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Transport in plants



Tarun sir

How we are moving in this Batch

lecture

ncERT

PYQ

Handwritten notes, Combined
assignment



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Plant physiology

Transport in plants -2Q

10Q

Mineral nutrition

Photosynthesis in higher plants

Respiration in plants

Plant Growth and development



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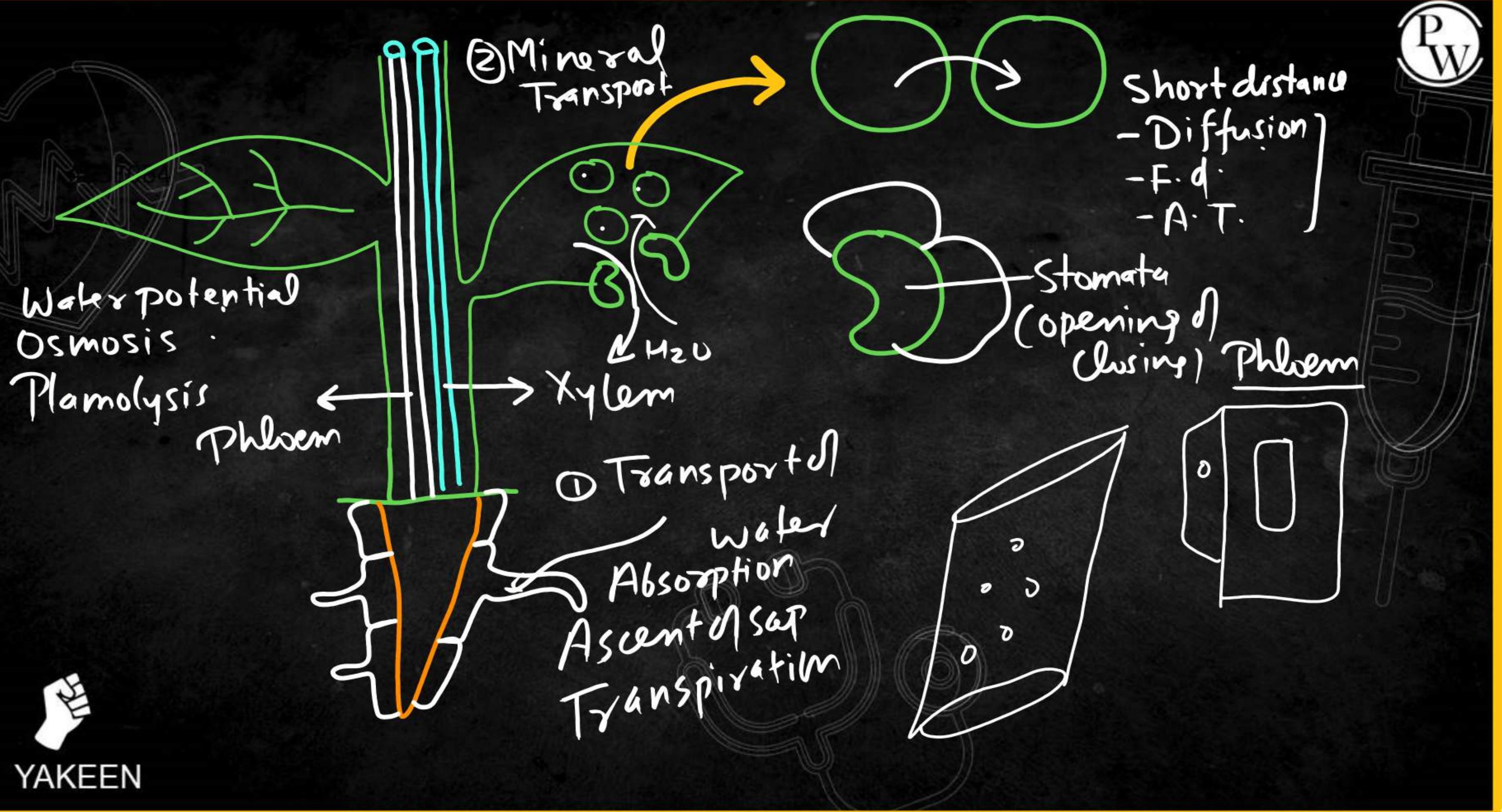


Transport in plants

Chapter tour



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Topics

Meaning of transport ✓

Short distance transport ✓ (Diffusion, Facilitated Diffusion, Active Transport)
Water potential ✓ Osmosis ✓ Plasmolysis

Imbibition ✓

Bulk Flow and mass Flow))

Transport of water

Absorption
Ascent of sap

Transport of mineral

phloem-transport

transpiration

Absorption / Transport

Sourve & Sink concept



Introduction

P
W

↳ It is strange How water moves → Root to tip of plant?

Is only water moves? → no other substance also moves

When we compare Plant transport & Animal transport

(a) Plant transport - occur for more distance

(b) Plant lack circulatory system

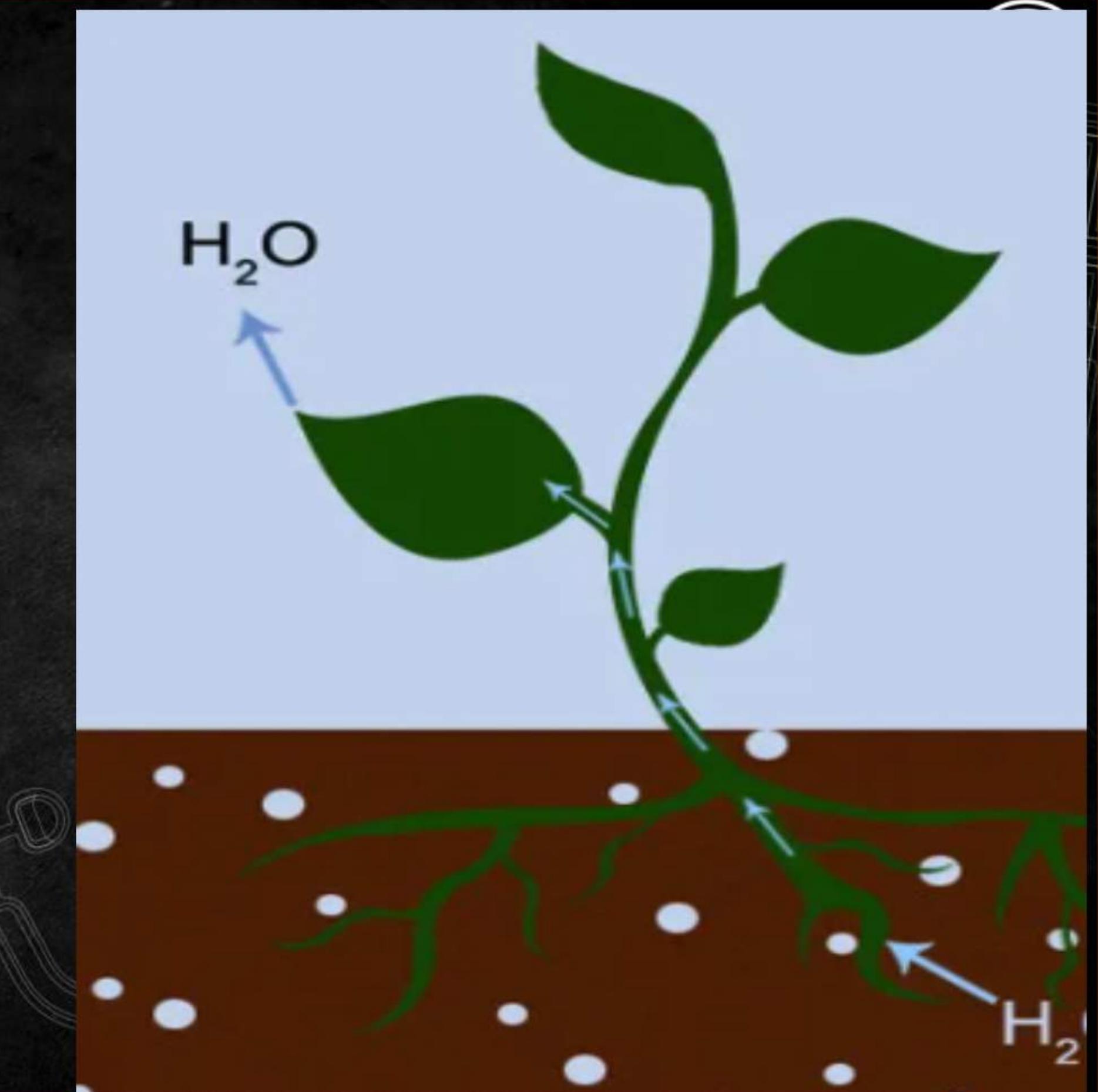


what to transport in Plant

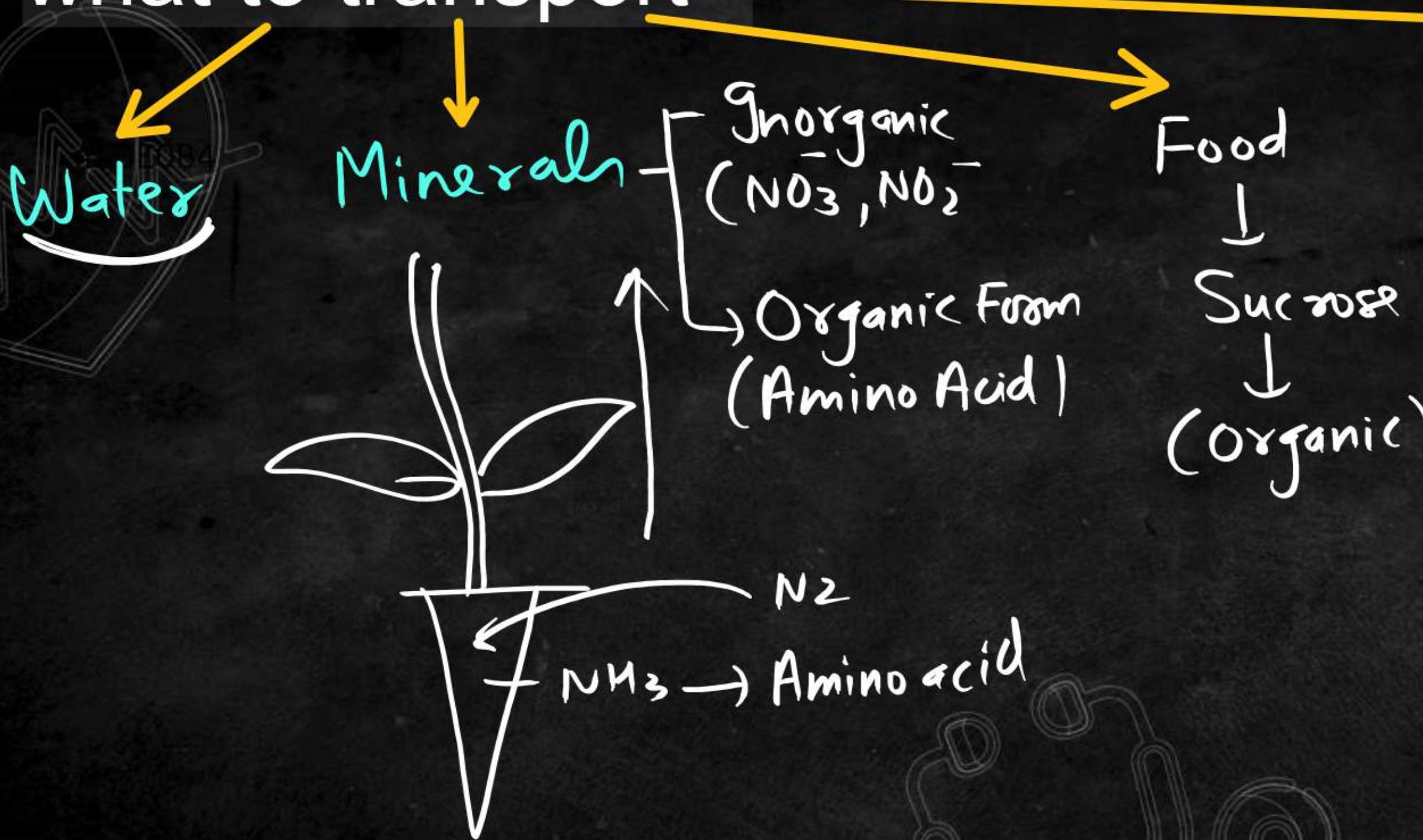
- (a) Water
- (b) Minerals
- (c) Food → Organic Food
(Sucrose)
- (d) PGR/Plant hormones



