

VOCAB LIST FOR CNS AND ANS LECTURE

CITOLOGY

1. Neurons
2. Neuroglia glia

1. Neurons

Soma: grey matter
Nuclei
Ganglia

Processes: white matter

1. Dendrites: multiple (multipolar neuron)
2. Axons, w synaptic knobs

2. Neuroglia

Astrocytes: structural support

Microglia: scavenging/repair

Ependymal cells: lining internal cavities

~ simple cuboid epithelium
luminal side: secretion of CSF and cilia to move it

Insulators:

Cells with processes wrapping around axon, forming a lipid sheath ~ plasma membrane *Axolemma*

CNS:

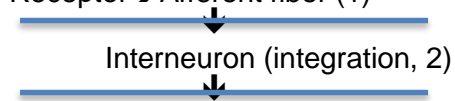
oligodendrocytes (octopus-like)

Peripheral:

Ganglia: *Satellite cells*
Fibers: *Schwann cells*

CIRCUITRY OF THE NERVOUS SYSTEM

Receptor → Afferent fiber (1)



Effectors ← Efferent fiber (1)

1=Peripheral nervous system

- 12 pairs of cranial nerves
- 31 pairs of spinal nerves

2= central nervous system (processing center)

Receptors:

1. Visceral
2. Somatic
3. Propioreceptors
4. Special receptors

Effectors:

Visceral: smooth muscle/glands
Somatic: skeletal muscle

Tracts:

Ascending:

First-through-third order

Descending:

Two neurons (upper and lower)

Afferent:

Spinothalamic

Somatosentory input

Spinoreticular

Pain from tissue injury

Gracile and cuneate fasciculi (above or below T6)

visceral pain
vibration,
deep discriminative touch

Spinocerebellar

proprioception

Efferent:

Corticospinal

Somatomotor output (fine motor control)

Reticulospinal

Regulating awareness of pain
Balance and posture

Tectospinal

Reflective head turning in response to visual and auditory stimuli.
Superior and inferior colliculi

Vestibulospinal
Balance and posture

Decussation:

Ascending: Gracile and cuneate fasciculus decussate at medial lemniscus; other tracks: spinal cord

Descending: most descending tracks don't decussate (except tectospinal, in midbrain)

GROSS ANATOMY OF THE CNS

Spinal cord:

1. Anterior median fissure
2. Posterior median groove
3. Central canal

Grey matter (central)
gray commissures
P,L,A horns

White matter (peripheral)
D,L,V columns, w
ascending and descending tracks

Brain:

1. Brainstem,
with reticular system
(controlling states of consciousness + *central pattern generators*)

- 1.1 Medulla oblongata
- 1.2 Pons
- 1.3 Midbrain

2. Diencephalon

- 2.1 Thalamus: gateway to cerebrum
- 2.2 Epithalamus: pineal gland
- 2.3 Hypothalamus:

Control center for ANS

3. Cerebellum:

Hemispheres
joined by *vermis*
separated by *longitudinal fissure*

Folia: folds
White matter:
arbor vitae

Grey matter:
Cortex (input)+
four deep nuclei/hemisphere
(output)

4. Cerebrum:

Hemispheres
joined by *corpus callosum*
separated by *longitudinal fissure*
Gyri (wrinkles)

Grey matter:
Cortex
+ Basal nuclei

- Caudate nucleus
- Putamen
- Globus pallidus

BRAINSTEM

MO: 4th ventricle (anterior boundary)

Pons: 4th ventricle

MB: Cerebral aqueduct

Diencephalon: 3rd ventricle (ventral) and lateral ventricles (lateral)

Reticular formation: MO, P, Midbrain, and caudal hypothalamus

- Awareness
Habituation
Sleep and consciousness
Pain modulation
(descending analgesic fibers)
- *Central pace generator:* rhythmic signals
Cardiac

Resp. centers

- Motor control,
Vasomotor
Maintenance of posture and
balance
Input to cerebellum

Pons: Sleep, respiration, bladder control

MO: cardiac and vasomotor centers

MO

Anterior:

