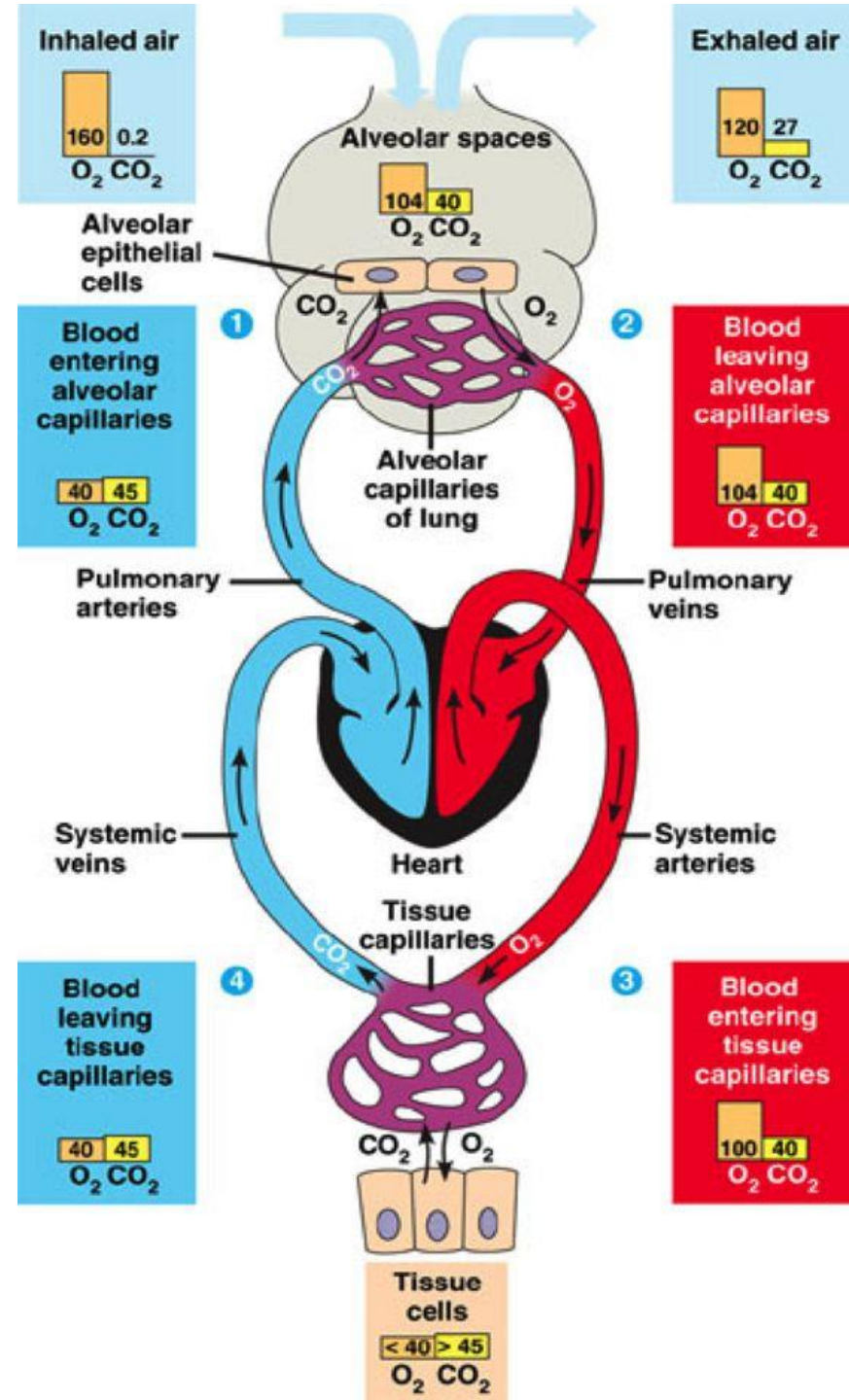
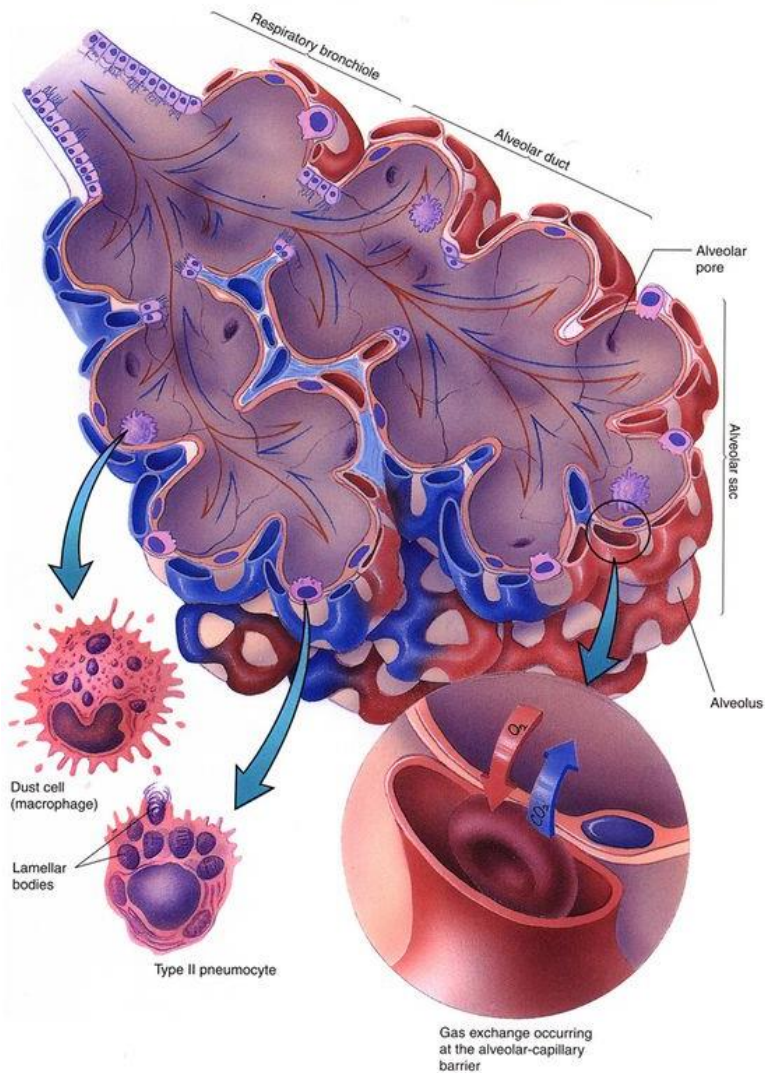


- It begins at the nostrils, through which the air enters the nasal cavities, and is continued by the nasopharynx, larynx, and trachea to the lung.
 - In its passage from the nostrils to the alveoli the air is usually purified, moistened, and warmed, and its volume is regulated by the nostrils and the larynx.
 - The respiratory organs provide for the exchange of gases between the blood and the atmosphere
 - The exchange of gases takes place in the pulmonary alveoli where the alveolar blood capillaries make contact with the air through the extremely thin alveolar wall.
 - The diaphragm and the other respiratory muscles, by increasing or diminishing the size of the thoracic cavity, govern the respiratory volume.
 - The respiratory passages are lined with a mucus-producing, ciliated, pseudostratified epithelium containing large numbers of goblet cells
- ❖ Dogs frequently breathe through their mouths (panting) because it provides for evaporating fluids, thus cooling the body

➤ The exchange of gases takes place in the pulmonary alveoli where the alveolar blood capillaries make contact with the air through the extremely thin alveolar wall (alveolar epithelial cells)



Nose

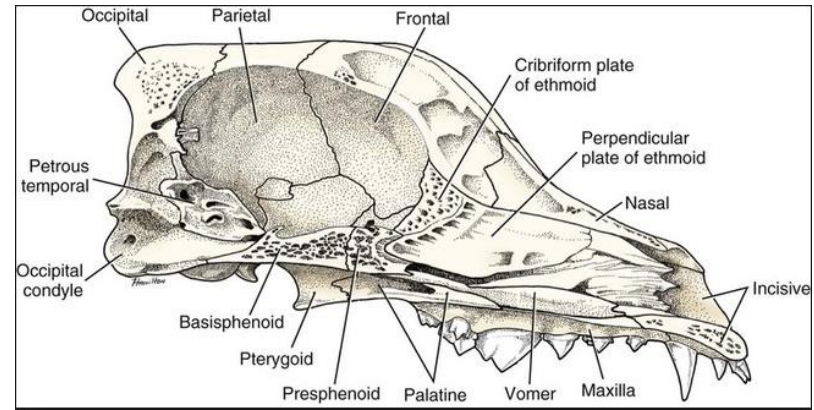
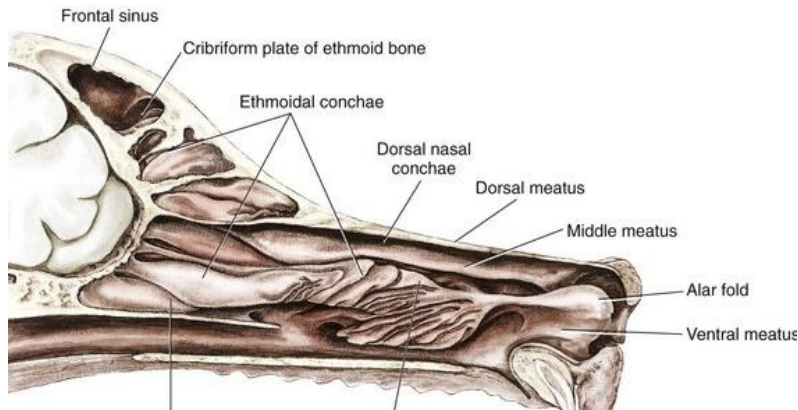
- The apex of the nose in the carnivores and pig protrude to some extent from the face
- The nostrils in the apex lead into the nasal cavity, to which are connected, directly or indirectly, several paranasal sinuses.
- The nasal septum divides the nasal cavity into right and left halves

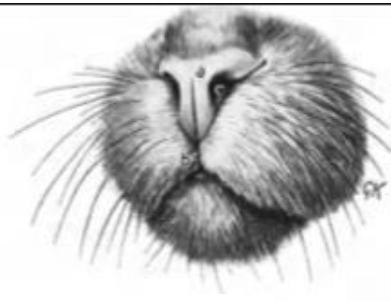
The wall of the nose consists of skin externally, a middle supporting layer of bone or (rostrally) cartilage, and a mucous membrane which lines the nasal cavity.

The osseous support of the wall is formed by the nasal, maxillary, incisive, frontal, lacrimal, and zygomatic bones, and by the perpendicular plate of the palatine bone.

The floor of the nasal cavity is the roof of the oral cavity, consist of portions of the incisive bones, the palatine processes of the maxillary bones, and the horizontal plates of the palatine bones, and it is covered with nasal mucosa dorsally and oral mucosa ventrally.

The vomer is attached to the dorsal surface of these bones and supports the nasal septum.





Cat



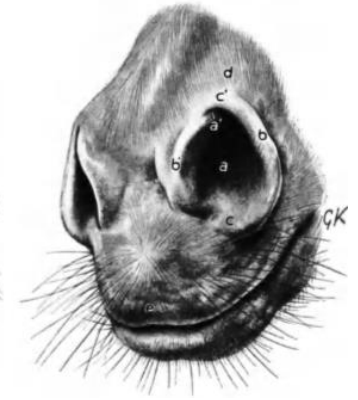
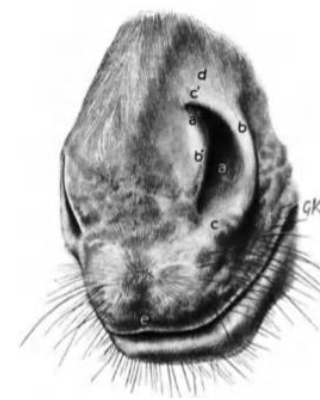
Dog