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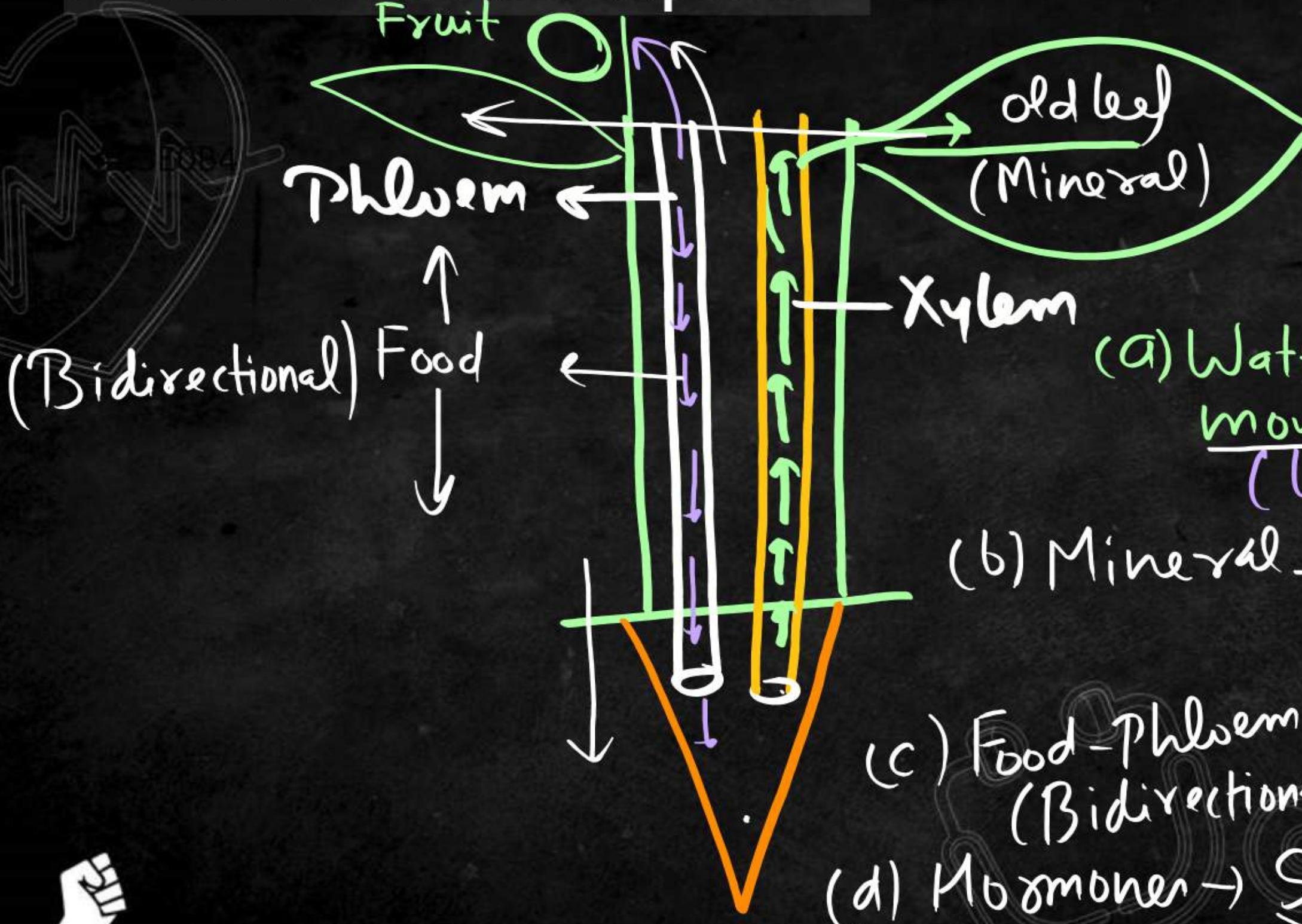
what to transport



Plant Growth
Hormone
(Organic)

Food
↓
Sucrose
(Organic)

Direction of transport



P W

(1) Xylem - Unidirectional
 (2) Phloem - Bidirectional

- (a) Water - It Always move through Xylem
 (Unidirectional)
- (b) Mineral - Xylem
 (Unidirectional)
- (c) Food - Phloem
 (Bidirectional)
 Phloem [Old to Young]
 (Multidirectional)
- (d) Hormones → Show - Unidirectional



How do we transport

(Complex traffic of substance →
in organs - Some substance
move in and some move
out)

Short distance
Transport



long distance
Transport

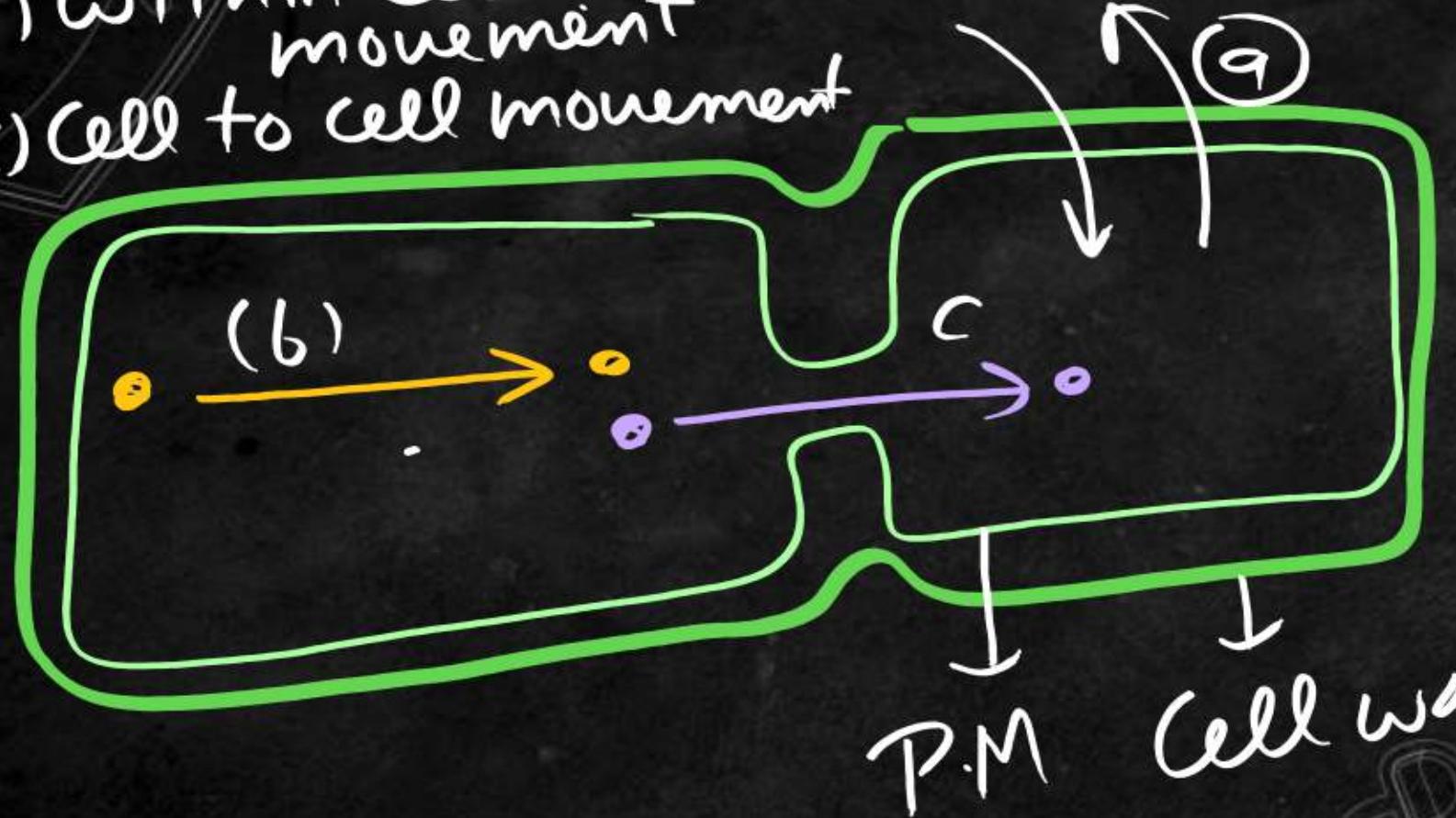


Type of transport

Short distance - meaning

(b) Within cell movement

(c) Cell to cell movement



(a) Entry or Exit From cell
→ the meaning

Long distance transport

Food



long distance
meaning - Point of Entry & Point of Use → Far apart



Type of transport

Short Distance transport
(How to achieve)

4 method

(a) Diffusion

(b) Facilitated Diffusion

(c) Active transport

(d) Cytoplasmic streaming

Long distance transport
(How to Achieve)

|| (a) By Xylem.

