Forms of Matter

Grade 5

Forms of Matter

Matter

- Anything that has mass and occupies space is called matter.

- Mass is used to measure the amount of matter in an object.
- Space occupied by any object is its volume.

⇒ " Anything that has mass and volume is called matter."

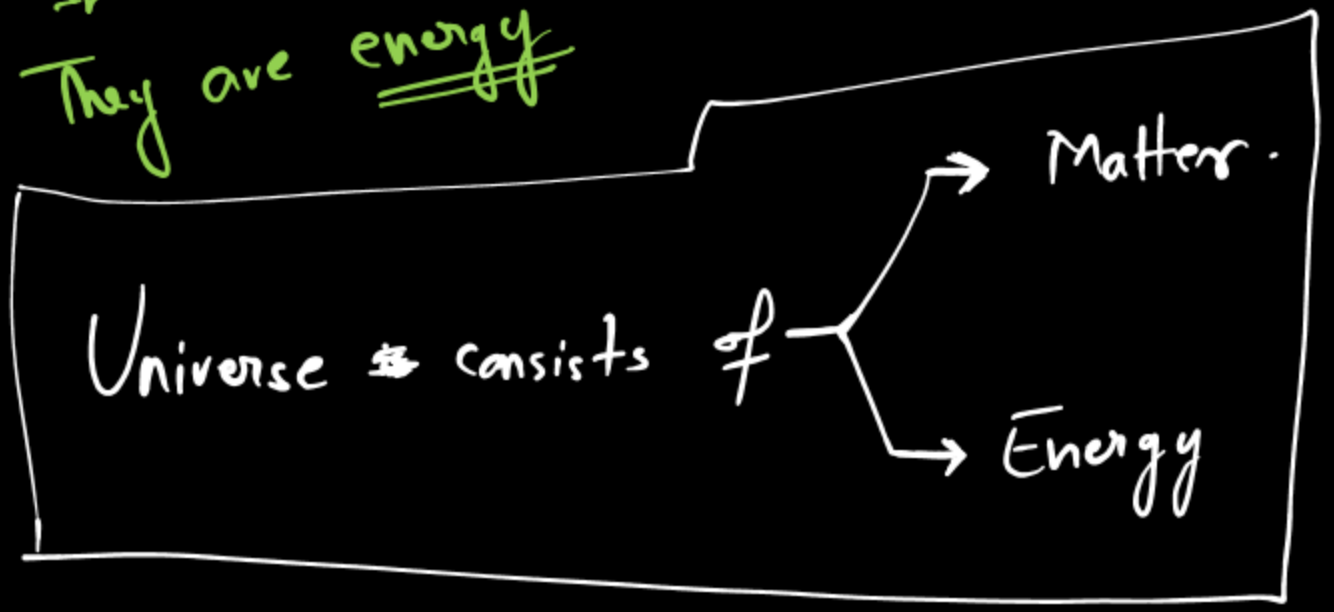
Examples of matter:

seed, ball, fruit, chair, stars, sun, planets, moons, mountain, river, water, air.

Light, sound, heat ⇒ Not matter

⇓

They are energy



Properties of matter

(i) Matter is made up of very small particles.