-Pyramids: corticospinal tracts

Posterior (ridges):

-Gracile and cuneate fasciculi

Lateral (bulge):

-Olive w olivary nucleus: signals from
spinal cord and brain to the cerebellum

-Medial lemniscus: decussation which
continues to thalamus

Pons

Fascicles

Transverse: join 2 cerebellar
hemispheres

Longitudinal: ascending, descending

Midbrain

1. Tectum:

superior and inferior colliculi

2. Central gray matter:

Controls awareness of pain

3. Cerebral peduncle:

anchors cerebrum

4. Crus:

corticospinal tracts

5. Substantia nigra:

Inhibitory signals to thalamus
and basal nuclei

6. Tegmentum, w red nucleus:

Collaborates with cerebellum
for fine motor control

Diencephalon

Thalamus: 23 nuclei

1. Gateway to cerebral cortex for
Special senses
Somatosensory signals

2. Motor control

Feedback loops with cerebellum
and basal nuclei

3. Part of limbic system

Hypothalamus: from optic chiasm to
mammillary bodies

1. Major integrating center of ANS
2. Master regulator of endocrine
system (anterior pituitary) +
secretion of oxytocin and ADH
 - Food and water intake
 - Circadian rhythms
 - Emotion_sexual drive

*Explains visceral responses
(Mammillary bodies)*

3. Intermediary between
hypocampus and cerebral
cortex (formation of new
memories)

Epithalamus:

Pineal gland: melatonin
secretion

Cerebellum

High density of neurons

Granule cells

Purkinje cells: comparison of intended vs outcome

Deep nuclei: relay output signals

Functions:

1. Control of motor coordination
 - tone and posture
 - coordination of eye and body movements
2. Subconscious evaluation of sensory input (cognitive)
 - a. Spatial perception
 - b. Passage of time
 - c. Tactile input
 - d. Emotion

3. Language

Peduncles

Superior (to MB): output
Middle (to pons): input from brain, comparing command with outcome
Inferior (to MO): proprioception

CEREBRUM

Primary: regions receiving input directly from brainstem or sense organs and issuing motor nerve fibers

Association area: integrative functions:

- Interpretation,
- Planning,
- Cognitive functions,

Memory

Primary cortex and association areas

General senses + somatic pain:

Primary somatosensory cortex
postcentral gyrus
lateral sulcus to crown to long. fissure
Sensory homunculus
(somatotopy, upside down)

Association area: posterior

Referred pain: due to shared interneuron at spinal cord

Visceral pain:

Viscerosensory cortex deep within lateral sulcus

Special senses:

1. Visual: posterior occipital
Association area: anterior
2. Auditory: superior temporal and insula
Association area: inferior
3. Balance: inferior postcentral gyrus (adjacent to sensations of the face)
4. Gustatory: inferior end of postcentral gyrus and anterior insula
5. Olfactory: medial temporal and inferior frontal lobe.

Association area for gustatory and olfactory: *orbitofrontal area*

Primary motor cortex (execution)

Precentral gyrus

Motor homunculus

Association area: frontal lobe (decision)

Basal nuclei:

- Caudate
- Putamen
- Globus pallidus

Control of highly practiced behaviors

(procedural memory)

Feedback to cortex and thalamus;

Planning and execution of movements

Higher abilities:

Prefrontal cortex: higher abilities:
abstract thought, foresight, judgment,
responsibility, etc.

Limbic system:

- Cingulate gyrus
- Hypocampus
- Amygdala
- Hypothalamus
- Thalamus?
- Parts of frontal lobe (orbitofrontal cortex)?

