Physiology (code)-year 2

Lecture 2 (Salivary functions and Regulation of Salivary Secretion)

By L. Rafida Al-Amiri

Basic Science Department

College of Dentistry

University of Basrah

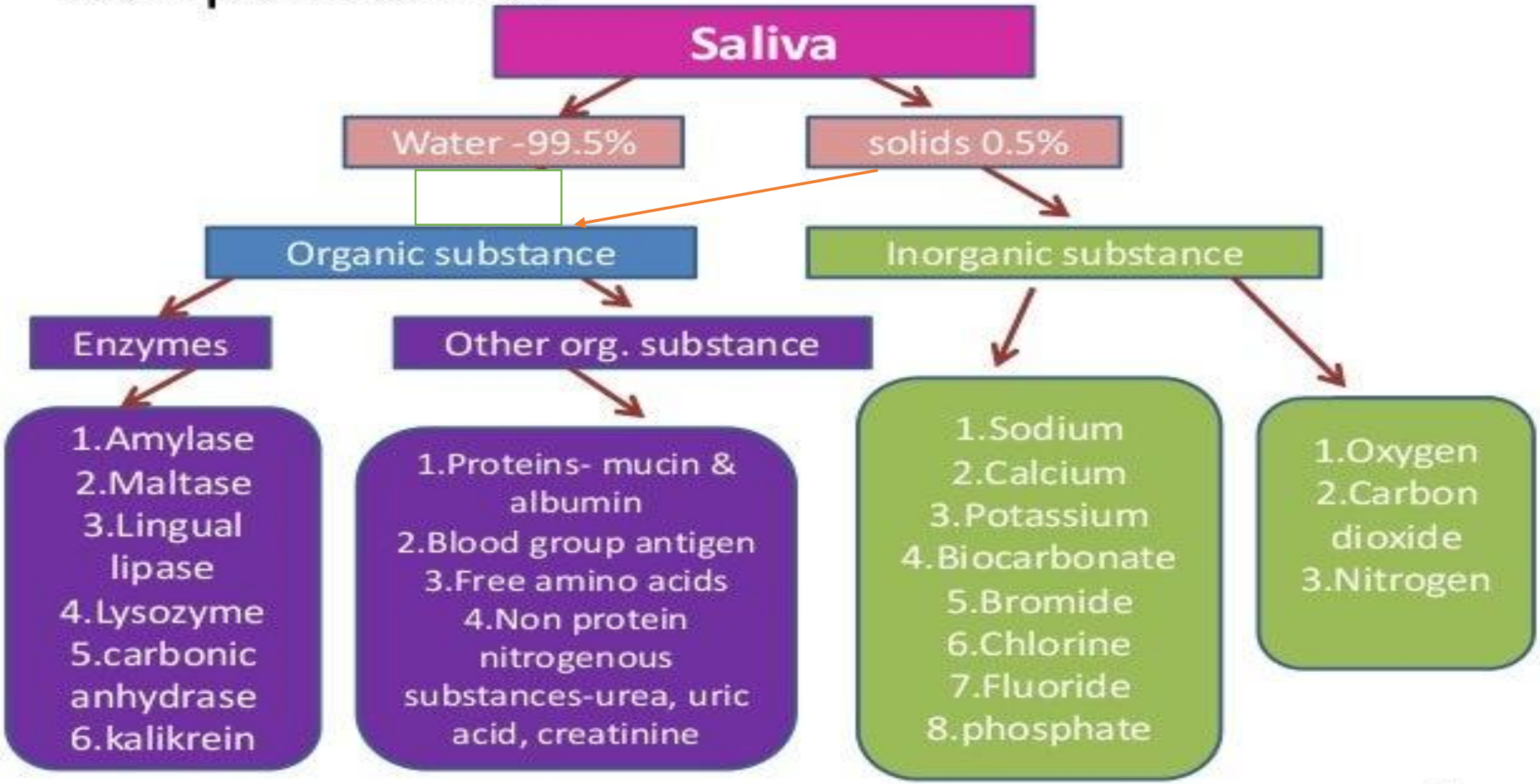
Objectives:

- Saliva Composition , Properties of Saliva
- Functions of Saliva ,Effect of drugs on salivary secretion
- Saliva As A Forensic Evidence
- Speech

Saliva Composition

Saliva: a thick, colorless, opalescent fluid that is constantly present in the mouth of humans and other vertebrates.

