

Neural Topics

- 1. neural cells & signals**
- 2. CNS**
- 3. PNS**
- 4. drugs**
- 5. diseases**

Neural Cells

1) neurons (20%)

function: transmit neural signals

- **sensory neuron - send environment info to CNS**
- **interneuron - process & act on environ. info**
- **motor neuron - send CNS info to muscles**

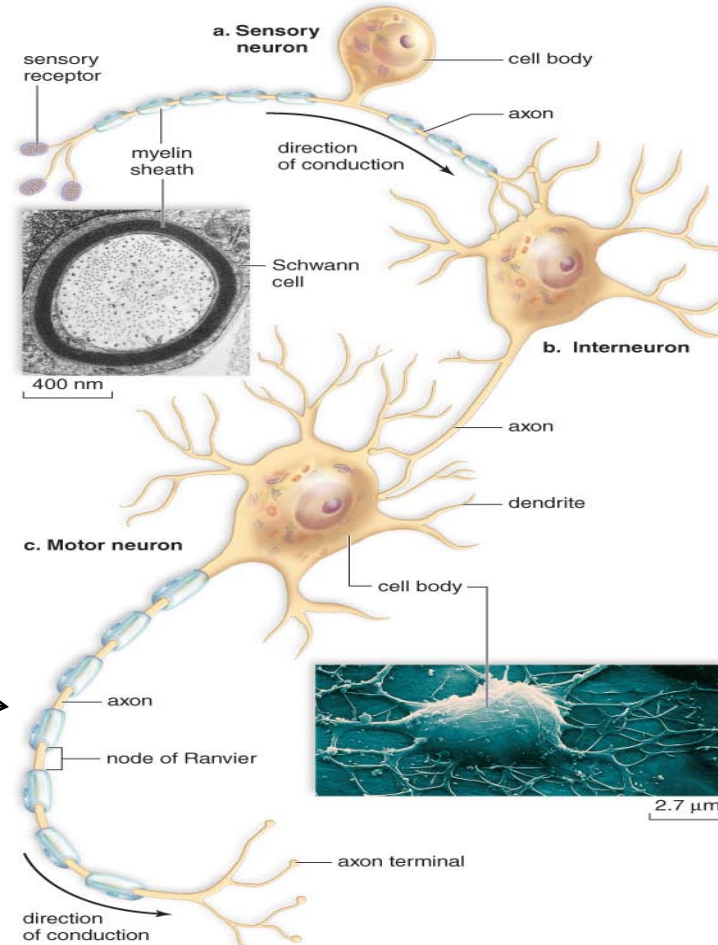
2) neuroglial cells (80%)

- **function: support & protect neurons**
- **Schwann cells (myelin) - protect signals**

Neuron & Neuroglia

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**3 neurons:
sensory,
interneuron,
motor**

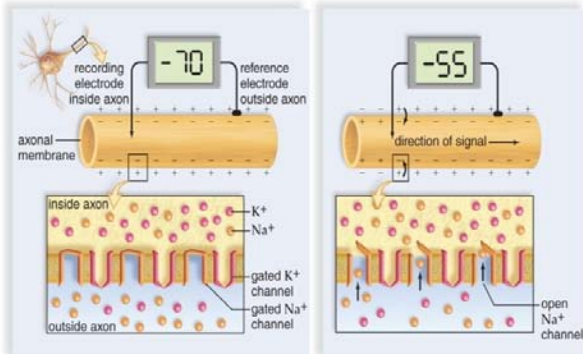


**neuroglia:
myelin =
insulates
neural signal**

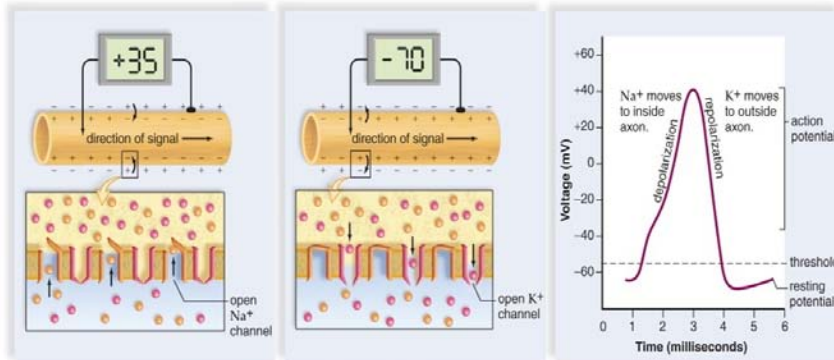
(myelin): © 2013/M.B. Bunge/Biological Photo Service;
(cell body): © doc-stock/Visuals Unlimited

Neural Signal (Action Potential)

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a. Resting potential: Na⁺ outside the axon, K⁺ and large anions inside the axon. Separation of charges polarizes the cell and causes the resting potential.
 b. Stimulus causes the axon to reach its threshold; the axon potential increases from -70 to -55. The action potential has begun.



c. Depolarization continues as Na⁺ gates open and Na⁺ moves inside the axon.
 d. Action potential ends: repolarization occurs when K⁺ gates open and K⁺ moves to outside the axon. The sodium-potassium pump returns the ions to their resting positions.
 e. An action potential can be visualized if voltage changes are graphed over time.

