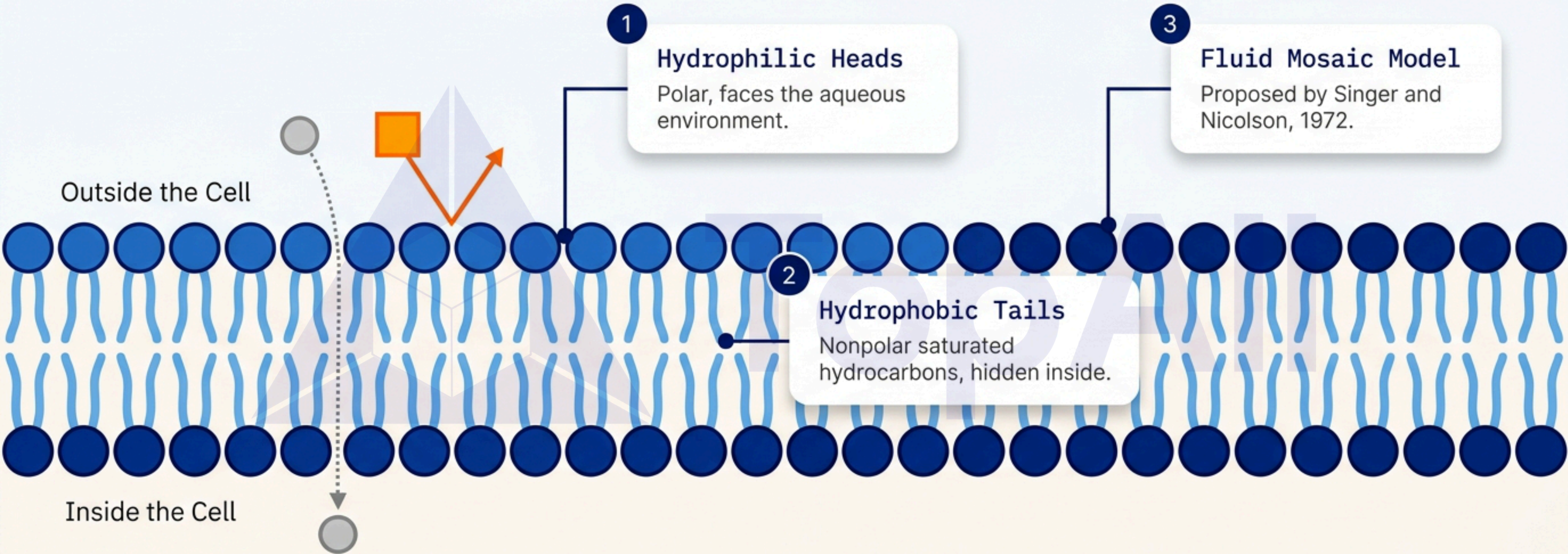


How Molecules Cross the Membrane

A visual guide to cellular logistics, permeability, and transport mechanisms

The Ultimate Gatekeeper



Selective Permeability: The membrane acts as a strict barrier, controlling which molecules can enter or exit to maintain the cell's internal living state.

