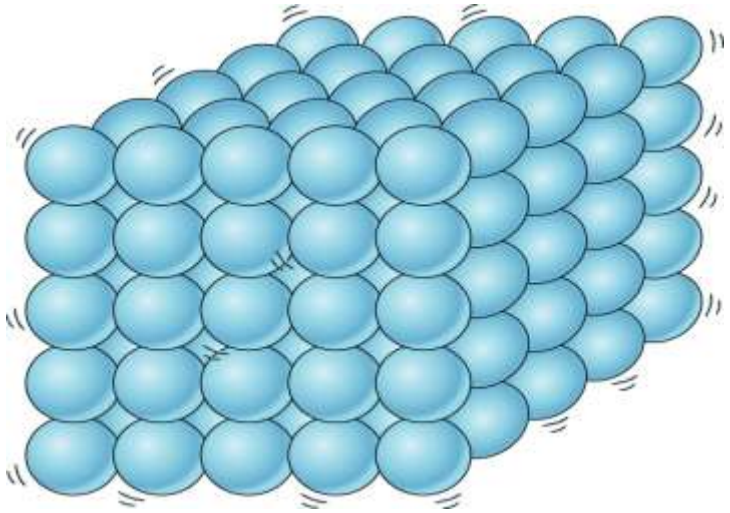
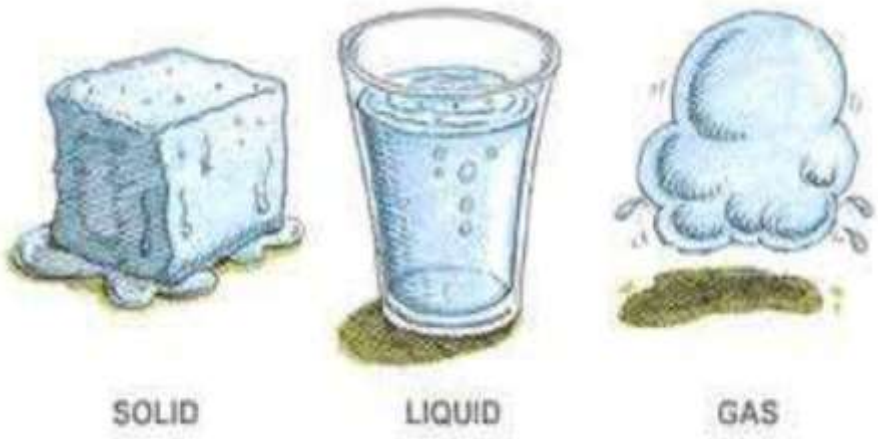