4 steps:

- 1) resting potential (-70 mV)
- at rest
- 2) threshold (-55mV)
- neuron ready to fire
- depolarize (+35 mV)
- neuron fires
- 3) repolarize (-70 mV)
- neuron resets

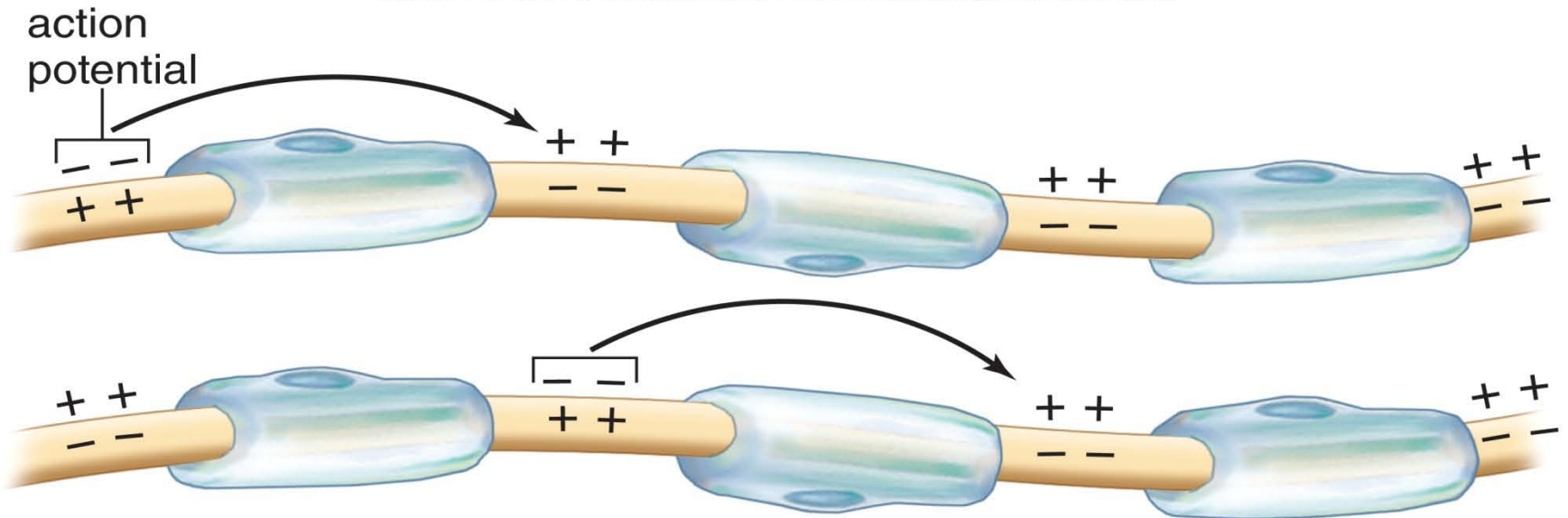
Neural Signals Travel

2 types:

1) unmyelinated axon: slow, 1 m/s

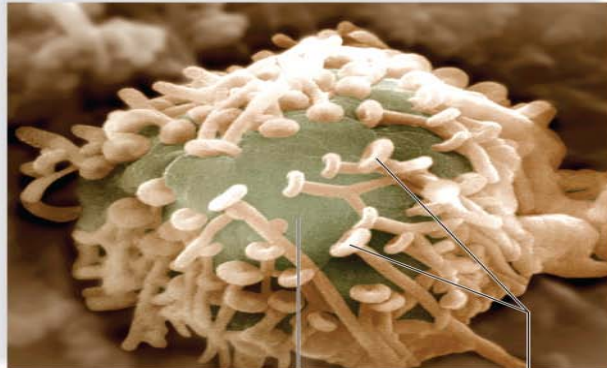
2) myelinated axon: fast, 100 m/s

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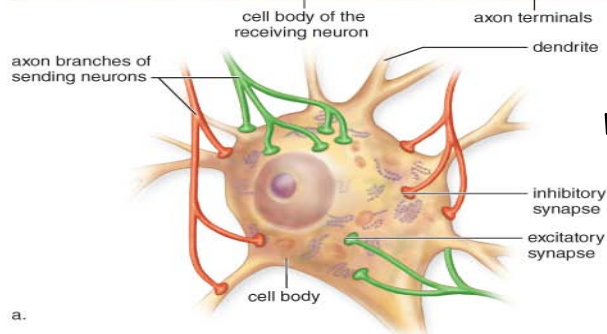
Neural Signals Integrate

