Physiology of Speech

Nasal Cavity
Oral Cavity
Pharynx
Larynx
Vocal Cords
Trachea
Lungs
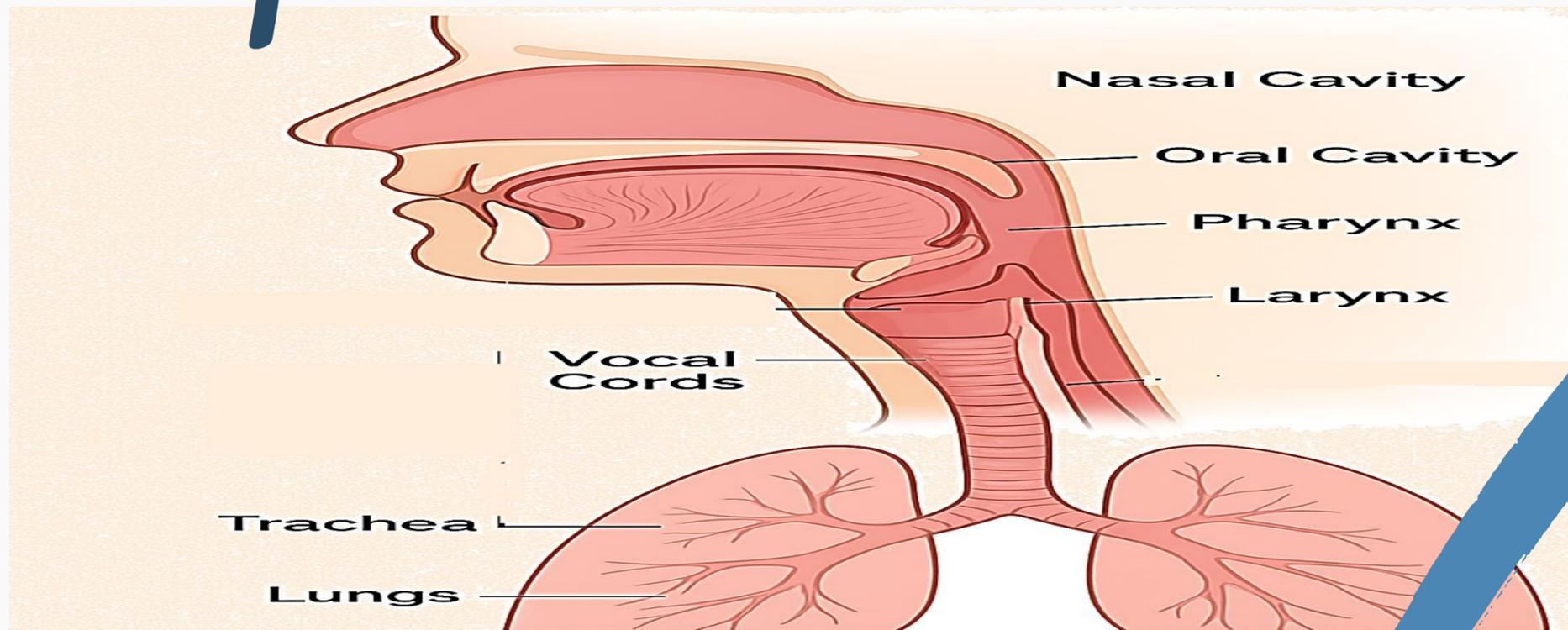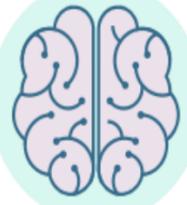
Prof.

Khaled Abdel-Sater M.D

2nd year Dental Students

Study Objectives

Knowledge Objectives

1.**Identify the primary speech organs** and describe their roles in respiration, phonation, and articulation.

2.**Explain the phonatory system**, including the function of the larynx and vocal cords in sound production.

3.**Describe the neural control of speech**, including the major cerebral cortex lobes involved in speech functions.