Composition of

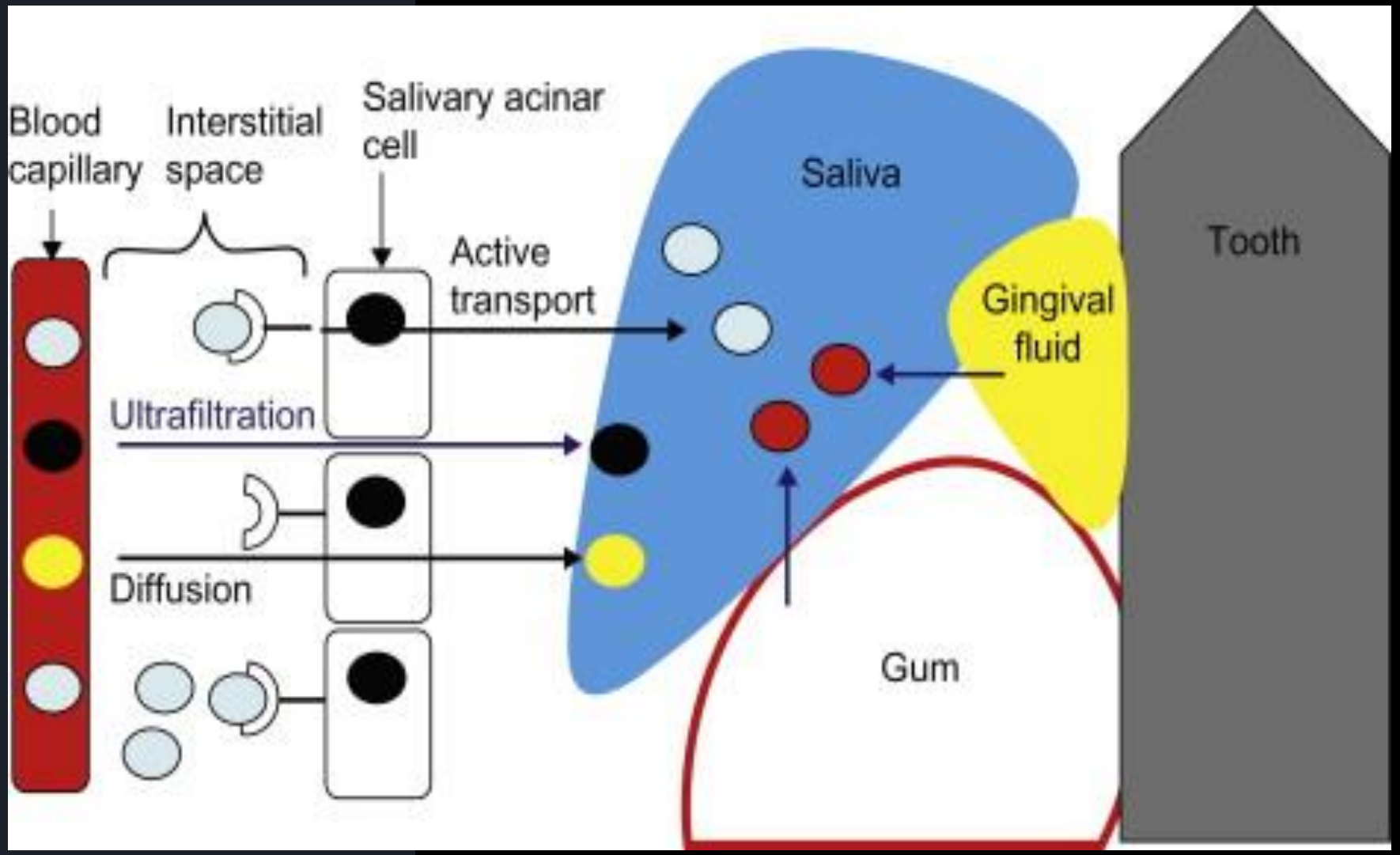


- **These composition interact in related function in the following general areas:**