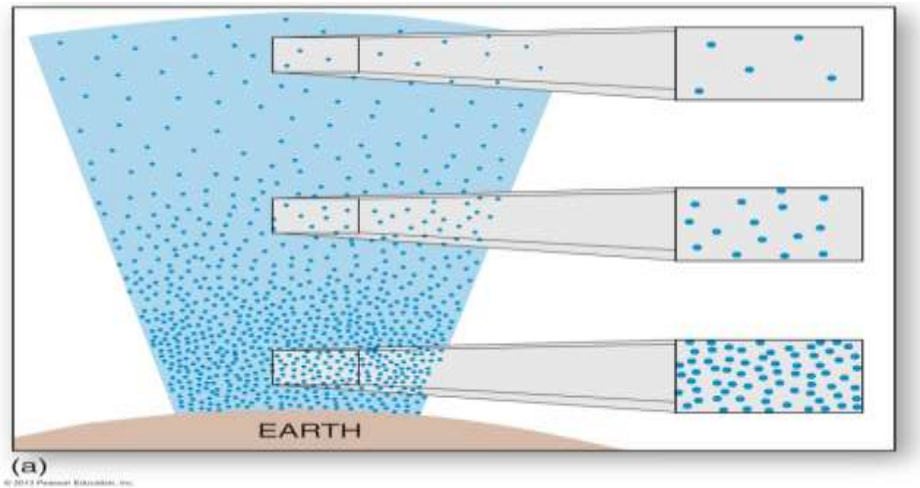
PART 3: PARTICLE MODEL of MATTER

SOLIDS, LIQUIDS, GASES

DENSITY

PRESSURE

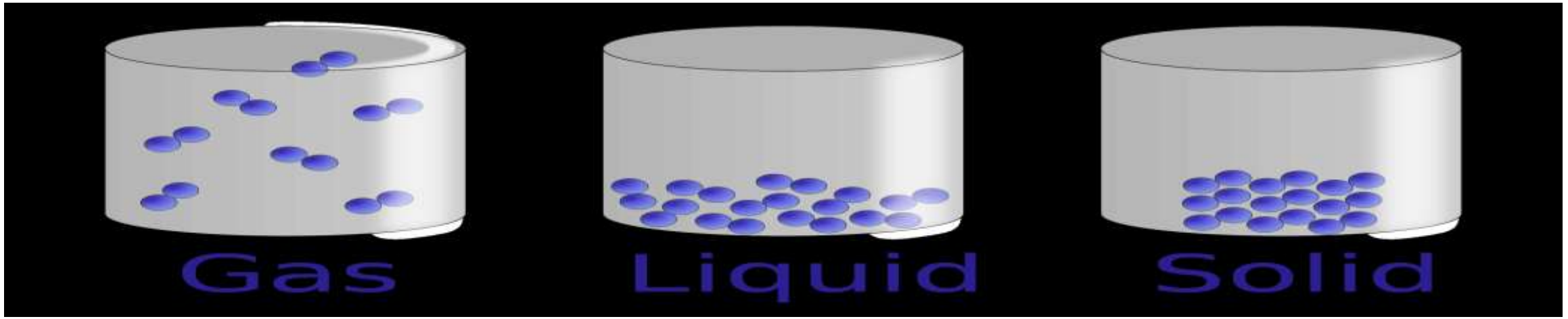




PARTICLES

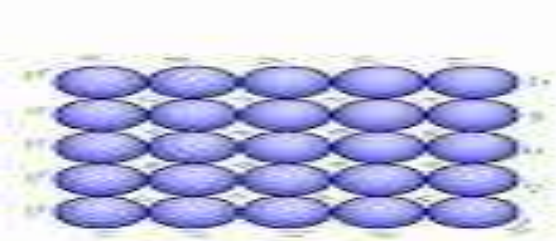
1. All non-living **MATTER** (solids, liquids and gases) is made up of microscopic particles called **atoms** and **molecules**.
2. The atoms of **one** substance will be a little different from the atoms of **another** substance.
3. These tiny particles all attract each other.
4. They also have energy, and are **moving** all the time.
5. **Hotter particles** have **more energy**, and so will **move faster** than colder particles.

