

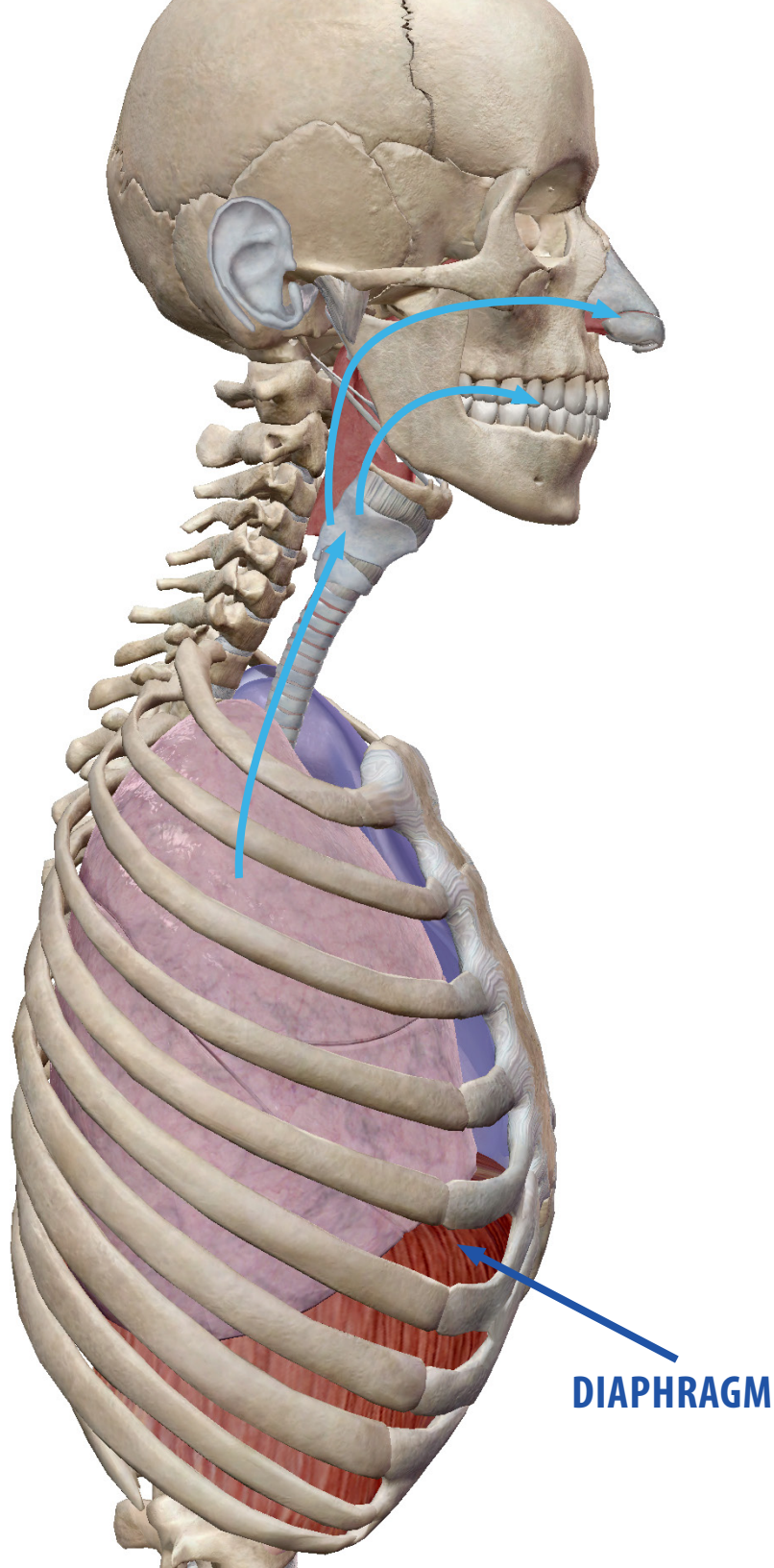
ANATOMY & PHYSIOLOGY OF SPEECH

The human body is highly adapted for speech. When we communicate using spoken language, we produce a wide range of sounds in a seemingly endless number of arrangements.

So how do we go from streams of air to the sounds that make up words? Read on to find out!

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THE LUNGS, TRACHEA, AND DIAPHRAGM

The words we speak start with air being exhaled from the lungs.

During exhalation, the diaphragm and external intercostal muscles relax, causing air to leave the lungs.

