MINISTRY OF HEALTH OF THE REPUBLIC OF UZBEKISTAN

TASHKENT STATE MEDICAL UNIVERSITY

Axmedova Sayyora Muxamadovna
Aytjanova Aysaule Esemuratovna

Anatomy of the Digestive, Excretory, and Respiratory Systems

EDUCATIONAL MANUAL

60910200-General medicine

CONTENTS

Digestive System

- Oral cavity: structure and divisions
- Teeth: structure, classification, and functions
- Tongue: structure and functions
- Salivary glands
- Pharynx and esophagus
- Stomach: shape, location, and wall structure
- Small and large intestines
- Liver, gallbladder, and pancreas
- Blood supply and innervation of digestive organs

Excretory System

- Structure and function of the urinary system
- Kidneys: structure, location, and function
- Nephron and urine formation
- Ureters, urinary bladder, and urethra
- Blood supply and innervation of the kidneys

Respiratory System

- Structure and functions of respiratory organs
- Nasal cavity, pharynx, and larynx
- Trachea and bronchi
- Lungs: lobes, alveoli, and pleura
- Mechanism of respiration
- Blood supply and innervation of the lungs

INTRODUCTION

According to the structural and functional organization of the human body, the **digestive, excretory, and respiratory systems** play essential roles in maintaining homeostasis. The **digestive system** provides the body with nutrients necessary for energy and cell repair; the **excretory system** removes metabolic waste and maintains water-salt balance; and the **respiratory system** ensures gas exchange by supplying oxygen and removing carbon dioxide.

Each of these systems has specific anatomical structures and physiological mechanisms, yet they are closely interconnected, working together to sustain life and internal stability of the human body.

Objective

To study the anatomical structure, physiological functions, and interrelations of the digestive, excretory, and respiratory systems and their importance in human health and medical practice.

Students must know:

- The structure, location, and main functions of the organs of all three systems;
- The histological structure of digestive, excretory, and respiratory organs;
- The blood supply, lymphatic drainage, and innervation of each system;
- The physiological processes of digestion, respiration, absorption, and excretion.

Students must be able to:

- Identify the organs of the digestive, respiratory, and excretory systems on models and specimens;
- Describe their topographical relationships and anatomical features;
- Explain how these systems cooperate in maintaining homeostasis;
- Apply anatomical and physiological knowledge in clinical practice.

Students must possess:

- Basic medical terminology in English, Latin, and Russian;
- Skills in anatomical observation and information analysis;
- Ability for independent study, professional responsibility, and use of scientific resources.

This educational manual will help students:

- Strengthen their understanding of the structure and functions of the digestive, excretory, and respiratory systems;
- Connect theoretical anatomy knowledge with clinical applications;
- Develop professional competencies such as:
  –Abstract thinking, analysis, and synthesis (GC-1);
  –Self-development and creativity (GC-5);
  –Use of biomedical information technologies (PC-1);
  –Application of physical, chemical, and biological principles in medicine (PC-7);
  –Assessment of the morphological and physiological state of the human body (PC-9).

Digestive system

The digestive organs perform functions such as the mechanical breakdown of food substances, their chemical decomposition under the influence of enzymes, absorption into the blood or lymph, and the elimination of waste products into the external environment. Most parts of the digestive system resemble a double-walled tube. The inner tube is formed by the mucous membrane of the organs, while the outer tube consists of muscle and serous layers. Between these two tubes lies the submucosal layer, which is made up of connective tissue rich in blood vessels.

These two layers can move relative to each other. The tissues of the submucosa and the muscle fibers are arranged in a spiral form, enabling movement from the oral cavity toward the rectum.

The walls of many digestive organs consist of four layers:
1. Inner — mucous membrane (mucosa)
2. Submucosal layer (submucosa)
3. Muscular layer (muscularis)
4. Outer — serous membrane (serosa)

The thickness and development of each layer depend on the function of the organ. In some organs, such as the stomach, the muscular layer is highly developed, while in others, like the small intestine, the mucous membrane is more prominent.

• Oral cavity
• Palate
• Teeth
• Tongue
• Salivary glands
• Pharynx
• Esophagus
• Stomach
• Small intestine
• Large intestine
• Liver
• Gallbladder
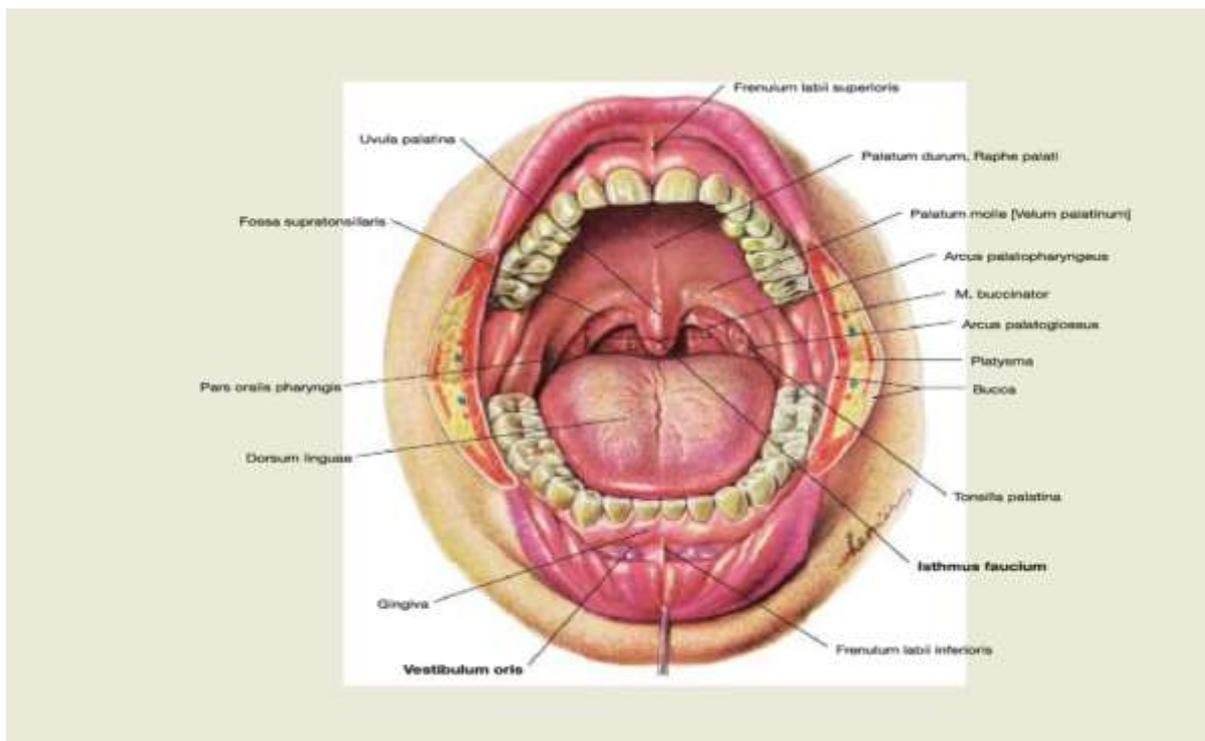• Pancreas
• Spleen
• Peritoneum
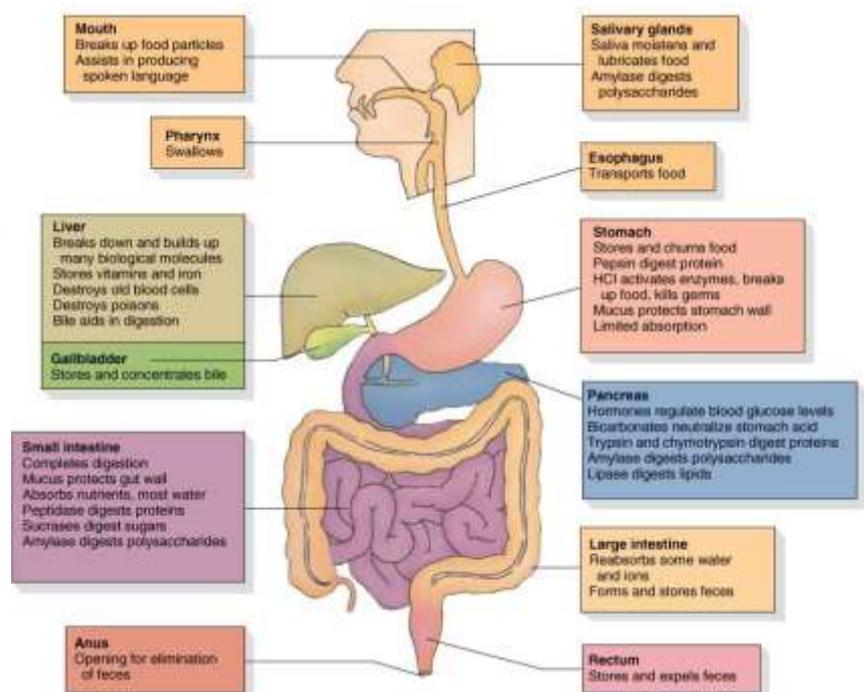
Oral cavity

The oral cavity communicates with the external environment through the oral fissure (rima oris).
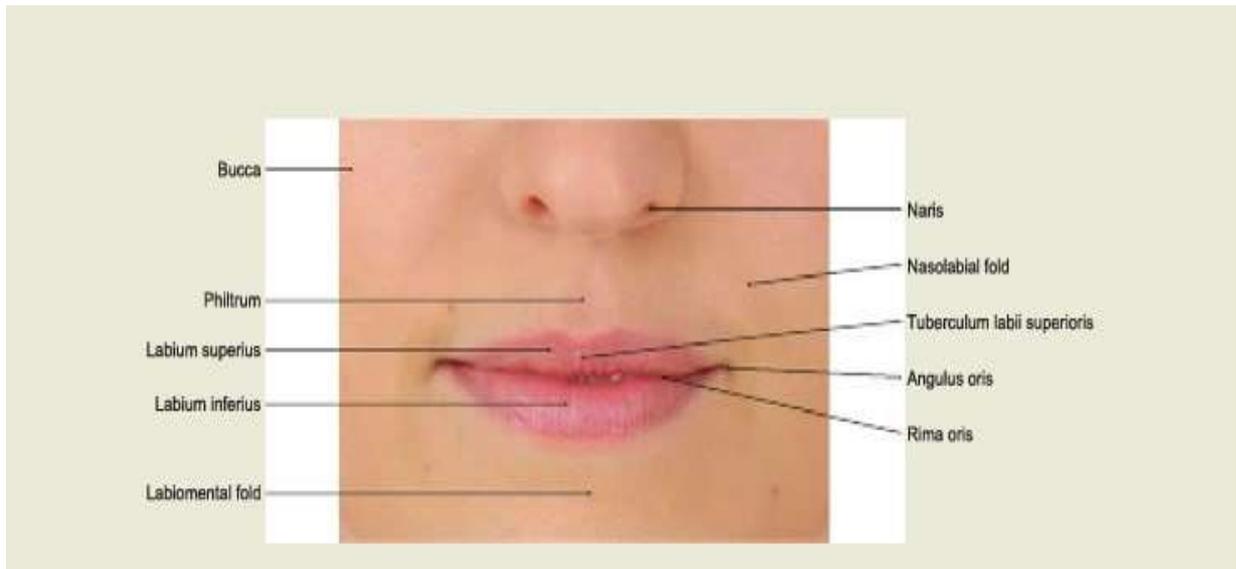
The oral cavity (cavitas oris) — from the Greek stoma, meaning "mouth"- consists of two parts:
 1. The oral vestibule (vestibulum oris), and
 2. The oral cavity proper (cavitas oris propria).

The boundary between these two parts is formed by the upper and lower rows of teeth.

The anterior wall of the vestibule is made up of the lips (labia oris), and the corners where the upper and lower lips meet form the commissures of the lips (commissurae labiorum).

The lips are composed of orbicular muscle fibers and are covered externally by skin and internally by a mucous membrane.
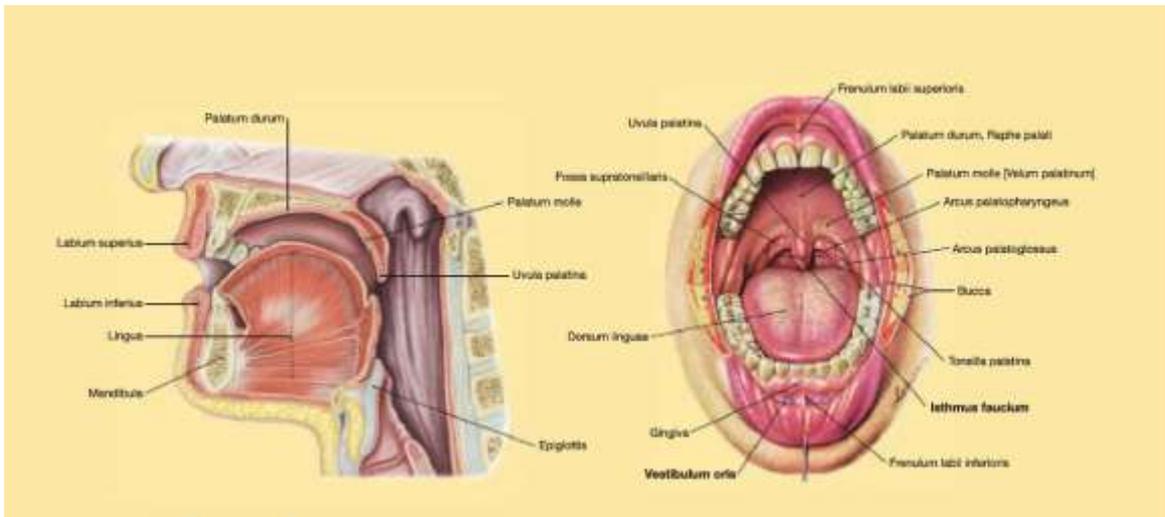

The posterior wall of the vestibule is formed by the teeth and gums (gingiva).

On the inner surface, the upper lip connects to the gum through the upper labial frenulum (frenulum labii superioris), and the lower lip connects through the lower labial frenulum (frenulum labii inferioris).

The lateral walls of the vestibule are formed by the cheeks (buccae).

The cheeks, along with the buccinator muscle (m. buccinator), are covered externally by skin and internally by a mucous membrane.
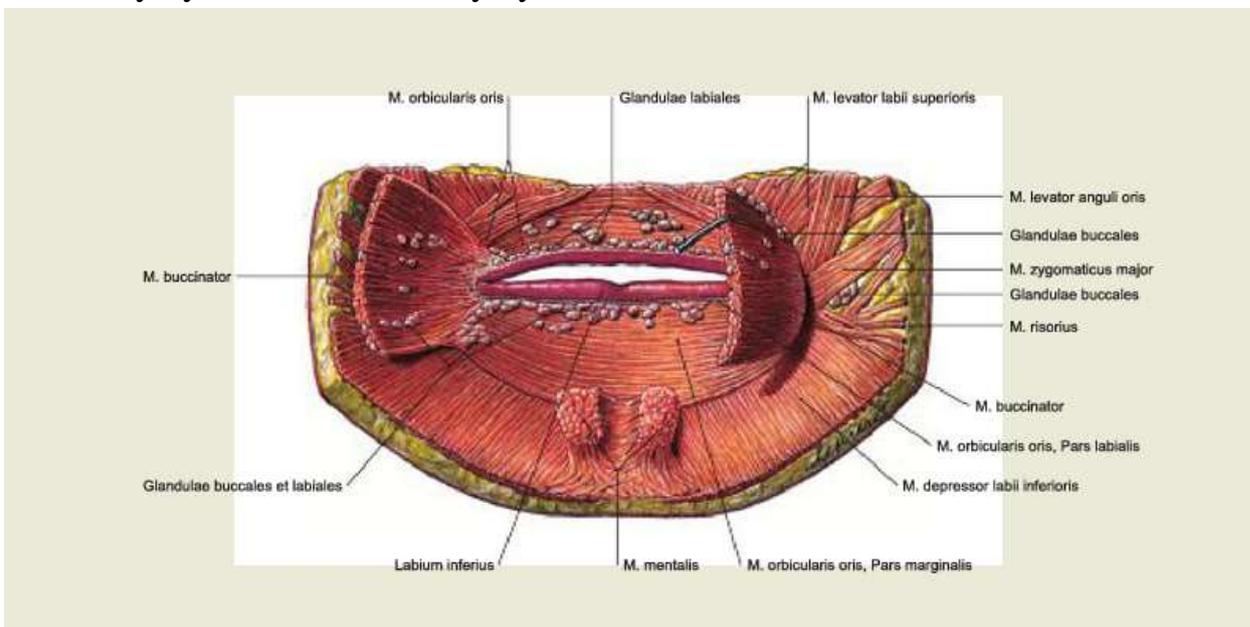
The roof of the oral cavity proper (cavitas oris propria) is formed by the hard and soft palate, while the floor is formed by the oral diaphragm (diaphragma oris), which is filled by the tongue.
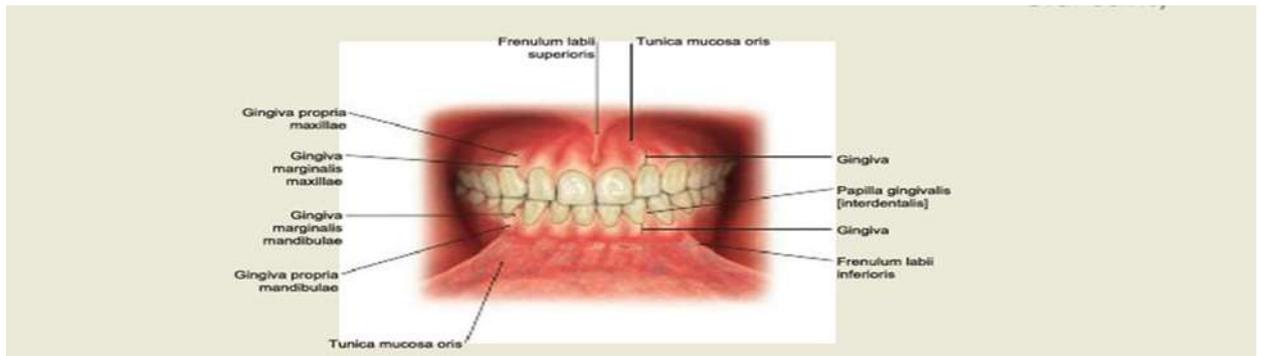
Beneath the tongue lies the lingual frenulum (frenulum linguae), and on each side of it are the sublingual caruncles (caruncula sublingualis), where the ducts of the submandibular and sublingual salivary glands open.

The oral diaphragm (diaphragma oris) is formed by paired mylohyoid muscles (m. mylohyoideus), on top of which the tongue is located.

Palate

The palate (palatum) consists of two parts: the hard palate (palatum osseum or palatum durum) located in the anterior region, and the soft palate (palatum molle) located in the posterior region.
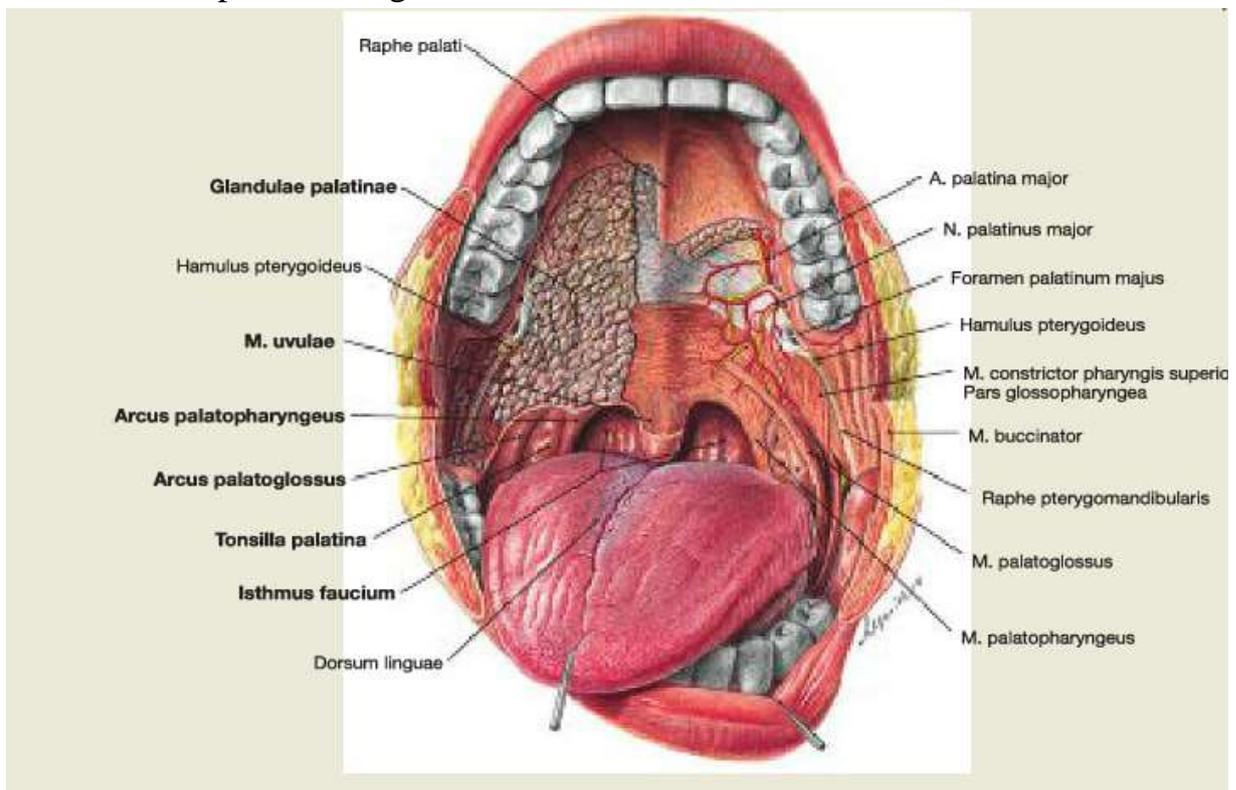
The hard palate is formed by the palatine processes of the maxilla and the horizontal plates of the palatine bones.

In the midline of the hard palate runs the palatine raphe (raphe palatinae), and in the anterior part there are transverse folds (plicae palatinae transversae).

The soft palate (palatum molle) is located posteriorly, hanging freely like a tent, and is called the velum palatinum.

On each side of the soft palate there are two arches:

• The palatoglossal arch (arcus palatoglossus), extending from the palate to the root of the tongue, and

• The palatopharyngeal arch (arcus palatopharyngeus), extending to the wall of the pharynx.

Between these two arches lies the palatine tonsil (tonsilla palatina).
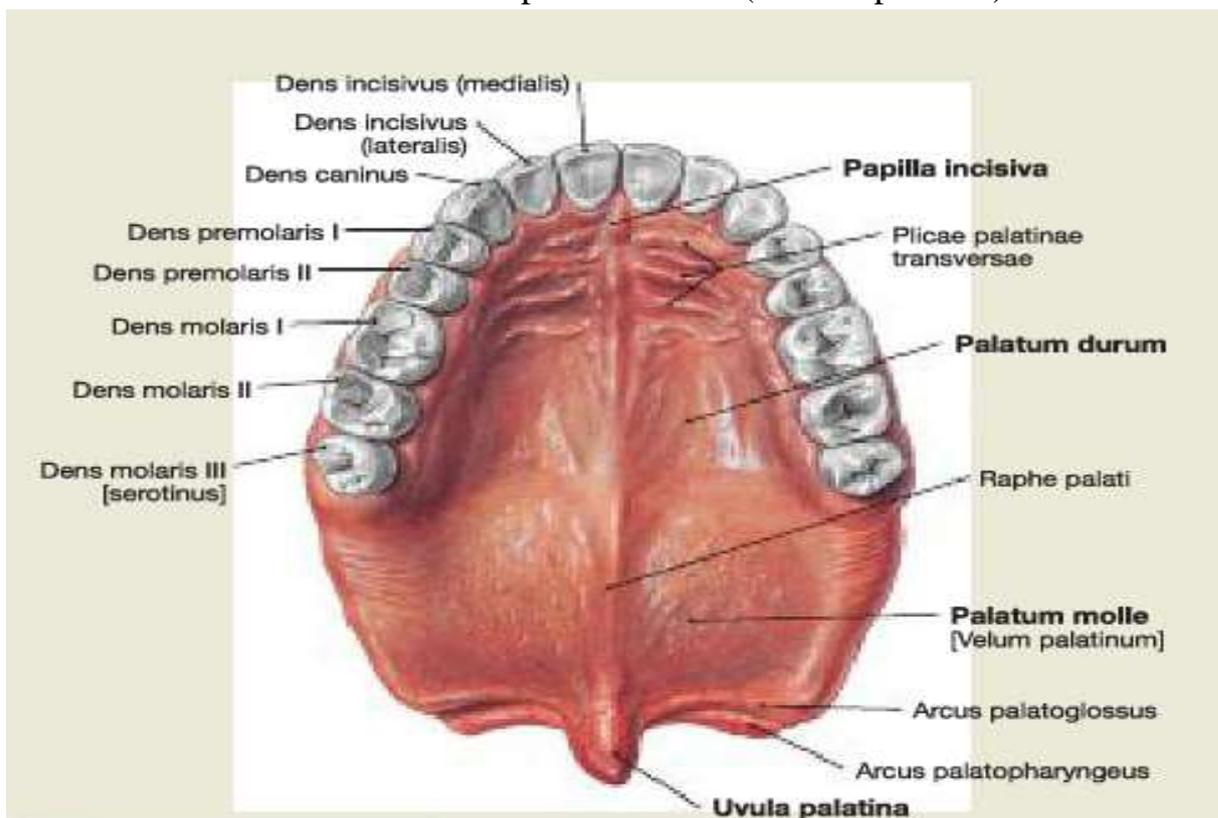
The basis of the soft palate consists of dense connective tissue (aponeurosis palatina) and muscle fibers. The muscles involved in forming the soft palate are striated muscles, including:

1. M. palatopharyngeus (palatopharyngeal muscle):

Forms the palatopharyngeal arch, originates from the soft palate and the pterygoid hamulus (hamulus pterygoideus) of the sphenoid bone, and inserts into the wall of the pharynx.

Its fibers are divided into the anterior bundle (fasciculus anterior) and the posterior bundle (fasciculus posterior).

The posterior bundle forms the palatopharyngeal sphincter muscle (m. sphincter palatopharyngeus).
Function: lowers the soft palate and elevates the pharynx.
2. M. palatoglossus (palatoglossal muscle):
Forms the palatoglossal arch, originates from the soft palate, and attaches to the side of the tongue, continuing with the transverse muscle of the tongue (m. transversus linguae).
Function: pulls the soft palate and tongue toward each other.
3. M. levator veli palatini (levator of the soft palate):
Originates from the base of the skull, near the auditory (Eustachian) tube in the temporal bone, and inserts into the soft palate.
Function: elevates the soft palate.
Innervation: vagus nerve (cranial nerve X).
4. M. tensor veli palatini (tensor of the soft palate):
Originates from the base of the skull, near the auditory tube in the temporal bone.
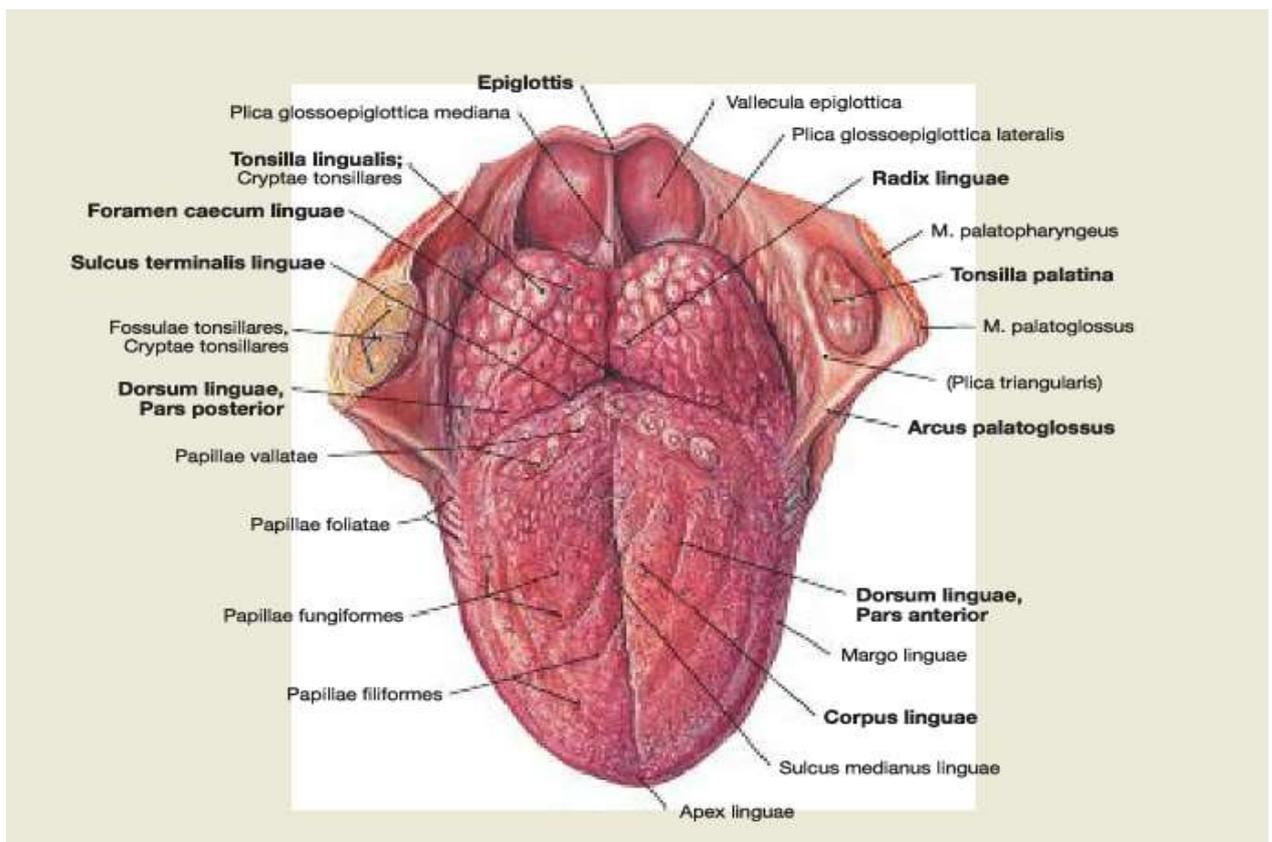Its tendon wraps around the pterygoid hamulus (hamulus processus pterygoidei) of the sphenoid bone and then spreads into the soft palate.
Function: tenses the soft palate.
Innervation: trigeminal nerve (cranial nerve V).
5. M. uvulae (muscle of the uvula):
Hangs freely from the middle of the soft palate.

Originates from the posterior nasal spine (spina nasalis posterior) of the palatine bone and forms the uvula.

Function: shortens the uvula.

The passage from the oral cavity proper into the throat (pharynx) is called the isthmus of the fauces (isthmus faucium).

