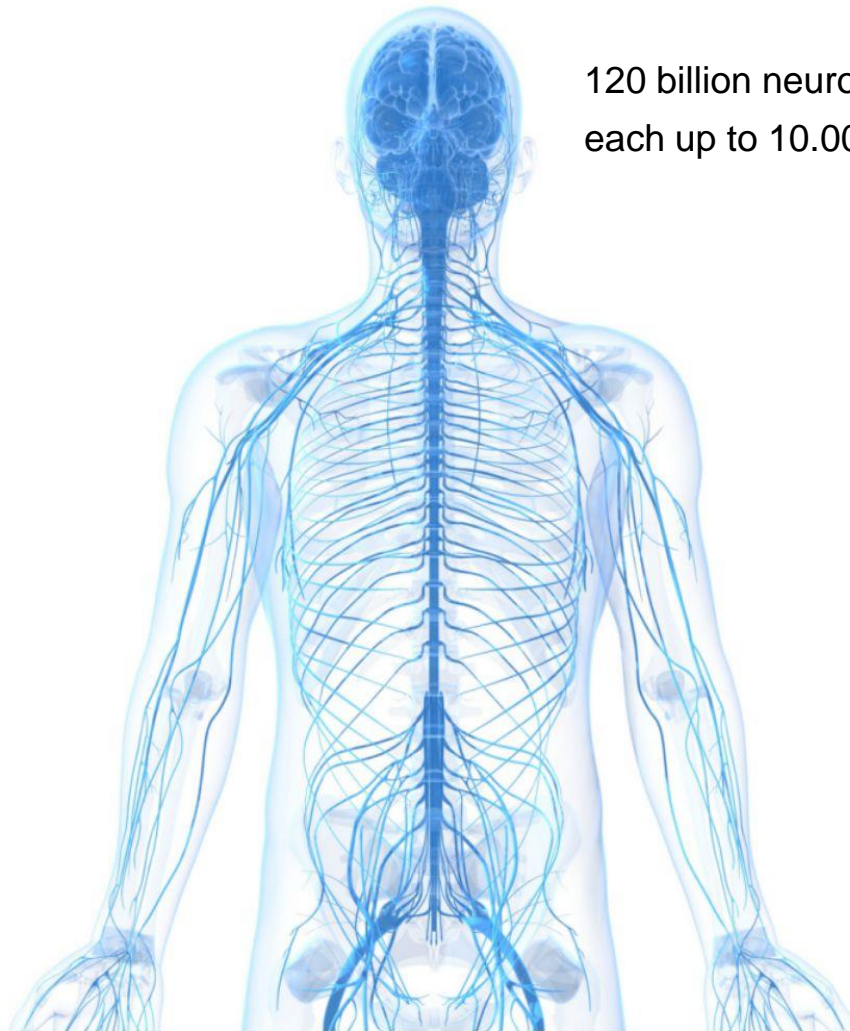


The human nervous system

■ The human nervous system

→ continuously collect and process sensory information and adapt accordingly



120 billion neurons (or more?),
each up to 10.000 connections

■ The human nervous system: structural organization



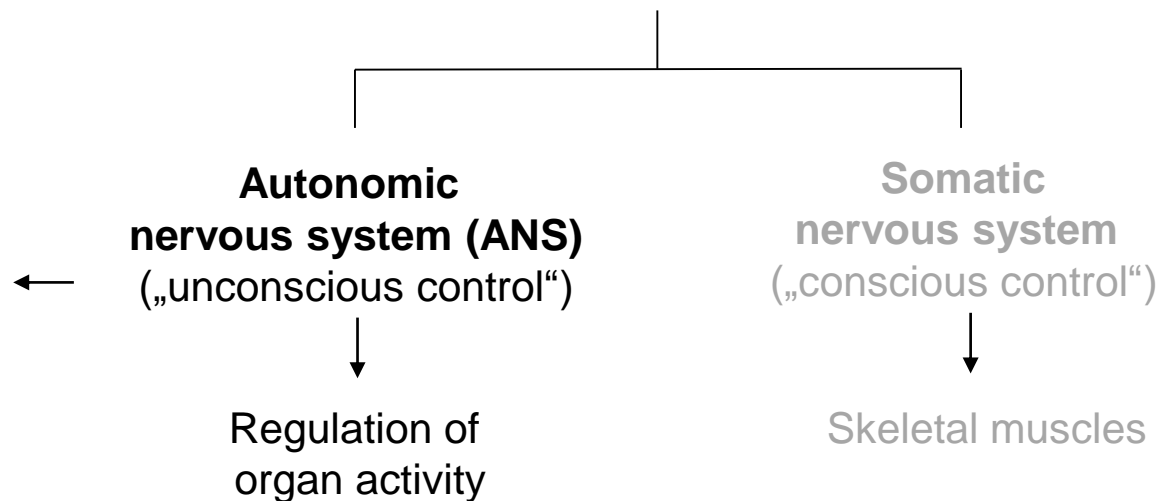
Central nervous system (CNS)



