300754
Neuroanatomy Review

Neuro Basics

Terminology

- **Tract**: bundle of CNS axons in white matter
- **Nerve**: bundle of axons found only in PNS
- **Afferent neurons**: receive information from sensory organs and transmit this input towards the CNS
- **Efferent neurons**: sends impulses away from CNS to the PNS
- **Ganglion**: collection of neuron cell bodies in the PNS (BG exception to rule)
- **Nuclei**: collection of neuron cell bodies in the CNS

Upper Motor Neurons

- Cells that carry motor commands from motor areas of brain and synapse directly on LMNs or indirectly through interneurons.
- Instruct LMNs to produce voluntary movements
- **Damage**: spastic, increased tone, hyperactive reflex, babinski sign, little muscle atrophy

Lower Motor Neurons

- Nerve cells that originate in ventral horn of spinal cord and send axons to skeletal muscles. Act as link between UMNs and muscles
- Produces muscle contractions
- Two types: alpha & gamma
- **Damage**: flaccid paralysis, decreased reflex, fasciculations, hypotonia, muscle atrophy

Regulated by:

1. Cerebellum - select correct sequences and check movement coordination
2. Basal ganglia - initiates and terminates movement

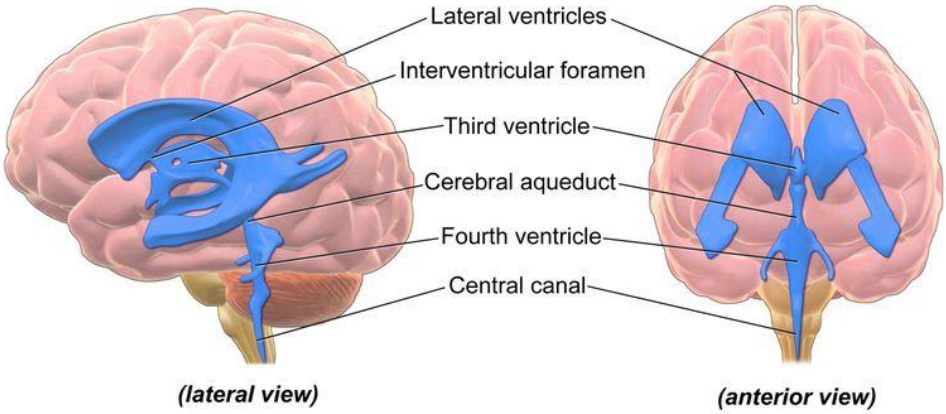
Meninges

1. **Dura mater**: outer-most, tough and inflexible, separate cranial cavity, protect brain from displacement
2. **Arachnoid mater:** transfer CSF from ventricles to blood stream
3. **Pia mater**: adheres to brain, produce CSF

Ventricular System

- **Lateral ventricles**: extend across large area of brain. Anterior horns of these structures are located in frontal lobes. Extend posteriorly into parietal lobes and their inferior horns are found in the temporal lobes.
- **Third ventricle:** lies between two thalamic bodies. The massa intermedia passes through it and the hypothalamus forms its floor and part of its lateral walls.
- **Fourth ventricle:** located between cerebellum and pons

All of the ventricles contain choroid plexuses which produce CSF by allowing certain components of blood to enter. The choroid plexuses are formed by the fusion of the pia mater, and the ependyma, the lining of the ventricles.



CNS Regions

Lobes

Temporal	Language comprehension, object, people and language recognition
Occipital	Visual processing
Parietal	Self awareness of surroundings, spatial awareness and navigation
Frontal	Personality, sociality and adapting to environment

Regions

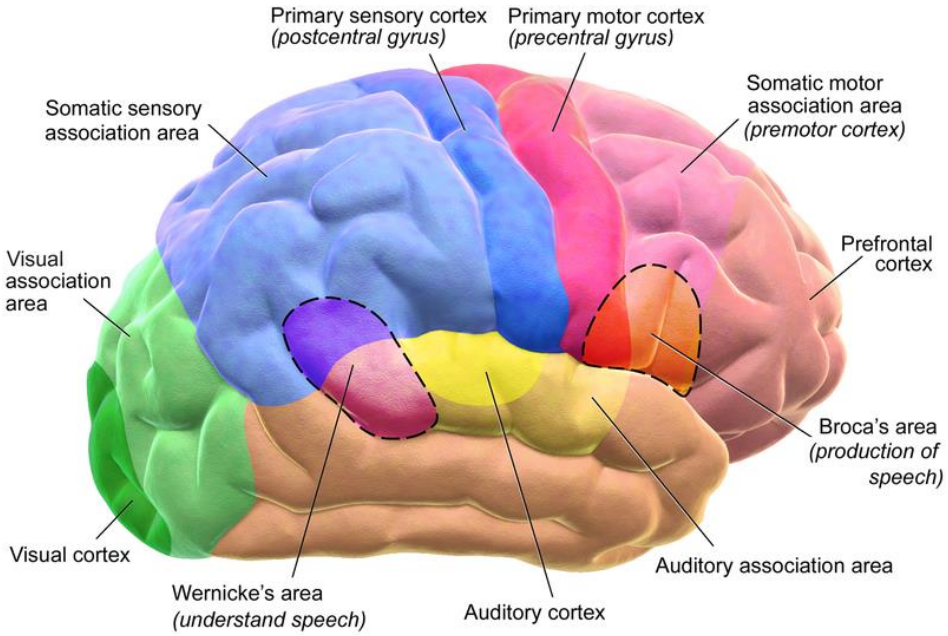
Basal ganglia	Voluntary motor movement, procedural learning, decision making, eye movement
Cerebellum	Locomotion, posture and balance, skilled motor tasks
Broca's area	Language expression
Wernicke's area	Language understanding
Corpus callosum	Connects left and right hemispheres
Medulla oblongata	Involuntary functions including vomiting, breathing, sneezing, regulation of heart rate and blood pressure
Hypothalamus	Temperature, circadian rhythm, hunger, thirst
Thalamus	Consciousness, sleep, awareness, alertness