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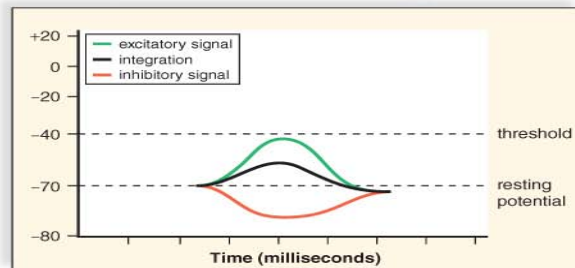
at each moment, each neuron receive many simult. signals

- a) inhibitory - stop action
- b) excitatory - start action



at each moment, each neuron "decides" to respond or not

- signals are integrated
- net sum = net action



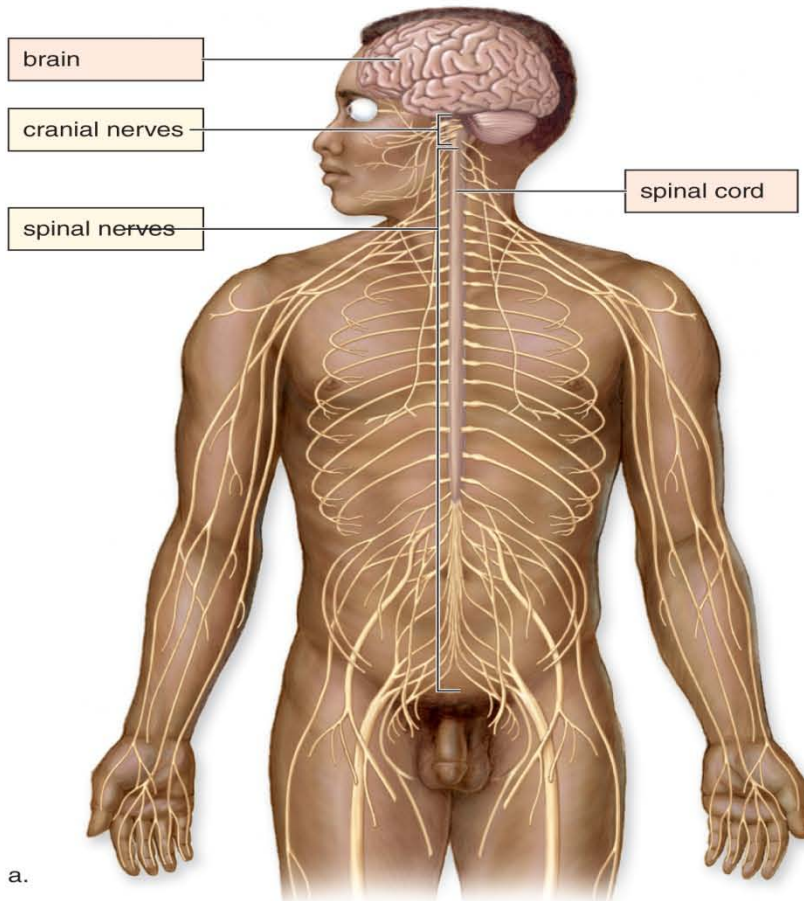
b.