Peripheral nervous system (PNS)

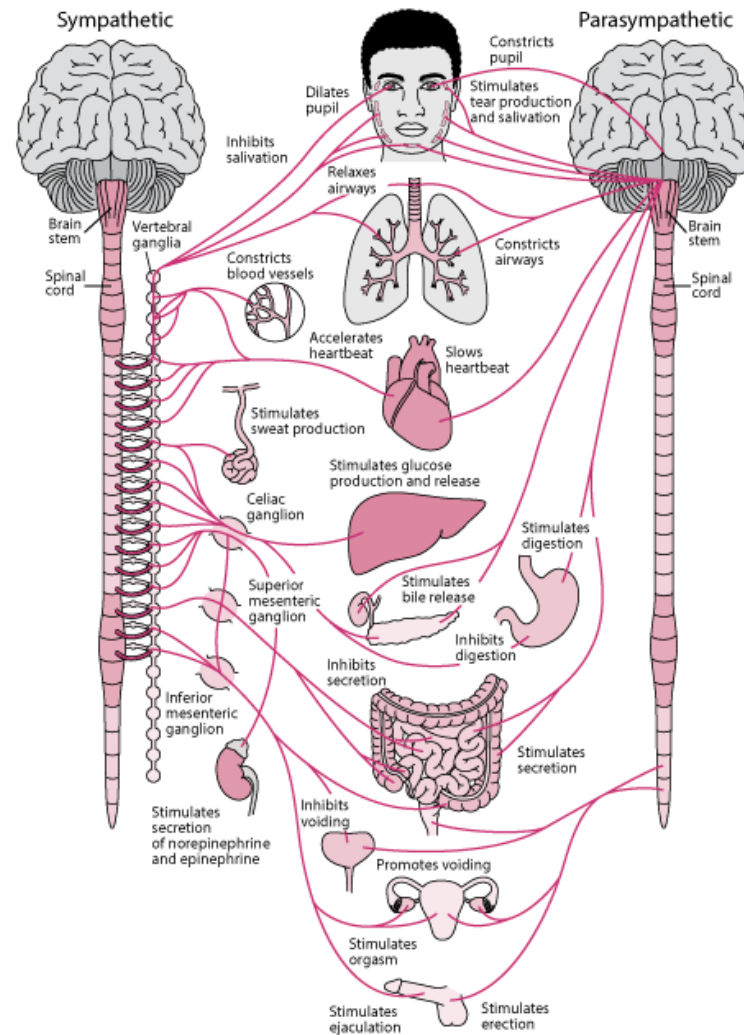
- Sympathetic division
Activation
- Parasympathetic division
Deactivation

