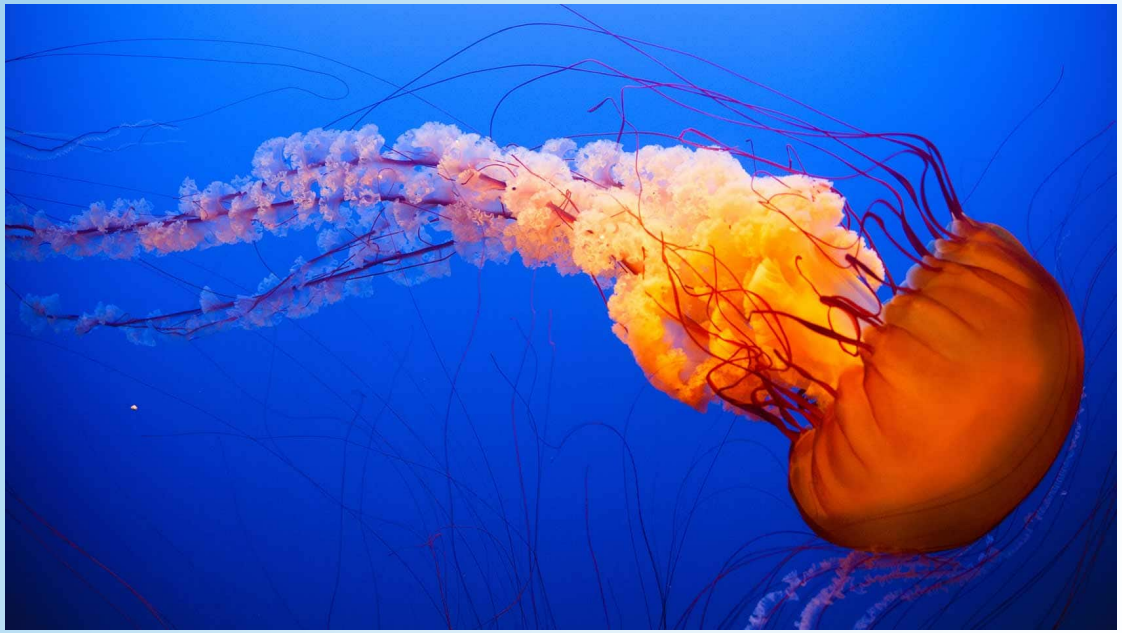
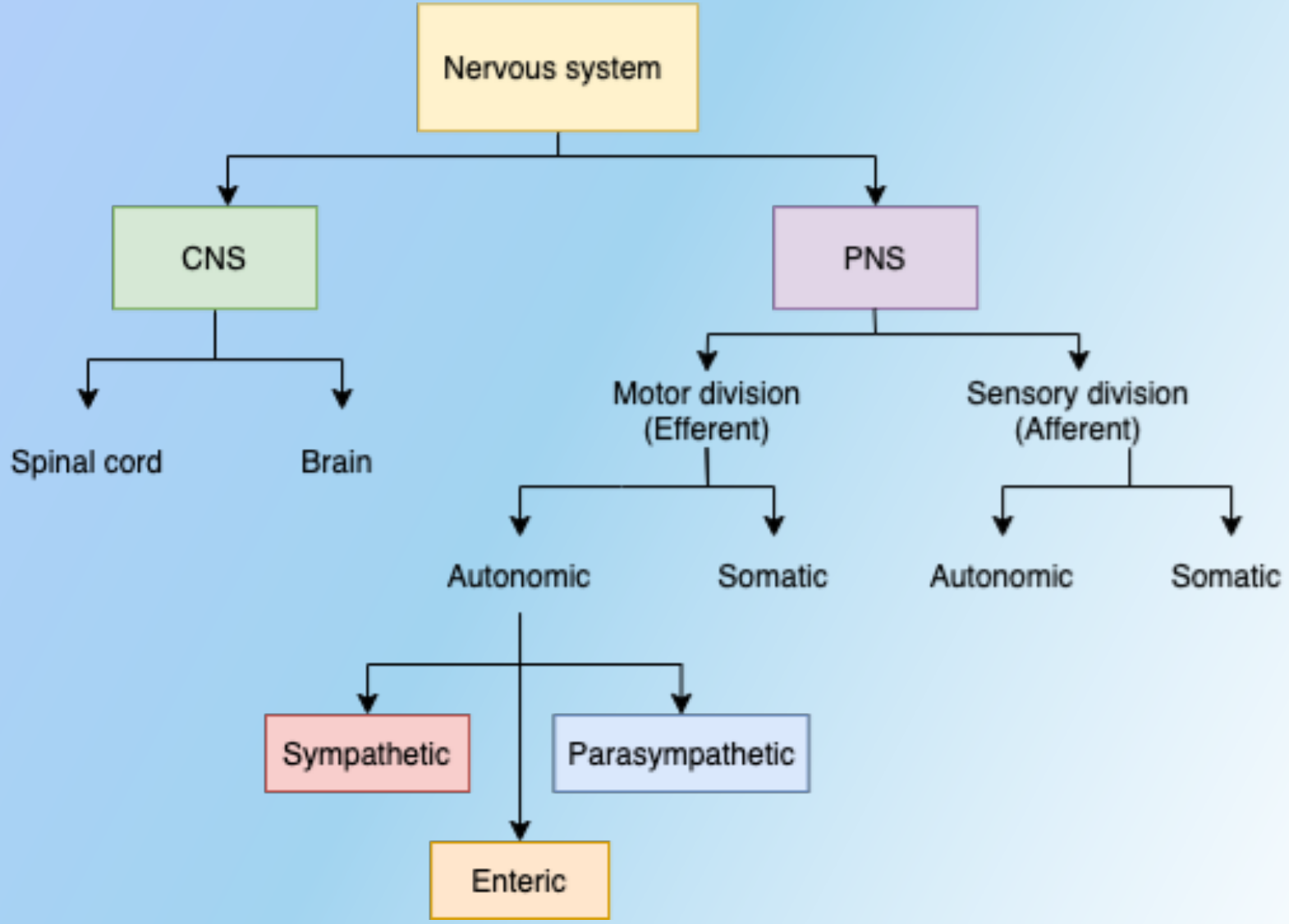
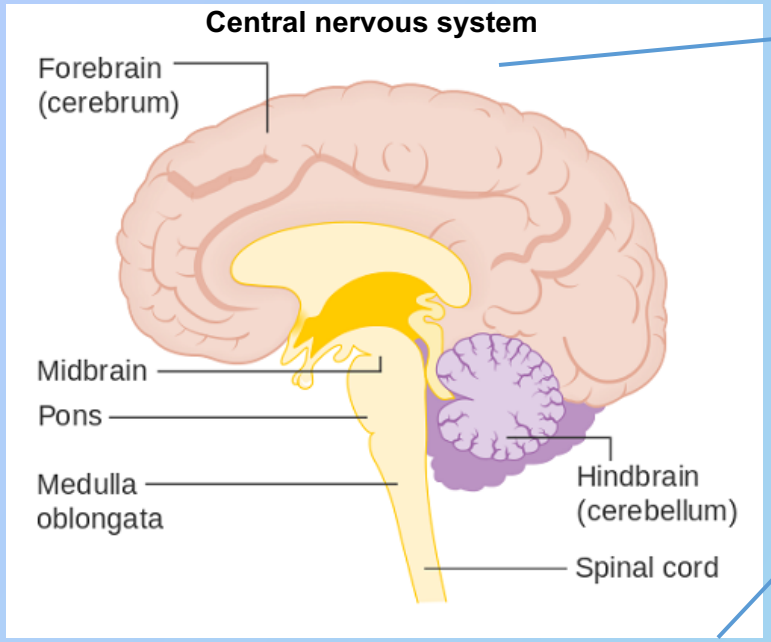
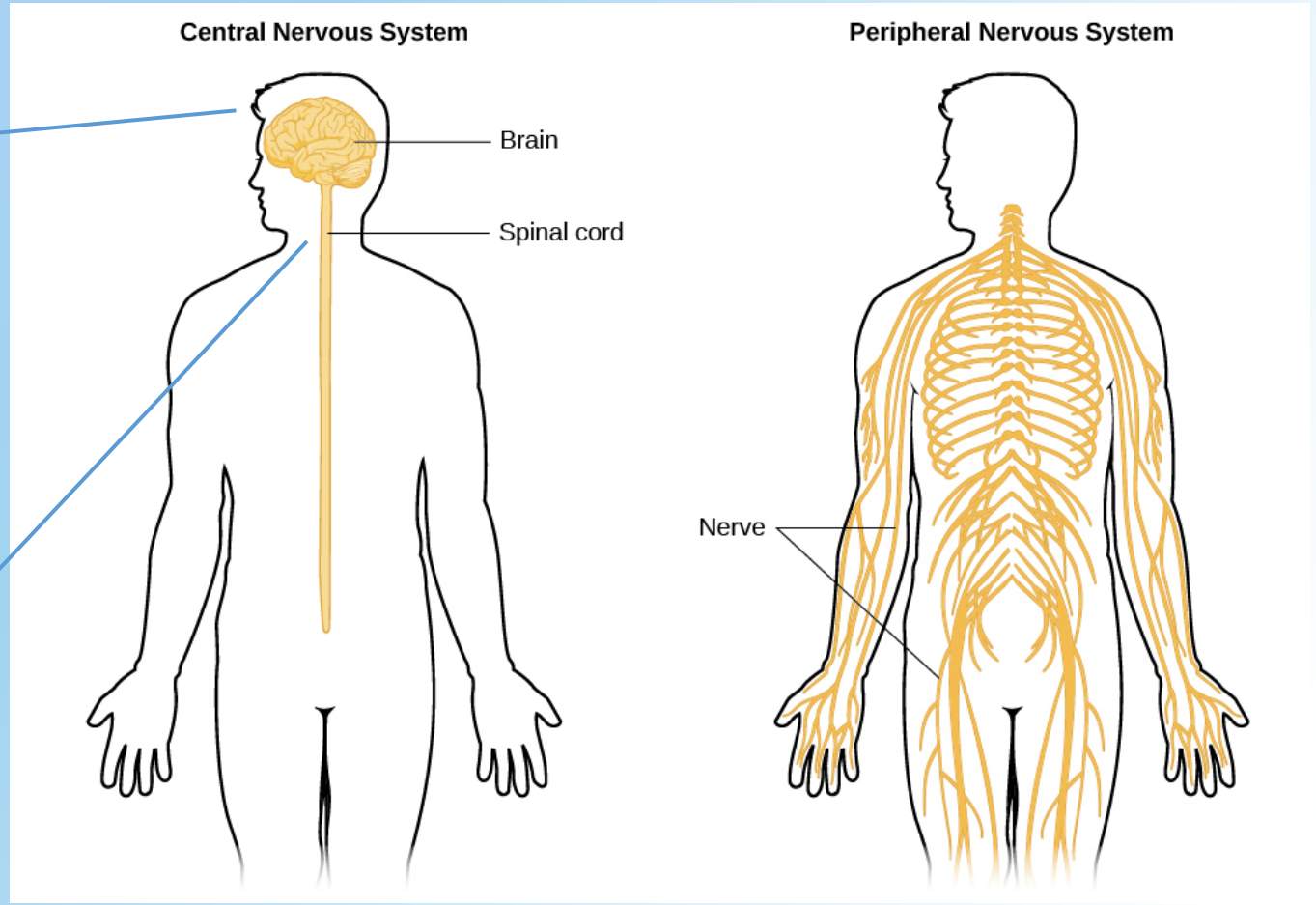
Neuroanatomy – the nervous system