Its boundaries are:

• Above: the soft palate

• Laterally: the palatoglossal and palatopharyngeal arches

• Below: the root of the tongue

Teeth

Teeth are divided into temporary (deciduous) teeth – dentes decidui and permanent teeth – dentes permanentes.
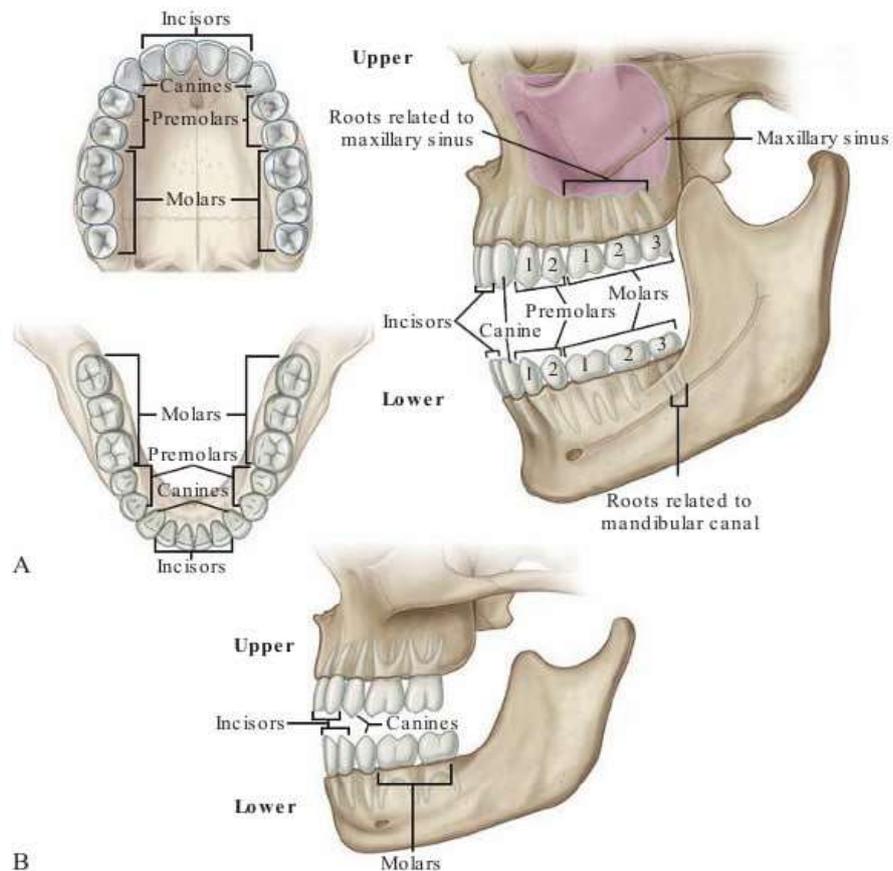
According to their structure and function, teeth are classified into the following groups: incisor tooth – dens incisivus (cutting tooth), canine tooth – dens caninus, premolar tooth – dens premolaris (small molar), and molar tooth – dens molaris (large molar). The third molar (dens molaris tertius) erupts later in life and is

therefore   called   the   "wisdom   tooth"   –   dens   serotinus.
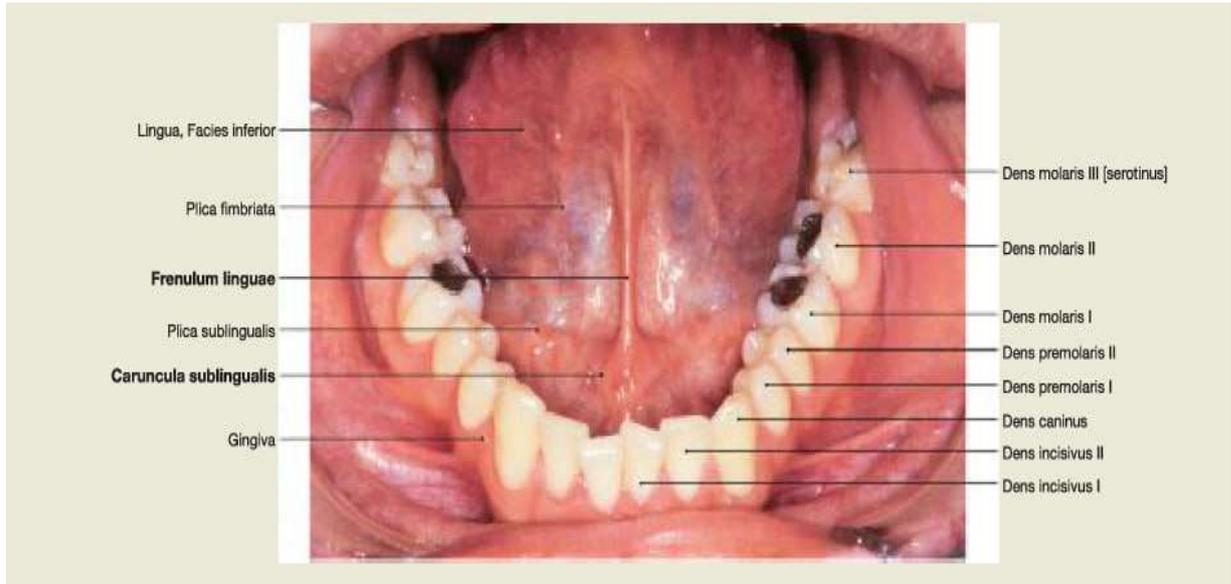
Each tooth consists of three main parts: crown (corona dentis), neck (collum dentis), and root (radix dentis). The crown protrudes above the alveolar process, while the root is embedded in the alveolar socket. The neck region is surrounded by the gum (gingiva). The visible part of the crown above the gum is called the clinical crown (corona clinica), and the part below the gum is known as the clinical root (radix clinica). The tip of the tooth root is the apex radicis dentis, and the small opening at this point is called the foramen apicis, which continues into the root canal – canalis radicis dentis.
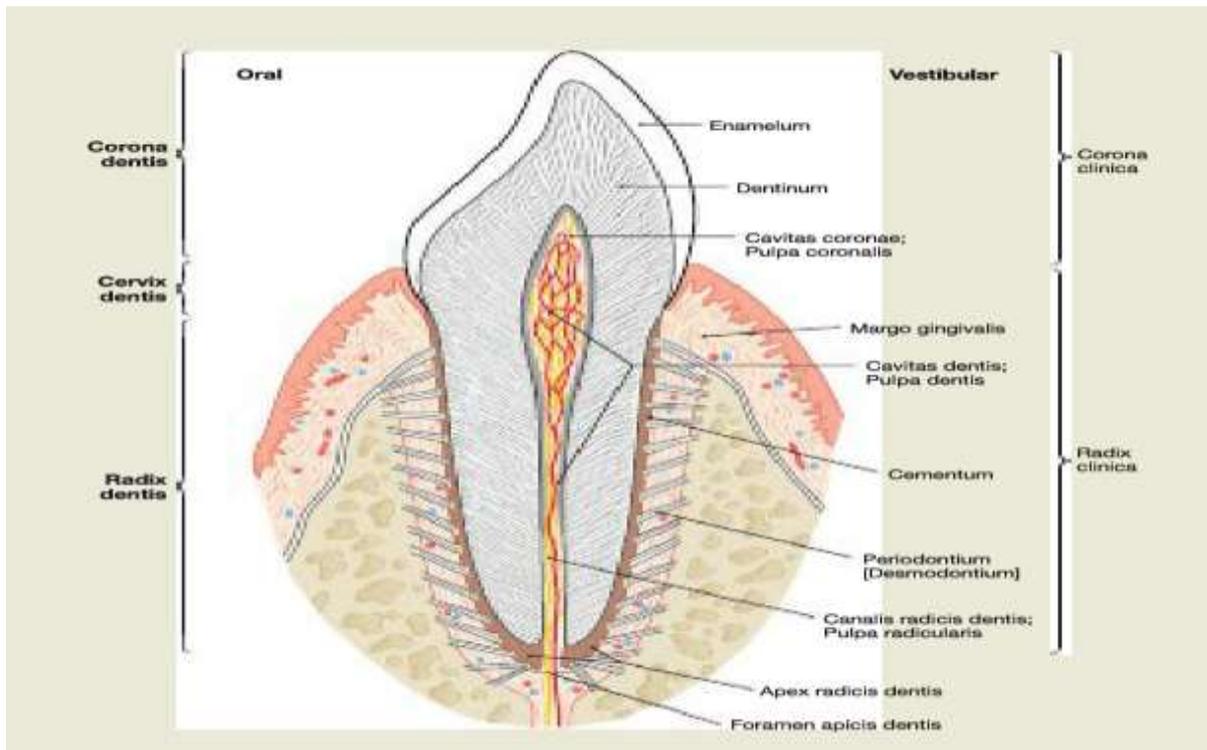
This canal is connected to the pulp cavity – cavitas dentis, which lies within the tooth crown (cavitas coronae) and extends through the root canal. Through the apical foramen, nerves, blood, and lymphatic vessels enter the pulp cavity, forming the dental pulp – pulpa dentis. The pulp is divided into the coronal pulp (pulpa coronalis) and the radicular pulp (pulpa radicularis). The connective tissue between the alveolar bone and the tooth root is called the periodontium. The gum projections between adjacent teeth are called dental papillae – papilla dentis. The main hard substance of the tooth is dentin – dentinum. The crown portion of the tooth is covered by enamel – enamelum, and the root portion by cementum – cementum.
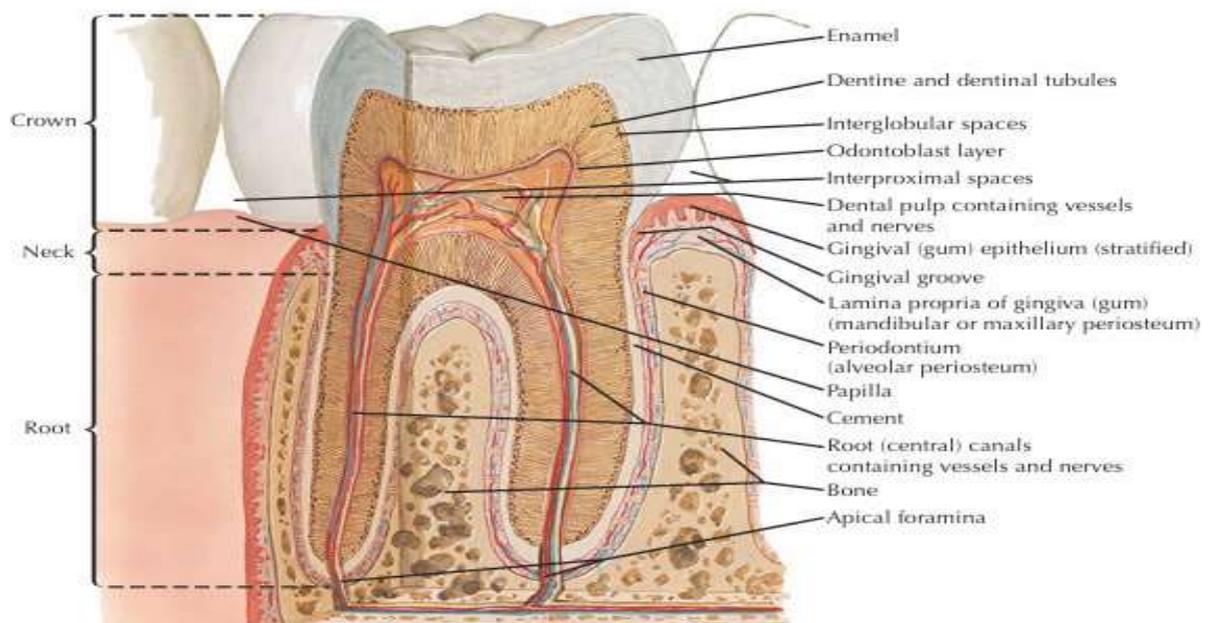
Teeth are arranged in two dental arches – 16 teeth in each jaw – forming the upper dental arch (arcus dentalis maxillaris) and lower dental arch (arcus dentalis mandibularis). Tooth surfaces are named as follows: facies vestibularis – surface facing the vestibule; for incisors and canines – facies labialis (labial surface); for premolars and molars – facies buccalis (buccal surface); facies lingualis – surface facing the tongue; facies palatina – surface facing the palate (for upper teeth); facies contactus – surface contacting adjacent teeth; facies mesialis – surface toward the midline of the dental arch; facies distalis – surface away from the midline. The cusps (cuspis dentis) and ridges (cristae) on the chewing surface – facies occlusalis – help in grinding food. Depending on the location, the cusps are named buccal cusp cuspis

buccalis, palatal cusp – cuspis palatinalis, and lingual cusp – cuspis lingualis.
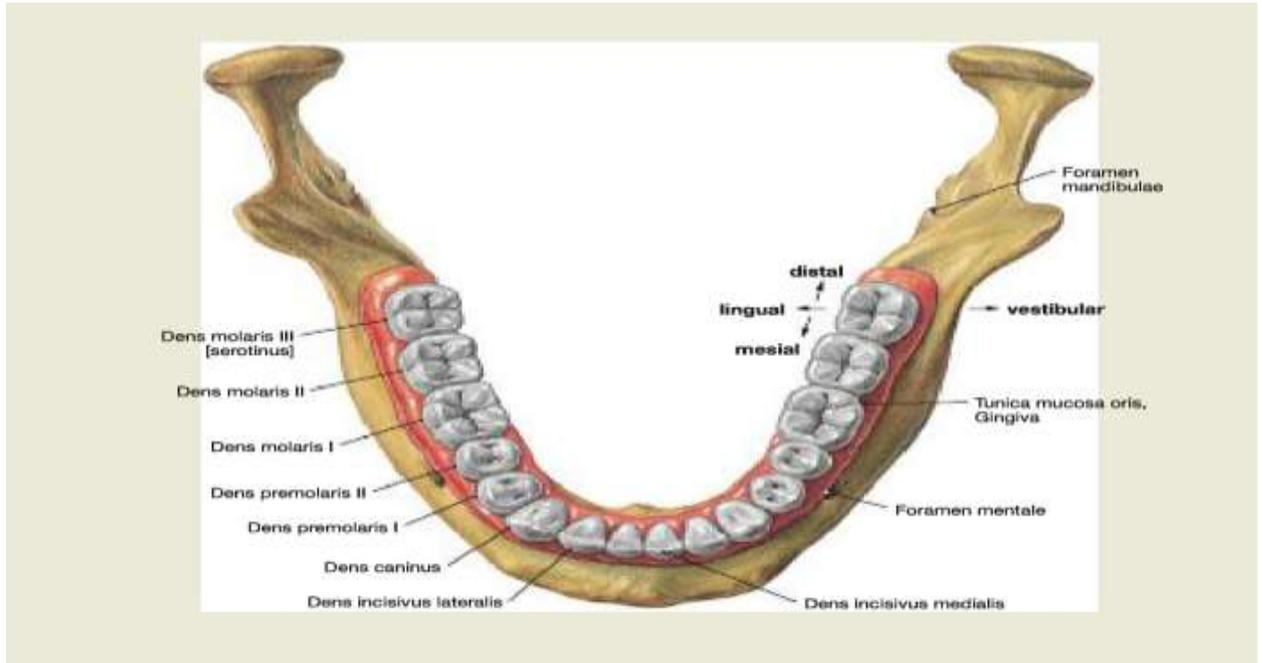
The occlusal surface contains ridges such as the transverse ridge (crista transversalis), triangular ridge (crista triangularis), and oblique ridge (crista obliqua). Between them lie fissures (fissurae occlusales) and pits (fossae occlusales). The number and position of tooth roots vary: incisors (dentes incisivi) – 4 in each jaw, each with one root; canines (dentes canini) – 2 in each jaw, each with one long root; premolars (dentes premolares) – 4 in each jaw, may have one or two roots; molars (dentes molares) – 6 in each jaw, upper molars usually have 3 roots (2 buccal, 1 palatal), while lower molars have 2 roots (1 mesial, 1 distal). The last molar (dens serotinus) is the wisdom tooth, which erupts much later. Sometimes, gaps between teeth occur, called diastema. Teeth are divided into temporary (deciduous) teeth – dentes decidui (dentes lactei) and permanent teeth – dentes permanentes. Deciduous teeth remain until they are replaced by permanent ones. Each jaw has 10 deciduous teeth: 4 incisors, 2 canines, and 4 molars (no premolars or third molars). The total number of deciduous teeth is 20, and permanent teeth – 32.

Dental formulae: deciduous teeth – 2.1.0.2; permanent teeth – 2.1.2.3. Eruption timetable: deciduous teeth – central incisors (6–8 months), lateral incisors (7–9 months), first molars (12–15 months), canines (16–20 months), second molars (20–24 months). Permanent teeth – first molars (6–7 years), central incisors (8 years), lateral incisors (9 years), first premolars (10 years), canines (11–13 years), second premolars (11–15 years), second molars (13–16 years), third molars or wisdom teeth (18–30 years). The first molars are the earliest permanent teeth to erupt, appearing behind the deciduous molars. Deciduous incisors and canines are replaced by permanent ones, while deciduous molars are replaced by permanent premolars. When the upper and lower dental arches meet, the upper incisors slightly overlap the lower incisors.
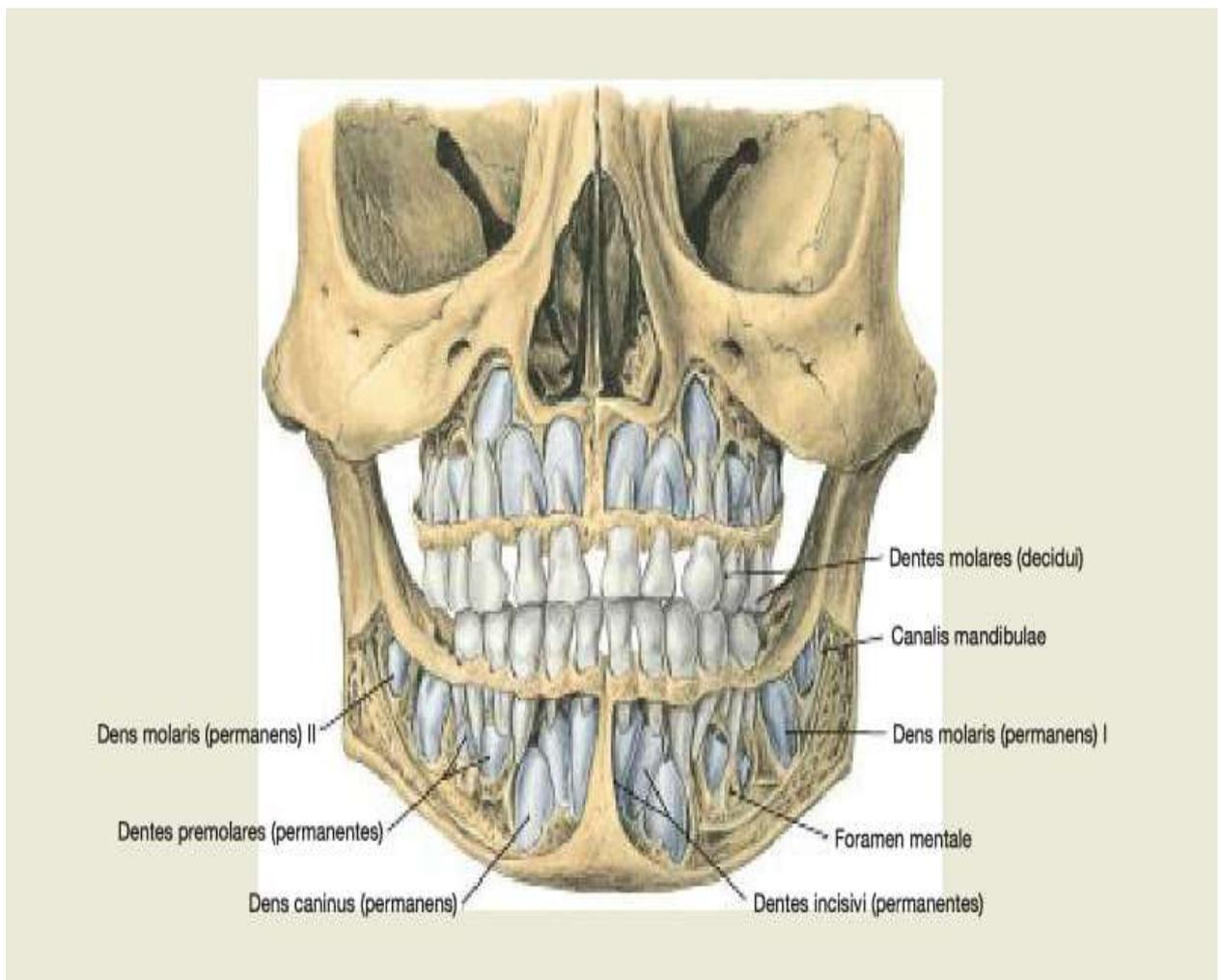
This contact between upper and lower teeth is called occlusion (pricus). Each lower tooth normally contacts two upper teeth – its antagonists – except for the lower central incisors and upper third molars, which have only one antagonist. The term articulation refers to the relationship between the upper and lower teeth during mandibular movement.

Tongue

The tongue is an organ composed of striated skeletal muscles. Its middle part is called the body – corpus linguae, the anterior portion forms the apex (tip), and the posterior portion forms the root – radix linguae.
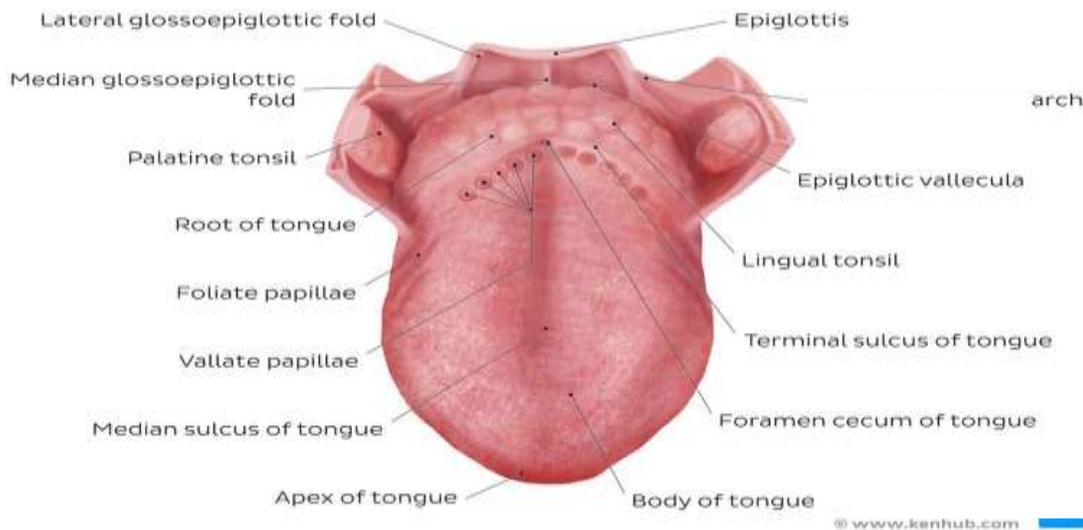
Between the body and the root lies a small depression called the foramen cecum linguae, from which a transverse groove, the sulcus terminalis, extends laterally. The upper surface is the dorsum linguae, which is divided by this groove into the anterior part – pars anterior and the posterior part – pars posterior. The lower surface, facies inferior linguae, bears mucosal folds called plicae fimbriatae. The lateral borders are known as margo linguae, and the median groove running along the midline is called the sulcus medianus linguae. At the root of the tongue lies the lingual tonsil – tonsilla lingualis, formed by lymphoepithelial tissue. Folds of mucosa connect the root of the tongue with the epiglottis: the median glossoepiglottic fold – plica glossoepiglottica mediana and the lateral glossoepiglottic folds – plicae glossoepiglotticae laterales. The upper surface is covered by a mucous membrane – tunica mucosa linguae, and on the underside lies the lingual frenulum – frenulum linguae. Filiform and conical papillae – papillae filiformes et conicae are located on the anterior part of the dorsum; they serve tactile sensory functions.
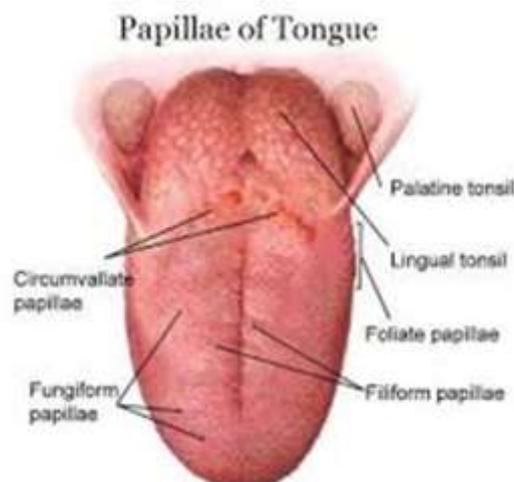
Fungiform papillae – papillae fungiformes are mushroom-shaped,

found on the tip and sides of the tongue; they contain taste buds.

Foliate papillae – papillae foliatae are arranged in folds along the lateral borders.

Vallate papillae – papillae vallatae, 7–12 in number, are located anterior to the foramen cecum, forming a V-shaped row with their apices directed posteriorly.

A connective tissue septum called the septum linguae divides the tongue into two halves.
At its base, a dense fibrous layer, the aponeurosis linguae, provides attachment for the tongue muscles.

Muscles of the Tongue

The tongue muscles are divided into intrinsic (proper) and extrinsic (skeletal) muscles. The extrinsic muscles originate from bones and continue into the intrinsic muscles.

(a) Extrinsic tongue muscles   (b) Palatoglossus and surface of tongue
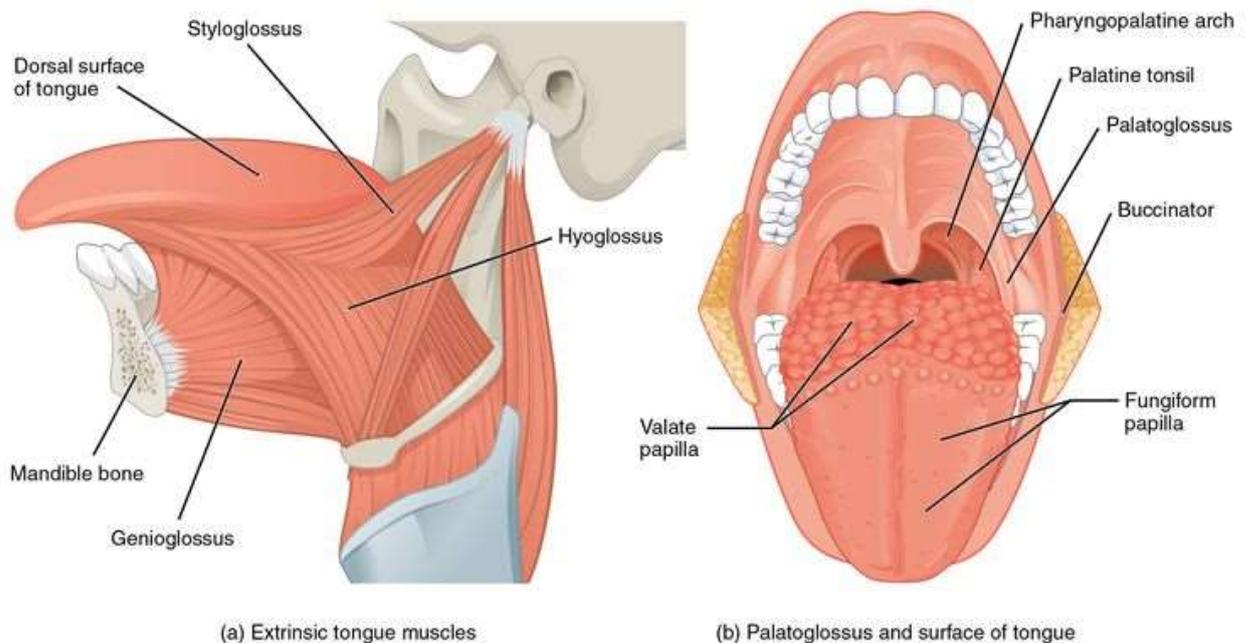
M. genioglossus (Genioglossus muscle) – arises from the mental spine of the mandible (spina mentalis) and continues into the vertical intrinsic muscle – m. verticalis.
Function:draws the tongue forward.
Origin:first branchial arch.
Innervation: hypoglossal nerve (n. hypoglossus, XII).

M. styloglossus (Styloglossus muscle) – arises from the styloid process (processus styloideus) of the temporal bone and continues into the superior and inferior

longitudinal intrinsic muscles – mm. longitudinales superior et inferior.
Function: pulls the tongue upward and backward.
Origin: second branchial arch.
Innervation: n. hypoglossus (XII).

M. hyoglossus (Hyoglossus muscle) – arises from the body and greater horns of the hyoid bone, and continues into the transverse intrinsic muscle – m. transversus linguae. It has two parts: m. chondroglossus (from the cartilage of the hyoid) and m. ceratoglossus (from the horn of the hyoid).
Function: retracts and depresses the tongue.
Origin: third branchial arch.
Innervation: n. hypoglossus (XII).

M. palatoglossus (Palatoglossus muscle) – arises from the soft palate and attaches to the side of the tongue, continuing into the transverse intrinsic muscle – m. transversus linguae.
Function: lowers the soft palate, narrows the oropharyngeal isthmus, and assists in tongue movement.

Salivary glands

The salivary glands open into the oral cavity and are divided into major salivary glands, which have excretory ducts, and minor glands, which do not. **The major salivary glands** include the parotid gland (glandula parotoidea), the sublingual gland (glandula sublingualis), and the submandibular gland (glandula submandibularis). **The minor salivary glands** are located on the surface of the lips
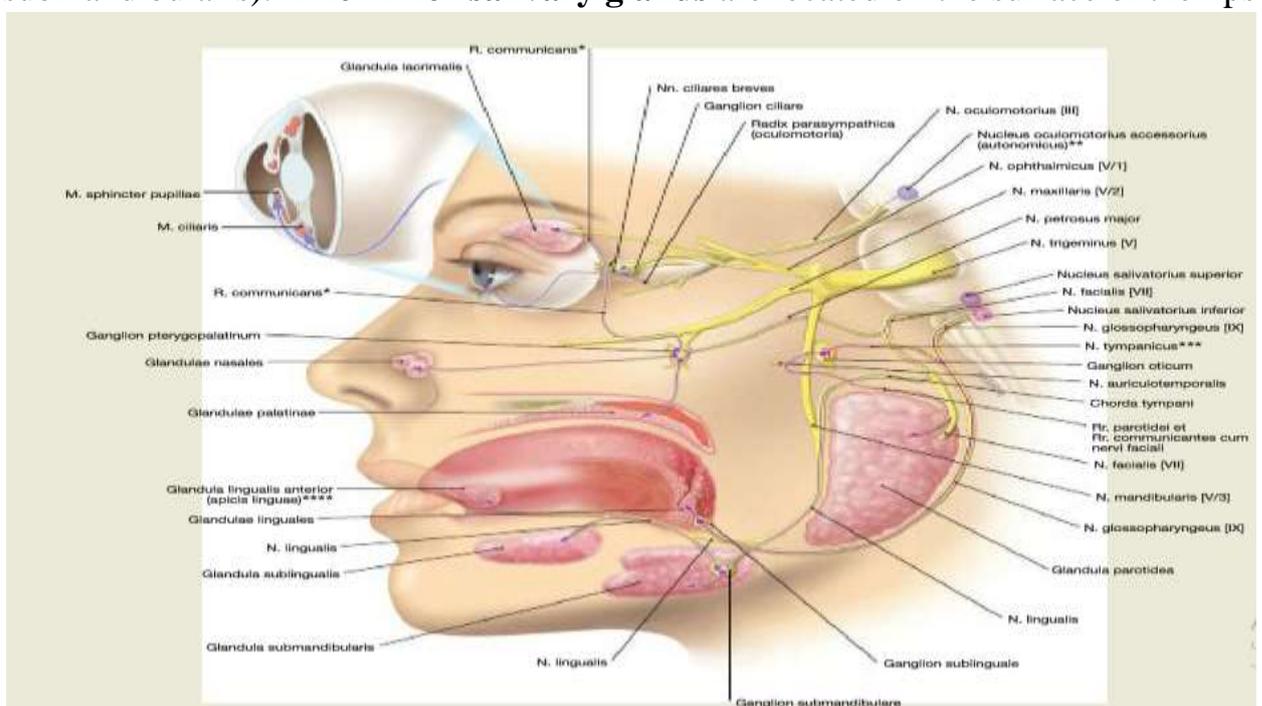
(glandulae labiales), in the cheek region (glandulae buccales), on the palate (glandulae palatinae), and on the tongue (glandulae linguales).