1. Bicarbonates, phosphates, and urea act to modulate pH and the buffering capacity of saliva.
2. Macromolecule proteins and mucins serve to cleanse, aggregate, and/or attach oral microorganisms and contribute to dental plaque metabolism.
3. Calcium, phosphate, and proteins work together as anti solubility factors and modulate demineralization and remineralization.
4. Immunoglobulins, proteins, and enzymes provide antibacterial action.

Components of Saliva

- Saliva is made from blood plasma and thus contains many of the chemicals that are found in plasma.
- Considerable research is focused on detecting in saliva chemical markers such as *anti-oxidants, hormones, antibodies and antigens* as biomarkers in the diagnosis of several oral and systemic diseases such as oral cavity cancer, dental caries, periodontal disease and oral dryness.


Blood capillary
Interstitial space
Salivary acinar cell
Active transport
Ultrafiltration
Diffusion
Saliva
Gingival fluid
Tooth
Gum

Properties of Saliva

1. The secretion of saliva differs from person to person and varies within the same individual at different times of day (a circadian rhythm). When resting with no external stimulation, the average flow rate of saliva secretion is about 0.25–0.35 ml/min.
2. The normal pH of saliva is 6 to 7, meaning that it is slightly acidic.
3. Saliva is isotonic, as it is formed in the acini, but it becomes hypotonic as it travels through the duct network.

• 4. However, the secretion of saliva is greatly increased (typically 4–10 times higher) when stimulated (chemically, mechanically or aromatically), with >50% attributed to saliva secreted from the parotid gland.

• 5. Major salivary glands contribute most of the secretion volume and electrolyte content to saliva, whereas minor salivary glands contribute little secretion volume and most of the blood-group substances.

- **Functions of Saliva**

1. Lubrication of food:

Assisted by chewing, saliva gets mixed with food in the mouth; the mucin which is a sticky substance helps to form bolus. Saliva prepares the food for swallowing forming a slippery coat over the bolus.

2. Solvent action:

Taste is a chemical sense. Any substance, the taste of which must be perceived, must be in dissolved state to stimulate the taste receptors present in taste buds thorough-out the oral cavity. Saliva acts as the solvent and thereby helps for perception of taste.

3. Cleansing action:

The continuous flow of saliva keeps the mouth clean, free from food particles; shed epithelial cells and foreign bodies. Moreover, the lysozyme present in saliva helps to kill certain bacteria. The evidence of this action is obvious during fever. In most of the fevers, the salivary secretion is diminished.

4. Digestive function:

Salivary amylase or ptyalin is a carbohydrate splitting enzyme. It acts at a pH of 6.8. It can act only on cooked starch. When the starch is boiled, the cellulose covering of starch granules break and amylase can penetrate cellulose.

5. Excretory function:

Several substances can be excreted in saliva, e.g., heavy metals like mercury, lead, iodides, alkaloids like morphine, antibiotics like penicillin, streptomycin, microorganisms like viruses causing mumps, measles, polio, etc. But most of the times, the saliva formed is being swallowed. Thus, it may not serve much of excretory function.