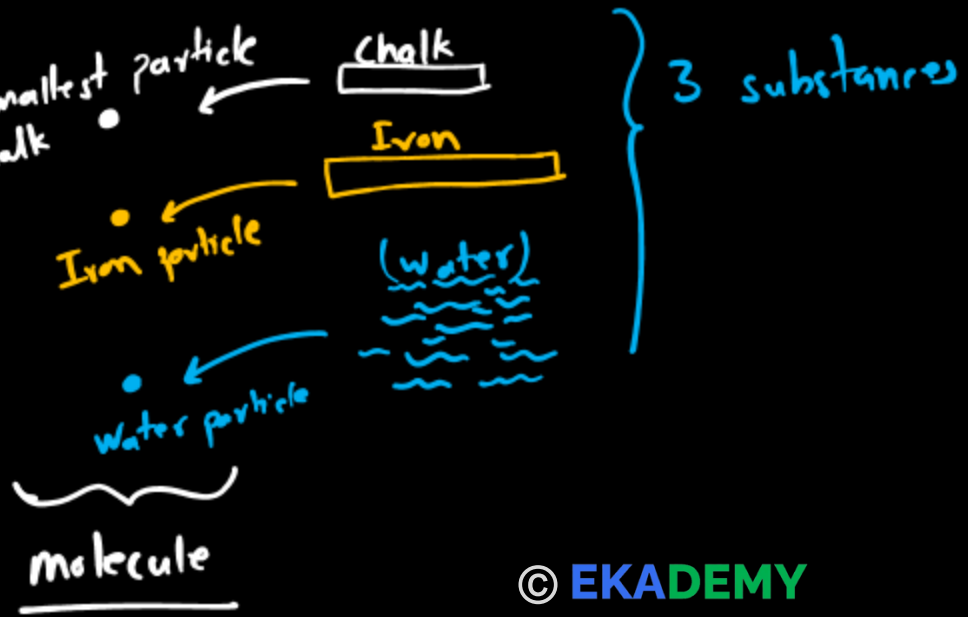
↓

they are so small that we may need microscope to see them.

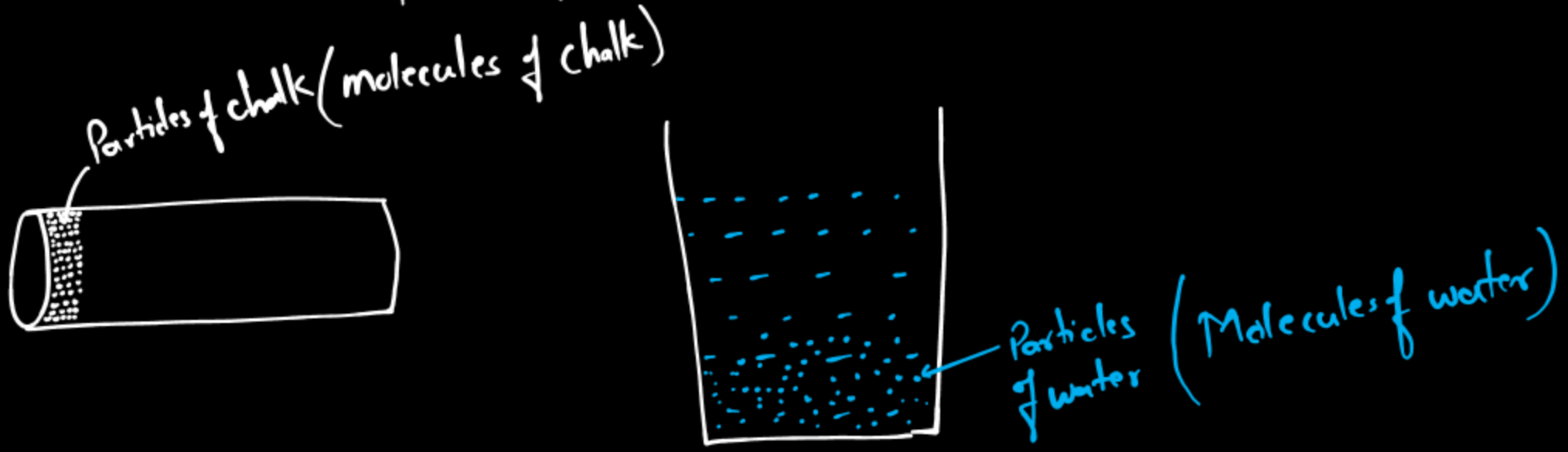
(ii) Particles are held together by strong force of attraction

(iii) The smallest particle of a substance that retains all the properties of the substance is known as the molecule of that substance

For example: Molecule of chalk: Smallest particle of chalk that has all the properties of chalk.



- Molecule of water
  - → Smallest particle of water, that has all the properties of water.



[These particles (molecules) are microscopic]

Forms of matter

Recap:

- Smallest particles of matter is called atoms or molecules.
  - Molecules are made up of one or more atom(s).

" Anything that has mass and occupies space.

mass → [amount of material inside the matter]

space → volume

States of matter

⇒ On earth matter exist in three physical/natural states

1. Solid matter (Solids)
2. Liquid matter (Liquids)
3. Gas matter (Gases)

Explained by:
- Distance between particles
- Force of attraction between particles

Two other states of matter found in our universe are:

4. Plasma ⟶ at very high temperature
5. Bose-Einstein Condensate (BEC)
   ⟶ at very low temperature

"Satyendra Nath Bose
SN Bose"

Solids

→ Particles (atoms/molecules) are very close to each other.