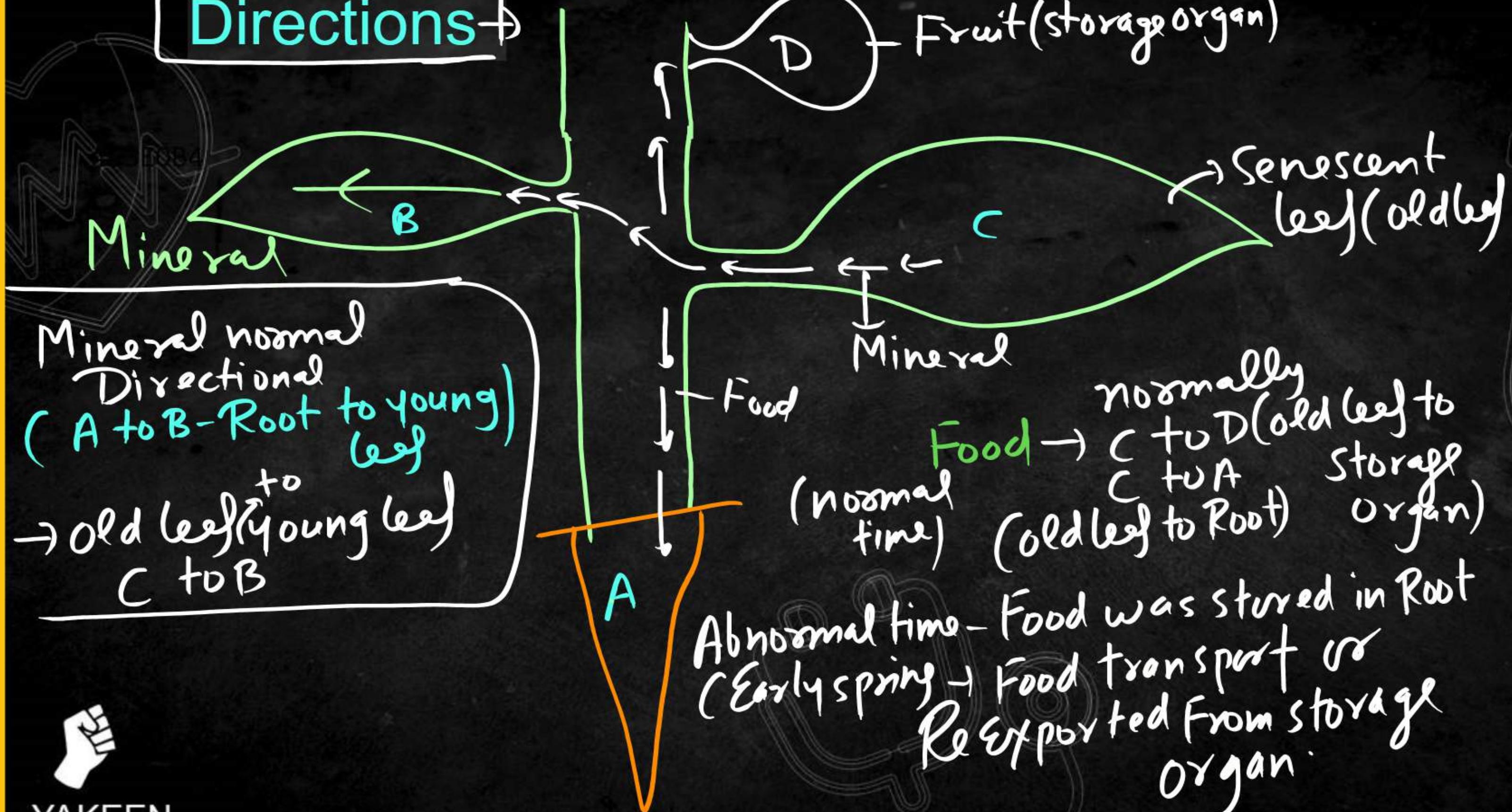
|| (b) By Phloem

long distance transport
through Xylem & phloem
is known as translocation



Directions →

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Have you ever wondered how water reaches the top of tall trees, or for that matter how and why substances move from one cell to the other, whether all substances move in a similar way, in the same direction and whether metabolic energy is required for moving substances. Plants need to move molecules over very long distances much more than animals do; they also do not have a circulatory system in place. Water taken up by the roots has to reach all parts of the plant, up to the very tip of the growing stem. The



photosynthates or food synthesised by the leaves have also to be moved to ^{Sucrose} all parts including the root tips embedded deep inside the soil. Movement across short distances, say within the cell, across the membranes and from cell to cell within the tissue has also to take place. To understand some of the transport processes that take place in plants, one would have to recollect one's basic knowledge about the structure of the cell and the anatomy of the plant body. We also need to revisit our understanding of diffusion, besides gaining some knowledge about chemical potential and ions.

When we talk of the movement of substances we need first to define what kind of movement we are talking about, and also what substances we are looking at. In a flowering plant the substances that would need to be transported are water, mineral nutrients, ^{Food} organic nutrients and plant growth regulators. Over small distances substances move by diffusion and by cytoplasmic streaming supplemented by active transport. Transport over longer distances proceeds through the ^{XIP} vascular system (the xylem and the phloem) and is called translocation.



An important aspect that needs to be considered is the direction of transport. In rooted plants, transport in xylem (of water and minerals) is essentially unidirectional, from roots to the stems. Organic and mineral nutrients however, undergo multidirectional transport. Organic



compounds synthesised in the photosynthetic leaves are exported to all other parts of the plant including storage organs From the storage organs they are later re-exported. The mineral nutrients are taken up by the roots and transported upwards into the stem, leaves and the growing regions. When any plant part undergoes senescence, nutrients may be withdrawn from such regions and moved to the growing parts. Hormones



or plant growth regulators and other chemical signals are also transported, though in very small amounts sometimes in a strictly polarised or unidirectional manner from where they are synthesised to other parts. Hence, in a flowering plant there is a complex traffic of compounds (but probably very orderly) moving in different directions, each organ receiving some substances and giving out some others.



Short distance transport

- (1) Diffusion | Simple diffusion
- (2) Facilitated Diffusion
- (3) Active transport
- (4) Cytoplasmic streaming