Passive Transport: Going with the Flow

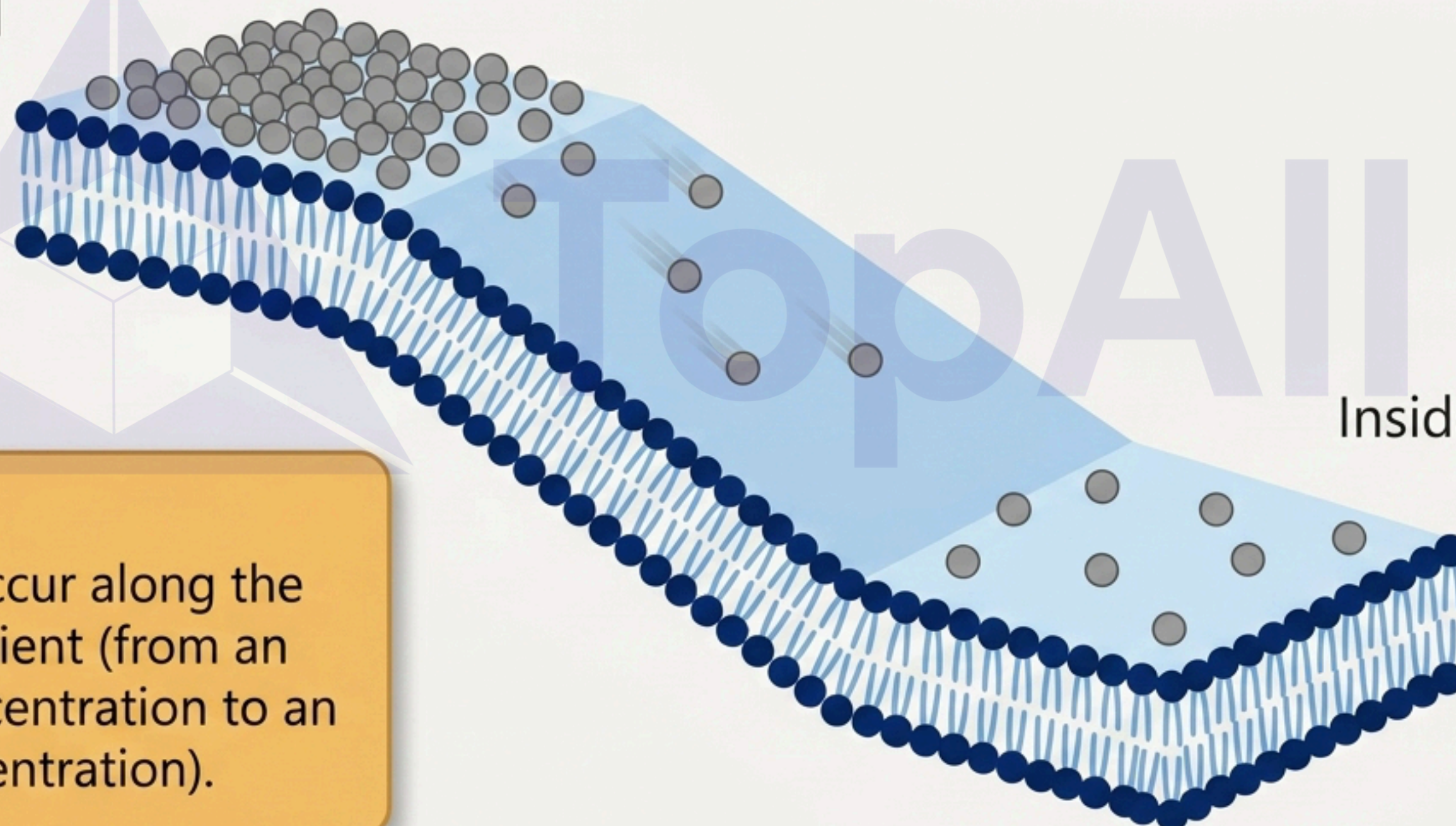
Molecules move across the membrane **without** the cell expending **any energy**.

Outside the Cell

Inside the Cell

The Golden Rule:

Movement must occur along the concentration gradient (from an area of higher concentration to an area of lower concentration).





You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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Simple Diffusion

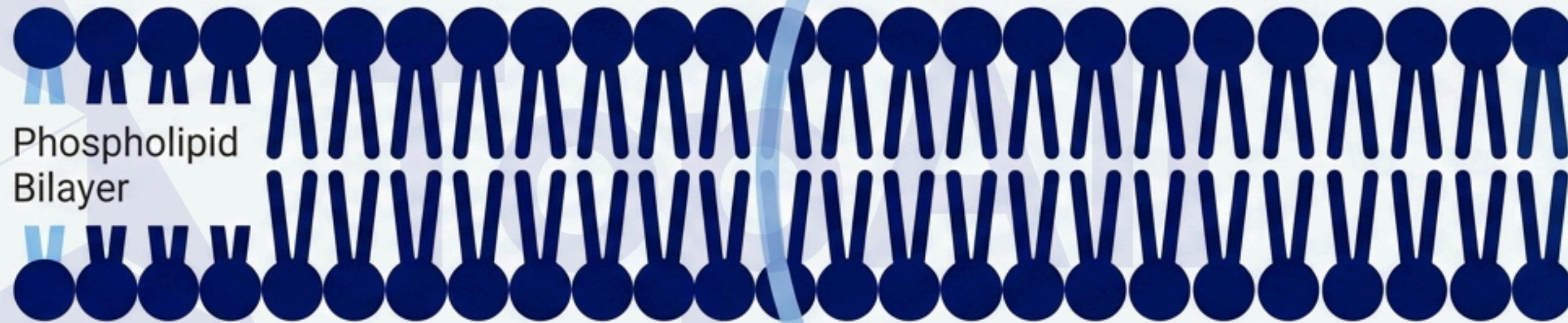
Target:
Neutral solutes.

