Energy and Chemical Reactions

Unit 2:

Energy and Chemical Reactions

for any physical or chemical change

↓

generally accompanied by

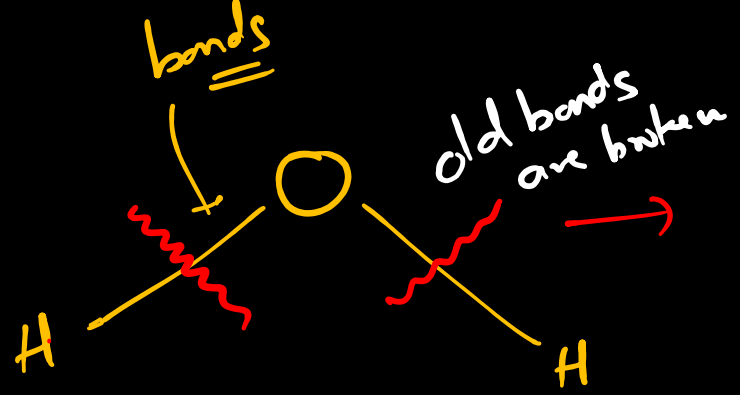
↓

transfer of energy

(absorbed from surrounding
or released into the surrounding)

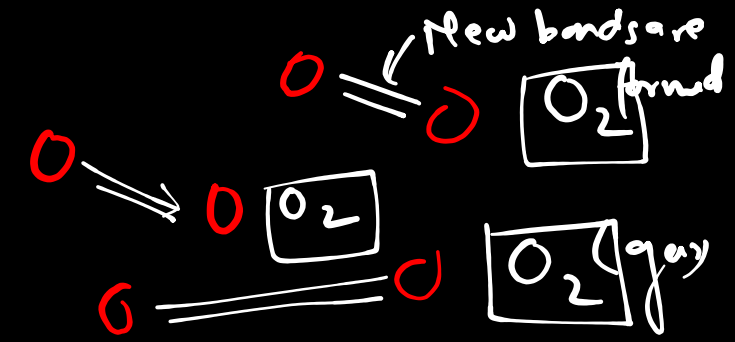
H_2O

molecule

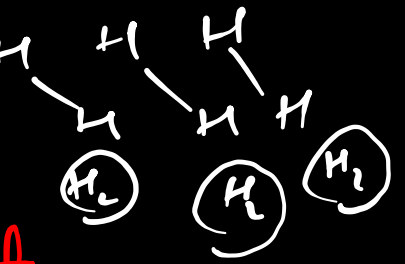


O

2H



$O=O$



To break these bonds, we need to supply energy

* when bonds broken, energy is absorbed
* when bonds are formed, energy is released.

- in the form of heat
- in the form of electricity
- in the form of sunlight

In chemical reactions,

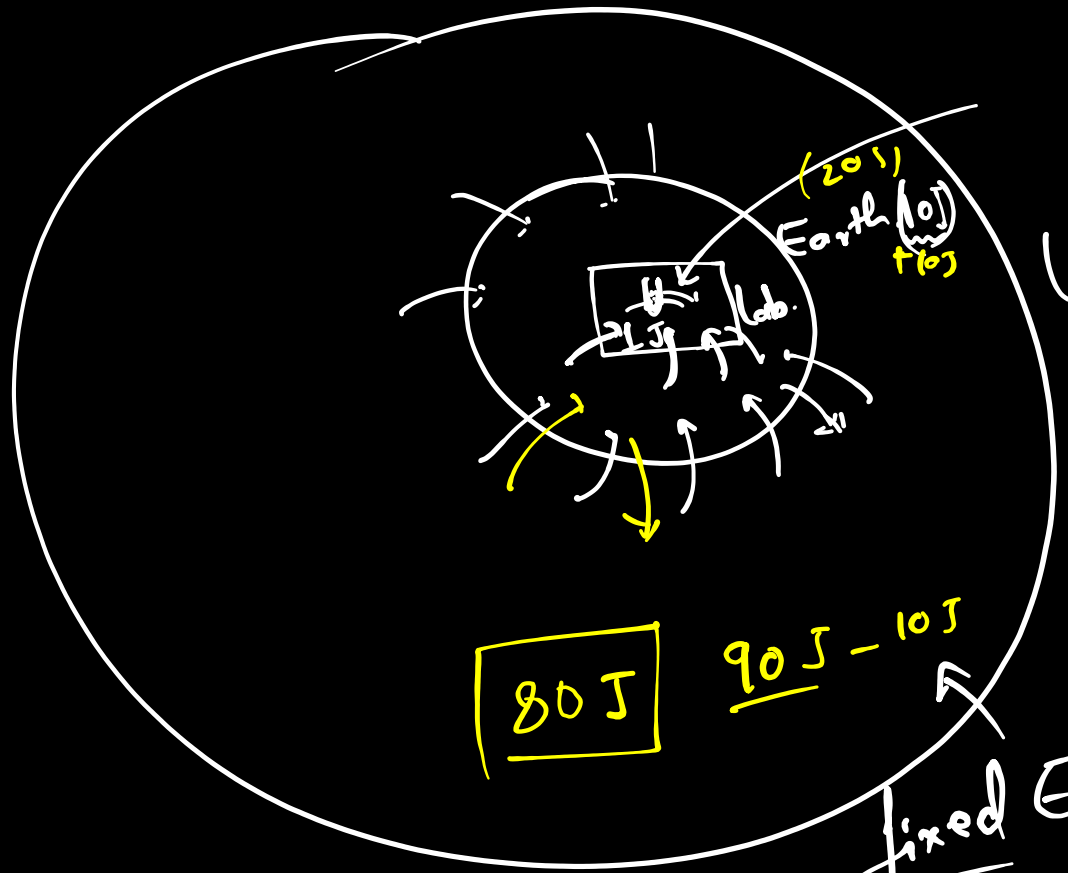
if energy required to break old bond(s) is more than the energy released during in the formation of new bond(s). , then,

such reactions are called endothermic reaction.

