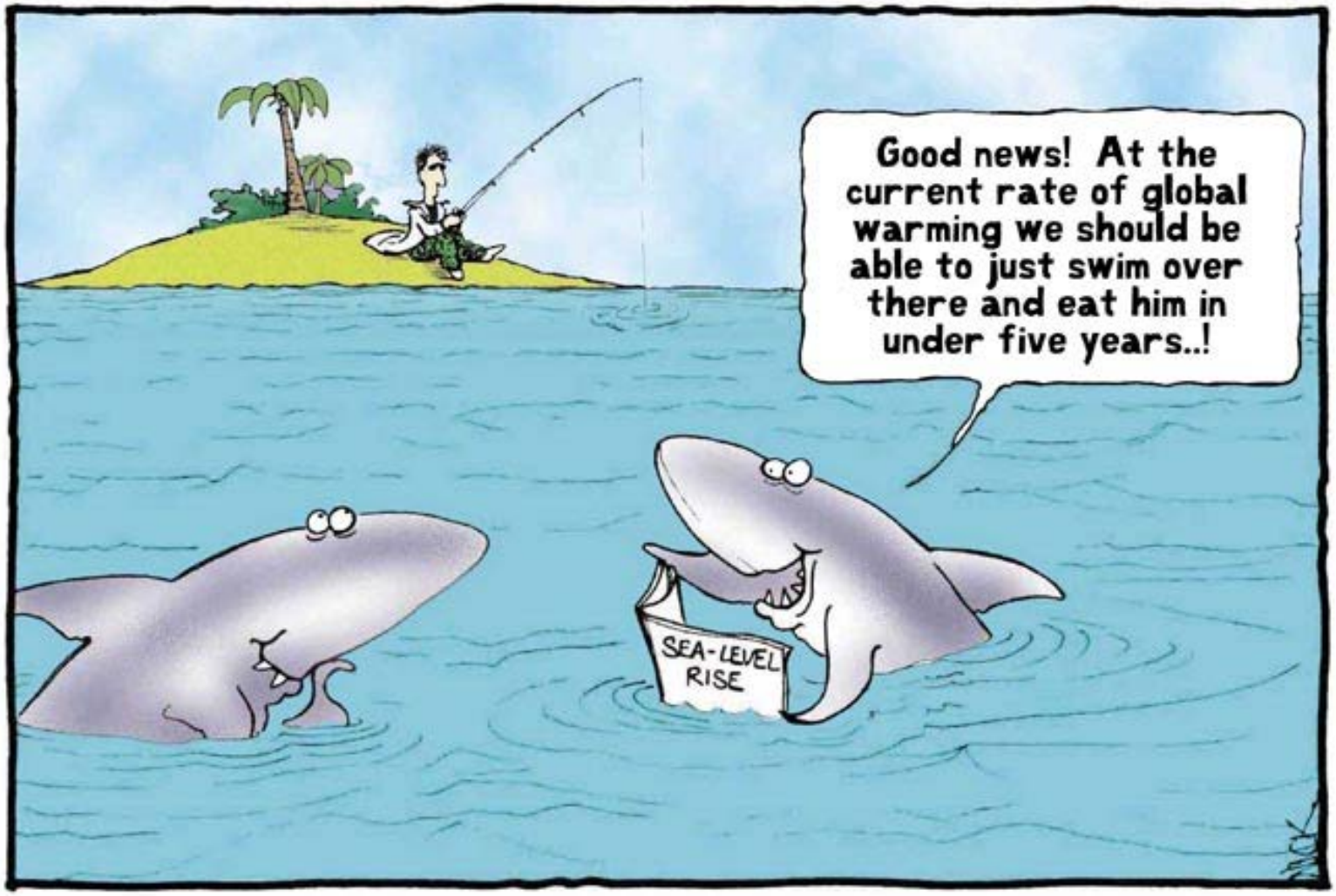
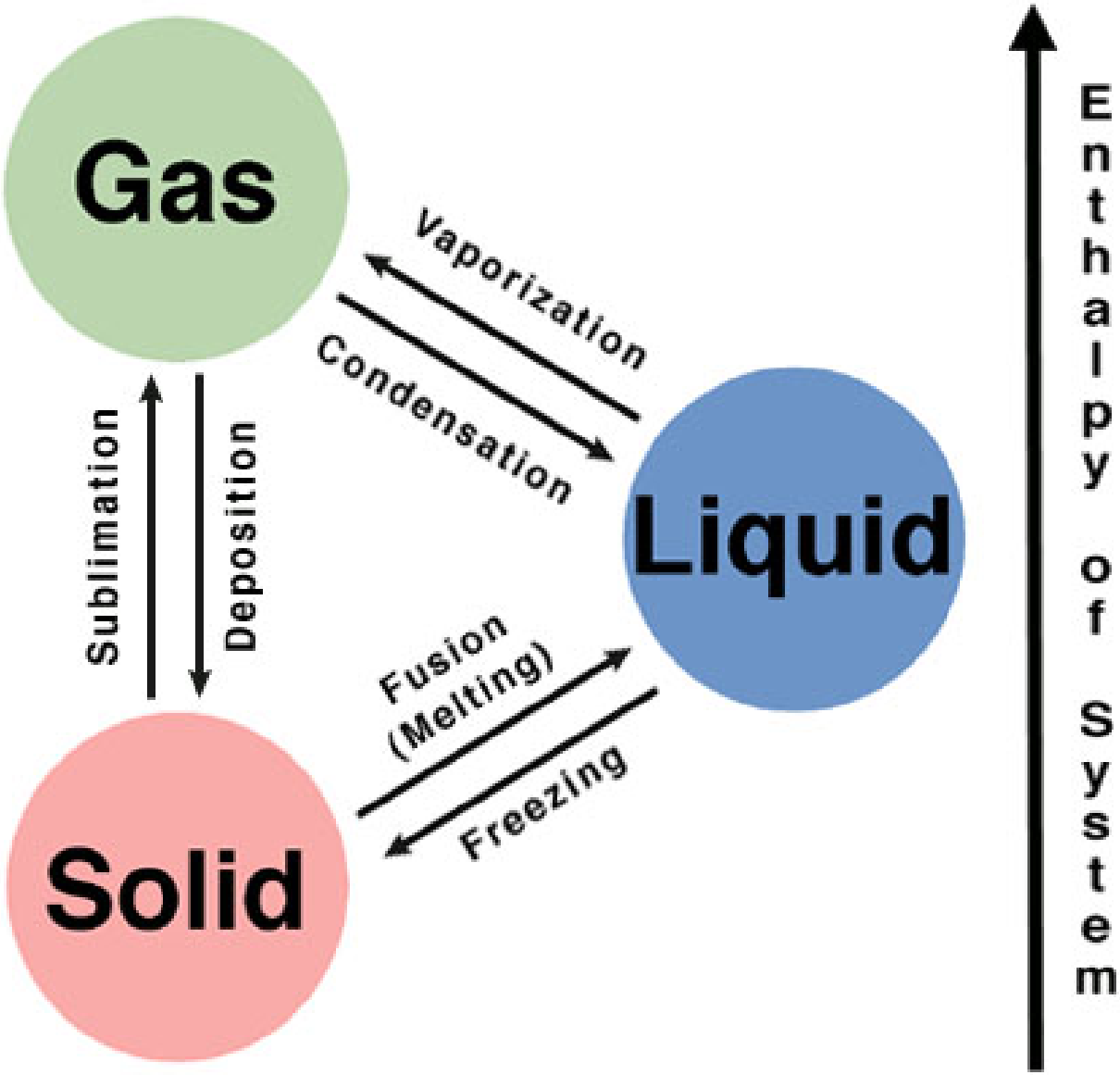