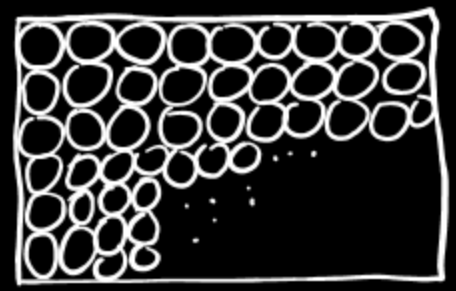
→ Space between the particles (atoms/molecules) is almost negligible.

→ Force of attraction between these particles is very-very strong.

→ Particles can not move from their position. However, they keeps on vibrating.

→ They are very difficult to compress.

→ Solids have definite (fixed) shape, size and volume.



Examples → Pen, Pencil, Book, Rock, Cup, Iron, Chalk, table, chair, etc.

[Note: All metals at normal temperature are solid except Mercury. [Mercury is in liquid state]]

What are Crystals ?

eg: • Sugar crystals
• Salt crystals
→ Copper sulphate crystal (Blue in colour)

⇒ Special type of solid., as they display special properties.

{ eg: → extra shine.
→ Vibrant colours.
→ extra hard.

→ Particles (molecules/atoms) are arranged in a uniform geometrical pattern that repeats itself to create unique shaped called crystal.

Crystal. [Repeated pattern]

- Natural crystals are found in caves or in mines
- Artificial crystals can be made in laboratory.

World's largest naturally occuring crystals are found in a cave of Mexico. These crystals are Gypsum.

* Gypsum is used to make plaster of paris (POP)

[Reading H.W.]

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Activity :

Aim: To make sugar crystal.

(2) Liquid State

⇒ In liquids, particles are still close together, but a little far apart compared to solids.

⇒ Particles (atoms/ molecules) has small space between them.

→ Particles are free to move and can intermix with each other.

→ Liquids do not have a fixed shape.

↳ They take the shape of the container.

→ Liquids have definite volume (amount of space occupied by any object)

↳ because of force of attraction their particles.

→ Liquids can flow freely from higher level to lower level.

Examples: Water, oil, milk.

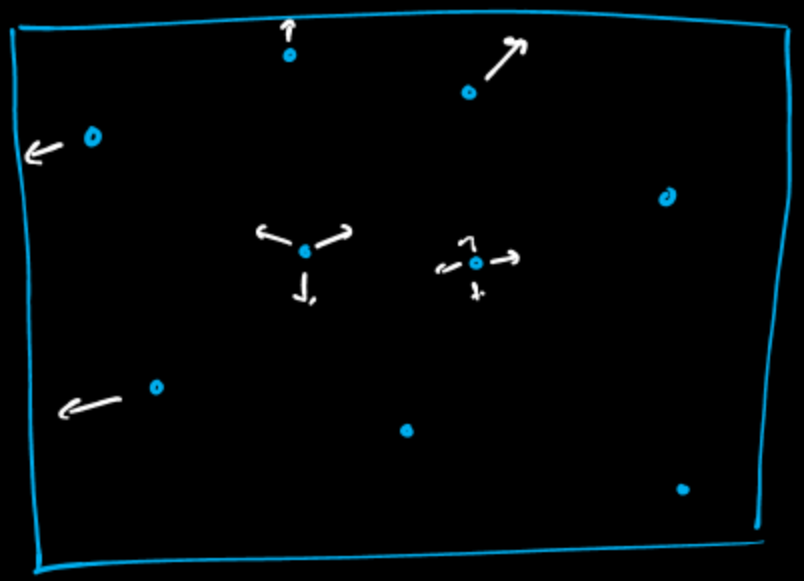
(3) Gases

⇒ Force of attraction between particles is very less (almost zero)

→ Particles are far away from each other.

→ Large space between the particles of gas.

→ Particles can move freely (flow freely) with high speed.



→ They collide with each other as well as the walls of the container in which they are kept.

→ They do not have definite shape. They take the shape of container.

→ They do not have definite volume. They take the volume of the container.

