CH. 1: ANATOMY & PHYSIOLOGY

CRANIAL NERVES

Gray shading= Not involved in speech, language, or hearing

Nerve No.	Name	Type	Function	Damage
I	Olfactory	Sensory	Sense of smell	
II	Optic	Sensory	Vision	
III	Oculomotor	Motor	Eye movement	
IV	Trochlear	Motor	Eye movement	
V	Trigeminal	Mixed	**Sensory Branches:** ● *Ophthalmic:* nose, eyes, forehead ● *Maxillary:* upper lip, maxilla, upper cheek, upper teeth, maxillary sinus, palate ● *Mandibular:* mandible, lower teeth, lower lip, tongue, part of cheek, part of external ear **Motor:** ● Jaw muscles: temporalis, lateral & medial pterygoids, masseter, tensor veli palatini, tensor tympani, mylohyoid, anterior belly of digastric	● Inability to close mouth ● Difficulty in chewing ● Trigeminal neuralgia (sharp pain in the facial area)
VI	Abducens	Motor	Eye movement	
VII	Facial	Mixed	**Sensory:** ● Taste-anterior 2/3 of tongue **Motor:** ● Facial expression/speech ● Muscles: buccinator, zygomatic, orbicularis oris, orbicularis oculi, platysma, stapedius, stylohyoid, frontalis, procerus, nasalis, depressor labii inferioris, depressor anguli oris, auricular muscles, various labial muscles, posterior belly of the digastric	● Mask-like appearance (minimal or no facial expression)
VIII	Vestibulocochlear	Sensory	**Vestibular branch:** ● Equilibrium or balance **Acoustic branch:** ● Transmits sensory info from the cochlea of the inner ear to the primary auditory cortex of the brain	● Hearing loss ● Problems with balance

IX	Glossopharyngeal	Mixed	**Sensory:** ● Taste- posterior 1/3 of tongue ● General sensation to the tympanic cavity, ear canal, Eustachian tube, faucial pillars, tonsils, soft palate, pharynx **Motor:** ● Innervates the stylopharyngeus, the muscle that raises and dilates the pharynx	● Difficulty with swallowing ● Unilateral loss of gag reflex ● Loss of taste and sensation from the posterior 1/3 of tongue
X	Vagus	Mixed	**Sensory:** ● Convey information from the digestive system, heart, trachea, pharynx, larynx **Motor:** ● Supply digestive system, heart, lungs ● *Recurrent laryngeal nerve:* branch that regulates the intrinsic muscles of the larynx, excluding cricothyroid ● *Pharyngeal branch:* supplies the pharyngeal constrictors; supplies all the muscles of the velum except the tensor tympani	● Difficulty of swallowing ● Paralysis of the velum ● Voice problems (partial paralysis of VF)
XI	Spinal Accessory	Motor (Cranial & Spinal)	● Supplies trapezius & sternocleidomastoid head and shoulder movements ● Soft palate innervation (uvula & levator veli palatini)	● Neck weakness ● Paralysis of the sternocleidomastoid inability to turn head ● Inability to shrug shoulders or raise arm above shoulder level
XII	Hypoglossal	Motor	● Supplies 3 extrinsic tongue muscles: styloglossus, hyoglossus, genioglossus ● Supplies all intrinsic muscles of the tongue	● Tongue paralysis ● Diminished intelligibility ● Swallowing problems

STRUCTURES OF THE BRAIN

STRUCTURE	COMPOSED OF	FUNCTION	DAMAGE

Peripheral nervous system	• Cranial nerves
	• Spinal nerves
	• Autonomic nervous system
	  o Sympathetic branch
	  o Parasympathetic branch
		• Collection of nerves
		• Carries sensory impulses from peripheral sense organs to the brain
		• Carries motor impulses from the brain to glands & muscles	

Autonomic nervous system	• Part of peripheral nervous system	• Controls & regulates the internal environment of our bodies	

