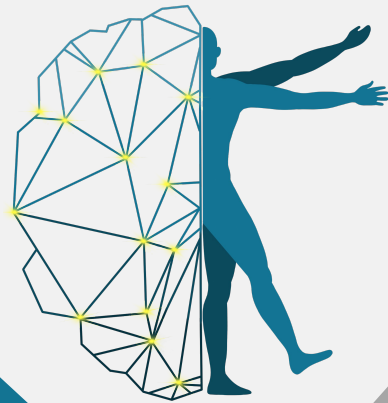
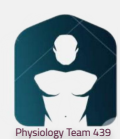


Revised & Approved



# Physiology of Speech

# Objectives:

- ❖ Describe brain speech areas as Broca's, Wernicke's and insula.
- ❖ Explain sequence of events in speech production.
- ❖ Explain speech disorders as aphasia with its types, dysarthria, Dysphonia etc.
- ❖ Explain difference between aphasia and dysarthria.

## Color index:

- ❖ **Important.**
- ❖ **Girls slide only.**
- ❖ **Boys slide only.**
- ❖ **Dr's note.**
- ❖ Extra information.



**Editing File**

## ● Speech:

Means of communication between the two individual or group of individuals\*.

- It is the highest function of the nervous system\*.
- Involves understanding of spoken & printed words\*.
- It is the ability to express ideas in speech & writing\*.
- **Means of communications:\***
  - Sensory Communication: Auditory communication - Visual communication.
  - Motor Communications: Talking - Writing.

### Types of Speech\*

#### Spoken speech:

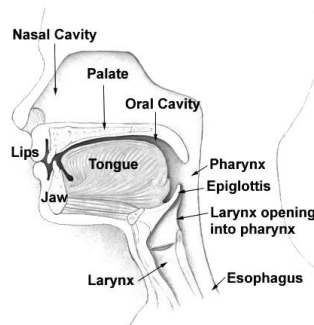
understanding spoken words & expressing ideas in speech.

#### Written speech:

understanding written words and expressing ideas in writing.

### Speech Structures:\*

- ❖ Oral cavity.
- ❖ Nasal cavity.
- ❖ Pharynx.
- ❖ Larynx.



### Steps of Communication:\*

**Collection of sensory input:**  
Auditory and visual

**Integration:**  
Hearing and articulation mechanism

**Motor execution**



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# Basic Events In Speech Production

# L19

## 1. Initiation:

Action that initiates the flow.

## 2. Phonation:

Action that modulates the quality of sounds.

## 3. Articulation:

Action that modulates or articulates.

## 01 ➤ INITIATION:

### Setting the airstream in motion:

- Creating airstream is an essential process of sound production.
- Change in pressure.

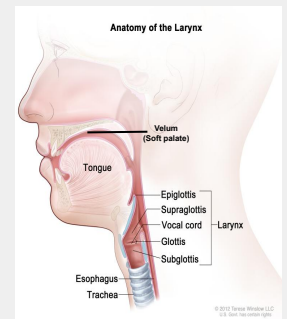
### Three mechanisms of initiation:

- 1. Pulmonic:** Pulmonic airstream mechanism: Lungs 95% of human speech sounds are produced in this way.
- 2. Glottalic:** Airstream mechanism via glottis.
- 3. Velaric:** Airstream mechanism : Velum.

### Direction Of Air Flow:

**Egressive/pressure Sound:**Exhalation: Deflation of lungs and consequent compression of the air Hello.....Hello.....

**Ingressive/suction Sound:**Inhalation: Sucking air into the lungs Hi.....Hi.....



## 02 ➤ PHONATION:

**Phonation** is a process of changing air stream Sound production by passage of air over the vocal cord Produce **speech sounds**, air stream distorted in one way or another Phonation is mainly achieved at **larynx, vocal cord.** ( produce the sounds )

### Major components:

- **Vocal cords, Glottis, Epiglottis.**
- **Three cartilages: Thyroid, Arytenoid and Cricoid.**

