

# Obecná fyziologie smyslů

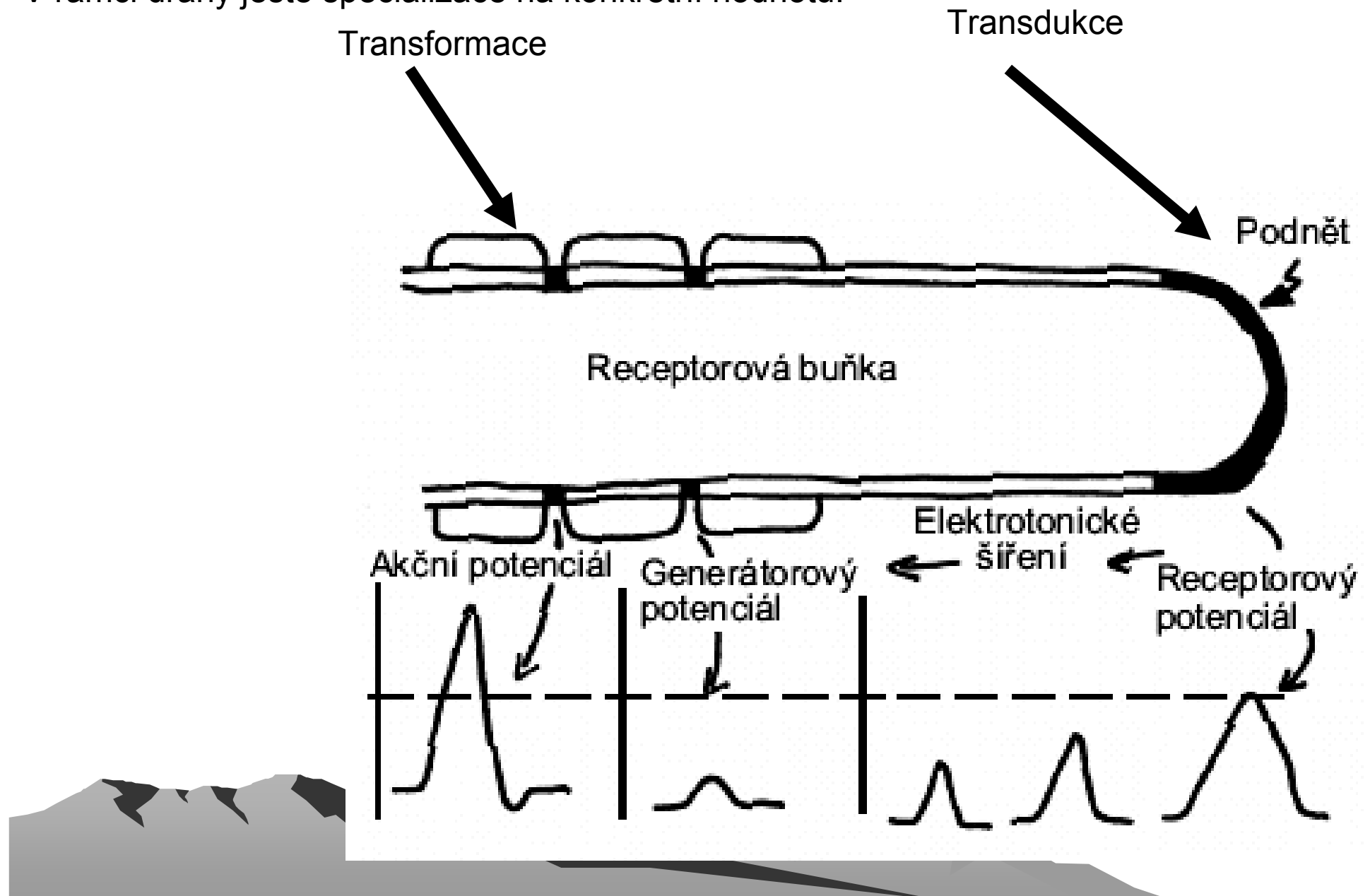
Co se děje na membránách.



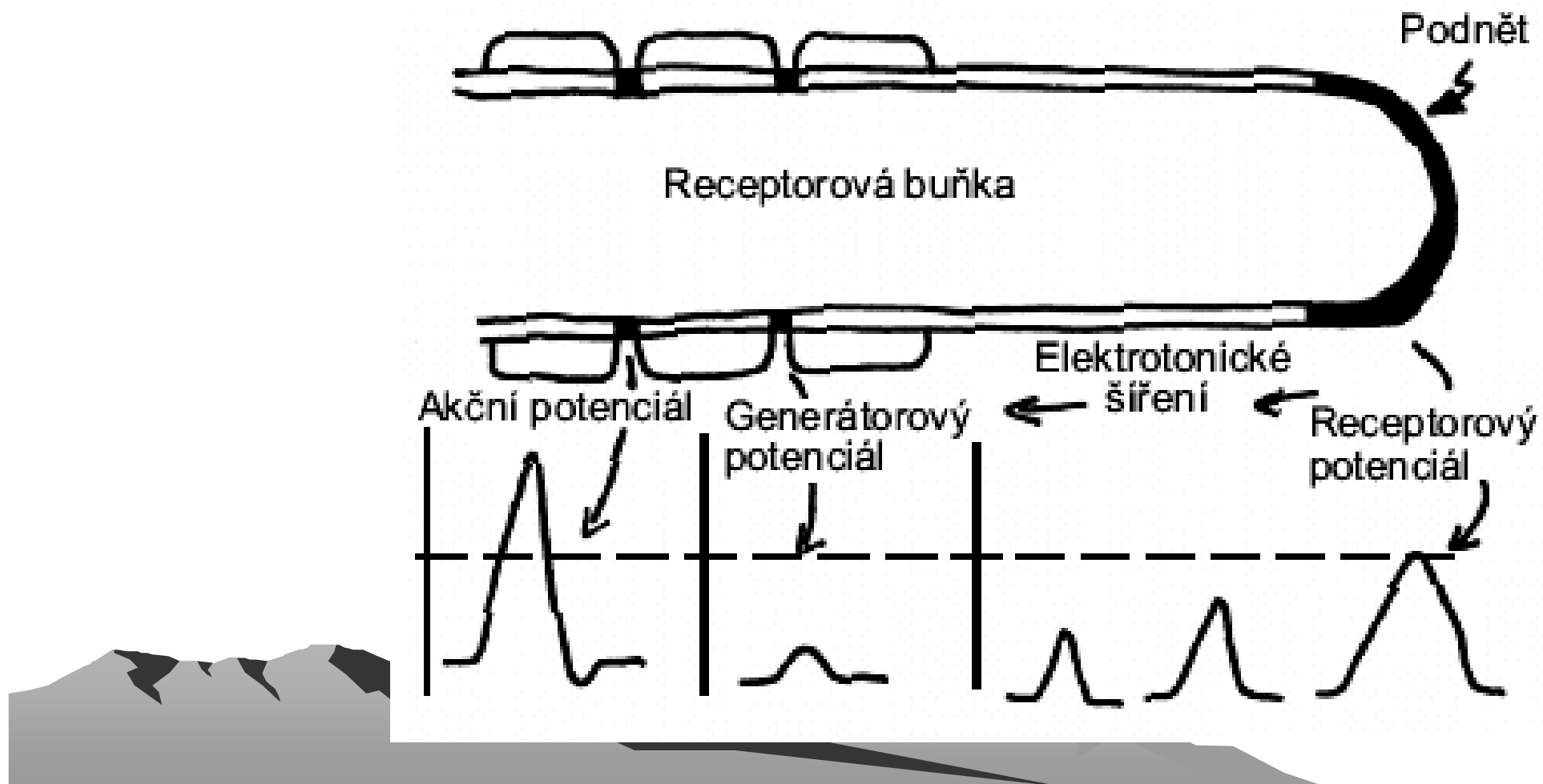
Svět smyslů – úloha mozku.

Paralelní dráhy specializované na určitou vlastnost (kvalitu).

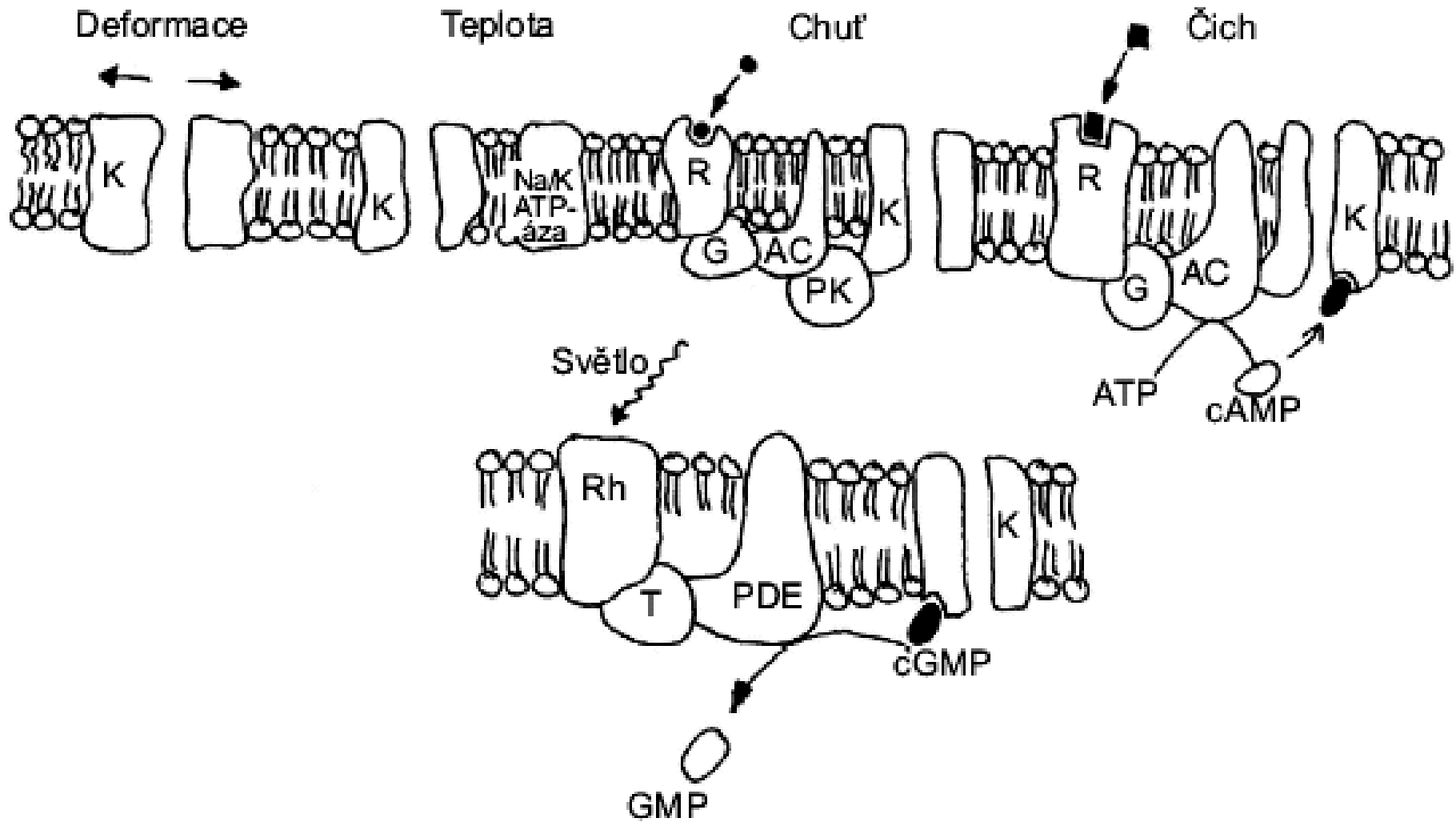
V rámci dráhy ještě specializace na konkrétní hodnotu.



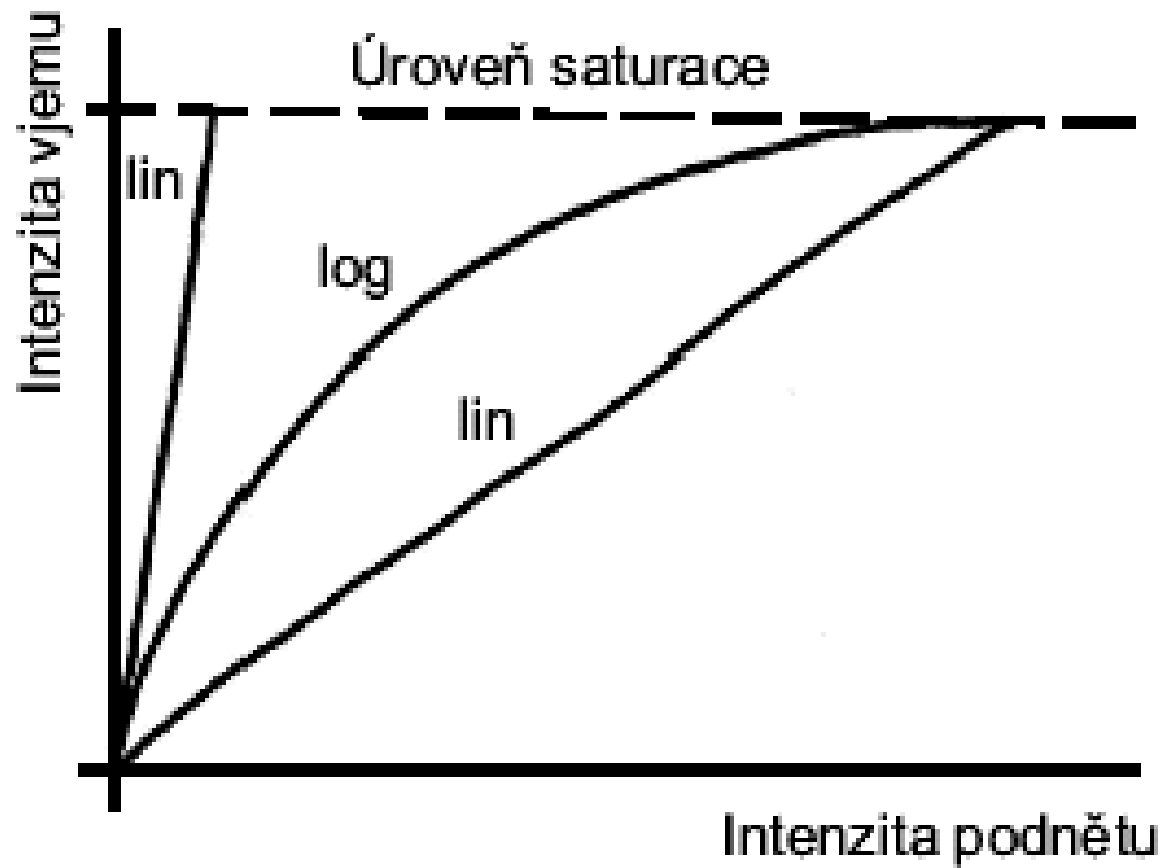
Receptorová buňka převádí energii podnětu na změnu iontové propustnosti.



Vlastnosti membrány jsou klíčem pro transdukcii.



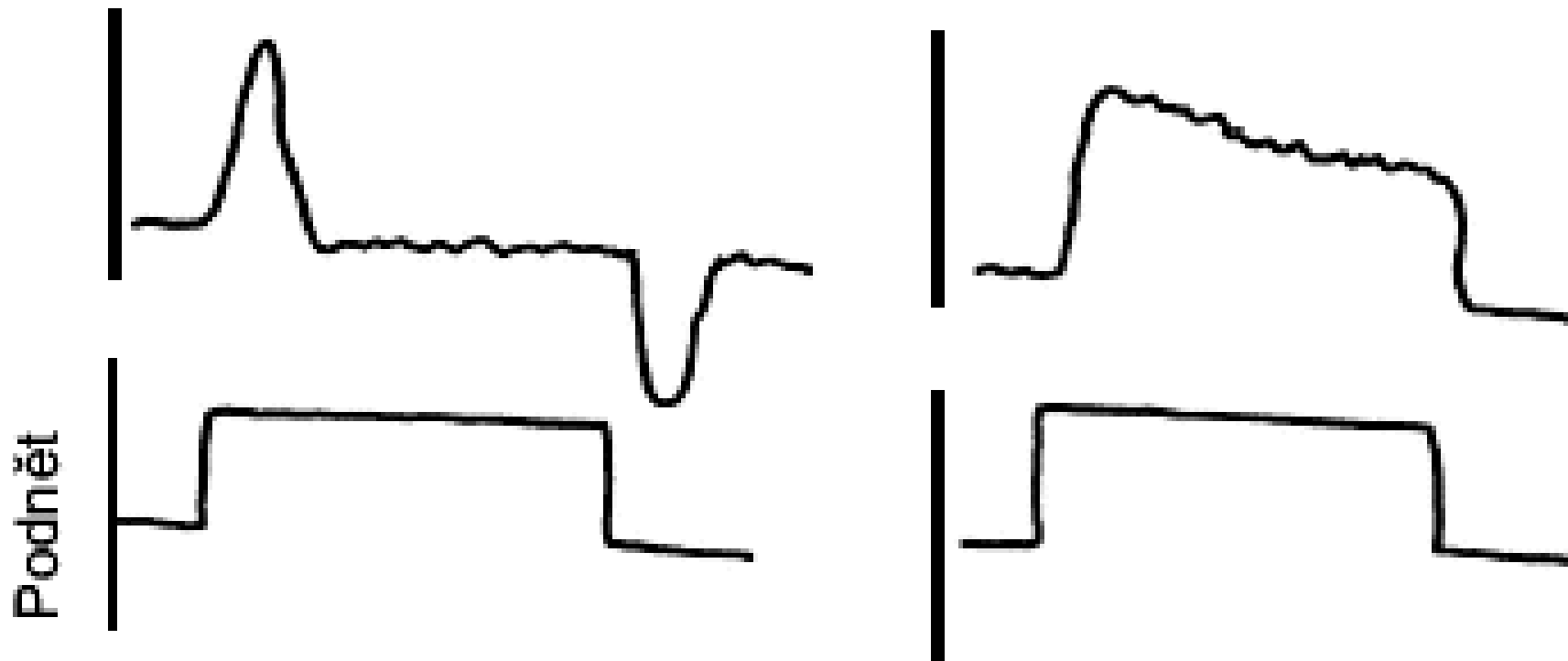
Intenzita podnětu a intenzita odpovědi.



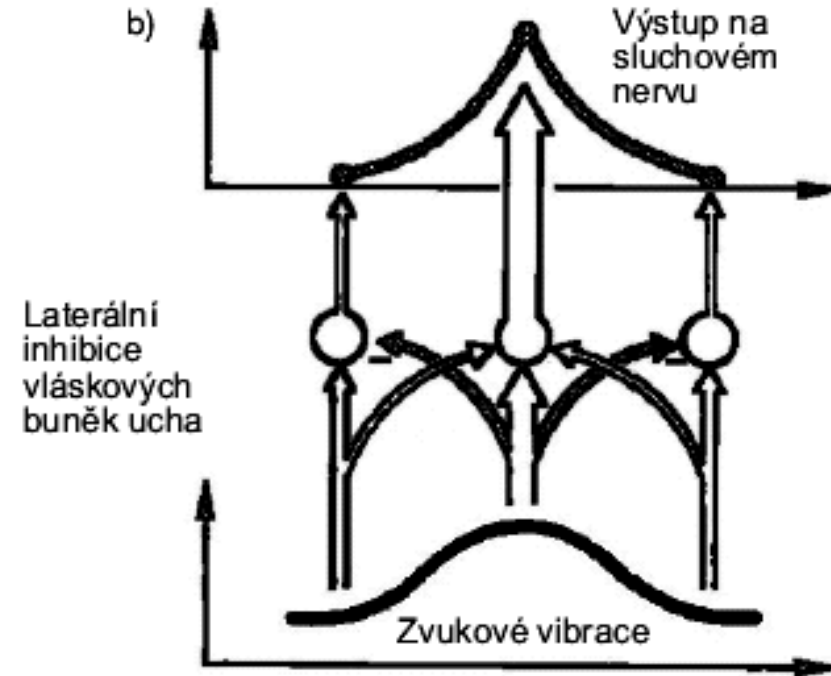
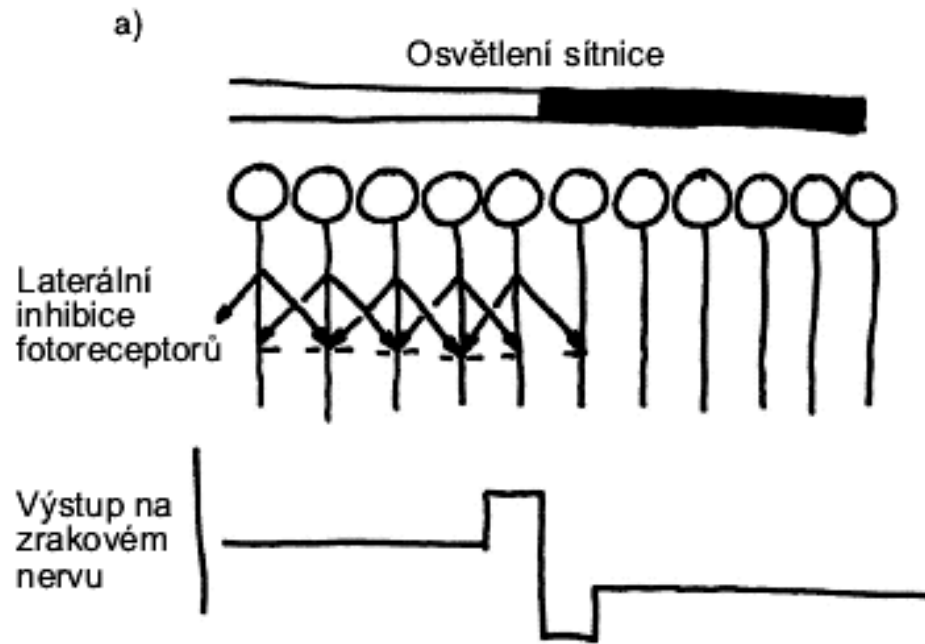
Trvání podnětu a trvání odpovědi.