Amygdala	Positive and negative emotional memories, fear
Hippocampus	Time and place memories
Pre-frontal cortex	Executive functions, consequences of decisions, personality, judgement of right and wrong

Gyri and Sulci

Pre-central gyrus	Voluntary movement
Post-central gyrus	Discriminative touch
Superior temporal gyrus	Sound localisation
Lingulus gyrus	Vision
Paracentral lobule	Somatosensation and movement from hips to feet
Occipitotemporal gyrus	Facial recognition

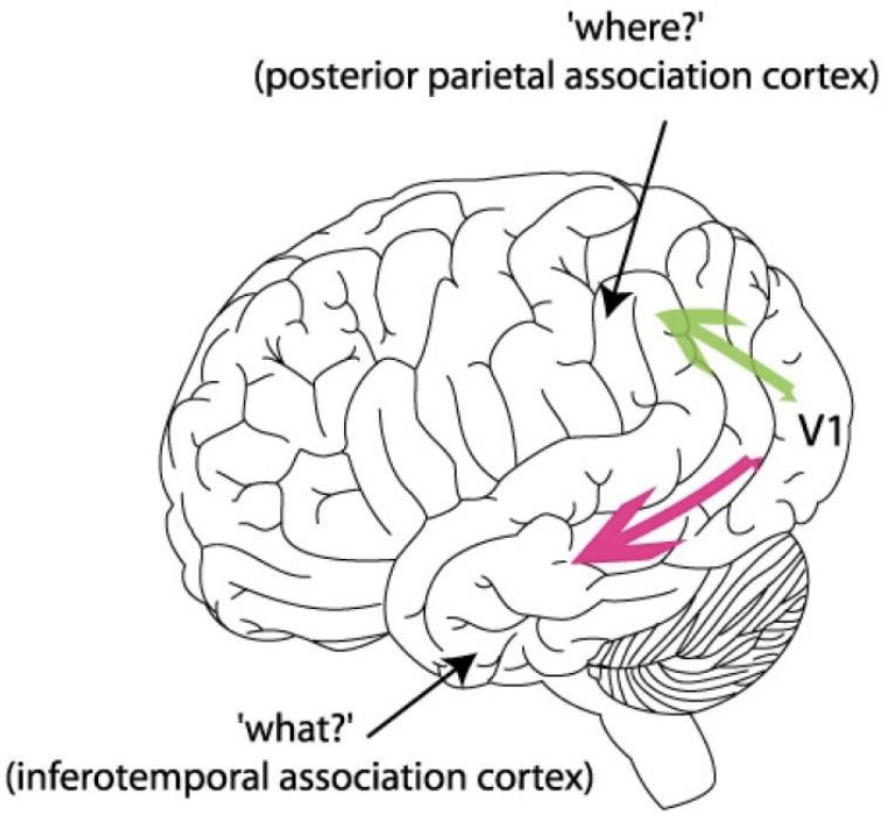
Brain Cortex



Area	Cortex	Function
<u>Occipital lobe</u> ⅛ cortex	2° visual cortex	• What & where pathways • Conjugate eye movements (smooth pursuit)
	1° visual striate cortex	<u>Brodmann Area 17</u> • Lingual & cuneus gyrus • Motion, form & colour of objects • Depth perception
	Association Cortex	<u>Brodmann Area 18 & 19</u> • Cuneus and occipitotemporal gyrus • Colour & complex shapes • Form, motion & depth of objects • **Lesion**: visual agnosia
<u>Frontal lobe</u> ⅓ cortex	Primary motor cortex	<u>Brodmann Area 4</u> • Precentral gyrus and paracentral lobule • Somatotopically organised: homunculus • Execution of voluntary skilled movements • **Lesion**: contralateral paresis, paralysis & hypertonia, Babinski reflex (UMNs)
	Premotor cortex	<u>Brodmann Area 6</u> • Anterior to precentral sulcus • Somatotopically organised: homunculus • Planning of voluntary skilled movements • **Lesion**: motor apraxia
	Supplementary motor cortex (SMA)	<u>Brodmann Area 8</u> • Superior frontal gyrus, anterior to paracentral lobule

