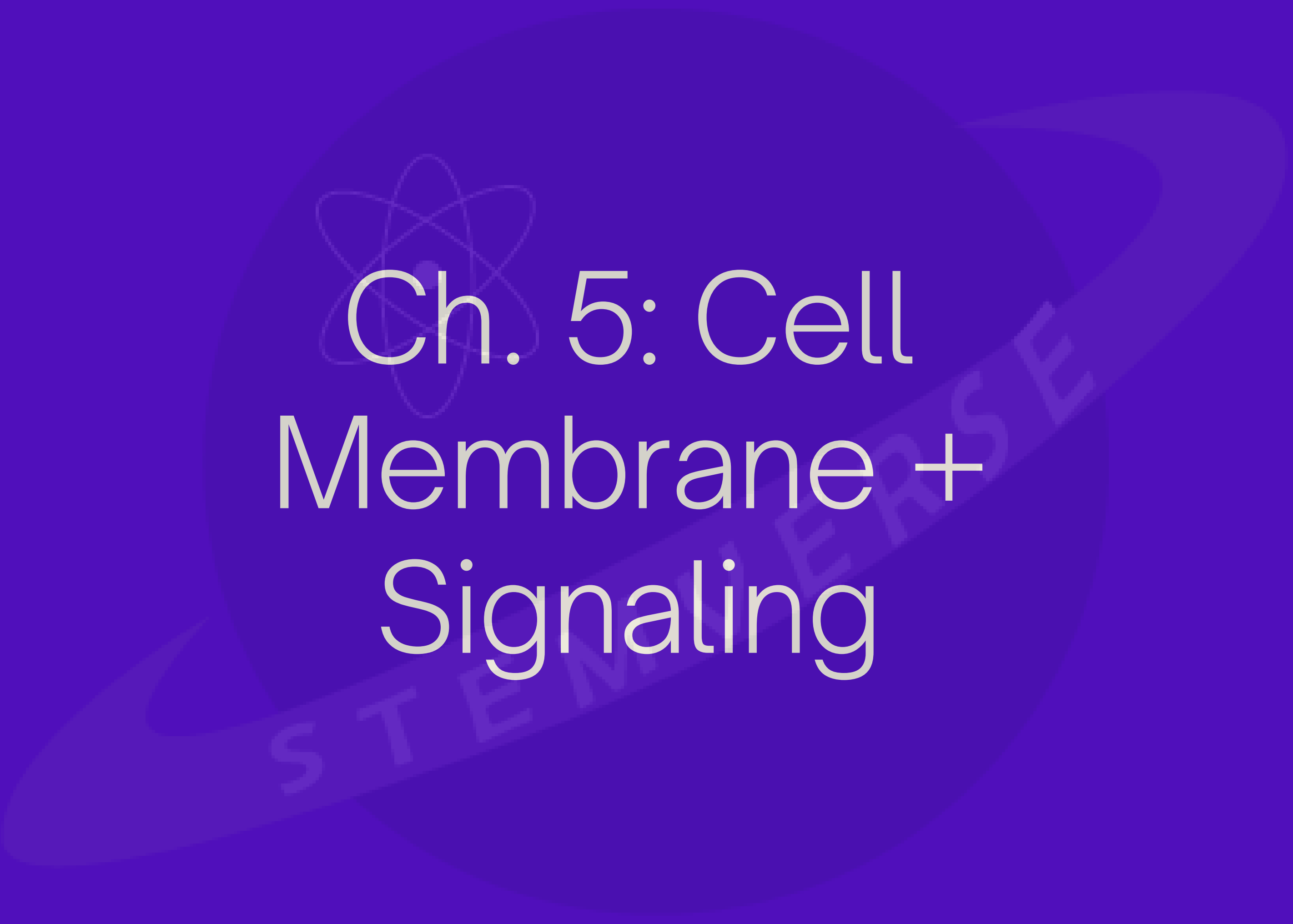


Ch. 5: Cell Membrane + Signaling



Cell membranes are fluid mosaics:

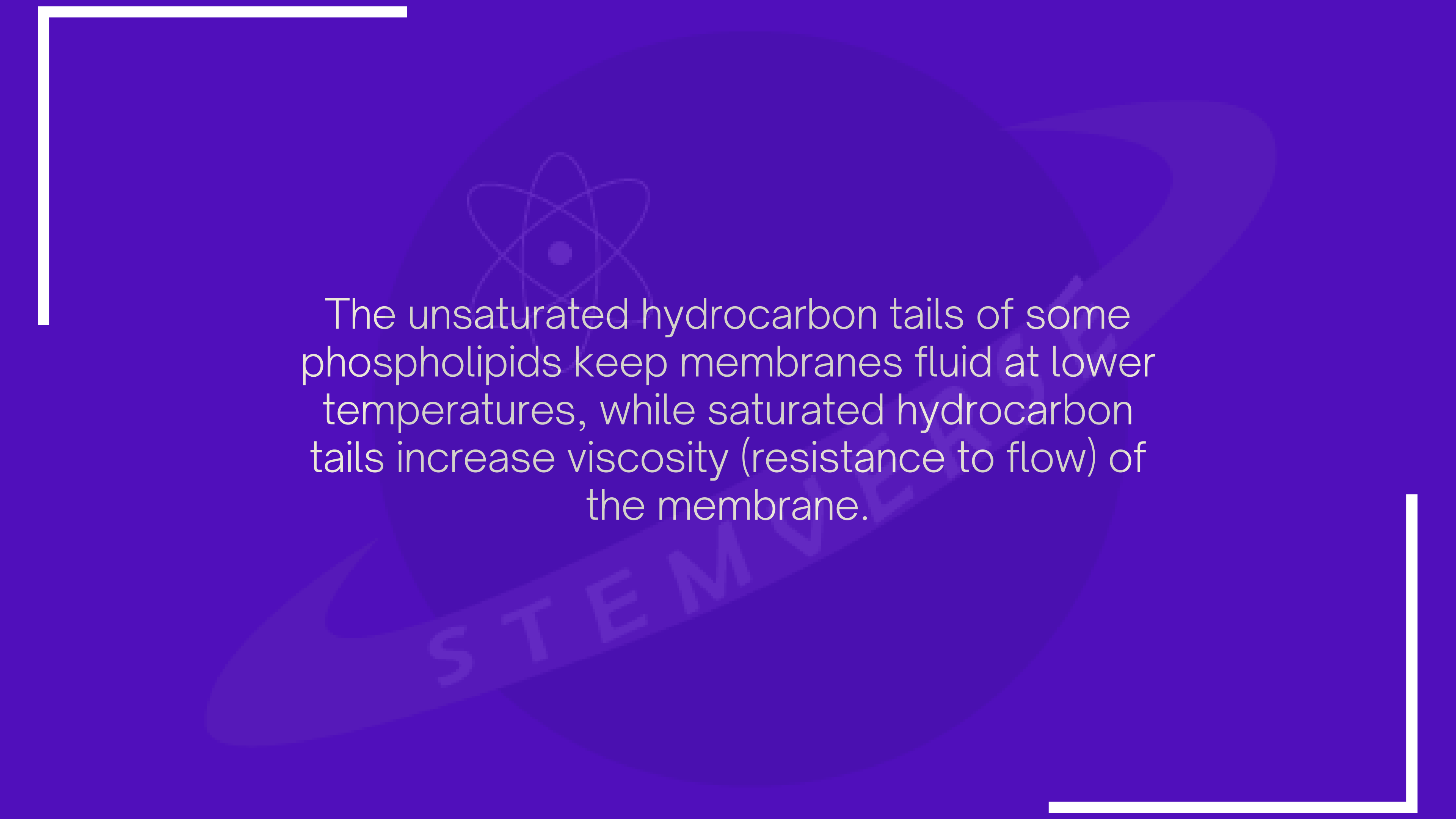


Selective Permeability - When a membrane allows some substances to cross more easily than others.