Mechanism:
Molecules pass
directly through
the nonpolar lipid
bilayer unassisted.

Outside the Cell

Phospholipid
Bilayer

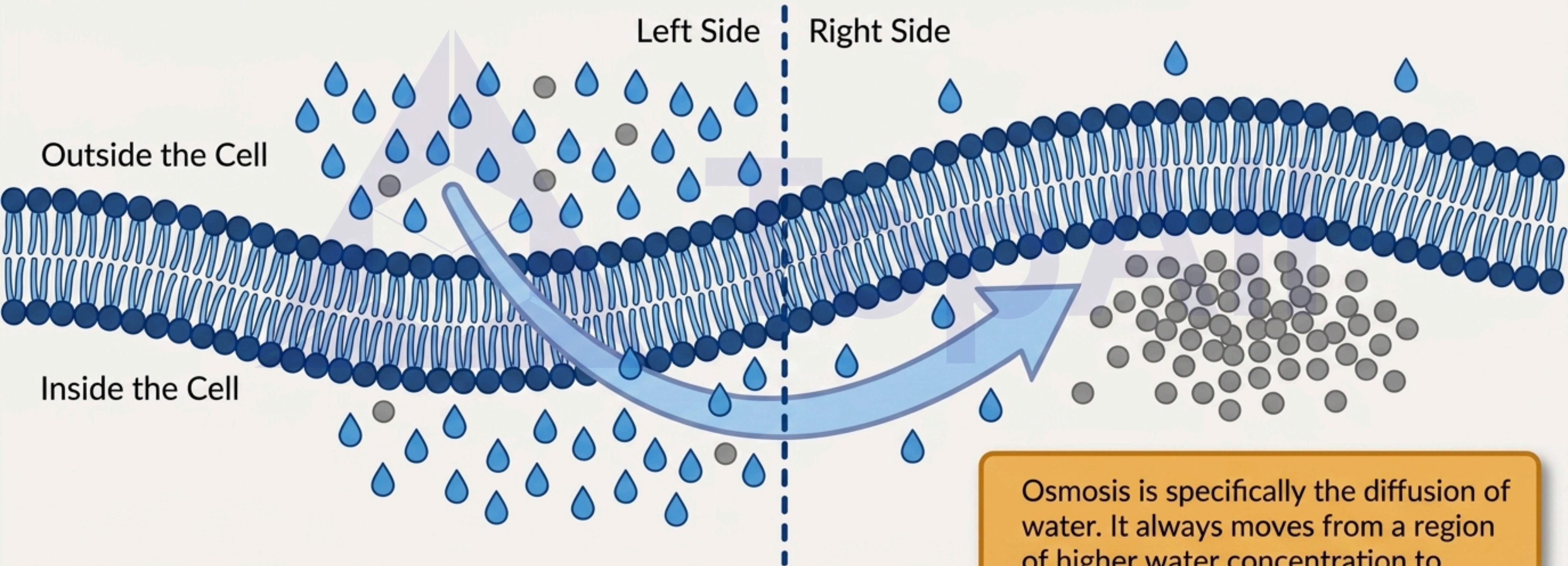
Inside the Cell



Because these molecules are neutral, they are not repelled by the hydrophobic interior of the membrane. They slip through the gaps naturally.

Osmosis: The Movement of Water

Water follows its own concentration gradient across the selectively permeable membrane.



Osmosis is specifically the diffusion of water. It always moves from a region of higher water concentration to lower water concentration.