Diferenční receptor

Proporcionální receptor

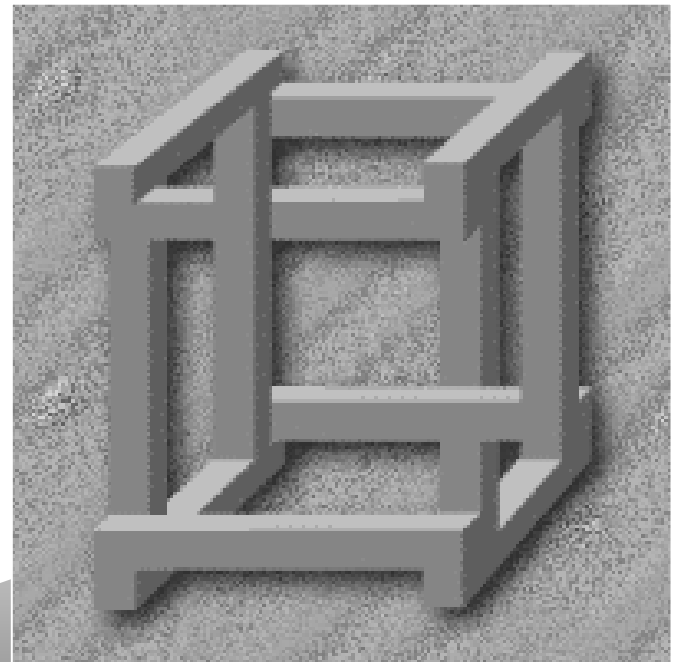


# Laterální inhibice: vyšší rozlišovací schopnost zesílení kontrastů



# Smyslové dráhy

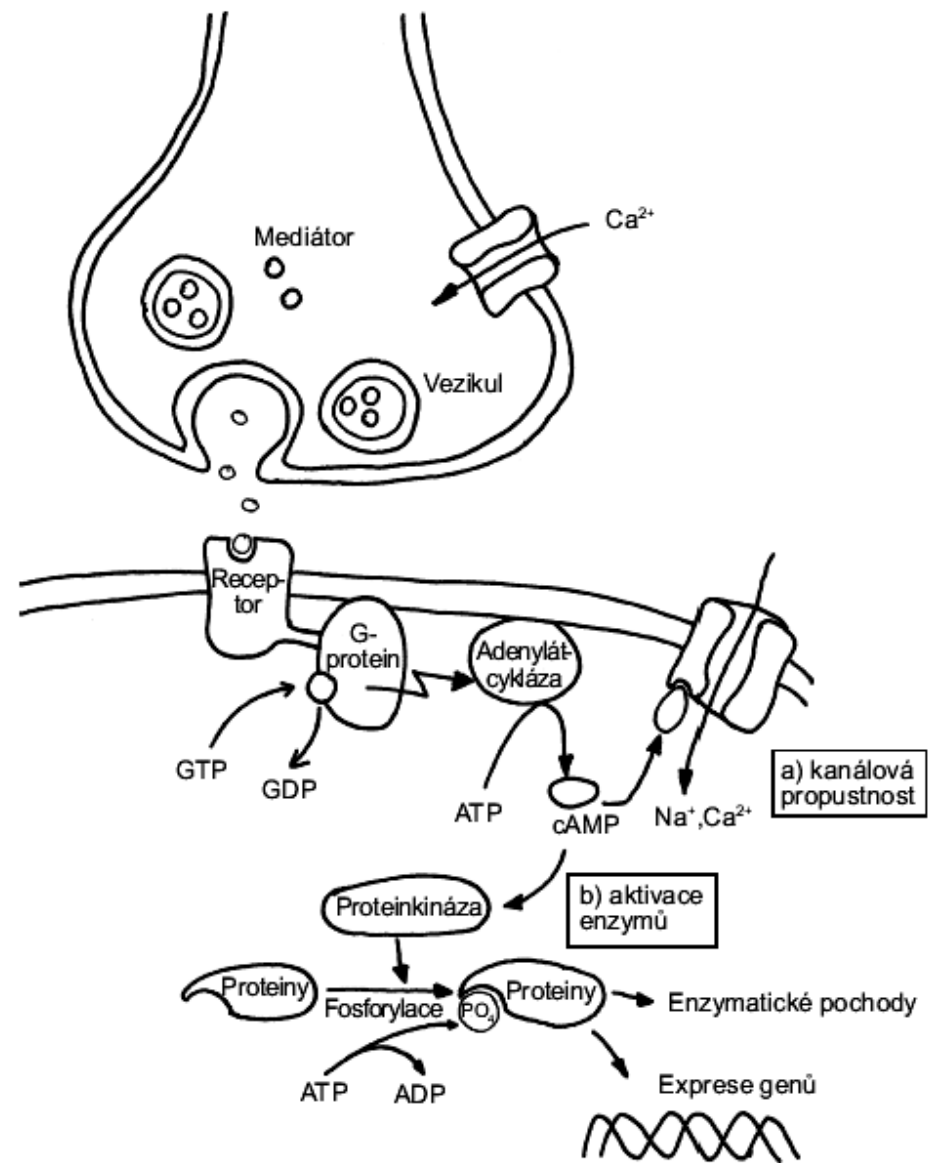
- Paralelní dráhy
- Specializace analyzátorů smyslové dráhy
- Úloha mozku integrovat do celku a interpretovat (zkušenost)



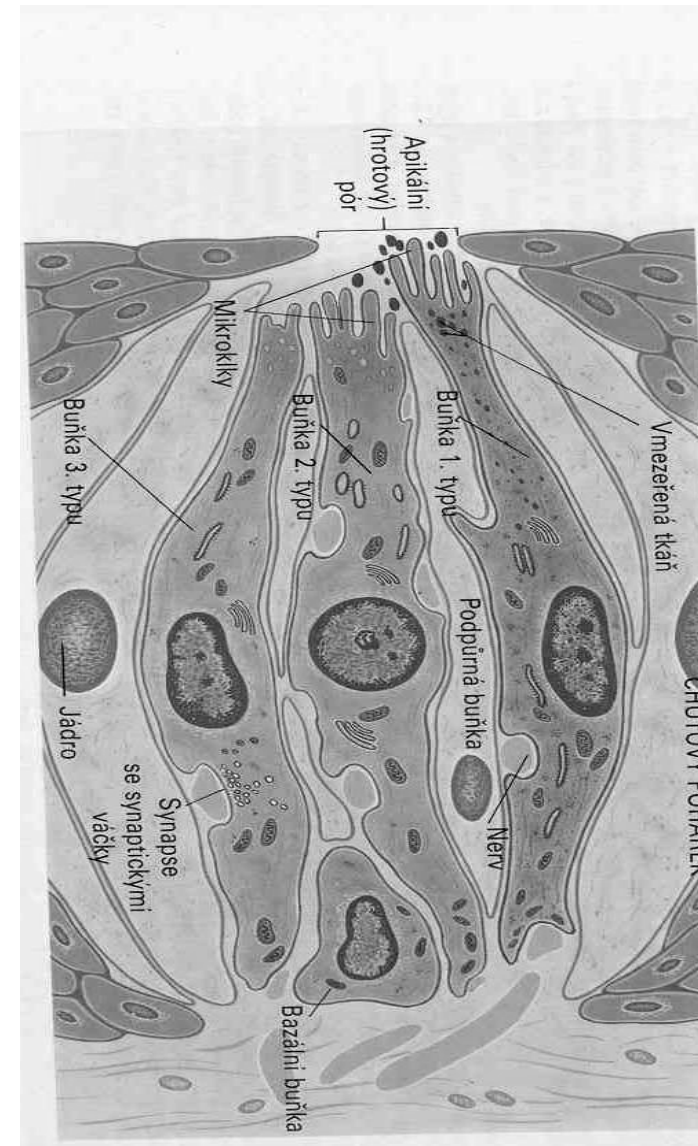
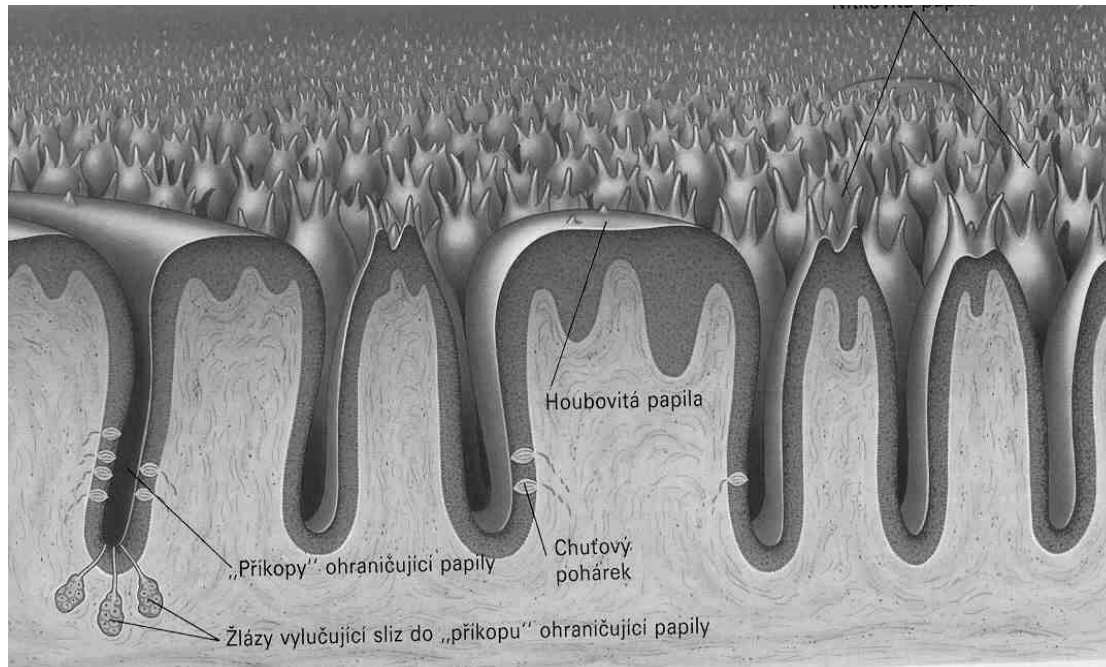


# Chemorecepce

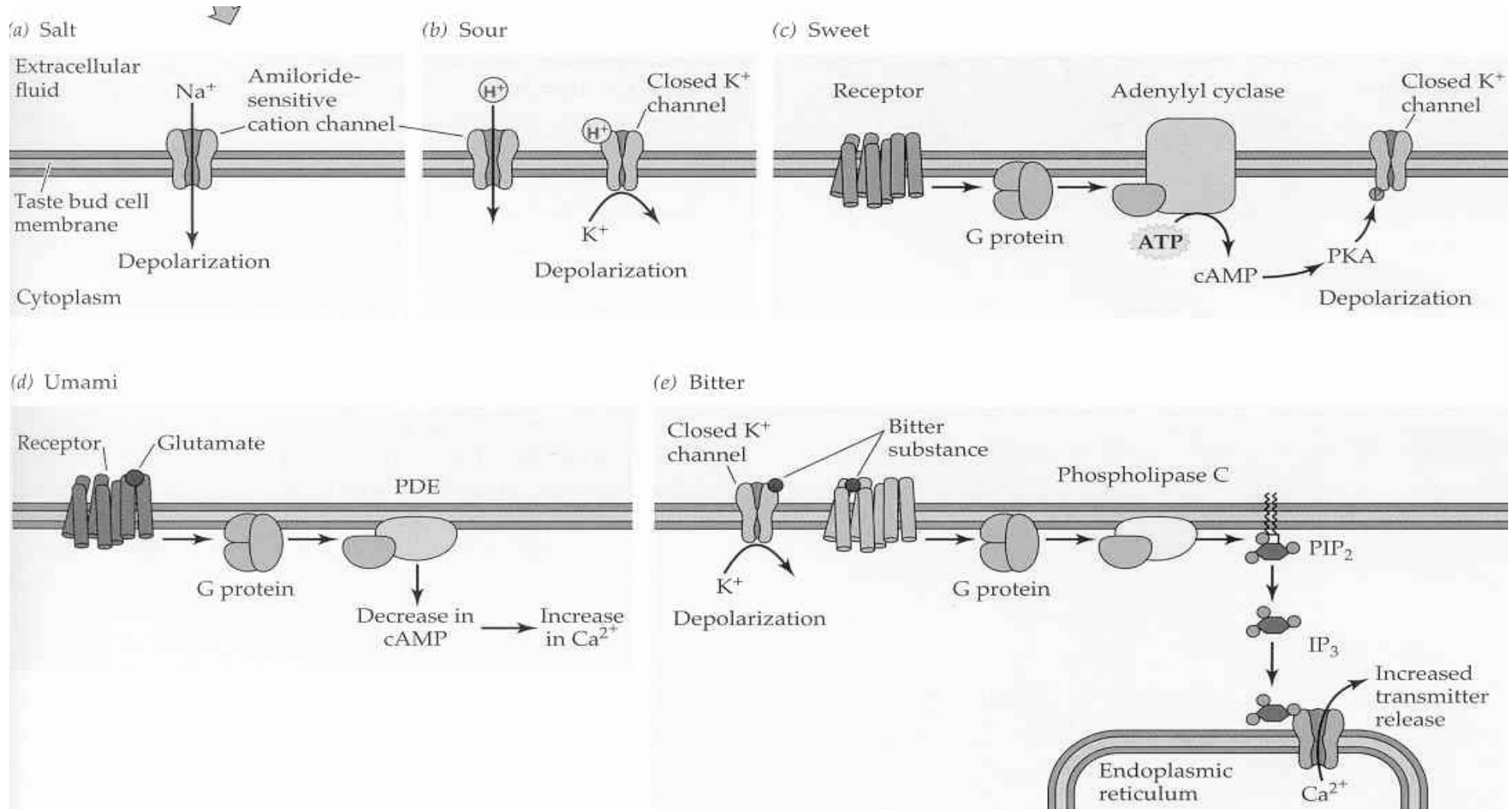
Vyzkoušené molekulární schéma  
Obecná chemorecepce buněk



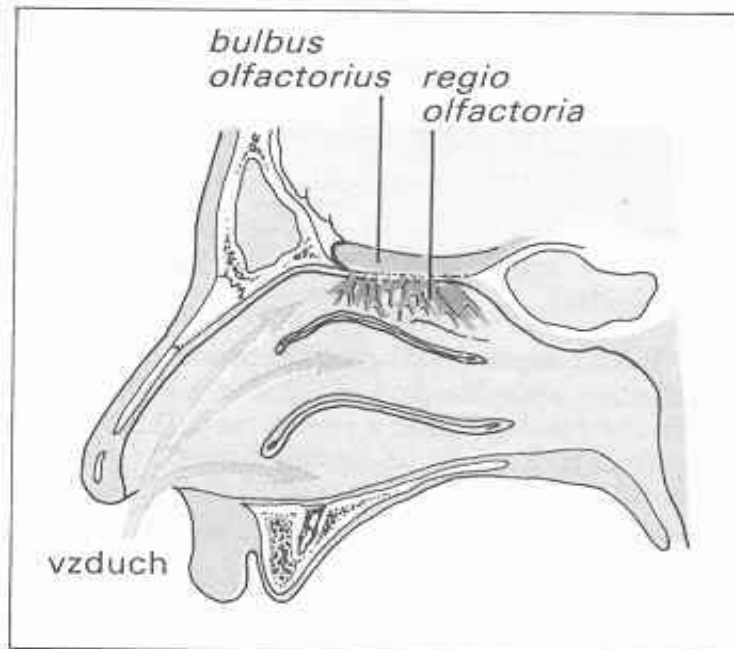
# Chuť



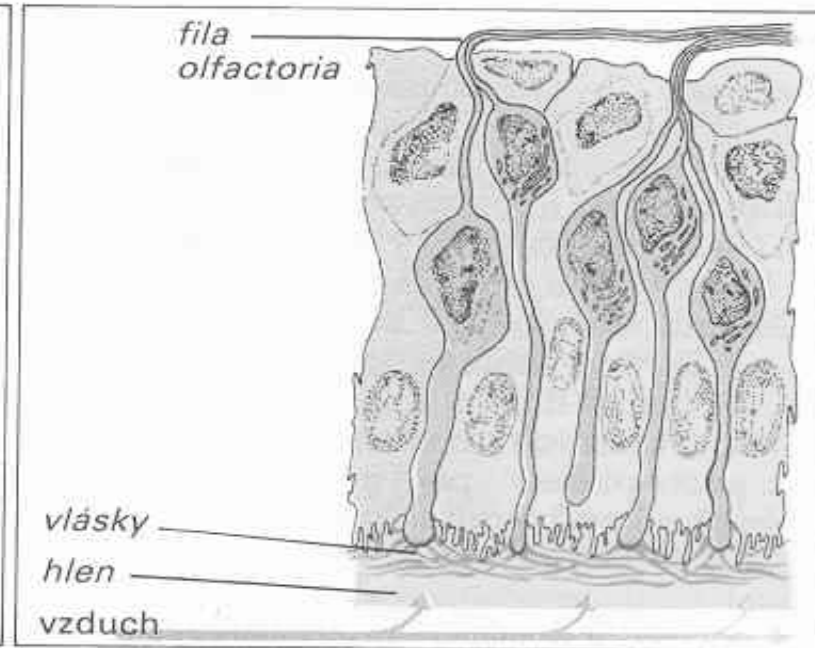
# Různě složité transdukční cesty 5 základních chutí.



# Čich

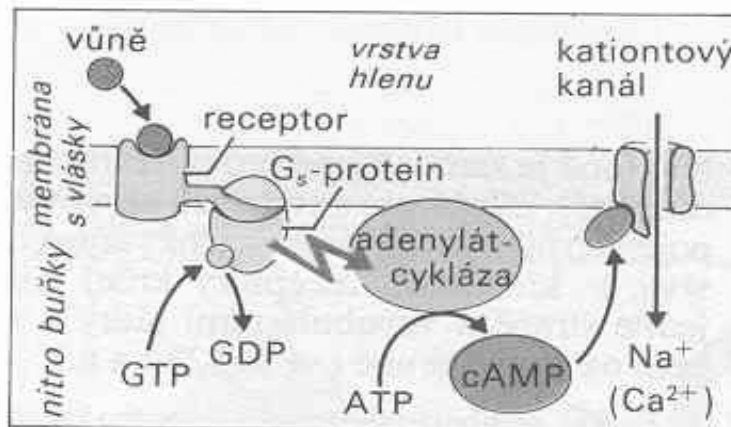


A. Nosní dutina a čichový orgán

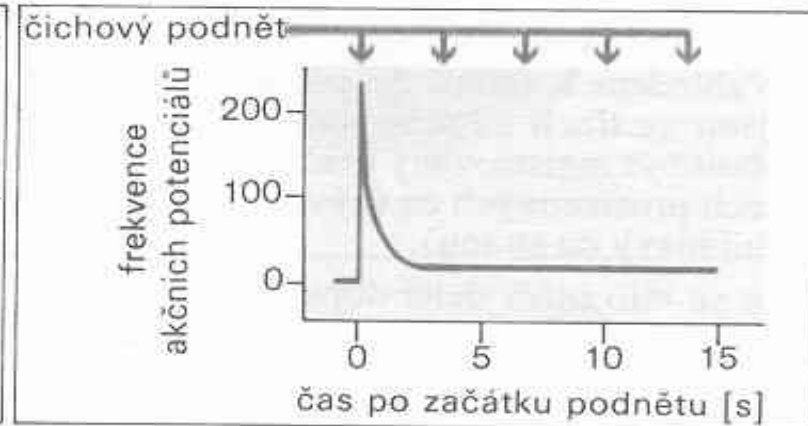


B. Čichový epitel

(podle Andrese)

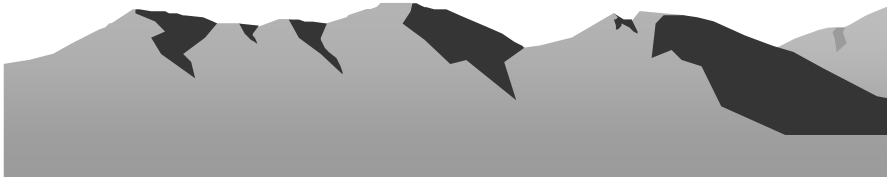
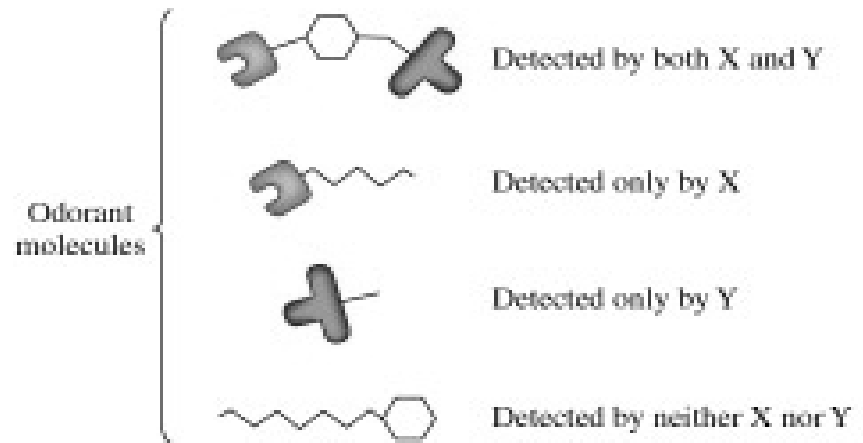
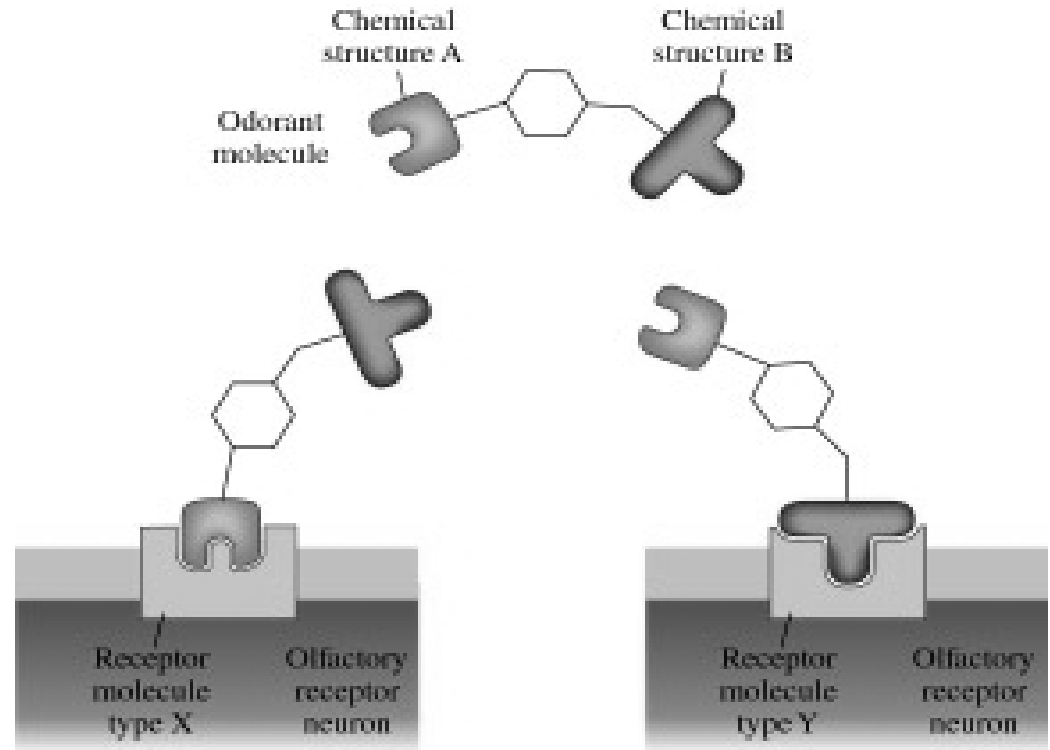