# Cont. Basic Events In Speech Production

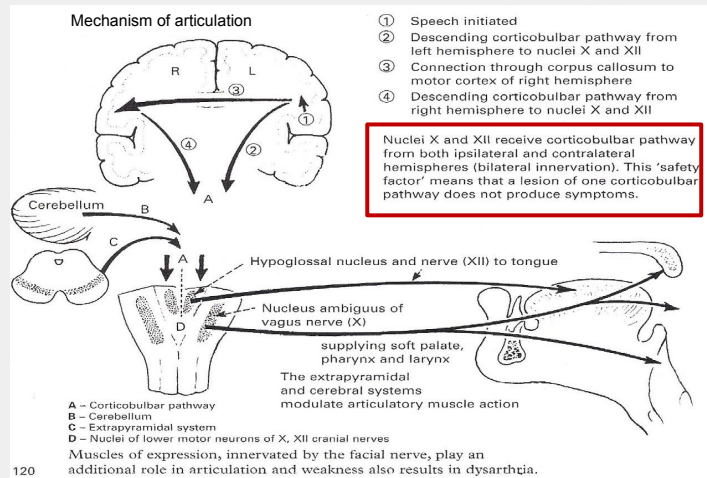


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## 03 ➤ ARTICULATION:

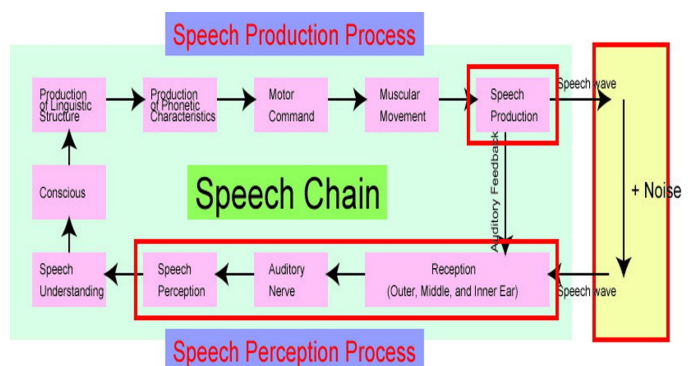
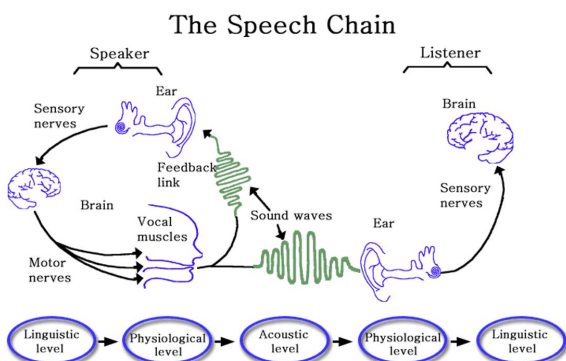
- **Muscular movements** of the mouth, tongue, larynx, vocal cords.
- Contribution by structures to shape airflow.
- A variety of speech sounds can be produced in terms of another way of airstream change – Articulation.
- Articulation is done mainly at **vocal cord**.
- An specific part of the vocal apparatus involved in the production of a speech sound.
- **Active articulators:** Lips, tongue, lower jaw, velum ( **structures of the mouth** ).
- Responsible for the intonations, timing, and rapid changes in intensities of the sequential sounds.

