

Schémata a animace zpracovalo

**Servisní středisko pro e-learning na MU**

CZ.1.07/2.2.00/28.0041

Centrum interaktivních a multimediálních studijních opor pro inovaci výuky a efektivní učení

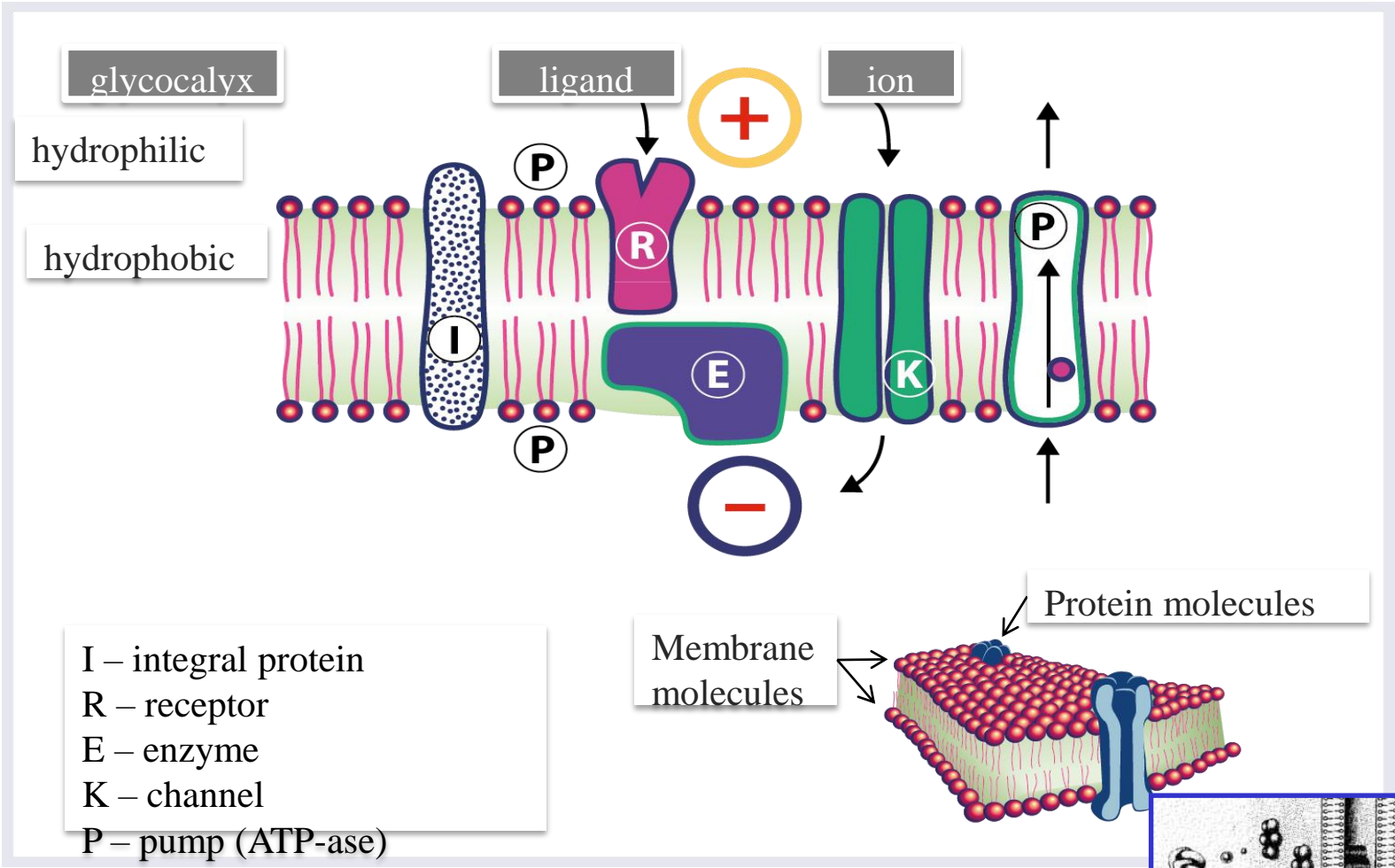


INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

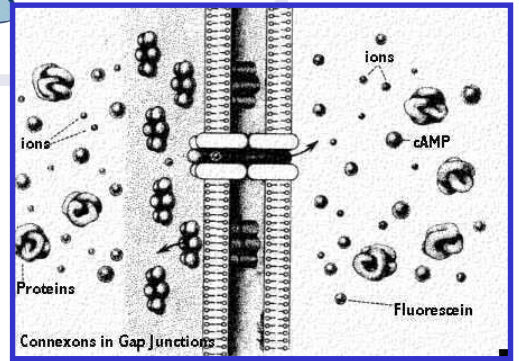