Pig



Goat



Horse

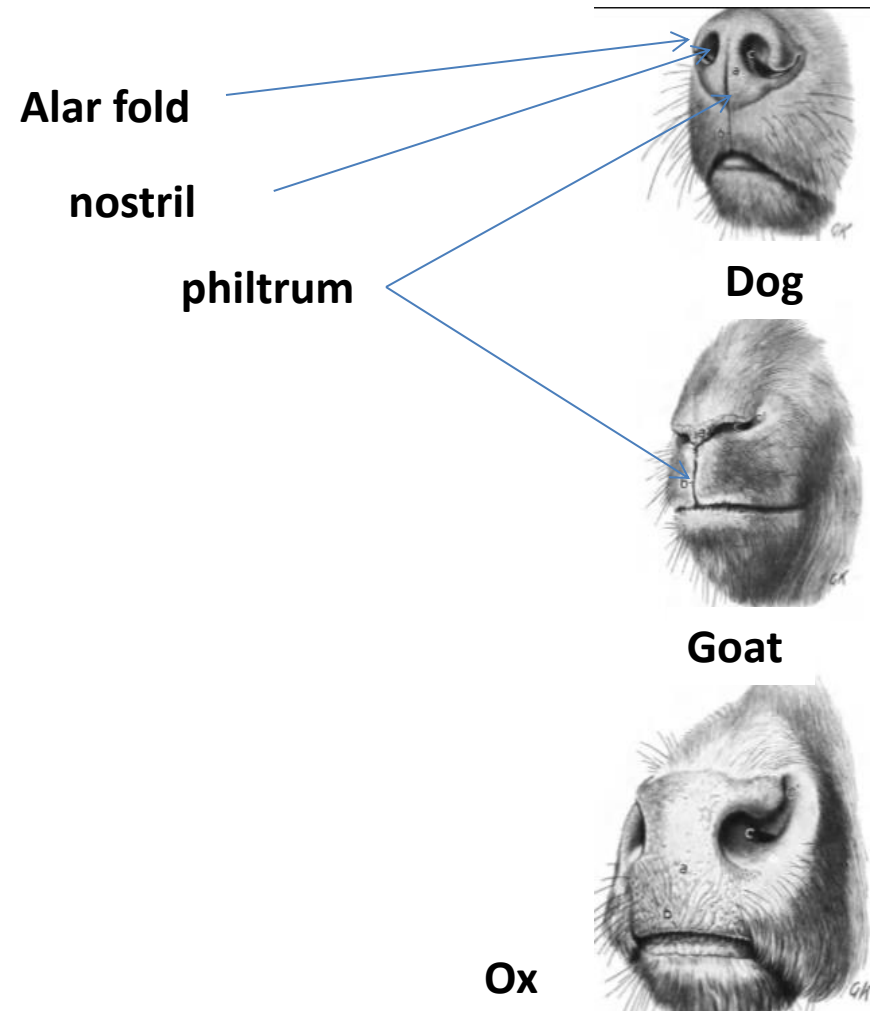


Sheep



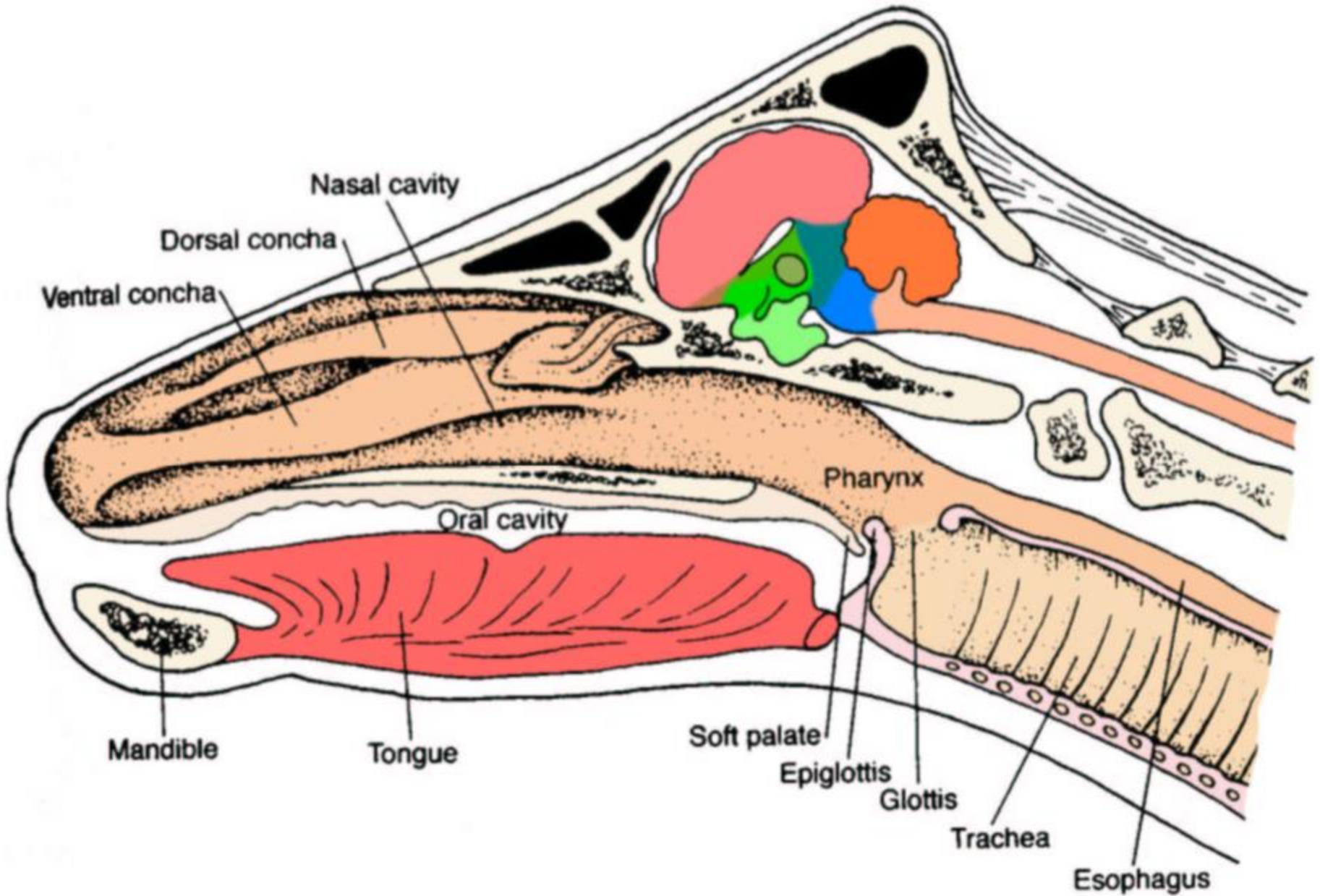
Ox

- ❖ **The philtrum** in the carnivores and small ruminants is deep and extends to the nostrils. In the pig, ox, and horse, it is shallow or absent.
- ❖ **The muscles** of the nose and upper lip act together to dilate the nostrils. These muscles are well developed in the horse and can transform the normally semilunar nostrils to become circular. They are poorly developed in the pig and carnivores.



Nasal cavities

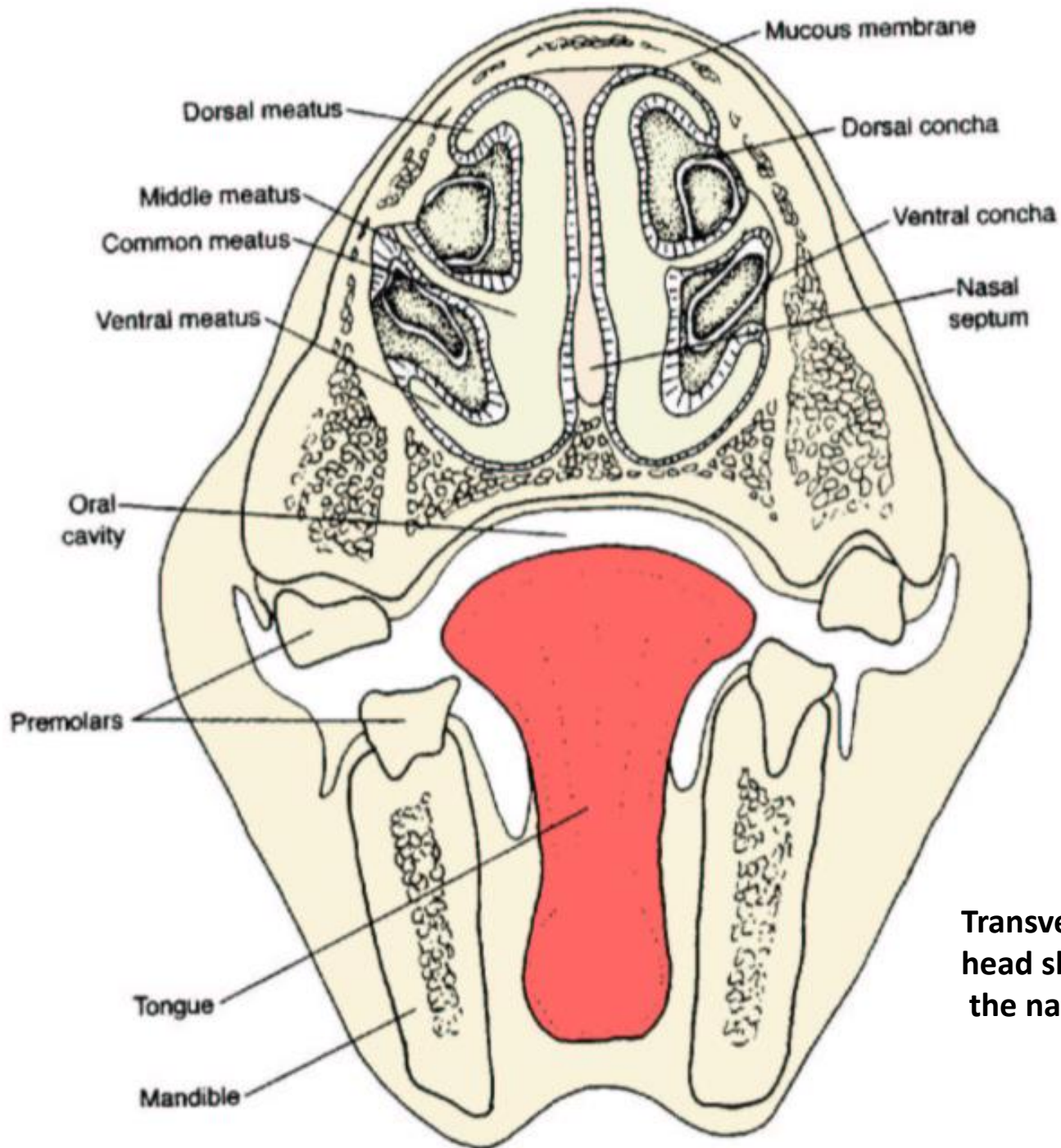
- Nasal cavities separated from each other by nasal septum and from the mouth by the hard and soft palates
- Each nasal cavity contains mucosa-covered turbinate bones (conchae) that project to the interior, for the dorsal and lateral walls separating the cavity into passages known as the common, dorsal, middle, and ventral meatuses
- The mucosa of the turbinates is well vascularized and serves to warm and humidify inhaled air.
- Another function for the conchae involves cooling blood through a counter-current heat exchange mechanism. Arteries that supply blood to the brain divide into smaller arteries at the base of the brain. These are bathed in a pool of venous blood that comes from the walls of the nasal cavities where it has been cooled. This keeps brain temperature 2 – 3 degrees cooler



Midsagittal section of the head of a cow with nasal septum removed

Division of the nasal cavity

1. **The narrow rostral portion** of the nasal cavity (vestibulum nasi)
 2. **The largest middle portion** of the nasal cavity contains the nasal conchae (dorsal and ventral conchae)
 3. **The small caudal portion** of the nasal cavity are the much more numerous ethmoidal conchae
- ❖ Caudoventrally, the nasal cavity communicates through the choanae , two openings separated by the vomer, with the nasopharynx .
 - ❖ The dorsal and ventral nasal conchae project from the lateral wall and divide the nasal cavity into three meatuses, in addition to the common fourth one
 1. **The dorsal nasal meatus** is a narrow passage between the roof of the nasal cavity and the dorsal concha and leads into the caudal part of the nose.
 2. **The middle nasal meatus** is between the dorsal and ventral conchae and it also leads into the caudal part.
 - ❖ In the carnivores and ruminants, this meatus is split caudally by the middle nasal concha into dorsal and ventral channels .
 3. **The ventral nasal meatus is the largest.** It lies between the ventral concha and the floor of the nasal cavity and leads into the nasopharynx. Most of the respiratory air passes through this meatus.
 4. **The common nasal meatus** , the narrow space between the nasal septum and the conchae, extends from the roof of the nasal cavity to the floor and is continuous laterally with the other meatuses. Similar air spaces between the ethmoidal conchae are the ethmoidal meatuses.



