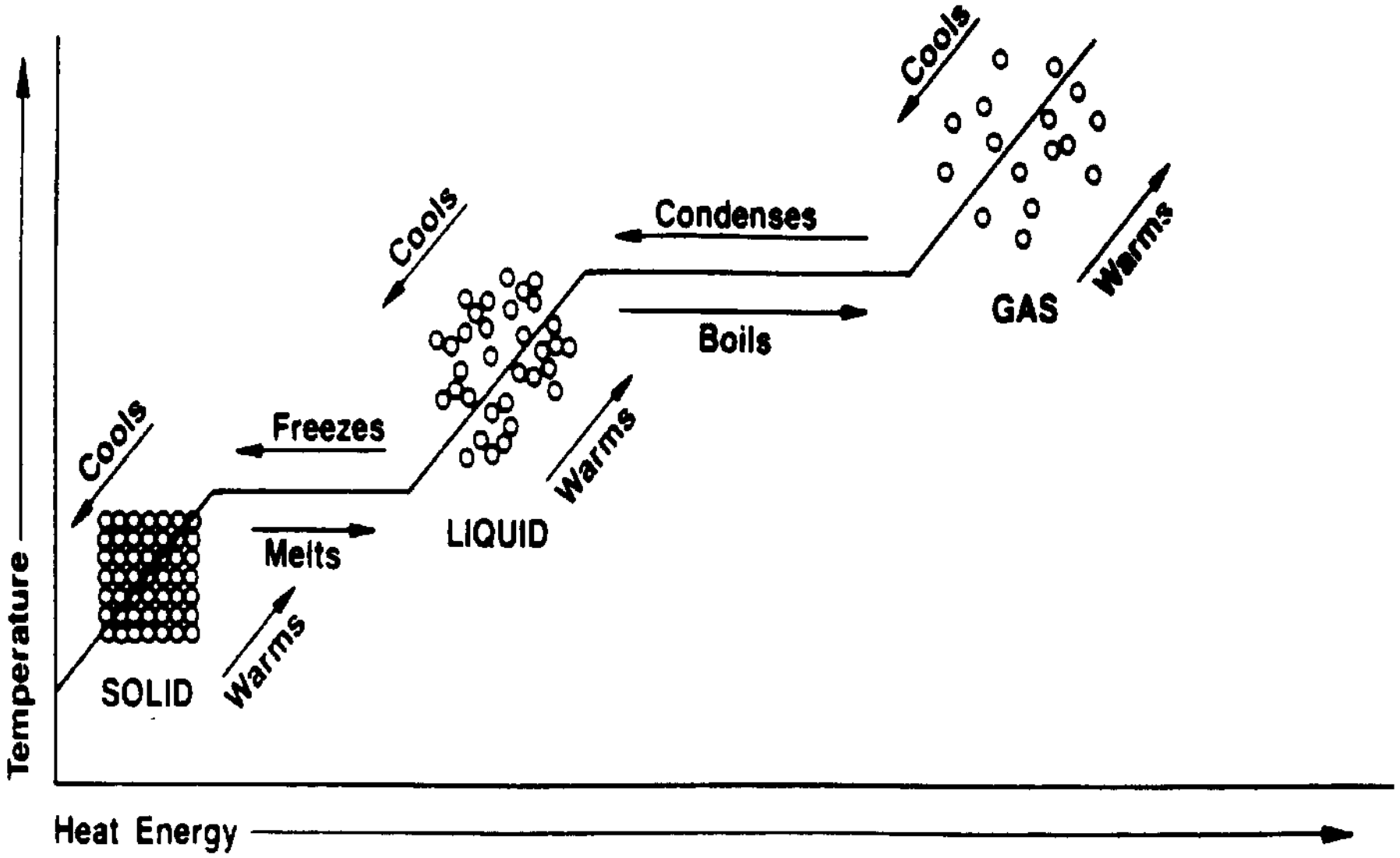
States of Matter
and
Phase Change

Phase Change Diagram



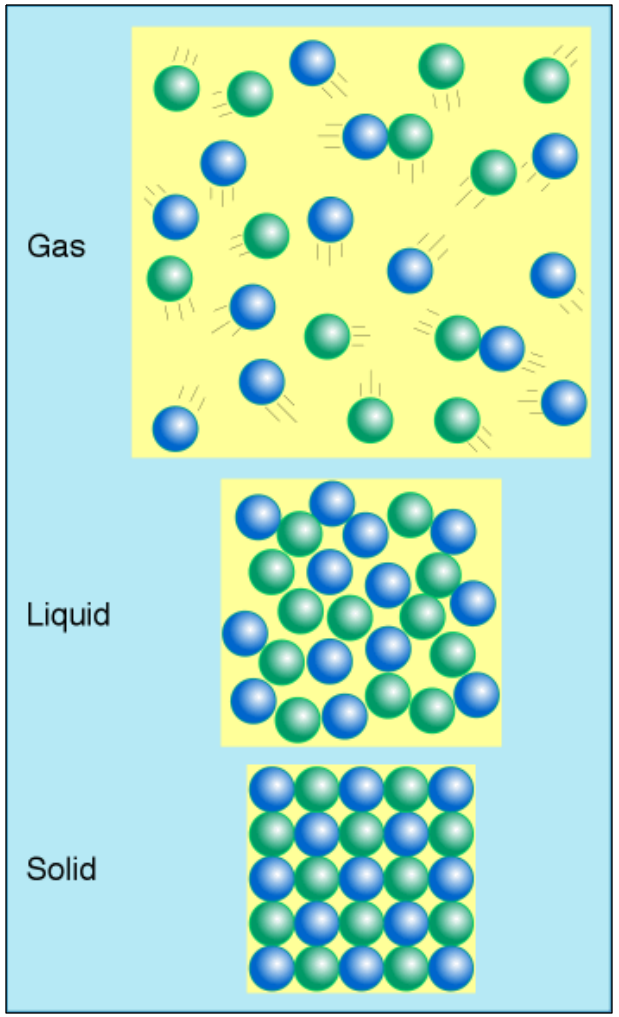
Water

- Water exists on our planet in three states.
- Ice, water, and water vapor
- What causes water to be in one phase or another?