Amphipathic - A molecule with both a hydrophilic region and a hydrophobic region.

Ex. Phospholipid (Hydrophilic head & hydrophobic tail).

Fluid Mosaic Model - The membrane is a mosaic of protein molecules bobbing in a fluid bilayer of phospholipids.



The unsaturated hydrocarbon tails of some phospholipids keep membranes fluid at lower temperatures, while saturated hydrocarbon tails increase viscosity (resistance to flow) of the membrane.



**Cholesterol helps
membranes resist
changes in fluidity.**

Integral Proteins - Penetrate the hydrophobic interior of the lipid bilayer.

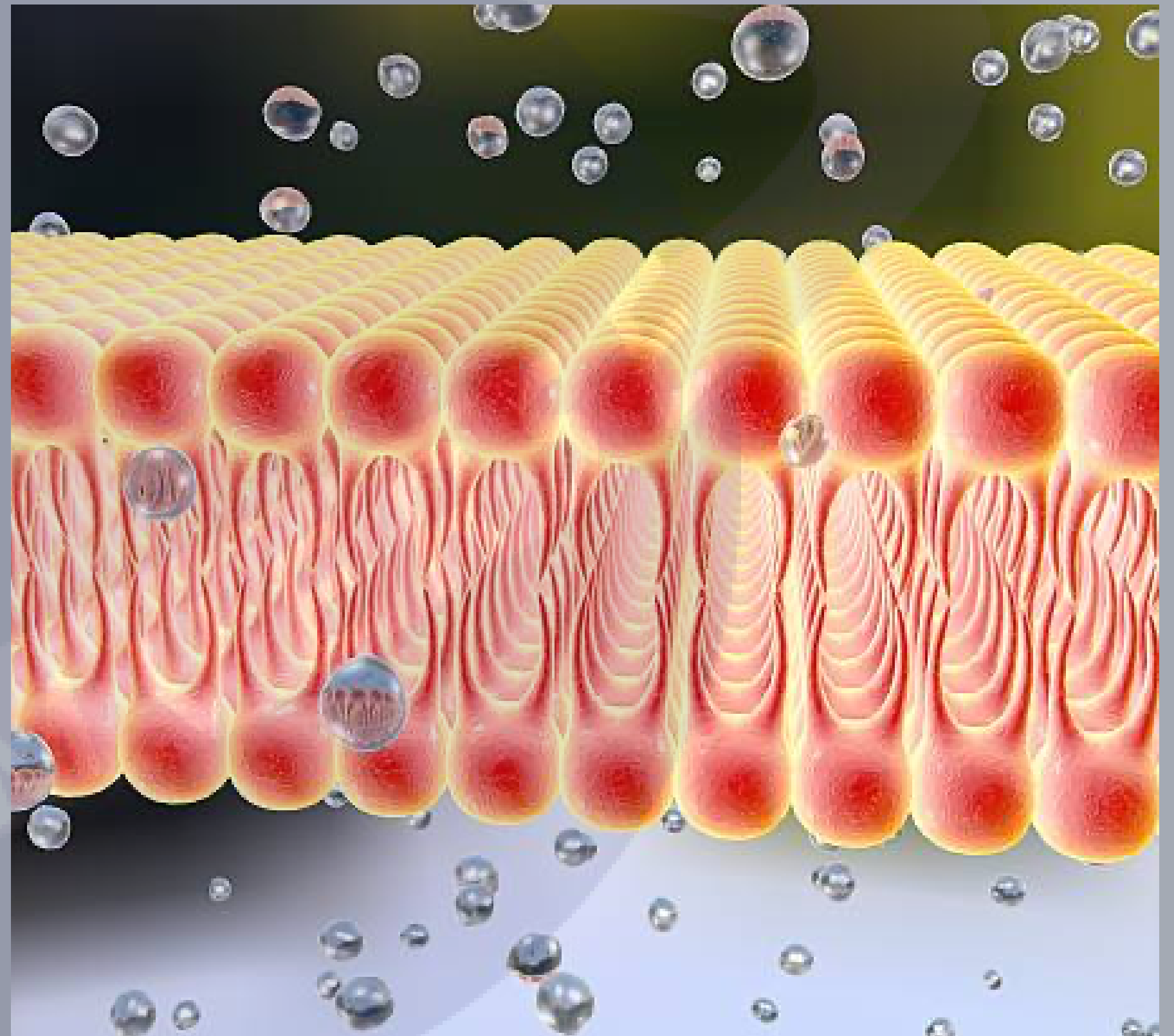
Ex. Transmembrane proteins.

Peripheral Proteins - Not embedded in the lipid bilayer, instead loosely bound to the surface of the membrane.

SHORT CHAINS OF SUGARS LINKED TO PROTEINS (GLYCOPROTEINS) AND LIPIDS (GLYCOLIPIDS) ON THE EXTERIOR SIDE OF THE PLASMA MEMBRANE INTERACT WITH SURFACE MOLECULES OF OTHER CELLS.

Functions of Membrane Proteins

- Transport
- Enzymatic Activity
- Signal Transduction
- Cell-to-cell Recognition
- Intercellular Joining
- Attachment to the cytoskeleton & ECM





Membrane Structure results in Selective Permeability:

Selective permeability of the plasma membrane controls the cells exchanges of molecules and ions with its surroundings.

Hydrophobic molecules are soluble in lipids and pass through membranes rapidly, whereas hydrophilic molecules and ions usually need specific transport proteins.

