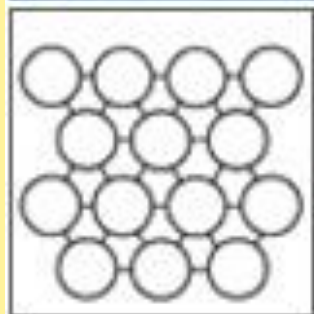


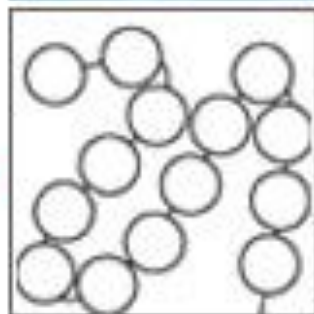
States of Matter

**What happens as matter
changes state?**

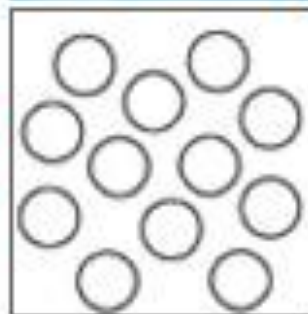
solid



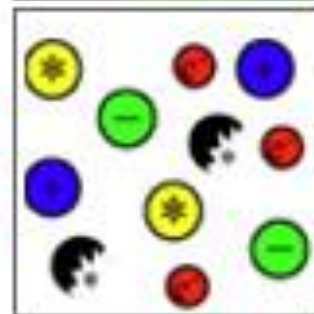
liquid





gaseous



plasma





 Energy/Temperature

 Molecule

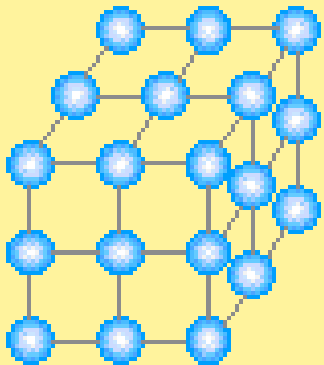
 Molecule (excited)

  Ions

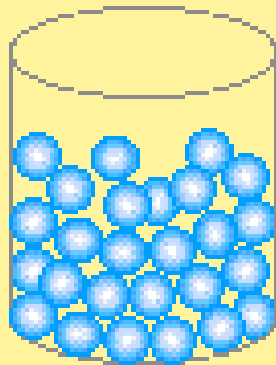
 Molecular fragment
(high energy)