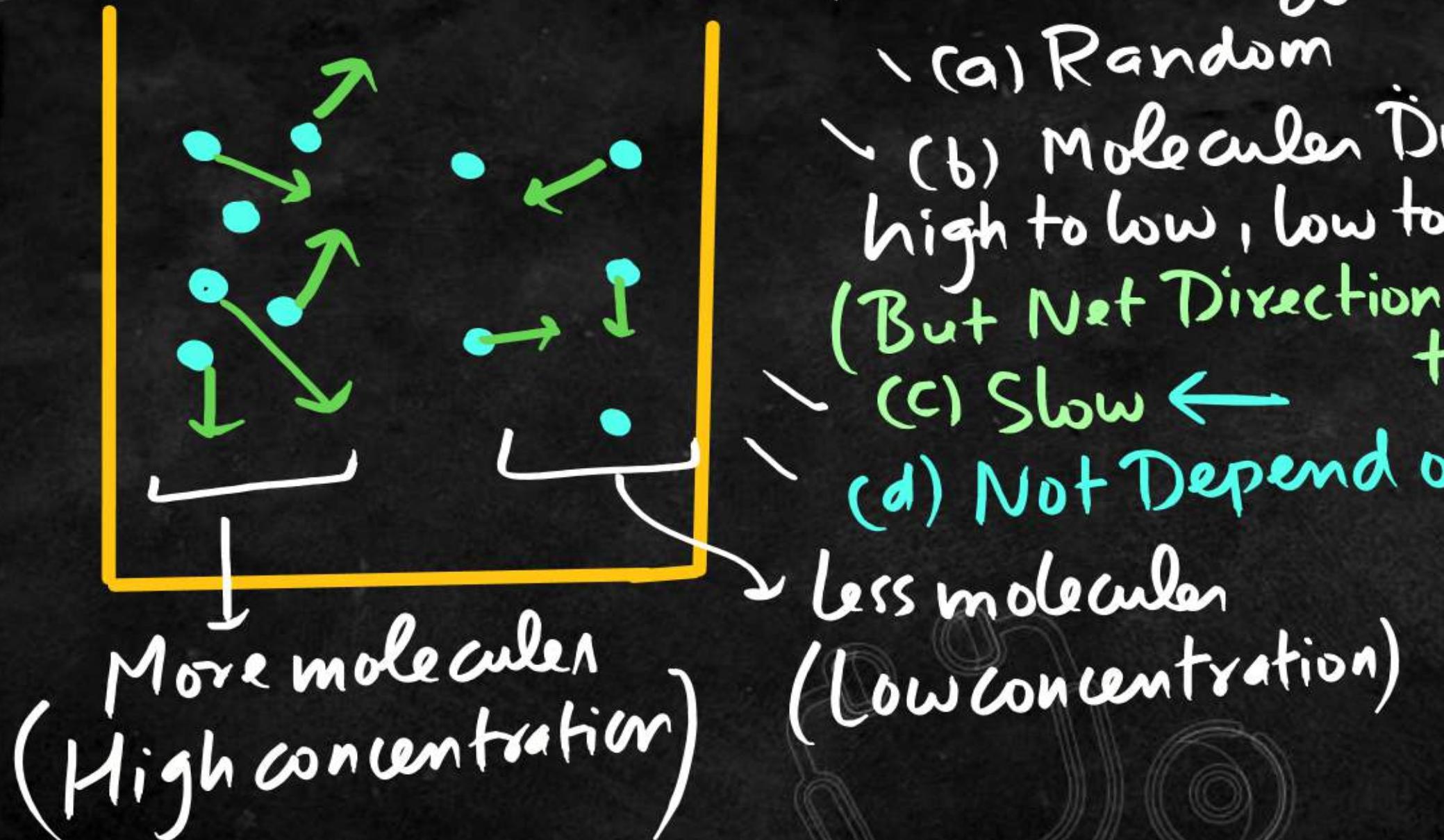
Diffusion

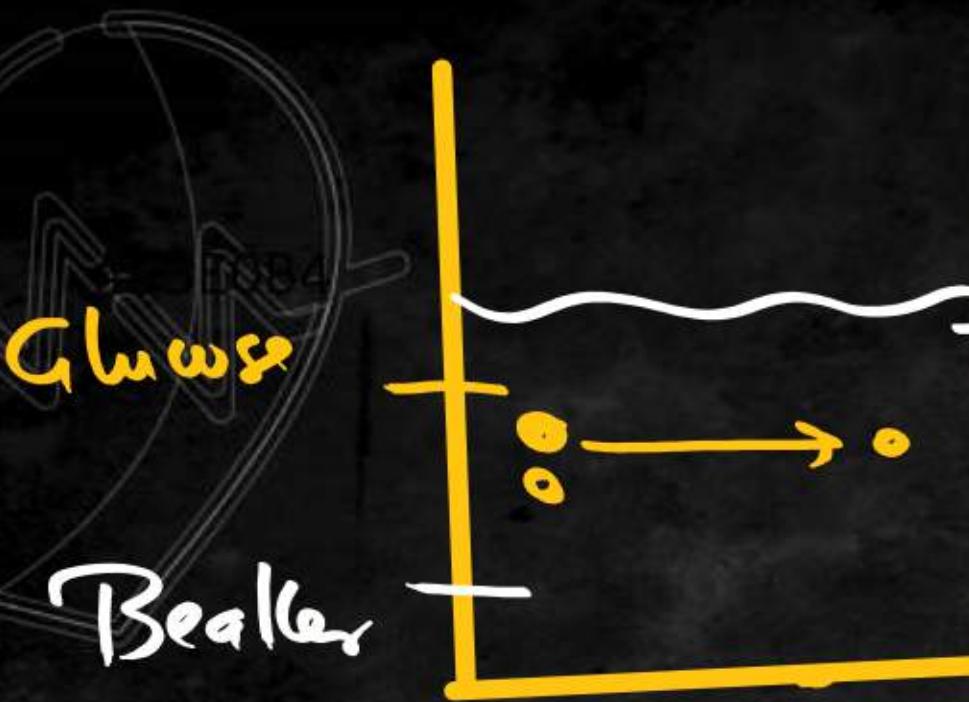
- It is Random movement of molecules of Gas & liquid



Features of Diffusion

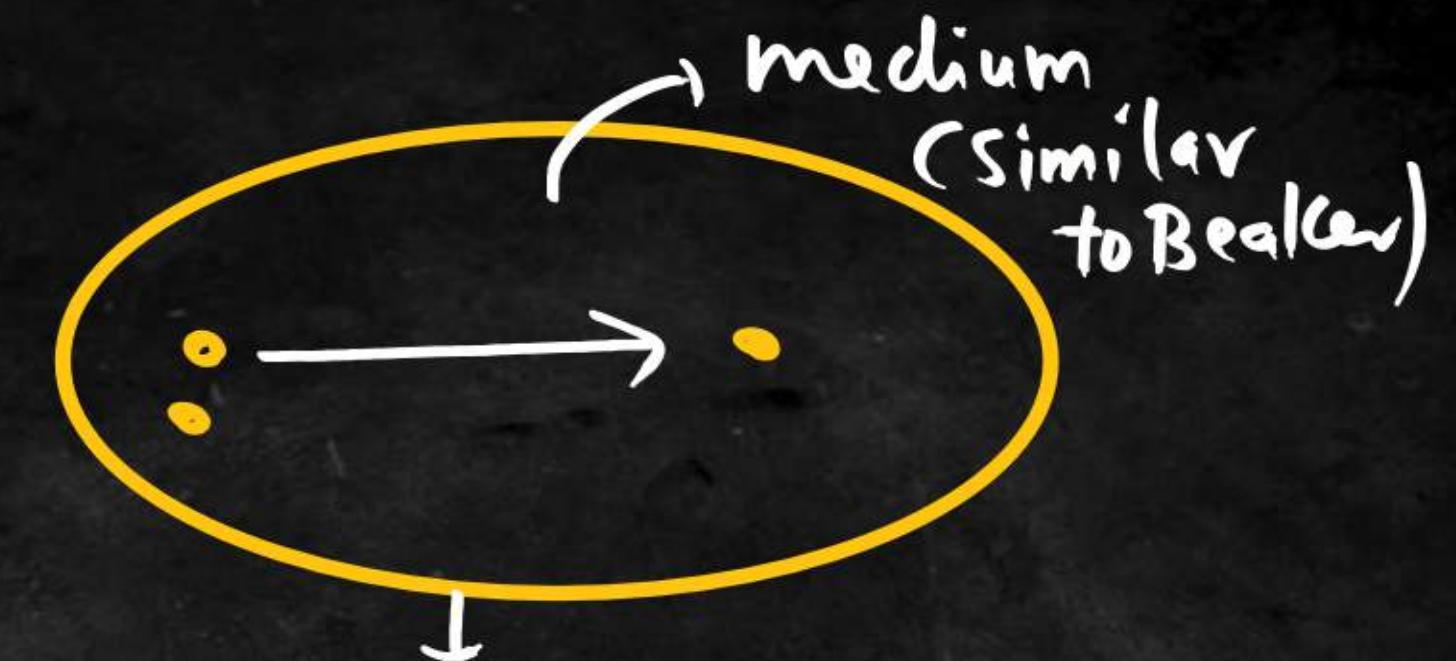
- (a) Random
- (b) Molecules Diffuse From high to low, low to high conc.
(But Net Direction is High conc. to low conc.)
- (c) Slow ←
- (d) Not Depend on living System





non-living system

Diffuse with
Same rate



Cell (living system)



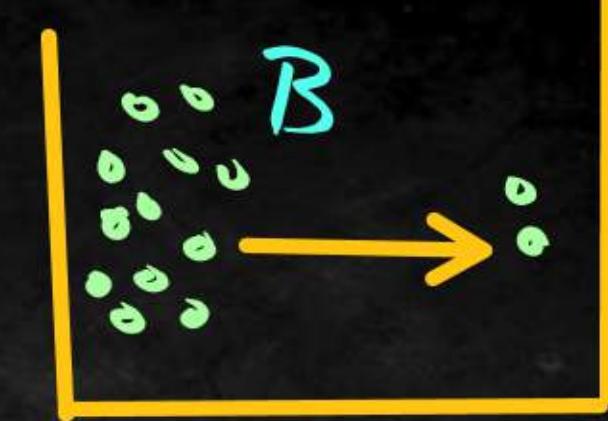
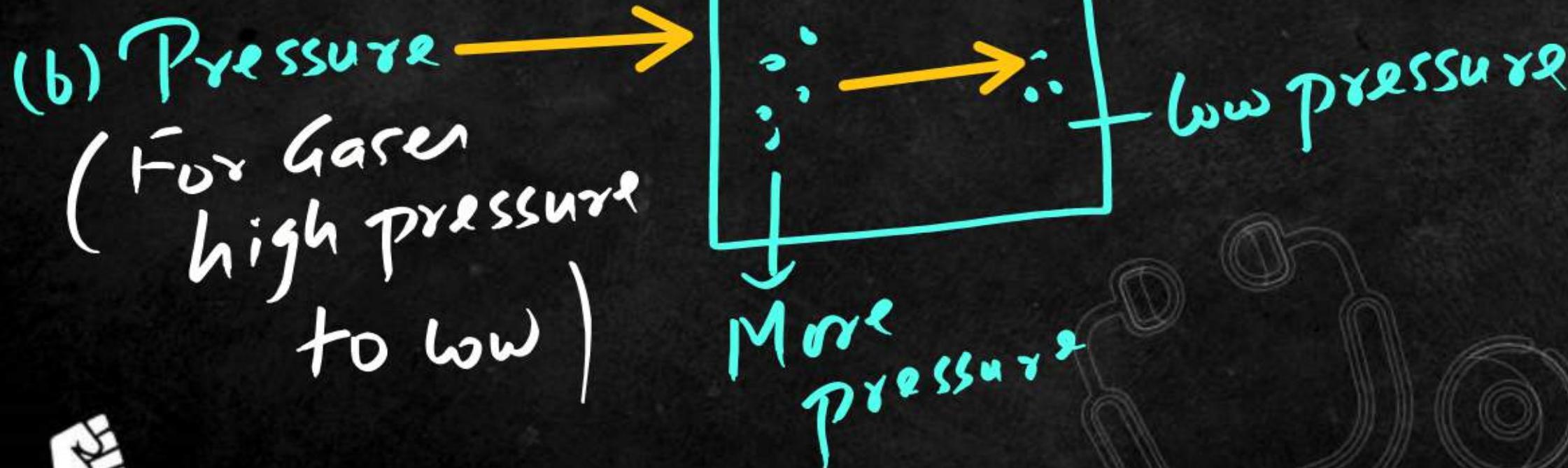
factors affecting Diffusion → Rate of Diffusion

(a) Concentration Gradient

More is conc. gradient

Faster is Diffusion

(B have More gradient than A)



