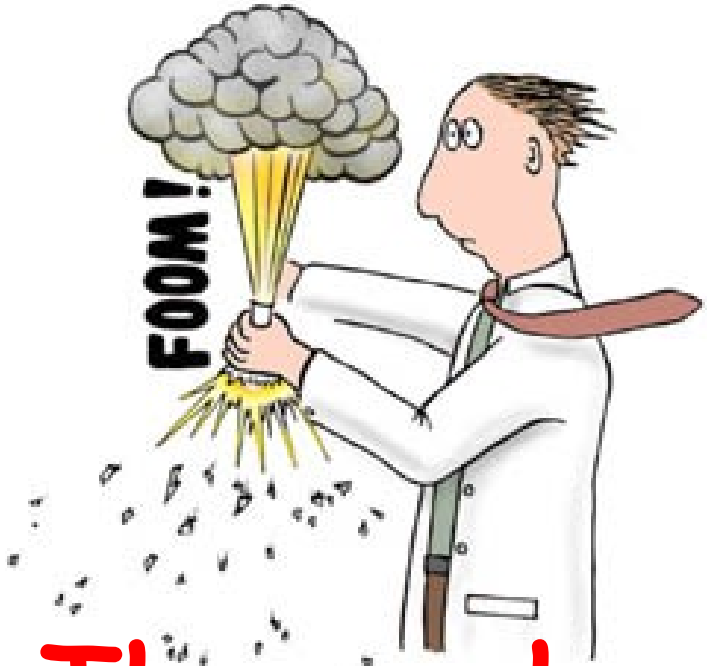


Basic Thermochemistry

Courtesy of lab-initio.com

CA Standards

Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).
Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.
Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.

Units for Measuring Heat

The **Joule** is the SI system unit for measuring heat:

$$1\,Joule = 1\,newton \cdot meter = \frac{1\,kg \cdot m^2}{s^2}$$

The **calorie** is the heat required to raise the temperature of 1 gram of water by 1 Celsius degree

$$1\,calorie = 4.18\,Joules$$

Energy

Energy is the capacity to do work, and can take many forms

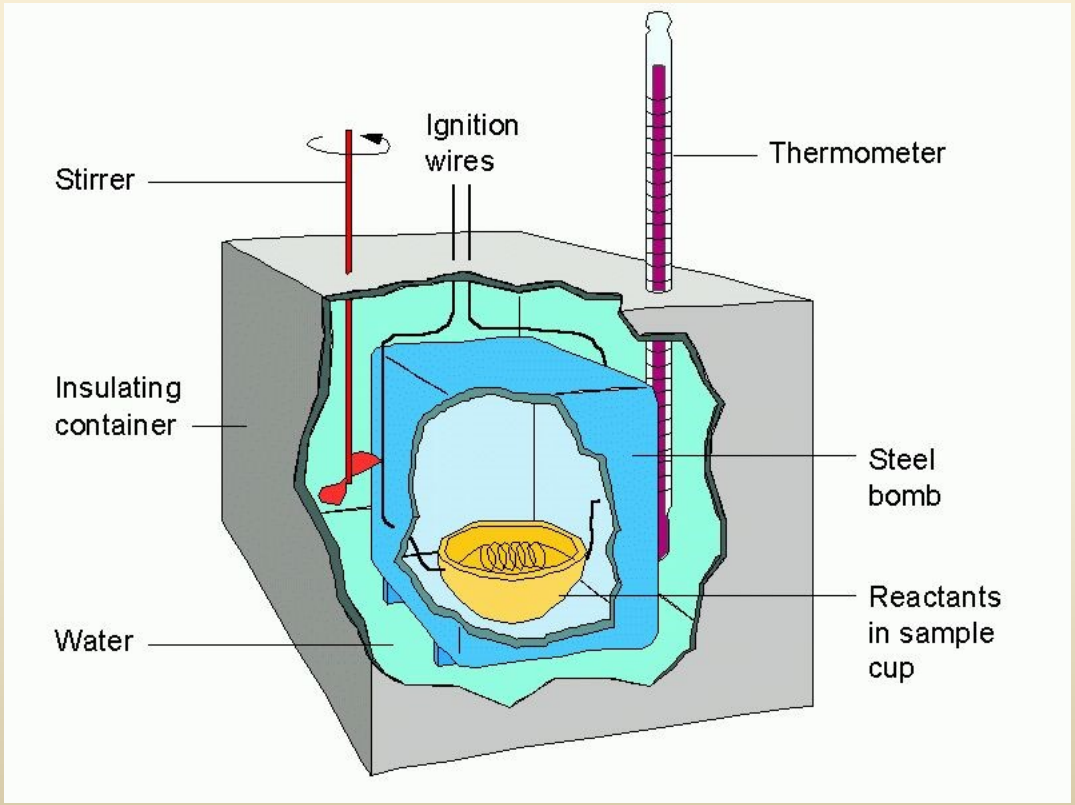
- Potential energy is stored energy or the energy of position
- Kinetic energy is the energy of motion
- Thermal energy (heat) is an outward manifestation of movement at the atomic level