 Free electron

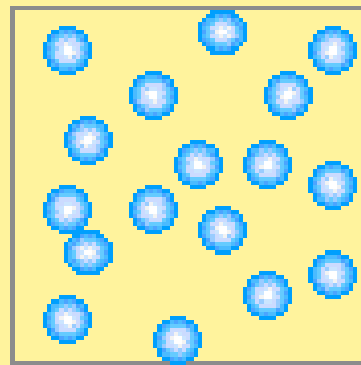
States of Matter



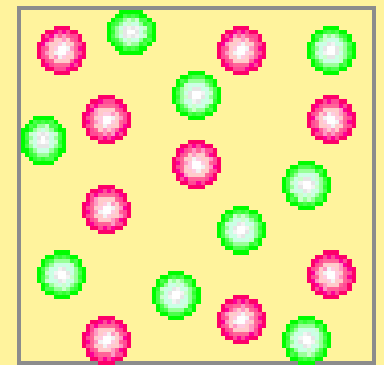
SOLID



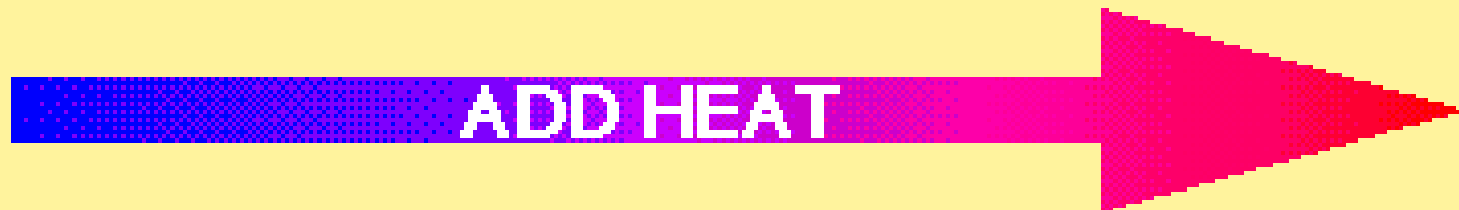
LIQUID



GAS



PLASMA



Solid

Example

Ice

H_2O

Cold

$T < 0^\circ C$



**Molecules
Fixed in
Lattice**

Liquid

Example

Water

H_2O

Warm

$0 < T < 100^\circ C$



**Molecules
Free to
Move**

Gas