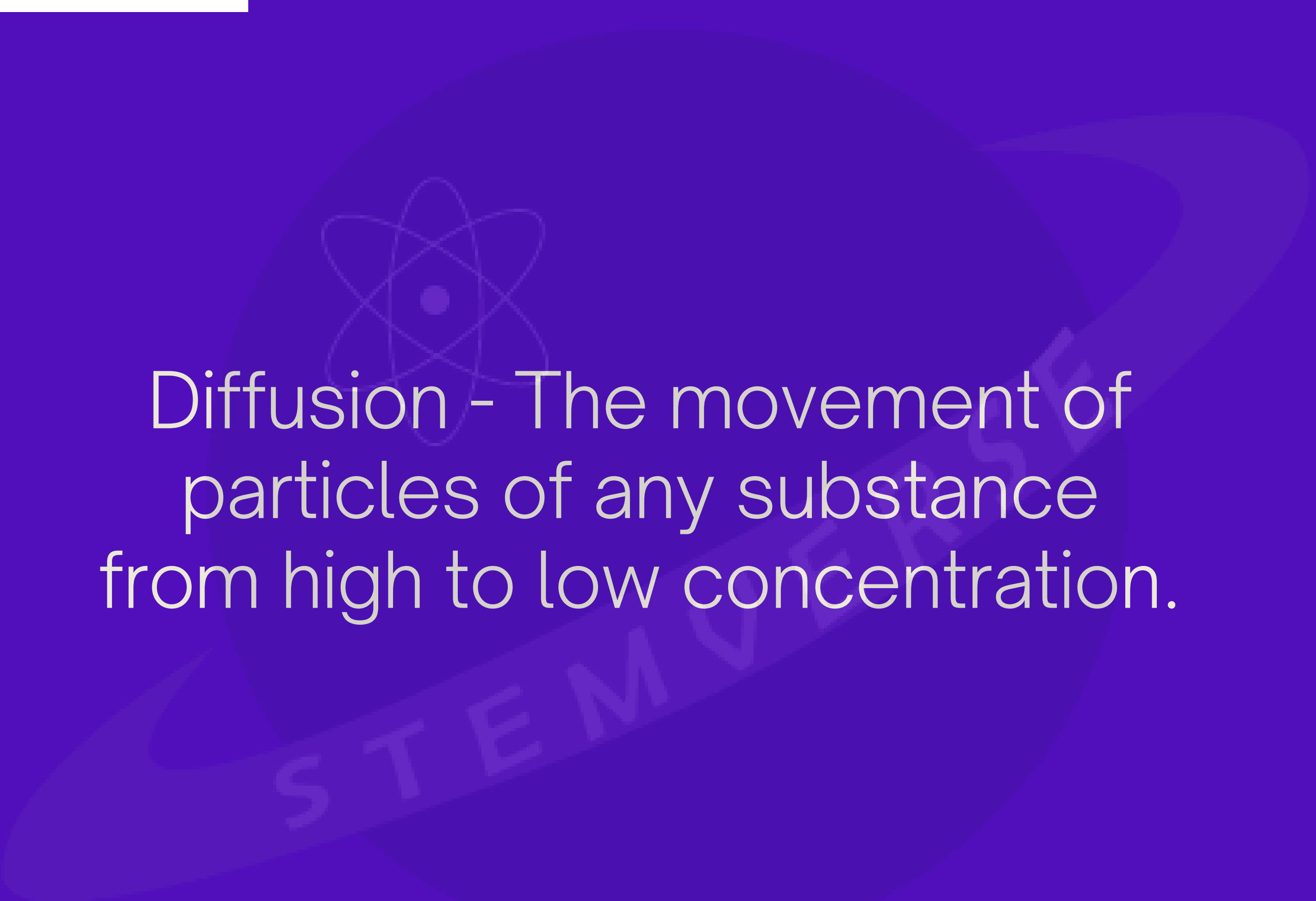
Transport Proteins - Channel proteins that function by having a hydrophilic channel that certain molecules or atomic ions use as a tunnel through the membrane.

Ex. Aquaporins (Help water pass through the cell membrane).

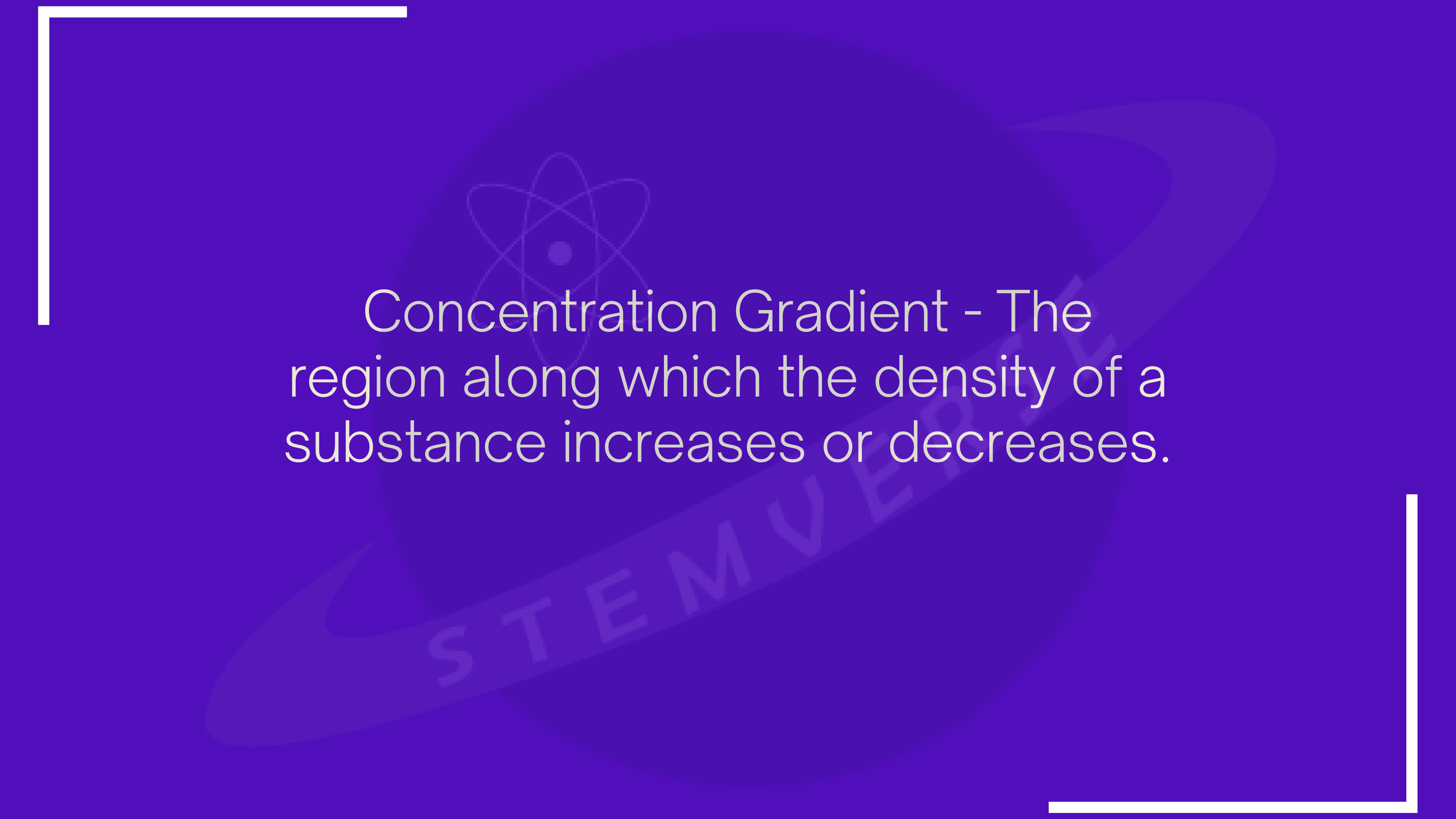


Passive Transport is the Diffusion of
a Substance across a Membrane
with no Energy Investment:

