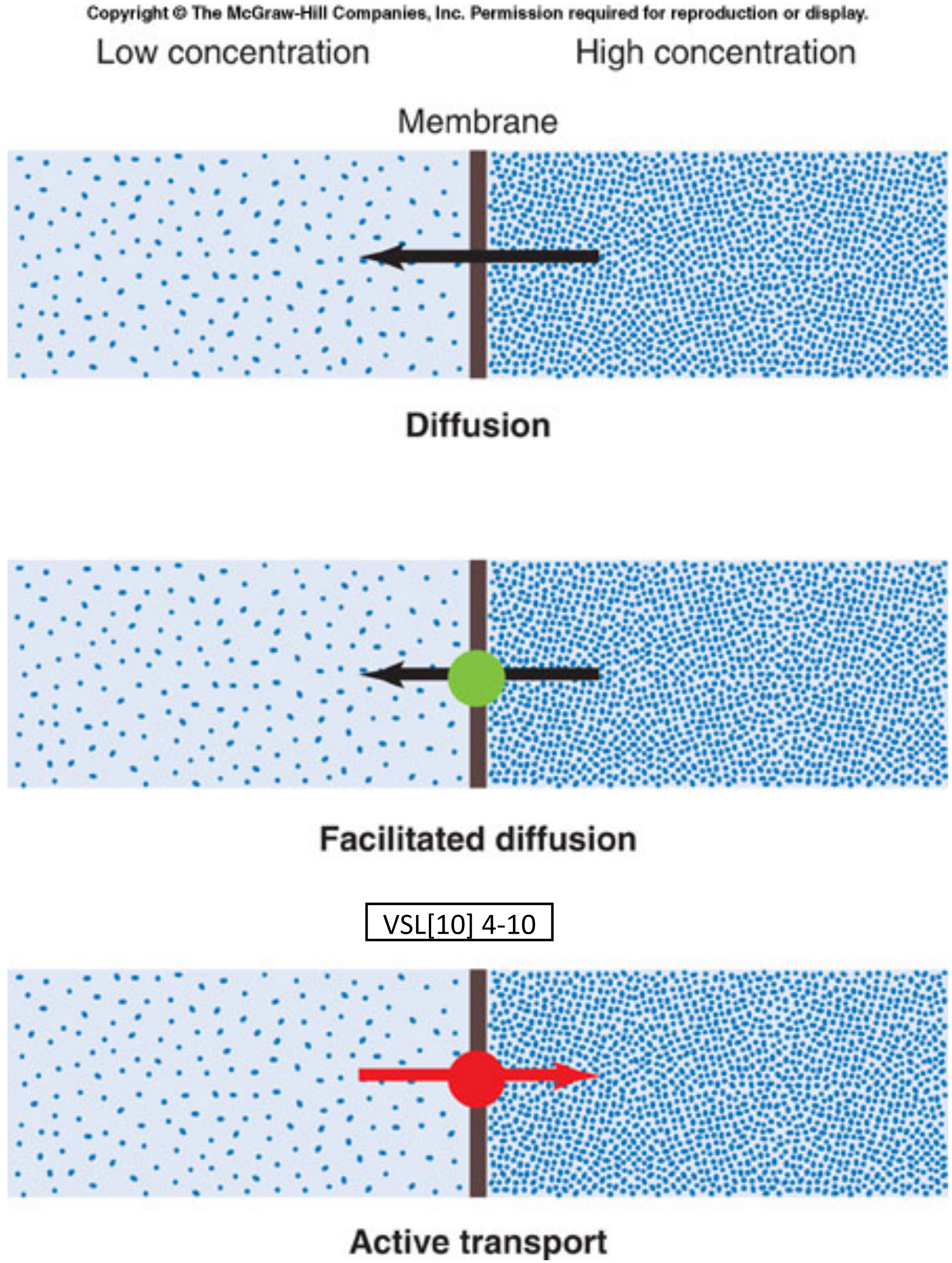
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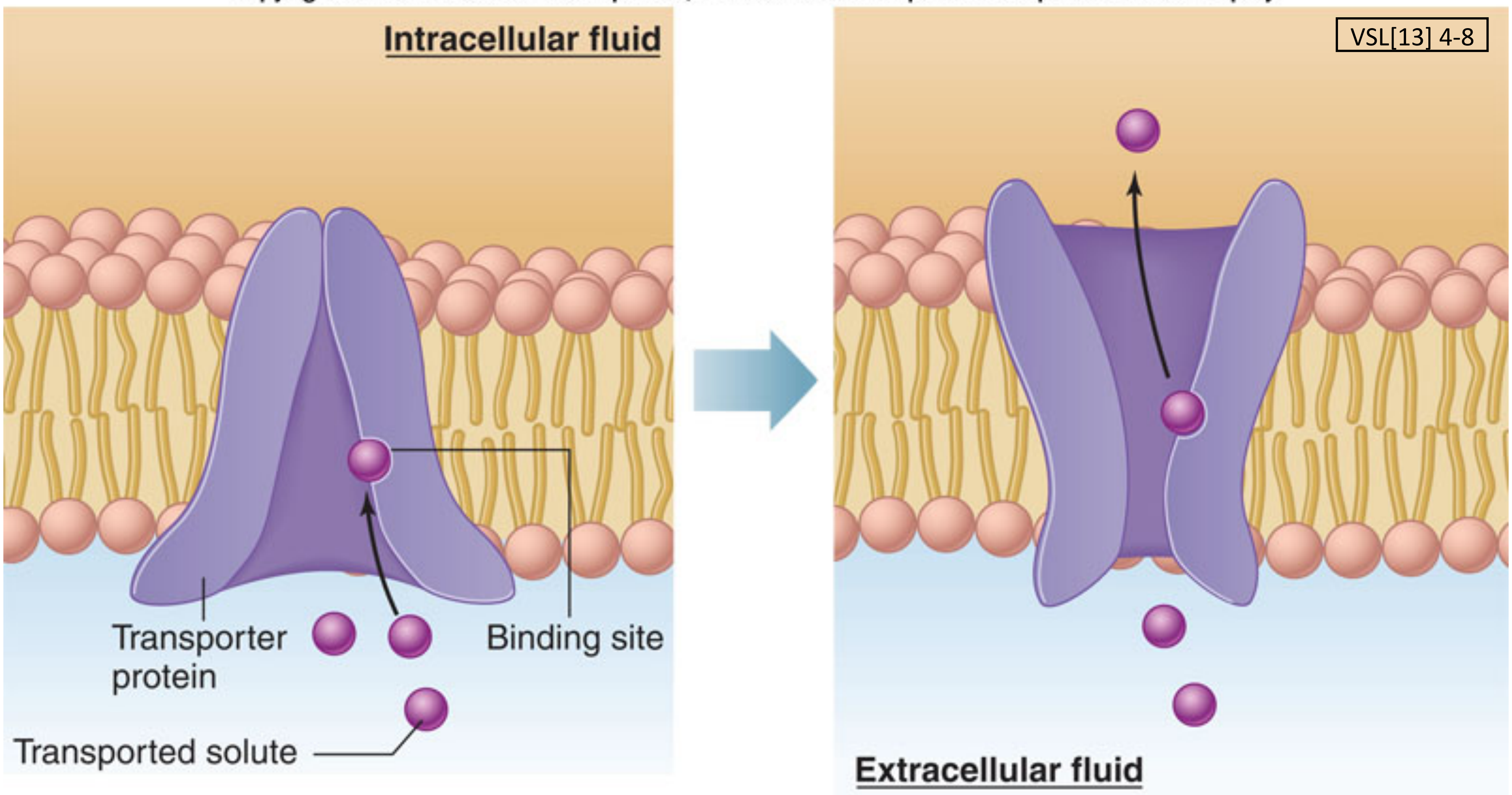
Low concentration
High concentration
Membrane
Diffusion
Facilitated diffusion
Active transport