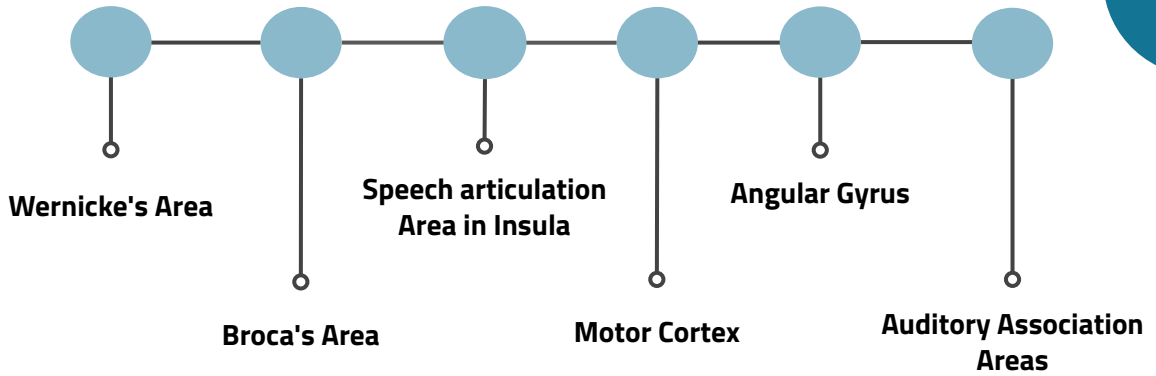
**Male Dr. : Very important picture specially this Part ( red square ).**



- Phonation: عملية إنتاج الأصوات
- Articulation: عملية ترتيب هذه الأصوات لإنتاج الكلمات

## More pictures explaining the Speech production processes:



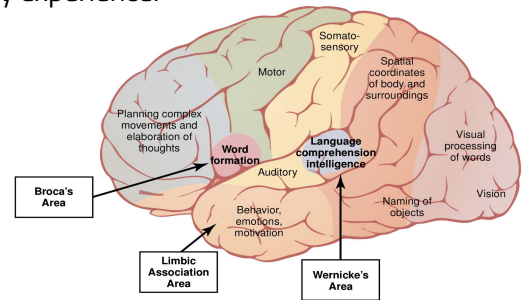


## 1

### Wernicke's area:\*

- At the posterior end of the **superior temporal gyrus**.
- Closely associated with 1 & 2 auditory areas.
- Responsible about **comprehension of auditory & visual information**, then projects it to Broca's area via arcuate fasciculus.
- Interpretations of sensory experience.
- Formation of thought in response to sensory experience.
- Choice of words to express thoughts.

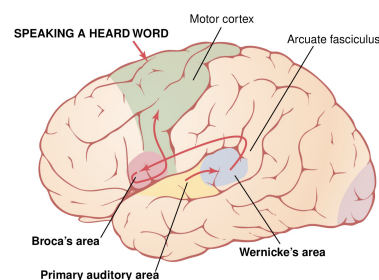
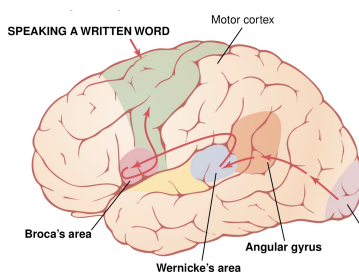
Language comprehension, intelligence, cognitive function, analysis, choice of the way we response,



## 2

### Broca's area:

- A special region in the frontal cortex, called Broca's area, provides the neural circuitry for **word formation**.\*
- This area, is located partly in the posterior lateral prefrontal cortex and partly in the premotor area (At the lower end of premotor area\*).\*
- It is here that **plans and motor patterns for expressing individual words** or even short phrases are initiated and executed.\*
- This area also works in close association with Wernicke's language comprehension center in the temporal association cortex.\*
- In adult who learn second language during adulthood. The MRI shows portion of Broca's area concerned with it is adjacent to but separate from area concerned with the native language. But in children who learn second language early in life there is only single area involved for both languages.\*



3

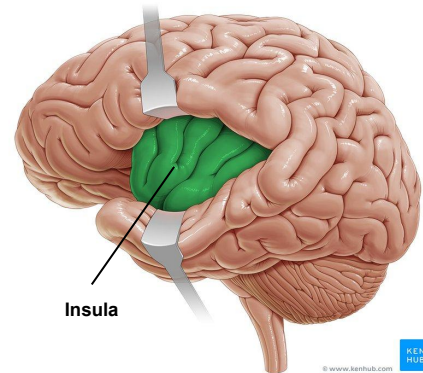
## Angular Gyrus:\*

- Lies behind Wernicke's area fused posteriorly into the visual cortex.
- Function: interpretation of information obtained from reading from visual cortex.