**MEMBRANE OF EXCITABLE CELL**

**ELECTRICAL TRANSMISSION OF INFORMATION**

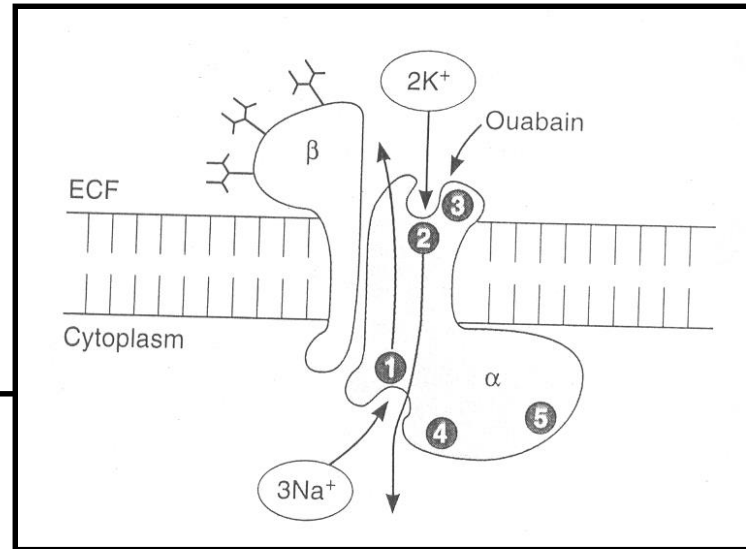
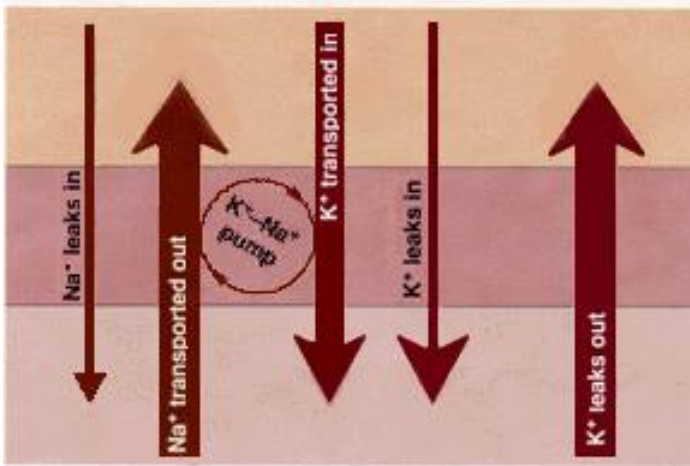
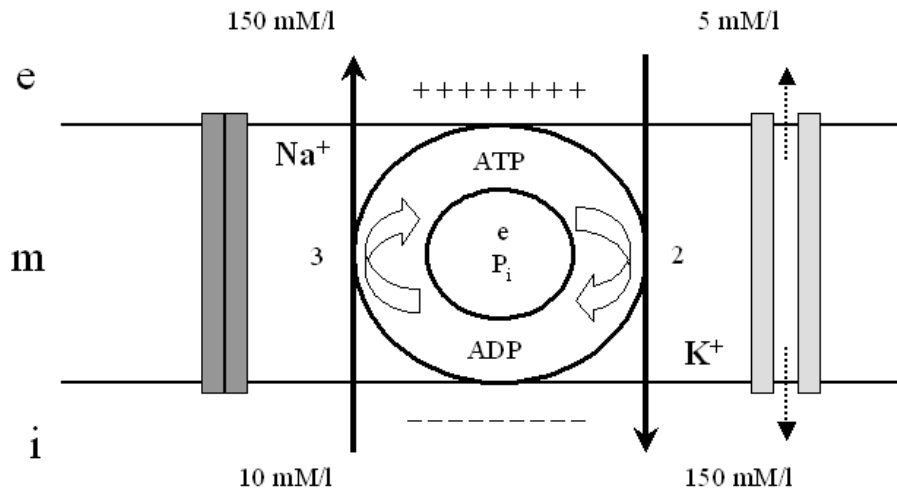
# PLASMATIC MEMBRANE



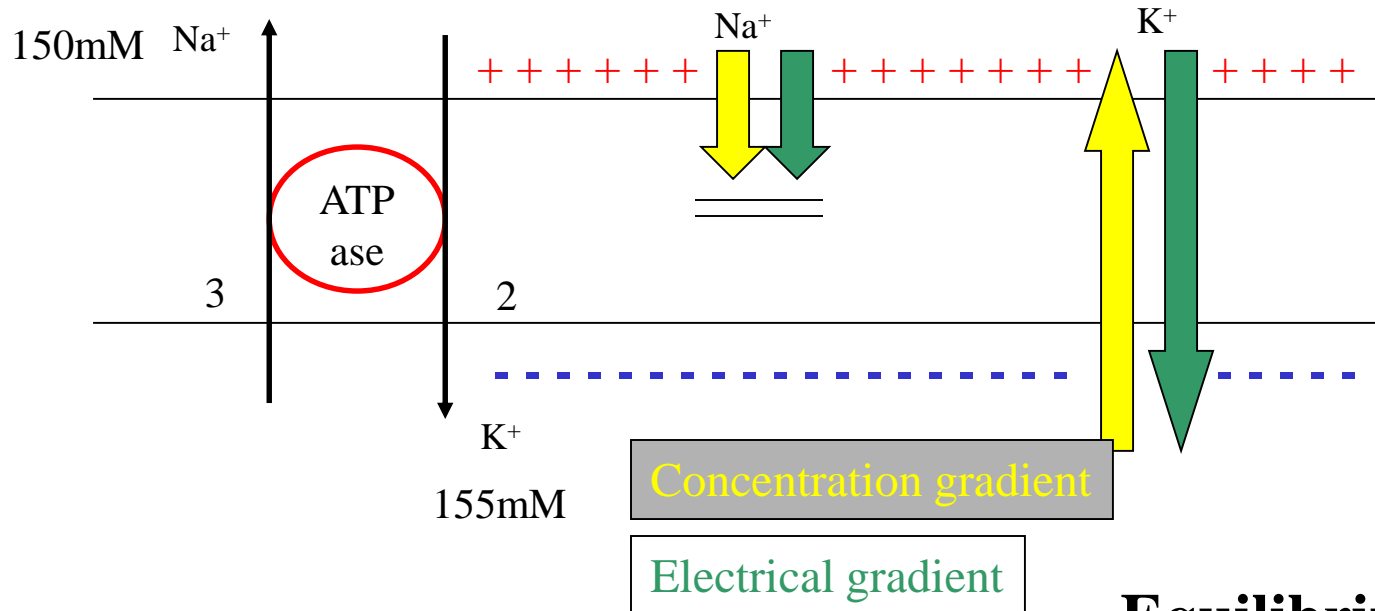
Nexus (gap junction) →



# SODIUM-POTASSIUM PUMP



# RESTING MEMBRANE VOLTAGE



Nernst equation:

$$E_x = \frac{R \cdot T}{F} \ln \frac{(C_{x_{out}})}{(C_{x_{in}})}$$

$$I_x = g_x \cdot (E - E_x)$$

**Equilibrium potential**

$$E_{Na} = +40 \text{ mV}$$

$$E_K = -90 \text{ mV}$$

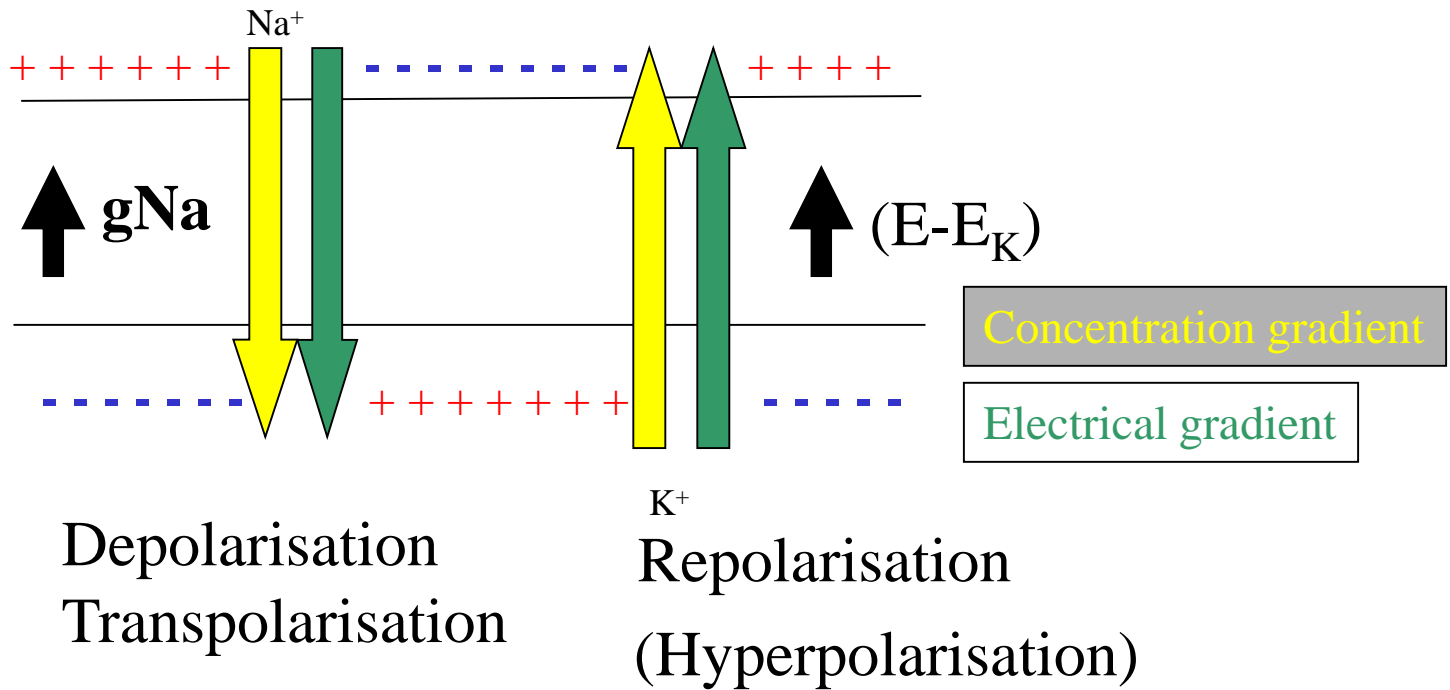