C. Transdukce čichového podnětu



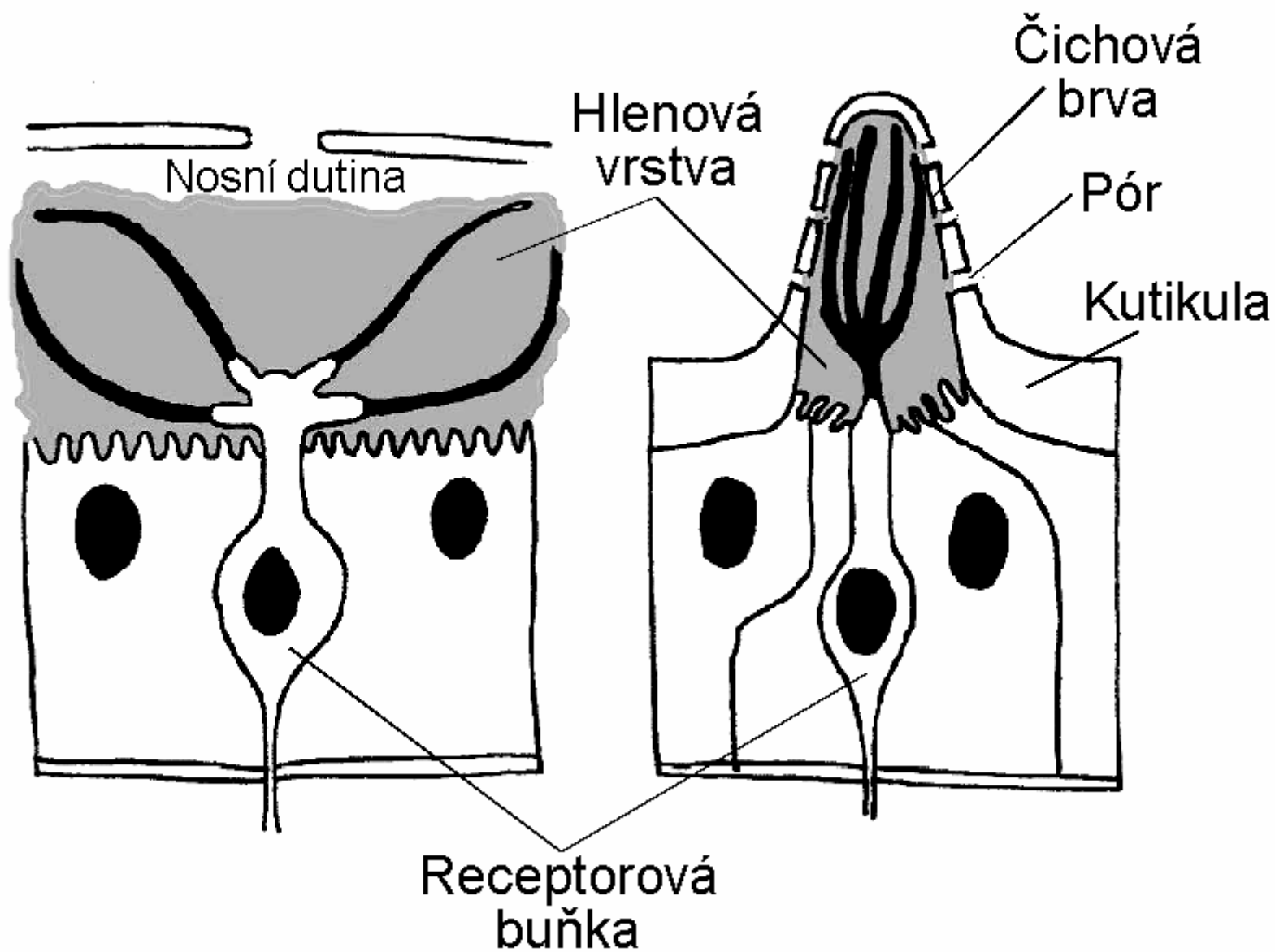
D. Adaptace čichu

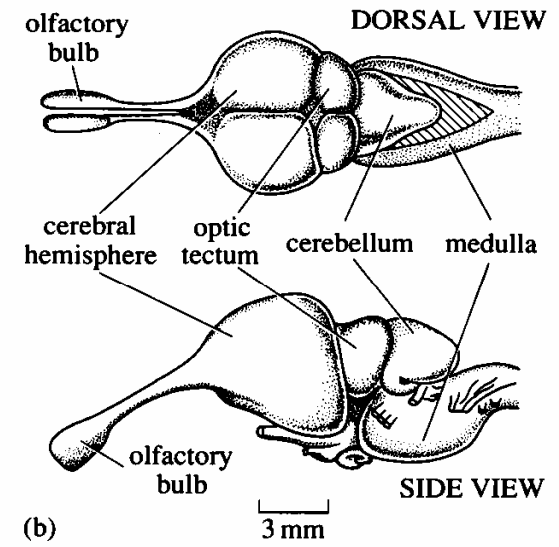
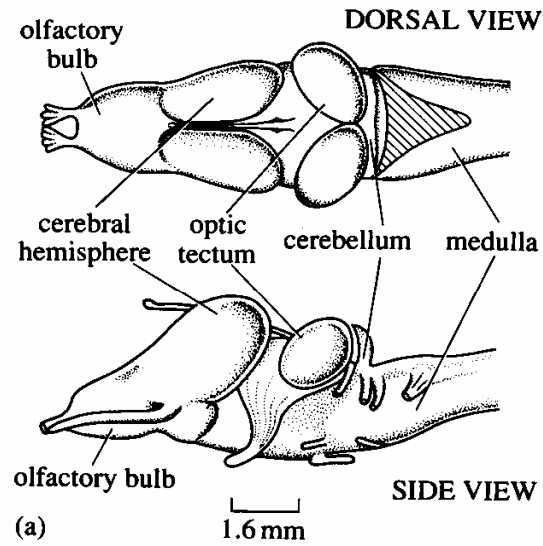
# Specifita srovnatelná s imunitní Cis/trans rozlišení



a) Savci

b) Hmyz





## Čichový lalok koncového mozku

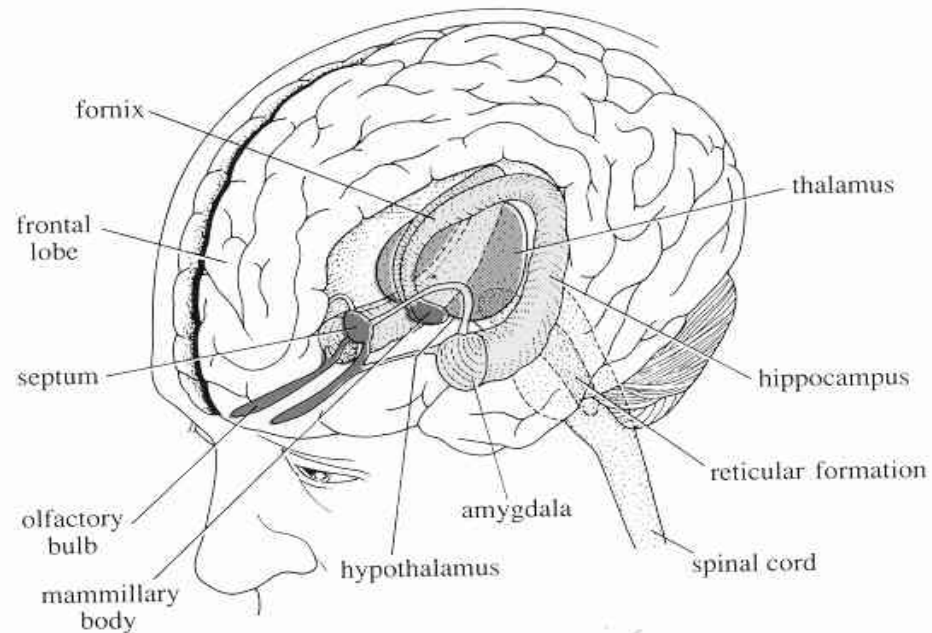
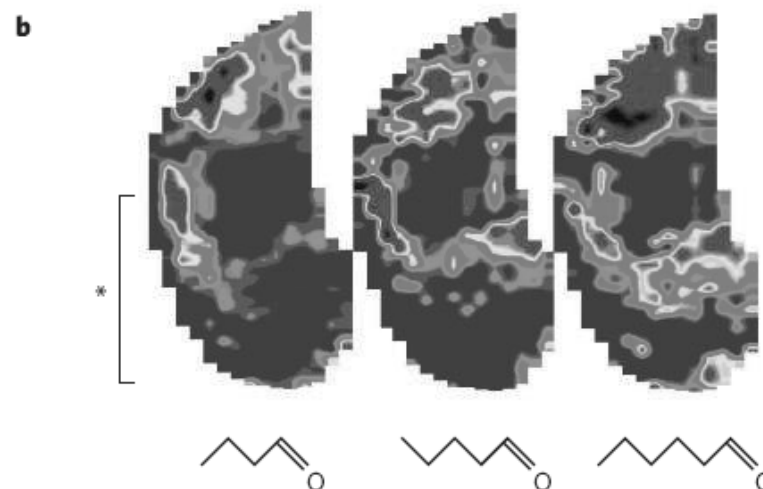
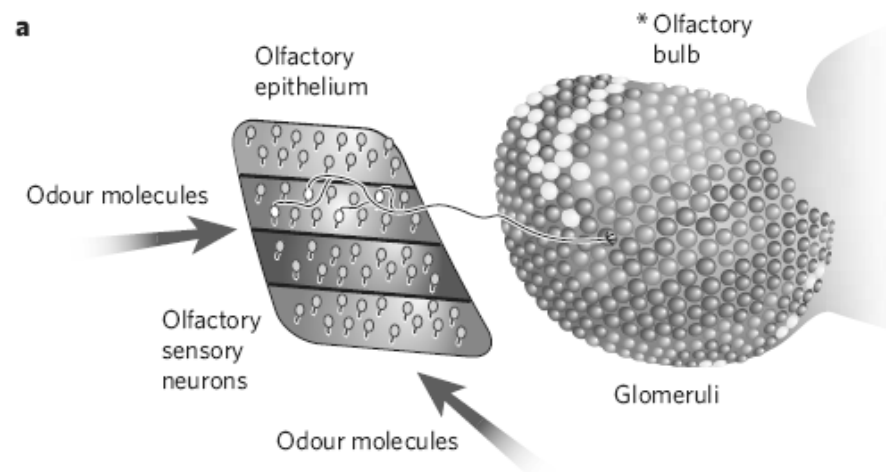
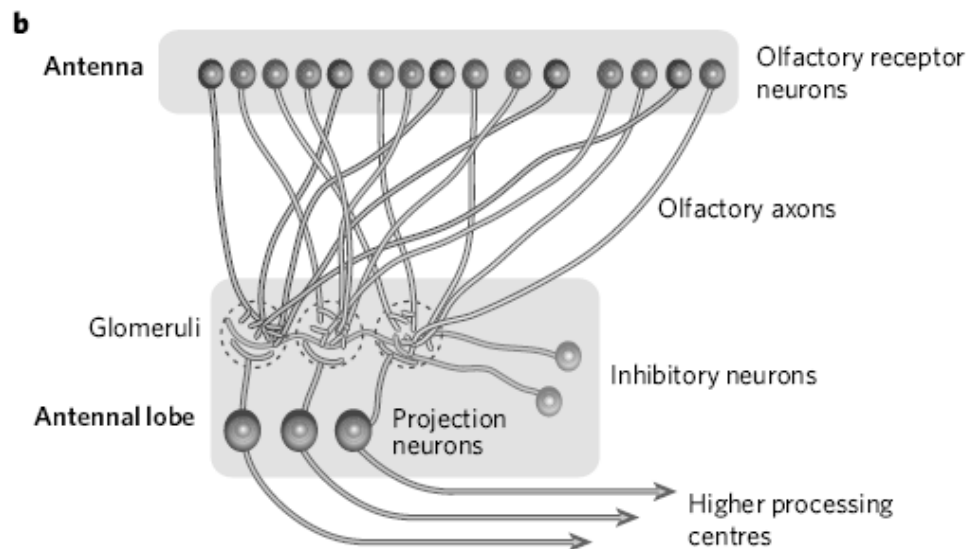


Figure 10.1 The limbic system (the main limbic system structures are shown in

Mapa vůní – vzorec aktivovaných  
Glomerulů  
Konvergence neprostorového parametru  
na prostorový



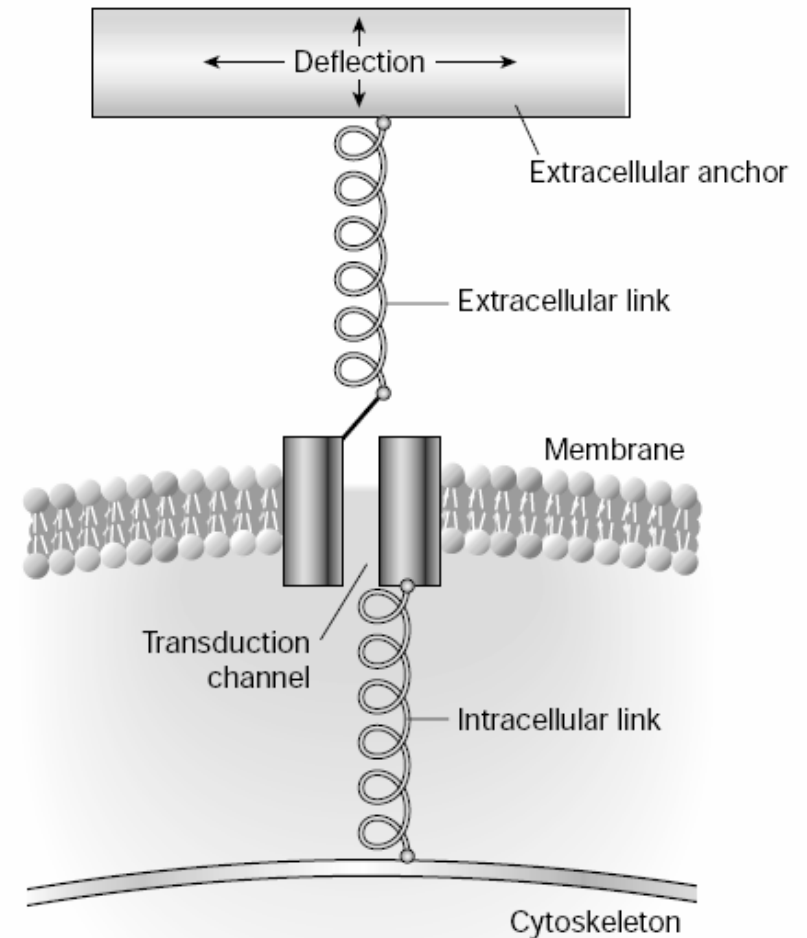
**Figure 1 | Odour images in the olfactory glomerular layer.** **a**, Diagram showing the relationship between the olfactory receptor cell sheet in the nose and the glomeruli of the olfactory bulb<sup>53</sup>. **b**, fMRI images of the different but overlapping activity patterns seen in the glomerular layer of the olfactory bulb of a mouse exposed to members of the straight-chain aldehyde series, varying from four to six carbon atoms. The lower part of the image in the left panel corresponds to the image on the medial side of the olfactory glomerular layer as shown in **a** (see asterisk). (Image in **a** adapted, with permission, from ref. 53; image in **b** adapted, with permission, from ref. 10.)



## Mechanorecepce

Bolest, dotek,  
Propriorecepce,  
Zvuk, gravitace,  
Pohyb,  
Vlhkost ?  
Magnetické pole?

Jednotné molekulární schéma



**Figure 1** General features of mechanosensory transduction. A transduction channel is anchored by intracellular and extracellular anchors to the cytoskeleton and to an extracellular structure to which forces are applied. The transduction channel responds to tension in the system, which is increased by net displacements between intracellular and extracellular structures.

# Somatosensorické vnímání

## Mechanoreceptors

Pacinian corpuscle  
Touch; vibration  
Rapid adaptation  
Myelinated axon

Meissner corpuscle  
Touch; vibration  
Rapid adaptation  
Myelinated axon

Ruffini corpuscle  
Touch; pressure  
Slow adaptation  
Myelinated axon

Merkel disk  
Touch; pressure  
Slow adaptation  
Myelinated axon

Hair follicle receptor  
Hair displacement  
Rapid adaptation  
Myelinated axon

## Thermoreceptors

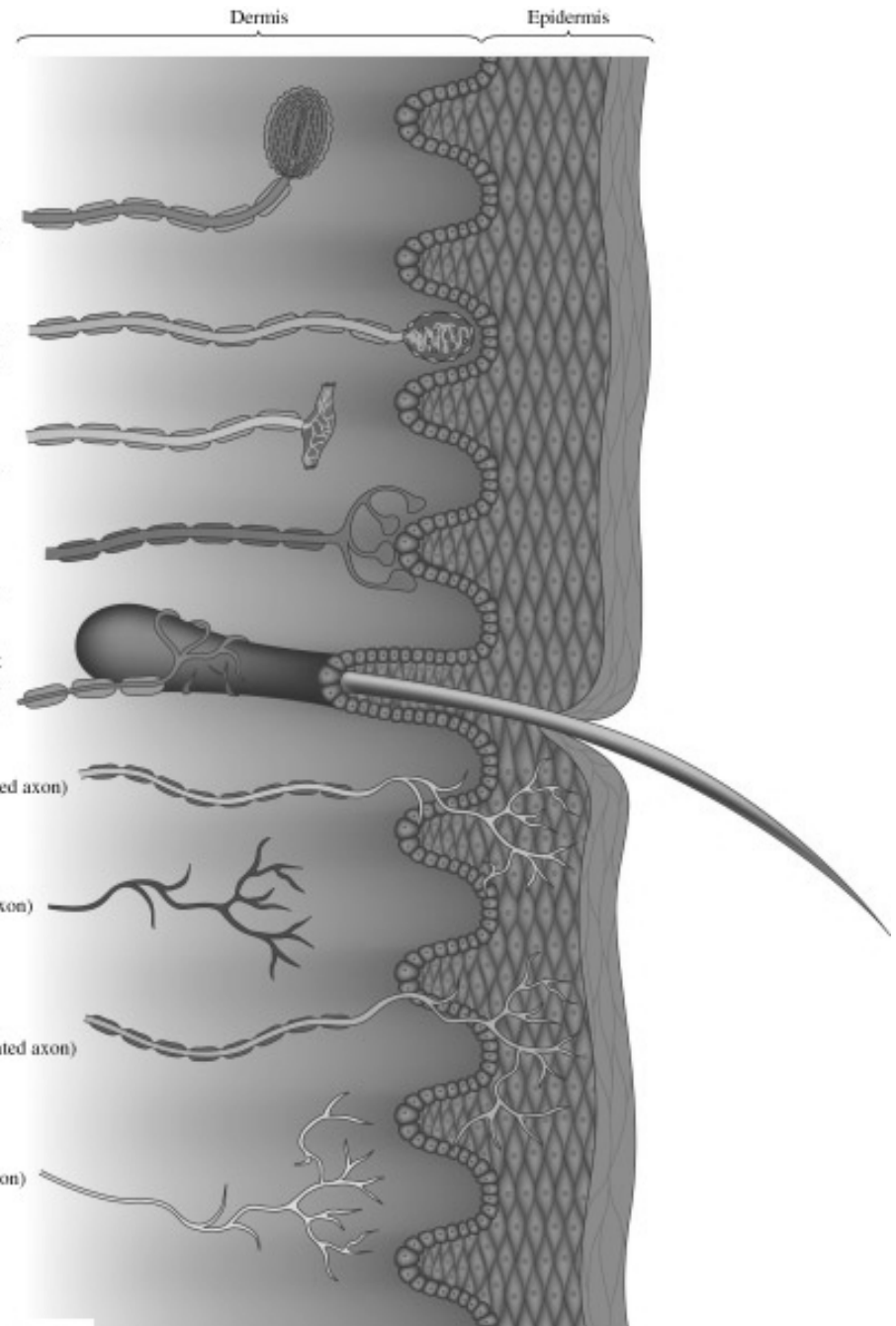
Cold (smaller myelinated axon)

Warm (unmyelinated axon)

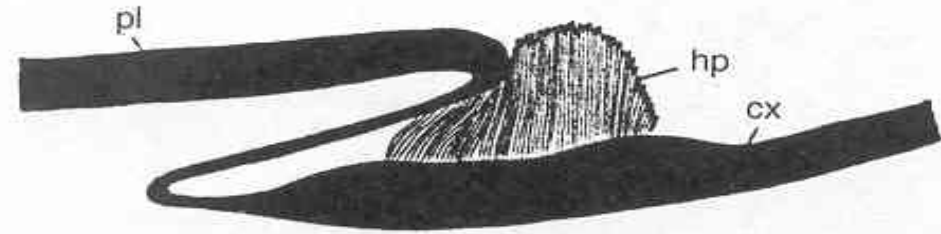
## Nociceptors

Rapid (smaller myelinated axon)

Slow (unmyelinated axon)



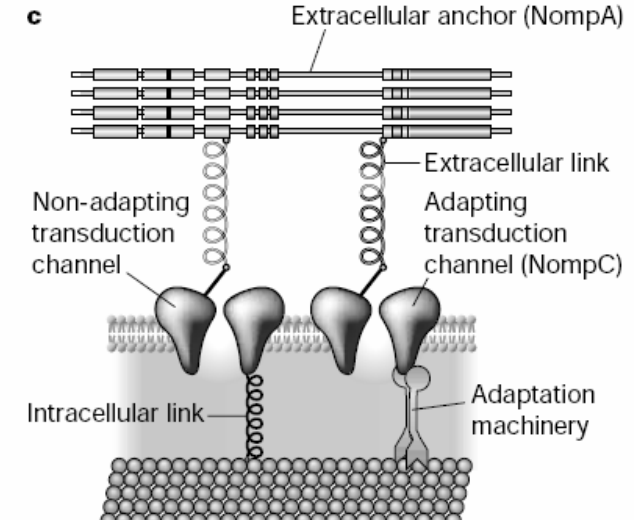
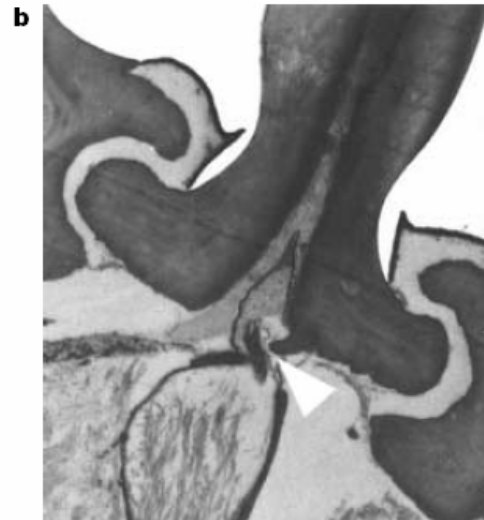
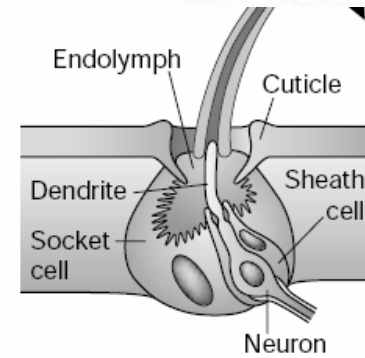
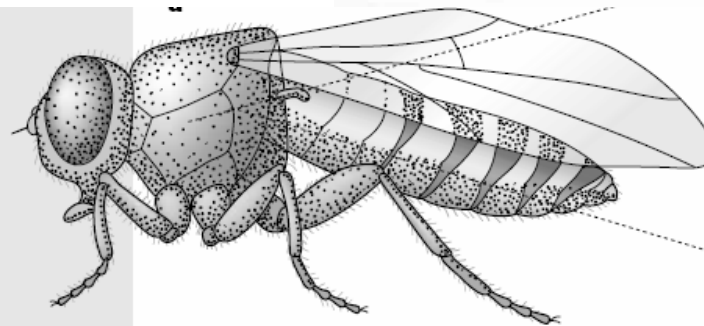
# Somatosensorické vnímání