4.**Locate Brodmann areas (22, 39, 40, 44, 45)** involved in speech production, comprehension, and coordination.

5.**Differentiate the major types of aphasia** based on the affected cortical area and clinical features.

Skills Objectives

6.**Analyze how respiratory, phonatory, and articulatory systems interact** to produce intelligible speech.

7.**Interpret clinical cases of speech deficits** and link them to dysfunction in specific cortical regions.

Attitude/Objectives

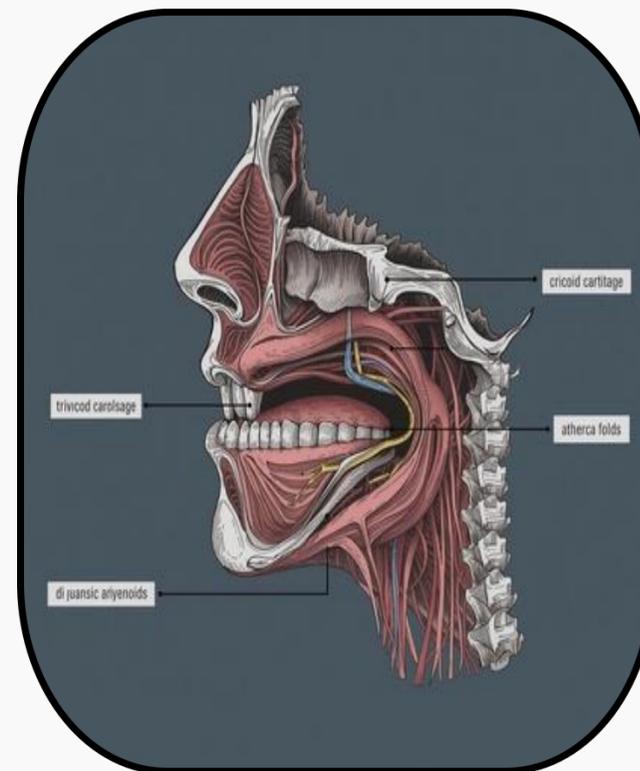8.Appreciate the complexity and integration of neural and muscular control required for normal verbal communication.