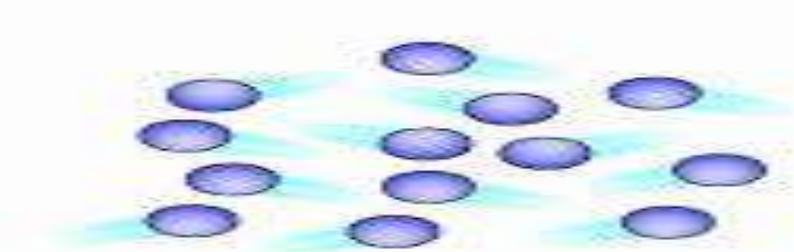
SOLIDS, LIQUIDS, GASES

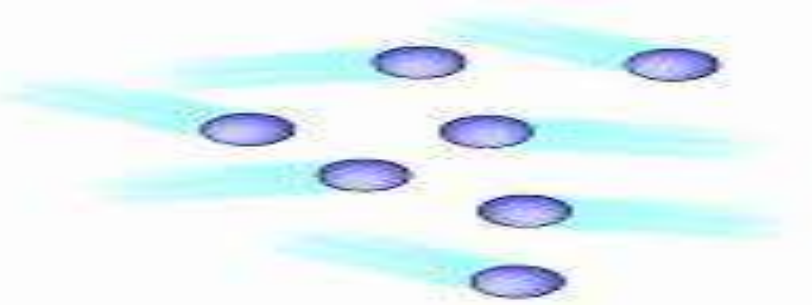


- Ice is frozen (solid) **water**. Steam is **water** vapour (gas). All three phases have the same chemical formula: **H2O**. So . . . what is **different** about them? ***Answer: Energy!***
- To get liquid water into steam, you **heat** it up. You are **adding energy** to the water particles. So they are **moving around faster**, and are **making big spaces** around themselves. **That's** how it becomes a gas.
- To get water into ice, you **cool** it down. You **take energy away** from these water particles. So they are **moving around slower**, and can only **make tiny spaces** between them. **That's** how it becomes a solid.

THEIR CHARACTERISTICS

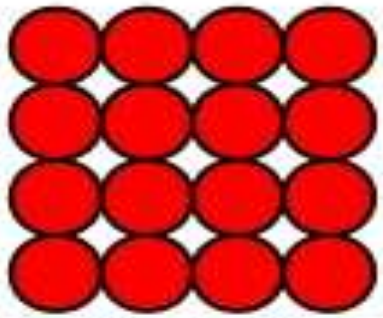






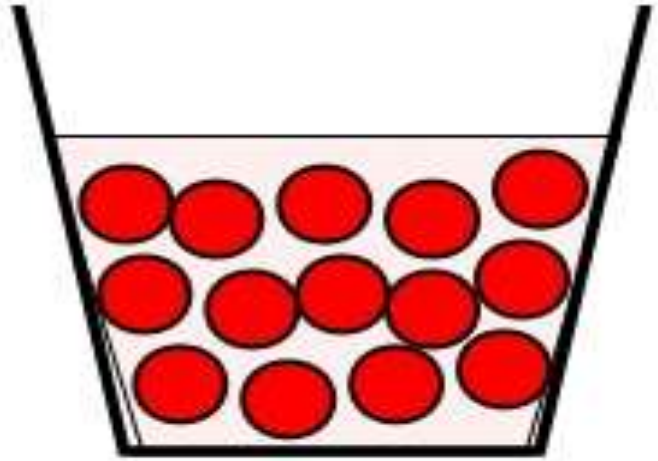
SOLIDS	LIQUIDS	GASES
Particles closely packed.	Particles loosely packed.	Particles move freely.
Strong forces hold them.	Are forces, but much weaker.	Forces not at all strong.
Keep their own shape.	Shape of their part of that container.	Shape of closed container.
Only enough energy to vibrate.	Enough energy to make spaces.	Enough energy to move fast.
Stays fixed in its own shape.	Can flow past each other.	Move around with no difficulty.

SOLIDS



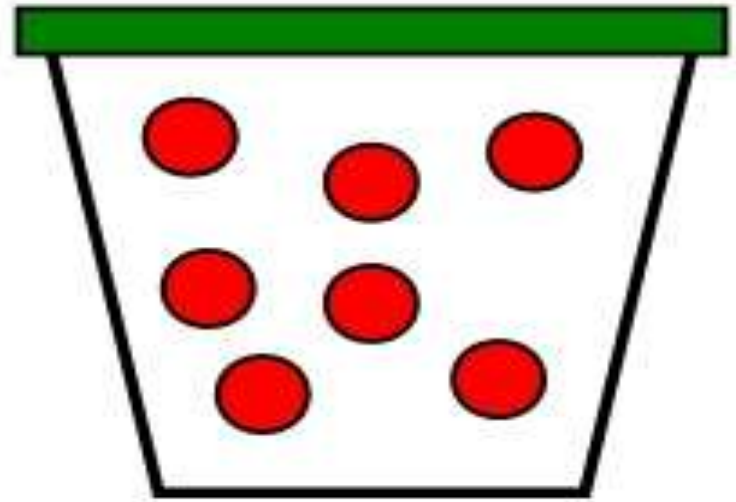
The molecules are held together with strong bonds. They don't move very easily so SOLIDS can keep their own shape and size

