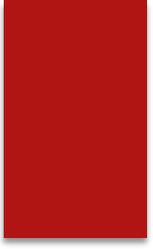


States of Matter

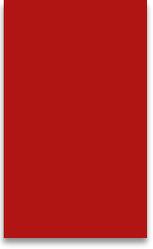
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What is matter?

Matter

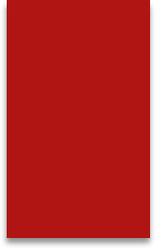
- ▶ Anything that **occupies space** and has **mass**
- ▶ Made up of **microscopic particles**
 - ▶ **Within a substance** all particles are the **same**
 - ▶ **Different substances** have **different particles**



What are the states
(phases) of matter?

States of Matter

- ▶ Every substance in the world around us exists in one of the following states of matter:
 - ▶ **Solid**
 - ▶ **Liquid**
 - ▶ **Gas**
 - ▶ **(Plasma)**



What is the difference
between a solid, liquid
and gas?

Solids

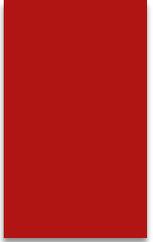
- ▶ Have a **definite shape**
- ▶ Have a **definite volume**
- ▶ **Difficult to compress**
- ▶ Do **not flow** (keep their shape)

Liquids

- ▶ **No definite shape**
- ▶ Have a **definite volume**
- ▶ **Difficult to compress**
- ▶ **Flow** easily

Gases

- ▶ **No definite shape**
- ▶ **No definite volume**
 - ▶ Take up the space given
- ▶ Easy to **compress**
- ▶ **Flow** easily



Why do the different
states of matter behave
differently?

It's all about the particles...

Particle Model

- ▶ The particle model is a way of **representing matter** through the use of particles
- ▶ Matter is made up of **tiny microscopic particles (atoms)**

Particle Model

- ▶ Why is this useful?
 - ▶ It allows us to **represent** each state of matter and helps explain the **differences in their properties and behaviours!**

Particle Model - Solids

- ▶ Particles arranged in **regular** way
- ▶ **Strong forces/bonds** holding them together
- ▶ Can't move out of position
 - ▶ **Don't change shape or volume**
- ▶ Can only **vibrate a bit**

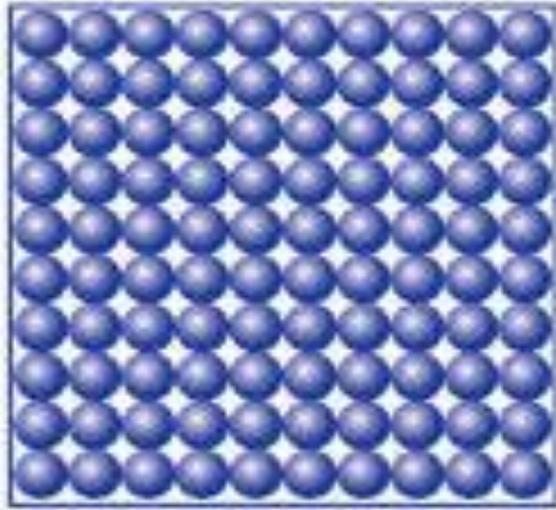
Particle Model - Liquids

- ▶ Particles **in contact** but can slide over each other
 - ▶ **Weak forces** holding them together
- ▶ **No regular** arrangement of particles
 - ▶ Always **takes on the shape** of the container

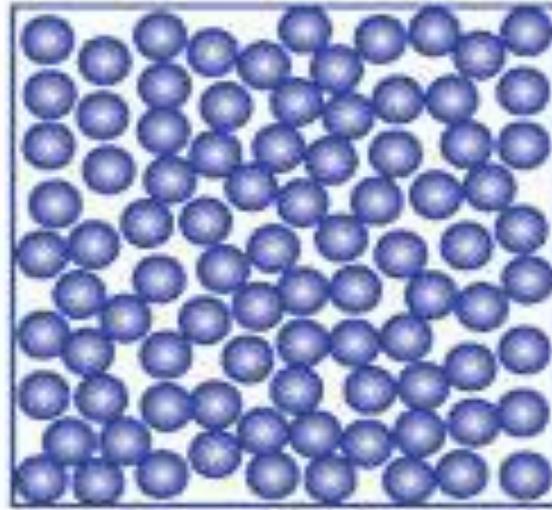
Particle Model - Gases

- ▶ Particles are **not touching**
- ▶ **Very weak forces** between particles
 - ▶ Complete **freedom of movement**; always moving and colliding
- ▶ Has **no shape** of its own
 - ▶ Always **takes on the shape** of the container