Homeostasis

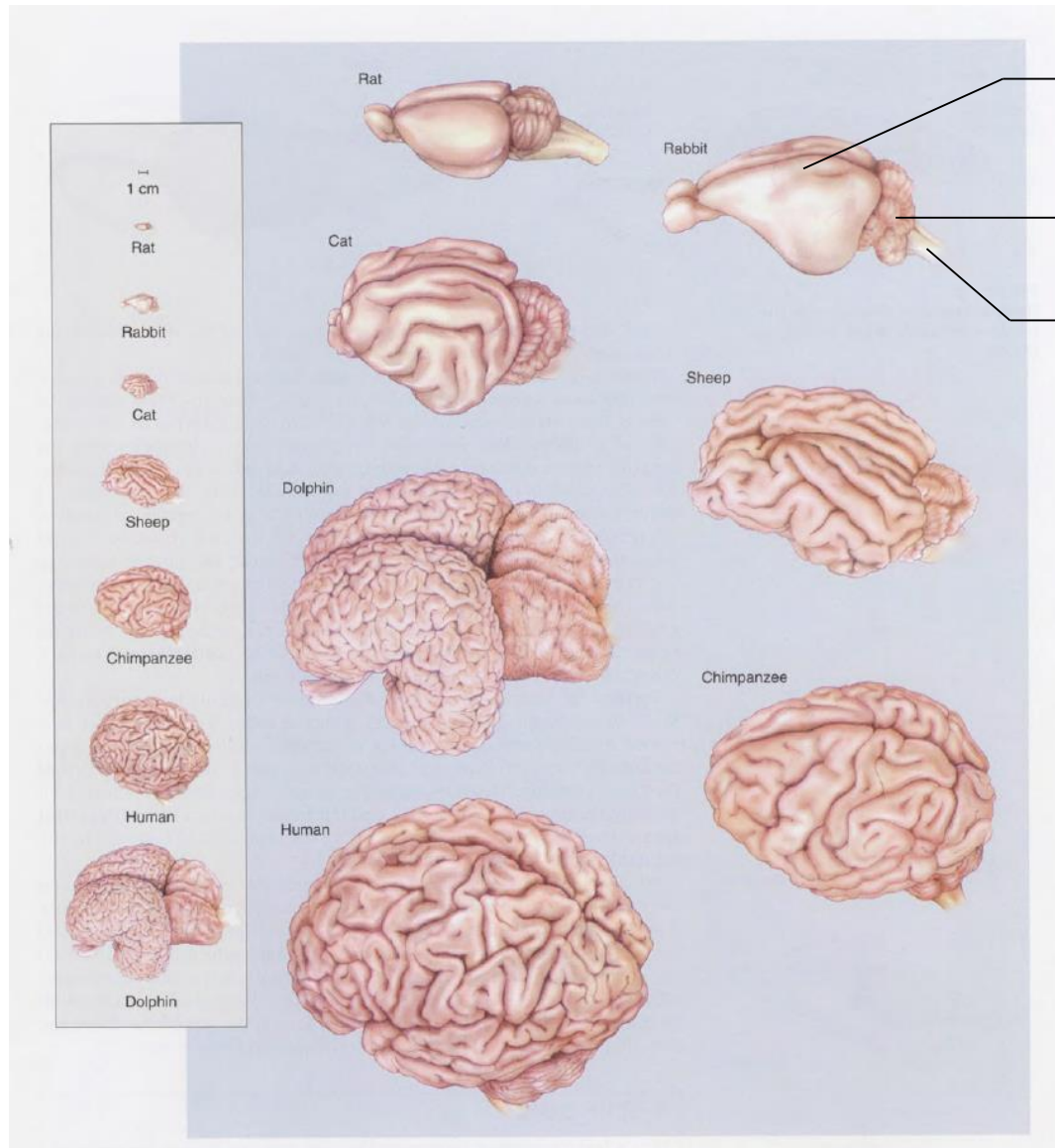


■ The autonomic nervous system (ANS)

Functional output of innervated structures/organs



■ Central nervous system: the brain

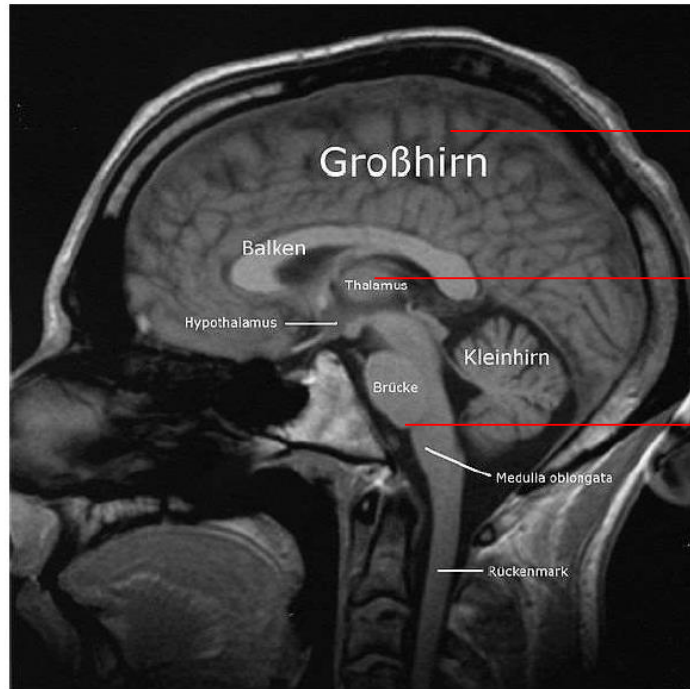


Cerebrum
(divided into two hemispheres)