100 cal. absorbed

80 cal. released

Net Energy = 20 cal absorbed

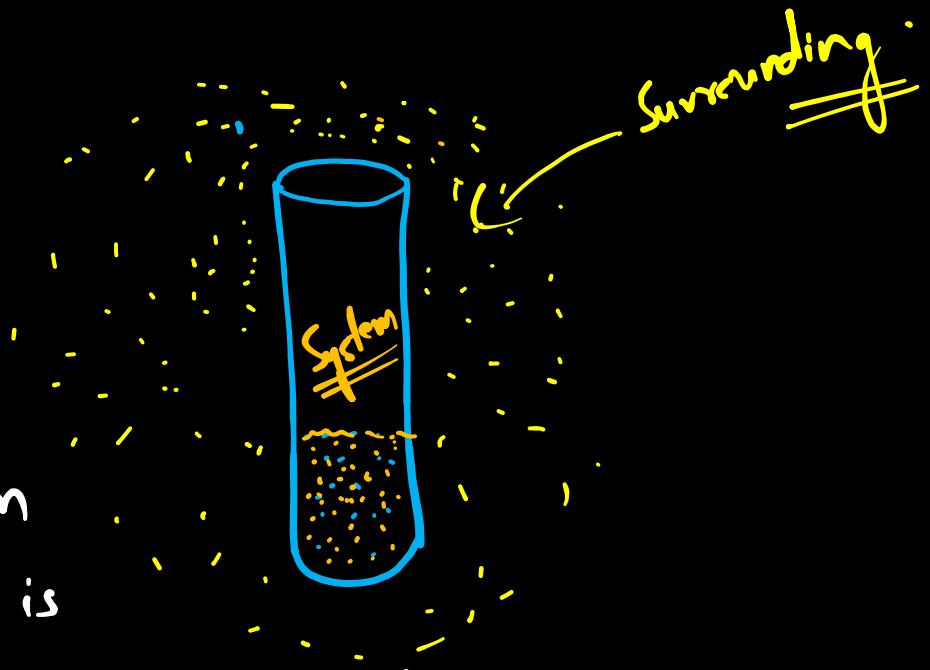


Law of Conservation of energy states that in any physical or chemical process, energy is neither created nor destroyed.

"The entire energy in the universe is conserved"

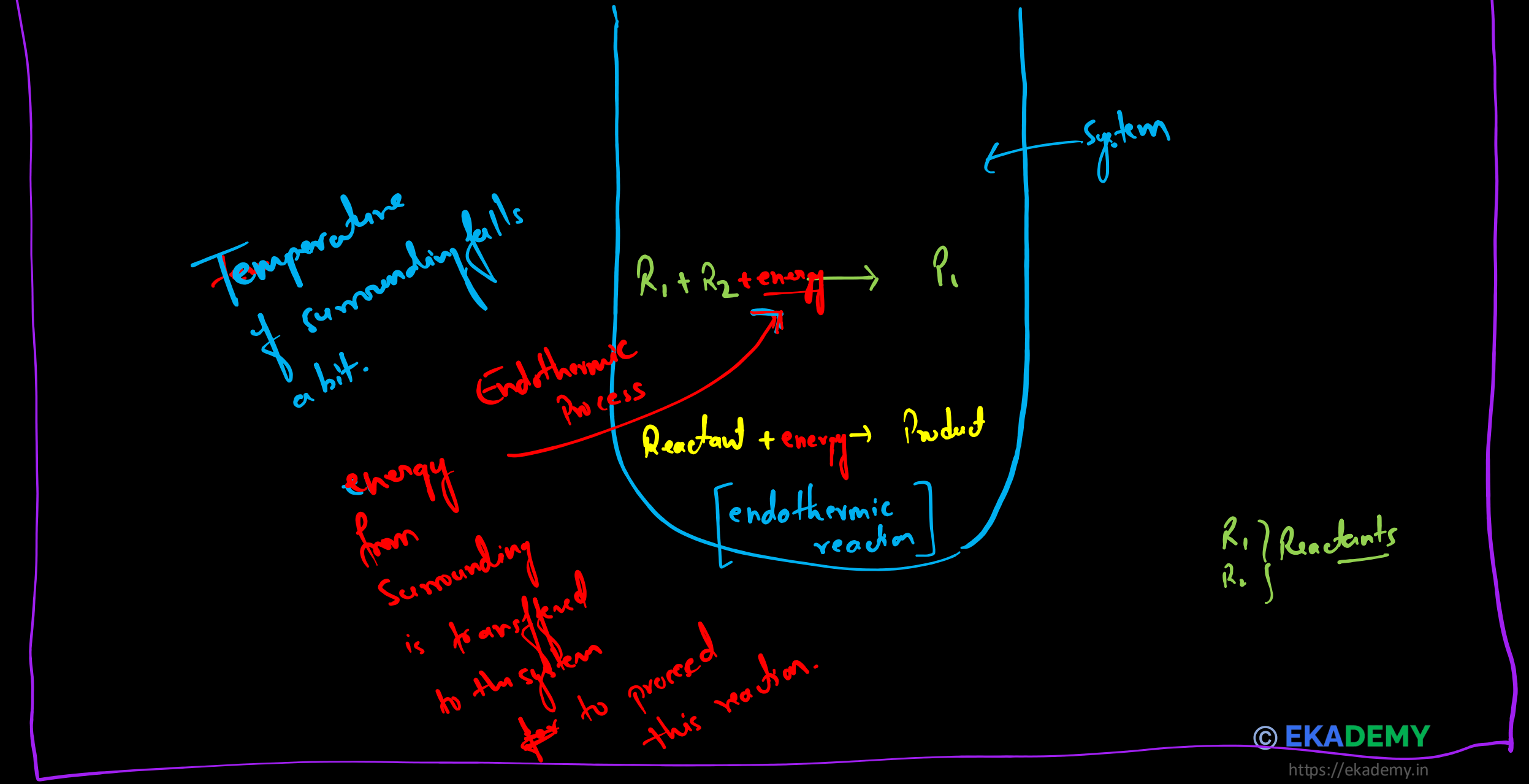
To understand how energy change takes place during a chemical reaction, we need to define two parts of the universe

