METHODICAL GUIDANCE
for the lecture

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<th>Academic subject</th>
<th>Human Anatomy</th>
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<tr>
<td>Module No 2</td>
<td>&quot;Splanchnology. Central nervous system and sensory organs&quot;</td>
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<tr>
<td>Year of study</td>
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<tr>
<td>Faculty</td>
<td>Foreign students' training faculty, specialty «Medicine»</td>
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Poltava – 2020
1. Educational basis of the topic

Splanchnology is a branch of anatomy, which studies the structure of the internal organs. *Internal organs*, *splanchna* (Greek) or *viscera* (Latin) are the organs located mainly in body cavities (thoracic or abdominal) and in the areas of head and neck. Internal organs form alimentary, respiratory, urinary and genital systems (the heart will be discussed in ‘Angiology’ section). The internal organs are responsible for important functions of the organism: homeostasis maintenance, metabolism, water and gases turnover, excretion of metabolic products and reproduction. The internal organs are traditionally referred to vegetable existence organs (*vegetabilis*) unlike animal existence organs (*soma*) which in turn are responsible for movements of the whole organism or its separate pars and environmental communication.

The main gross structural pattern for the hollow organs is a tube. The digestive tube has two openings: inlet and outlet; the respiratory system and the genitourinary apparatus have only one opening. The tubular organs communicate with parenchymal internal organs.

The respiratory system comprises the organs responsible for the air passage, respiratory metabolism, voice producing, inhaled air perception, clearing, warming and humidification. These organs may be divided into the respiratory tracts (upper and lower) and the lungs. The pulmonary alveoles are directly responsible for diffusion of the gases (oxygen and carbon dioxide) to blood and back. The upper respiratory tracts comprise the nasal cavity the oropharynx and laryngopharynx. The lower respiratory tracts consist of the larynx, the trachea and the bronchi. The respiratory system features a special complex voice-formation organ — the larynx and the initial part of the olfaction organ. One of the key features of the respiratory tracts is that their walls are made of tough tissues (bone and cartilaginous), which prevent them from collapsing allowing the air circulate freely despite pressure difference during inhalation and exhalation. The air inspired may pass not only through the nasal cavity but also through the oral cavity.

2. Learning objectives of the lecture:

- To study the fundamental data on internal organs.
- Study the areas and lines of the abdomen.
To study the general anatomy of the digestive tract and the differences of its various departments.

To study the peritoneum, its derivatives and its relationship with internal organs.

To study the peculiarities of the process of digestion in various parts of the digestive tube.

To study the fundamental data on the respiratory system.

To study the general anatomy of the respiratory system.

To study the clinical aspects of the respiratory system.

3. Objectives of developing the future specialist’s personality (educational aims and objectives): familiarization with axiological, ethical and deontological principles of medical profession.

4. Interdisciplinary integration

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<tr>
<td>Biology</td>
<td>Phylogeny of the digestive and respiratory systems</td>
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<td>Anatomy, histology</td>
<td>Ontogeny of the digestive and respiratory systems;</td>
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<td>The name of pathologies</td>
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5. The plan and organization of lecture structure

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<th>No</th>
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<th>Type of lecture. Means of motivation. Teaching materials</th>
<th>Time allocation</th>
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<td>1.</td>
<td>The preparatory stage</td>
<td>pp. 1-2</td>
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<td>Determining the relevance of the topic, learning objectives and motivation.</td>
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<td>2.</td>
<td>The main stage</td>
<td>Introductory lecture Feedback and questions to students</td>
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<td>Delivering the lecture material according to the plan:</td>
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<td>1. Fundamental data on internal organs.</td>
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<td>2. Areas and lines of the abdomen.</td>
<td>PPT presentation with diagrams and tables.</td>
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<td>3. General anatomy of the digestive tract and the differences of its various departments.</td>
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<td>4. Peritoneum, its derivatives and its relationships with internal organs.</td>
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<td>5. Features of the digestive process in various parts of the digestive tube.</td>
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<td>6. Features of the respiratory organs.</td>
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<td>The development of the digestive system in ontogenesis.</td>
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**The Digestive Apparatus.** The apparatus for the digestion of the food consists of the **digestive tube** and of certain **accessory organs**.

The **Digestive Tube** (*alimentary canal*) is a musculomembranous tube, about 9 metres long, extending from the mouth to the anus, and lined throughout its entire extent by mucous membrane. It has received different names in the various parts of its course: at its commencement is the **mouth**, where provision is made for the mechanical division of the food (*mastication*), and for its admixture with a fluid secreted by the salivary glands (*insalivation*); beyond this are the organs of deglutition, the **pharynx** and the **esophagus**, which convey the food into the **stomach**, in which it is stored for a time and in which also the first stages of the digestive process take place; the stomach is followed by the **small intestine**, which is
divided for purposes of description into three parts, the **duodenum**, the **jejunum**, and **ileum**. In the small intestine the process of digestion is completed and the resulting products are absorbed into the blood and lacteal vessels. Finally, the small intestine ends in the **large intestine**, which is made up of **cecum, colon, rectum**, and **anal canal**, the last terminating on the surface of the body at the **anus**. The accessory organs are the **teeth**, for purposes of mastication; the three pairs of **salivary glands** — the **parotid, submandibulary**, and **sublingual** — the secretion from which mixes with the food in the mouth and converts it into a bolus and acts chemically on one of its constituents; the **liver** and **pancreas**, two large glands in the abdomen, the secretions of which, in addition to that of numerous minute glands in the walls of the alimentary canal, assist in the process of digestion.

Alimentary canal embryo is laid in the form of primary intestinal tube is the embryonic period divided by the mouth, pharynx, esophagus, stomach and intestines. There is a differentiation in embryogenesis structural elements in the walls of the digestive tract and digestive glands develop.

The digestive system begins to function during the prenatal period. At the 4th month in the intestine of the fetus content appears greenish - meconium; it consists of wapasha epithelial cells, mucus, bile and substances which swallows the fetus. Since that time in the intestine find digestive enzymes. By the end of the period of fetal digestive system reaches the stage of development where it can provide vital functions of the newborn. Most are differentiated structures provide breastfeeding baby, and, above all, the act of sucking. Changes in the digestive organs after birth due to a significant degree the composition and quantity of food, which is used in different age periods. Food is an important formative factor in individual development of the digestive system.