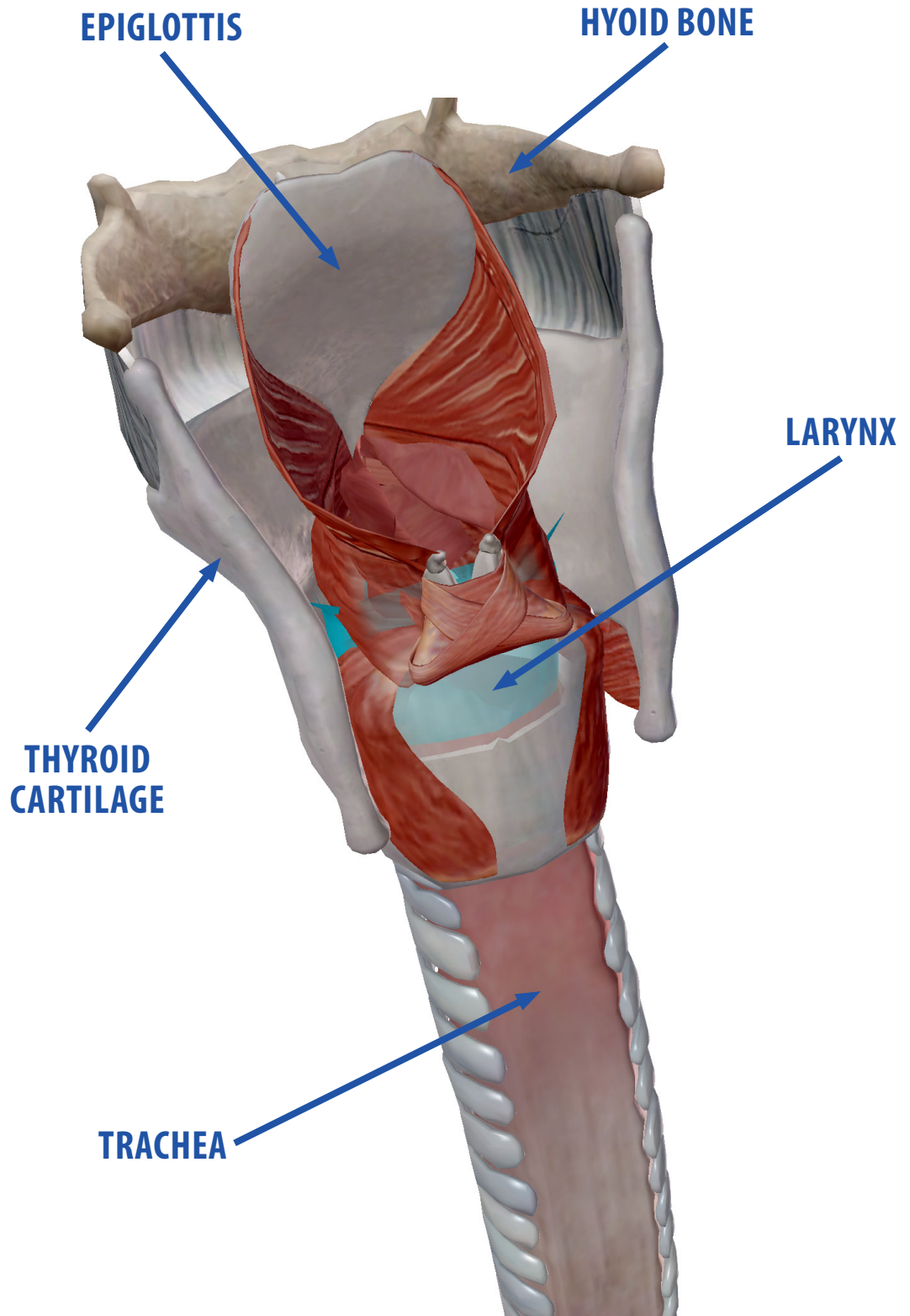
On its way out of the body, the air passes through the trachea, larynx, and pharynx before finally leaving through the oral or nasal cavity.

THE LARYNX

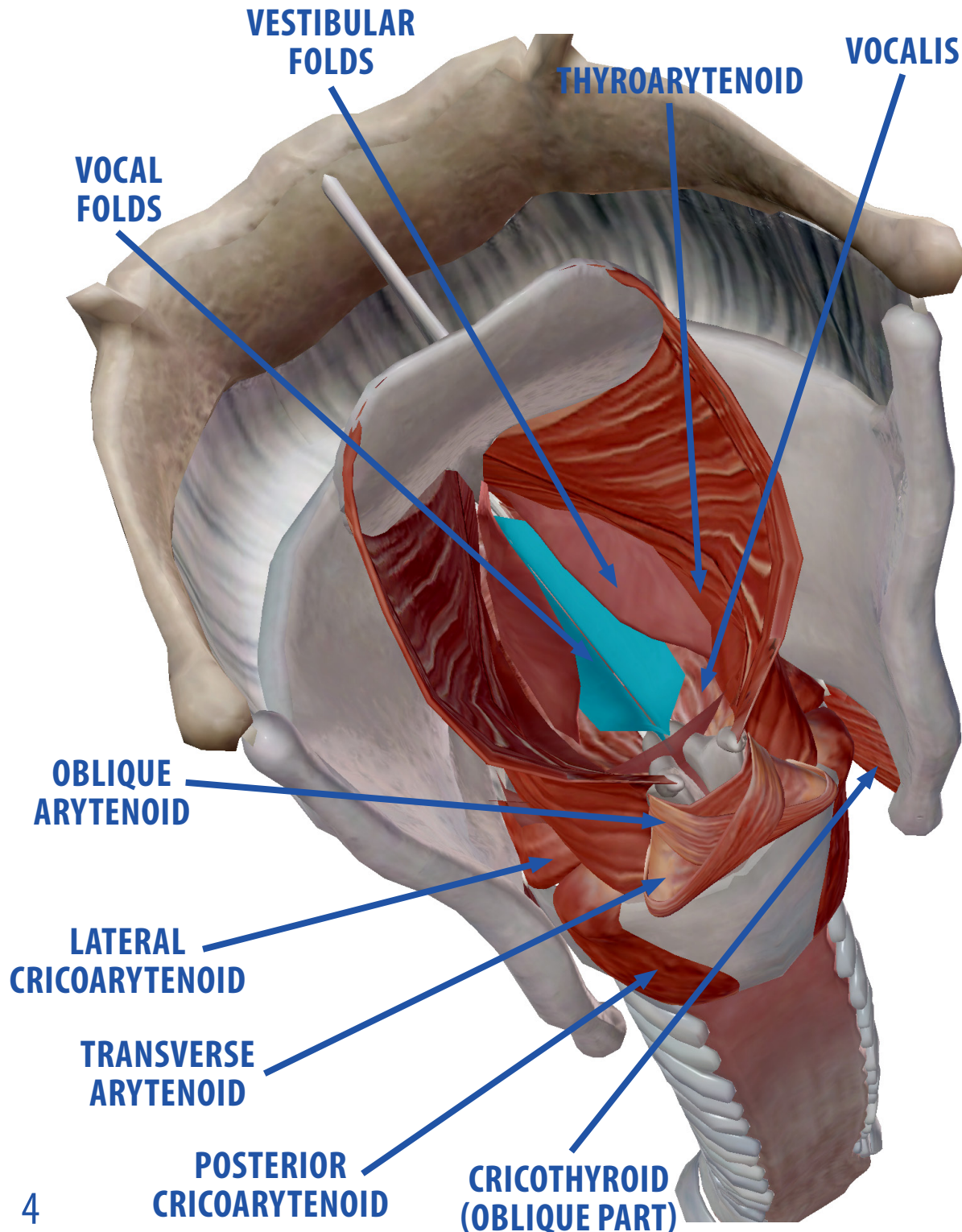
The larynx is the uppermost airway of the lower respiratory system.

