RAMA UNIVERSITY

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FACULTY OF ENGINEERING &TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

Channel proteins:

Channel proteins form open pores through the membrane, allowing the free passage of any molecule of the appropriate size. Ion channels, for example, allow the passage of inorganic ions such as Na+, K+, Ca^{2+}, and Cl- across the plasma membrane.

Once open, channel proteins form small pores through which ions of the appropriate size and charge can cross the membrane by free diffusion.

These opening and closing of channel proteins is regulated by presence or absence of extracellular signaling.

Carrier proteins:

❖In contrast to channel proteins, carrier proteins selectively bind and transport specific small molecules, such as glucose.

❖Rather than forming open channels, carrier proteins act like enzymes to facilitate the passage of specific molecules across membranes.

❖In particular, carrier proteins bind specific molecules and then undergo conformational changes that open channels through which the molecule to be transported can pass across the membrane and be released on the other side.

Mechanism of transport via transporter protein

Transporter proteins span the lipid bilayer several times, forming a transmembrane channel lined with hydrophilic amino acid side chains.

The channel provides an alternative path for a specific substrate to move across the lipid bilayer without its having to dissolve in the bilayer, further lowering *G*‡ for transmembrane diffusion.

The result is an increase of several orders of magnitude in the rate of transmembrane passage of the substrate.

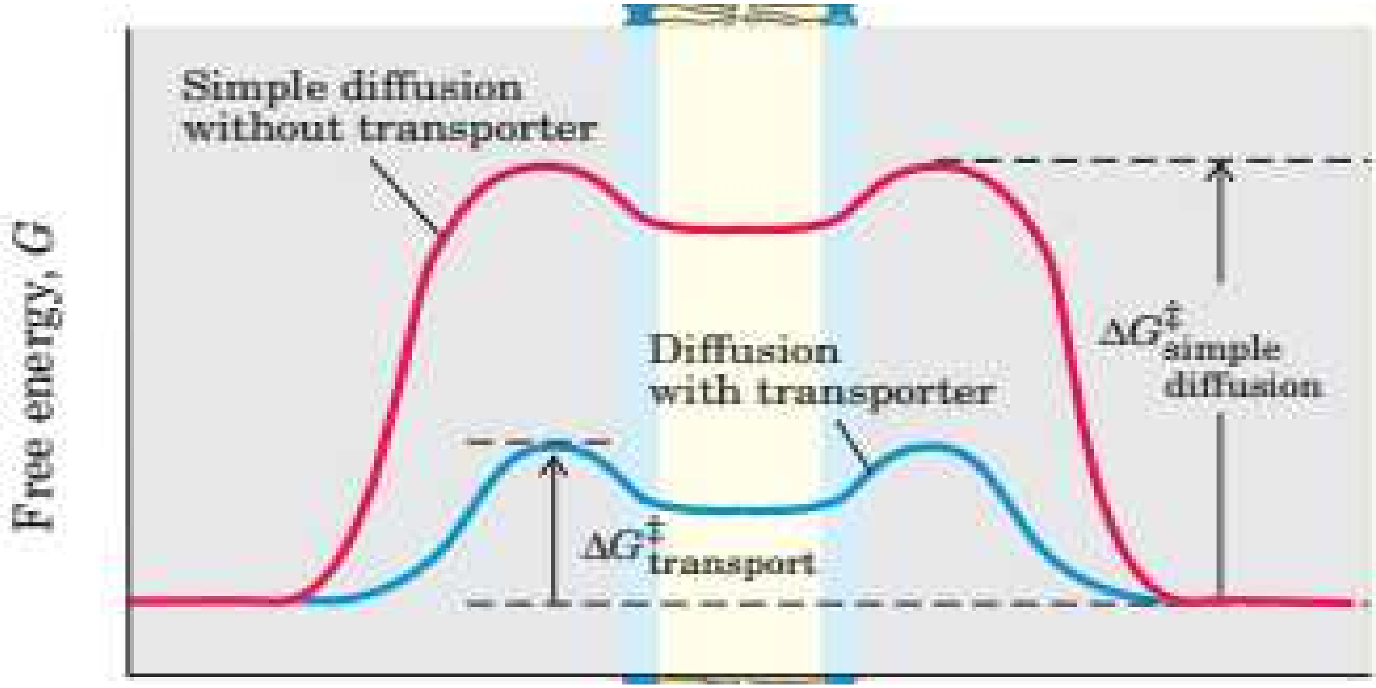


Figure: Energy changes accompanying passage of a hydrophilic solute through the lipid bilayer of a biological membrane. A transporter protein reduces the *G*‡ for transmembrane diffusion of the solute. It does this by forming noncovalent interactions with the dehydrated solute to replace the hydrogen bonding with water and by providing a hydrophilic transmembrane passageway.