The minor glands open directly onto the surface where they are located, while the major salivary glands open into the oral cavity through ducts. The parotid gland (glandula parotoidea) is located in the lateral region of the face, in front of the auricle. The duct of the parotid gland (ductus parotoideus) passes through the buccinator muscle (m. buccinator) and opens into the oral vestibule opposite the second upper molar tooth. The parotid gland has a superficial part (pars superficialis) and a deep part (pars profunda). Sometimes, an accessory gland (glandula parotoidea accessoria) may also be present. The submandibular gland (glandula submandibularis) is located in the submandibular fossa (fossa submandibularis) beneath the lower jaw. The duct of this gland (ductus submandibularis) opens into the oral cavity proper at the sublingual caruncle (caruncula sublingualis) beneath the tongue. The sublingual gland (glandula sublingualis) is located under the tongue, above the mylohyoid muscle (m. mylohyoideus). Its main duct (ductus sublingualis major) opens into the oral cavity proper near the duct of the submandibular gland. The small ducts of the sublingual gland (ductus sublinguales minores, 18–20 in number) open along the sublingual fold (plica sublingualis) beneath the tongue.

Pharynx

Pharynx — the pharynx is the part where the digestive and respiratory systems intersect. It begins at the base of the skull and continues to the level of the 6th–7th cervical vertebrae. The pharynx is located between the oral cavity and the larynx.

Therefore, it is divided into three parts: the nasal part (pars nasalis), the oral part (pars oralis), and the laryngeal part (pars laryngea). The portion corresponding to the base of the skull is called the pharyngeal vault (fornix pharyngis). The nasal part of the pharynx lies between the base of the skull and the soft palate. The choanae — openings that connect the nasal cavity to the pharynx — open into this part.

The auditory tube (tuba auditiva or Eustachian tube), which connects the middle ear cavity with the pharynx,
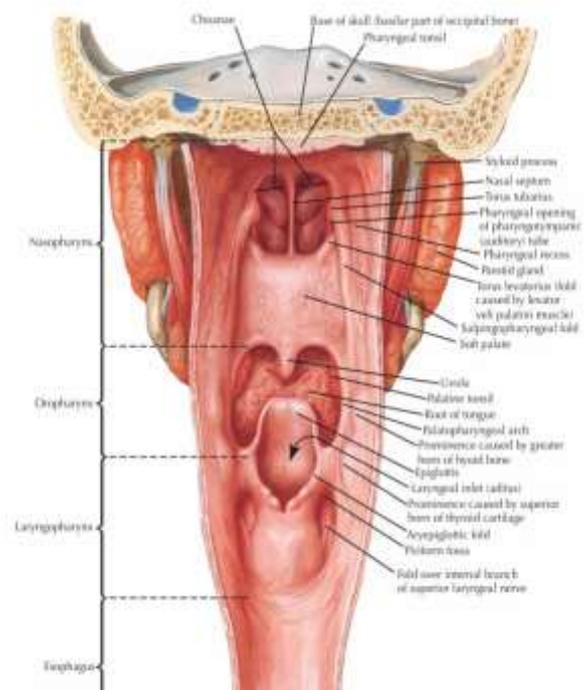
also opens here at the pharyngeal opening (ostium pharyngeum tubae). The mucous membrane around this opening contains lymphoepithelial tissue known as the tubal tonsil (tonsilla tubaria). A similar accumulation of tissue forms the pharyngeal tonsil (tonsilla pharyngea) in the roof of the pharynx. The small pits of the tonsils are called fossulae tonsillae, and the grooves inside them are cryptae tonsillae. Together with the palatine tonsils (tonsillae palatinae) and lingual tonsil (tonsilla lingualis), they form the lymphoepithelial ring. In the region of the auditory tube, two folds can be seen: the salpingopharyngeal fold (plica salpingopharyngea) and the salpingopalatine fold (plica salpingopalatina), as well as the torus tubarius — a prominence formed by the auditory tube. Another prominence, torus levatorius, is formed by the levator veli palatini muscle. In the oral part of the pharynx, the epiglottic vallecula (vallecula epiglottica) lies between the epiglottis and the tongue, bounded by the lateral and median glossoepiglottic folds (plica glossoepiglottica lateralis et mediana).
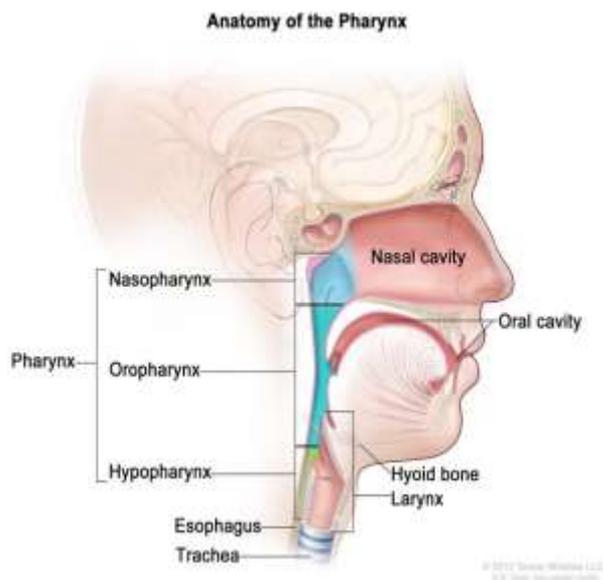
Anatomy of the Pharynx

Nasal cavity
Oral cavity
Nasopharynx
Oropharynx
Pharynx
Hypopharynx
Hyoid bone
Larynx
Esophagus
Trachea

In the laryngeal part, the piriform recesses (recessus piriformis) are found. The narrowed junction between the pharynx and esophagus is called the pharyngoesophageal constriction (constrictio pharyngoesophagealis). The wall of the pharynx consists of a fibrous layer covered internally by mucosa and externally by a muscular layer, which is enveloped by fascia. The mucosa is lined by ciliated epithelium in the nasal region, and by stratified squamous epithelium with mucous glands elsewhere. The pharyngeal muscles are made of striated fibers and divided into constrictor and longitudinal groups. The constrictor muscles include three layers: the superior, middle, and inferior constrictors (m. constrictor pharyngis superior, medius, and inferior). The superior constrictor has several parts: pars pterygopharyngea (arising from the pterygoid processes), pars buccopharyngea (from the pterygomandibular raphe), and pars mylopharyngea (from the mylohyoid line of the mandible). The middle constrictor arises from the hyoid bone: pars chondropharyngea (from the body) and pars ceratopharyngea (from the greater horns). The inferior constrictor originates from the thyroid and cricoid cartilages: pars thyropharyngea and pars cricopharyngea. These muscles constrict the pharynx during swallowing. The longitudinal muscles include m. stylopharyngeus (from the styloid process), m. salpingopharyngeus (from the auditory tube), and m.

palatopharyngeus (from the soft palate and pterygoid process). Their function is to elevate and shorten the pharynx during swallowing. The innervation is provided mainly by the glossopharyngeal nerve (n. glossopharyngeus, IX) and the vagus nerve (n. vagus, X). The tonsils (tonsillae) are lymphoid tissues located in the mucosa of the pharynx. The pharyngeal lymphoid ring, or Pirogov–Waldeyer ring, consists of the paired palatine and tubal tonsils and the unpaired pharyngeal and lingual tonsils. The palatine tonsils (tonsillae palatinae) are located in the tonsillar fossa between the palatoglossal and palatopharyngeal arches (arcus palatoglossus and arcus palatopharyngeus). The pharyngeal tonsil (tonsilla pharyngea) lies in the upper wall of the nasal part of the pharynx. The tubal tonsils (tonsillae tubariae) are found near the openings of the auditory tubes. The lingual tonsil (tonsilla lingualis) is situated in the mucosa at the root of the tongue

Esophagus

The esophagus is the continuation of the pharynx and extends to the stomach. It is located from the level of the sixth cervical vertebra to the eleventh thoracic vertebra, with an average length of 23–25 cm. The esophagus is divided into three parts: the cervical part (pars cervicalis), the thoracic part (pars thoracica), and the abdominal part (pars abdominalis).
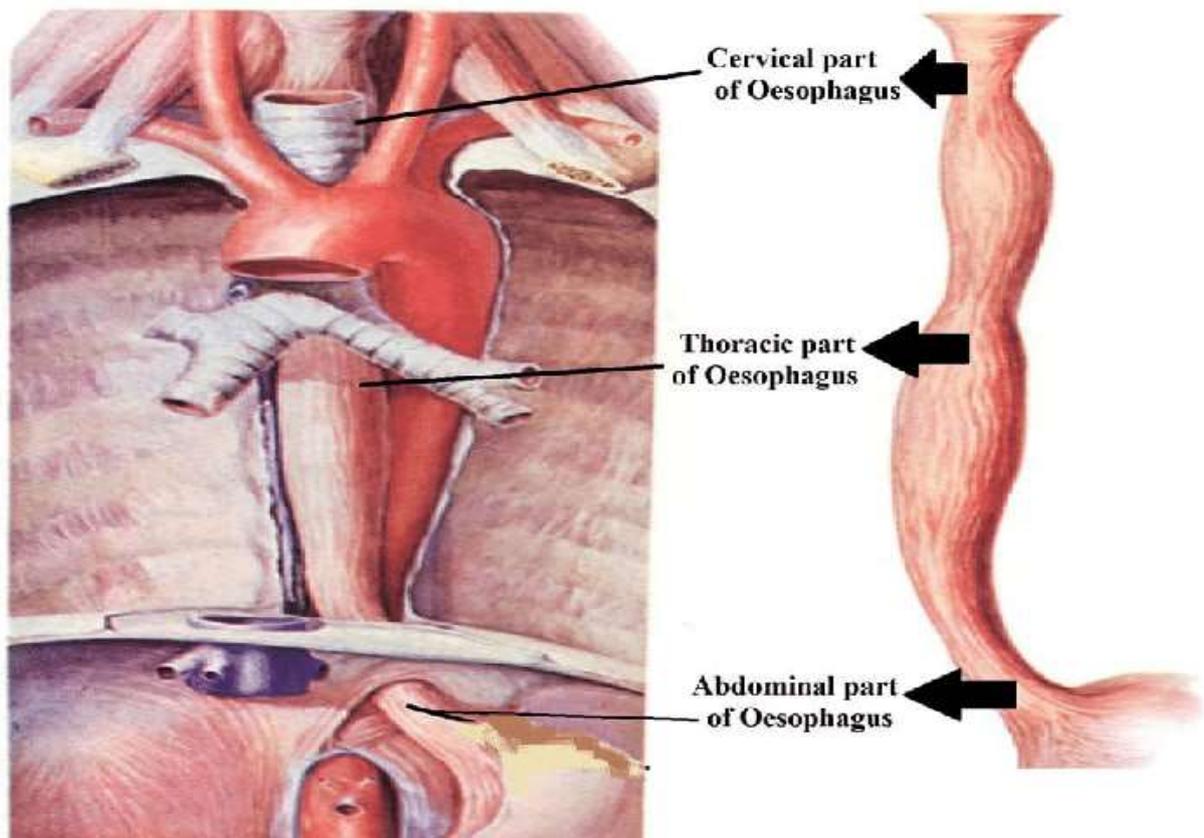
The cervical part lies in the neck region, the thoracic part extends through the thoracic cavity to the diaphragm, and the abdominal part lies below the diaphragm. The esophageal lumen does not have the same diameter throughout; there are certain constrictions. Anatomical constrictions of the esophagus occur in the following regions:

(1) at the junction of the pharynx and esophagus – the pharyngoesophageal constriction (constrictio pharyngooesophagealis);

(2) at the level where the trachea divides into the main bronchi – the bronchial constriction (constrictio bronchialis);

(3) where the esophagus passes through the diaphragm – the diaphragmatic constriction (constrictio phrenica).
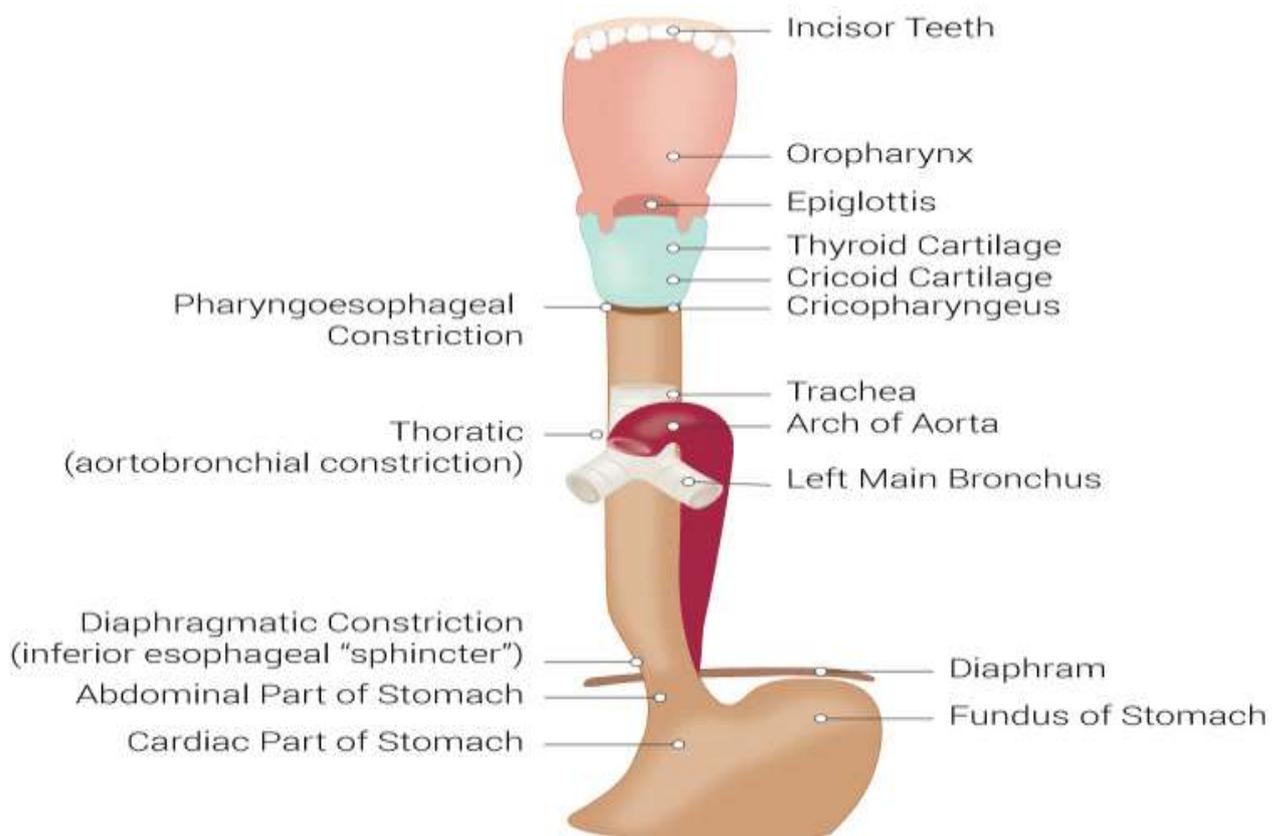
Physiological constrictions are also present:

the aortic constriction – where the esophagus crosses the aorta; (2) the cardiac constriction – at the junction between the esophagus and the stomach. The esophageal wall consists of four layers: (1) the mucous membrane (tunica mucosa), which lines the inner surface and contains numerous mucus-secreting glands (glandulae oesophageae); (2) the submucosal layer (tela submucosa), which allows

the mucosa to form folds; (3) the muscular layer (tunica muscularis), composed of striated muscle fibers in the upper part and smooth muscle fibers in the lower part. It consists of two layers: an outer longitudinal layer and an inner circular layer. The main muscles associated with the esophagus include the cricoesophageal tendon (tendo cricooesophageus) arising from the cricoid cartilage, the bronchoesophageal muscle (m. bronchooesophageus) originating from the bronchi, and the pleuroesophageal muscle (m. pleurooesophageus) originating from the pleura. (4) The outer surface of the esophagus (tunica adventitia) is covered by connective tissue. The abdominal part of the esophagus is externally covered by the peritoneum. In adults, the esophagus is about 23–25 cm long. The distance from the incisor teeth to the esophagus is about 15–17 cm, and the total distance from the incisor teeth to the stomach is approximately 40–42 cm.

Stomach

Stomach – Ventriculus or Gaster The stomach is an organ located in the upper part of the abdominal cavity, mostly on the left side. Its anterior wall is called *paries anterior*, and its posterior wall is called *paries posterior*.
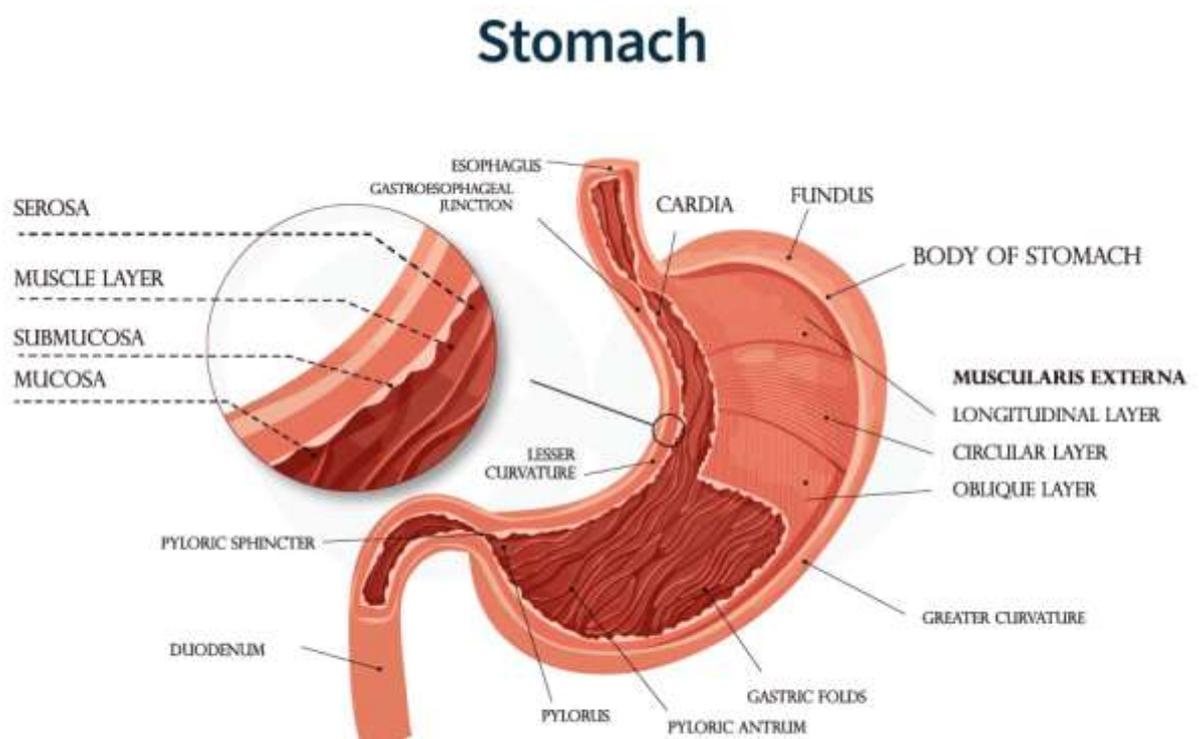
The area where the stomach connects with the esophagus is called the cardiac part (*pars cardiaca*), and the opening through which the esophagus enters the stomach is

the cardiac orifice (*ostium cardiacum*). The part where the stomach continues into the duodenum is the pyloric part (*pars pylorica*), and the opening there is the pyloric orifice (*ostium pyloricum*). The fundus or fornix is the dome-shaped upper part of the stomach directed toward the left. The region between the fundus and the pyloric part is the body of the stomach (*corpus ventriculi*). The portion of the pyloric part closer to the body expands into the antrum pyloricum, while the section leading into the duodenum is called the pyloric canal (*canalis pyloricus*).
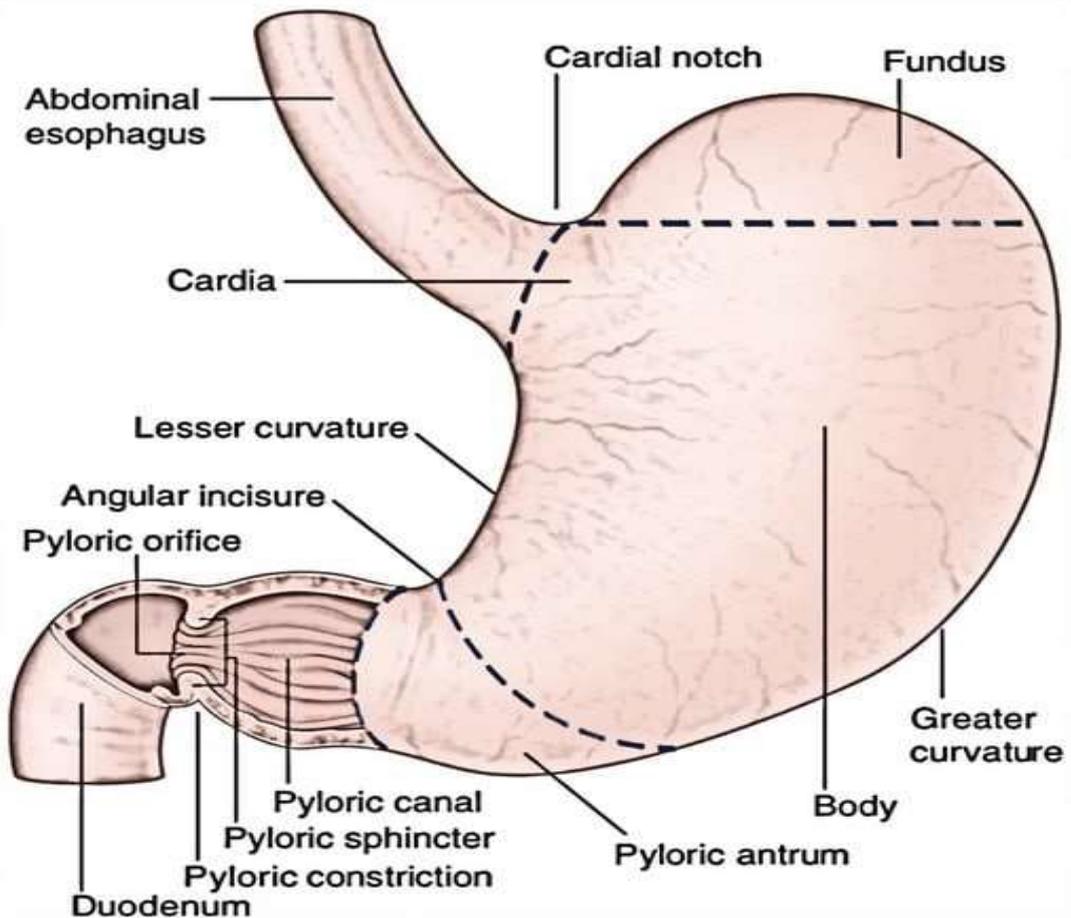
The lesser curvature (*curvatura ventriculi minor*) is the upper and right border of the stomach, and the greater curvature (*curvatura ventriculi major*) is the convex lower and left border. At the junction between the body and pyloric part, the two curvatures form the angle of the stomach (*angulus ventriculi*), which has a notch called the angular incisure (*incisura angularis*). The stomach wall consists of four layers: (1) **Mucous membrane – Tunica mucosa:** Forms folds (*plicae gastricae*). Contains gastric glands that secrete gastric juice (*succus gastricus*). According to location, the glands are divided into: *glandulae cardiacae* (in the cardiac region), *glandulae gastricae propriae* (in the body and fundus; composed of chief cells producing pepsinogen and parietal cells producing hydrochloric acid), and *glandulae pyloricae* (in the pyloric region, consisting mainly of chief cells). Also contains gastric

lymphatic follicles (*folliculi lymphatici gastrici*) and a thin muscle layer called *lamina muscularis mucosae*. The surface has gastric areas (*areae gastricae*) with gastric pits (*foveolae gastricae*) opening to glands. (2) **Submucosa – Tela submucosa:** Forms folds on the inner surface. Along the lesser curvature, these folds run longitudinally, forming the gastric canal (*canalis gastricus*), which connects the cardiac and pyloric orifices. The folds at the pyloric opening form a valve-like structure (*valvula pylorica*) separating the stomach and duodenum. (3) **Muscular layer – Tunica muscularis:** Composed of smooth muscle fibers arranged in three layers—outer longitudinal (*stratum longitudinale*), middle circular (*stratum circulare*), and inner oblique (*fibrae obliquae*). The circular fibers are well developed at the pylorus, forming the pyloric sphincter muscle (*m. sphincter pylori*), which regulates the passage of food into the duodenum. (4) **Serous layer – Tunica serosa:** Represents the visceral layer of the peritoneum.
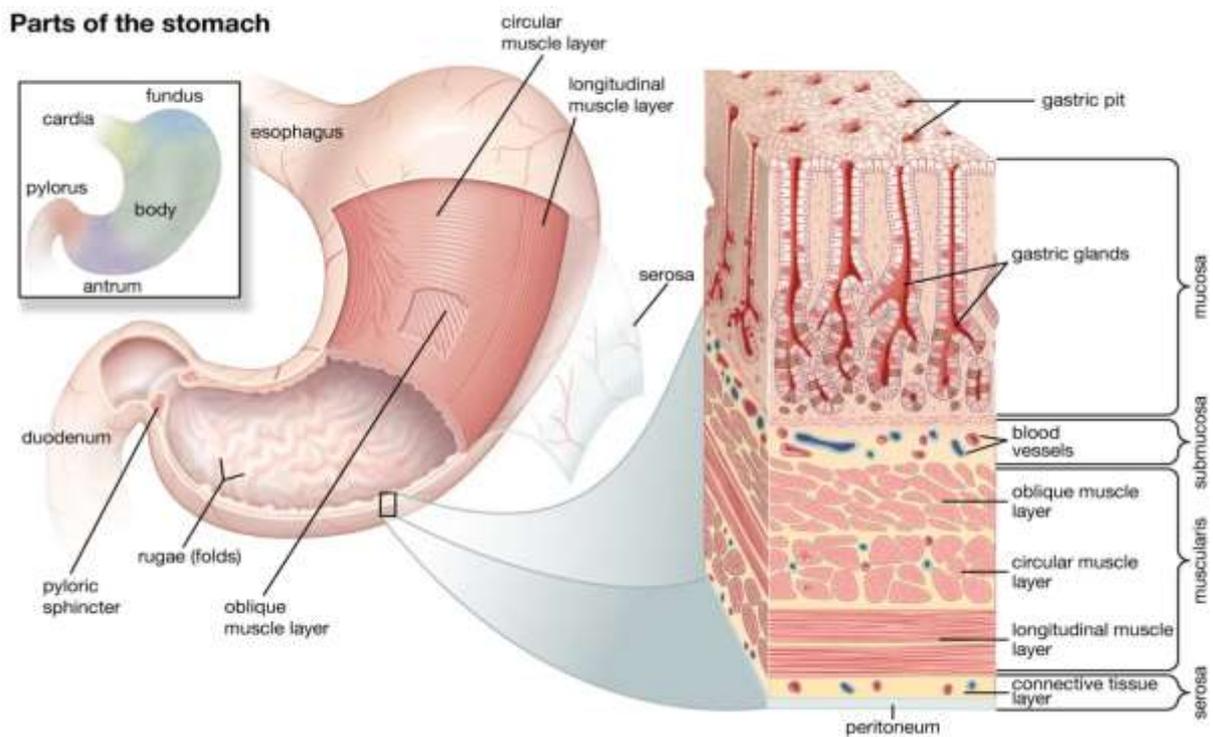
Forms several ligaments: *ligamentum hepatogastricum* (between liver and lesser curvature), *ligamentum gastrolienale* (between stomach and spleen), and *ligamentum gastrocolicum* (between stomach and transverse colon). Since the stomach is completely covered by the peritoneum, it is classified as an intraperitoneal organ.