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(c) temperature →

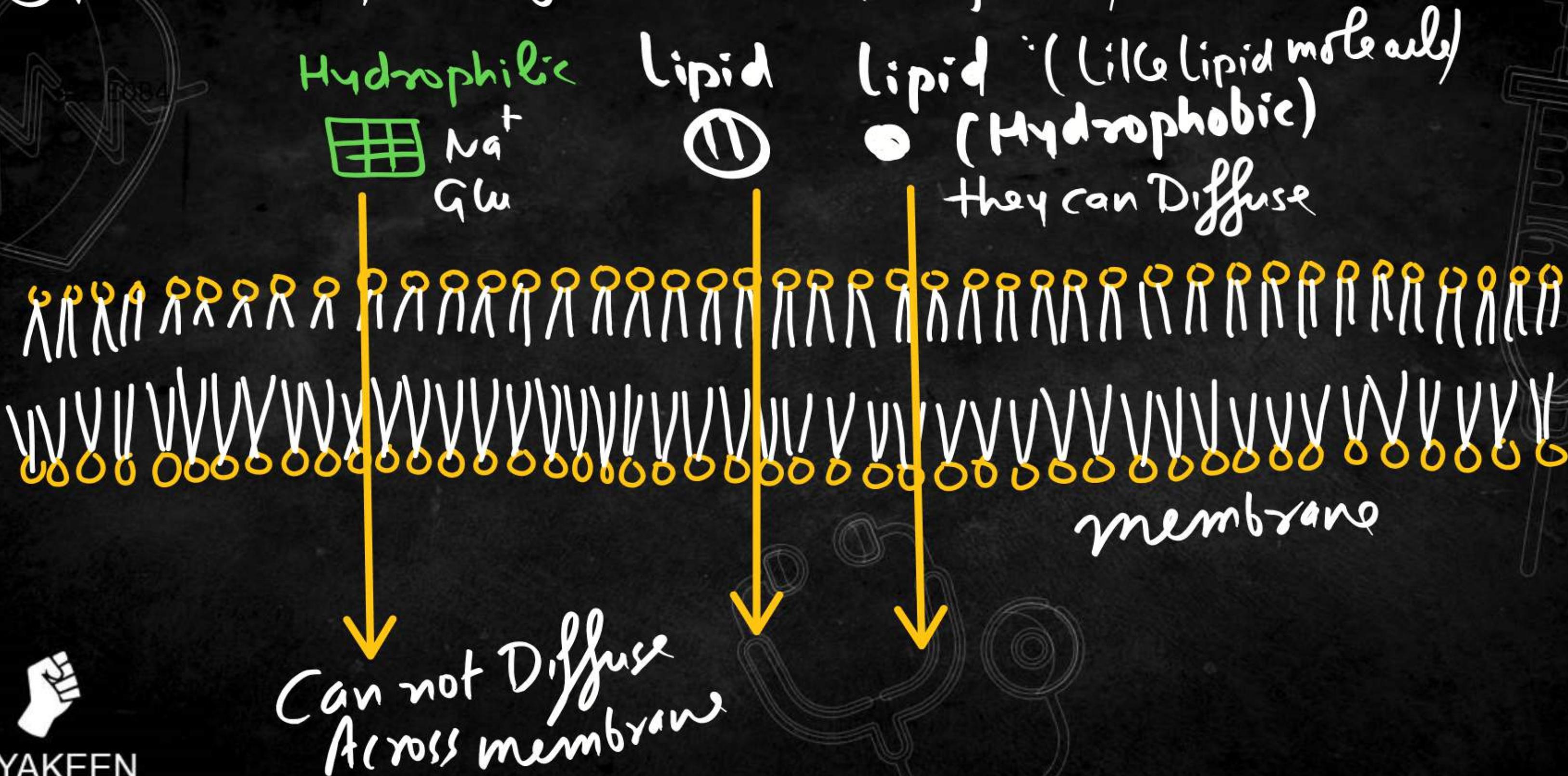
↳ more is temperature

↓
Random movement inc.

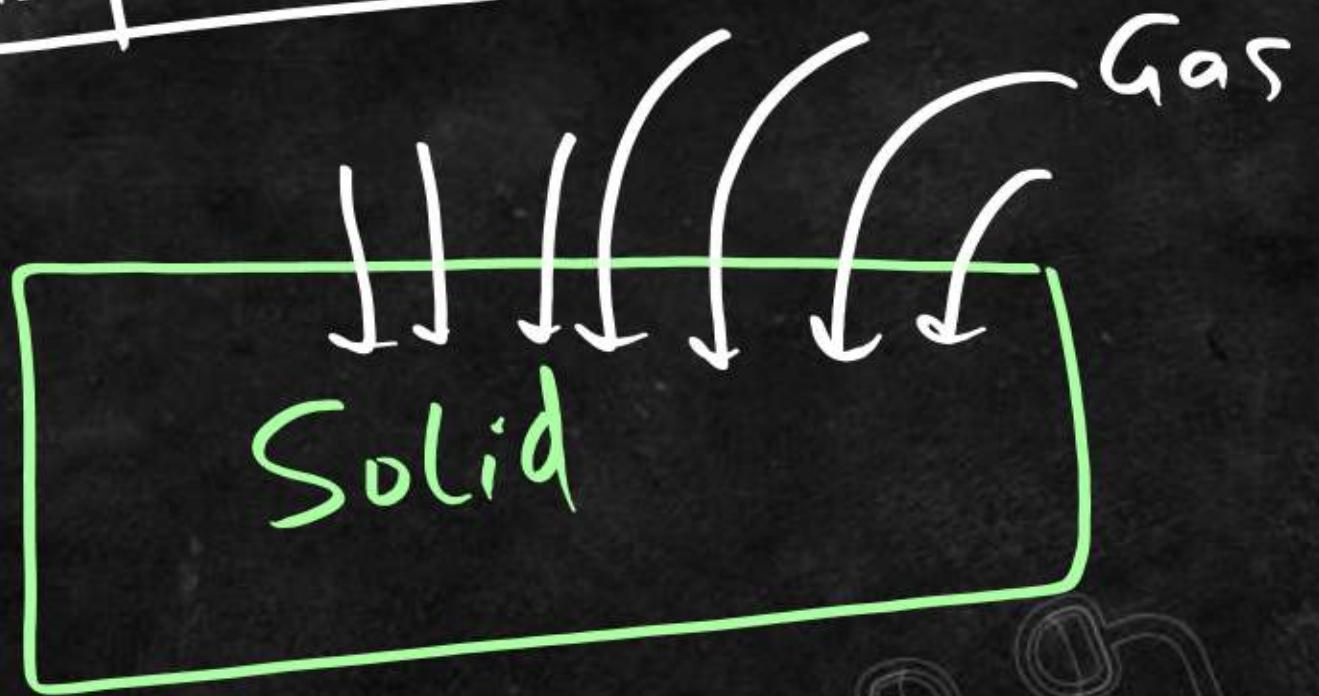
↑
Rate of Diffusion also increase



④ Permeability through membrane (For lipid of small size Diffusion is faster)



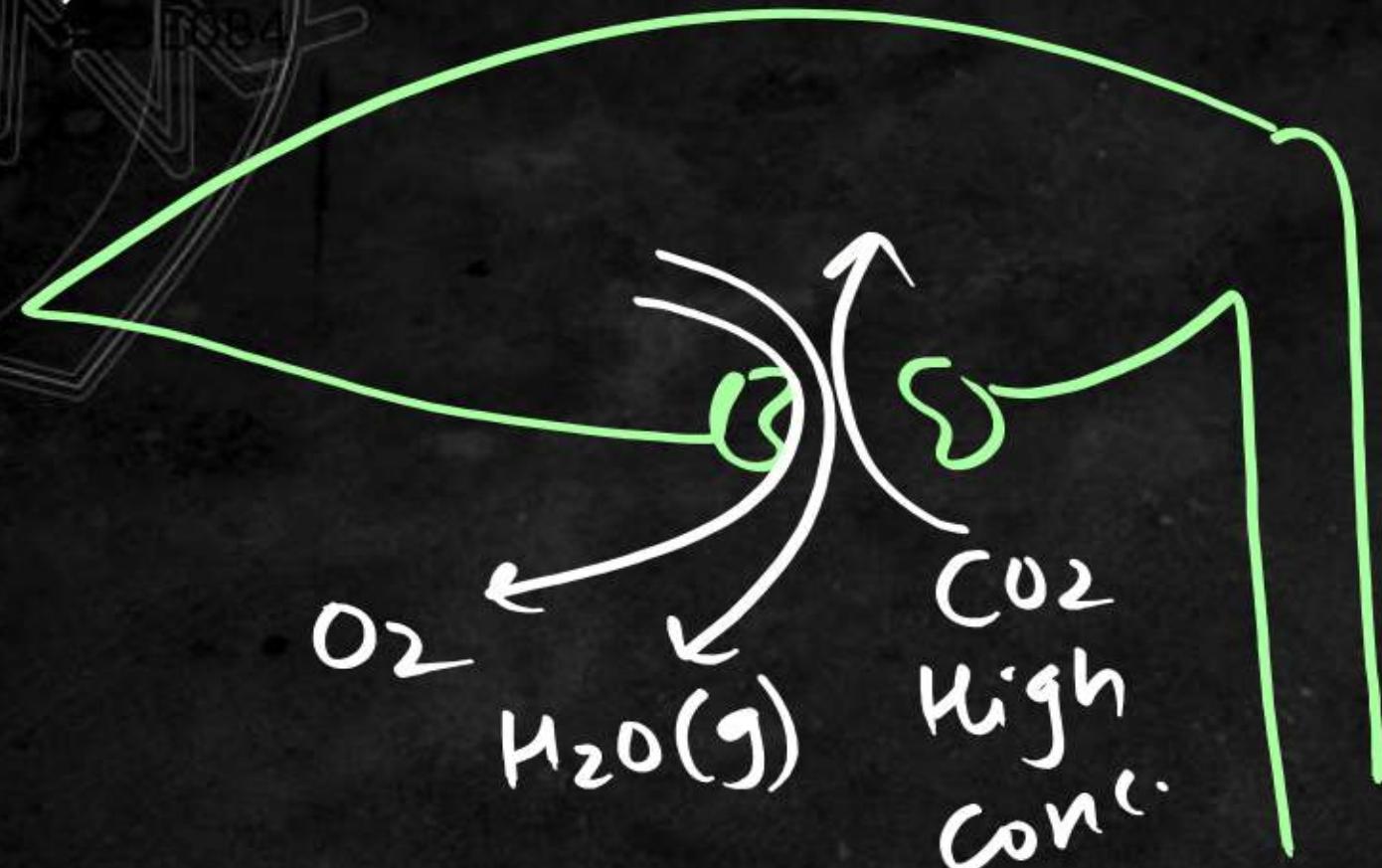
Note - Diffusion for liquid and Gas is Quite Common
Diffusion of Solid not occur But Diffusion inside Solid is possible