In the third week of the embryo in the thickness of the endoderm close to the ventral surface of the pipe is laid. At the caudal (proctodeum) and cranial (stomadeum) formed by the ends of the bay. Later they break, pharyngeal and rectal membrane, connected to the tube and thus formed the primary entodermal gut. With endoderm formed mucosa and cancer of the mesenchymal muscular layer and serous membrane. On the serous membrane formed primary colon peritoneum, pleura,
pericardium. Primary colon is divided into two sections: the head and trunk. In oral produce department of oral (oral rear formation) and of pharyngeal (throat and protrusion, which give rise to the development of the respiratory system).

In the trunk release department foregut (esophagus, stomach, pancreas and upper duodenum), midgut (thin, blind, ascending and transverse colon), hindgut (descending colon, sigmoid, rectum).

**The digestive system (systema digestorium)** consists of the digestive tract and digestive glands. Digestive tract begins oral and consists of the pharynx, esophagus, stomach, small and large intestines.

**Oral cavity (cavitas oris, stoma)** limited front lips, side - cheeks, above - palate, bottom - hyoid muscles. Oral cavity divided into the vestibule and the actual mouth. Mouth Vestibule (vestibulum oris) is an oral cleft (rima oris), which is placed horizontally between the upper and lower lips.

Outside the vestibule limited cheeks and lips separated from the actual oral teeth and alveolar bone jaws, which are covered with mucous membrane, called a gums (gingiva). The **oral cavity** of neonates is smaller, shorter, wider and lower, closer to the eye socket.

**The upper and lower lip** (labium superior et inferior) merge and pass each other and form a mouth angle (angulus oris). The outer surface of the lips - a skin part (pars sutanea) internal - the mucous membrane (pars mucosa) located between the intermediate part (pars intermedia). The skin of the upper lip in the midline is upper lip groove (philtrum), that ending tubercle (tuberculum).

In the thick lips contains circular muscle mouth, and they covered the inner surface of the mucosa, which continues to cellular processes of the upper and lower jaws, cleft fused with their periosteum. By the middle line between the lips and gums and mucous membrane thickens forms two folds - the upper lip frenulum (frenulum labii superioris) and lower lip frenulum (frenulum labii inferioris). The lips, together on each side, limit the mouth slit, forming a spike lips (comissura labiorum).

Newborn upper lip is relatively thick, the midline is a hump that persists for several weeks after birth. The lower lip seems to come. The transition of the lip in newborns narrow, so when the mouth is closed, externally visible mucosa. On the surface of the
mucosa of the lips is the villi, which help preserve the nipple. In the thick lips well
developed muscles, through which stays child and squeezes the nipple. These
structural features of the lips kept for infants; while bottle-fed baby are smoothed
rather than when breastfeeding.

The **Cheeks (buccae)** form the sides of the face, and are continuous in front
with the lips. They are composed externally of integument; internally of mucous
membrane; and between the two of a muscular stratum, besides a large quantity of
fat, areolar tissue, vessels, nerves, and buccal glands.

The **Gums (gingivae)** are composed of dense fibrous tissue, closely
connected to the periosteum of the alveolar processes, and surrounding the necks
of the teeth. They are covered by smooth and vascular mucous membrane, which is
remarkable for its limited sensibility. Around the necks of the teeth this membrane
presents numerous fine papillae, and is reflected into the alveoli, where it is
continuous with the periosteal membrane lining these cavities.

**Oral vestibule** in front and laterally limited by the cheeks (buccae), which
consist of skin, muscle and mucosa. Between the skin and cheek muscles are clusters
of fat – the buccal fat pad (corpus adiposum buccae), which is particularly well
developed in babies. Of infants fatty body of the cheek leads to thickening of the
wall of the oral cavity and there by reduces the atmospheric pressure on it, which
contributes to the process of sucking. Actually oral cavity bounded in front and on the
sides of the teeth and jaws alveolar bone. The upper wall of their own oral forms
palate (palatum), which are divided into hard palate (palatum durum) and soft palate
(palatum molle). Bone basis palate are the palatine processes of the maxilla and
horizontal plate of the palatine bone. The mucous membrane covering the hard
palate, thickened and tightly adherent to the periosteum. In front of the palate are
several transverse palatine folds (plicae palatinae transversae) incisive papilla (papilla
incisiva) and is in the middle palatine suture (raphe palatini). The soft palate is a
continuation of the hard palate and consists of two layers of mucosa, which is located
between palatal aponeurosis (aponevrosis palatina), and muscle.

**Soft palate** has three parts: the blind palate (velum palatinum) uvula (uvula
palatina) and two pairs of brackets. To the muscles of the soft palate include:
muscle - palatal lifts curtain (m. levator veli palatini), muscle - palatal curtain tensioner (m. tensor veli palatini), tongue muscle (m. uvulae), palate - lingual muscle (m. palatoglossus) mouth - pharyngeal muscle (m. palatopharyngeus). You need to understand is that in the process of swallowing muscles - lifts, muscle - tensioner curtain palatal and velopharyngeal muscle presses the palatal curtain to the rear and side walls of the pharynx and thus separates the oral part of the pharynx from the nose, which prevents the entry of food into the nasal cavity. The muscles of the soft palate and pharynx throat constrict and divide food into small portions. The act of swallowing is complex nervous mechanism of its regulation center located in the medulla oblongata. Before the advent of cellular dental arch upper and lower jaws do not close up, and the gap between them manage mucous cheeks. At the free edge of the gums at incisors and canines are moving folds of mucous participating in the act of sucking.

**The hard palate** in newborns, short and wide, arches his poorly marked. Only after a year long palate begins to exceed its width. In the mucosal surface visible transverse palatine folds. In the back of the palate to 3 years of age are whitish clusters of epithelial cells, so-called "epithelial pearls".

**The soft palate** in newborns located horizontally at the level of the vault of the pharynx. Tab rickety little, sometimes it forked, which may indicate the covert of cleft palate. Palatine tonsils newborn small, they do not fill all the holes tonsilis fossa, resulting in over tonsils formed over tonsils fossa. Anteroinferior of tonsil covered with triangular fold of mucous, which is expressed to 3 years of age The surface of the tonsils in young children is relatively plain crypt navigation and shallow. The growth of the tonsils is uneven. The fastest growth is observed up to a year, and at the age of 4-6 years.