a: © Science VU/Lewis-Everhart-Zeevi/Visuals Unlimited

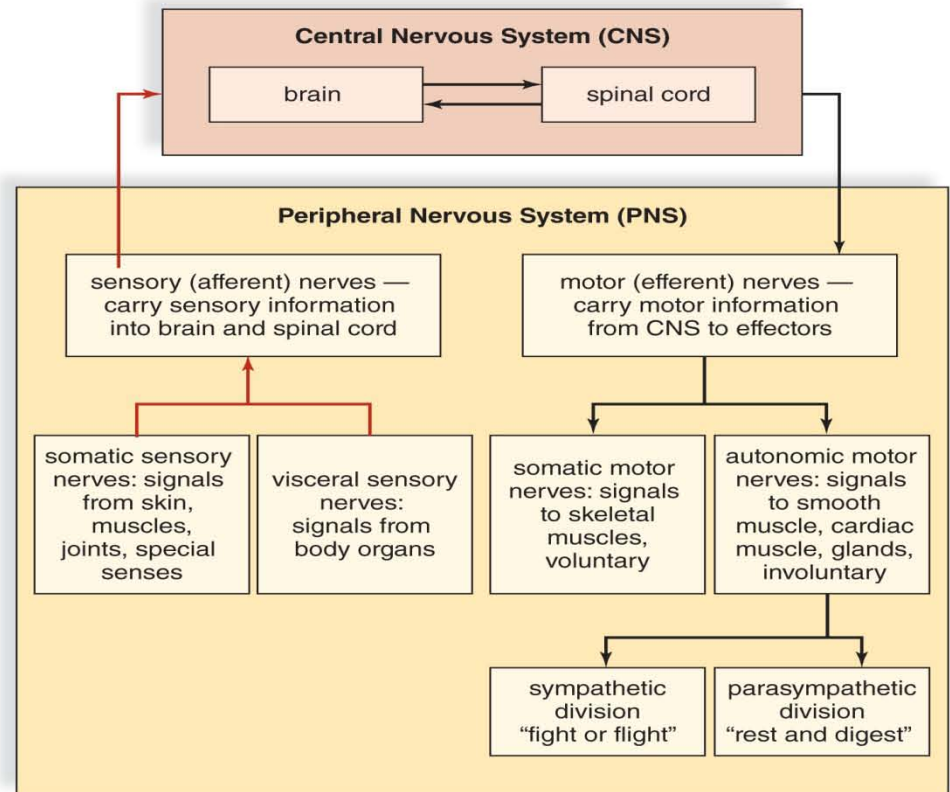
Neural System Org.

2 div: CNS & PNS

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a.



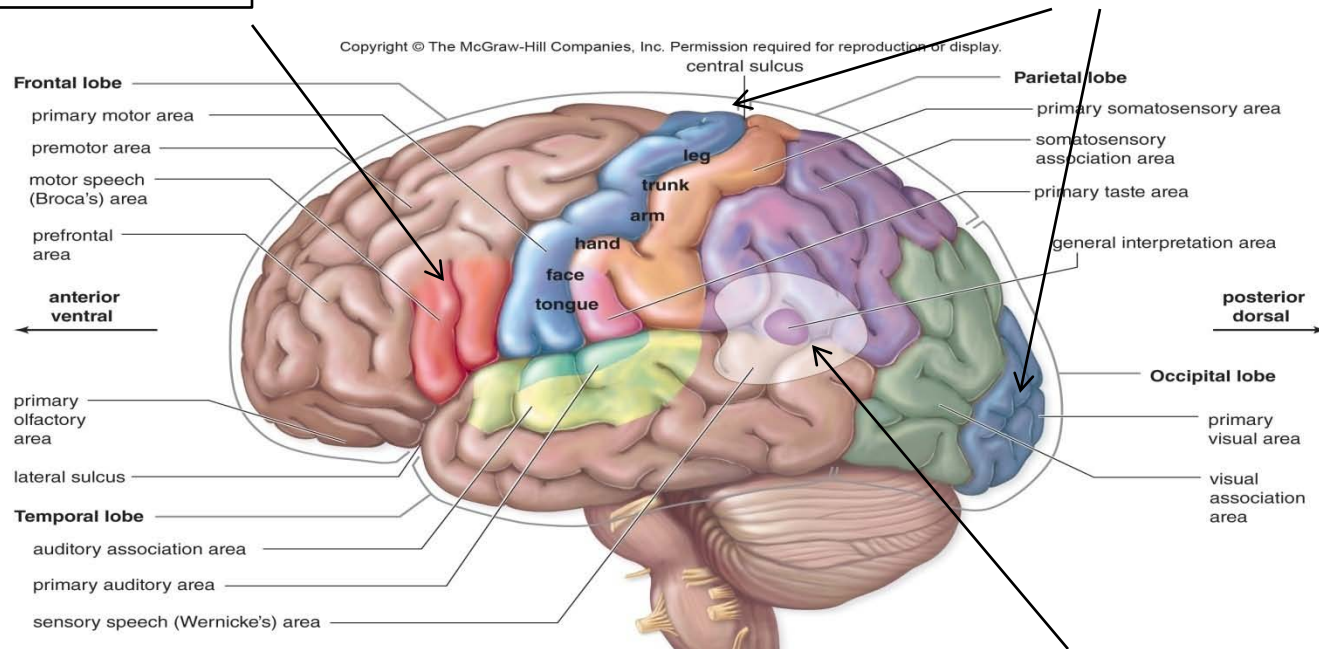
b.

