

Respiratory system

Nasal cartilages

RESPIRATORY SYSTEM

How dull it is to pause, to make an end,
To rust unburnished, not to shine in use,
As though to breathe were life!

Alfred, Lord Tennyson (1809-1892)
Ulysses (1842)



Respiratory system

Conducting portion

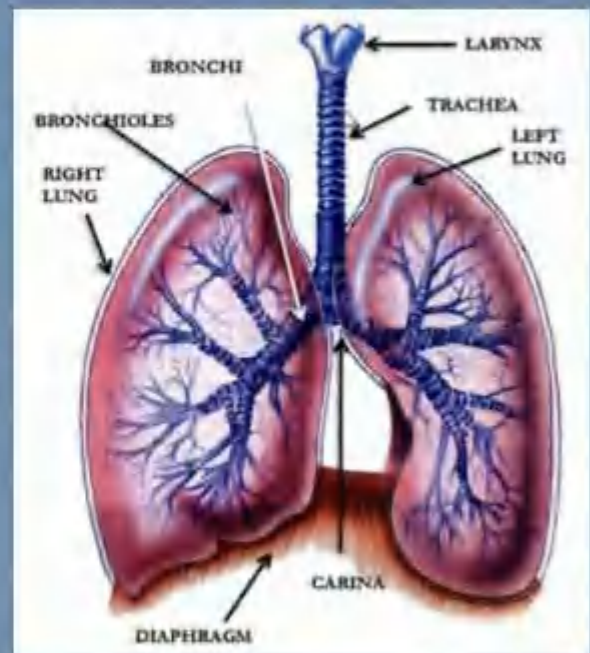
- Includes:-
- Nostrils
 - Nasal cavity
 - Nasopharynx
 - Larynx
 - Trachea
 - Bronchi
 - Bronchioles

Respiratory portion

- Includes:-
- Respiratory bronchioles
 - Alveolar ducts
 - Alveolar sacs
 - pulmonary Alveoli

Pumping mechanism

- Includes:-
- Two pleural sacs
 - Thoracic cage (bones & Ms)
 - Diaphragm



UPPER RESPIRATORY TRACT

NOSE

NASAL CAVITY

NASOPHARYNX

LARYNX

NOSTRILS

In domestic animals, the nose is embedded within the skeleton of the face and projects a little in the pig & dog .

EXTERNAL

NOSE

AREA



Guess WHAT?



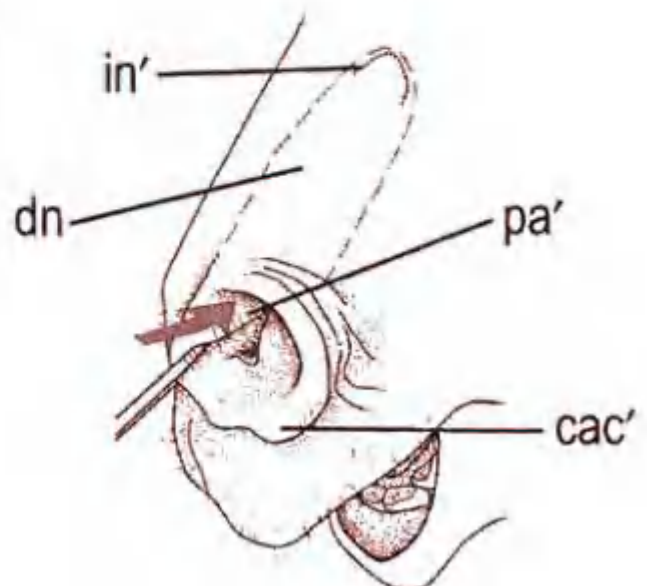
Nostrils horse

The nostrils was divided by the alar fold into two parts :

1- dorsal part : false nostril .

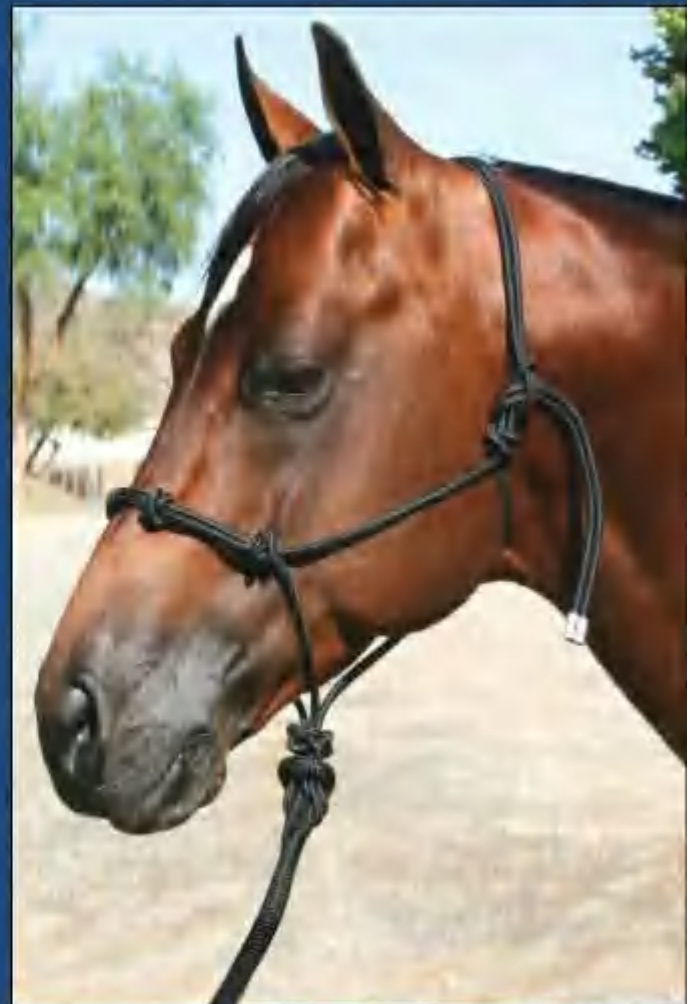
2-ventral part : true nostril .

Comma shaped, converted into circular at racing & forced breathing .



NASAL PLANE

- The skin between the nostrils and upper lip form the naso-labial plane in bovines and the nasal plane in the sheep & goat .



Nostril ox, sheep & goat

- In ox: Small & oval.
- In sheep: slit like.
- In goat: oval.



Dog
comma-shaped



Camel
oblique fissure with rounded borders



Pig
Small & rounded & present on the
cranial surface of snout

Nasal cartilages

- 1- Nasal septal cartilage.
- 2- dorsal parietal nasal cartilage (narrow in the horse).
- 3- ventral parietal nasal cartilage (narrow in horse ,absent in camel).
- 4- medial accessory cartilage.
- 5- lateral accessory cartilage.
- 6- Alar cartilage (present in horse only).



