

M U N I

M E D

4

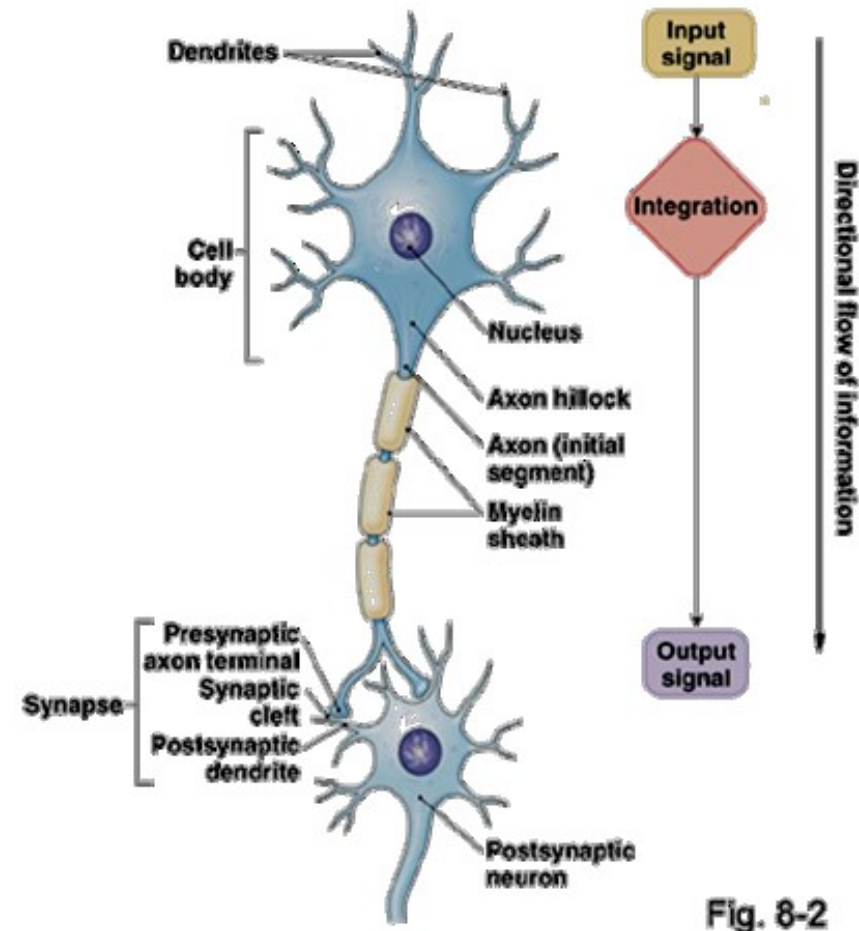
Synapse a integrace informace na synaptické úrovni

Udržovací aktivity

„Uvnitř“ neuronu

- ✓ ...
- ✓ Syntéza
- ✓ Transport
- ✓ ...

Neuron



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Zpracování a přenos informace

Membrána neuronu

- ✓ Recepce signálu
- ✓ Integrace signálu
- ✓ Generování AP
- ✓ Vedení AP
- ✓ Přenos signálu

Akční potenciál

- Rychlá změna napětí na membráně
- Vznik na axonovém hrbolu nebo iniciálním segmentu
- Šíří se membránou
- Princip vše nebo nic

Klidový potenciál
cca. -70 mV

Prahový potenciál
cca. -55 mV

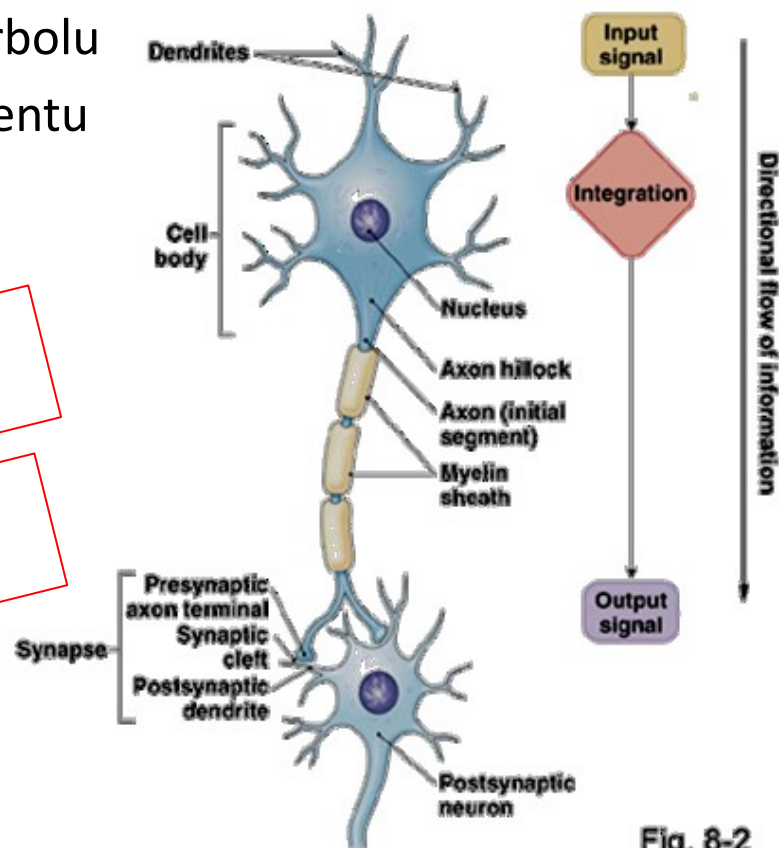
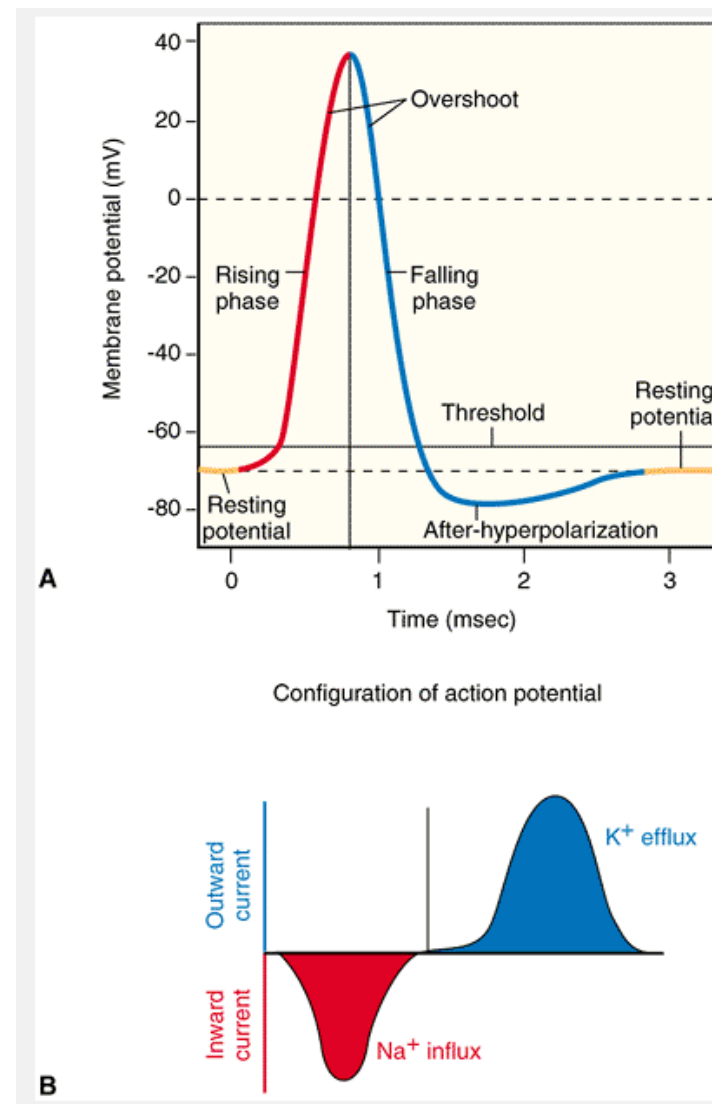