$$E_{Cl} = -70 \text{ mV}$$

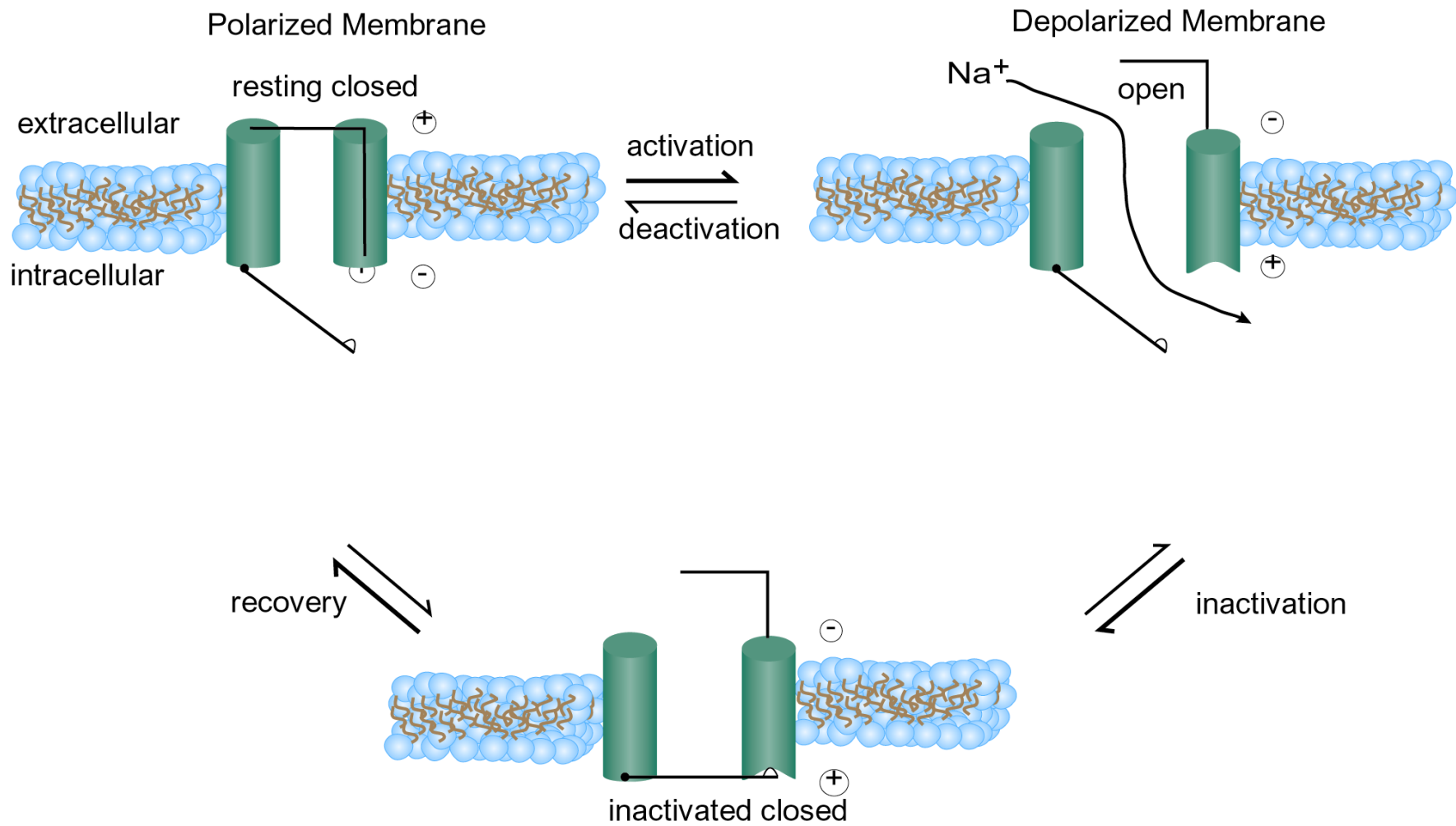
$$E_{Ca} = +60 \text{ mV}$$

$$E_r = -85 \text{ mV}$$

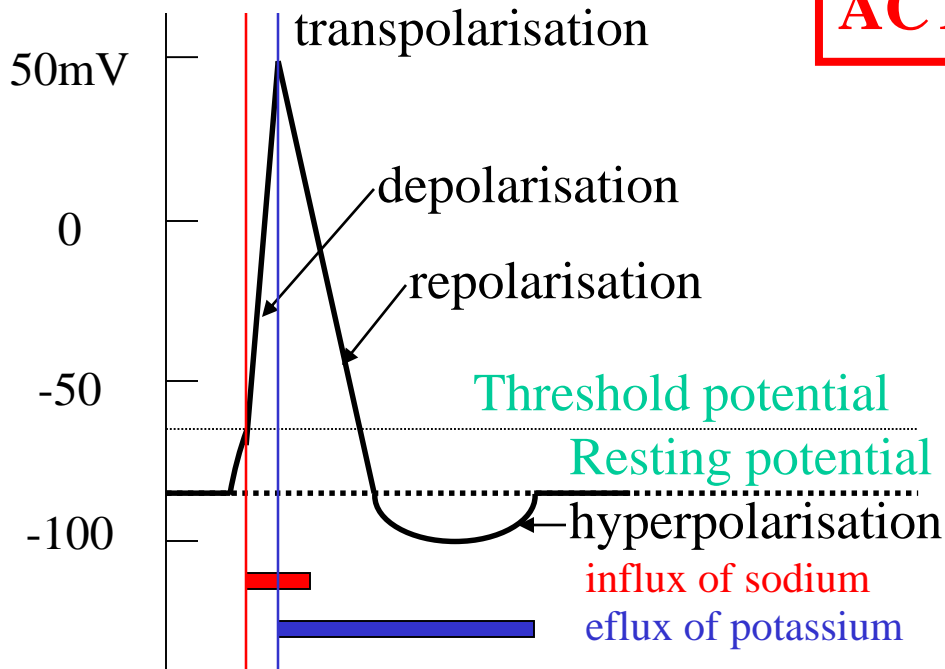
I – current, E – voltage, g – specific voltage and time-dependent conductance