Transverse section of the horse head showing the division of the nasal cavities

Nasal bone

Nasal septum

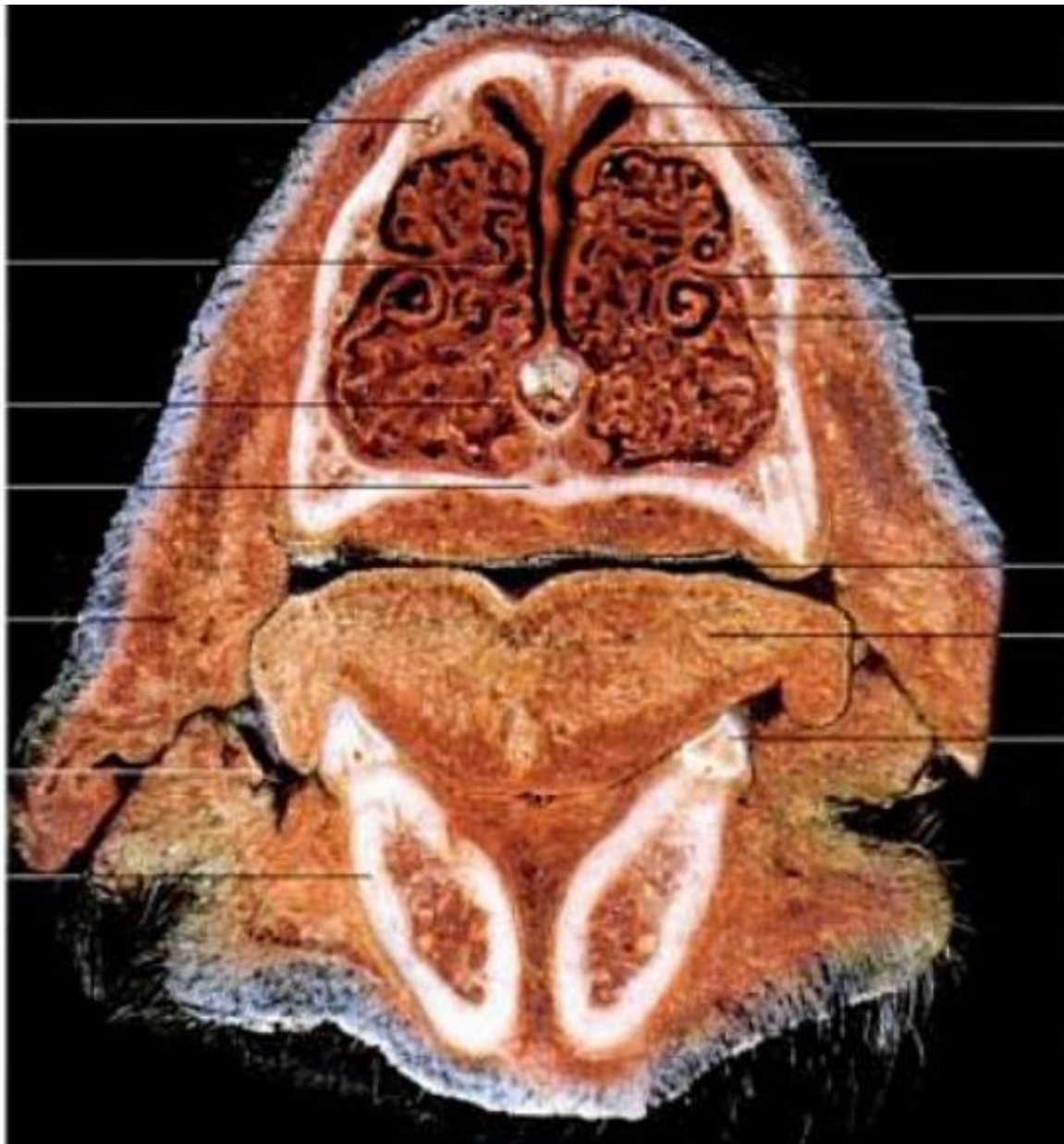
Vomer

Maxilla and
hard palate

Cheek

Buccal vestibule

Mandible

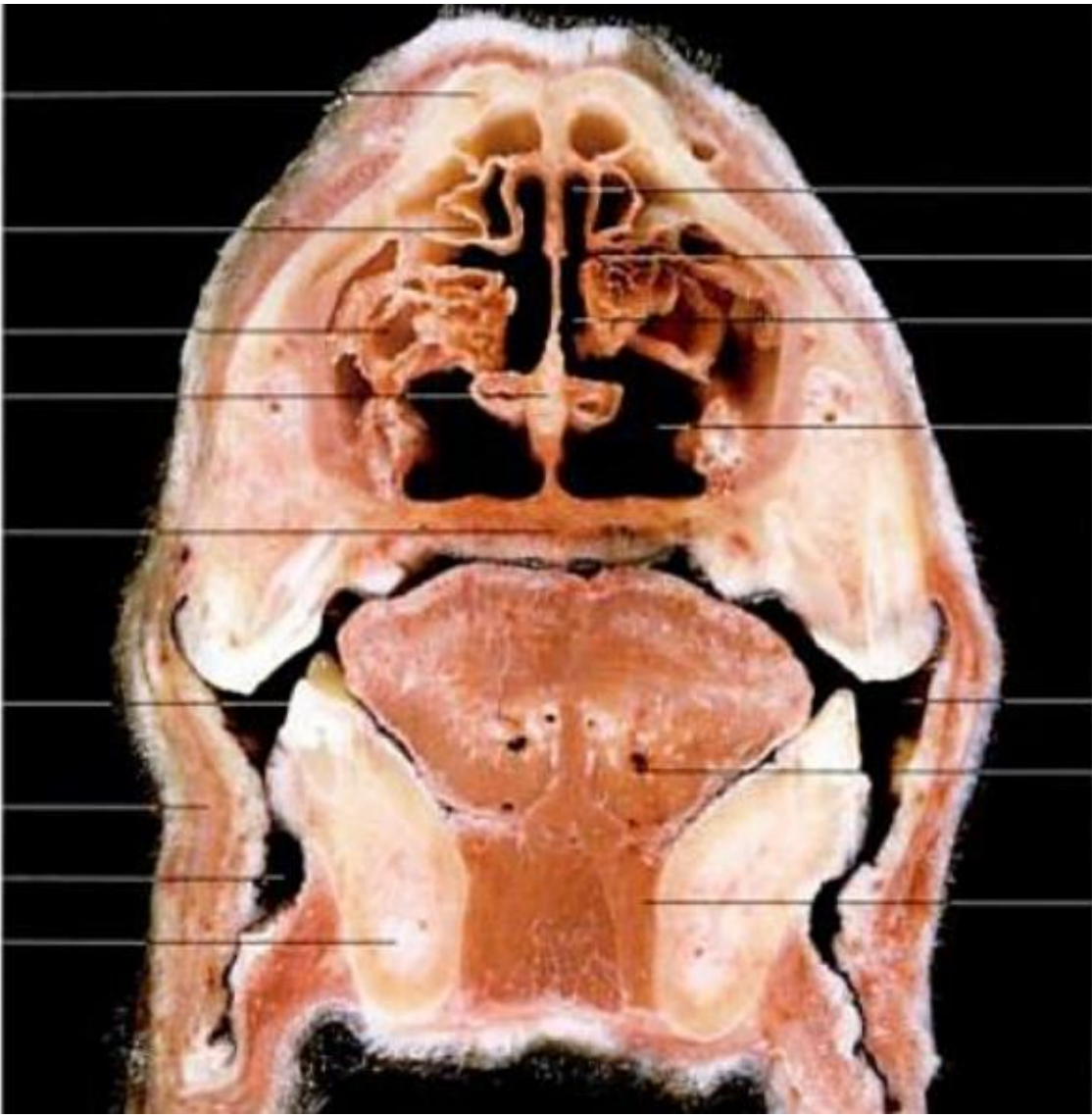


Dorsal nasal meatus
Dorsal nasal concha

Ventral nasal concha
Base lamella
Spiral lamella

Oral cavity
Body of the tongue

P2



Nasal bone

Dorsal nasal concha

Middle nasal concha

Nasal septum

Vomer,
maxilla and
hard palate

P3

Cheek

Buccal vestibule

Mandible

Dorsal nasal meatus

Middle nasal meatus

Common nasal meatus

Ventral nasal meatus

Oral vestibule

Body of tongue

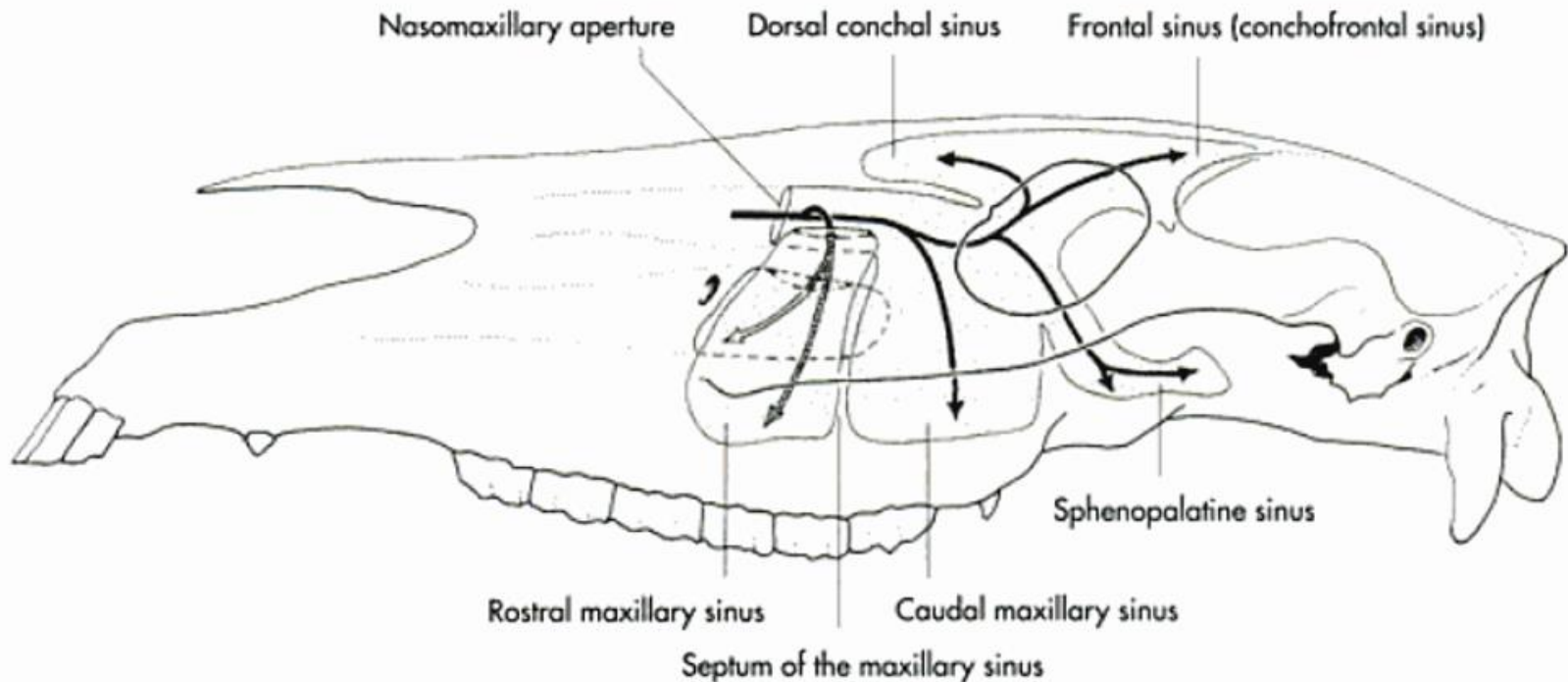
Geniohyoid muscle

Paranasal sinuses

The paranasal sinuses are diverticula of the nasal cavity, which form air-filled cavities between the external and internal lamina of the bones of the skull.

The following paranasal sinuses can be found in the skull of domestic mammals:

1. **Maxillary sinus**
2. **Frontal sinus**
3. **Palatine sinus**
4. **Sphenoidal sinus**
5. **Lacrimal sinus**
6. **Dorsal conchal sinus and ventral conchal sinus, in the pig, ruminants and horse**
7. **Ethmoid cellules in pigs and ruminants**



Pharynx

located caudal to the nasal cavities and is a common passageway for air and food. It comprises of an oropharynx, a laryngophyrnx and a nasopharynx .

The nasopharynx is dorsal to the soft plate where it continues the ventral nasal meatus through the conchae. It communicates via the pharyngeal opening of the auditory tubes itself, and the guttural pouch with middle ear.

❖ The guttural pouch is a paired air-filled space with a capacity of 300 to 500ml. It extends From the base of the skull and the atlas to the nasopharynx.

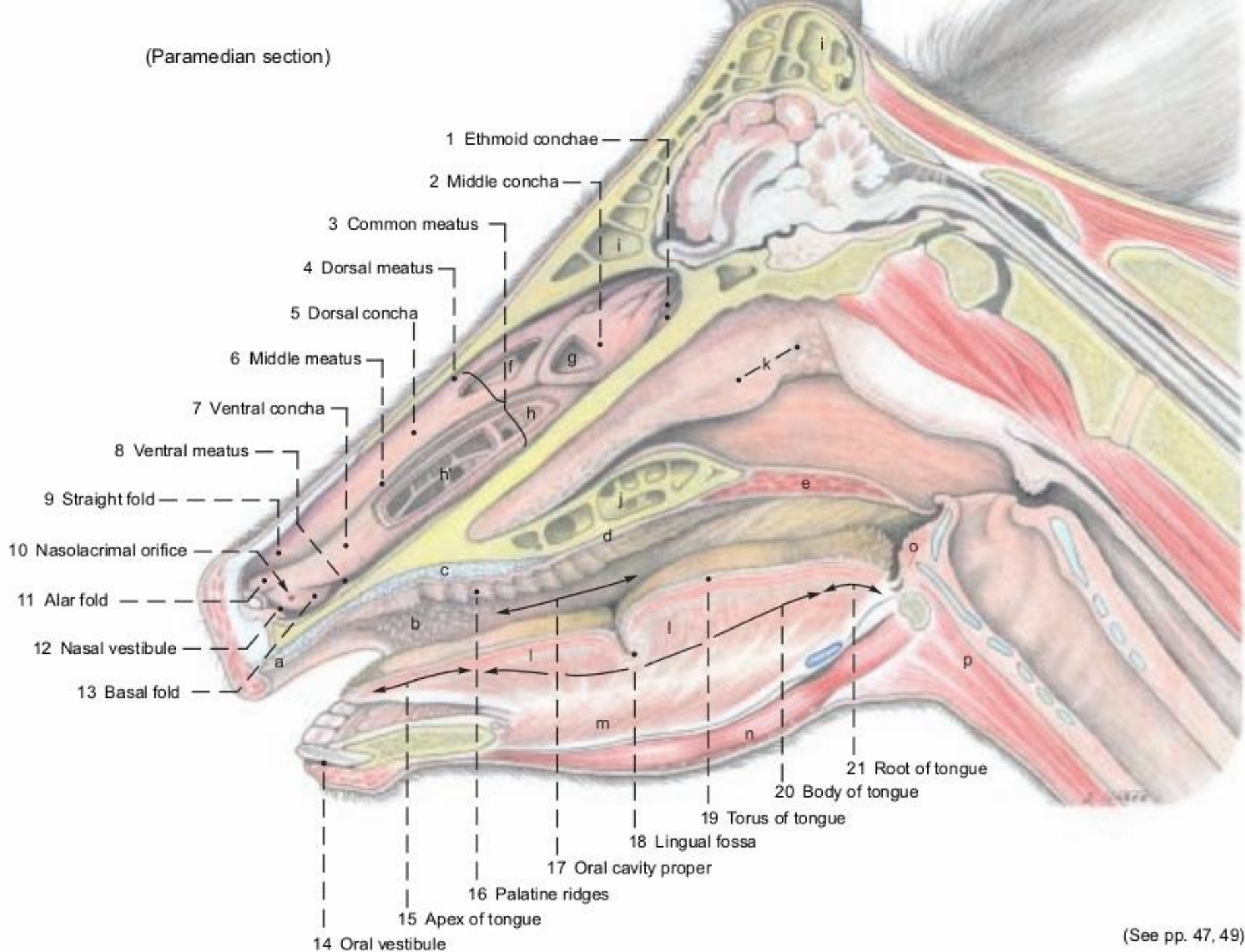
➤ The openings to the pharynx include:

- 1) Two posterior nares
- 2) Two eustachian tubes,
- 3) A mouth (oral cavity),
- 4) A glottis,
- 5) An esophagus

➤ The opening from the pharynx leading to the continuation of the respiratory passageway is the glottis.

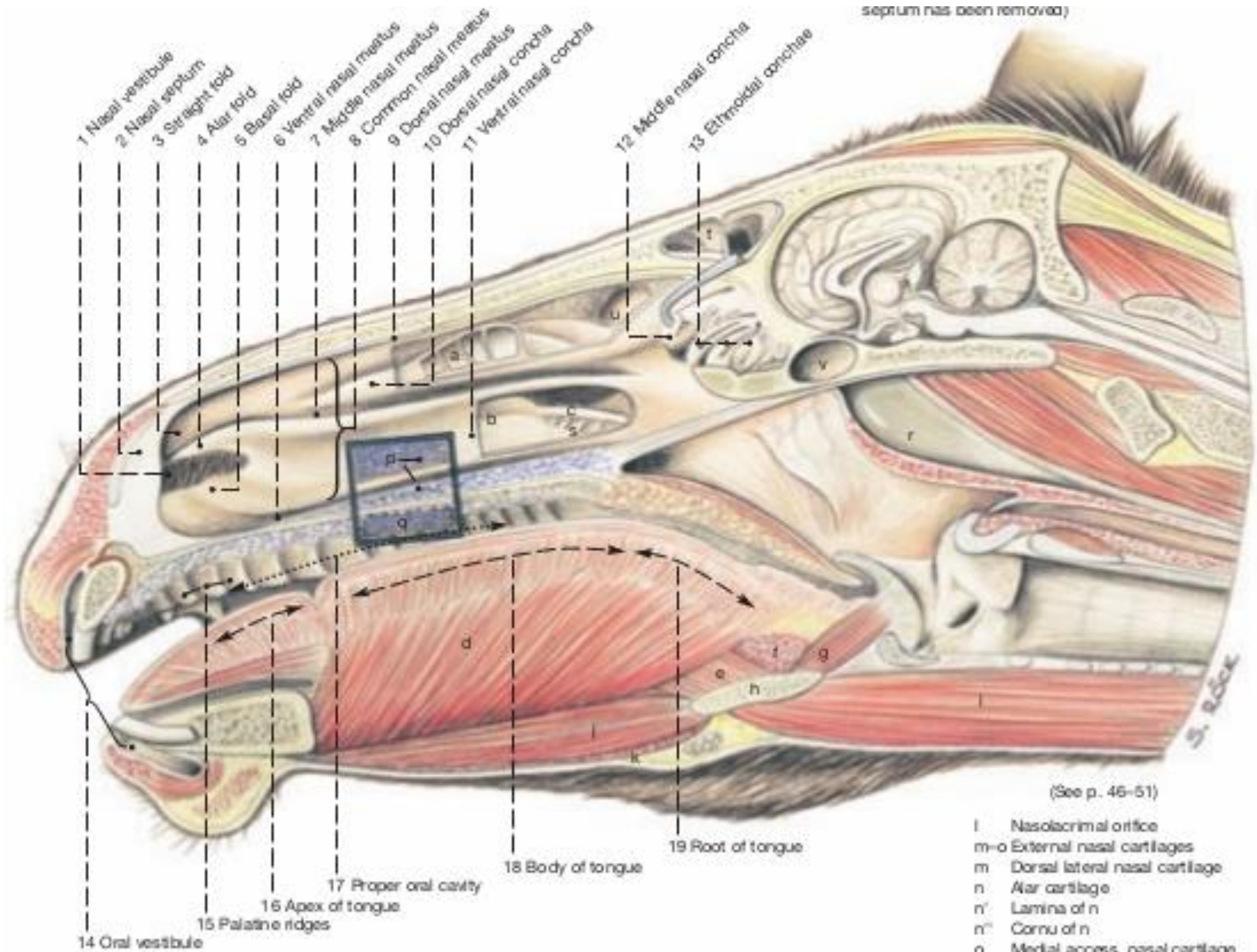
➤ Immediately caudal to the glottis is the larynx, organ of phonation (called the sirinx in birds)

(Paramedian section)



(See pp. 47, 49)

septum has been removed)