Cerebrum

function: coordinate brain functions, eg reading

**Broca's (red)
- motor speech**

**motor cortex (blue) - speak
visual cortex (blue) - see word**



Wernicke's (beige) - interpret

Reading

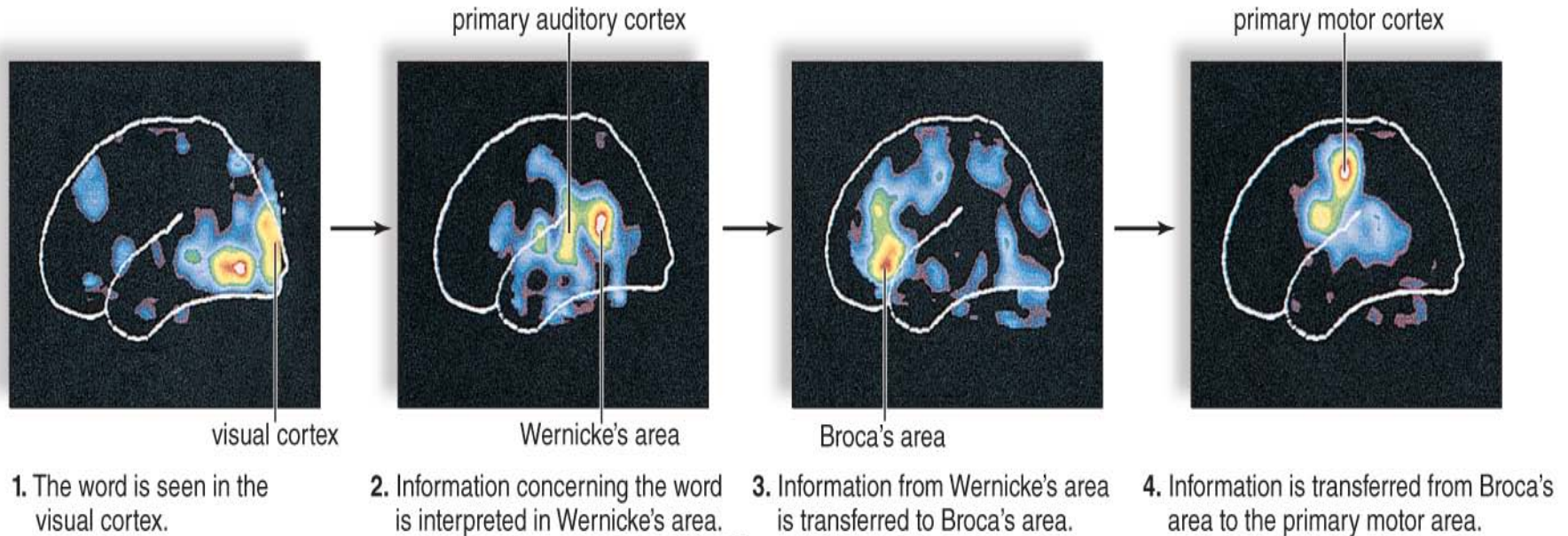
visual cortex
see word

Wernicke's
interpret

Broca's
form words

motor cortex
use tongue

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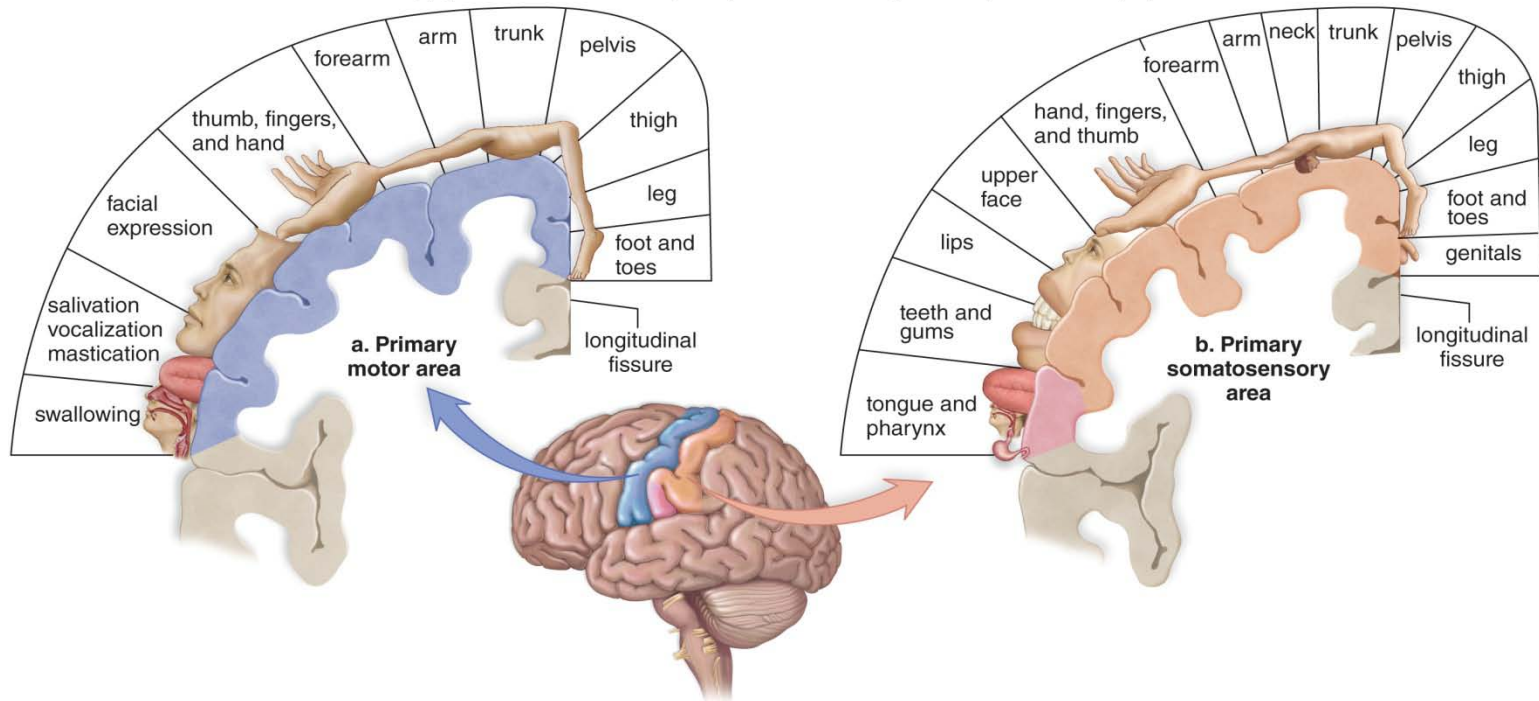