# ACTION POTENTIAL



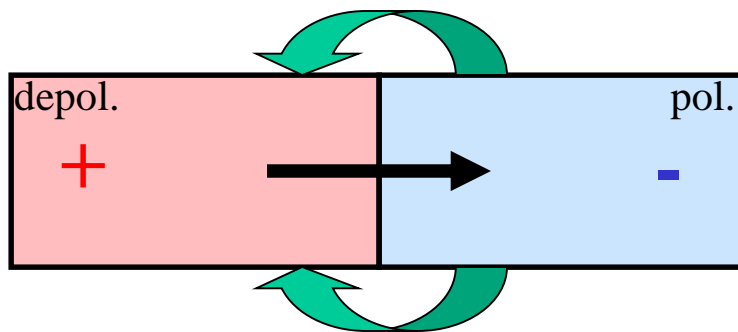


# ACTION POTENTIAL

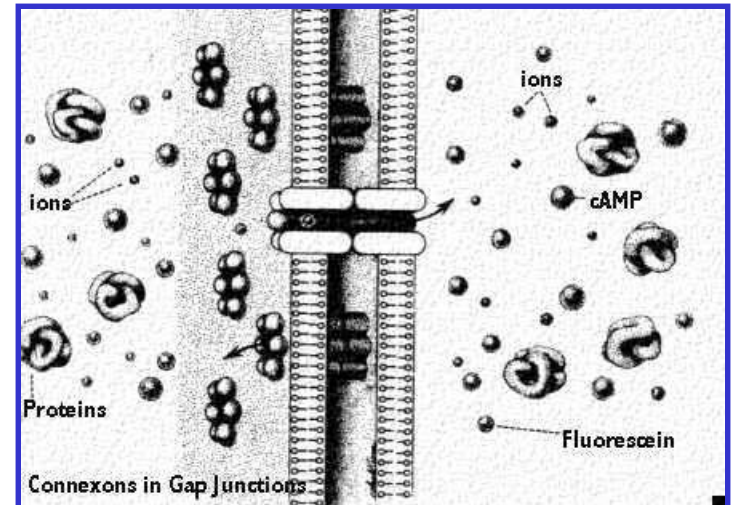


- Unit of excitation activity
- „All or nothing“ response
- Propagation without decrement („domino effect“)
- **Refractery**

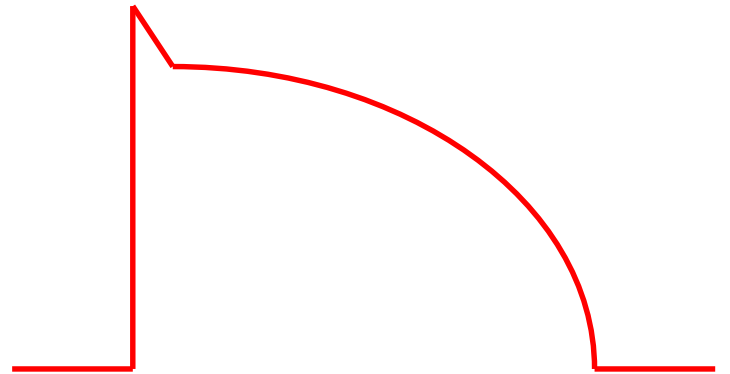
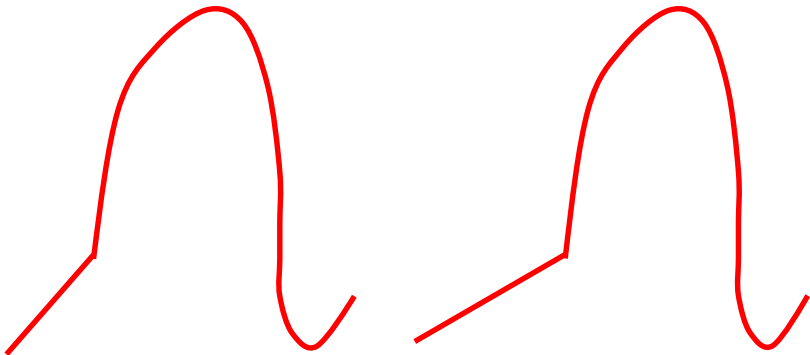
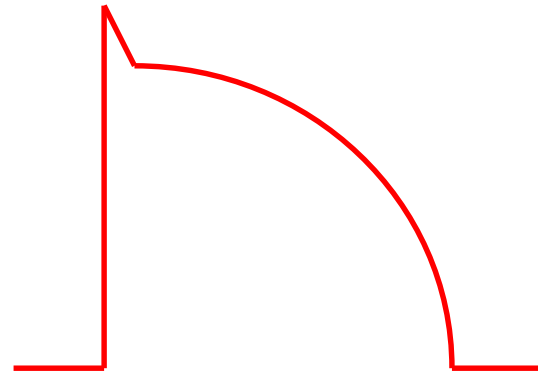
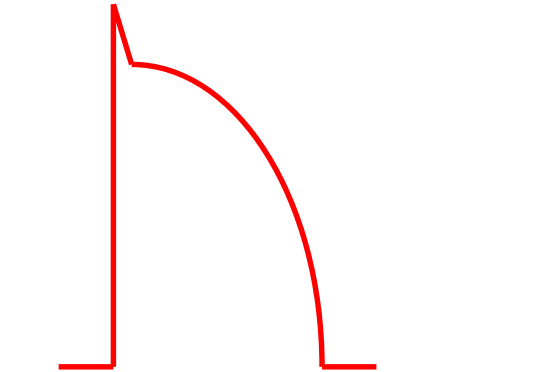
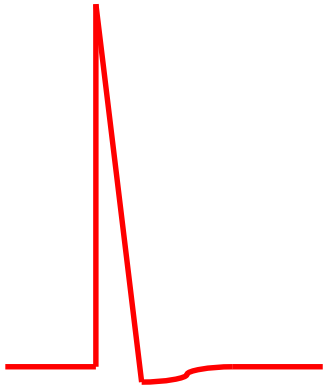
## Local current



Propagation with decrement







Velocity of excitation propagation (depolarisation front) is a function of:

- Intensity of local currents
- Resistance outside the conductor (myelin)
- Resistance of the conductor (indirect relationship)

Nodes of Ranvier, saltatory conduction

**Neuron**

input section  
(coding of inf.)

transmission section  
(transmission of inf.)

output section  
(decoding of inf.)



