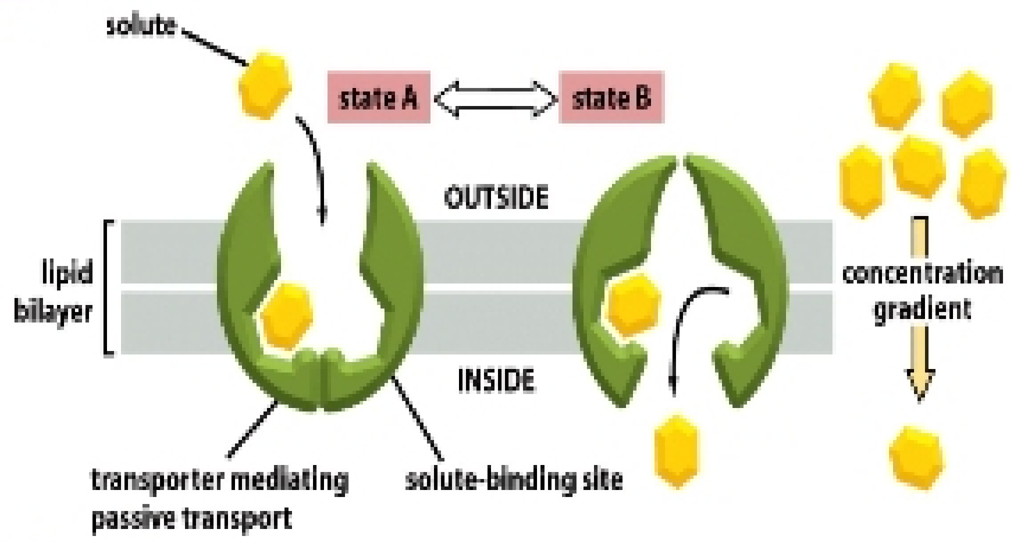
1. List the 3 classes/types of membrane transport proteins, the basic characteristics of each, and an example of each.

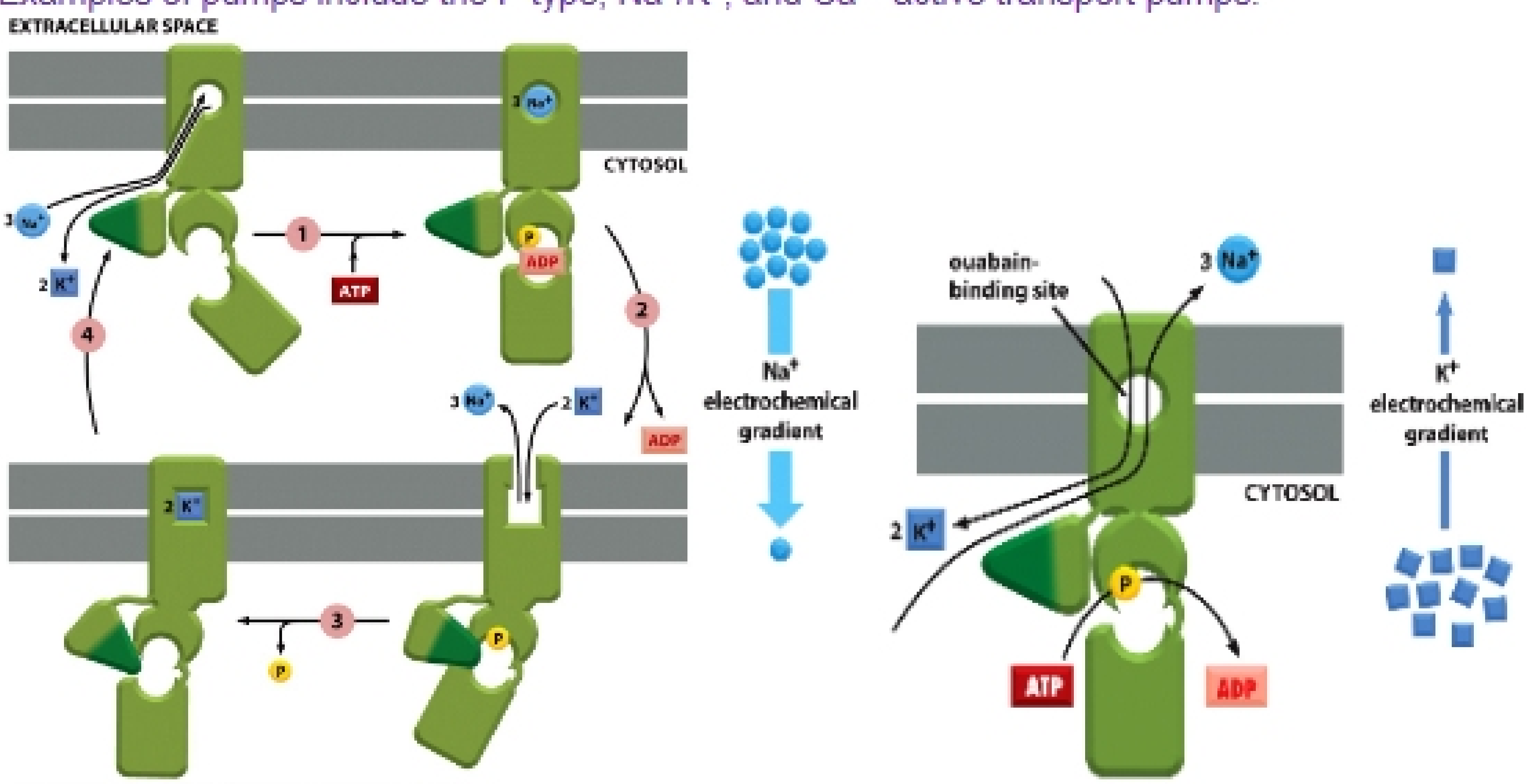
The 3 types of membrane transport proteins are: (1) transporters, (2) pumps, and (3) channels.
Characteristics of transporters include:
- bind the specific solute to be transported and undergo a series of conformational changes to transfer the bound solute across the membrane
- transport occurs at a moderate rate