Interconversion of states of matter

⇒ The three states of matter (solids, Liquids & Gases) are interconvertible.

Solid $\xrightarrow{\text{heat}}$ Liquid $\xrightarrow{\text{heat}}$ Gas

- Solid melts to form liquid on increasing temperature.

  eg: ice melts to form liquid water.

Solid state

+ heat $\xrightarrow{\text{Melting or fusion}}$

Liquid state

+ heat $\xrightarrow{\text{Vaporisation}}$

Gas state

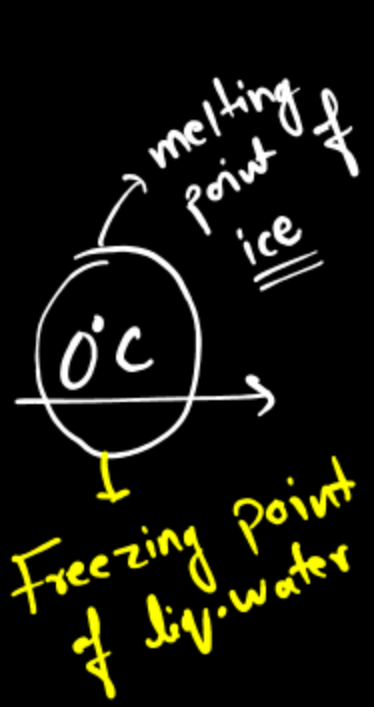
Gas $\xrightarrow[\text{(condensation)}]{\text{cools down}}$ Liquid $\xrightarrow[\text{(freezing)}]{\text{cools down}}$ Solid

⇒ Heat / Temperature is one factor which is responsible for interconversion of states of matter.

⇒ Pressure is the second factor responsible for interconversion of states of matter.

Iron + heat $\xrightarrow{\sim 1500^\circ C}$ Molten Iron + heat $\xrightarrow{\sim 3500^\circ C}$ Iron Vapour

Solid (Liquid) Gas



Ice + heat → Liquid Water + heat

Solid Liquid

→ Water Vapour

Gas

⇒ Different matter has different temperature requirements for state conversion.

"Water is the only matter on the earth that exist in all the three states naturally."

Poles → ice

River / ocean → Liquid water

Atmosphere → Water Vapour.

Few solids on heating directly converts into gas.

(They Do not melt to form liquid)

This process is called sublimation.

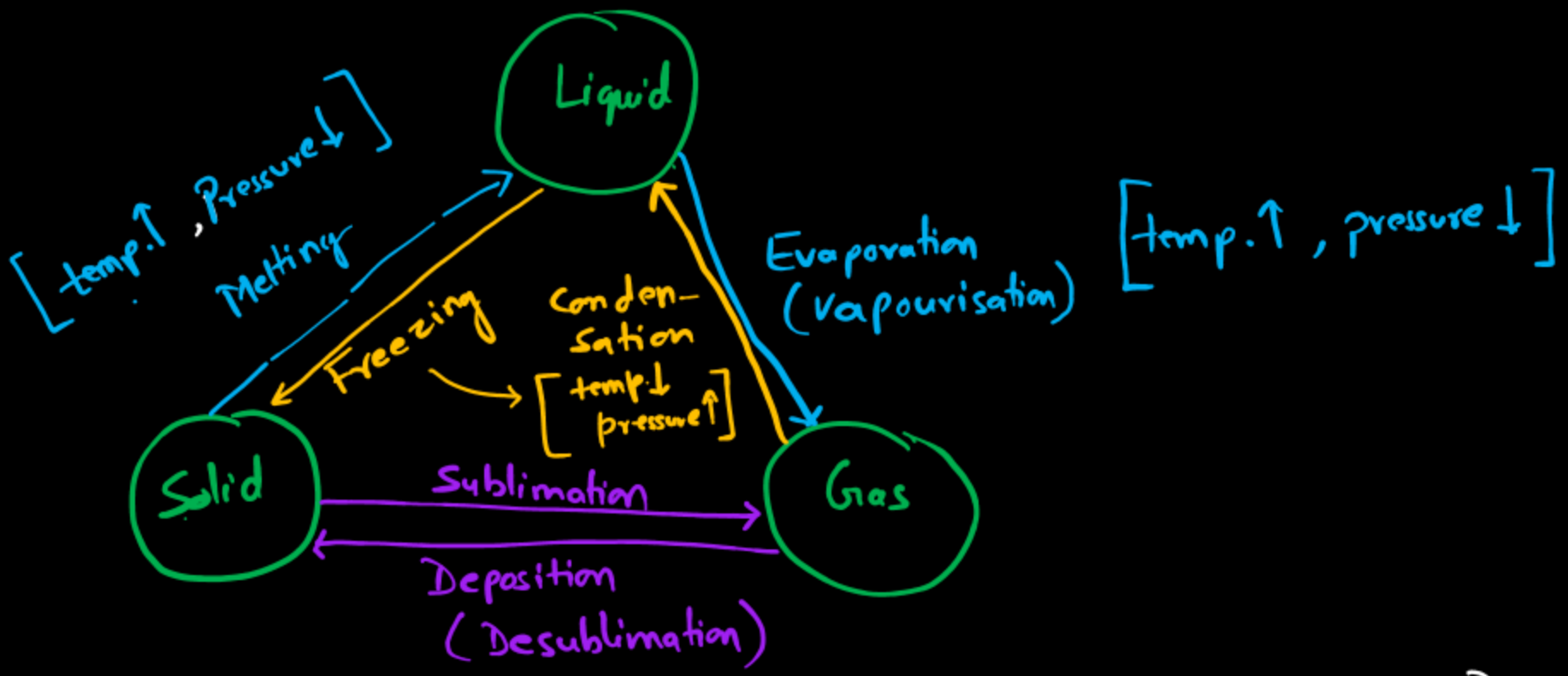
=> Vapours (gas) of these substances on cooling / increasing pressure converts back into solid state directly.