- System
- Surroundings

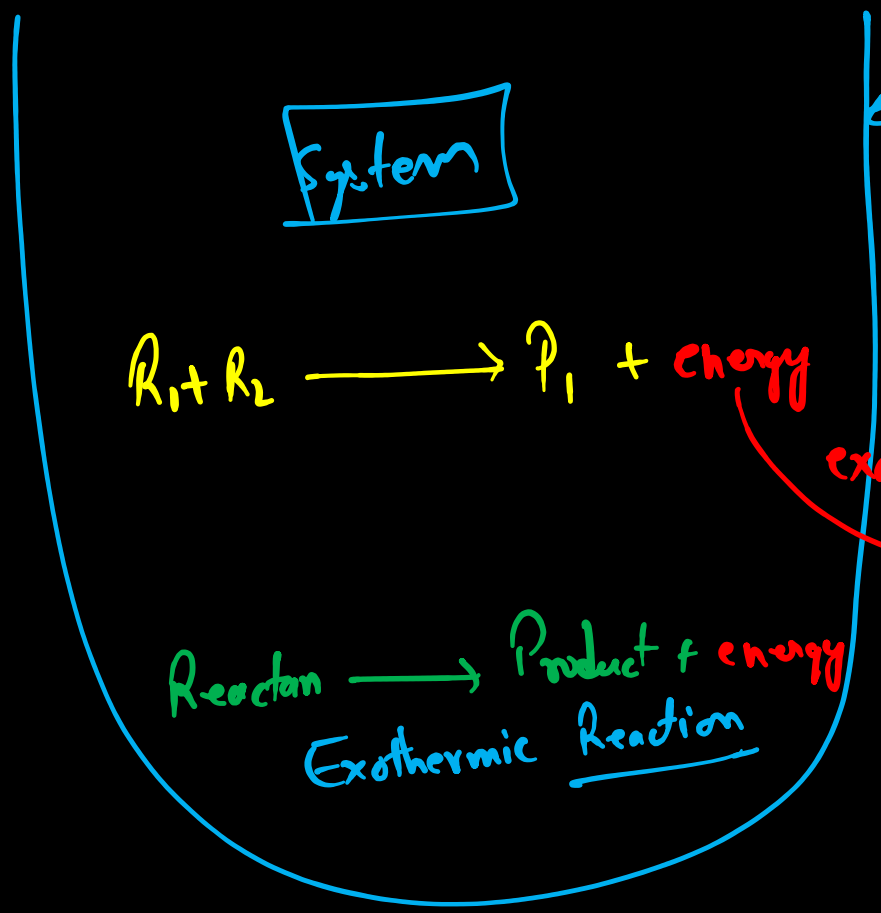


System: The system is the specific portion of matter in a given space that is being studied during an experiment or an observation.

Surroundings: The surroundings is everything in the universe that is not part of the system.



