



UNIT – 3

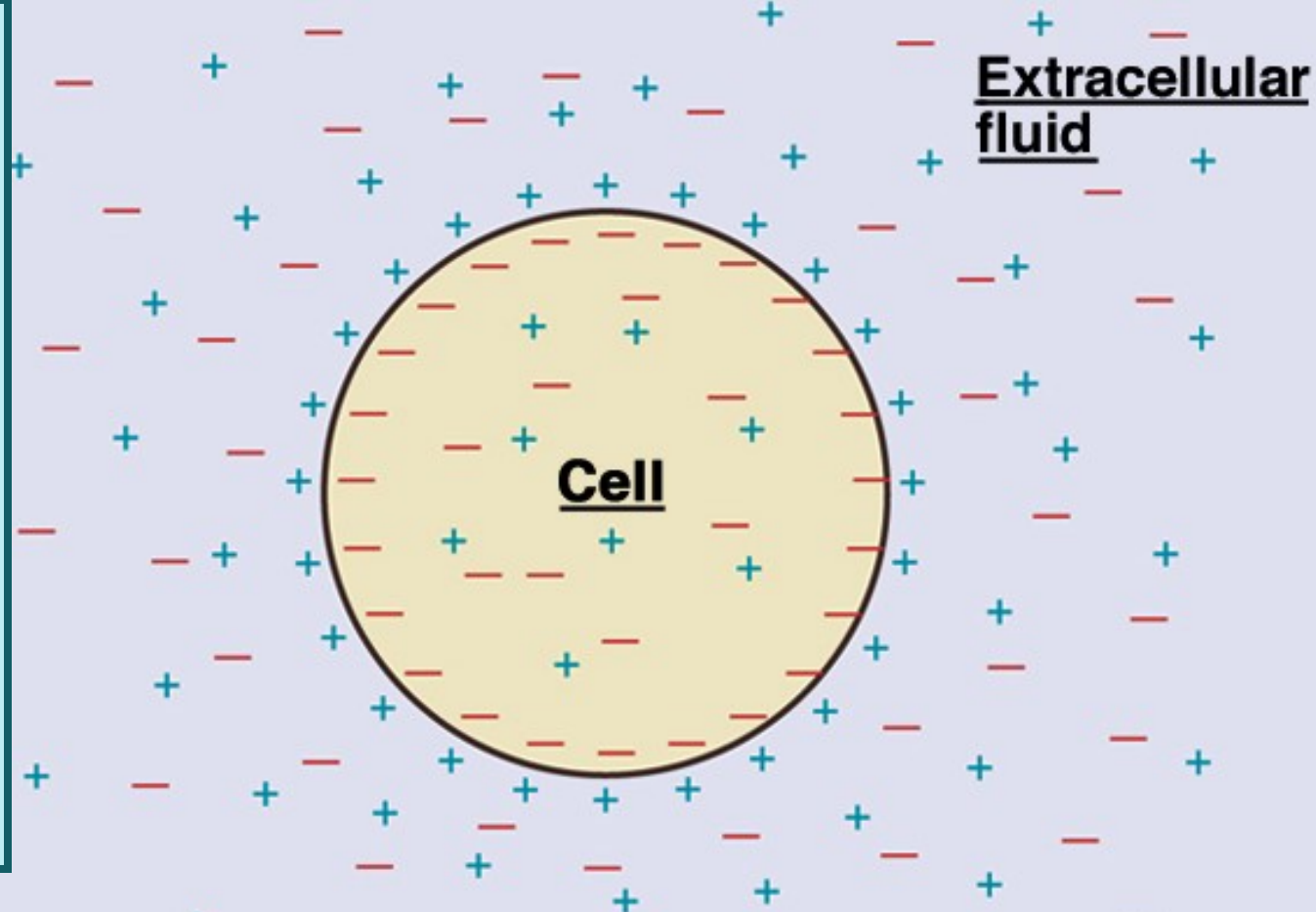
BIOPOTENTIAL ELECTRODES & CONFIGURATION

Origin of biopotential and its propagation

Membrane Potentials

- Electrical signals are the basis for processing information and neuronal response
- The impulses are conducted by presynaptic and postsynaptic neurons
- The **Resting Potential** in cells are normally more negative inside than outside. This varies from -9mV to -100mV . This is **just the opposite of osmolarity**
- Excitable tissues of nerves and muscles cells have higher potentials than other cells (epithelial cells and connective tissue cells).
- Dead cells do not have membrane potentials.

A cell is “polarized” because the interior (ICF) side of the membrane is relatively more negative than the exterior (ECF).



The membrane potential is due to the sodium ions found in the extracellular matrix and the potassium ions found in the intracellular matrix

- Membrane potentials are due to the **diffusion** of ions down their concentration gradients, the **electric charge** of the ion, and any **membrane pumps** for that ion.
- **Influx** is the net movement of ions into the cell from the ECF.
- **Efflux** is the net movement of ions out of the cell to the ECF.
- **Flux** (the movement of charges) is always measured in millivolts (mV).