Recap:

States of matter can be changed
- by changing temperature
- by changing pressure.

↑ increasing ✓

↓ decreasing ✓



Examples of solids that sublimes:

(i) Camphor

(ii) Solid CO_2 (Dry ice)

(iii) Naphthalene balls

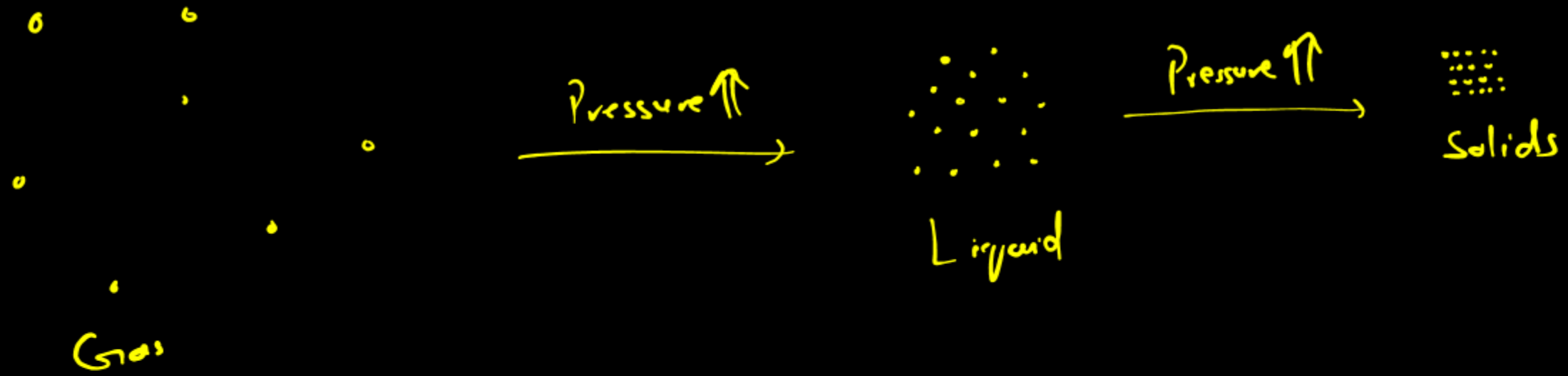
Physical Change and Chemical Change

Physical Change

⇒ Only physical appearance changes (like shape, size, looks, texture, etc.) during physical change.

eg. ice (Solid water) melts to form water (Liquid water), is a physical change.

- melting of ice cream



Ex

eg: Petroleum gas → (Pressure) → Liquid Petroleum Gas

PG

↓

LPG

Gas cylinders

⇒ Identity of matter does not change during physical change.