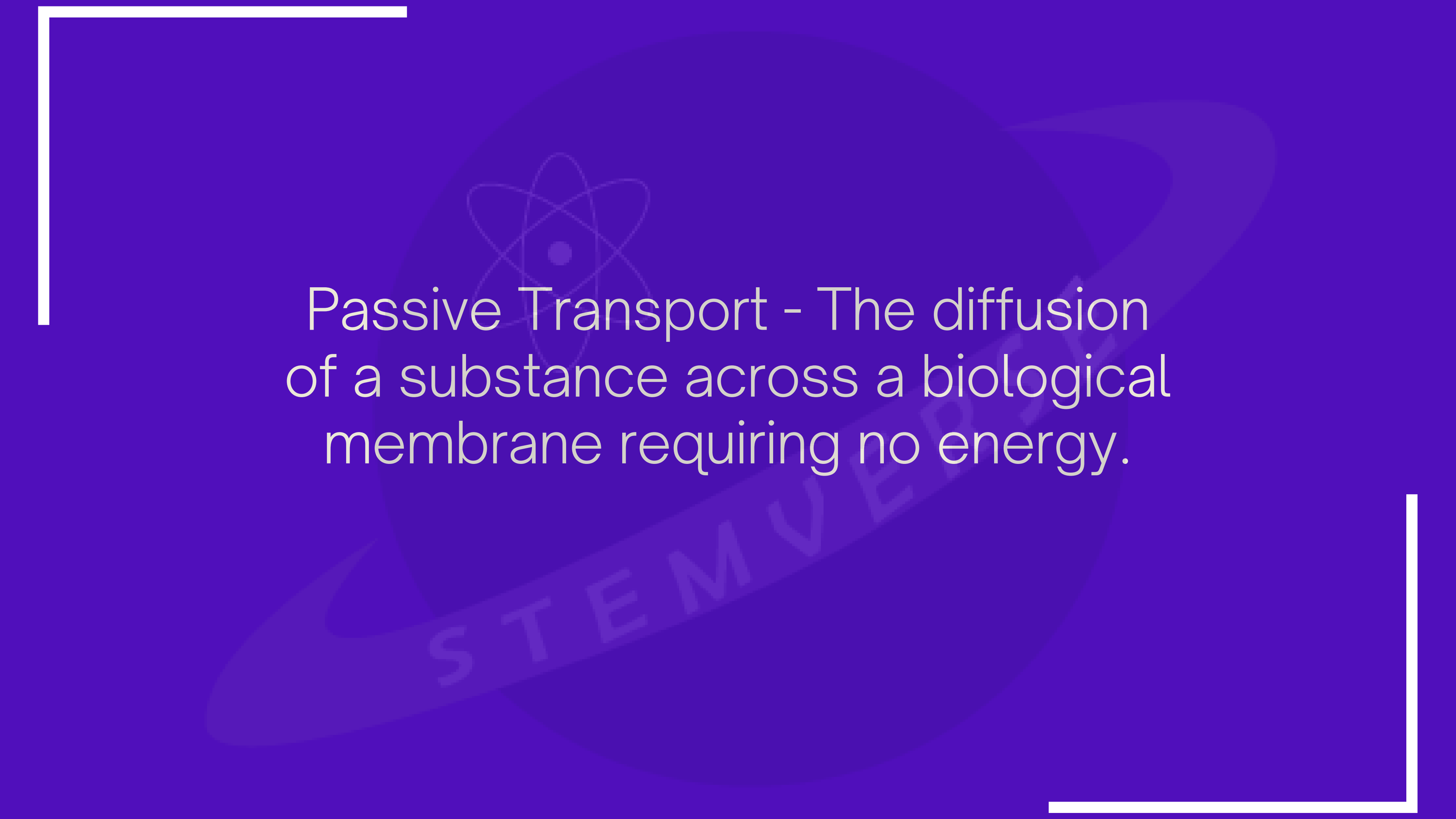
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Diffusion - The movement of particles of any substance from high to low concentration.



Concentration Gradient - The region along which the density of a substance increases or decreases.


The background is a solid purple color. In the center, there is a faint, light purple graphic. It consists of a stylized atom with a central nucleus and three elliptical orbits. Below the atom, the words "STEM VIVER" are written in a large, bold, sans-serif font, slanted upwards from left to right. The text is also in a light purple color, matching the atom graphic.

Passive Transport - The diffusion of a substance across a biological membrane requiring no energy.




Osmosis - The diffusion of water across a selectively permeable membrane (Artificial & Cellular).





Tonicity - The ability of a surrounding solution to cause a cell to lose or gain water.



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Hypertonic - More
solute outside the
cell (Cell loses
water & shrivels).

Hypotonic - Less
solute outside the
cell (Cell gains
water & bursts).



Isotonic - Same solute concentration outside & inside the cell (Normal for animal cells).

STEM CELL

Osmoregulation -
The control of
solute
concentrations &
water balance.



Turgid - When a plant is placed in a hypotonic solution it becomes firm (Normal for plant cells).

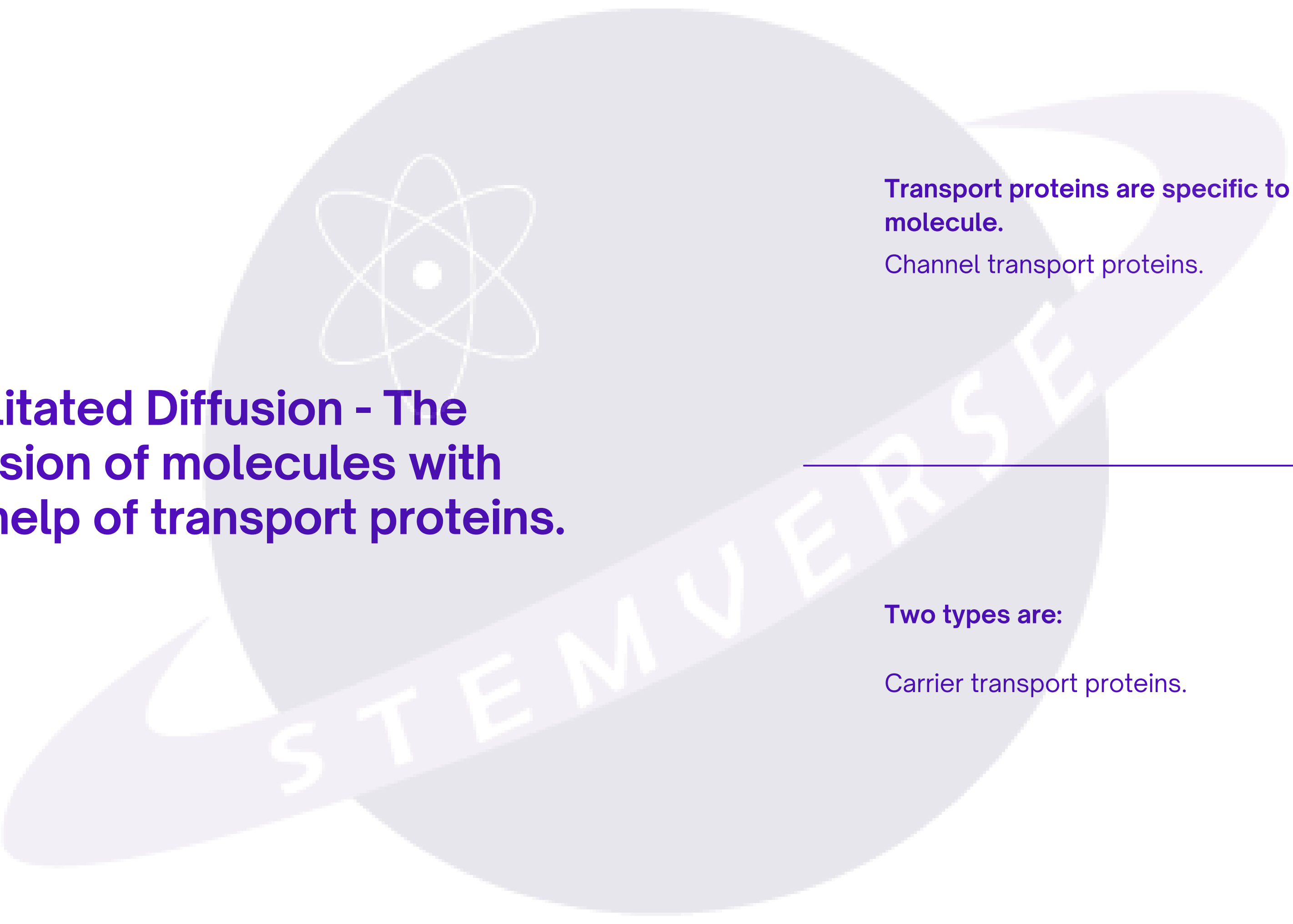
STEMVIEW

Plasmolysis -
When a plant is
placed in a
hypertonic
solution it shrivels.