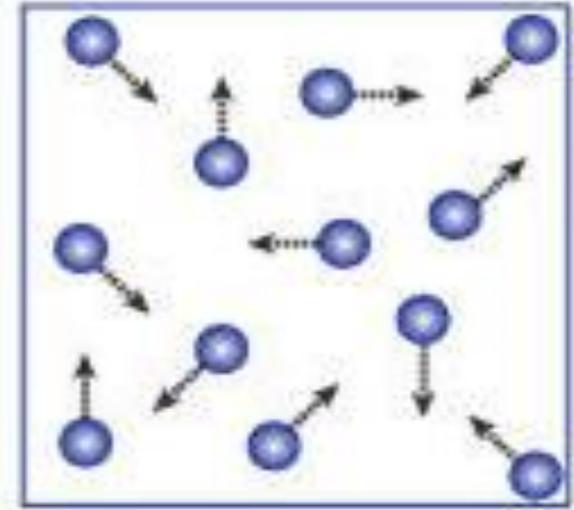
Particle Model



Solid



Liquid

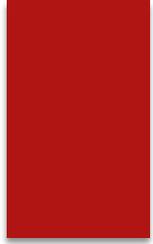


Gas

- Neatly arranged
- Strong forces of attraction between particles (physical bonds)
- No real movement of particles

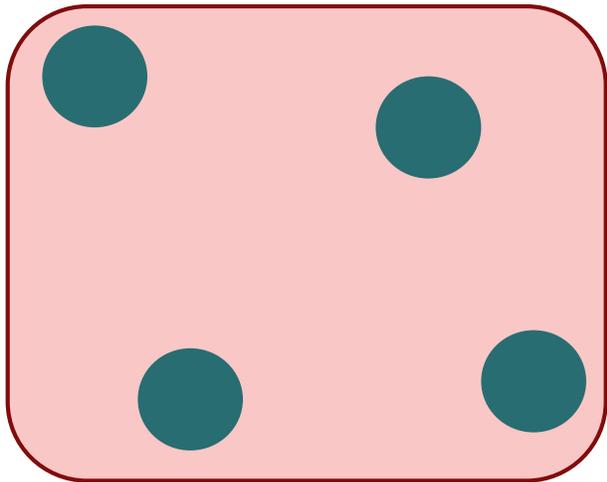
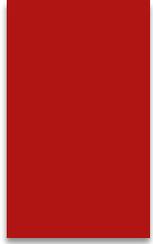
- Close together but not as structured as a solid
- Weak forces of attraction between particles
- Particles can slide over each other

- Far apart
- No forces of attraction between particles
- Move a lot!

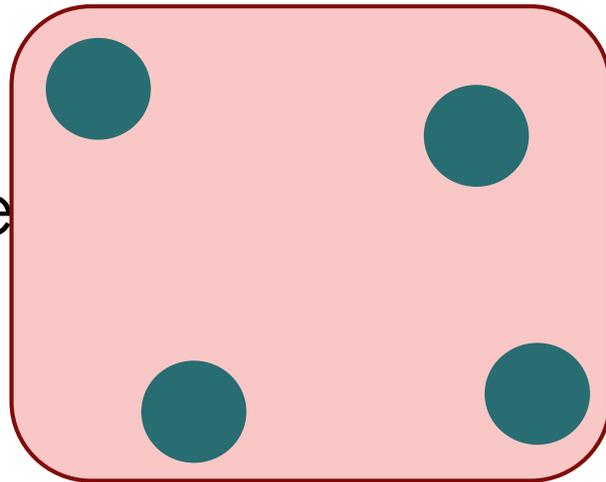


Why can we compress
gases but not solids or
liquids?