1. Centers for gratification and aversion (amygdala aversion)
2. Emotion (Amygdala and hypothalamus)
Amygdala: Fear
3. Memory:
Amygdala: emotional

Hippocampus: new declarative memories (Cognitive + sensory), relayed to cortex (memory consolidation)

1+2+3 ~ personality

Output: Amygdala

- Visceral (hypothalamus)
- Conscious (cortex)

Lateralization:

Left: categorical
(sequential and analytical)

Right: representational
(integrated, holistic)

Language control (left hemisphere)

Wernicke's area:

Recognition of spoken and written language

Brocas' area:

Motor program for speech (pre-motor cortex)

Area affected	Pathology
Substantia nigra	Parkinson's disease
Basal nuclei	Dyskinesias <ul style="list-style-type: none"> • Inhibited movements • Exaggerated movements (ballismus)
Language areas, VII and XII	Aphasias
Cerebellum	ADHD (impulse control problems)
Hippocampus	No new declarative memories
Frontal lobe	Irresponsible behavior, profanity

AUTONOMIC NERVOUS SYSTEM

Control of visceral function

Basic traits:

1. Effector (motor)

Smooth muscles
Cardiac muscles
Glands

Reflexes also involve afferent (sensory) pathways

2. Involuntary

(But Biofeedback)

3. Two-neuron system, with synapses in ganglia:

Pre-ganglionic neuron
R: nicotinic, muscarinic

Post-ganglionic neuron

Cholinergic R: muscarinic
Adrenergic R: alpha, beta

4. Modulatory rather than primary stimulation.

Denervation causes hypersensitivity
Based on dual innervation: two divisions:

- Sympathetic
- Parasympathetic

Frequently antagonistic

	Sympathetic (thoracolumbar)	Parasympathetic (cranio-sacral)
Spinal cord origin	T1-L2	III, VII, IX, X S2-S4
Location of ganglia	Far from target <ul style="list-style-type: none"> • Paravertebral • Collateral 	Close to target
Postganglionic neurotransmitters	NE	ACh

Note: ACh=acetyl choline; NE=norepinephrine or noradrenaline

System	Sympathetic	Parasympathetic
Cardiovascular	Increased heart rate Vasoconstriction In organs Vasodilation of skeletal muscle	Decreased heart rate Little effect on vascular tone
Lungs	Bronchodilation	Bronchoconstriction Increased secretion of mucus
Digestive	Decreased motility	Increased motility and secretion
Liver	Glycogen breakdown	Glycogen synthesis
Skin	Piloerection	No effect
Eye	Pupillary dilation Thinning of lens for far vision	Pupillary constriction
Bladder	No effect	emptying

Sympathetic		
Location of pre-ganglionic neuron	Lateral horn of spinal grey matter T1-L2	
Location of post-ganglionic neuron	Paravertebral ganglia White and grey communicating rami	<u>Spinal route:</u> skin and skeletal m.
And routes	Different level of paravertebral ganglia Collateral ganglia	<u>Sympathetic route:</u> Thoracic viscera <u>Splanchnic route:</u> All viscera of abdomen and reproductive organs
Plexuses And additional ganglia	Sympathetic	Plexus <ul style="list-style-type: none"> • Carotid • Cardiac • Pulmonary
	Splanchnic	Abdominal aortic plexus: collateral (prevertebral) ganglia

Parasympathetic		
Location of pre-ganglionic neuron	Nuclei of cranial pairs III, VII, IX, X and S2-S4	
Location of post-ganglionic neuron	Go directly to organs (except for terminal ganglia)	
Terminal ganglia	III Ciliary g. VII Pterygopalatine g. VII Submandibular g. IX Otic g.	Ciliary and pupillary constrictor muscles (III) Salivary glands (VII) (except parotid) Nasal glands (VII) Lacrimal glands (VII) Parotid gland (IX)
Cranial pair X (90% of fibers)	Plexus <ul style="list-style-type: none"> • cardiac • pulmonary • esophageal • Abdominal aortic Celiac ganglia	Heart Lungs Esophagus Viscera of abdominal cavity (except distal colon); celiac ganglion
Sacral portion	Inferior hypogastric plexus Pelvic n.	Distal colon, <ul style="list-style-type: none"> ▪ rectum, ▪ bladder, reproductive organs

+ adrenal medulla, which is an endocrine organ that secretes adrenaline (85%) and nor-adrenaline (15%); modified post-ganglionic neuron specialized in secretion