Small intestine

Small intestine – Intestinum tenue The small intestine begins at the exit part of the stomach and ends in the initial section of the large intestine located in the right iliac

region. In the small intestine, the chemical digestion of food continues under the influence of digestive juices, and absorption occurs. The main function of the small intestine is to ensure the absorption of digested nutrients into the blood and lymph. Its length is 7–9 meters, which is 3–4 times longer than the human body. The small intestine consists of three parts: the duodenum, the jejunum, and the ileum. The duodenum (*duodenum*), about 25–30 cm long, is the initial part of the small intestine. Two-fifths of the remaining length is formed by the jejunum (*jejunum*), and three-fifths by the ileum (*ileum*). The duodenum is considered an *extraperitoneal* organ, meaning only its anterior surface is covered by the peritoneum. It lies against the posterior abdominal wall and has a C-shaped (horseshoe) form. Its upper part (*pars superior*) continues downward as the descending part (*pars descendens*) through the superior bend (*flexura duodeni superior*). The descending part continues as the horizontal part (*pars horizontalis*) through the inferior bend (*flexura duodeni inferior*), and then as the ascending part (*pars ascendens*). The transition from the duodenum to the jejunum forms the duodenojejunal flexure (*flexura duodenojejunalis*).
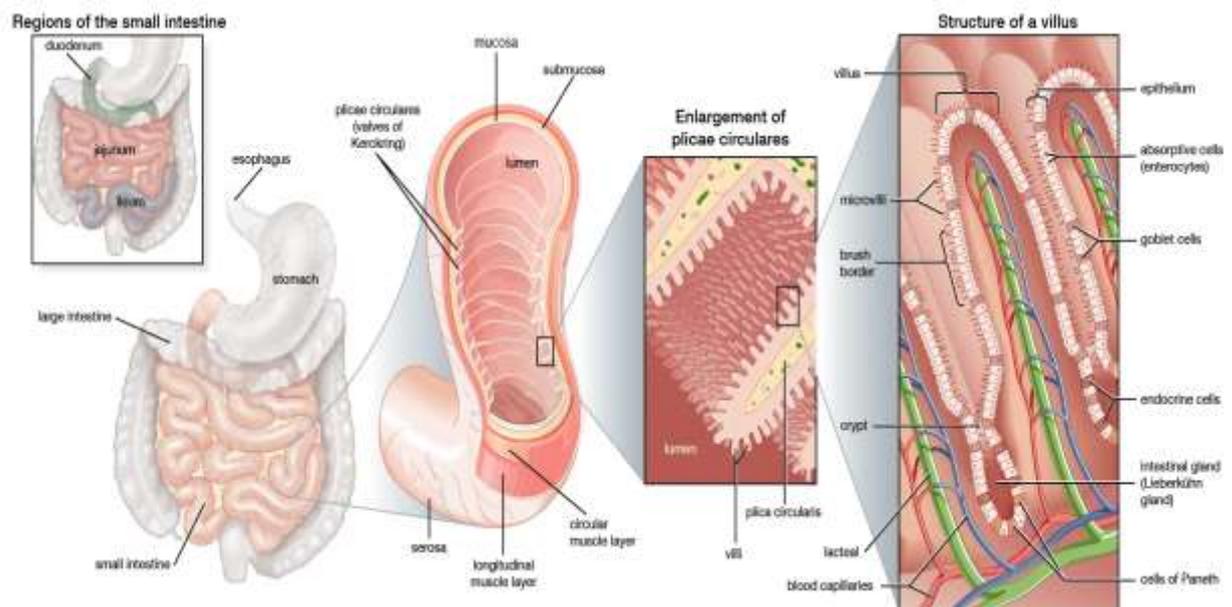
The jejunum and ileum are completely surrounded by the peritoneum, thus they are *intraperitoneal* organs. The wall of the small intestine consists of the following layers: mucous membrane (*tunica mucosa*), submucosa (*tunica submucosa*), muscular layer (*tunica muscularis*), and serous membrane (*tunica serosa*). The mucous membrane of the small intestine contains numerous villi (*villi intestinales*), which greatly increase the absorptive surface. The villi are covered with enterocytes and goblet cells, reaching up to 1 mm in length. On one square millimeter of the jejunal surface, there are 22–40 villi, while in the ileum there are 18–30 per square

millimeter. The total surface area of all intestinal villi is 4–5 square meters, 2–3 times greater than the surface area of the skin.
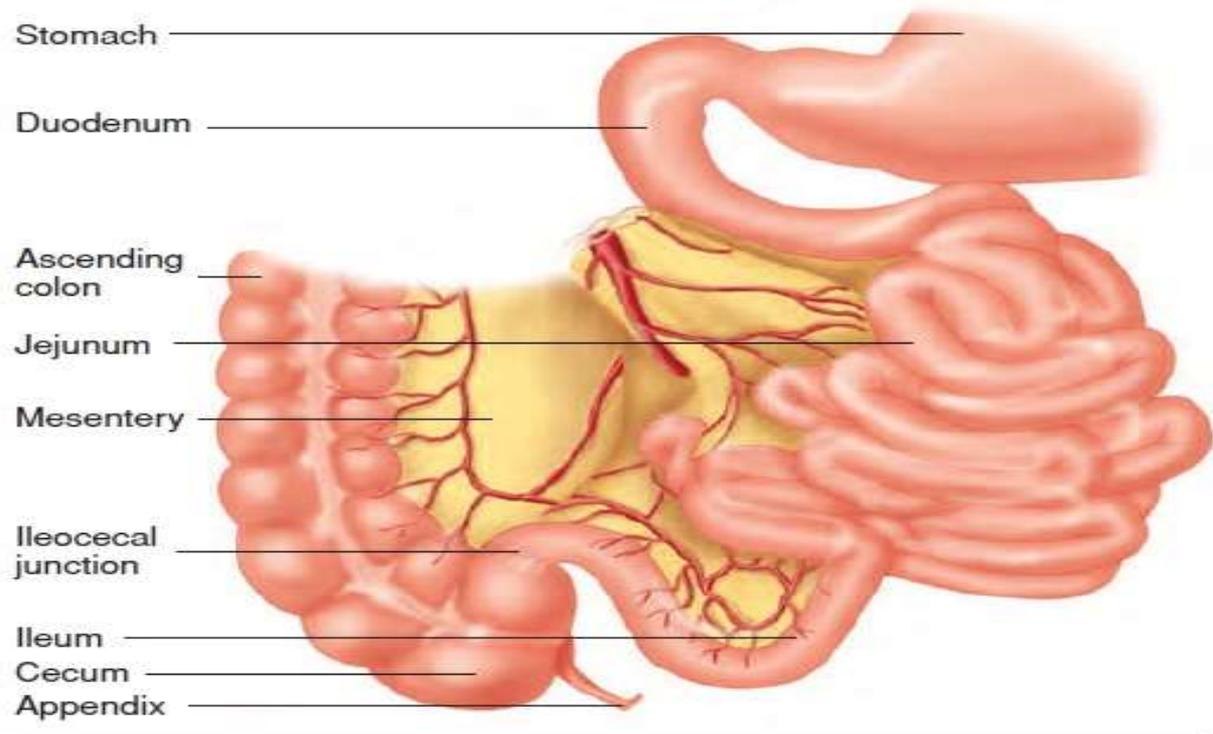
Each villus is covered by microvilli visible under an electron microscope, which further enhance absorption. Inside each villus are blood and lymph vessels. The number of villi is greater in the jejunum, where they are thinner but longer. The mucous membrane also contains smooth muscle fibers called *lamina muscularis mucosae*. Circular folds (*plicae circulares*) are formed by both the mucosa and submucosa (*tela submucosa*). In the duodenum, additional longitudinal folds (*plica longitudinalis duodeni*) appear on the inner medial surface. On these folds are found the major duodenal papilla (*papilla duodeni major*) and, slightly above it, the minor duodenal papilla (*papilla duodeni minor*). The common bile duct and the main pancreatic duct open into the major papilla, while the accessory pancreatic duct opens into the minor papilla. In the submucosa of the duodenal beginning, there are tubular glands called *glandulae duodenales*. In the rest of the small intestine, similar tubular glands (*glandulae intestinales*) are located within the mucosa and produce intestinal juice. The mucosa of the small intestine also contains lymphoid follicles. Solitary follicles (*folliculi lymphatici solitarii*) are found throughout the small intestine, while in the ileum, groups of lymphoid follicles (*folliculi lymphatici aggregati*) are present. The muscular layer (*tunica muscularis*) consists of two layers: an outer longitudinal layer (*stratum longitudinale*) and an inner circular layer (*stratum circulare*). Circular fibers constrict the intestinal lumen, while longitudinal

fibers shorten the intestine and widen the lumen. The outer serous membrane (*tunica serosa*) covering the jejunum and ileum is derived from the visceral layer of the peritoneum. Its folds form the mesentery, which supports the small intestine. Beneath it lies the subserous layer (*tela subserosa*).

Large intestine

The large intestine — *intestinum crassum* — is a continuation of the small intestine and consists of the following parts: 1) the cecum (*caecum*); 2) the ascending colon (*colon ascendens*); 3) the transverse colon (*colon transversum*); 4) the descending colon (*colon descendens*); 5) the sigmoid colon (*colon sigmoideum*); and 6) the rectum (*rectum*). The parts of the large intestine are covered by the peritoneum as follows: the cecum, transverse colon, and sigmoid colon are intraperitoneal (completely covered by peritoneum); the ascending and descending parts are mesoperitoneal (covered on three sides); and the upper one-third of the rectum is intraperitoneal, the middle third is mesoperitoneal, and the lower third is extraperitoneal.
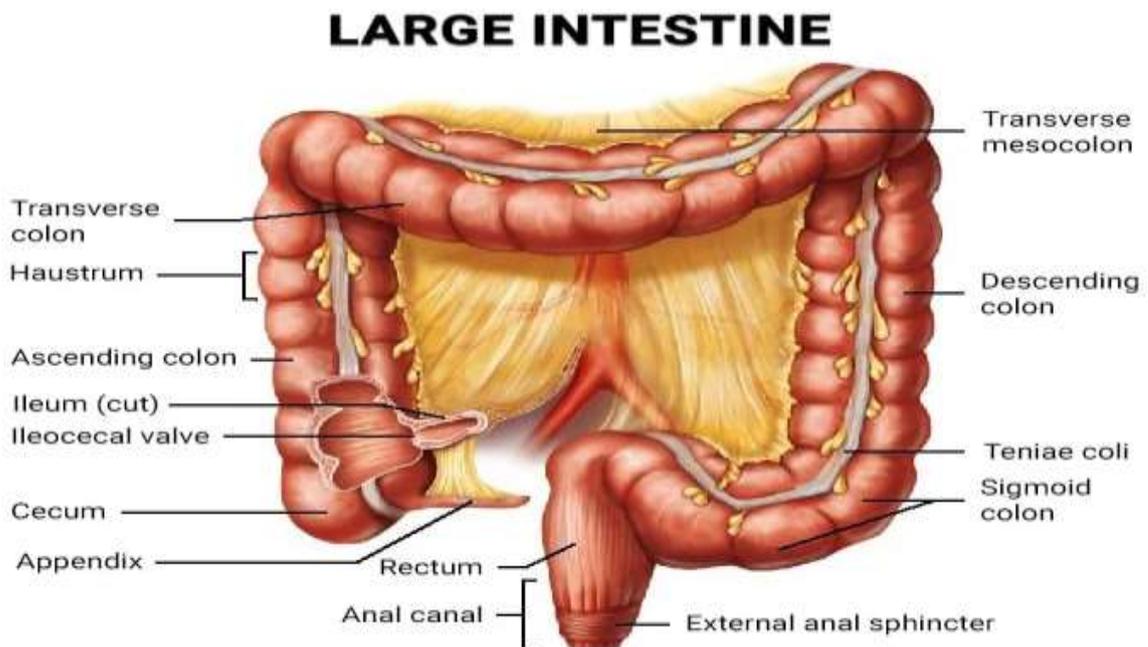
The wall of the large intestine consists of the following layers: 1) *tunica serosa* — the outermost layer, the serous membrane; 2) *tela subserosa* — the subserous layer; 3) *tunica muscularis* — the muscular layer, consisting of longitudinal fibers (*stratum longitudinale*) and circular fibers (*stratum circulare*). The muscle fibers are not evenly distributed throughout the wall; in certain areas they form thicker bundles. 4) *tela submucosa* — the submucosal layer; 5) *tunica mucosa* — the mucous membrane, which contains the *lamina muscularis mucosae* and the intestinal glands (*glandulae intestinales*).

LARGE INTESTINE
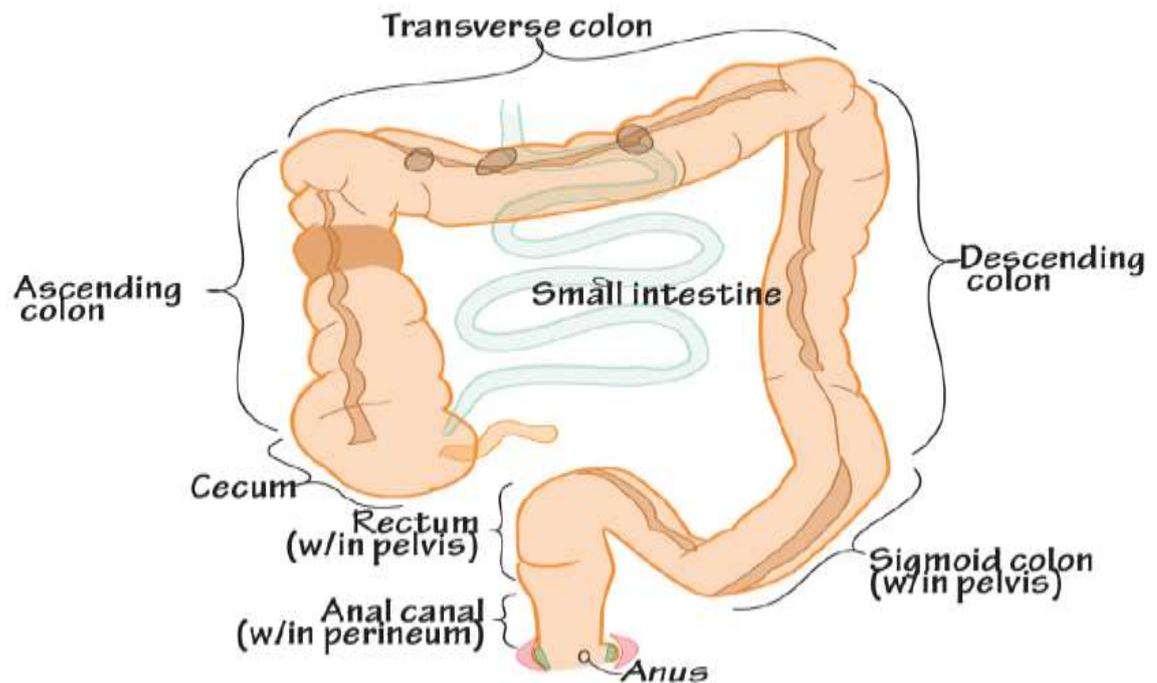
The large intestine differs from the small intestine by the following features: 1) the large intestine has a larger diameter; 2) the longitudinal muscle fibers form three distinct bands called *teniae coli*; 3) the circular muscles form sac-like dilatations called *haustra coli*; 4) on the outer surface there are small fatty appendages known as *appendices epiploicae*. The *teniae coli* are unique to the large intestine and are formed by the aggregation of longitudinal muscle fibers. They begin at the base of the vermiform appendix (*appendix vermiformis*) and end at the rectum. The *teniae coli* are divided into three types: 1) the free band (*tenia libera*), located on the anterior surface of the cecum and ascending colon, continuing onto the posterior surface of the transverse colon; 2) the mesocolic band (*tenia mesocolica*), located where the transverse mesocolon attaches; and 3) the omental band (*tenia omentalis*), found where the greater omentum is attached to the transverse colon. Differences between the mucous membranes of the large and small intestines: 1) villi are absent in the large intestine; 2) circular folds are found in the small intestine, whereas the large intestine has semilunar folds (*plicae semilunares coli*); 3) solitary lymphatic follicles are present in the large intestine. The cecum (*caecum*) lies in the right iliac region. At the junction between the ileum and cecum, circular muscle fibers form the *sphincter ileocaecalis*, while mucosal folds form the *valva ileocaecalis*, separating the small and large intestines. Attached

to the cecum is the vermiform appendix (*appendix vermiformis*), which opens into the cecum via the *ostium appendicis vermiformis*. The mucosa of the appendix contains numerous lymphoid follicles forming the *folliculi lymphatici aggregati appendicis vermiformis*. Like the cecum, the appendix is completely covered by the peritoneum and is attached by its mesentery, the *mesoappendix*. The ascending colon (*colon ascendens*) is not covered by the peritoneum on its posterior surface. It passes upward to the inferior surface of the liver, where it bends to form the right colic flexure (*flexura coli dextra*) and continues as the transverse colon. The transverse colon (*colon transversum*) is attached to the posterior abdominal wall by the transverse mesocolon (*mesocolon transversum*). Near the spleen, it bends downward forming the left colic flexure (*flexura coli sinistra*) and continues as the descending colon (*colon descendens*), which then leads to the sigmoid colon (*colon sigmoideum*).
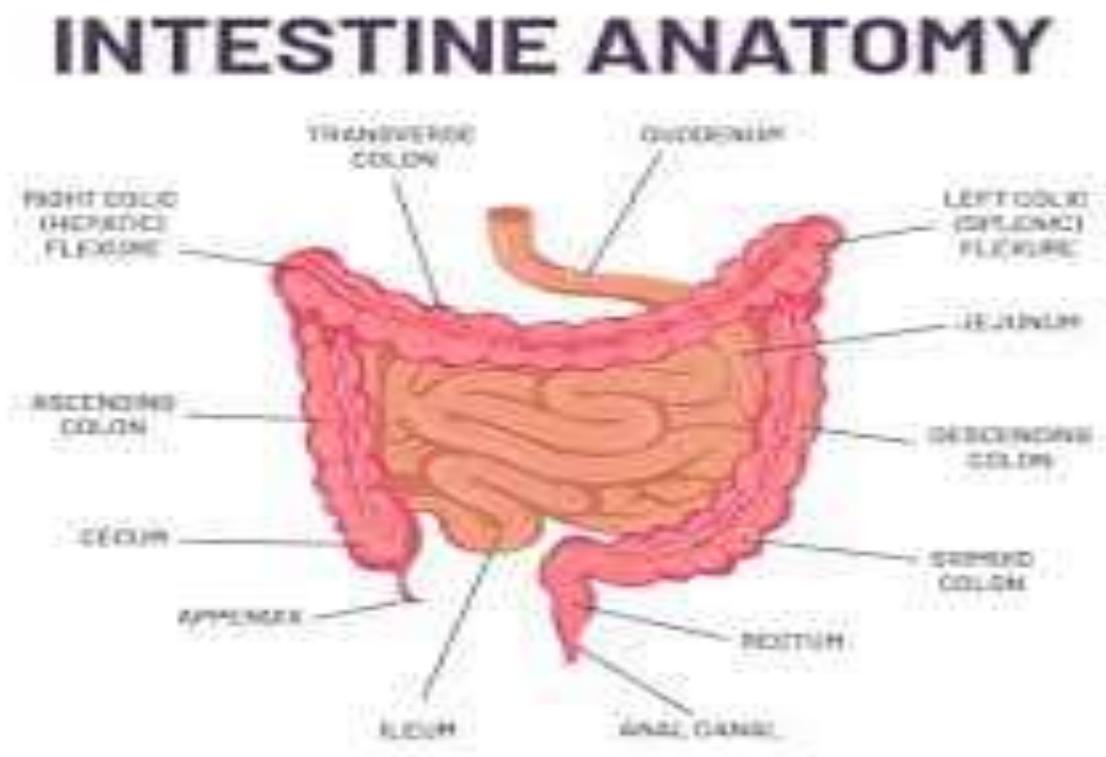
The anal canal (*canalis analis*) is formed by the lower one-third of the rectum and contains the anorectal flexure (*flexura anorectalis*). The mucosa in this region forms longitudinal folds called *columnae anales*. The point where the mucosa transitions to skin is called the *linea anocutanea*. The rectum (*rectum*) is the terminal part of the large intestine, ending at the anal opening (*anus*). In this region, circular muscle fibers thicken to form the internal

anal sphincter (*m. sphincter ani internus*), while the external anal sphincter (*m. sphincter ani externus*) lies beneath the skin and consists of striated muscle fibers. The external sphincter has three parts: a) *pars profunda* — the deep part; b) *pars superficialis* — the superficial part; and c) *pars subcutanea* — the subcutaneous part. Between the two sphincters lies a groove called the *sulcus intersphinctericus*. At the beginning of the rectum, near the base of the sacrum, there is a curvature called the *flexura sacralis*. Along its course, the rectum has three lateral flexures (*flexurae laterales*): a) the upper right (*flexura superodextra lateralis*); b) the middle left (*flexura intermediosinistra lateralis*); and c) the lower right (*flexura inferodextra lateralis*). Within the mucosa of the rectum are transverse folds (*plicae transversae recti*). The dilated part of the rectum is called the *ampulla recti*. The muscular layer of the rectum consists of an inner circular layer (*stratum circulare*) and an outer longitudinal layer (*stratum longitudinale*). The longitudinal fibers continue into several perineal muscles: a) *m. rectococcygeus* — connecting the rectum and coccyx; b) *m.m. anorectoperineales (m.m. rectourethrales)* — connecting the rectum, anal canal, and perineal muscles, or between the rectum and urethra; and c) *m. rectovesicalis* — connecting the rectum to the urinary bladder.

Liver

Liver (Hepar) is the largest gland, weighing about 1500 grams. It is located in the right hypochondriac region of the abdominal cavity. The bile produced by the liver flows into the duodenum. The liver performs a barrier (detoxifying) function: toxic substances formed during protein breakdown are absorbed in the intestine, enter the liver through the blood, and are neutralized there. The liver also participates in carbohydrate and fat metabolism. The liver has two surfaces: the diaphragmatic surface (facies diaphragmatica), which lies against the diaphragm, and the visceral surface (facies visceralis), which faces the internal organs. On the diaphragmatic surface, the following parts are distinguished: 1) Pars superior — the upper part, which has a cardiac impression (impressio cardiaca) formed by the heart; 2) Pars anterior — the anterior part; 3) Pars dextra — the right part; 4) Pars posterior — the posterior part; 5) Area nuda — a small uncovered area not covered by the peritoneum, where the groove for the inferior vena cava (sulcus venae cavae), the fissure for the ligamentum venosum (fissura ligamenti venosi), and the venous ligament (lig. venosum) are located. The falciform ligament (lig. falciforme hepatis) separates the liver into two lobes: the right lobe (lobus hepatis dexter) and the left lobe (lobus hepatis sinister).

Liver

Right hepatic duct

Hepatic portal vein

Common hepatic duct

Gallbladder

Cystic duct

Duodenum (first past of small intestine)

Common bile duct

Left hepatic duct

Spleen

Hepatic artery

Stomach

Pancreas

Sternum

5th rib

Liver

(a) Location

LIVER ANATOMY, segments

Right posterior section

Right anterior section

Left medial section

Left lateral section

Right hepatic vein

Middle hepatic vein

Left hepatic vein

Umbilical vein (remnant)

Hepatic duct

Inferior vena cava

Hepatic artery

Portal vein

Cystic duct

Gall bladder

Bile duct

The right lobe, in turn, is divided into the quadrate lobe (lobus quadratus) anteriorly and the caudate lobe (lobus caudatus) posteriorly, both visible on the visceral surface. In addition to the falciform ligament, there are the coronary ligament (lig. coronarium hepatis) and its right and left triangular margins (ligg. triangulare dextrum et sinistrum). On the anterior surface, the round ligament (lig. teres hepatis) extends to the umbilical region. On the visceral surface, several ligaments connect the liver to nearby organs: lig. hepatorenale (to the right kidney), lig. hepatogastricum (to the stomach), and lig. hepatoduodenale (to the duodenum). On the inferior surface lies the fossa for the gallbladder (fossa vesicae felleae) and the groove for the inferior vena cava (sulcus venae cavae).
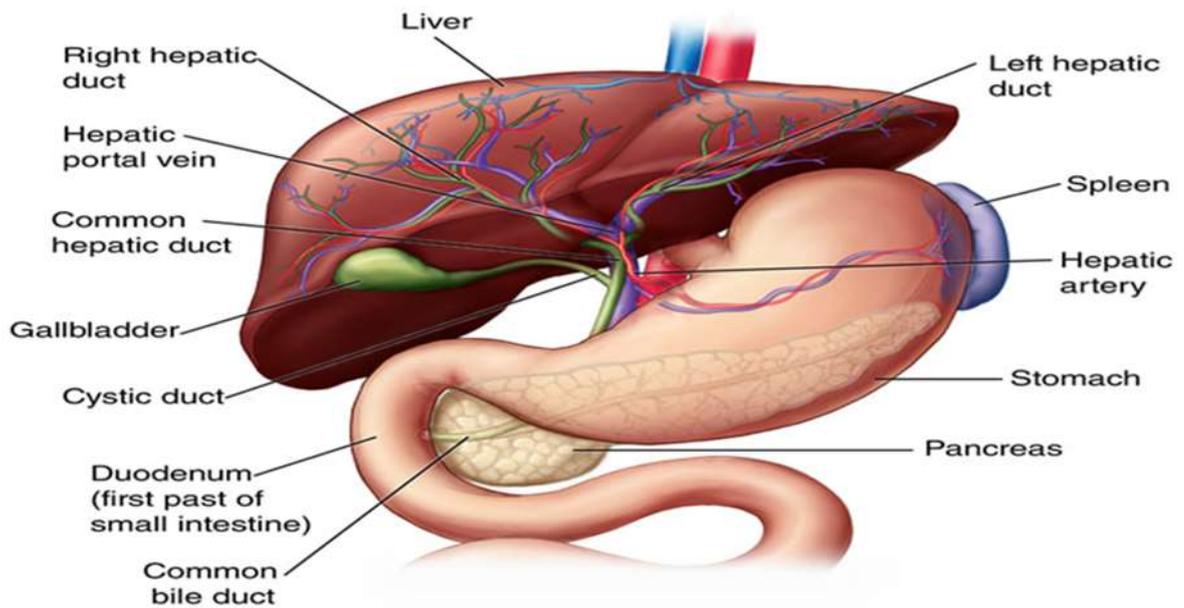
The hepatic hilum (porta hepatis) is located on the visceral surface, where the hepatic artery (a. hepatica), portal vein (v. portae), common hepatic duct (ductus hepaticus communis), nerves, and lymphatic vessels enter or exit the liver. The peritoneum envelops the liver almost completely, except for the bare area. The outer covering is called tunica serosa, and beneath it lies the subserous layer (tela subserosa). The liver is also enclosed in a fibrous capsule (tunica fibrosa), which extends inward from the porta hepatis, dividing the organ into lobes, segments, and lobules. The hepatic lobules (lobuli hepatis) are surrounded by interlobular veins (v. interlobularis). In the center of each lobule lies the central vein (v. centralis). Blood enters the liver through the hepatic artery and portal vein, which branch into smaller vessels (a. et v. interlobularis). These give rise to terminal vessels (a. v. capillaris), which form sinusoidal capillaries connecting interlobular veins with the central vein—creating a special venous network. Between the sinusoidal capillaries are liver cells (hepatocytes), among which the bile canaliculi (ductuli biliferi) begin. These join to form interlobular bile ducts (ductuli interlobulares), which merge into the common hepatic duct (ductus hepaticus communis). The right hepatic duct (ductus hepaticus dexter) and left hepatic duct (ductus hepaticus sinister) form the common hepatic duct. The right duct is formed by the union of anterior and posterior branches, while the left duct is formed by medial and lateral branches. Additionally, the caudate lobe has its own right (ductus lobi caudati dexter) and left (ductus lobi caudati sinister) bile ducts. The common hepatic duct joins the cystic duct (ductus cysticus) from the gallbladder to form the common bile duct (ductus choledochus), which runs within the hepatoduodenal ligament and opens into the duodenum together with the pancreatic duct at the major duodenal papilla.

anterior view — inferior vena cava — posterior view

aorta — falciform ligament — left triangular ligament — aorta — coronary ligament

right lobe — left lobe — porta hepatis — hepatic veins

fissure for teres ligament — caudate lobe — caudate process — right triangular ligament

proper hepatic artery

teres ligament — portal vein

gallbladder — common bile duct — quadrate lobe — gallbladder
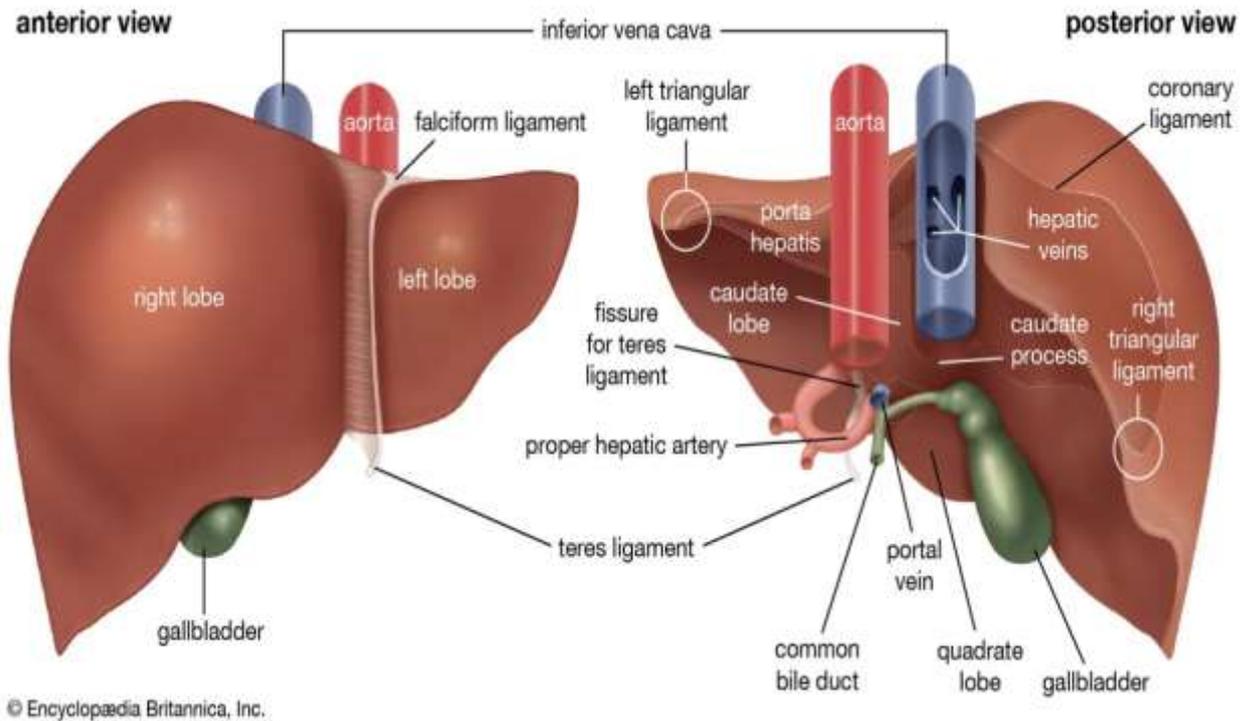
The sphincter muscle (m. sphincter ductus choledochi) controls bile flow into the intestine. When it contracts, bile is prevented from entering the intestinal lumen, and bile accumulates in the gallbladder. The structural and functional unit of the liver is the hepatic lobule, which is hexagonal in shape and has a central vein (v. centralis) in the middle. At the corners of lobules lie portal triads composed of a branch of the portal vein, a hepatic artery, and a bile duct. Between neighboring lobules lies another structural unit — the hepatic acinus, which represents the smallest functional microregion of the liver. The liver is divided into segments: the caudate lobe (lobus caudatus) forms segment I (segmentum posterius); in the left lobe are segment II (segmentum posterius laterale), segment III (segmentum anterius laterale), and segment IV (segmentum mediale sinistrum); in the right lobe are segment V (segmentum anterius mediale), segment VI (segmentum anterius laterale), segment VII (segmentum posterius laterale), and segment VIII (segmentum posterius mediale).