Nora Sønstebø

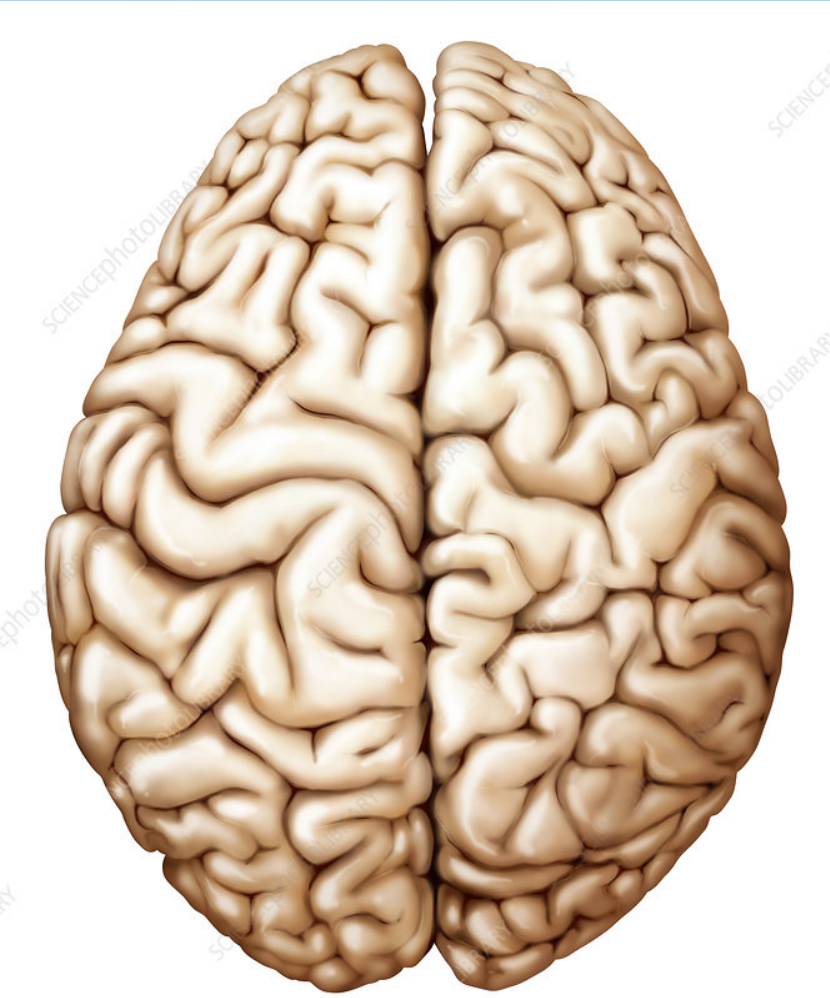



Nervous system
CNS
PNS
Spinal cord
Brain
Motor division
(Efferent)
Sensory division
(Afferent)
Autonomic
Somatic
Autonomic
Somatic
Sympathetic
Parasympathetic
Enteric

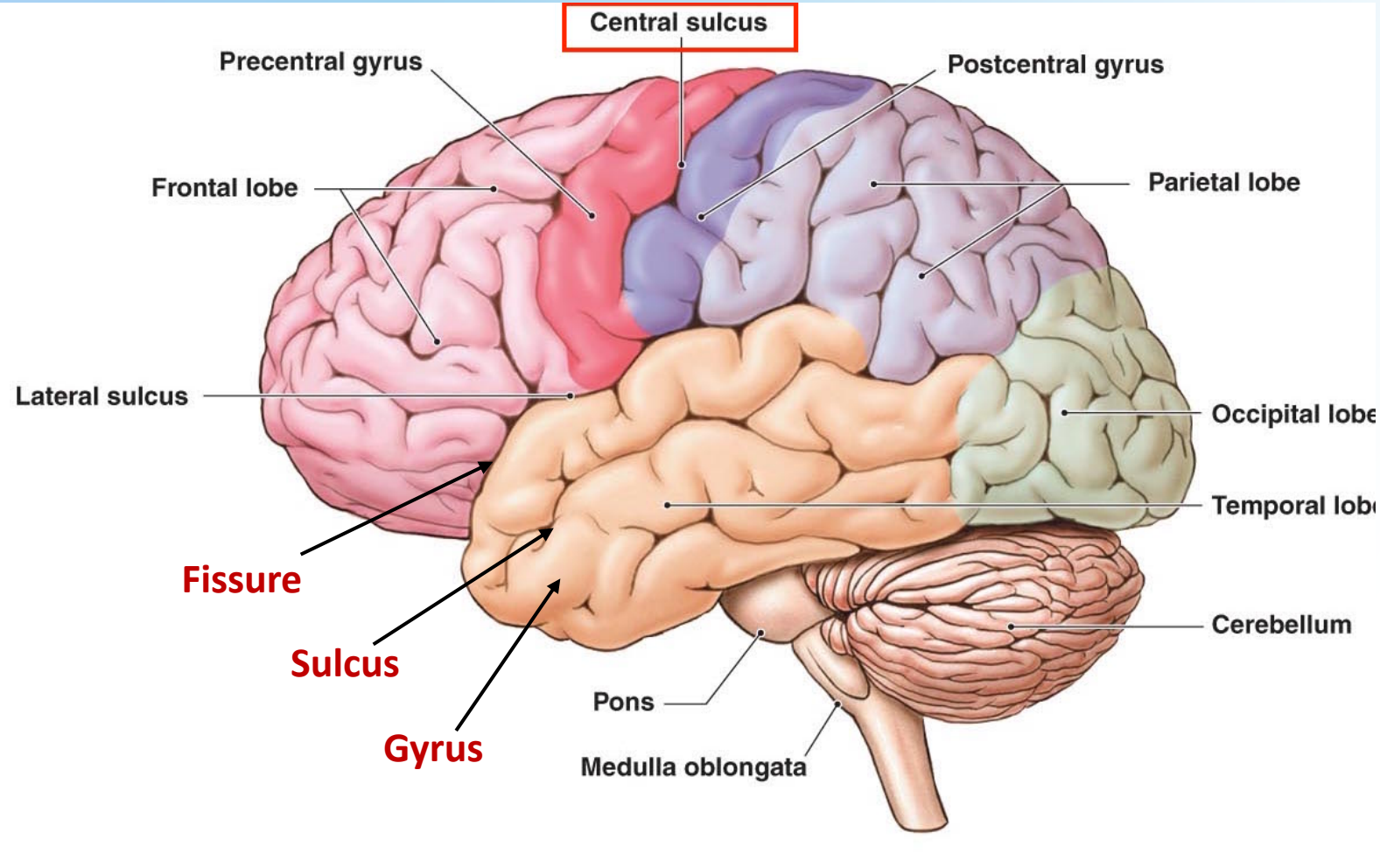

Central nervous system
Forebrain
(cerebrum)
Midbrain
Pons
Medulla
oblongata
Hindbrain
(cerebellum)
Spinal cord


Central Nervous System
Brain
Spinal cord
Peripheral Nervous System
Nerve

Cerebrum



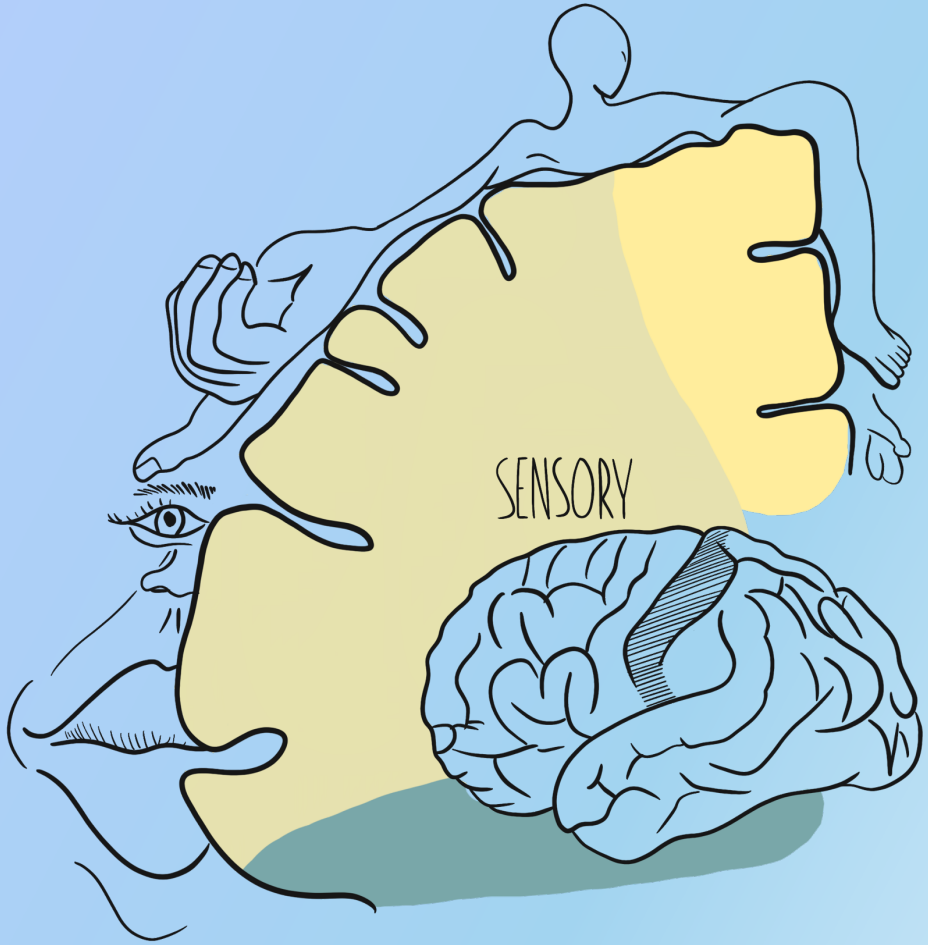
2 hemispheres



4 lobes

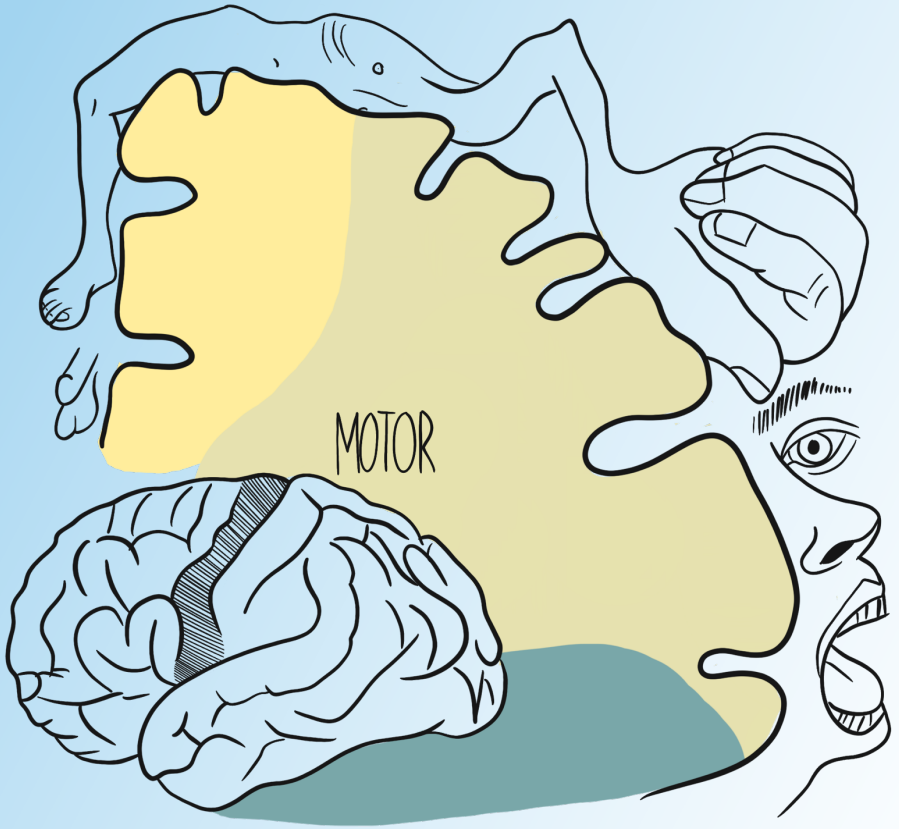
Sensory Homunculus

Postcentral gyrus (parietal lobe)