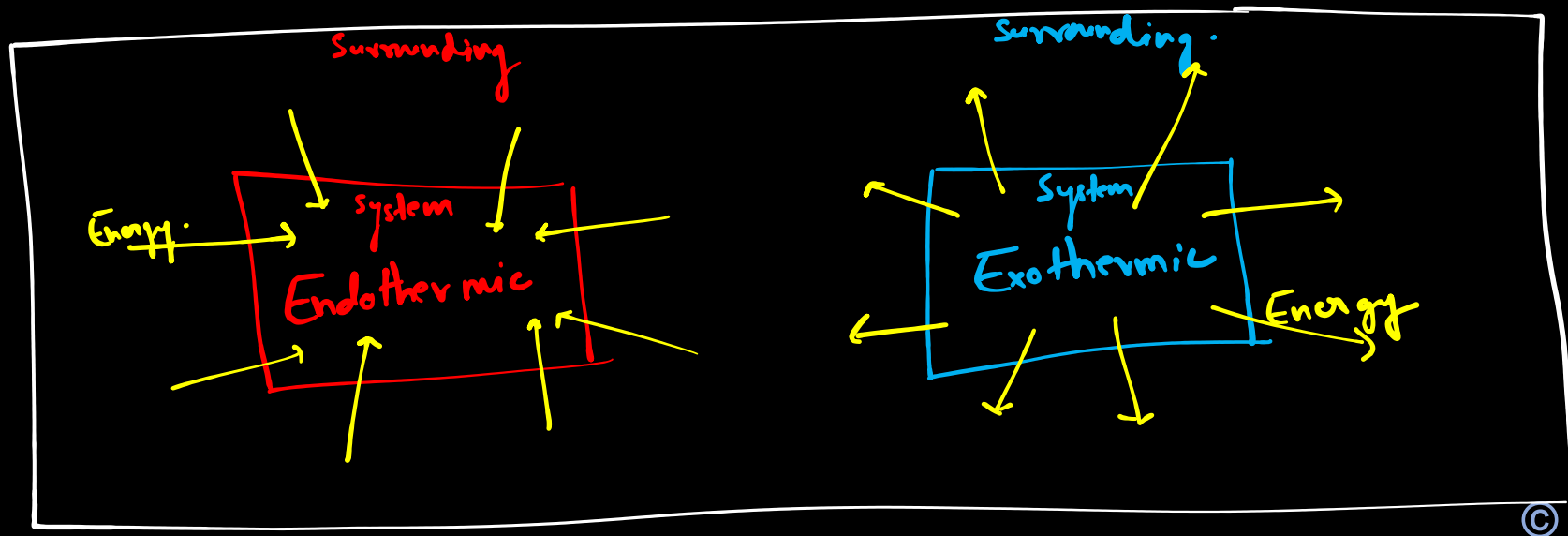
Surrounding



Transfer / flow of energy within system and surroundings

Endothermic Process : Energy is absorbed by the system from its surroundings.

Exothermic Process : Energy is released by the system into its surroundings.



Endothermic Reactions

A chemical reaction that absorbs energy (heat energy) is called an endothermic reaction.

$$\text{Reactants} + \text{Energy} \longrightarrow \text{Products}$$

Examples of endothermic reaction:

(i) Process of cooking or baking of food involves the use of energy (heat) to produce cooked food / cake.

(ii) Photosynthesis, in which green plants absorbs light energy from sun to make food (glucose) and oxygen.

(11) For Phase change of state are endothermic process

Solid ⟶ Liquid

Solid + Energy(heat) ⟶ Liquid

Liquid + energy ⟶ Gas

Ice ⟶ Water

Exothermic Reactions

A chemical reaction that releases energy (heat energy) is called an exothermic reaction

$$\text{Reactant(s)} \longrightarrow \text{Product(s)} + \text{Energy (heat)}$$

Examples of Exothermic Reactions

① Combustion / Burning :→

Wood $\xrightarrow{\text{burns}}$ [heat + light energy] + ash + smoke

② Cellular Respiration :→

$\underbrace{C + O_2}_{\text{glucose}} \longrightarrow \underbrace{CO_2}_{\text{is burned inside cell to provide}} + \text{energy}$ energy.

(iii) Decomposition of organic matter (composting) is exothermic reaction.