Cerebellum

Brain stem

- Central nervous system: the brain



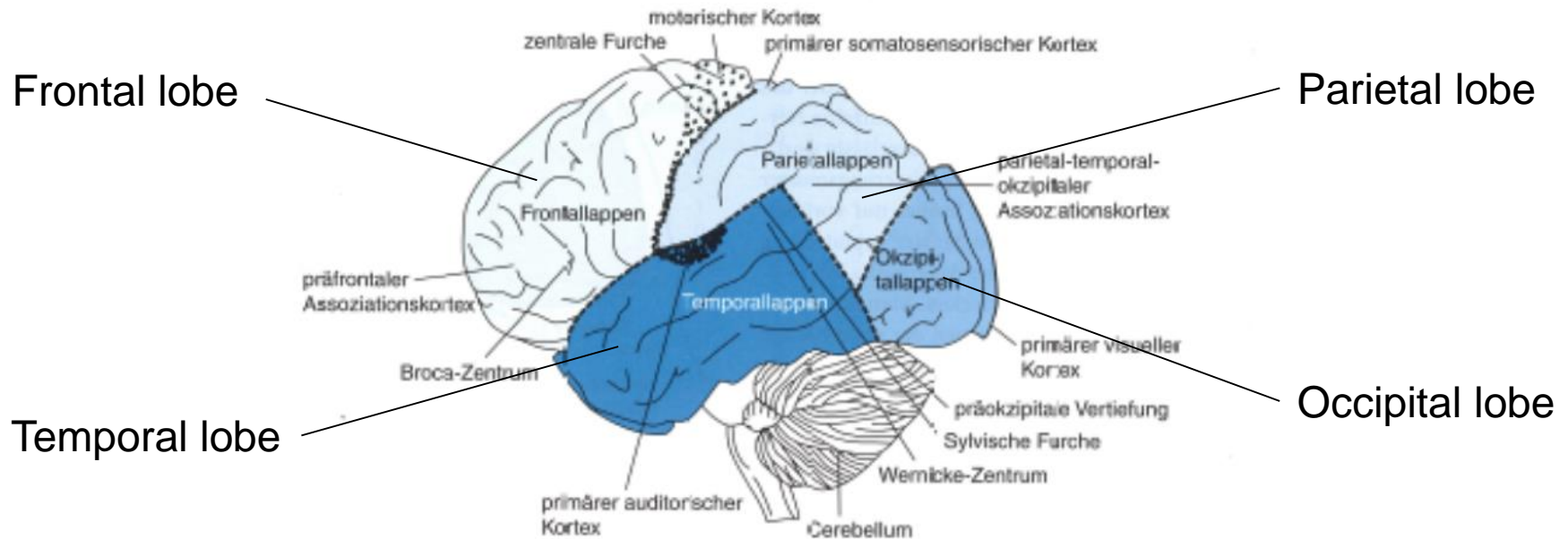
Cerebrum (largest part: cerebral cortex)

Diencephalon (Thalamus/Hypothalamus)

Brainstem

- Cerebral cortex: higher cognitions, conscious control
- Thalamus: filters and transmits information to various regions (in the cortex)
Hypothalamus: regulates internal organs, monitors ANS
- Brainstem: vital functions (e.g. breathing, body temperature)