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CNS - Homunculus

sensory area: interprets each sensation

motor area: implements each muscle movement

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Limbic System Functions

1) memory & learning

- remember vs use past memories
- review memory types: long, short, skill

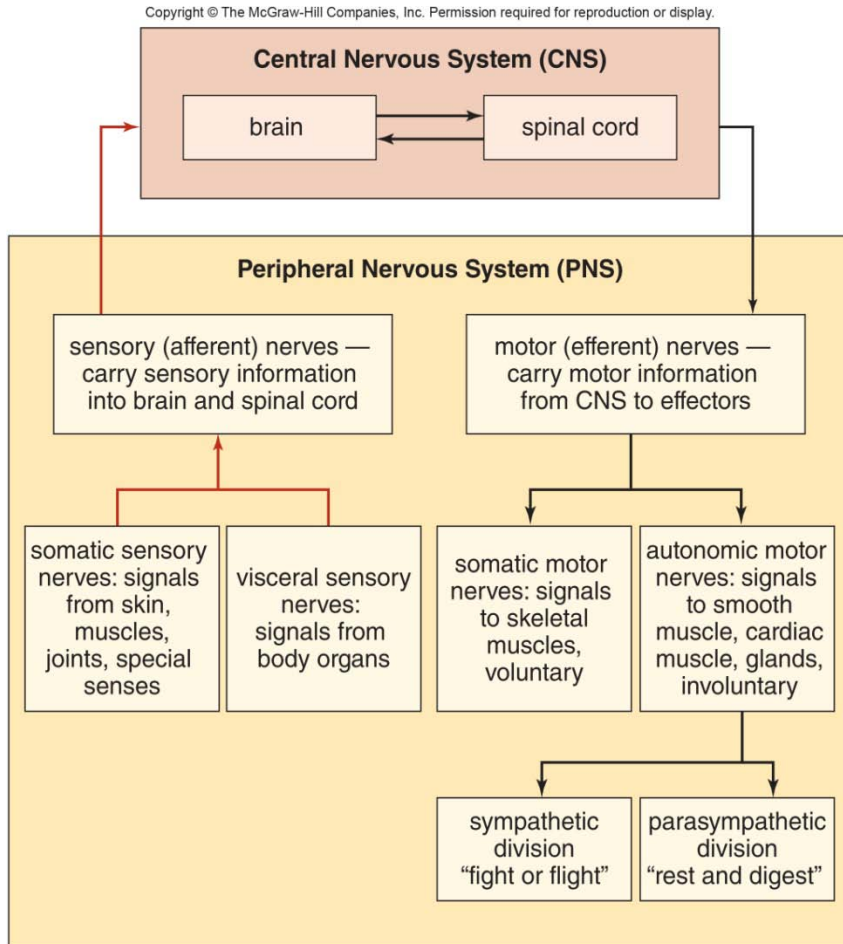
2) language & speech

- semantic memory
- review Wernicke's & Broca's areas
- review left & right hemi-spheres