Gallbladder

The gallbladder (vesica fellea or vesica biliaris) is pear-shaped and consists of the following parts: the fundus of the gallbladder (fundus vesicae felleae), the body (corpus vesicae felleae), the neck (collum vesicae felleae), and the expanded funnel-shaped part — the infundibulum of the gallbladder (infundibulum vesicae felleae). The neck of the gallbladder continues as the cystic duct (ductus cysticus), which joins the common hepatic duct to form the common bile duct (ductus choledochus), opening into the duodenum.
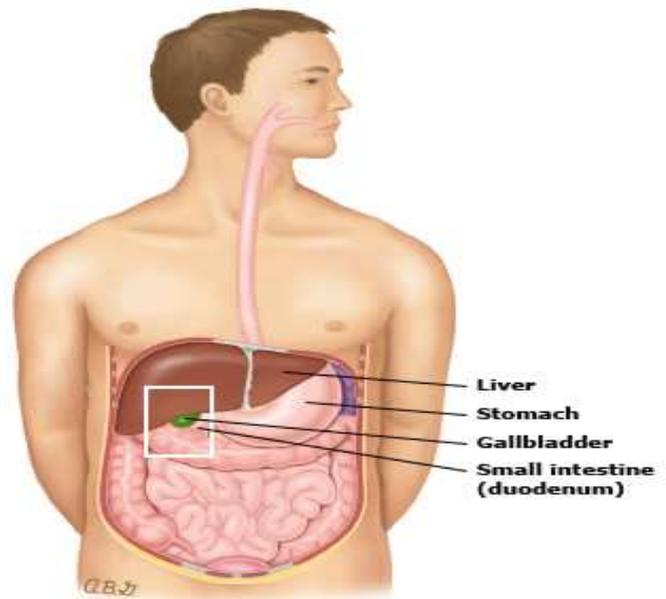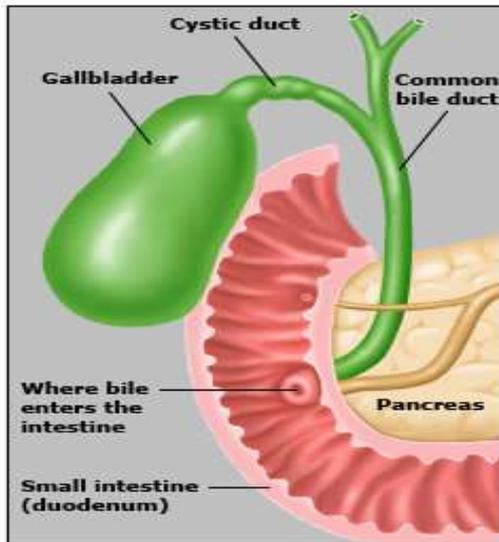
The wall of the gallbladder consists of the following layers: a) **Tunica serosa** — serous layer; b) **Tunica subserosa** — subserous layer; c) **Tunica muscularis** — muscular layer; d) **Tunica mucosa** — mucous membrane, which forms folds known as **plicae mucosae (rugae)**. In the mucous membrane of the cystic duct (ductus cysticus), the folds form a spiral structure called **plica spiralis**.
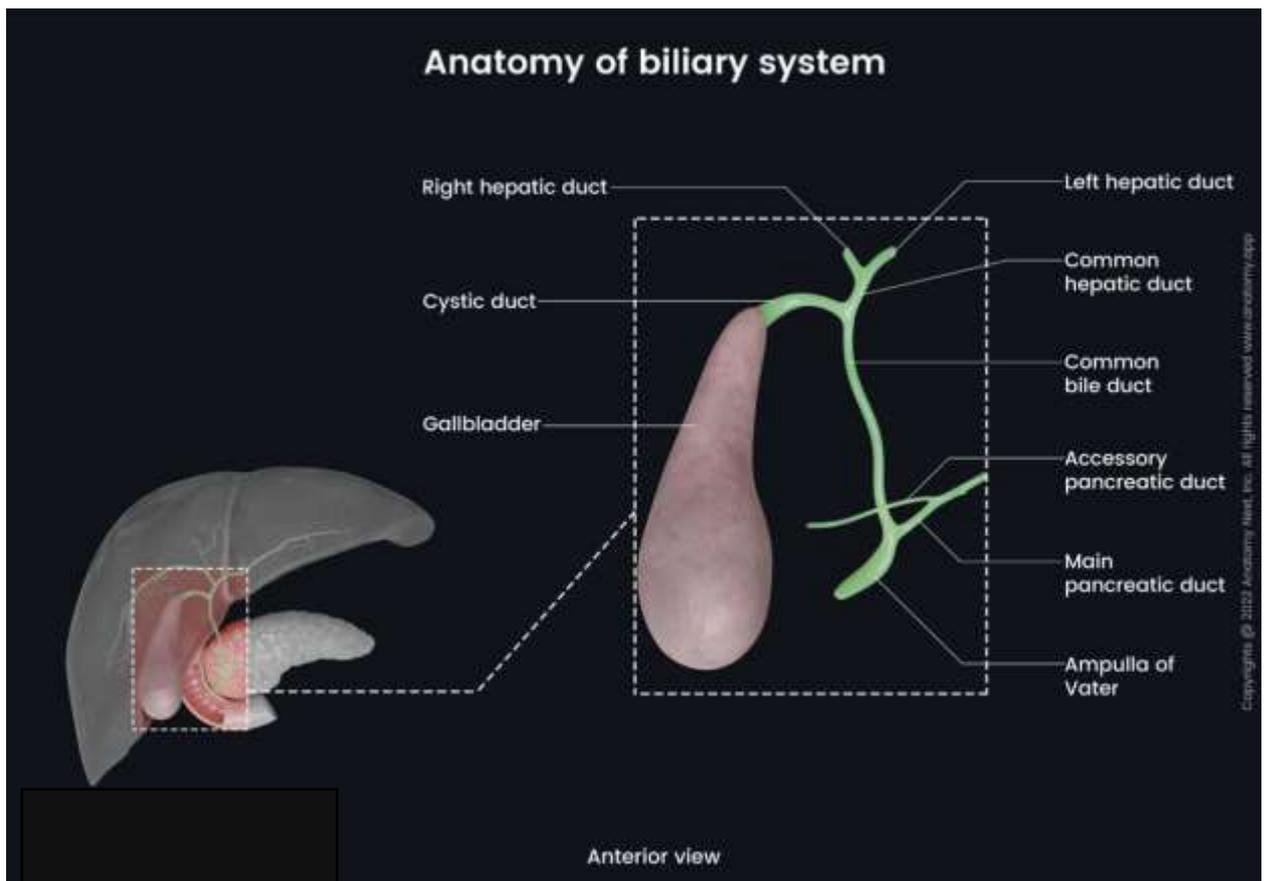
At the site where the common bile duct (ductus choledochus) opens into the duodenum, there is a sphincter muscle called **m. sphincter ductus choledochi**. Since the common bile duct joins with the pancreatic duct, their expanded region is called the **ampulla hepatopancreatica**, which is surrounded by the **m. sphincter ampullae**. The mucous membrane of the common bile duct contains glands known as **glandulae ductus choledochi**.

Pancreas

The **pancreas** is located behind the stomach. It consists of the **head (caput pancreatis)**, **body (corpus pancreatis)**, and **tail (cauda pancreatis)**. The body of the pancreas has an **anterior superior surface (facies anterio superior)**, a **posterior surface (facies posterior)**, and an **anterior inferior surface (facies anterio inferior)**, as well as **superior, anterior, and inferior borders (margo superior, anterior, inferior)**. Since the peritoneum covers only the anterior surface, the pancreas is considered an **extraperitoneal organ**.

The head of the pancreas has a **hook-shaped process (processus uncinatus)** and a **notch (incisura pancreatis)**, while the body has a **tuber omentale (omentum tuberosity)**.
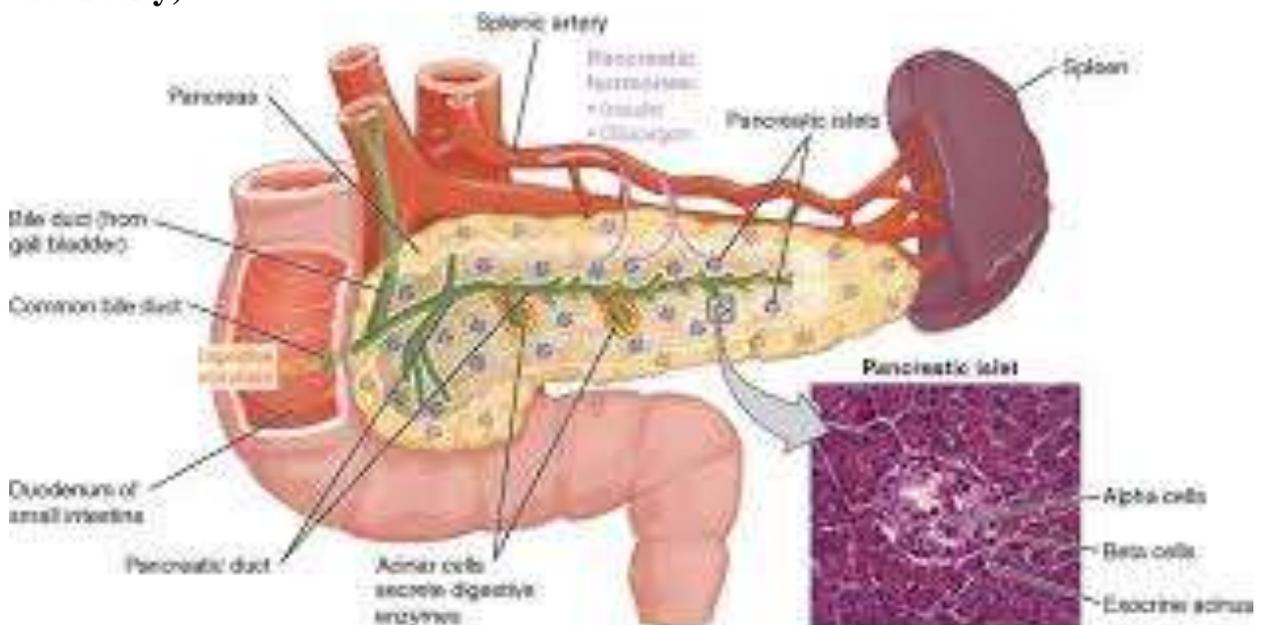
The **main pancreatic duct (ductus pancreaticus)** joins the **common bile duct** and opens into the duodenum at the **major duodenal papilla (papilla duodeni major)**. In addition to the main duct, the pancreas also has an **accessory pancreatic duct (ductus pancreaticus accessorius)**, which opens into the duodenum at the **minor duodenal papilla (papilla duodeni minor)**. At the opening of the pancreatic duct, there is a **sphincter muscle (m. sphincter ductus pancreatici)**.

PANCREAS

GALLBLADDER

SPLEEN

PANCREATIC DUCT

RIGHT AND LEFT HEPATIC DUCT OF LIVER

COMMON HEPATIC DUCT

TAIL

COMMON BILE DUCT

CYSTIC DUCT

DUODENUM

BODY

ACCESSORY PANCREATIC DUCT

PANCREAS

MINOR DUODENAL PAPILLA

HEAD

MAJOR DUODENAL PAPILLA

JEJUNUM
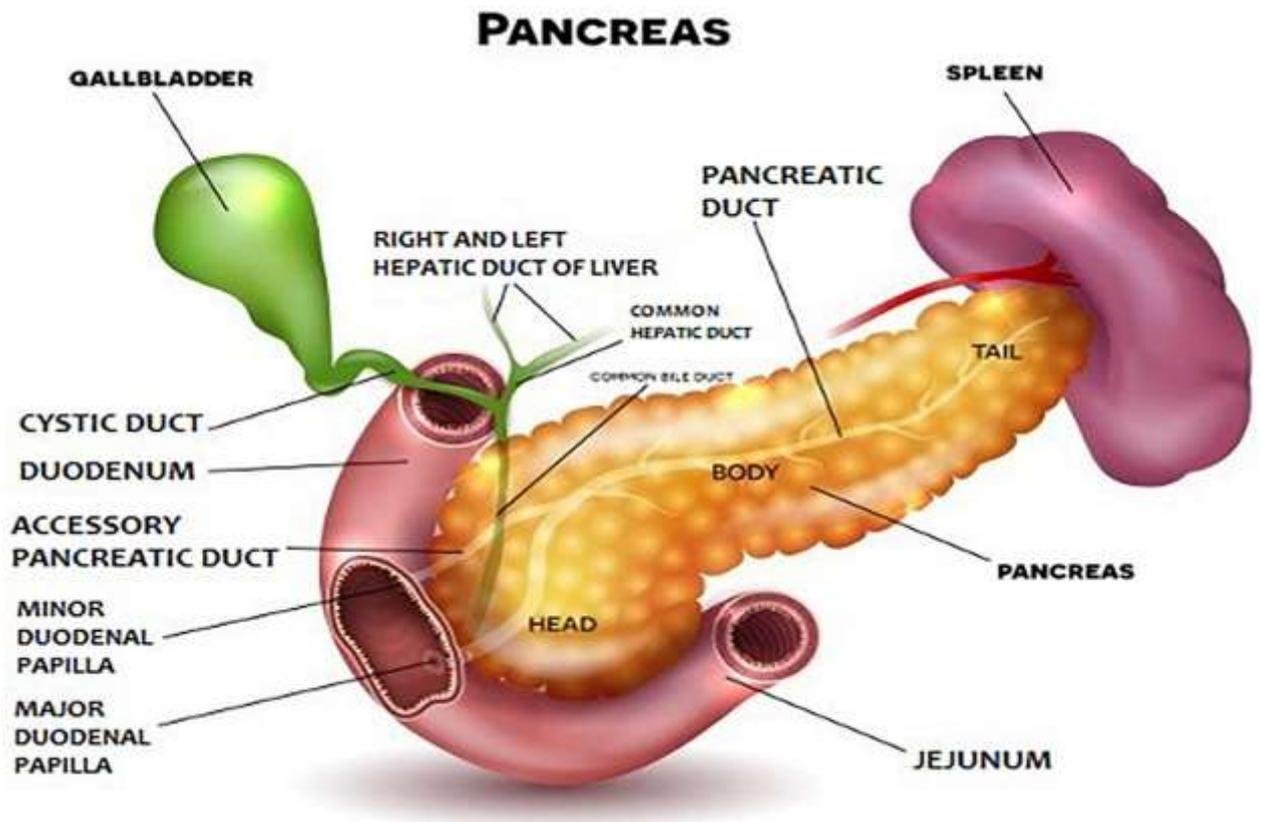
The pancreas is a **mixed gland** (both exocrine and endocrine). As an **exocrine gland**, it secretes **pancreatic juice** into the duodenal cavity to aid digestion. As an **endocrine gland**, it contains clusters of cells called **islets of Langerhans (insulae pancreaticae)** that secrete the hormone **insulin** into the bloodstream. Insulin regulates the **blood sugar level**.

Spleen

The **spleen (lien)** is a **parenchymatous, unpaired organ** located in the abdominal cavity. It performs **immunological, filtering, hematopoietic**, and **metabolic** functions, participating in the metabolism of **iron, proteins**, and other substances. The spleen is situated in the **upper left region of the abdominal cavity**. It has a **diaphragmatic surface (facies diaphragmatica)**, which faces the diaphragm, and a **visceral surface (facies visceralis)**, which is in contact with neighboring organs. The visceral surface is related to the **stomach (facies gastrica)**, the **left kidney (facies renalis)**, and the **left colic flexure (facies colica)** of the large intestine. The spleen has an **anterior end (extremitas anterior)**, a **posterior end (extremitas posterior)**, an **upper border (margo superior)**, and a **lower border (margo inferior)**.

Externally, the spleen is covered by a **serous membrane (tunica serosa)**. Beneath it lies a **fibrous capsule (tunica fibrosa)**, from which **trabeculae splenicae** extend inward as supporting structures.
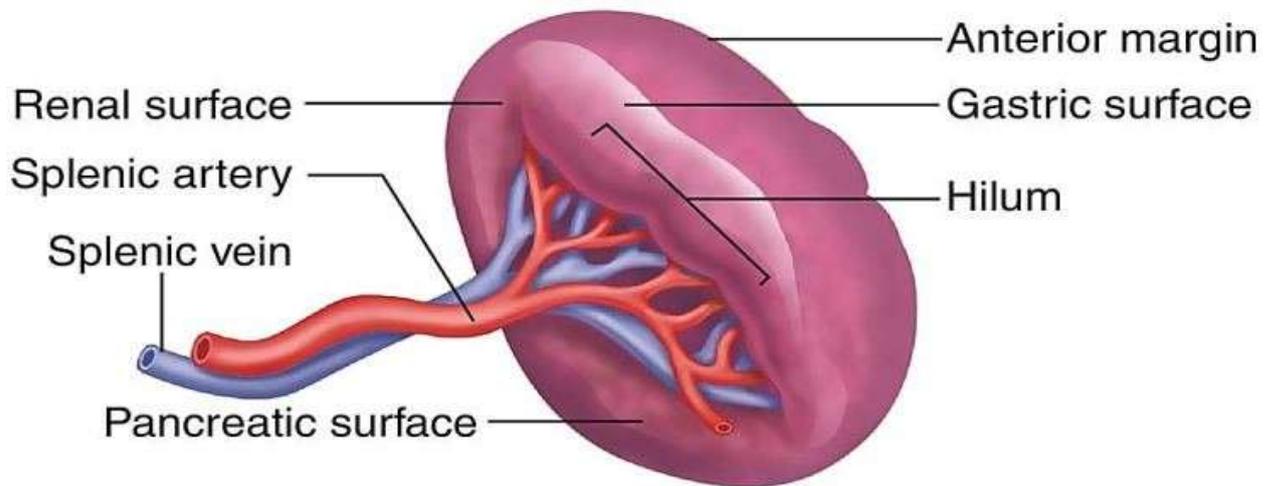
Inside the spleen, between the trabeculae, lies the **splenic pulp (pulpa splenica or pulpa lienalis)**, which consists of **red pulp (pulpa rubra)** and **white pulp (pulpa alba)**. Within the spleen are also found **lymphatic nodules (noduli lymphoidei splenici or lienales)**.

The area where the **blood vessels and nerves** enter and leave the spleen is called the **splenic hilum (hilus lienalis)**. The spleen is completely covered by the peritoneum and is connected by ligaments to the **stomach (lig. gastrolienale)**, the **left kidney (lig. lienorenale)**, and the **diaphragm (lig. phrenicolienale)**.

Peritoneum

Peritoneum — the peritoneum is a serous membrane that lines the abdominal cavity and covers the organs within it. This membrane consists of two layers: the *tunica serosa* and the *tela subserosa*. The serous membrane that lines the inner surface of the abdominal wall is called the *parietal peritoneum* (*peritoneum parietale*); the serous membrane that covers the organs within the abdominal cavity is called the *visceral peritoneum* (*peritoneum viscerale*). The parietal and visceral layers of the peritoneum are continuous with each other, and between them lies the *peritoneal cavity* (*cavitas peritonei*). The internal side of the anterior abdominal wall muscles is covered by the parietal peritoneum. In the lower part of the anterior abdominal wall, five folds directed toward the umbilical region can be seen. There is an unpaired median fold — *plica umbilicalis mediana* — and paired folds — *plica umbilicalis mediales* and *plica umbilicales*

laterales.

In the inguinal canal region, there is the *inguinal fossa* (*fossa inguinales*), and in the femoral canal region, the *femoral fossa* (*fossa femoralis*).
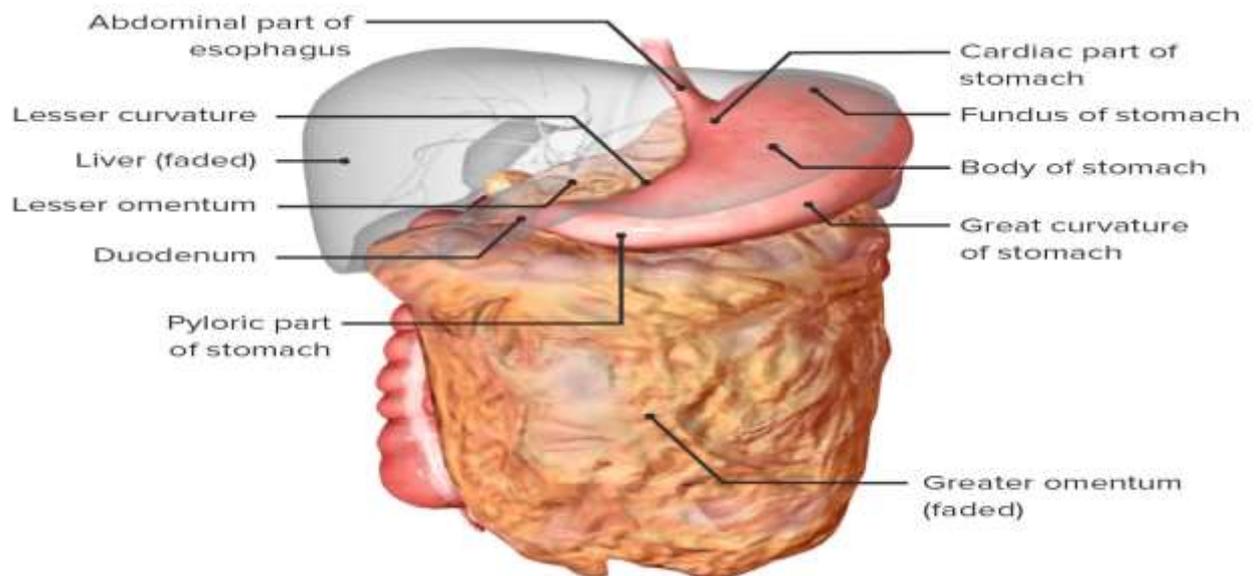
From the anterior abdominal wall, the peritoneum extends to the surface of the diaphragm. From the diaphragm, the serous membrane continues as the visceral peritoneum. As a result, several ligaments are formed between the diaphragm and the liver — the *falciform ligament* (*lig. falciforme hepatis*), the *coronary ligament* (*lig. coronarium hepatis*), and the *right and left triangular ligaments* (*lig. triangulare dextrum et sinistrum*). The visceral peritoneum covering the liver continues to the surface of the right kidney through the *hepatorenal ligament* (*lig. hepatorenale*). From the porta hepatis to the lesser curvature of the stomach extends the *hepatogastric ligament* (*lig. hepatogastricum*), and from the porta hepatis to the duodenum extends the *hepatoduodenal ligament* (*lig. hepatoduodenale*). The *hepatogastric* and *hepatoduodenal* ligaments together form the *lesser omentum* (*omentum minus*). The lesser omentum consists of the following ligaments:
a) *lig. hepatophrenicum* — part of the left coronary ligament of the liver;
b) *lig. hepatoesophageale* — extends from the visceral surface of the liver to the abdominal part of the esophagus;
d) *lig. hepatogastricum* — extends from the visceral surface of the liver to the lesser curvature of the stomach;
e) *lig. hepatoduodenale* — extends from the visceral surface of the liver to the duodenum.

At the region of the lesser curvature of the stomach, the peritoneum splits into two layers and surrounds the stomach completely, meeting again at the greater curvature. From the greater curvature, the peritoneum extends downward over the anterior

surface of the intestines and then turns upward in the pelvic region to join the parietal peritoneum of the posterior abdominal wall. The peritoneum, consisting of two layers, continues as the posterior parietal peritoneum of the abdominal wall. The lower layer of the peritoneum in this area participates in the formation of the transverse colon mesentery. The merging of the visceral peritoneum of the stomach's greater curvature and the transverse colon forms a four-layered serous membrane — the *greater omentum* (*omentum majus*). The *greater omentum* (*omentum majus*) consists of the following ligaments:

a) *lig. gastrophrenicum* — between the diaphragm and the stomach;
b) *lig. gastrosplenicum* — between the stomach and the spleen;
d) *lig. gastrocolicum* — between the stomach and the transverse colon;
e) *lig. phrenicosplenicum* — between the diaphragm and the spleen;
f) *lig. splenorenale* — between the spleen and the left kidney;
g) *lig. pancreaticosplenicum* — between the spleen and the pancreas;
h) *lig. pancreaticocolicum* — between the transverse colon and the pancreas;
i) *lig. splenocolicum* — between the spleen and the transverse colon;
j) *lig. phrenicocolicum* — between the diaphragm and the transverse colon.
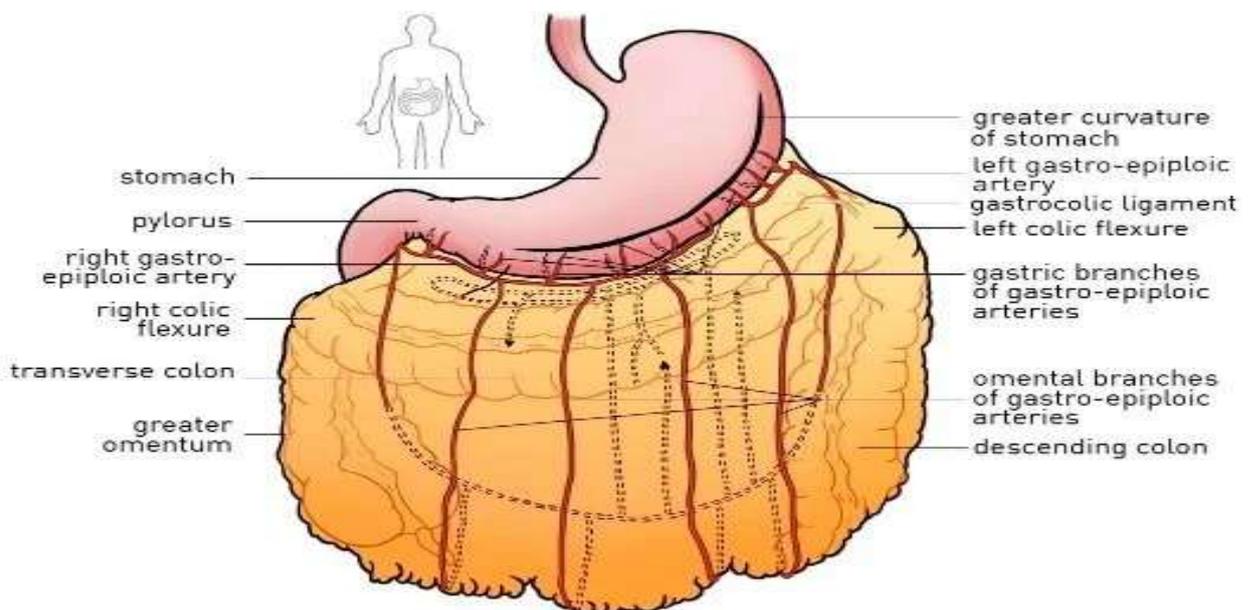
From the posterior abdominal wall, the peritoneum extends to the small intestine as a double-layered fold called the *mesentery* (*mesenterium*). The root of the small intestinal mesentery attached to the posterior abdominal wall is called the *radix mesenterii*.

On the posterior abdominal wall, the peritoneum covers the ascending and descending parts of the large intestine on three sides. The cecum, transverse colon, and sigmoid colon are completely covered by peritoneum, thus forming mesenteries. These mesenteries are named: *mesoappendix* (of the vermiform appendix),

mesocolon transversum (of the transverse colon), and *mesocolon sigmoideum* (of the sigmoid   colon).
The upper part of the rectum is intraperitoneal, the middle part is mesoperitoneal, and the lower part is extraperitoneal.

In the pelvic region, the peritoneum descends onto the organs of the pelvis. In females, it covers the uterus, urinary bladder, and rectum, forming pouches and folds between them. The peritoneum descends from the anterior abdominal wall onto the upper surface of the urinary bladder, then passes onto the uterus, forming the *vesicouterine pouch* (*excavatio vesicouterina*).
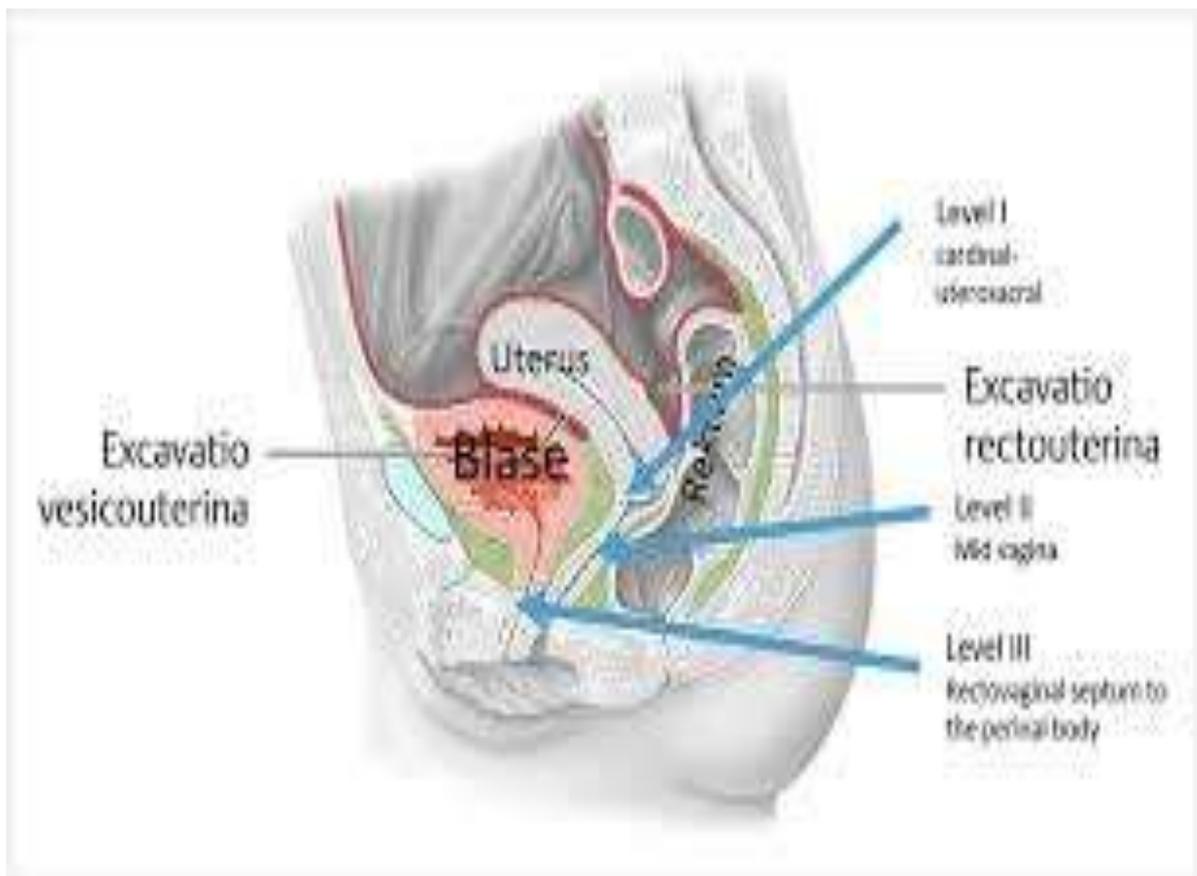
From the posterior surface of the uterus, the peritoneum reflects onto the rectum, forming the *rectouterine pouch* (*excavatio rectouterina*), also known as *Douglas pouch*. In males, the peritoneum passes from the anterior abdominal wall onto the urinary bladder and from there onto the rectum, forming the *rectovesical pouch* (*excavatio rectovesicalis*).

| Peritoneum parietale | | Peritoneum urogenitale |
| Ort der Blasenpunktion | | Excavatio rectovesicalis |

b
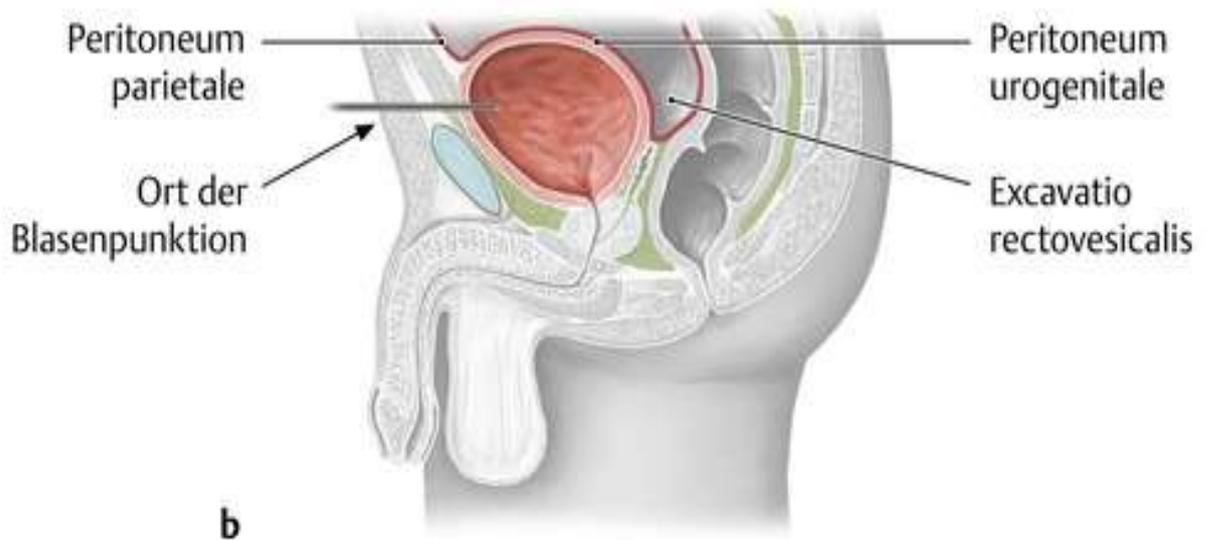
The peritoneum also forms folds, including the *broad ligament of the uterus* (*ligamentum latum uteri*), which contains the uterine tubes, blood vessels, and nerves. The peritoneal cavity (*cavitas peritonealis*) is divided into two main sections: the *greater sac* (*bursa major*) and the *lesser sac* (*bursa omentalis*). The *lesser sac* is located behind the stomach and lesser omentum (*omentum minus*). The entrance to the lesser sac is called the *epiploic foramen* (*foramen epiploicum*, or *foramen of Winslow*), which connects the lesser sac to the greater sac.