- Central nervous system: the cerebral cortex

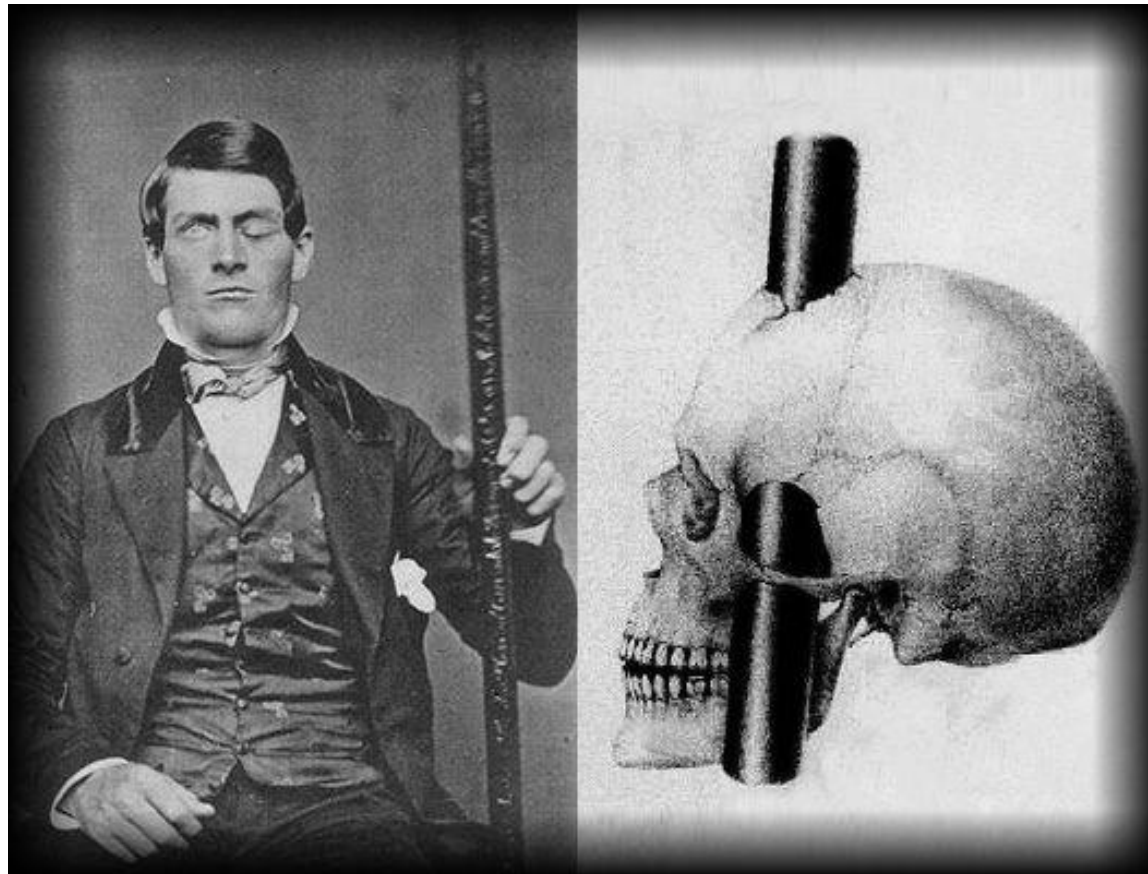


- Frontal lobe: planning, behavioral coordination, ethical reasoning, motor processing
- Temporal lobe: auditory perception, speech, complex visual perception
- Parietal lobe: sensory processing (e.g. spatial information, sense of touch, attention)
- Occipital lobe: visual processing

- Central nervous system: the cerebral cortex

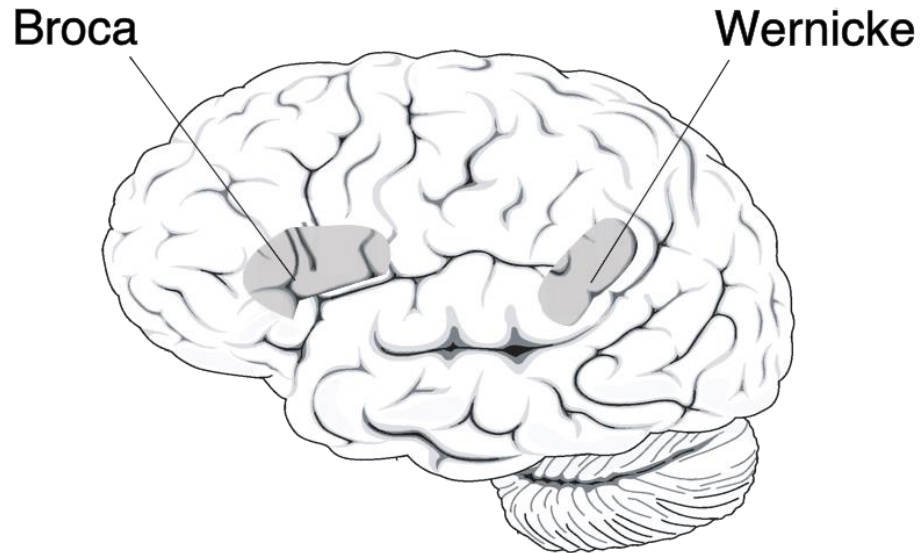
- Case study: Phineas Gage (1823 – 1860)

Changes in personality due to damages of the frontal lobe



(Wikipedia)

- Central nervous system: the cerebral cortex
 - Processing language: **Broca's and Wernicke's area**



Broca's area: speech production

Wernicke's area: speech comprehension

- Central nervous system: the cerebral cortex
 - Processing language: **Broca's and Wernicke's area**

Question: Are you driving home over the weekend?

Broca-Aphasia: „Warum, ja ... Donnerstag, äh, äh, äh, nein, äh, Freitag ...
Bar-ba-ra ... Frau ... und, äh, Auto ... Autobahn ... weißt
du ... ausruhen und ... fernseh.“

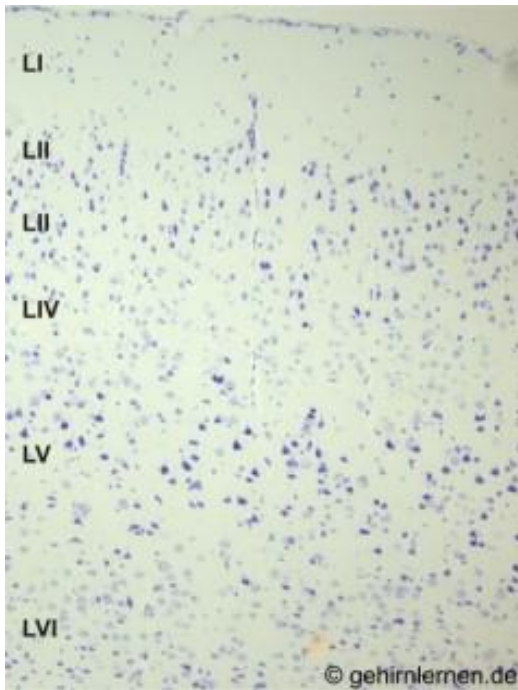
- Central nervous system: the cerebral cortex
 - Processing language: **Broca's and Wernicke's area**

Question: Why are you in the hospital?