We use more than100 muscles just to say a simple word e.g. Hi

Primary Speech Organs
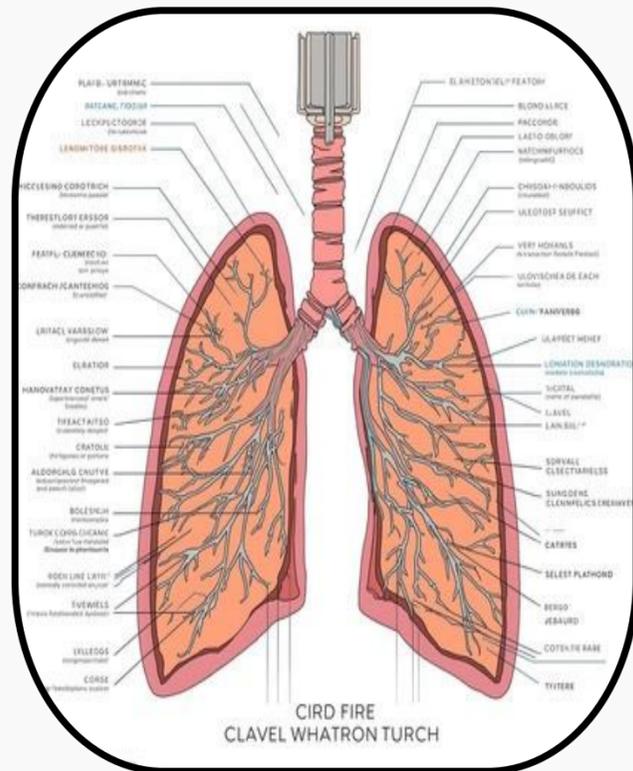
Respiratory system
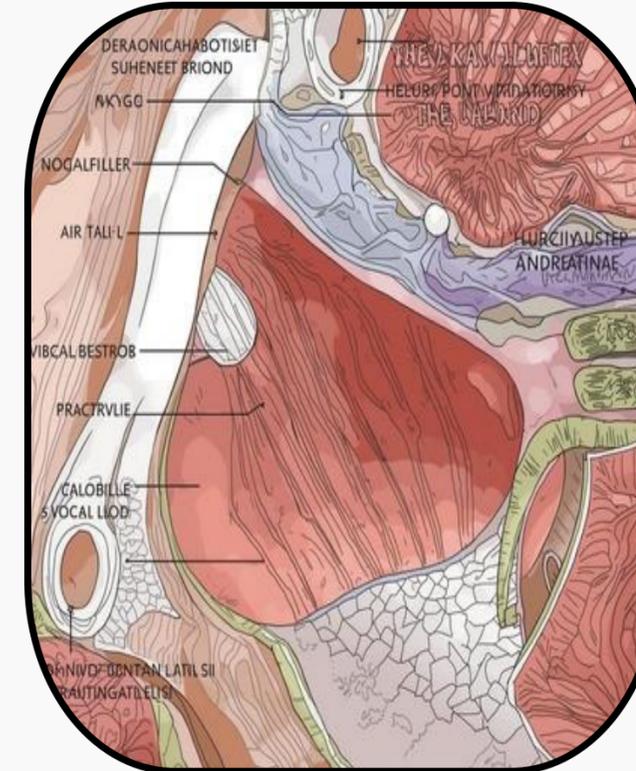Lungs, trachea
Provide the power for speech by pushing **air** out of the body.
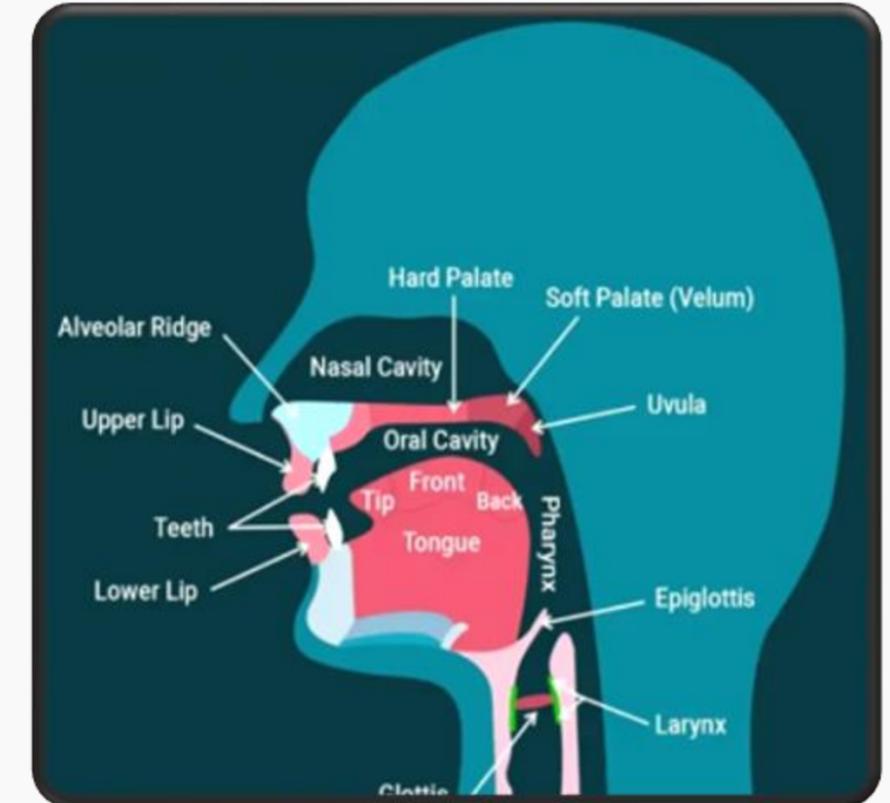
Larynx
(voice box)
The larynx houses the **vocal folds**.