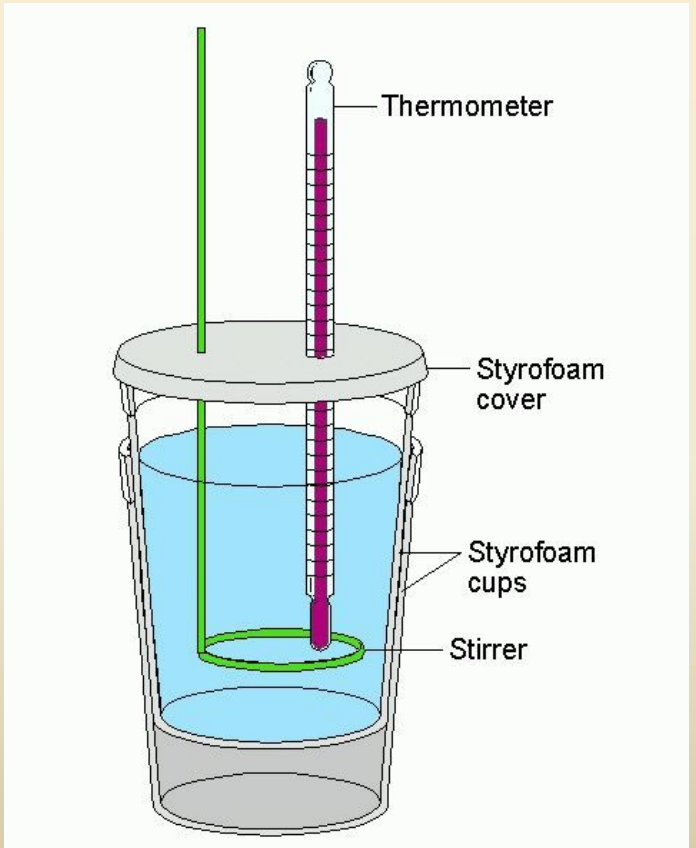
Heat (Enthalpy) Change, ΔH

Definition: *The amount of heat energy released or absorbed during a process.*

Calorimetry

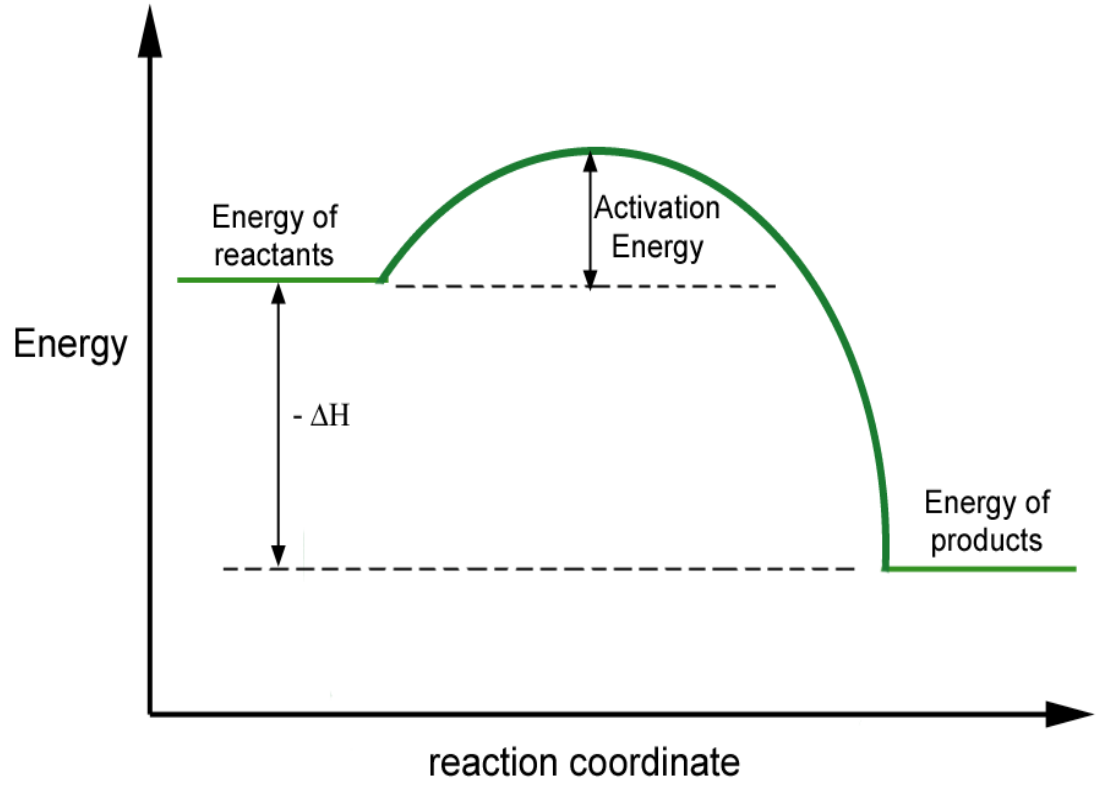
The amount of heat absorbed or released during a physical or