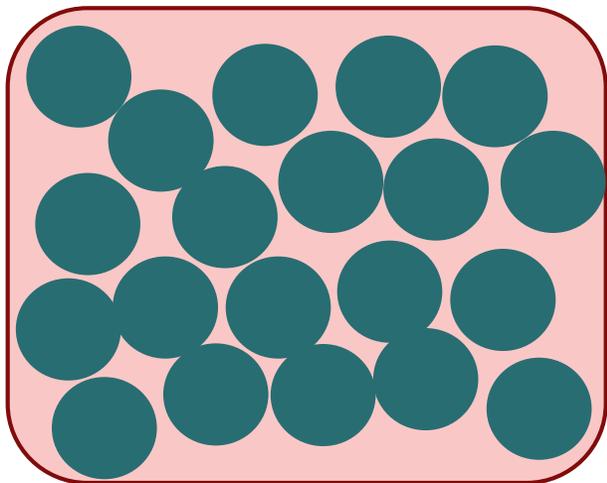
Think about the particles...



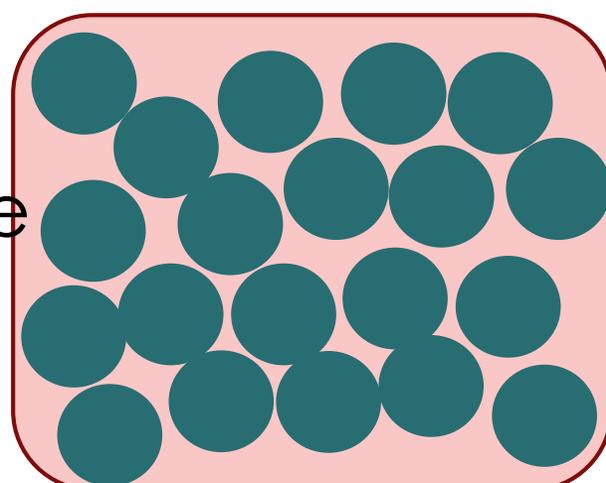
Add Pressure



Compressible!