↓

"Its chemical nature remains same"

⇒ Physical change is reversible process.

eg: { ice $\underset{\text{freeze}}{\overset{\text{melts}}{\rightleftharpoons}}$ liquid water }

More examples of physical change:

1. Painting of walls.
2. Slicing of bread.
3. Boiling of water (water → vapour)

* Changing the physical states of matter is always a physical change.

Solid ⇄ Liquid ⇄ Gas

Chemical change

→ Matter changes its chemical nature and turns into a completely different substance.

⇒ During chemical change physical properties of matter also changes along with chemical properties.

→ Chemical change is <u>irreversible process.</u>

<u>Eg:</u> → Cooking of food.

→ Burning of wood.

H.W.

{ →

→

Dry ice → Solid CO_2

Solutions :

⇒ It is formed when a substance is completely dissolves in a solvent.

Forexample :

- Water + Sugar → Sugar solution.
- Water + Sugar + Salt → ORS (Oral Rehydration Solution)
- Carbon dioxide (CO_2) + Water → Soda water / Sparkling water.
- Water + sugar + salt + lemon juice → Lemonade
- Salt + water ⟶ Brine

⇒ Solution is a mixture of two or more substances.

Soluble Substance : Sugar, salt, honey, CO_2, O_2 etc.

"that dissolves completely in liquids".

Insoluble Substance : Chalk powder, sand, pebbles, stones, nail, etc.

"that donot dissolves completely in liquid".

Immiscible liquids : eg. [oil + water]

"do not mix with each other to form homogenous mixture".

Miscible liquids

Water + milk

Water + honey

Water + lemon juice

Solution = Solute(s) + Solvent

Small in amt. compared to solvent.

Solvent → can be liquid, solid or gas.

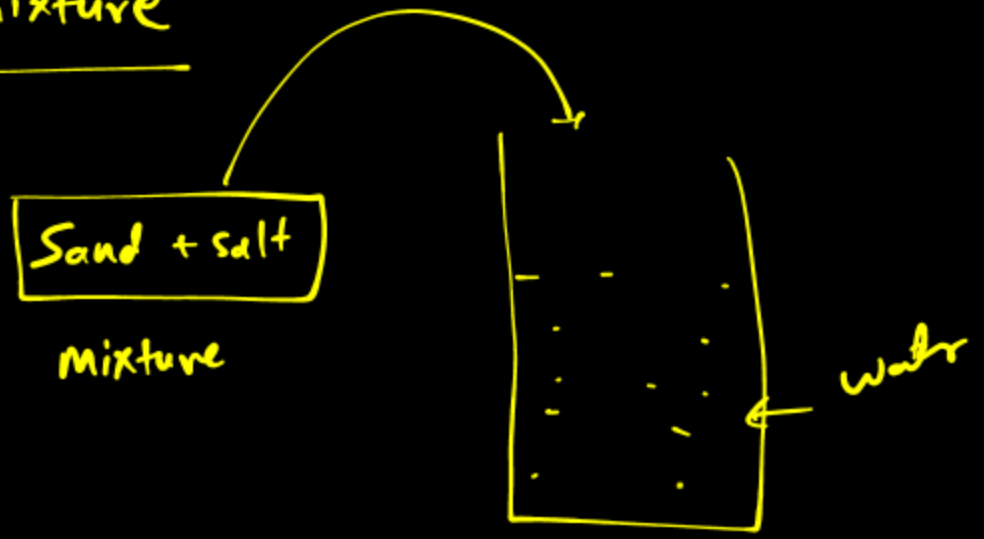
→ generally they are liquids.

→ Water is most common solvent.