It sits on top of the trachea and is surrounded by a series of cartilages collectively referred to as the laryngeal skeleton. These cartilages are connected by ligaments and moved by a variety of muscles.

Though the airway remains open during breathing, the epiglottis closes off the entry to the larynx during swallowing in order to keep food and/or liquid from entering the trachea.



MANIPULATING THE VOCAL FOLDS



The vocal folds (true vocal cords), stretch across the interior of the larynx. They enclose the vocal ligaments.

Sound is produced when air coming up through the larynx causes the vocal folds to vibrate. This is called phonation. The intrinsic muscles of the larynx alter the quality and pitch of the sound by manipulating the distance between and tension of the vocal folds.

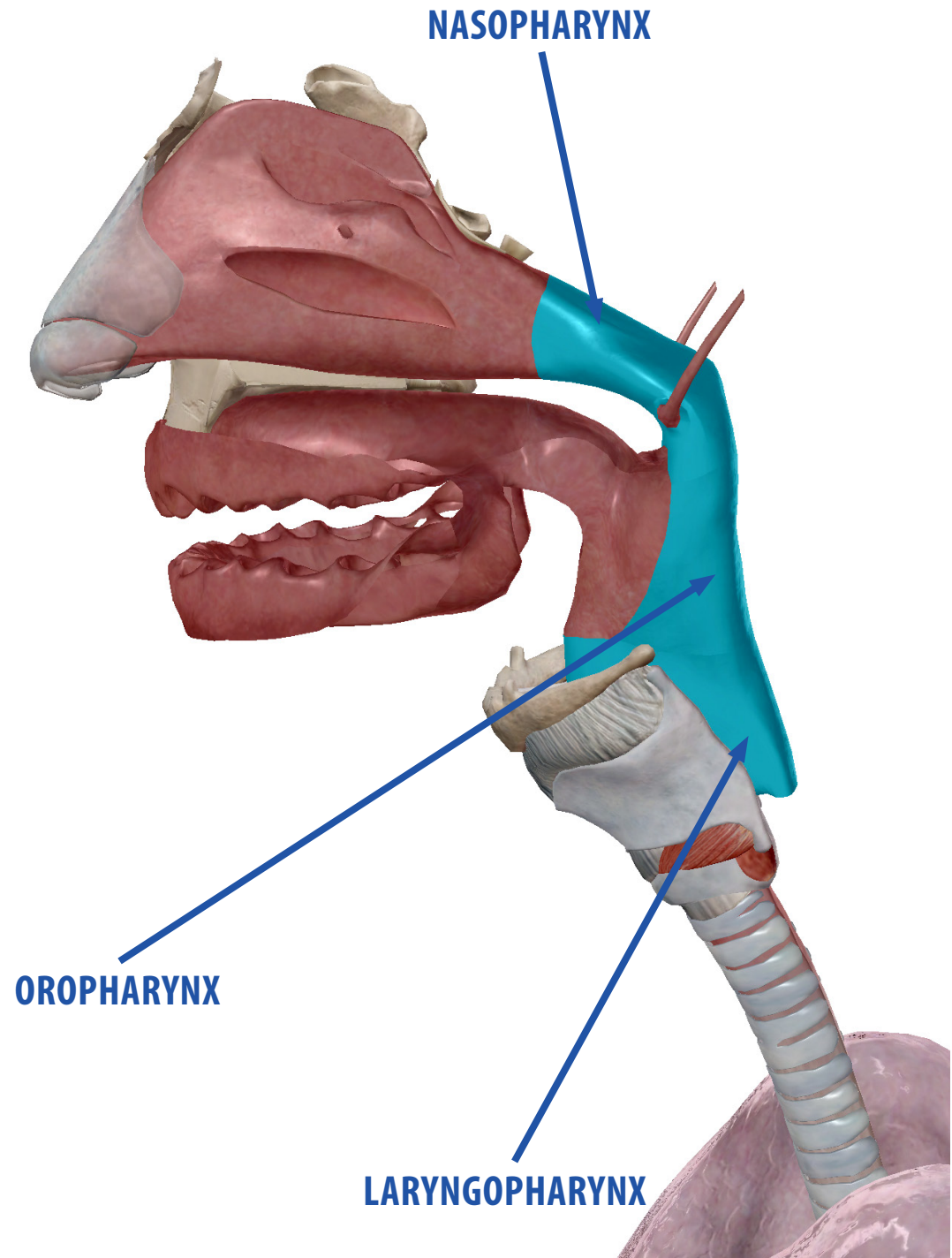
The vestibular folds (false vocal cords) aren't used for speech but help close off the glottis during swallowing.