Flaccid - When the concentration of solute is equal inside & outside the plant cell becomes limp.





Facilitated Diffusion - The diffusion of molecules with the help of transport proteins.

Transport proteins are specific to a molecule.

Channel transport proteins.

Two types are:

Carrier transport proteins.



Ion Channel -
Channel proteins
that transport ions.

Gated Channels - Open or close in response to a stimulus.



Stimulus can be electrical or chemical.

Active transport uses energy to move solutes against their gradients:

Active Transport - Consumes free energy so that a cell can maintain internal concentrations of small solutes that differ from concentrations in its environment.

Sodium Potassium Pump - Exchanges Na^+ (Sodium) for K^+ (Potassium) across the plasma membrane.

The cytoplasmic side of the membrane is negatively charged relative to the extracellular side because of an unequal distribution of cations & anions on both sides.

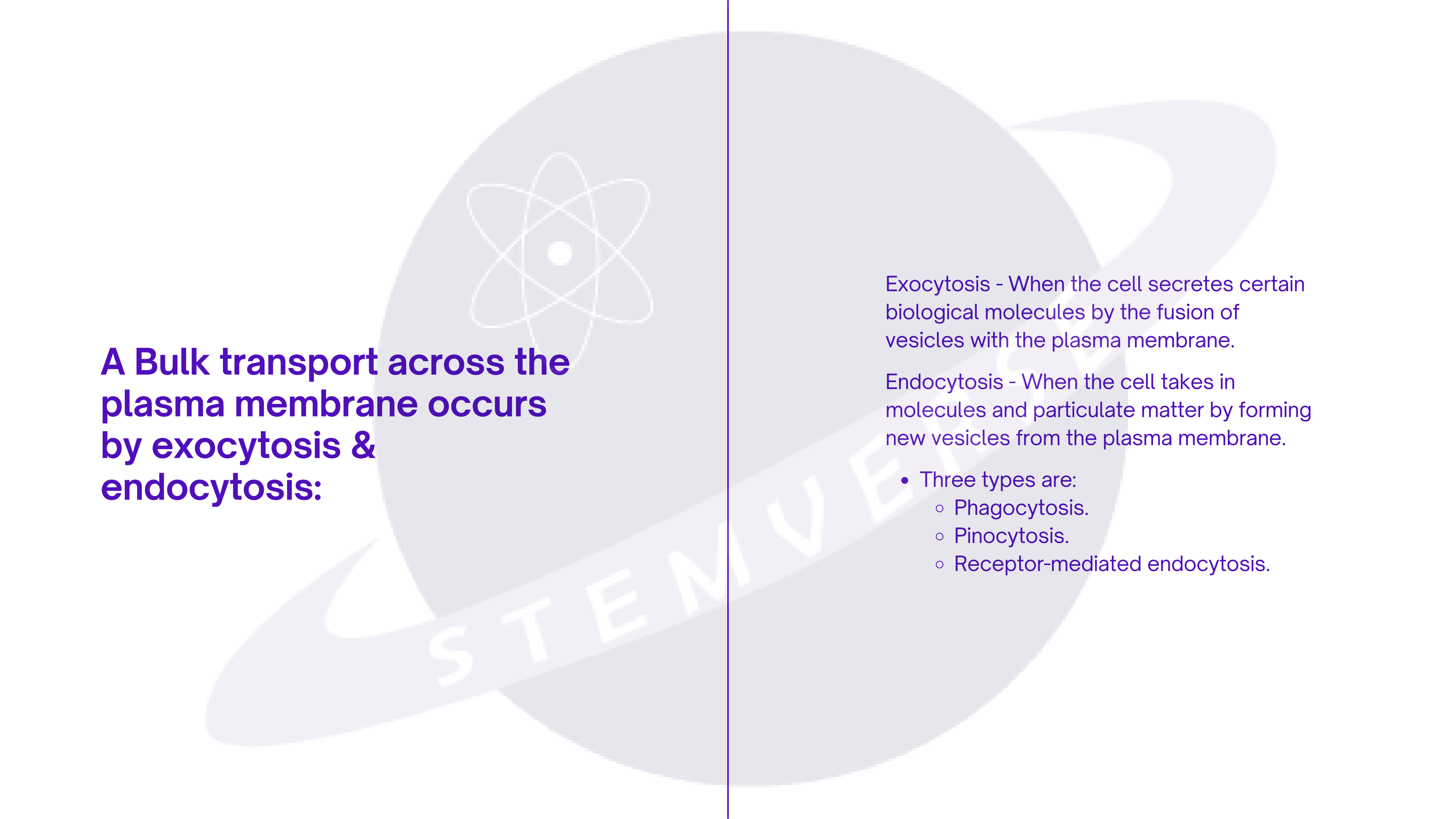


Electrochemical Gradient - The combination of a chemical and electric force acting on an ion.

Electrogenic Pump - A transport protein that generates voltage across a membrane.

Proton Pump - The main electrogenic pump of plants, fungi & bacteria.

Cotransport - A transport protein can couple the "downhill" diffusion of the solute to the "uphill" transport of a second substance against its own concentration gradient.