Sympathetic branch	• Part of autonomic nervous system	• Mobilizes body for "fight or flight"
		  o accelerates heart rate
		  o dilates pupils
		  o raises blood pressure
		  o increases blood flow
		  o arouses emotions	

Parasympathetic branch	• Part of autonomic nervous system	• Relaxes the body after fight or flight	
Central nervous system	• Spinal cord • Brain	• Motor command center for planning, originating, & carrying out the transmission of messages	

Brainstem	• Internally:
	  o longitudinal fiber tracts
	  o cranial nerve nuclei
	  o reticular formation
	• Outwardly
	  o midbrain
	  o pons
	  o medulla
		• Connects spinal cord with the brain via the diencephalon
		• Acts as bridge between cerebellum and all other CNS structures	

Midbrain	• Superior peduncles (Connect brainstem to cerebellum) • Substantia nigra	• Control postural reflexes • Visual reflexes • Eye movements • Coordination of vestibular-generated eye & head movement	
Pons	• Inferior & middle peduncles	• Connection point between cerebellum & cerebral • Transmits info relative to movement from cerebrum to cerebellum	
Medulla	• Contains pyramidal tracts	• Uppermost portion of spinal cord • Includes centers that control breathing, digestion, heart rate, blood pressure • VERY important for speech production b/c contains descending fibers that transmit motor info to cranial nerve nuclei • Many pyramidal tracts decussate at level of medulla contralateral control	
Diencephalon	• Third ventricle • Thalamus	• Connects spinal cord with brain	

	• Hypothalamus		
Thalamus	• Contained in diencephalon in brainstem	• Regulates & relays sensory info that flows into the brain • Receives info about motor impulses from cerebellum & basal ganglia • Relays this info to motor areas • CRITICAL for maintenance of consciousness & alertness	
Hypothalamus	• Lies inferior to thalamus	• Helps integrate the actions of the ANS • Controls emotions	
Reticular activating system	• Structure contained in the midbrain, brainstem, & upper portion of spinal cord	• Integrates motor impulses flowing out of the brain role in execution of motor activity • Attention & consciousness • Sleep-wake cycle	
Basal ganglia	• Composed of gray matter • Near thalamus & lateral ventricles • Part of extrapyramidal system • Contains Corpus Striatum, composed of: o globus pallidus o putamen o caudate nucleus	• System of neural pathways that have connections with many cortical and subcortical areas • Receives info primarily from the frontal lobe • Transmits info to higher centers of the brain via the thalamus	• Unusual body postures • dysarthria • changes in body tone • involuntary and uncontrolled movements (dyskinesias) that interfere with a person's ability to walk, speak, or do other activities
Cerebellum	• Located just below the cerebrum and behind the brainstem	• Acts as a “modulator” of neuronal activity through its efferent & afferent circuits • Regulates equilibrium, body posture, & coordinated fine motor movements • VERY IMPORTANT FOR SPEECH PRODUCTION	• Ataxia abnormal gait, disturbed balance • Ataxic dysarthria
Frontal lobe	• Located on the anterior portion of the cerebrum • Contains: o Primary motor cortex o Supplementary motor cortex o Broca's area	• Deliberate formation of plans and intentions that dictate a person's conscious behavior	• Difficulty carrying out consciously organized activity
Primary motor cortex	• Located on precentral gyrus	• Controls voluntary movements of skeletal muscles on the opposite side of the body • Uses the pyramidal system to control muscle movements	
Supplementary motor cortex		• Involved in motor planning of speech; plays a secondary role in regulating muscle movements	