(See p. 46-51)

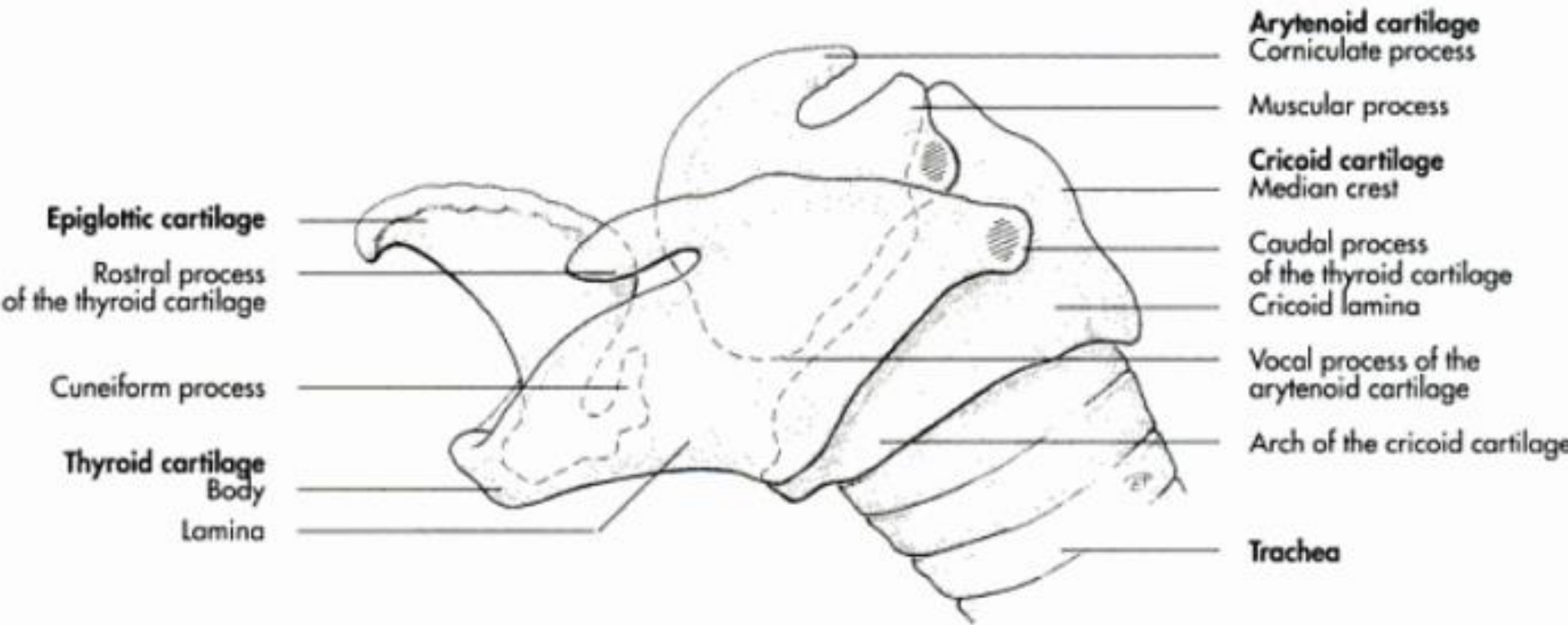
- l Nosolacrimal orifice
- m-o External nasal cartilages
- m Dorsal lateral nasal cartilage
- n Alar cartilage
- n' Lamina of n
- n'' Cornu of n
- o Medial access. nasal cartilage
- n Covered nasal pieces of vert.

Larynx

The larynx is a short cartilaginous tube that connects the lower part of the pharynx with the trachea, and contains the organ of phonation.

The skeleton of the larynx is composed of the following cartilages:

1. The unpaired cricoid cartilage caudally
 2. The unpaired thyroid cartilage ventrally and laterally
 3. The paired arytenoid cartilages dorsally,
 4. The unpaired epiglottis rostrally.
 5. In addition to these there are the interarytenoid cartilages and the inconstant sesamoid cartilages
- The epiglottis fits like a lid over the entrance of the larynx and closes it during swallowing.
 - The corniculate and cuneiform cartilages of man are processes of the arytenoid, while are epiglottic cartilages in the domestic mammals.
 - The cricoid, thyroid, and the body of the arytenoid cartilages consist of hyaline cartilage, while the epiglottis, cuneiform, and the vocal and corniculate processes of the arytenoid cartilages consists of elastic cartilage.



Epiglottic cartilage

Rostral process
of the thyroid cartilage

Cuneiform process

Thyroid cartilage

Body
Lamina

Arytenoid cartilage

Corniculate process

Muscular process

Cricoid cartilage

Median crest

Caudal process

of the thyroid cartilage

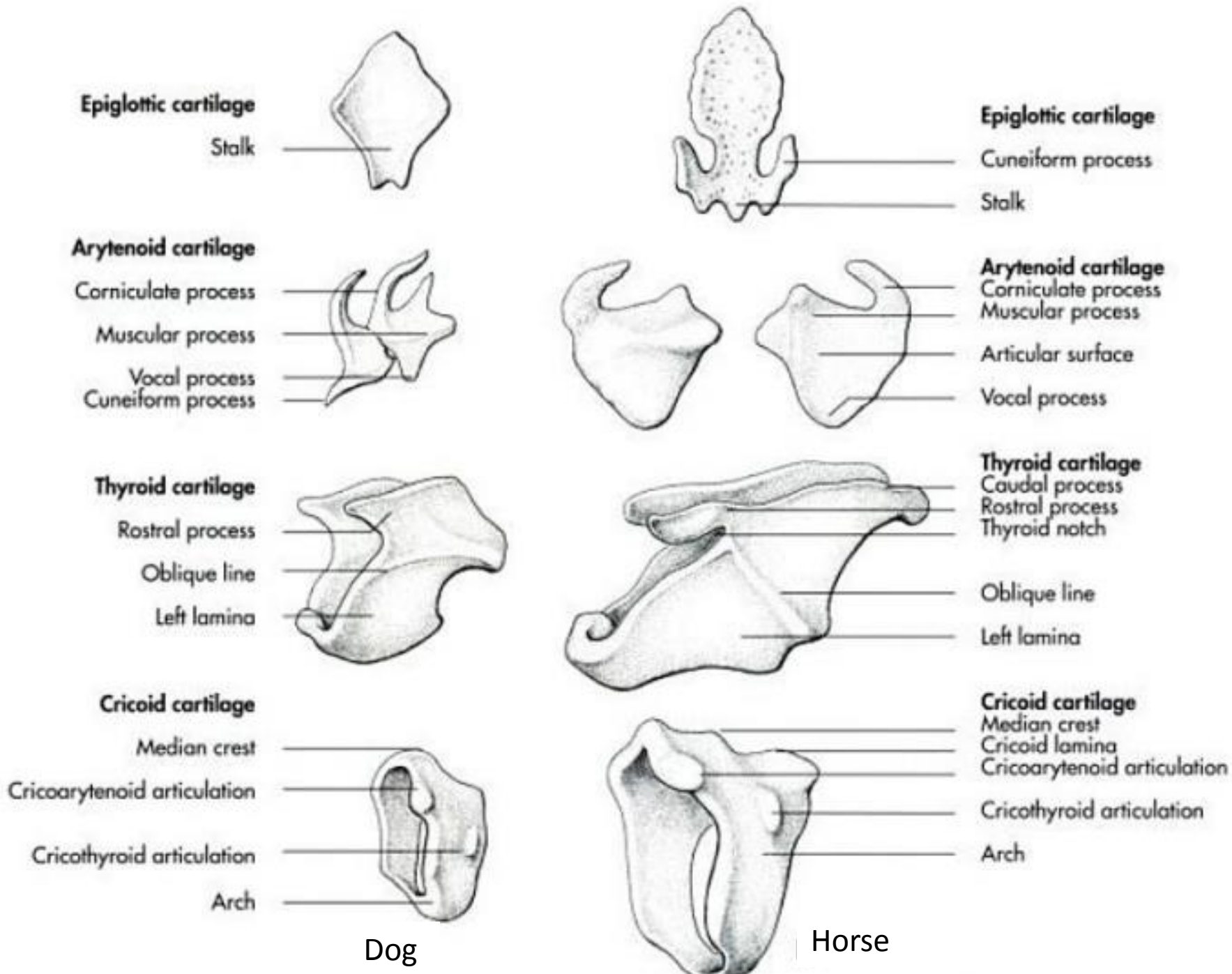
Cricoid lamina

Vocal process of the

arytenoid cartilage

Arch of the cricoid cartilage

Trachea





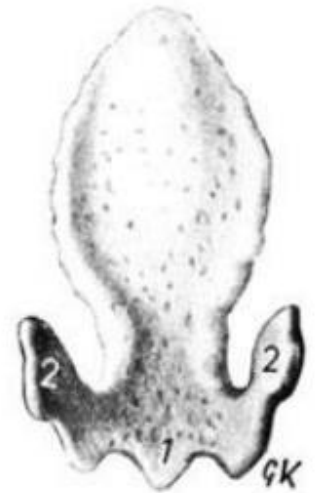
(Dog)



(Pig)



(Ox)



(Horse)

Epiglottic cartilage dorsal aspect

Trachea

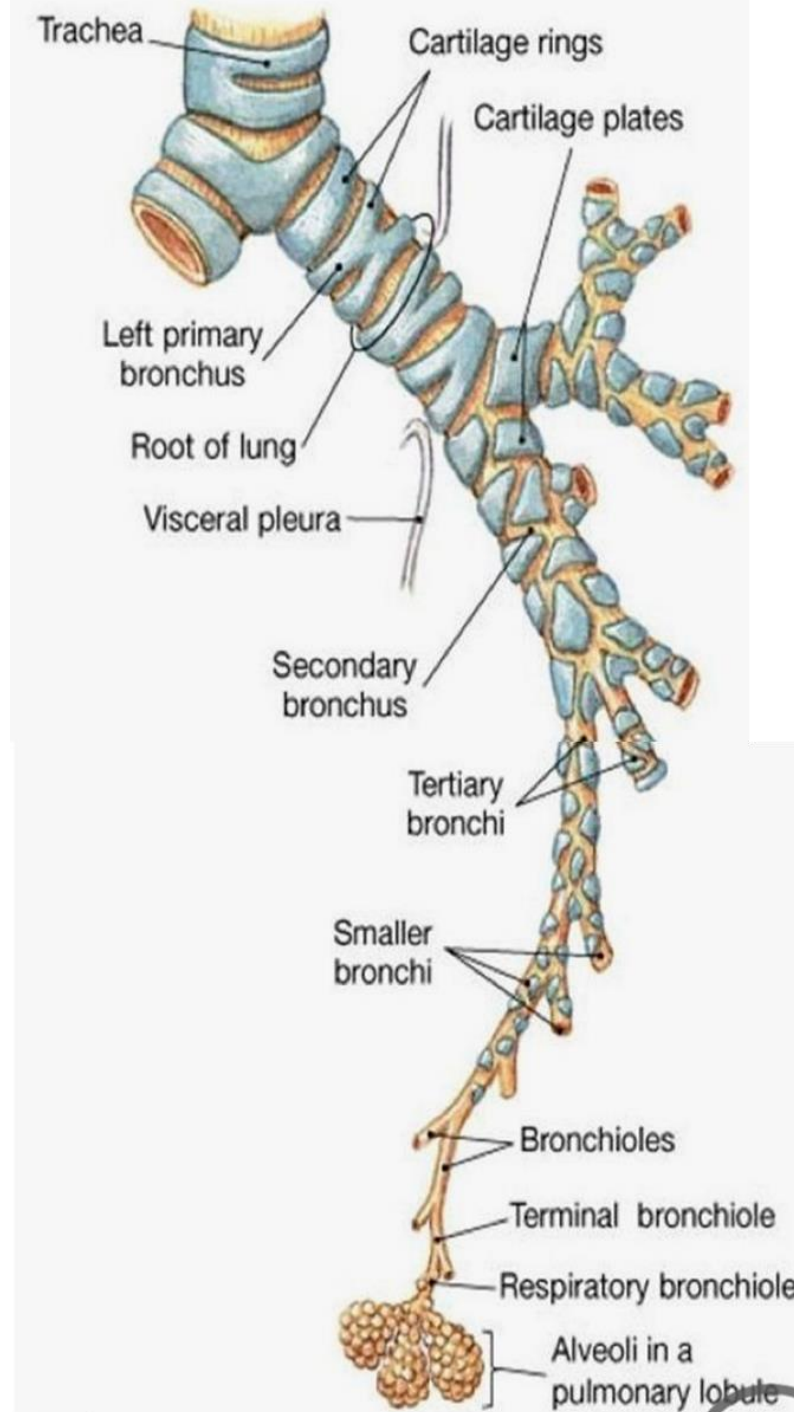
The trachea is a noncollapsible tube which continues the respiratory pathway from the cricoid cartilage of the larynx to the root of the lung where it bifurcates to form the right and left principal bronchi.