THE PHARYNX, ORAL CAVITY, & NASAL CAVITY

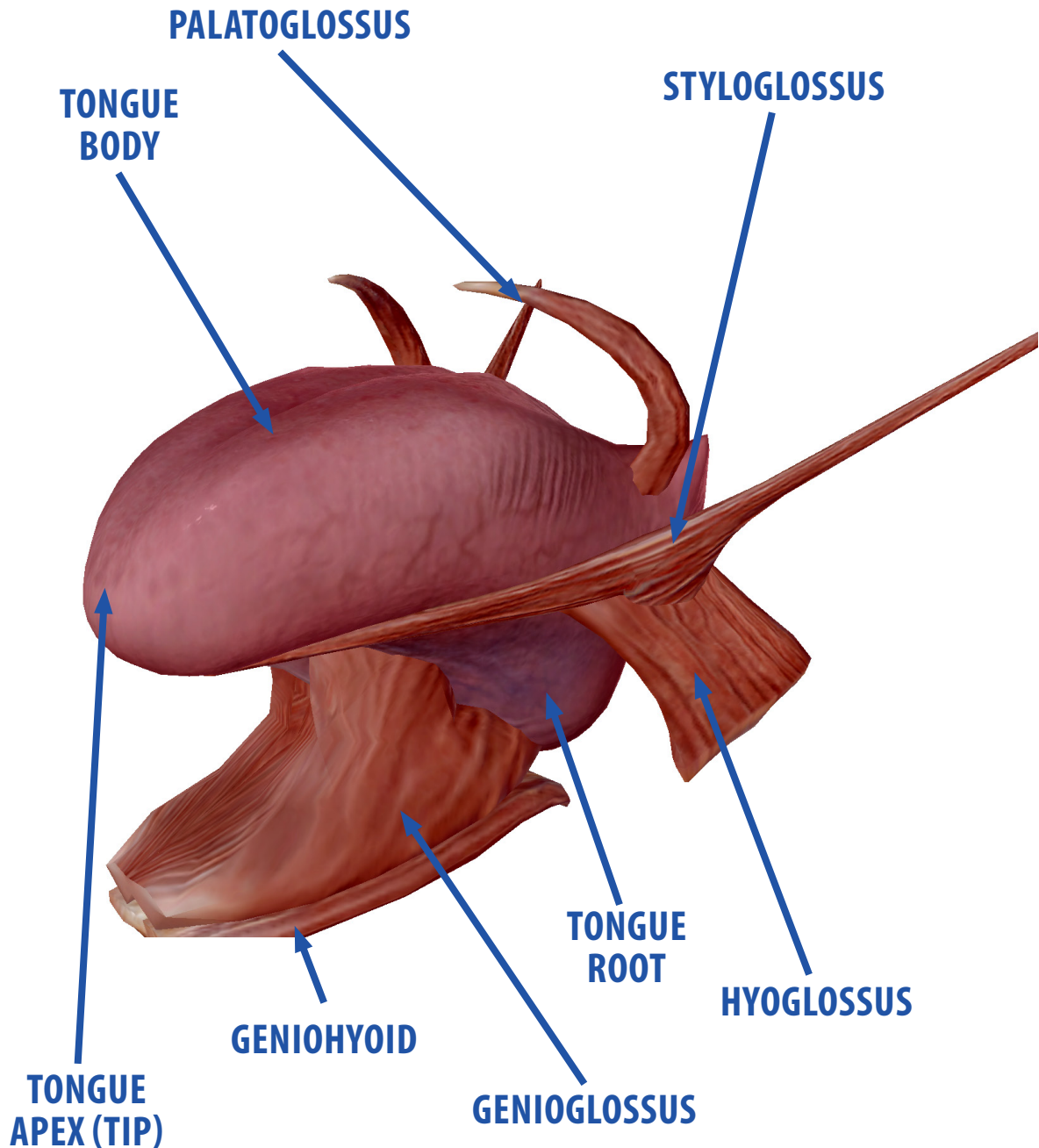
The pharynx is a musculomembranous tube that serves as an airway connecting the larynx with the oral and nasal cavities.

It is also part of the alimentary canal, allowing food to pass into the esophagus.

It has three parts: the laryngopharynx, the oropharynx, and the nasopharynx.



ARTICULATION: THE TONGUE



The tongue's four intrinsic muscles give it great flexibility. They work together with the extrinsic tongue muscles to allow the tongue a wide range of motion within the mouth/vocal tract.

Different parts of the tongue impede the air stream along the vocal tract to create a variety of speech sounds.

Fun fact!