Fig. 281 (Horse)



Fig. 280 (Ox)



Fig. 277 (Pig)



Fig. 278 (Pig)

Nasal Cartilages in Domestic Mammals

Note semicircular-shaped cartilages supporting the flexible external nares of the horse. These are readily palpable in the animal.

Nasal Cartilages in horse



The alar cartilages (A) are the first in a long line of incomplete cartilaginous rings which maintain patency of respiratory passages since air is an easily compressible fluid. The alar cartilages have muscles attached that aid in flaring the nostrils since the horse is an obligate nasal breather. Horses can't mouth breathe as we do when we need more oxygen, instead, the horse opens its nostrils wide.



Nasal Cartilages in horse

- Dorsal lateral nasal cartilage
- Nasal septum
- Plate of the alar cartilage
- Horn of the alar cartilage
- Incisive bone





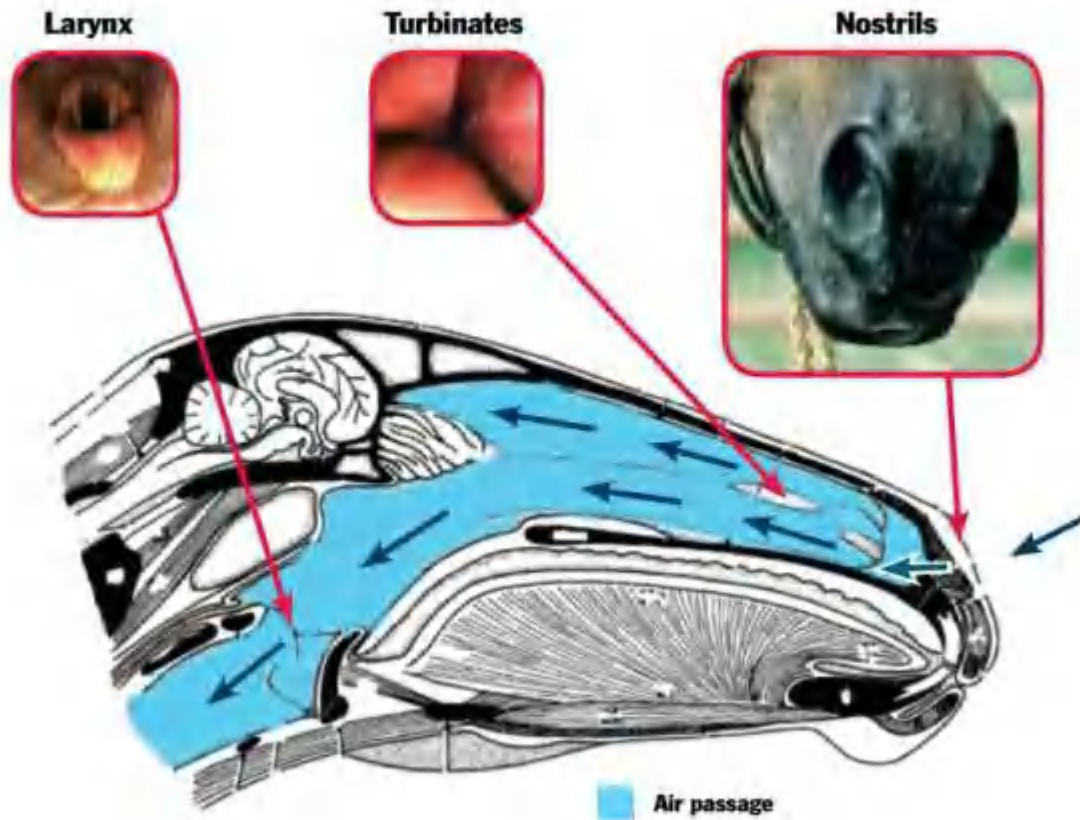
Dilated nostril of fresh cadaver. 1, orifice of the nasolacrimal duct (often swollen shut in an embalmed cadaver); 2, nasal septum. On a live animal the duct can be cannulated in order to flush out the conjunctival sacs of the eye.

Dorsal lateral nasal cartilage
Ventral lateral nasal cartilage
Nasal septum
Lateral accessory nasal cartilage



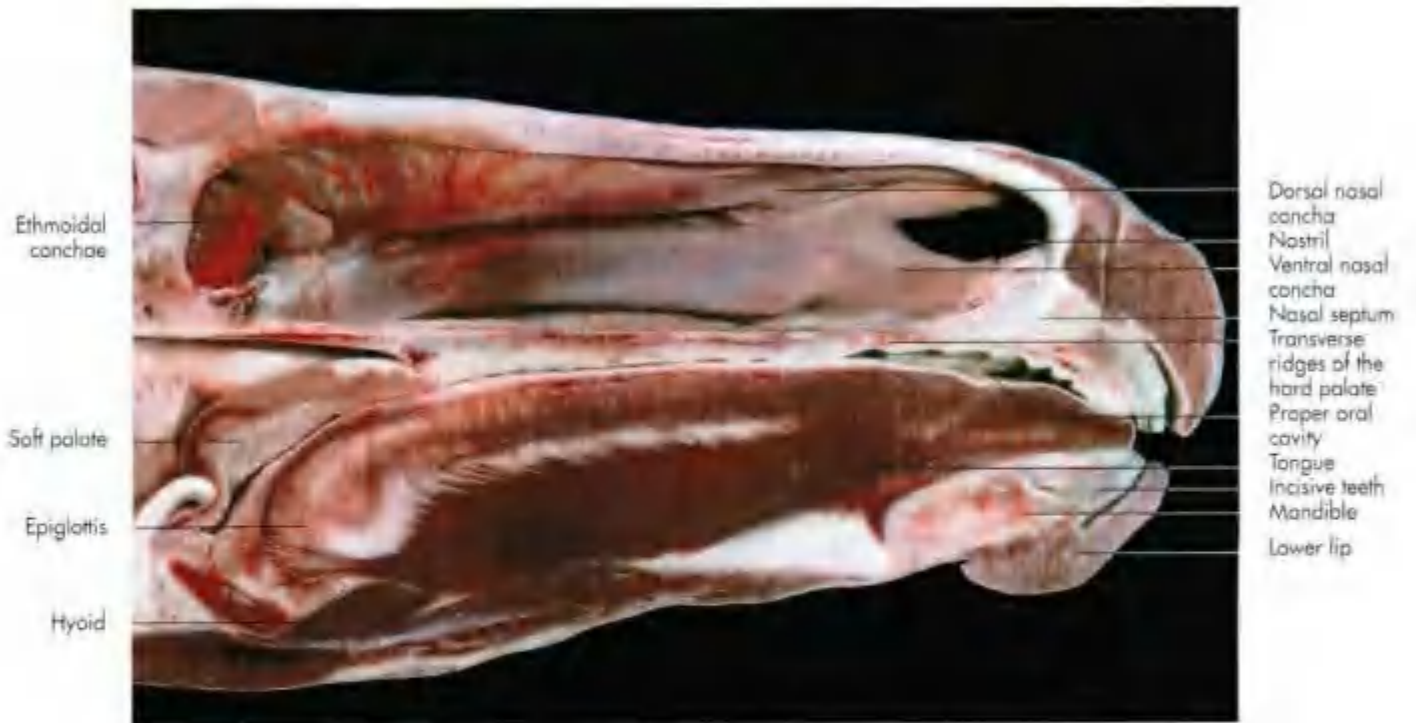
Lecture notes on
The Respiratory System
“NASAL CAVITY”



