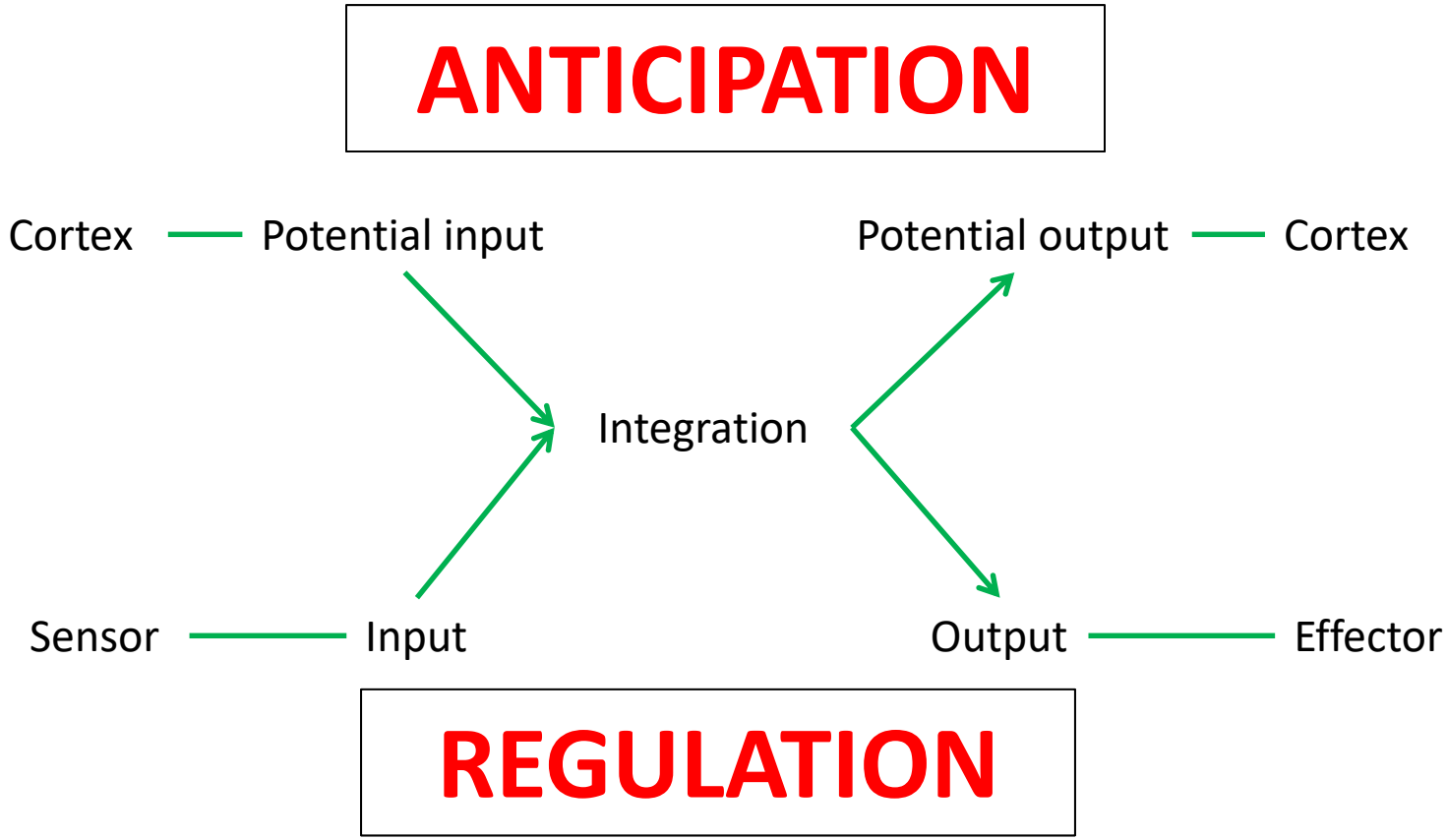
2

Hierarchy and evolution of nervous system

Evolutionary approach

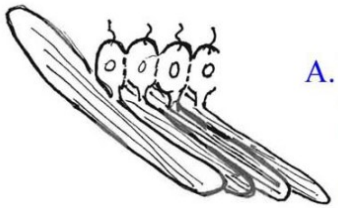
Evolution is not revolution

The role of nervous system



Evolution of the nervous system

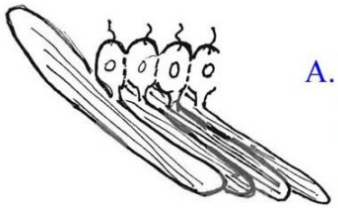
Input → Integration → Output



A. Myoepithelium: contractile epithelial cells responding to stimulation and interconnected by electrical synapses (gap junctions)

Evolution of the nervous system

Input → Integration → Output

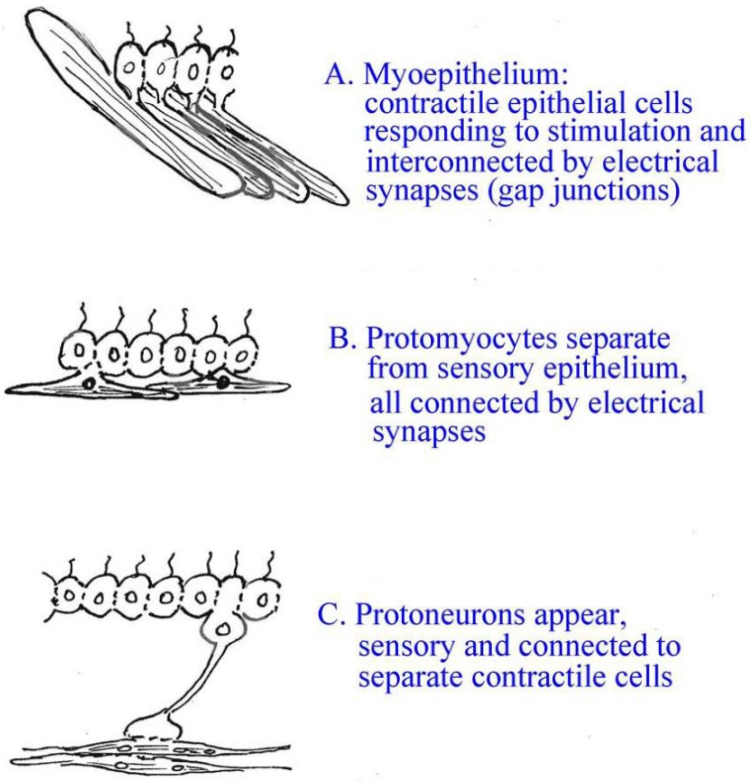


A. Myoepithelium: contractile epithelial cells responding to stimulation and interconnected by electrical synapses (gap junctions)

B. Protomyocytes separate from sensory epithelium, all connected by electrical synapses

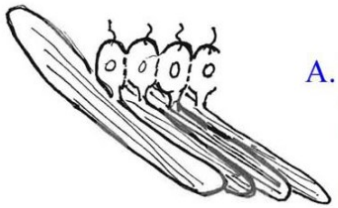
Evolution of the nervous system

Input → Integration → Output



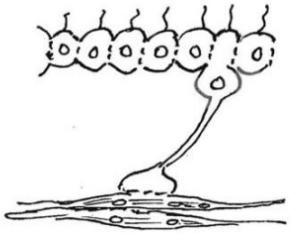
Evolution of the nervous system

Input → Integration → Output

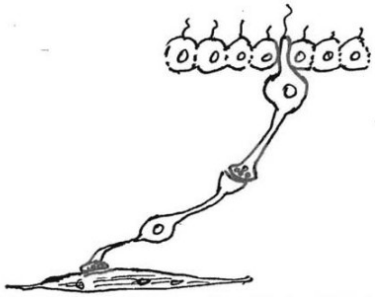


A. Myoepithelium: contractile epithelial cells responding to stimulation and interconnected by electrical synapses (gap junctions)