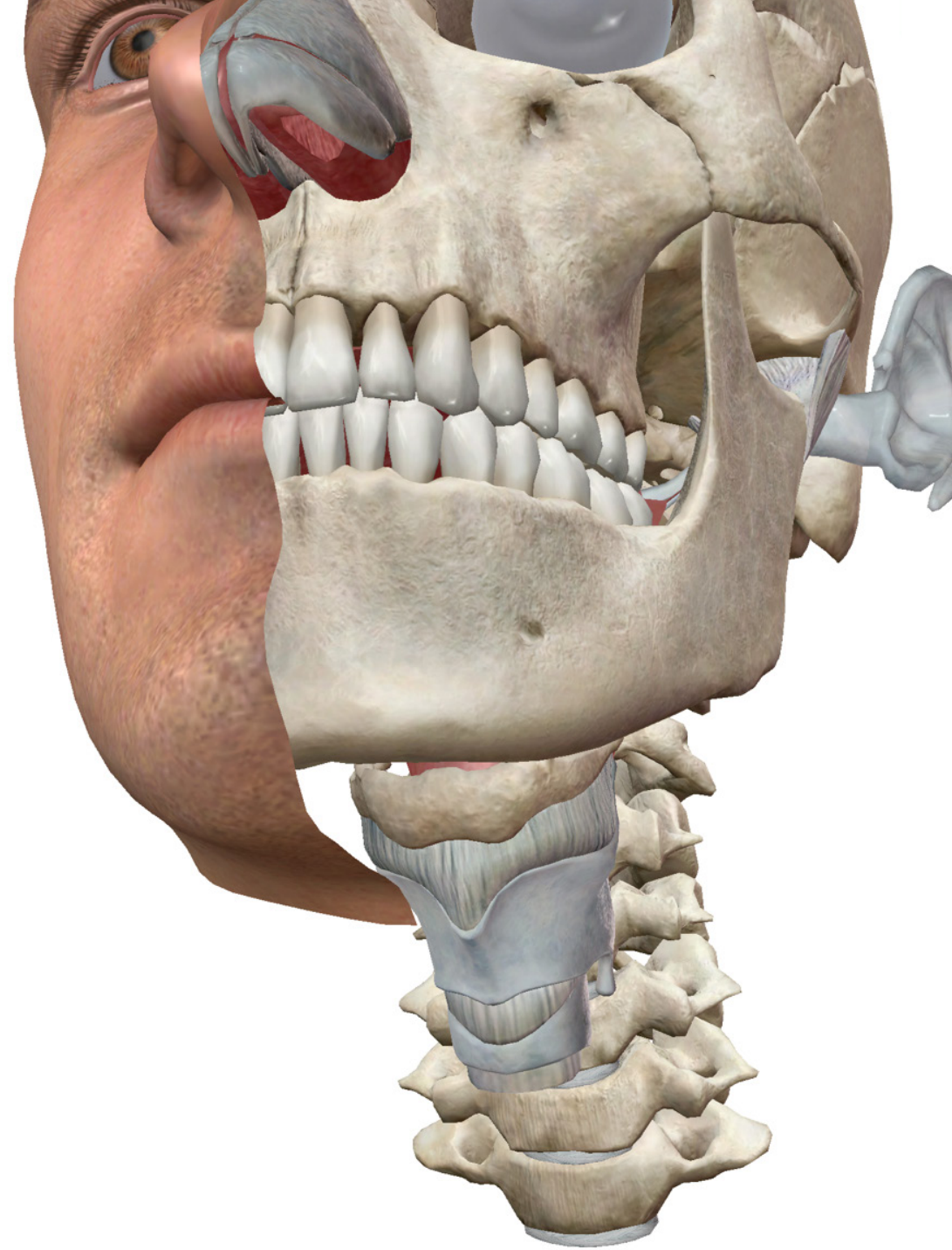
The tongue is a muscular hydrostat, made up of several muscles. Octopus' tentacles and elephants' trunks are also muscular hydrostats.