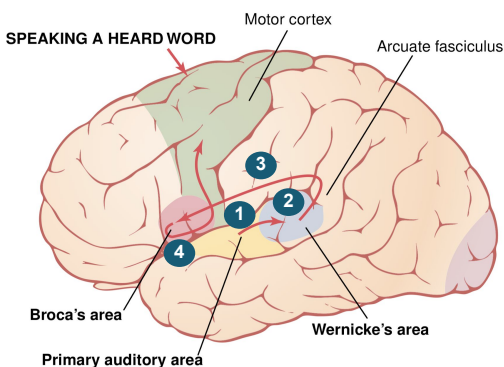
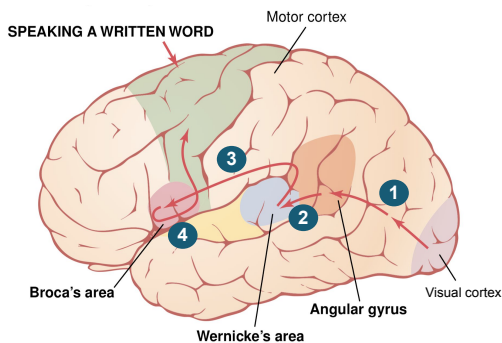
4

## Insula:\*

- is a portion of the cerebral cortex folded deep within the lateral sulcus
- Hand and eye motor function.



## Physiology of Speech\*



- ❖ **W. area** receive information from both auditory & visual areas. (2)
- ❖ Project it to B. areas via arcuate fasciculus. (3)
- ❖ **Broca's area** process information received from W. area into detailed & **co-ordinated pattern of vocalization** & then project that pattern to the **motor area/ cortex** to initiate the appropriate movement of the lips & larynx to produces speech.
- ❖ Initiation of movement of muscle of speech in tongue, larynx & lips. (4)
- ❖ If writing is concerned, then information received from W. area is processed in the area of hand skills. **co-ordinated pattern of muscle movement** projected to the arms & hand region of the motor cortex. initiation of necessary muscle movement in the hand & arms required for writing a particular word. (4)

## ● Association Areas:\*

These areas receive and analyze signals simultaneously from multiple regions of both the motor and sensory cortices as well as from subcortical structures.

❖ The most important association areas are:\*

### 1. Parieto-occipito-temporal association area:

- Analysis of the Spatial Coordinates of the Body.
- Area for Language Comprehension.
- Area for Initial Processing of Visual Language (Reading).
- Area for Naming Objects.

### 2. Prefrontal association area.

### 3. Limbic association area.

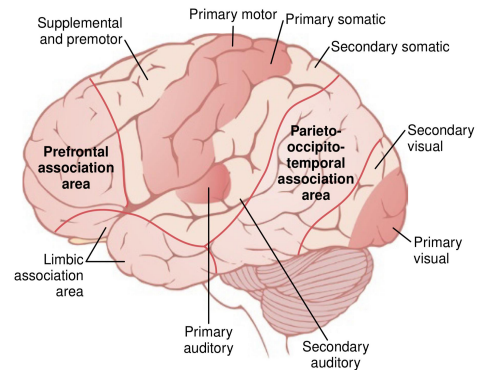


Figure 57-4 Locations of major association areas of the cerebral cortex, as well as primary and secondary motor and sensory areas.

## Speech Disorders

### 1. Disordered Phonation:\*

**Phonation:** Sound production by passage of air over the vocal cord.

**Dysphonia:** Abnormal sound production due to problem in vocal cord e.g., paralysis, Cerebrovascular accident (CVA), other causes.