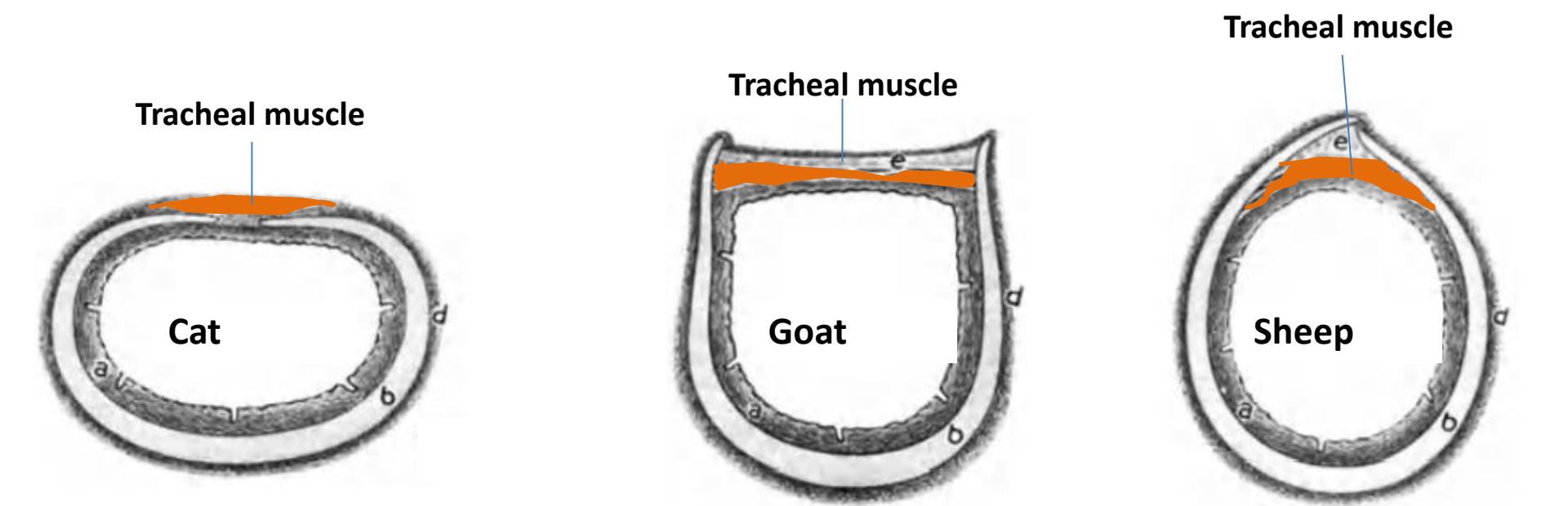
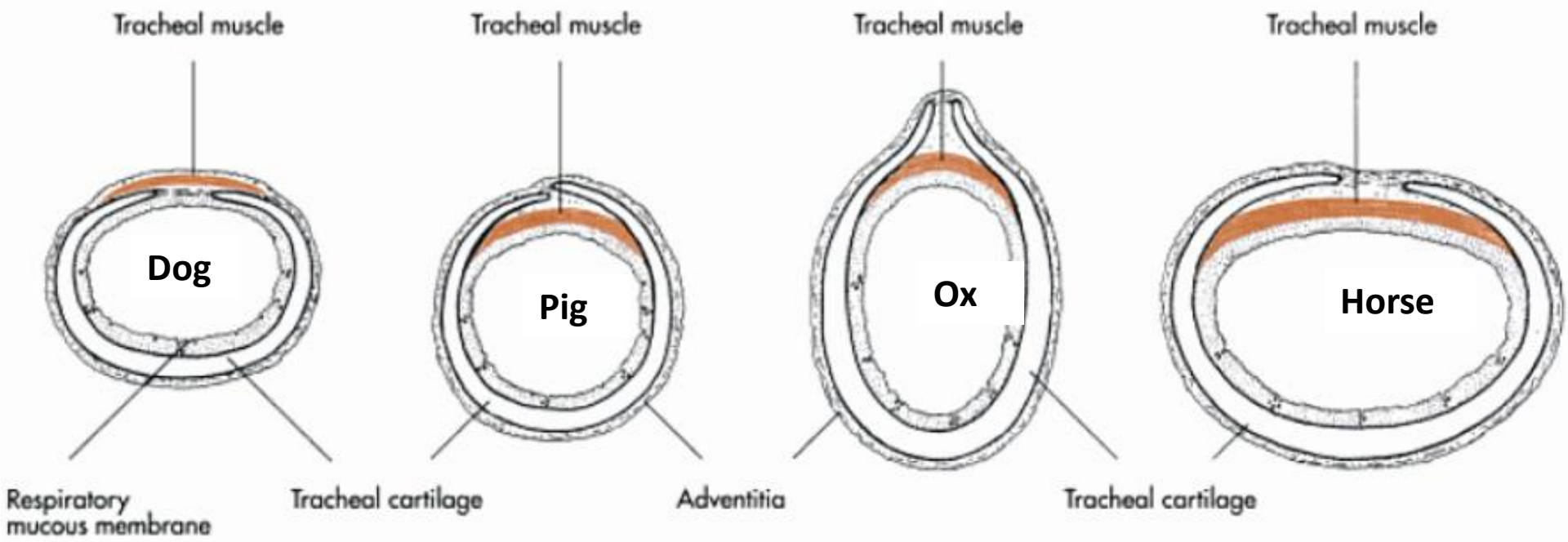
Position. In the neck, the trachea is related dorsally to the oesophagus and the longus colli and longus capitis muscles, which cover the ventral surface of the vertebral column. The trachea represents the primary passageway for air into the lungs, continued from the larynx cranially and divides caudally to form the left and right bronchi.

- Tracheal wall contains cartilaginous rings to prevent collapse of the tracheal airway
- Each tracheal ring is incomplete (not joined dorsally), which permits variation in diameter for increased ventilation requirements.
- Right and left bronchi and their subdivisions continue all the way to the alveoli
- The final and smallest subdivisions of the air passages.

Subdivision of the trachea to the alveoli are: -

1. trachea
2. bronchi
3. bronchioles
4. terminal bronchioles
5. respiratory bronchioles
6. alveolar duct
7. alveolar sac
8. alveoli





Tracheal structure

- The trachea consists of a series of incomplete cartilaginous rings of the hyaline type, which prevent the collapse of the tube and are covered with an adventitia and lined with a mucous membrane
- The tracheal cartilages are united by annular ligaments which fuse with the perichondrium and consist mainly of fibrous but also of elastic tissue.
- On the dorsal surface, the connective tissue is loose, contains lymphoid tissue, and fills the space between the free ends of the cartilages. Between this connective tissue and the mucous membrane is the trachealis, a smooth muscle with mainly transversely oriented fibres.
- In the carnivores, the trachealis lies external to the cartilages.

- Non-alveolated: They include the trachea, bronchi, and membranous bronchioles. These airways, along with their accompanying arteries and veins, lymphatic vessels, nerves, interlobular septa, and pleura, constitute the non-parenchymal portion of the lung.
- Alveoli associated with the more distal alveolar sacs constitute the lung parenchyma.
- It has been estimated that approximately 87% of the total lung volume is alveolar, 6% of which is composed of tissue, and the remainder of which is gas.
- Both the right and the left lung are enveloped by a thin layer of connective tissue (the visceral pleura), which focally extends into the parenchyma, dividing it into several lobes (upper, middle, and lower on the right side and upper and lower on the left).
- A potential space (the pleural cavity) separates the visceral pleura from the parietal pleura, which lines the chest wall, mediastinum, and diaphragm.

The number of the tracheal cartilages varies among individuals

Animal	Tracheal cartilages
Horse	48-60
Ox	48-60
Sheep	48-60
Goat	48-60
Pig	29-36
Dog	42-46
Cat	38-43

The lungs

The lungs originate in the embryo from the floor of the foregut, usually as a single median bud, which soon splits into right and left lung buds.

The lungs are located in the pleural sacs which come together medially to form the mediastinum

The walls of the pleural sacs are:

1. The costal pleura adhere laterally to the ribs
2. The diaphragmatic pleura caudally to the diaphragm
3. The mediastinal pleura medially to the organs in the mediastinum or to the other pleural sac

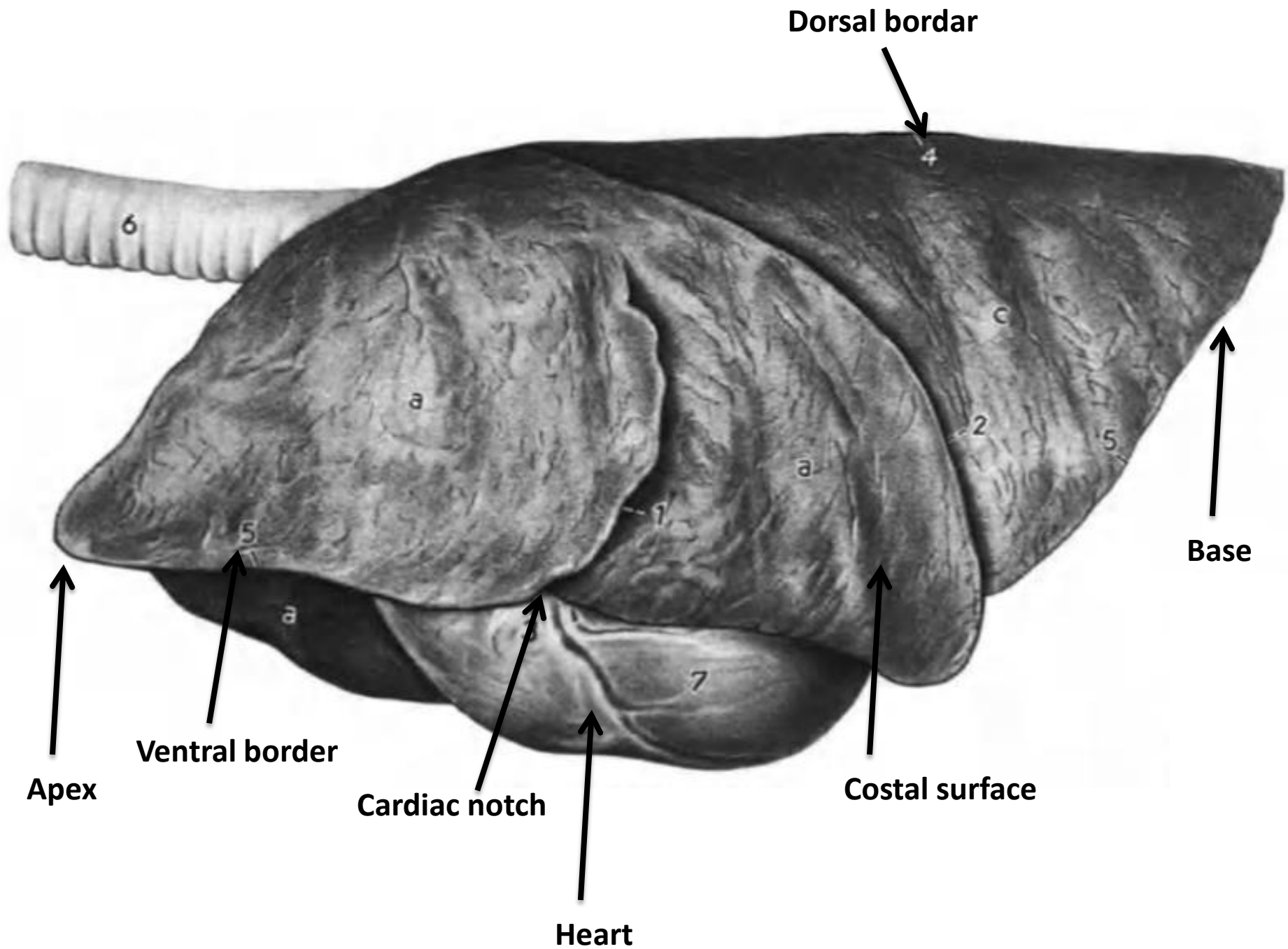
Each lung is shaped like a semicone and has an apex, which is directed cranially and lies at the thoracic inlet, and an oblique base, which faces caudoventromedially and lies on the diaphragm.

Surfaces of the lungs

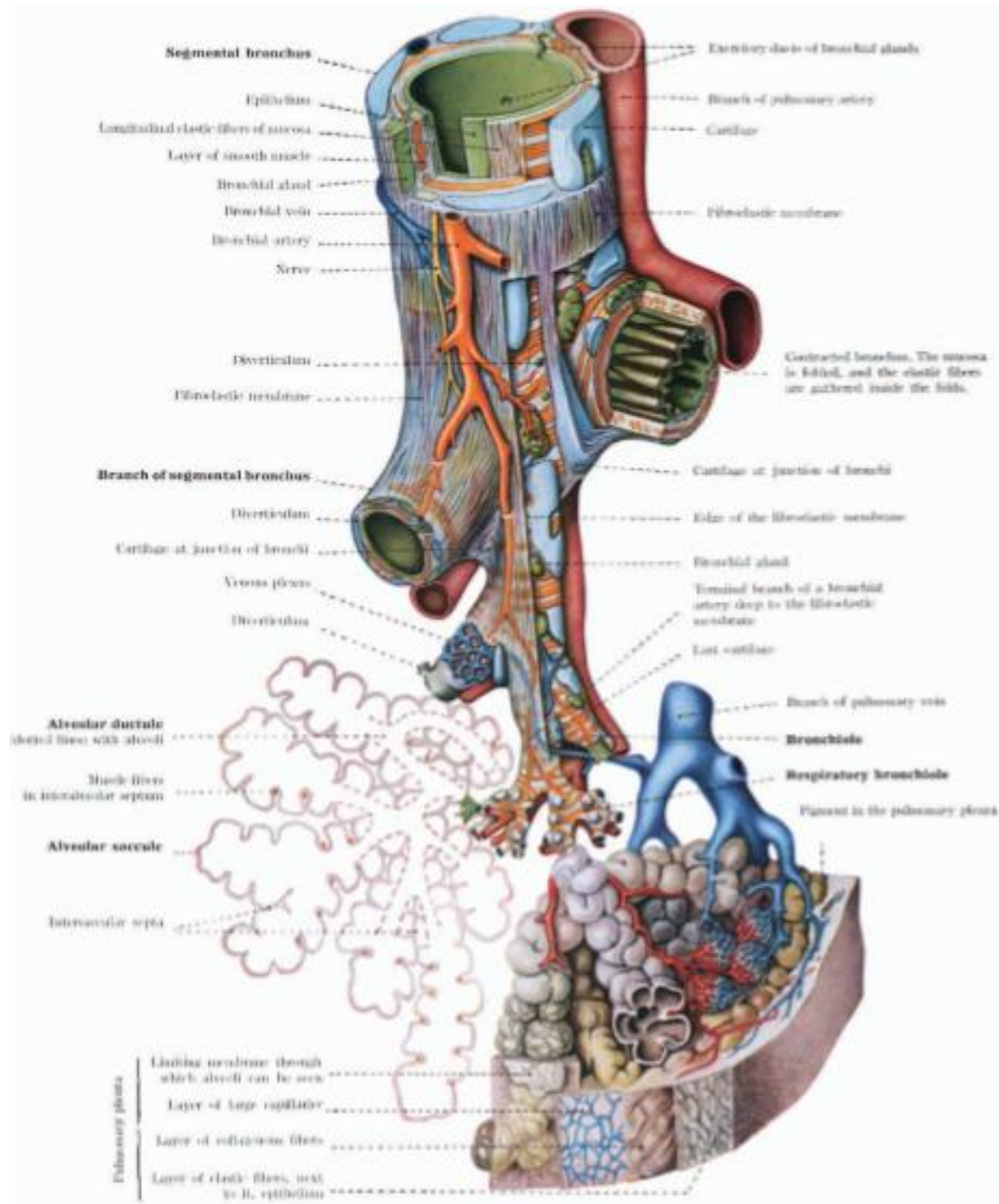
1. The costal surface lies against the ribs and bears their impressions
2. The medial surface lies against the bodies of the thoracic vertebrae and the mediastinum and displays the impressions of the organs located in the mediastinum
3. The diaphragmatic surface which is at the base of the lung, is concave and lies on the diaphragm.