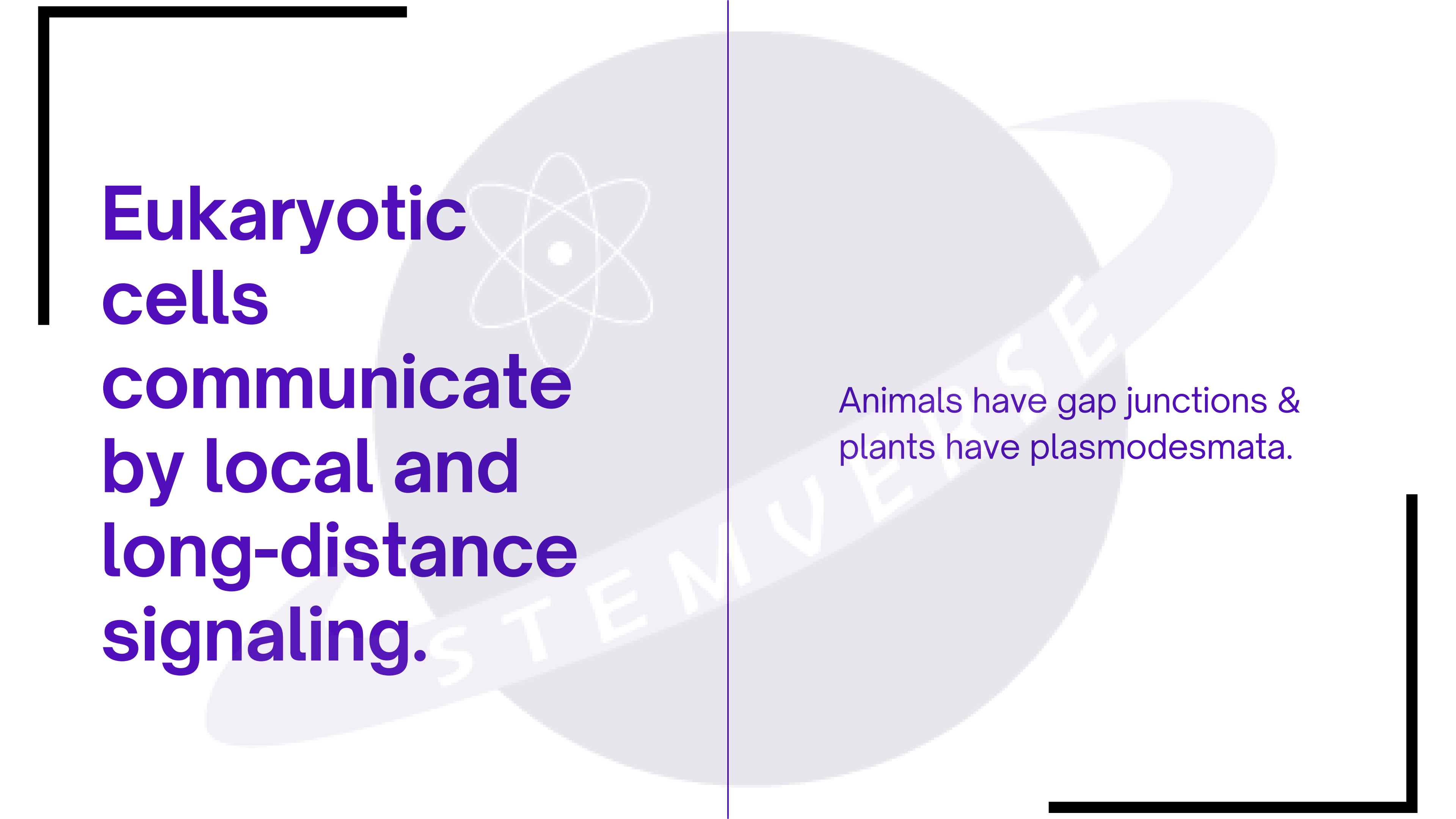
A Bulk transport across the plasma membrane occurs by exocytosis & endocytosis:

Exocytosis - When the cell secretes certain biological molecules by the fusion of vesicles with the plasma membrane.

Endocytosis - When the cell takes in molecules and particulate matter by forming new vesicles from the plasma membrane.

- Three types are:
 - Phagocytosis.
 - Pinocytosis.
 - Receptor-mediated endocytosis.

The Plasma
Membrane Plays a
Key Role in Most
Cell Signaling:




**Eukaryotic
cells
communicate
by local and
long-distance
signaling.**

Animals have gap junctions &
plants have plasmodesmata.