#### Causes:

- Paralysis of **both** vocal cord e.g. whispering sound and inspiratory stridor.  
Stridor is a high-pitched, wheezing sound caused by disrupted airflow. Inspiratory stridor is one of the three types of stridor. In this type, you can only hear the abnormal sound when you breathe in. This indicates an issue with the tissue above the vocal cords.
- Paralysis of **left** vocal cord: The voice becomes weak and cough bovine. **Mainly due to recurrent laryngeal palsy.**



## 2. Dysarthria:

- ❖ mean disorder/ disturbances in articulation e.g. **slurred speech**.\*
- ❖ **Abnormality in articulation (motor dysfunction)** Due to neurological conditions involving motor function (upper or lower motor neuron lesion).\*
- ❖ In some individuals who has no abnormality in the speech centre or in its pathways results in **stuttering speech**.\* مشاكل في النطق ، مخارج الحروف غير واضحة

### 2a. Slurred Speech:\*

Language is intact, Paralysis, slowing or in coordination of muscles of articulation or local discomfort causes various different patterns of dysarthria.

- ❖ Speaking softly or barely able to whisper.
- ❖ Slow rate of speech.
- ❖ Rapid rate of speech with a "mumbling" quality.
- ❖ Limited tongue, lip, and jaw movement.
- ❖ Abnormal intonation (rhythm) when speaking.
- ❖ Changes in vocal quality ("nasal" speech or sounding "stuffy").
- ❖ Hoarseness.

#### Examples:

- ❖ gravelly' speech of upper motor neuronal lesions of lower cranial nerves.
- ❖ jerky, ataxic speech of cerebellar lesions (Scanning Speech).
- ❖ the monotone of Parkinson's disease (Slurred).
- ❖ speech in myasthenia that fatigues and dies away. Many aphasic patients are also somewhat dysarthric.



### 2b. Stuttering:\*

- ❖ **Stuttering affects the fluency of speech.**
- ❖ Talking with involuntary repetition of sounds, especially initial consonants.
- ❖ **It begins during childhood and, in some cases, lasts throughout life.**
- ❖ The disorder is characterized by disruptions in the production of speech sounds, also called "disfluencies".
- ❖ Have right cerebral dominance and widespread overactivity in the cerebral cortex and cerebellum. This includes increased activity of the supplementary motor area.

# Cont. Speech Disorders

## 3. Aphasia:

- ❖ Is loss of or defective language from damage to the speech center within the left hemisphere.\*
- ❖ Abnormality of language function due to injury of language centres in cerebral cortex. Comprehension or expression of words will be affected. Due to thrombus or embolism of cerebral vessels, trauma.\*
- ❖ NOTE: There is no damage to vision, hearing or motor paralysis. The damage is in speech centers in categorical hemisphere.\*

Lesion area	Type of aphasia
<b>Wernicke's Area</b>	<p><b>Sensory or Wernicke's aphasia (fluent):</b> Broca's area receive unprocessed disorganized information from wernicke's area</p> <ul style="list-style-type: none"> <li>❖ Lesion of wernikes area +/- arcuate fasucul.*</li> <li>❖ Impaired <b>comprehension</b> / understanding.*</li> <li>❖ Loss of intellectual function.*</li> <li>❖ Failure to interprets meaning of written or spoken words.*</li> <li>❖ Meaningless words &amp; excessive talk (in severe cases).*</li> <li>❖ <b>FLUENT:</b> Meaningless words with loss of comprehension/ understanding.*</li> </ul>
<b>Broca's Area</b>	<p><b>Motor or Broca's aphasia (non fluent):</b> Projection to motor cortex is not working</p> <ul style="list-style-type: none"> <li>❖ Patient will understand spoken &amp; written words but find it <b>difficult to speak</b> or to write.*</li> <li>❖ <b>NON FLUENT</b>, Understanding normal but Voice production defective.*</li> <li>❖ Poorly articulated speech, slow with great effort &amp; abnormal rhythm.*</li> <li>❖ In some cases speech may be limited to 2-3 words.*</li> </ul>
<b>Arcuate Fasciculus*</b>	<p><b>Conductive aphasia (fluent):</b></p> <ul style="list-style-type: none"> <li>❖ Lesion of nerve fibres of arcuate fasciculus.</li> <li>❖ Patient understand speech of others but can not repeat it.</li> <li>❖ Meaningless speech.</li> <li>❖ <b>Normal comprehension but the Transmission from wernicke's area to broca's area is disrupted.</b></li> </ul>
<b>Angular Gyrus*</b>	<p><b>Anomic aphasia</b></p> <ul style="list-style-type: none"> <li>❖ Lesion of angular gyrus, thus Broca's &amp; Wernicke's are intact.*</li> <li>❖ Unable to name the objects.*</li> <li>❖ Speech &amp; auditory comprehension is normal but visual comprehension is abnormal, due to visual information is not processed &amp; not transmitted to wernicke's area.*</li> <li>❖ <b>Dyslexia (word blindness) interruption in the flow of visual experience into Wernicke's area from visual area.*</b></li> </ul> <p>Depending on the extent of lesion in the angular gyrus ·major lesion or minor a specific letter or number will be affected</p> <p>مثلاً ما راح يقدر يشوف حرف الألف فتكون مشوشة أو مقلوبة أو معوجة يحسبو عنده صعوبات تعلم ولكن هو ما يشوف الحرف They do well after special classes and training, <b>finds it hard to differentiate between d,b and p,q</b></p>