# SYNAPSES

- excitatory
- inhibitory

Action potential  
Calcium ions

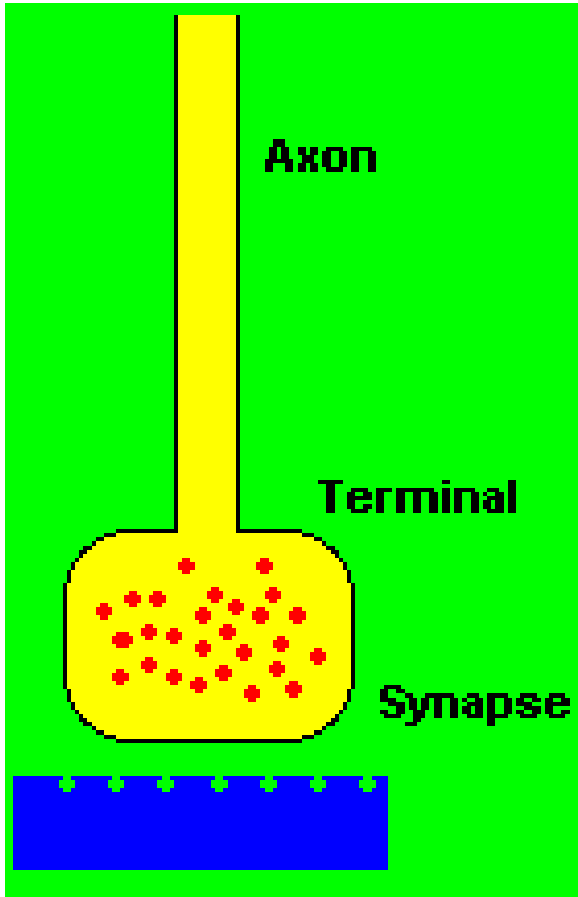
Synaptic vesicles (exocytose)

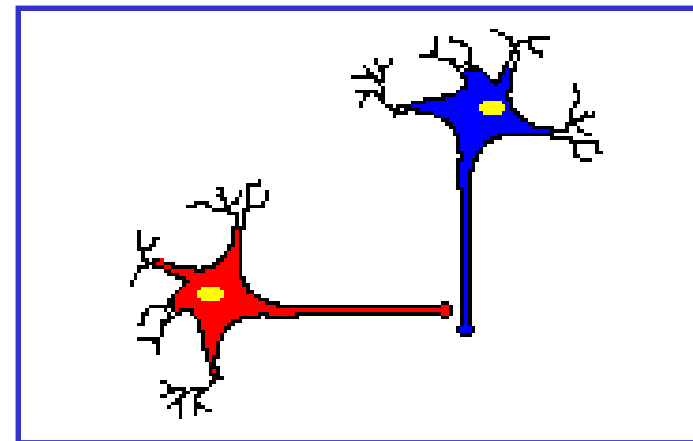
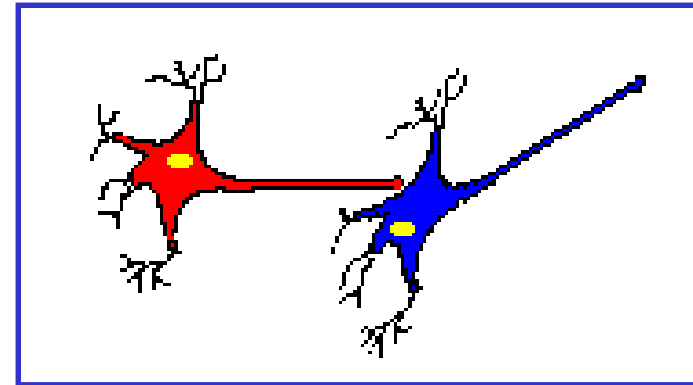
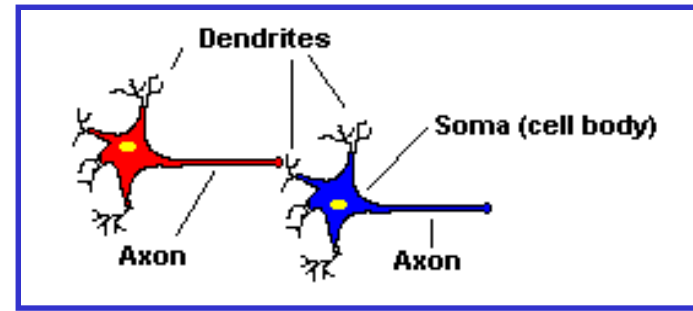
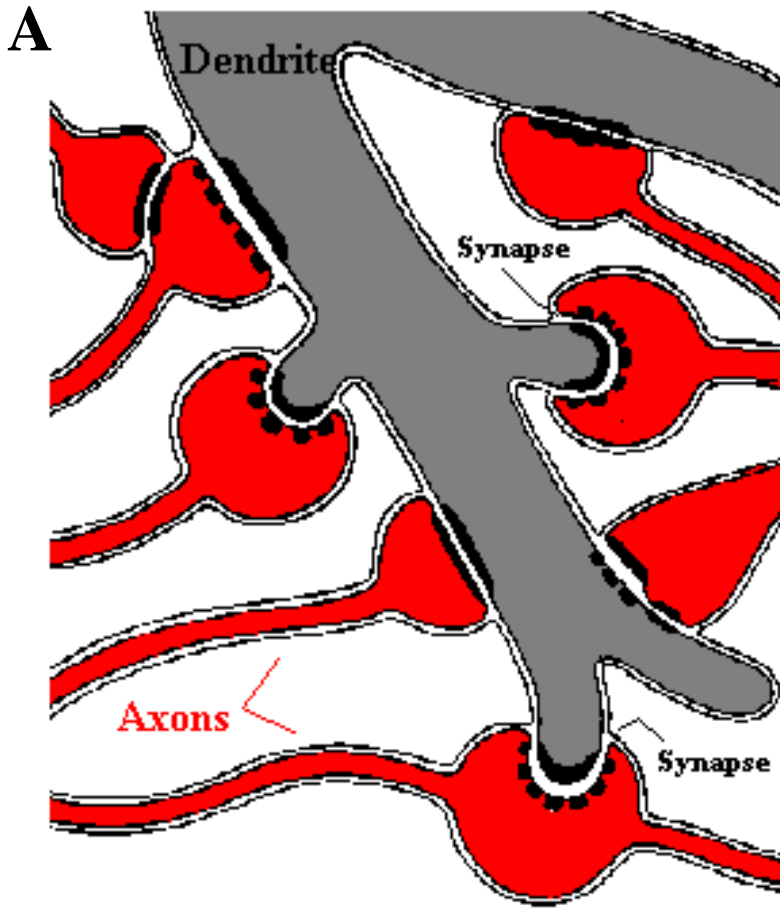
Neurotransmitter (mediator)