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Left Hemisphere	Right Hemisphere
Verbal	Nonverbal, visuospatial
Logical, analytical	Intuitive
Rational	Creative

PNS



2 divisions:

1) **sensory - sense environment (touch, smell, taste, hear, see)**

2) **motor - move in environment**

a) **SNS (skeletal muscles)**

b) **ANS**

(smooth & cardiac muscles)

1) **sympathetic**

2) **parasympathetic**

SNS

SNS = somatic nervous system

**function: reg. body movements
(skeletal muscles)**

features:

1) voluntary movements

- reg. by brain

eg pick up pencil

2) involuntary movements

- reg. by spinal cord

eg spinal reflexes

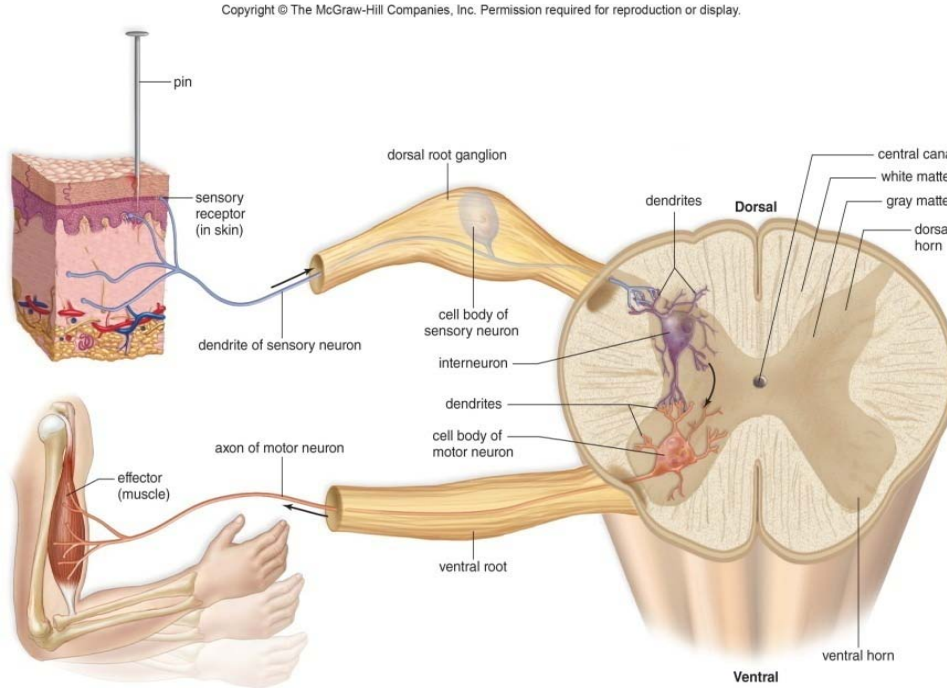
- move away from sharp objects

Reflex

function: fast protective response (inherited)
- prick -> pull away

steps:

- 1) skin prick**
- 2) sensory neuron**
- send signal to brain and cord
- 3) interneuron**
- process signal
- decide action
- 4) motor neuron**
- send signal to muscle
- 5) muscle**
- effect action,
pull away



ANS (2)

ANS = autonomic nervous system

**function: reg. organ activities
(smooth & cardiac muscles)**

features:

- 1) arousal activities (sympathetic div.)
eg faster heart rate to fight or run**
- 2) relaxation activities (para-sympathetic div.)
eg slower heart rate to relax**

note: same organ; opposite effects)

Organ Actions (1)

Describe the effect of the parasympathetic and sympathetic actions on the following organs:

- 1) pupil**
- 2) salivation**
- 3) resp. rate**
- 4) heart rate**
- 5) blood vessel**
- 6) digestion**
- 7) bladder**
- 8) orgasm**

Sympathetic

function: tension and resource usage

**- prepares body for immediate response to danger
eg faster heart beat, slower digestion**

features:

- 1) prod. mental & body alertness**
- 2) fast body movements & resource usage**
- 3) uses adrenaline (epinephrine)**
- 4) increase: HR, BP, BR, pupil dilation
decrease: blood flow for digestion, salivation**
- 5) wears down with continual stress**

Para-sympathetic

function: relaxation & resource buildup

**- prepares body for present & future needs
eg slower heart beat, faster digestion**

features:

- 1) prod. mental & body relaxation**
- 2) slow body repair and buildup of resources**
- 3) uses acetylcholine (ACh)**
- 4) decrease: HR, BP, BR, pupil constriction
increase: blood flow for digestion, salivation**
- 5) needs the stimulation of stress**