The *lesser omentum* (*omentum minus*) extends from the lesser curvature of the stomach and the beginning of the duodenum to the liver. It consists of two main ligaments:

1. *Hepatogastric ligament* (*lig. hepatogastricum*) — between the liver and the stomach.
2. *Hepatoduodenal ligament* (*lig. hepatoduodenale*) — between the liver and the duodenum.
3. The *hepatoduodenal ligament* contains the *portal triad*:

- The *common bile duct* (*ductus choledochus*),
- The *hepatic artery proper* (*a. hepatica propria*),
- The *portal vein* (*v. portae*).

The peritoneal cavity in women is an open space communicating with the external environment through the uterine tubes, uterus, and vagina. In men, the peritoneal cavity is a completely closed space.

Respiratory system

The **respiratory system (systema respiratorium)** refers to the organs that perform gas exchange between the air from the external environment and the blood in the lungs.

According to their functions, the respiratory organs are divided into air-conducting organs — nasal cavity, larynx, trachea, bronchi — and the gas-exchanging organ, which is the lungs.

In practice, the respiratory system is divided into upper respiratory tract — nasal and oral cavities, pharynx; and lower respiratory tract — larynx, trachea, bronchi, and lungs. The following functions are closely connected with the respiratory tract: purification of the air, increasing its humidity, warming or cooling, smelling, etc. Therefore, in the upper part of the respiratory organs, there are numerous venous vascular networks in the submucosal layer, which serve to warm the inhaled air. The glands of the mucous membrane produce a secretion that moistens the air.

The respiratory tract also performs a protective function. The ciliated epithelium and macrophage cells on the inner surface capture microbes and dust particles. The lungs regulate water balance, with about 15–20% of water being excreted through them. The concentration of acids and bases in the body is maintained by removing carbon dioxide through the lungs. In addition, the respiratory organs help eliminate certain chemical substances such as alcohol, ether, chloroform, acetone, and ammonia. Besides these, the respiratory organs also perform the function of voice formation.

Normal breathing is nasal breathing because the nasal cavity contains olfactory receptors and ciliated epithelial cells that perform a protective function.Common structural characteristics of all parts of the respiratory organs:

They have a tubular structure.

Their inner layer contains cells that produce mucus (secretions).

Up to the segmental bronchi, the inner surface is covered with ciliated epithelium.

The nose (nasus) has a root (radix nasi), tip (apex nasi), bridge (dorsum nasi), and wings (ala nasi).

The external part of the nose is formed by cartilaginous tissue (cartilagines nasi) and consists of the following cartilages:

1. Cartilago alaris major — the large cartilage of the nasal wing, with a medial crus (crus mediale) and a lateral crus (crus laterale).
2. Cartilagines alares minores — the small cartilages of the nasal wings.
3. Cartilagines nasi accesoriae — the accessory cartilages of the nose.
4. Cartilago septi nasi — the cartilage of the nasal septum.

5. Cartilago vomeronasalis — the cartilage located between the vomer bone and the nasal cavity.

Organs of the Respiratory System

- Nasal cavity
- Larynx
- Cavity of the Larynx
- Trachea
- Bronchi
- Pulmo
- Branching of the bronchi inside the lungs
- Pulmonary segments
- Pleura
- Mediastinum
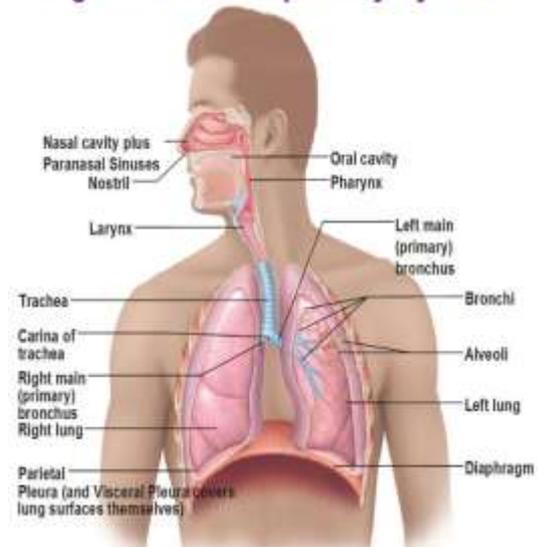
Nasal cavity

Nasal cavity – It is the continuation of the external nose (*nasus externus*), which has a bony and cartilaginous structure. The entrance opening of the nasal cavity is called the *nares*. The nasal cavity is divided into two parts by the nasal septum (*septum nasi*). The anterior part of the septum consists of cartilage, while the posterior part consists of bone. Therefore, the septum has the following parts:

a) *pars membranacea* – membranous part;

b) *pars cartilaginea* – cartilaginous part;

c) *pars ossea* – bony part;

d) *organum vomeronasale* – vomeronasal organ

The beginning area of the nasal cavity is called the nasal vestibule (*vestibulum nasi*). The posterior openings of the nasal cavity that continue into the pharynx are called *choanae*. The mucous membrane of the nasal cavity is covered with ciliated epithelium and contains mucous glands. Beneath the mucous membrane, there are numerous venous plexuses. These structures help to clean, warm, and humidify or cool the inhaled air.

A-Floor, roof and lateral walls
B-Conchae on lateral walls
C-Coronal section
D-Air channels in right nasal cavity
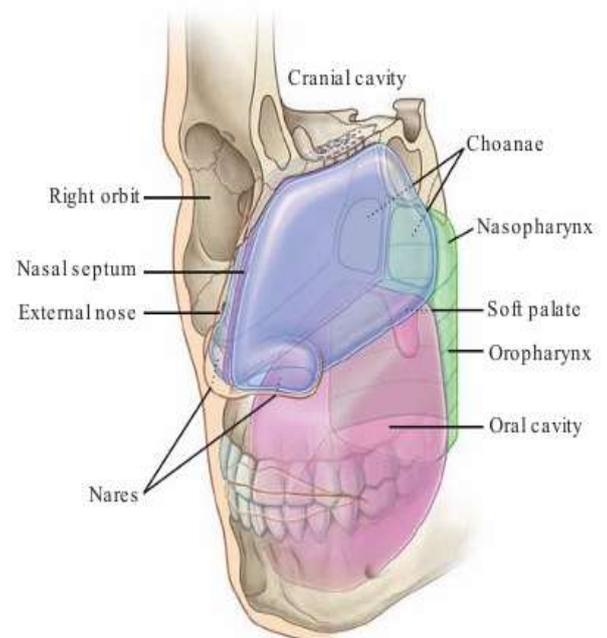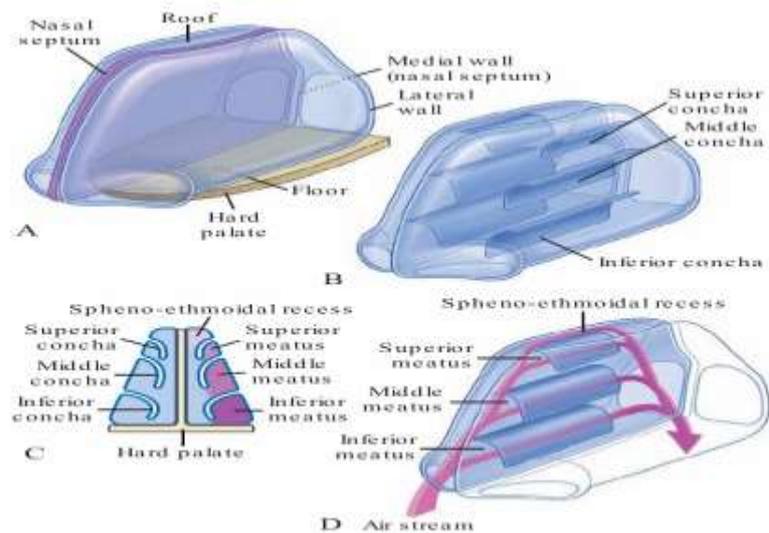
Fig. 8.208 Nasal cavities. A. Floor, roof, and lateral walls. B. Conchae on lateral walls. C. Coronal section. D. Air channels in right nasal cavity.

They are mainly located in the middle and inferior nasal conchae regions. Therefore, the middle and inferior nasal passages are called the respiratory region (*regio respiratoria*). In the superior nasal passage, the receptors of the olfactory nerve are located, so this part of the nasal cavity is called the olfactory region (*regio olfactoria*). The nasal cavity contains the following conchae:
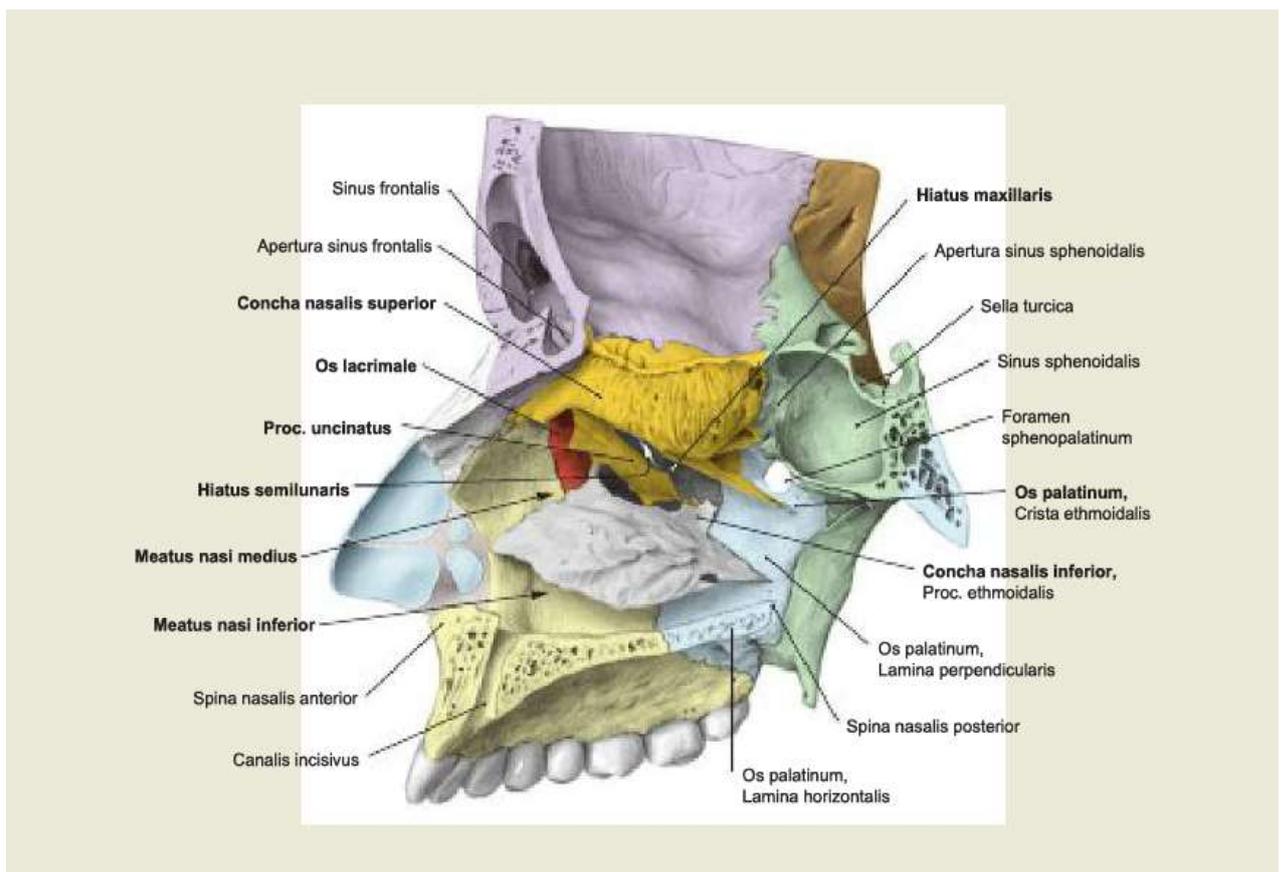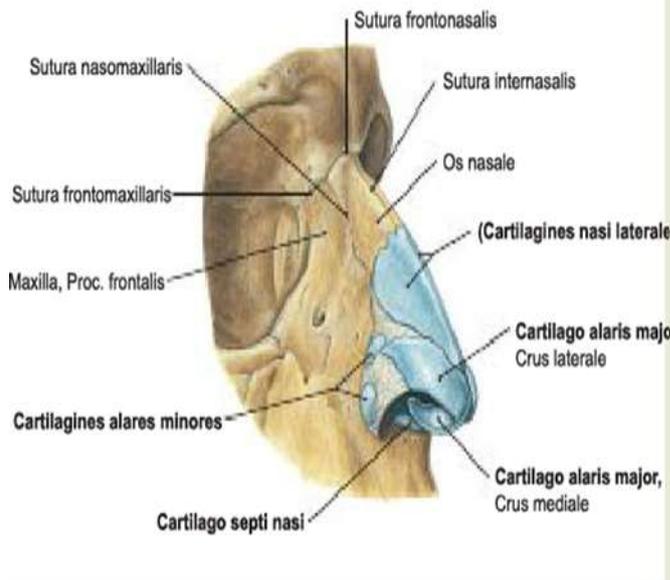
a) *concha nasi suprema* – highest nasal concha;

b) *concha nasi superior* – superior nasal concha;

c) *concha nasi media* – middle nasal concha;

d) *concha nasi inferior* – inferior nasal concha.

Between these conchae, the following air passages are found:

a) *meatus nasi superior* – superior nasal meatus;

b) *meatus nasi medius* – middle nasal meatus.

In this area, there are the *atrium meatus medii*, the *bulla ethmoidalis* (ethmoidal bulla), the *infundibulum ethmoidale* (ethmoidal infundibulum), and the *hiatus semilunaris* (semilunar hiatus). c) *meatus nasi inferior* – inferior nasal meatus. In this passage, there is an opening of the nasolacrimal duct called the *apertura ductus nasolacrimalis*. d) At the posterior part of the nasal cavity, all air passages e5join to form a common nasal passage – *meatus nasi communis*.

This common passage continues as the *meatus nasopharyngeus*, which opens into the nasopharynx. Around the nasal cavity, there are air-filled paranasal sinuses (*sinus paranasales*), which are lined with mucous membrane. These sinuses include: 1) the maxillary sinus (*sinus maxillaris*) located in the maxillary bone;

2) the frontal sinus (*sinus frontalis*) in the frontal bone;
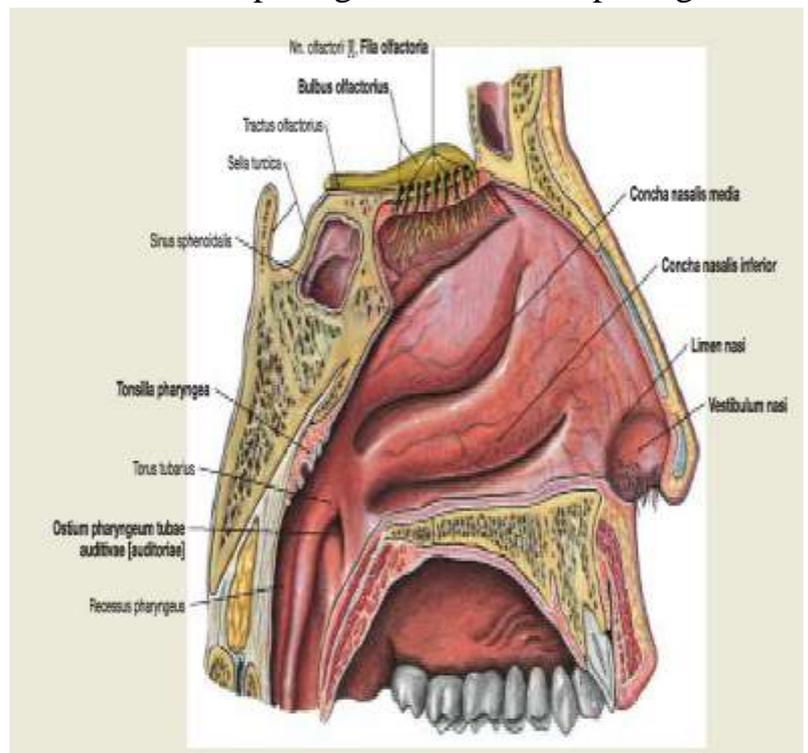
3) the ethmoidal cells (*cellulae ethmoidales*) located in the ethmoid bone, which are divided into anterior (*cellulae ethmoidales anteriores*), middle (*cellulae ethmoidales mediae*), and posterior (*cellulae ethmoidales posteriores*) groups;

4) the sphenoidal sinus (*sinus sphenoidalis*) located in the sphenoid bone.

The air from the nasal cavity continues into the pharynx. In the anterior region of the pharynx, the larynx (*larynx*) is located.

Larynx

Larynx – The larynx is located at the anterior surface of the neck, at the level of the 4th–5th cervical vertebrae. Posteriorly, it is related to the pharynx, while laterally it is surrounded by blood vessels and nerves of the neck. Superiorly, the larynx is suspended from the hyoid bone, and inferiorly it narrows slightly and continues as the trachea. The larynx consists of paired and unpaired **cartilages, ligaments**, and **muscles**.

The cartilages of the larynx include:

1) cricoid cartilage (*cartilago cricoidea*);
2) thyroid cartilage (*cartilago thyroidea*);
3) arytenoid cartilage (*cartilago arytenoidea*);
4) epiglottic cartilage (*cartilago epiglottica*);
 5) corniculate cartilage (*cartilago corniculata*);
6) cuneiform cartilages (*cartilago cuneiformis*).

The cricoid cartilage is ring-shaped and located at the base of the larynx. Its posterior part is broader and called the *lamina*, while the anterior and lateral parts form the *arcus*. On its posterior surface, there is an articular surface for the arytenoid cartilage (*facies articularis arytenoidea*), and on the anterior surface there is an articular surface for the thyroid cartilage (*facies articularis thyroidea*).
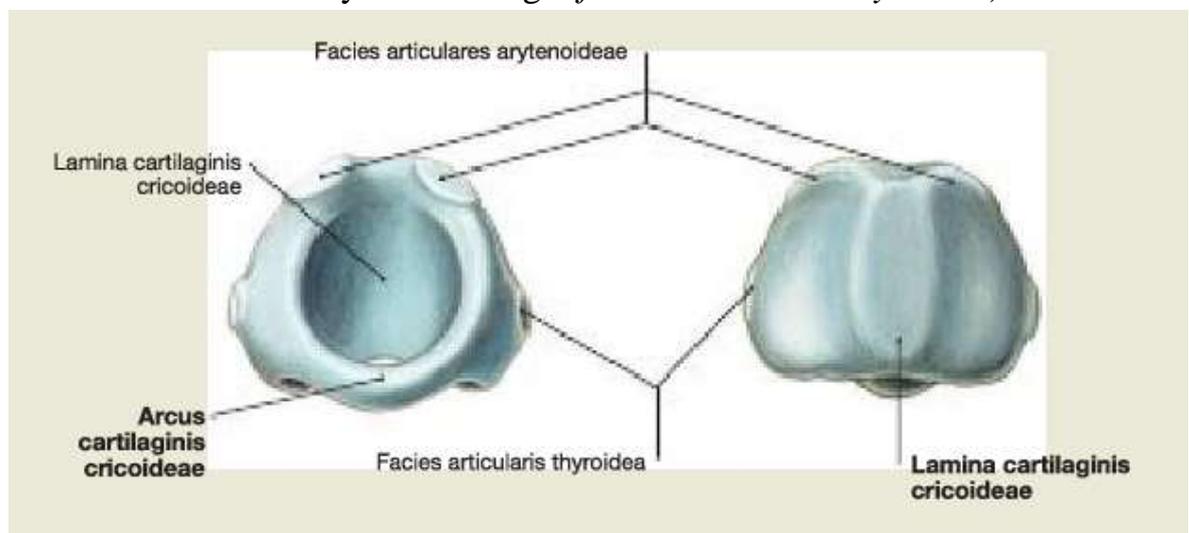
The thyroid cartilage consists of two laminae – *lamina dextra et sinistra* – which meet in the midline to form the laryngeal prominence (*prominentia laryngea*). In

males, this prominence forms a sharp angle that can be seen under the skin (Adam's apple), while in children and females, it forms a blunt angle and is not prominent externally. The upper part of the thyroid cartilage has a superior notch (*incisura thyroidea superior*) and a superior horn (*cornu superius*). The lower part has an inferior horn (*cornu inferius*) and an inferior notch (*incisura thyroidea inferior*). On its external surface, there is an oblique line (*linea obliqua*) for muscle attachment.
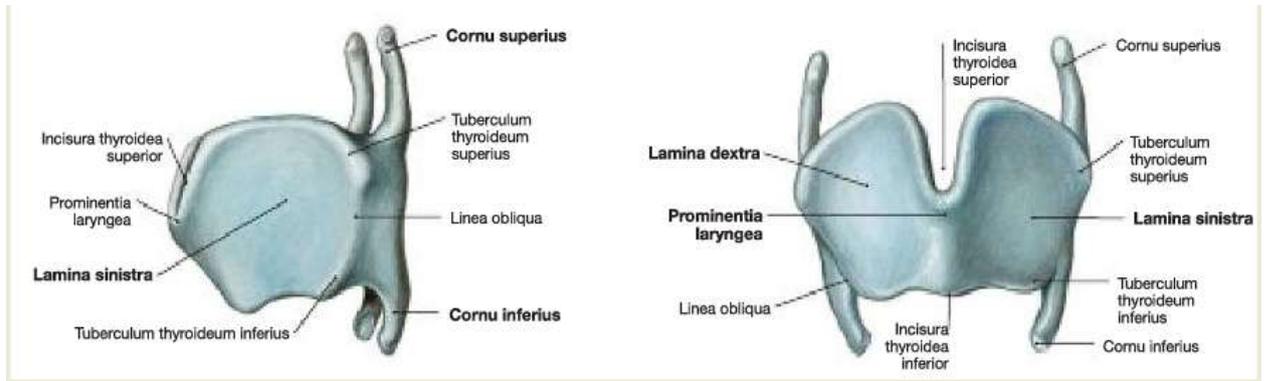
The arytenoid cartilage- is located on the upper surface of the posterior part of the cricoid cartilage. It has a pyramidal shape with a base (*basis*) and an apex (*apex*). The articular surface of this cartilage is called the *facies articularis*. It has the following surfaces: a) *facies anterolateralis* – anterolateral surface; b) *facies medialis* – medial surface; c) *facies posterior* – posterior surface. From the anterior surface of the arytenoid cartilage extends the vocal process (*processus vocalis*), to which the vocal ligament attaches, and the muscular process (*processus muscularis*), which provides attachment for the laryngeal muscles. The joint between the cricoid and arytenoid cartilages is the *articulatio cricoarytenoidea*, surrounded by the *capsula articularis cricoarytenoidea*. The ligaments of this joint include:

a) *lig. cricoarytenoideum* – stretched between the cricoid and arytenoid cartilages;
b) *lig. cricopharyngeum* – located between the cricoid cartilage and pharynx.
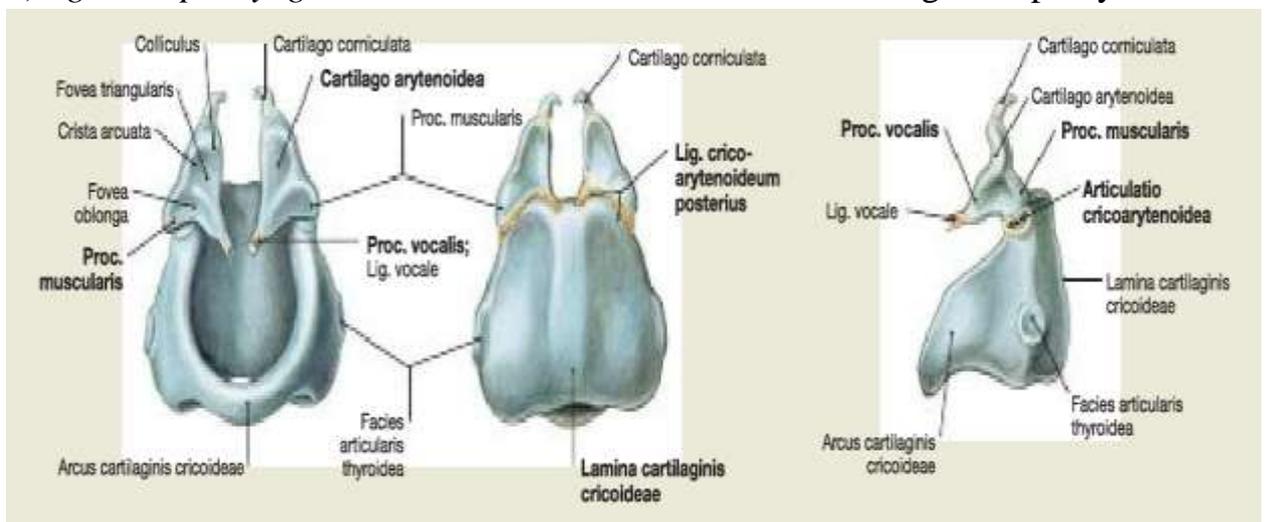
The epiglottic cartilage (*cartilago epiglottica*) lies at the entrance of the laryngeal

inlet. It has a stem (*petiolus epiglottidis*) and a tubercle (*tuberculum epiglotticum*). The epiglottis is fixed in place by the following ligaments:

a) *lig. thyroepiglotticum* – connects the epiglottis to the thyroid cartilage;

b) *lig. hyoepiglotticum* – connects the epiglottis to the hyoid bone.

In front of the epiglottis is a fatty body called the *corpus adiposum preepiglotticum*. The smaller cartilages of the larynx, such as the corniculate and cuneiform cartilages, are located within the folds of the aryepiglottic ligament.

The thyroid cartilage is connected to the hyoid bone by the *membrana thyrohyoidea*. The middle thickened part of this membrane forms the *lig. thyrohyoideum medianum*, and its lateral portions form the *lig. thyrohyoidea lateralia*, which contain a small cartilage called the *cartilago triticea*. The hyoid bone and epiglottis are connected by the *lig. hyoepiglotticum*, and the epiglottis and thyroid cartilage are connected by the *lig. thyroepiglotticum*. Between the cricoid and thyroid cartilages lies the *lig. cricothyroideum*. One of the most important ligaments is the true vocal ligament (*lig. vocale*), which extends from the inner surface of the thyroid cartilage to the vocal process of the arytenoid cartilage. Above the true vocal ligament lies the false vocal ligament or vestibular ligament (*lig. vestibulare*), which runs parallel to the true one. The laryngeal cartilages are connected to each other by joints. The joint between the thyroid and cricoid cartilages is the *articulatio cricothyroidea*. Its capsule (*capsula articularis cricothyroidea*) is reinforced by the following ligaments: a) *lig. ceratocricoideum* –

between the inferior horn of the thyroid cartilage and the cricoid cartilage; b) *lig. cricothyroideum medianum* – extends from the upper surface of the cricoid cartilage to the thyroid cartilage; c) *lig. cricotracheale* – between the cricoid cartilage and the tracheal cartilage. Movement in this joint brings the anterior surface of the cricoid cartilage closer to the thyroid cartilage, while the posterior surface and arytenoid cartilage move backward, tightening the vocal folds. Between the cricoid and arytenoid cartilages, there is the *articulatio cricoarytenoidea*, which allows rotational movements of the arytenoid cartilage around its axis. The laryngeal muscles are divided into three groups:

1) constrictors; 2) dilators; and 3) tensors of the vocal folds.

All of them are composed of striated muscle fibers.

I. Constrictors:

1. *M. cricoarytenoideus lateralis* – arises from the lateral surface of the cricoid cartilage and inserts into the muscular process of the arytenoid cartilage. Contraction brings the vocal processes closer together, narrowing the rima glottidis.
2. *M. arytenoideus transversus* – connects the posterior surfaces of the arytenoid cartilages, closing the posterior part of the glottis.
3. *M. arytenoideus obliquus* – runs obliquely between the arytenoid cartilages and continues into the *m. aryepiglotticus*, narrowing the laryngeal inlet.
4. *M. thyroarytenoideus* – originates from the posterior surface of the thyroid cartilage and attaches to the muscular process of the arytenoid cartilage. Its upper fibers, *pars thyroepiglottica*, constrict the laryngeal cavity and relax the vocal ligaments.

II. Dilators:

5. *M. cricoarytenoideus posterior* – arises from the posterior surface of the cricoid cartilage and attaches to the muscular process of the arytenoid cartilage. Contraction moves the vocal processes apart, widening the rima glottidis.
6. *M. thyroepiglotticus* – runs from the inner surface of the thyroid cartilage to the epiglottis, widening the laryngeal inlet.

III. Tensors of the vocal ligaments:

7. *M. cricothyroideus* – connects the cricoid cartilage with the inferior horn of the thyroid cartilage and consists of two parts: a straight part (*pars recta*) and an oblique part (*pars obliqua*). Its contraction tilts the thyroid cartilage forward, increasing the tension of the vocal ligaments.
8. *M. vocalis* – lies within the true vocal fold, extending from the inner surface of the thyroid cartilage to the lateral surface of the vocal process of the

arytenoid cartilage. Contraction of this muscle brings the attachment points closer, relaxing the vocal fold.

The extrinsic muscles that move the larynx include *m. sternohyoideus*, *m. sternothyroideus*, and *m. thyrohyoideus*. The muscles that act on the glottis are classified as follows:

9. Muscles that open the glottis – *m. cricoarytenoideus posterior*;
10. Muscles that close the glottis – *m. cricoarytenoideus lateralis*, *m. arytenoideus transversus*, and *m. arytenoideus obliquus*;
11. Muscles that tense the vocal folds – *m. thyroarytenoideus*, *m. vocalis*, and *m. cricothyroideus*;
12. Muscles that depress the epiglottis – *m. aryepiglotticus* and *m. thyroepiglotticus*.

Cavity of the Larynx

The entrance opening to the **laryngeal cavity** — *aditus laryngis* — is located between the epiglottic cartilage, the apex of the arytenoid cartilage, and the aryepiglottic folds (*plica aryepiglotticae*). The **laryngeal cavity** has a structure similar to an hourglass. Its upper widened part is called the **laryngeal vestibule** (*vestibulum laryngis*). The lower boundary of the vestibule extends down to the vestibular folds (*plica vestibularis*). These folds contain the false vocal ligaments (*ligamenta vestibularia*). Between these folds lies the **rima vestibuli** — the vestibular cleft.