Example

Steam

H_2O

Hot

$T > 100^\circ C$



**Molecules
Free to
Move, Large
Spacing**

Plasma

Example

Ionized Gas

$H_2 \rightarrow H^+ + H^+ +$
 $+ 2e^-$

Hotter

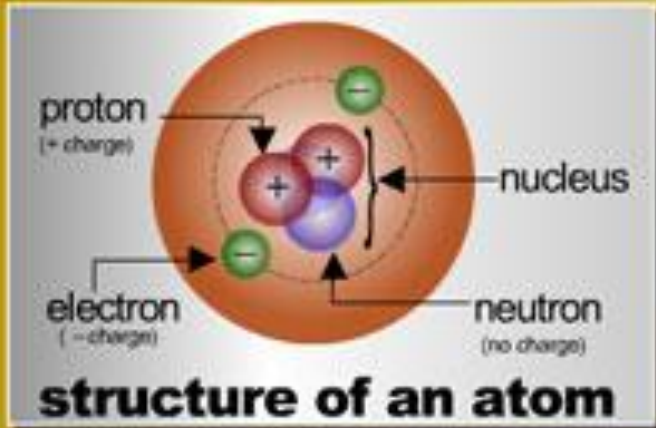
$T > 100,000^\circ C$

$I > 10$ electron
Volts

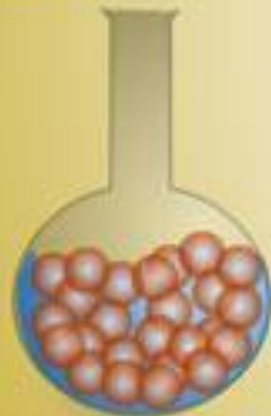


**Ions and
Electrons
Move
Independently,
Large
Spacing**

PHASES OF MATTER