ENERGY

ENERGY

- When energy is added to a substance that energy causes the particles in the substance to move faster and farther apart.
- What happens to the particles when energy is taken away from a substance?



Phase Change

- Energy content is responsible for the different phases of matter.
- Matter can be made to change phase when energy is added to or taken away from a substance.

ENERGY

Adding Energy

- Phase changes that require the addition of energy are called ***endothermic*** changes.

(*endo* = inside, *therm* = heat)

- Which phase changes are endothermic?
  - Melting (solid → liquid)
  - Boiling (liquid → gas)
  - Sublimation (solid → gas)

Removing Energy

- Phase changes that require the addition of energy are called ***exothermic*** changes.

(*exo* = outside, *therm* = heat)

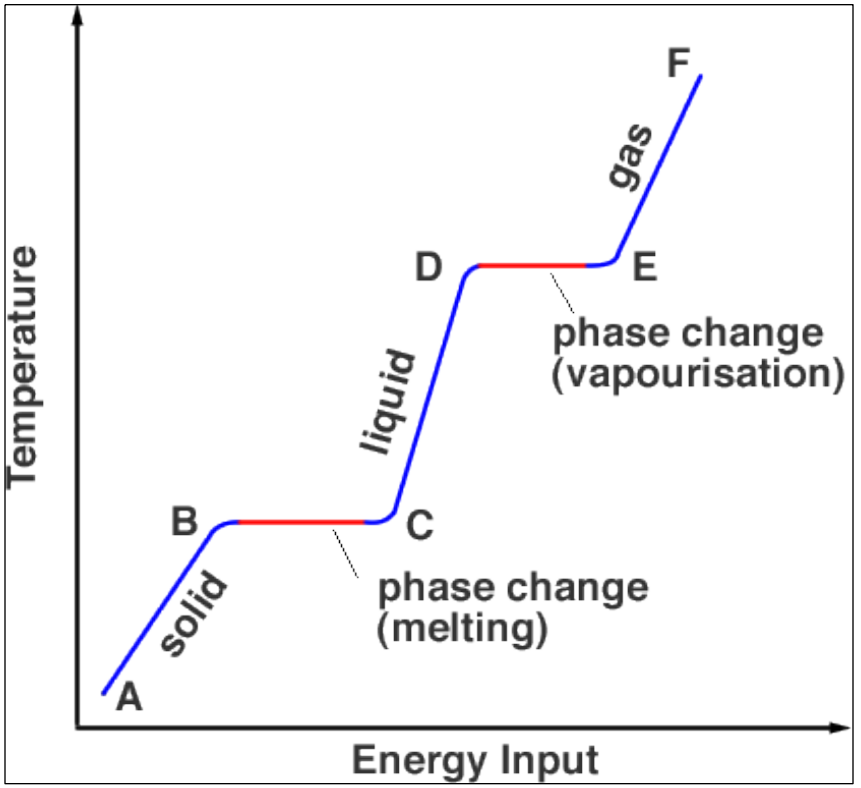
- Which phase changes are exothermic?
  - Freezing (liquid → solid)
  - Condensation (gas → liquid)
  - Deposition (reverse sublimation) (gas → solid)

Block of Ice to Steam

- Block of Ice to Water Vapor

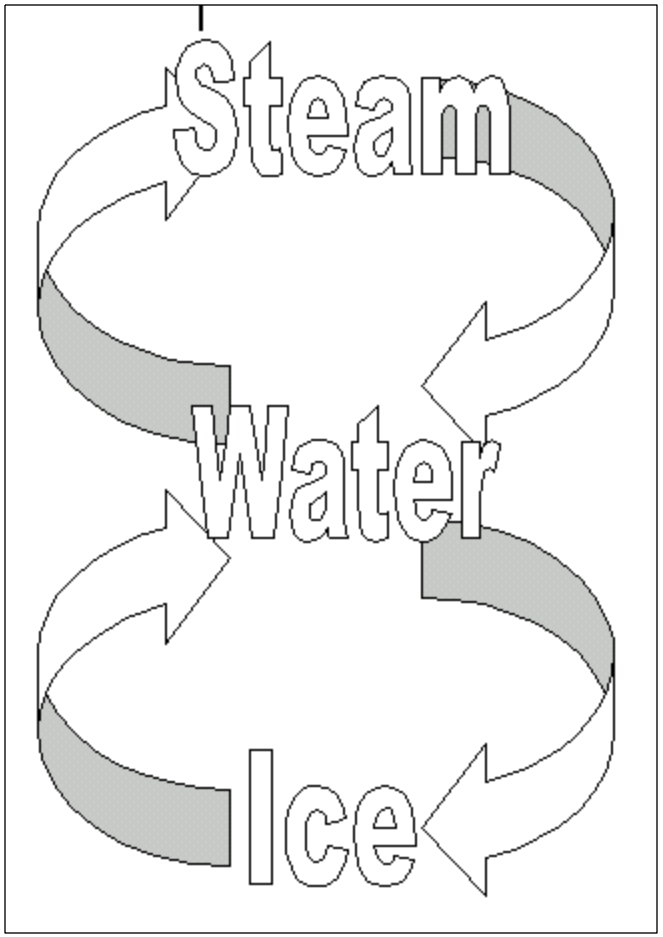
Melting- Solid to Liquid

- Melting is the changing of a solid to a liquid when the substance absorbs heat energy.
- Melting Point
  - Water 0° C.
  - Table salt 801° C.
  - Diamond 3700° C.