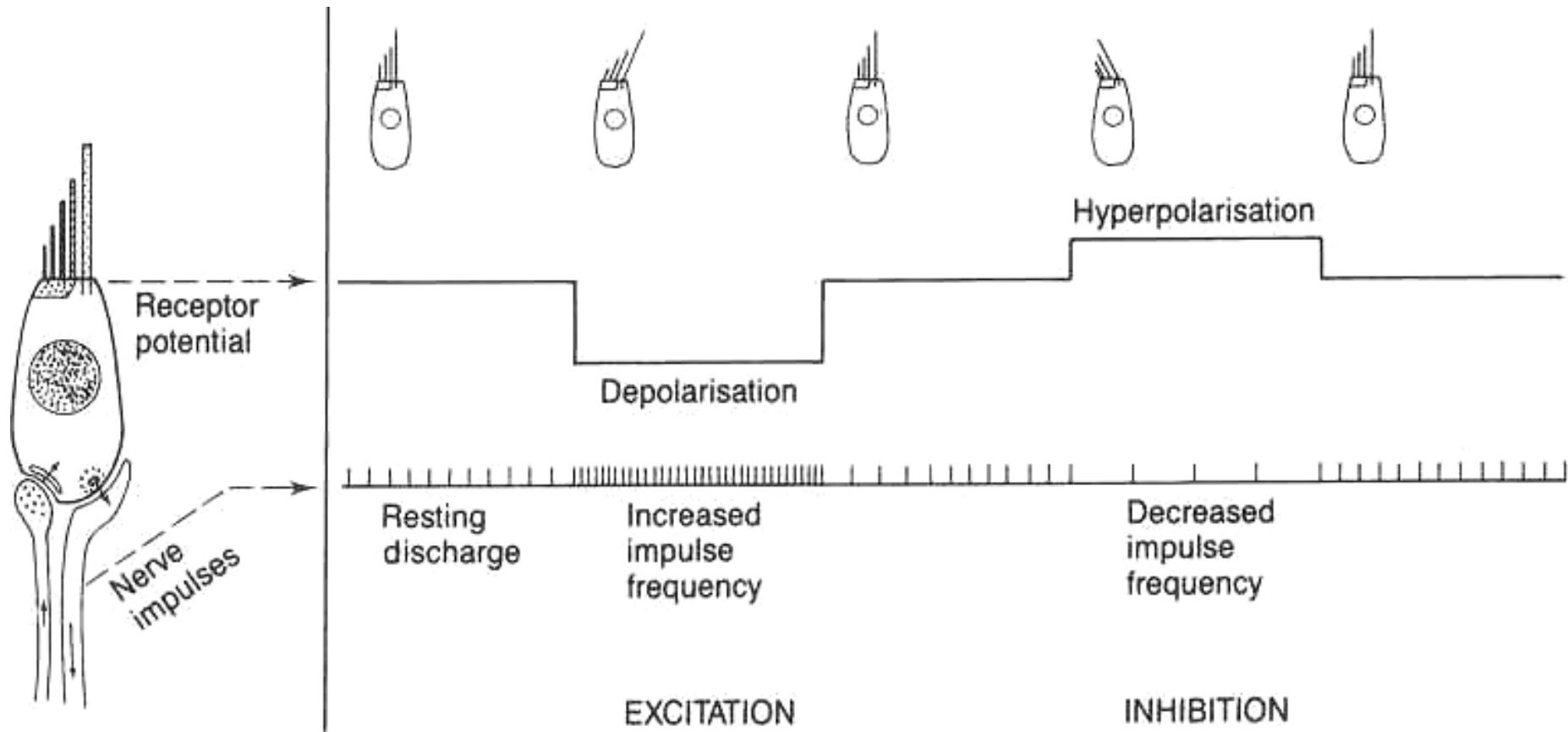
**Figure 6.3** (a) The figure shows the brushwork of sensilla at the articulation of the second leg of the cockroach, *Periplaneta americana*. The thick cuticle of the pleuron (pl) thins to a delicate articular membrane and then thickens again to form the cuticle surrounding the coxa (cx), the first segment of the leg. The brush of sensilla forms a hairplate (hp). From Pringle, 1938

**Figure 3** *Drosophila* bristle-receptor model.

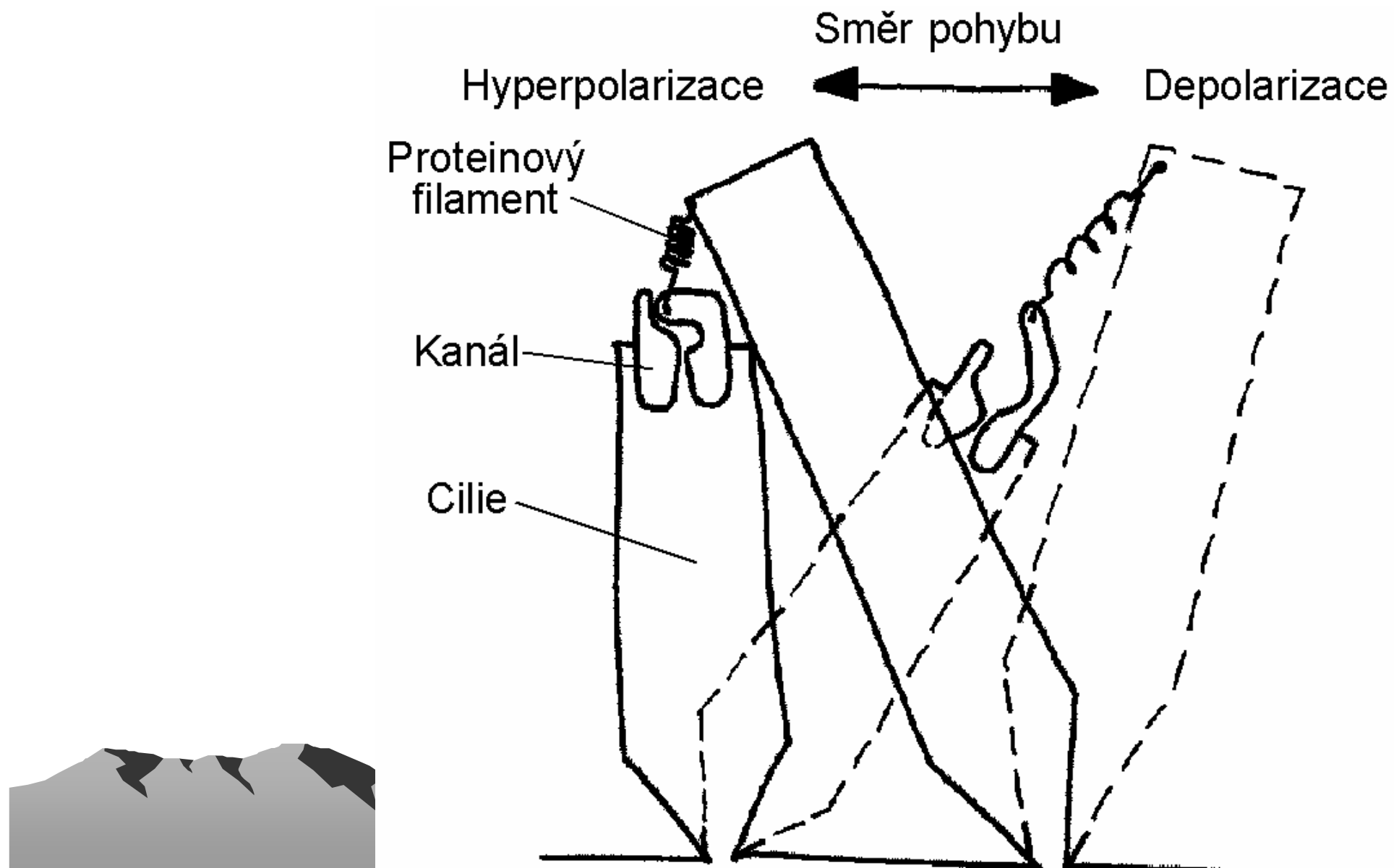
**a.** Lateral view of *D. melanogaster* showing the hundreds of bristles that cover the fly's cuticle. The expanded view of a single bristle indicates the locations of the stereotypical set of cells and structures associated with each mechanosensory organ. Movement of the bristle towards the cuticle of the fly (arrow) displaces the dendrite and elicits an excitatory response in the mechanosensory neuron. **b.** Transmission electron micrograph of an insect mechanosensory bristle showing the insertion of the dendrite at the base of the bristle. The bristle contacts the dendrite (arrowhead) so that movement of the shaft of the bristle will be detected by the neuron. **c.** Proposed molecular model of transduction for ciliated insect mechanoreceptors, with the locations of NompC and NompA indicated.



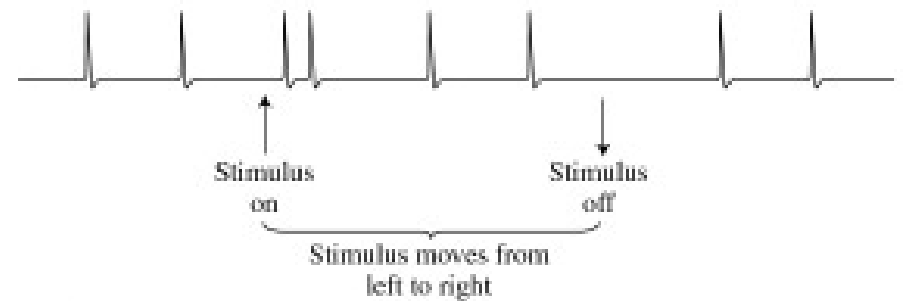
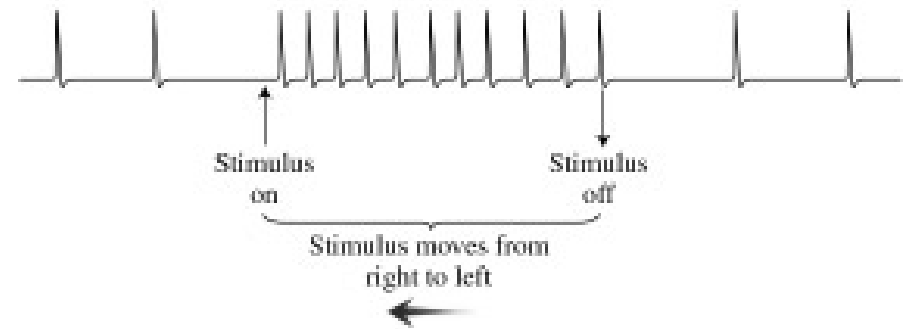
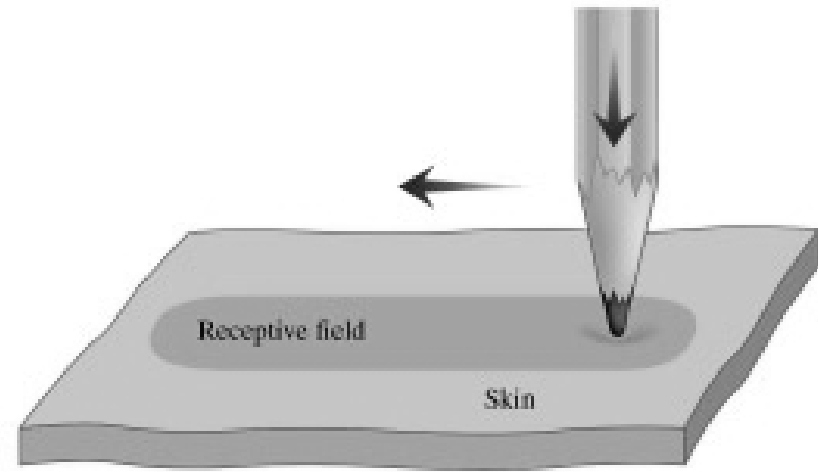
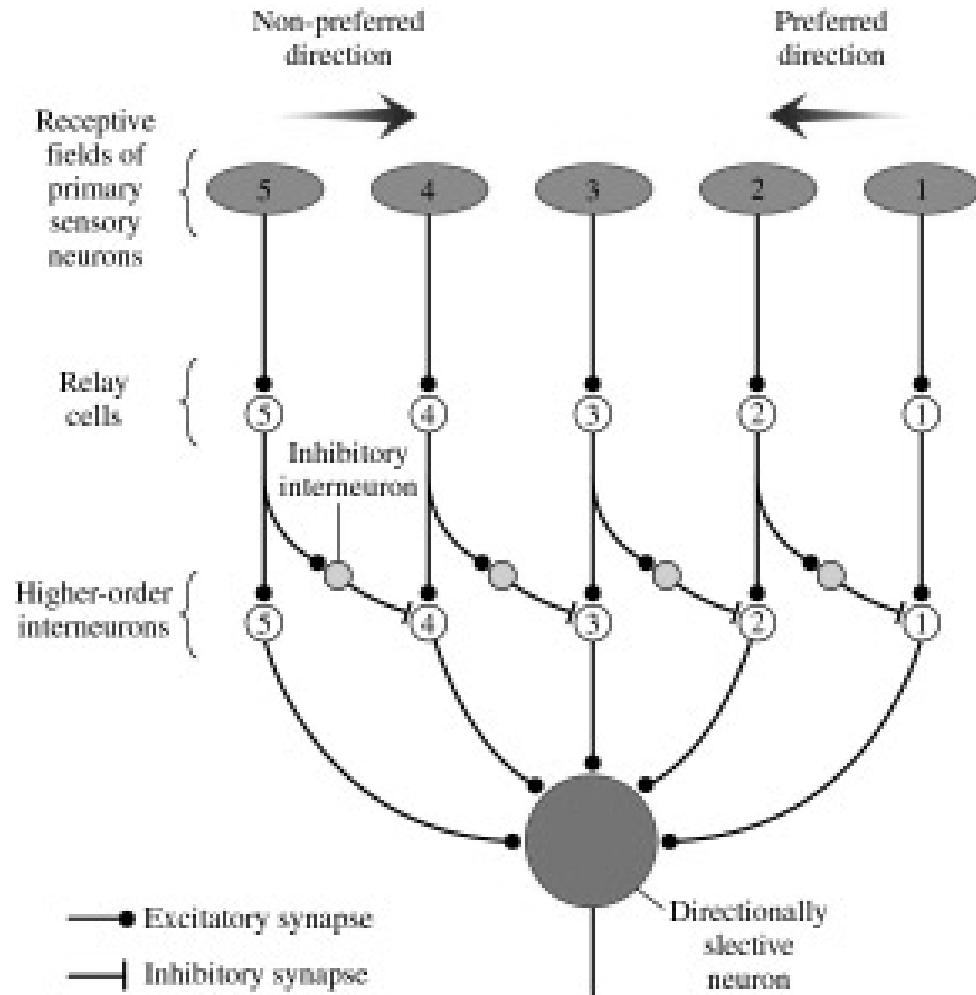
# Vlásoková buňka – specialista na jemný pohyb



# Vlásoková buňka – specialista na jemný pohyb

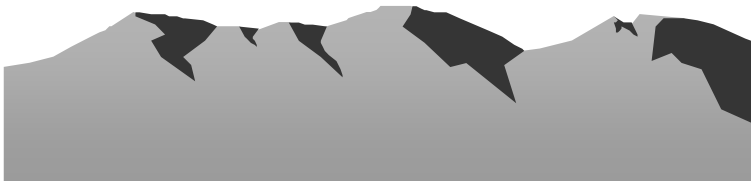
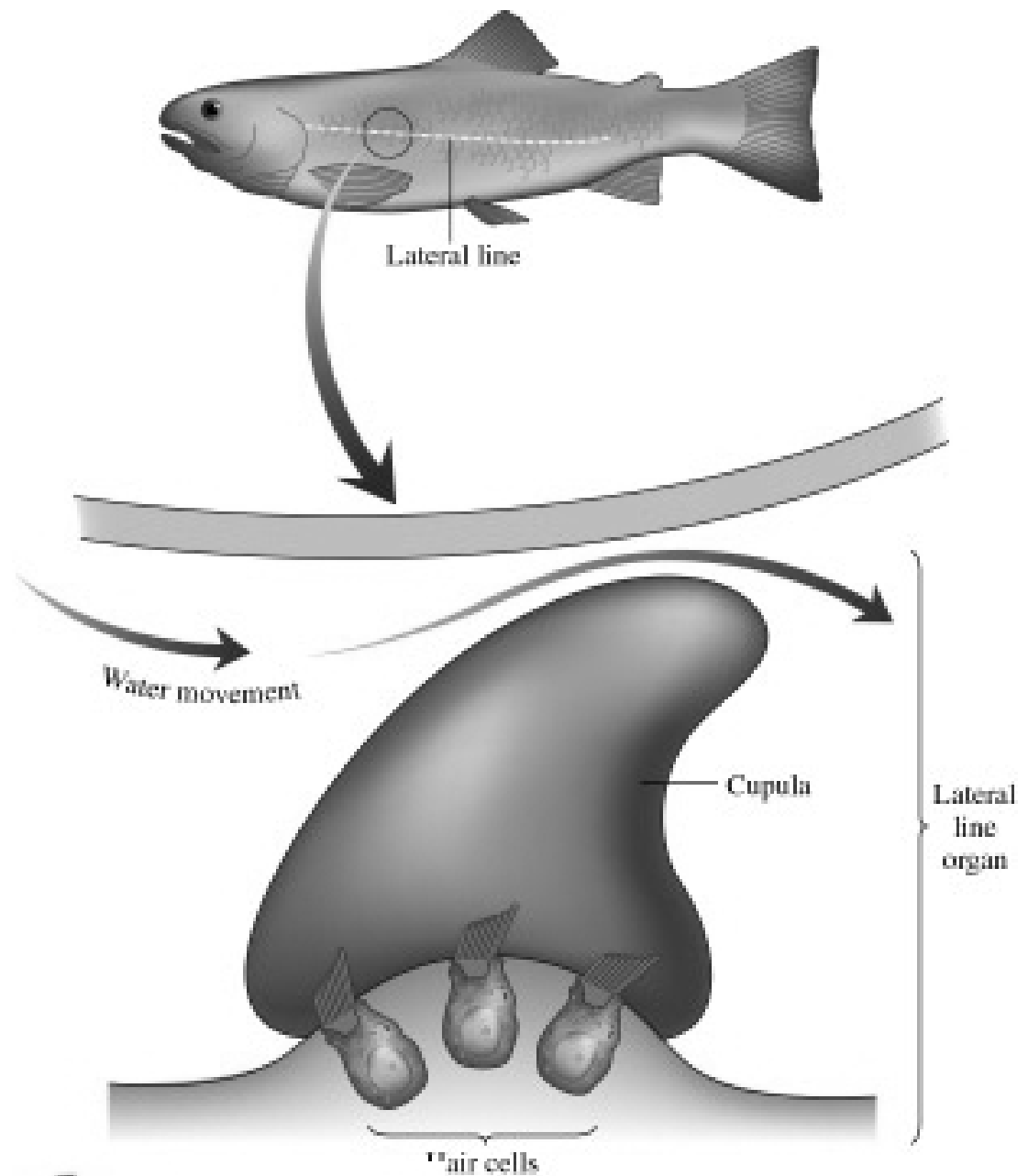


# Periferní detektor směru pohybu



Proudový smysl -  
Kanálek přepažený  
kupulou s receptory

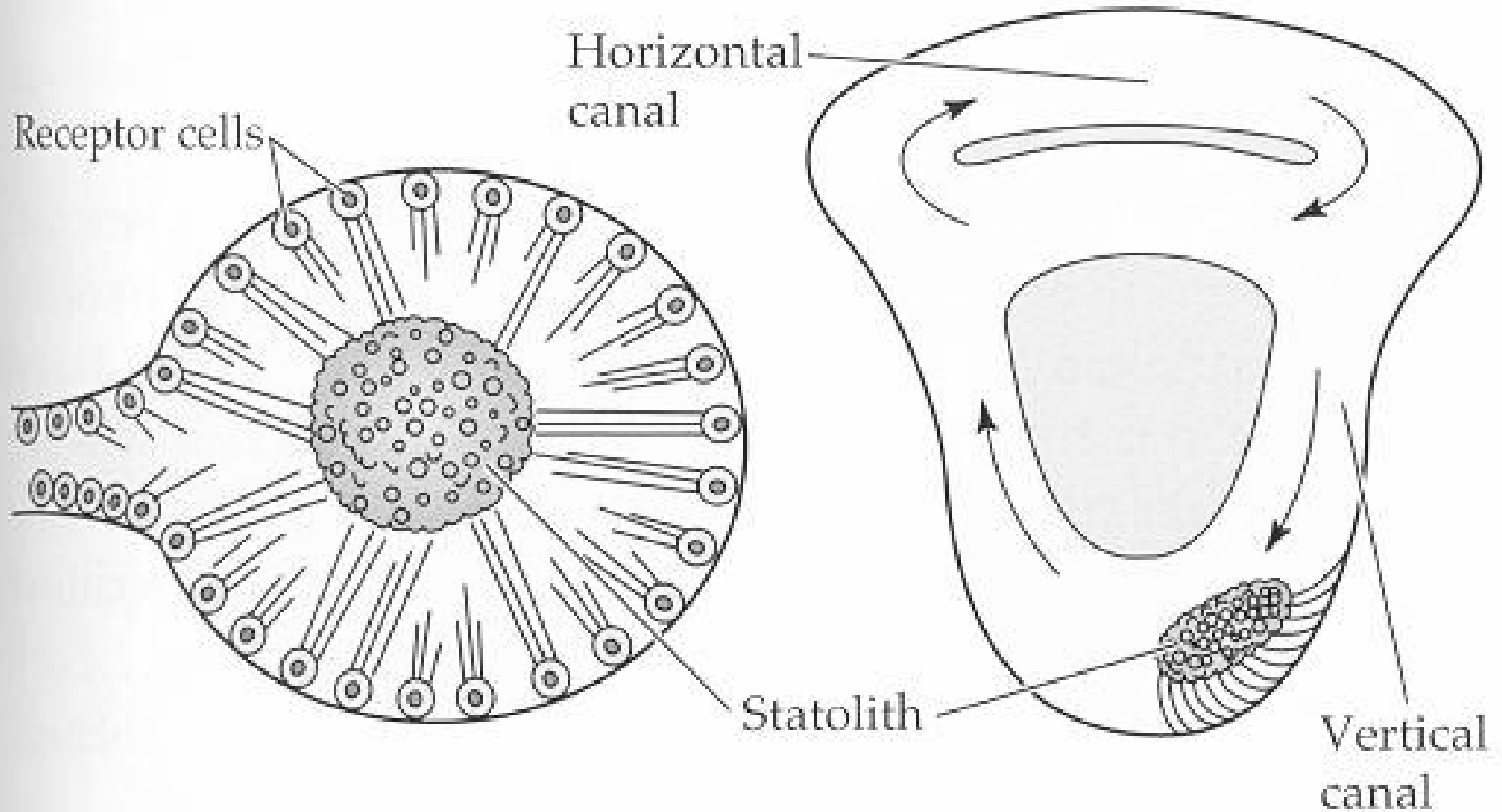
Ryba animace



# Statocysta

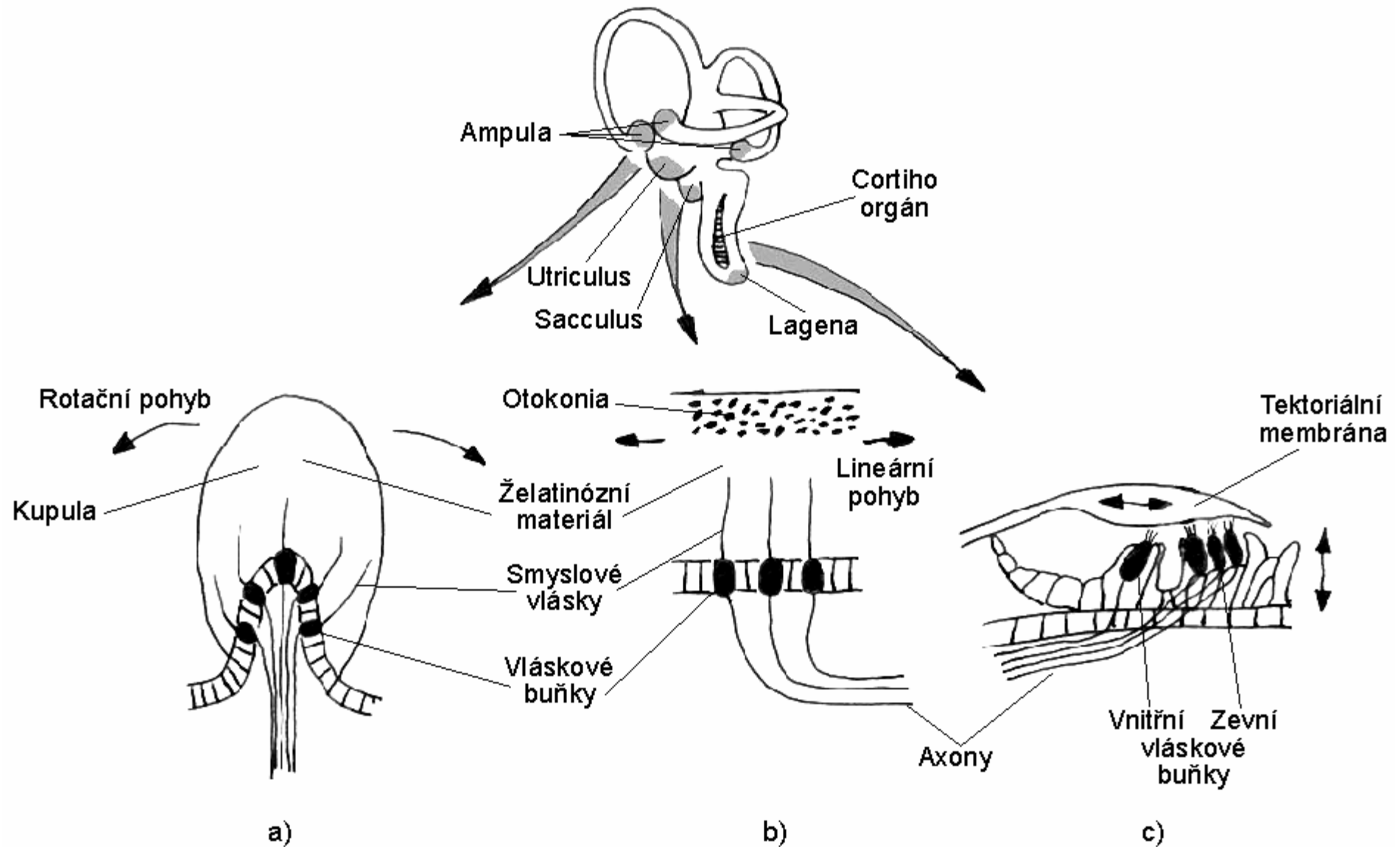
(a) Statocyst of a scallop (*Pecten*)