Solid



Liquid



Gas

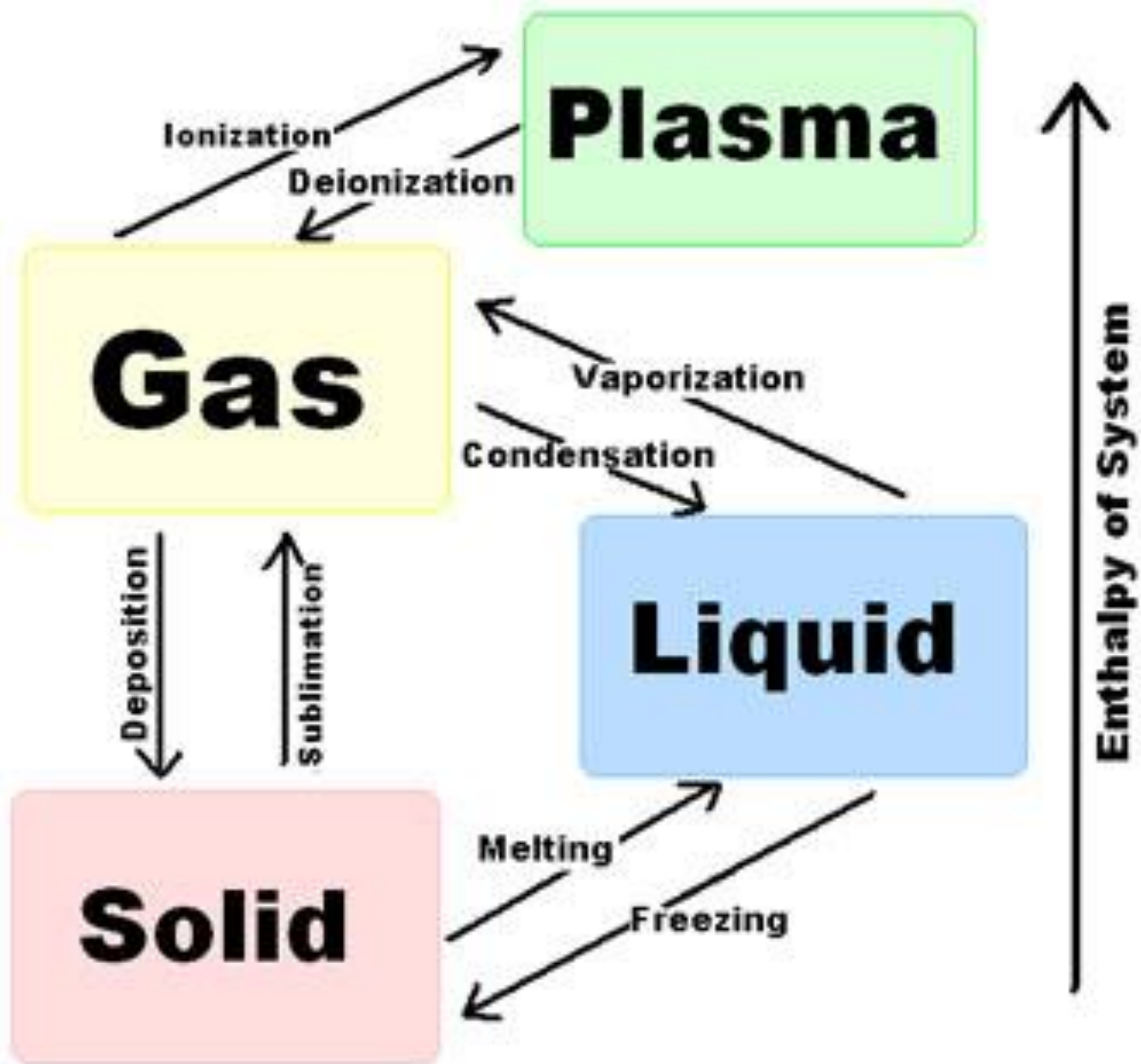


Plasma

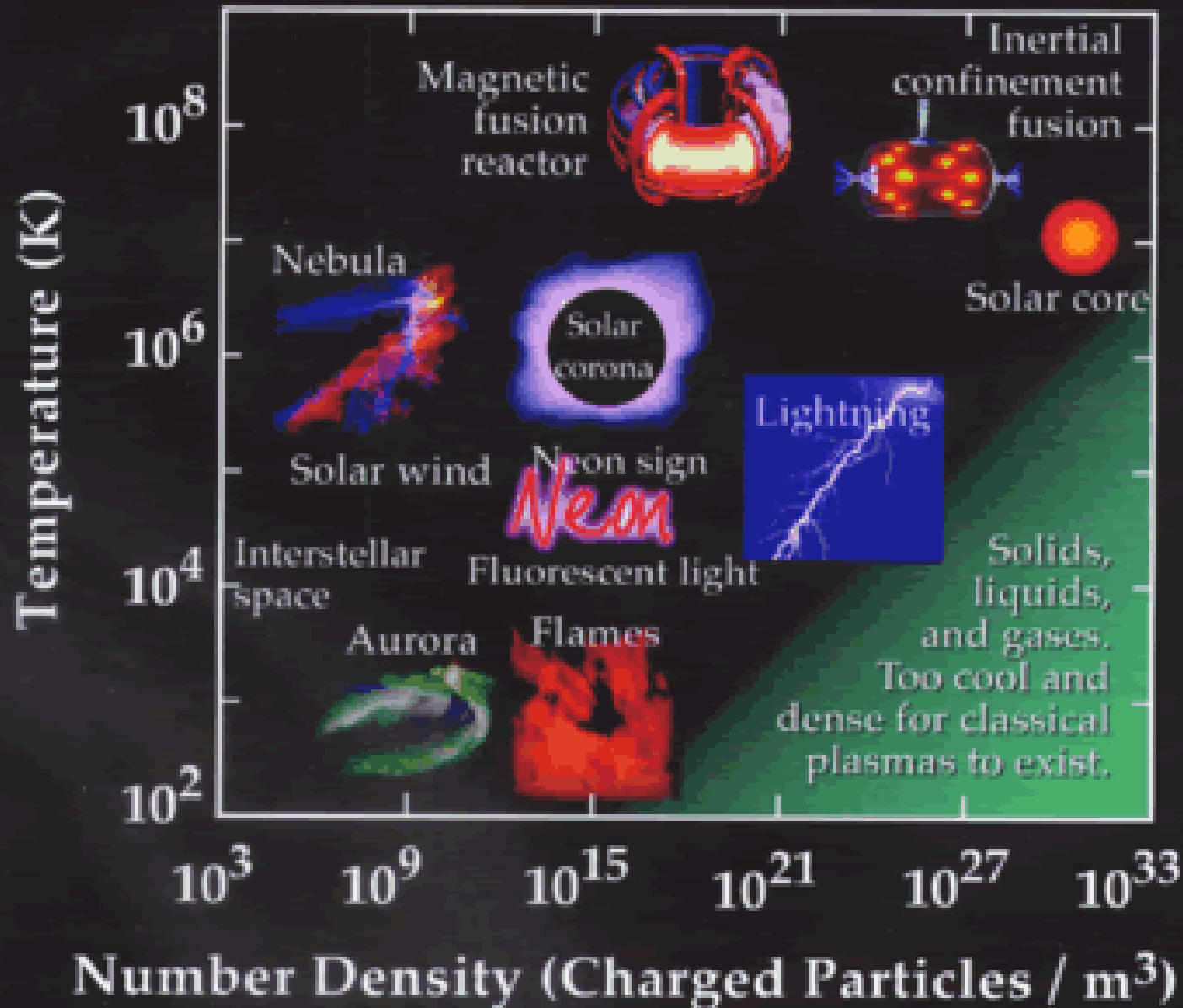
LOW

HIGH

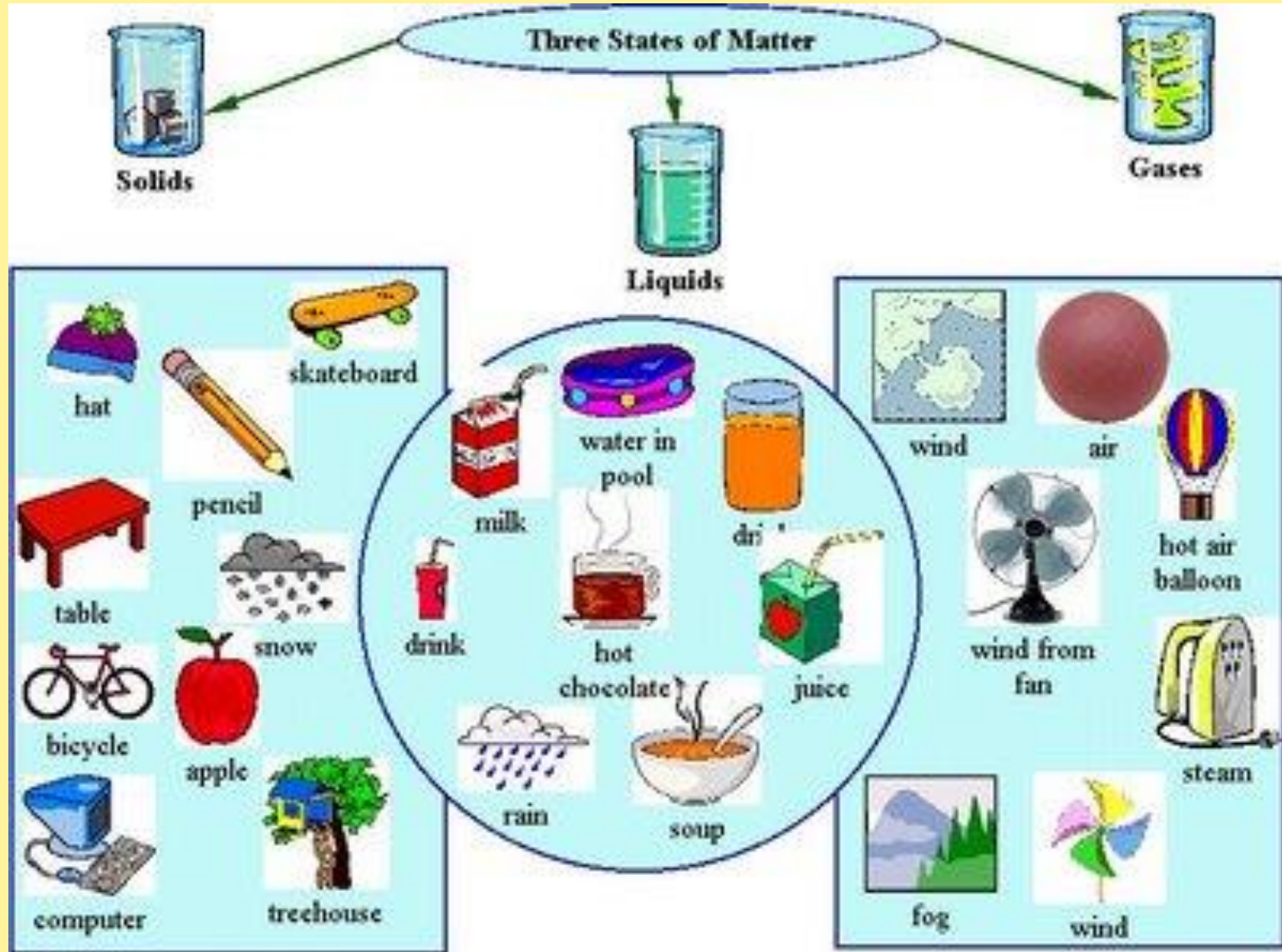
Temperature or Energy

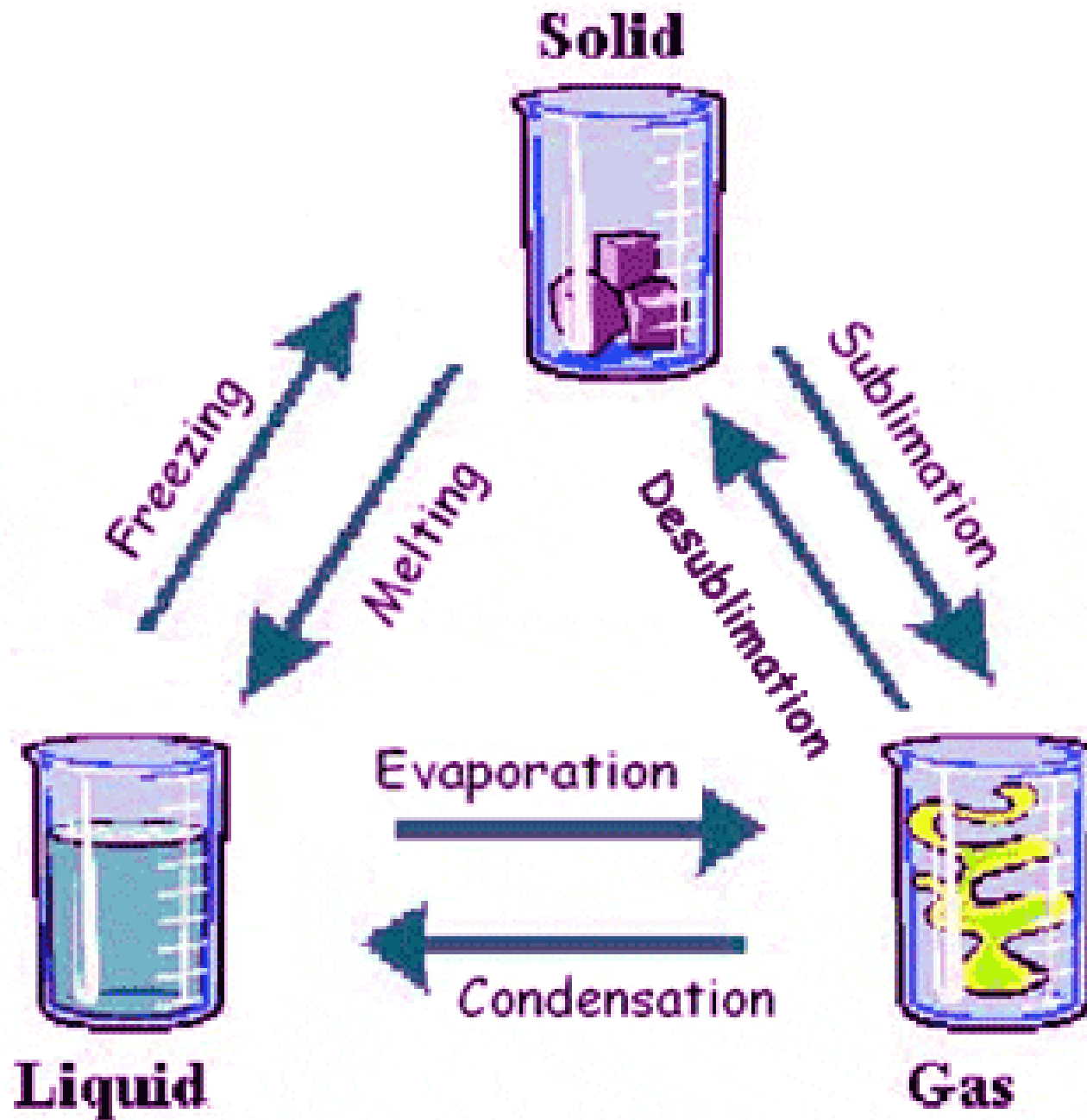


Plasmas - The 4th State of Matter



Plasma is interesting, but let's focus more on the 3 states of matter we encounter on a daily basis.