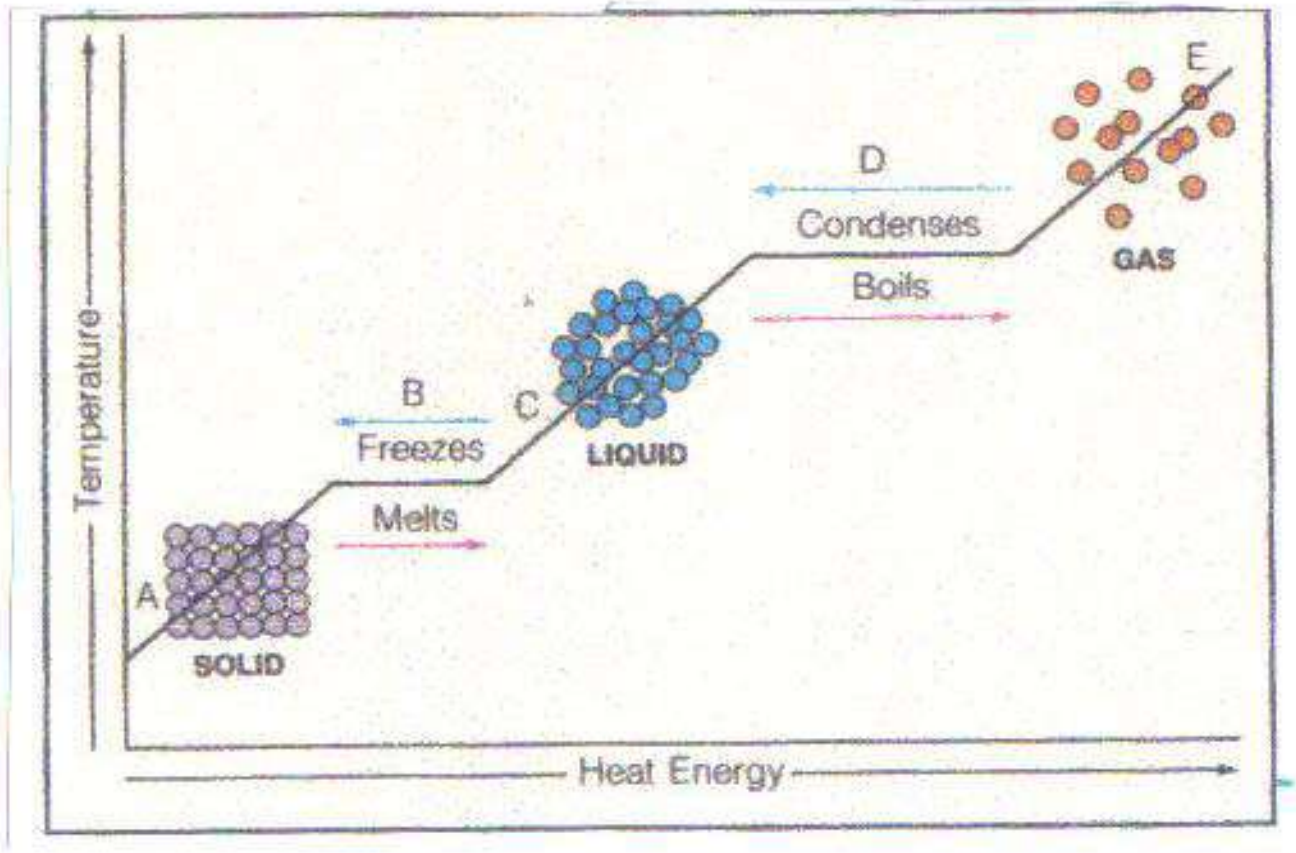


Freezing- Liquid to Solid

- Opposite of melting: liquid changing to a solid is freezing.
- Freezing occurs when a substance loses heat energy.
- The freezing point of a substance is equal to the melting point!