LIQUIDS

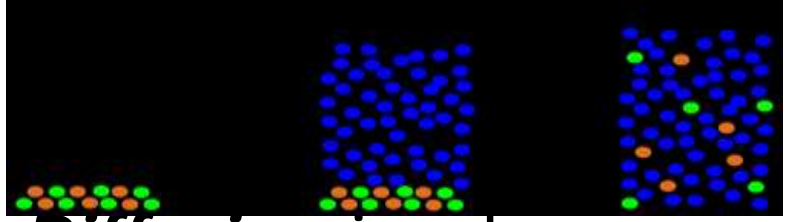


The molecules have weaker bonds. They can move around slightly so LIQUIDS can flow. They can't keep their shape unless they're in a container.

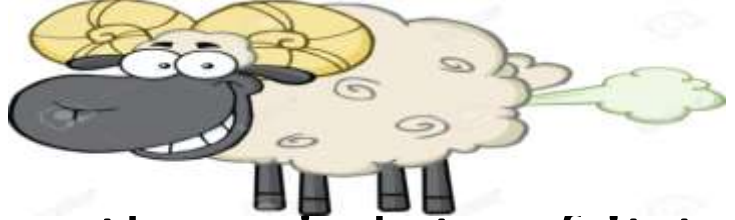
GASES



The molecules are free to move around. They can spread around an open space quickly and freely. GASES can't keep their shape unless they are kept in a *sealed* container.