**General anatomy of the respiratory system.**

**Clinical aspects.**

The respiratory system can be divided structurally into upper and lower divisions, and functionally into a conducting division and a respiratory division. The principal functions of the respiratory system are gaseous exchange, sound production,
and assistance in abdominal compression. The term respiration refers to three separate but related functions:

1. ventilation (breathing);
2. gas exchange, which occurs between the air and blood in the lungs and between the blood and other tissues of the body; and
3. oxygen utilization by the tissues in the energy-liberating reactions of cell respiration.

Ventilation and the exchange of gases (oxygen and carbon dioxide) between the air and blood are collectively called external respiration. Gas exchange between the blood and other tissues are collectively known as internal respiration. A relaxed adult breathes an average of 15 times a minute, ventilating approximately 6 liters of air during this period. This amounts to over 8,000 liters in a 24-hour period. Strenuous exercise increases the demand for oxygen and increases the respiratory rate fifteenfold to twentyfold, so that about 100 liters of air are breathed each minute. If breathing stops, a person will lose consciousness after 4 or 5 minutes. Brain damage may occur after 7 to 8 minutes, and the person will die after 10 minutes.

Knowledge of the structure and function of the respiratory system is therefore of the utmost importance in a clinical setting.

**Physical Requirements of the Respiratory System**

The respiratory system includes those organs and structures that function together to bring gases in contact with the blood of the circulatory system. In order to be effective, the respiratory system must comply with certain physical requirements.

- The surface for gas exchange must be located deep within the body so that incoming air will be sufficiently warmed, moistened, and cleansed of airborne particles before coming in contact with it.
- The membrane must be thin-walled and selectively permeable so that diffusion can occur easily.
- The membrane must be kept moist so that oxygen and carbon dioxide can be dissolved in water to facilitate diffusion.
- The system must have an extensive capillary network.
• The system must include an effective ventilation mechanism to constantly replenish the air.
• The system must function autonomically through effective monitoring and feedback mechanisms. However, it must also be able to function voluntarily for desired increased or decreased rates. The respiratory system adequately meets all of these requirements, thus ensuring that all of the trillions of cells of the body will be able to carry on the metabolic processes necessary to maintain life.

**Functions of the Respiratory System**

The four basic functions of the respiratory system, not all of which are associated with breathing, are as follows:

• It provides oxygen to the bloodstream and removes carbon dioxide.
• It enables sound production or vocalization as expired air passes over the vocal folds.
• It assists in abdominal compression during micturition (urination), defecation (passing of feces), and parturition (childbirth). The abdominal muscles become more effective during a deep breath when the air is held in the lungs by closing the glottis and fixing the diaphragm. This same technique is used when lifting a heavy object, in which case the diaphragm indirectly assists the back muscles.
• It enables protective and reflexive nonbreathing air movements, as in coughing and sneezing, to keep the air passageways clean.

**Basic Structure of the Respiratory System.**

The major passages and structures of the respiratory system are the nasal cavity, pharynx, larynx and trachea, and the bronchi, bronchioles, and pulmonary alveoli within the lungs. The structures of the upper respiratory system include the nose, pharynx, and associated structures; the lower respiratory system includes the larynx, trachea, bronchial tree, pulmonary alveoli, and lungs. On the basis of general function, the respiratory system is frequently divided into a conducting division and a respiratory division. The conducting division includes all of the cavities and structures that transport gases to and from the pulmonary alveoli. The respiratory division consists of the pulmonary alveoli, which are the functional units of the respiratory system where gas exchange between the air and the blood occur.
The External Nose (NasusExternus; Outer Nose)—The external nose is pyramidal in form, and its upper angle or root is connected directly with the forehead; its free angle is termed the apex. Its base is perforated by two elliptical orifices, the nares, separated from each other by an antero-posterior septum, the columna. The margins of the nares are provided with a number of stiff hairs, or vibrissae, which arrest the passage of foreign substances carried with the current of air intended for respiration. The lateral surfaces of the nose form, by their union in the middle line, the dorsum nasi, the direction of which varies considerably in different individuals; the upper part of the dorsum is supported by the nasal bones, and is named the bridge. The lateral surface ends below in a rounded eminence, the alana.
**The Nasal Cavity** (CavumNasi; Nasal Fossa)—The nasal chambers are situated one on either side of the median plane. They open in front through the nares, and communicate behind through the choanae with the nasal part of the pharynx. The nares are somewhat pear-shaped apertures, each measuring about 2.5 cm. antero-posteriorly and 1.25 cm. transversely at its widest part. The choanae are two oval openings each measuring 2.5 cm. in the vertical, and 1.25 cm. in the transverse direction in a well-developed adult skull. Inside the aperture of the nostril is a slight dilatation, the vestibule, bounded laterally by the ala and lateral crus of the greater alar cartilage, and medially by the medial crus of the same cartilage. It is lined by skin containing hairs and sebaceous glands, and extends as a small recess toward the apex of the nose. Each nasal cavity, above and behind the vestibule, is divided into two parts: an olfactory region, consisting of the superior nasal concha and the opposed part of the septum, and a respiratory region, which comprises the rest of the cavity.

**Lateral Wall**—On the lateral wall are the superior, middle, and inferior nasal conchae, and below and lateral to each concha is the corresponding nasal passage or meatus. Above the superior concha is a narrow recess, the sphenoid recess, into which the sphenoidal sinus opens. The superior meatus is a short oblique passage extending about half-way along the upper border of the middle concha; the posterior ethmoidal cells open into the front part of this meatus. The middle meatus is below and lateral to the middle concha, and is continued anteriorly into a shallow depression, situated above the vestibule and named the atrium of the middle meatus. On raising
or removing the middle concha the lateral wall of this meatus is fully displayed. On it is a rounded elevation, the bulla ethmoidalis, and below and in front of this is a curved cleft, the hiatus semilunaris.

The bulla ethmoidalis is caused by the bulging of the middle ethmoidal cells which open on or immediately above it, and the size of the bulla varies with that of its contained cells.