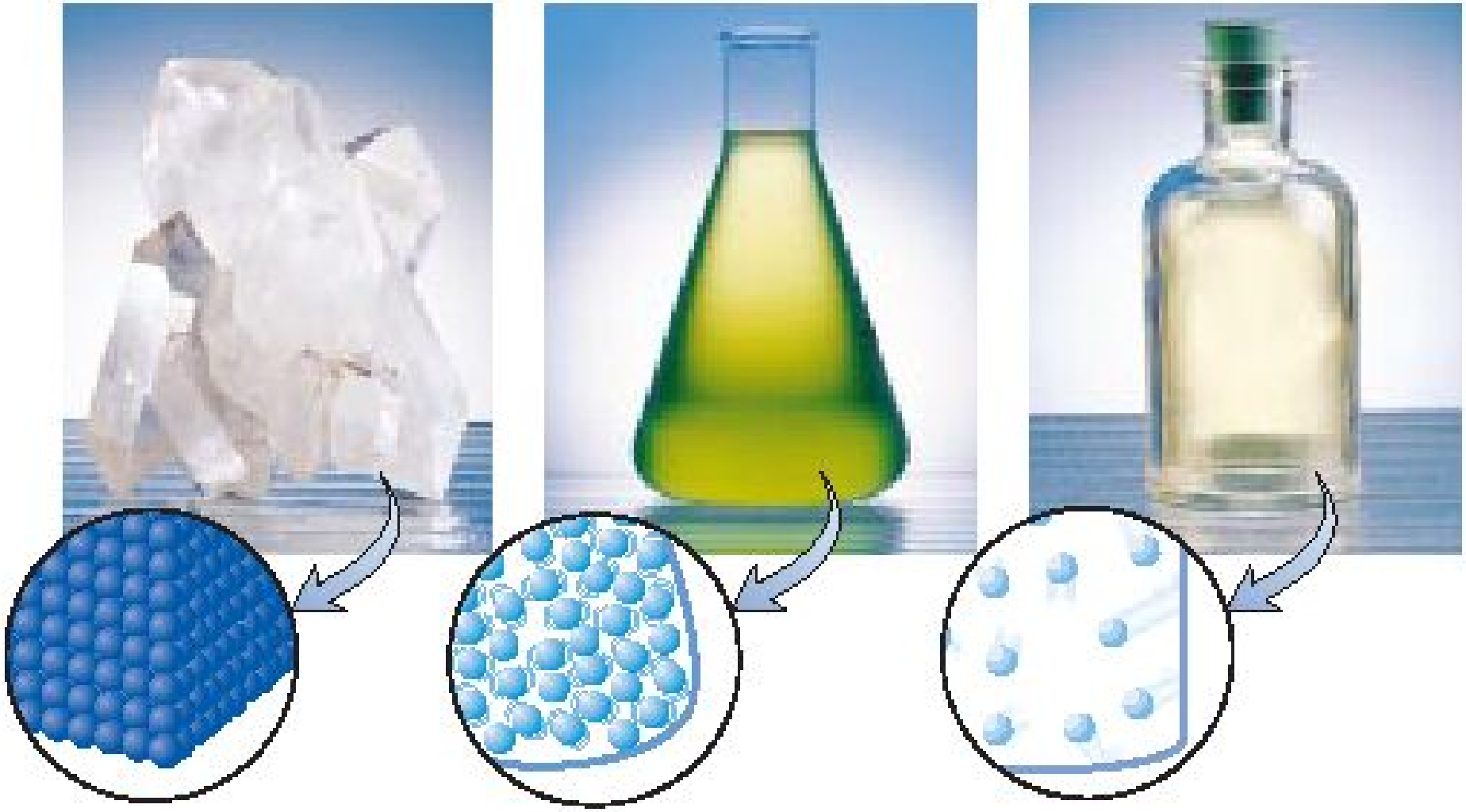
Phase Changes