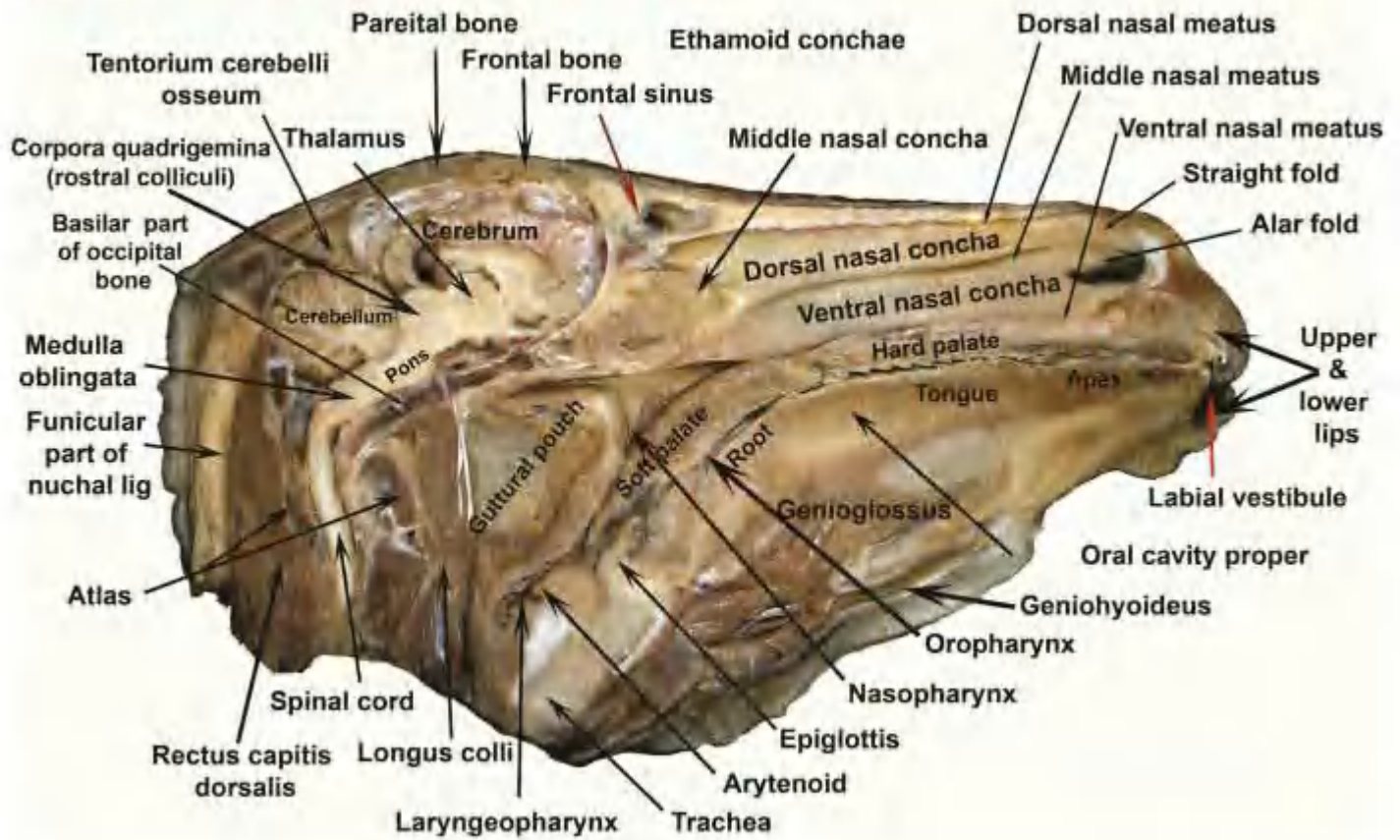


2.89 Gesichtsschädel eines Pferdes im Medianschnitt, Blick in die Nasenhöhle

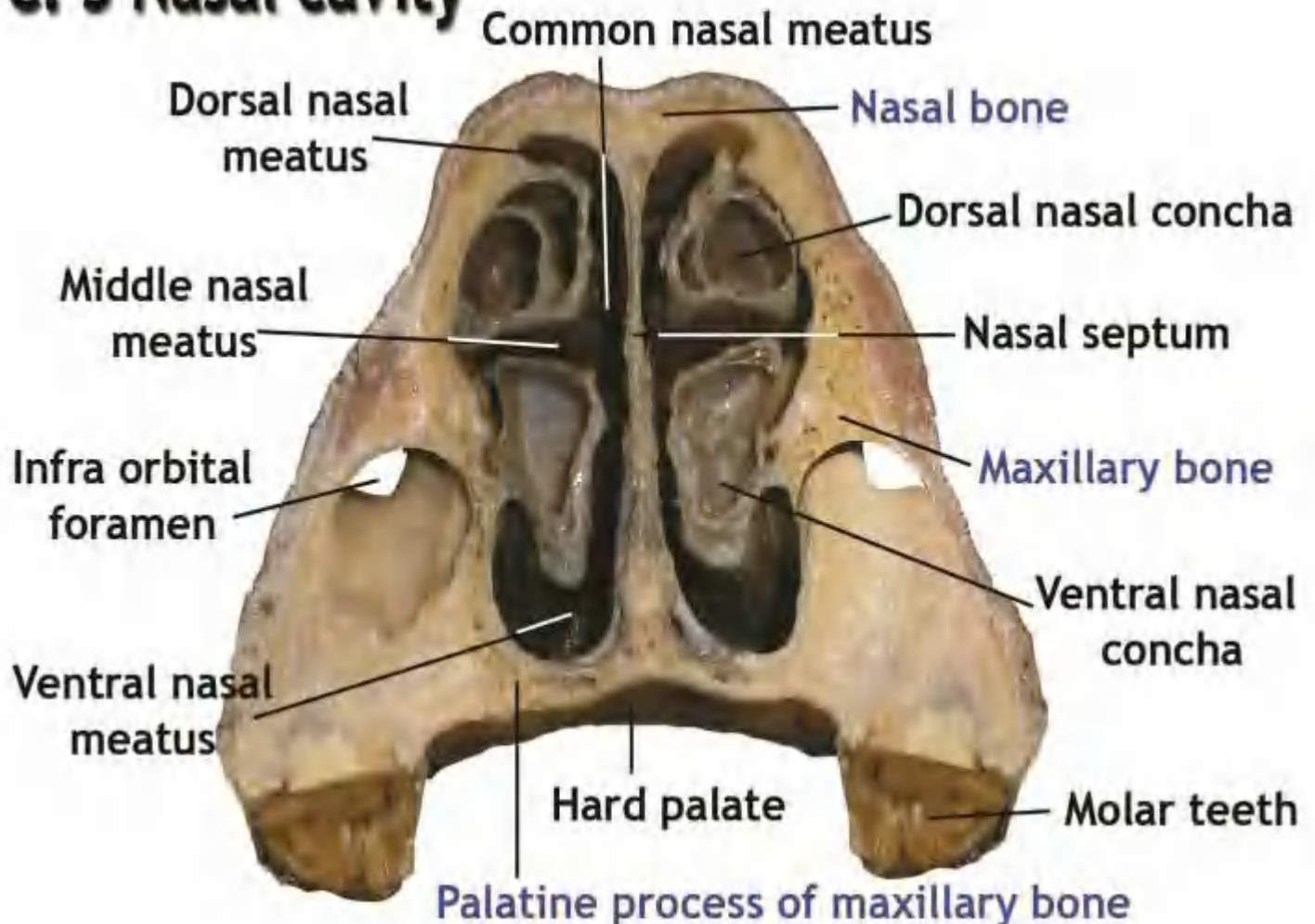
- | | | |
|--------------------------------|--|--|
| 1 Os incisivum | 10 For. sphenopalatinum (durch Vomer verdeckt) | 17 Blick durch den Riss im Endoturbinale I in den Sinus frontalis (Pfd. Sinus conchofrontalis) |
| 2 Canalis interincisivus | 11 Os pterygoideum | 18 Endoturbinale II |
| 3 Os nasale | 12 Rest der abgetragenen knöchernen Nasenscheidewand | 19 Endoturbinale III und IV |
| 4 Maxilla | 13 Sinus sphenoidalis | 20 Os conchae nasalis ventralis |
| 5 Proc. palatinus der Maxilla | 14 Septum sinuum frontalem | 21 Crista conchalis |
| 6 Proc. alveolaris der Maxilla | 15 Os ethmoidale | |
| 7 Vomer | 16 Endoturbinale I | |
| 8 Meatus nasopharyngeus | | |
| 9 Os palatinum | | |