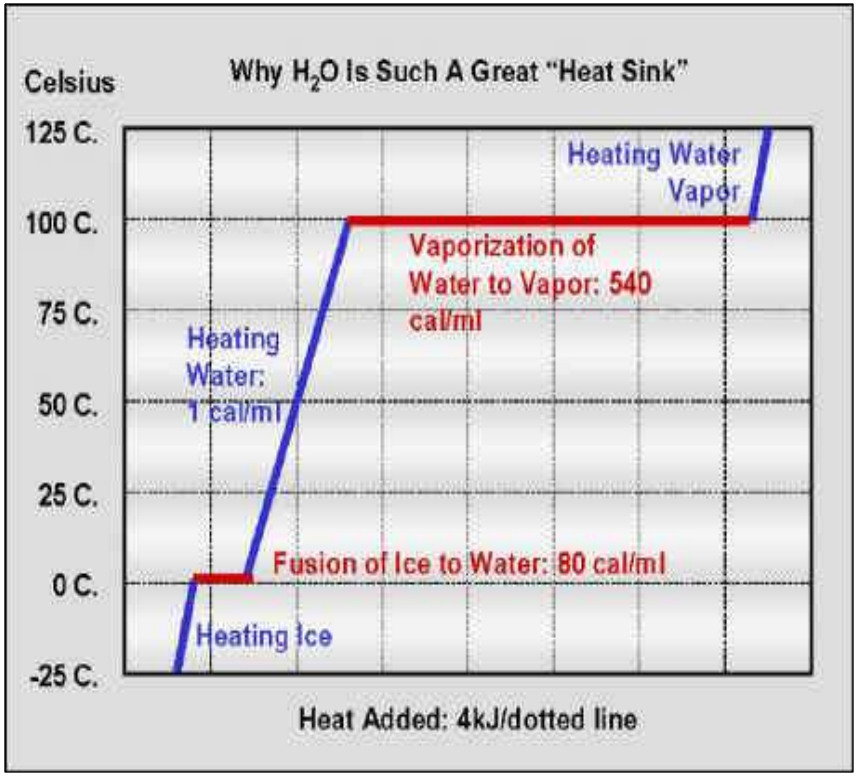


Phase Change Graph



Vaporization- Liquid to Gas

- Vaporization is the changing of a liquid to a gas when the substance absorbs heat energy.
- Vaporization occurring at the surface of a liquid is called evaporation.



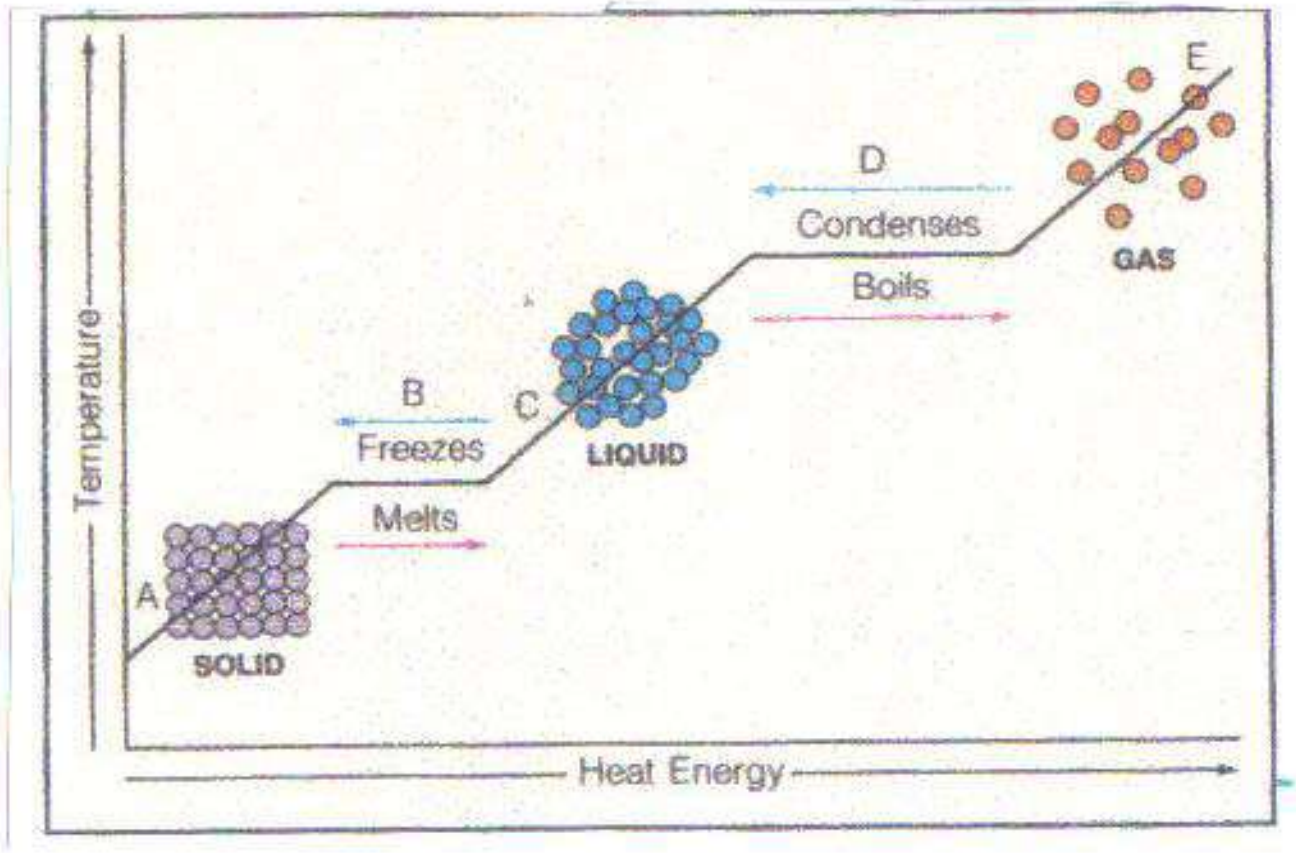
Evaporation- a Cooling Process

- As water in the perspiration evaporates from your skin it absorbs and carries away heat energy from your body.

Boiling

- If enough heat energy is applied to a substance particles inside the liquid can change to gas.
- These particles travel to the surface of the liquid and then into the air. This process is called boiling.