Courtesy www.lab-initio.com


Gas
Liquid
Solid
Vaporization
Condensation
Sublimation
Deposition
Fusion
(Melting)
Freezing
Enthalpy of System

Three Phases of Matter



(a) Particles in a solid (b) Particles in a liquid (c) Particles in a gas

Kinetic Molecular Theory (KMT)

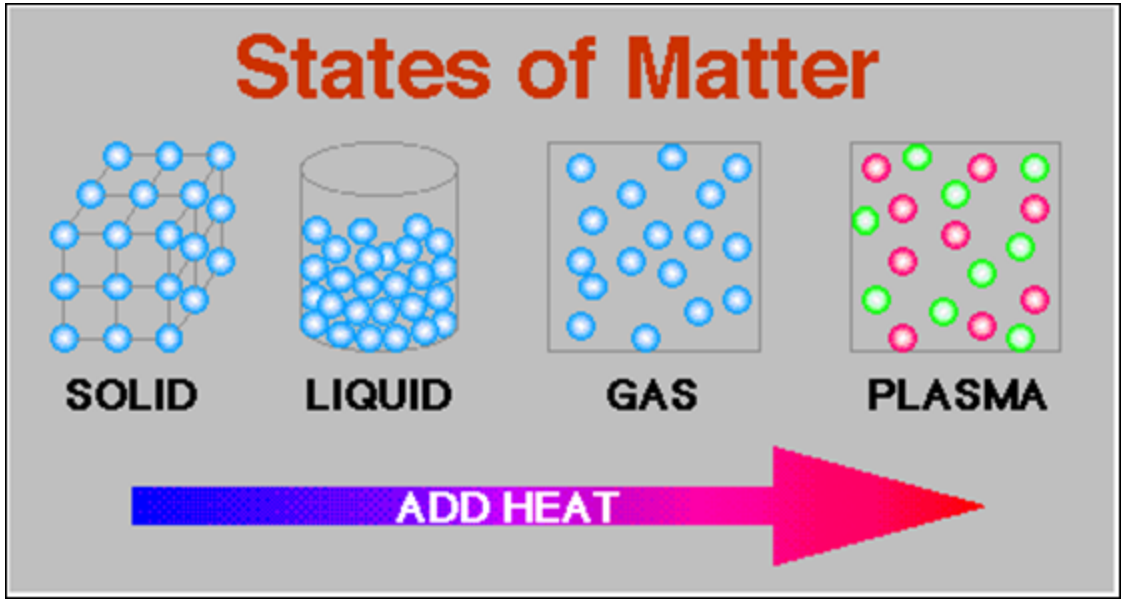
ki·net·ic

1. pertaining to motion.
2. caused by motion.
3. characterized by movement: Running and dancing are kinetic activities.

Think about how this applies to solids, liquids and gasses!!

Source: Websters Dictionary

Phase Differences



Solid – definite volume and shape; particles packed in fixed positions; particles are not free to move (KMT)

Liquid – definite volume but indefinite shape; particles close together but not in fixed positions; particles are free to move (KMT)

Gas – neither definite volume nor definite shape; particles are at great distances from one another; particles are free to move (KMT)

Phase changes - Represents phases as a function of

Sublimation is the process in which a solid changes directly into a gas, skipping the liquid phase. (endothermic)

Deposition—Gas can move directly to a solid, skipping the liquid phase)