Drugs

depressant: alcohol, heroin
stimulant: nicotine, cocaine, ecstasy
psychoactive: marijuana

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Table 13.2 Drug Influence on CNS and Route

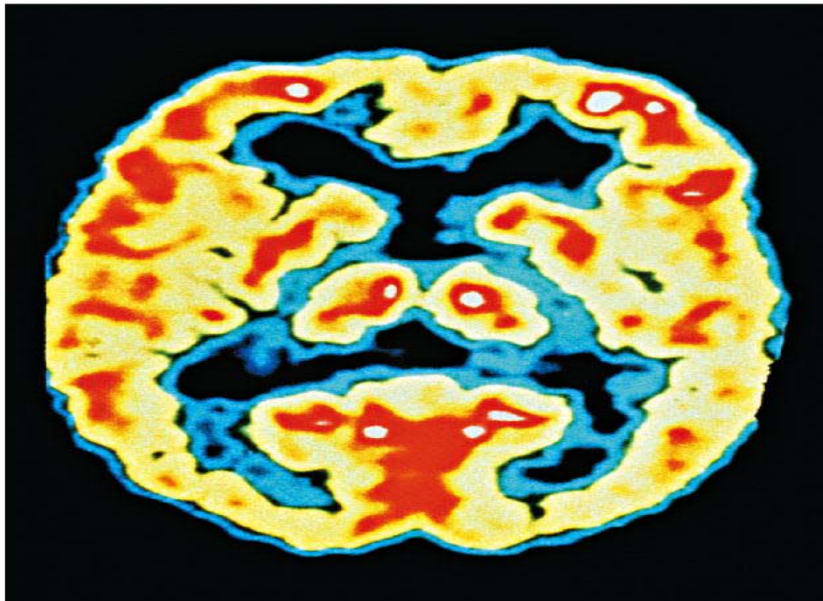
Substance	Effect	Mode of Transmission
Alcohol	Depressant	Drink
Nicotine	Stimulant	Smoked or smokeless tobacco
Cocaine	Stimulant	Sniffed/snorted, injected, or smoked
Methamphetamine/ Ecstasy	Stimulant	Smoked or pill form
Heroin	Depressant	Sniffed/snorted, injected, or smoked
Marijuana/K2	Psychoactive	Smoked or consumed

Alzheimer

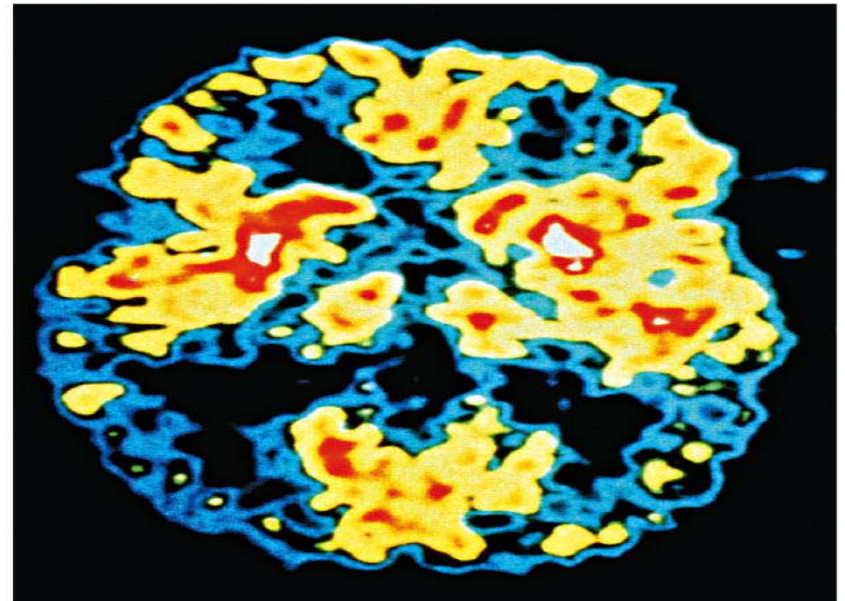
ACh (acetylcholine): mental & physical coord.

Alzheimer: ↓ACh → impaired mental function (no memory)

Parkinson: ↓ACh → impaired physical function (not coord.)



a) Healthy brain



b) Brain with Alzheimer's

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Neural Diseases

Describe the effects of:

- 1) alcohol**
- 2) nicotine**
- 3) cocaine**
- 4) methamphetamine/ecstasy**
- 5) heroin**
- 6) marijuana**

Describe the cause & effects of:

- 1) Alzheimer's**
- 2) MS**
- 3) stroke**
- 4) amnesia**