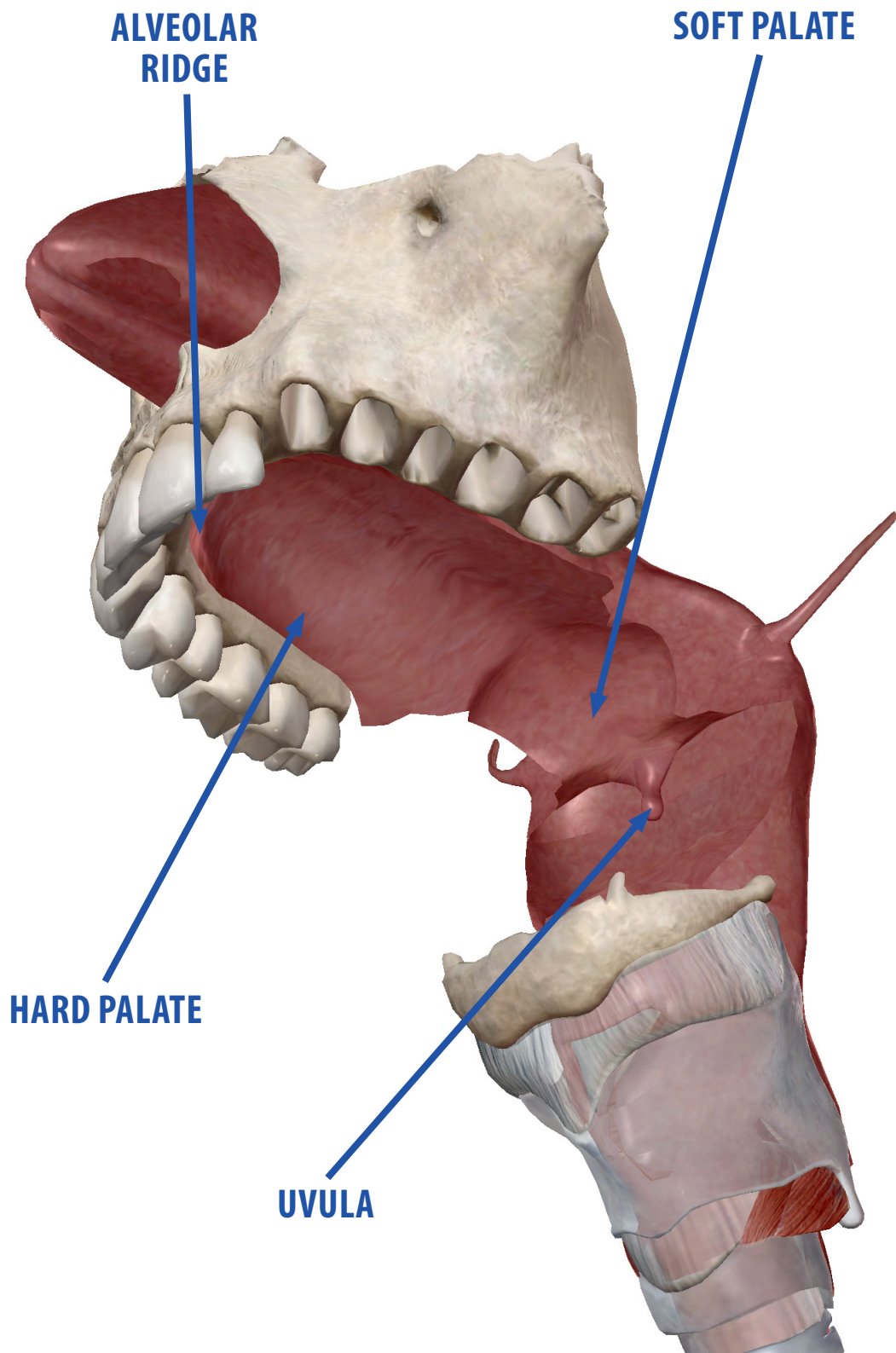
ARTICULATION: LIPS AND TEETH

The lips can create speech sounds by obstructing the stream of air either fully or partially. Consonants produced using both lips are referred to as bilabial consonants.

The lips and teeth can be used in combination to produce labiodental sounds like [f] and [v].

Additionally, the tongue can go between the teeth to produce interdental sounds like the “th” in “those” and “mouth.”





ARTICULATION: HARD AND SOFT PALATES

The tongue creates speech sounds by obstructing the flow of air at various places on the hard palate. The alveolar ridge is a bump just behind the front teeth and is the place of articulation for [t] and [d] sounds.

When the tongue obstructs air at the soft palate (velum) you get velar consonants like [k] and [g].

For nasal sounds like [m], [n], and [ŋ]* the velum is lowered so air can escape out of the nose instead of the mouth.

* [ŋ] is an “ng” sound, like at the end of the word “running”

BASIC PROPERTIES OF CONSONANTS

Voicing: If a consonant is voiced, the vocal folds are vibrating. If a consonant is unvoiced, the vocal folds are relaxed.

Place of articulation: Where is the airstream obstructed?

Manner of articulation: How obstructed is the air stream? For example, stop consonants involve a full obstruction of the air stream, but fricatives let a tiny bit of air hiss through a narrow opening.

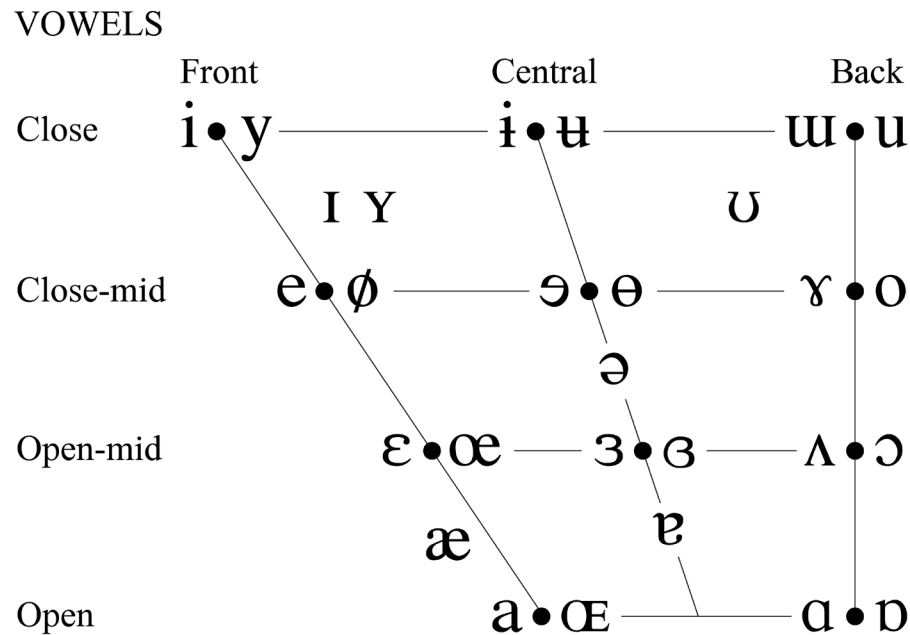
CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill				r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

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BASIC PROPERTIES OF VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

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Where is the tongue positioned? Is it high or low relative to the roof of the mouth? How far back in the mouth is it?

Tense/lax? How long or short is the vowel, and how tense is the mouth during pronunciation?