The hiatus semilunaris is bounded inferiorly by the sharp concave margin of the uncinate process of the ethmoid bone, and leads into a curved channel, the infundibulum, bounded above by the bulla ethmoidalis and below by the lateral surface of the uncinate process of the ethmoid. The anterior ethmoidal cells open into the front part of the infundibulum, and this in slightly over 50 per cent. of subjects is directly continuous with the frontonasal duct or passage leading from the frontal air sinus; but when the anterior end of the uncinate process fuses with the front part of the bulla, this continuity is interrupted and the frontonasal duct then opens directly into the anterior end of the middle meatus. Below the bulla ethmoidalis, and partly hidden by the inferior end of the uncinate process, is the ostium maxillare, or opening from the maxillary sinus; in a frontal section this opening is seen to be placed near the roof of the sinus. An accessory opening from the sinus is frequently present below the posterior end of the middle nasal concha. The inferior meatus is below and lateral to the inferior nasal concha; the nasolacrimal duct opens into this meatus under cover of the anterior part of the inferior concha.

**Medial Wall**

The medial wall or septum is frequently more or less deflected from the median plane, thus lessening the size of one nasal cavity and increasing that of the other; ridges or spurs of bone growing into one or other cavity from the septum are also sometimes present. Immediately over the incisive canal at the lower edge of the cartilage of the septum a depression, the nasopalatine recess, is seen. In the septum close to this recess a minute orifice may be discerned; it leads backward into a blind pouch, the rudimentary vomeronasal organ of Jacobson, which is supported by a strip of cartilage, the vomeronasal cartilage. This organ is well-developed in many of the
lower animals, where it apparently plays a part in the sense of smell, since it is supplied by twigs of the olfactory nerve and lined by epithelium similar to that in the olfactory region of the nose.

The **roof** of the nasal cavity is narrow from side to side, except at its posterior part, and may be divided, from behind forward, into sphenoidal, ethmoidal, and frontonasal parts, after the bones which form it.

The **floor** is concave from side to side and almost horizontal anteroposteriorly; its anterior three-fourths are formed by the palatine process of the maxilla, its posterior fourth by the horizontal process of the palatine bone. In its anteromedial part, directly over the incisive foramen, a small depression, the **nasopalatinerecess**, is sometimes seen; it points downward and forward and occupies the position of a canal which connected the nasal with the buccal cavity in early fetal life.

**The three functions of the nasal cavity and its contents are as follows:**

- The nasal epithelium covering the conchae serves to warm, moisten, and cleanse the inspired air. The nasal epithelium is highly vascular and covers an extensive surface area. This is important for warming the air but unfortunately also makes humans susceptible to nosebleeds because the nasal mucosa may dry and crack. Nasal hairs called vibrissae (vi-bris'e), which often extend from the nostrils, filter macroparticles that might otherwise be inhaled. Dust, pollen, smoke, and other fine particles are trapped along the moist mucous membrane lining the nasal cavity.
- The olfactory epithelium in the upper medial portion of the nasal cavity is concerned with the sense of smell.
- The nasal cavity affects the voice by functioning as a resonating chamber.

**TheMucous Membrane (membrana mucosa nasi).**

The nasal mucous membrane lines the nasal cavities, and is intimately adherent to the periosteum or perichondrium. It is continuous with the skin through the nares, and with the mucous membrane of the nasal part of the pharynx through the choanae.
From the nasal cavity its continuity with the conjunctiva may be traced, through thenasolacrimal and lacrimal ducts; and with the frontal, ethmoidal, sphenoidal, and maxillary sinuses, through the several openings in the meatuses. The mucous membrane is thickest, and most vascular, over the nasal conchae. It is also thicker over the septum; but it is very thin in the meatuses on the floor of the nasal cavities, and in the various sinuses. Owing to the thickness of the greater part of this membrane, the nasal cavities are much narrower, and the middle and inferior nasal conchae appear larger and more prominent than in the skeleton; also the various apertures communicating with the meatuses are considerably narrowed.

The accessory sinuses or air cells of the nose are the frontal, ethmoidal, sphenoidal, and maxillary; they vary in size and form in different individuals, and are lined by ciliated mucous membrane directly continuous with that of the nasal cavities.

The Frontal Sinuses (sinus frontales), situated behind the superciliary arches, are rarely symmetrical, and the septum between them frequently deviates to
one or other side of the middle line. Their average measurements are as follows: height, 3 cm.; breadth, 2.5 cm.; depth from before backward, 2.5 cm. Each opens into the anterior part of the corresponding middle meatus of the nose through the frontonasal duct which traverses the anterior part of the labyrinth of the ethmoid. Absent at birth, they are generally fairly well developed between the seventh and eighth years, but only reach their full size after puberty.

The Ethmoidal Air Cells (cellulae ethmoidales) consist of numerous thin-walled cavities situated in the ethmoidal labyrinth and completed by the frontal, maxilla, lacrimal, sphenoidal, and palatine. They lie between the upper parts of the nasal cavities and the orbits, and are separated from these cavities by thin bony laminae. On either side they are arranged in three groups, anterior, middle, and posterior. The anterior and middle groups open into the middle meatus of the nose, the former by way of the infundibulum, the latter on or above the bulla ethmoidalis. The posterior cells open into the superior meatus under cover of the superior nasal concha; sometimes one or more opens into the sphenoidal sinus. The ethmoidal cells begin to develop during fetal life.

The Sphenoidal Sinuses (sinus sphenoidales) contained within the body of the sphenoid vary in size and shape; owing to the lateral displacement of the intervening septum they are rarely symmetrical. The following are their average measurements: vertical height, 2.2 cm.; transverse breadth, 2 cm.; antero-posterior depth, 2.2 cm. When exceptionally large they may extend into the roots of the pterygoid processes or great wings, and may invade the basilar part of the occipital bone. Each sinus communicates with the sphenoethmoidal recess by means of an aperture in the upper part of its anterior wall. They are present as minute cavities at birth, but their main development takes place after puberty.