Broca's area	• Located on the third convolution of the left cerebral hemisphere; anterior to the portion of the primary motor cortex that controls lip, tongue, jaw, and laryngeal movements	• Motor movements involved in speech production • Necessary for fluent, well-articulated speech	• Motor speech problems
Parietal lobe	• Located on the upper sides of the cerebrum behind the frontal lobe • Contains two areas important for speech: o supramarginal gyrus o angular gyrus	• Primary somatosensory area • It integrates contralateral somesthetic sensations such as pressure, pain, temperature, and pain	• Damage to supramarginal gyrus conduction aphasia, agraphia (writing disorder) • Damage to angular gyrus writing, reading, & naming difficulties, transcortical sensory aphasia
Occipital lobe	• Behind the parietal lobe at the lower posterior portion of the head, just above the cerebellum • Contains primary visual cortex	• Primarily concerned with vision	
Temporal lobe	• Lowest one third of the cerebrum; inferior to the frontal & parietal lobes & in front of occipital lobe • Contains: o Primary auditory cortex o Auditory association cortex o Wernicke's area	• The primary auditory cortex receives sound stimuli from the acoustic nerve bilaterally; the auditory association area then synthesizes that info so it can be recognized as whole units • Auditory association cortex o analyzes speech sounds so that the person recognizes words and sentences in the dominant hemisphere o in the non-dominant hemisphere analyzes nonverbal sound stimuli (environmental noise & music) • Wernicke's area: o comprehension of spoken & written language	• Wernicke's aphasia Patient produces fluent but meaningless speech
Pyramidal system	• Contains o Corticobulbar tract and corticospinal tract	o Direct motor activation pathway that is primarily responsible for facilitating voluntary movement (including speech)	
Corticospinal tract	o Terminates in muscles of the limbs and trunk o 80-85% of the fibers decussate in medulla	o Communicate with spinal nerves	

Corticobulbar tract	o Originate in the motor cortex o Terminate in the brainstem at motor nuclei of cranial nerves III-XI; fibers then decussate at brainstem	● Critical for speech production ● Control all voluntary movements of the speech muscles ● Innervate muscles of the larynx, pharynx, soft palate, tongue, face, & lips	
Extrapyramidal tract	o Composed of: o Subcortical nuclei: red nucleus, substantia nigra, subthalamus, basal ganglia, & the pathways that connect these structures to one another	o Helps maintain posture and tone and helps regulate the movement that results from lower motor neuron activity	o Involuntary movement disorders
Projection fibers	o Efferent fibers come together at internal capsule (the concentrated and compact projection fibers near the brainstem); pass through basal ganglia & thalamus	o Create connections between the cortex and subcortical structures like the cerebellum, basal ganglia, brainstem, and spinal cord o Form upper motor neuron system of the pyramidal tract, which is the direct activation pathway for the voluntary motor movements o Relay info to glands and muscles	
Association fibers	o Most important association fiber Arcuate fasciculus	o Connect areas within a hemisphere; assist in maintaining communication between the structures in a hemisphere o Arcuate fasciculus Connects Broca's area to Wernicke's area; verbal memory, language acquisition, meaningful language production	
Commissural fibers	o Most important corpus callosum	o Interhemispheric fibers; connect corresponding areas of the two hemispheres o Corpus callosum connects the two hemispheres at their base	o Damage to corpus callosum Disconnection syndromes characterized by problems in naming, reading, movement, and other functions
Aorta	o Divides into: o Two carotid arteries and two subclavian arteries	o The main artery of the heart o Carries blood from the left ventricle to all parts of the body except the lungs	
Subclavian arteries	o Branch into right and left vertebral arteries	o Supply upper extremities	
Vertebral arteries	o Branch into basilar artery	o They enter the skull and branch out to supply the spinal cord & many organs of the body	
Basilar artery	o Divide into the two posterior cerebral arteries at the level of the pons		