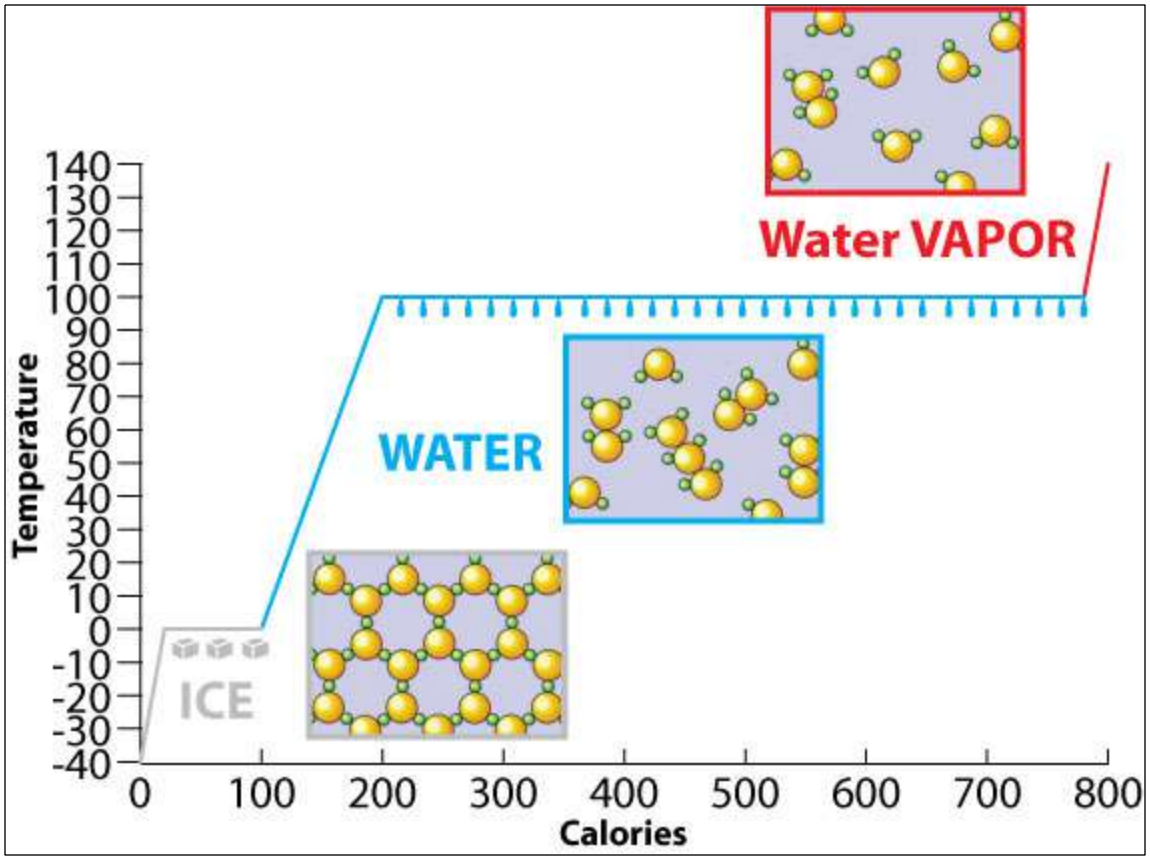
Phase Change Graph



Boiling Point

- Boiling Point – temperature at which a substance boils.
  - Water 100° C.
  - Table salt 1413° C.
  - Diamond 4200° C.
- What is the difference between evaporation and boiling?