Fig. 8-2



Synapse

- Komunikace mezi neurony

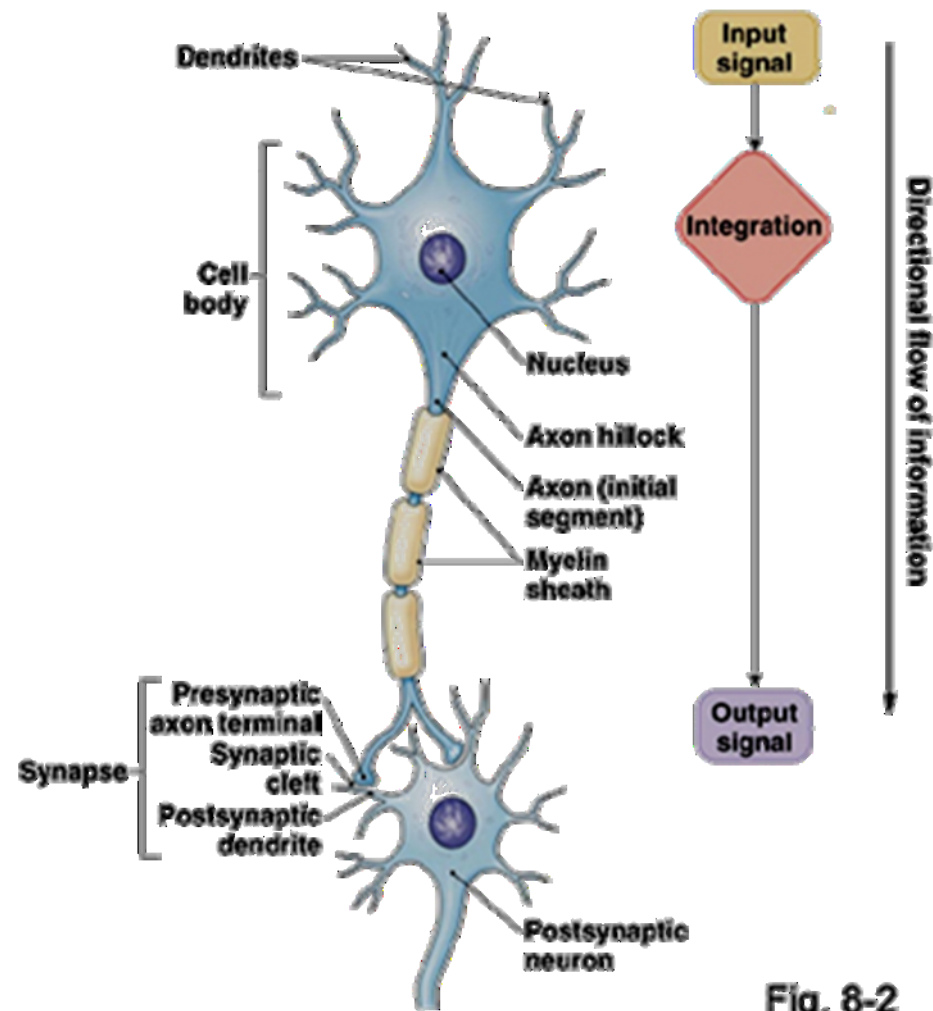


Fig. 8-2

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Synapse

- Komunikace mezi neurony
- Elektrické
- Chemické

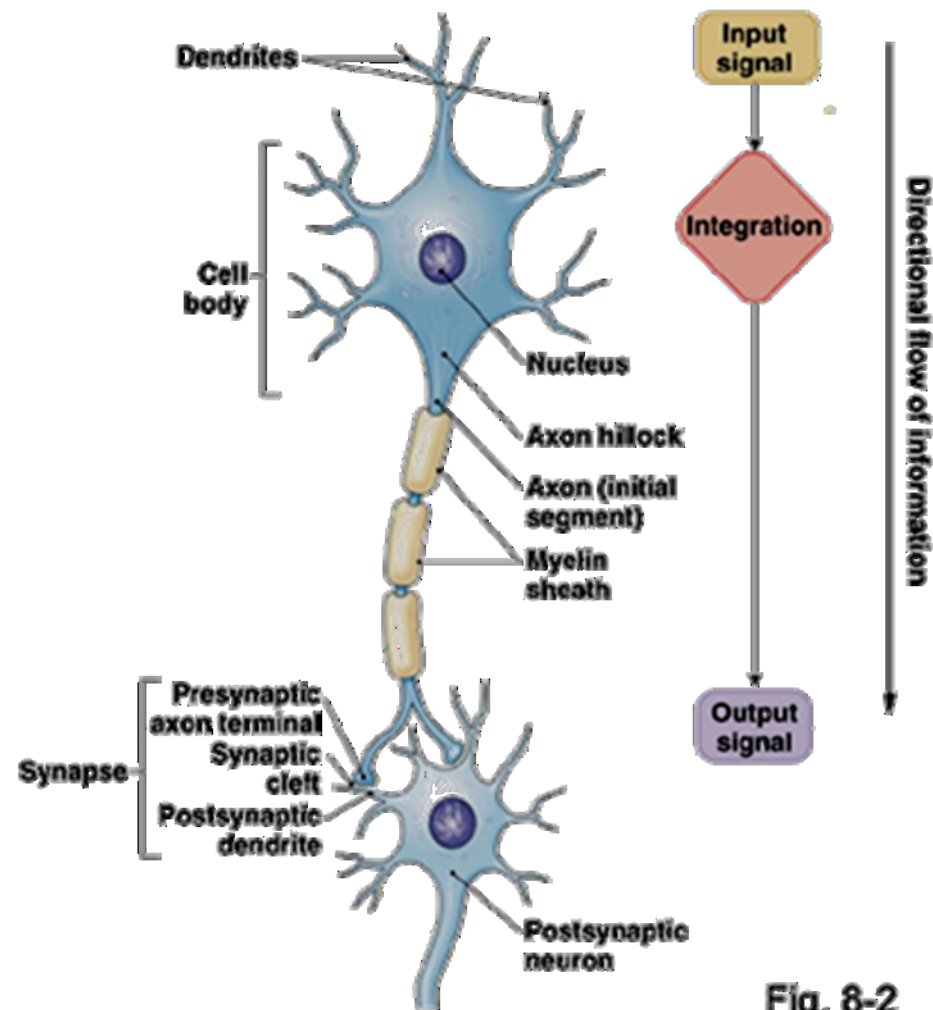
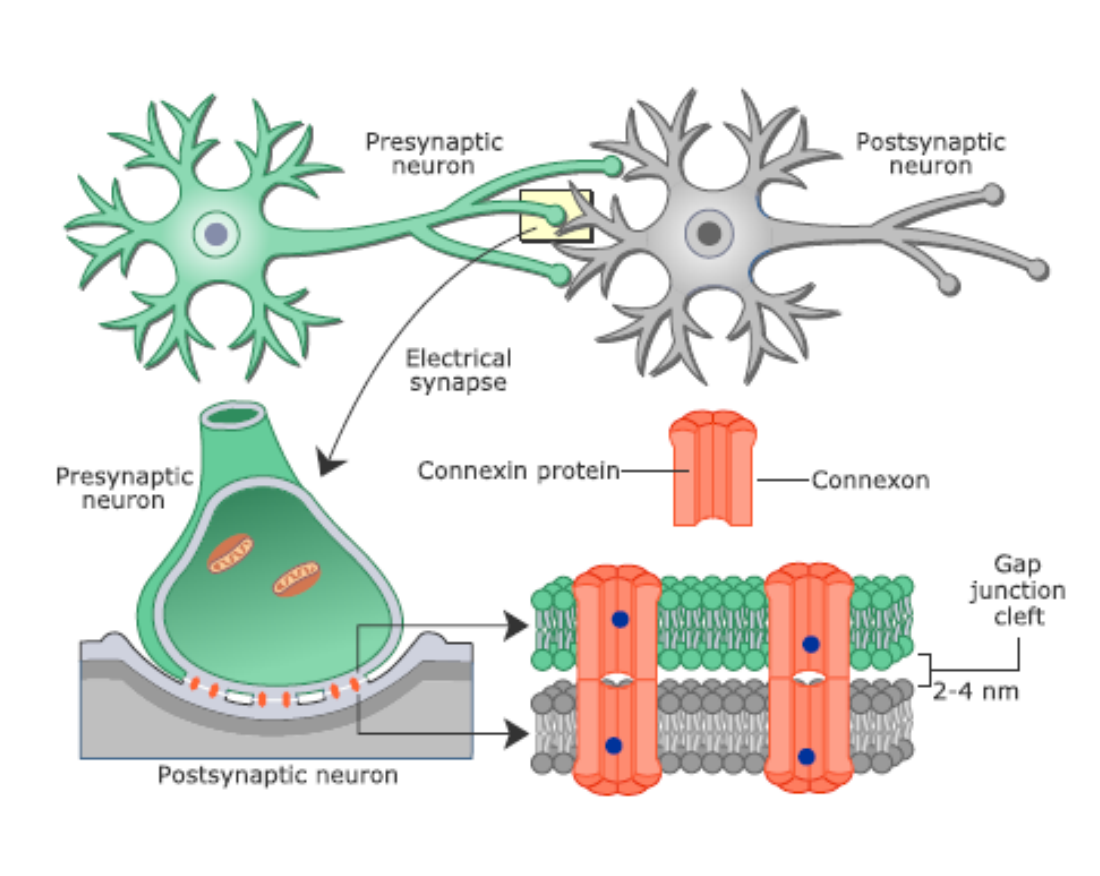


Fig. 8-2

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Elektrické synapse

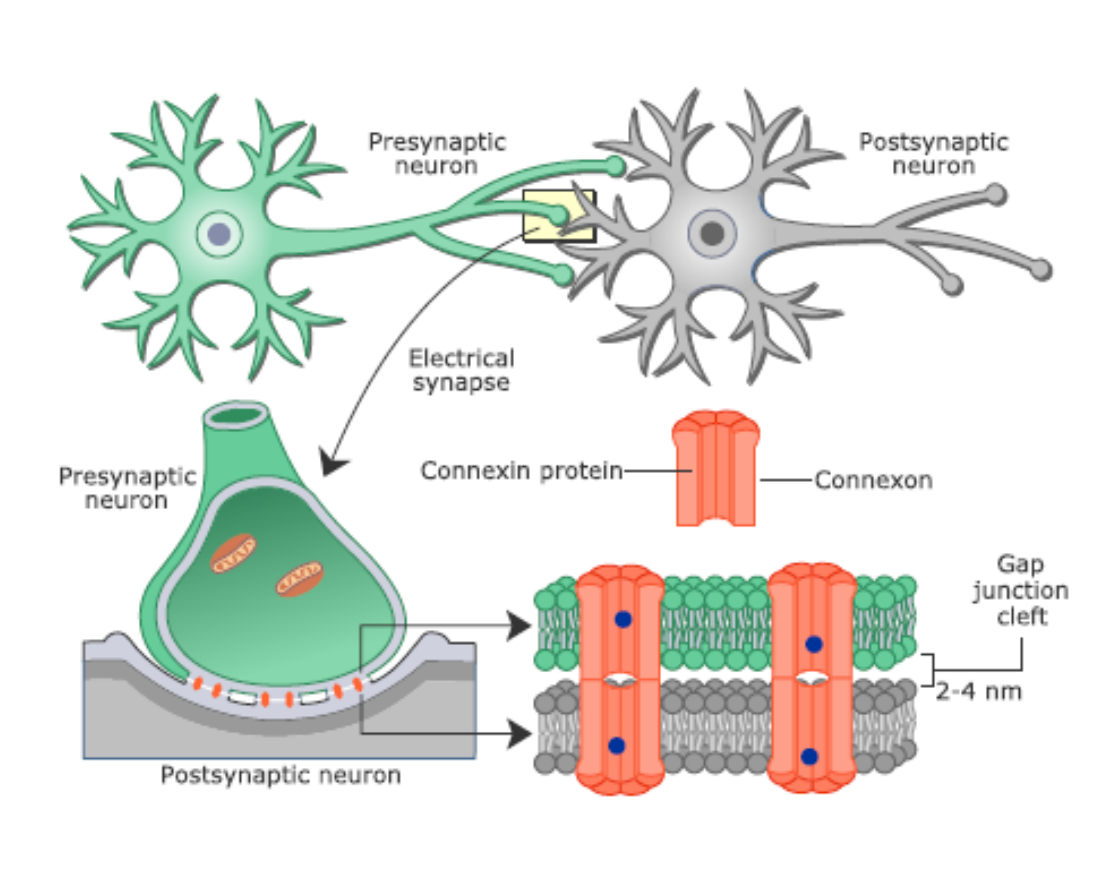
- Evolučně staré
- Méně než chemických
- Ubikvitární



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Elektrické synapse

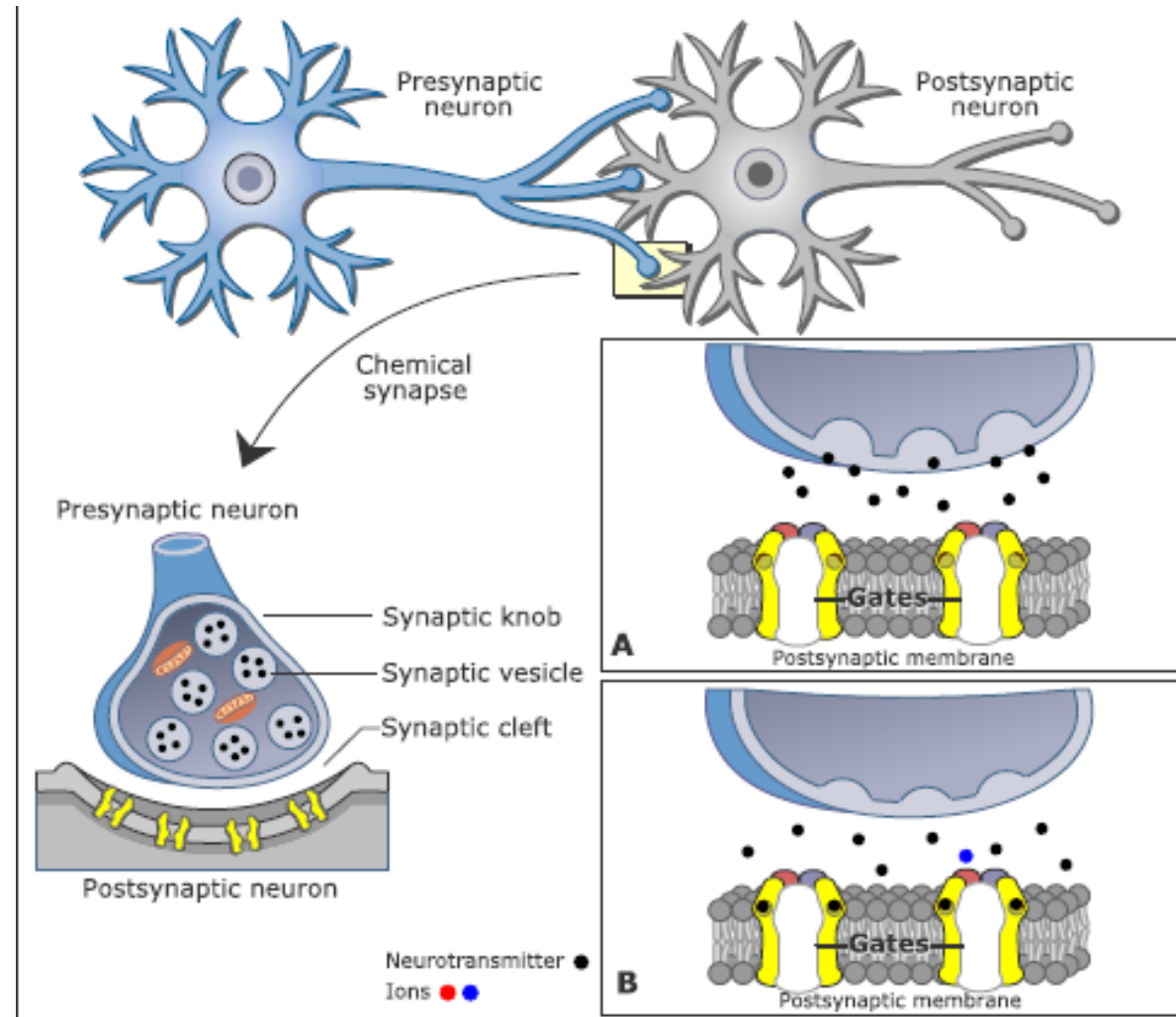
- Evolučně staré
- Méně než chemických
- Ubikvitární
- Gap junctions
- Obousměrný přenos
- Rychlost