Border of the lungs

1. The rounded dorsal border, the medial surface meets the costal surface dorsally to form it,
2. The sharp ventral border meets ventrally to form it, the ventral border presents the cardiac notch, which permits the heart and pericardium to make contact with the lateral thoracic wall



- **Colour.** The colour of the lung depends on the amount of blood it contains. If the animal is bled completely, the lung is pink, but if blood remains in the lung after death, it is a darker red.
- ❖ The human lung is often gray, grayish blue, or even black because of the accumulation of dust and carbon particles. This is true also of the lungs of cats and dogs that have been kept for the most part in large cities or indoors.
- **Weight.** Because of the considerable amount of air contained in the lung, it will float in water. Lungs of stillborn animals will sink. If they float, the animal has breathed and is considered to have been alive and therefore should not be called stillborn. This flotation test is of importance in some forensic cases. Diseased lungs may also sink due to the presence of exudate replacing the residual air in the alveoli. The absolute weight of the lung differs with the species. On the average, it represents 1-1.5 per cent of the body weight.
- **The size** of the lung depends on the amount of air it contains and is considerably larger after inspiration than after expiration. The collapsed lung is smaller than the functional lung after expiration, and results from the introduction of air into the pleural sacs (pneumothorax) in the live animal, or, after death, when the pleural cavities are opened. The right lung is always larger than the left, the proportion being 4:3. BRONCHIAL



Bronchial tree

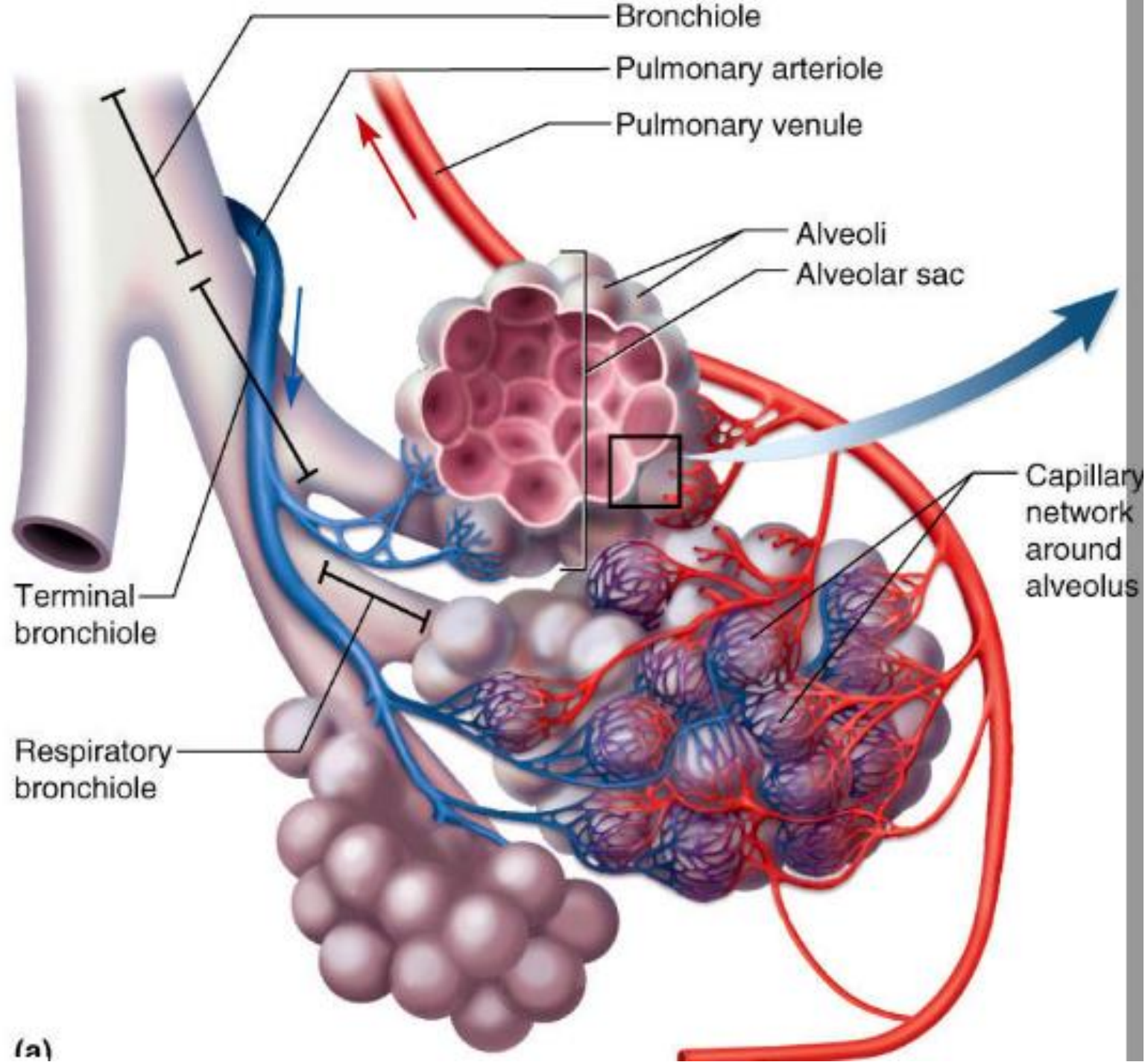
The bronchi divided within the lungs

A. Respiratory passages

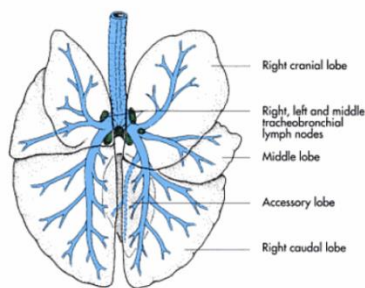
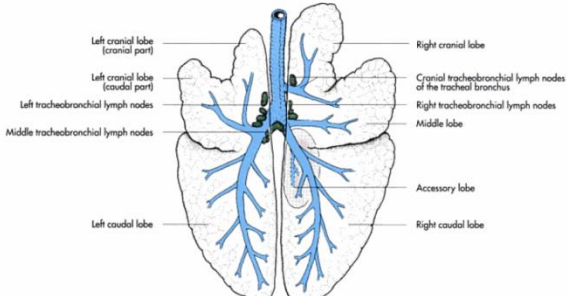
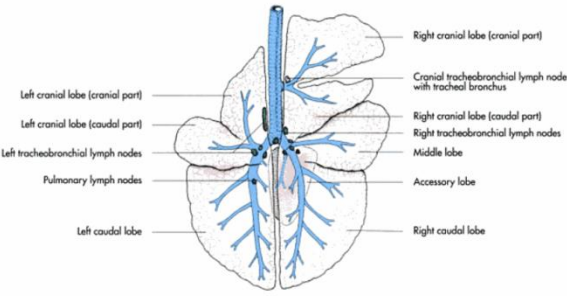
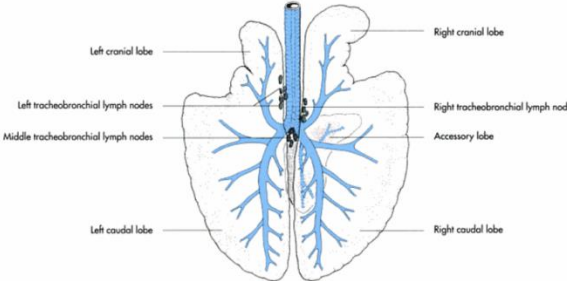
1. Principal bronchi
2. Lobar bronchi
3. Segmental bronchi
4. Subsegmental bronchi
5. True and terminal bronchiole

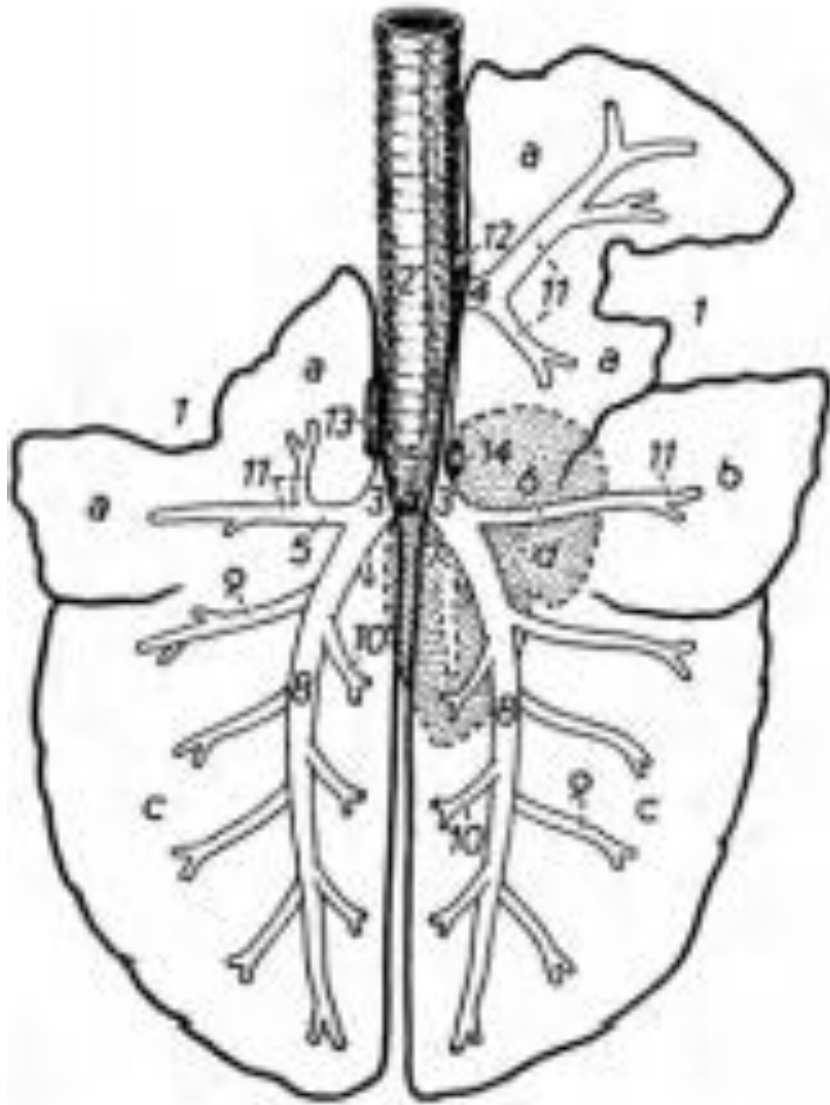
B. Sites of gaseous exchange within the lungs

1. Respiratory bronchiole
2. Alveolar duct
3. Alveolar sac
4. Pulmonary alveoles

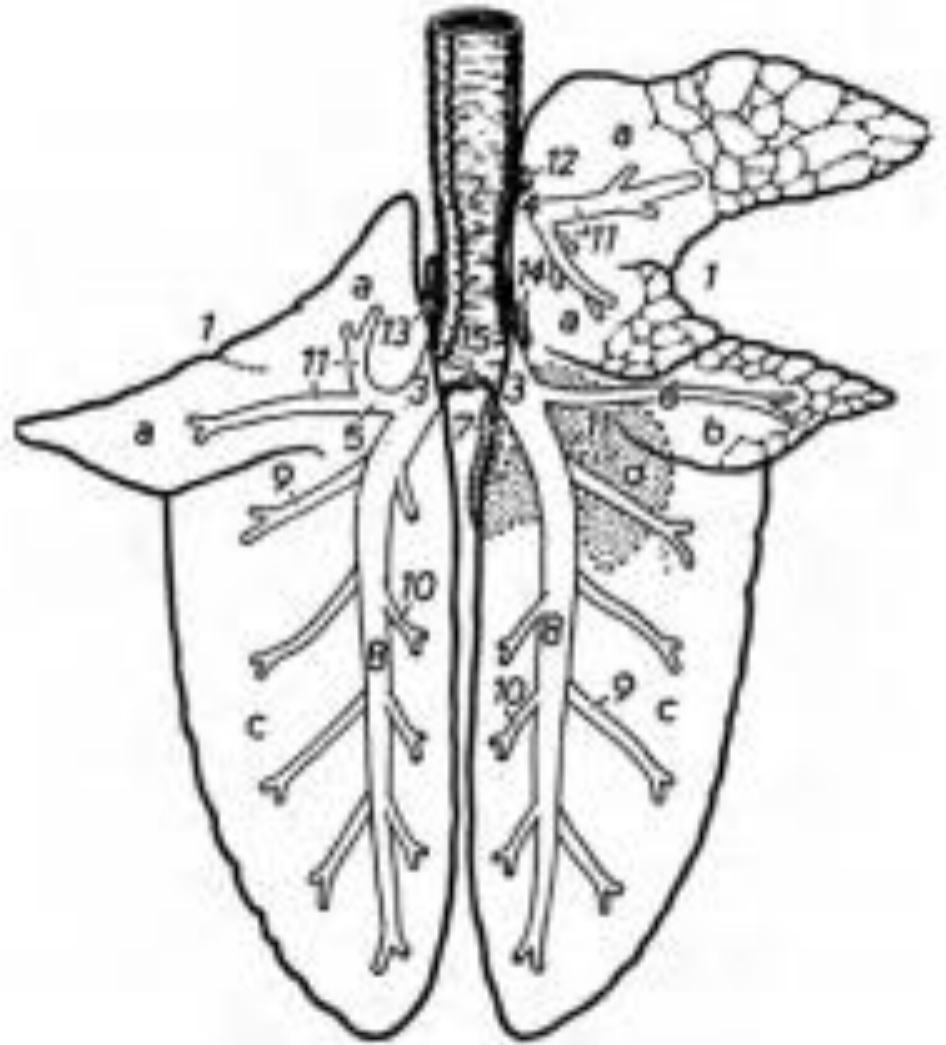


Lobation of the lungs of the domestic mammals

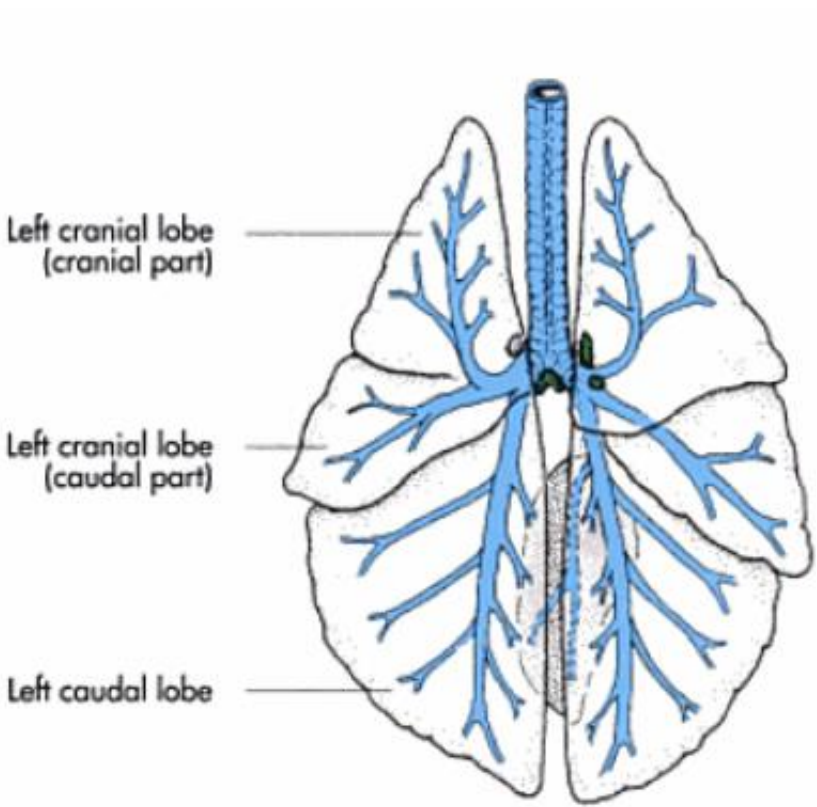
Animal	Left lung	Right lung	Schematic
Carnivores	Divided Cranial lobe Caudal lobe	Cranial lobe Middle lobe Caudal lobe Accessory lobe	 <p>Labels for carnivore schematic: Right cranial lobe, Right, left and middle tracheobronchial lymph nodes, Middle lobe, Accessory lobe, Right caudal lobe.</p>
Pig	Divided Cranial lobe Caudal lobe	Cranial lobe Middle lobe Caudal lobe Accessory lobe	 <p>Labels for pig schematic: Left cranial lobe (cranial part), Left cranial lobe (caudal part), Left tracheobronchial lymph nodes, Middle tracheobronchial lymph nodes, Left caudal lobe, Right cranial lobe, Cranial tracheobronchial lymph nodes of the tracheal bronchus, Right tracheobronchial lymph nodes, Middle lobe, Accessory lobe, Right caudal lobe.</p>
Ruminants	Divided Cranial lobe Caudal lobe	Divided Cranial lobe Middle lobe Caudal lobe Accessory lobe	 <p>Labels for ruminant schematic: Left cranial lobe (cranial part), Left cranial lobe (caudal part), Left tracheobronchial lymph nodes, Pulmonary lymph nodes, Left caudal lobe, Right cranial lobe (cranial part), Cranial tracheobronchial lymph node with tracheal bronchus, Right cranial lobe (caudal part), Right tracheobronchial lymph nodes, Middle lobe, Accessory lobe, Right caudal lobe.</p>
Horse	Cranial lobe Caudal lobe	Cranial lobe Caudal lobe Accessory lobe	 <p>Labels for horse schematic: Left cranial lobe, Left tracheobronchial lymph nodes, Middle tracheobronchial lymph nodes, Left caudal lobe, Right cranial lobe, Right tracheobronchial lymph nodes, Accessory lobe, Right caudal lobe.</p>