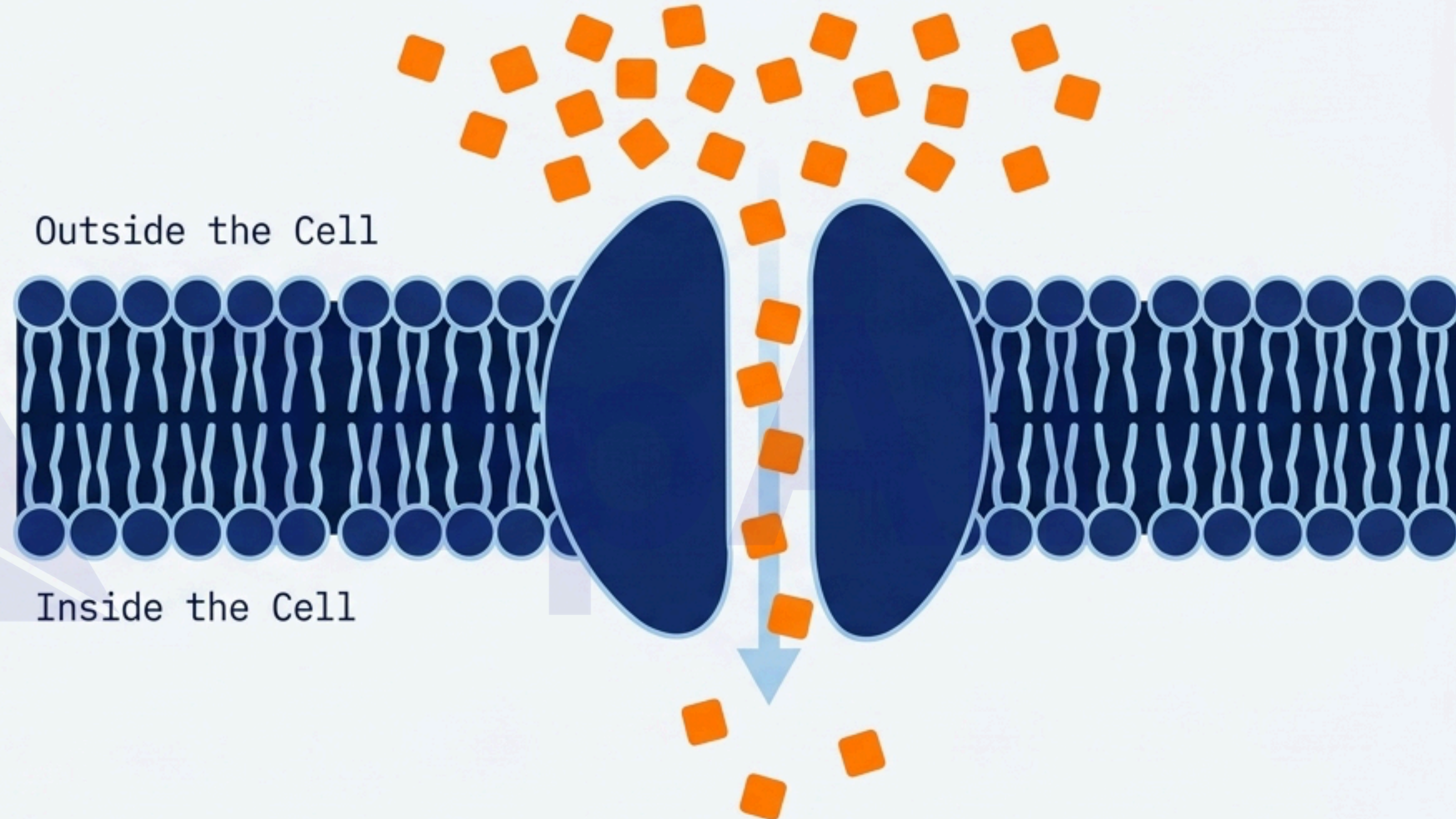
Carrier Proteins (Facilitated Transport)

The Problem:

Polar molecules cannot pass through the nonpolar lipid bilayer.

The Solution:

Membrane proteins act as carriers or channels to facilitate transport.



This is still **Passive Transport**! It requires a protein assistant, but no energy is used because it still moves from High to Low concentration.

