

# Neuronal signalling

Resting potential of the neuron (= resting membrane potential) - description, essential ionic fluxes.

Action potential – description, ionic fluxes, places of generation. Propagation of action potential in myelinated and unmyelinated axon.

Excitatory and inhibitory postsynaptic potentials, temporal and spatial summation.

# Cell membrane

- fosfolipid doublelayer
- transporters
- ion channels

# **Extracellular and intracellular ion concentration**

# Resting membrane potential

A difference in the electrical potential across the plasma membrane of an unstimulated excitable cell.

In a resting neuron the electrical potential difference is about 65 mV.

Because the net charge outside of the membrane is arbitrarily defined as zero,  
→ **resting membrane potential is -65 mV.**

**factors**: the unequal distribution of electrically charged ions in ECF and ICF, (*Na<sup>+</sup>-K<sup>+</sup> pump*) and the selective permeability of the membrane to K<sup>+</sup> (*ion channels*).

# Ion currents

Simplified view:

- $\text{Na}^+$  enter the cell: **depolarization**
- $\text{K}^+$  leave the cell: **repolarization, hyperpolarization**
- $\text{Cl}^-$  enter the cell: **hyperpolarization**

# Information processing

- dendrites and body - input and integration
- axon - information transmission
- information:
  - processes and soma: **electrical changes**  
local or action potentials
  - synapses: **chemical transmitter release**

# Neuronal signalling

- local – **receptor potential**
- local – **synaptic potentials**

# Receptor and synaptic potentials

- amplitude 0,1-10 mV (graded responses)
- duration: 5-100 ms (receptor p.),  
5 ms-20 min (synaptic p.)
- propagation: with decrement, passive
- depolarization or hyperpolarization



# Postsynaptic (=synaptic) potential

- **Excitatory** (e.g.  $\text{Na}^+$  entering the cell)
- **Inhibitory** (e.g.  $\text{K}^+$  leaving the cell)

# Neuronal signalling

- propagated – action potential

# Action potential

- short-lived reversal of membrane potential reaching + 30 mV
- physiologically, is triggered at the axon hillock
- threshold
- amplitude 70-100 mV
- duration 1-10 ms
- uniform response all-or-none
- propagation: without decrement, active, one direction
- refractory period

# **Propagation of action potential in myelinated axon**

# Toxins

- **Na<sup>+</sup> channel:**

tetrodotoxin (puffer fish),  
saxitoxin and brevetoxin  
(dinoflagellatae → shellfish)  
α-toxin, β-toxin (scorpion),  
batrachotoxin (frog)

- **K<sup>+</sup> channels:**

dendrotoxin (wasps),  
apamine (bees),  
charybdotoxin (scorpion)

# Information coding

# Integrating mechanisms:

Spatial summation

Temporal summation