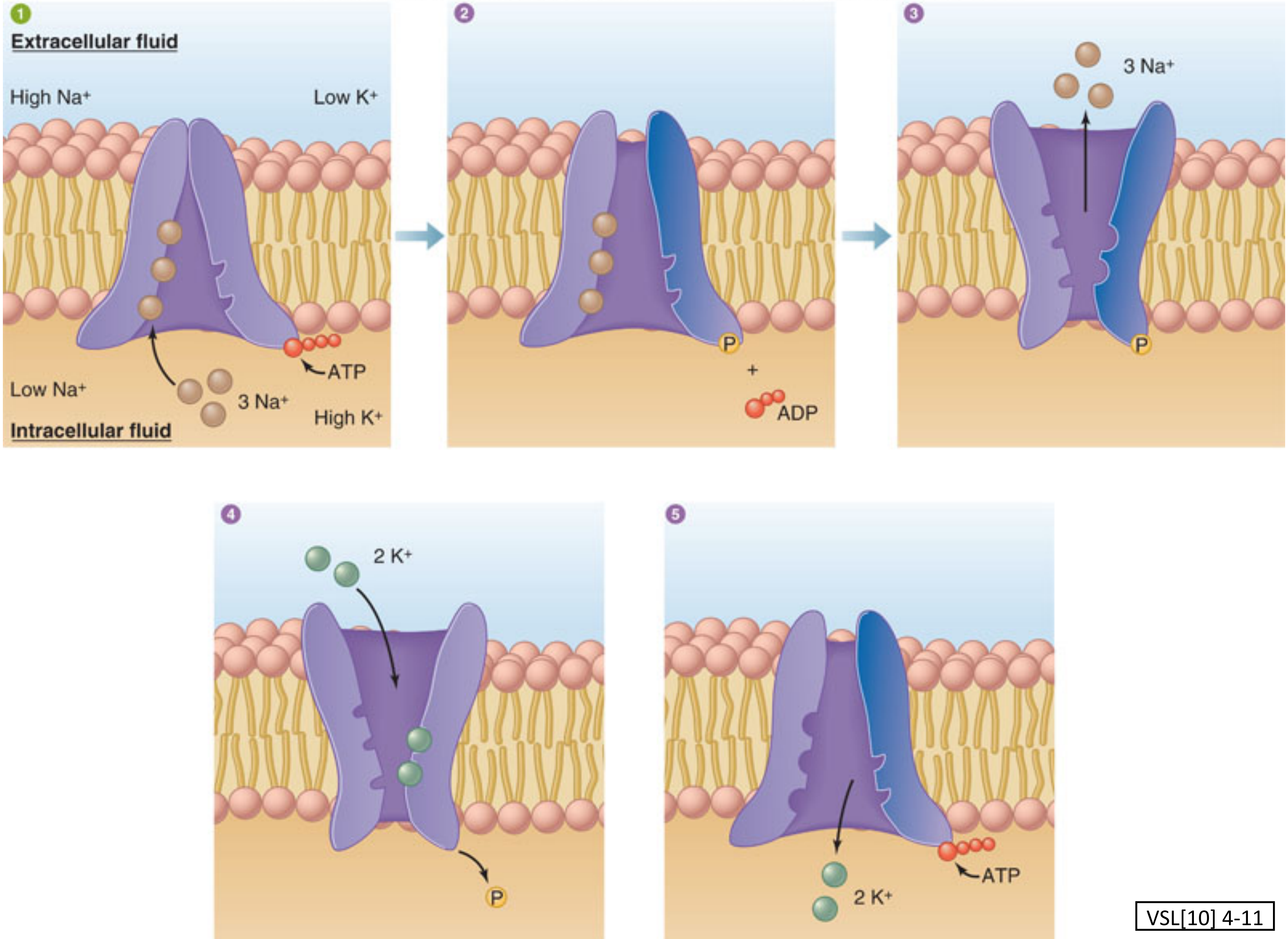
VSL[10] 4-10

| *Diffusion distance (μm)* | *Time required for diffusion* |
|---|---|
| 1 | 0.5 msec |
| 10 | 50 msec |
| 100 | 5 sec |
| 1000 (1 mm) | 8.3 min |
| 10,000 (1 cm) | 14 hr |

