal Energy: energy due to temperature
- Directly proportional to temp. (As TE ↑, temp↑)



Thermometers

- In a thermometer, the expansion of the liquid is directly proportional to increase in temp.





Absolute Zero

- The molecules have NO kinetic energy; molecules have lowest energy possible

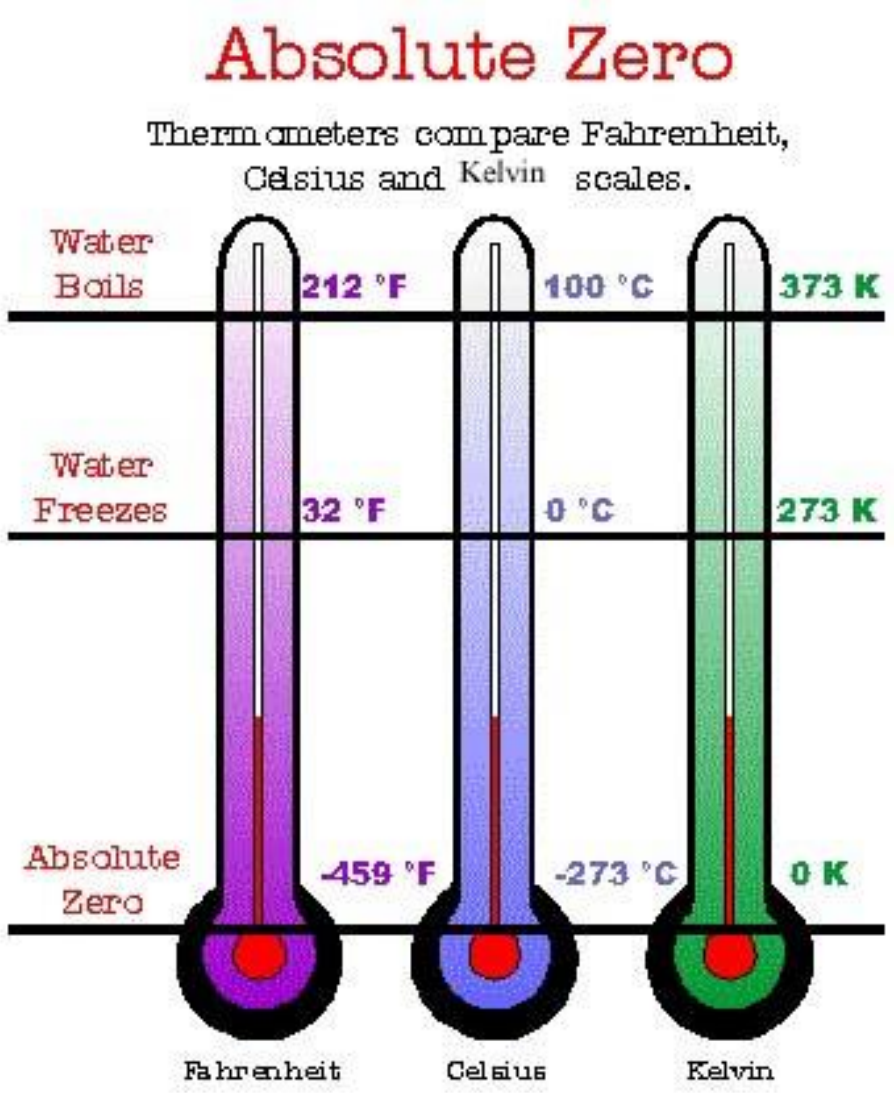
Temperature Scales

	Absolute Zero	Water Freezes	Water Boils
Kelvin	**0**	**273**	**373**
Celsius	**-273**	**0**	**100**
Fahrenheit	**-459**	**32**	**212**