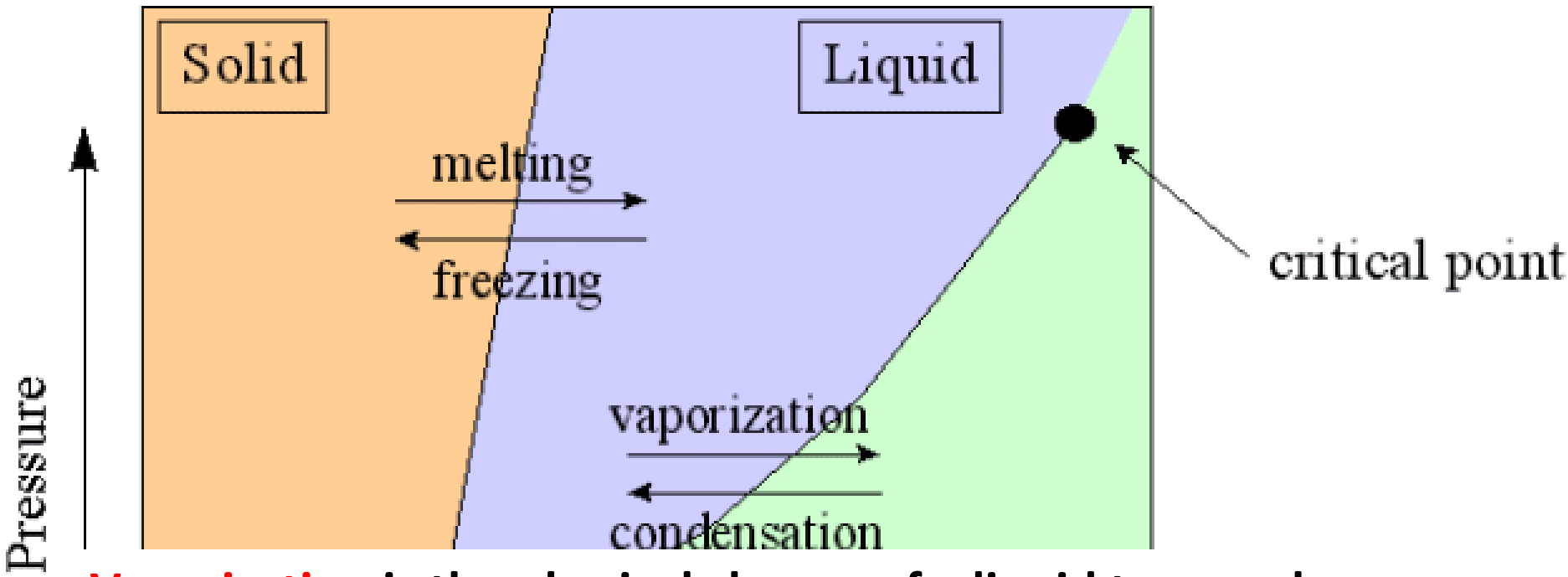
Sublimation point = deposition point.

Freezing is the physical change of a liquid to a solid by removal of energy as heat (exothermic)

Melting is the physical change of a solid to a liquid by the addition of energy as heat (endothermic)

Melting point = freezing point.

Phase changes



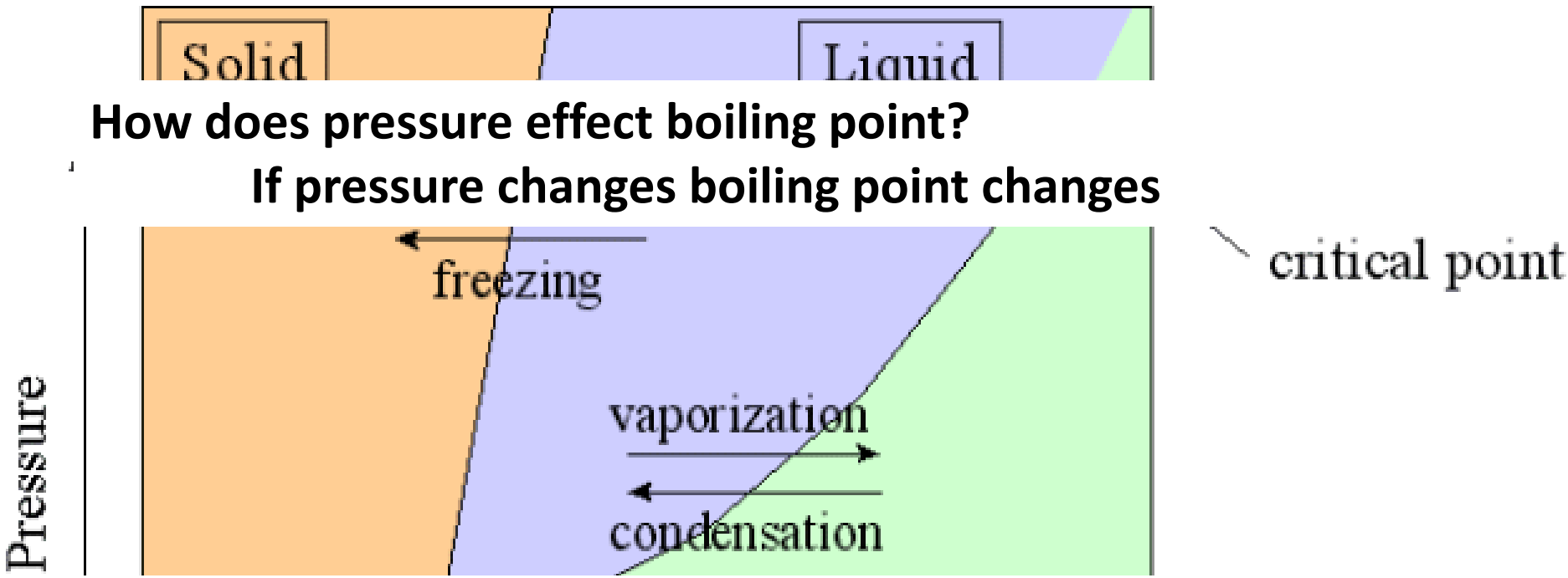
<u>Vaporization</u> is the physical change of a liquid to a gas by addition of energy as heat (endothermic)

Evaporation vs. Boiling:

-Evaporation happens at room temp.

<u>Condensation</u> is the physical change of a gas to a liquid by the removal of energy as heat (exothermic)

Phase changes



How does pressure effect boiling point?