B. Protomyocytes separate from sensory epithelium, all connected by electrical synapses

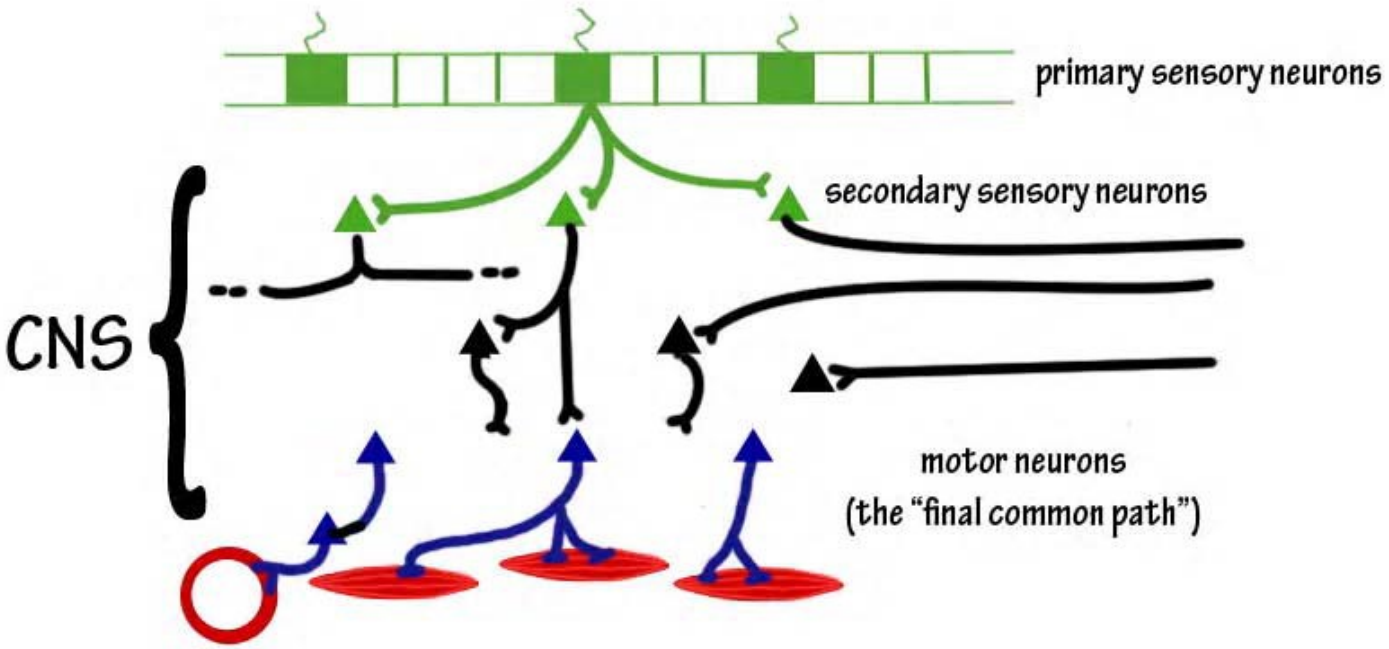


C. Protoneurons appear, sensory and connected to separate contractile cells



D. Neurons appear, separate from both neurosensory cells and contractile cells. Chemical synapses appear.

Evolution of the nervous system



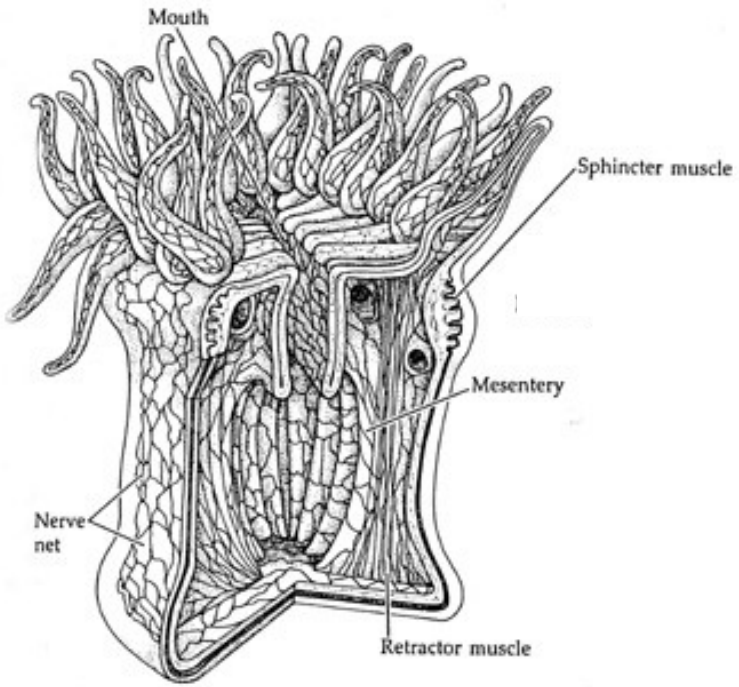
Input

Integration

Output

Evolution of the nervous system

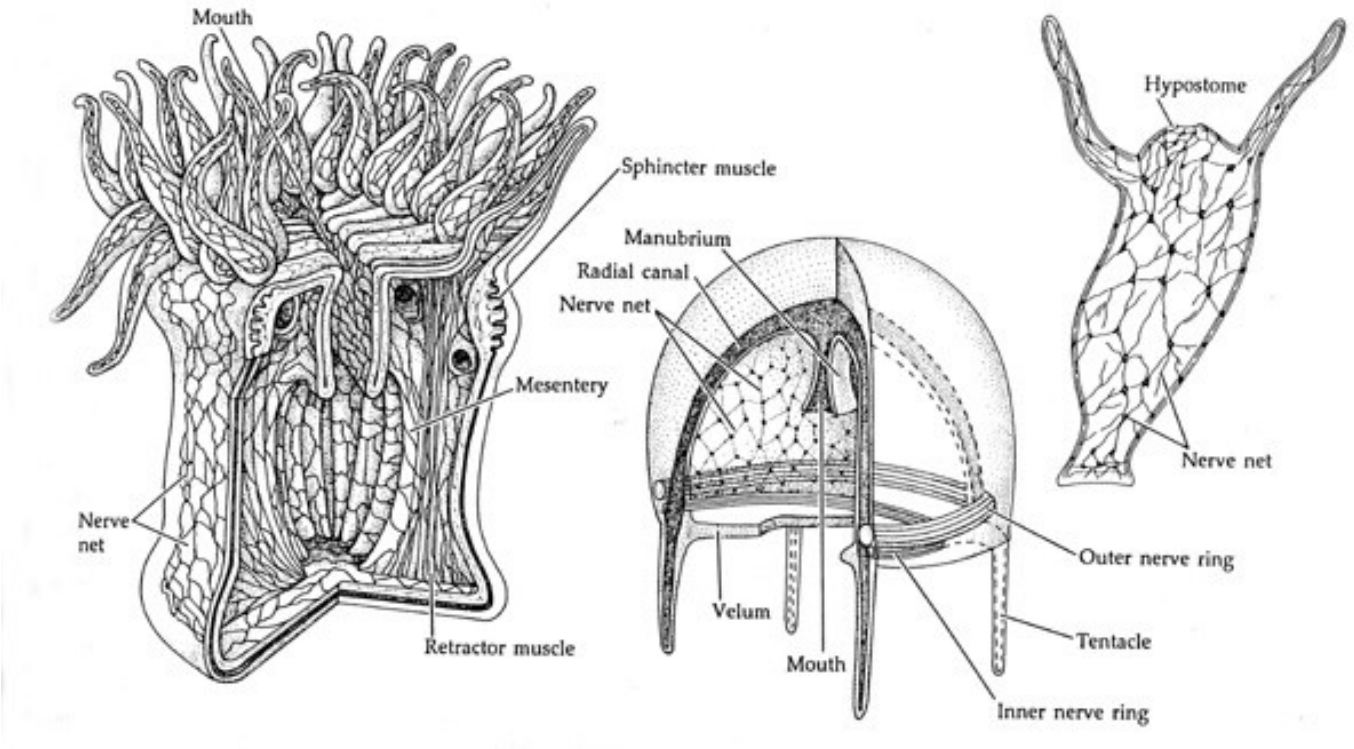
- Polyp
  - Reticular NS
  - Nonspecific reaction on irritation



http://xavierinterestingscience.weebly.com/cnidaria.html

Evolution of the nervous system

- Jellyfish
  - Around propulsion part is nervous system into the ring
  - Coordinated contraction – coordinated movement