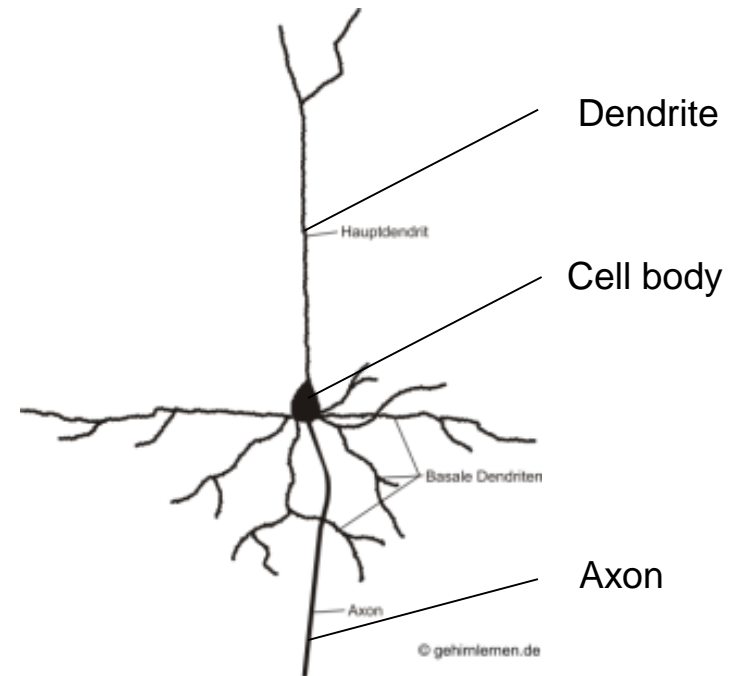
Wernicke-Aphasia: „Mann, ich bin am Schwitzen, ich bin furchtbar nervös, wissen Sie, ab und zu verheddere ich mich, ich kann die Terpen nicht erwähnen, vor einem Monat, ein kleines bisschen, hab ich vieles ganz gut gemacht. Ich bin eine Zumutung, aber andererseits, Sie wissen schon, was ich meine, muss ich rumrennen, alles durchsehen, zittern und lauter so Sachen.“ (Gardner, 1975)

■ Central nervous system: the cerebral cortex

- 2-5 mm thick layer; evolutionary younger part of the brain



Divided into six layers
(Cortex of a rat; 20 times enlarged; Nissl-staining)

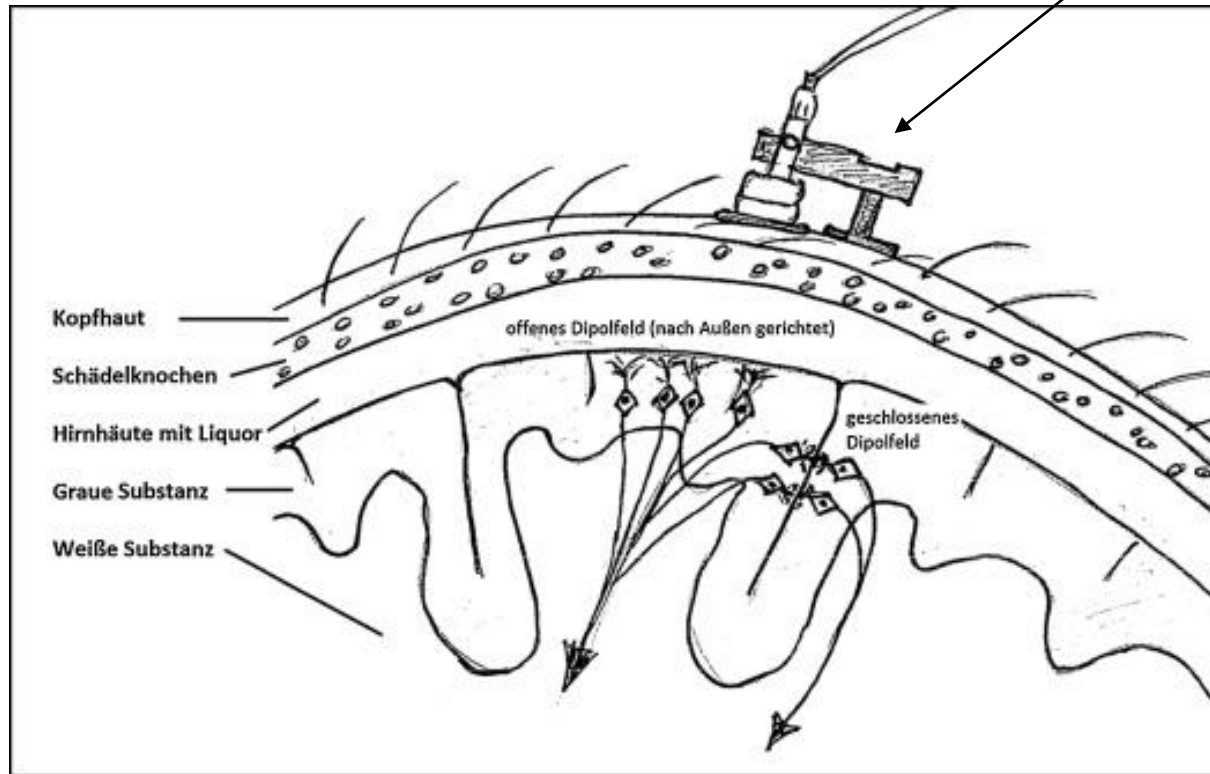


85% of the neurons:
pyramid cells

■ Central nervous system: the cerebral cortex

- Registration of electrical activity from the cortex via electrodes placed on the scalp