If pressure changes boiling point changes

<u>Critical temperature</u>: temperature above which the vapor can not be liquefied.

<u>Critical pressure</u>: pressure required to liquefy <u>AT</u> the critical temperature.

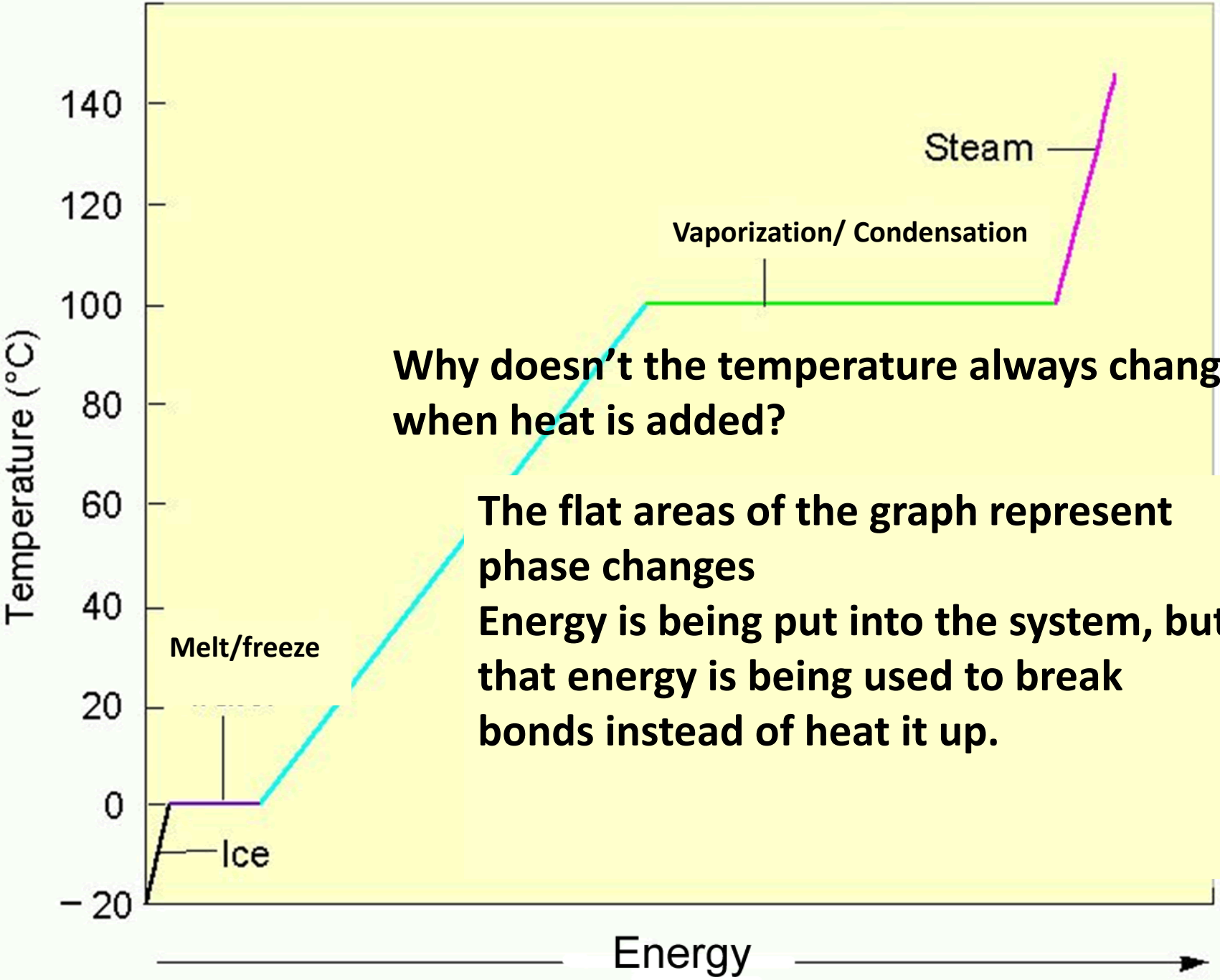
<u>Critical point</u>: critical temperature & pressure

Temperature

Review

- ENDOTHERMIC Reaction- Requires energy (or takes in energy) in order to occur

- EXOTHERMIC Reaction- Give off energy in order to occur



Why doesn't the temperature always change when heat is added?