Phonatory system

Vocal Folds
Vocal folds vibrate to create voice sounds.

Articulatory system
Oral cavity (lips, teeth, tongue, hard palate, soft palate) and nasal cavity.

Your tongue never gets tired... even though it never stops working!

Neural Control of Speech Mechanisms

Brain Areas

such as **areas** 4, 17, 18, 19, 22, 39, 40, 41, 42, 44, 45

Both central and peripheral nervous systems work together to ensure normal speech

Neural Pathways

The corticobulbar tract and cranial nerves (trigeminal (V), facial (VII), glossopharyngeal (IX), vagus (X), XI (Accessory) and hypoglossal (XII). are crucial pathways that transmit signals from the brain to the speech-producing muscles.

The fastest speakers on Earth can talk at over 600 words per minute

Cerebral Cortex Brodmann Areas

HISTOLOGY
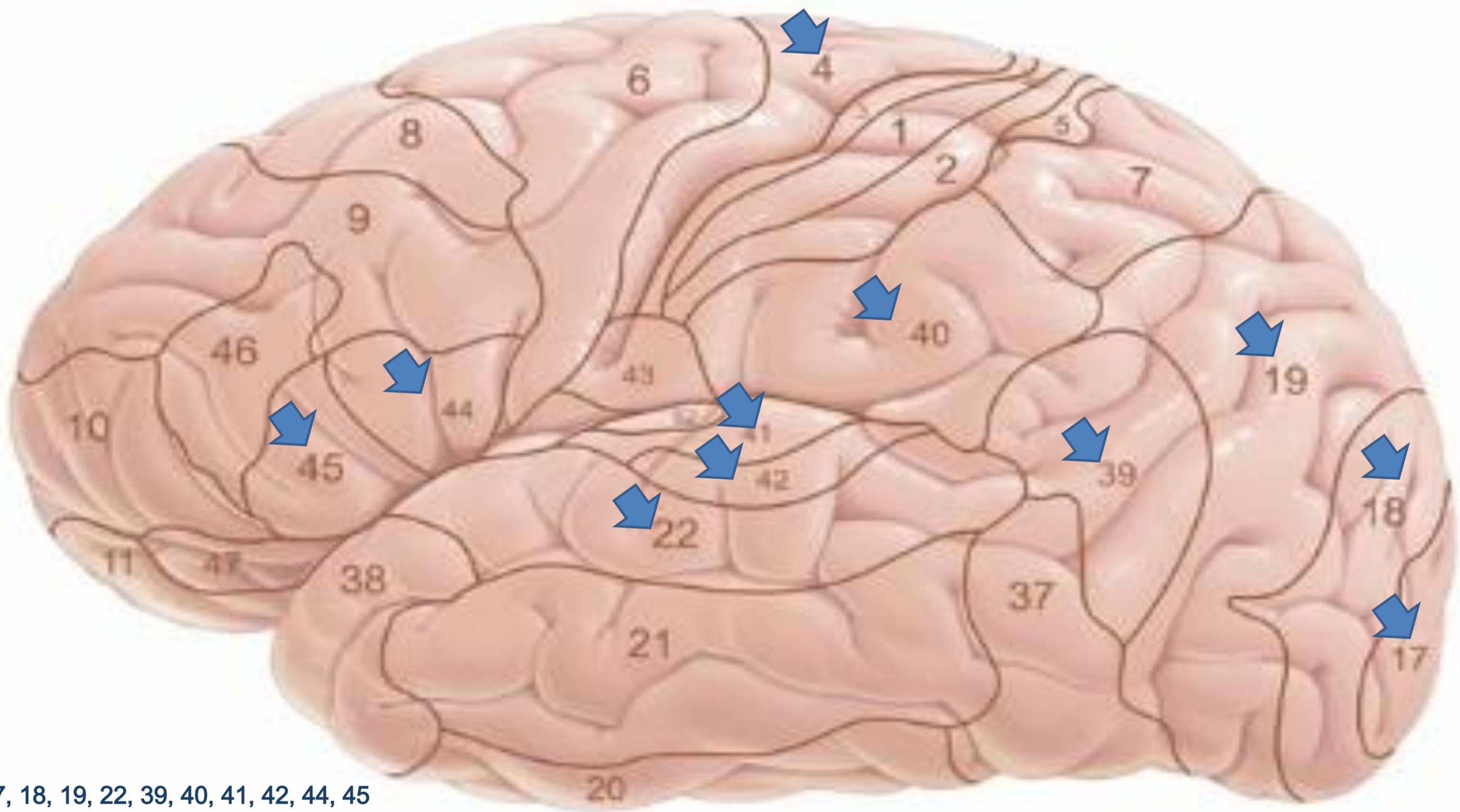
Areas 4, 17, 18, 19, 22, 39, 40, 41, 42, 44, 45