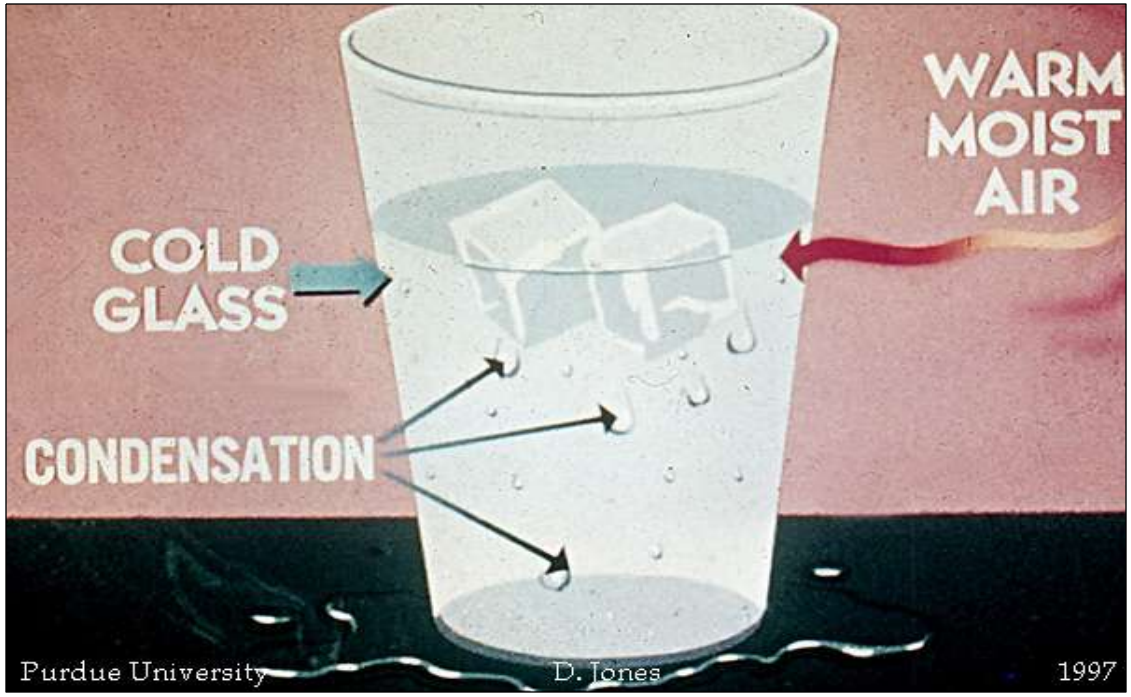
Water Phase Change Graph



Condensation- Gas to Liquid

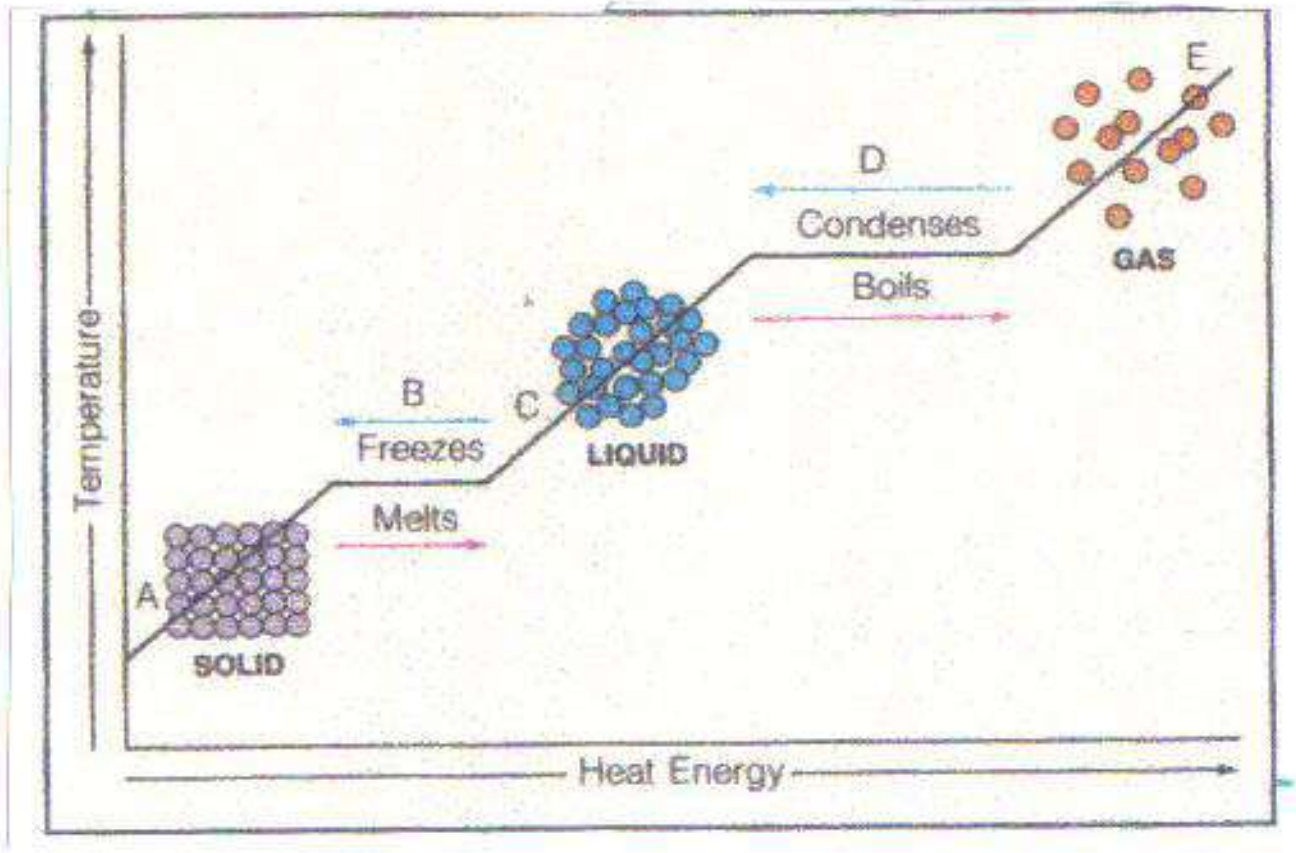
- Gases can change phase, also in a gas to liquid phase change.
- A substance in the gas phase that loses heat will change to a liquid. This is called condensation.

Condensation



- Water vapor in surrounding air loses heat energy when it comes in contact with the cold glass. Water vapor condenses and becomes liquid drops of water.