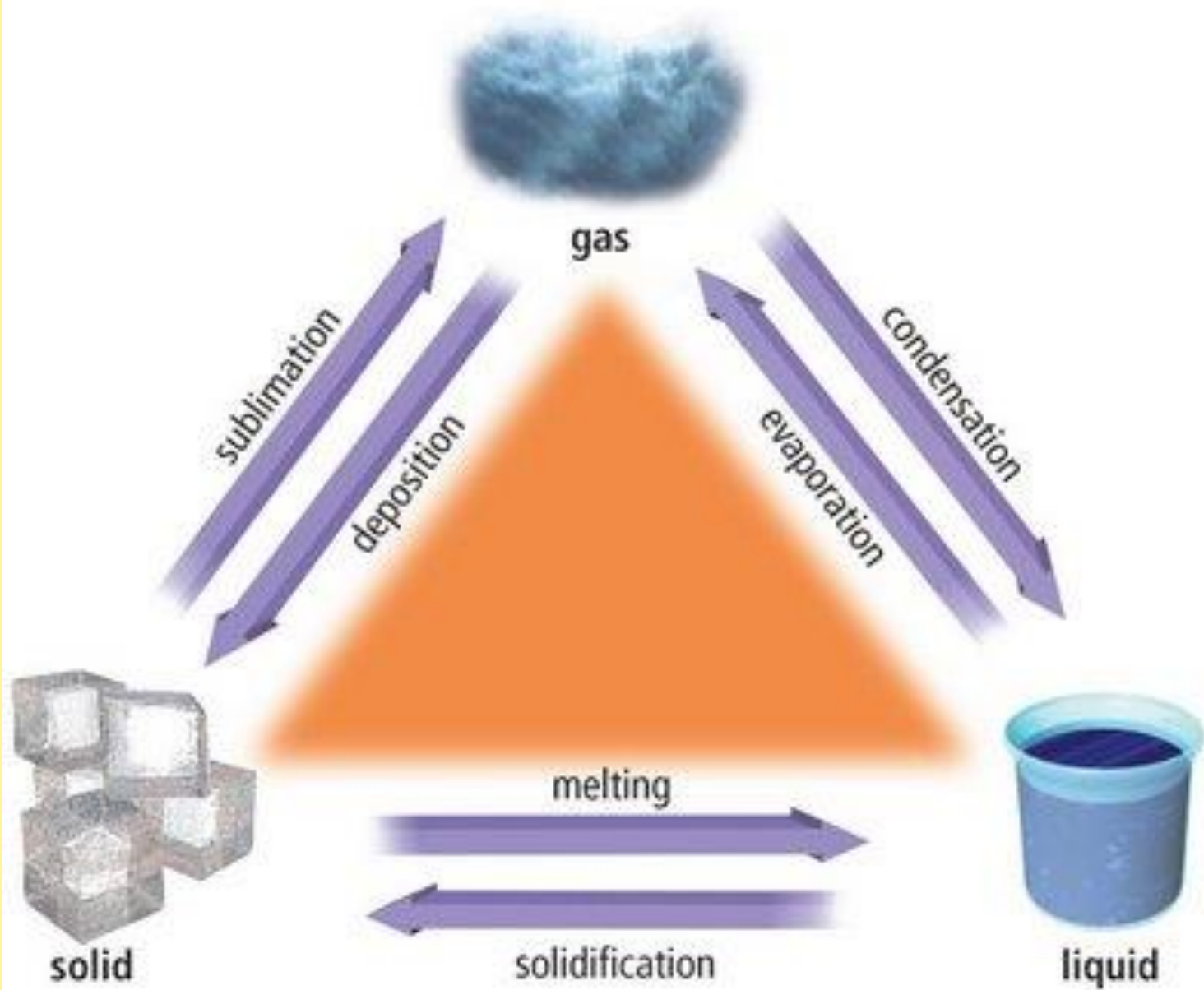
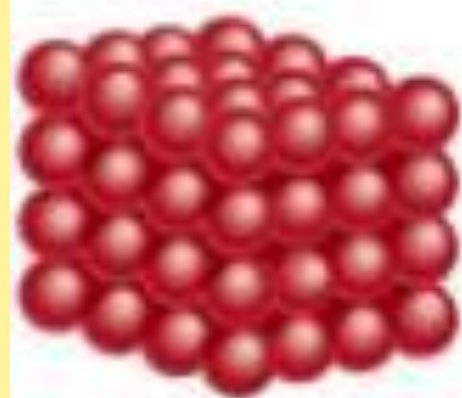
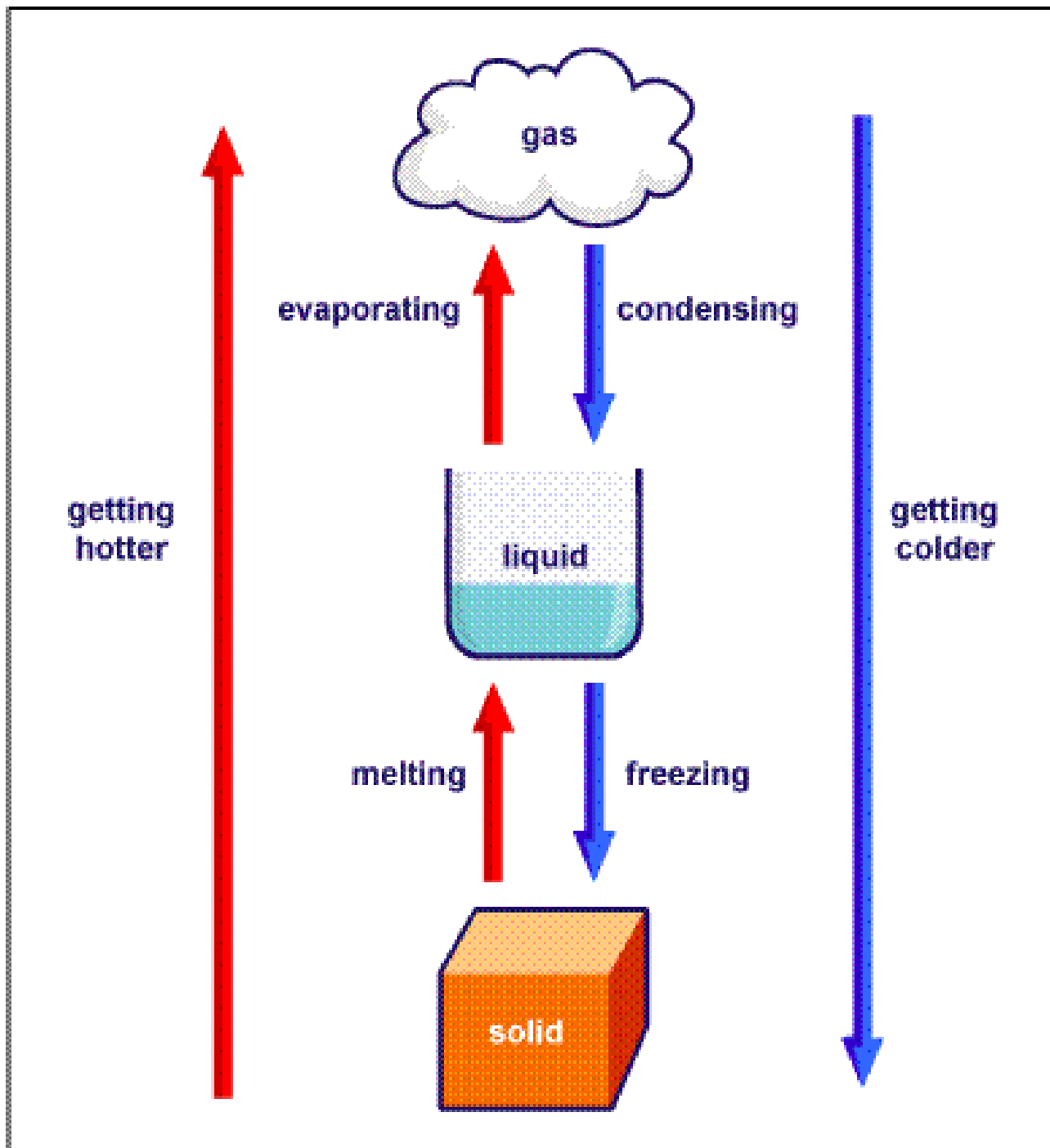