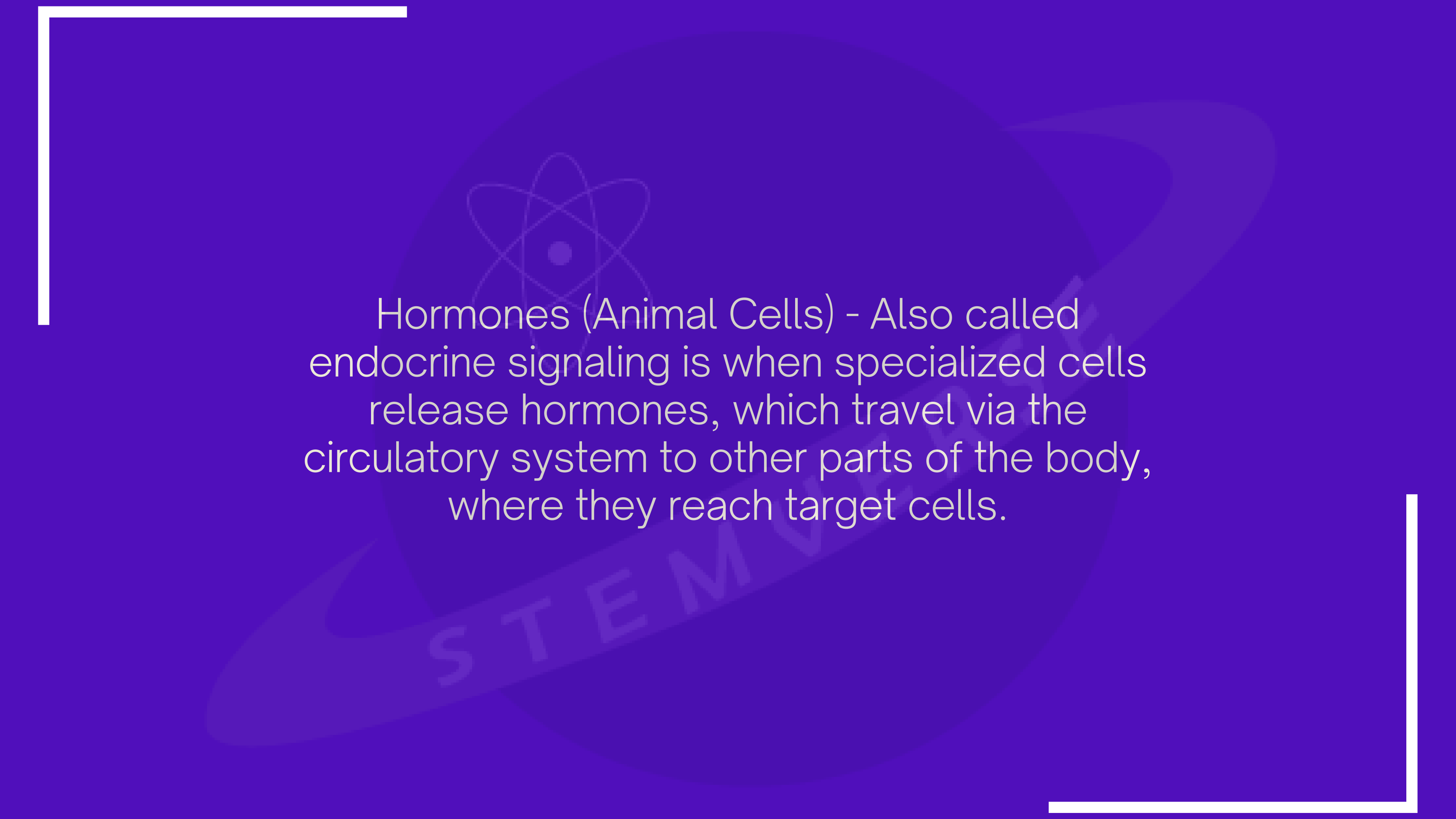


**Local
signaling in
animal cells is
called
paracrine
signaling.**

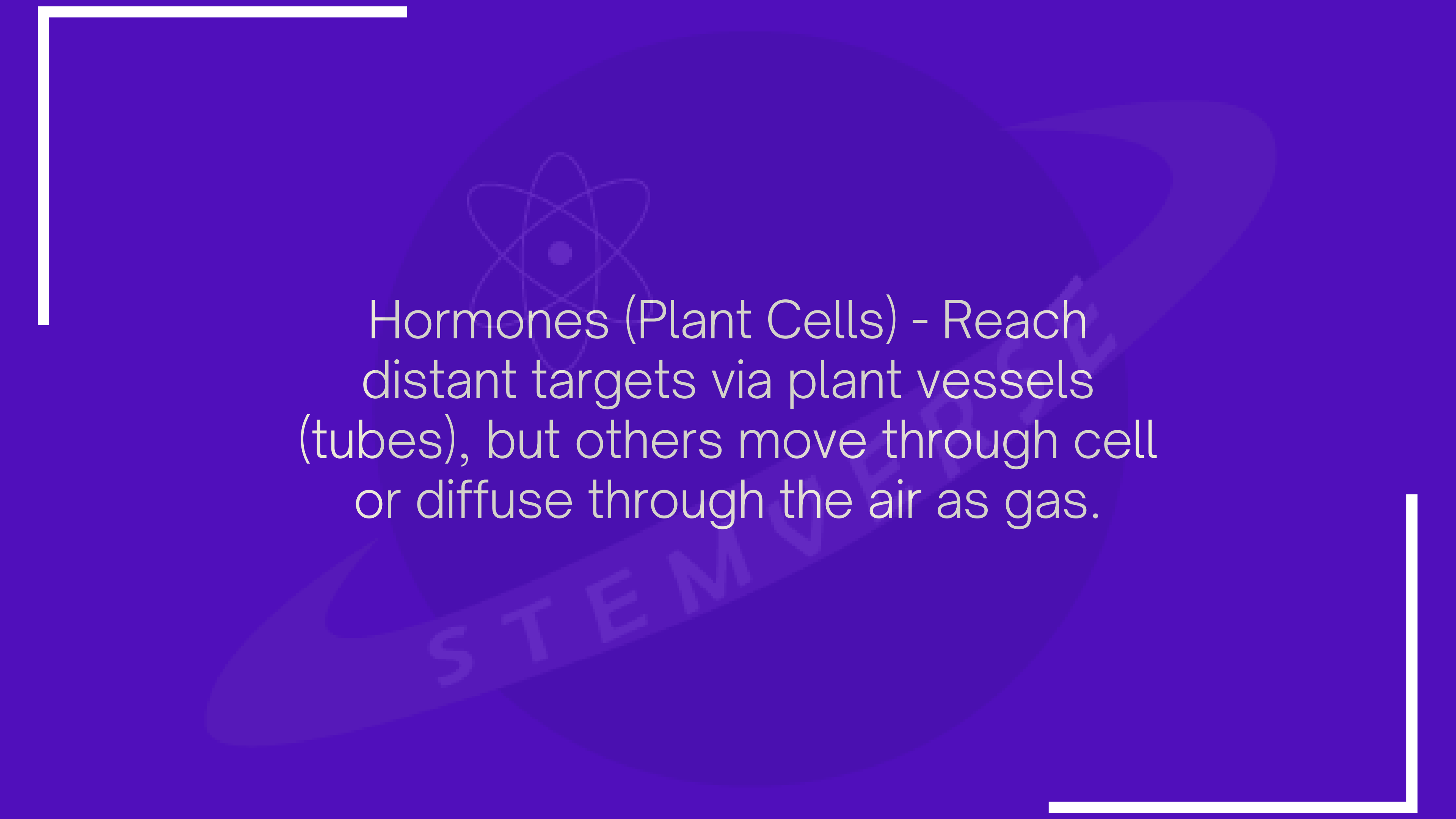
- Ex. Growth factors.
- Synaptic signaling.



For long distance
signaling, animals
and plants use
hormones.



Hormones (Animal Cells) - Also called endocrine signaling is when specialized cells release hormones, which travel via the circulatory system to other parts of the body, where they reach target cells.

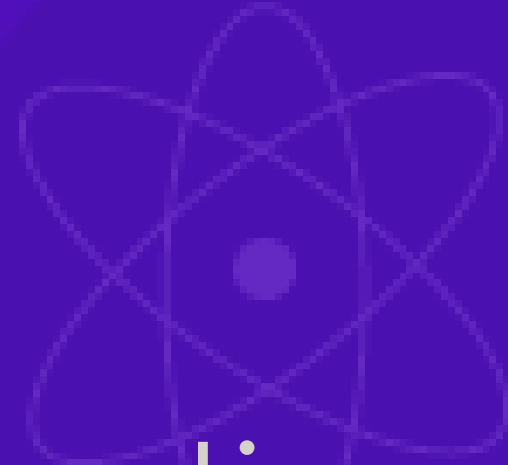


Hormones (Plant Cells) - Reach distant targets via plant vessels (tubes), but others move through cell or diffuse through the air as gas.