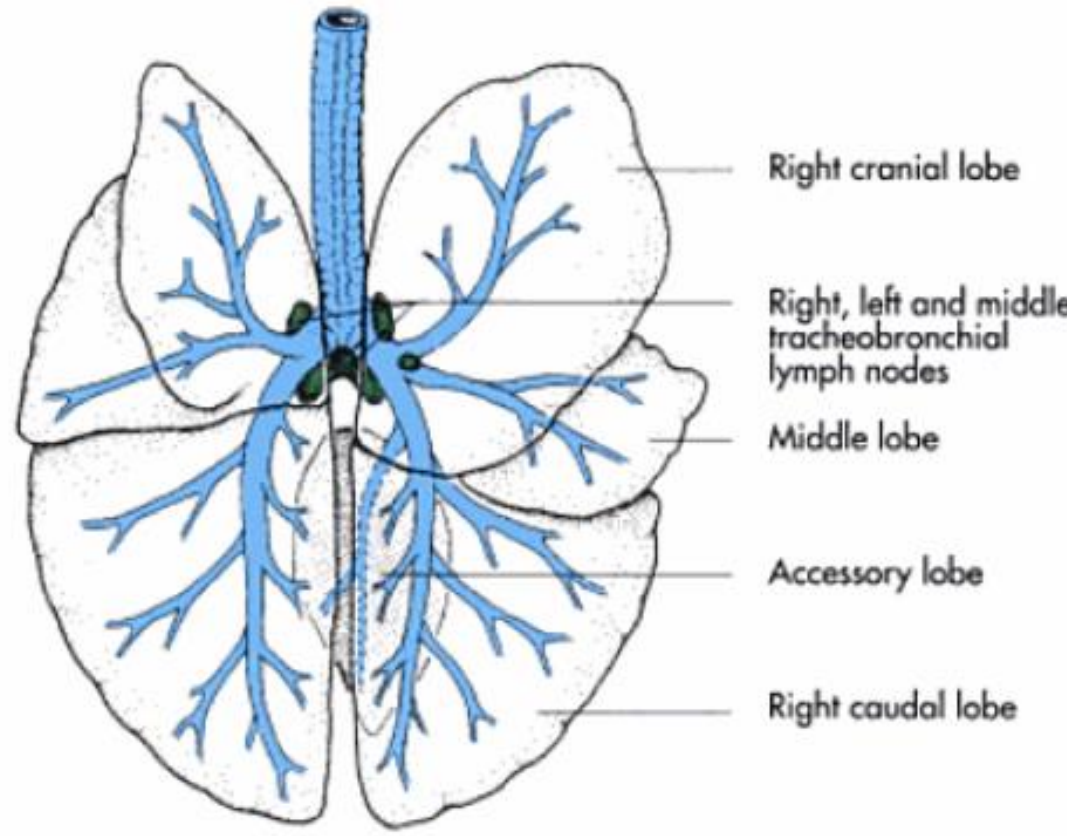
Sheep



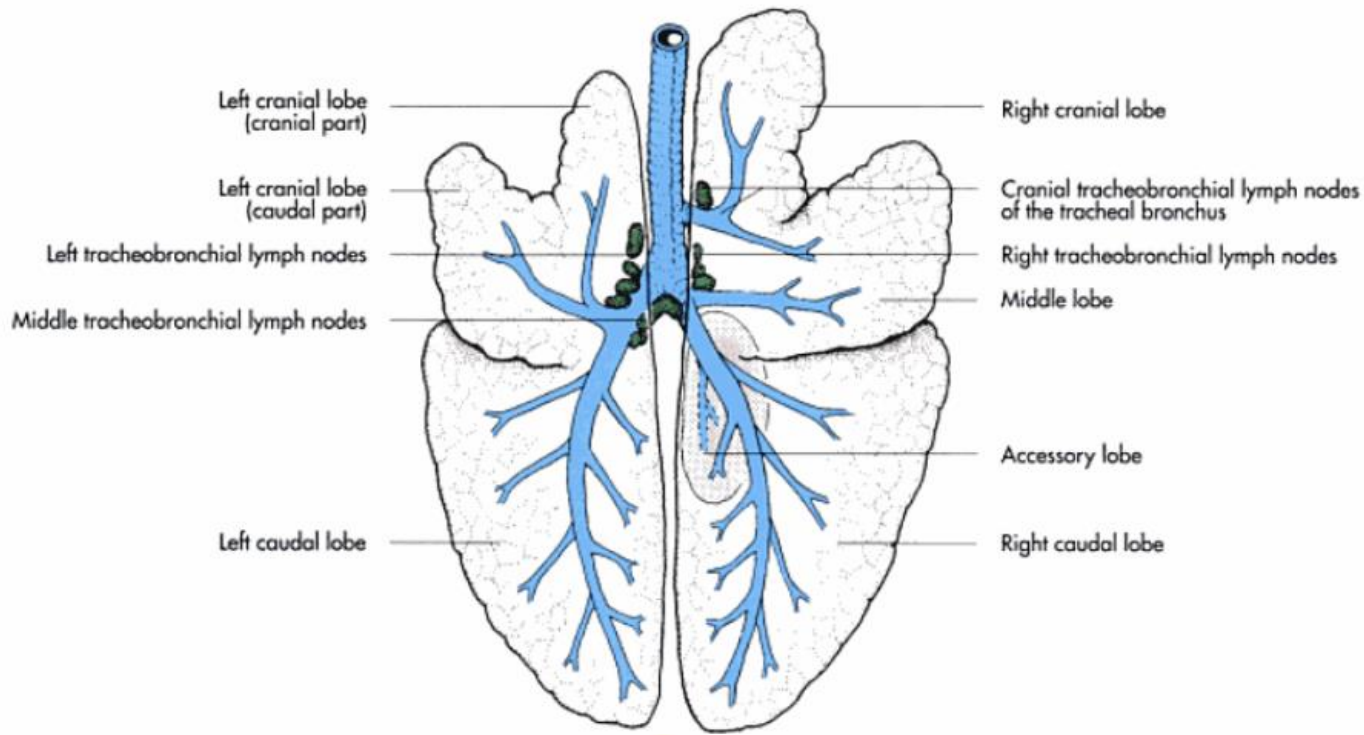
Goat



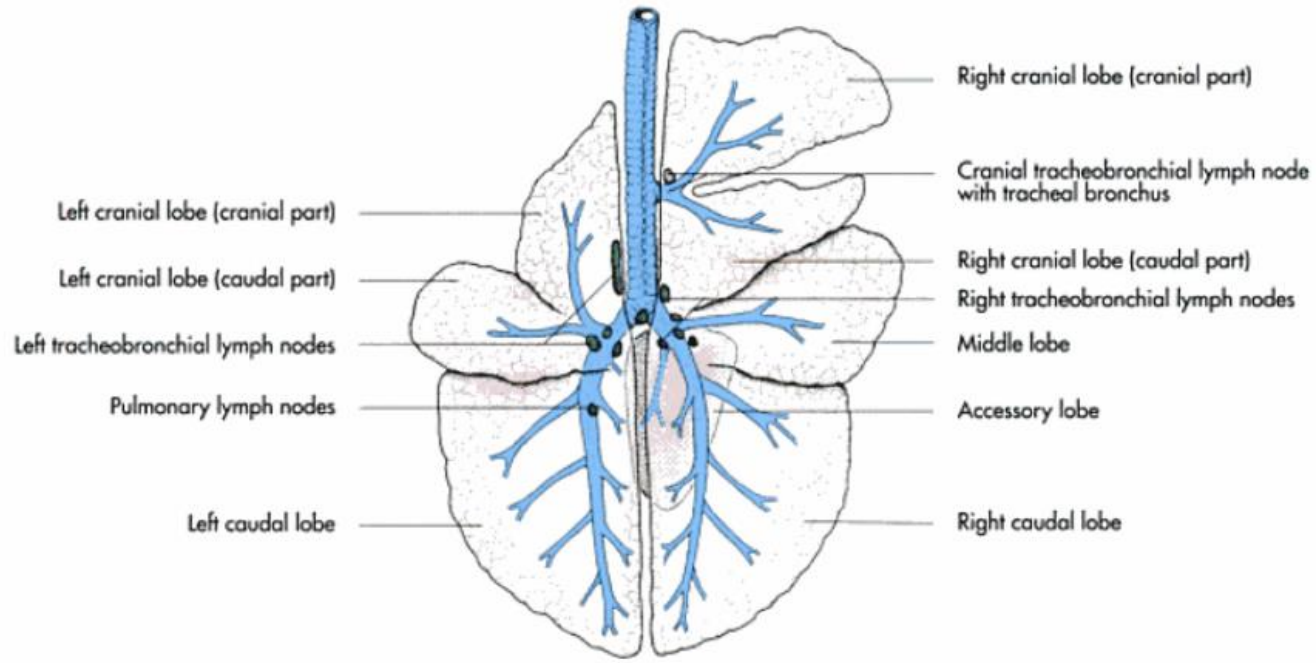
Cat



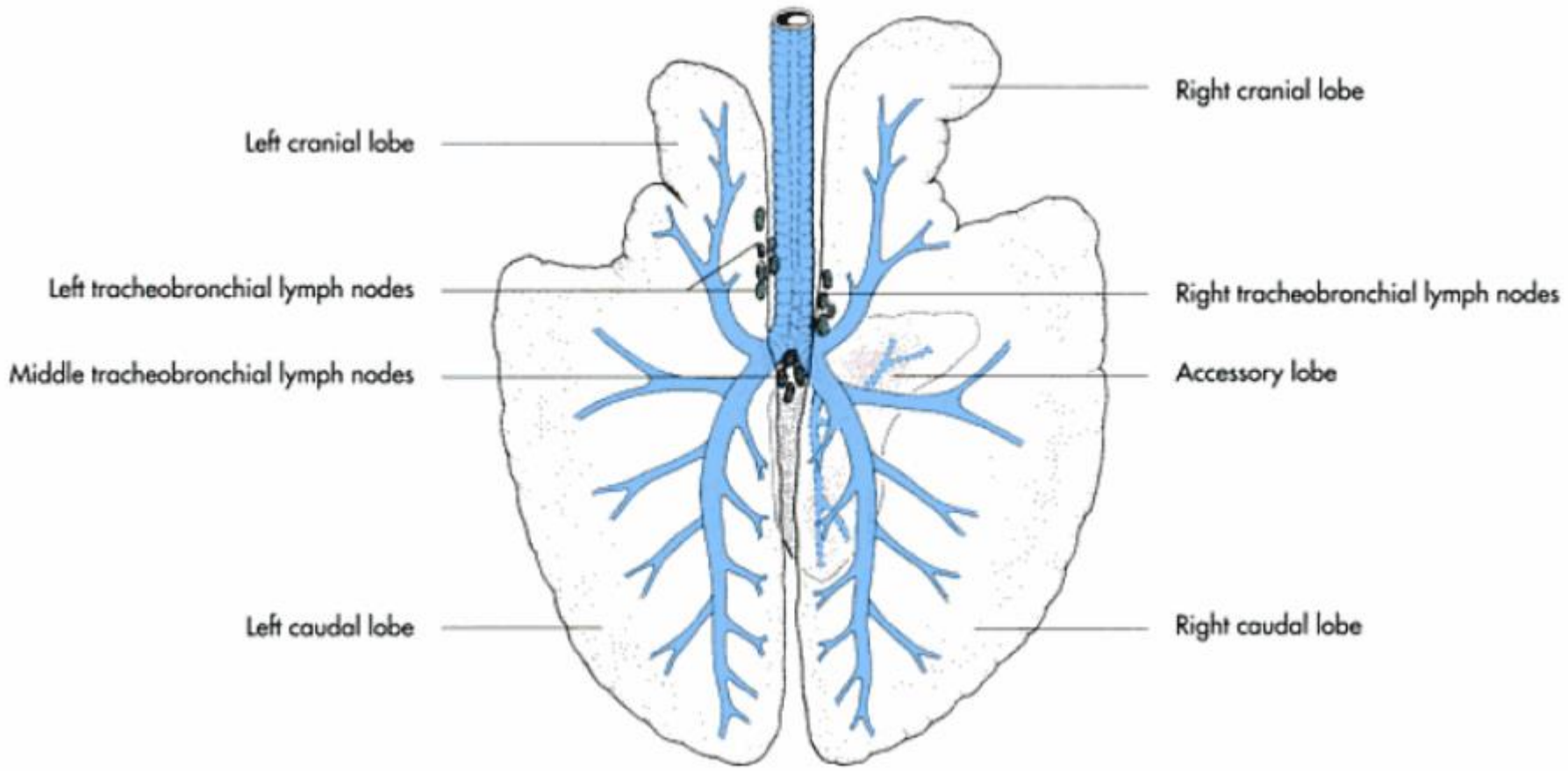
Dog



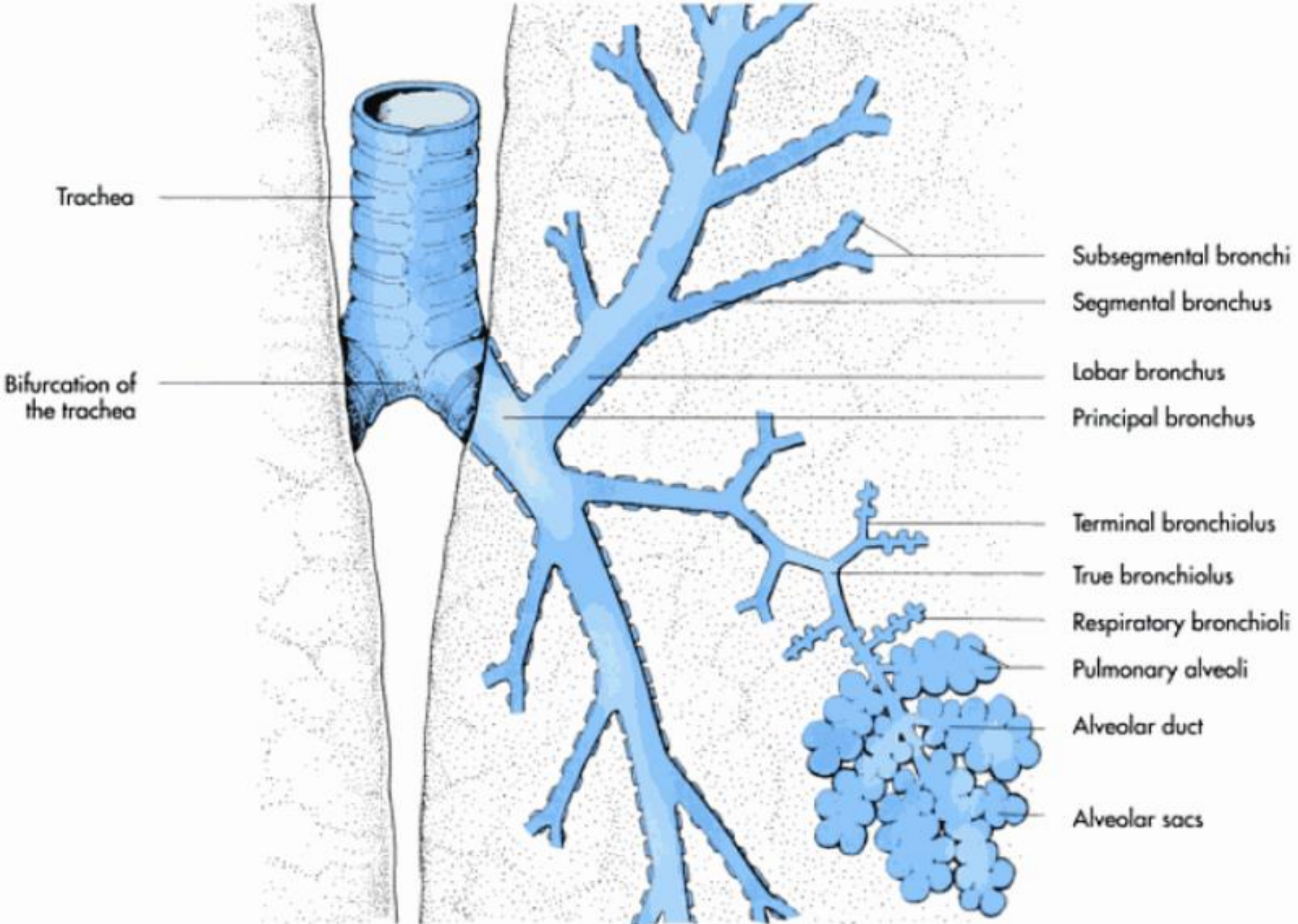
Pig



Ox



Horse



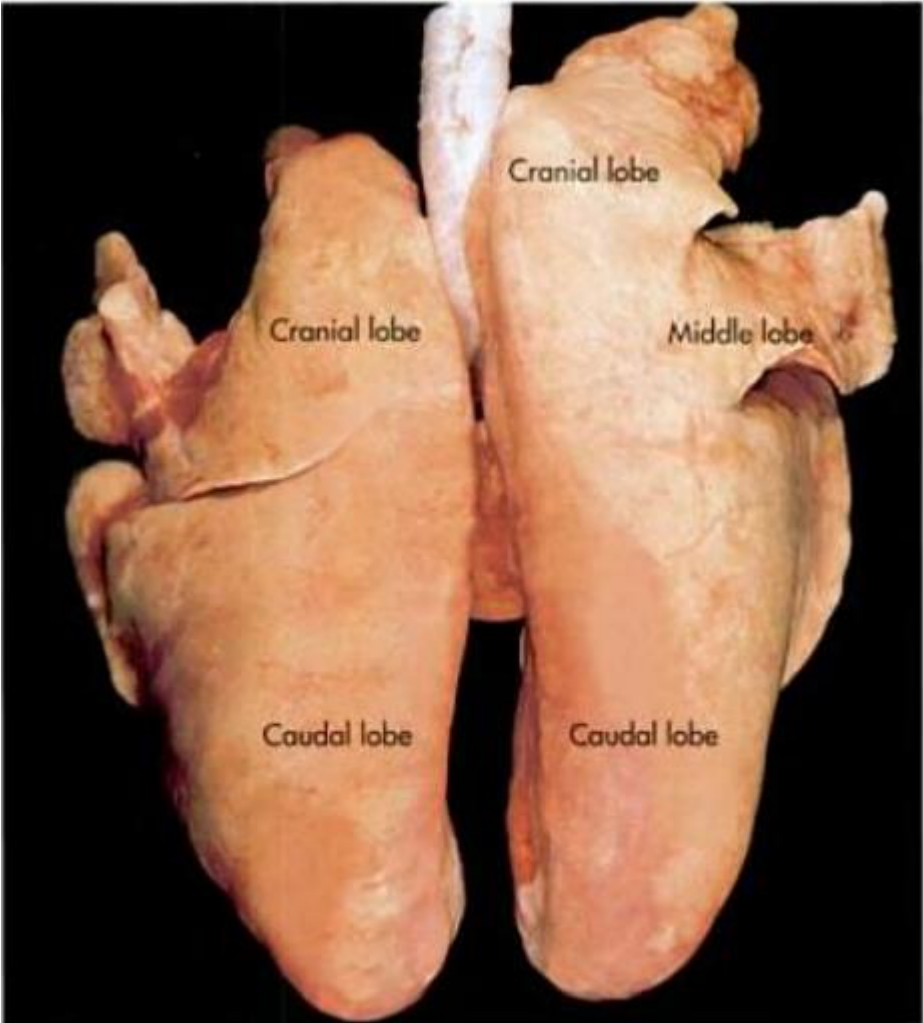


Fig. 8-31. Lungs of a pig (dorsal aspect); courtesy of PD Dr. J. Maierl, Munich.

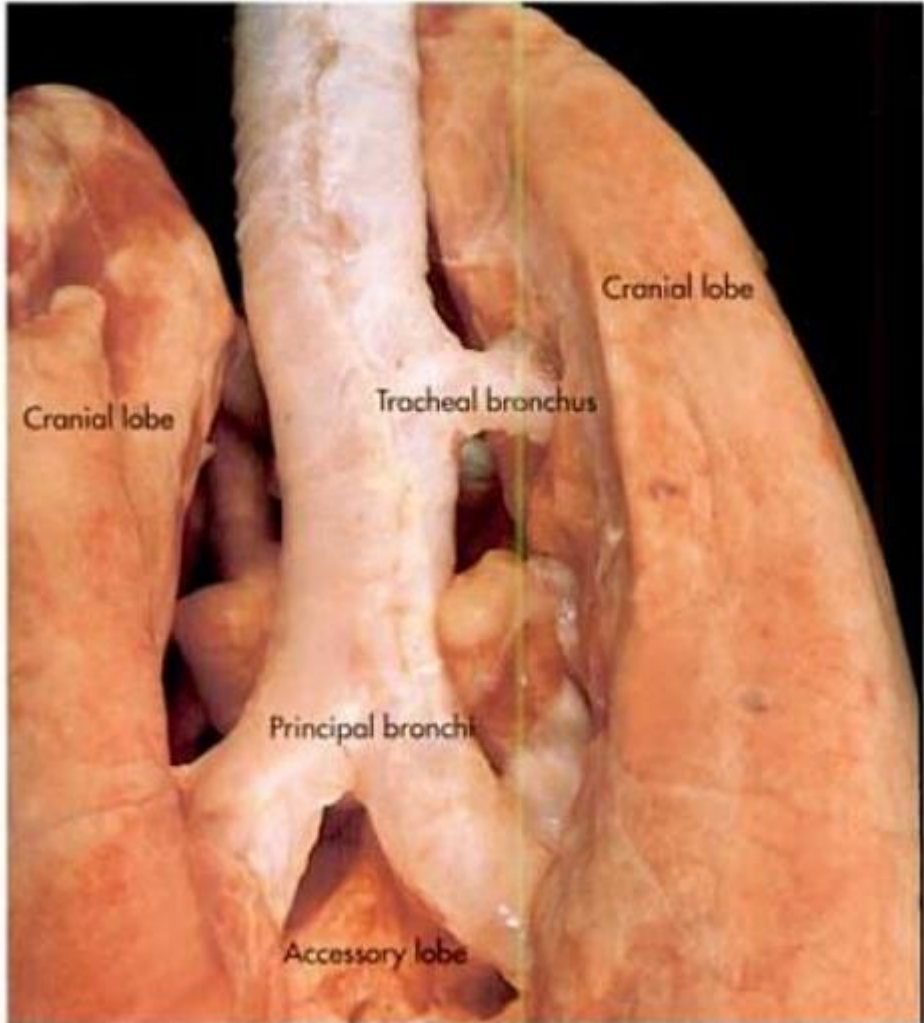