DIFFUSION

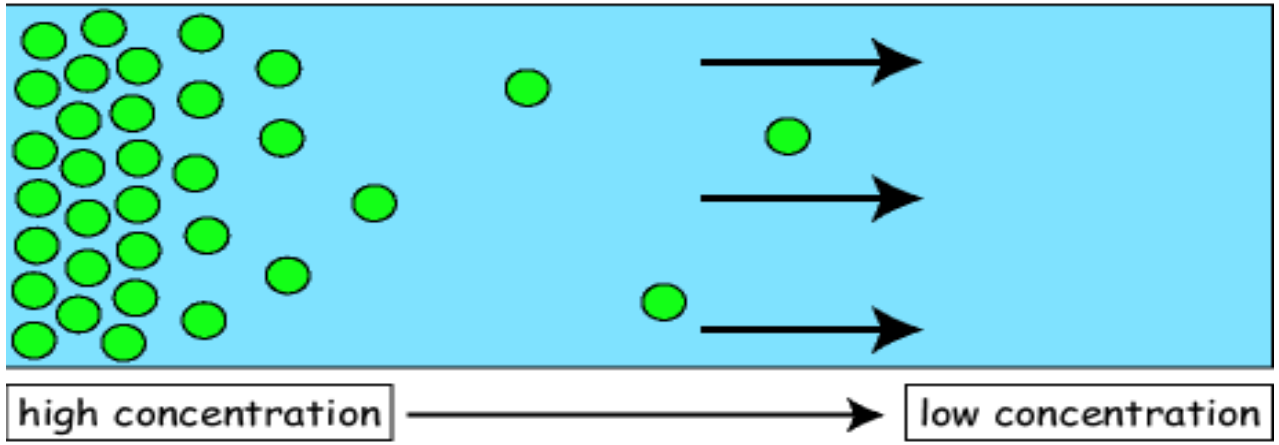


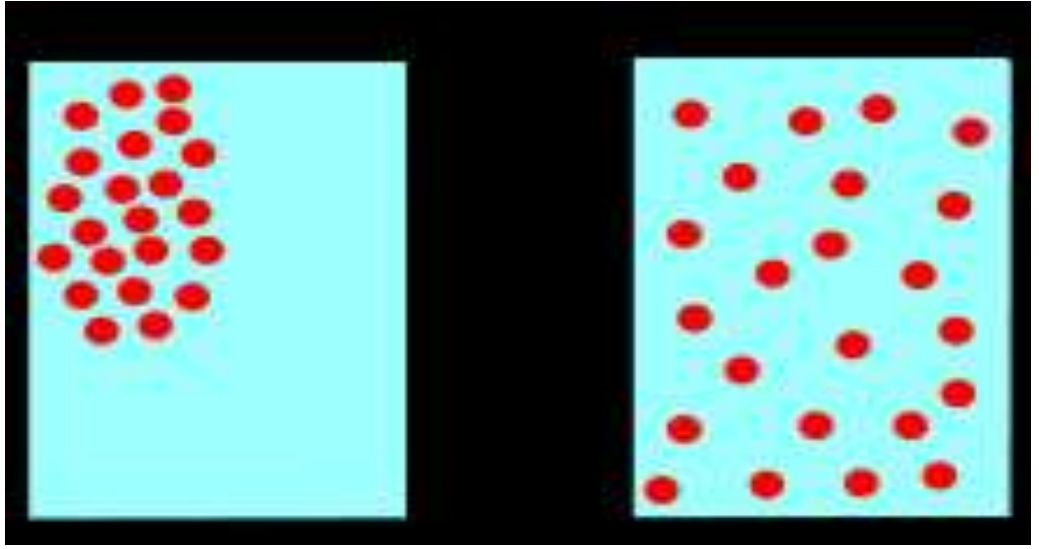
Diffusion is when something moves <u>from</u> where there is lots of it <u>to</u> where there is less of it, <u>until it is the same</u> amount all round.

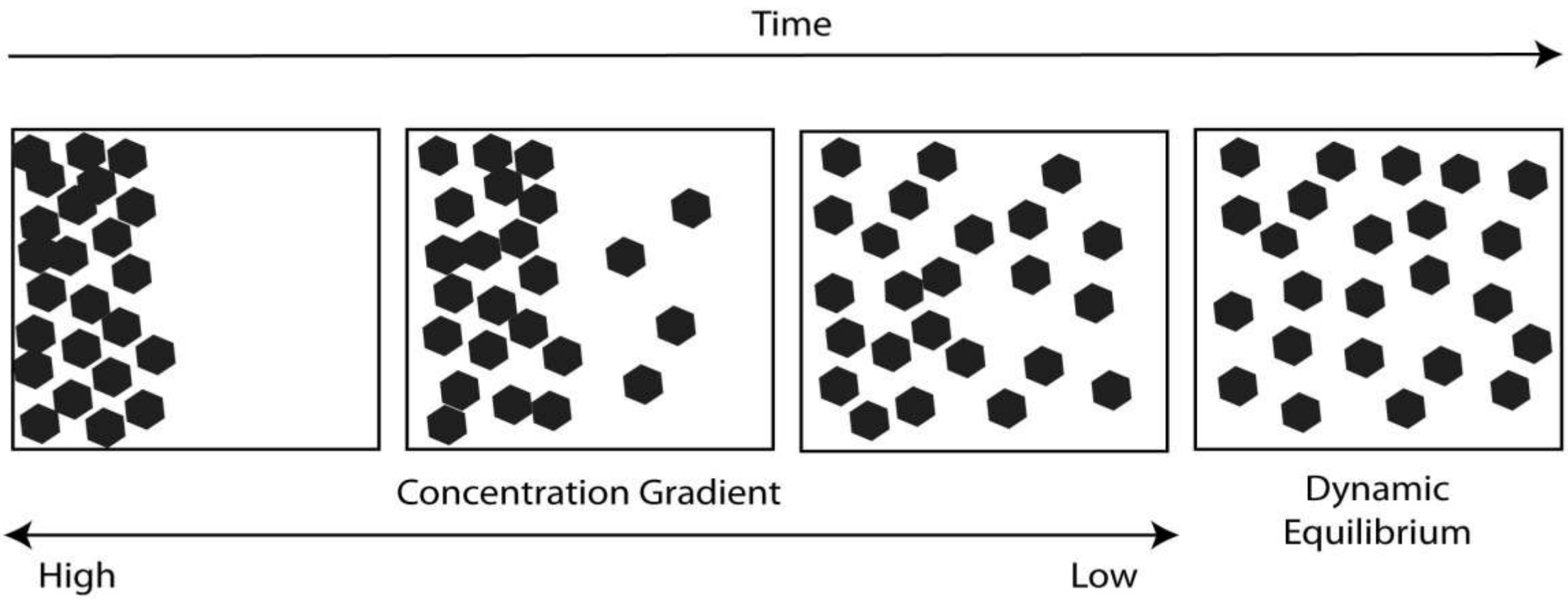
<u>So</u>: It moves from an area of higher concentration to an area of lower concentration, until equilibrium is reached.