Below the vestibular fold is the true vocal fold (*plica vocalis*), formed by the true vocal ligament (*ligamentum vocale*). Between the vestibular and vocal folds lies the **laryngeal ventricle** (*ventriculus laryngis*).

The narrow slit between the two true vocal cords forms the **rima glottidis**, which leads to the expanded **infraglottic**

cavity (*cavitas infraglottica*). The rima glottidis is divided into the following parts:
a)*pars intermembranacea* —the intermembranous part,
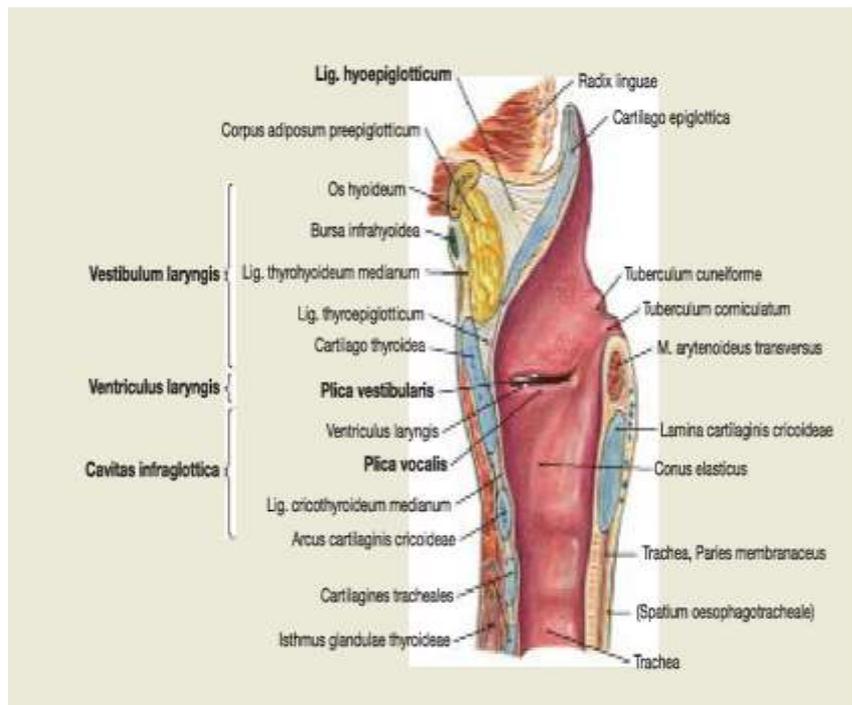
b)*pars intercartilaginea* — the intercartilaginous part,
c) *pars interarytenoidea* — the part between the arytenoid cartilages.
The **infraglottic cavity** continues downward as the **trachea**. The inner surface of the larynx is lined with a mucous membrane (*tunica mucosa*), which contains **laryngeal glands** (*glandulae laryngeales*).

Trachea

The trachea is a continuation of the larynx and extends from the sixth cervical vertebra to the fifth thoracic vertebra. The cervical part of the trachea is called **pars cervicalis**, while the thoracic part is known as **pars thoracica**. The lower end of the trachea divides into two main bronchi. The area where it divides is called the **bifurcatio tracheae**. At the internal surface of the tracheal bifurcation, there is a ridge-like structure known as the **carina tracheae**. Behind the trachea lies the esophagus.

The framework of the trachea is formed by **semicircular cartilaginous rings** called **cartilagines tracheales**. The open ends of these cartilaginous rings are connected by smooth muscle fibers called the **musculus trachealis**. The cartilaginous rings are joined together by **annular ligaments (ligg. annularia)**.

Since the posterior ends of the cartilages are not connected, a membranous wall called the

Thyroid cartilage
Cricothyroid ligament
Common carotid artery
Medial margin of sternocleidomastoid muscle
Cricothyroid muscle
Cricoid cartilage
Thyroid gland
Cupula (dome) of pleura
Trachea

paries membranaceus is formed in this region, consisting of muscle fibers. The inner surface of the trachea is lined with a mucous membrane covered by **ciliated epithelium**.
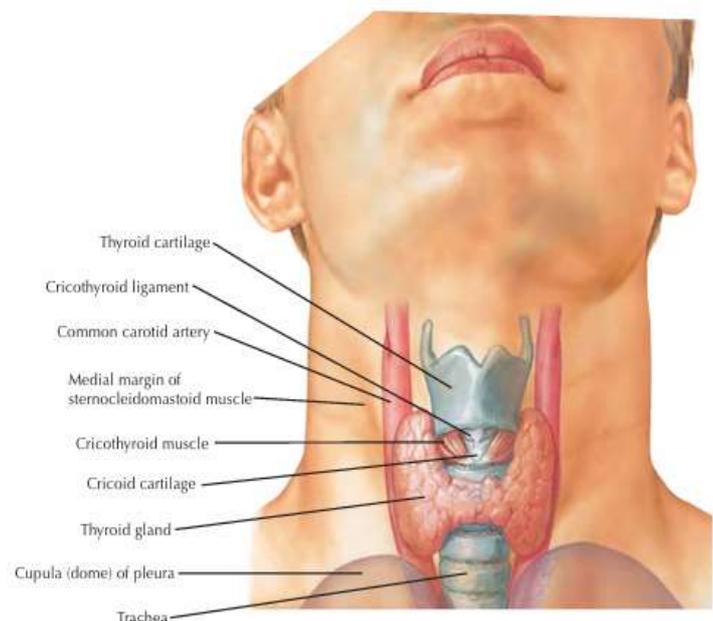
Bronchi

The bronchi (**bronchus**) are organs that conduct air from the trachea to the pulmonary alveoli, ensure its reverse flow, and purify it from harmful particles. The bronchi develop from the **ventral part of the anterior intestinal tube**, and their walls originate from the **endoderm** and **mesoderm**.

As a result of the trachea dividing into two parts, two main bronchi — the **right and left primary bronchi (bronchi principales dexter et sinister)** — are formed. The **right bronchus** is wider but shorter. Since it is positioned more vertically, it appears as a continuation of the trachea. In contrast, the **left bronchus** is narrower, longer, and forms a smaller angle with the trachea.

Trachea and major bronchi of the lungs

© 2008 Encyclopædia Britannica, Inc.

The structure of the bronchial wall is similar to that of the trachea. The main bronchi enter the **hilum of the lungs** and then divide into smaller bronchi.
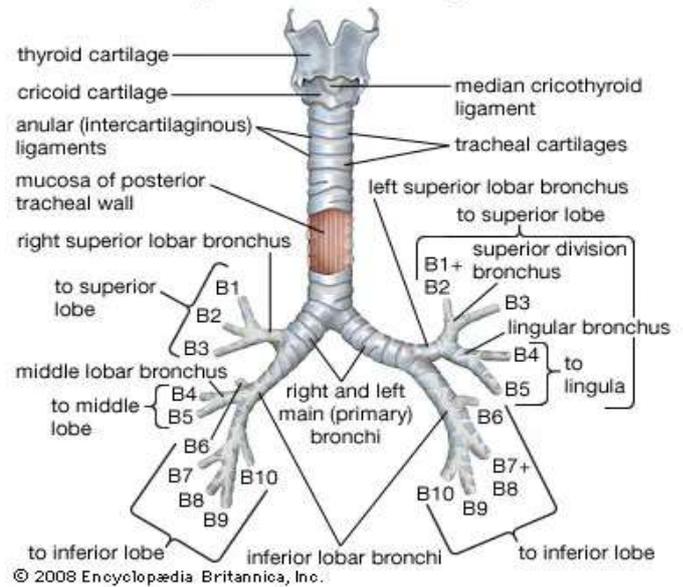
Pulmo

The lungs are located in the thoracic cavity (cavitas thoracis). The right lung is called *pulmo dexter*, and the left lung is called *pulmo sinister*. The right lung is larger in size.

Each lung has a base (basis pulmonis) and an apex (apex pulmonis). The inferior surface of the lung rests on the diaphragm and is called the facies diaphragmatica; the outer surface, facing the ribs, is the facies costalis; and the inner surface, facing the mediastinum, is the facies mediastinalis.

The anterior border is called *margo anterior*, and the inferior border is called *margo inferior*.

On the inner surface of the lung is the hilum pulmonis (lung hilum), which contains the main bronchus, pulmonary artery, nerves, veins, and lymphatic vessels. Together, these structures form the root of the lung (radix pulmonis).
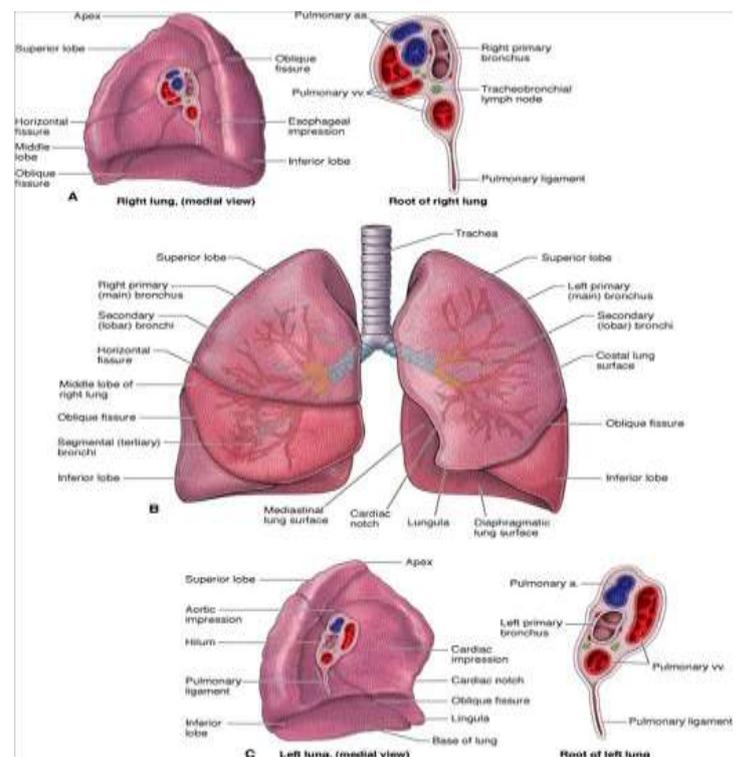
The surface of the lung is divided into lobes by interlobar fissures (fissurae interlobares).

Each lung has an oblique fissure (fissura obliqua) that separates the upper and lower lobes.

The right lung also has an additional horizontal fissure (fissura horizontalis) that separates the upper lobe from the middle lobe.

Thus, the right lung consists of three lobes: *lobus superior, lobus medius,* and *lobus inferior*, while the left lung consists of two lobes: *lobus superior* and *lobus inferior*.

Branching of the bronchi inside the lungs

From the hilum of the lung, the main bronchus divides within the lung according to the number of its lobes. The lobar bronchi (bronchi lobares) are three in the right lung and two in the left lung.

As the lobar bronchi divide further, they form segmental bronchi (bronchi segmentales), each corresponding to a specific lung segment.

At the hilum of the lung, the main bronchus (*bronchus principalis*) enters and then divides within the lung according to the number of lobes. These branches are called lobar bronchi (*bronchi lobares*): there are three in the right lung and two in the left lung.

Further division of the lobar bronchi gives rise to segmental bronchi (*bronchi segmentales*), each corresponding to a bronchopulmonary segment of the lung.

I. Segmental bronchi of the superior lobe of the right lung (*bronchus lobaris superior dexter*):

1. *Bronchus segmentalis apicalis (B-I)* – apical segmental bronchus of the upper lobe;
2. *Bronchus segmentalis posterior (B-II)* – posterior segmental bronchus;
3. *Bronchus segmentalis anterior (B-III)* – anterior segmental bronchus.

II. Segmental bronchi of the middle lobe of the right lung (*bronchus lobaris medius*):

1. *Bronchus segmentalis lateralis (B-IV)* – lateral segmental bronchus;
2. *Bronchus segmentalis medialis (B-V)* – medial segmental bronchus.

III. Segmental bronchi of the inferior lobe of the right lung (*bronchus lobaris inferior dexter*):

1. *Bronchus segmentalis superior (B-VI)* – superior segmental bronchus of the lower lobe;
2. *Bronchus segmentalis basalis medialis (B-VII)* – medial basal segmental bronchus;
3. *Bronchus segmentalis basalis anterior (B-VIII)* – anterior basal segmental bronchus;
4. *Bronchus segmentalis basalis lateralis (B-IX)* – lateral basal segmental bronchus;
5. *Bronchus segmentalis basalis posterior (B-X)* – posterior basal segmental bronchus.

IV. Segmental bronchi of the superior lobe of the left lung (*bronchus lobaris superior sinister*):

1. *Bronchus segmentalis apicoposterior (B-I + B-II)* – apical and posterior segmental bronchus;
2. *Bronchus segmentalis anterior (B-III)* – anterior segmental bronchus;
3. *Bronchus lingularis superior (B-IV)* – superior lingular segmental bronchus;
4. *Bronchus lingularis inferior (B-V)* – inferior lingular segmental bronchus.

V. Segmental bronchi of the inferior lobe of the left lung (*bronchus lobaris inferior sinister*):

1. *Bronchus segmentalis superior (B-VI)* – superior segmental bronchus;
2. *Bronchus segmentalis basalis medialis (B-VII)* – medial basal segmental bronchus;
3. *Bronchus segmentalis basalis anterior (B-VIII)* – anterior basal segmental bronchus;
4. *Bronchus segmentalis basalis lateralis (B-IX)* – lateral basal segmental bronchus;
5. *Bronchus segmentalis basalis posterior (B-X)* – posterior basal segmental bronchus.

Within the lung segments, smaller bronchi called intra-segmental bronchi (*bronchi intrasegmentales*) are found. These bronchi divide repeatedly—about eight times—forming lobular bronchioles (*bronchioli lobulares*), which have an internal diameter of about 1 mm. Each lung contains approximately 800–1000 lobules.

Further division of the lobular bronchioles produces the terminal bronchioles (*bronchioli terminales*), with diameters of 0.3–0.5 mm. The terminal bronchioles branch into respiratory bronchioles (*bronchioli respiratorii*), whose walls give rise

to alveolar ducts (*ductuli alveolares*). These ducts end in alveolar sacs (*sacculi alveolares*), whose walls are covered with blood capillaries—this is where gas exchange occurs.

The structure of the bronchial wall is similar to that of the trachea. The main and lobar bronchi contain C-shaped cartilaginous rings, while smaller bronchi have semilunar cartilaginous plates. Smooth muscle fibers (*fibrae musculares*) lie beneath the cartilage and become circular at the level of smaller bronchi. The inner surface is lined with ciliated epithelial cells and mucous glands.

When the bronchi divide eight times, bronchioles of 1 mm diameter—the lobular bronchioles—are formed. The portion of the lung supplied by a single lobular bronchiole is called a secondary pulmonary lobule (*lobulus pulmonis secundarius*). The terminal bronchiole contains no cartilage and no mucous glands. It continues into the respiratory bronchiole (*bronchiolus respiratorius*), then into the alveolar ducts (*ductuli alveolares*), and finally ends in the alveolar sacs (*sacculi alveolares*). The smallest morphological and functional unit of the lung is the acinus (*acinus pulmonis*). Each acinus consists of one terminal bronchiole and its branches — the respiratory bronchioles, alveolar ducts, and alveolar sacs. The structures formed by one respiratory bronchiole (its alveolar ducts and sacs) are called a primary pulmonary lobule (*lobulus pulmonis primarius*).

The total number of alveolar sacs in both lungs is about 300–350 million, with a combined surface area of 35–100 m². The combination of several acini forms lobules, groups of which constitute segments, and the segments together form the lobes of the lungs — three in the right lung and two in the left.

Pleura

The lungs, as well as the inner walls of the thoracic cavity, are covered by a serous membrane called the *pleura*. The pleura consists of two parts: the serous membrane that covers the outer surface of the lungs is called the *pleura visceralis* (visceral pleura), while the inner surface of the thoracic cavity is lined by the *pleura parietalis* (parietal pleura).
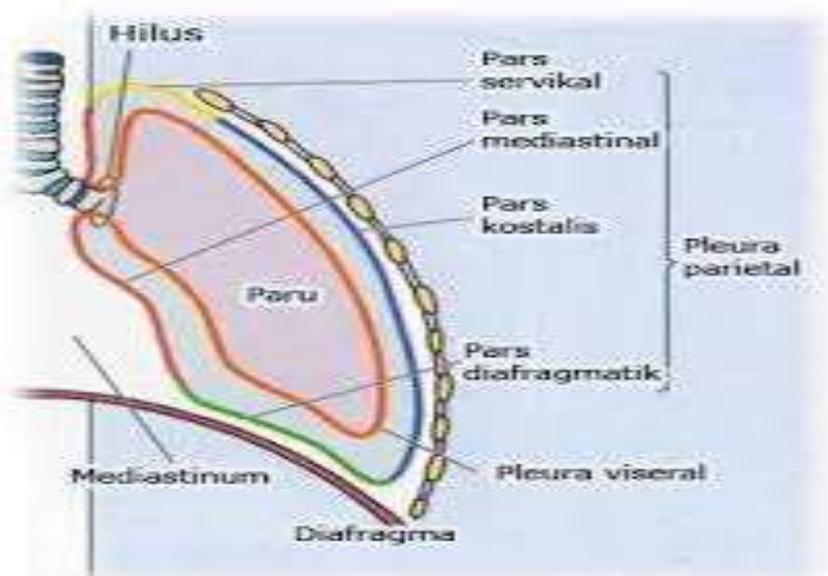
The visceral pleura that surrounds the lungs continues into the parietal pleura at the region of the lung hilum through a fold of tissue known as the *lig. pulmonale*. Both the visceral and parietal pleurae consist of two layers — the *tunica serosa* and the *tela subserosa*.

Although the parietal pleura forms a single continuous serous membrane, it is divided into three parts:

1. **Pleura costalis** — the serous membrane covering the inner surfaces of the ribs.
2. **Pleura diaphragmatica** — the serous membrane covering the upper surface of the diaphragm facing the thoracic cavity.
3. **Pleura mediastinalis** — the serous membrane extending vertically from the inner surface of the sternum to the lateral surface of the vertebral column.

Anteriorly, this serous membrane continues into the *pleura costalis*; inferiorly, into the *pleura diaphragmatica*; and in the region of the lung hilum, into the *visceral pleura*.

The space between the visceral and parietal layers, which contains a small amount of serous fluid and maintains negative pressure, is called the *cavitas pleuralis* (pleural cavity).

There are also recesses (pleural pockets) between the parts of the parietal pleura, known as *recessus pleurales*. On both sides of the thoracic cavity, between the costal and diaphragmatic pleurae, there is a recess called the *recessus costodiaphragmaticus*, located in the lower lateral region of the thorax.

Only on the left side, there is an additional recess located between the *pleura costalis* and *pleura mediastinalis* in the region of the heart — this is called the *recessus costomediastinalis*.

Excretory system

The development of the urinary and genital organs occurs in three stages. At each stage of development, new buds are formed.

In the initial stage, the primary kidney — pronephros — develops; later, a new bud forms the secondary or mesonephric kidney — mesonephros; and in the third stage, the final or permanent kidney — metanephros — appears.
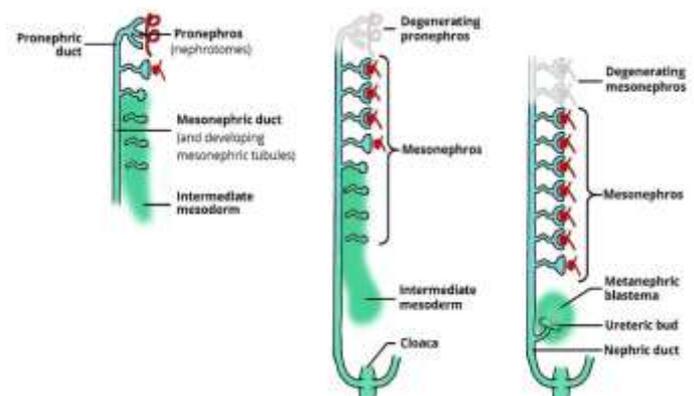
Each stage's bud forms anew, and it is not a continuation of the previous one.

The pronephros stage lasts only about 20–40 hours and then undergoes reduction (degeneration).

The mesonephros develops in pairs on each side of the dorsal body wall from the nephrogenic tissue. Its derivatives consist of a collection of closed tubules. From the abdominal aorta, blood vessels penetrate the closed ends of these tubules, forming glomeruli. The open ends of the mesonephric tubules join together to form larger ducts, which continue as the mesonephric duct (ductus mesonephricus) — also known as the Wolffian duct.

Each Wolffian duct opens separately into the cloaca, a common chamber located in the pelvic region. Because the mesonephros is located along the posterior bo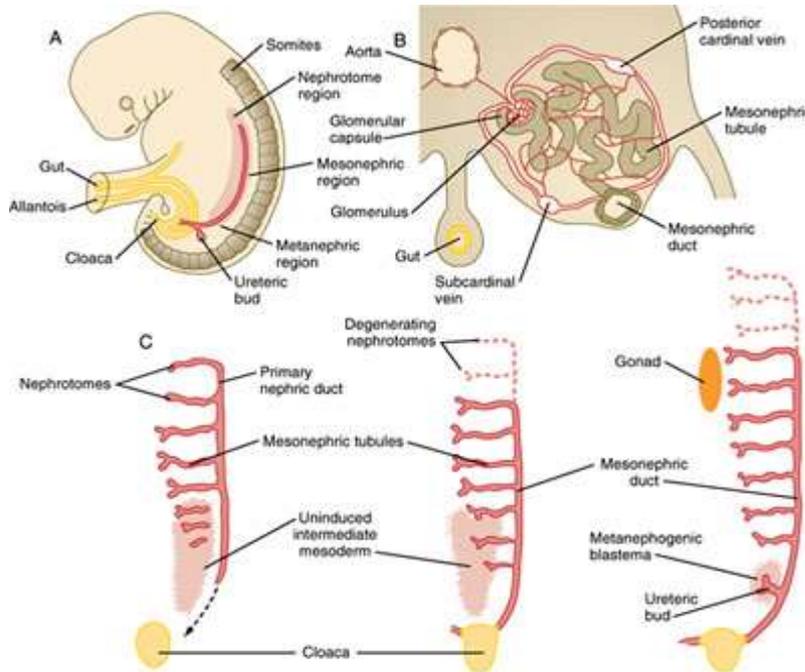dy wall, it is also called the body kidney (corpus renis). The mesonephros does not give rise to the urinary organs but contributes to the development of the genital system.

Parallel to the Wolffian duct, another duct forms — the paramesonephric duct (ductus paramesonephricus), or Müllerian duct.

If the Wolffian ducts open separately into the cloaca, the two Müllerian ducts fuse together before opening into the cloaca, forming a common cavity.

By the fourth week of embryonic development, the metanephric buds — the definitive kidneys (metanephros) — form from the metanephrogenic mesenchyme.

Since the metanephros originates in the pelvic region, it is also called the pelvic kidney.

From the first to second month of embryonic life, both mesonephros and metanephros develop. The metanephros consists of tubules whose closed ends are invaded by capillaries from the abdominal aorta, forming glomeruli. From these tubules, the nephrons of the definitive kidney develop.

From the upper part of the Wolffian duct, near its opening into the cloaca, a blind diverticulum grows upward — this gives rise to the ureter, the renal pelvis (pelvis renalis), and the major and minor calyces (calyces renales majores et

minores). These ducts connect with the metanephros, completing the formation of the urinary system.

Because the urinary organs develop from two different origins, certain developmental anomalies may occur, such as failure of the ureter to connect with the kidney.

From the mesonephros, the testes (in males) or ovaries (in females) develop.

The Wolffian duct (ductus mesonephricus) gives rise to the ductus deferens in males, whereas in females it atrophies.

The Müllerian duct (ductus paramesonephricus) gives rise to the uterine tubes (tubae uterinae) in females, and the fusion of the two ducts forms the uterus. In males, these ducts regress.

In the early stages of embryonic development, the urinary ducts, genital ducts, and intestinal tract open into a common cavity — the cloaca.

During the second week of development, a frontal septum forms within the cloaca, dividing it into parts.

The anterior part gives rise to the urinary bladder (vesica urinaria), while the posterior part, derived from the ectoderm, becomes the lower part of the rectum

- Kidney
- Internal structure of kidney
- Renal pelvis
- Major and minor calyces
- Ureter
- Urinary bladder
- Urethra
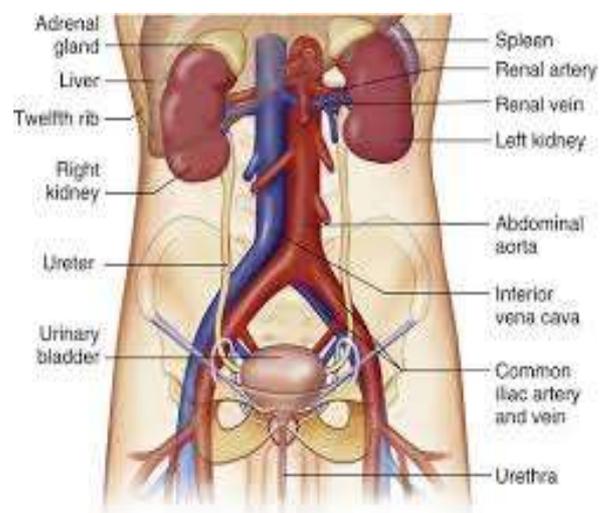
Kidney

The kidney is located on the posterior wall of the abdominal cavity and is considered an **extraperitoneal organ** in relation to the peritoneum. The **right kidney** is positioned slightly lower than the left. The kidney is a **bean-shaped organ**, with the following parts:

- **Upper pole** – *extremitas superior*
- **Lower pole** – *extremitas inferior*
- **Medial border** – *margo medialis*

- **Lateral border** – *margo lateralis*
- **Anterior surface** – *facies anterior*
- **Posterior surface** – *facies posterior*

On the medial border of the kidney, there is a depression called the **renal hilum (hilus renalis)**. The renal artery, renal vein, lymphatic vessels, nerves, and ureter pass through this hilum. Externally, the kidney is surrounded by a **fibrous capsule (capsula fibrosa)**. Outside this capsule lies a layer of **adipose tissue (capsula adiposa)**. Covering both of these layers is a **connective tissue fascia (fascia renalis)**, which is a continuation of the fascia of the posterior abdom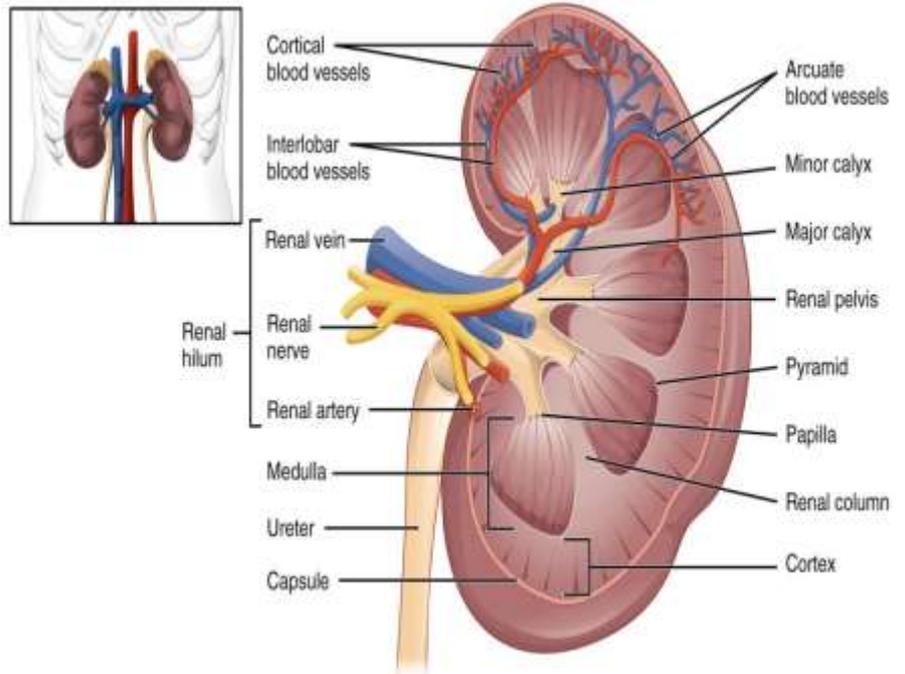inal wall muscles. At the **lateral border** of the kidney, this fascia divides into two layers — **anterior** and **posterior** — which enclose the kidney but do not fuse at the **medial border**.

The **anterior layer** of the fascia runs along the anterior surfaces of the renal vessels, aorta, and inferior vena cava, and then merges with the fascia on the opposite side. The **posterior layer** passes behind the blood vessels and attaches to the vertebral bodies. At the **upper pole** of the kidney, the anterior and posterior layers of the fascia **fuse**, whereas at the **lower pole**, they **remain separate**. Within the fascia of the kidney, **fatty bodies (corpus adiposum pararenale)** are found.