Fig. 8-32. Lungs of a pig, demonstrating the tracheal bronchus (dorsal aspect); courtesy of PD Dr. J. Maierl, Munich.

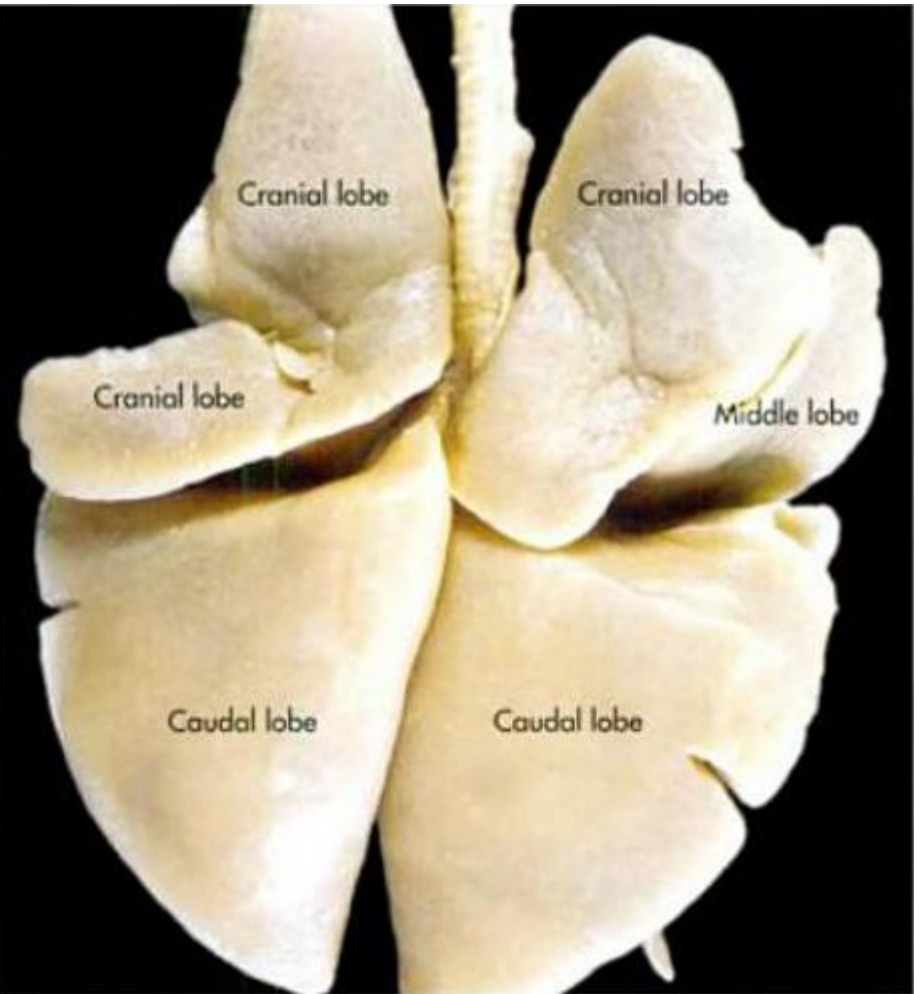


Fig. 8-33. Trachea and lung of a cat (dorsal aspect, S10 plastinate); courtesy of H. Dier, Vienna.

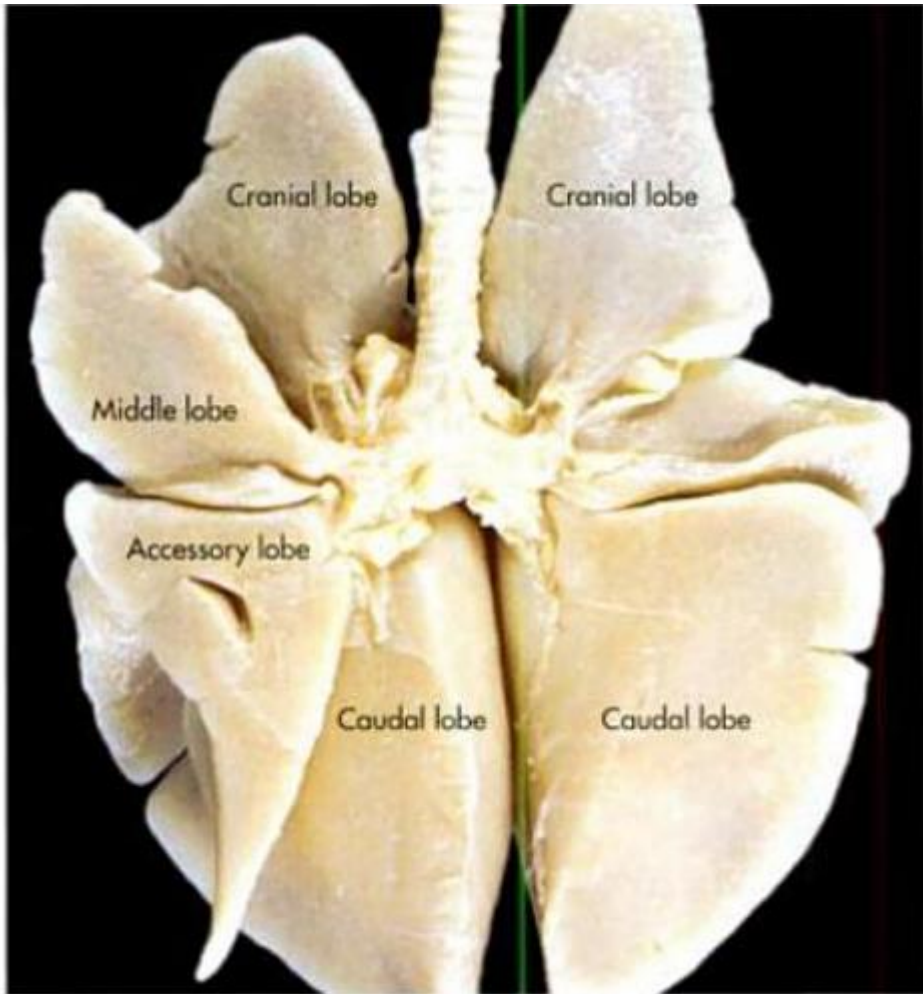


Fig. 8-34. Trachea and lung of a cat (ventral aspect, S10 plastinate); courtesy of H. Dier, Vienna.