1. **In gases** – if our baked-beans-eater sits in the front corner of our classroom and farts all morning, that smell will gradually move out from him/her until everyone in the classroom can smell it. These gases have **<u>moved</u>** by means of diffusion **from** where there is lots of it **to** where it is less.
2. **In liquids** – if you pour a spoonful of Oros into a glass of water and wait long enough, that Oros will eventually spread <u>evenly</u> through the whole glass, by means of diffusion.

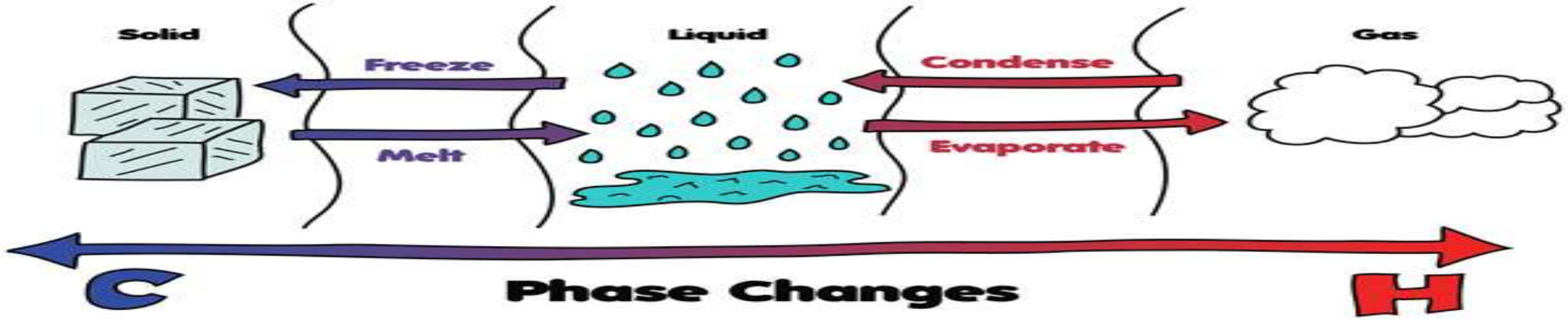
   (So do **not** urinate in the bath – it spreads!)
3. **In solids** – diffusion can**not** happen in solids. ***Why not***?