(b) Statocyst of a crab





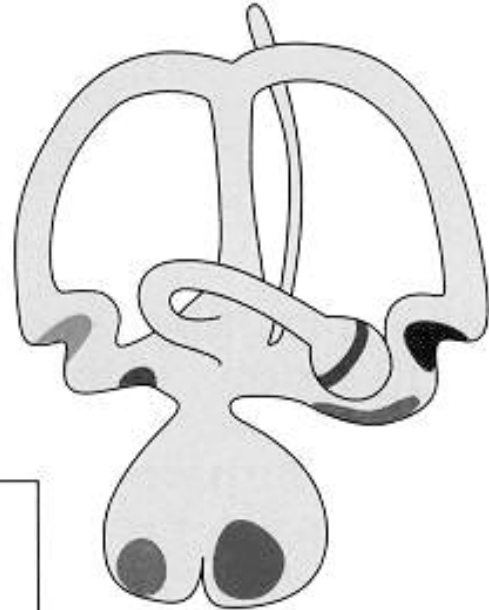
# Vestibulární aparát a sluchový orgán



Fish (Myxine)



Frog



Bird



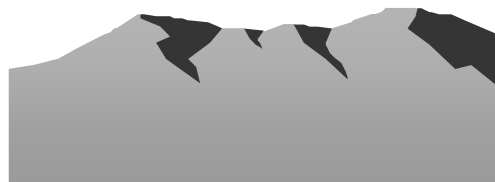
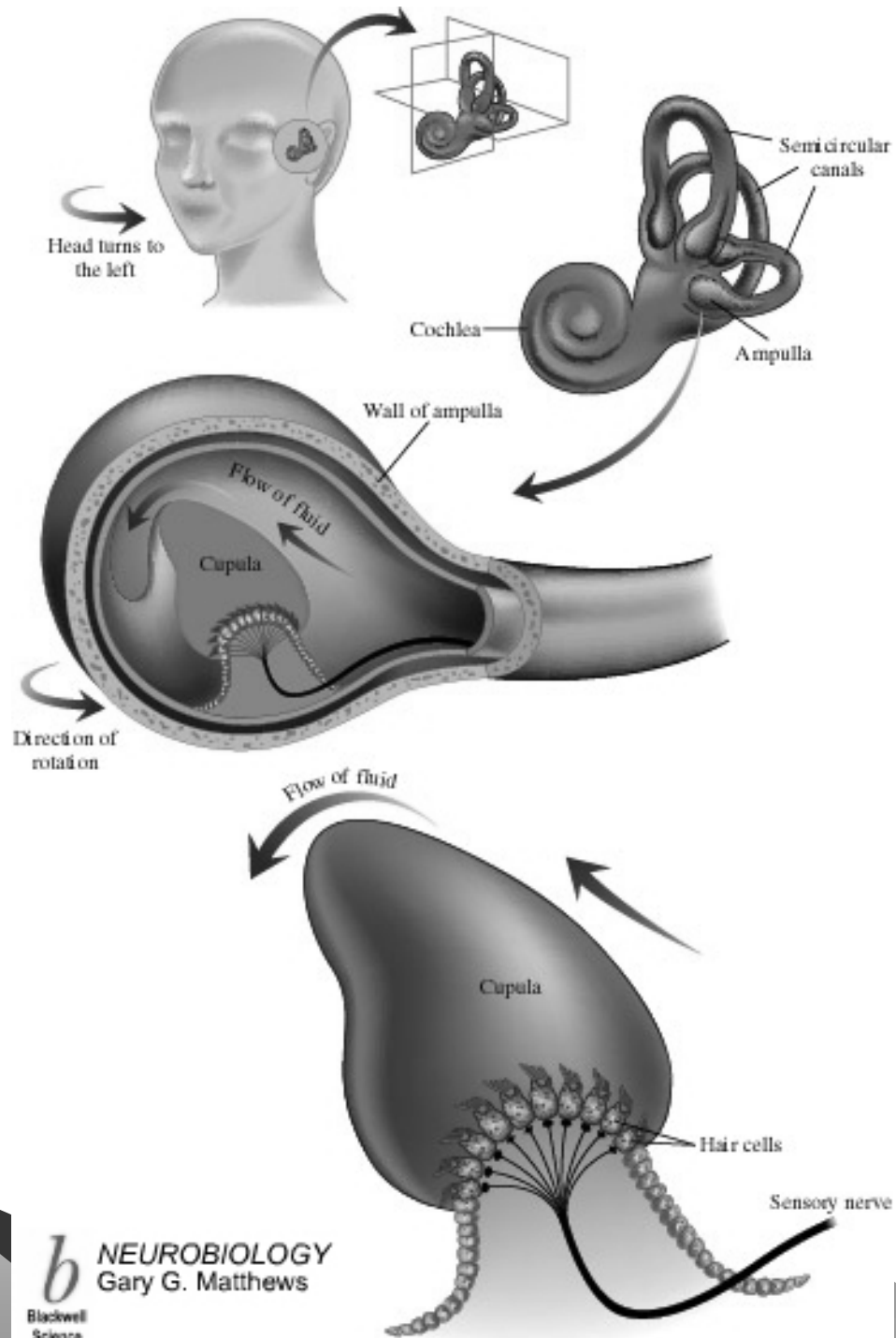
Mammal

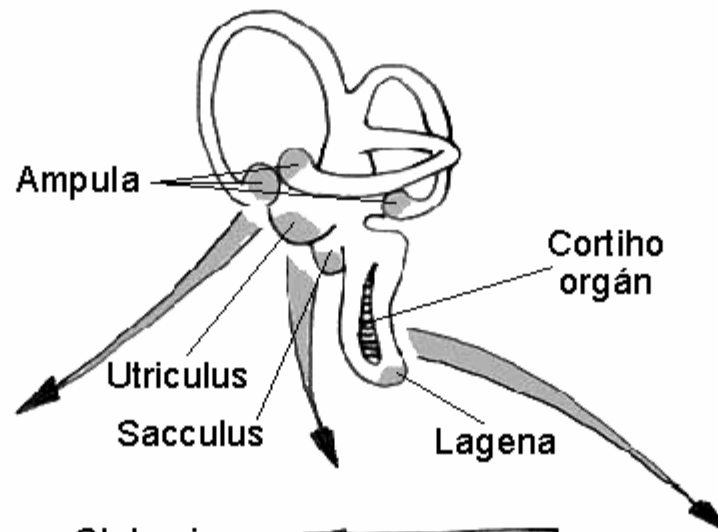


KEY

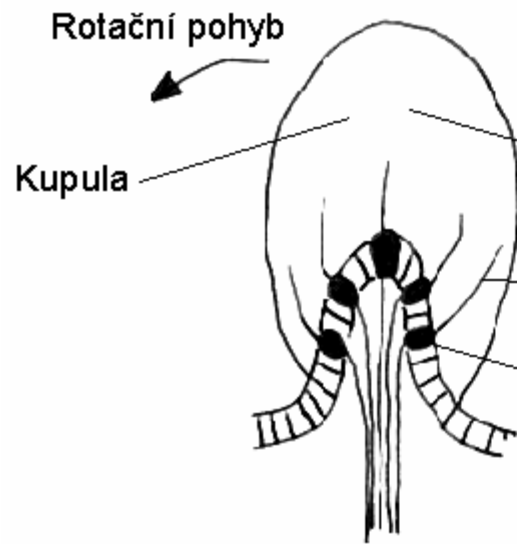
	Anterior crista
	Lateral crista
	Posterior crista
	Macula communis
	Macula lagenae
	Macula neglecta
	Macula sacculi
	Macula utricula
	Papilla basilaris



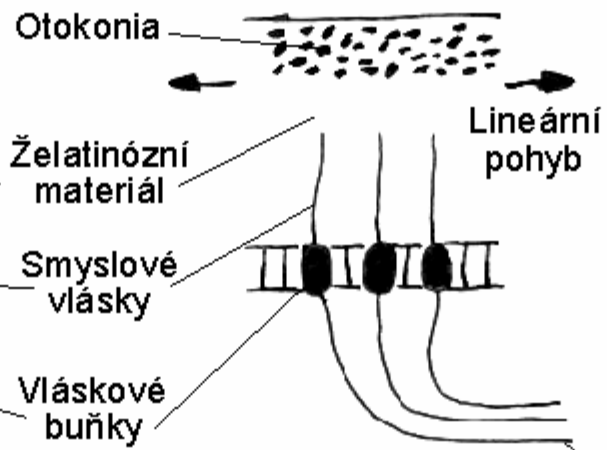




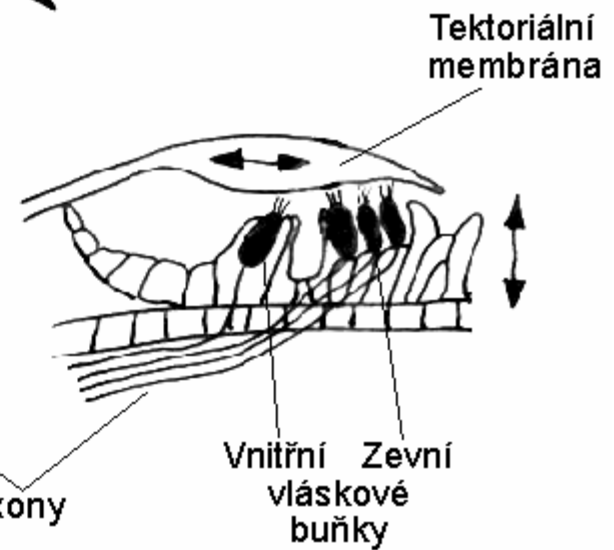
Cortiho orgán



a)



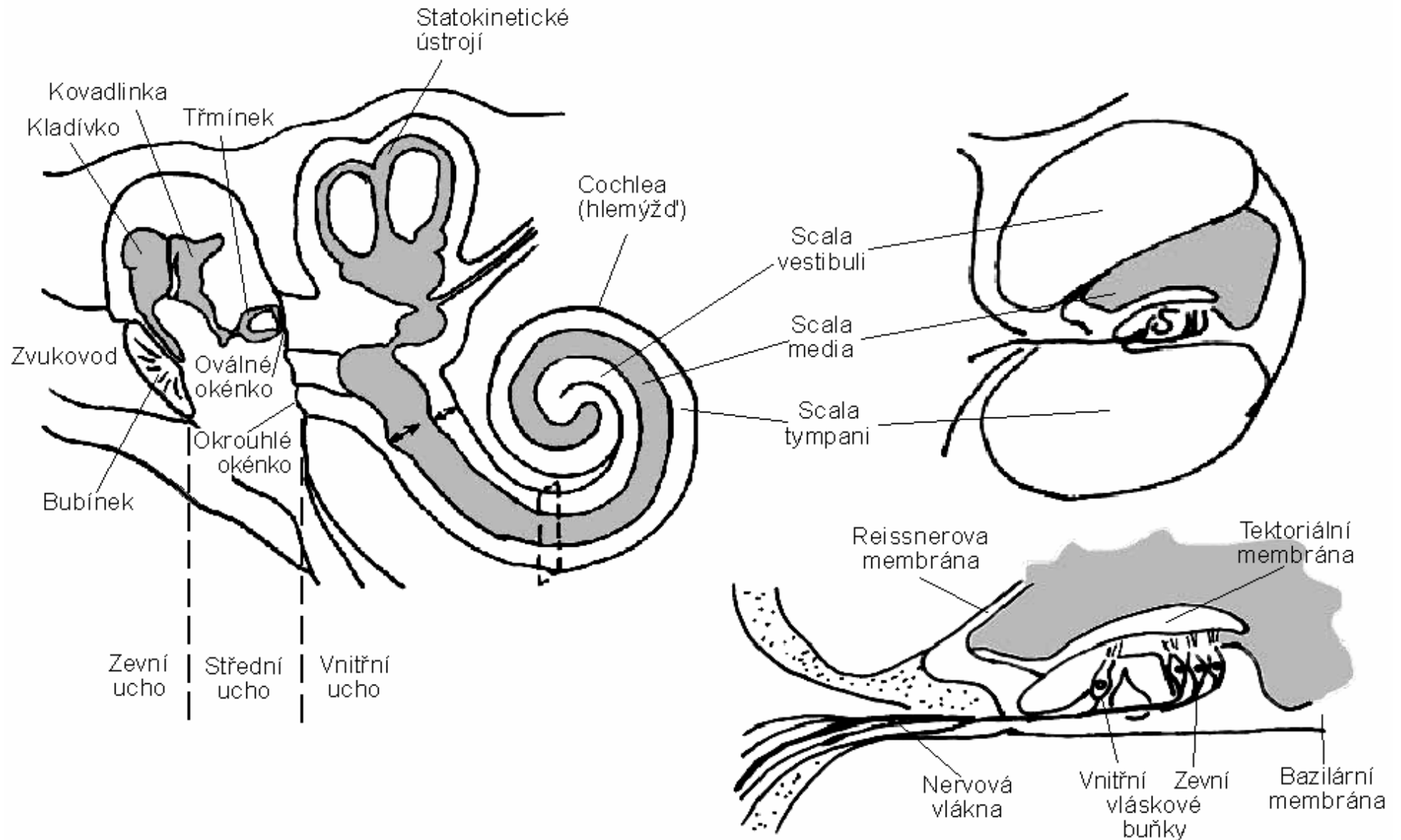
b)



c)



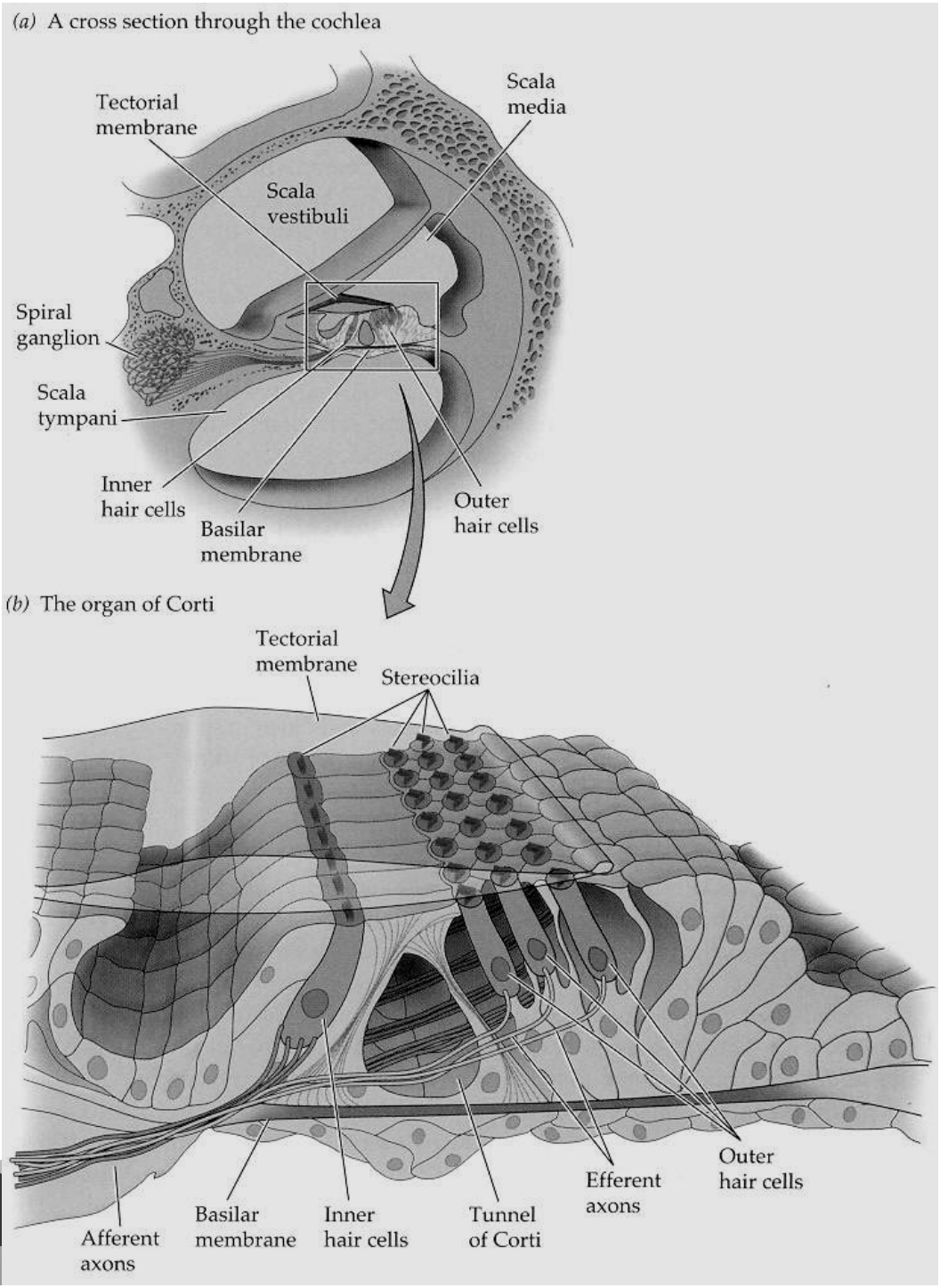
# Sluchový aparát savců



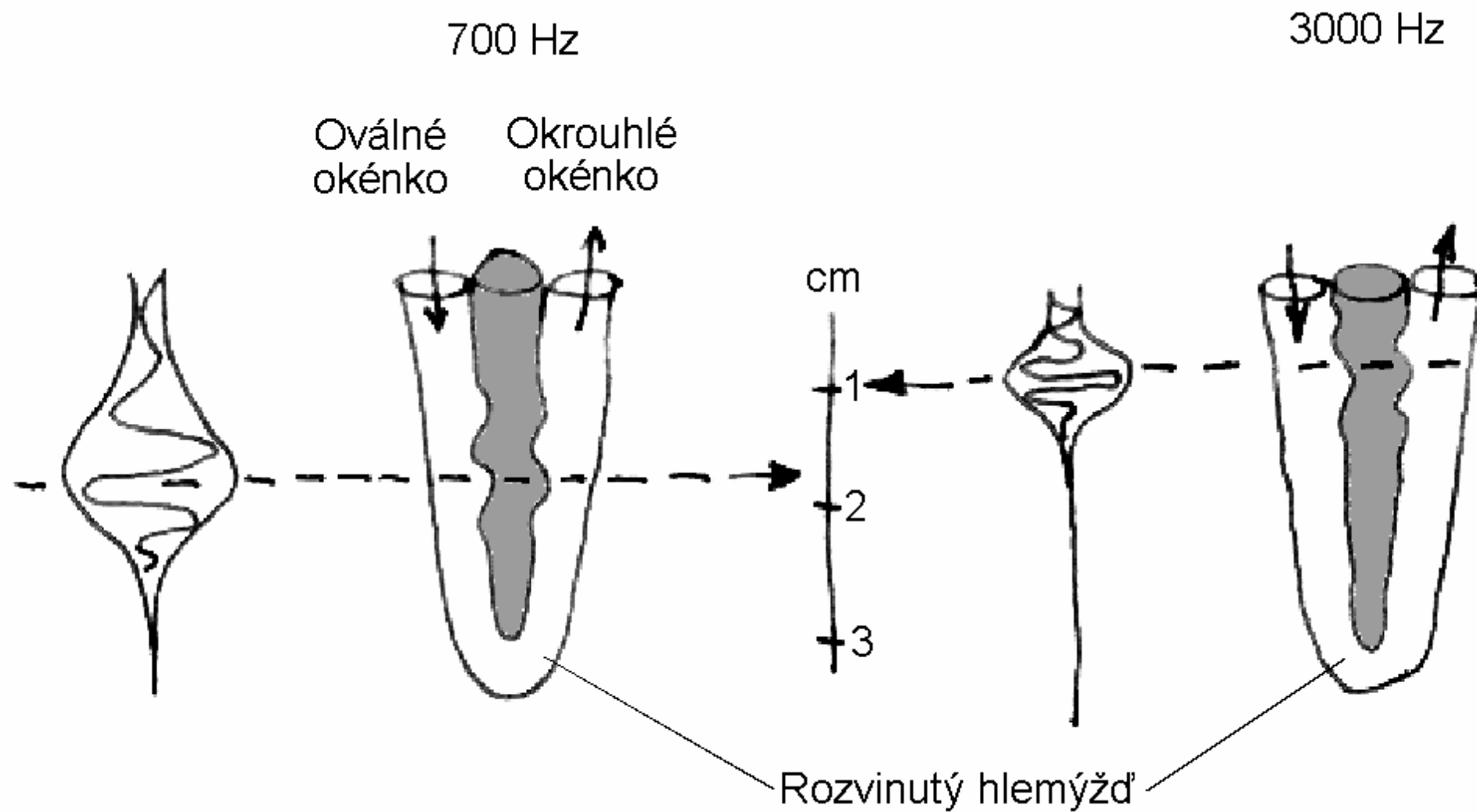
# Sluchový aparát savců Vnitřní ucho

## Animace ear.

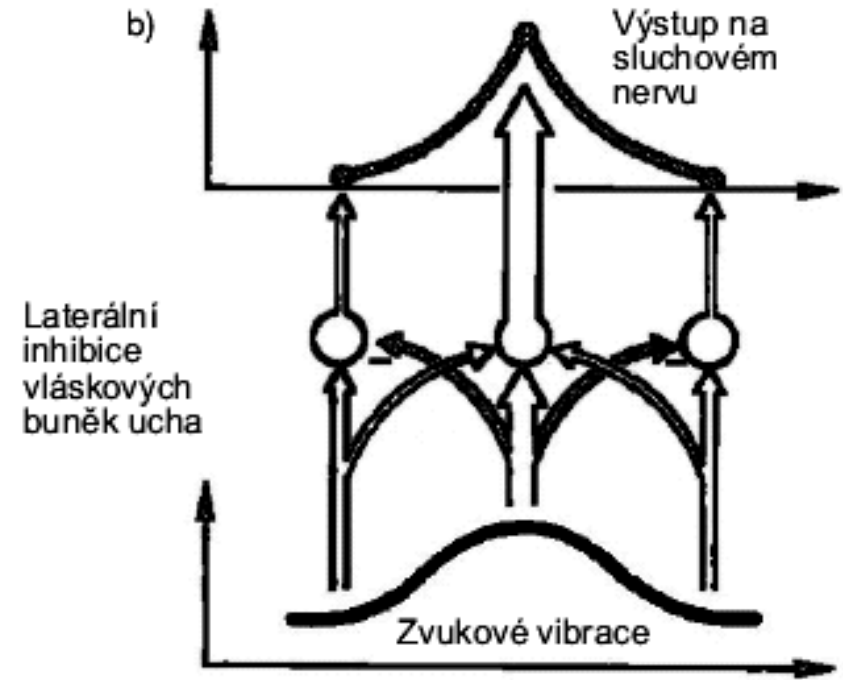
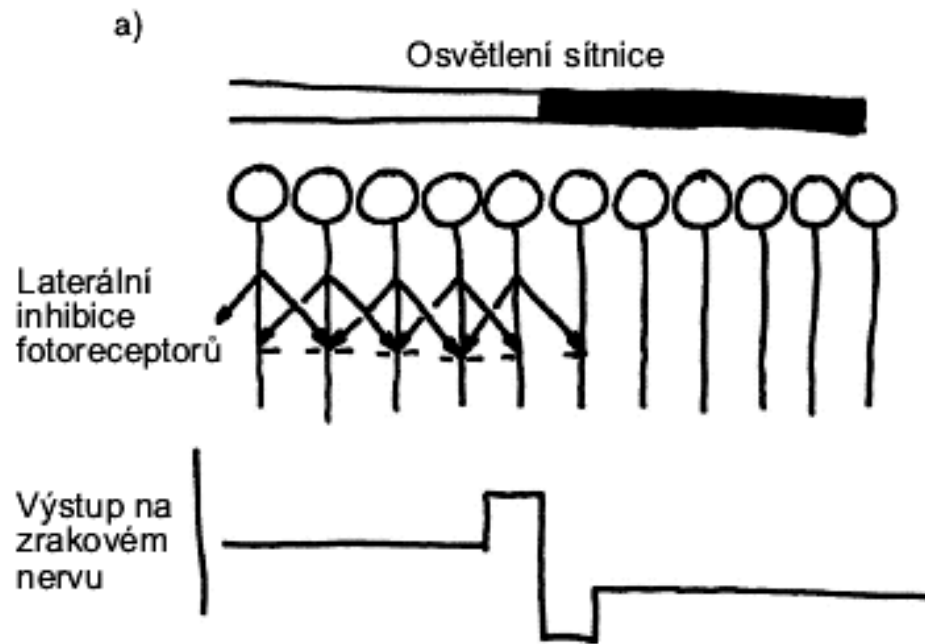
[http://highered.mcgraw-hill.com/olc/dl/120108/bio\\_e.swf](http://highered.mcgraw-hill.com/olc/dl/120108/bio_e.swf)



Výška tónu se promítá do prostorově lokalizovaného maxima.