438: Damage to the Broca's area results in the inability to speak fluently despite having normal comprehension and vocal mechanisms. On the other hand, Wernicke's aphasia is the inability to understand or produce meaningful language even though they can speak fluently.

## 3. Aphasia: (cont.)

Lesion area	Type of aphasia
<b>Insula*</b>	<p><b>Insula damage: Progressive non-fluent aphasia:</b></p> <ul style="list-style-type: none"> <li>❖ deterioration of normal language function.</li> <li>❖ normal comprehension.</li> <li>❖ Intact other non-linguistic cognition.</li> <li>❖ it's due to Degenerative disorders (such as Alzheimer's disease) or Atrophy of the left anterior insular cortex. +In old age people</li> <li>❖ How is it differentiated from Broca's Aphasia? 1- It's progressive. 2- Degenerative disorder.</li> </ul>
<b>(mixture of all)*</b>	<p><b>Global Aphasia (Central Aphasia):</b>  <b>This means the combination of the expressive problems of Broca's aphasia and the loss of comprehension of Wernicke's.</b>                      The patient can <b>neither speak nor understand</b> language, It is due to widespread damage to speech areas and is the commonest aphasia after a severe left hemisphere infarct.                      Writing and reading are also affected.</p>

### Lesions of Different Areas in The Brain:

This table is in males slide only + Important

Area	Lesion Features
Auditory association areas	Word deafness
Visual association areas	Word blindness called dyslexia
Wernicke's Aphasia	Unable to interpret the thought
Broca's Area Causes	Motor Aphasia
Global Aphasia	Unable to interpret the thought Motor Aphasia

### **Dyscalculia\*** Not related to language function

- Difficulty in learning or comprehending arithmetic and mathematics.
- Seen in developmental disorder.



The whole page is EXTRA

# Summary of Speech Disorders

## Dysphonia

Abnormal sound production due to problem in vocal cord.

## Dysarthria

**Abnormality in articulation (motor dysfunction)** Due to neurological conditions involving motor function.  
e.g. :

### 1. Slurred Speech:

Language is intact, Paralysis, slowing or in coordination of muscles of articulation or local discomfort causes various different patterns of dysarthria.

### 2. Stuttering:

Talking with involuntary repetition of sounds, especially initial consonants.

## Aphasia

loss of or defective language from damage to the speech center within the left hemisphere.

### 1. Wernicke's aphasia (fluent):

**Impaired comprehension +** Meaningless words. (Sensory)

### 3. Conductive aphasia (fluent):

Normal comprehension but the Transmission from wernicke's area to broca's area is disrupted.

### 5. Insula damage: Progressive non-fluent aphasia:

deterioration of normal language function.

### 2. Broca's aphasia (non fluent):

understand spoken & written words but find it **difficult to speak** or to write (motor).