→ Water is aka Universal solvent

Separation of substances from the mixture

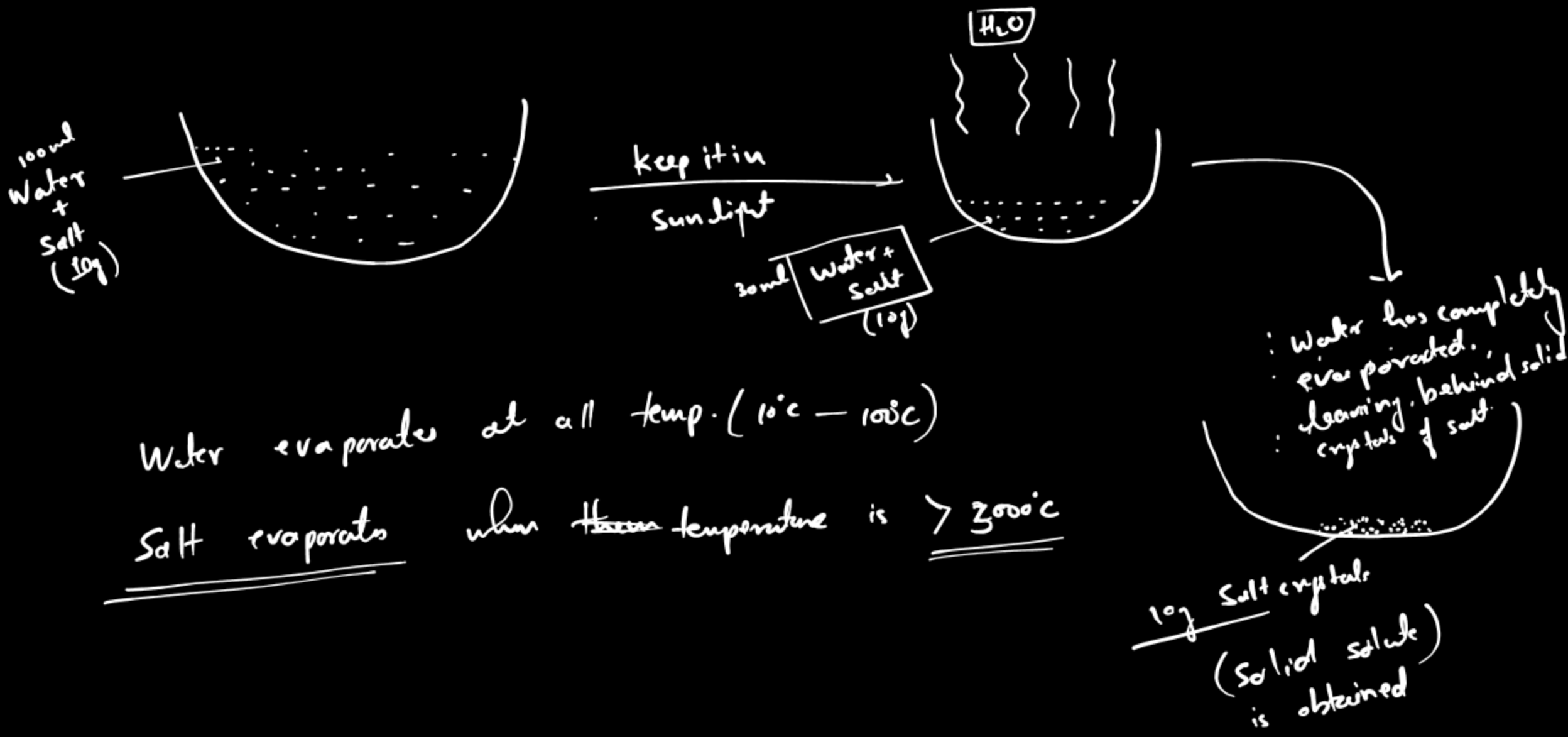
⇒ Different methods of seperation.
of soluble and insoluble substances from liquids.



① Evaporation :- [to separate soluble solute from solution]

↳ Liquid turns into gas (at any temperature)

eg: Separtion of salt from salt-water solution.



Water evaporates at all temp. (10°C — 100°C)

Salt evaporates when temperature is > 3000°C

(2) Distillation :