Presynaptic membrane

Synaptic cleft

Postsynaptic membrane  
(local change of voltage)





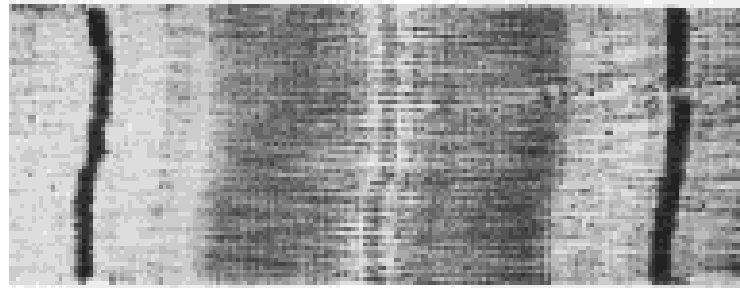
**SYNAPSIS:**

A – axodendritic

B – axosomatic

C - axoaxonal

Sarcomere



Z line

Z line

Thin filaments

actin

Thick filaments

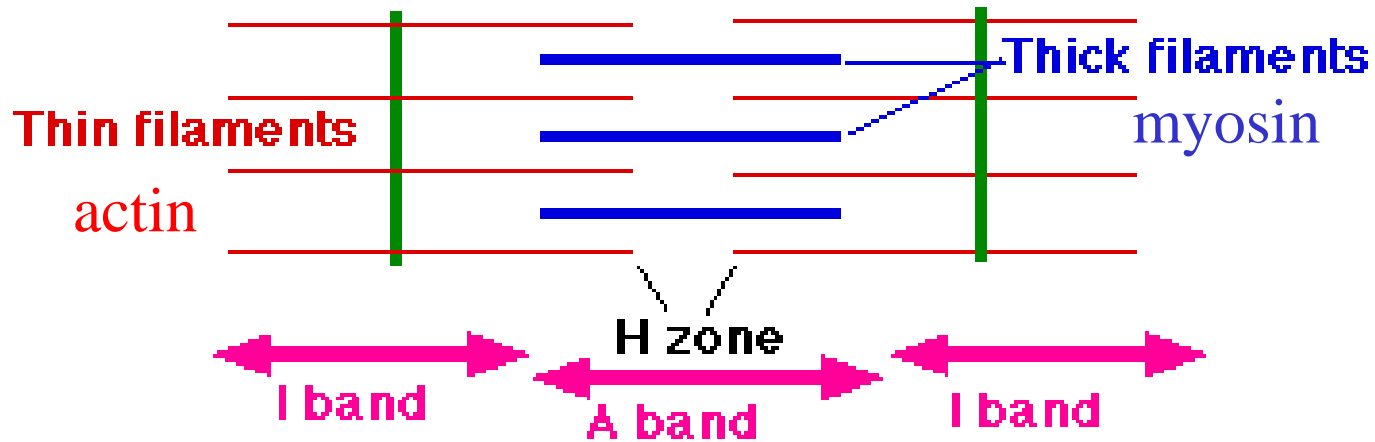
myosin

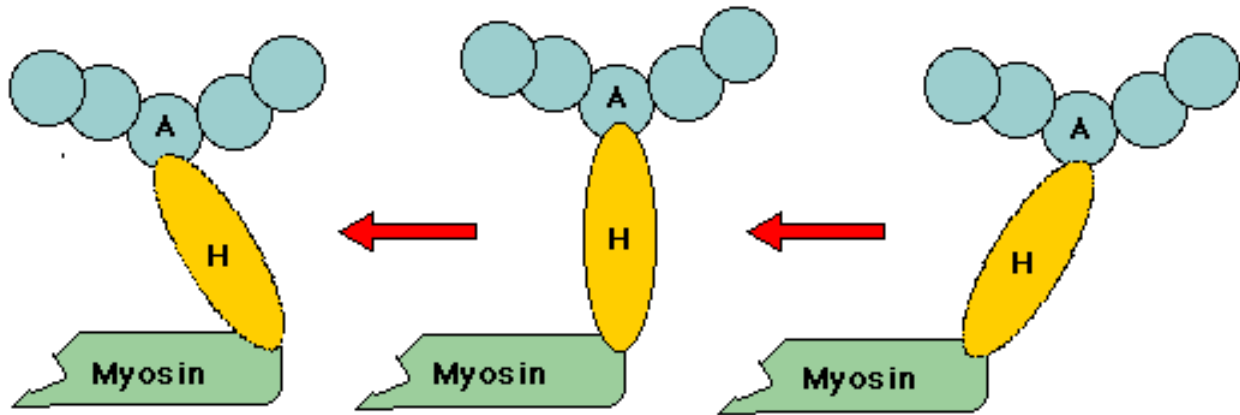
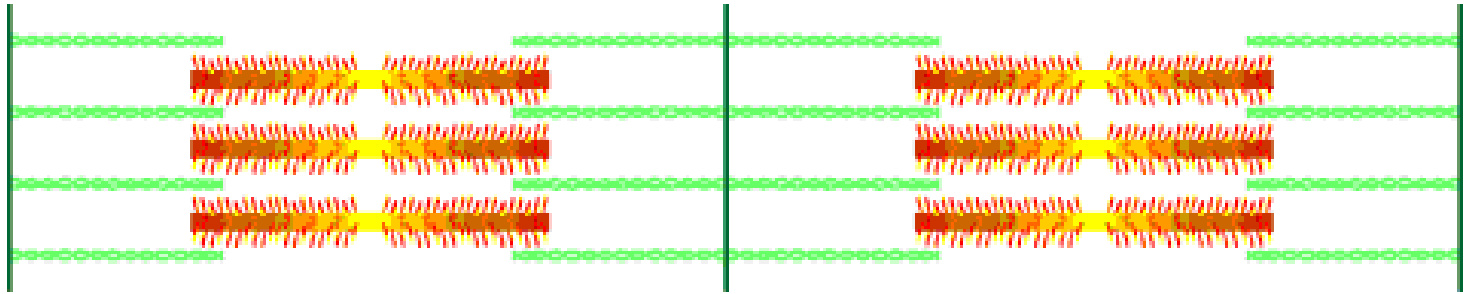
H zone

I band

A band

I band



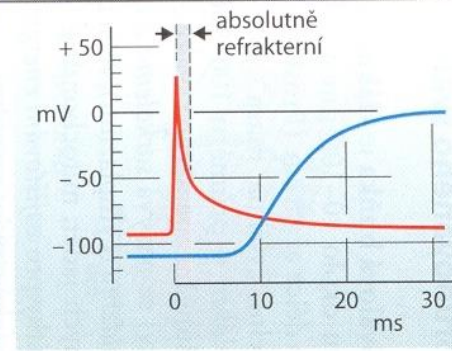
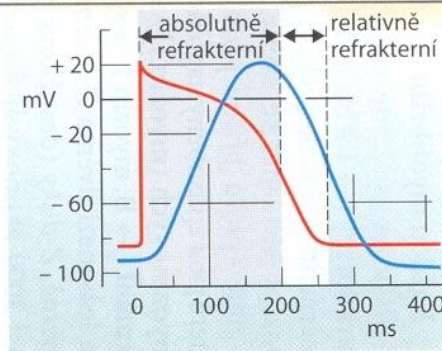
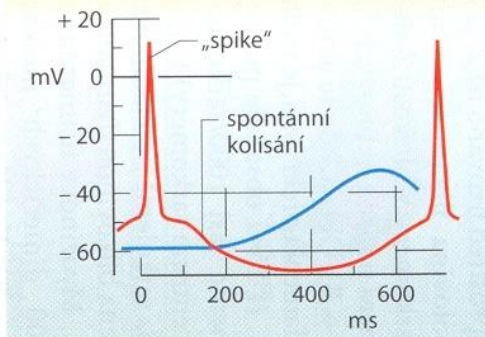


## Stavba a funkce

	hladký sval	srdeční sval (příčně pruhovaný)	kosterní sval (příčně pruhovaný)
motorická ploténka	žádná	žádná	ano
vlákna	fuziformní, krátká (max. 0,2 mm)	větvená	cylická, dlouhá (max. 15 cm)
mitochondrie	nečetné	četné	nečetné (v závislosti na typu svalu)
buněčné jádro/vlákno	1	1	četná
sarkomera	žádná	ano, délka max. 2,6 $\mu\text{m}$	ano, délka max. 3,65 $\mu\text{m}$
elektrické spřažení	částečně (jednotkový typ)	ano (funkční syncytium)	ne