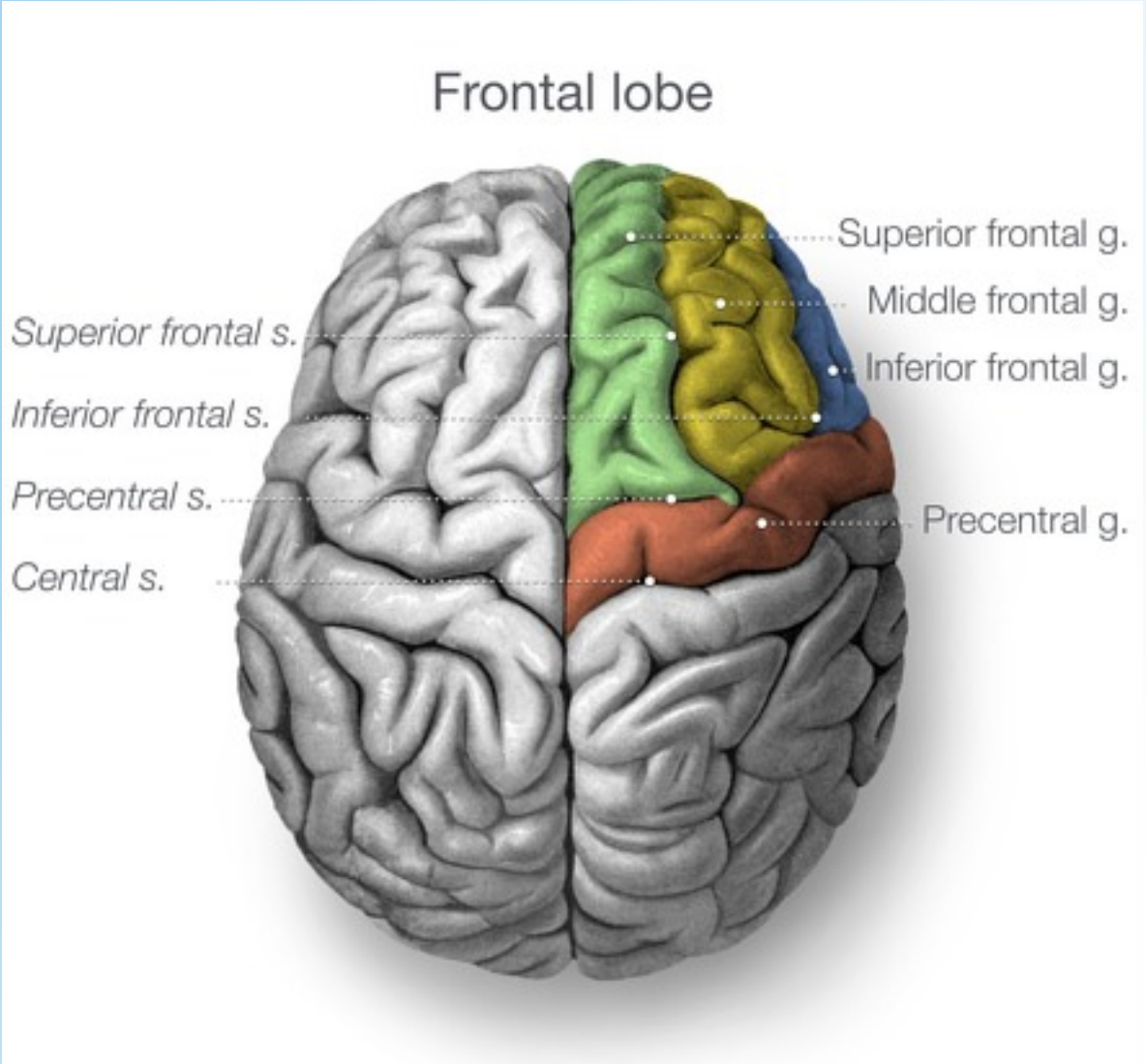
Motor Homunculus

Precentral gyrus (frontal lobe)



Frontal lobe

- **Precentral gyrus**
  - Primary motor cortex (Area 4)
- **Inferior frontal gyrus**
  - Broca speech area in the dominant hemisphere (areas 44 and 45)



Frontal lobe

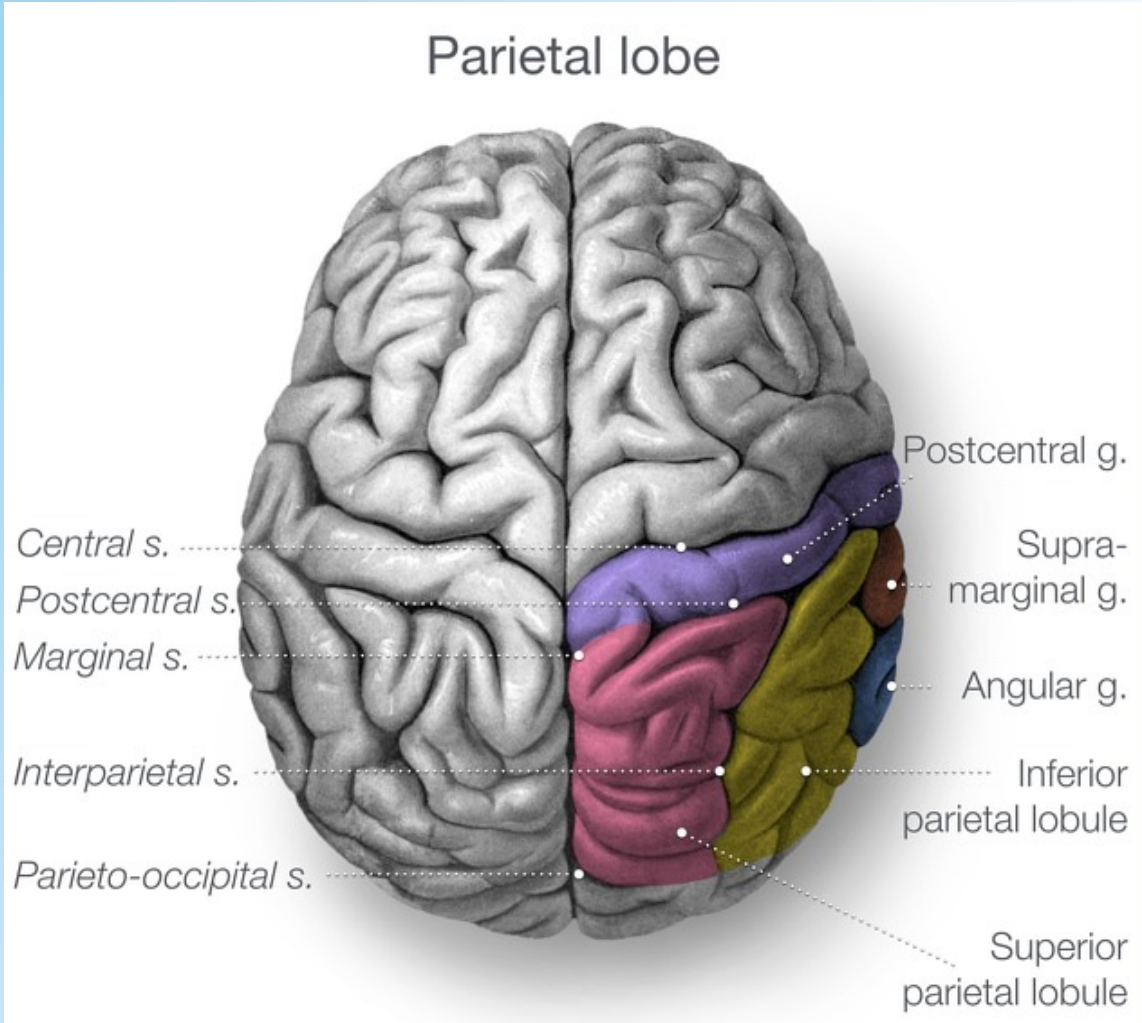
- **Prefrontal cortex**
  - Complex cognitive behavior
  - Problem-solving
  - Decision making
  - Social behavior
  - Personality expression

Thinking
Reasoning
Judgment
Learning
Emotion
Planning
Impulse-control

The prefrontal cortex in females matures two years earlier than in males

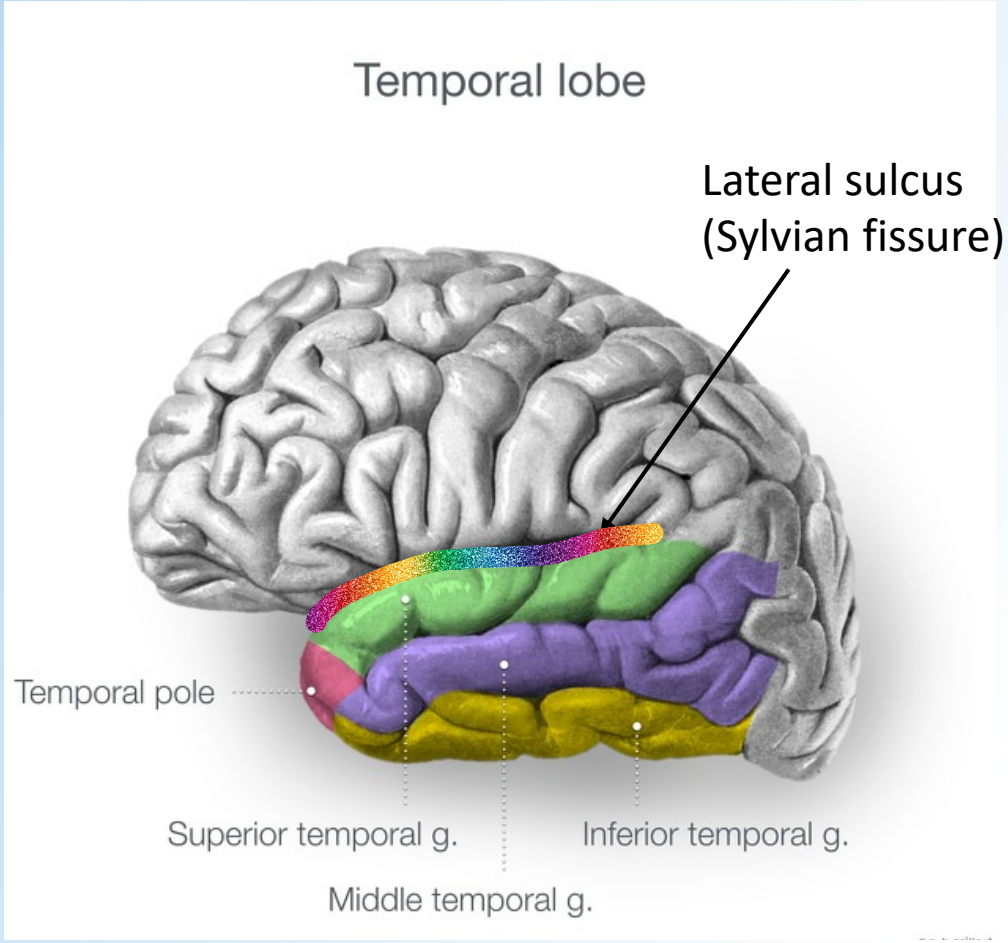
Parietal lobe

- **Sensory association cortex**
  - Body orientation (proprioception), touch, balance, vision, pain, temperature
- **Postcentral gyrus**
  - Primary somatosensory cortex (Area 3,1,2)