Figure 7.5A Changes of state

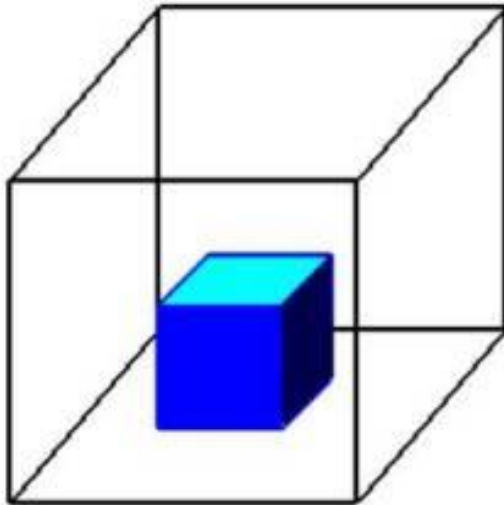






Phases of Matter

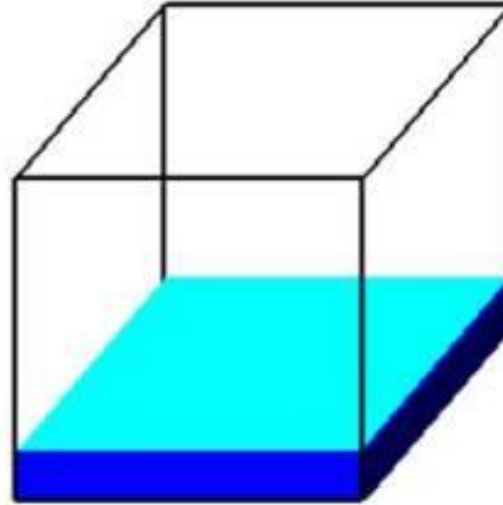
Glenn
Research
Center



Solid

Holds Shape

Fixed Volume

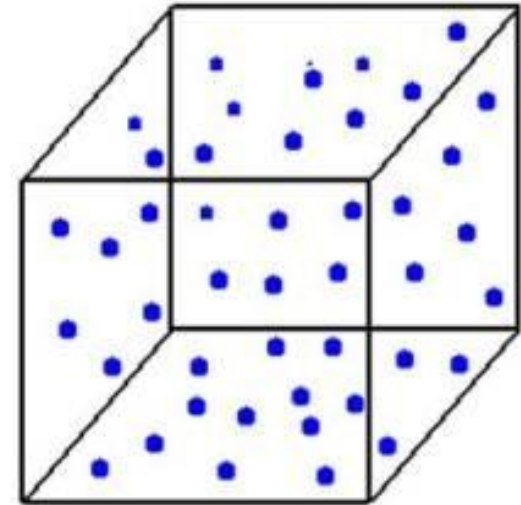


Liquid

Shape of Container

Free Surface

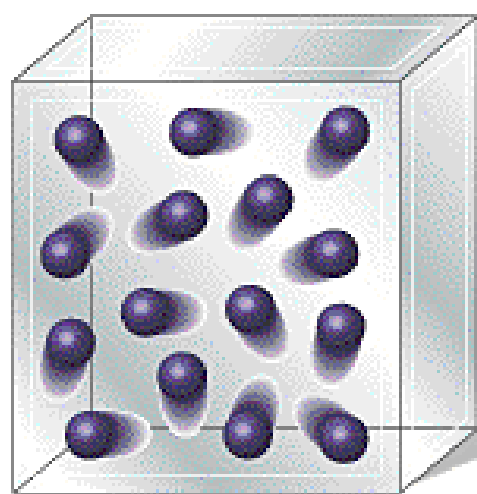
Fixed Volume



Gas

Shape of Container

Volume of Container



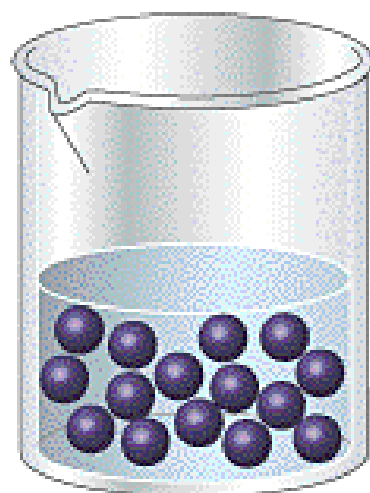
Gas

Total disorder; much empty space; particles have complete freedom of motion; particles far apart.

Cool or
compress



Heat or
reduce
pressure



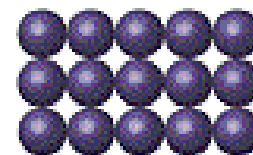
Liquid

Disorder; particles or clusters of particles are free to move relative to each other; particles close together.

Cool



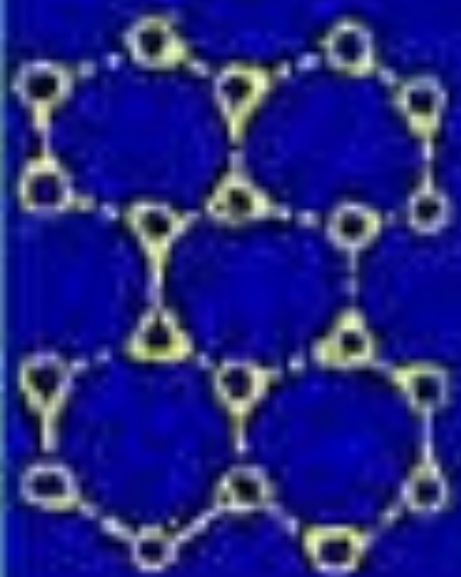
Heat



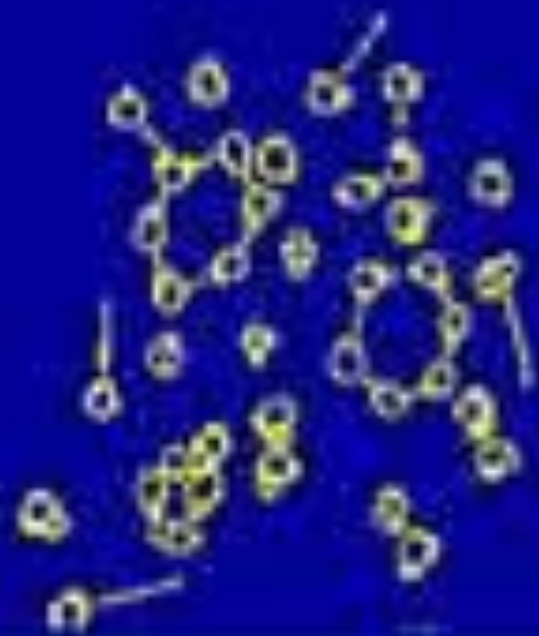
Crystalline solid

Ordered arrangement; particles are essentially in fixed positions; particles close together.