Scalp
Cranial bone
Meninges
Grey matter
White matter



(Böhme, 2016)

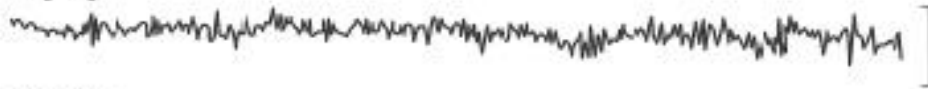
- Due to the anatomical structure of the pyramidal cells, electrical fields can sum up and become strong enough to be registered on the scalp

■ Central nervous system: the cerebral cortex

➤ Basic rhythms („spontaneous-EEG“)

Waking-EEG

aufgeregt



Beta-Rhythm (~17-30 Hz)

Relaxed wakefulness

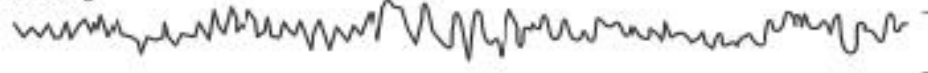
entspannt



Alpha-Rhythm (~10 Hz)

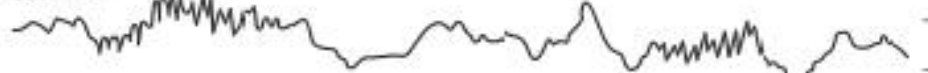
Sleepy / asleep

schläfrig



Theta-Rhythm (~4-7 Hz)

schlafend



Delta-Rhythm (~0.5-2 Hz)