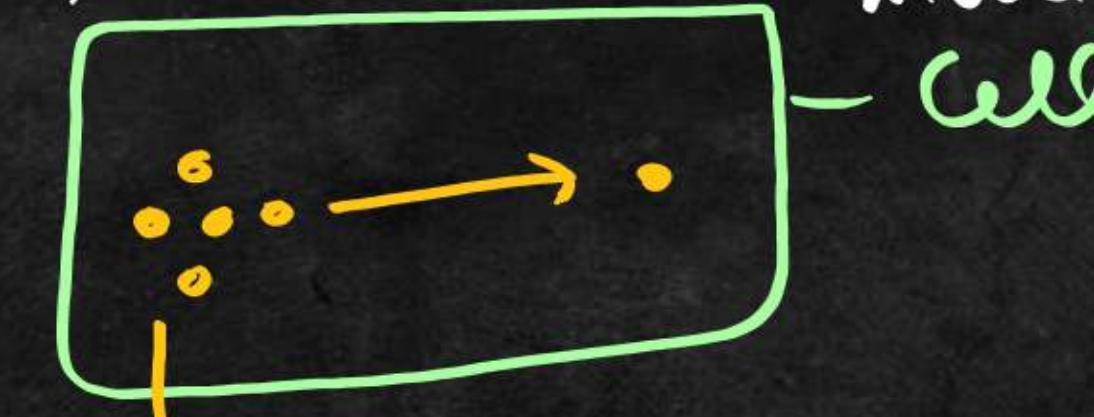
Role of Diffusion in plants



(a) Movement of Gases always occur with the help of Diffusion in plants



(b) Molecule inside cytoplasm move by Diffusion



Glucose

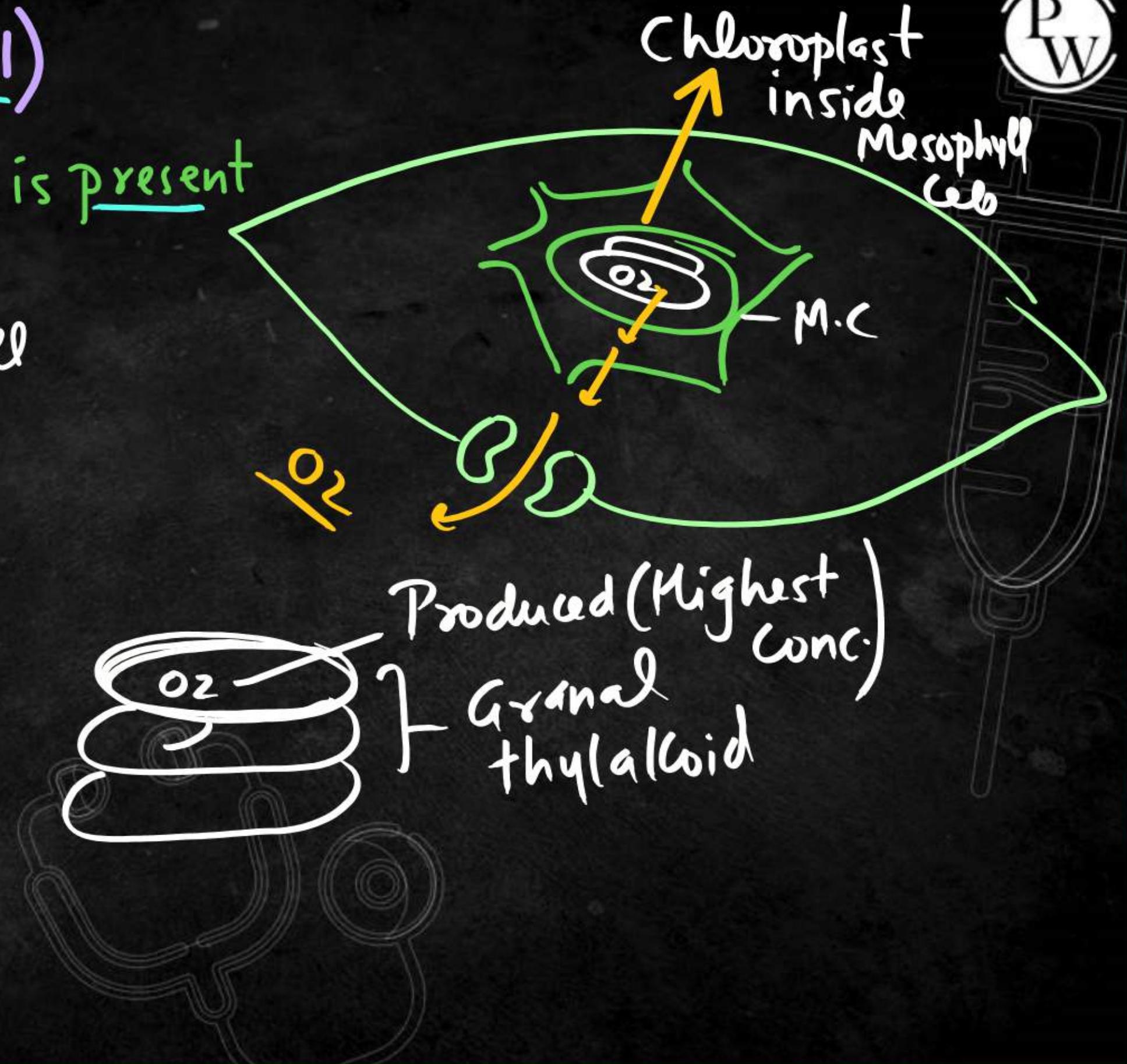
(c) Movement of Gases Across Membrane By Diffusion
Lipid Move By Diffusion



Conceptual Thinking Question (CTQ-1)

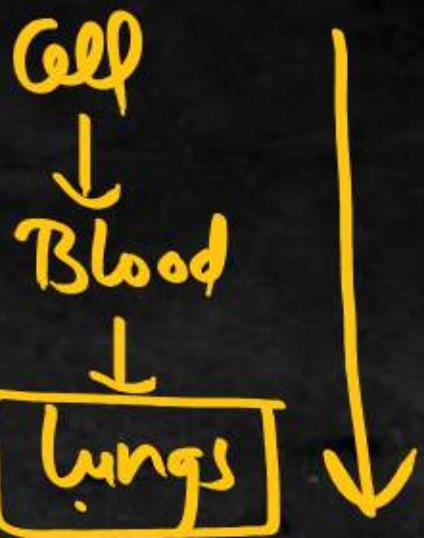
Q1 Highest concentration of O_2 is present

- (a) Atmosphere.
- (b) Inside cytoplasm of mesophyll cell in Day.
- (c) Inside Chloroplast in mesophyll in Day
- (d) Inside thylakoid lumen in mesophyll Day



Can you Answer ?

lowest conc. of CO₂ in Our Body



Plant - lowest conc.
of CO₂ ??



11.1 MEANS OF TRANSPORT

11.1.1 Diffusion

Energy not Required

Movement by **diffusion** is passive, and may be from one part of the cell to the other, or from cell to cell, or over short distances, say, from the inter-cellular spaces of the leaf to the outside. No energy expenditure takes place.

In diffusion, molecules move in a random fashion, the net result being substances moving from regions of higher concentration to regions of lower.

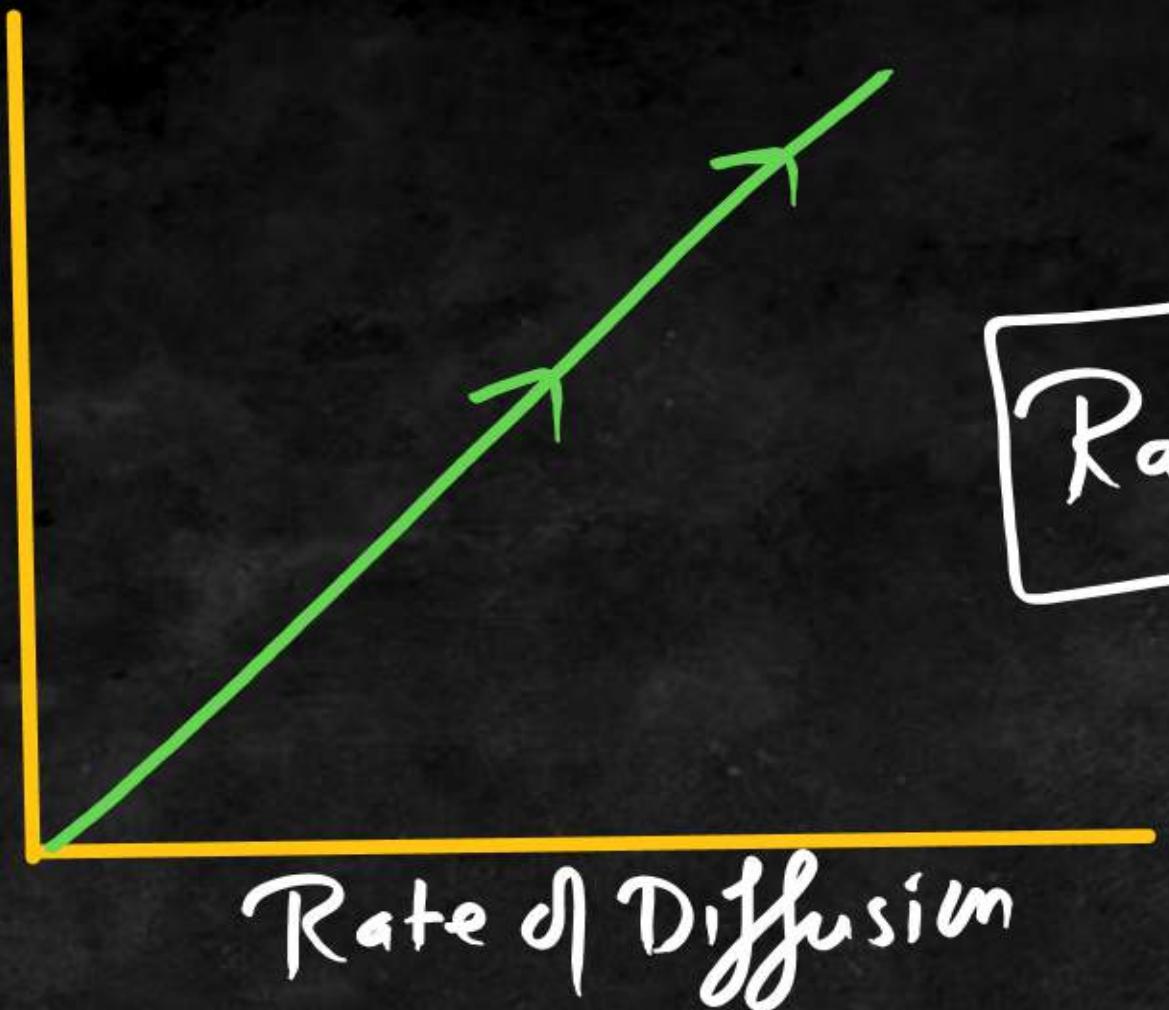


concentration. Diffusion is a slow process and is not dependent on a living system. Diffusion is obvious in gases and liquids, but diffusion in solids is more likely rather than of solids. Diffusion is very important to plants since it is the only means for gaseous movement within the plant body.

Diffusion rates are affected by the gradient of concentration, the permeability of the membrane separating them, temperature and pressure.