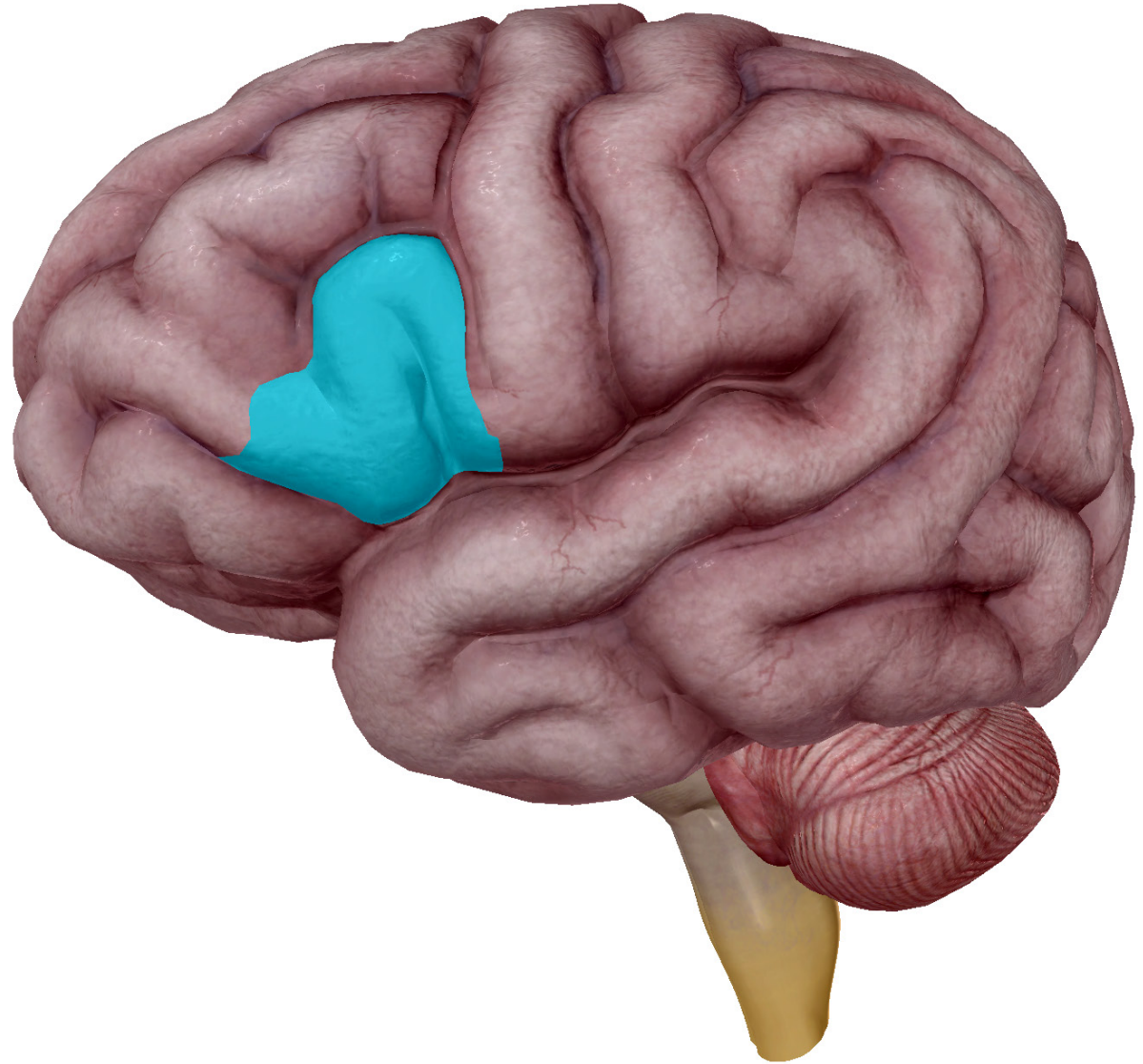
Rounded? Are the lips rounded?

Nasal? Is air allowed to escape through the nose? English doesn't have true nasal vowels but sometimes vowels will become nasalized in the presence of a nasal consonant.