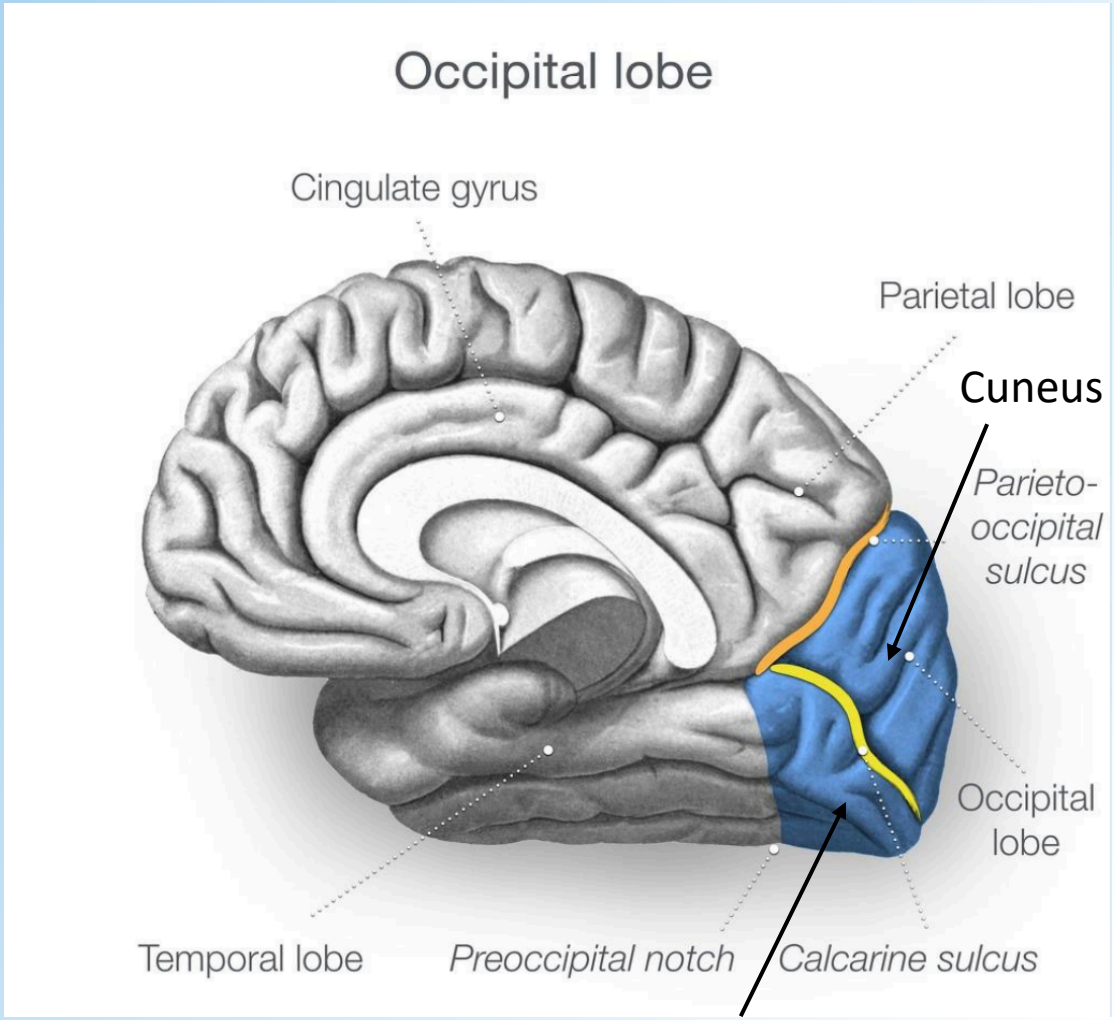
Temporal lobe

- **Superior temporal gyrus**
  - Wernicke speech area (area 22)
- **Transverse temporal gyri of Heschl**
  - Found within the lateral sulcus
  - Primary auditory areas (areas 41 and 42)



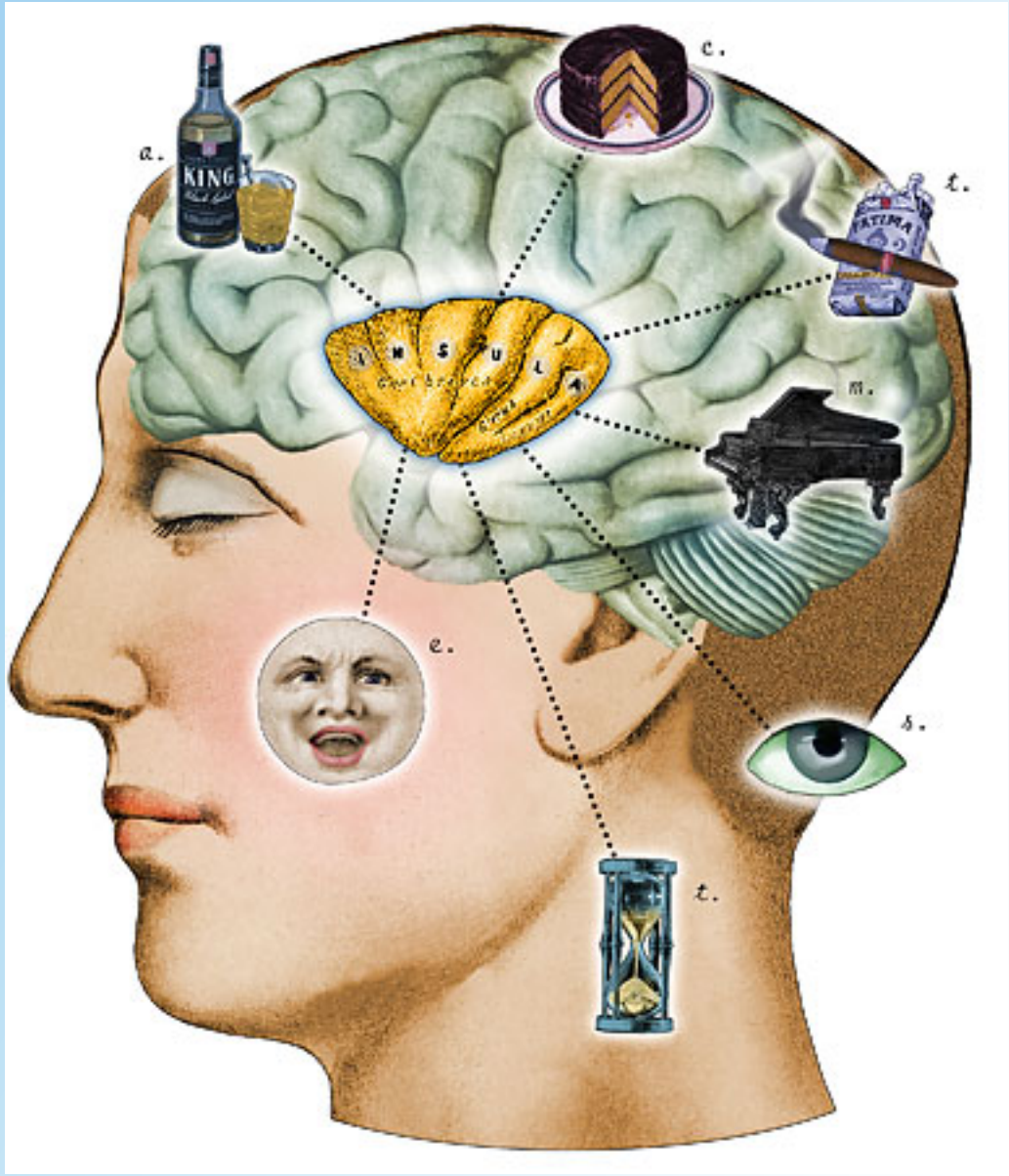
Occipital lobe

- **Cuneus and Lingual gyrus**
  - Primary visual cortex (Broadmann area 17, areas 18, and 19)



Insular cortex

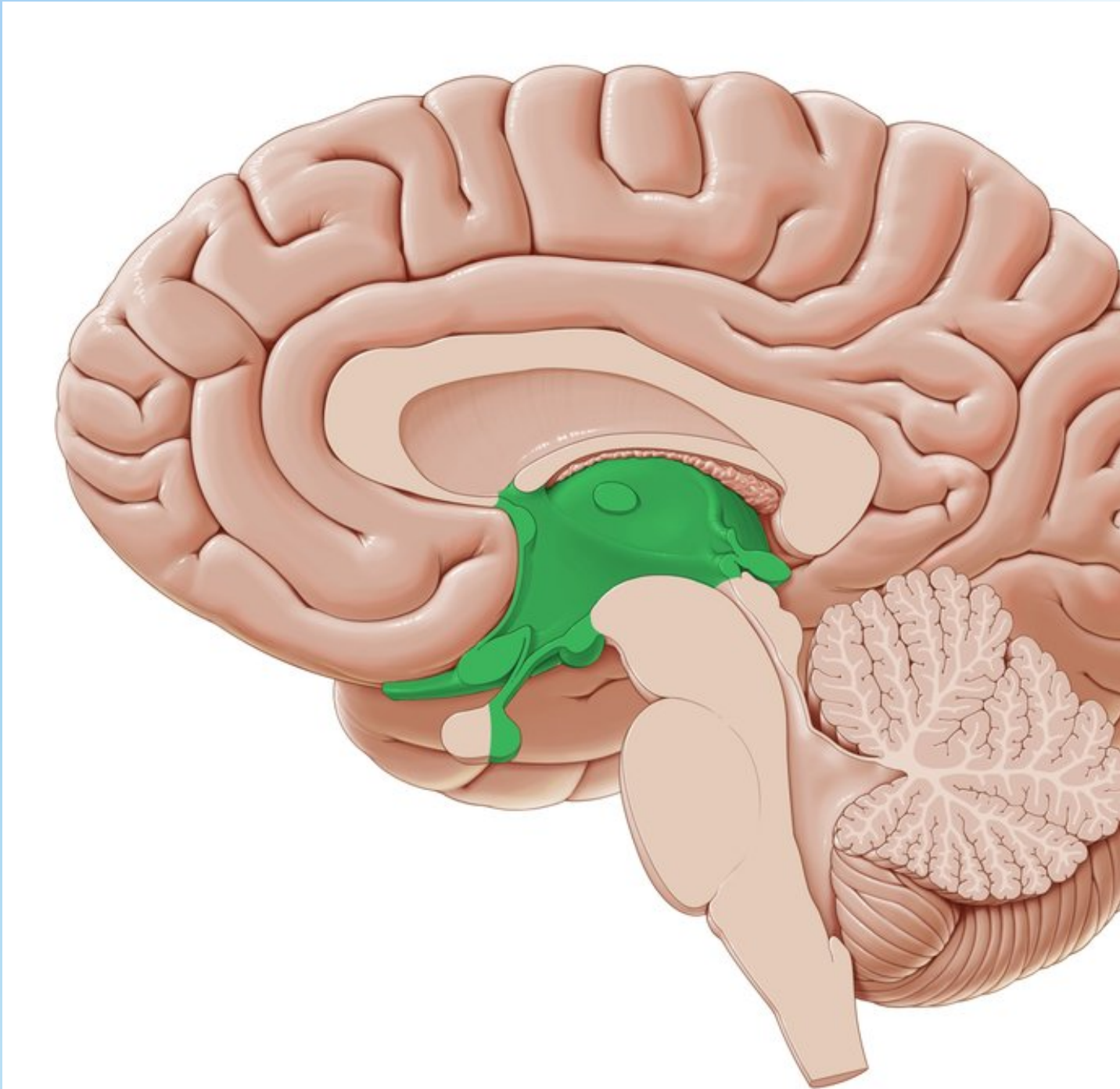
- Lies within the lateral sulcus
- Involved in homoestasis, emotions, taste and conciousness



Diencephalon

Consist of:

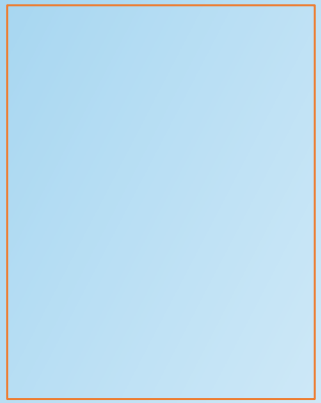
- **Thalamus**
- **Hypothalamus**
- Epithalamus
- Subthalamus
- 3rd ventricle



Thalamus

- Processes sensations (except for smell/olfaction)
  - Relay station, «Post office»
- Consolidates sensory inputs into a cohesive feeling or experience

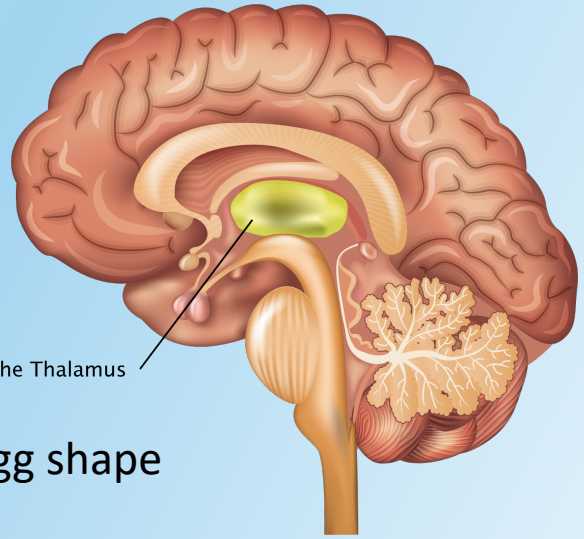
Heat



Tex

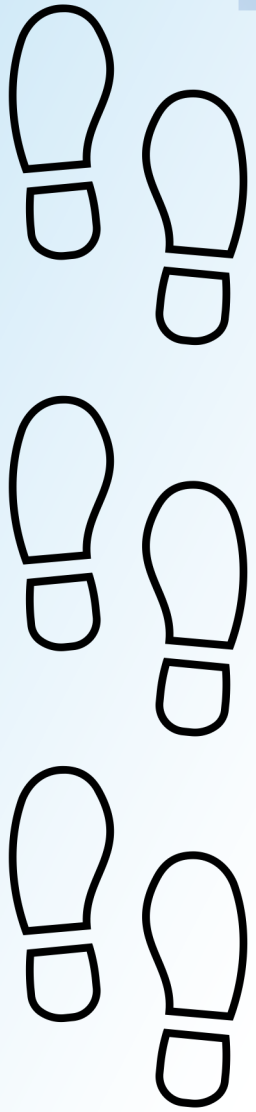
Shape

Egg shape



Thalamus – other functions

- Regulation of consciousness
- Stimulating feeling of wakefulness and alertness
- Temporarily suppressing unimportant sensations
  - Allow cerebrum to concentrate on important tasks