B&L[5], Table 1-1

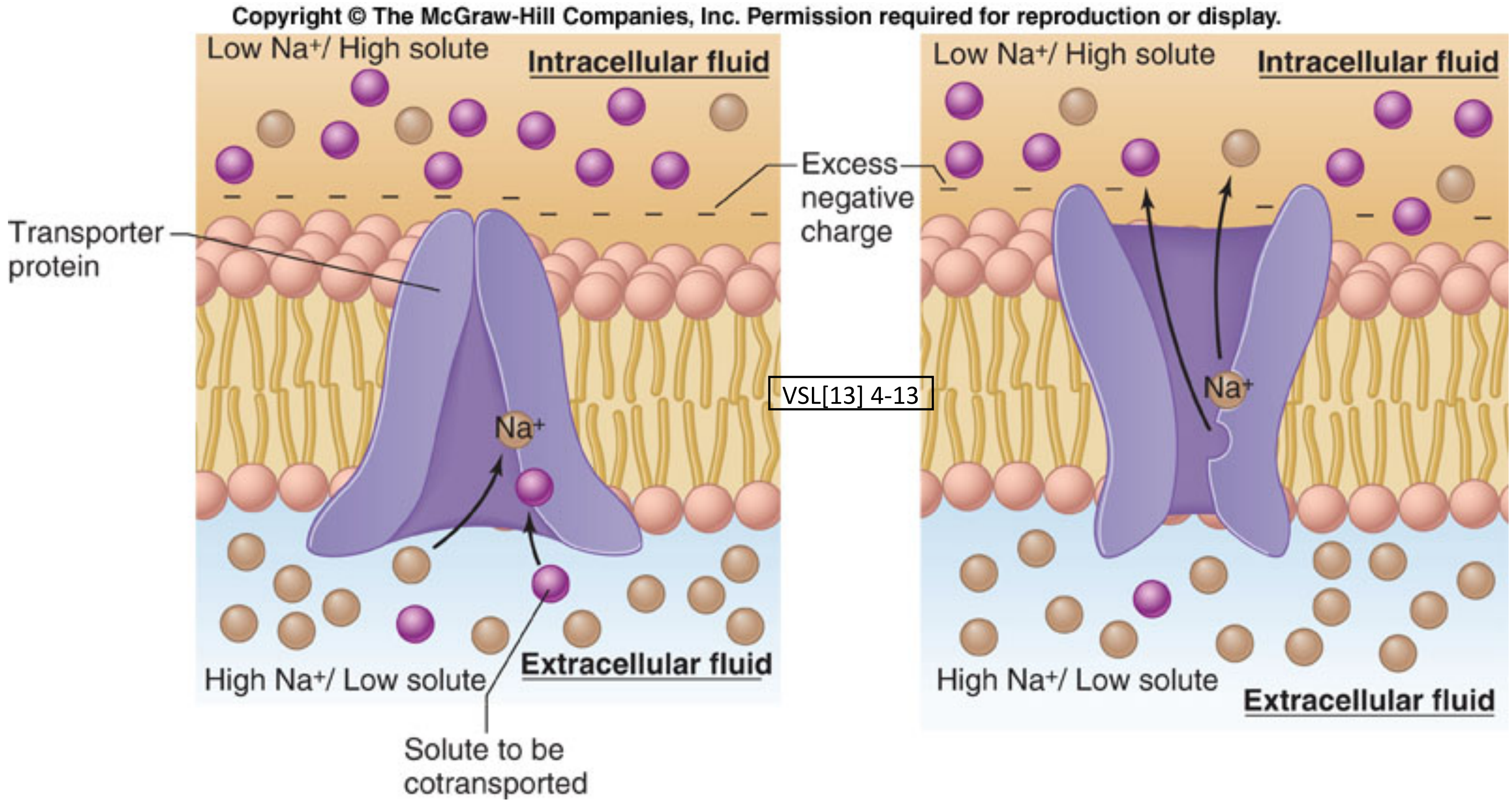



Model of mediated (facilitated) transport. The transporter binding site is initially exposed to solute on one side of the membrane. A change in the conformation of the transporter (carrier) protein (possibly induced by the binding of the solute) then exposes the binding site to the other side of the membrane – thus, the substance is transported from one side of the membrane to the other. Such systems can work in only one direction or in both directions.