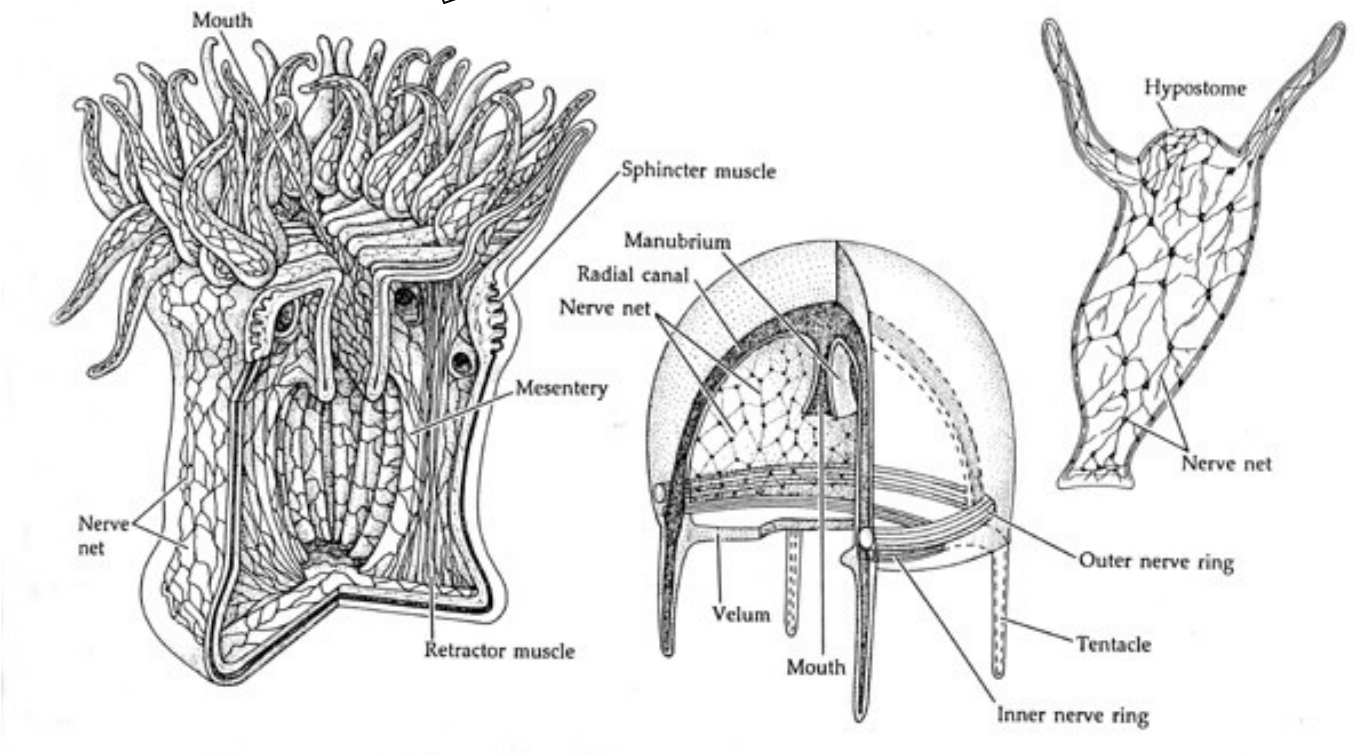


http://xavierinterestingscience.weebly.com/cnidaria.html

Evolution of the nervous system

- Jellyfish
  - Around propulsion par… …ystém into the ring
  - Coordinated cont… … coordinated movement

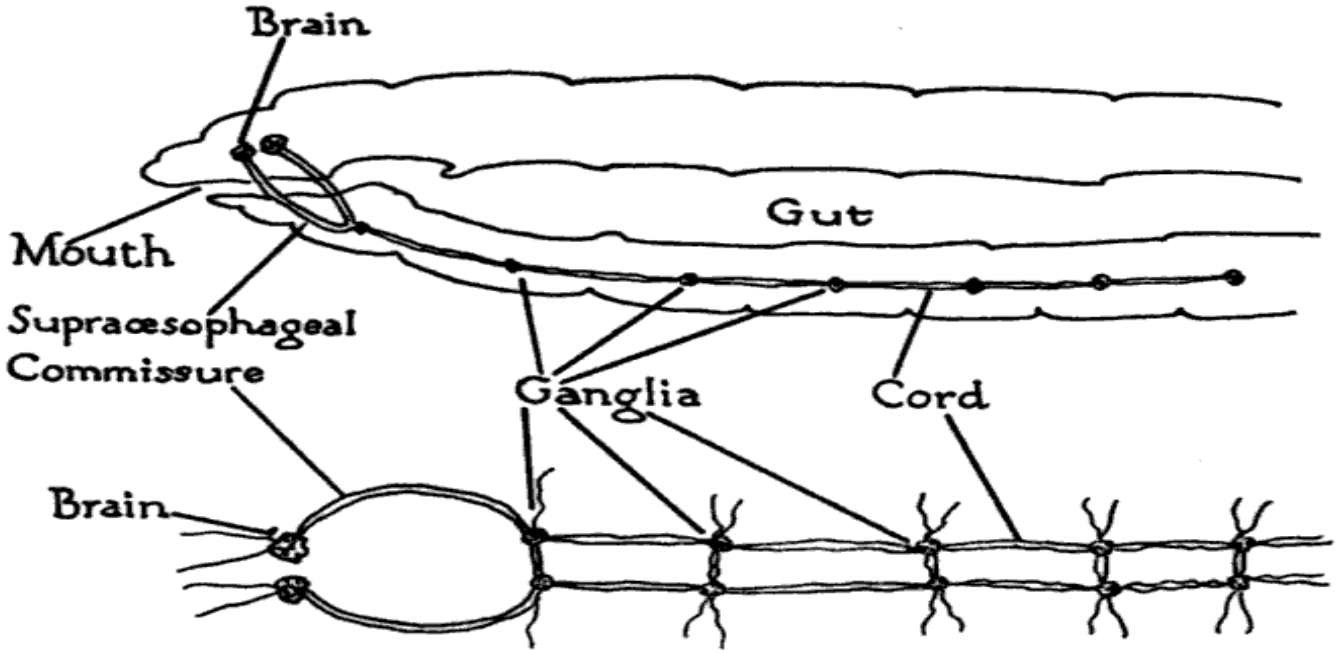
FOTORECEPTION



http://xavierinterestingscience.weebly.com/cnidaria.html

Evolution of the nervous system

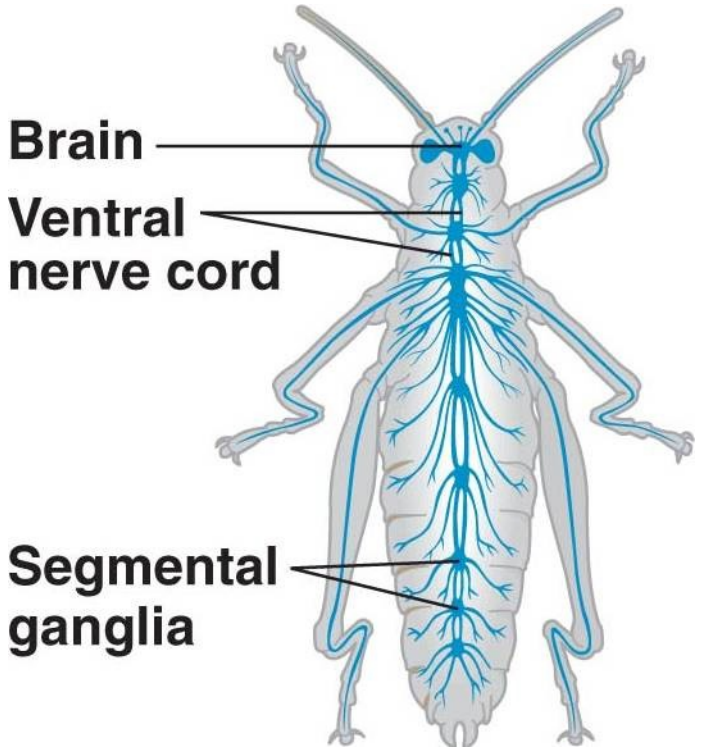
- Worms
  - Segmented nervous system
  - Left – right coordination
  - Ganglia
  - „Brain“ ganglion – head – forward locomotion – food intake