Sagittal section of the head of horse



C. S Nasal cavity



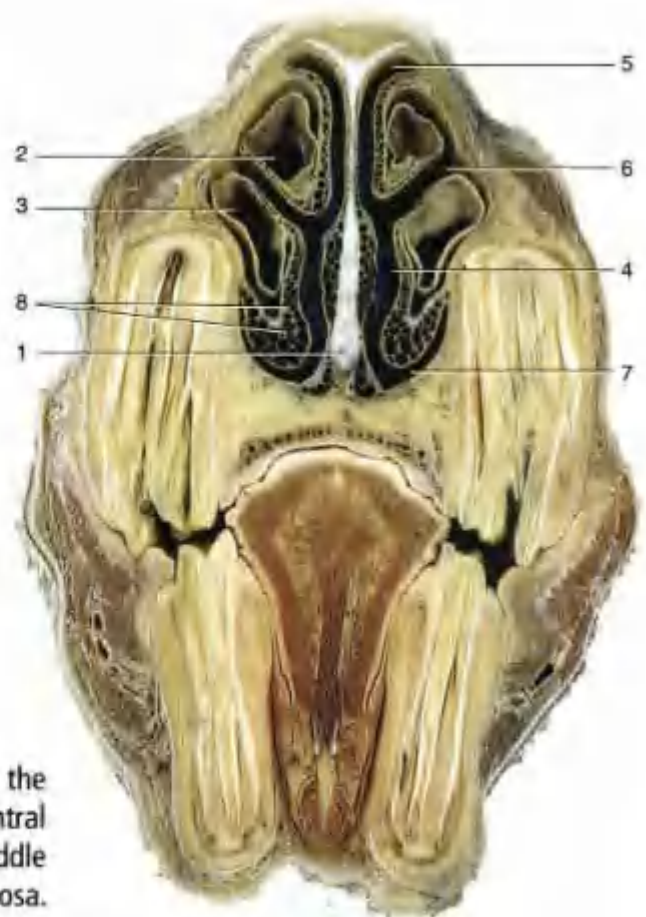
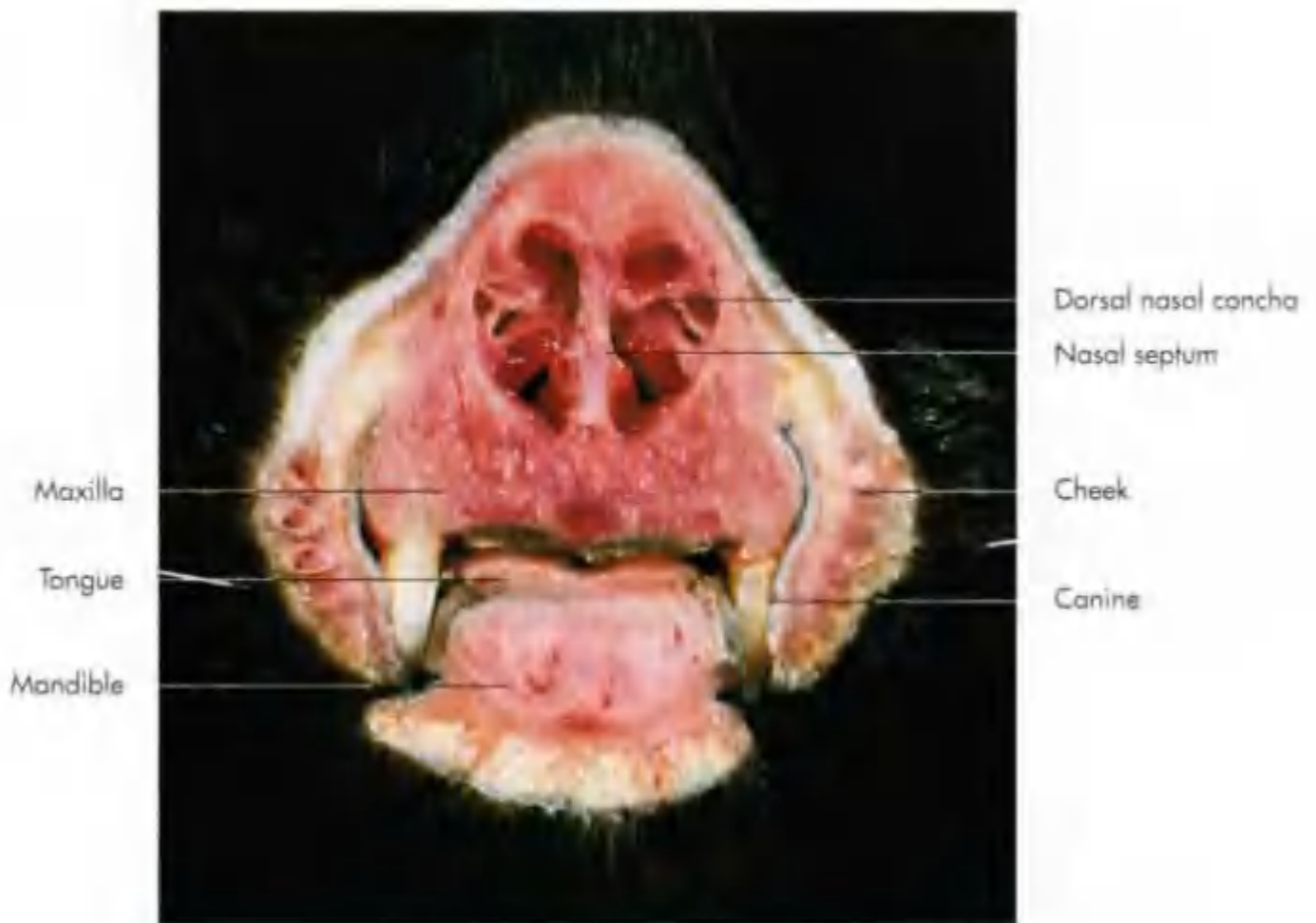
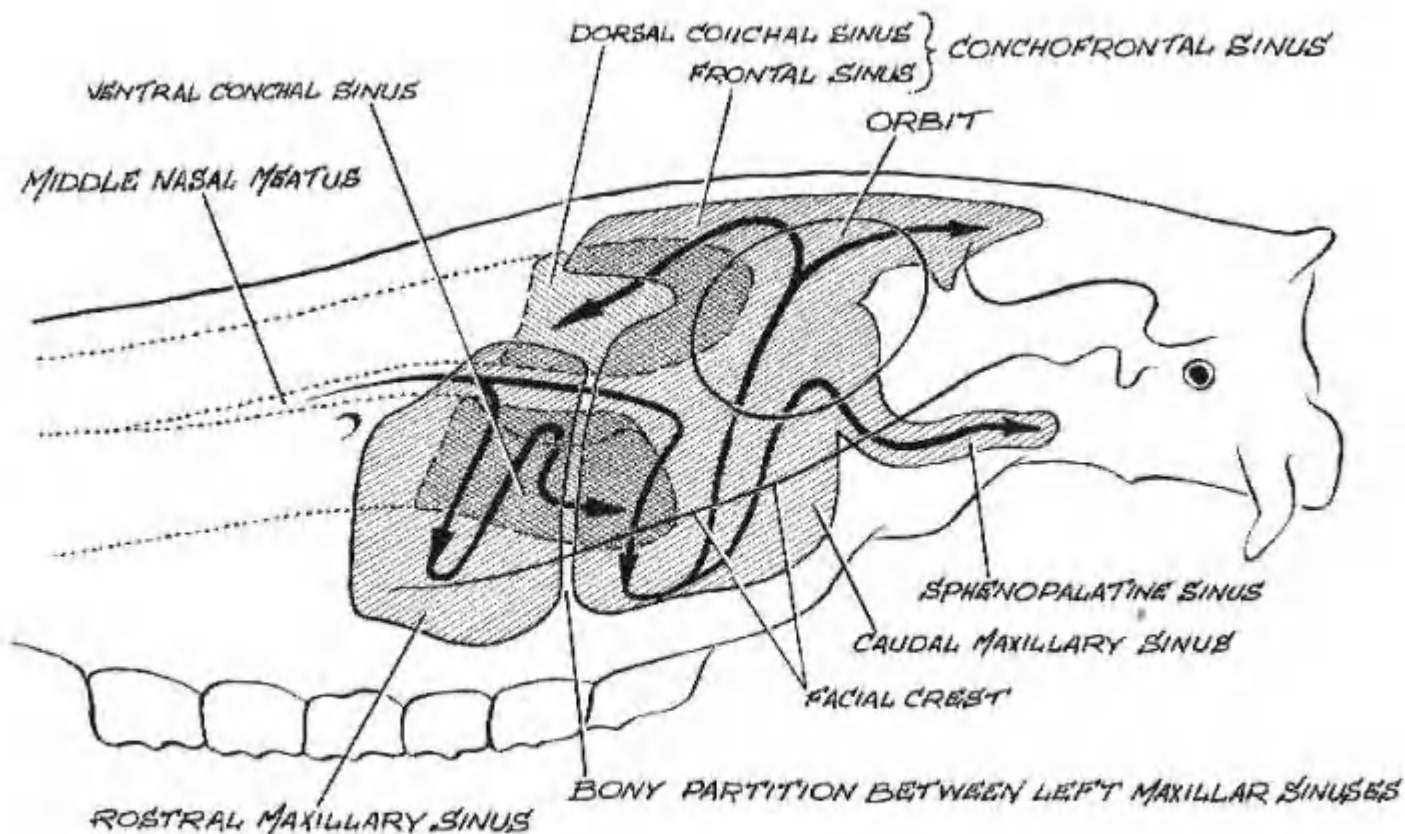


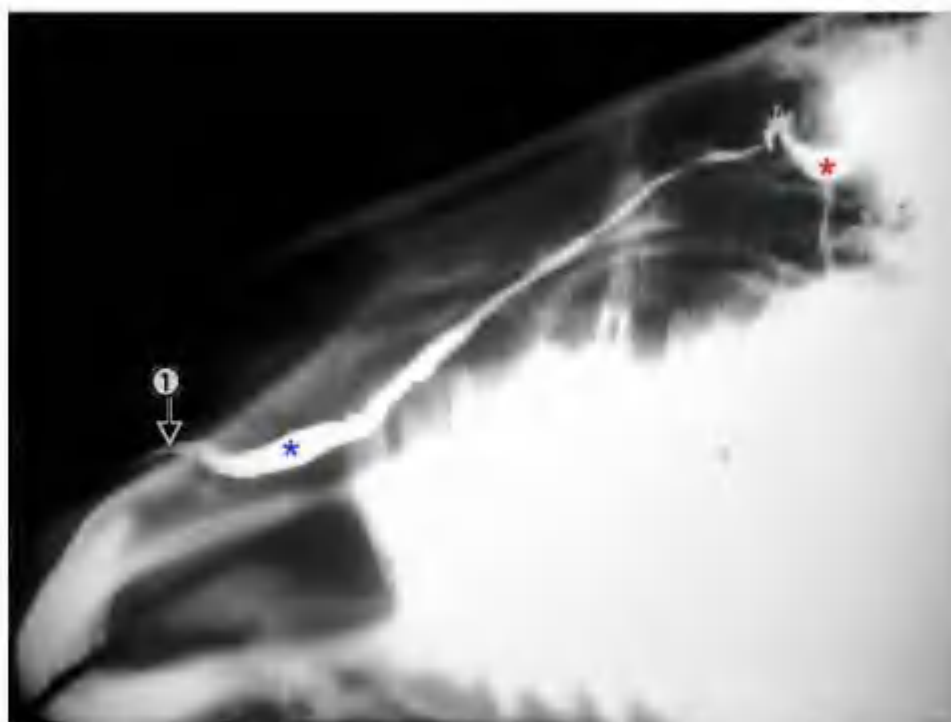
Figure 4-5 Transverse section of the equine head at the level of P4. 1, Nasal septum; 2, dorsal concha; 3, ventral concha; 4, common meatus; 5, dorsal meatus; 6, middle meatus; 7, ventral meatus; 8, venous plexus in nasal mucosa.