Pyramidal Tract

Motor areas, somatic sensory areas

Left Internal Capsule

Corticonuclear Tract

Midbrain

3, 4, 6

Motor nuclei of cranial nerves

Pons

Corticobulbar tract

5, 7, 9, 10, 11 and 12

Medulla

Corticospinal tract

AHCs

Spinal Cord

Centers of Speech

Primary auditory area (41-42)

Aud. Assoc. area (22) understand meaning of impulse

Ideational area

Wernick's
- Form thoughts
- Choose words needed for expression of these thoughts

area 45 Exner's area program the movement of muscles of the hands

Motor area4 hand region

Hand muscles

Primary visual area (17)

Vis. assoc. area (18-19) understand meaning of impulse

area 44 Broca's area program the movement of muscles of articulation

Motor area 4 face region

Pierre Paul Broca
1824–1880

General interpretative area

Sensory aspect

area 22, 39, 40

Motor aspect

Speech muscles

Speech centers

Area	Function
(1) Wernicke's area (general interpretative area)	Interpretation of auditory & visual information to form a though
(2) Broca's area (area 44)	Co-ordination of vocalization
(3) Hand skills area (Exner's area)	Co-ordination of hand movement
(4) Auditory areas: A. Primary auditory area (41, 42) B. Auditory association area (area 22)	Hearing Understanding the meaning (interpretation) of spoken words
(5) Visual areas: A. Primary visual area (17) B. Visual association areas (18,19)	Vision (written words & images) Understanding the meaning of written words.

Types of Aphasia

Type	Defect	Area damaged
1- **Auditory aphasia** (word deafness)	Inability to understand **spoken** words	**Auditory association area** in superior temporal gyrus
2- **Visual aphasia** (word blindness)	Inability to understand **written** words	**Visual association area** in occipital lobe
3- **Wernicke's aphasia** (fluent aphasia)	Inability to **interpret the meaning** of spoken or written words or **express thoughts in words** (meaningless & excessive talk is characteristic)	**Wernicke's area**
4- **Broca's aphasia** (non fluent – motor aphasia)	Inability of the vocal cords **to produce words** instead of noises. Speech is poorly articulated, produced slowly & with great effort (limited to 2 or 3 words)	**Broca's area**
5- **Motor apraxia** (agraphia)	Inability to **express thoughts by written words** in absence of paralysis Hand movements become uncoordinated & useless	**Hand skill area**

Dysarthria

Dysarthria a is a disorder of speech in which articulation of words is impaired, but the comprehension of spoken and written speech is not affected.

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Nicole Kidman

Joe Biden

Emily Blunt

Marilyn Monroe

Steve Harvey