6. Helps in speech:

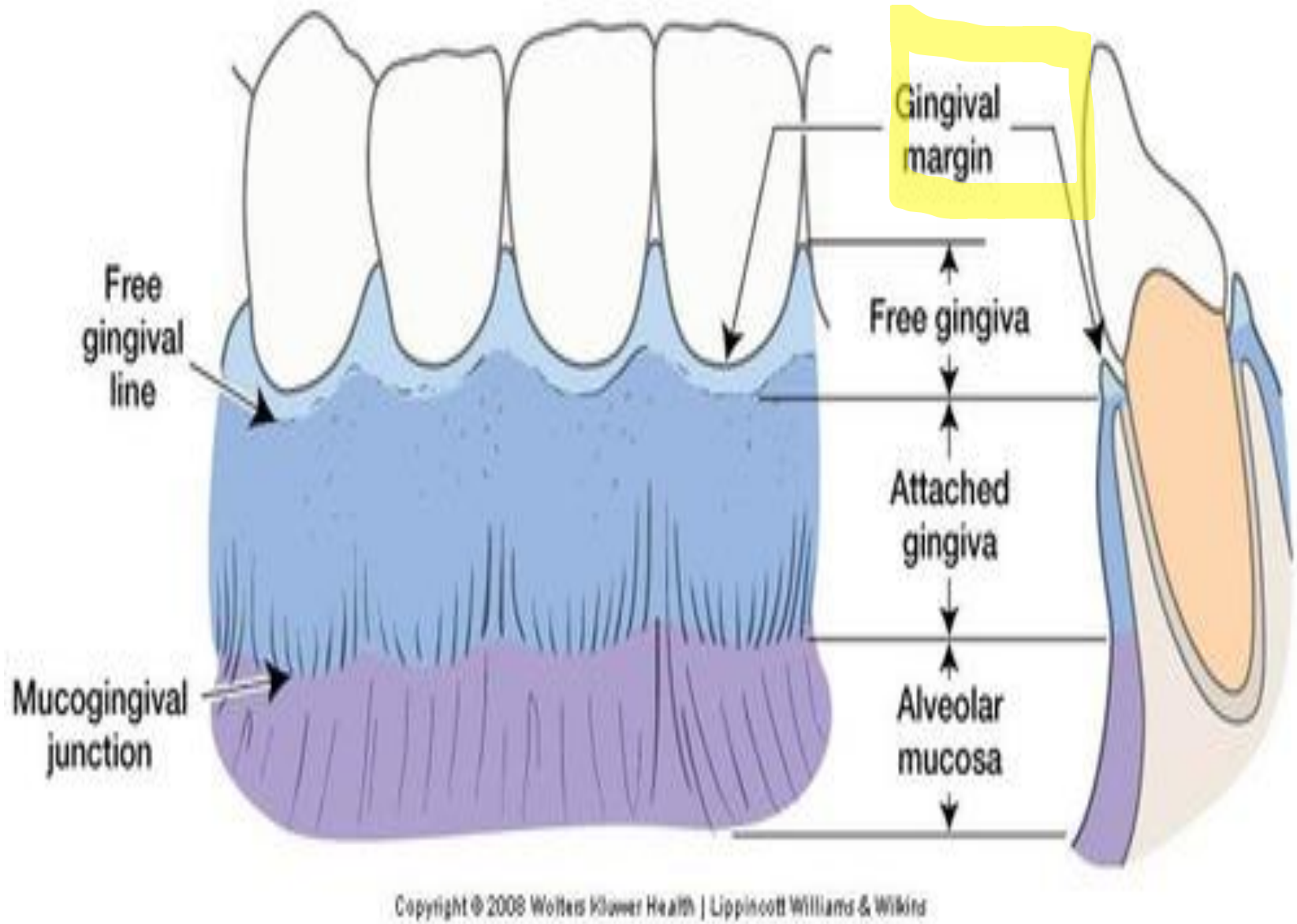
The moistening action of saliva in the mouth helps in articulation of speech. Those who speak for a long time sip a little water in between to facilitate articulation of speech.

7. Role in regulating water content in body:

Since saliva contains 99.5% water and daily secretion of saliva is one liter or more, decrease in body water content decreases salivary secretion and results in thirst sensation.