Conc.
gradient



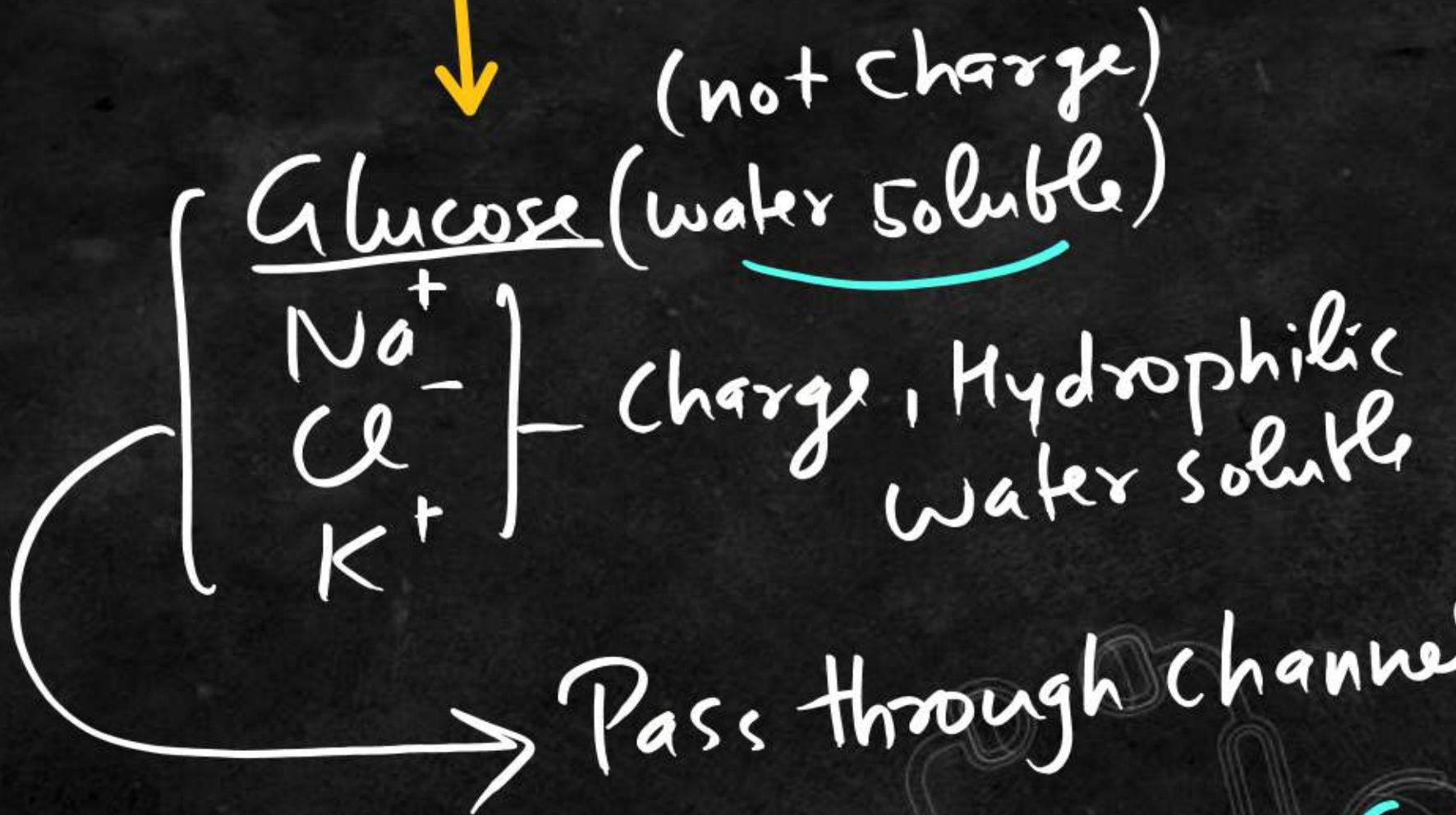
Rate of Diffusion \propto Conc. gradient



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- Hydrophobic Substance like Lipid can Diffuse Directly
- Substance with hydrophilic moiety - move with help of channel (membrane protein)

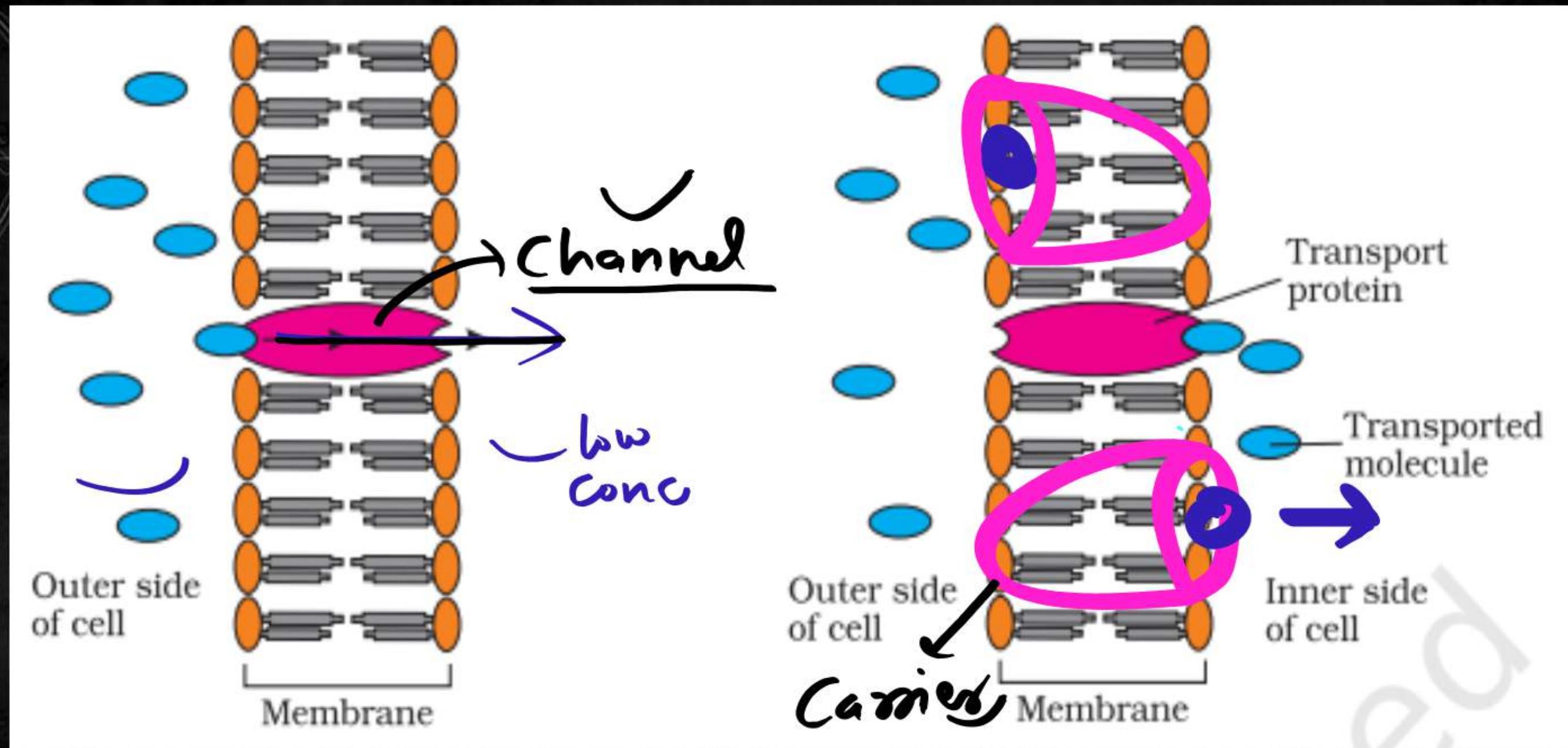


Facilitated Diffusion is a type of Diffusion

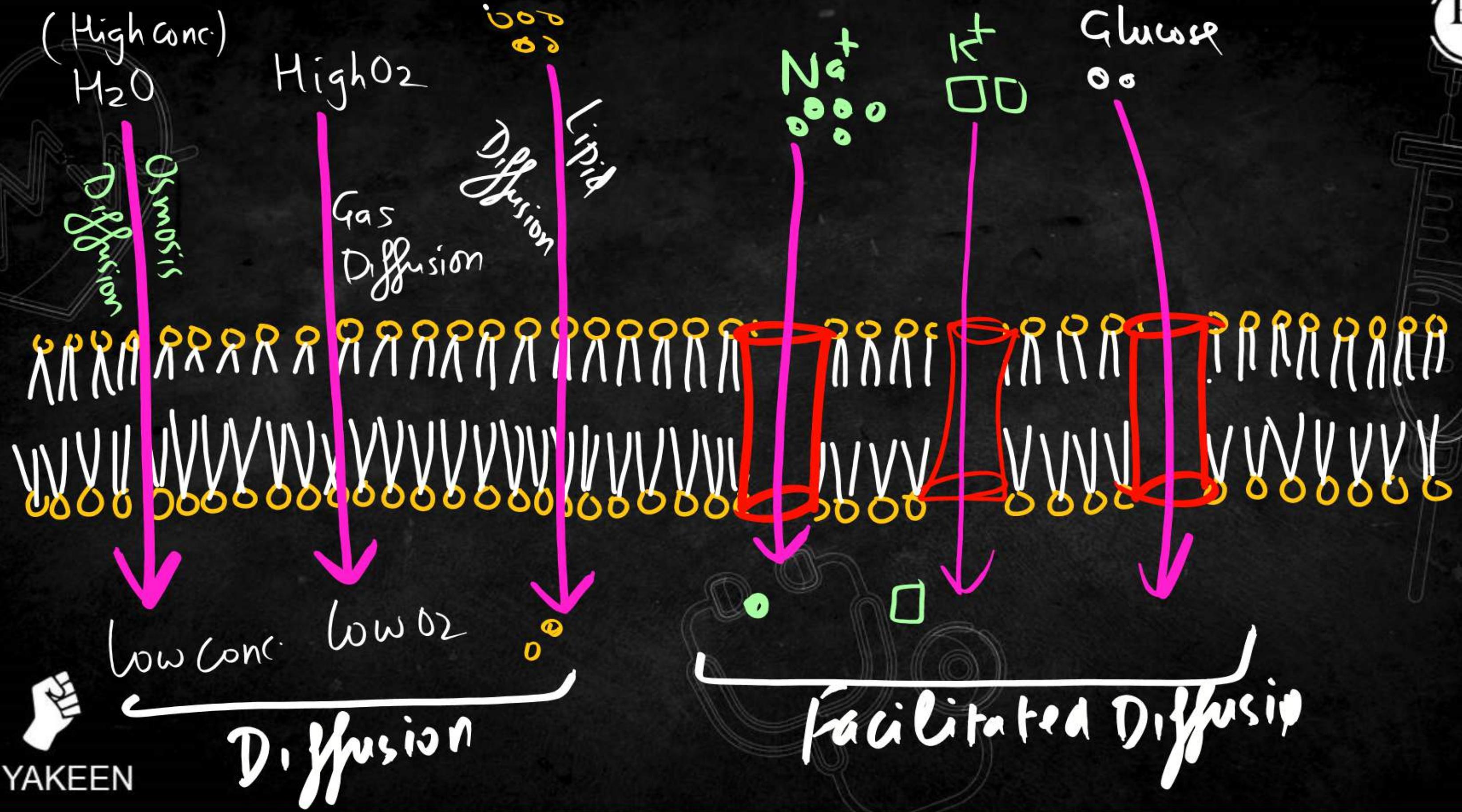
Where Hydrophilic Substance can move from High conc. to low

Conc. By Membrane Protein like channel





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Since movement occur with the help of channel



Channel is made up of Protein

(transport protein)

Some Features of Facilitated Diffusion → Features of Channel

(a) Passive → not Require Energy

(b) Downhill → High conc. to Low conc.