The Maxillary Sinus (sinus maxillaris; antrum of Highmore), the largest of the accessory sinuses of the nose, is a pyramidal cavity in the body of the maxilla. Its base is formed by the lateral wall of the nasal cavity, and its apex extends into the zygomatic process. Its roof or orbital wall is frequently ridged by the infra-orbital
canal, while its floor is formed by the alveolar process and is usually 1/2 to 10 mm. below the level of the floor of the nose; projecting into the floor are several conical elevations corresponding with the roots of the first and second molar teeth, and in some cases the floor is perforated by one or more of these roots. The size of the sinus varies in different skulls, and even on the two sides of the same skull. The adult capacity varies from 9.5 c.c. to 20 c.c., average about 14.75 c.c. The following measurements are those of an average-sized sinus: vertical height opposite the first molar tooth, 3.75 cm.; transverse breadth, 2.5 cm.; antero-posterior depth, 3 cm. In the antero-superior part of its base is an opening through which it communicates with the lower part of the hiatus semilunaris; a second orifice is frequently seen in, or immediately behind, the hiatus. The maxillary sinus appears as a shallow groove on the medial surface of the bone about the fourth month of fetal life, but does not reach its full size until after the second dentition. At birth it measures about 7 mm. in the dorso-ventral direction and at twenty months about 20 mm.

Pharynx

The pharynx (far'ingks) is a funnel-shaped organ, approximately 13 cm (5 in.) long, that connects the nasal and oral cavities to the larynx of the respiratory system and the esophagus of the digestive system. The supporting walls of the pharynx are composed of skeletal muscle, and the lumen is lined with a mucous membrane.
Within the pharynx are several paired lymphoid organs called tonsils. Commonly referred to as the “throat” or “gullet,” the pharynx has both respiratory and digestive functions. It also provides a resonating chamber for certain speech sounds. The pharynx is divided on the basis of location and function into three regions.

The nasopharynx serves only as a passageway for air, because it is located above the point of food entry into the body (the mouth). It is the uppermost portion of the pharynx, positioned directly behind the nasal cavity and above the soft palate. A pendulous uvula hangs from the middle lower portion of the soft palate. The paired auditory (eustachian) tubes connect the nasopharynx with the tympanic cavities. The pharyngeal tonsils, or adenoids, are situated in the posterior wall of the nasal cavity. During the act of swallowing, the soft palate and uvula are elevated to block the nasal cavity and prevent food from entering.

Occasionally a person may suddenly exhale air (as with a laugh) while in the process of swallowing fluid. If this occurs before the uvula effectively blocks the nasopharynx, fluid will be discharged through the nasal cavity.

The oropharynx is the middle portion of the pharynx between the soft palate and the level of the hyoid bone. Both swallowed food and fluid and inhaled air pass through it. The base of the tongue forms the anterior wall of the oropharynx. Paired palatine tonsils are located on the posterior lateral wall, and the lingual tonsils are found on the base of the tongue.

The laryngopharynx is the lowermost portion of the pharynx. It extends inferiorly from the level of the hyoid bone to the larynx and opens into the esophagus and larynx. It is at the lower laryngopharynx that the respiratory and digestive systems become distinct. Swallowed food and fluid are directed into the esophagus, whereas inhaled air is directed anteriorly into the larynx.
Larynx

The larynx (laringks), or “voice box,” is a continuation of the conducting division that connects the laryngopharynx with the trachea. It is positioned in the anterior midline of the neck at the level of the fourth through sixth cervical vertebrae. The larynx has two functions. Its primary function is to prevent food or fluid from entering the trachea and lungs during swallowing and to permit passage of air while breathing. A secondary role is to produce sound. jor concern.

The larynx is shaped like a triangular box. It is composed of a framework involving nine cartilages: three are large unpaired structures, and six are smaller and paired. The largest of the unpaired cartilages is the anterior thyroid cartilage. The laryngeal prominence of the thyroid cartilage is commonly called the “Adam’s apple.” It is an anterior vertical ridge along the larynx that can be palpated on the midline of the neck. The thyroid cartilage is typically larger and more prominent in males than in females because of the effect of male sex hormones on the development of the larynx during puberty. The spoon-shaped epiglottis has a framework of hyaline cartilage, referred to as the epiglottic cartilage.

The epiglottis is located behind the root of the tongue where it aids in closing the glottis, or laryngeal opening, during swallowing. The lower end of the larynx is formed by the ring-shaped cricoid (kri’koid) cartilage. This third unpaired cartilage
connects the thyroid cartilage above and the trachea below. The paired arytenoid (ar"ı-te'noid) cartilages, located above the cricoid and behind the thyroid, are the posterior attachments of the vocal folds. The other paired cuneiform cartilages and corniculate (kornikyulat) cartilages are small accessory cartilages that are closely associated with the arytenoid cartilages. Two pairs of strong connective tissue bands are stretched across the upper opening of the larynx from the thyroid cartilage anteriorly to the paired arytenoid cartilages posteriorly. These are the vocal folds (true vocal cords) and the vestibular folds (false vocal cords).

The vestibular folds support the vocal folds and produce mucus from its epithelial lining, which keep the vestibular folds from drying out. The vestibular folds are not used in sound production, but rather the vocal folds vibrate to produce sound. Stratified squamous epithelium lines the vocal folds, whereas the rest of the larynx is lined with pseudostratified ciliated columnar epithelium. This is an important anatomical modification considering the tremendous vibratory action of the vocal folds in the production of sound.

The laryngeal muscles are extremely important in closing the glottis during swallowing and in speech. There are two groups of laryngeal muscles: extrinsic muscles, responsible for elevating the larynx during swallowing, and intrinsic muscles that, when contracted, change the length, position, and tension of the vocal folds. Various pitches are produced as air passes over the altered vocal folds. If the vocal folds are taut, vibration is more rapid and causes a higher pitch. Less tension on the vocal folds produces lower sounds. Mature males generally have thicker and longer vocal folds than females; therefore, the vocal folds of males vibrate more slowly and produce lower pitches.

The loudness of vocal sound is determined by the force of the air passed over the vocal folds and the amount of vibration. The vocal folds do not vibrate when a person whispers. Sounds originate in the larynx, but other structures are necessary to convert sound into recognizable speech. Vowel sounds, for example, are produced by constriction of the walls of the pharynx. The pharynx, paranasal sinuses, and oral and nasal cavities act as resonating chambers. The final enunciation of words is accomplished through movements of the tongue and lips.
The trachea (trachea) commonly called the “windpipe,” is a semirigid, tubular organ, approximately 12 cm (4 in.) long and 2.5 cm (1 in.) in diameter, connecting the larynx to the principal (primary) bronchi. It is positioned anterior to the esophagus as it extends into the thoracic cavity. A series of 16 to 20 C-shaped hyaline cartilages form the supporting walls of the trachea. These tracheal cartilages ensure that the airway will always remain open. The open part of each of these cartilages faces the esophagus and permits the esophagus to expand slightly into the trachea during swallowing.