https://en.wikipedia.org/wiki/Earthworm

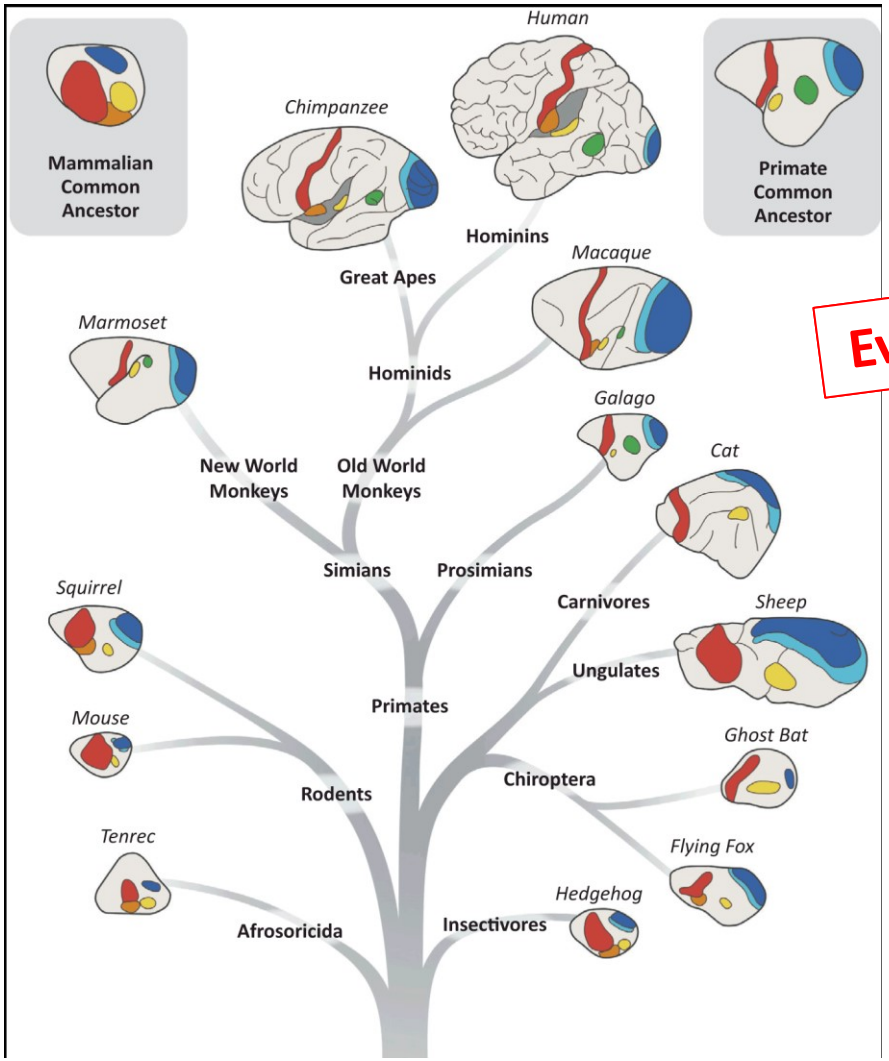
Evolution of the nervous system

- Insect
  - „Sophisticated“ NS
  - Coordinated movement
  - „Developed“ senses
  - Communication skills (bee)



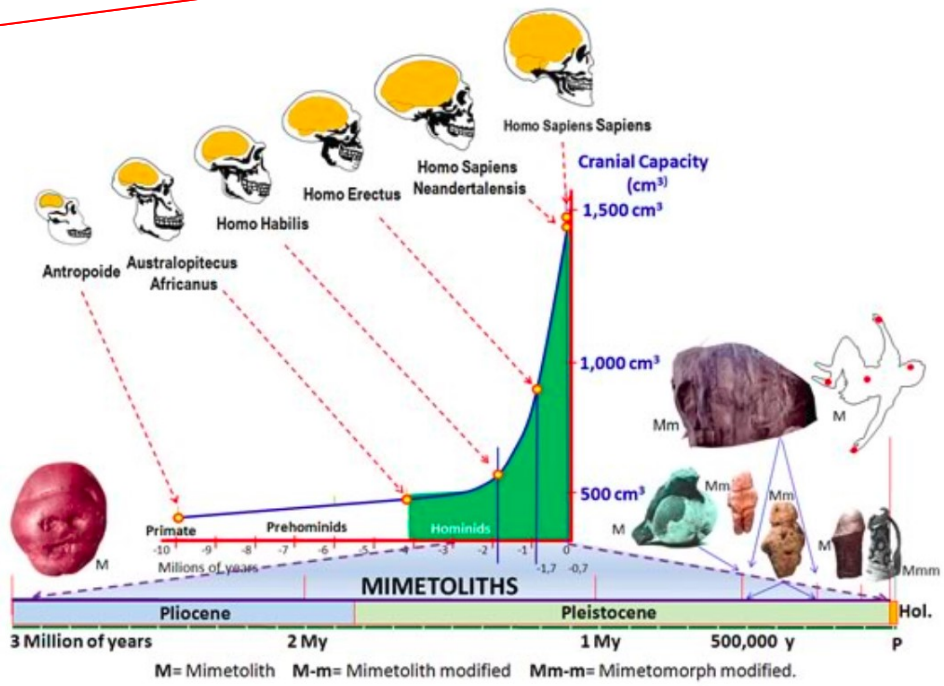
http://bilingualbiology10.blogspot.cz/2013/08/topic-11b-arthropods-izeltlabuak.html

Evolution of the nervous system



- Mammalians and humans
  - Peak of NS development

Evolution is shaped by environment



http://scienceblogs.com/pharyngula/2013/12/27/frugal-to-the-point-of-vacuity/

http://www.rupestreweb.info/mimesis.html

Basics of behavior enabling survival

- **Multipurpose movements**
  - The most basic actions of individual organisms
  - ***Locomotion***: to approach or to avoid something
  - ***Orienting***: towards or away from something
  - ***Exploring/foraging/seeking*** (includes the first two plus motivation)

Basics of behavior enabling survival

- **Multipurpose movements**
  - The most basic actions of individual organisms
  - ***Locomotion***: to approach or to avoid something
  - ***Orienting***: towards or away from something
  - ***Exploring/foraging/seeking*** (includes the first two plus motivation)
- **Background (maintenance) activity**
  - respiration, temperature regulation, postural reflexes

Basics of behavior enabling survival

- **Multipurpose movements**
  - The most basic actions of individual organisms
  - ***Locomotion***: to approach or to avoid something
  - ***Orienting***: towards or away from something
  - ***Exploring/foraging/seeking*** (includes the first two plus motivation)
- **Background (maintenance) activity**
  - respiration, temperature regulation, postural reflexes
- **Motivation**

Head receptors and forward locomotion - sophisticated sensorimotor abilities

- **Sensory analyzing mechanisms**
  - Connected to inputs from cranial nerves

Head receptors and forward locomotion - sophisticated sensorimotor abilities

- **Sensory analyzing mechanisms**
  - Connected to inputs from cranial nerves
- **Associated motor apparatus**
  - For directing the receptors (orienting movements)
  - For controlling alterations in posture and locomotion under guidance from these receptors