$$F = C\,(1.8) + 32$$

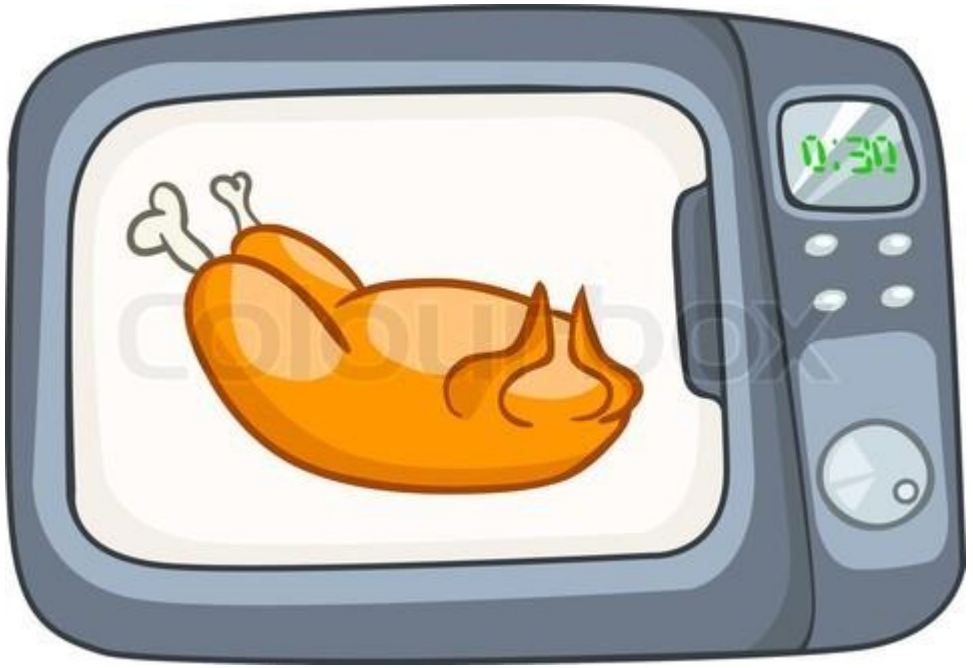
$$C = (F - 32)/1.8$$

$$K = C + 273.15$$



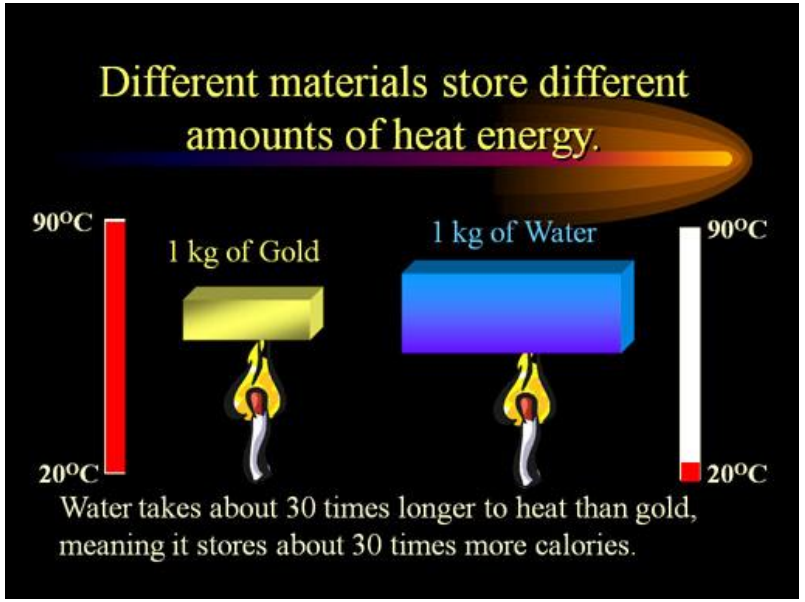
11.1 Heat & Thermal Energy

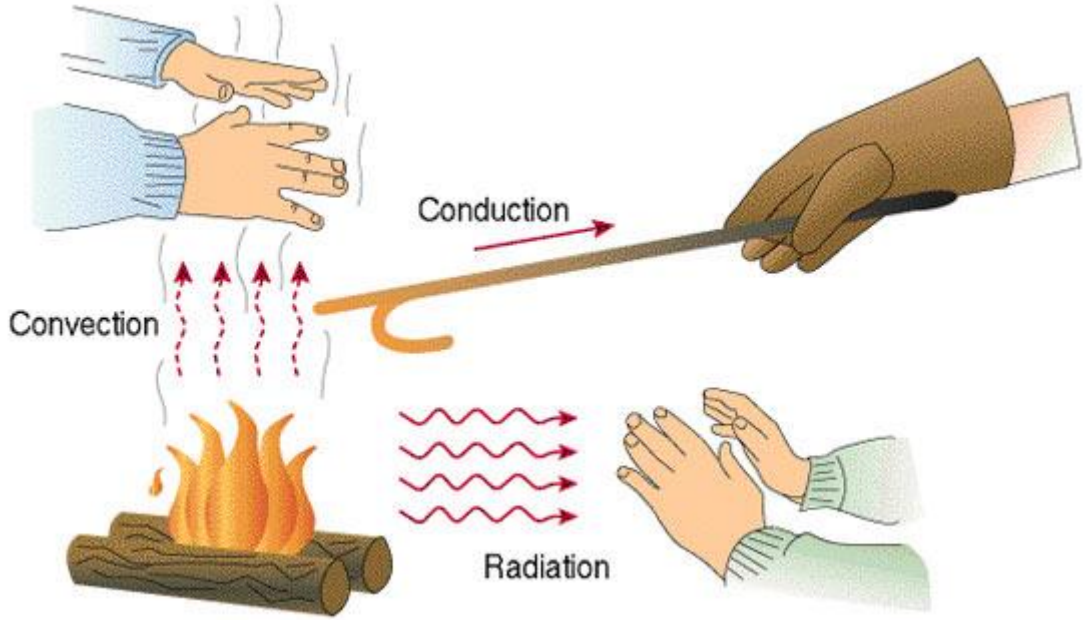
- If it takes 30 seconds to heat this piece of chicken, how long would it take to heat two pieces of chicken?