The mucosa (surface lining the lumen) consists of pseudostratified ciliated columnar epithelium containing numerous mucus-secreting goblet cells. It provides the same protection against dust and other particles as the membrane lining the nasal cavity and larynx. Medial to the lungs, the trachea splits to form the right and left principal bronchi. This junction is reinforced by the carina (karina), a keel-like cartilage plate.
The bronchial tree is so named because it is composed of a series of respiratory tubes that branch into progressively narrower tubes as they extend into the lung. The trachea bifurcates into right and left principal (primary) bronchi at the level of the sternal angle behind the manubrium. Each principal bronchus has hyaline cartilage rings within its wall surrounding the lumen to keep it open as it extends into the lung. Because of the more vertical position of the right principal bronchus, foreign particles are more likely to lodge here than in the left principal bronchus. The principal bronchus divides deeper in the lungs to form lobar (secondary) bronchi and segmental (tertiary) bronchi. The bronchial tree continues to branch into even smaller tubules called bronchioles. There is little cartilage in the bronchioles. The thick smooth muscle that encircles their lumina can constrict or dilate these airways.

Bronchioles provide the greatest resistance to air flow in the conducting passage a function analogous to that of arterioles in the circulatory system. A simple cuboidal epithelium lines the bronchioles rather than the pseudostratified columnar epithelium that lines the bronchi. Numerous terminal bronchioles connect to
respiratory bronchioles that lead into alveolar ducts, and then into alveolar sacs. The conduction portion of the respiratory system ends at the terminal bronchioles, and the respiratory portion begins at the respiratory bronchioles.

Asthma is an infectious or allergenic condition that involves the bronchi. During an asthma attack, there is a spasm of the smooth muscles in the respiratory bronchioles. Because of an absence of cartilage at this level, the air passageways constrict.

**PULMONARY ALVEOLI, LUNGS, AND PLEURAE**

Pulmonary alveoli are the functional units of the lungs, where gas exchange occurs. Right and left lungs are separately contained in pleural membranes.

**Pulmonary Alveoli**

The alveolar ducts open into pulmonary alveoli (alveoli) as outpouchings along their length. Alveolar sacs are clusters of pulmonary alveoli. The alveolar ducts, pulmonary alveoli, and alveolar sacs make up the respiratory division of the lungs. Gas exchange occurs across the walls of the tiny pulmonary alveoli; hence, these minute expansions (0.25–0.50 mm in diameter) are the functional units of the respiratory system. The vast number of these structures (about 350 million per lung) provides a very large surface area (60–80 square meters, or 760 square feet) for the diffusion of gases. The diffusion rate is further increased by the fact that the wall of each pulmonary alveolus is only one cell layer thick, so that the total air-blood barrier is only one pulmonary alveolar cell with its basement membrane and one blood capillary cell across, or about 2 micrometers. This is an average distance because type
II alveolar cells are thicker than type I alveolar cells. Type I alveolar cells permit diffusion, and type II alveolar cells (septal cells) secrete a substance called surfactant that reduces the tendency for pulmonary alveoli to collapse.

Pulmonary alveoli are polyhedral in shape and are usually clustered together, like the units of a honeycomb, in the alveolar sacs at the ends of the alveolar ducts. Although the distance between each alveolar duct and its terminal pulmonary alveoli is only about 0.5 mm, these units together compose most of the mass of the lungs.

**Lungs.** The large, spongy lungs are paired organs within the thoracic cavity. Each lung extends from the diaphragm to a point just above the clavicle, and its surfaces are bordered by the ribs to the front and back. The lungs are separated from one another by the heart and other structures of the mediastinum (medeastinum) which is the area between the lungs. All structures of the respiratory system beyond the principal bronchi, including the bronchial tree and the pulmonary alveoli, are contained within the lungs. Each lung has four surfaces that match the contour of the thoracic cavity.

The mediastinal (medial) surface of the lung is slightly concave and contains a vertical slit, the hilum through which pulmonary vessels, nerves, and bronchi pass. The inferior surface of the lung, called the base of the lung, is concave as it fits over the convex dome of the diaphragm. The superior surface, called the apex (cupola) of the lung, extends above the level of the clavicle. Finally, the broad, rounded surface in contact with the membranes covering the ribs is called the costal surface of the lung. Although the right and left lungs are basically similar, they are not identical.
The left lung is somewhat smaller than the right and has a cardiac impression on its medial surface to accommodate the heart. The left lung is subdivided into a superior lobe and an inferior lobe by a single fissure.

The right lung is subdivided by two fissures into three lobes: superior, middle, and inferior lobes. Each lobe of the lung is divided into many small lobules, which in turn contain the pulmonary alveoli. Lobular divisions of the lungs make up specific bronchial segments. Each bronchial segment has its own blood supply and if diseased it can be surgically isolated. The right lung contains 10 bronchial segments and the left lung contains 8.

**Pleurae**

Pleurae (ploore) are serous membranes surrounding the lungs and lining the thoracic cavity. The visceral pleura adheres to the outer surface of the lung and extends into each of the interlobar fissures. The parietalpleura lines the thoracic walls and the thoracic surface of the diaphragm. A continuation of the parietal pleura and between the lungs forms the boundary of the mediastinum. Between the visceral and parietal pleurae is the slitlike pleural cavity. It contains a lubricating fluid that allows the membranes to slide past each other easily during respiration. An inferiorly extending reflection of the pleural layers around the roots of each lung is called the pulmonary ligament. The pulmonary ligaments help support the lungs. The moistened serous membranes of the visceral and parietal pleurae are normally flush against each other like two wet pieces of glass, and therefore the lungs are stuck to the thoracic wall. The pleural cavity (intrapleural space) between the two moistened membranes contains only a thin layer of fluid secreted by the serous membranes.
The pleural cavity in a healthy, living person is thus potential rather than real; it can become real only in abnormal situations when air enters the intrapleural space. Because the lungs normally remain in contact with the thoracic wall, they get larger and smaller along with the thoracic cavity during respiratory movements.