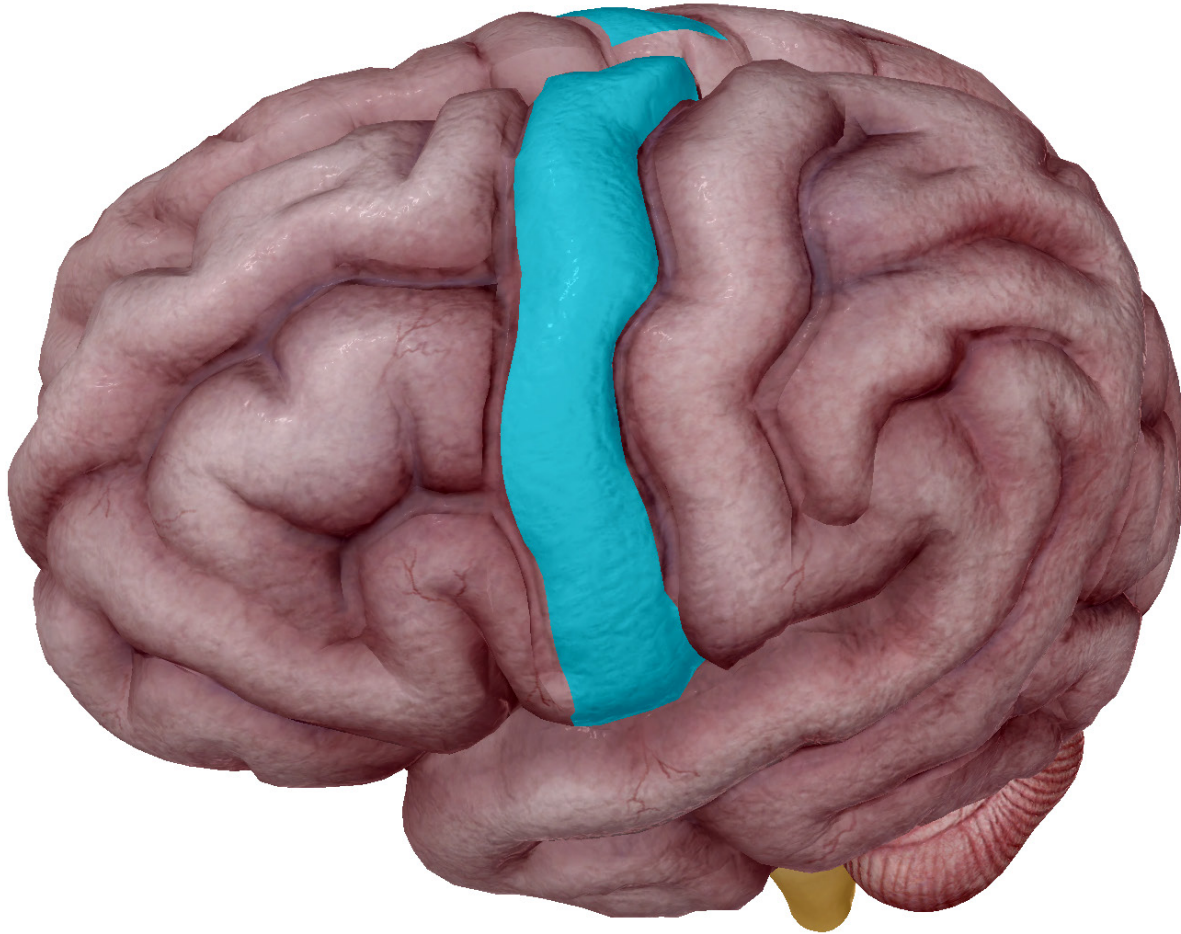
THE BRAIN'S ROLE IN SPEECH PRODUCTION

Broca's Area is a part of the brain particularly notable for its involvement in speech. It is composed of the pars opercularis (BA 44) and pars triangularis (BA 45) of the (left) inferior frontal gyrus.

It helps plan out words and sentences by integrating different types of linguistic information. Damage to Broca's Area can cause Broca's aphasia, or expressive aphasia. People with this type of aphasia have trouble producing fluent speech, but their language comprehension remains intact.



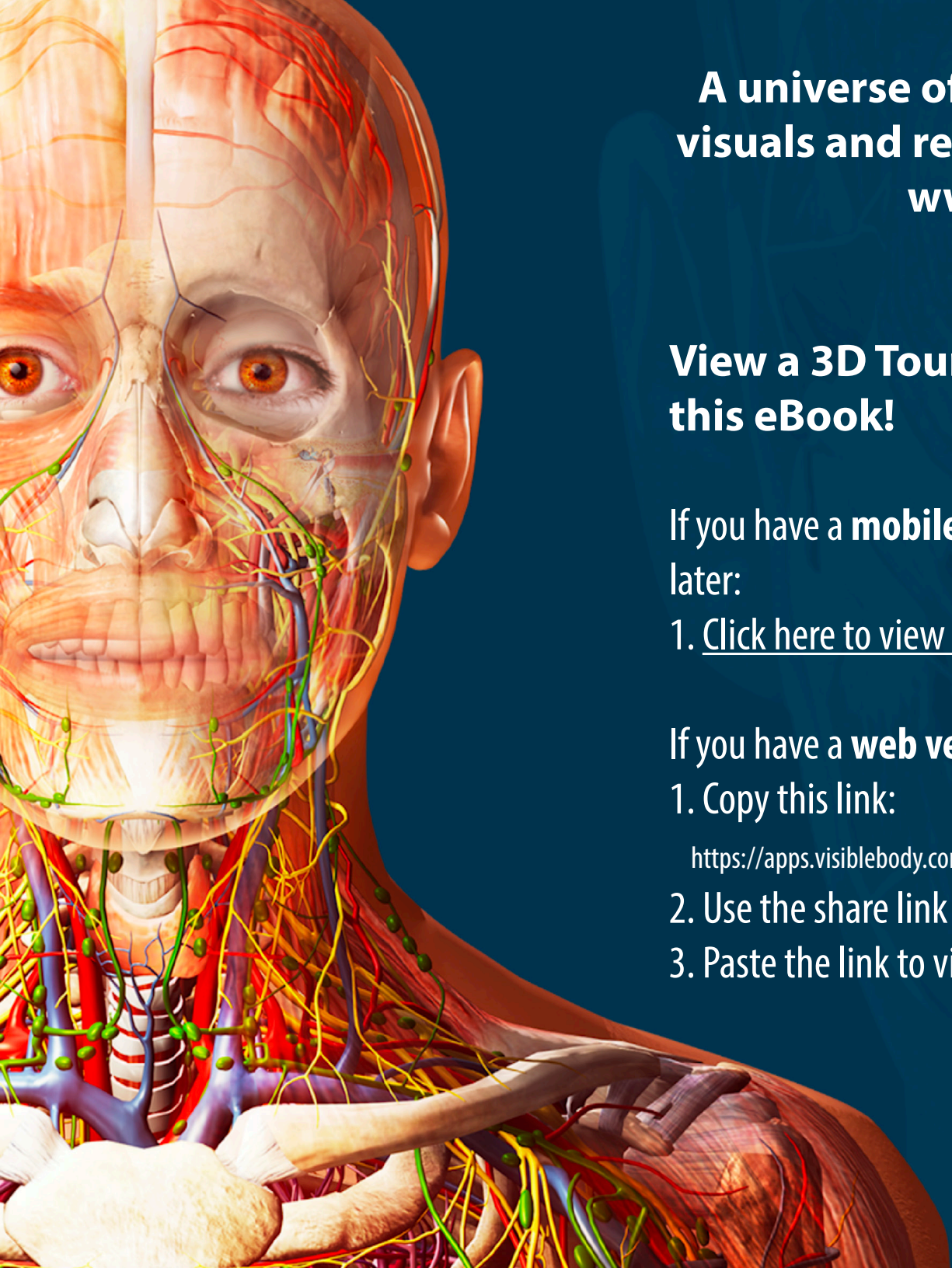
ISSUING MOTOR COMMANDS



The right and left motor cortex (precentral gyri) enable speech by sending commands to the muscles.

Apraxia is when motor planning problems prevent fluent speech. The brain has trouble getting the right messages to the muscles, but there is no muscle weakness.

Dysarthria occurs when a person has trouble moving the muscles required for speech, either as a result of neurological damage or damage to the speech organs (peripheral dysarthria).



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