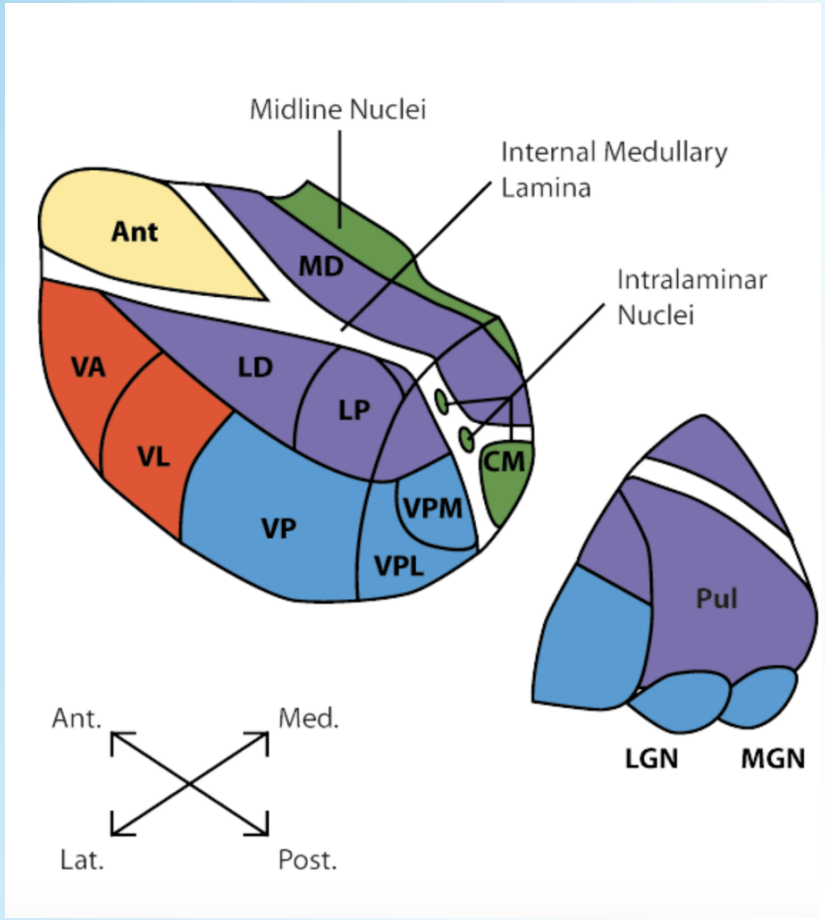
Thalamus 120 nuclei – 5 high yield

Ventral posterolateral (VPL)

- Sensory information
  - Senses from limbs and trunk: Vibration, pain, pressure, proprioception, light touch, temperature
- Projects information to the primary somatosensory cortex

Ventral posteromedial (VPM)

- Face sensation, taste
- Projects information to the primary somatosensory cortex



Lateral geniculate body (LGB)

- Vision
- Projects information to primary visual cortex (occipital lobe)
- «**L**ight» = **L**ateral

Medial geniculate body (MGB)

- Hearing
- Projects information to primary auditory cortex (temporal lobe)
- «**M**usic» = **M**edial

Ventral lateral (VL)

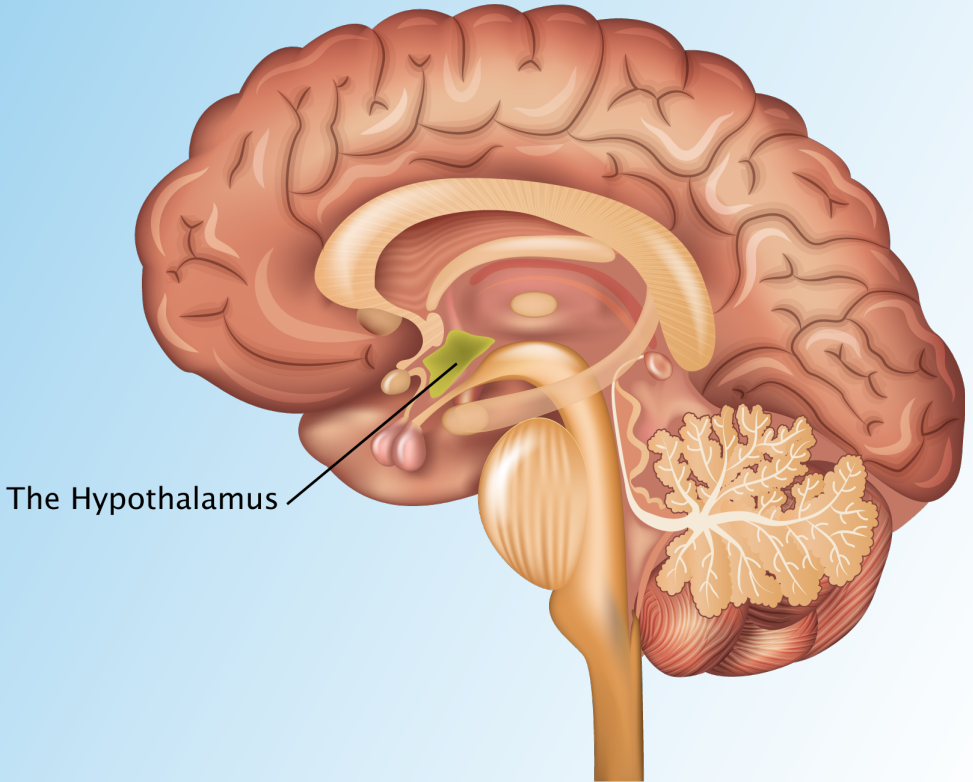
- Coordination and modulation of motor movement
- Projects information to the primary motor cortex

Hypothalamus

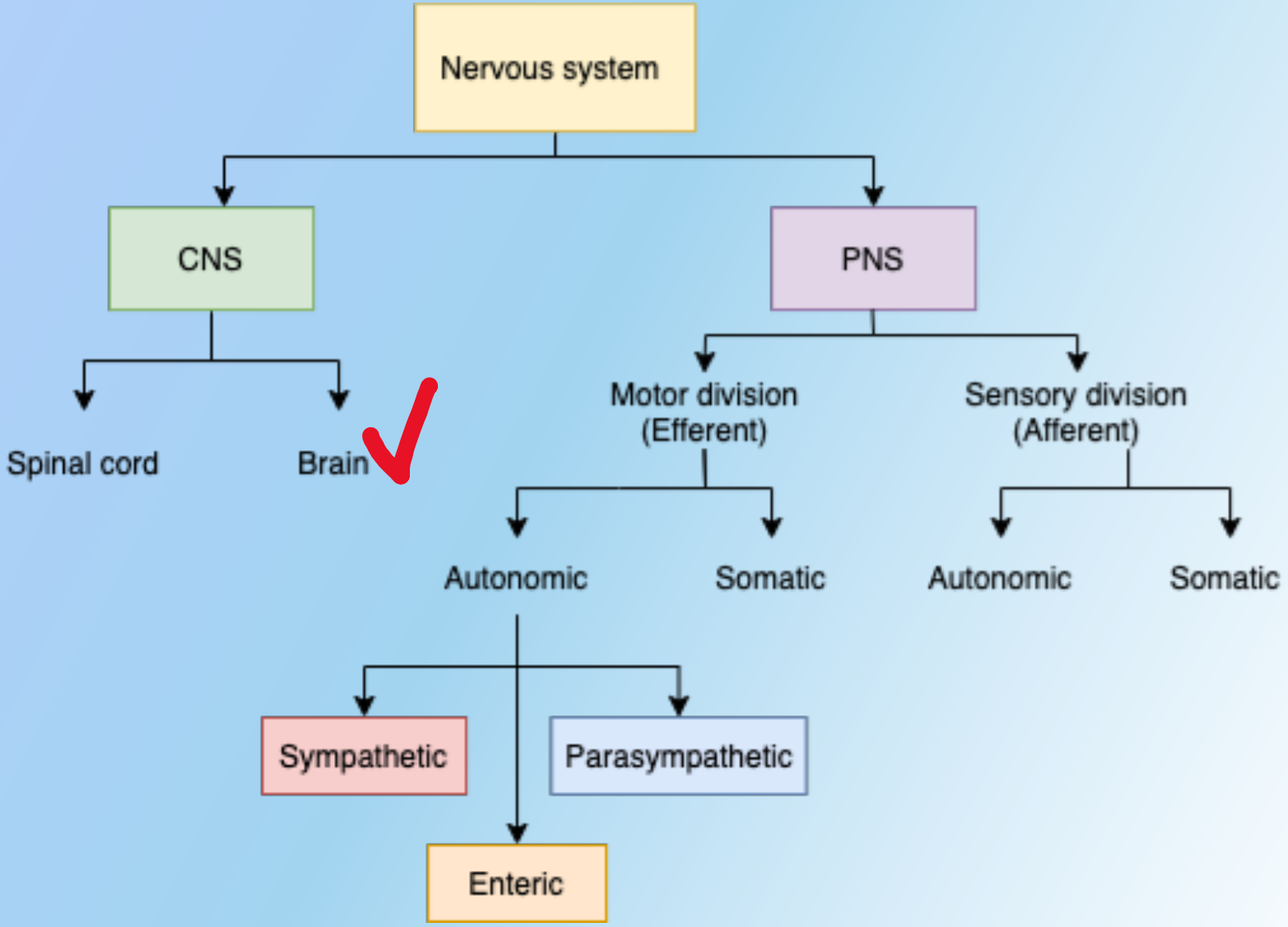
- Integrate autonomic responses to different emotions (anger, fear, pain)
- Regulation of body rhythms
- Regulation of food intake
- Link to the endocrine system

Maintains homeostasis by regulating
Thirst and water balance
Adenohypophysis (ant. pit.)
Neurohypophysis (post. Pit.)

Hunger
Autonomic nervous system
Temperature
Sexual urges
”TAN HATS”