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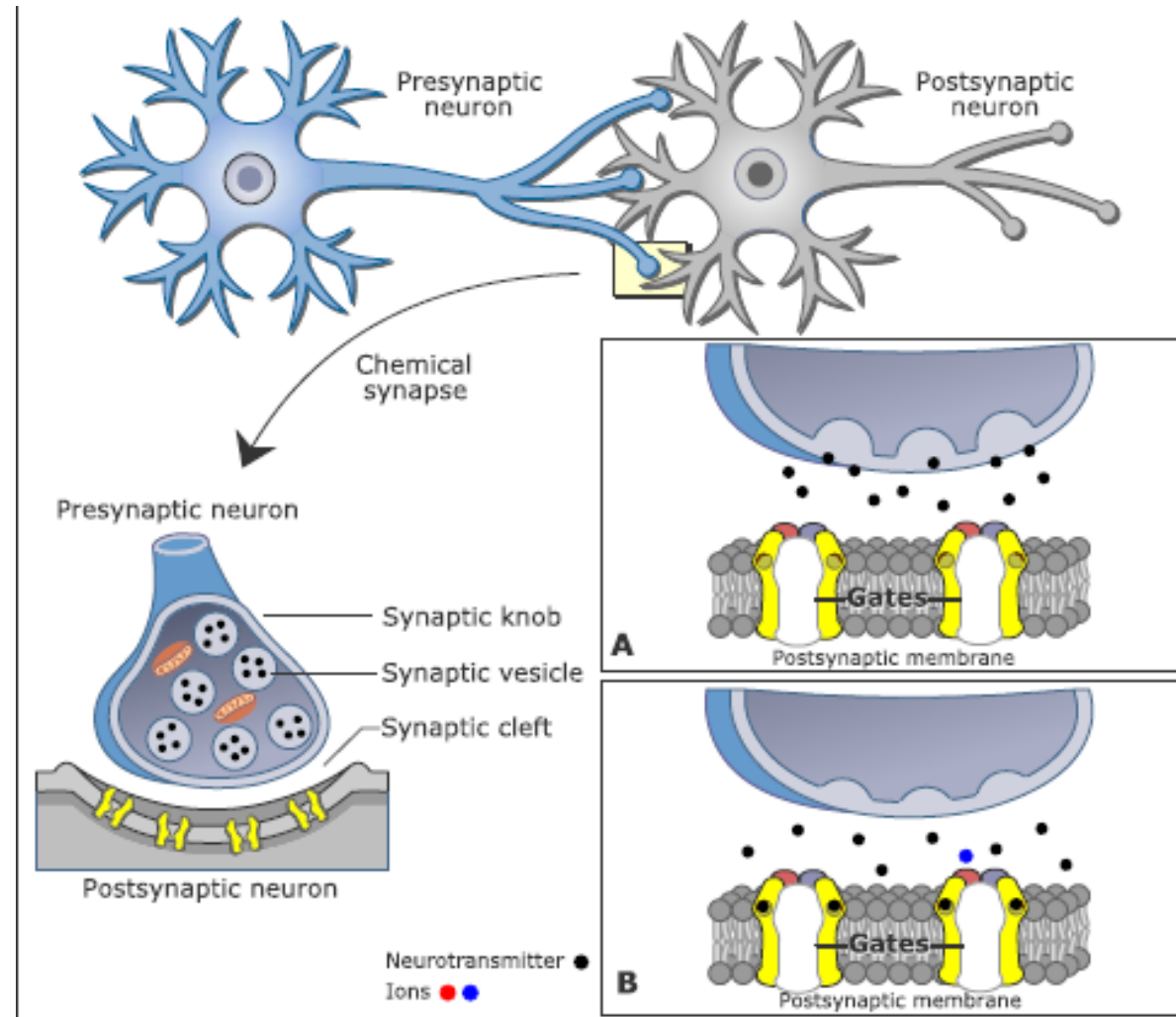
Chemické synapse

- Evolučně mladší
- Většinový typ

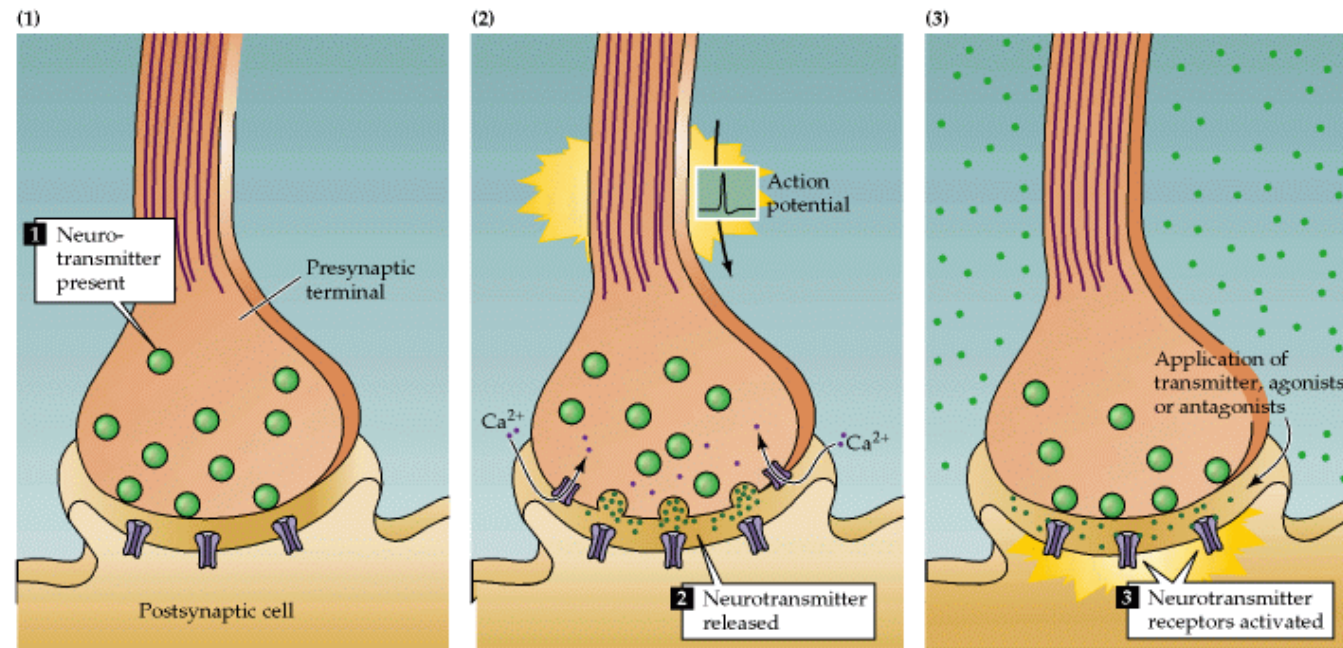


Chemické synapse

- Evolučně mladší
- Většinový typ
- Jednosměrný přenos
- Synaptická štěrbina
- Neurotransmitter