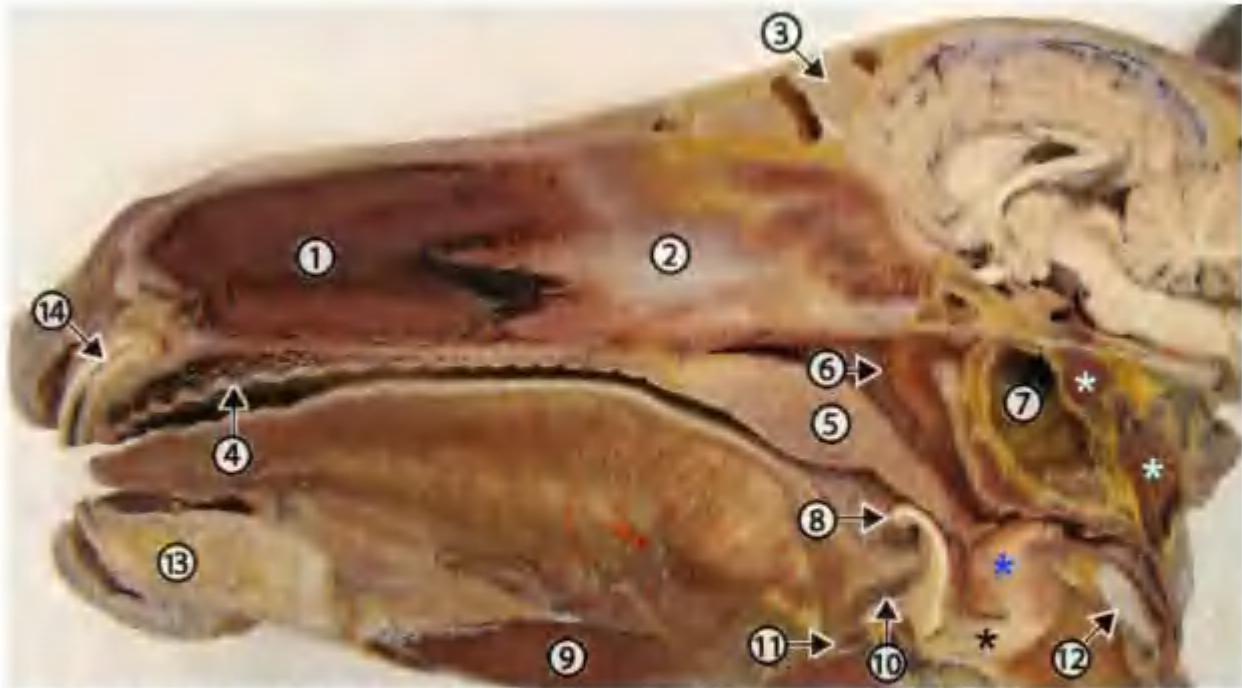
- 1-Sinus maxillaris rostralis
- 2-Sinus maxillaris caudalis
- 3-Septum sinuum maxillarium
- 4-Canalis infraorbitalis
- 5-Crista facialis
- 6-Apertura conchomaxillaris
- 7-Apertura nasomaxillaris
- 8-Apertura frontomaxillaris
- 9-Sinus frontalis
- 10-For. Infraorbitale
- 11-Orbita



*SCHEMA OF LEFT PARANASAL SINUSES OF HORSE
THE ENTRANCE TO ALL SINUSES IS FROM THE MIDDLE NASAL MEATUS.*



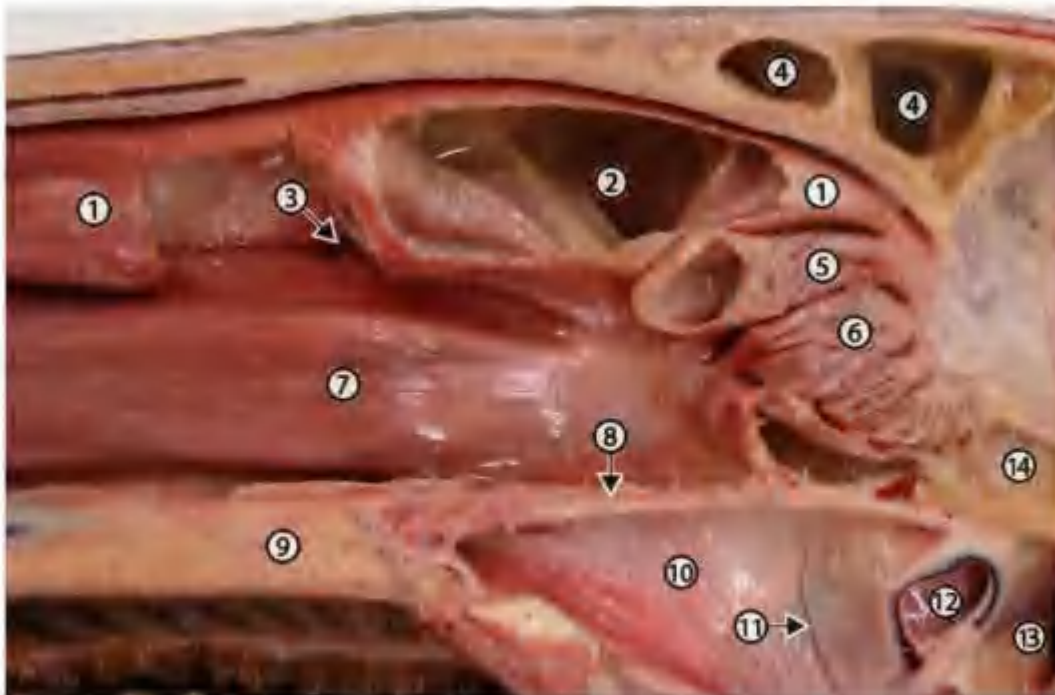
Lateral radiograph of a horse head. Contrast medium is in the nasolacrimal duct (blue asterisk) and the ventral conjunctival sac (red asterisk). The contrast medium was injected into the duct through a cannula that was inserted into the orifice (1) of the nasolacrimal duct.