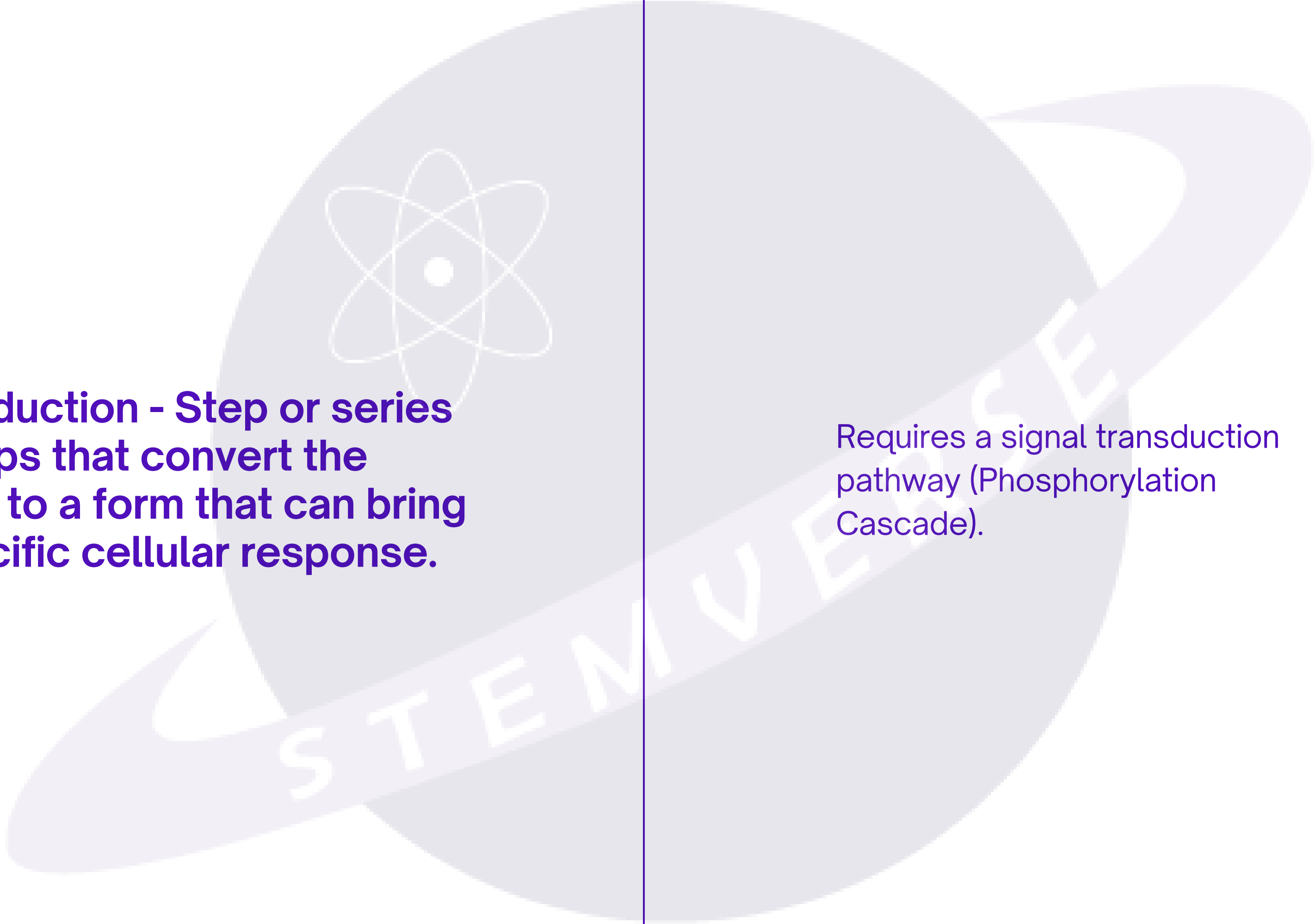
3 Stages of Cell Signaling

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Reception - The target cell's detection of a signaling molecule coming from outside the cell.

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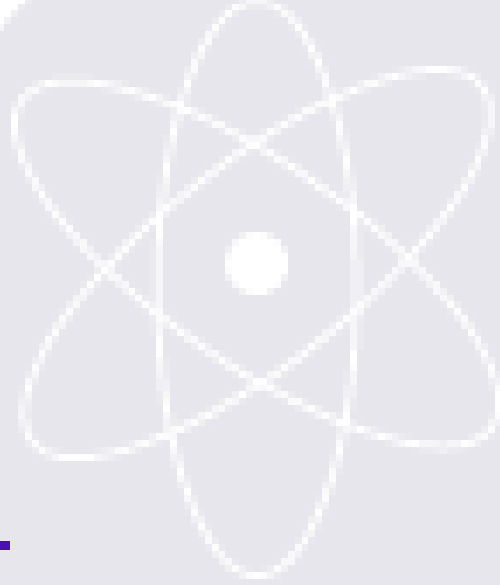
The background of the slide features a large, light purple circular logo for Stem University. Inside the circle is a stylized atomic symbol with a central white dot and three intersecting elliptical orbits. A thick, light purple swoosh curves around the bottom and right side of the circle. The words "STEM UNIVERSITY" are written in a light purple, sans-serif font, following the curve of the swoosh. A thin vertical purple line runs down the center of the slide, separating the two text blocks.

Transduction - Step or series of steps that convert the signal to a form that can bring a specific cellular response.

Requires a signal transduction pathway (Phosphorylation Cascade).

Response -
Cellular response
triggered by the
transducer signal.

Ligand - A molecule that specifically binds to another molecule.



**Transmembrane Receptor -
transmits information from the
extracellular environment to the
inside of the cell by changing shape
when a specific ligand binds to it.**

- G-protein-coupled receptors (GPCRs) -
Work with cytoplasmic G proteins.
- Ligand-gated ion channels - Open or
close in response to binding by signaling
molecules.



Protein Kinases - An enzyme that transfers phosphate groups from ATP to a protein (Adds phosphate to protein).



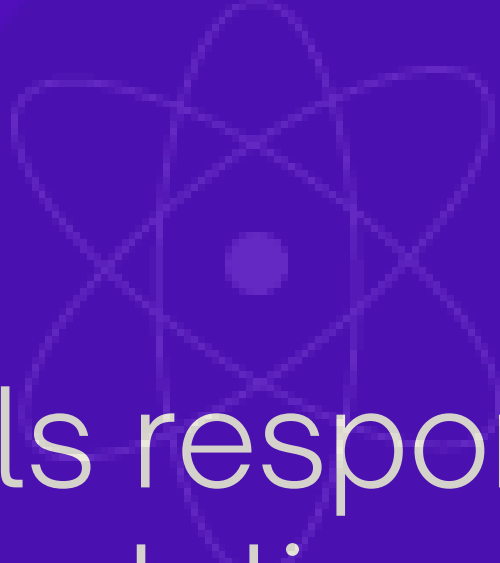
Protein Phosphatases - Enzymes that can rapidly remove phosphate groups from proteins (Dephosphorylation).

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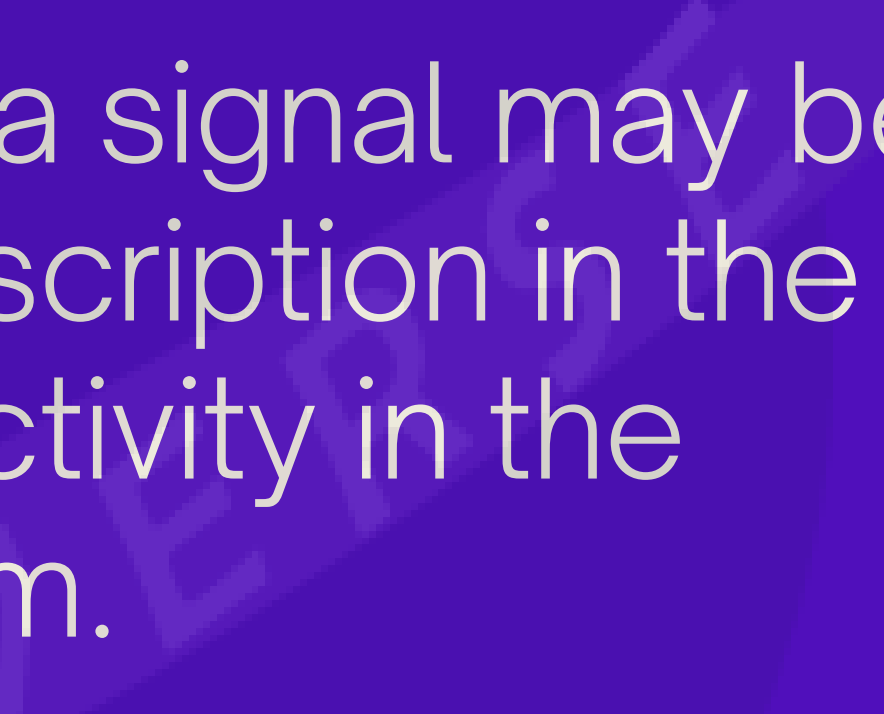
The background of the slide features a large, light purple circular logo for Stem University. Inside the circle is a stylized atomic symbol with a central white dot and three intersecting elliptical orbits. A purple ring orbits the circle, with the words 'STEM UNIVERSITY' written in white capital letters along its path.

**Second Messengers -
Small, nonprotein, water-
soluble molecules or ions
involved in signaling
pathways.**

- Ex. Cyclic AMP (cAMP)
- Ex. Calcium ions (Ca ²⁺)



The cells response to a signal may be the regulation of transcription in the nucleus or of an activity in the cytoplasm.



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