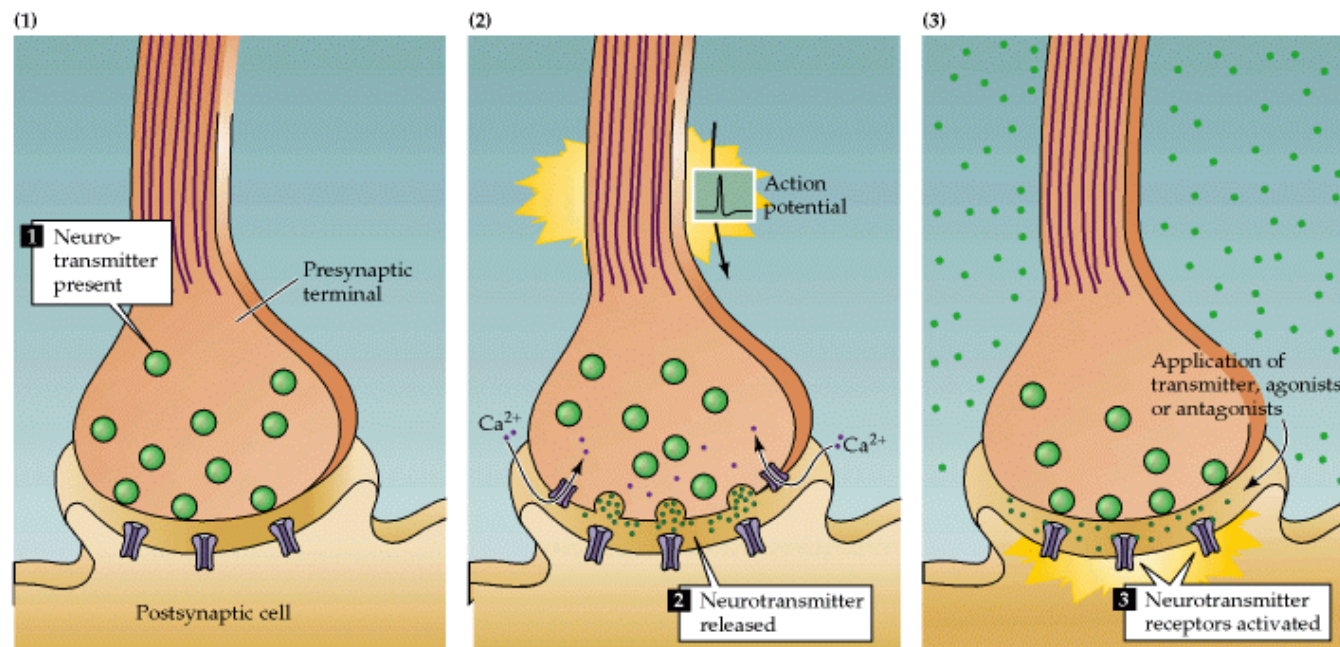
Neurotransmitter



<http://www.slideshare.net/CsillaEgri/presentations>

- Přítomen v presynaptickém neuronu

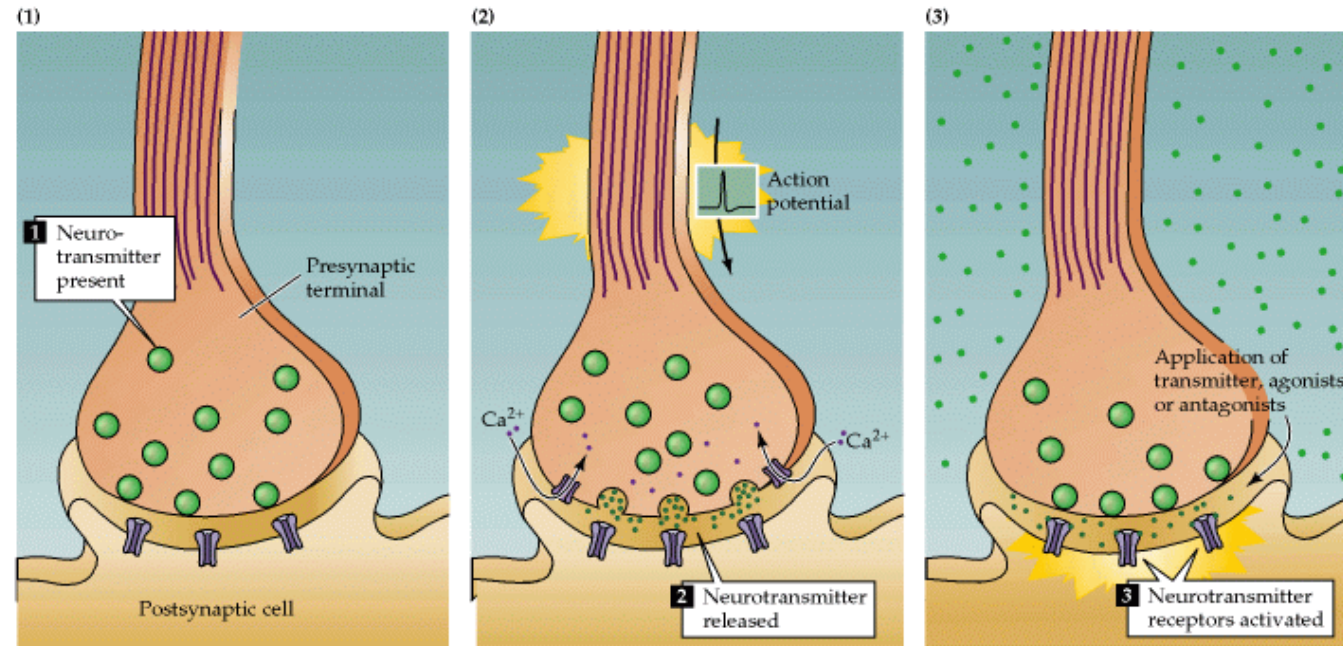
Neurotransmitter



<http://www.slideshare.net/CsillaEgri/presentations>

- Přítomen v presynaptickém neuronu
- Uvolněn do synaptické štěrby následkem depolarizace presynaptického neuronu (Ca^{2+} dependentní mechanismus)

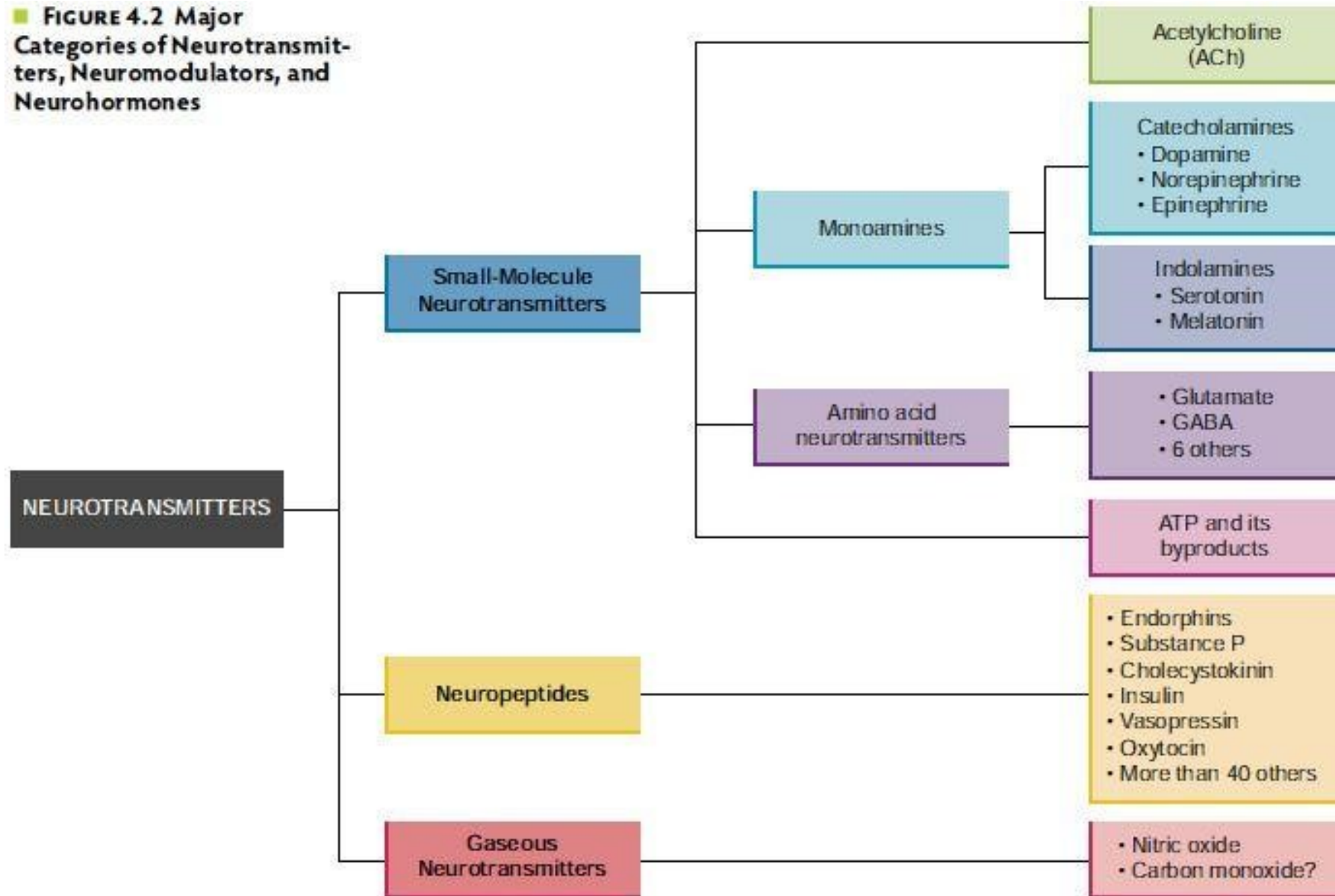
Neurotransmitter



<http://www.slideshare.net/CsillaEgri/presentations>

- Přítomen v presynaptickém neuronu
- Uvolněn do synaptické štěrby následkem depolarizace presynaptického neuronu (Ca^{2+} dependentní mechanismus)
- Postsynaptická membrána musí obsahovat specifické receptory

■ **FIGURE 4.2 Major Categories of Neurotransmitters, Neuromodulators, and Neurohormones**



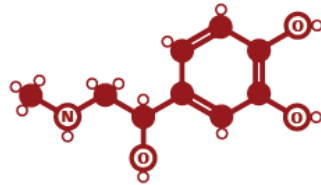
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THE STRUCTURES OF NEUROTRANSMITTERS

STRUCTURE KEY: ● Carbon atom ○ Hydrogen atom ○ Oxygen atom (N) Nitrogen atom (R) Rest of molecule

ADRENALINE

Fight or flight neurotransmitter



Produced in stressful or exciting situations. Increases heart rate & blood flow, leading to a physical boost & heightened awareness.

NORADRENALINE

Concentration neurotransmitter



Affects attention & responding actions in the brain, & involved in fight or flight response. Contracts blood vessels, increasing blood flow.

DOPAMINE

Pleasure neurotransmitter



Feelings of pleasure, and also addiction, movement, and motivation. People repeat behaviours that lead to dopamine release.

SEROTONIN

Mood neurotransmitter



Contributes to well-being & happiness; helps sleep cycle & digestive system regulation. Affected by exercise & light exposure.

GABA

Calming neurotransmitter



Calms firing nerves in CNS. High levels improve focus; low levels cause anxiety. Also contributes to motor control & vision.

ACETYLCHOLINE

Learning neurotransmitter



Involved in thought, learning, & memory. Activates muscle action in the body. Also associated with attention and awakening.

GLUTAMATE

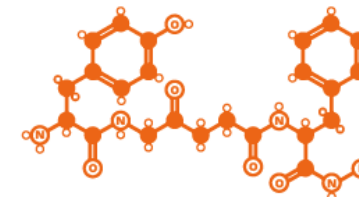
Memory neurotransmitter



Most common brain neurotransmitter. Involved in learning & memory, regulates development & creation of nerve contacts.

ENDORPHINS

Euphoria neurotransmitters



Released during exercise, excitement, & sex, producing well-being & euphoria, reducing pain. Biologically active section shown.



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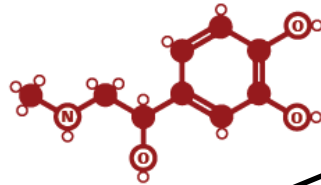


THE STRUCTURES OF NEUROTRANSMITTERS

STRUCTURE KEY: ● Carbon atom ○ Hydrogen atom ⊙ Oxygen atom ⊙ Nitrogen atom ⊙ Rest of molecule

ADRENALINE

Fight or flight neurotransmitter



Produced in stressful or exciting situations. Increases heart rate & blood flow, leading to a physical boost & heightened awareness.

NORADRENALINE

Concentration neurotransmitter



Involved in thought, learning, & memory. Activates muscle action in the body. Also associated with attention and awakening.

ACETYLCHOLINE

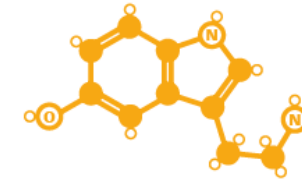
Most common neurotransmitter



Most common brain neurotransmitter. Involved in learning & memory, regulates development & creation of nerve contacts.

SEROTONIN

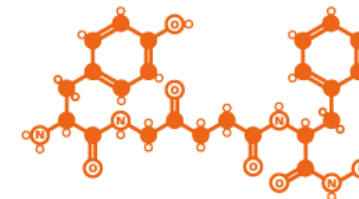
Mood neurotransmitter



Contributes to well-being & happiness; helps sleep cycle & digestive system regulation. Affected by exercise & light exposure.

ENDORPHINS

Euphoria neurotransmitters



Released during exercise, excitement, & sex, producing well-being & euphoria, reducing pain. Biologically active section shown.

GABA

Calming neurotransmitter



Calms firing nerves in CNS. High levels improve focus; low levels cause anxiety. Also contributes to motor control & vision.