high concentration
low concentration
solute

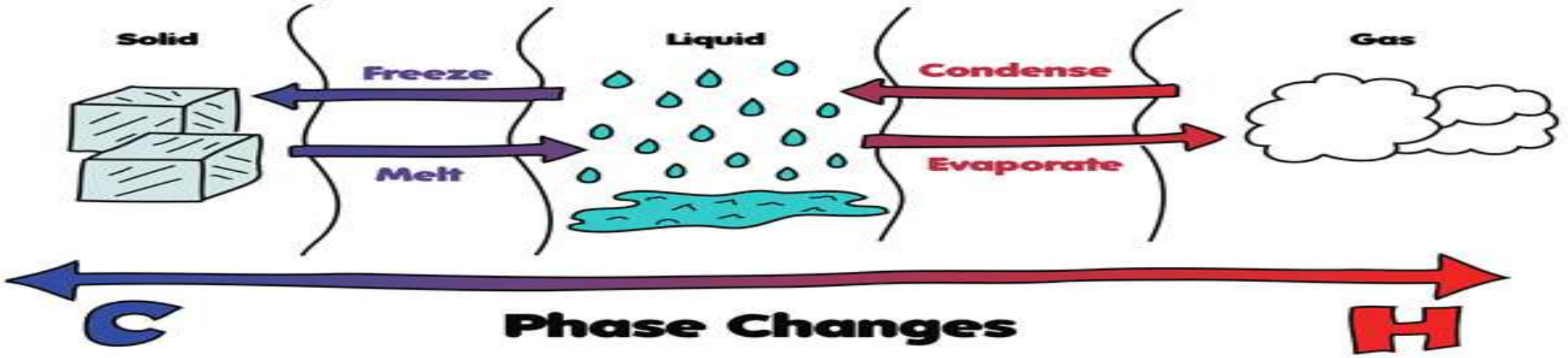



Time
Concentration Gradient
High
Low
Dynamic Equilibrium

CHANGING PHASE/STATE



- Water is **liquid** between 0°C and 100°C.
- 0°C is **freezing point**. So liquid water **at 0°C** becomes solid water (ice) **at 0°C**.
- In the same way, 0°C is **melting point**. Because solid water (ice) **at 0°C** becomes liquid water **at 0°C**.
- So if you add heat to ice, its temperature increases steadily. . .
- . . . but when it gets to 0°C, you keep adding heat energy, but the **temperature** cannot get higher until all the ice has melted into **liquid at 0°C**.



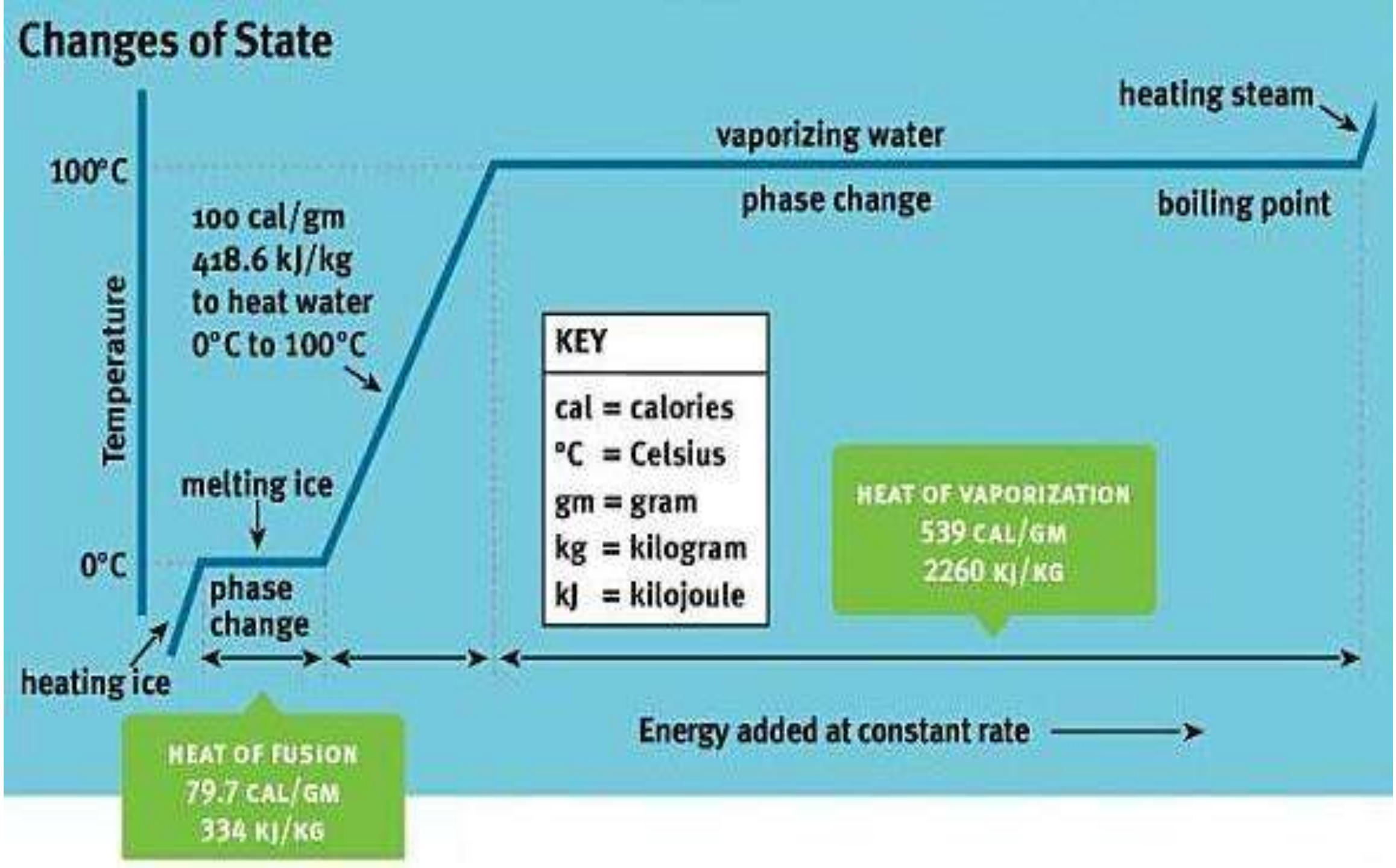
- Now, if you keep adding heat to this water, its temperature rises steadily. . .
- . . . but when it gets to 100°C, you keep adding heat energy, but the temperature can**not** rise until all the water has boiled (<u>evaporated</u>) into **gas at 100°C**.