(iv) Rusting of iron is also exothermic reaction

(v) Few phase change / state change are exothermic process

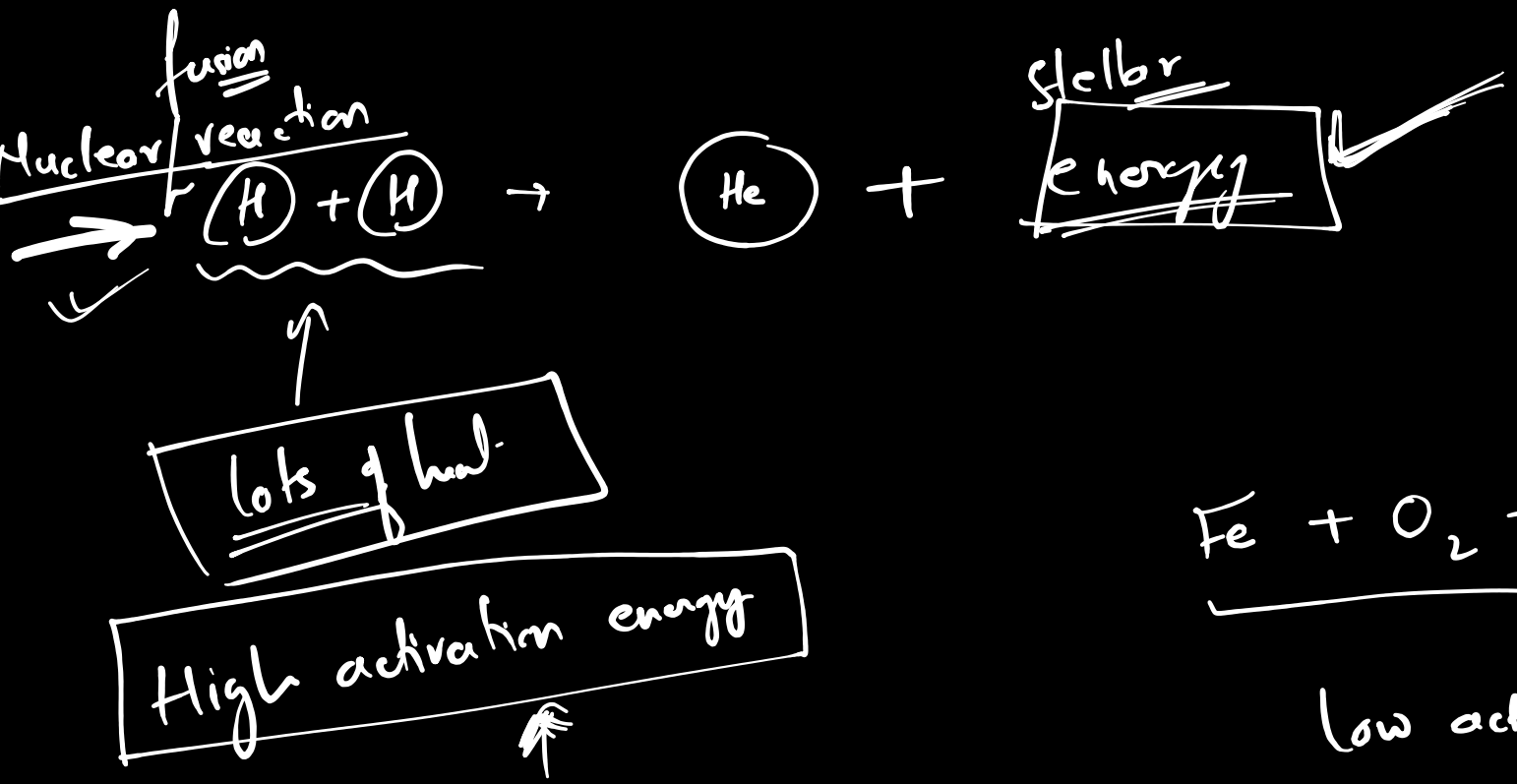
- Liquid ⟶ Solid.
- Gas ⟶ Liquid

Water ⟶ ice

Activation Energy

↳ Energy required to start any chemical reaction / process.

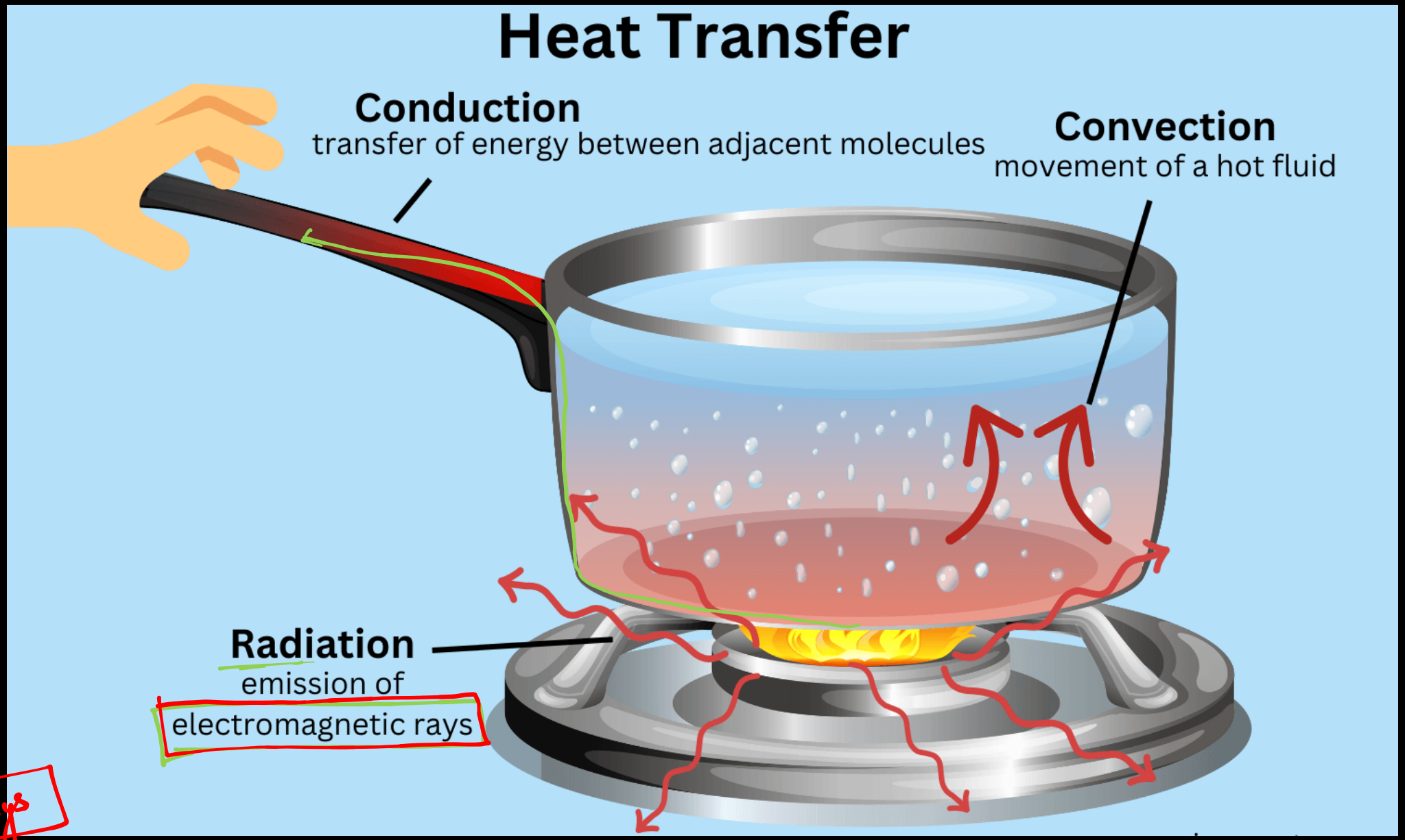
Nuclear fusion reaction



$Fe + O_2 + H_2O \longrightarrow$ Rust + energy

Low activation

Heat Transfer



(Heat Transfer) (Thermodynamics)