chemical change can be measured, usually by the change in temperature of a known quantity of water in a calorimeter.





Exothermic Processes

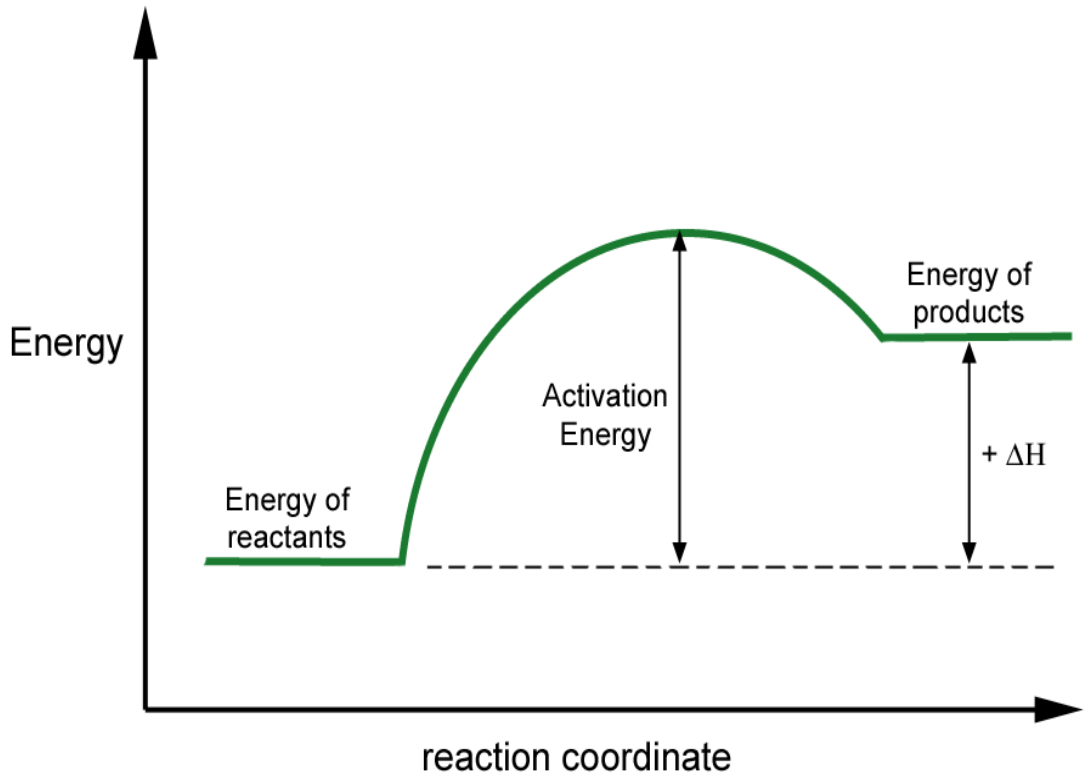
Processes in which energy is released as it proceeds, and surroundings become warmer