HYPOTHALAMIC NUCLEI			
Region	**Nucleus**	**Function**	**Lesion**
Anterior (supraoptic)	Preoptic nucleus	Thermoregulation Sexual behavior	
	Supraoptic nucleus and Paraventricular nucleus	Regulate water balance Produce ADH (vasopressin) and oxytocin	Diabetes insipidus
	Suprachiasmatic nucleus	Circadian rhythms	
	Anterior hypothalamic nucleus	Thermoregulation (dissipation of heat) Cooling - sweating (parasympathetic)	Hyperthermia
	Lateral nucleus	Hunger Stimulated by ghrelin, inhibited by leptin	Anorexia Starvation Failure to thrive in infants
Middle (tuberal)	Venteromedial nucleus	Satiety Neuroendocrine control – stimulated by leptin	Hyperphagia (abnormally increased appetite)
Posterior (mammillary)	Posterior nucleus	Increase blood pressure Pupillary dilation Heating – shivering (sympathetic) Vasopressin release	Hypothermia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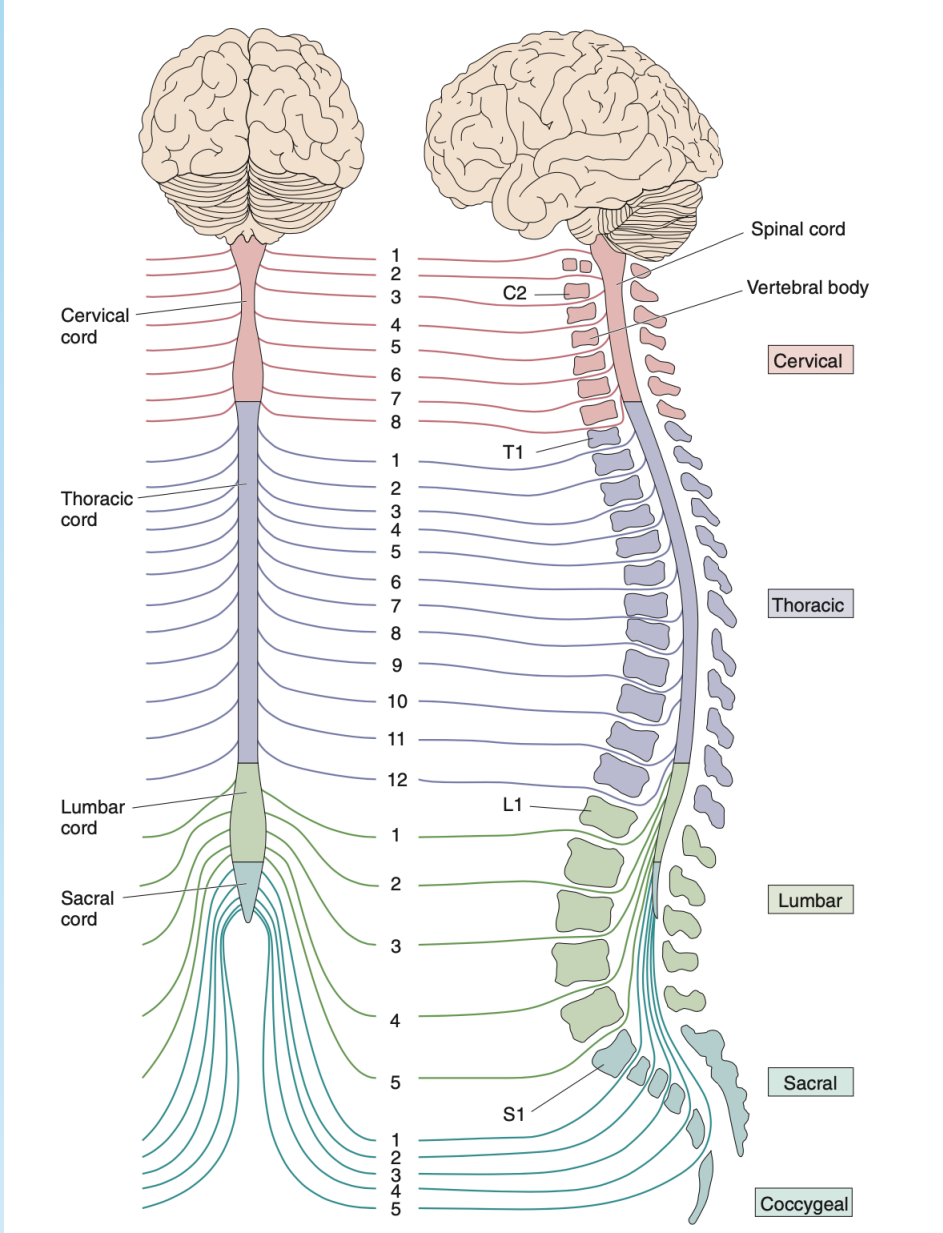
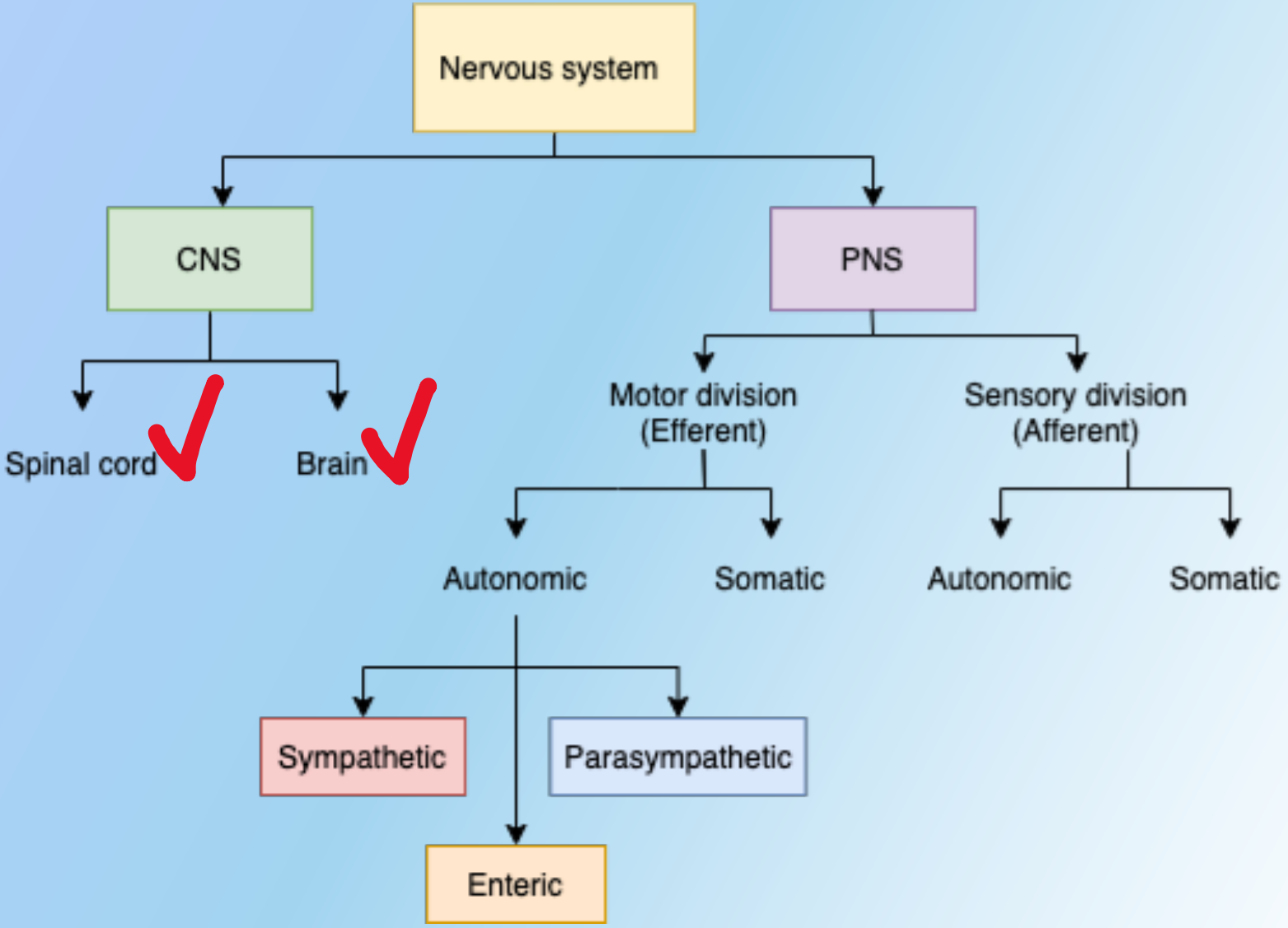
Enteric

Spinal cord

- **Afferent** spinal nerves carry sensory information from the body to the brain
  - ***Arrive*** *the brain*
- **Efferent** spinal nerves carry motor information from the brain to the body
  - ***Exit*** *the brain*

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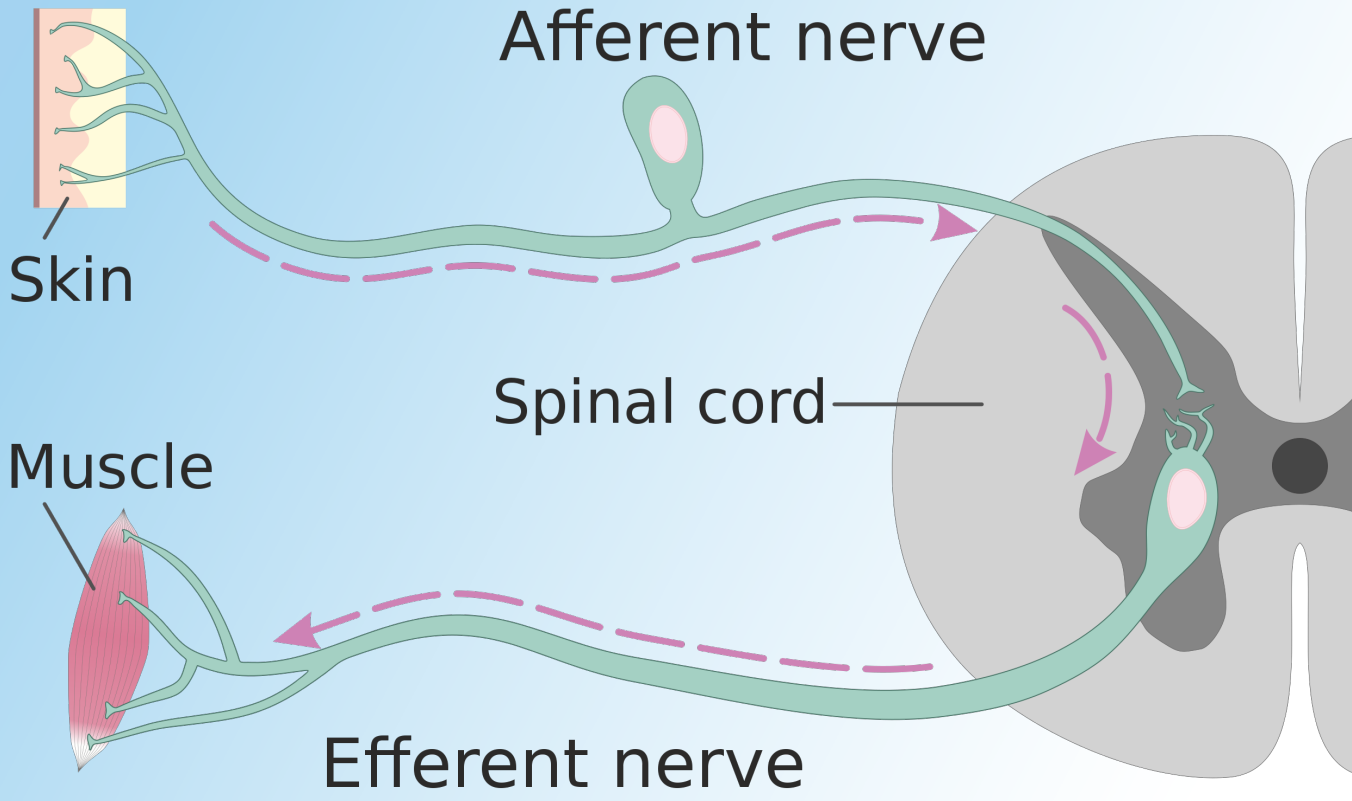
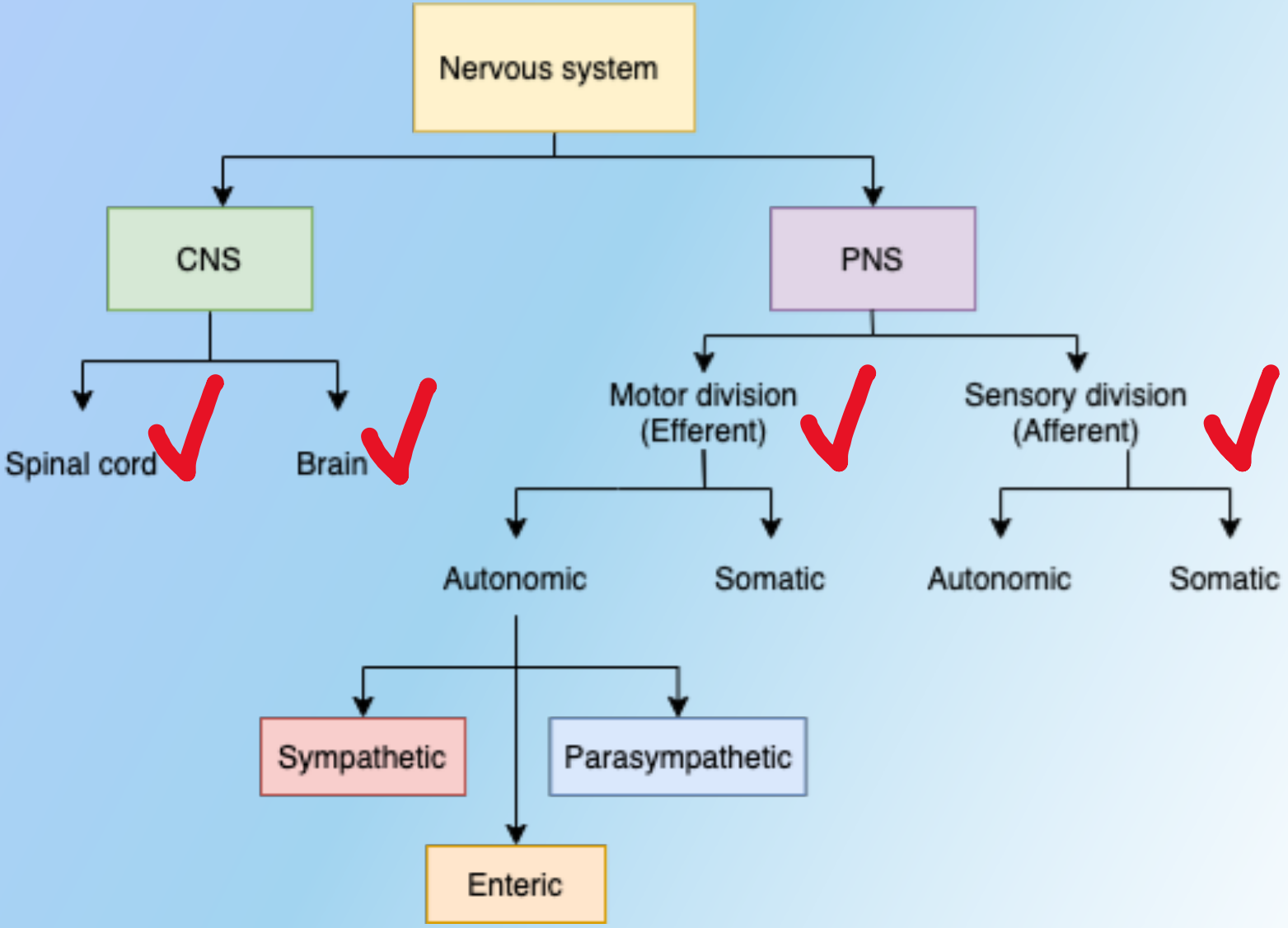
Peripheral nervous system (PNS)

In the PNS, afferent and efferent projections are always from the perspective of the spinal cord!