Matter ← atoms, molecules

Has ability to transfer heat

Thermodynamics

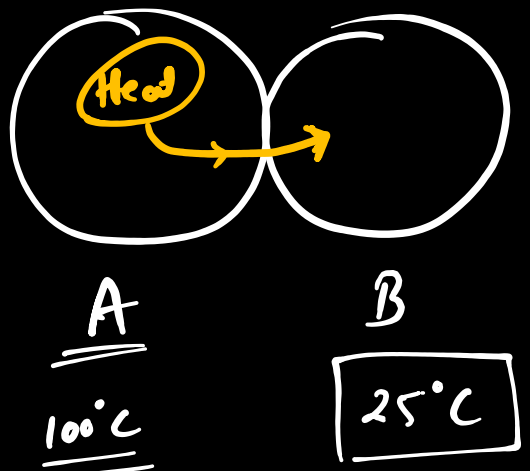
heat

motion / change

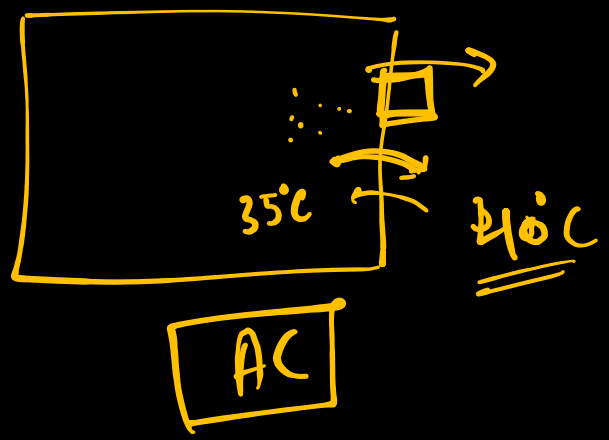
motion (movement) of heat

Temperature

→ Degree of hotness or coldness of a body/object



- Heat transfer from an object at high temp. to an object at low temp.
- Heat continues to flow till both the object acquires same temp.



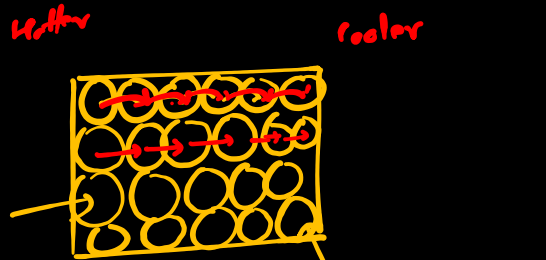
Modes of Heat Transfer

3 modes

- (I) conduction (solid objects)
- (II) Convection (liquid / gas) ⇒ fluid
- (III) Radiation (any medium / no medium)

① Conduction :

(Direct-contact of particles/object)



⇒ The process of transmission of heat/energy from one particle of the medium to another with the particles being in direct contact with each other.

Examples :

① Ice cube melting on your palm.
② Handle of tea-pan becomes hots.
③ Ironing of cloth.

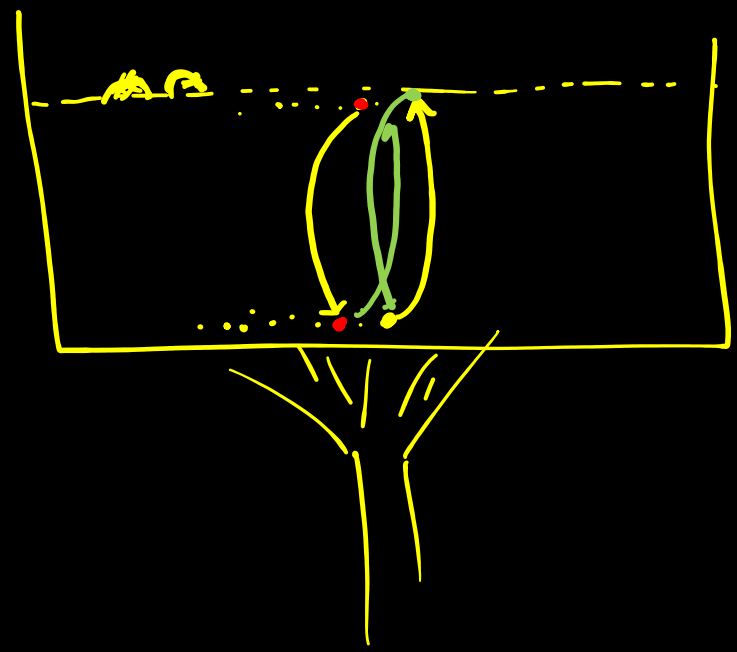
② Convection

↳ Particles move from one place to other.

⇒ The movement of fluid molecules from higher temp. regions to lower temp. regions.