Active transport

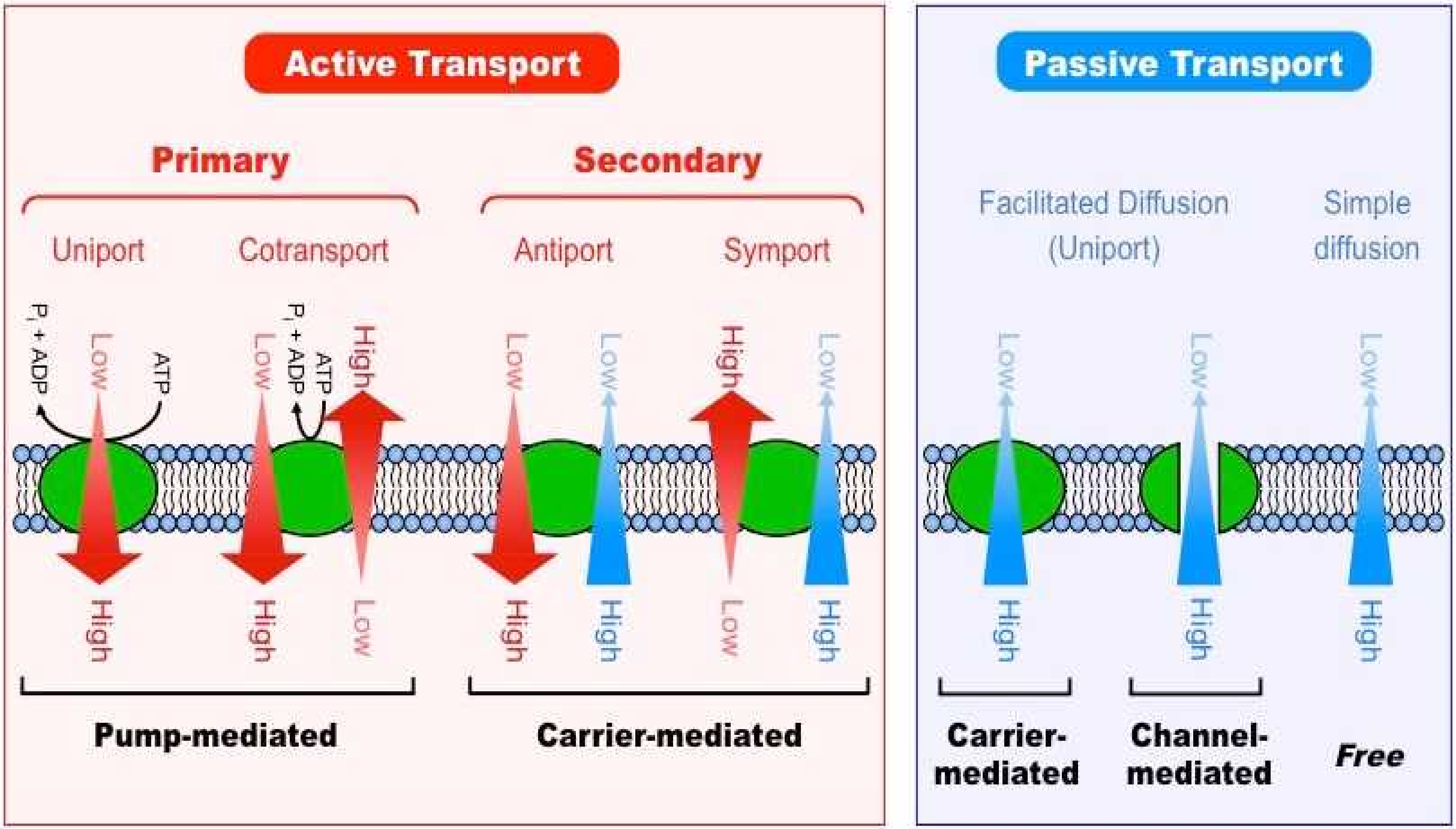
Active transport involves the movement of materials against a concentration gradient (low concentration ⇒ high concentration). i.e. molecules can be transported in an energetically unfavorable direction across a membrane (e.g., against a concentration gradient) if their transport in that direction is coupled to ATP hydrolysis as a source of energy.

Membrane proteins can thus use the free energy stored as ATP to control the internal composition of the cell.

There are two main types of active transport:

*Primary **(direct)** active transport* – Involves the direct use of metabolic energy (e.g. ATP hydrolysis) to mediate transport i.e. solute accumulation is coupled directly to an exergonic chemical reaction, such as conversion of ATP to ADP Pi

*Secondary **(indirect)** active transport* – Involves coupling the molecule with another moving along an electrochemical gradient. **Secondary active transport** occurs when endergonic (uphill) transport of one solute is coupled to the exergonic (downhill) flow of a different solute that was originally pumped uphill by primary active transport.



Active Transport
Primary
Secondary
Uniport
Cotransport
Antiport
Symport
Pi + ADP
ATP
Low
High
Pump-mediated
Carrier-mediated
Passive Transport
Facilitated Diffusion
(Uniport)
Simple
diffusion
Carrier-
mediated
Channel-
mediated
Free