Posterior cerebral artery		o Supply lateral and lower portions of the temporal lobes and the lateral and middle portions of the occipital lobes	
Carotid arteries	o As they enter the neck, left and right carotid arteries branch into an internal and external carotid artery		
External carotid artery	o Branches into: o Middle cerebral artery and anterior cerebral artery	o Supplies muscles of the mouth, nose, forehead, and face	
Internal carotid artery		o Major supplier of the brain	
Middle cerebral artery		o Supplies the entire lateral surface of the cortex, including the major regions of the frontal lobe --> it supplies blood to the major areas involved with motor and sensory function and language, speech, and hearing function o Specifically: o motor cortex, Broca's area, primary auditory cortex, Wernicke's area, supramarginal gyrus, angular gyrus, somatosensory cortex	o Strokes, aphasia, reading and writing deficits, contralateral hemiplegia, and an impaired sense of pain, temperature, touch, and position
Anterior cerebral artery		o Supplies the middle portion of the parietal and frontal lobes, corpus colosseum and basal ganglia	o Cognitive deficits such as impaired judgment, concentration, and reasoning; paralysis of the feet and legs
Circle of Willis	o Forms at the base of the brain where the two carotid and the two vertebral arteries going	o Provides a common blood supply to various cerebral branches; if an artery is blocked above the circle, brain damage will occur because the brain has no alternate source of blood; if an artery is blocked below the circle, brain damage may be minimal because alternate channels of blood flow may be maintained	

MUSCLES
RESPIRATION

THORACIC MUSCLES OF INSPIRATION, P. 6	
MUSCLES & INNERVATION	**FUNCTION**
diaphragm (C3-C5)	distends abdomen, enlarges vertical dimension of thorax, depresses central tendon of diaphragm
serratus posterior superior (C7, T1-T4)	elevates rib cage
levator costarum brevis (T2-T12)	elevates rib cage
levator costarum longis (T2-T12)	elevates rib cage
external intercostal (T2-T11)	elevates rib cage

ACCESSORY MUSCLES- SHOULDER & UPPER ARM	
MUSCLES & INNERVATION	**FUNCTION**
pectoralis major (C4-TI)	increases transverse dimension of rib cage through elevation of sternum
pectoralis minor (C4-T1)	increases transverse dimension of rib cage
serratus anterior (C5-C7)	elevates ribs 1-9
levator scapulae (C3-C5)	elevates scapula, supports neck
rhomboideus major (C5)	stabilizes shoulder girdle
rhomboideus minor (C5)	stabilizes shoulder girdle
internal intercostal (T2-T11)	depresses ribs 1-11
innermost intercostal (T2-T11)	depresses ribs 1-11
transversus thoracicus (T2-T6)	depresses ribs 2-6

ABDOMINAL MUSCLES OF EXPIRATION, P. 7	
MUSCLES & INNERVATION	**FUNCTION**
latissimus dorsi (C6-C8)	stabilizes the posterior abdominal wall for expiration
rectus abdominis (T7-T12)	flexes vertebral column
transversus abdominis (T7-T12)	compresses abdomen
internal oblique abdominis (T7-T12)	compresses abdomen, flexes and rotates trunk
quadratus lumborum (T12, L1-L4)	supports abdominal compression through bilateral contraction, which fixes abdominal walls

PHONATION

INTRINSIC LARYNGEAL MUSCLES, P. 11 *CONTROL SOUND PRODUCTION	
MUSCLES & INNERVATION	**FUNCTION**
thyroarytenoid (X)	the internal thyroarytenoid is the primary portion of the thyroarytenoid muscle that vibrates and produces sound
lateral cricoarytenoid (X)	adducts vocal folds, increases medial compression
transverse arytenoid (X)	adducts vocal folds
oblique arytenoid (X)	pulls apex of arytenoids in a medial direction
cricothyroid (X)	lengthens and tenses vocal folds
posterior cricoarytenoid (X)	abducts vocal folds

EXTRINSIC LARYNGEAL MUSCLES, P. 12 *SUPPORT LARYNX & FIX ITS POSITION □ Elevators: elevation of the larynx □ Depressors: depression of the larynx	
ELEVATORS & INNERVATION	**DEPRESSORS & INNERVATION**
digastric (V, VII)	thyrohyoid (XII, C1)
geniohyoid (XII, C1)	omohyoid (C1-C3)
mylohyoid (V)	sternothyroid (C1-C3)
stylohyoid (VII)	sternohyoid (C1-C3)
hyoglossus (XII)	
genioglossus (XII)	