SI unit of temperature : Kelvin (K)

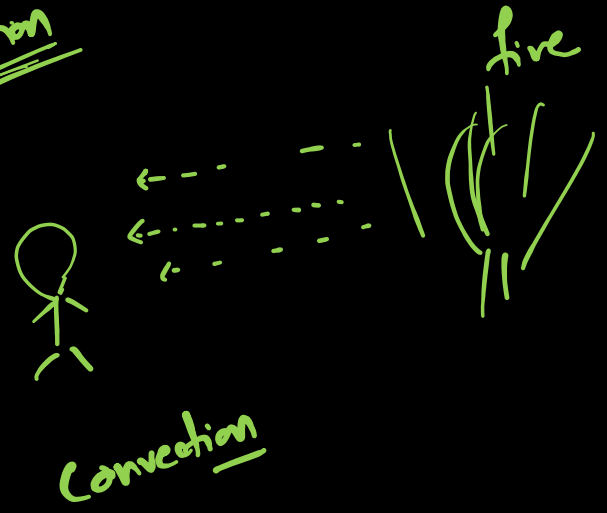
International Standard



③ Radiation :

" It does not require any medium and can be used to transfer heat in vacuum as well."

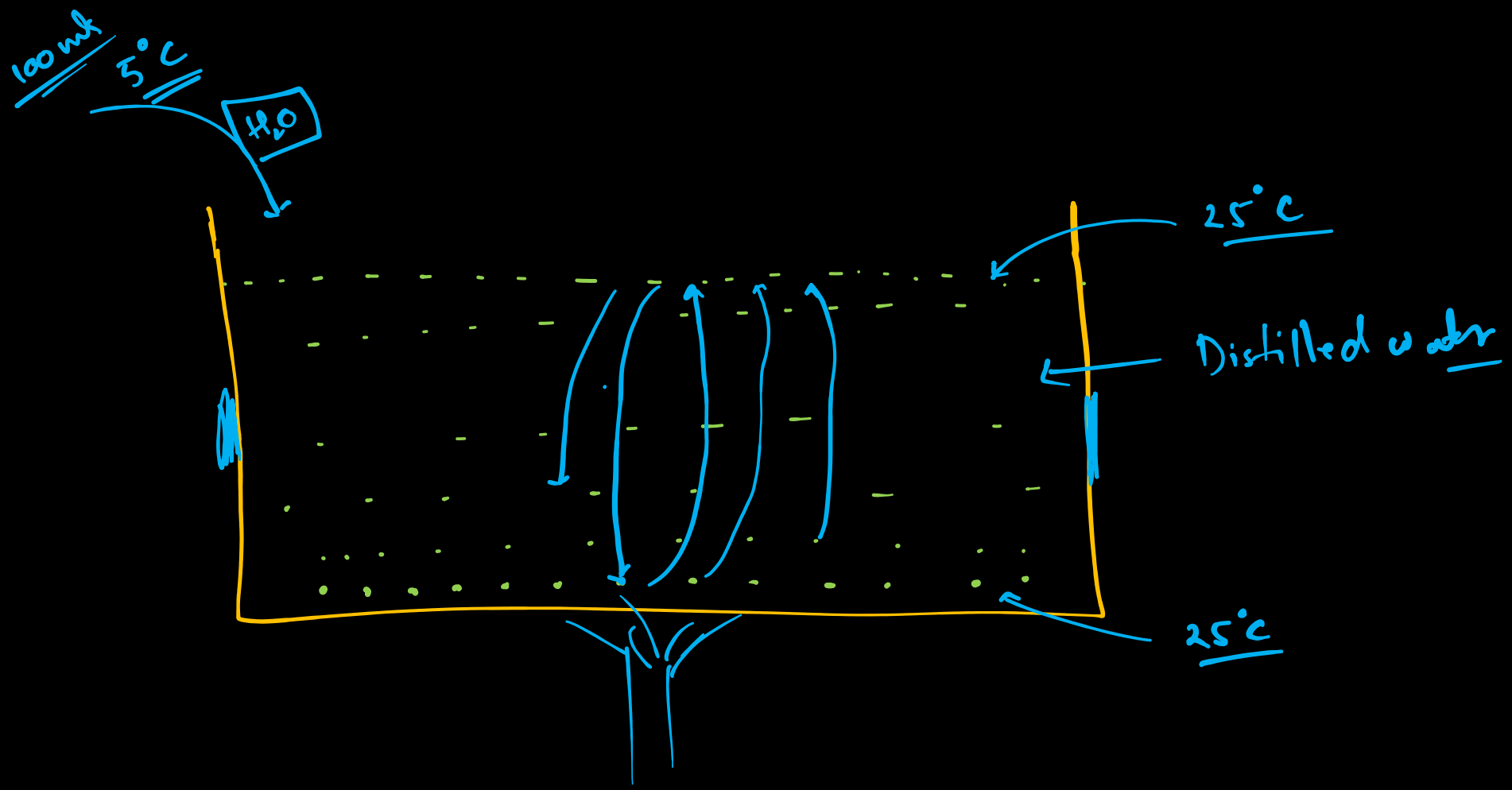
⇒ Most potent form of heat transfer