### 4. Anomic aphasia:

**visual comprehension is abnormal,** due to visual information is not processed & not transmitted to wernicke's area.

### 6. Global Aphasia:

the **combination** of the expressive problems of **Broca's** aphasia and the loss of comprehension of **Wernicke's**.

# Hemisphere\*

- Both are active they work together complement each other.
- depending on the function executed one hemisphere is active more than the other one.

## Left Hemisphere (the categorical hemisphere):

1. The left hemisphere controls the right side of the body.
2. Produce and understand language.
3. understanding and manipulating language: recognition, use, and understanding of words and symbols.
4. Speech.
5. Identification of objects by name.
6. Mathematics, logic, analysis.

## Right Hemisphere (the representational hemisphere):

1. The right hemisphere controls the left side of the body.
2. Temporal and spatial relationships.
3. Analyzing nonverbal information.
4. Communicating emotion.
5. Recognition of emotion.
6. Recognition of tunes, rhythms.
7. Holistic problem solving.



# MCQ & SAQ:

L19

**Q1:** When the individual is unable to recognise everyday objects and name them correctly, this is known as:

- A. Prosopagnosia.
- B. Anomia.
- C. Agnosia.
- D. Aphosonomia.

**Q3:** When an individual has a disruption of the ability to speak is known generally as:

- A. Wernicke's aphasia.
- B. Broca's aphasia.
- C. Beidecker's aphasia.
- D. Anomic aphasia.

**Q5:** When an individual displays a deficit in the comprehension of speech involving difficulties in recognising spoken words and converting thoughts into words is known as:

- A. Wernicke's aphasia.
- B. Broca's aphasia.
- C. Beidecker's aphasia.
- D. Anomic aphasia.

**Q2:** Which speech disorder affects the fluency of speech?

- A. Stuttering.
- B. Dysphonia.
- C. Dysphasia.
- D. Global aphasia.

**Q4:** Which speech center damage will cause motor aphasia?

- A. Wernicke's area.
- B. Angular gyrus.
- C. Insula.
- D. Broca's area.

**Q6:** Which one is function of right Hemisphere?

- A. Speech.
- B. Recognition of emotion.
- C. Understand language.
- D. Mathematics.

6: B  
5: A  
4: D  
3: B  
2: A  
1: B  
key:  
answer

**1- what are the Brain Areas Concerned with Speech / Language**

**2- what are the The most important association areas?**

**3-What are the causes of dysphonia?**

**4- Compare between right Hemisphere and left Hemisphere?**

**A1:** Wernicke's Area - Broca's Area - Speech articulation Area in Insula -Motor Cortex -Angular Gyrus - Aud Assoc Areas.

**A2:** Parieto-occipitotemporal association area -Prefrontal association area -Limbic association area.

**A3:** - Paralysis of both vocal cords.  
- Paralysis of left vocal cord.

**A4:** page 13.

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- Homoud Algadheb.
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- Abdulaziz Alomar.
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- Abdullah Binjadou.
- Abdullah Alanzan.
- Abdullah Alhumimidi.
- Abdulrahman Almegbel.
- Abdulrahman Barashid.
- Abdulrhman Alsuhaibany.
- Abeer Awwad.
- Ahmad Alkhayatt.
- Aljoharah Albnyan.
- Aljoud Algazlan.
- Almaha Alshathri.
- Arwa Al-Qahtani.
- Bader Alrayes.
- Bassam Alasmari.
- Bushra Alotaibi.

- Faisal Jazzar.
- Feras Alqaidi.
- Ghaida Alassiry.
- Ghaida Alshehri.
- Hamad Almousa.
- Haya Alanazi.
- Hind Almotywea.
- Ibraheem Altamimi.
- Ibrahim Alnamlah.
- Joud Alarifi.
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- Noura Alshathri.
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- Shayma Alghanoum.
- Tarfah Alkaltham.
- Yara Alasmari.
- **Yara Alomar.**
- Yara Alzahrani.
- Yazeed Alqahtani.
- ziyad Alhosan.