Heat

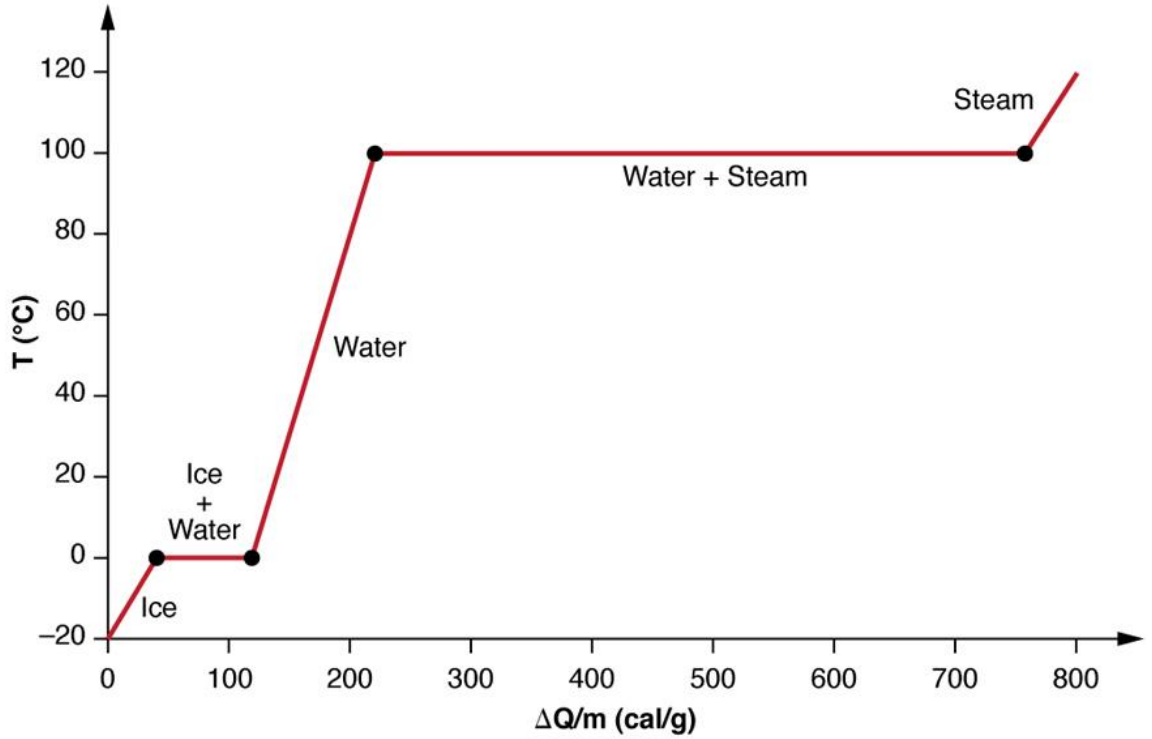
- Heat: thermal energy that is moving
- Thermal energy/temperature increase depends of mass and material from which an object is made
- Specific Heat: amount of heat needed to raise the temperature of one kg of material by one degree Celsius





Phase Changes

- Each material/matter has specific temperatures it changes phases at specific temperatures



Calculating Energy Changes from Heat

$$\triangle Q = m c \triangle T$$

Substance	J/kg/°C or J/kg/K	cal/g/°C or cal/g/K
Water (0 °C to 100 °C)	4186	1.000
Methyl Alcohol	2549	0.609
Ice (-10 °C to 0 °C)	2093	0.500
Steam (100 °C)	2009	0.480
Benzene	1750	0.418
Wood (typical)	1674	0.400
Soil (typical)	1046	0.250
Air (50 °C)	1046	0.250
Aluminum	900	0.215
Marble	858	0.205
Glass (typical)	837	0.200
Iron/Steel	452	0.108
Copper	387	0.0924
Silver	236	0.0564
Mercury	138	0.0330
Gold	130	0.0310
Lead	128	0.0305