The thoracic cavity has four distinct compartments: a pleural cavity surrounds each lung; the pericardial cavity surrounds the heart; and the mediastinum contains the esophagus, thoracic duct, major vessels, various nerves, and portions of the respiratory tract. This compartmentalization has protective value in that infections are usually confined to one compartment. Also, damage to one organ usually will not involve another. For example, pleurisy, an inflamed pleura, is generally confined to one side; and a penetrating injury to the thoracic cavity, such as a knife wound, may cause one lung to collapse but not the other.

**Respiratory Volumes and Capacities**

The respiratory system is somewhat inefficient because the air enters and exits at the same place, through either the nose or the mouth. Consequently, there is an incomplete exchange of gas during each ventilatory cycle, and approximately five-sixths of the air present in the lungs still remains when the next inspiration begins. The amount of air breathed in a given time and the degree of difficulty in breathing are important indicators of a person’s respiratory status. The amount of air exchanged during pulmonary ventilation varies from person to person according to age, gender, activity level, general health, and individual differences. Respiratory volumes are
measured with a spirometer. Any ventilatory abnormalities can then be compared to what is accepted as normal.

7. Materials for activating students during the lecture:
Models of the digestive tube. Models of the bronchial tree, lungs.

Theoretical questions.
1. What is the subject of splanchnology?
2. Classification of the organs by structure.
3. Discuss the structure of hollow organs.
4. Characterize the mucosa of the hollow organs.
5. Describe structure of the submucosa and muscular layer.
6. What the tubular organs are covered with from outside?
7. Discuss the structure of parenchymal organs.
8. How the topography of the internal organs is studied?
9. Name the lines used for description of the organs’ skeletal relations.
10. Name the chief functions of the alimentary system.
11. Name the organs related to the respiratory system.
12. What organs belong to the respiratory system? Name the organs related to upper and lower respiratory tracts.
13. Describe structure of the nose.
15. Describe the boundaries and communications of the superior nasal meatus.
16. Describe the boundaries and communications of the middle nasal meatus.
17. Describe the boundaries and communications of the inferior nasal meatus.
18. What is the common nasal meatus? Where the olfactory region of nasal mucosa is situated?
19. Name the paranasal sinuses and discuss their significance.
20. The larynx, its significance and structure.
21. What cartilages form the laryngeal skeleton? Describe their morphology.
22. The structure of the trachea, bronchi.
23. Describe exterior of the lungs.
24. What are the hilum and the root of lung?
25. Discuss exterior differences between the right and left lungs.
26. Give definition of the pulmonary segment.
27. Give description of bronchi branching.
28. What bronchial divisions belong to the bronchial tree? Discuss its significance.
29. What elements form the alveolar tree? Discuss its significance.
30. Give definition of the acinus.
31. What is pleura and what layers are distinguishable in it? Discuss its significance.
32. Give definition of the pleural cavity.
33. Give definition of the pleural recess. Name the recesses you know. Discuss their functional significance.
34. Describe the boundaries of lungs.
35. Do boundaries of lungs and pleural cavity have the same surface relations? Give definition of the mediastinum.
36. What compartments are distinguishable in the mediastinum?
37. What organs reside in the superior mediastinum?
38. What organs reside in the compartments of the inferior mediastinum, namely in the anterior, middle and posterior?

**Situational problems**

1. Patient 45-years-old accidentally drank acetic acid. Burn what department of alimentary system will occur firstly?
   A. Small intestine
   B. Oesophagus
   C. Oral cavity, oropharynx.
   D. Pharynx
   E. Stomach.

2. The examination of the patient revealed hypertrophy and inflammation of the lymphoid tissue, swelling of the mucous membrane of the soft palate between the arches (acute tonsillitis). Which of the tonsils is contained in the norm in this place?
   A. Tonsilla tubaria
B. Tonsilla pharyngealis  
C. Tonsilla lingualis  
D. Tonsilla palatina  
E. All answers are correct  

3. During the first days of a newborn child, a pediatrician detected that milk gets into the child's nasal cavity. What malformation does this fact indicate?  
A. Esophagus constriction.  
B. Diverticulum of esophagus.  
C. Esophageal atresia,  
D. Cleft clip.  
E. Non-closed palate.  

4. On examination, the doctor found a small ulcer on the front left palatine arch. On what muscle possible spread infection process?  
A. M. uvulae  
B. M. palatoglossus  
C. M. palatopharyngeus  
D. M. genioglossus  
E. M. hyoglossus  

5. A 40-year-old patient complained of pain and edema in the site of oral cavity floor. After exanimation, the inflammatory process in the site of the major excretory duct of the sublingual gland was diagnosed. Where does this duct open to?  
A. Plica sublingualis.  
B. Vestibulum oris.  
C. Foramen caecum linguae.  
D. Caruncula sublingualis.  
E. Recessus gingivalis.  

6. A 56-year-old patient complained of pain and edema in the site of oral cavity floor. After exanimation, the inflammatory process in the site of the minor excretory duct of the sublingual gland was diagnosed. Where does this duct open to?  
A. Recessus gingivalis.  
B. Vestibulum oris.
C. Foramen caecum linguae.
D. Caruncula sublingualis.
E. Plica sublingualis.

7. A 53-year-old patient complained of pain and edema in the site of oral cavity floor. After examination, the inflammatory process in the site of the excretory duct of the parotid gland was diagnosed. Where does this duct open to?
   A. Vestibulum oris.
   B. Recessus gingivalis.
   C. Foramen caecum linguae.
   D. Caruncula sublingualis.
   E. Plica sublingualis.

8. After a face injury, a patient has hematoma in the cheek area. What salivary glands secretion outflow is blocked by the hematoma?
   A. Bucral.
   B. Parotid.
   C. Submandibular.
   D. Labial.
   E. Sublingual.

9. Dentist during the inspection of the oral cavity found between the middle and posterior third of tongue papillae inflammation. Inflammation which papillae doctor found?
   A. Papillae foliatae
   B. Papillae fungiformes
   C. Papillae vallatae
   D. Papillae filiformes
   E. Papillae conicae

10. On examination, vestibule of mouth dentist found redness on the buccal mucosa, opposite to the upper second molar tooth. Which major salivary gland can be damaged the first place?
    A. Submandibular
    B. Sublingual
C. Palatine
D. Parotid
E. Lingual

11. During the X-ray, examination of a 30-year-old patient in vertical position a doctor detected the presence of air in the stomach. What part of the stomach is it in?
A. In the body.
B. In the cardial.
C. At the fundus
D. In the pyloric.
E. In the area of the lesser curvature.