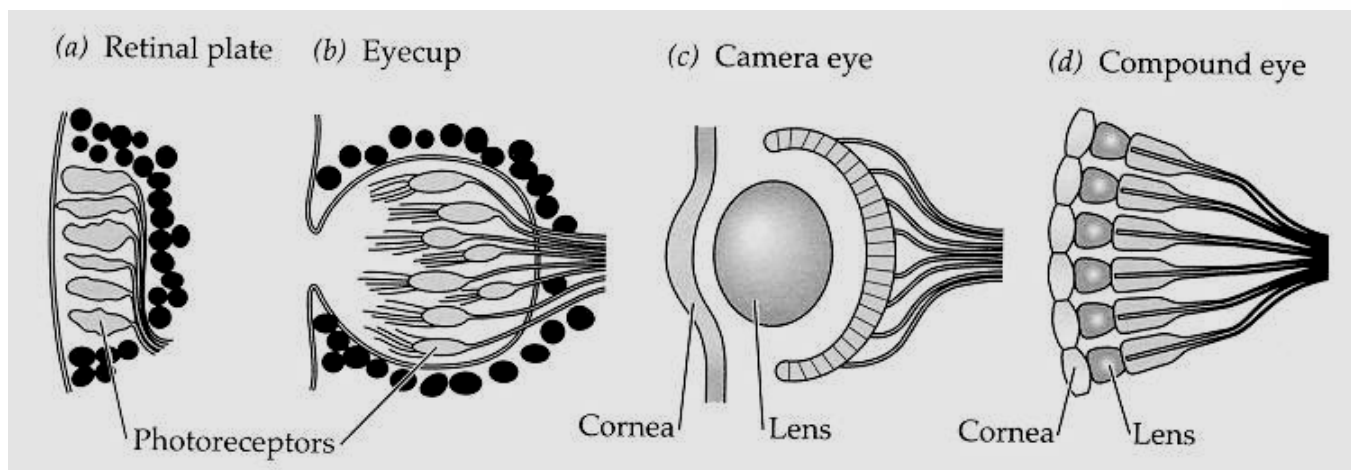
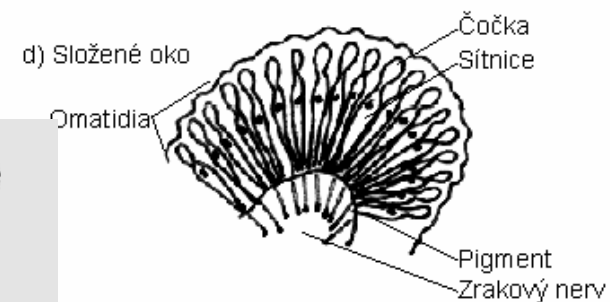
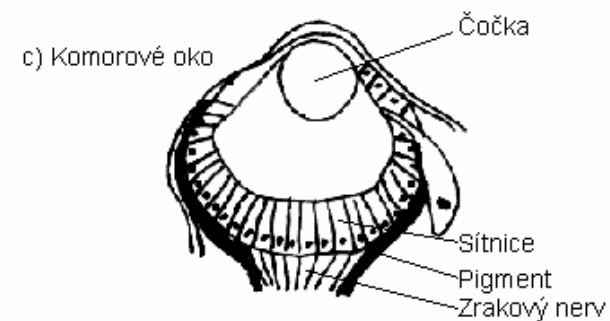


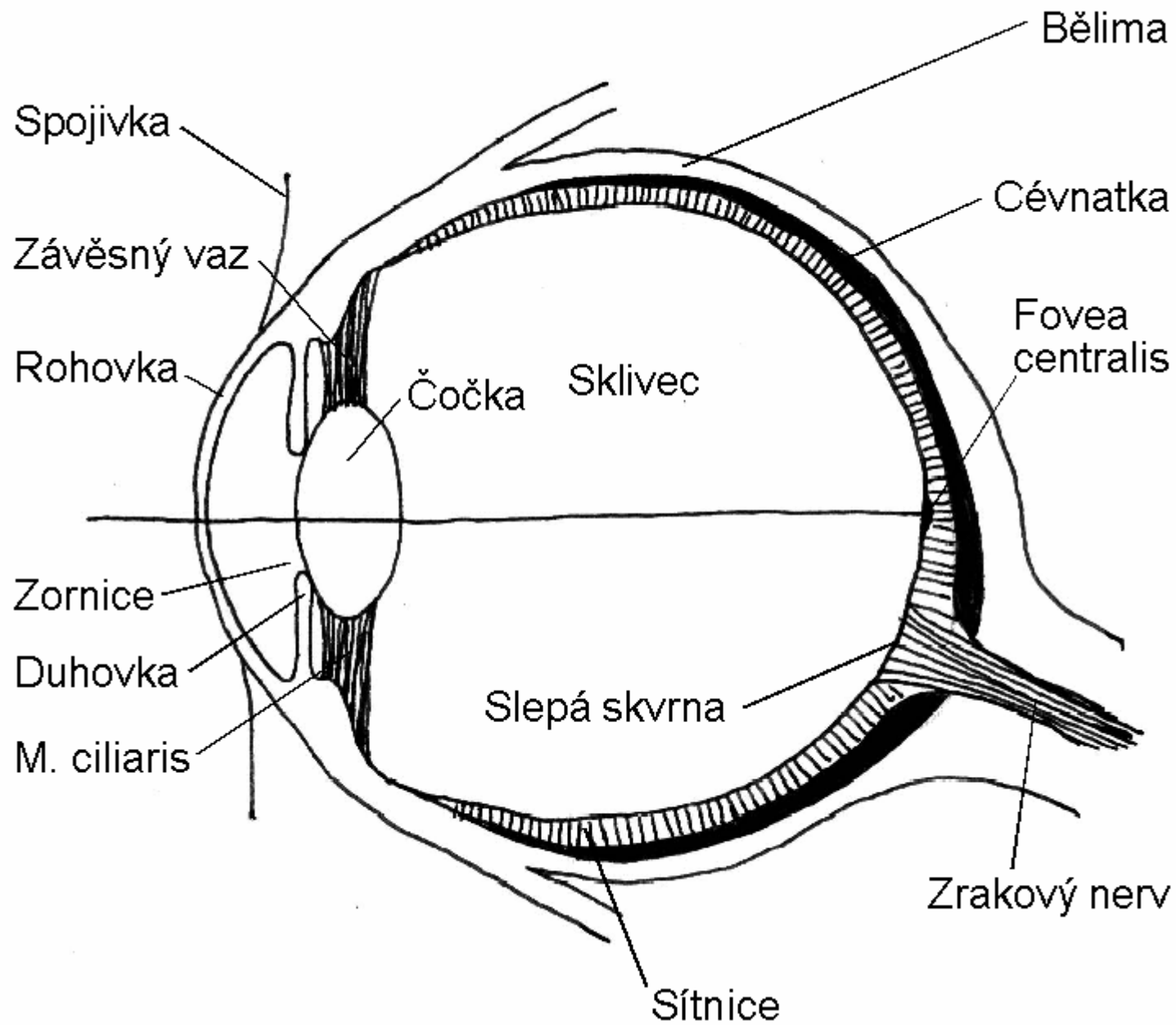
# Vyostření maxima – laterální inhibice



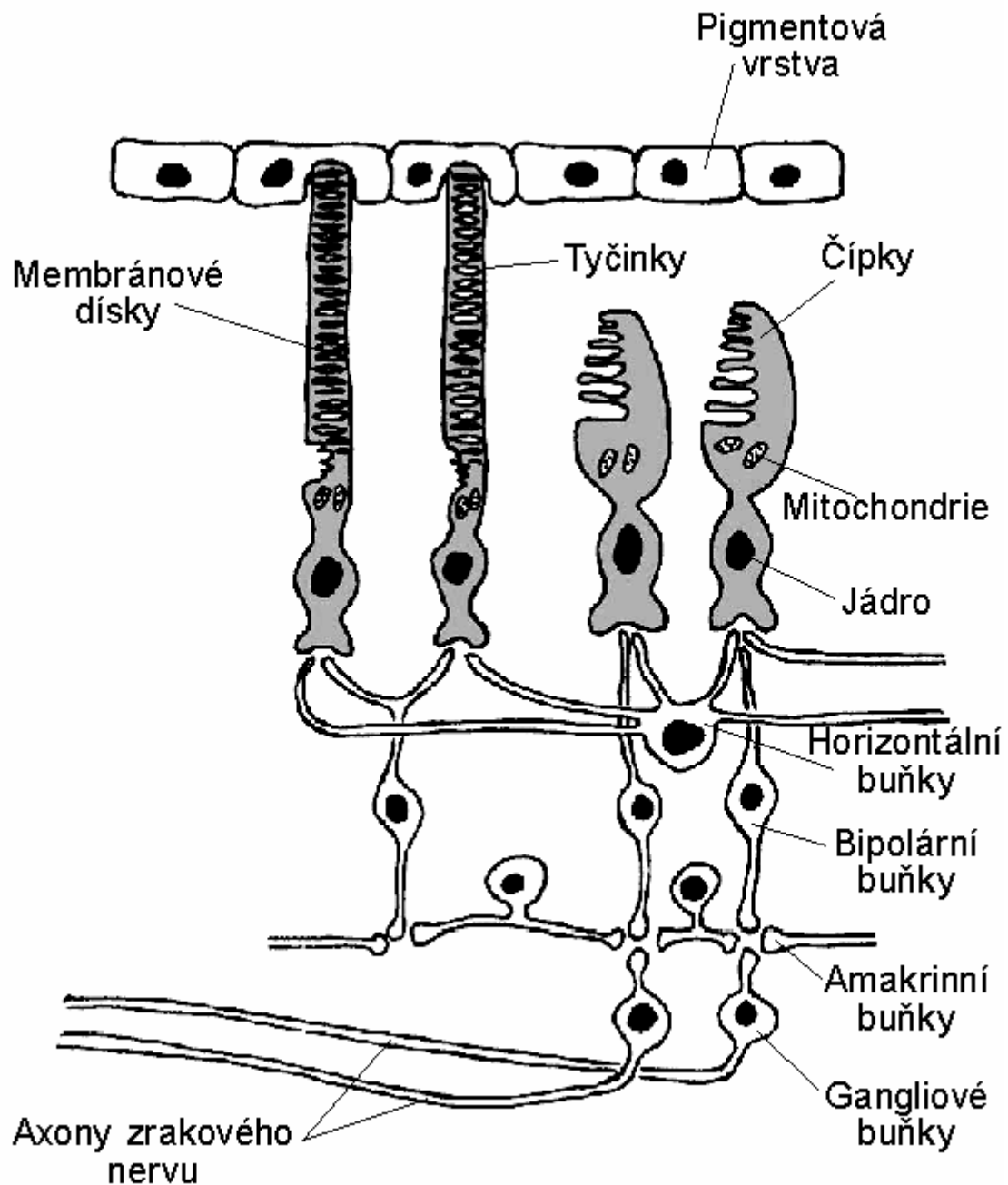


# Fotorecepce

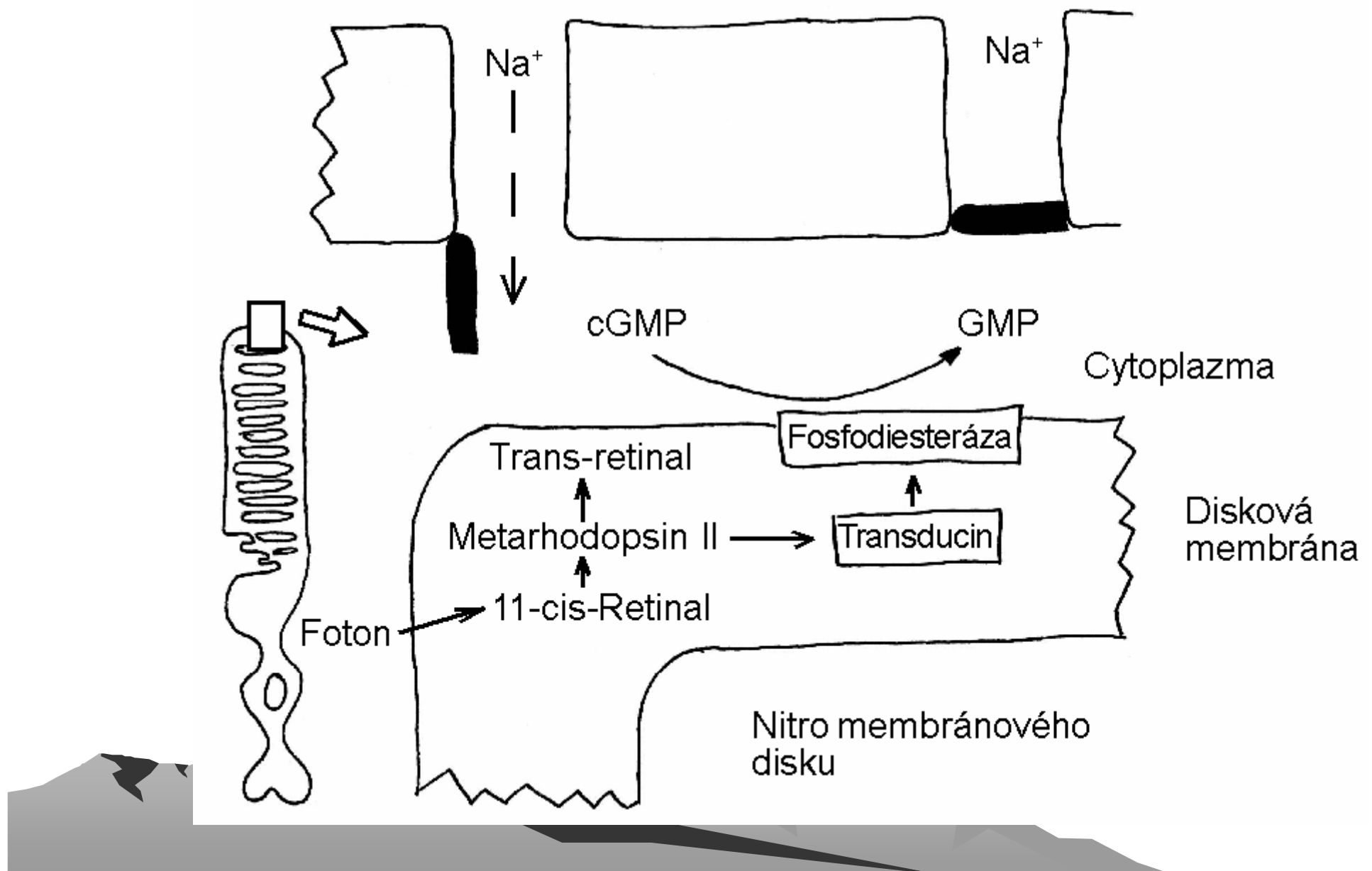




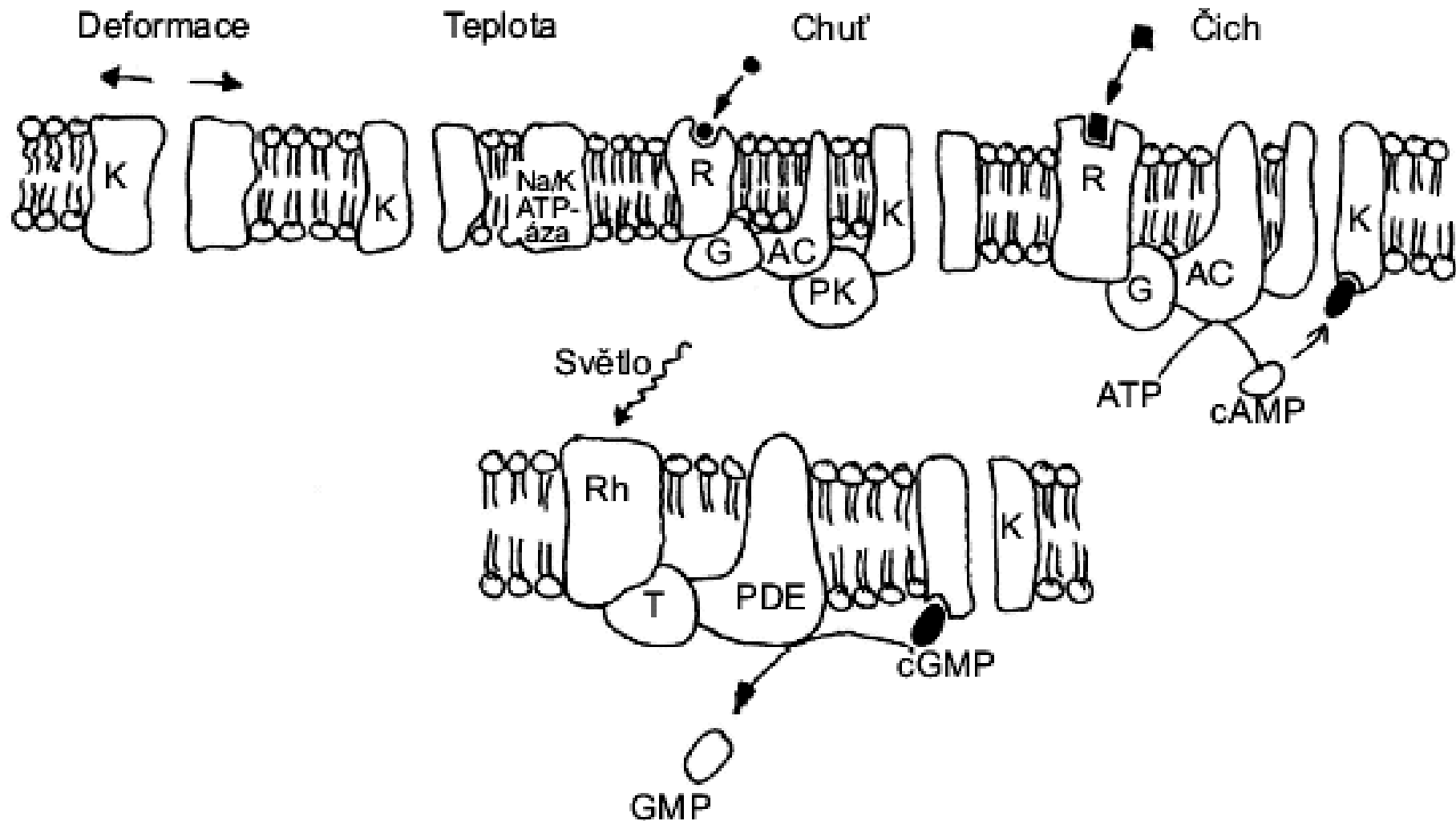
# Receptory Periferní spoje a dráhy

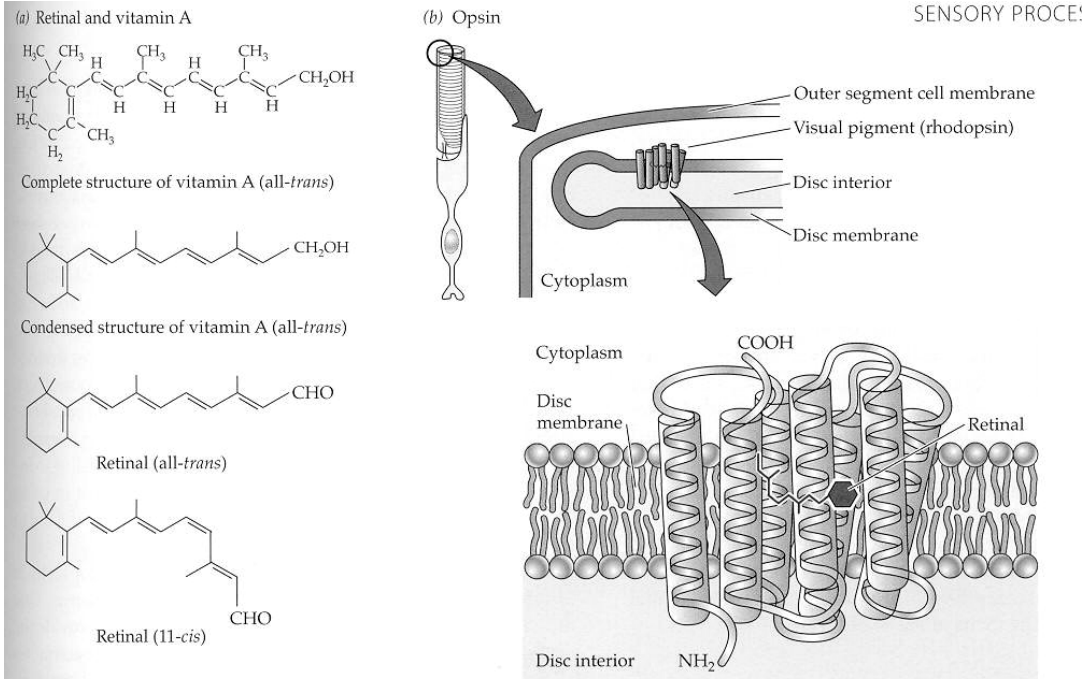


# Fototransdukce světelného kvanta na změnu potenciálu



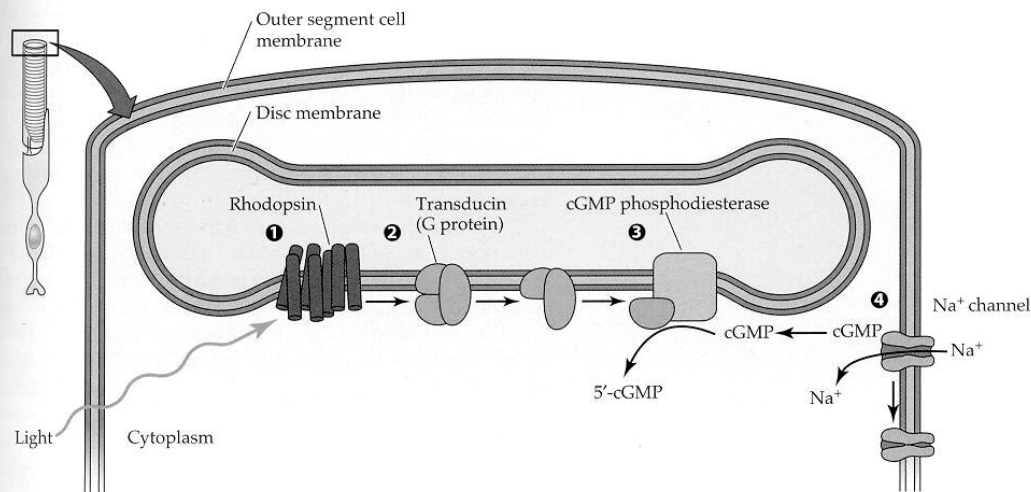
# Fotorepce a chemorecepce – podobný princip