(c) Occur Across membrane By (channel)

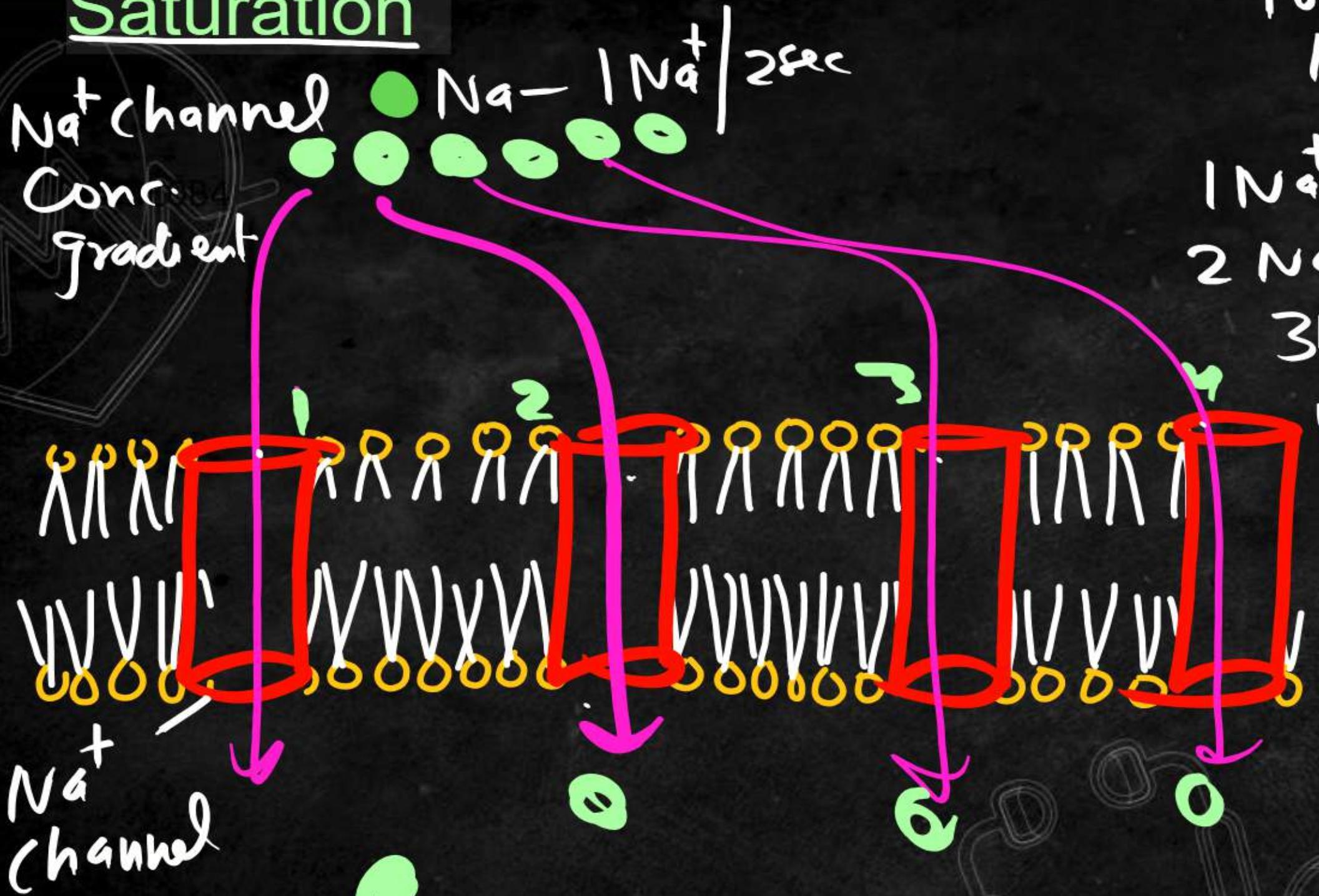
Channel properties



- (1) made up of protein
- (2) Saturation $[S]$
- (3) Selectivity or Specificity $\frac{S}{I}$
- (4) Inhibition
- (5) Channel always open | can be controlled



Saturation



total channel = 4
1 Na⁺ / 2sec - move

1 Na⁺ → 2 sec

2 Na⁺ → 2 sec

3 Na⁺ → 2 sec

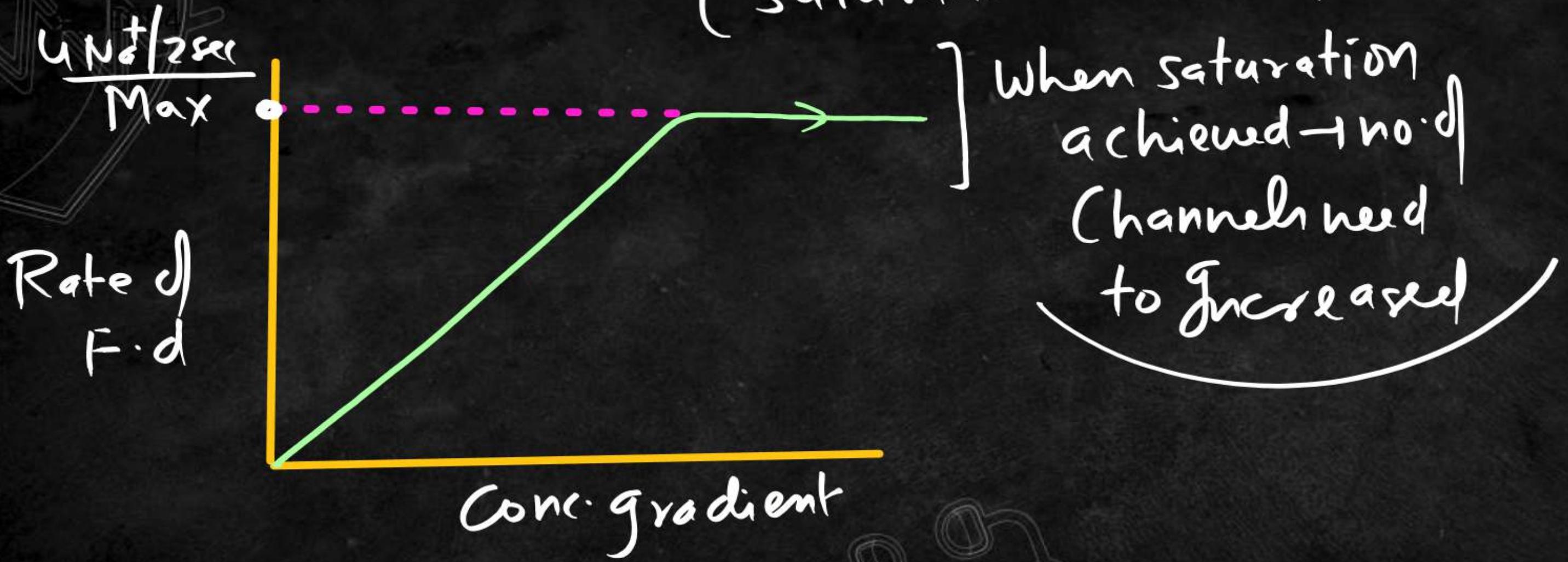
4 Na⁺ → 2 sec

5 Na⁺ → 2 sec

Across Membrane
(All channel get occupied)

5 Na⁺ → 4 sec

In Facilitated diffusion \rightarrow all channels got occupied
(Saturation - achieved)



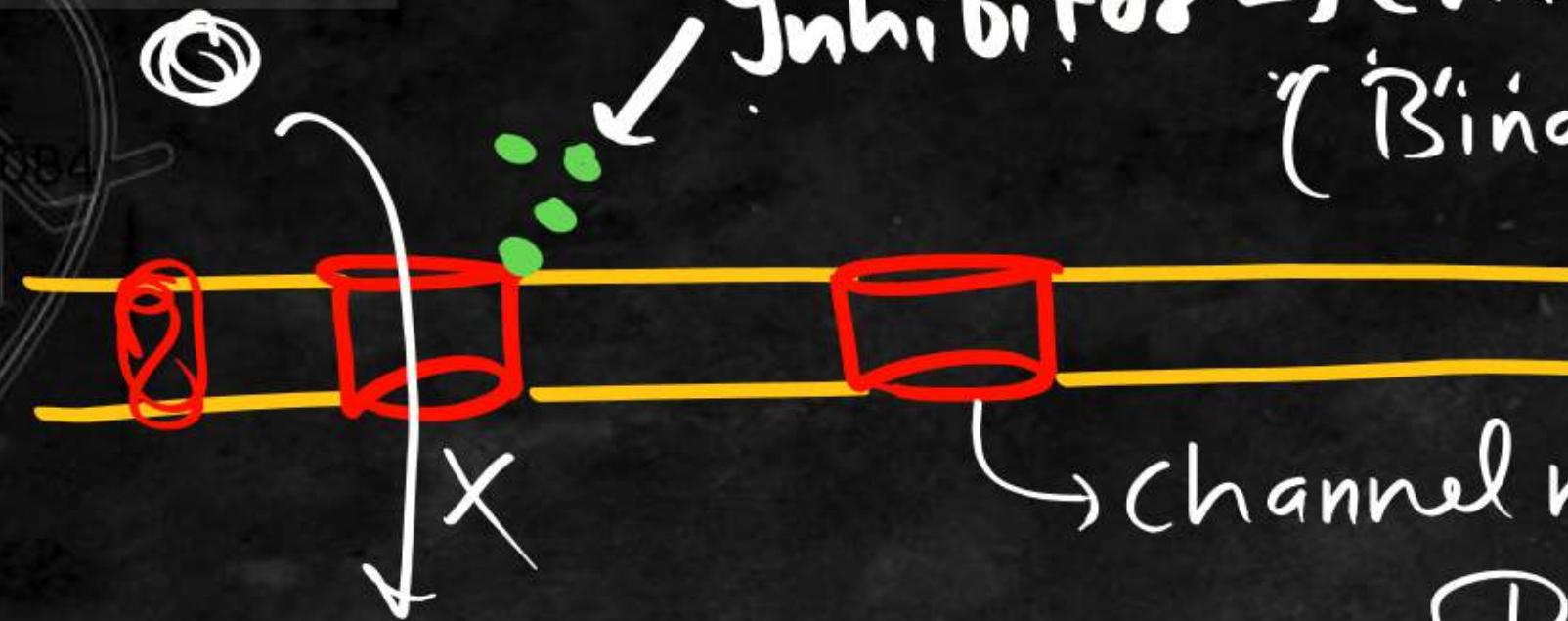
⑪ Selective



Channel is Selective
For Substance to pass



inhibition



Some chemical can inhibit movement across membrane
Inhibitor → change shape
(Bind at side chain)

channel made up of
Protein



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P
W



THANK YOU !!



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