ARTICULATION

MUSCLES OF THE PHARYNX, P. 18	
MUSCLES & INNERVATION	**FUNCTION**
salpingopharyngeus (X, XI)	elevates lateral pharyngeal wall
stylopharyngeus (XI)	elevates and opens pharynx
superior pharyngeal constrictor (X, XI)	constricts pharyngeal diameter, pulls pharyngeal wall forward
middle pharyngeal constrictor (X, XI)	narrows diameter of pharynx
inferior pharyngeal constrictor, cricopharyngeus (X, XI)	constricts superior orifice of esophagus
inferior pharyngeal constrictor, thyropharyngeus (X, XI)	reduces diameter of lower pharynx

MUSCLES OF THE SOFT PALATE, P. 20	
MUSCLES & INNERVATION	**FUNCTION**
levator veli palatini (X, XI)	primary elevator of velum
tensor veli palatini (V)	tenses velum, dilates Eustachian tube
palatoglossus (X, XI)	elevates and depresses velum
palatopharyngeus (X, XI)	narrows pharyngeal cavity, lowers velum, may assist in elevating larynx

ELEVATORS OF THE MANDIBLE, P. 22	
MUSCLES & INNERVATION	**FUNCTION**
masseter (V)	elevates mandible
temporalis (V)	elevates mandible, draws mandible back if protruded
medial (internal) pterygoid (V)	elevates mandible
lateral (external) pterygoid (V)	protrudes mandible

DEPRESSORS OF THE MANDIBLE, P. 22	
MUSCLES & INNERVATION	**FUNCTION**
anterior belly of digastric (V)	depresses mandible in conjunction with posterior belly of digastric; pulls hyoid forward
posterior belly of digastric (VII)	depresses mandible in conjunction with anterior belly of digastric; pulls hyoid back
geniohyoid (XII, C1)	depresses mandible
mylohyoid	depresses mandible

INTRINSIC MUSCLES OF THE TONGUE, P. 24	
MUSCLES & INNERVATION	**FUNCTION**
superior longitudinal (XII)	shortens tongue, turns tip upward, assists in turning lateral margins upward
inferior longitudinal (XII)	shortens tongue, pulls tip downward, assists in retraction
transverse muscles (XII)	narrow and elongate tongue
vertical muscles (XII)	flatten the tongue

EXTRINSIC MUSCLES OF THE TONGUE, P. 24	
MUSCLES & INNERVATION	**FUNCTION**
genioglossus (XII)	forms bulk of tongue; is able to retract tongue, draw tongue downward, draw entire tongue anteriorly to protrude tip or press tip against alveolar ridges and teeth
styloglossus (XII)	draws tongue up and back, may draw sides of tongue upward t help make dorsum concave
hyoglossus (XII)	retracts and depresses tongue
chondroglossus (XII)	depresses the tongue
palatoglossus	some consider it a muscle of the velum, but it helps elevate the tongue (but depresses the velum)

MUSCLES OF THE FACE, P. 25	
MUSCLES & INNERVATION	**FUNCTION**
mentalis (VII)	pulls lower lip out, wrinkles and elevates chin
platysma (VII)	depresses mandible
risorius (VII)	retracts lips at corners
buccinator (VII)	constricts oropharynx; moves food onto grinding surfaces of molars
depressor labii inferioris (VII)	pulls lip down and out to dilate orifice
depressor anguli oris (triangularis) (VII)	helps to press lower and upper lips together; depresses corners of mouth
zygomaticus minor (VII)	elevates upper lip
zygomatic major (VII)	retracts and elevates angle of mouth
orbicularis oris inferioris & superioris (VII)	pulls lips together, seals lips, serves as point of insertion for other muscles, interacts with other muscles to produce facial expressions
levator labii superioris (VII)	elevates upper lip
levator labii superioris alaeque nasi (VII)	elevates upper lip