- PNS **afferents** are axons of sensory neurons carrying sensory information from the body, *into* the spine
- PNS **efferents** are axons of spinal cord motor neurons carrying motor-movement signals *out of* the spine to the muscles

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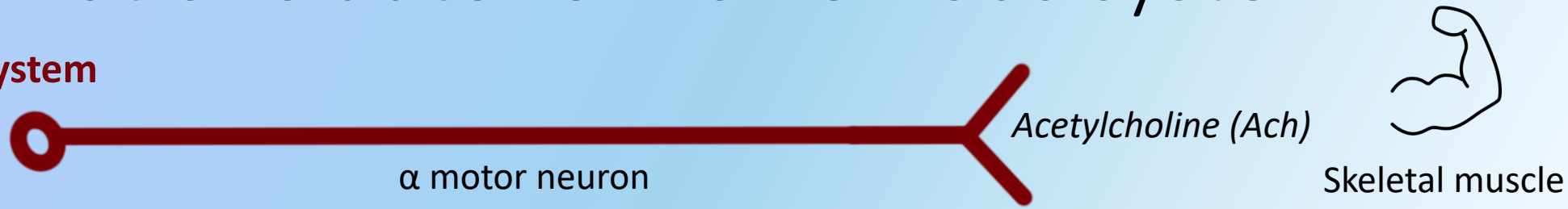
Somatic vs autonomic nervous system

Somatic nervous system



Autonomic nervous system

Sympathetic nervous system

Parasympathetic nervous system

Somatic nervous system (SNS)

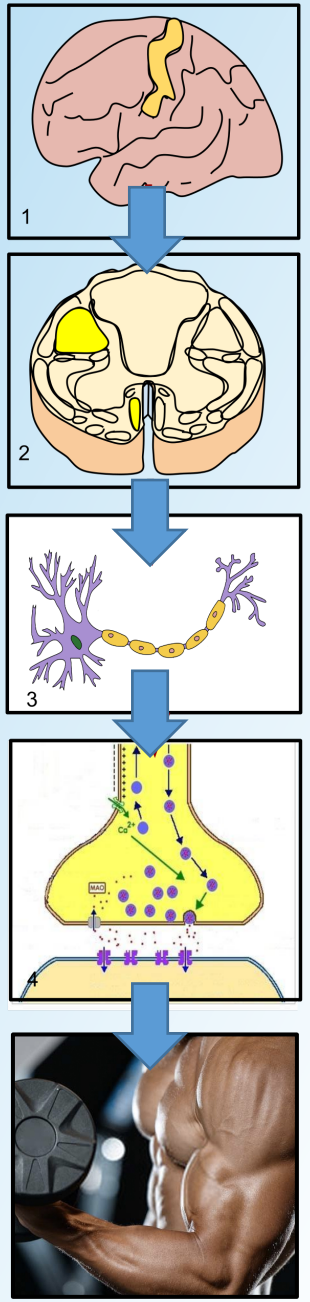
«Voluntary nervous system»

Two parts:

1. **Spinal nerves:** Peripheral nerves carrying sensory information *into* and motor commands *out of* the spinal cord
2. **Cranial nerves:** Nerve fibers carrying information into and out of the brain stem

Somatic nervous system (SNS)

1. (Brain) Precentral gyrus: the origin of nerve signals initiating movement
2. Corticospinal tract: Mediator of message from brain to skeletal muscles
3. Axon: the messenger cell that carries the command to contract muscles
4. Neuromuscular junction: the messenger axon cell tells muscle cells to contract
5. Muscle contraction