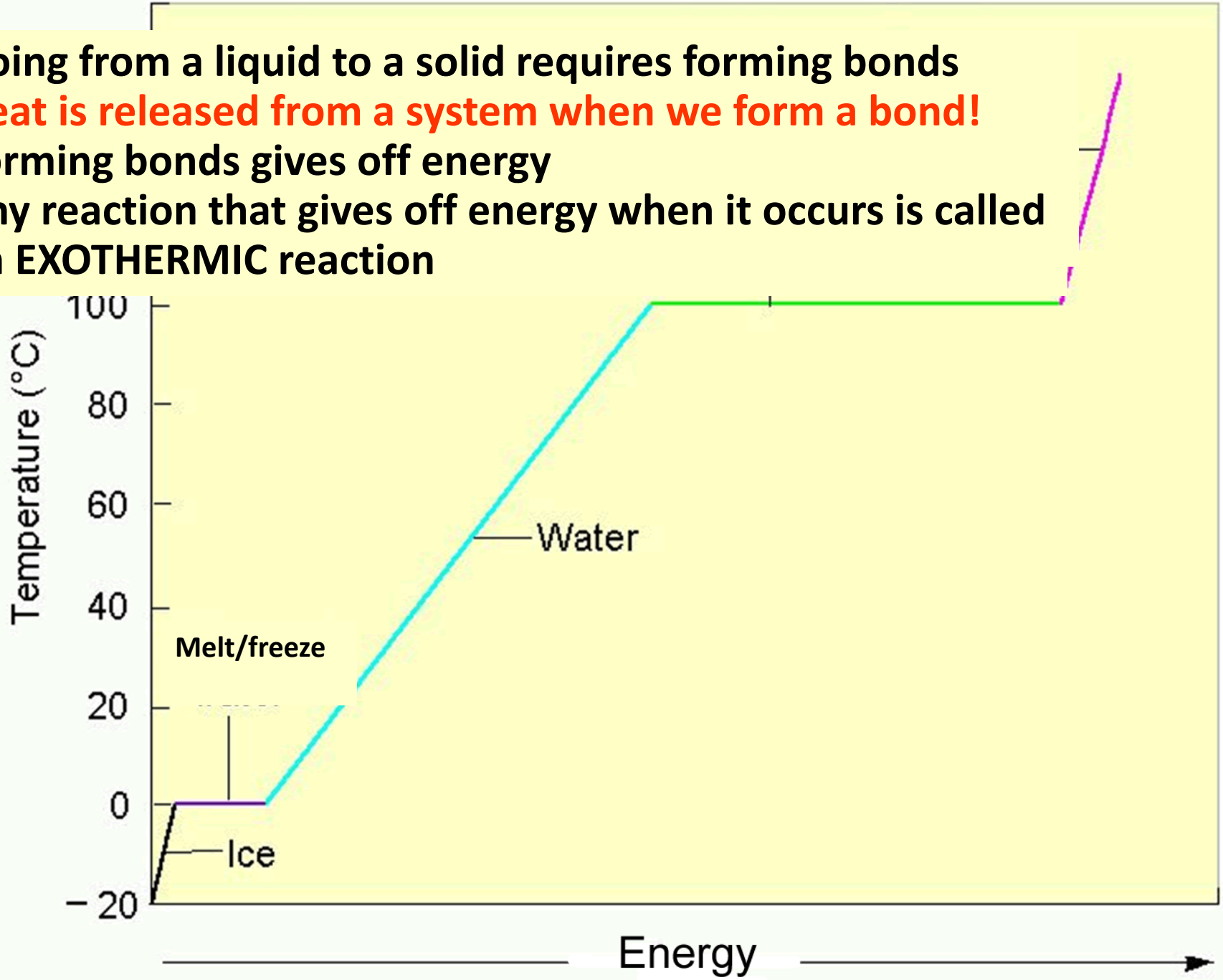
The flat areas of the graph represent phase changes
Energy is being put into the system, but that energy is being used to break bonds instead of heat it up.

Going from a liquid to a solid requires forming bonds

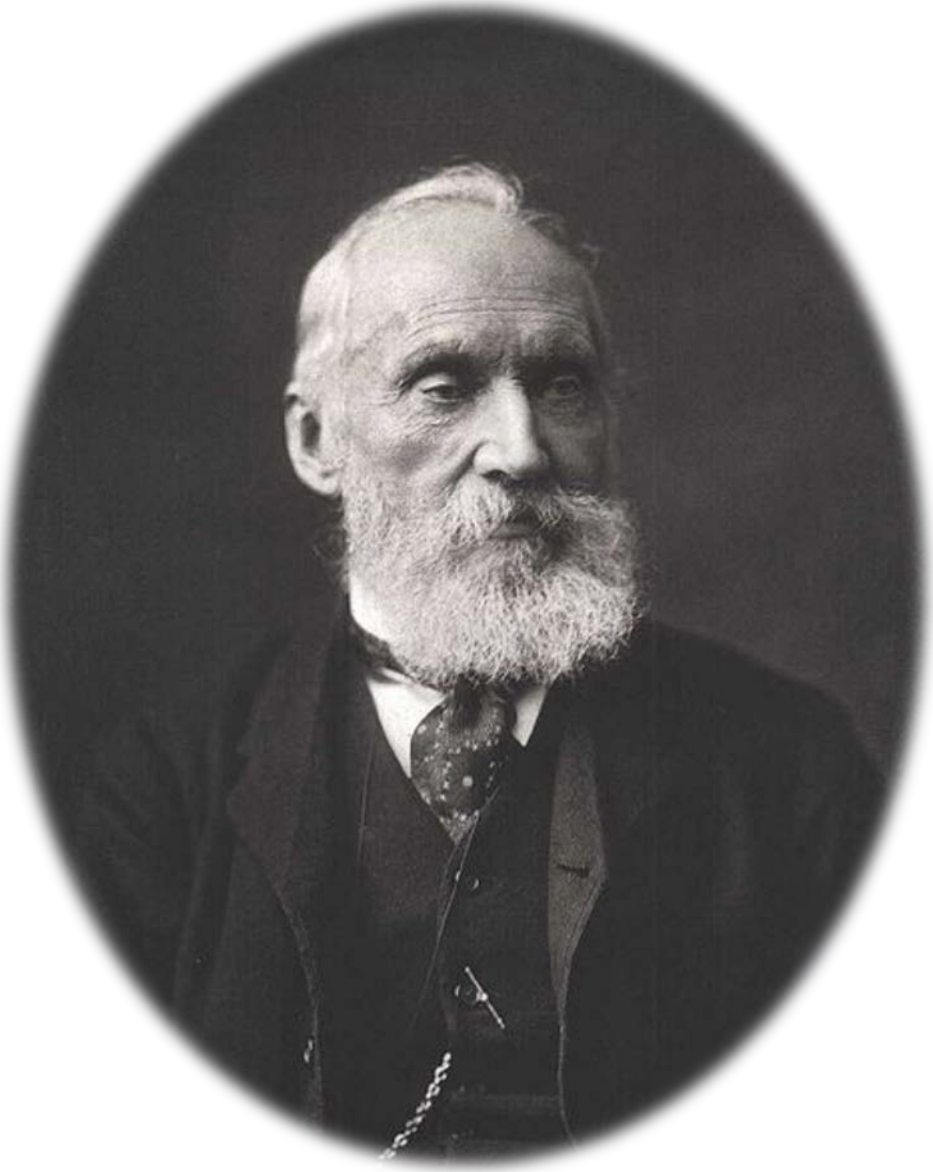
Heat is released from a system when we form a bond!