Deep sleep

Tiefschlaf



Coma

Koma



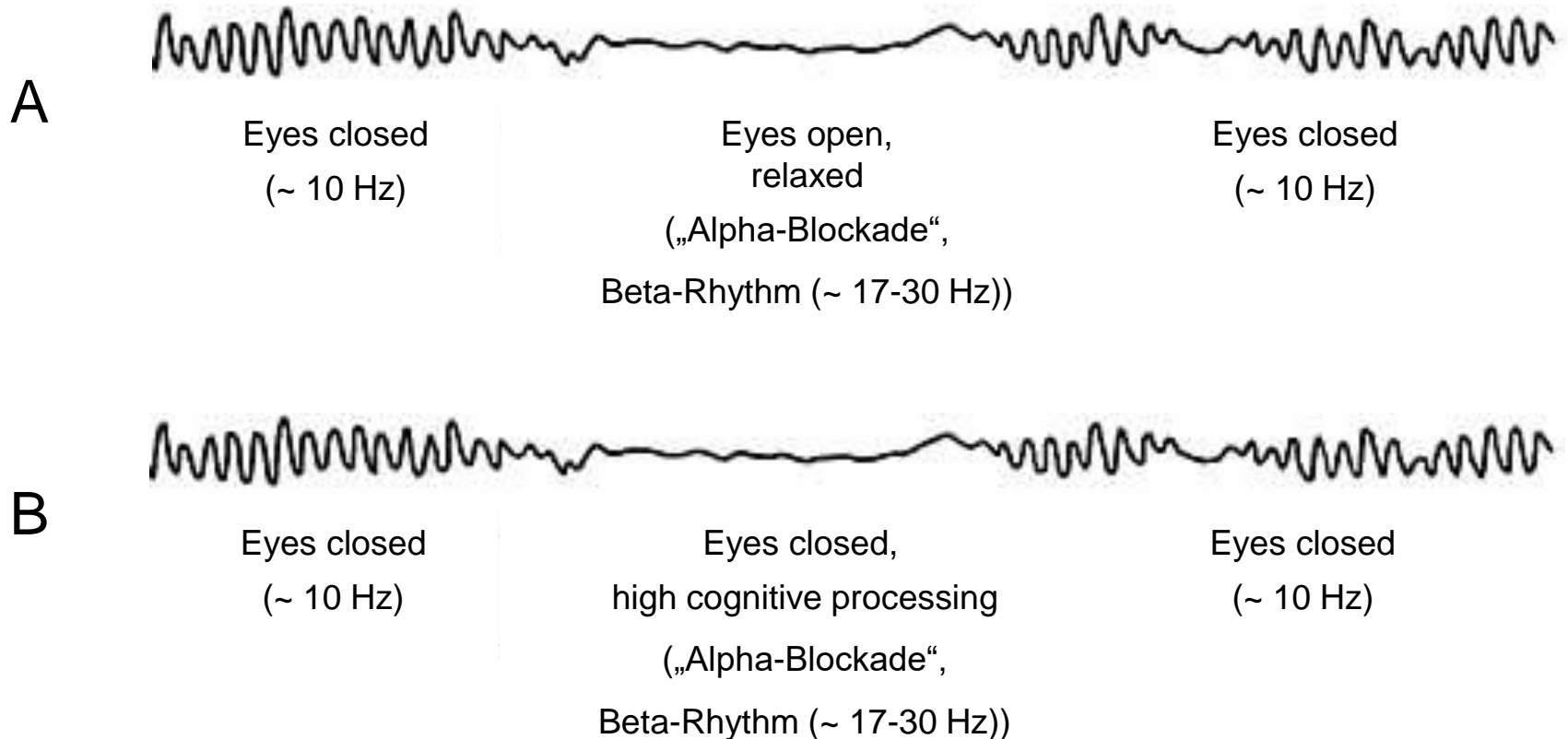
1 s

50 mV

- The lower the frequency, the lower the degree of central nervous activation (!)

■ Central nervous system: the cerebral cortex

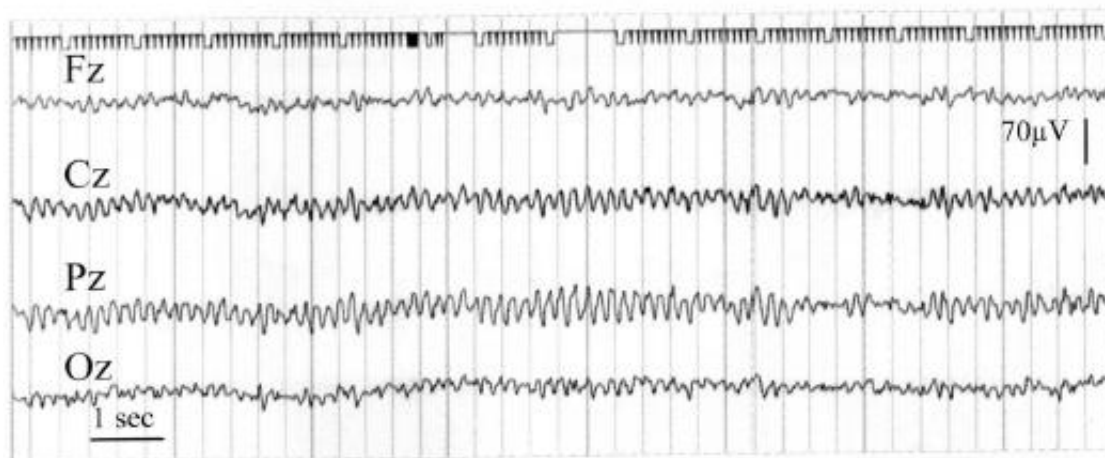
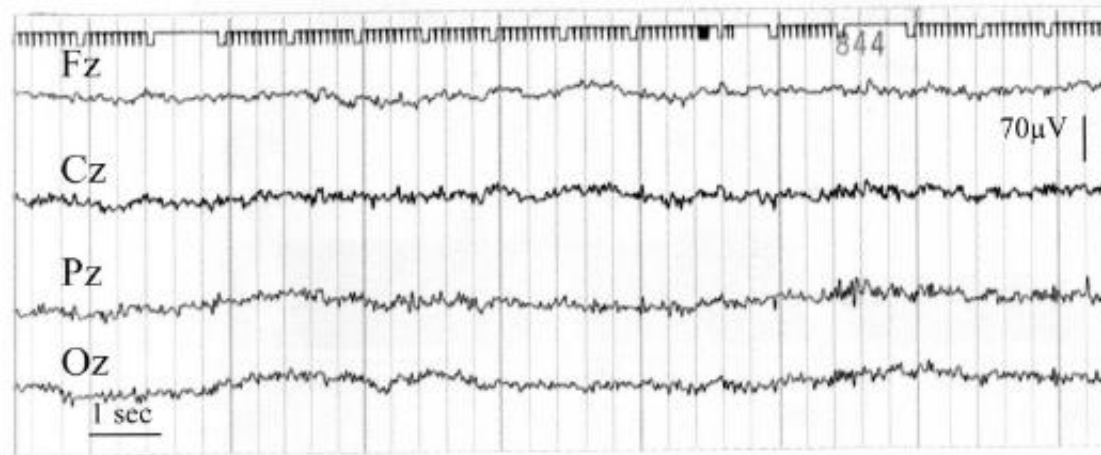
- Alpha blockade > frequency shift



- Complex intellectual operations are possible only on a high frequency level (!)

■ Central nervous system: the cerebral cortex

- EEG Single-case study with a Zen-Master (Coromaldi et al., 2006)



Beta-Rhythm
(„Waking-EEG“)

Deep meditation