12. During a duodenal intubation, the probe does not pass from the stomach into the duodenum. What part of the stomach is an obstacle (tumor) in?
A. In the body area.
B. In the cardial part.
C. In the fundus area.
D. In the pyloric part.
E. In the area of the lesser curvature

13. A patient has pain in epigastric region. What organs disease can it indicate?
A. Fundus of stomach, transverse colon.
B. Small intestine, liver.
C. Spleen, kidney.
D. Colon, gallbladder.
E. Stomach, duodenum

14. Children frequently have nasal breathing affection caused by the overgrowth of the pharyngeal mucous membrane lymphoid tissue. Which tonsils excrescence may cause this?
A. Palatine.
B. Pharyngeal.
C. Lingual.
D. Tubal.
E. All mentioned.
15. A 10-year-old child complains of nasal breathing affection. Examination has shown that the cause of this is lymphoid tissue hypertrophy. Which tonsil is increased?
A. Left tubal tonsil.
B. Palatine.
C. Lingual.
D. Pharyngeal.
E. Right tubal tonsil.

16. A patient was admitted to the surgical department with suspected inflammation of Meckel's diverticulum. What part of bowels should be examined in order to discover the diverticulum in course of an operation?
A. Jejunum
B. Duodenum
C. Ileum
D. Caecum
E. Colon ascendens

17. A patient complains about impaired evacuatory function of stomach (long-term retention of food in stomach). Examination revealed a tumour of initial part of duodenum. Specify localization of the tumour:
A. Pars ascendens
B. Pars inferior
C. Pars descendens
D. Pars superior
E. Flexura duodeni inferior

18. During the endoscopy the inflammation of a major papilla of the duodenum and the disturbances of bile secretion were found. In which part of duodenum were the problems found?
A. Ascendant part
B. Bulb
C. Lower horizontal part
D. Upper horizontal part
19. An injured person was delivered to the hospital with a penetrating wound in the left lateral region of abdomen. What part of the large intestine is most likely damaged?
A. Colon transverses
B. Colon ascendens
C. Colon descendens
D. Caecum
E. Rectum

20. A 69-year-old patient has got an abscess of frontal lobe as a result of purulent infection in nasal cavity. What anatomical formation did the infection penetrate through?
A. Foramen rotundum
B. Foramen ovale
C. Foramen ethmoidalae posterior
D. Foramen sphenopalatinum
E. Foraminae cribrosae

21. X-ray examination revealed an accumulation of suppuration in maxillary sinus. Into what nasal meatus excretes the suppuration?
A. Median nasal
B. Nasopharyngeal
C. Inferior nasal
D. Superior nasal
E. Common nasal

22. A 18-year-old patient came to the out-patient department with the complaints of bleeding trauma in the vestibule of his nose. On examination: the mechanical injure of the mucous layer of the vestibule without continuation into nasal cavity proper. What is the boundary between the vestibule and nasal cavity proper?
A. Nasal roller
B. Nasal limen
C. Nasal septa
23. A 35-year-old patient applied to a doctor with complaints about having intense rhinitis and loss of sense of smell for a week. Objectively: nasal cavity contains a lot of mucus that covers mucous membrane and blocks olfactory receptors. In what part of nasal cavity are these receptors situated?
   A. Inferior nasal turbinate
   B. Median nasal turbinate
   C. Superior nasal turbinate
   D. Common nasal meatus
   E. Vestibule of nose

24. A patient was admitted to a hospital with a knife wound of the thorax on the right and pneumothorax. Percussion has shown that the inferior right lung border rose to the III rib level. Where is it located normally?
   A. IX rib.
   B. VII rib.
   C. VIII rib.
   D. VI rib.
   E. V rib.

25. A 37-year-old patient has suffered from pulmonary tuberculosis since childhood. Amputation of the middle lobe of the right lung has been performed. Which segments have been amputated?
   A. Posterior and anterior.
   B. Superior and anterior.
   C. Medial basal and lateral basal.
   D. Superior lingular and inferior lingular.
   E. Lateral and medial.

26. During the right-side lobectomy surgeon reached the right lung root in pick out and process its components. Point the order of lung root component from top to bottom?
   A. Bronchus, pulmonary artery, pulmonary veins.
B. Pulmonary artery, bronchus, pulmonary veins.
C. Pulmonary vein, pulmonary artery, bronchus.
D. Bronchus, pulmonary artery, phrenic nerve.
E. Phrenic nerve, bronchus, pulmonary artery and vein.

27. A 50-year-old patient with carcinoma of lung had a right-side lobectomy (ablation of the superior lobe of the lung) performed. How many segments were ablated during the operation?
A. Four.
B. Three.
C. Five.
D. Two.
E. None.

28. A patient has an exudative pleurisy. At what level should the pleural puncture along the posterior axillary line be taken?
A. VII intercostal space
B. VIII intercostal space
C. IX intercostal space
D. XI intercostal space
E. VI intercostal space

29. After the carried dull trauma of thorax, at a patient pain appeared in a breastbone which increased at percussion, edema of neck and thorax. About the damaging of organs of what mediastinum can we think?
A. All departments
B. Posterior.
C. Upper.
D. Middle.
E. Anterior

30. A 45-year-old patient was hospitalized with complaints of high temperature, pain during respiration, dyspnea and cough. Examination and radiodiagnóstics diagnosed pleurisy. For exudation evacuation pleurocentesis was prescribed. In what place of the pleura cavity is the largest quantity of exudation?
A. Under the root of lungs.
B. In the phrenico-mediastinal sinus.
C. In the costomediastinal sinus.
D. Under the cervical pleura.
E. In the costodiaphragmatic recess

8. Tasks for self-check
1. Thematical tables.
2. The models of the digestive tube, respiratory organs, the skull.
3. Educational literature, methodical guidance for the lecture.

9. Materials for the next lecture (key issues)


Questions: 1. Name the types of nephrons.
2. What are the parts and constrictions of the ureters?
3. What are the parts of the bladder?
4. What is a nephron? Name its parts.
5. Specify parts of the genital organs.

10. References
The basic

**Additional**


The methodical guidance has been compiled by **N.L. Svinthythka, Associate Professor at the Department of Human Anatomy, PhD in Medicine, Associate Professor**