Forming bonds gives off energy

Any reaction that gives off energy when it occurs is called an EXOTHERMIC reaction



Pressure and Temperature



William Thomson
“Lord Kelvin”

Air Pressure- measured with a barometer

- Baro = weight
- Meter = measure

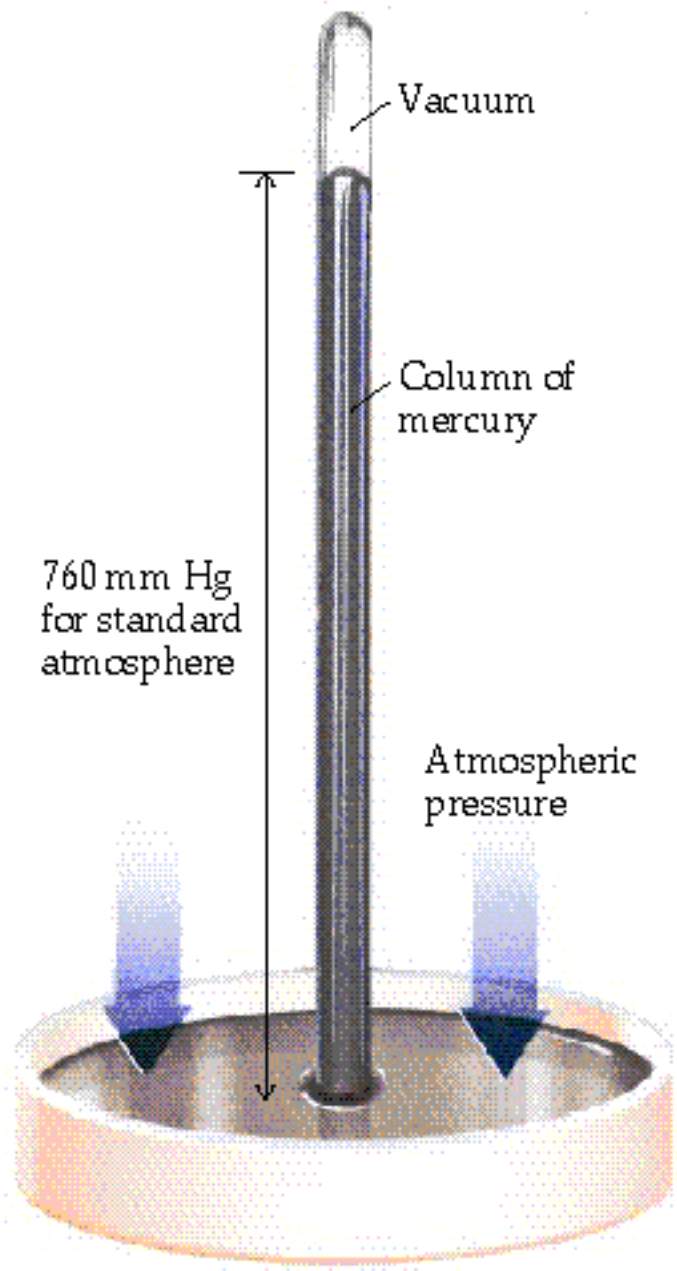
Developed by Evangelista Torricelli during the 17th century.

Pressure is the force created by the collisions of molecules with the walls of a container.