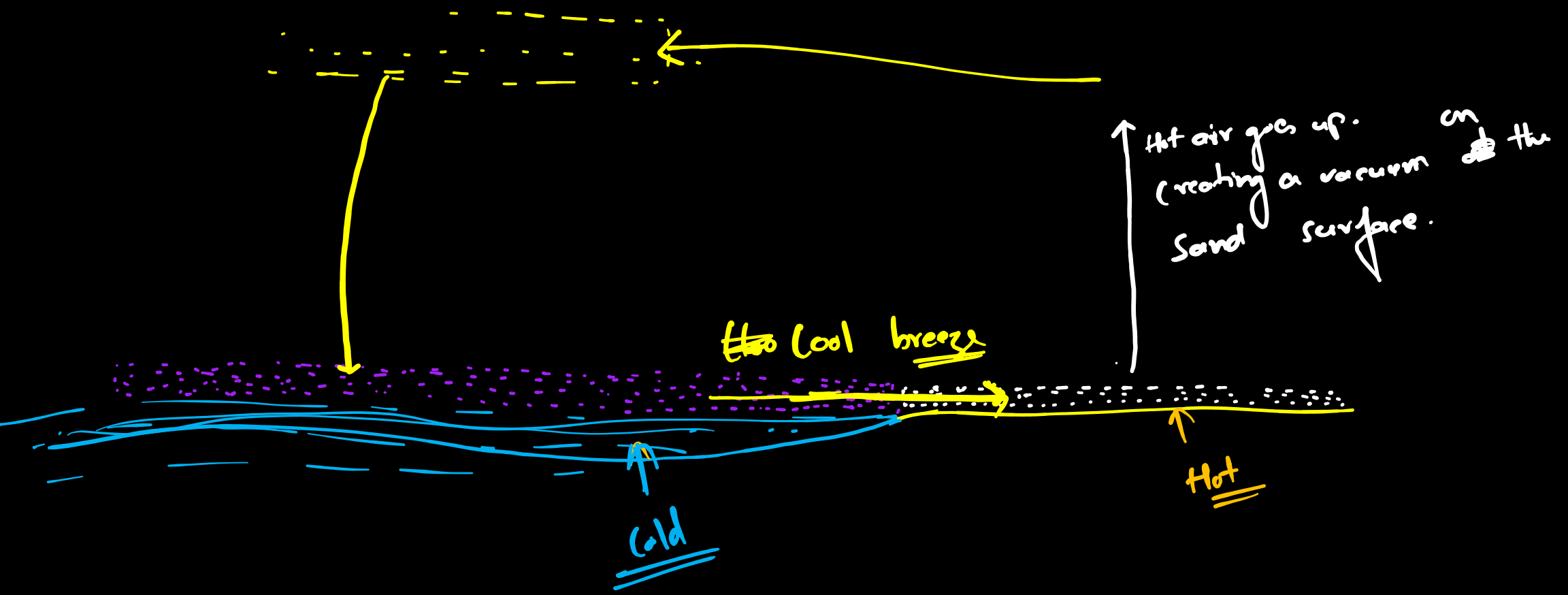


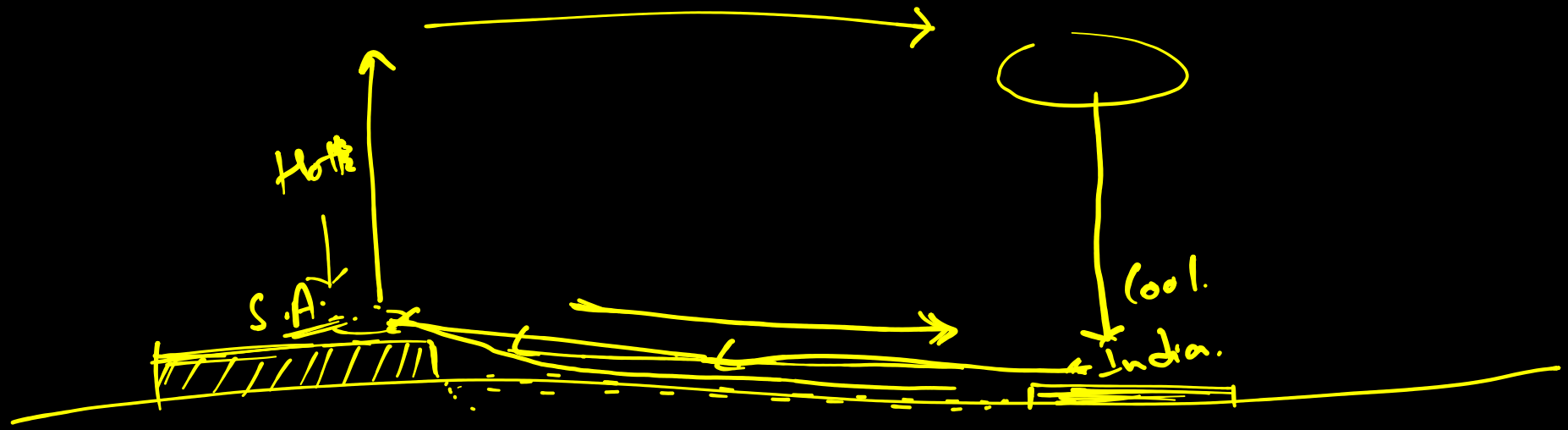
" It can transfer other forms of energy as well."

eg: Sun's radiation carry heat from sun to earth.

light







Summer

Convection : → Wind
→ Storm
→ Rain
etc.

End of the chapter