Midline view of split equine head. 1, nasal septum covered with mucosa; 2, cartilage of the nasal septum; 3, midline bony septum between frontal sinuses; 4, hard palate; 5, soft palate; 6, orifice of auditory tube (entrance to guttural pouch); 7, interior of guttural pouch; light blue asterisk, longus capitis m., blue asterisk, arytenoid cartilage covered with mucosa; black asterisk, vocal fold; 8, epiglottis; 9, geniopharyngeus m., 10, hyoepiglottis m.; 11, basihyoid bone; 12, cricoid cartilage; 13, mandibular symphysis; 14, pulp cavity. NOTE: In this image the tip of the epiglottis is abnormally positioned ventral to the soft palate. The normal position is dorsal



Equine split head after removal of the nasal septum to expose the nasal cavity. 1, dorsal concha; 2, ventral concha; 3 ethmoidal conchas; 4, vomer (bone); 5, frontal sinus; 6, hard palate; 7, soft palate; 8, orifice of the auditory tube on the lateral wall of the nasopharynx. At this place, an endoscope can be passed into the guttural pouch. 9, stylohyoid bone; 10, medial retropharyngeal lymph nodes adjacent to the ventral wall of the guttural pouch; 11, cricoid cartilage; 12, cricoid cartilage (ventral), 13, trachea; 14, ossified rostral edge of the thyroid cartilage; 15, basihyoid bone; asterisk, palatine tonsil.



Split equine head. 1, dorsal concha (ethmoconcha I); 2, dorsal conchal sinus; 3, nasomaxillary aperture; 4, frontal sinus; 5, ethmoconcha II; 6, ethmoconcha III; 7, ventral concha; 8, vomer; 9, hard palate; 10, lateral wall of the nasopharynx; 11, entrance to the auditory tube and guttural pouch; 12, lumen of the auditory tube; 13, guttural pouch; 14, sphenopalatine sinus.

Lecture notes on

The Respiratory System

The LARYNX

LARYNX

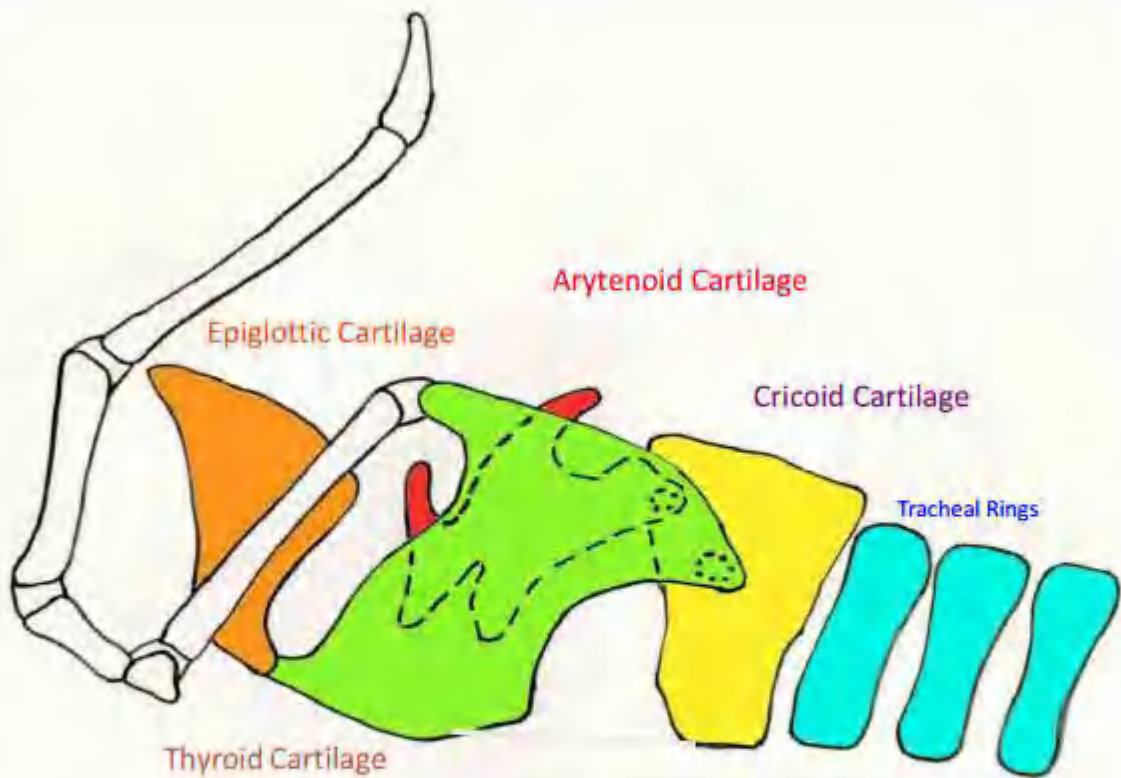
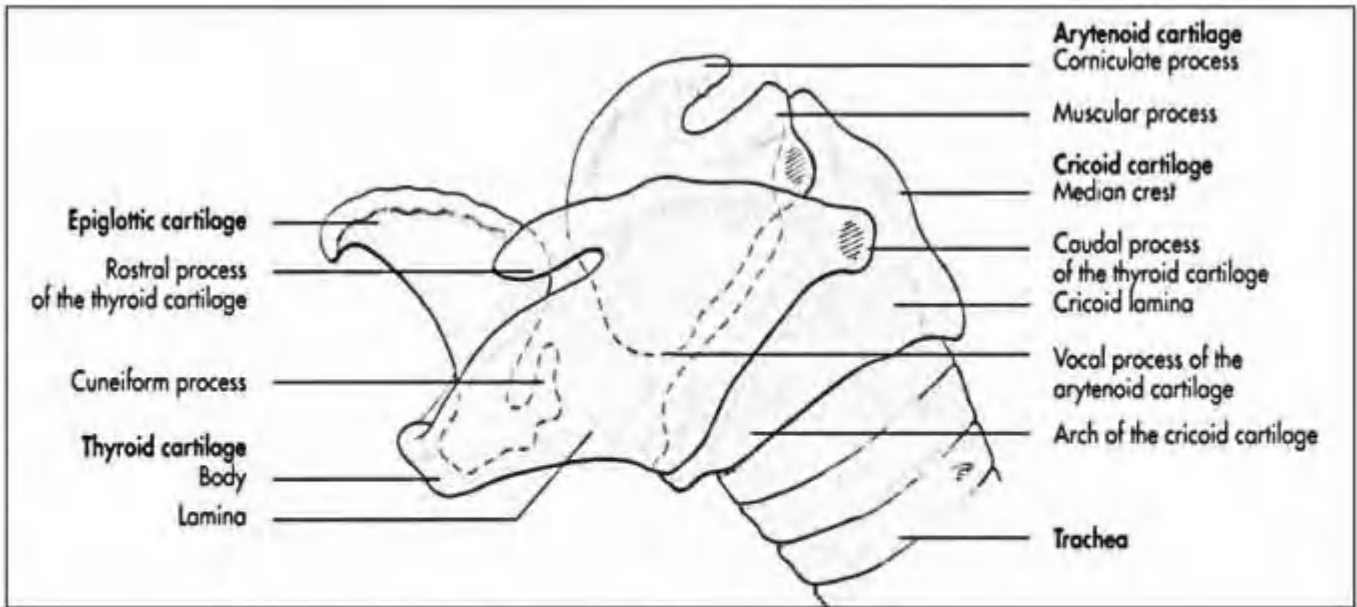
**ORGAN OF SOUND PRODUCTION (PHONATION) =
"VOICE BOX"**

Sound is produced by vibrating vocal folds.