8. Buffering function:

Saliva contains bicarbonate, phosphate, proteins, etc. They act as buffers to keep the salivary pH within the normal limits. Decreased pH predisposes to caries whereas increase in pH will be responsible for tartar material and destroys the alveogingival margin.



EFFECT OF DRUGS & CHEMICAL ON SALIVARY SECRETION

1) Parasympathomimetic drugs like acetylcholine & pilocarpine increase the salivary secretion

2) Sympathomimetic drugs like adrenaline & ephedrine stimulates salivary secretion

3) Histamine stimulates the secretion of saliva

4) Parasympathetic depressants like atropine inhibit the secretion of saliva

5) Anaesthetics decrease the secretion due to central inhibition.

Is the atropine stimulating or inhibit the secretion of saliva?

- **Saliva helps maintain tooth integrity**
  - The inorganic and organic salivary components mentioned above help prevent demineralization of tooth enamel by buffering against large pH changes.
  - Proteins such as statherins, histatins, cystatins, and several others form a protective barrier, called a *pellicle*, around tooth enamel and actively promote remineralization with calcium and phosphate. This enables long-term maintenance of protective tooth enamel.
  - Fluoride also helps promote the formation of stronger, more caries-resistant tooth enamel, by replacing magnesium and carbonate within enamel crystals.

Saliva as a diagnostic aid:

- Oral diseases: High risk caries patient, Patient susceptible to candidiasis .
- Diagnostic aid for clinical problems :psychological problems, smoking, poisoning .
- Systemic diseases affecting saliva :Sjogren's syndrome, Cystic fibrosis.

Saliva as a Forensic Evidence

Saliva is a complex biological extracellular fluid , It is an indicator of various plasma components. In human, saliva is 99.5% water plus electrolytes, mucus, white blood cells, epithelial cells (from which DNA can be extracted).

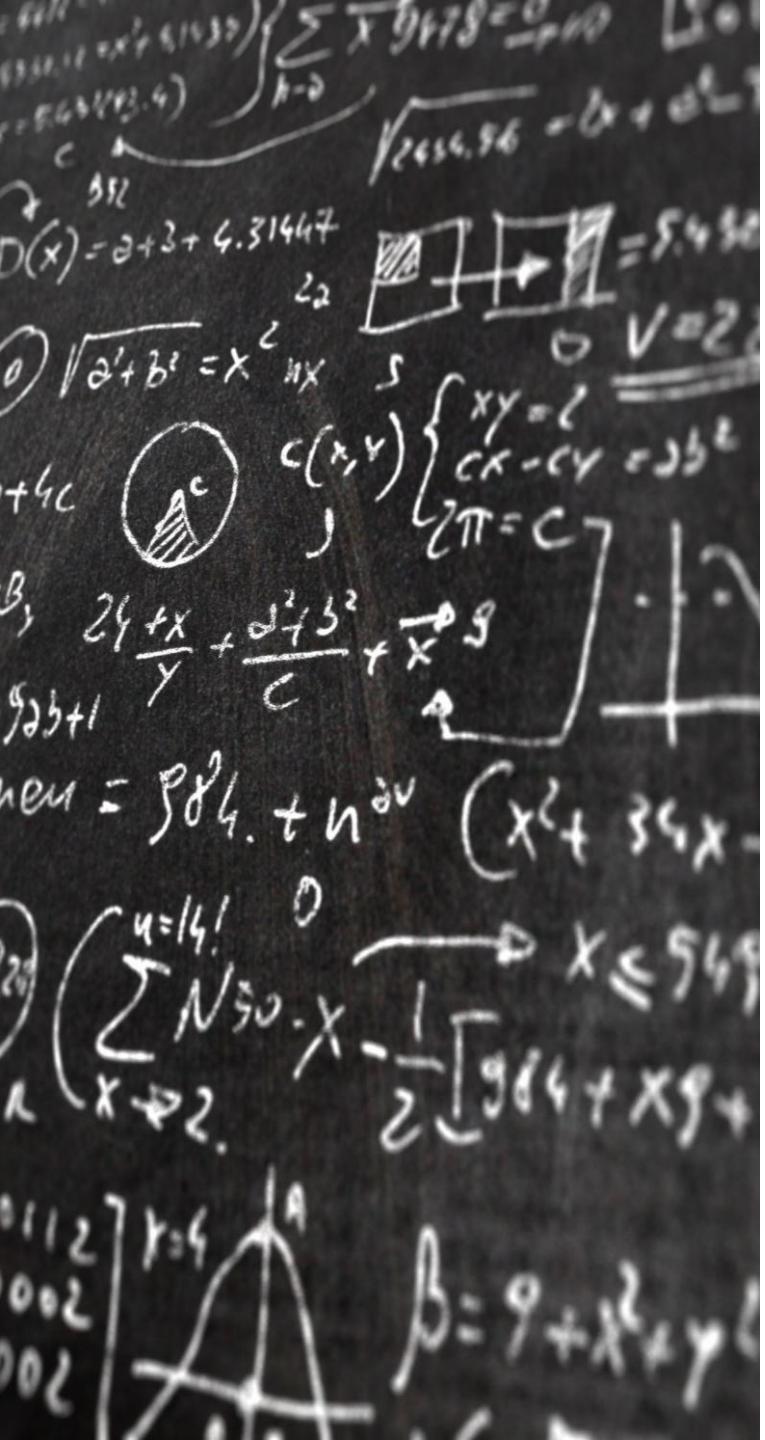
Besides maintaining the homeostasis of oral structures such as tooth integrity, it also plays a critical role in genomics, proteomics, and bioinformatics.