Evolution of the brain

- Neural tube
- Locomotion
- Rostral receptors

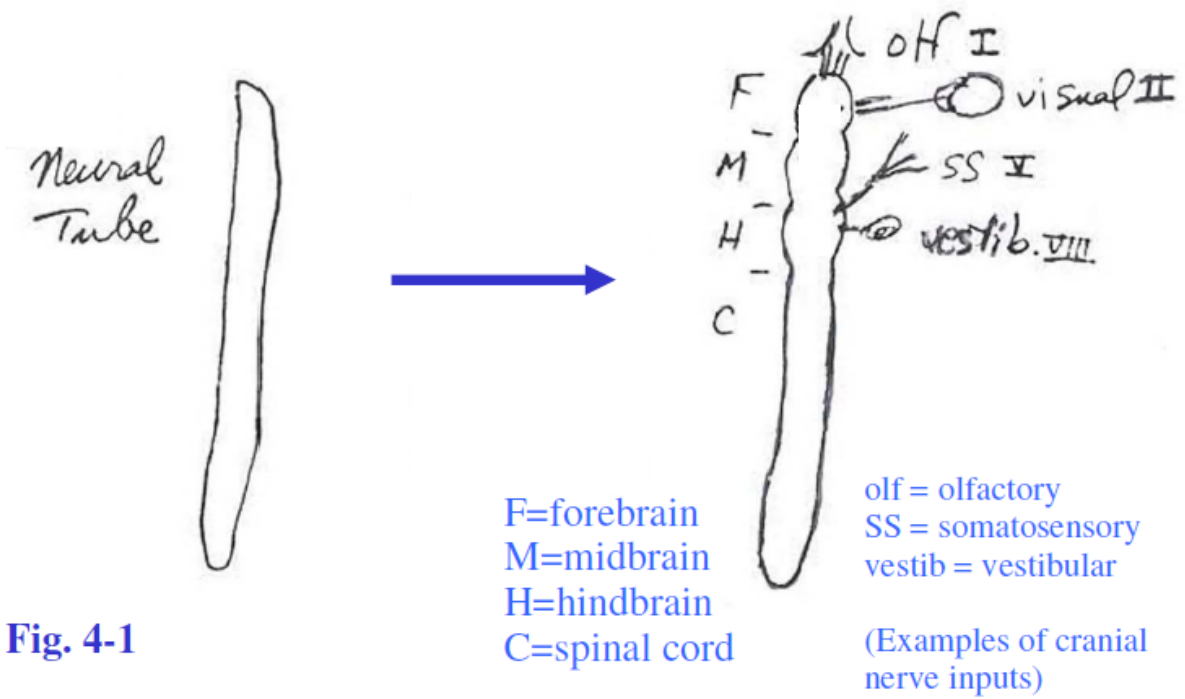


Fig. 4-1

Evolution of the brain

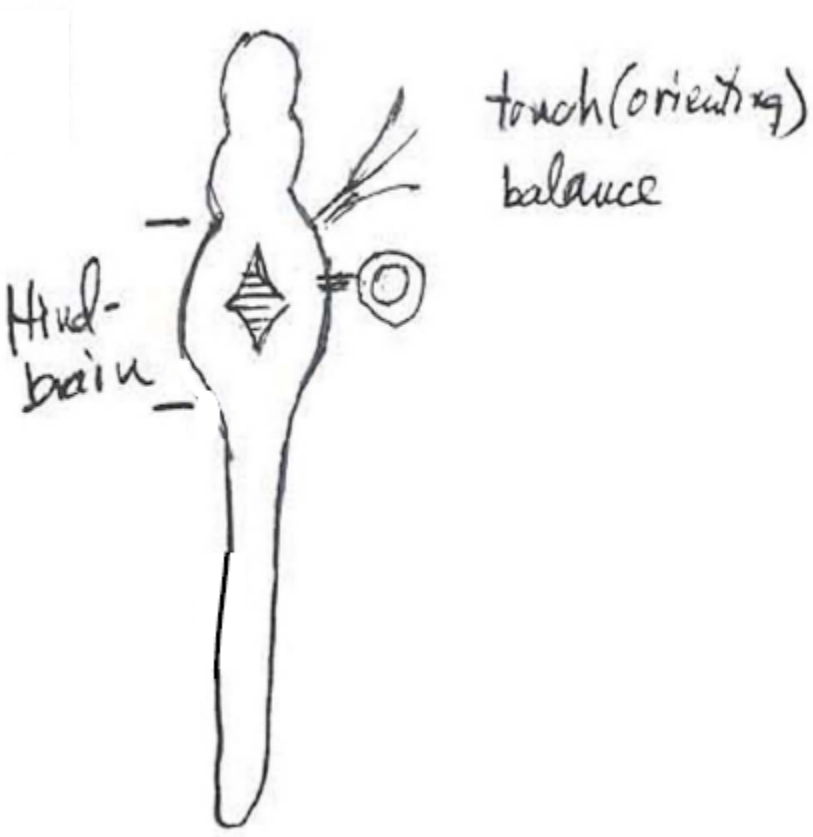
- **Expansion of hindbrain**

  (Rhombencefalon - Medula oblongata, pons Varoli, cerebellum)

- Input
  - Information form head sensors

- Output
  - Motor system

    (Fixed action pattern - reflex/instinct behavior)



Evolution of the brain

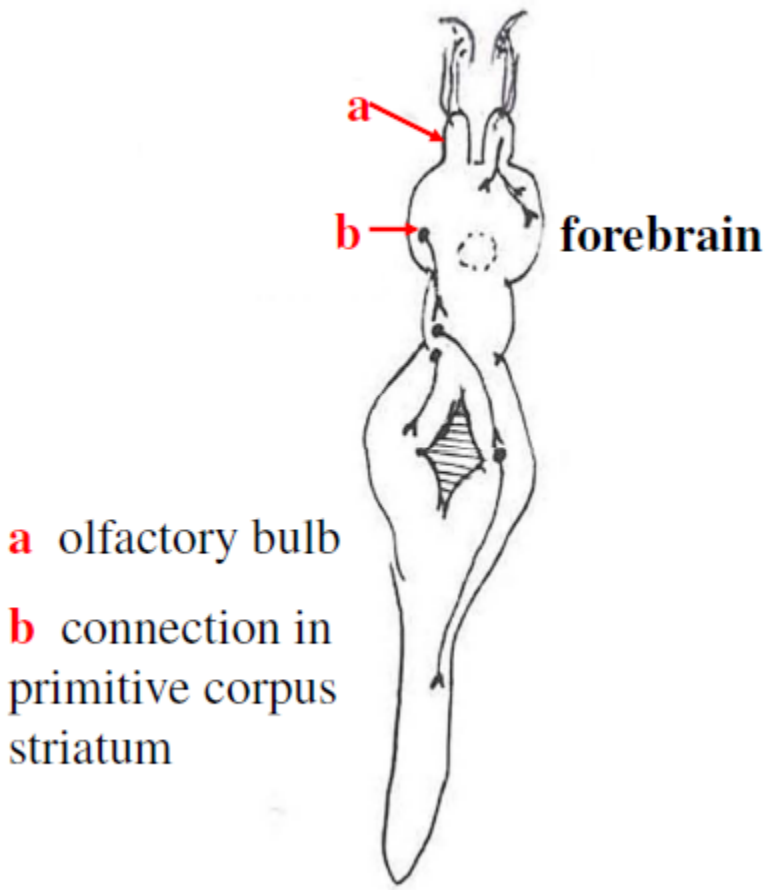
- **Expansoin of forebrain 1**

  (Prosencephalon - diencephalon, telencephalon)

  (simultaneously with hindbrain)

- Input
  - Olfaction (Approach/avoidance)
- Output
  - Motor system

    (via corpus striatum)