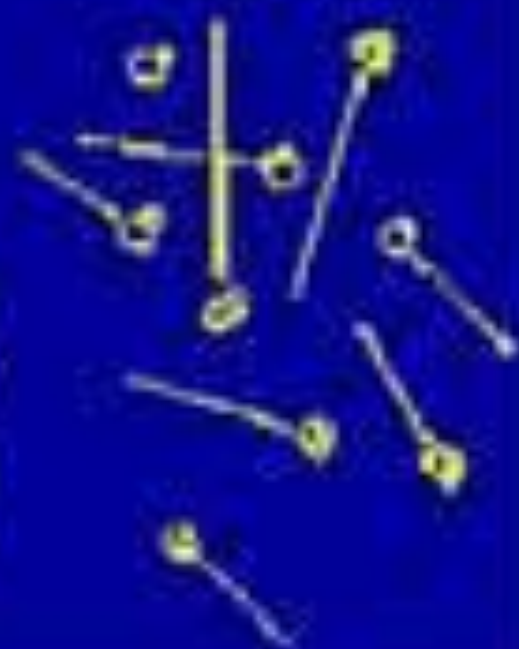
SOLID



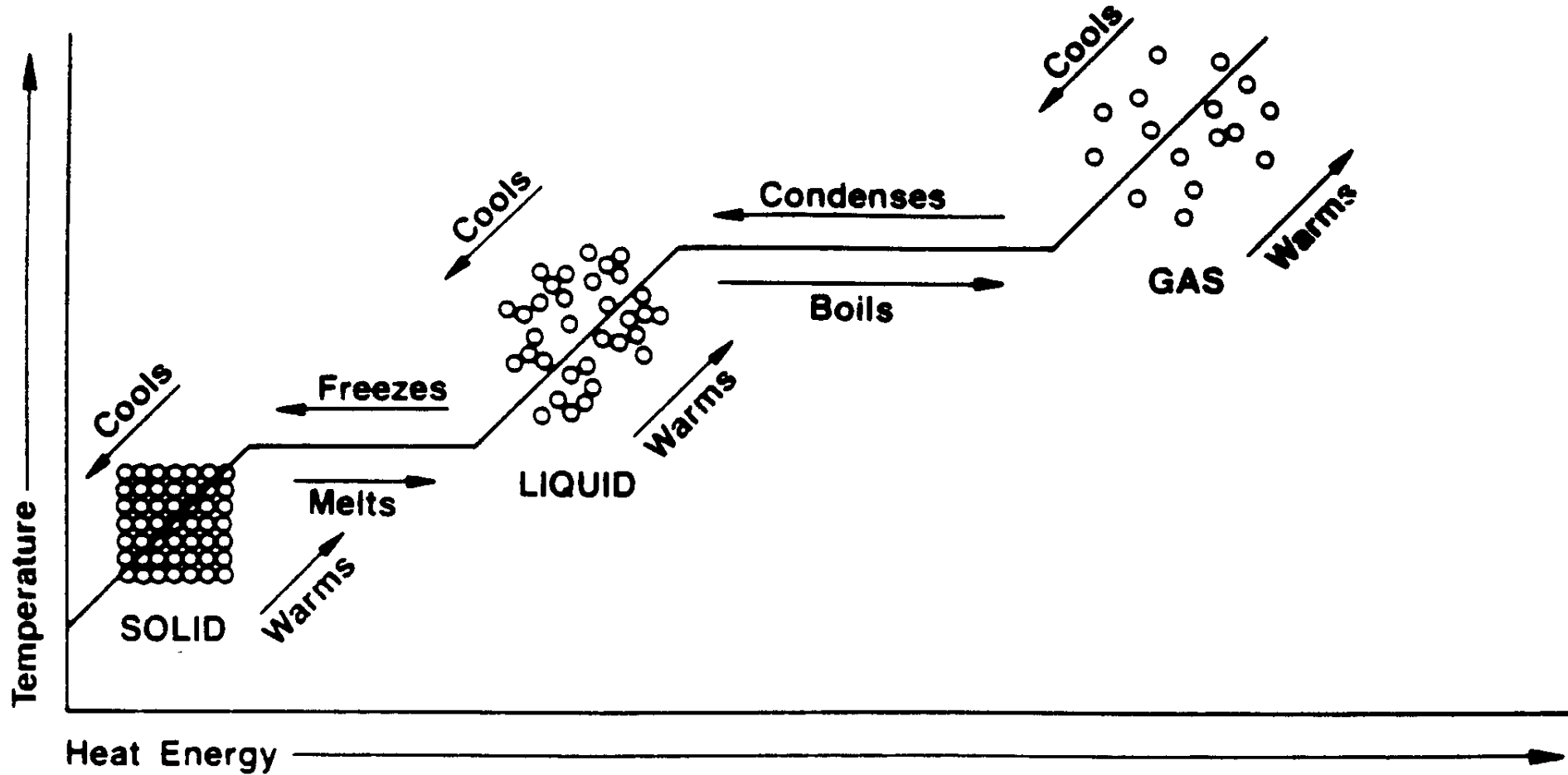
LIQUID



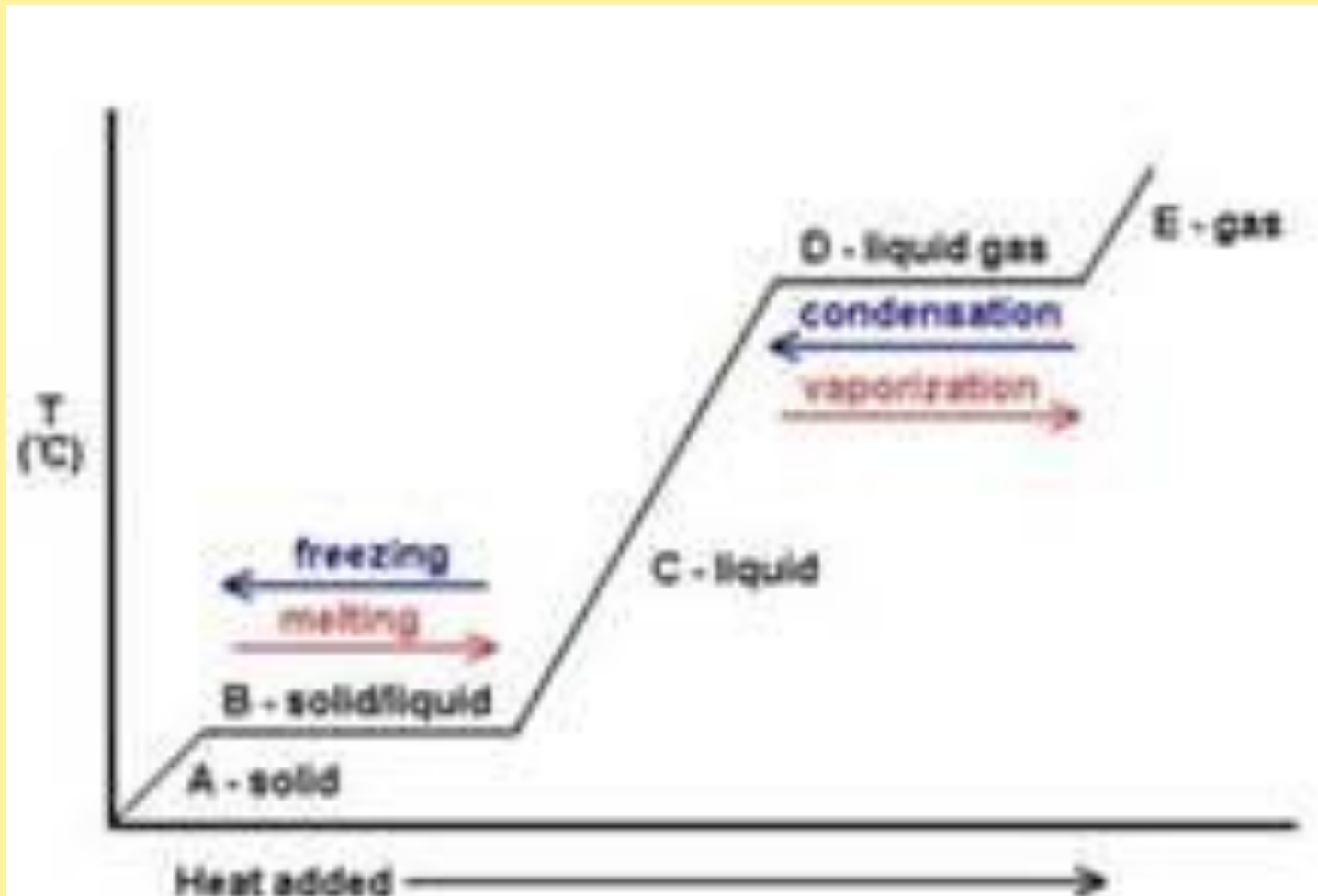
GAS

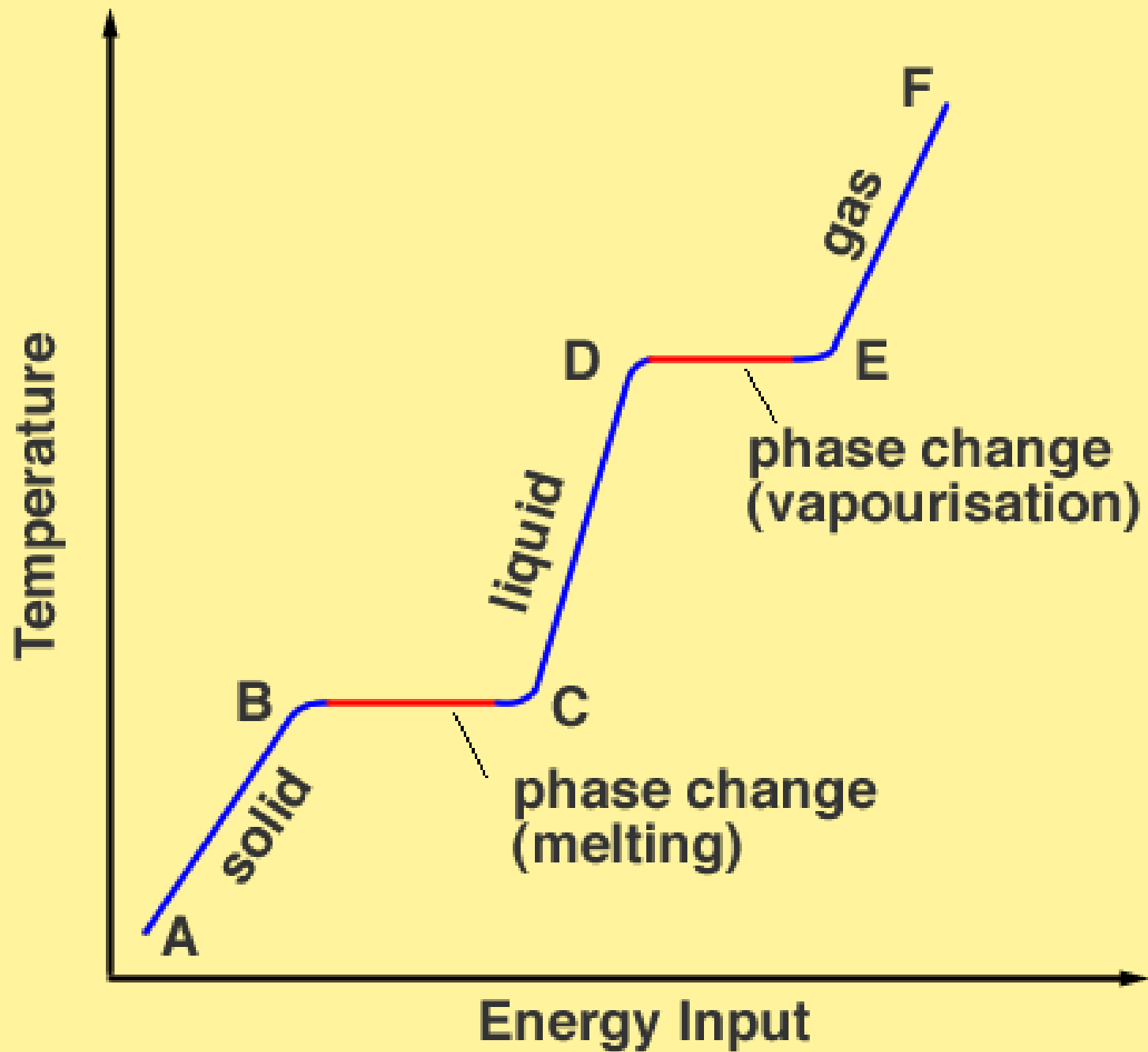


You must know this!



Phase Change Diagram...





**Analyze this
picture of a glass
of root beer
poured over ice.**

What is the solid?

What is the liquid?

What is the gas?