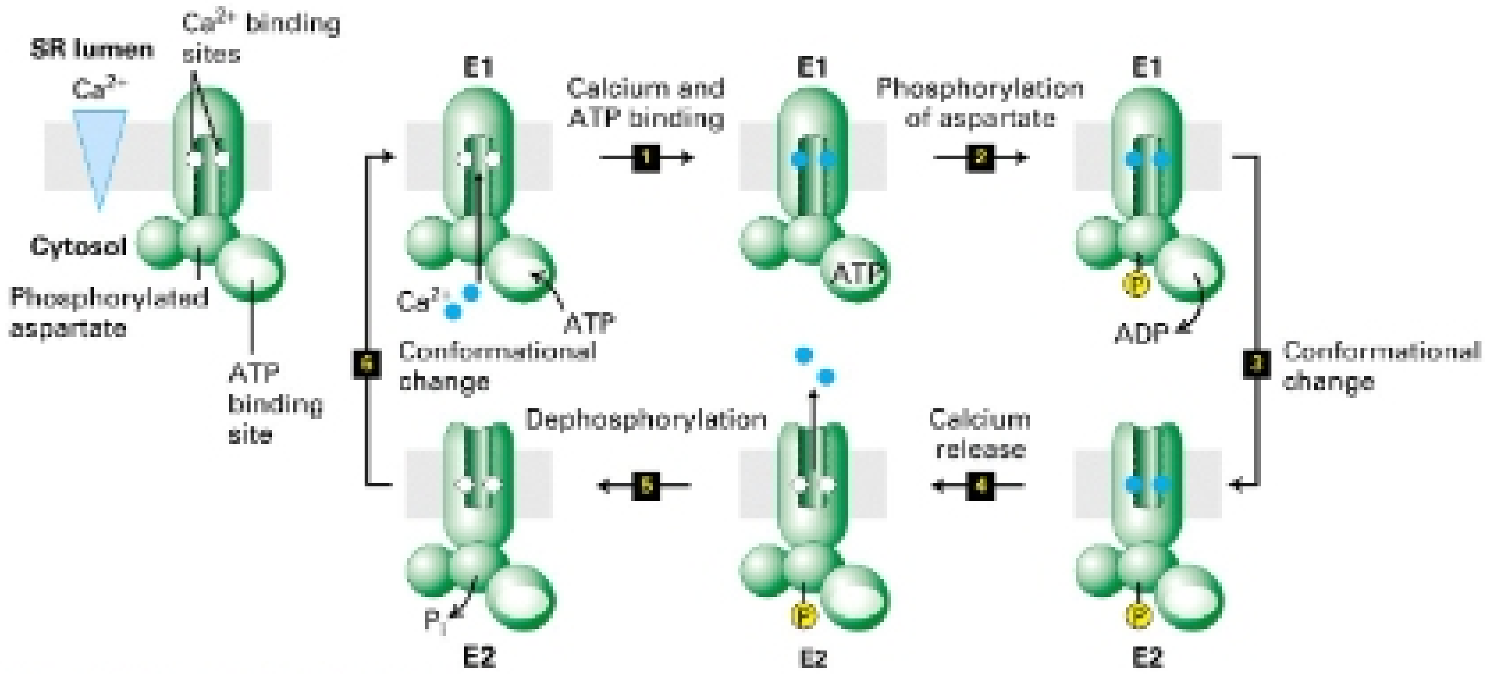
Examples of carrier-mediated transport include glucose transport in red blood cells and amino acid transport in bacteria.