Internal structure of kidney

In a longitudinal section of the kidney, two distinct regions can be observed: the outer cortex (cortex renis) and the inner medulla (medulla renis). Although there is a clear boundary between these two regions, the cortical substance extends into the medulla, forming renal columns (columnae renales). As a result, the medullary substance is divided into pyramid-shaped structures known as renal pyramids (pyramides renales). The base of each pyramid faces the cortex, while its apex points toward the renal hilum. The apex of a pyramid is called the renal papilla (papilla

renalis). The small area at the tip of the papilla is known as the cribriform area (area cribrosa), which contains many small openings — foramina papillaria. The medullary rays of the kidney extend into the cortex and form the pars radiata region, while the intervening cortical tissue is called pars convoluta.
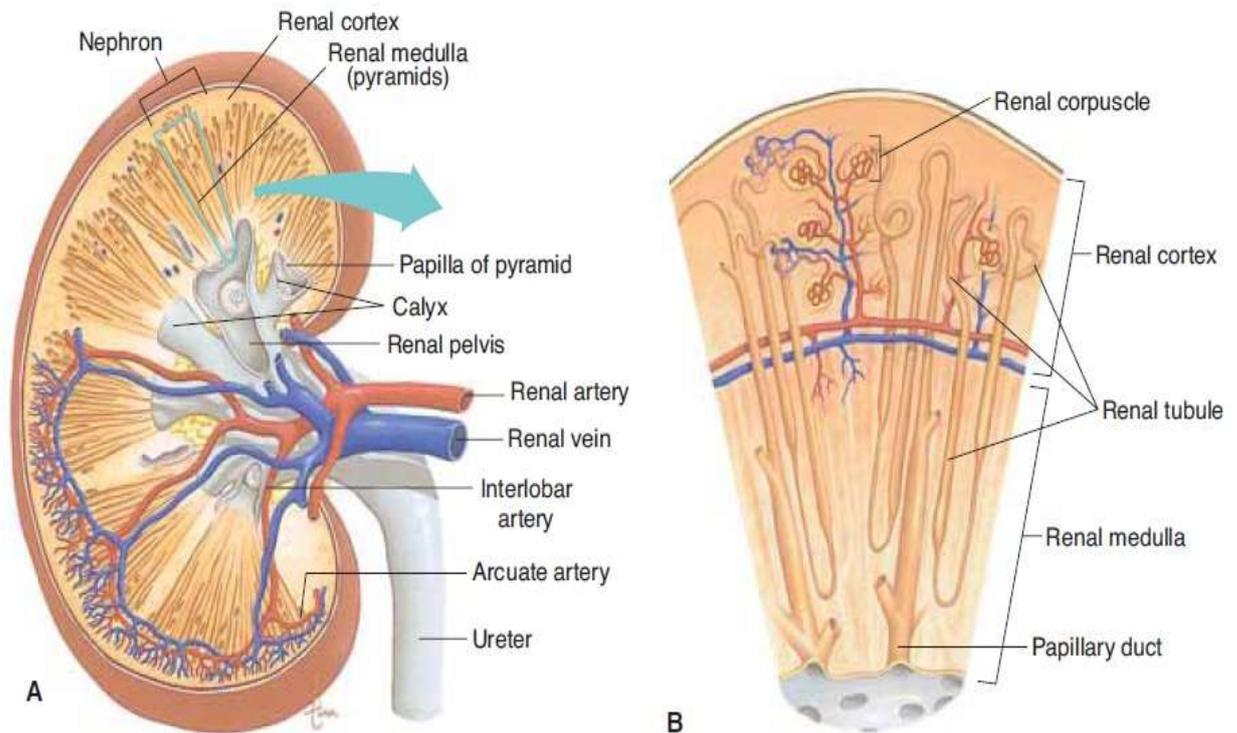
Together, the pars convoluta and pars radiata form a cortical lobule (lobulus corticalis). Thus, each cortical lobule consists of two main parts: the radiated part (pars radiata) containing the straight tubules of nephrons, and the convoluted part (pars convoluta) containing the convoluted tubules. The renal cortex contains straight and convoluted segments of nephrons, whereas the renal medulla mainly contains the straight parts and collecting ducts (ductus papillares), which open at the papillary foramina. The nephron is the morphological and functional unit of the kidney. It consists of a renal corpuscle (corpusculum renis) and the associated renal tubules (proximal convoluted tubule, loop of Henle, distal convoluted tubule, and collecting duct). Each renal tubule begins as a blind-ended sac, invaginated at one point to form a double-walled capsule, called the Shumlyansky–Bowman capsule (capsula glomeruli). Between its two layers is the capsular space, while inside lies a tuft of capillaries known as the glomerulus. Together, the capsule and glomerulus form the renal corpuscle, located in the pars convoluta of the cortex. The glomerulus filters blood plasma to produce primary urine, which passes into the renal tubules. As the filtrate moves through these tubules, water, glucose, amino acids, and salts are reabsorbed into the bloodstream, forming secondary (final) urine. Each kidney contains about one million nephrons. The average nephron length is 35–50 mm, and

the Bowman capsule has a diameter of about 0.2 mm with around 50 capillary loops. Blood pressure in the renal capillaries is relatively high — about 70 mmHg — due to the short distance between the renal arteries (arising from the abdominal aorta) and the glomerular capillaries. The total surface area of the filtering capillaries is 1.5–2 m². At the point where the afferent arteriole (vas afferens) enters the glomerulus, myoepithelial (juxtaglomerular) cells are located in the vessel wall. These cells can constrict the arteriole, temporarily stopping blood flow to some nephrons, thus halting urine formation in those units. These cells also secrete renin, a hormone that increases blood pressure. Juxtamedullary nephrons are located near the boundary between the cortex and medulla. In these nephrons, the afferent (vas afferens) and efferent (vas efferens) arterioles have similar diameters, and their vessel walls lack myoepithelial cells. The efferent arterioles of these nephrons do not form secondary capillary networks but drain directly into venous vessels. The kidney receives blood through the renal artery (a. renalis), which branches into a. polaris superior, a. centralis, and a. polaris inferior. These vessels form interlobar arteries (aa. interlobares), which, at the boundary between cortex and medulla, give rise to arcuate arteries (aa. arcuatae). From the arcuate arteries arise interlobular arteries (aa. interlobulares), which further give rise to afferent arterioles (vas afferens) supplying the glomeruli. The glomerular capillaries drain into efferent arterioles (vas efferens), which then form another network of capillaries around the renal tubules before uniting into venules and renal veins. Thus, two types of capillary networks are found in the kidney: (1) the miraculous (portal) arterial network, between the afferent and efferent arterioles (within the glomerulus), and (2) the ordinary capillary network, between an arteriole and a venule (around the tubules). This double capillary system ensures efficient filtration and reabsorption of substances from the blood. The kidney is divided into five segments:
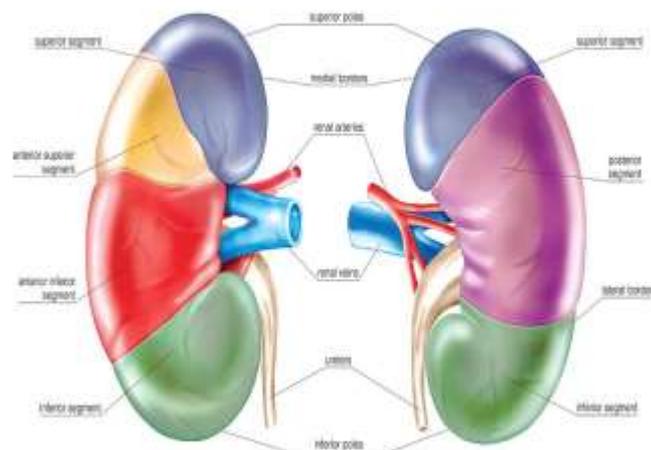
(1) segmentum superius — upper segment;
(2) segmentum anterius superius — upper part of the anterior segment;
(3) segmentum anterius inferius — lower part of the anterior segment;
(4) segmentum inferius — lower segment; and

(5) segmentum posterius — posterior segment.

Renal pelvis, Major and minor calyces, Ureter

The secondary urine formed in the kidney drains through the foramina papillaria located at the apex of the renal papillae, then passes into the minor calyces, major calyces, and the renal pelvis, and finally enters the ureter.

There are about 8–9 minor calyces (calyces renales minores) in each kidney. One part of the wall of each minor calyx covers the papillary area of 1–2 renal pyramids, while the other part continues into the major calyces (calyces renales majores).

There are three major calyces:

      1. Calyx superior — upper calyx
      2. Calyx medius — middle calyx
      3. Calyx inferior — lower calyx

The major calyces join together to form the renal pelvis (pelvis renalis). The ureter begins from the renal pelvis and continues down to the base of the urinary bladder. It is an extraperitoneal organ located along the posterior abdominal wall. The ureter is about 30 cm long and has an internal diameter of about 4 mm. Its abdominal portion, which extends to the pelvic brim (linea terminalis), is called the pars abdominalis; the part within the pelvic cavity is called the pars pelvina; and the part within the bladder wall is called the pars intramuralis.

The ureter has four natural constrictions:

1. At the junction between the renal pelvis and the ureter
2. At the transition between the abdominal and pelvic portions
3. Along the pelvic portion of the ureter
4. At the entry point into the wall of the urinary bladder

The walls of the renal pelvis, calyces, and ureter consist of three layers:

1. Outer layer — tunica adventitia
2. Middle layer — tunica muscularis, composed of two layers of smooth muscle fibers
3. Inner mucous membrane — tunica mucosa

Renal cortex
Renal capsule
Renal medulla
Minor calyx
Major calyx
Renal sinus
Renal column
Fat in renal sinus
Renal pelvis
Renal papilla
Renal pyramid
Ureter
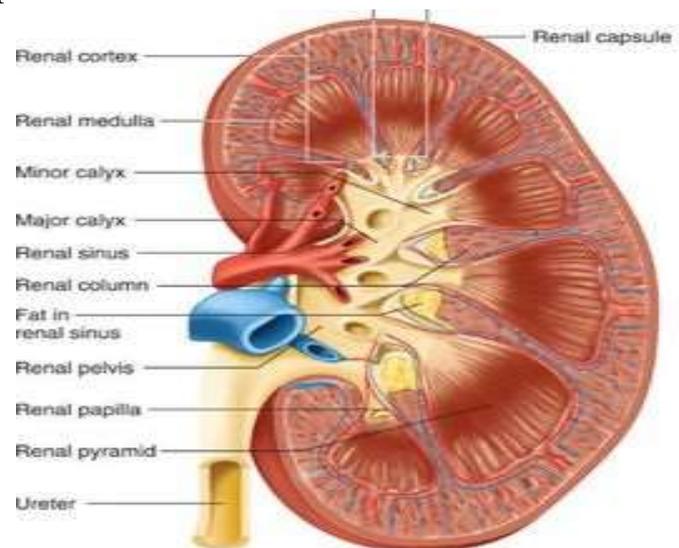
Urinary bladder

The urinary bladder (vesica urinaria) has a capacity of 500–700 ml and is located in the pelvic cavity. As the bladder fills with urine, it rises upward into the abdominal cavity. The base (fundus vesicae) of the bladder is directed posteriorly and downward. The neck (cervix vesicae) continues into the urethra. Between the apex vesicae (the anterior end of the bladder, located near the anterior abdominal wall) and the fundus, lies the body (corpus vesicae) of the bladder. From the apex of the bladder to the umbilical region of the anterior abdominal wall runs the median umbilical ligament (lig. umbilicale medianum) — a fibrous remnant of the fetal urachus.

The external surface of the bladder is covered by the serous layer (tunica serosa). Beneath it lies the muscular layer (tunica muscularis), which consists of outer longitudinal, middle circular, and inner longitudinal and transverse bundles.

These smooth muscle fibers together form the detrusor muscle (m. detrusor urinae), whose main function is to expel urine from the bladder.

At the internal urethral orifice (ostium urethrae internum), circular muscle fibers are well developed, forming the internal sphincter muscle of the bladder (m. sphincter vesicae).

Beneath the muscular layer lies the submucosal layer (tela submucosa), which is well developed, except in the trigone of the bladder (trigonum vesicae) — in this region, the mucosa is firmly fused with the muscular layer. The trigone of the bladder is a triangular area located between the two ureteric openings (ostia ureterum) and the internal urethral orifice (ostium urethrae internum).

Male urinary bladder and urethra

peritoneum — neck of bladder — fundus of bladder
ductus (vas) deferens
body of urinary bladder
superior pubic ramus
tendinous arch of levator ani muscle
uvula of bladder
paravesical space and venous plexus
prostatic fascia
obturator internus muscle
prostate and prostatic urethra
levator ani muscle
seminal colliculus (verumontanum)
bulbourethral (Cowper) gland
sphincter urethrae muscle in deep perineal space
inferior pubic ramus
ischiocavernosus muscle
crus of penis
vestibular bulb
investing (Gallaudet) fascia
bulbospongiosus muscle
membranous layer of subcutaneous tissue of perineum (Colles fascia)
bulbar part of spongy urethra

The inner surface of the bladder is lined by the mucous membrane (tunica mucosa), which contains vesical glands (glandulae vesicales).
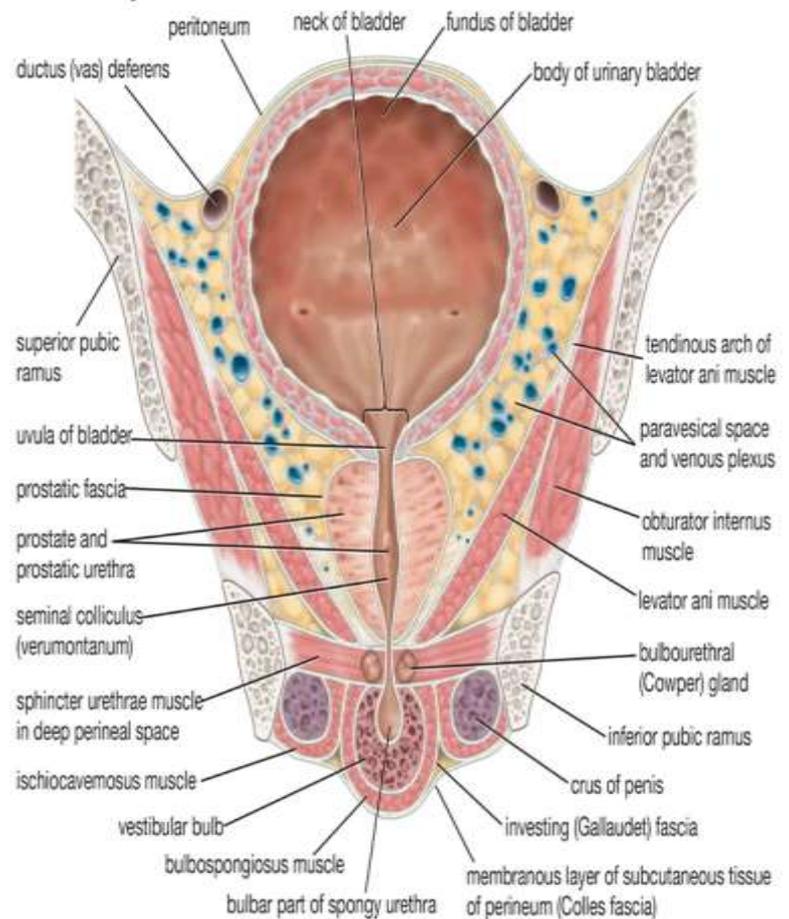
When the bladder is empty, the mucous membrane forms numerous folds, which disappear as the bladder fills.

The outermost covering of the bladder is the serous membrane (tunica serosa) — a continuation of the peritoneum.

Beneath it lies the subserous layer (tunica subserosa).

The muscular layer (tunica muscularis) is composed of the following muscles:

 1. m. trigoni vesicae — the muscle of the bladder trigone, consisting of a deep part (m. trigoni vesicae profundus) and a superficial part (m. trigoni vesicae superficialis).

 2. m. detrusor vesicae — the muscle responsible for expelling urine.

Beneath the muscular layer lies the submucosal tissue (tela submucosa), which is absent in the trigone area.
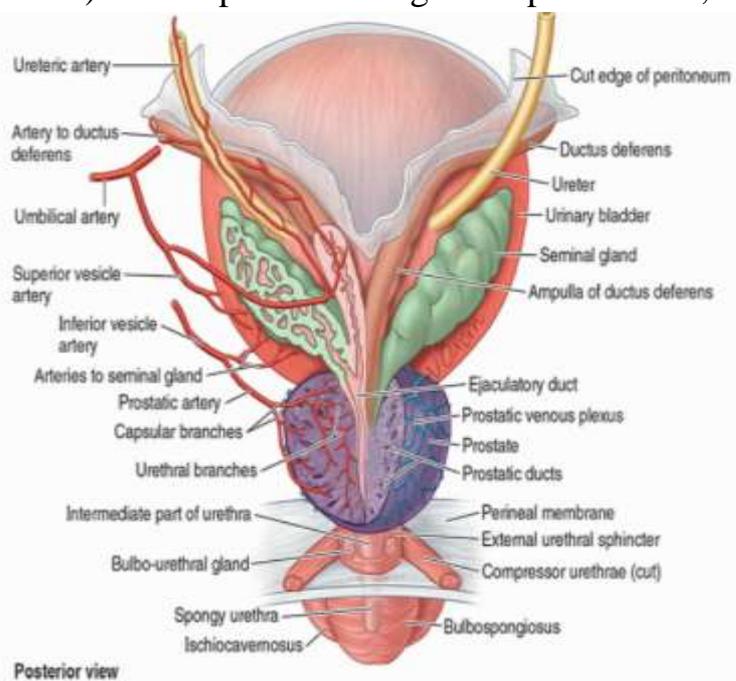
The inner surface of the bladder is covered by the mucous membrane (tunica mucosa).

The urinary bladder is connected externally to several muscles:

1. m. pubovesicalis — extends between the pubic bone and the bladder;

 2. m. rectovesicalis — stretches between the rectum and the bladder;

 3. In males, between the prostate gland and the bladder lies the m. vesicoprostaticus;

 4. In females, between the bladder and the vagina lies the m. vesicovaginalis.

Urethra

The female urethra — urethra feminina — extends between the internal urethral opening (ostium urethrae internum) in the urinary bladder and the external urethral opening (ostium urethrae externum). As it passes through the pelvic wall, it is surrounded by transverse striated muscle fibers forming a ring called the m. sphincter urethrae. The wall of the female urethra consists of a muscular layer (tunica muscularis), a submucosal layer (tela submucosa), and a mucous membrane (tunica mucosa). The urethral glands (glandulae urethrales) open into its lumen. The male urethra — urethra masculina

Ureteric artery
Artery to ductus deferens
Umbilical artery
Superior vesicle artery
Inferior vesicle artery
Arteries to seminal gland
Prostatic artery
Capsular branches
Urethral branches
Intermediate part of urethra
Bulbo-urethral gland
Spongy urethra
Ischiocavernosus
Posterior view

Cut edge of peritoneum
Ductus deferens
Ureter
Urinary bladder
Seminal gland
Ampulla of ductus deferens
Ejaculatory duct
Prostatic venous plexus
Prostate
Prostatic ducts
Perineal membrane
External urethral sphincter
Compressor urethrae (cut)
Bulbospongiosus

— also extends between the internal urethral opening (ostium urethrae internum) and the external urethral opening (ostium urethrae externum). It is divided into the following parts:
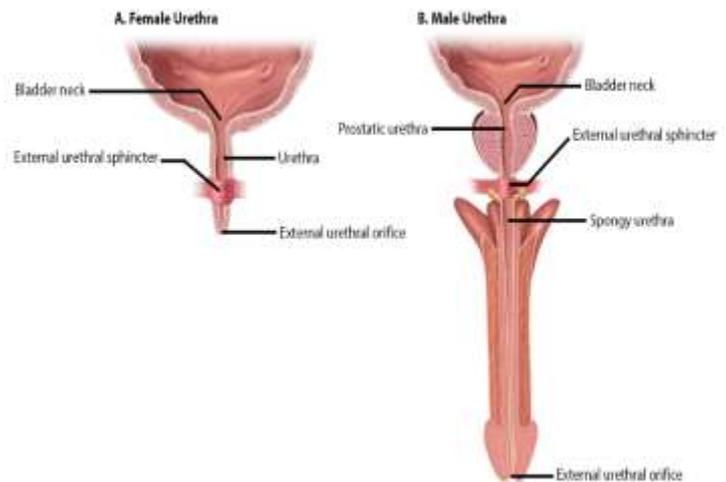
1. Pars intramuralis (preprostatica) — the portion within the bladder wall up to the prostate gland;

2. Pars prostatica — the part passing through the prostate gland;

3. Pars intermedia (membranacea) — the shortest and narrowest part, located between the urogenital diaphragm muscles;

4. Pars spongiosa — the longest portion running through the penis.

I. Pars prostatica — the initial section of the urethra, located below the urinary bladder. On its posterior wall is a raised area called the colliculus seminalis (seminal colliculus). This area also contains the crista urethralis (urethral crest) and the small prostatic utricle (utriculus prostaticus). The muscular layer (tunica muscularis) is composed mainly of circular smooth muscle fibers (stratum circulare), which form the m. sphincter urethrae internus (internal urethral sphincter), also known as m. sphincter supracollicularis. This muscle contracts to prevent the mixing of urine and seminal fluid. Longitudinal muscle fibers (stratum longitudinale) are also present.

II. Pars membranacea — the shortest and narrowest part of the urethra, passing through the urogenital diaphragm. It is surrounded by transverse striated muscle fibers forming the m. sphincter urethrae externus (external urethral sphincter).

III. Pars spongiosa — the terminal and longest part of the urethra, passing through the penis. It contains small dilations (fossa navicularis urethrae), urethral glands (glandulae urethrales), and a muscular layer consisting mainly of longitudinal muscle fibers (stratum longitudinale). The inner surface is lined with a mucous membrane (tunica mucosa). The urethra ends with the external urethral opening (ostium urethrae externum).

Questions on the Digestive, Excretory and Respiratory Systems

1. Into what parts is the cavitas oris (oral cavity) divided?
2. What parts make up the dens (tooth)?
3. What are the three main parts of the lingua (tongue) called?
4. What is the difference between the palatum durum (hard palate) and the palatum molle (soft palate)?
5. Where is the tonsilla palatina (palatine tonsil) located?
6. How many parts does the pharynx consist of, and what are their names?
7. How many layers does the wall of the oesophagus consist of?
8. What parts form the ventriculus (stomach)?
9. How many lobes are there in the hepar (liver), and what are their names?
10. With which organ is the vesica fellea (gallbladder) connected?
11. Where is the pancreas located, and what is its main function?
12. List the parts of the intestinum tenue (small intestine) in order.
13. What parts make up the intestinum crassum (large intestine)?
14. What function does the lien (spleen) perform in the body?
15. The ductus choledochus (common bile duct) is formed by the union of which two ducts?
16. What is the pleura, and what are its main parts called?
17. What is the difference between the visceral pleura and the parietal pleura?
18. Which surface is covered by the pleura diaphragmatica?
19. What is the pleural cavity (*cavitas pleuralis*), and what type of pressure does it contain?
20. What is meant by *recessus pleuralis*?
21. Where is the *recessus costodiaphragmaticus* located?
22. What is the name of the recess found only in the left pleural cavity?
23. Where is the mediastinum located, and what structures form its walls?
24. What are the main divisions of the mediastinum?
25. What organs are located in the anterior mediastinum (*mediastinum anterius*)?
26. Which organs are found in the posterior mediastinum (*mediastinum posterius*)?
27. Where is the boundary between the superior and inferior mediastinum?
28. Into how many parts is the inferior mediastinum divided, and what are their names?
29. Which structures are found in the middle mediastinum (*mediastinum medium*)?
30. What is the anatomical significance of the *ligamentum pulmonale*?

31. What is the name of the muscle ring that surrounds the female urethra?
32. How many main layers form the wall of the female urethra?
33. What type of glands open into the female urethra?
34. What are the two openings that mark the beginning and end of the female urethra?
35. Which muscle prevents the mixing of urine and seminal fluid in males?
36. What is the shortest part of the male urethra?
37. In which part of the male urethra is the colliculus seminalis located?
38. What is the function of m. sphincter urethrae externus?
39. What is the longest part of the male urethra?
40. What is the name of the small dilated area in the spongy part of the urethra?
41. Through which organ does the spongy urethra pass?
42. What type of tissue makes up the tunica muscularis of the urethra?
43. What is the internal opening of the urethra called?
44. Which part of the urethra passes through the prostate gland?
45. What type of epithelium lines the inner surface of the urethra?

Tests on the Digestive, Excretory and Respiratory Systems

1. Which number tooth is the dens caninus (canine tooth)?
   A) I
   B) II
   C) III
   D) IV
2. Where is the radix linguae (root of the tongue) located?
   A) In the anterior 1/3 of the tongue
   B) In the posterior 1/3 of the tongue
   C) In the middle part of the tongue
   D) In front of the apex linguae
3. Where are the papillae vallatae (vallate papillae) located?
   A) Apex linguae
   B) Facies inferior linguae
   C) Pars dorsalis linguae
   D) Radix linguae
4. Where is the glandula parotidea (parotid gland) located?
   A) Regio parotideomasseterica
   B) Regio submandibularis

C) Regio sublingualis

D) Regio buccalis

5. What type of tissue forms the palatum molle (soft palate)?

A) Fibrous plate

B) Muscular tissue

C) Cartilaginous tissue

D) Bone tissue

6. Where is the tonsilla palatina (palatine tonsil) located?

A) In the fossa tonsillaris

B) In the radix linguae

C) In the nasopharynx

D) In the cavitas oris propria

7. What is the lowest part of the pharynx called?

A) Nasopharynx

B) Oropharynx

C) Laryngopharynx

D) Hypopharynx

8. How many physiological constrictions does the oesophagus have?

A) 2

B) 3

C) 4

D) 5

9. What is the cardia ventriculi?

A) The lower part of the stomach

B) The opening into the stomach

C) The exit from the stomach

D) The curvature of the stomach

10. In which part of the stomach is the pylorus ventriculi located?

A) Corpus ventriculi

B) Fundus ventriculi

C) Pars pylorica

D) Curvatura major

11. How many layers does the tunica muscularis ventriculi consist of?

A) 2

B) 3

C) 4

D) 5

12. How many lobes can be distinguished in the hepar (liver)?

A) 2

B) 3

C) 4

D) 5

13. What structures pass through the porta hepatis?

A) Vena cava superior, arteria hepatica, ductus hepaticus communis

B) Vena portae, arteria hepatica propria, ductus hepaticus communis

C) Vena cava inferior, arteria splenica, ductus choledochus

D) Vena portae, arteria gastrica, ductus cysticus

14. Which row correctly lists the three parts of the vesica fellea (gallbladder)?

A) Fundus, corpus, collum

B) Basis, corpus, apex

C) Fundus, radix, ductus

D) Collum, radix, apex

15. From which structure does the exocrine part of the pancreas begin?

A) Ductus pancreaticus major

B) Acini pancreaticae

C) Islets of Langerhans

D) Ductus pancreaticus accessorius

16. The ductus choledochus (common bile duct) is formed by the union of which two ducts?

A) Ductus hepaticus communis and ductus cysticus

B) Ductus hepaticus dexter and sinister

C) Ductus pancreaticus and ductus cysticus

D) Ductus hepaticus sinister and choledochus

17. With which organ is the duodenum anatomically closely connected?

A) Pancreas

B) Spleen

C) Vesica fellea

D) Colon sigmoideum

18. What are the haustrae coli in the intestinum crassum (large intestine)?

A) Protrusions on the intestinal wall

B) Pockets inside the intestine

C) Fat pouches

D) The midline of the intestine

19. To which system does the lien (spleen) belong?

A) Digestive system

B) Lymphatic system

C) Respiratory system

D) Urinary system

20. The lungs are covered externally by which membrane?
    A) Fascia thoracica
    B) Pleura
    C) Peritoneum
    D) Pericardium
21. What is the part of the pleura that covers the surface of the lungs called?
    A) Pleura costalis
    B) Pleura parietalis
    C) Pleura visceralis
    D) Pleura mediastinalis
22. Which part of the pleura covers the inner wall of the thoracic cavity?
    A) Pleura visceralis
    B) Pleura parietalis
    C) Pleura diaphragmatica
    D) Pleura pulmonalis
23. What is the name of the pleural cavity?
    A) Cavitas mediastini
    B) Cavitas thoracica
    C) Cavitas pleuralis
    D) Cavitas pulmonalis
24. How many parts does the parietal pleura have?
    A) 2
    B) 3
    C) 4
    D) 5
25. What does the *pleura diaphragmatica* cover?
    A) The inner surface of the ribs
    B) The thoracic surface of the diaphragm
    C) The surface of the lungs
    D) The heart
26. Where does the visceral pleura continue into the parietal pleura?
    A) At the apex of the lung
    B) At the root of the lung
    C) In the middle mediastinum
    D) At the diaphragm
27. What type of pressure is found in the pleural cavity (*cavitas pleuralis*)?
    A) Positive
    B) Zero

C) Negative

D) Variable

28. What is the space between the pleura covering the ribs and the diaphragm called?

A) Recessus costomediastinalis

B) Recessus costodiaphragmaticus

C) Recessus pulmonalis

D) Recessus apicalis

29. Which recess is found only in the left pleural cavity?

A) Recessus diaphragmaticus

B) Recessus pulmonalis

C) Recessus costomediastinalis

D) Recessus pleuralis

30. Where is the mediastinum located?

A) In the abdominal cavity

B) Between the lungs

C) Around the heart

D) Below the diaphragm

31. How many main parts does the mediastinum have?

A) 2

B) 3

C) 4

D) 5

32. Which organs are located in the anterior mediastinum?

A) Esophagus and aorta

B) Heart, pericardium, and ascending aorta

C) Lungs and bronchi

D) Diaphragm and trachea

33. What is located in the posterior mediastinum?

A) Thymus gland

B) Heart

C) Esophagus and thoracic aorta

D) Pulmonary veins

34. Into how many divisions is the inferior mediastinum divided?

A) 2

B) 3

C) 4

D) 5

35. The female urethra extends between:

A) The renal pelvis and urinary bladder
B) The internal and external urethral openings
C) The ureters and urinary bladder
D) The kidney and ureter

36. The female urethra is surrounded by transverse striated muscle fibers forming:
A) M. sphincter urethrae
B) M. detrusor vesicae
C) M. sphincter vesicae
D) M. levator ani

37. The wall of the female urethra consists of all EXCEPT:
A) Tunica muscularis
B) Tela submucosa
C) Tunica serosa
D) Tunica mucosa

38. The glands that open into the female urethra are called:
A) Glandulae renales
B) Glandulae urethrales
C) Glandulae vesicales
D) Glandulae bulbourethrales

39. The male urethra extends from:
A) Kidney to bladder
B) Ureter to bladder
C) Internal to external urethral opening
D) Penis to testis

40. The pars intramuralis of the male urethra is located:
A) In the bladder wall before the prostate
B) Inside the prostate gland
C) In the penis
D) Inside the testis

41. The part of the male urethra passing through the prostate is called:
A) Pars spongiosa
B) Pars prostatica
C) Pars membranacea
D) Pars intramuralis

42. The shortest and narrowest part of the male urethra is:
A) Pars spongiosa
B) Pars prostatica
C) Pars membranacea

D) Pars intramuralis

43. The colliculus seminalis is found in which part of the urethra?
    A) Pars spongiosa
    B) Pars prostatica
    C) Pars membranacea
    D) Pars intramuralis

44. The m. sphincter urethrae internus prevents:
    A) Urine from entering the ureters
    B) Seminal fluid from mixing with urine
    C) Urine from entering the prostate
    D) Urine from entering the kidneys

45. The m. sphincter urethrae externus is located in:
    A) Pars membranacea
    B) Pars prostatica
    C) Pars spongiosa
    D) Pars intramuralis

46. The longest part of the male urethra is:
    A) Pars membranacea
    B) Pars intramuralis
    C) Pars spongiosa
    D) Pars prostatica

47. The small dilations in the spongy part of the urethra are called:
    A) Fossa navicularis urethrae
    B) Utriculus prostaticus
    C) Colliculus seminalis
    D) Crista urethralis

48. The male urethra ends at:
    A) Ostium urethrae internum
    B) Ostium urethrae externum
    C) Ostium vesicae urinariae
    D) Ostium renale

49. The inner surface of the urethra is lined by:
    A) Tunica adventitia
    B) Tunica muscularis
    C) Tunica mucosa
    D) Tela submucosa

Situation task

References

1. Bahodirov, F. (2018). Human Anatomy. Tashkent: Uzbekistan Medical Academy Publishing House.

2. Karimov, A., & Gadayev, A. (2019). Basics of Human Physiology and Anatomy. Tashkent: Science and Technology Publishing.

3. Ahmedov, A. (2020). Human Anatomy: A Study Guide. Tashkent: Innovative Development Publishing House.

4. Tortora, G. J., & Derrickson, B. (2021). Principles of Anatomy and Physiology (16th ed.). Hoboken, NJ: Wiley.

5. Marieb, E. N., & Hoehn, K. (2020). Human Anatomy & Physiology (11th ed.). Pearson Education.

6. Ross, M. H., & Pawlina, W. (2021). Histology: A Text and Atlas (8th ed.). Wolters Kluwer.

7. Moore, K. L., Dalley, A. F., & Agur, A. M. R. (2022). Clinically Oriented Anatomy (9th ed.). Wolters Kluwer.

8. Sadler, T. W. (2021). Langman's Medical Embryology (15th ed.). Wolters Kluwer.

9. Shermukhamedov, N., & Qodirova, D. (2017). Human Anatomy: A Laboratory Manual. Tashkent: Medical Publishing House.

10. Standring, S. (2020). Gray's Anatomy: The Anatomical Basis of Clinical Practice (42nd ed.). Elsevier.