It is an important discriminating element in forensic biology, acting as an indicator of salivary gland conditions and toxicological and drug monitoring.

Source:

Disadvantages

- Some patients require a longer time for sample collection
- Contamination from food, beverages, kissing etc.
- Microbial urease can bias measurements
- Short delays in analysis might affect the results
- Xerostomia in some patients on hemodialysis
- Have to store at -80 °C as soon as possible after collection

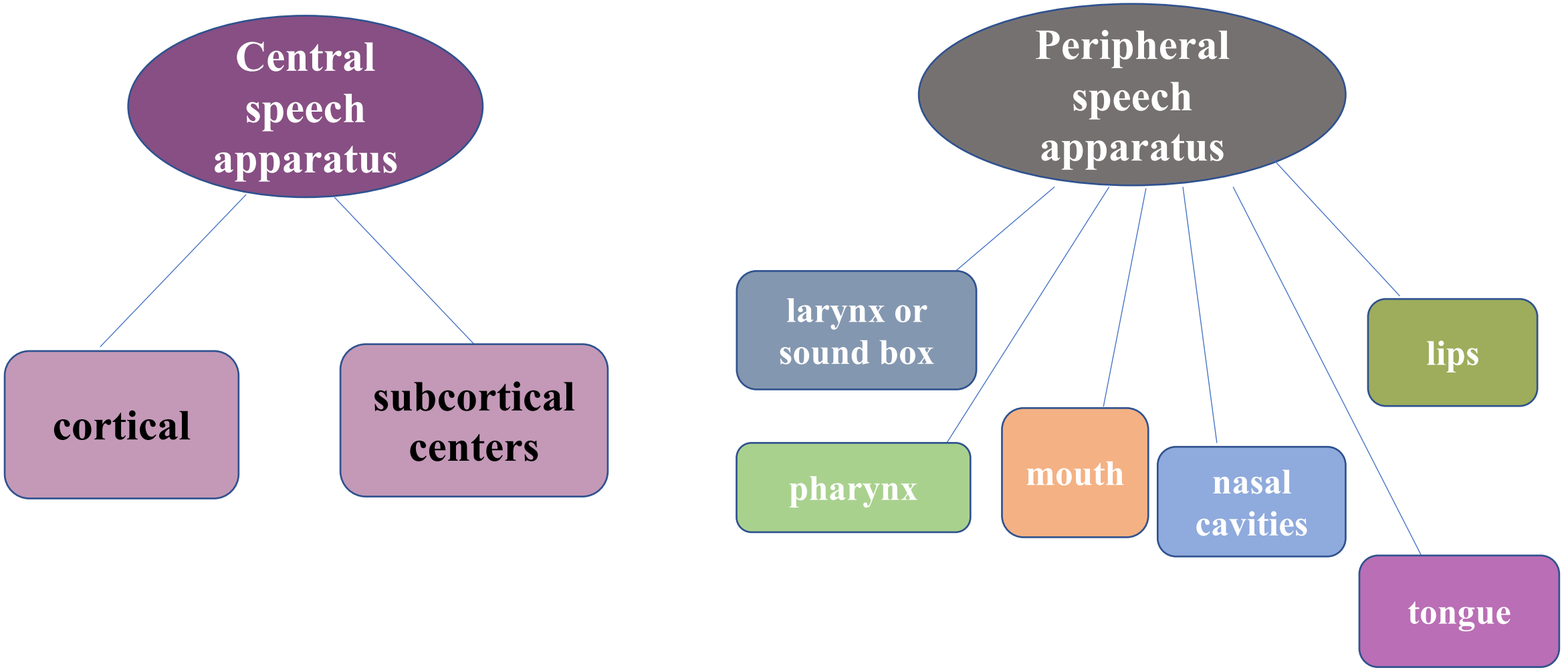


Speech

Is defined as the expression of thoughts by production of articulate sound, bearing a definite meaning. It is one of the highest functions of brain.

- When a sound is produced verbally, it is called the Speech.
- If it is expressed by visual symbols, it is known as Writing.
- If visual symbols or written words expressed verbally, known as Reading.

- **Mechanism of Speech**



Nervous control over Speech

Many parts of cortical and subcortical areas are involved in the mechanism of speech.

- ❖Subcortical areas concerned with speech are controlled by cortical areas of dominant hemisphere.
- ❖In about 95% of human beings, the left cerebral hemisphere is functionally dominant, and those persons are right-handed.