<u>The same principle applies</u> if you **cool** a gas into a liquid (<u>condens-ation</u>), and if you then **cool** that liquid into ice (<u>freeze</u> it).

Use this information to explain the next graph (on page 26).

<u>*Sublimation*</u> = a solid with bonds so weak it can be heated straight into a gas, without becoming a liquid first – like *dry ice* (which is *frozen carbon dioxide)*.

<u>*ReSublimation*</u> = a gas cooled directly into a solid (with no liquid).


Changes of State
heating steam
vaporizing water
100°C
phase change
boiling point
100 cal/gm
418.6 kJ/kg
to heat water
0°C to 100°C
Temperature
KEY
cal = calories
°C = Celsius
gm = gram
kg = kilogram
kJ = kilojoule
melting ice
HEAT OF VAPORIZATION
539 CAL/GM
2260 KJ/KG
0°C
phase
change
heating ice
HEAT OF FUSION
79.7 CAL/GM
334 KJ/KG
Energy added at constant rate

QUESTIONS (Pages 83-84)

Question 1 [5]

- All matter is made of **particles** called atoms.
- Each type of atom is **different** from the others.
- Particles **attract** each other.
- Particles are always **moving**.
- The **hotter** they are, the **faster** they move.

Question 2 [10]

Characteristic	Solids	Liquids	Gases
Arrangement	Fixed, regular	LOOSE	SPREAD
Forces	STRONG	Weak	VERY WEAK
Shape	FIXED	CONTAINER	Not fixed
Spaces	Very small	CLOSE	LARGE
Movement	SLOW	Fast	VERY FAST

-

Question 3

1. Diffusion: Movement of particles from where it is in high concentration to where it is in low concentration, until it is in equilibrium. [2]
2. Equilibrium: All areas have the same number of particles. [2]
3. Gas particles have more energy to make bigger spaces to move through. Liquid particles have less energy, so make smaller spaces: longer to move. [4]

Question 4 [12]

	HEATED	COOLED
SPEED	Faster	Slower
DISTANCES	Increases	Decreases
ATTRACTION	Decreases	Increases

Question 5

A. Sublimation B. Evaporation C. Condensation
D. Freezing E. Melting [5]

Question 6

1. Melting 2. Evaporation 3. Condensation
4. Freezing 5. Sublimation 6. Melting
7. Evaporation [7]

Question 7

[3]

1. Remove heat 2. Remove heat 3. Add heat