Reactants → Products + energy

Endothermic Processes

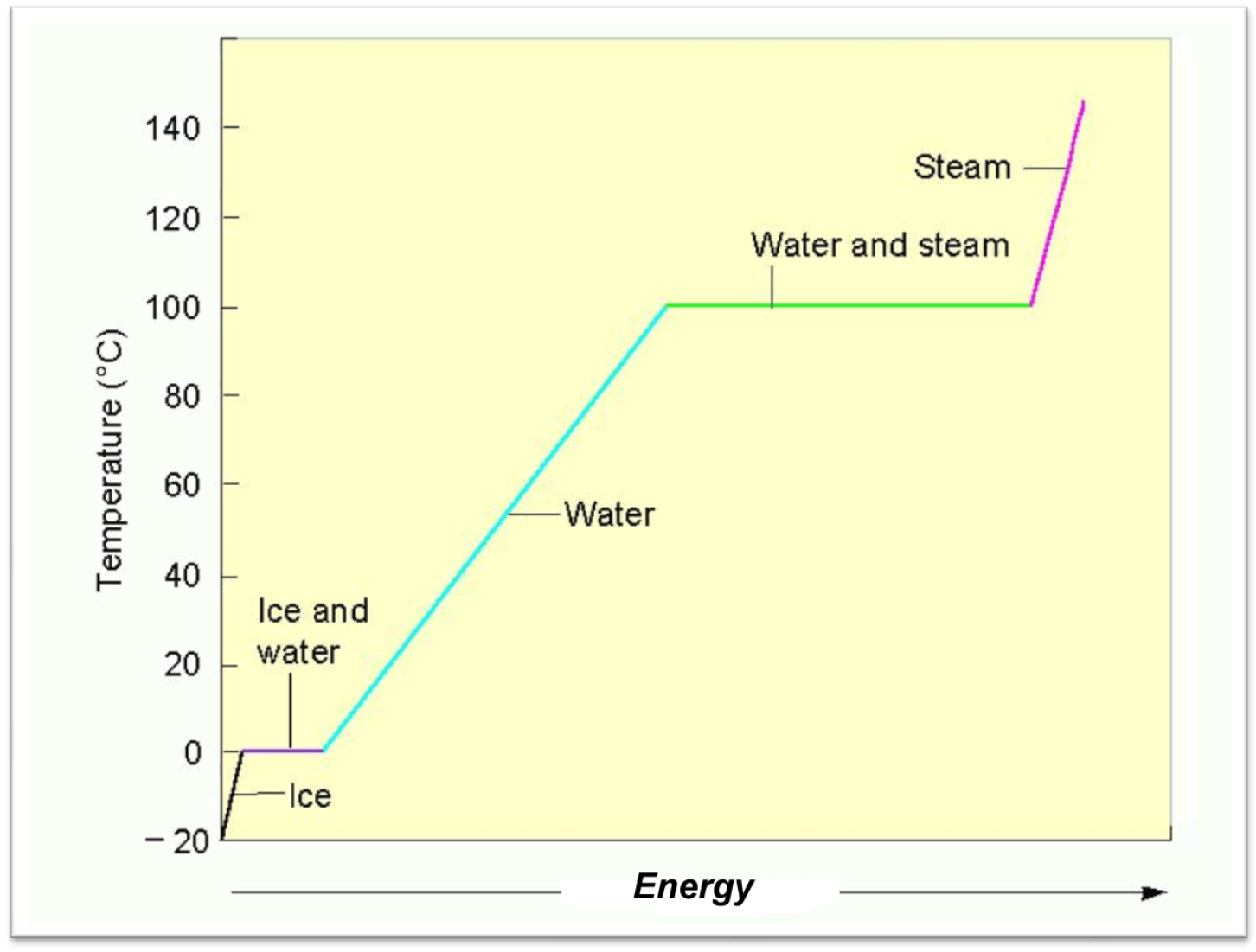
Processes in which energy is absorbed as it proceeds, and surroundings become colder