Evolution of the brain

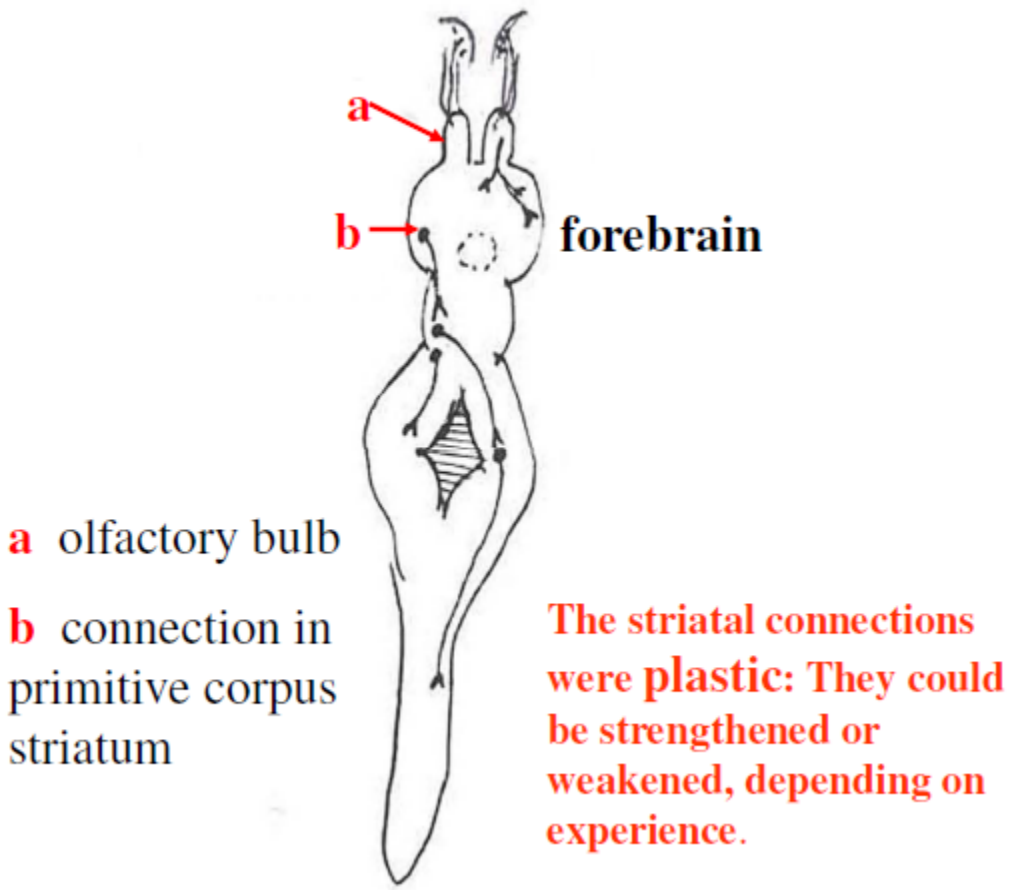
- **Expansoin of forebrain 1**

  (Prosencephalon - diencephalon, telencephalon)

  (simultaneously with hindbrain)

- Input
  - Olfaction (Approach/avoidance)
- Output
  - Motor system

    (via corpus striatum)



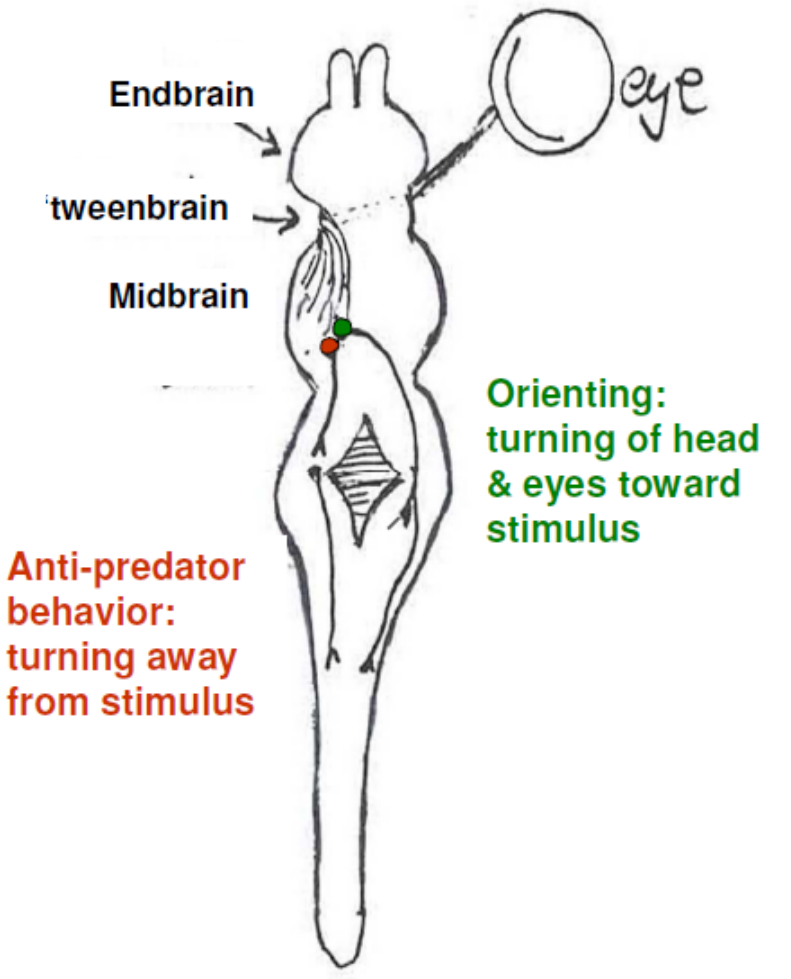
Evolution of the brain

- **Expansion of midbrain**

- Input
  - Vision, sense of hearing (distant senses)

- Output
  - Motor system
    (Approach – contralateral m.)
    (Avoidance – ipsilateral m.)

- Advantage
  - Speed
  - Acuity



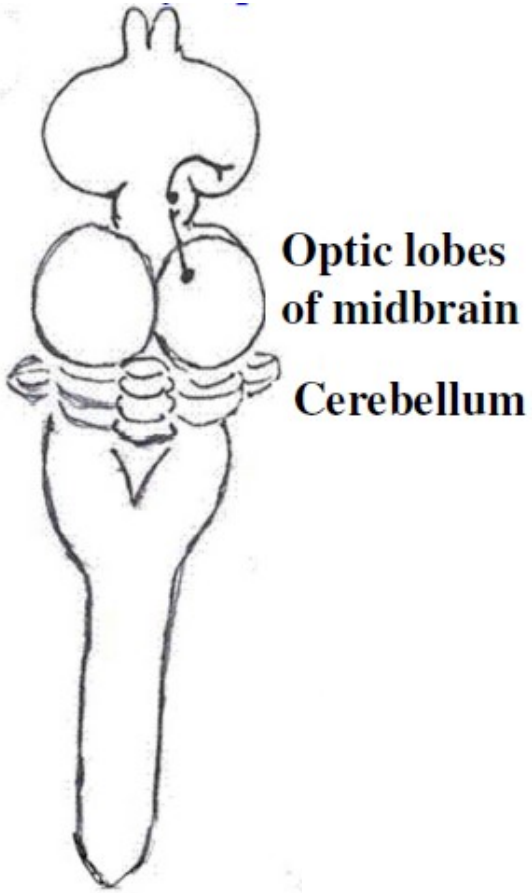
Evolution of the brain

- **Expansoin of forebrain 2**

  (Prosencephalon - diencephalon, telencephalon)

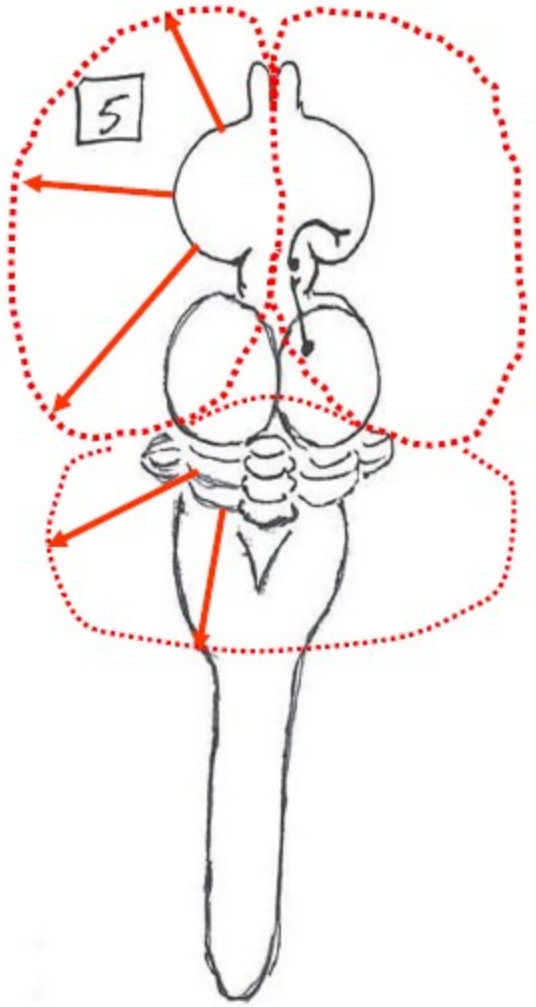
- Input
  - Nonolfactory systems connected to forebrain
  - Mainly vision and hearing
- Advantage
  - Plastic connections of forebrain
- Thalamus
  - Gating

    (Corpus striatum and cortex)