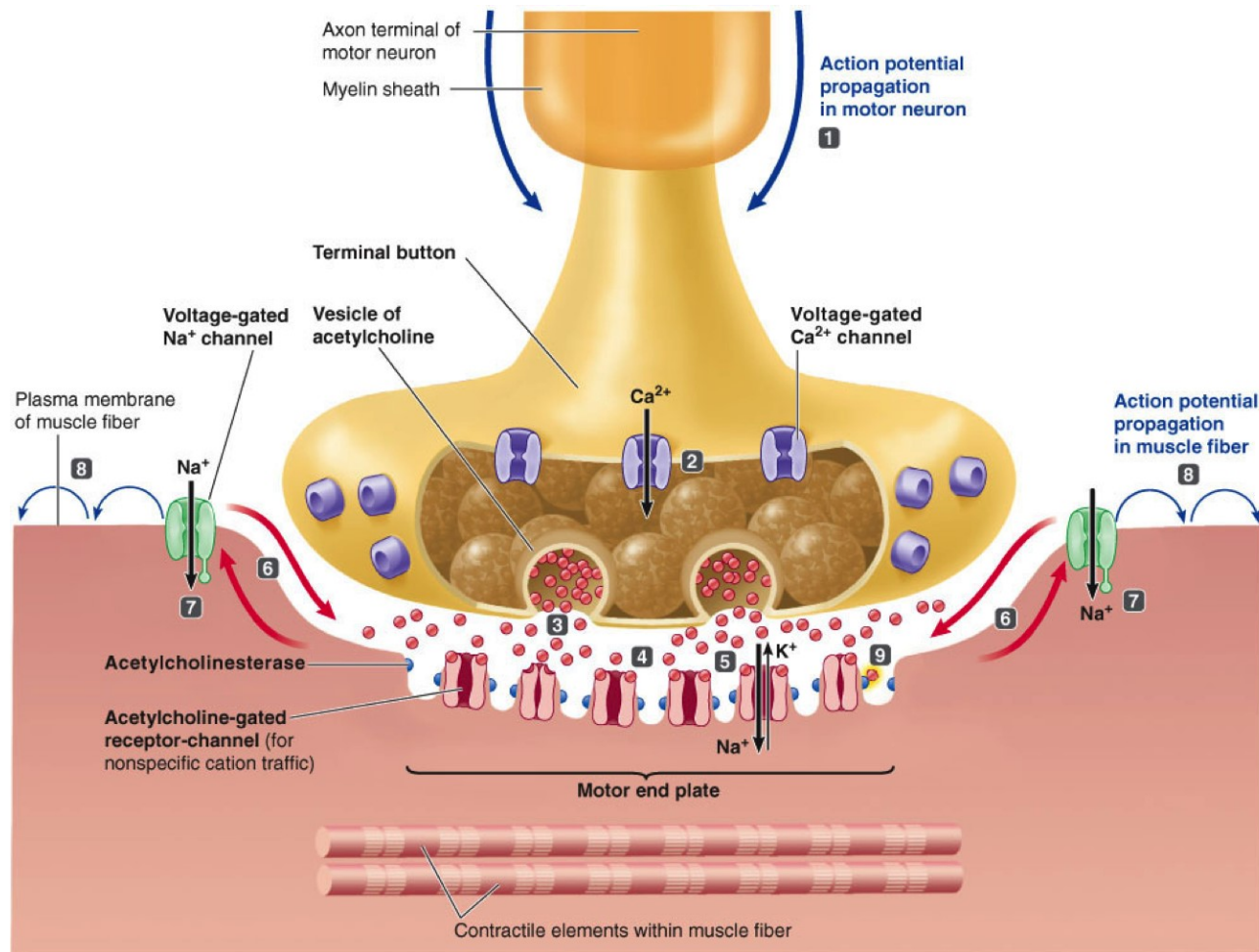
Excitační
(kyselina glutamová, acetylcholin)
X
Inhibiční
(GABA)



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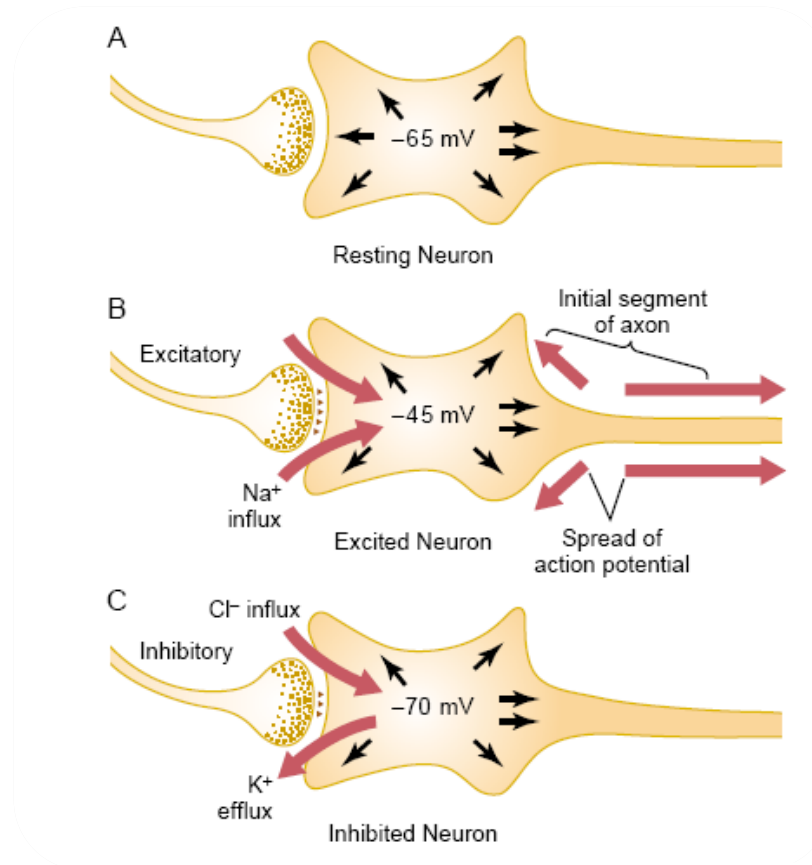


Neuromuskulární spojení



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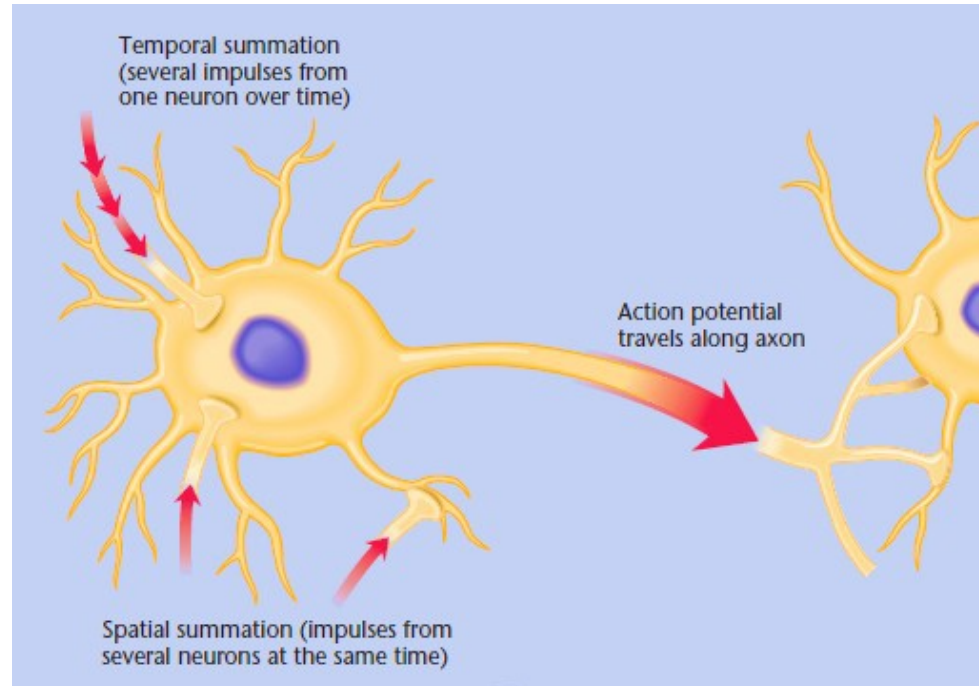
Excitační/inhibiční postsynaptický potenciál



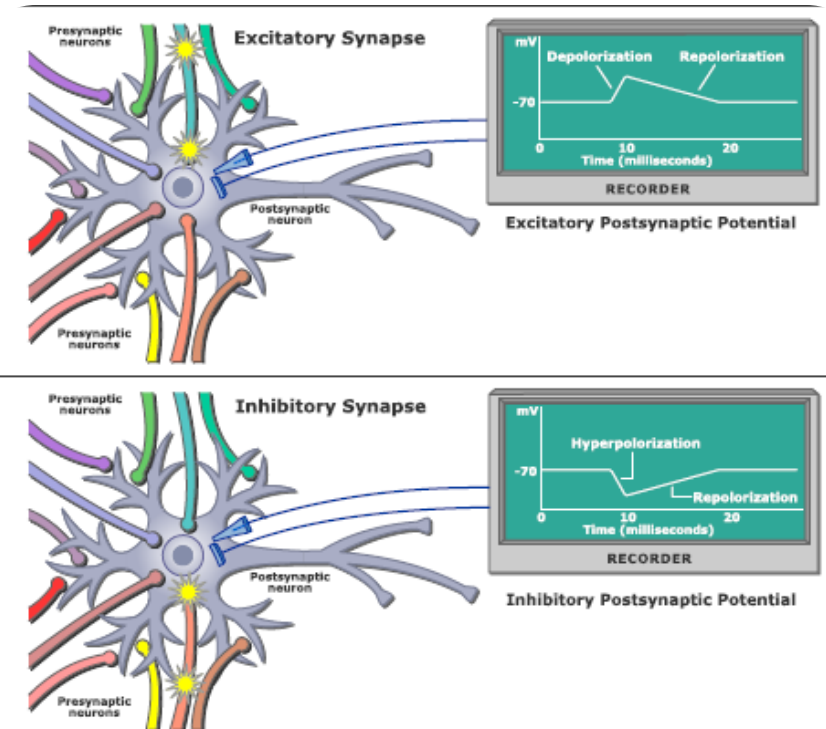
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Sumace signálu