Reactants + energy → Products

Water phase changes

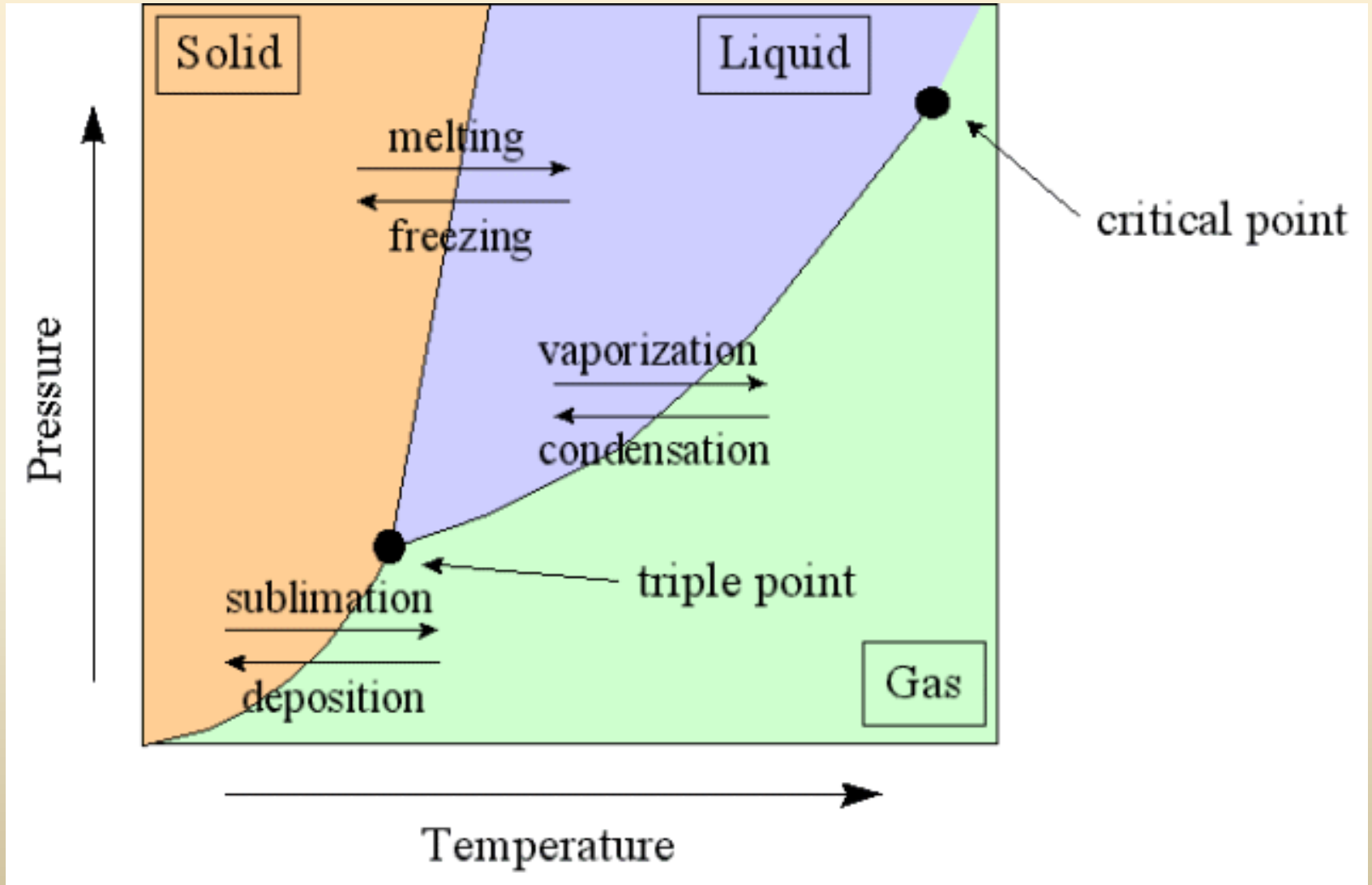
Temperature remains **constant** during a phase change.



Phase Change Diagram

Processes occur by addition of energy →

← Processes occur by removal of energy



Phase Diagram

- Represents phases as a function of temperature and pressure.
- Critical temperature: temperature above which the vapor can not be liquefied.
- Critical pressure: pressure required to liquefy AT the critical temperature.
- Critical point: critical temperature and pressure (for water, T_c = 374°C and 218 atm).