Evolution of the brain

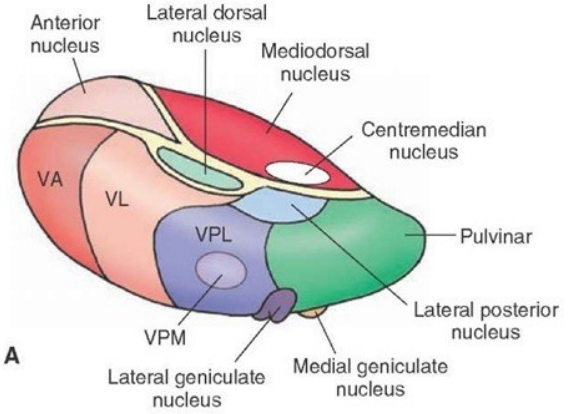
- **Expansoin of forebrain 3**
- Neocortica expansion
- Simultaneous expansion of
  - Neostiratum
  - Neocerebellum
- Advantage
  - „High resolution“ information processing
  - Anticipation



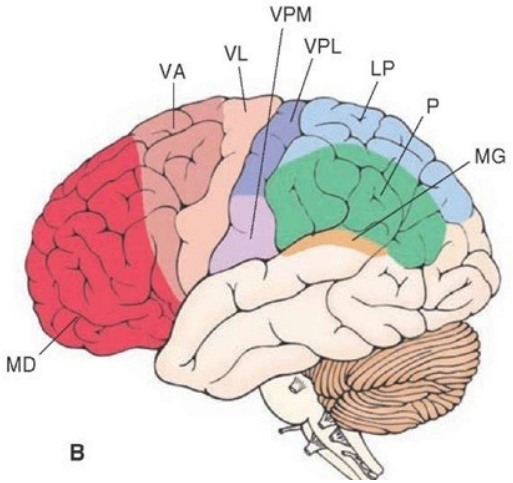
Thalmus and neocortex

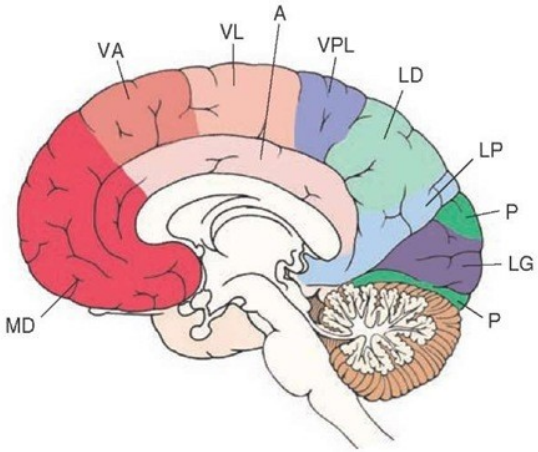
Gating

- Thalamic nuclei
  - Nonspecific
  - Specific



- Reciprocal connections between thalamus and neocortex

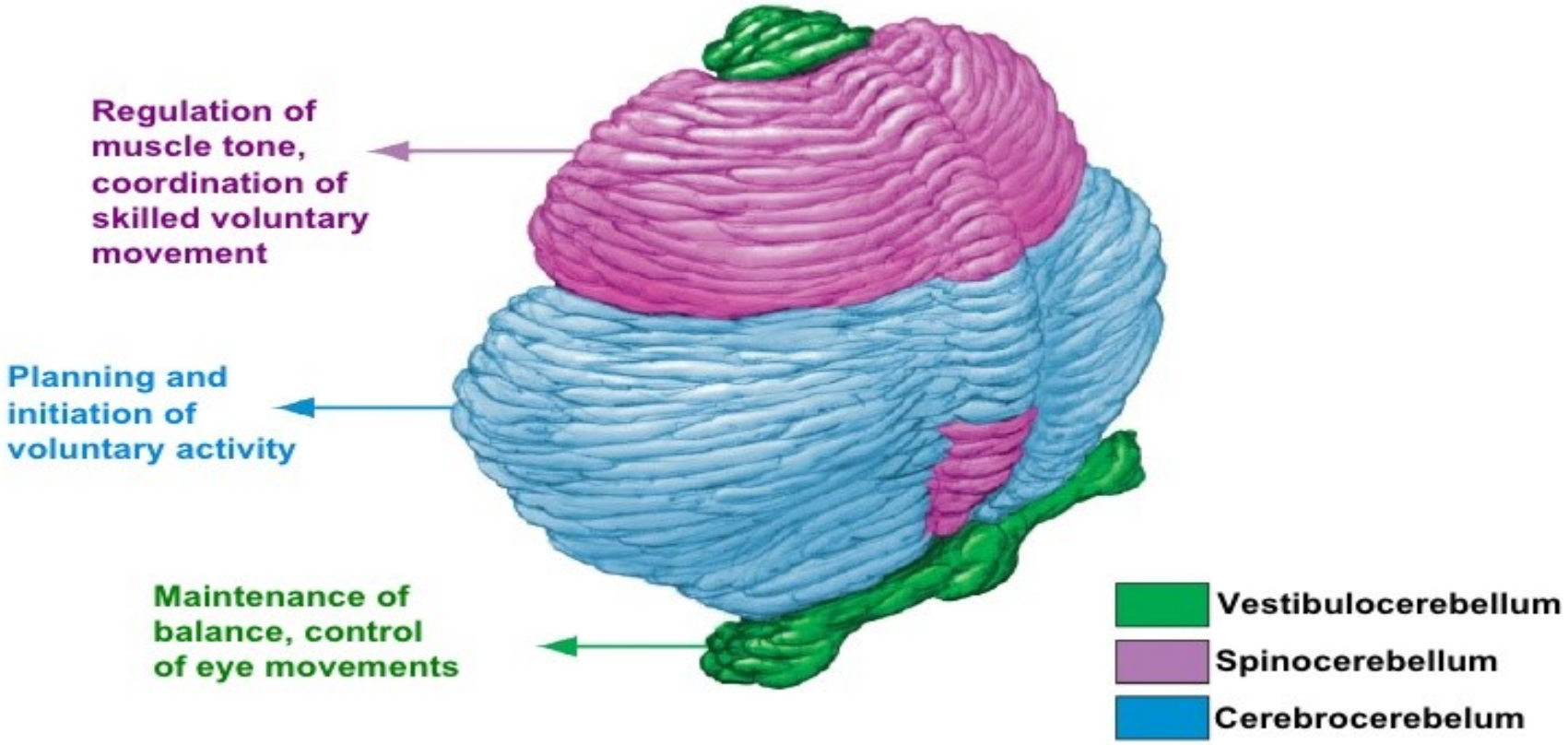




http://what-when-how.com/neuroscience/the-thalamus-and-cerebral-cortex-integrative-systems-part-2/