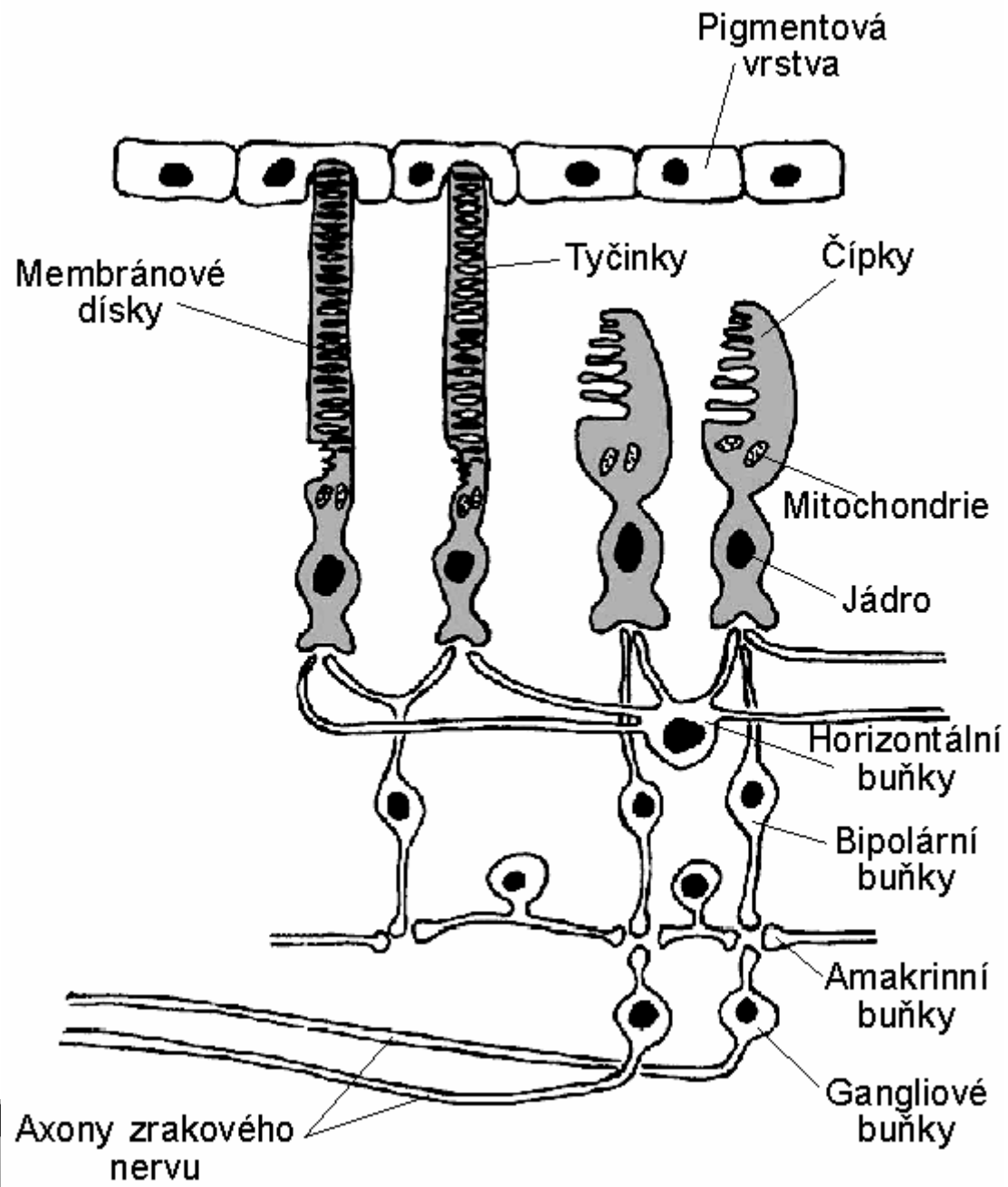


# Animace rhodopsin.

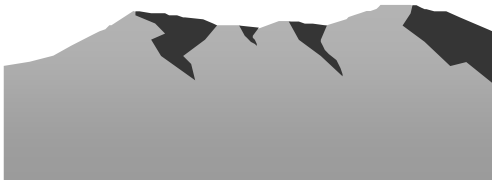
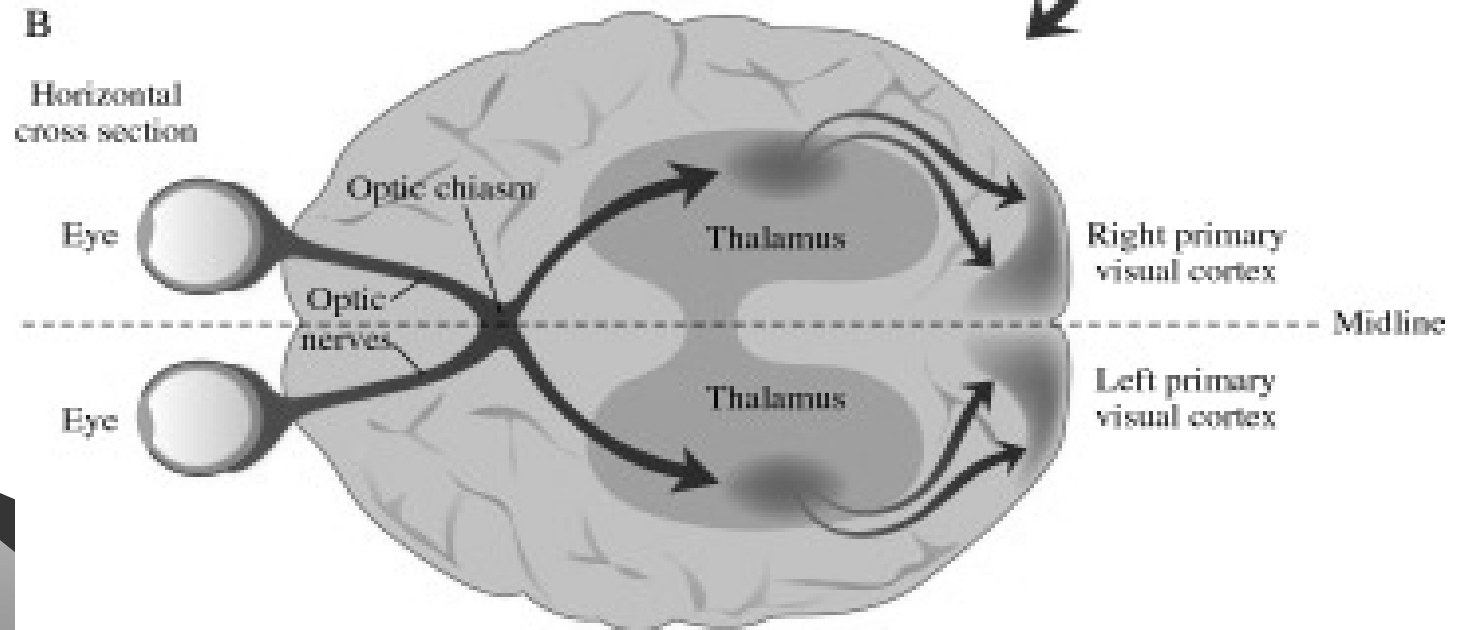
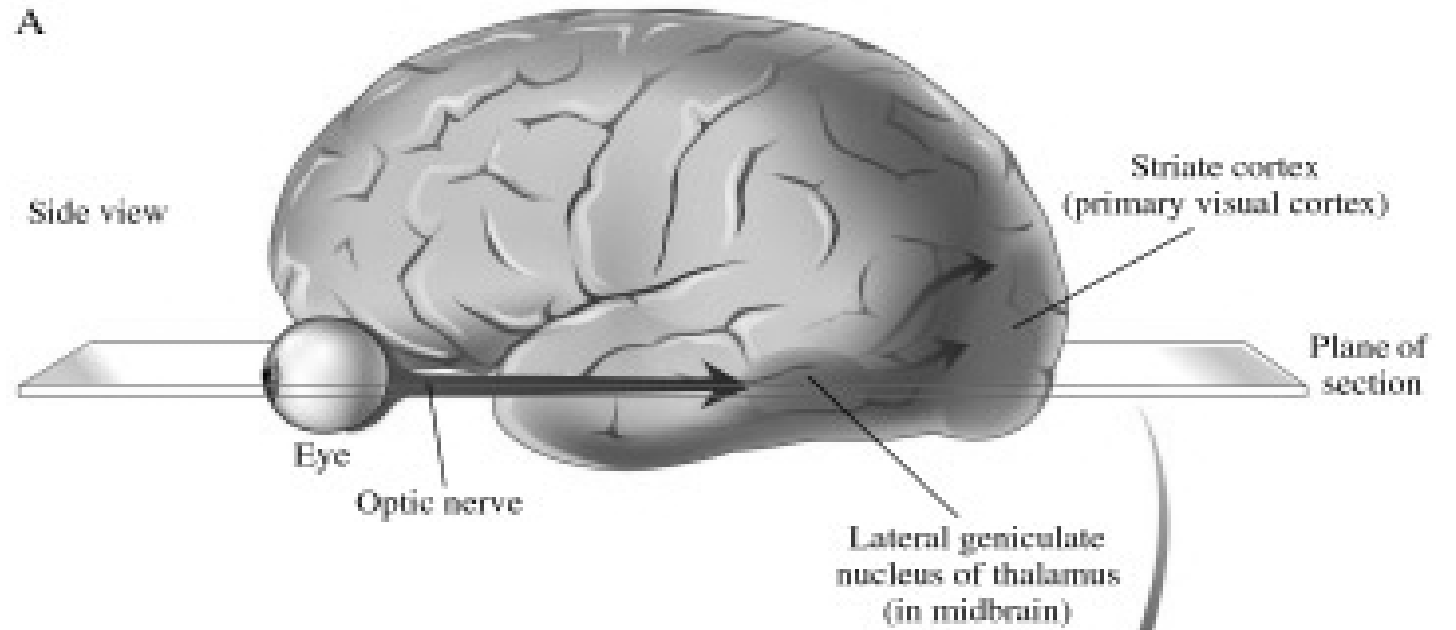
**Figure 13.13 Rhodopsin is a photopigment composed of two parts: retinal and opsin**  
 (a) Chemical structures of vitamin A and of retinal. Vitamin A is shown both as a complete structure (top) and as a skeleton structure (middle). Vitamin A is converted to retinal, which has two isomers (11-*cis* and all-*trans*). (b) Three-dimensional structure of the protein (opsin) portion of vertebrate rhodopsin. Seven  $\alpha$ -helical regions of the protein span the membrane; retinal is attached to an amino acid residue within the seventh membrane-spanning region.



# Zraková dráha



# Zraková dráha





# Biologické rytmy



Rytmické děje jsou přirozenou součástí funkce organismu.

Předpovídají pravidelné změny bez ohledu na přechodné výkyvy.



Rytmické děje jsou přirozenou součástí funkce organismu.

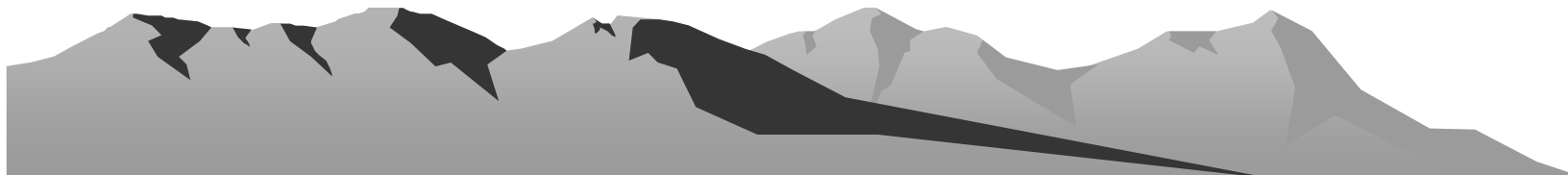
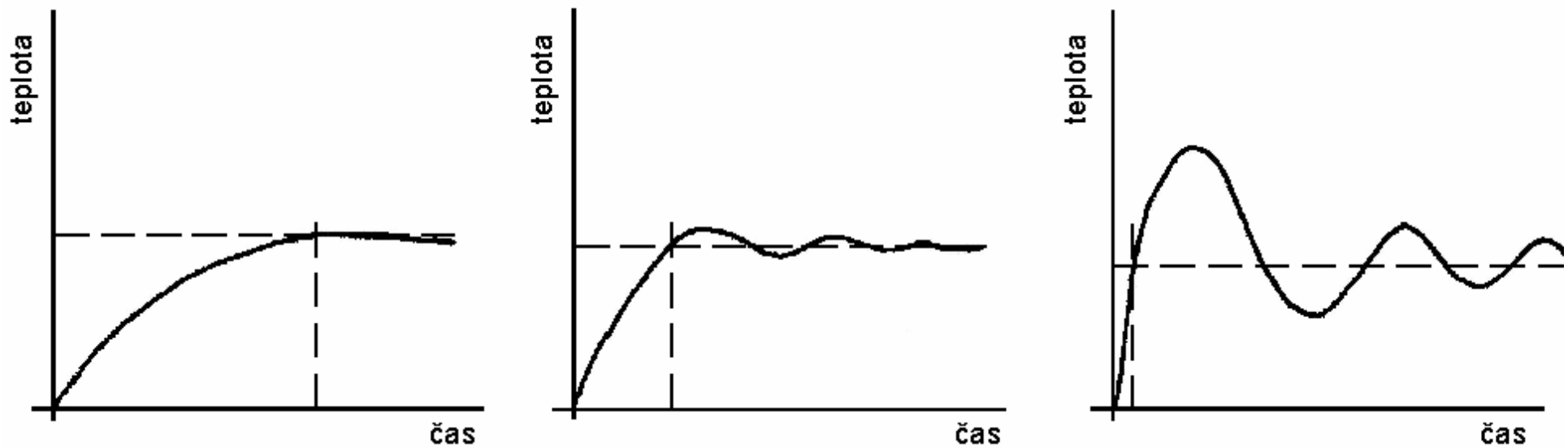
Bez vnějších korelátů: nervové vzruchy, srdeční rytmus, dechový rytmus...



Rytmické děje jsou přirozenou součástí funkce organismu.

Bez vnějších korelátů: nervové vzruchy, srdeční rytmus, dechový rytmus...

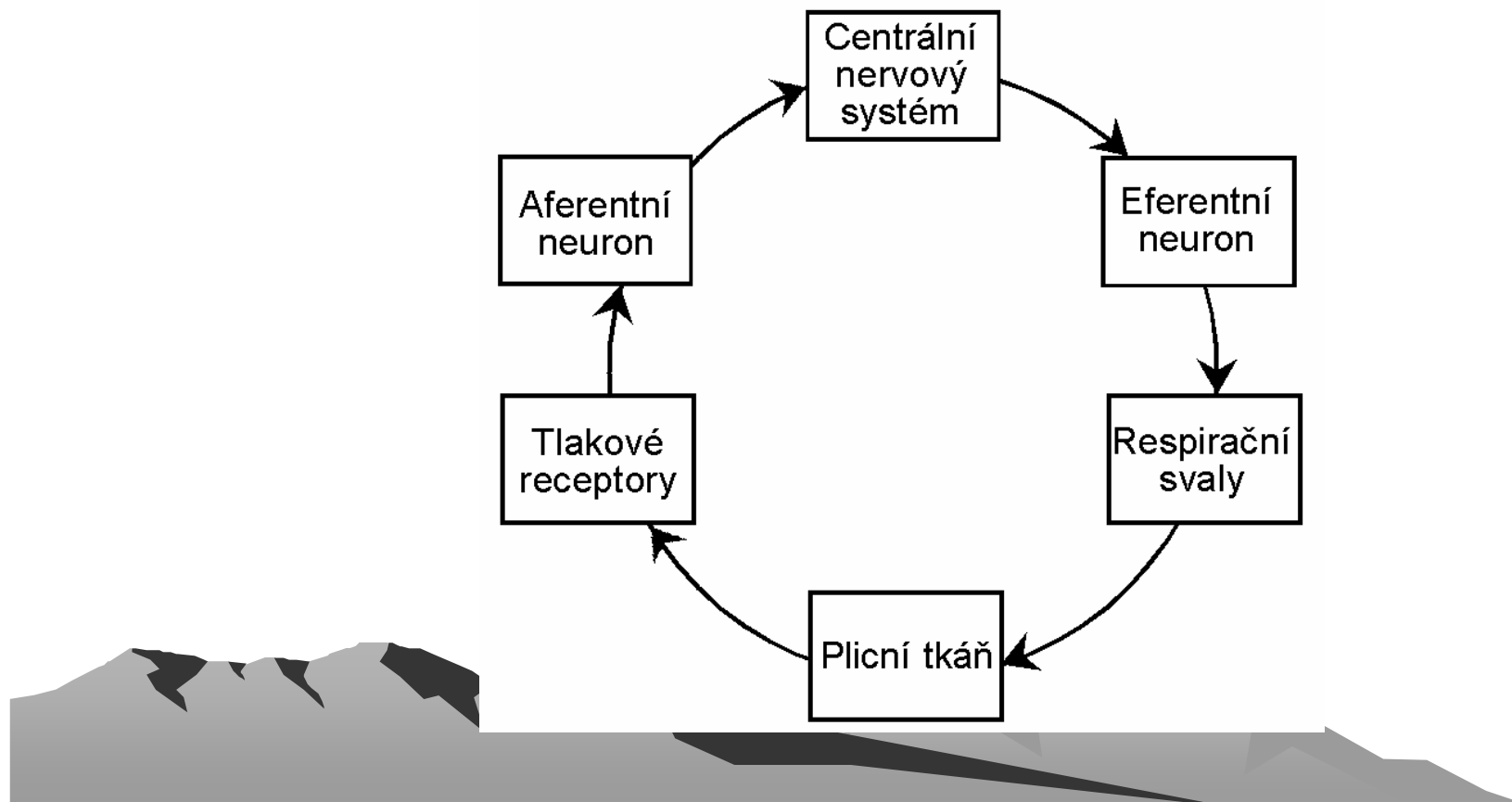
Negativní zpětná vazba je zdrojem kmitů – regulace homeostázy.



Rytmické děje jsou přirozenou součástí funkce organismu.

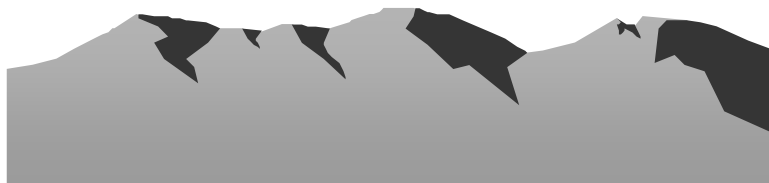
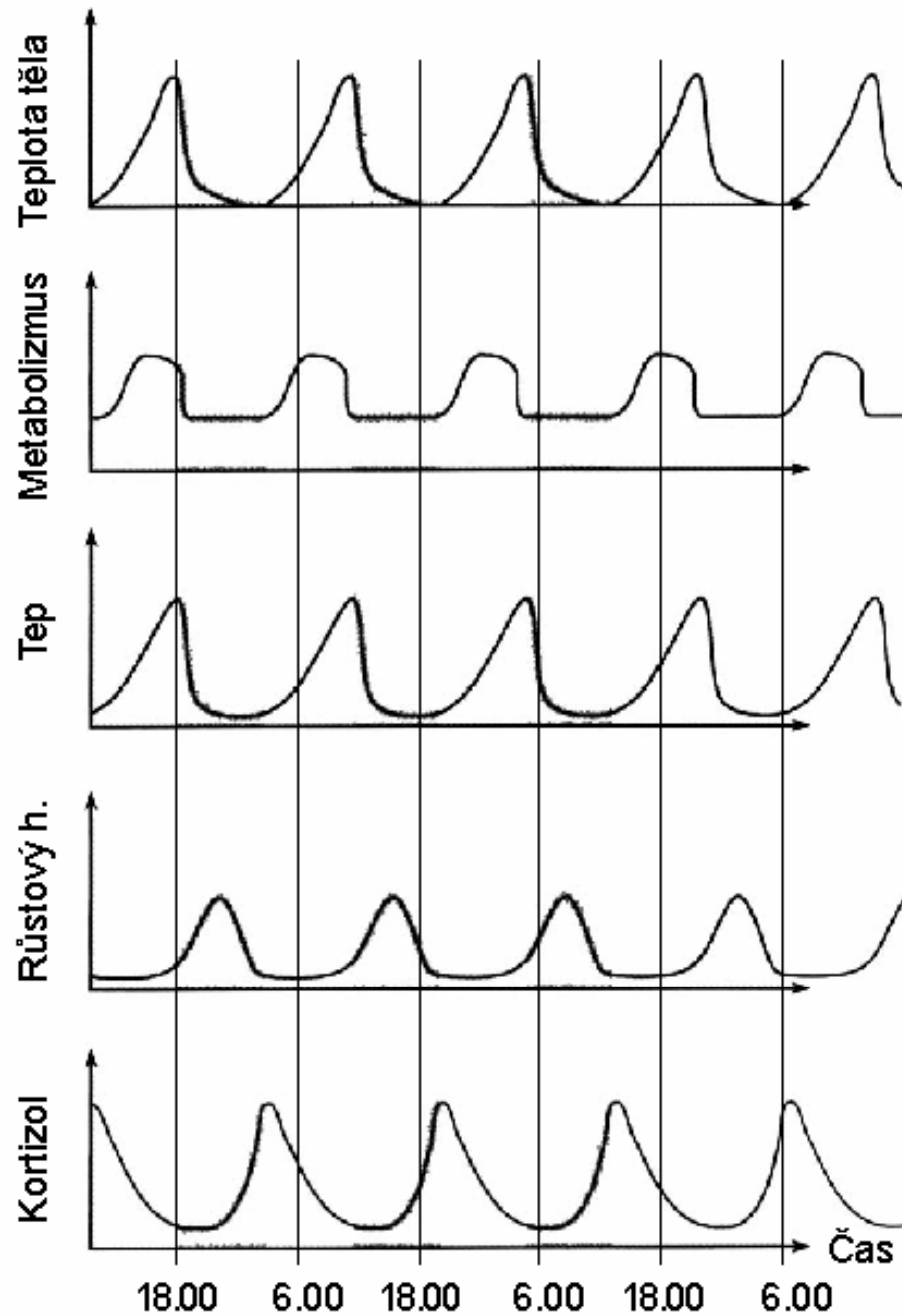
Bez vnějších korelátů: nervové vzruchy, srdeční rytmus, dechový rytmus...