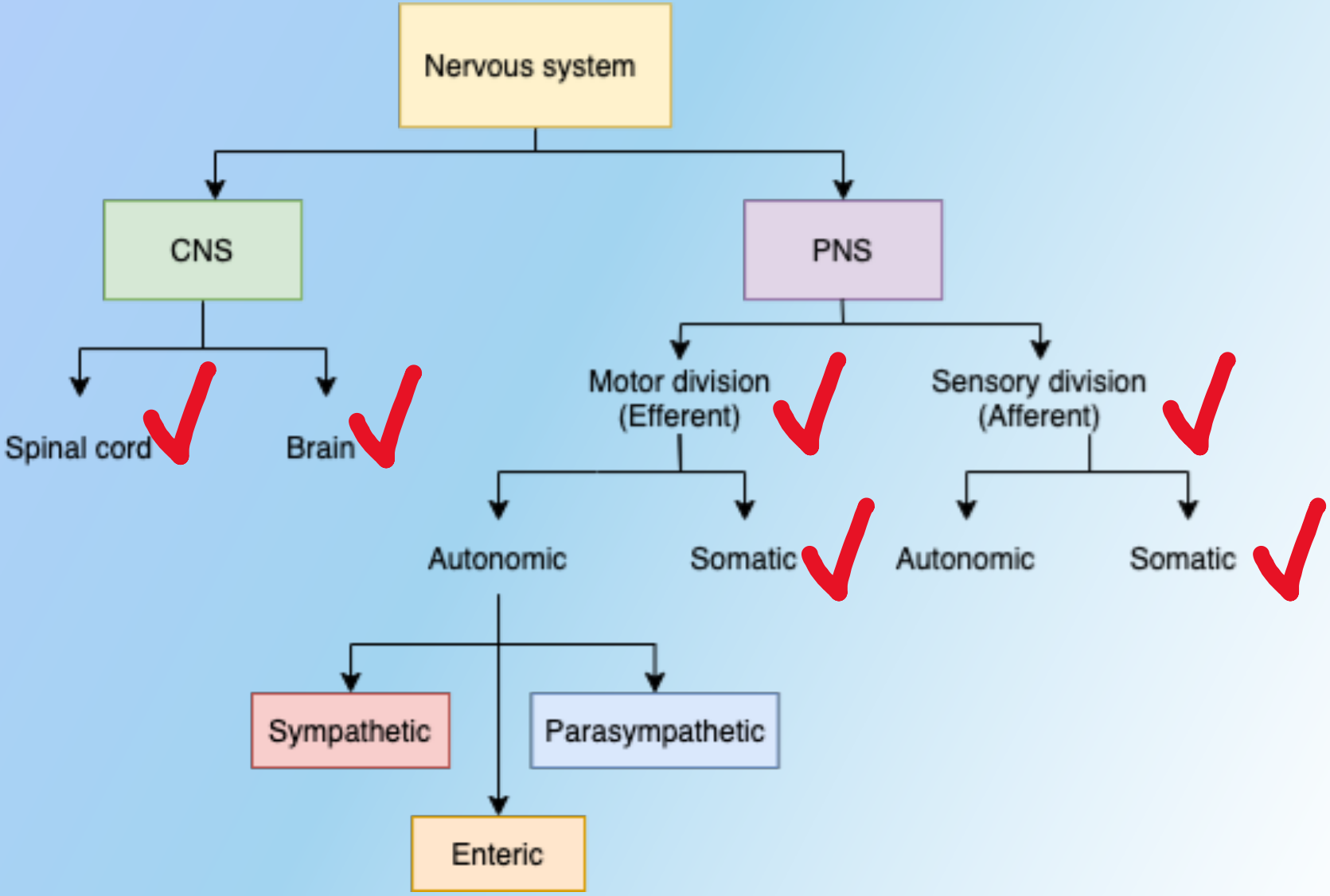
Precentral gyrus

Corticospinal tract

α motor neuron

Acetylcholine

Skeletal muscle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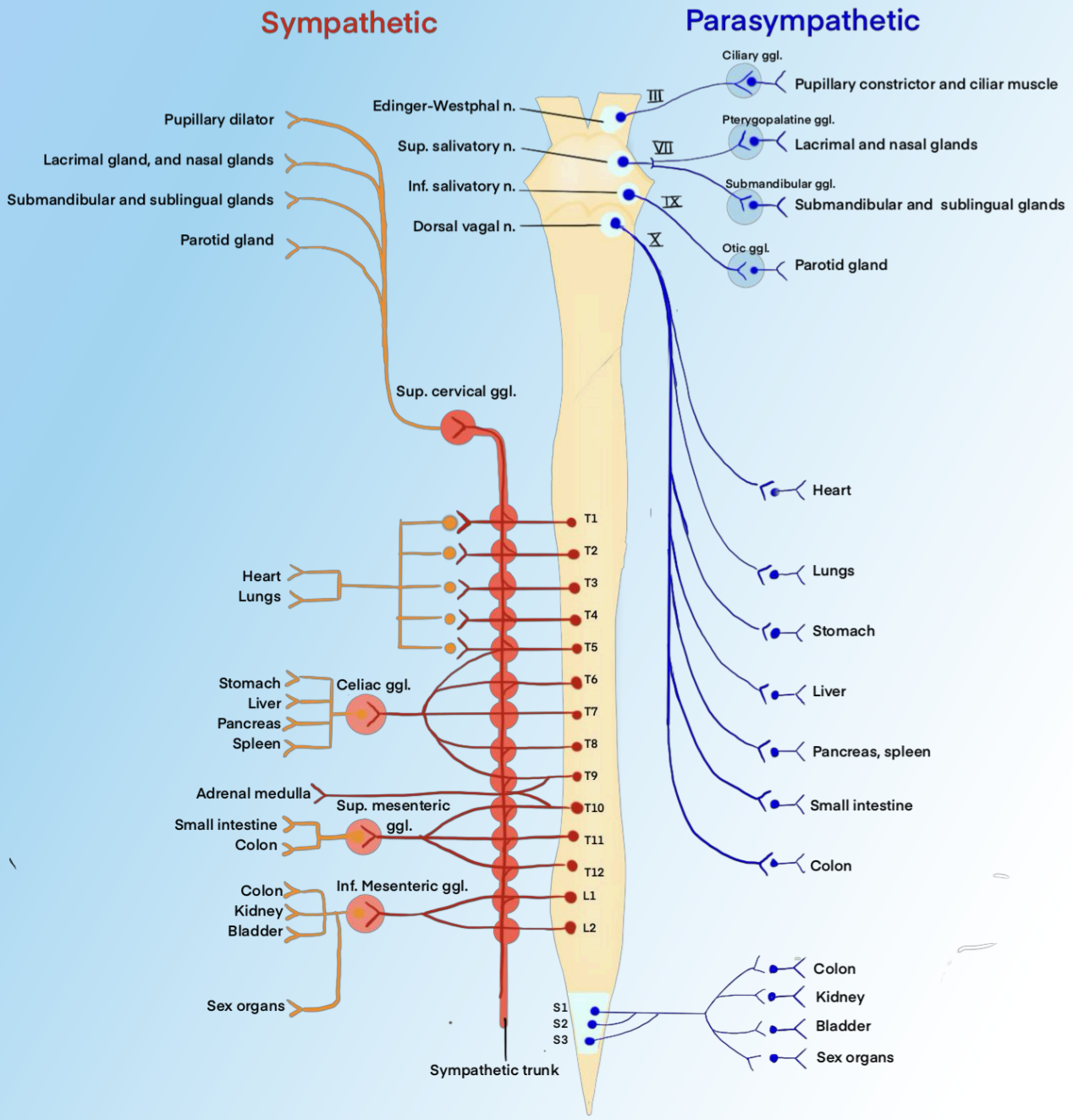
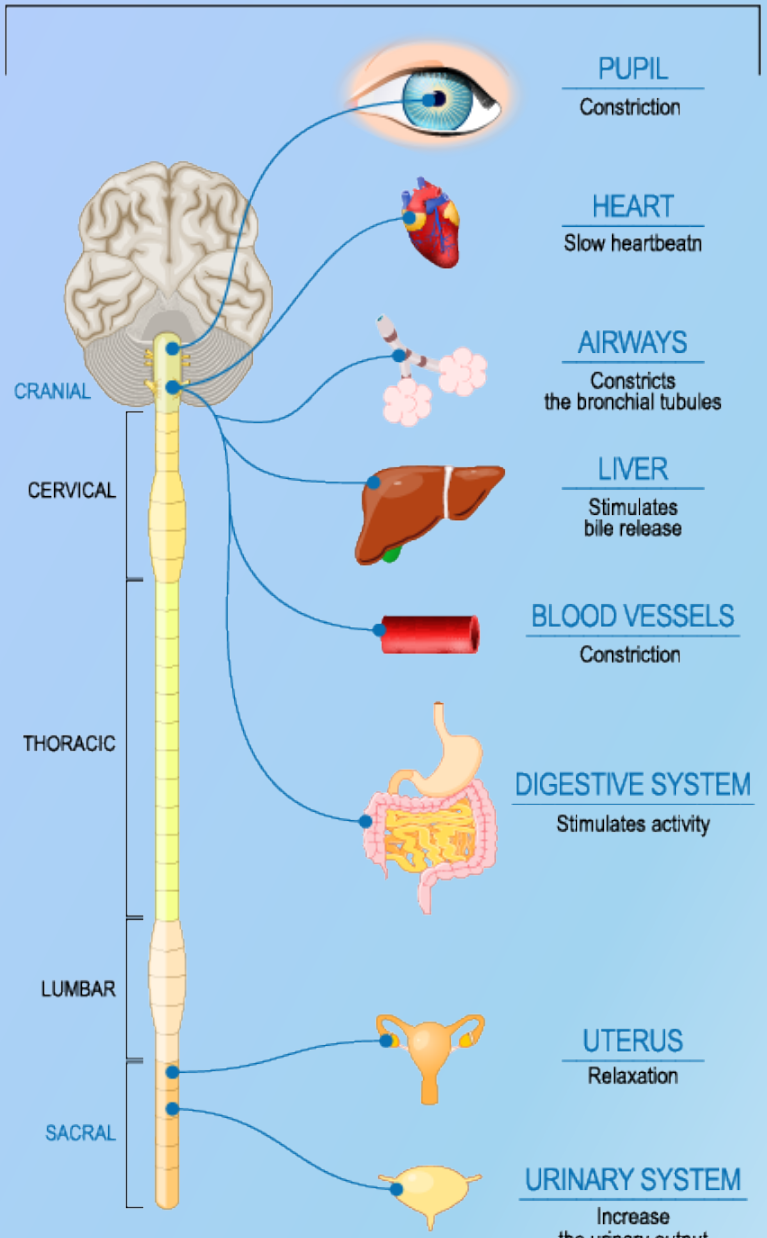
Autonomic nervous system

«Involuntary nervous system»

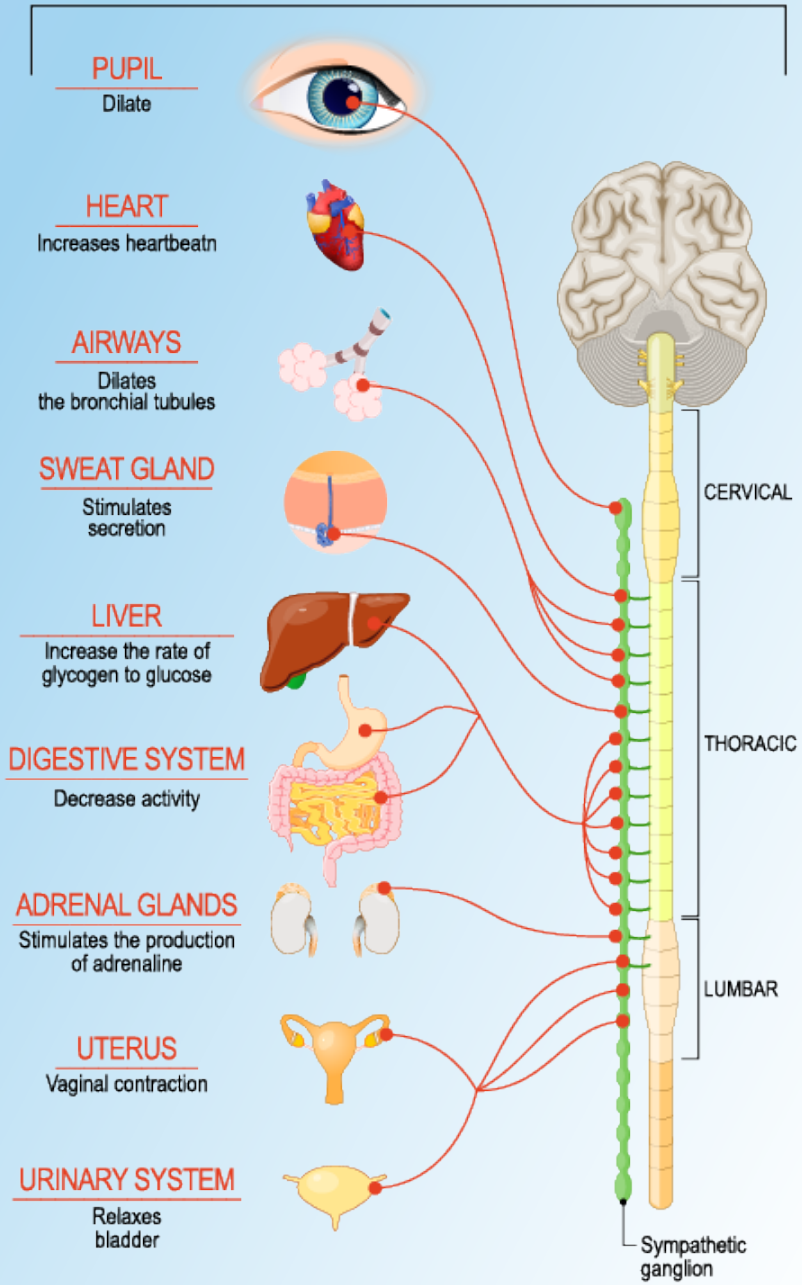
- **Sympathetic division**
  - Thoracolumbar outflow (T1-L2)
- **Parasympathetic division**
  - Craniosacral outflow (CN III, VII, IX, X, S2-S4)
- **Enteric division**



Parasympathetic

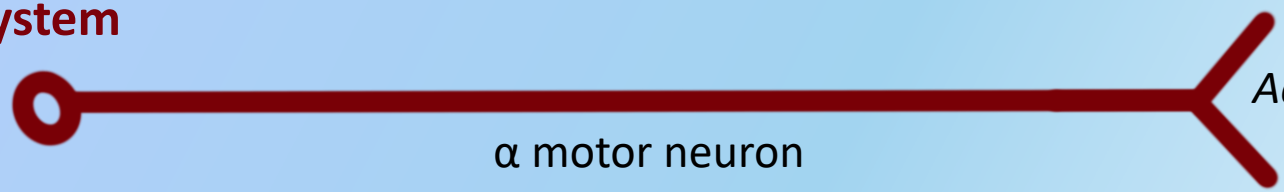


Sympathetic



Somatic vs autonomic nervous system

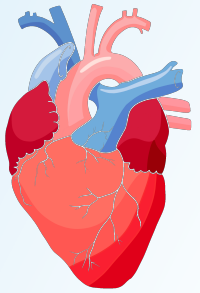
Somatic nervous system



Skeletal muscle

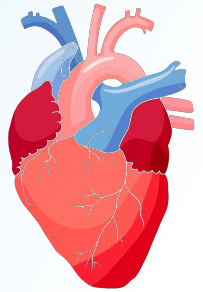
Autonomic nervous system

Sympathetic nervous system



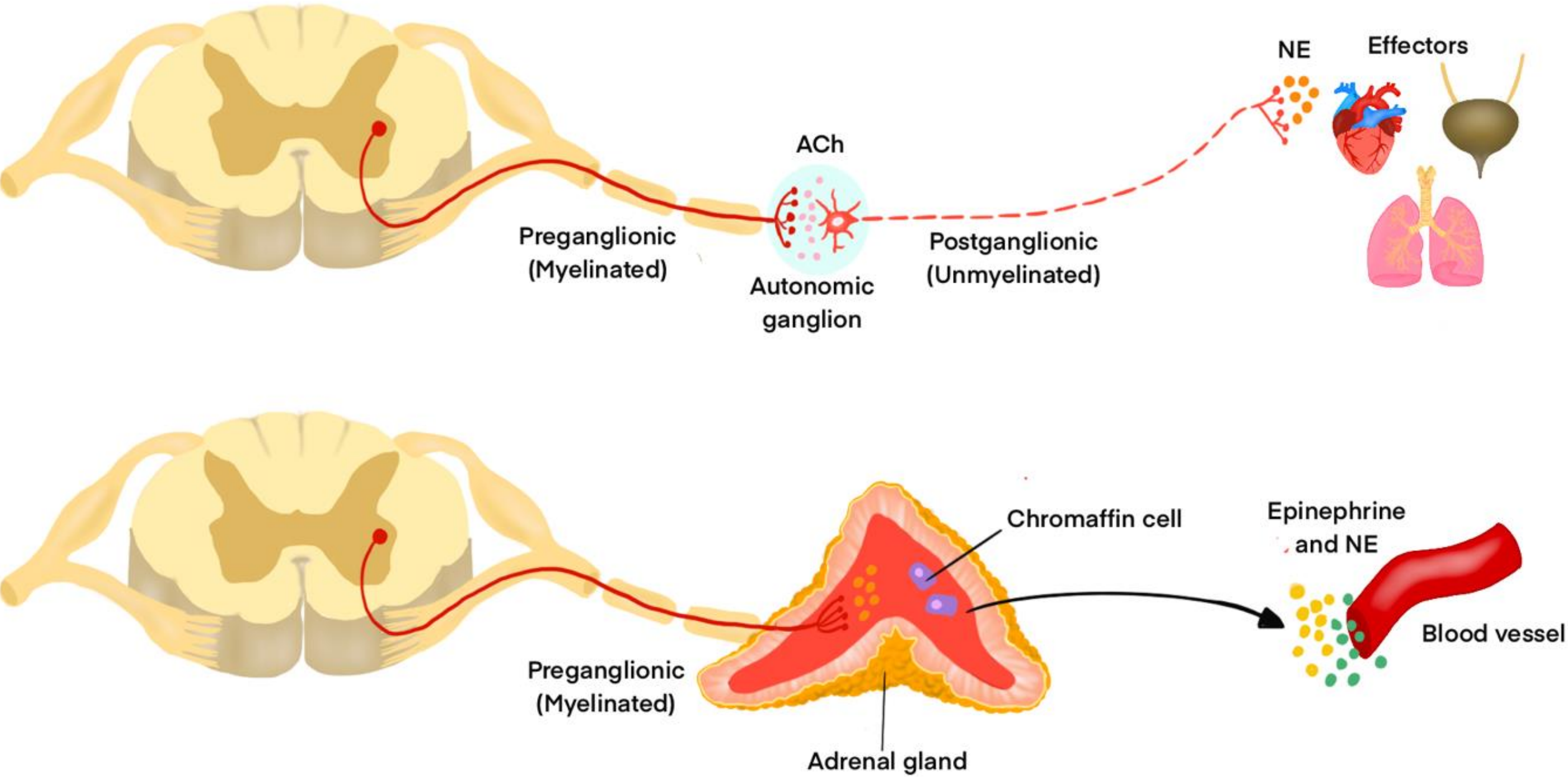
Tachycardia

Parasympathetic nervous system



Bradycardia

Sympathetic nervous system



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