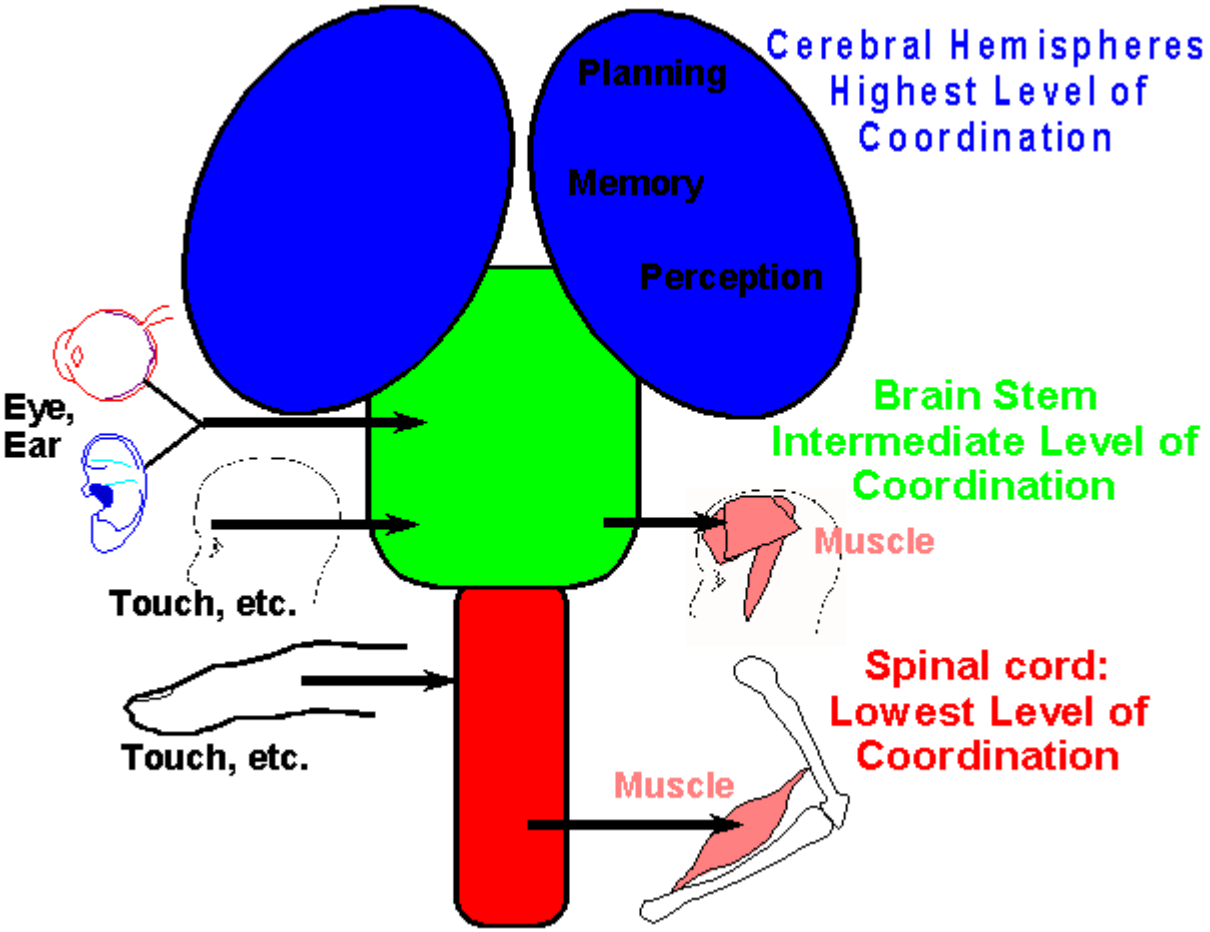
Cerebellum

Coordination



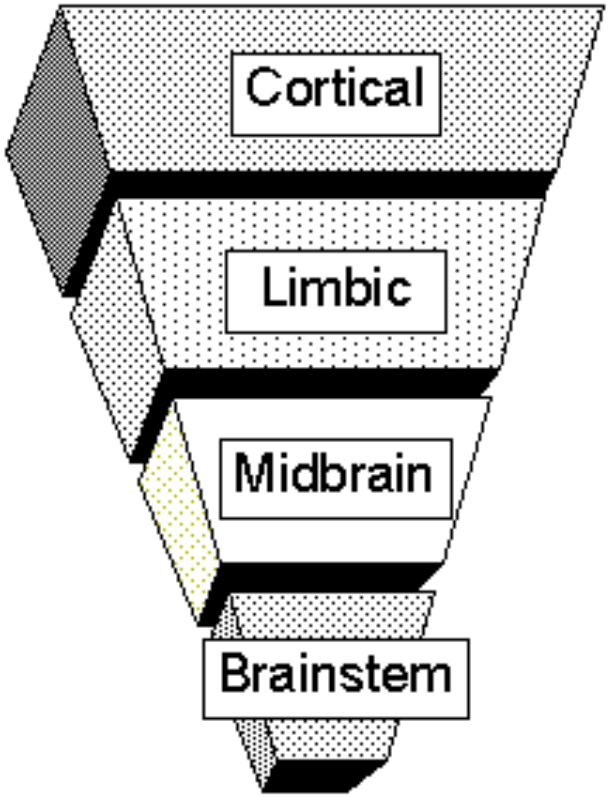
http://www.slideshare.net/HarshshaH103/cerebellum-its-function-and-releveance-in-psychiatry

Hierarchy of central nervous system



http://www.indiana.edu/~p1013447/dictionary/cns.htm

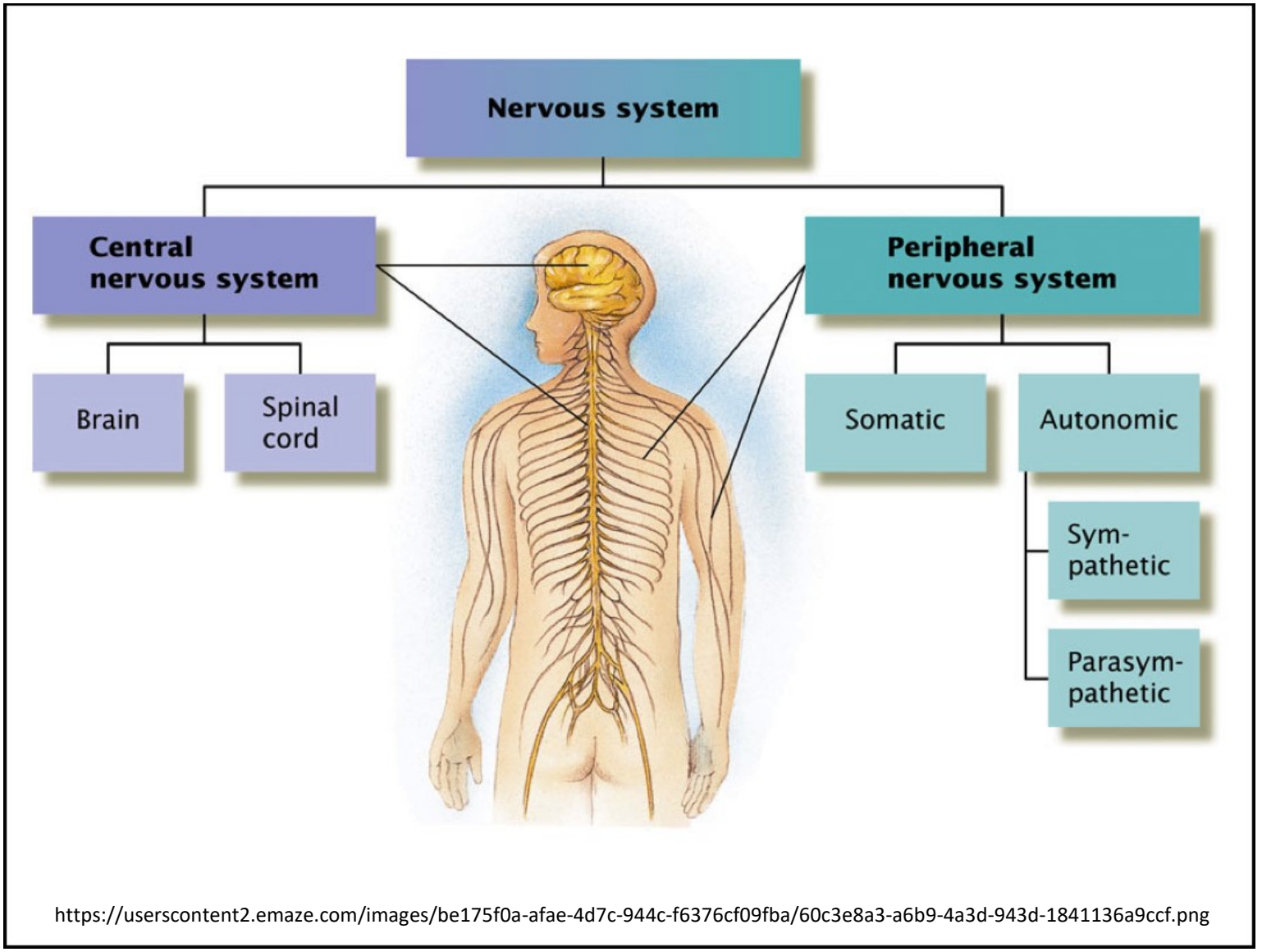
Hierarchy of central nervous system



Abstract Thought
Concrete Thought
Affiliation
Attachment
Sexual Behavior
Emotional Reactivity
Motor Regulation
"Arousal"
Appetite/Satiety
Sleep
Blood Pressure
Heart Rate
Body Temperature

https://rajugurusamy.files.wordpress.com/2007/11/memories1.gif?w=497

Hierarchy of central nervous system



https://userscontent2.emaze.com/images/be175f0a-afae-4d7c-944c-f6376cf09fba/60c3e8a3-a6b9-4a3d-943d-1841136a9ccf.png