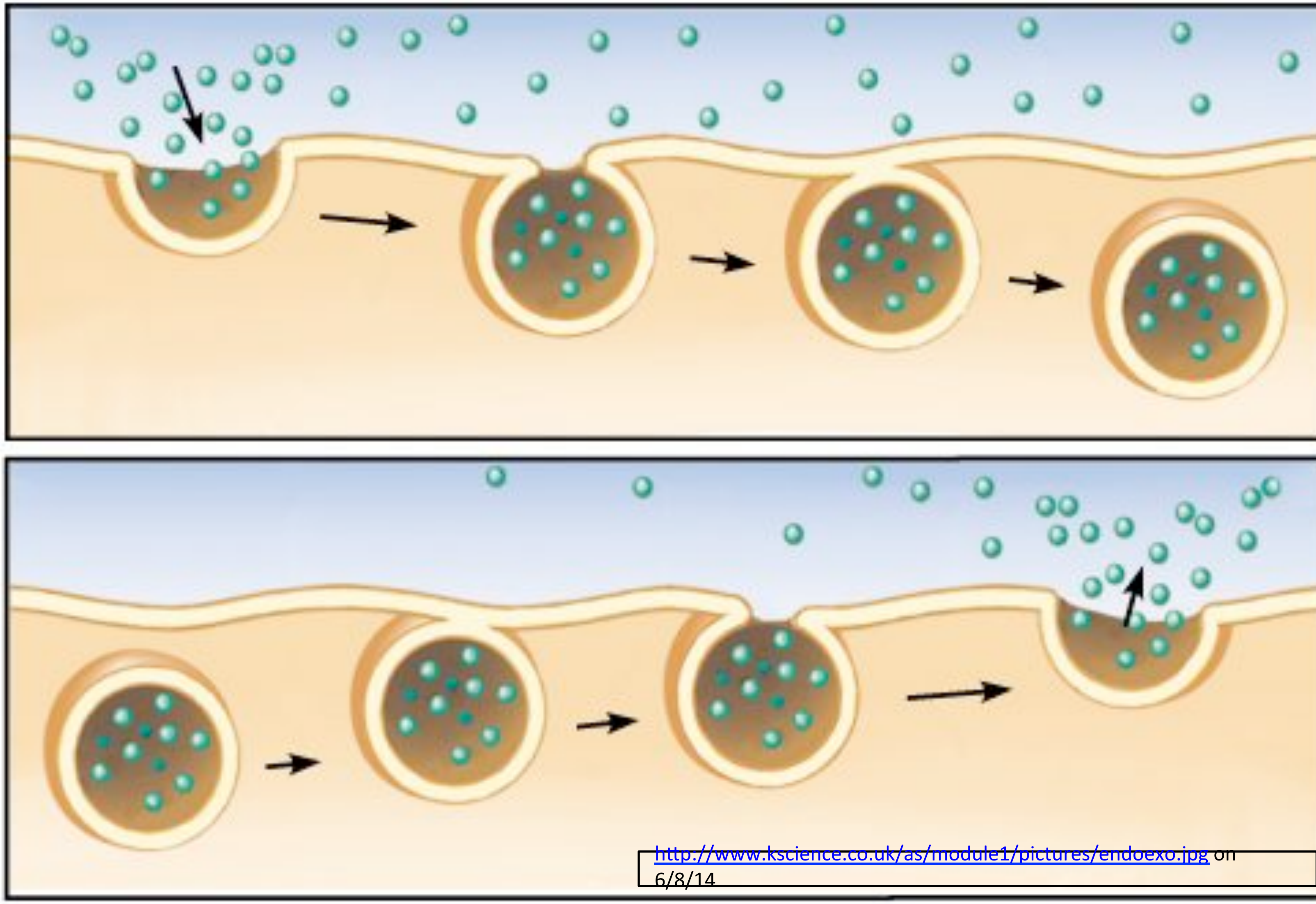


1
Extracellular fluid
High Na+
Low K+
ATP
Low Na+
3 Na+
High K+
Intracellular fluid
2
P
+
ADP
3
3 Na+
P
4
2 K+
P
5
ATP
2 K+