An Early Barometer

Column height of Mercury (Hg) measures Pressure of atmosphere

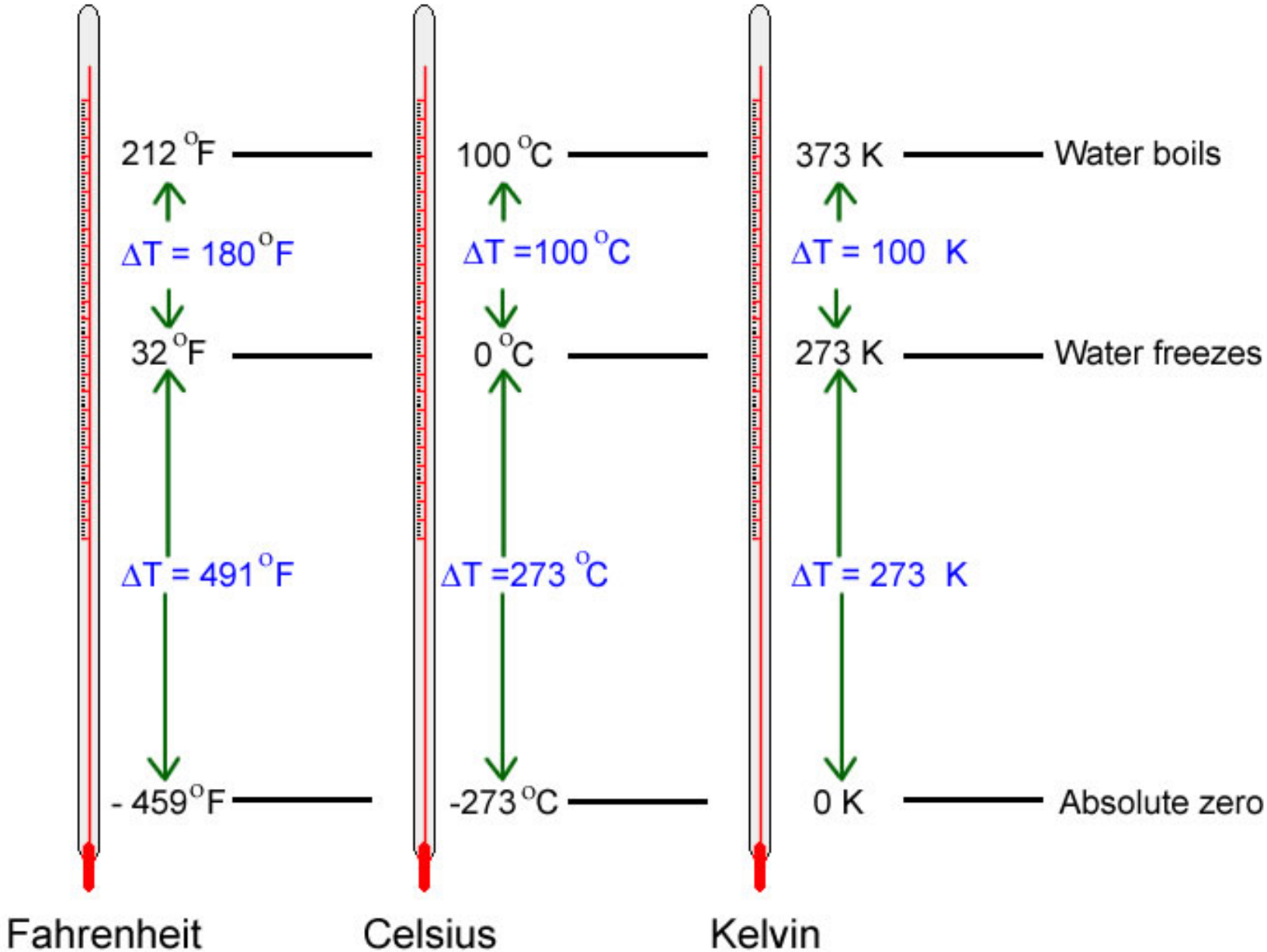
The normal pressure at sea level can is 760 mmHg. (measurement)



Standard Pressure (memorize)

- 1 atm (standard atmosphere)
- 101.3 kPa (kilopascals)
- 14.7 lbs/in^2
- 760 mm Hg (millimeters of mercury)
- 760 torr

Temperature-the Kelvin Scale



Standard Temperature

Standard Temperature equals:

- **273 Kelvin (273 K)**
- **0 °C**

Converting Celsius to Kelvin

Gas law problems involving temperature require that the temperature be in KELVINS!

Kelvins = °C + 273

°C = Kelvins -273

Either of these:

- 273 Kelvin (273 K)
- 0 °C

And any one of these:

- 1 atm
- 101.3 kPa
- 14.7 lbs/in^2 (psi)
- 760 mm Hg
- 760 torr

Standard Temperature *and* Pressure

"STP"

Pressure Conversions

A. What is 475 mm Hg expressed in atm?

$$475 \text{ mm Hg} \times \frac{1 \text{ atm}}{760 \text{ mm Hg}} = 0.625 \text{ atm}$$

B. The pressure of a tire is measured as 29.4 psi.

What is this pressure in mm Hg?

$$29.4 \text{ psi} \times \frac{760 \text{ mm Hg}}{14.7 \text{ psi}} = 1.52 \times 10^3 \text{ mm Hg}$$

Pressure Conversions

C. What is 2 atm expressed in torr?

D. The pressure of a tire is measured as 32.0 psi.

What is this pressure in kPa?

PARTNER UP AND READ THE CASE STUDY AND ANSWER THE FOLLOWING QUESTIONS!

Questions???

- How does external pressure influence the boiling point of water?
- How does a pressure cooker speed up the cooking?
- At a higher altitude, Mount Everest, why does it take longer to cook?
- Would a pressure cooker come in handy at Mount Everest? Why or why not?
- Why does a slow cooker cook slowly?
- What is the advantage of using an autoclave (generates steam with high pressure and temperature) to sterilize surgical instruments rather than simply boiling them in water?
- Why is induced hypothermia used for patients who are undergoing certain surgeries?
- A humidifier can be a burn hazard. Why does 100°C steam burn more severely than 100°C of water?