- Časová
- Prostorová

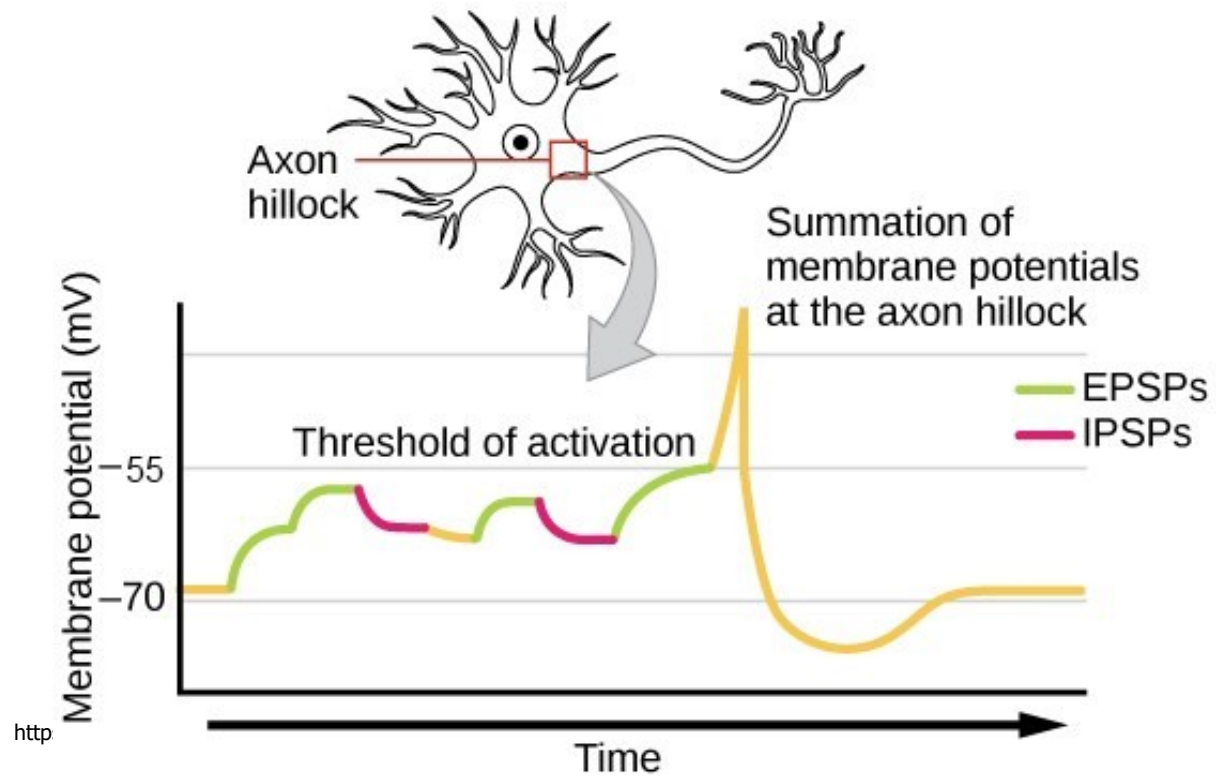


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Sumace signálu



http

<http://www.geon.us/Memory/images/Summation.jpg>

Konvergence signálu

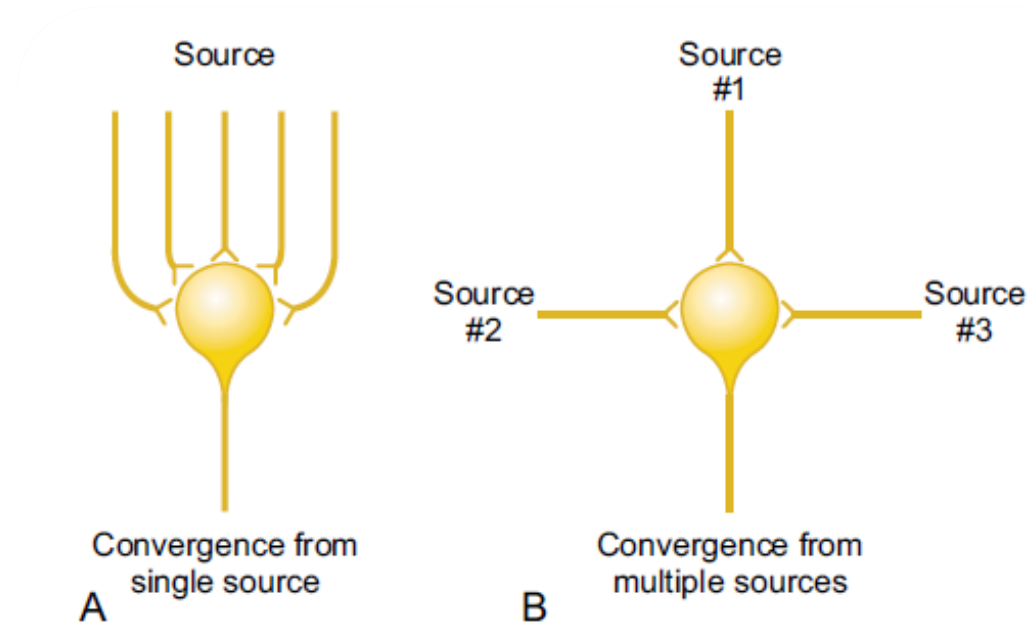


Figure 46-12

“Convergence” of multiple input fibers onto a single neuron. *A*, Multiple input fibers from a single source. *B*, Input fibers from multiple separate sources.

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Konvergence signálu

Průměrný počet synapsí
na neuron u primátů

- ✓ Primární zrakový
kortex (area17)
– cca. 4 000
- ✓ Primární motorický
kortex (area4)
– cca. 60 000

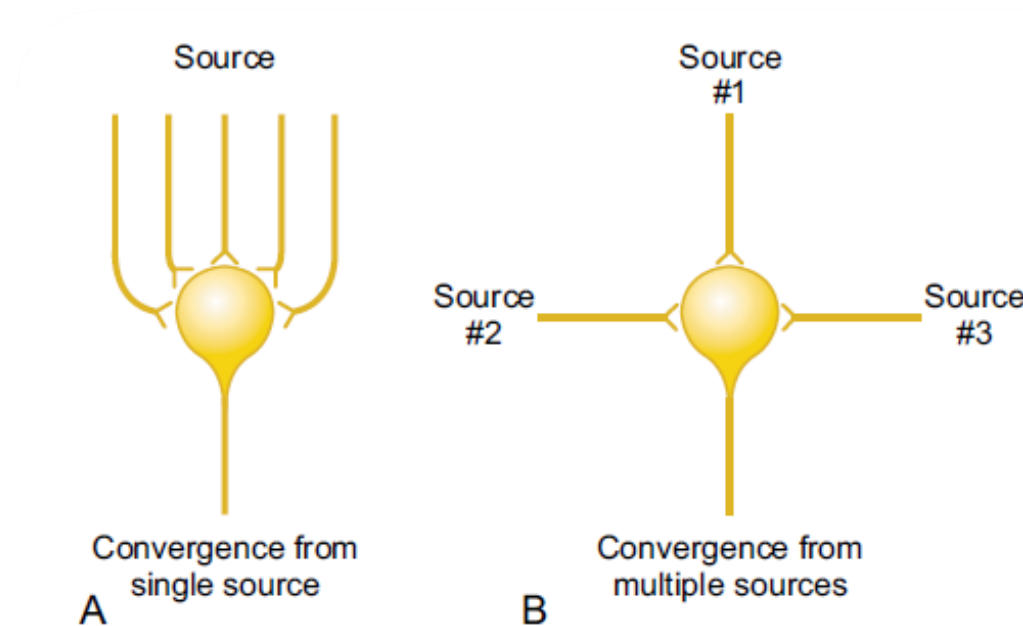


Figure 46-12

“Convergence” of multiple input fibers onto a single neuron. *A*, Multiple input fibers from a single source. *B*, Input fibers from multiple separate sources.

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Divergence signálu

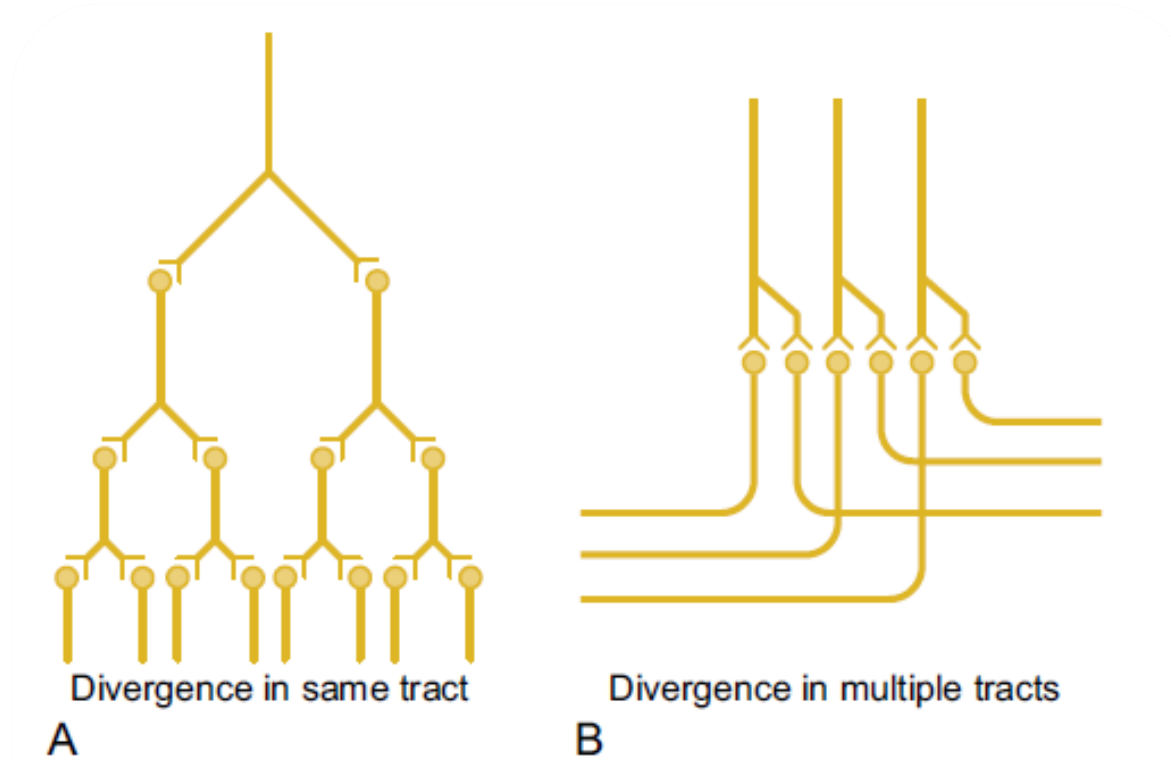
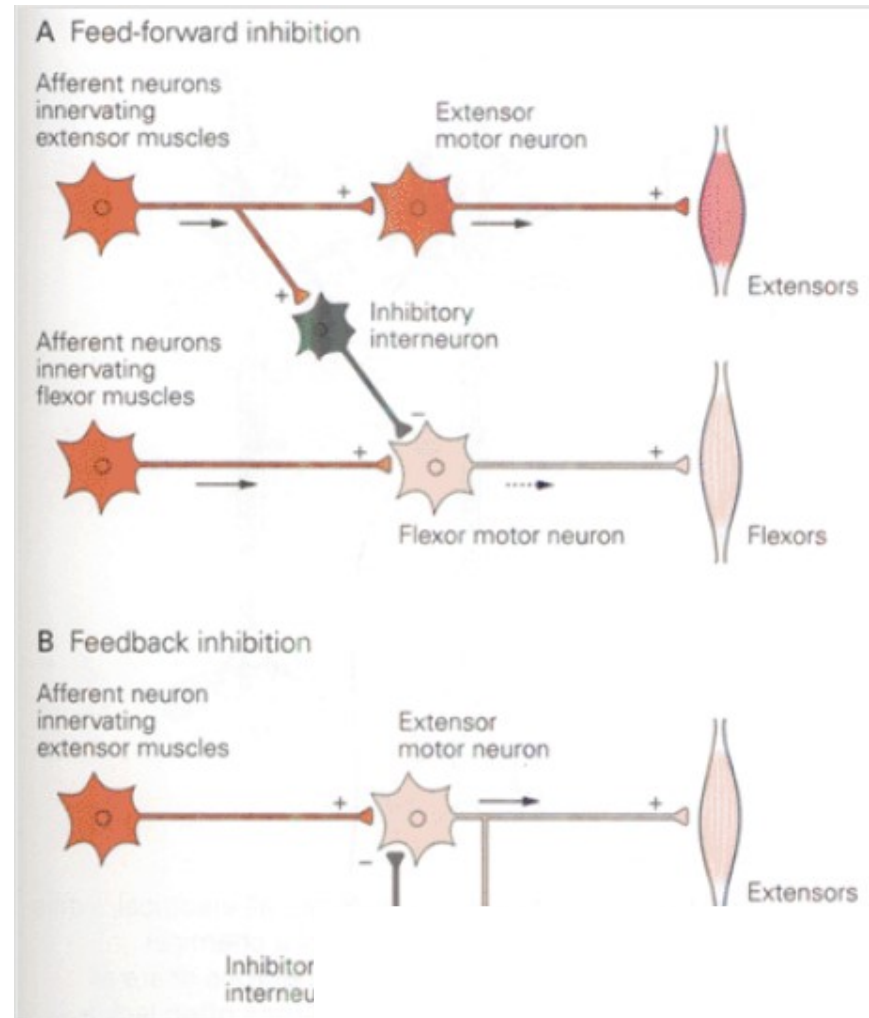