Negativní zpětná vazba je zdrojem kmitů – regulace homeostázy.



Rytmicita s vazbou na prostředí

Cirkadiánní = asi 24 hod perioda



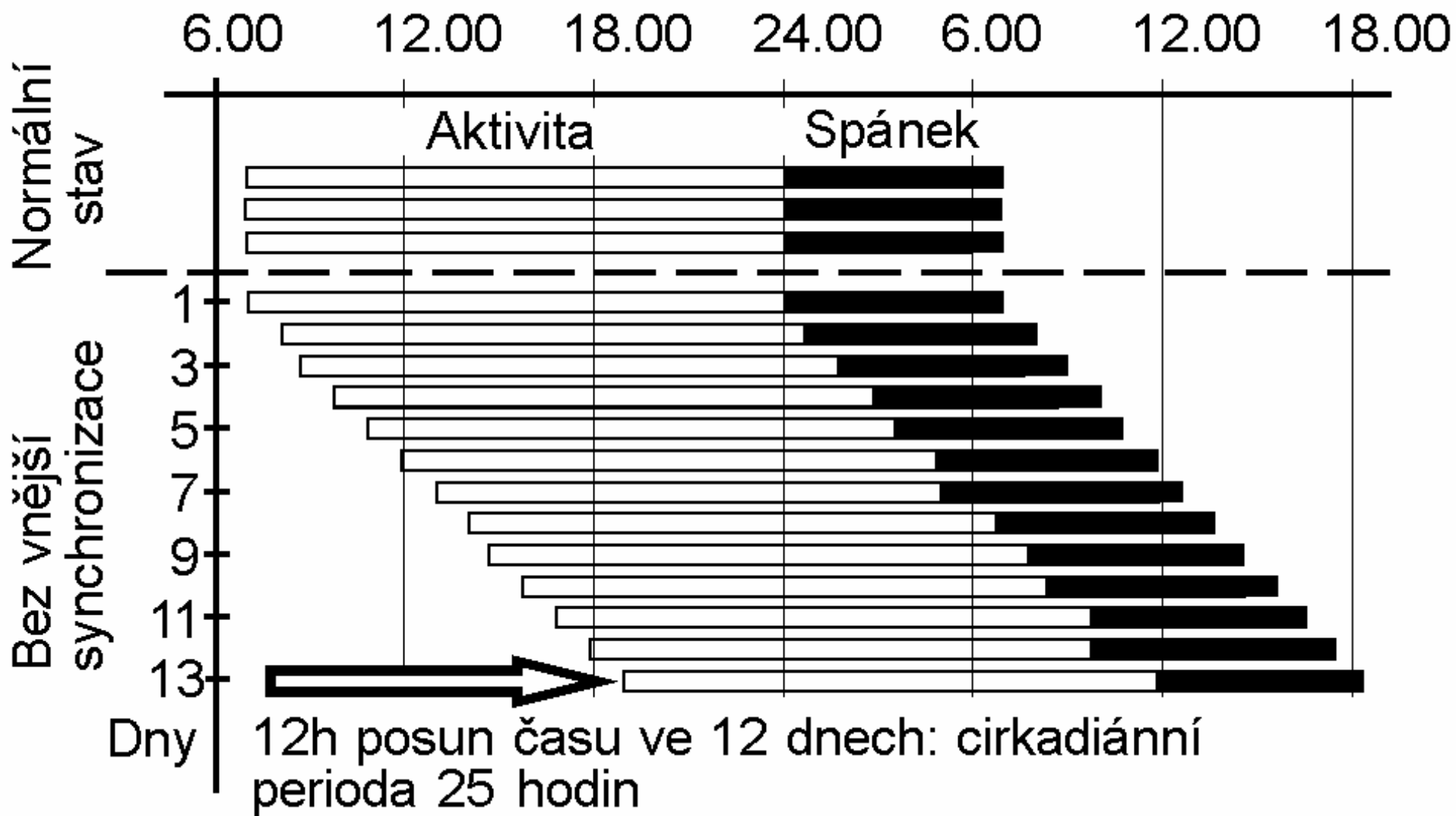
S vnějšími koreláty:

Synchronizátory:

Silné, slabé

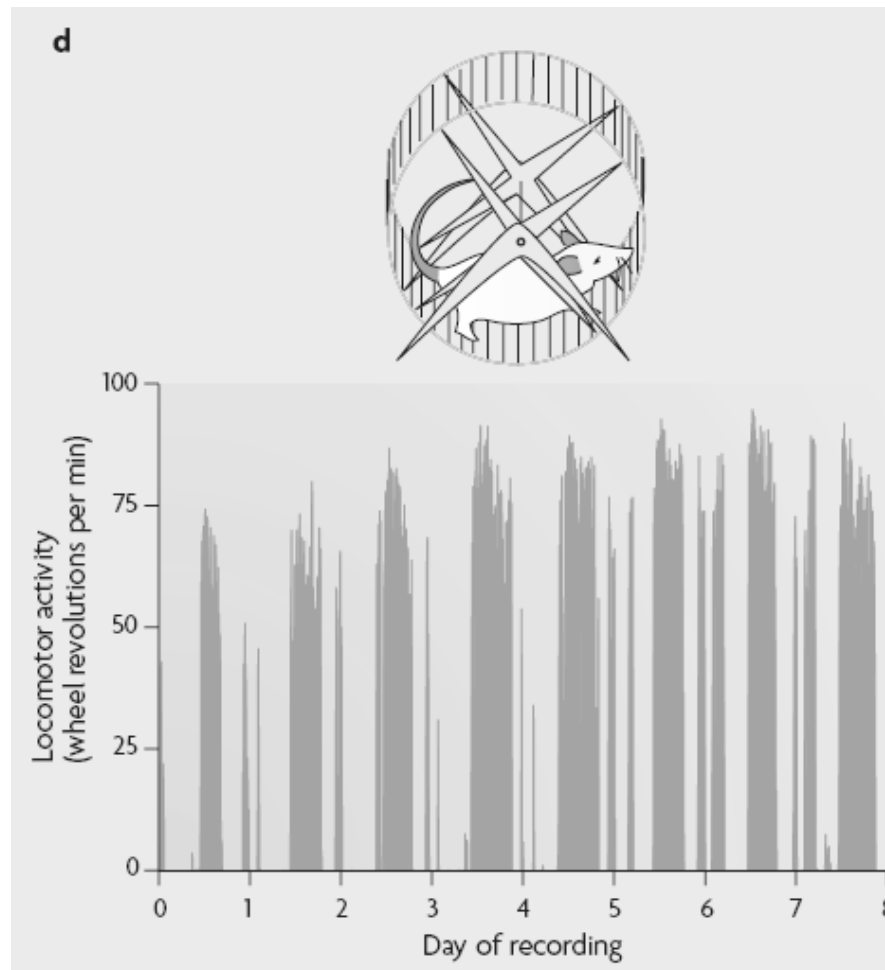
24 hodinové, lunární, anuální



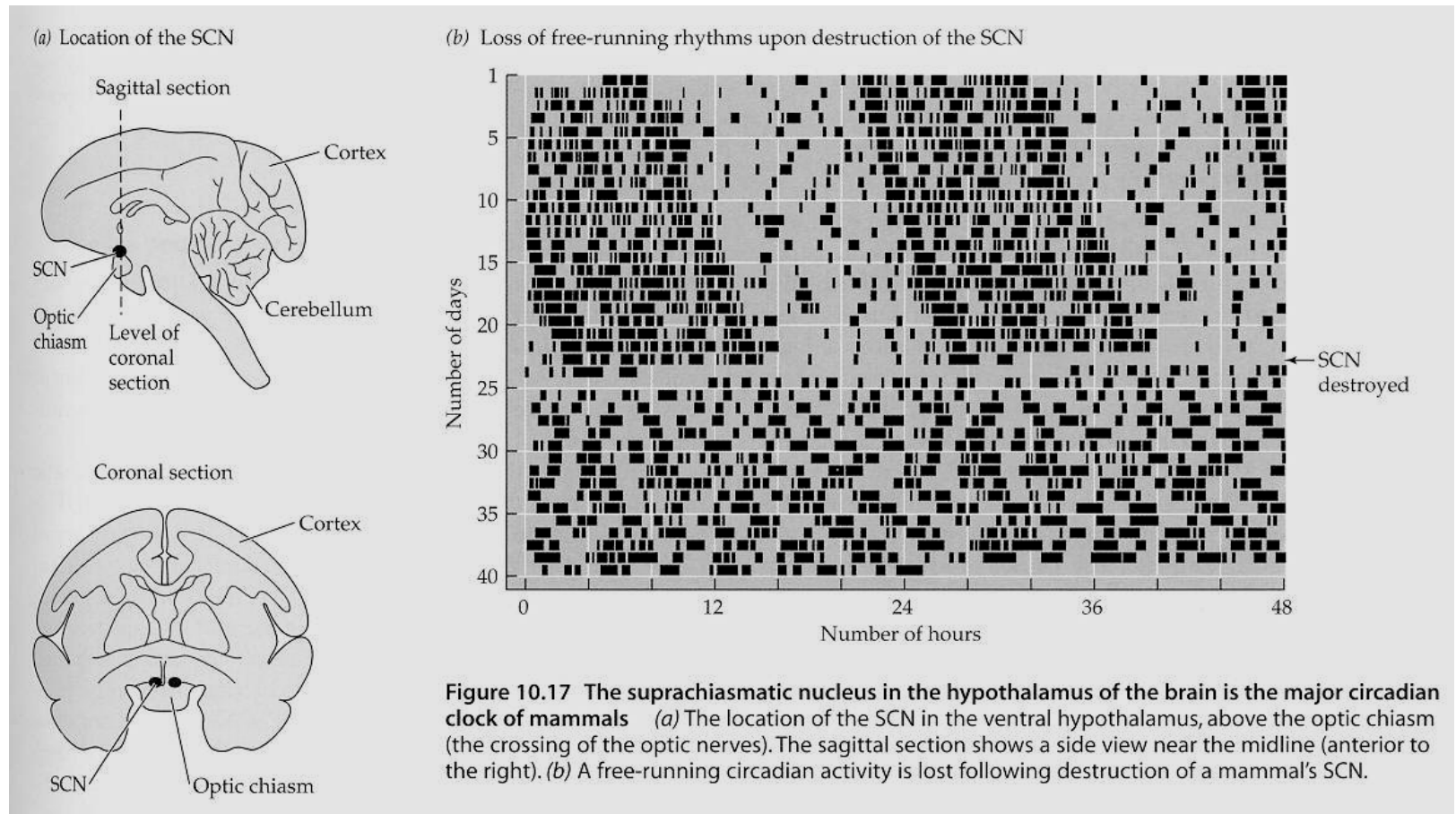




Jak se měří?  
Běhací kolo (mlýnek)



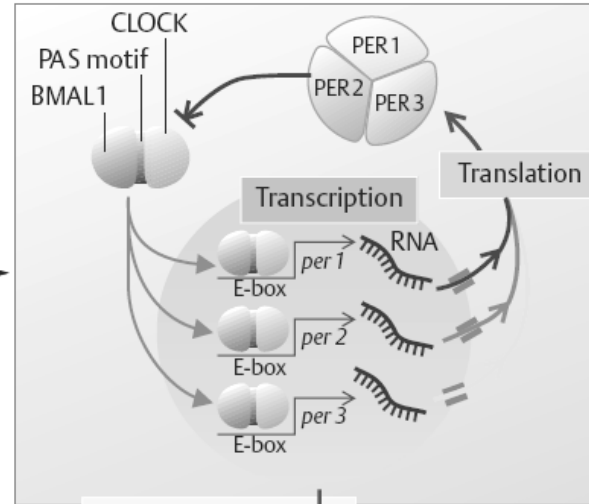
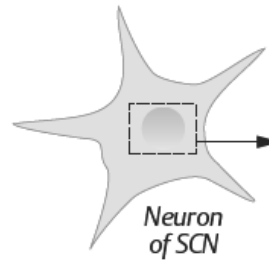
# Suprachiasmatické jádro a řízení motorické aktivity



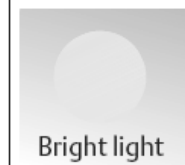
# Molekulární hodiny a zpětnovazebná smyčka synchronizovaná světlem.

## A. Circadian rhythm generator in suprachiasmatic nucleus (SCN)

1 Genetic feedback loop in SCN cells (oscillator)



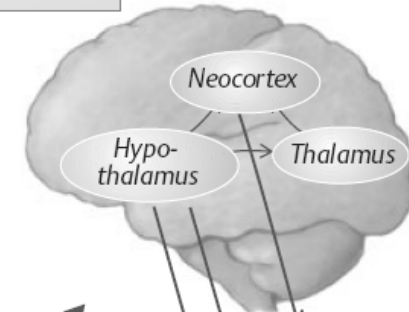
4 Effectorsystems in CNS



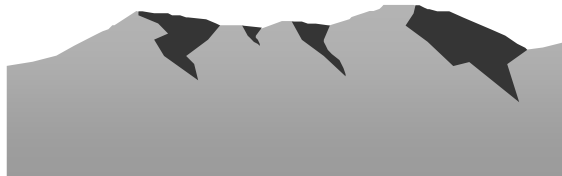
2 Zeitgeber



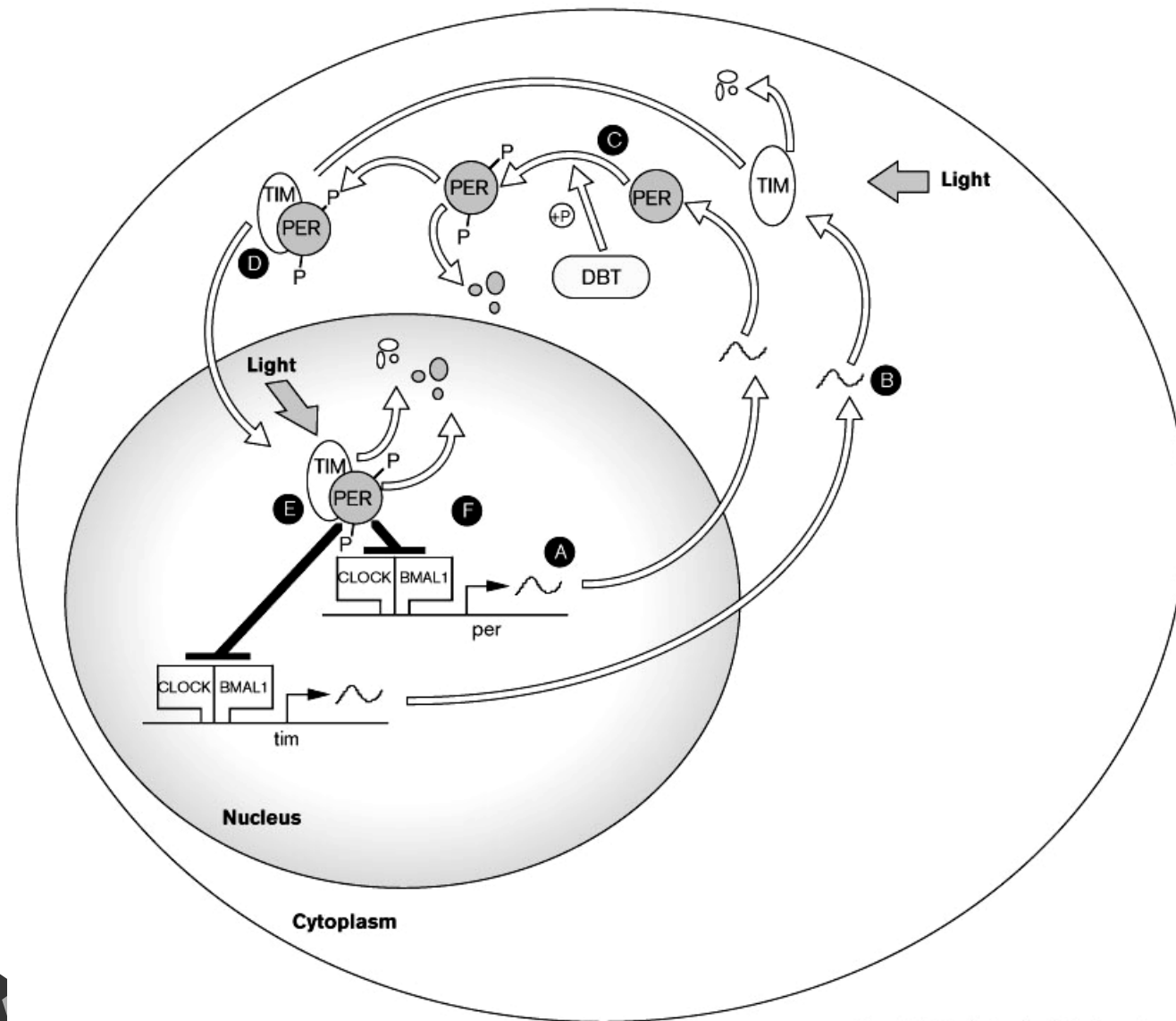
3 Coupled oscillators in SCN



5 Circadian rhythms of:  
- CRH secretion  
- Core temperature,  
- Sleep-wake cycle (see B),  
etc.



# Molekulární hodiny a zpětnovazebná smyčka synchronizovaná světlem.



# Centrální a periferní oscilátory

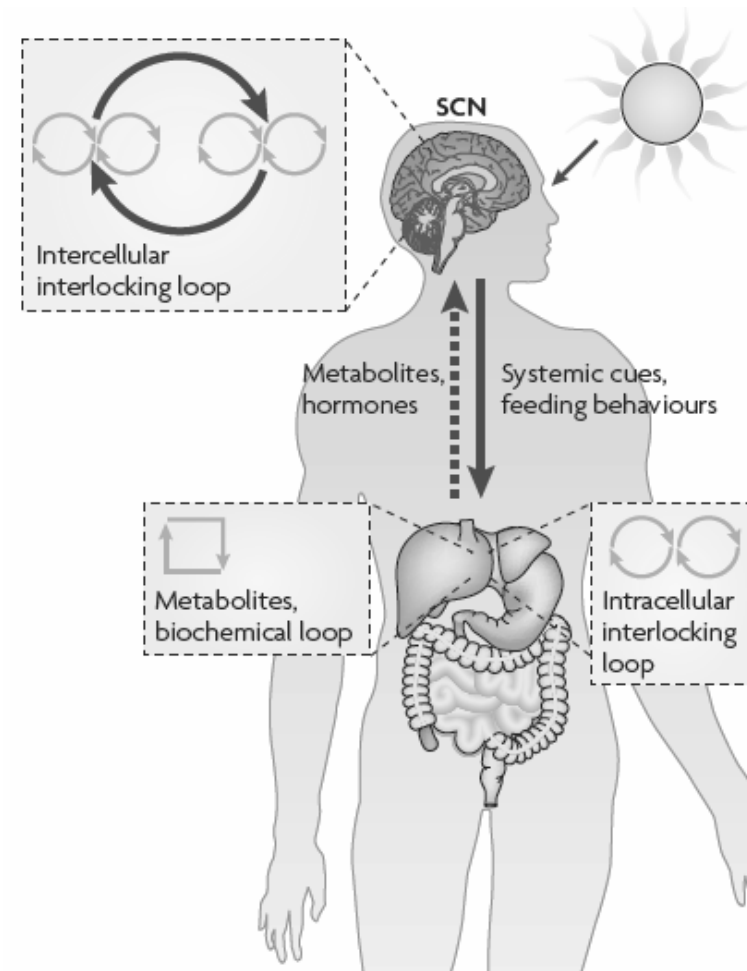
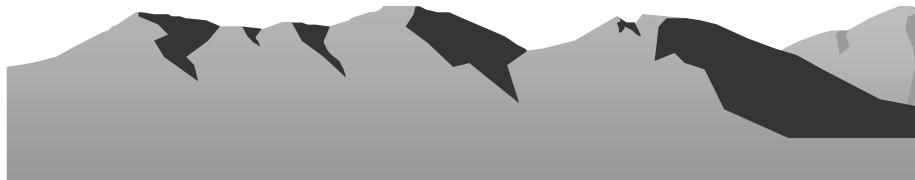
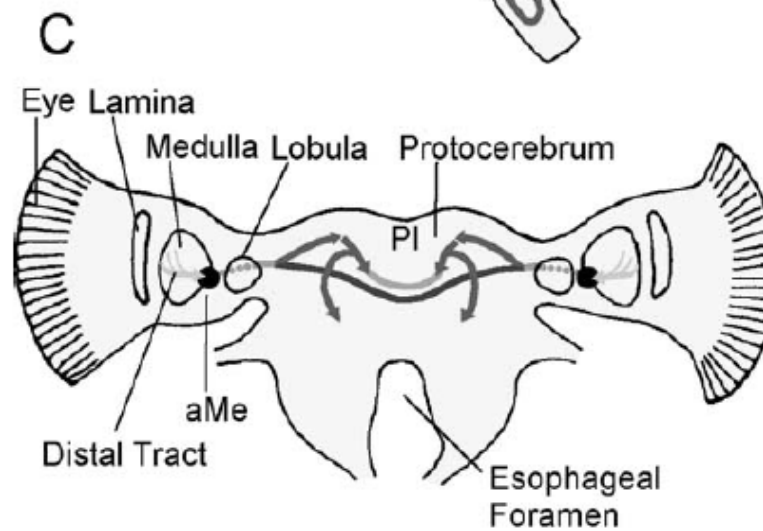
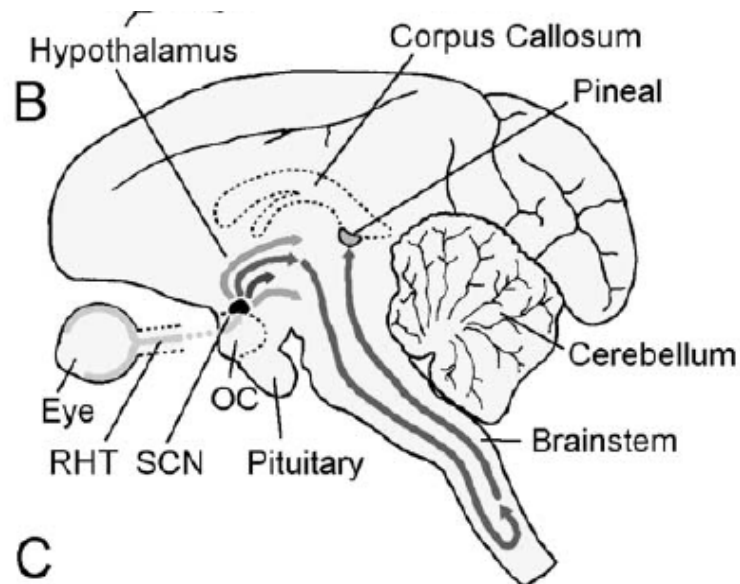


Figure 4 | **Loops surrounded by loops: whole organism oscillations in humans.** Intracellular clock regulation, which consists of multiple interlocking transcriptional and translational loops, exists in all the cells, including those located in the clock master, the suprachiasmatic nucleus (SCN), and the peripheral organs such as the liver. The SCN, however, possesses an additional intercellular regulation that synchronizes individual neurons into a robust pacemaker, which integrates environmental signals such as light, governs the rhythmic behaviour and sends out systemic cues to synchronize the whole body. By contrast, small molecules such as metabolites and hormones may feed back to regulate the peripheral and central clocks.



# Synchronizace světlem



Chronobiologie

Chronopatologie