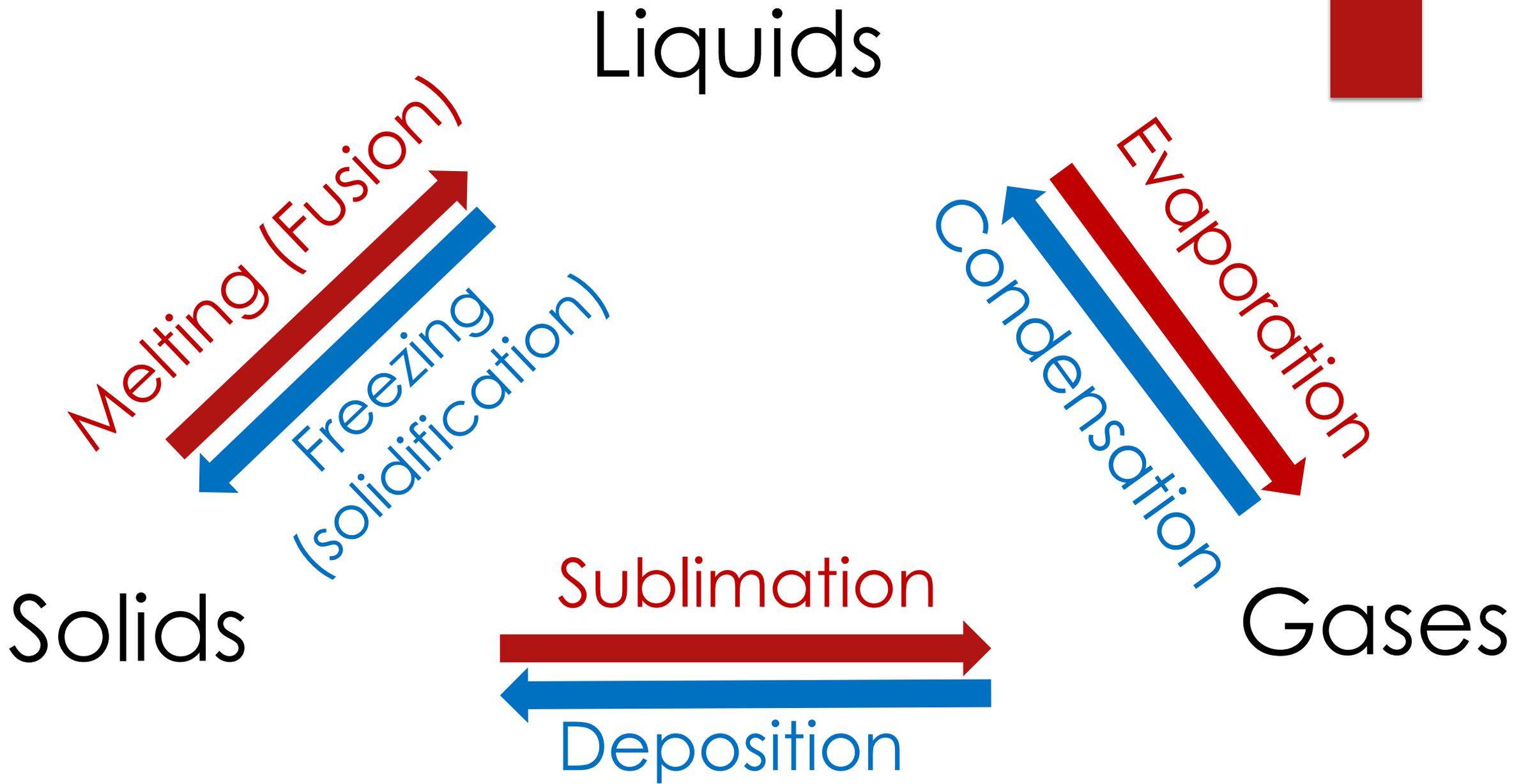
Add Pressure



Incompressible!