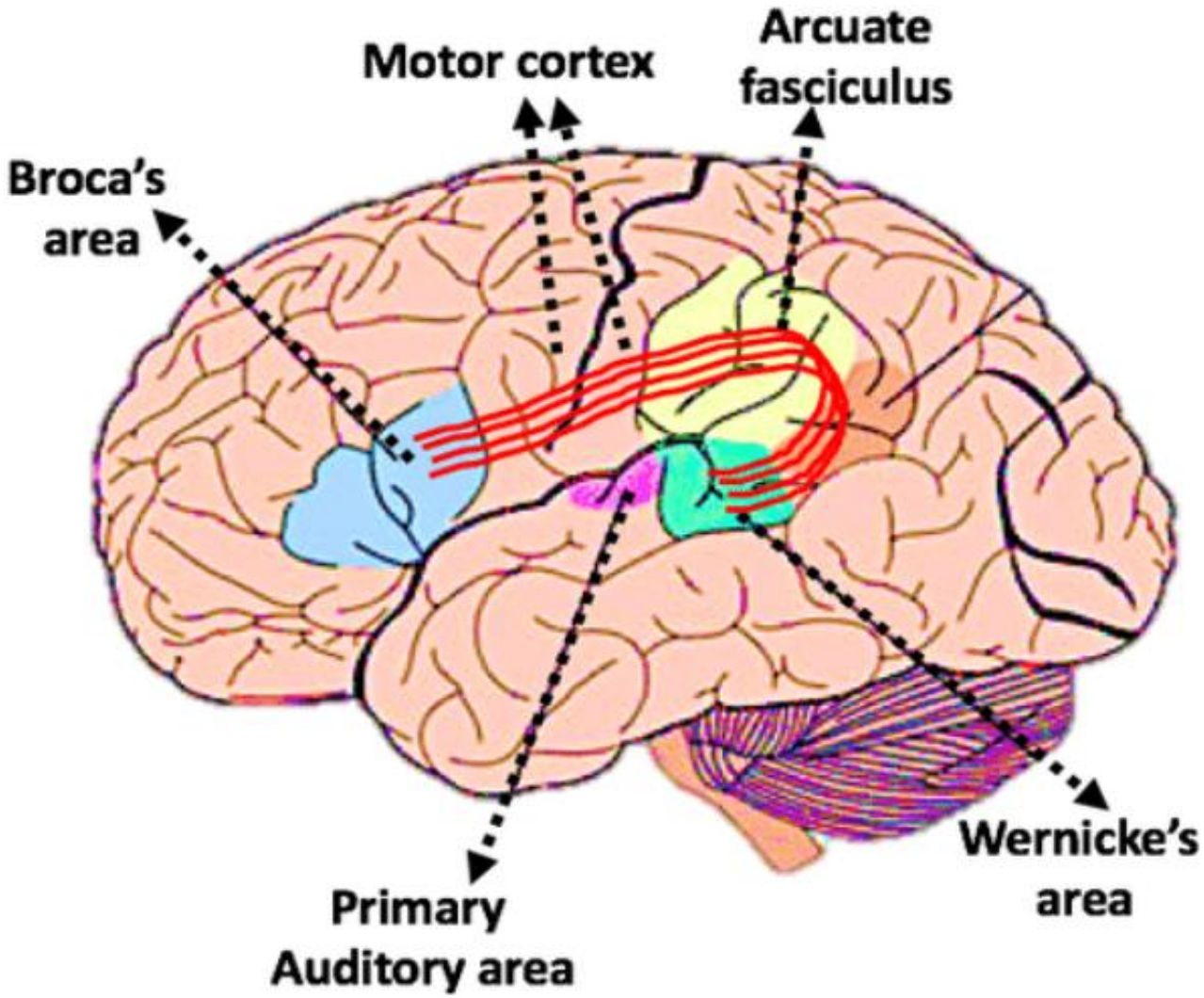
Nervous control over Speech

Motor areas

- Broca's Area
- Precentral cortex – Premotor & Primary Motor Area

Sensory areas

- Auditory Association Area
- Visual Association Area
- Wernicke's area



Broca's area: involved in production of speech sound

Wernicke's area: involved in Understanding of speech

Motor cortex: controls the Movements of muscles

Arcuate fasciculus: connects Wernicke's area to Broca's area.

Parts of the Brain that controls Speech

Applied Physiology

Communication disorder characterized by disrupted speech.

1. Aphasia
2. Dysarthria
3. Dysphonia
4. Stammering.

APHASIA (in Greek, Aphasia = without speech) Aphasia is defined as the loss or impairment of speech due to brain damage.

Developmental disorders – Poor development or atrophy of damage of speech centers. Aphasia is not due to paralysis of muscles of articulation.

Applied Physiology

DYSARTHRIA

Dysarthria is defined as the difficulty or inability to speak because of paralysis or ataxia of muscles involved in articulation.

DYSPHONIA

Dysphonia is a voice disorder. Often, it is characterized by hoarseness and a sore or a dry throat. Hoarseness means the difficulty in producing sound while trying to speak or a change in the pitch or loudness of voice. The voice may be weak, scratchy or husky.

STAMMERING

Stammering or shuttering is a speech disorder characterized by hesitations and involuntary repetitions of certain syllables or words. It is also described as a speech disorder in which normal flow of speech is disturbed by repetitions, prolongations or abnormal block or stoppage of sound and syllables.

It is due to the neurological incoordination of speech, and it is common in children. Stammering is associated with some unusual facial and body movements.

Exact cause for stammering is not known. It is thought that stammering may be due to genetic factors, brain damage, neurological disorders or anxiety.


Thank
you