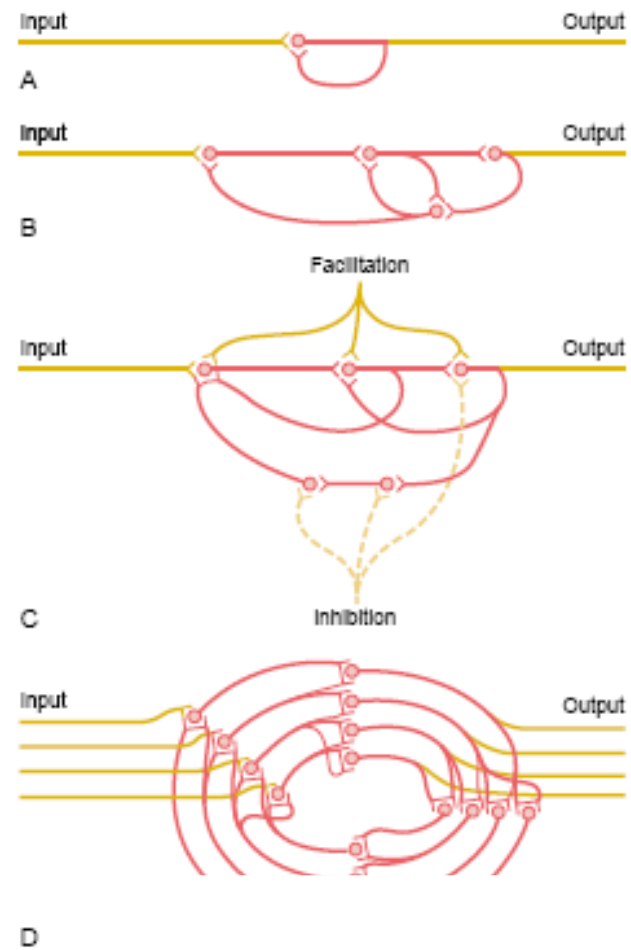
Figure 46-11

“Divergence” in neuronal pathways. *A*, Divergence within a pathway to cause “amplification” of the signal. *B*, Divergence into multiple tracts to transmit the signal to separate areas.

Networking



Networking



Neurotransmise

vs.

Neuromodulace

- Přenos informace

- Regulace aktivity NS

Neurotransmise

vs.

Neuromodulace

- Přenos informace
- Specifická

- Regulace aktivity NS
- Difúzní (volume transmission)

Neurotransmise

vs.

Neuromodulace

- Přenos informace
- Specifická
- Receptory
 - Iontové kanály

- Regulace aktivity NS
- Difúzní (volume transmission)
- Receptory
 - Pomalé G-proteiny

Neurotransmise

vs.

Neuromodulace

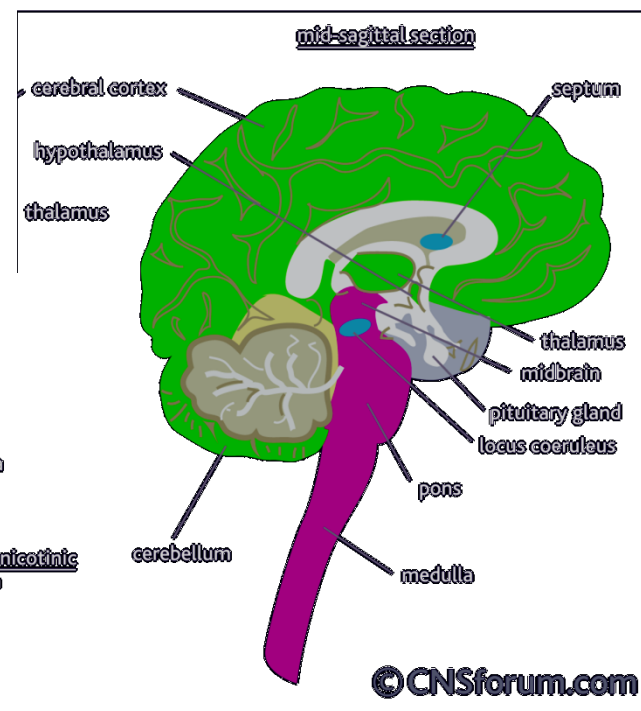
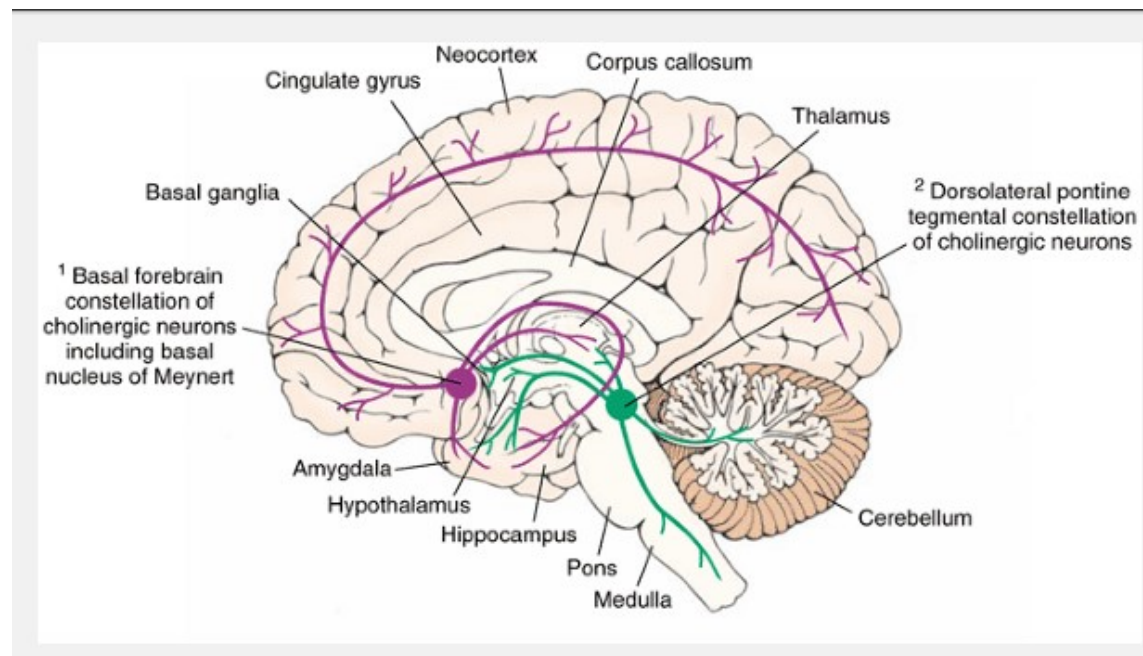
- Přenos informace
- Specifická
- Receptory
 - Iontové kanály
- Krátký účinek
 - Změny membránového potenciálu

- Regulace aktivity NS
- Difúzní (volume transmission)
- Receptory
 - Pomalé G-proteiny
- Déletrvající účinek
 - Změny vlastností synapsí atd.

Acetylcholin

- Nucleus basalis (Meynerti) a řada dalších jader
- Nikotinové receptory
- Muskarinové receptory

- Regulace spánku/bdění
- Kognitivní funkce
- Chování
- Emoce

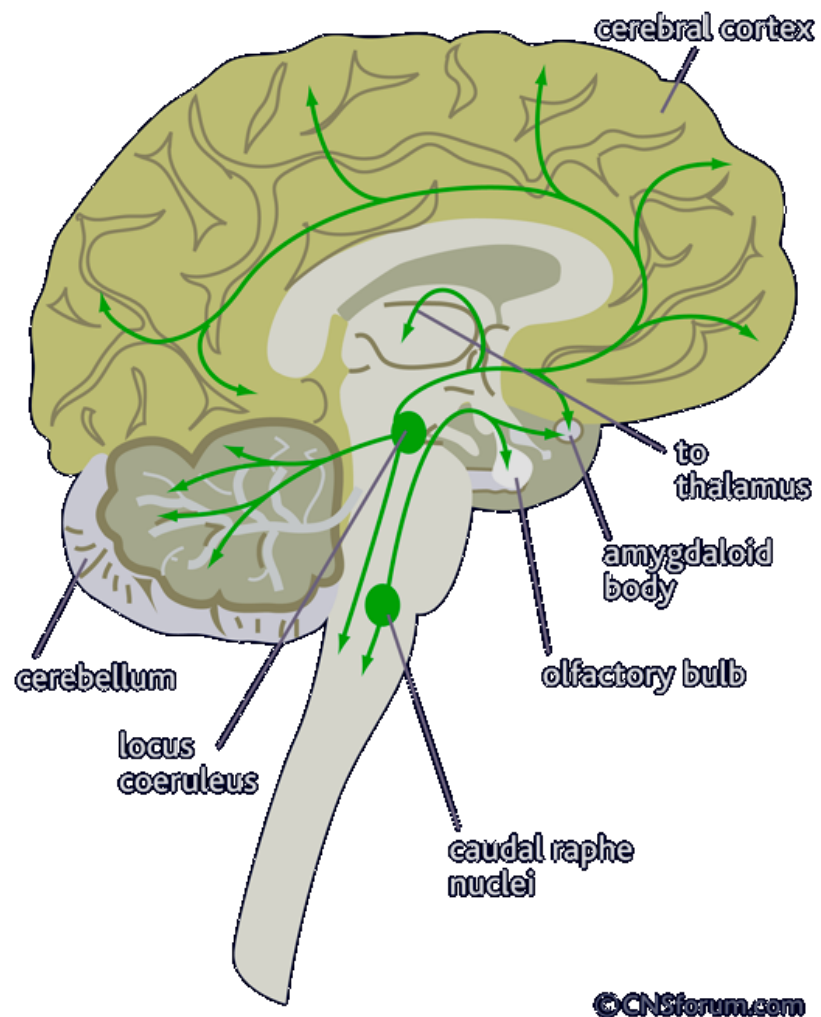


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Noradrenalin

- Locus coeruleus
- Nuclei raphe caudalis

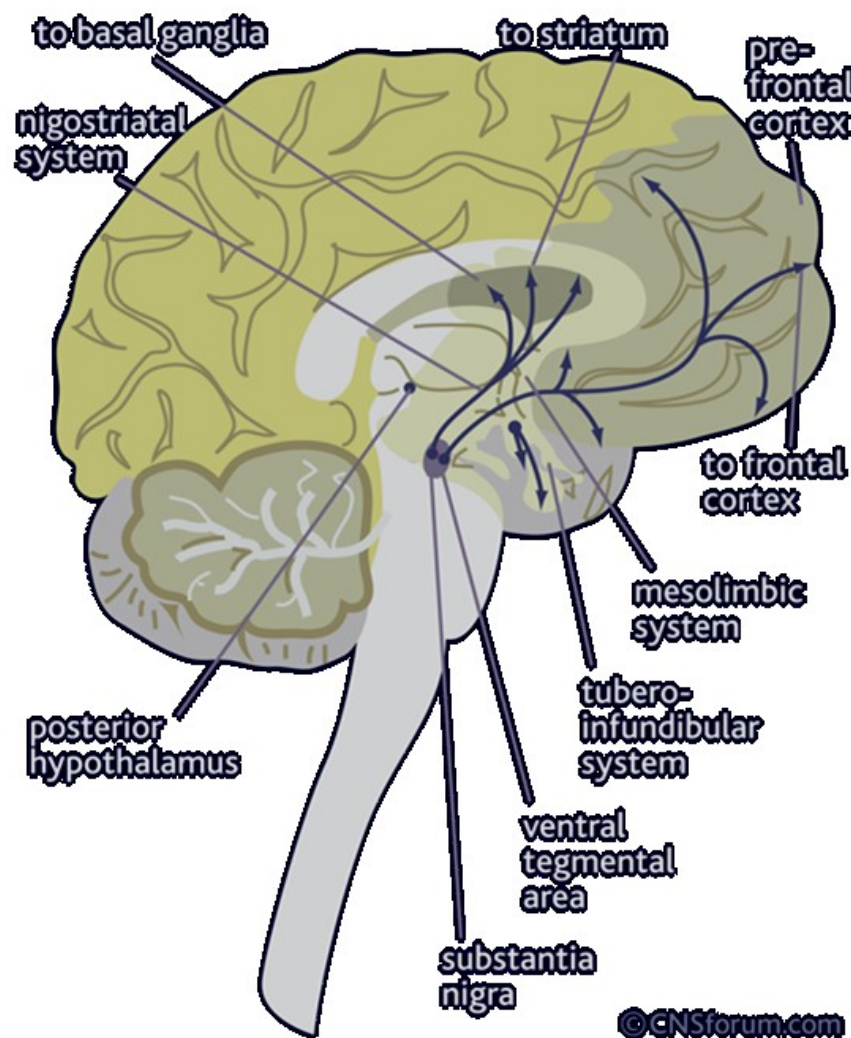
- Bdělost
- Responzivita na nečekané podmínky
- Paměť
- Učení