VSL[10] 4-11

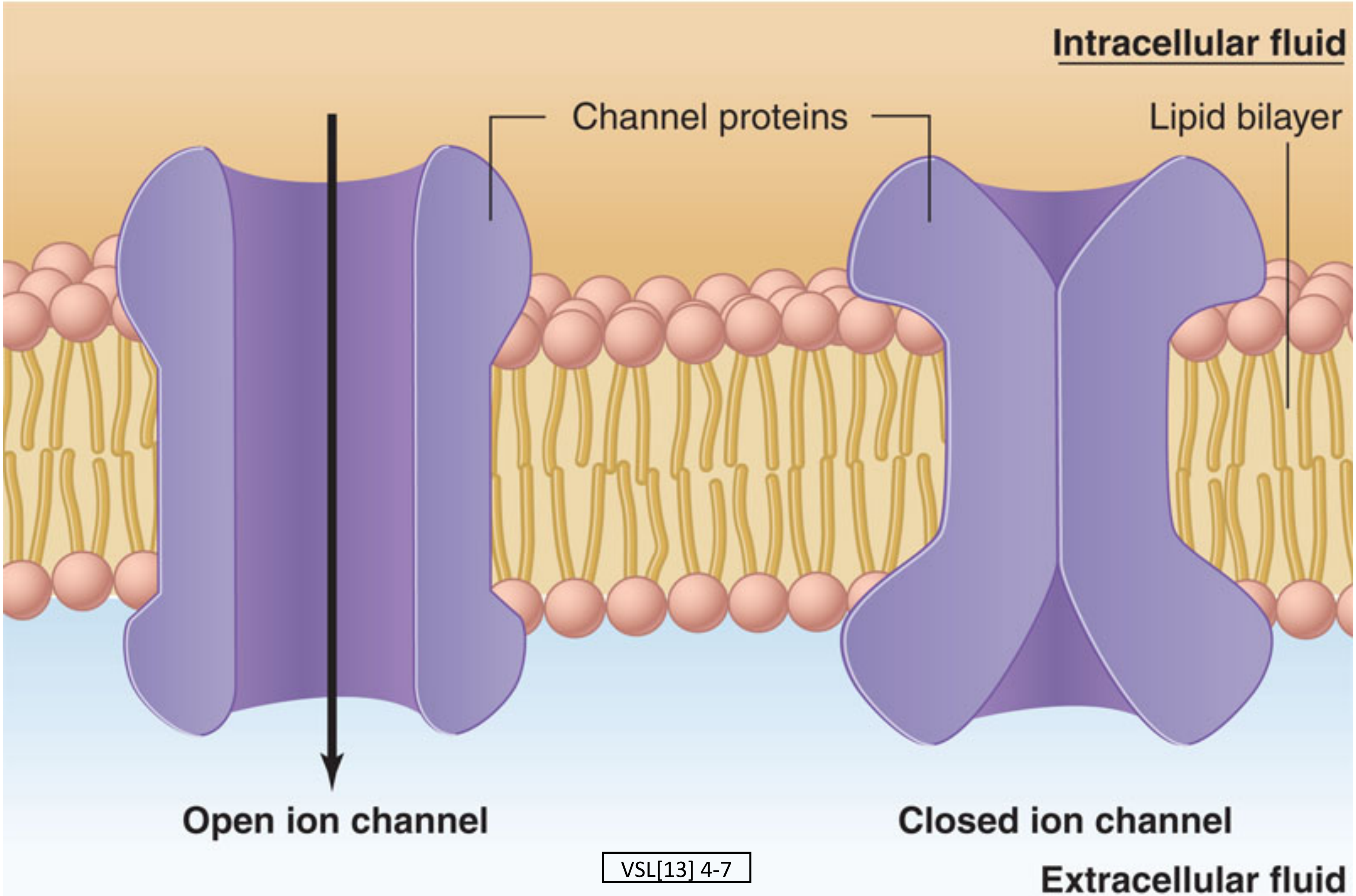



Model of a secondary active transport system. The binding of $Na^+$ to its' binding site on the transporter protein (left panel) allows binding of a different solute (purple) to its' binding site. Binding of both substances causes a conformational change in the transporter protein (right panel) that exposes both binding sites to the intracellular fluid. $Na^+$ has moved down its' concentration gradient; the (other) solute has been moved up it's concentration gradient by means of the energy in the $Na^+$ concentration gradient.



http://www.kscience.co.uk/as/module1/pictures/endoexo.jpg on 6/8/14

A simple model of endocytosis (top panel) and exocytosis (bottom panel.


Intracellular fluid
Channel proteins
Lipid bilayer
Open ion channel
Closed ion channel
VSL[13] 4-7
Extracellular fluid

## TABLE 4–2 *Major Characteristics of Pathways by which Substances Cross Membranes*

| | *Diffusion* | | *Mediated Transport* | | |
|---|---|---|---|---|---|
| | THROUGH LIPID BILAYER | THROUGH PROTEIN CHANNEL | FACILITATED DIFFUSION | PRIMARY ACTIVE TRANSPORT | SECONDARY ACTIVE TRANSPORT |
| Direction of net flux | High to low concentration | High to low concentration | High to low concentration | Low to high concentration | Low to high concentration |
| Equilibrium or steady state | $C_o = C_i$ | $C_o = C_i^*$ | $C_o = C_i$ | $C_o \neq C_i$ | $C_o \neq C_i$ |
| Use of integral membrane protein | No | Yes | Yes | Yes | Yes |
| Maximal flux at high concentration (saturation) | No | No | Yes | Yes | Yes |
| Chemical specificity | No | Yes | Yes | Yes | Yes |
| Use of energy and source | No | No | No | Yes: ATP | Yes: ion gradient (often $Na^+$) |
| Typical molecules using pathway | Nonpolar: $O_2$, $CO_2$, fatty acids | Ions: $Na^+$, $K^+$, $Ca^{2+}$ | Polar: glucose | Ions: $Na^+$, $K^+$, $Ca^{2+}$, $H^+$ | Polar: amino acids, glucose, some ions |

*In the presence of a membrane potential, the intracellular and extracellular ion concentrations will not be equal at equilibrium.

VSL[10]

# END

## Video 3, Module 1