Characteristics of pumps include:
- transport occurs at a very slow rate
- often require ATP as an energy source to function

Examples of pumps include the P type, Na^+/K^+, and Ca^{2+} active transport pumps.





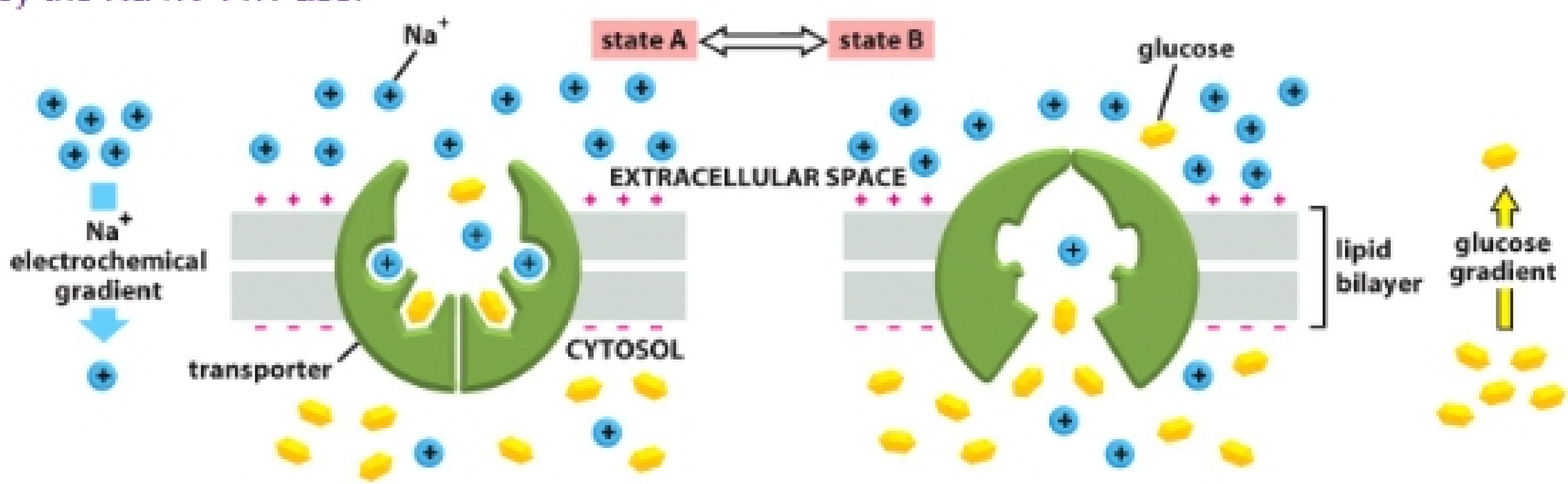
Characteristics of channels include:

- interact with the solute to be transported much more weakly than in transporters
- form aqueous pores that extend across the lipid bilayer; when open, these pores allow specific solutes (usually inorganic ions of appropriate size and charge) to pass through them and thereby cross the membrane
- transport occurs at a very fast rate
- can occur via symport, antiport, or uniport
- integral membrane proteins with a hydrophilic pore that provides a path for ion movement
- most channels exist in open and closed states so that ion movement can be regulated

An example of a symport channel is the Na^+/glucose channel, and an example of an antiport channel is the Na^+/H^+ channel. Another example of a channel is the K^+ leak channel.

2. Use an intestinal epithelial cell as an example to explain how glucose, sodium, and potassium are transported.

Glucose is transported via coupled transport with Na^+; this occurs through a symport mechanism. The Na^+ gradient drives the transport of glucose. The energy for this process is indirectly supplied by the Na^+/K^+ ATPase.



Na^+ is transported through voltage-gated Na^+ channels. Closed channels are depolarized, causing them to open for a short time. Open channels then inactivate themselves. After the refractory period of inactivation, inactivated channels revert back to the closed state. The inactivated state ensures that signals are unidirectional. There are 24 transmembrane spans (composing 1 peptide) in a single voltage-gated Na^+ channel. The IFM (isoleucine, phenylalanine, methionine) complex is the only way to shut off a voltage-gated Na^+ channel.