sarkoplazmatické retikulum	málo vyvinuté	přiměřeně vyvinuté	silně vyvinuté
Ca <sup>2+</sup> -„spínač“	kalmodulin/kaldesmon	troponin	troponin
pacemaker	zčásti spontánně rytmicky činný (1 s <sup>-1</sup> –1h <sup>-1</sup> )	ano (sinoatriální uzel asi 1 s <sup>-1</sup> )	ne (nutný nervový podnět)
odpověď na podnět	změna tonu nebo frekvence rytmu	„vše nebo nic“	odstupňovaná
tetanizovatelný	ano	ne	ano
pracovní rozsah	křivka délka/síla je proměnlivá	na vzestupu křivky síla/délka (viz tab. 2.15 E)	v maximu křivky síla/délka (viz tab. 2.15 E)

## odpověď na podnět

potenciál —  
napětí svalu —



- **RESTING MEMBRANE POTENTIAL IS A CONDITION OF EXCITABILITY**
- **IT DEPENDS ON HIGH RESTING MEMBRANE CONDUCTIVITY FOR POTASSIUM**

**ACTION POTENTIAL IS A PROPAGATED ELECTRICAL SIGNAL GENERATED BY FAST SODIUM CURRENT INTO THE CELL<sub>x</sub>**



- **ACTION POTENTIAL REPRESENTS UNIT OF INFORMATION**
- **CODING OF INFORMATION IN THIS SYSTEM IS PERFORMED BY CHANGED FREQUENCY OF ACTION POTENTIALS**