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Dopamin

- Nigrostriální systém
 - Pohyb
 - Senzorika
- Ventrosegmentno-meso-
limbicko-frontální systém
 - Systém odměny
 - Kognitivní funkce
 - Emoční chování
- Tubero-infundibulární systém
 - Regulace hypotalamo-
hypofyzárního systému
- D1 receptory – stimulační
- D2 receptory - inhibiční

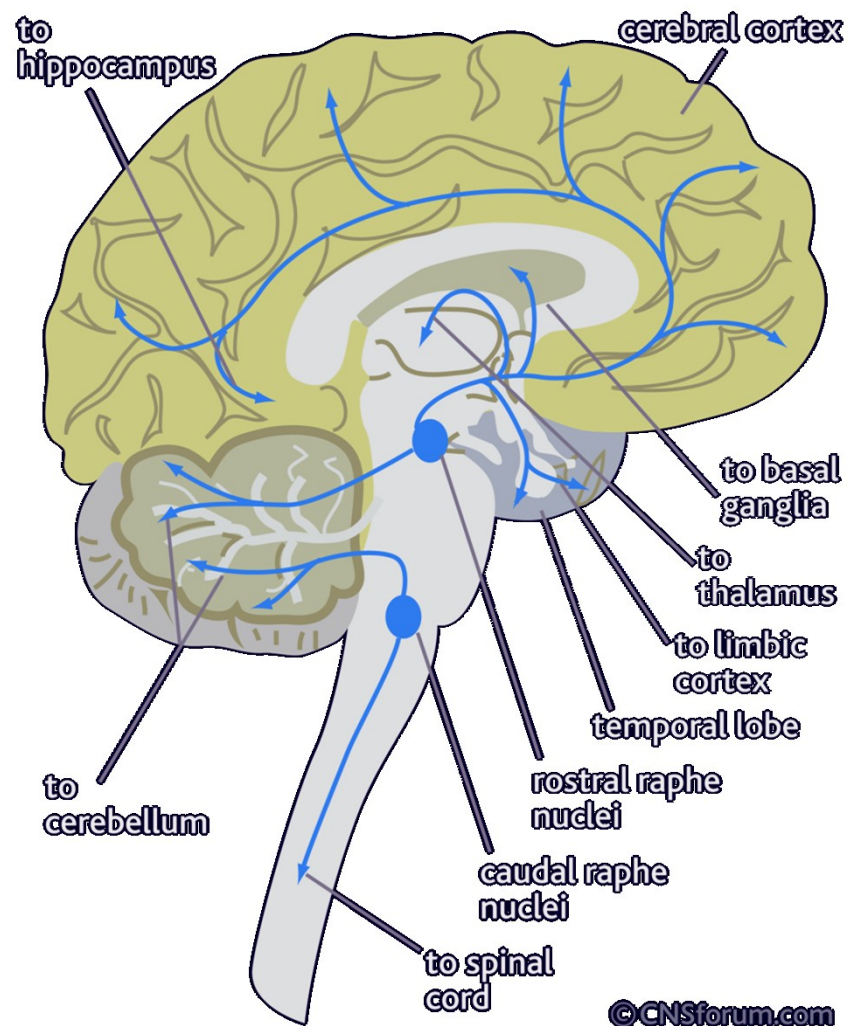


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Serotonin

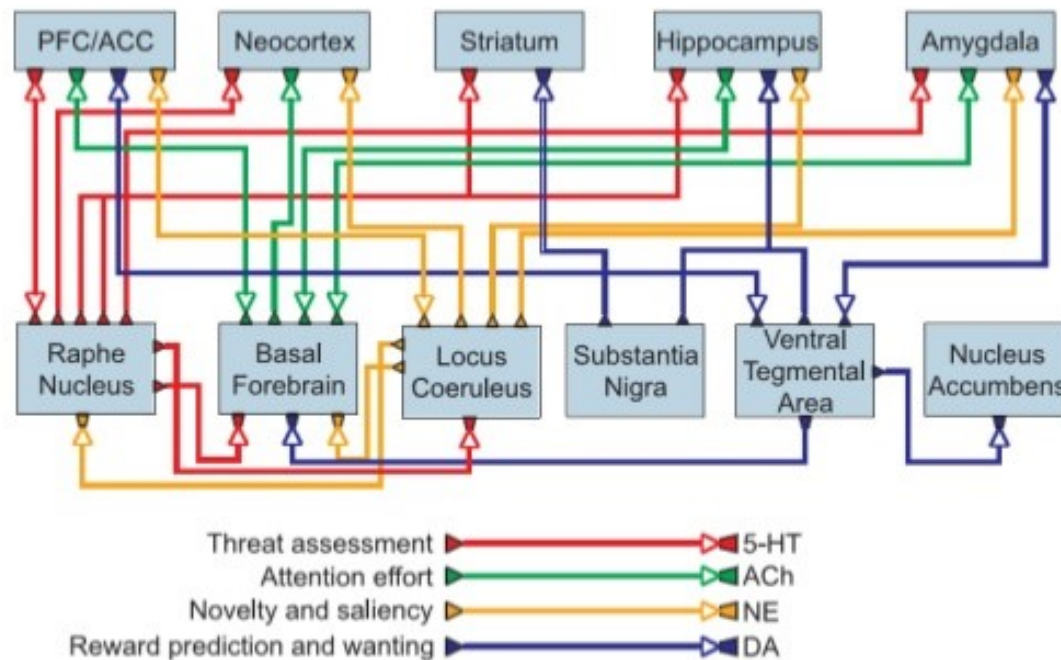
- Nuclei raphe rostralis
- Nuclei raphe caudalis

- Úzkost/relaxace
- Impulzivnost
- Spánek



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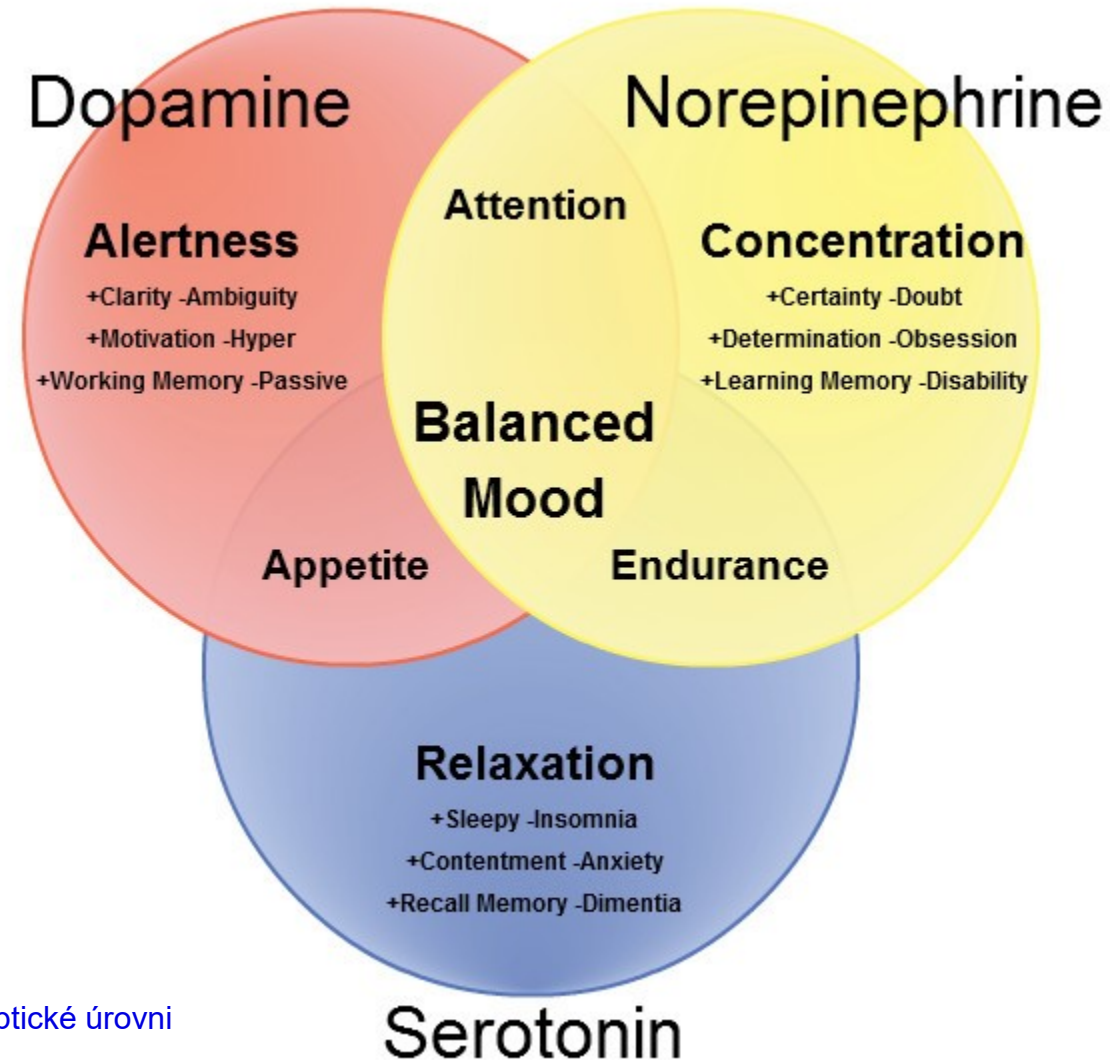
Neuromodulační systémy



Jeffrey L. Krichmar, Adaptive Behavior 2008; 16; 385

<http://image.slidesharecdn.com/neuromodulationincognition-140119031056-phpapp02/95/neuromodulation-in-cognition-5-638.jpg?cb=1419657931>

Neuromodulační systémy



71. Synapse a integrace informace na synaptické úrovni, neurotransmise vs. neuromodulace

- ✓ Synapse
 - Definice
 - Elektrické vs. chemické
- ✓ Definice a základní klasifikace neurotransmiterů
- ✓ Excitační/inhibiční postsynaptické potenciály vs. Akční potenciál
 - Časová a místní sumace signálu
- ✓ Konvergence a divergence signálu
- ✓ Neurotransmise vs. neuromodulace
 - Příklady neuromodulačních systémů

M U N I

M E D