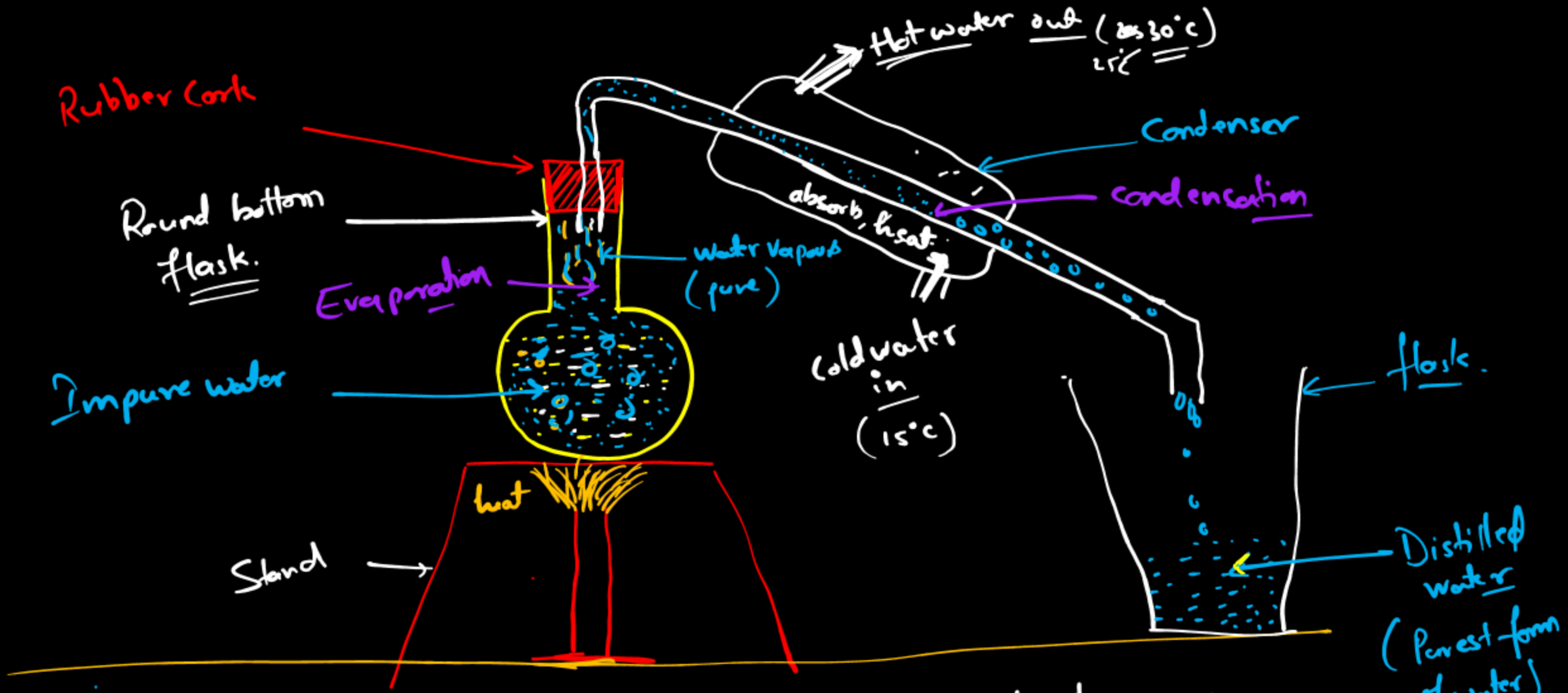
→ This process is used to seperate dissolved or undissolved impurity in a liquid.

→ it involves evaporation and condensation

→ In this process we get back the liquid/water after condensation.

- Distillation
- Sedimentation - Decantation
- Filtration

] Read



* Distilled water is very important for various chemical experiments / process.

→ Tap water / Mineral water → contains a small amount of dissolved salts

↳ important for our body.

Distillation → ① Evaporation

↳ ② condensation

↓

dissolved / undissolved impurities

③ Sedimentation and Decantation

⇒ For insoluble impurities.

⇒ Only Insoluble impurities from water/liquid can be seperated using sedimentation and decantation.

* Put sand in a glass of water and stir it.
* Keep this mixture undisturbed for few minutes.
* The sand settles down at the bottom of glass. ⇒ Sedimention
* Gently pour the water/liquid at top into another container, without disturbing the sand at the bottom.

⇓

[Decantation]

(4) Filtration

"Filtration method is used to separate an insoluble solid from a mixture of a solid and a liquid."

For filtration we need → Sieve, Filter paper → for exp.

⇒ When mixture of sand + water is filtered.

- Sand stays behind on the filter paper. (Residue)
- Water passes through the filter paper. (Filtrate)

[eg: Filtered tea leaves from the tea.]

Quiz in the next class.