Phase Change Graph



Sublimation – Solid to Liquid

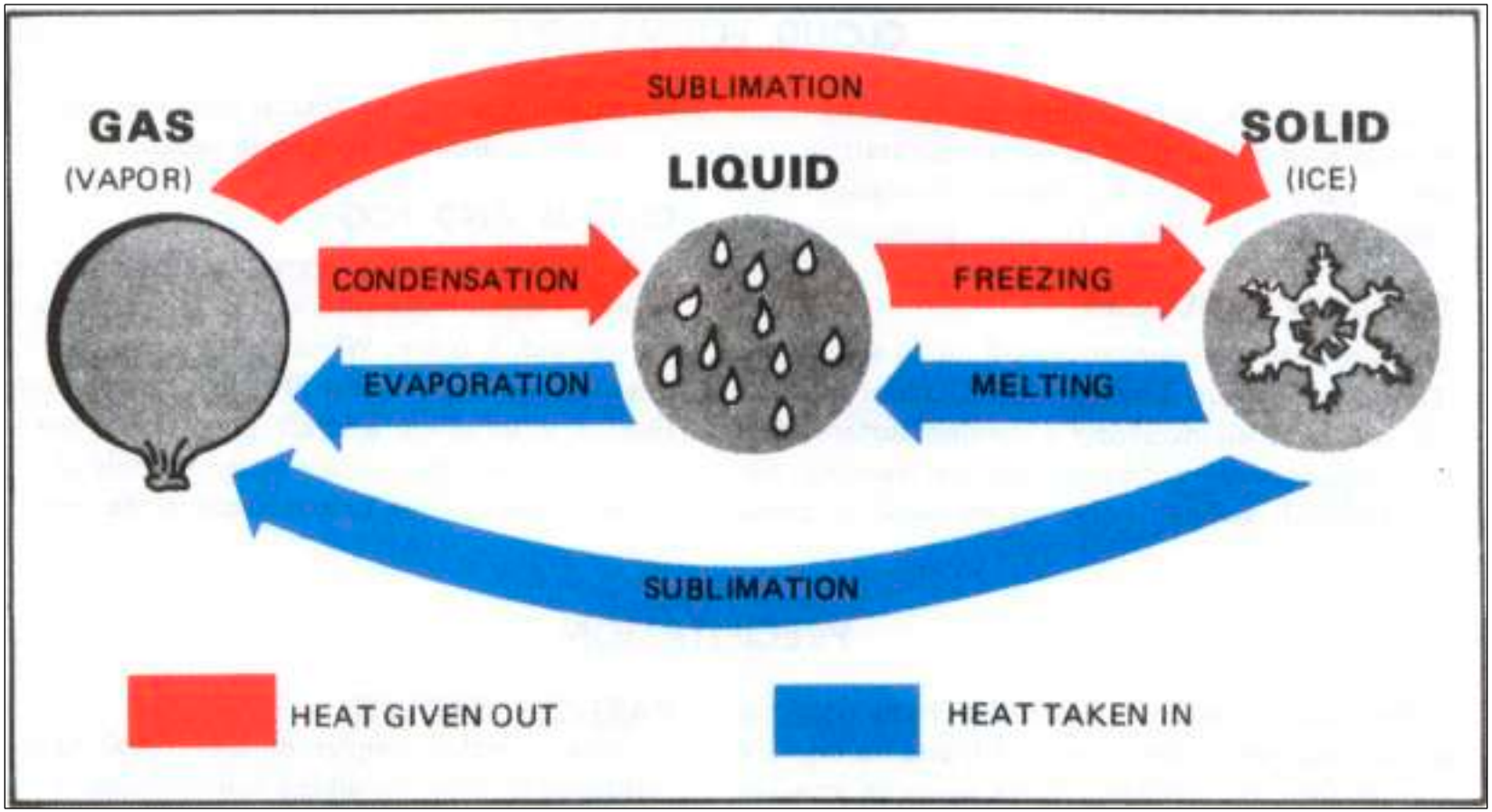
- Solid to gas phase change occurs when the surface particles of a solid change directly into a gas.

Sublimation – Solid to Liquid

- You may notice this in the cold winter with snow. The snow does not melt, but slowly disappears.
- Dry ice goes directly from solid carbon dioxide to gas.