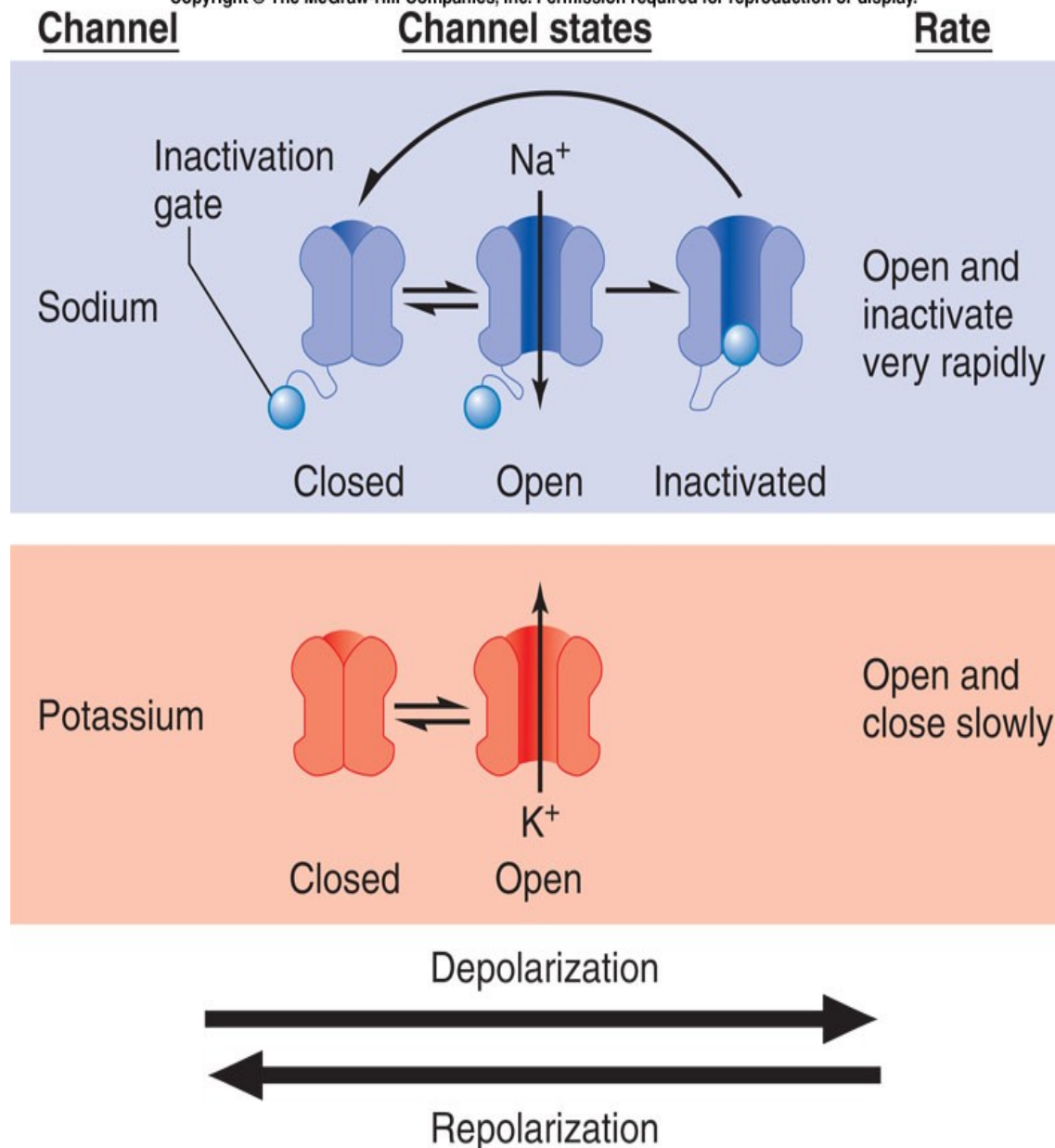
Action Potentials

- An **action potential** occurs when there is a reversal of the normal resting potential, going from negative to positive. Also called **depolarization**.
- Depolarization occurs when a stimulus causes the **voltage-gated Na⁺ channels** to open, allowing Na⁺ to rapidly influx down its concentration gradient.
- The sudden **in-rush of positive sodium ions** reverses the membrane potential for a few milliseconds.
- Then the **voltage-gated K⁺ channels** open, allowing K⁺ to rapidly efflux due to its concentration gradient. This brings the membrane back to negative inside and is called **repolarization**.

Action Potentials

- Even though the voltage has returned to negative, the membrane is not at resting potential because it now has too much Na^+ inside and not enough K^+ ions.
- The presence of high Na^+ inside causes the Na^+/K^+ pumps to increase by a power of 3. The faster pump rate quickly restores the membrane back to its steady-state resting condition.

Sodium channels have 2 gates, a normal **voltage (activation) gate** (which is closed at rest) and an **inactivation gate** (which is open at rest). The rapid opening of the voltage gate lets Na^+ rush in and depolarizes the cell. This is immediately followed by closing of the inactivation gate which stops the Na^+ influx. At the same time the K^+ gate opens letting K^+ efflux (repolarization).



References

- Bennett, Tom, PowerPoint slides, 3/23/05
- Jack, Pasternak J. An Introduction to Human Molecular Genetics.