Meninges - protective membranes	Ventricles	Blood brain barrier	Cerebrospinal fluid
Dura Mater: The tough, outermost layer that provides structural support. **Arachnoid Mater**: The middle layer with a spider-web-like appearance, containing cerebrospinal fluid (CSF) in the subarachnoid space. **Pia Mater**: The delicate, innermost layer that closely adheres to the brain and spinal cord. Separated from the arachnoid by a space filled with cerebrospinal fluid	Hollow structures in the brain filled with cerebrospinal fluid (CSF). They include the lateral ventricles, third ventricle, and fourth ventricle, which are continuous with the central canal of the spinal cord. CSF supports and cushions the brain.	A selective permeability barrier formed by tight junctions between endothelial cells in capillaries of the brain, which restricts the entry of macromolecules, including toxins and drugs, while allowing necessary substances like glucose to pass through.	Produced by ependymal cells, it fills the ventricles and subarachnoid space. It provides physical support, removes waste, and maintains the brain's chemical environment.

Identify the Factors that Affect Ion Movement Across the Membrane

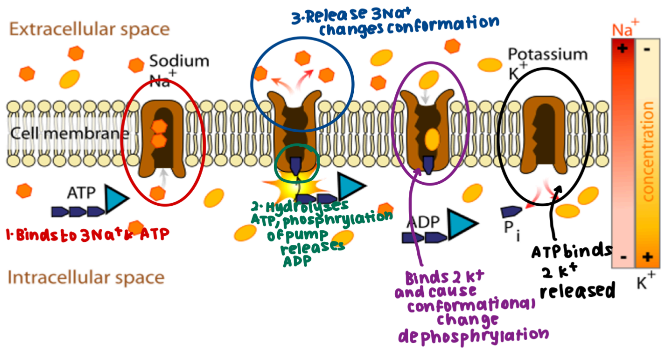
Extracellular - Intracellular fluid	Phospholipid bilayer	Membrane proteins	Driving forces
Water is the main component of both extracellular and intracellular fluid. Because water is polar, cations and anions dissolve easily, becoming surrounded by spheres of hydration. These hydration shells insulate the ions and prevent them from freely crossing the hydrophobic core of the phospholipid bilayer, meaning ion movement requires transport proteins.	The phospholipid bilayer is composed of hydrophilic phosphate head groups that face the aqueous environments and hydrophobic hydrocarbon tails that face inward, away from water. The hydrophobic region of the membrane forms a barrier to charged and polar molecules, making it very difficult for ions to move across without specialised transport proteins.	**Ion channels** - form hydrophilic pores across the bilayer, and are selectively permeable, can be gated by voltage (changes in MP) or ligand (responds to binding to neurotransmitters). **Ion pumps** - actively transport the ions against their concentration gradient and requires ATP **Aquaporines** - specialised water channels.	**Concentration gradient** - the ions always moves from a region of high to low concentration **Electrical gradient** - ions move according to the electric field across the membrane. At the resting potential (- 60 mV), the cations move into the cell **Electrochemical balance** - the combined effect of the concentration and electrical.

Distinguish the Factors Affecting an Ionic Equilibrium Potential and a Cell's Membrane Potential

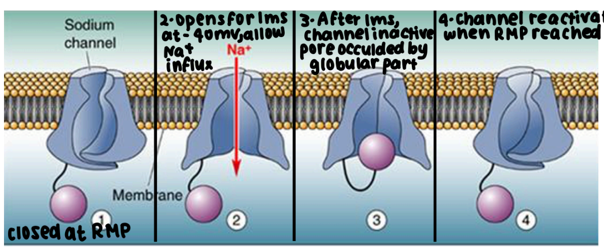
Ionic equilibrium - the electrical potential across the membrane that exactly balances out the concentration gradient (no net movement for a single ion) Calculated - Nernst equation **Ionic concentration** : steeper difference between extra and intra leads to higher driving force. **Ionic charge** : Determines the direction of the electrical force. **Membrane permeability** : does not depend on it, assumes that all the ions permeable	Cell membrane potential - the actual measured voltage across the neuronal membrane Calculated - Goldman equation **Concentration Gradients of Multiple Ions -** each of the ions that are present tends to pull the Vm to E ion, the final resting potential is a compromise of all the ions that are present **Relative Membrane Permeability** - the more permeable ion would influence the Vm more.

Describe the Function of the Na/K-ATPase (Na-K Pump)

Na^+: out ~145 mM, in ~15 mM.
K^+: out ~5 mM, in ~150 mM.
Cl^-: out ~150 mM, in ~13 mM.
Ca^{2+}: out ~1.8 mM, in ~0.0001 mM (very steep gradient).

Mechanism	Function
	- Maintains the resting membrane potential and concentration gradient - Sets the ionic concentration gradient that accounts for the RMP. - The pump does not change Vm during the action potential, it simply resets and maintains ionic gradients in the background. **Extra things** The pump can work in reverse if both the intracellular k+ and na+ is high and has a relatively low ATP concentration If the pumps stops working the following will be affected - - AP : AP can still fire for a while cause the gradient is already set, over time the AP becomes weaker - Ionic concentration : Na^+ builds up inside, K^+ leaks out, gradients lost. - Electrical potential: Vm drifts toward 0 (depolarisation block, no excitability). (3 Na^+ out : 2 K^+ in : 1 ATP hydrolysed)

Describe how Selectivity and Gating Occur in Na+ and K+ Channels

K+ channels	Na+ channels
1. Two-pore-domain potassium channels (K2p) - contains 2 pore loop domains that are generally open, they contribute to the opening K+ leak that sets the RMP of the cell. 2. voltage gated potassium channels (KV) - open states depend on MP, normally closed at RMP, called the delayed rectifiers 3. Calcium-activated potassium channels - ligand (calcium) activated 4. Inward-rectifying potassium channels - passes the positive charge easily into the cell	

Describe the Phases of an Action Potential, Including what Channels are Involved and When, membrane permeability and ionic concentration