		• Somatotopically organised • Motor planning of complex movements • **Lesion**: no permanent loss of movement
	Frontal eye fields	<u>Brodmann Areas 6, 8, 9</u> • Middle frontal gyrus • Conjugate eye movements • **Lesion**: ipsilateral deviation of eyes and transient contralateral gaze paralysis
	Broca's area	<u>Brodmann Area 44, 45</u> (dominant hemisphere) • Left inferior frontal gyrus • Expressive language • **Lesion**: expressive aphasia
	Pre-frontal cortex	<u>Brodmann Areas 9-12</u> • Superior, inferior, middle frontal gyri, orbital gyri, anterior cingulate gyrus • Regions: dorsolateral, medial, orbitofrontal • Executive functions <u>Dorsolateral cortex</u> • Decision making & judgement (L), empathy & feelings (R) • Tests: digit span recall, Wisconsin card sorting test, understanding proverbs <u>Orbitofrontal cortex</u> • Motivation & behavioural consequences • **Lesion**: bilateral damage, inappropriate social and sexual behaviour, lethargy, unmotivated
<u>Parietal lobe</u> ⅕ cortex	1° Somatosensory (SI)	<u>Brodmann Areas 1-3</u> • Postcentral gyrus & posterior paracentral lobule • Somatotopically organised • Discriminative touch • **Lesion**: contralateral loss of touch, pain, proprioception
	2° Somatosensory (SII)	<u>Brodmann Area 43</u> • Posterior to SI, opercular area to insula • Interprets significance of tactile input • Localisation of taste sensation
	Association cortex	<u>Brodmann Areas 5 & 5</u> • Superior parietal lobule <u>Brodmann Areas 39 & 40</u> • Inferior parietal lobule • Attention & awareness of self and personal space • Integrating tactile & visual movements in relation to space, time, language, maths <u>The Where Pathway - posterior parietal lobe</u> • Separation of visual world into objects and background and its relative location • **Lesions**: dyslexia, confusion (dominant), sensory neglect, apraxia (non-dominant)

<u>Temporal lobe</u> ¼ cortex	1° Auditory cortex (AI) 2° Auditory cortex (AII)	<u>Brodmann Areas 41, 42, 22</u> • Transverse temporal gyrus (AI) • Superior temporal gyrus (AII) • Tonotopically organised • Sound localisation, discrimination (AI) & interpretation (AII) • **AI lesion**: damaged hearing perception & impaired localisation • **AII lesion:** word deafness, verbal agnosia
	Inferotemporal association cortex	<u>Brodmann Areas 20, 21, 28, 34, 35, 37</u> • Middle & inferior temporal gyri • Parahippocampal & fusiform gyri • **Lateral**: recognising stimuli and patterns and language • **Medial**: faces, places, objects • **Lesions**: agnosia <u>The What Pathway</u> • Object identification so it can be named (verbally labelled) and its meaning understood • **(L) lesion:** associative agnosia (can't relate name and function) • **(R) lesion:** apperceptive agnosia (no appreciation)
	Uncus & Hippocampus	• Converts short term memories to long term (consolidation) • Place map • **Lesion**: memory recall deficit • **Uncal damage:** deja vu, olfactory hallucination, epilepsy



Cranial Nerves

Sensory function - I, II, V1, V2, VIII
Motor function - III, IV, VI, XI, XII
Sensory & Motor function - V3, VII, IX, X

	Cranial Nerve	Function	Foramina
Straight to cortex	I Olfactory	Smell	Cribiform
Midbrain	II Optic	Vision	Optic canal
	III Oculomotor	Pupil response Superior, inferior, medial rectus of eye Inferior oblique muscles	Superior orbital fossa
	IV Trochlear	Downward and inward eye movements Superior oblique muscles	Superior orbital fossa
Pons	V Trigeminal 1) Ophthalmic 2) Maxillary 3) Mandibular	Facial sensation and mastication	1) Superior orbital fossa 2) Rotundum 3) Ovale
	VI Abducens	Outward eye movement Lateral rectus of eye	Superior orbital fossa
	VII Facial	Facial expression and taste of ⅔ tongue	Internal auditory fossa
	VIII Vestibulocochlear	Hearing and balance	Internal auditory fossa
Medulla	IX Glossopharyngeal	Taste of ⅓ tongue and gag reflex	Jugular
	X Vagus	Swallowing, cough, cardiac, gastrointestinal, respiration	Jugular
	XI Accessory	Neck and shoulder movements	Jugular
	XII Hypoglossal	Tongue movement	Hypoglossal