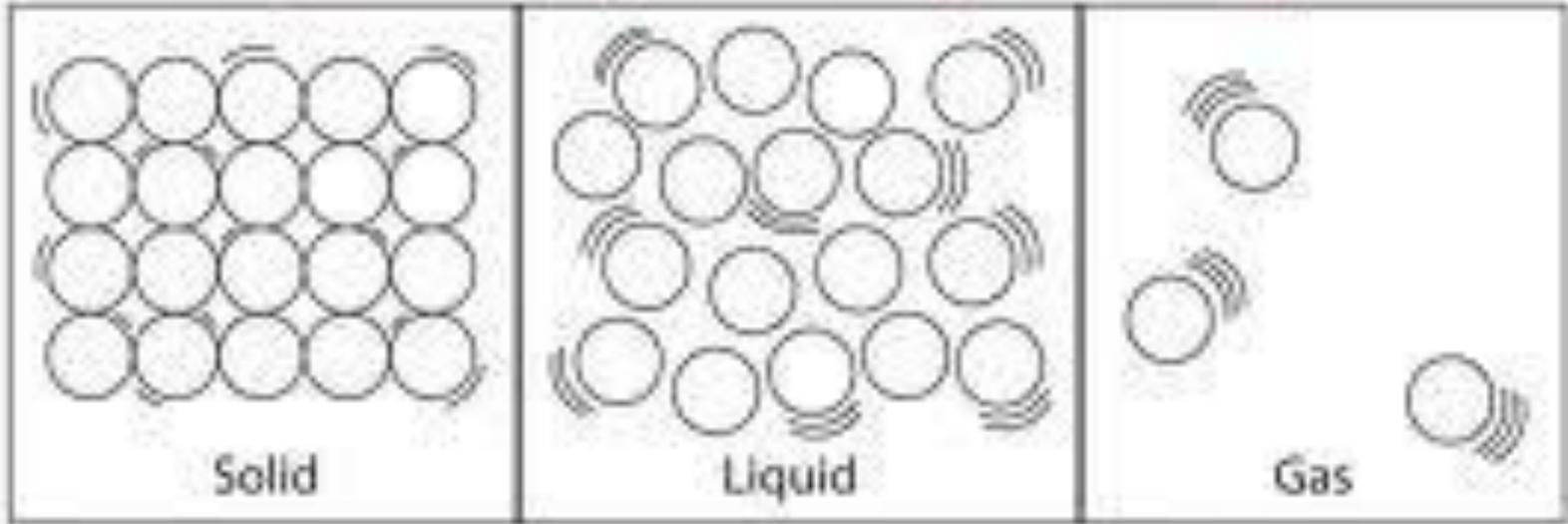
Phase Changes

- ▶ Substances can move from one phase to another through the **addition or removal of energy**
- ▶ **More** energy = **more** particle movement!



Increase Temperature

Adding Energy



Decrease temperature

Removing Energy

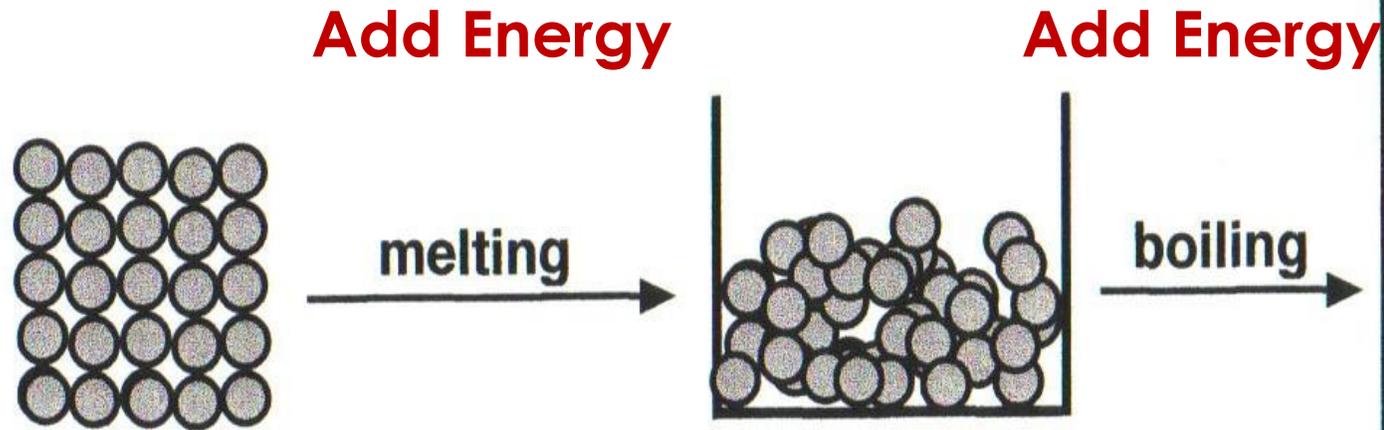
Phase Changes

- ▶ The temperature at which a **solid** starts to become **liquid** is called the **melting point**
 - ▶ At this point, both the solid and liquid states exist together

Phase Changes

- ▶ The temperature at which a **liquid** starts to become a **gas** is called the **boiling point**
 - ▶ At this point, both the liquid and gas states exist together
 - ▶ This is why you see bubbles form when you boil water – that is the gas being formed from the liquid

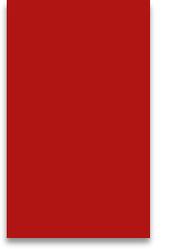
Kinetic Theory of Matter



SOLID: molecules are packed tightly together in an orderly arrangement and not free to move about.

LIQUID: molecules are in contact with each other but are free to move about.

GAS: molecules are widely separated and completely free. They are in constant motion at high speed.



Why does water
evaporate from puddles if
it didn't reach the boiling
point?

Evaporation vs Boiling Point

- ▶ Note: a substance **doesn't necessarily** have to be heated to its **boiling point** to evaporate!
- ▶ The particles near the **surface** can get energy from the sun and this can be **enough to cause a change of state**