http://www.youtube.com/watch?v=7_p9LOTUIDQ

Energy in Phase Change

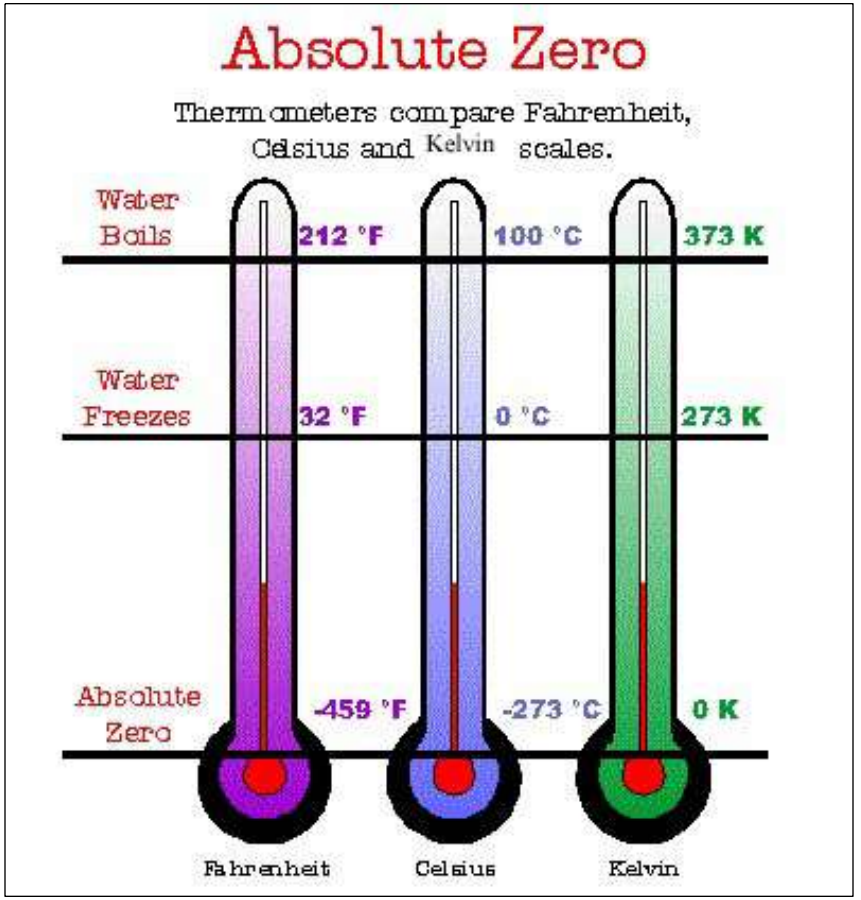


Phase Change

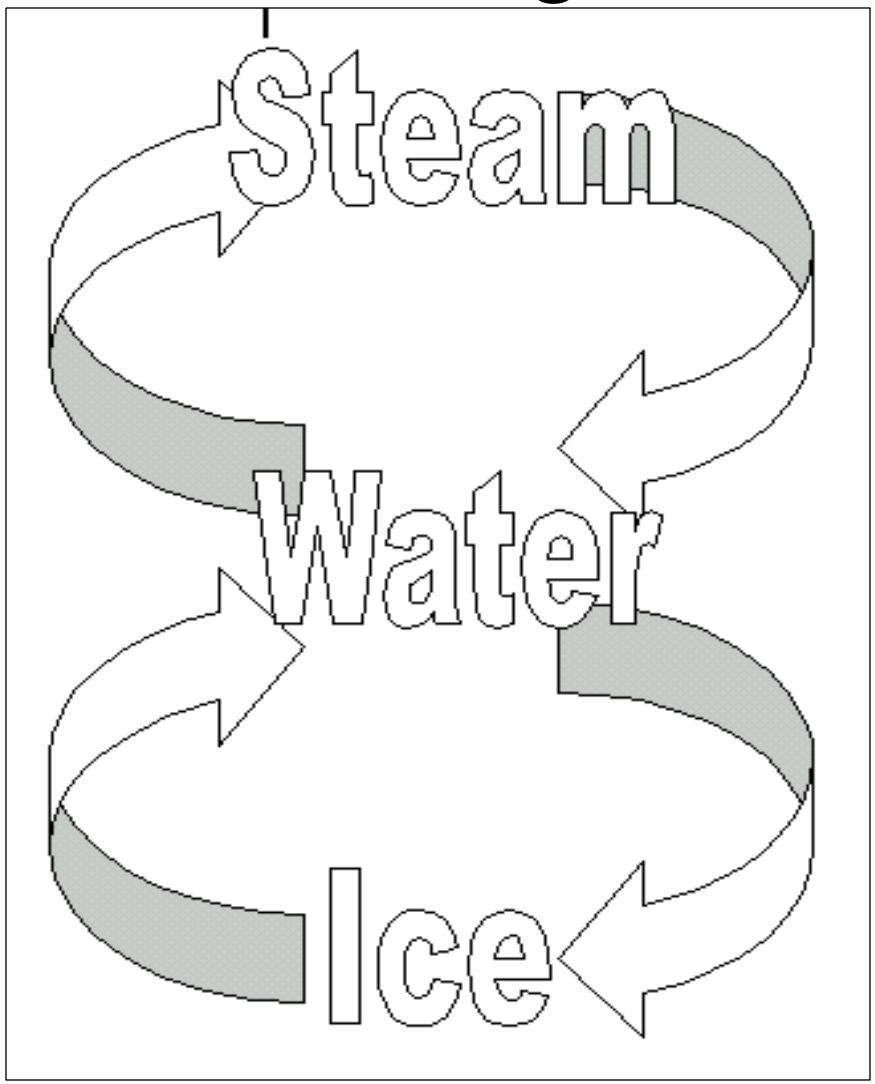
- Phase Change Diagram in Water

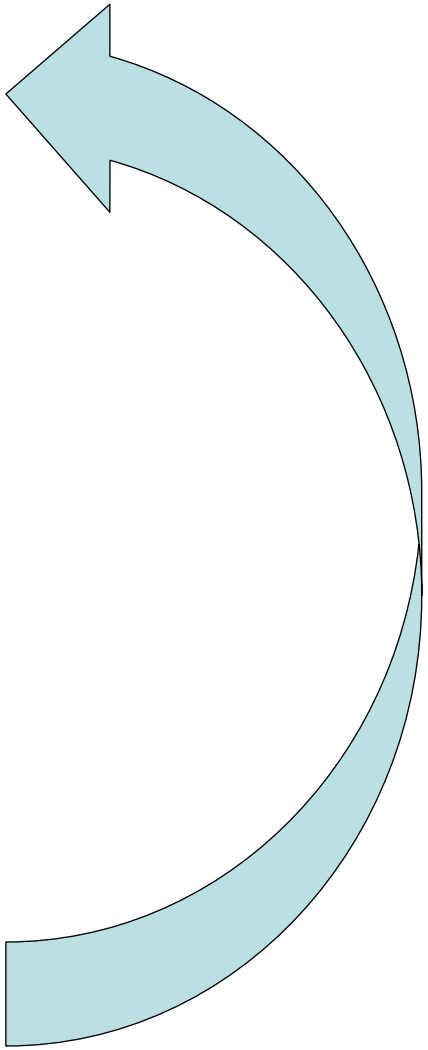
Temperature Comparisons

- Boiling Point of H_2O
  - -212° F
  - -100° C
- Melting Point of H_2O
  - 32° F
  - 0° C
- Freezing Point of H_2O
  - 32° F
  - 0° C



Add the correct terms to the diagram…





Phase Change Graph