Active Transport and the Na⁺/K⁺ Pump

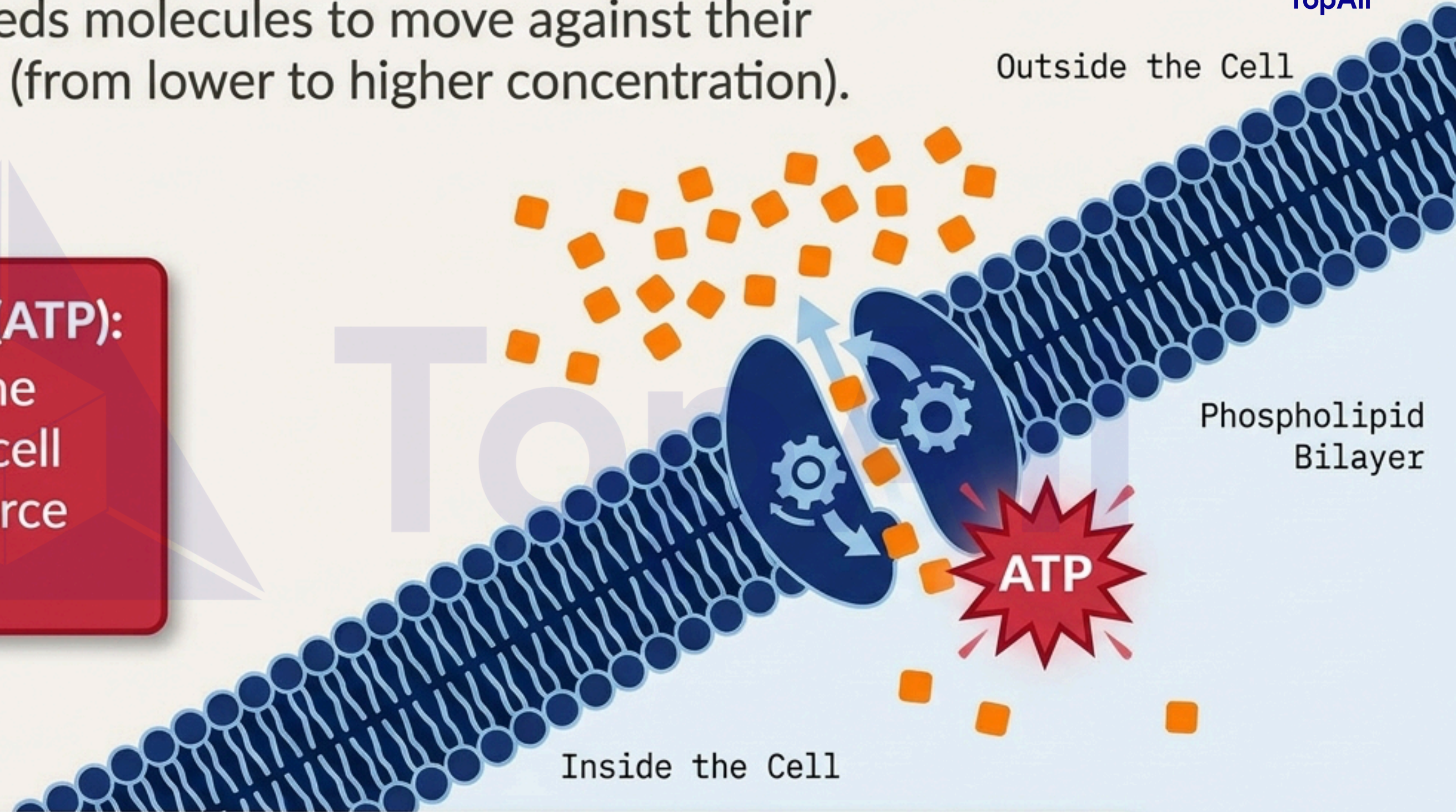


Sometimes, the cell needs molecules to move against their concentration gradient (from lower to higher concentration).

Outside the Cell

ENERGY REQUIRED (ATP):

Because this defies the natural gradient, the cell must utilize ATP to force the transport.



Example: The Na⁺/K⁺ Pump actively pumps ions across the membrane to maintain vital cellular gradients.



You've Learned the Theory.

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