Character of the sound can be modified by the resonating chamber: cavity of larynx, pharynx, nasal cavity, oral cavity

Structure of the larynx:

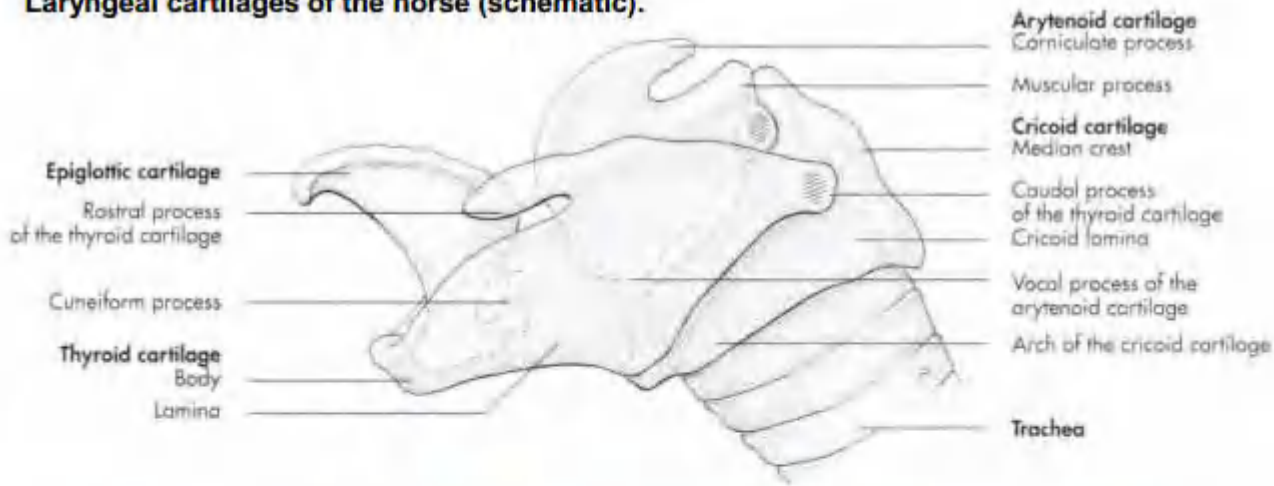
- 1. Cartilages**
- 2. Joints and ligaments**
- 3. Muscles**
- 4. Cavity**
- 5. Membranes**



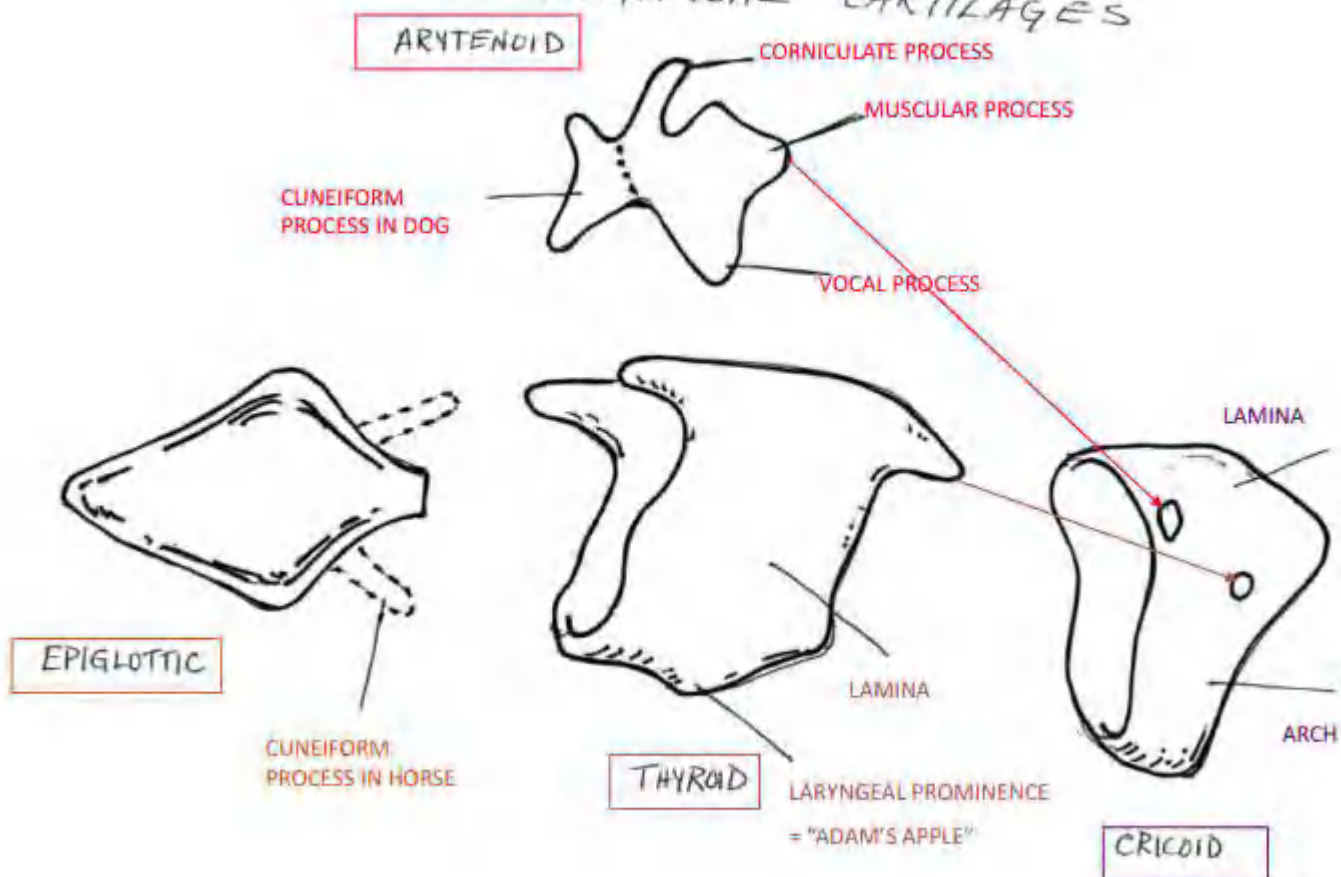
Hyoid Apparatus and Laryngeal Cartilages

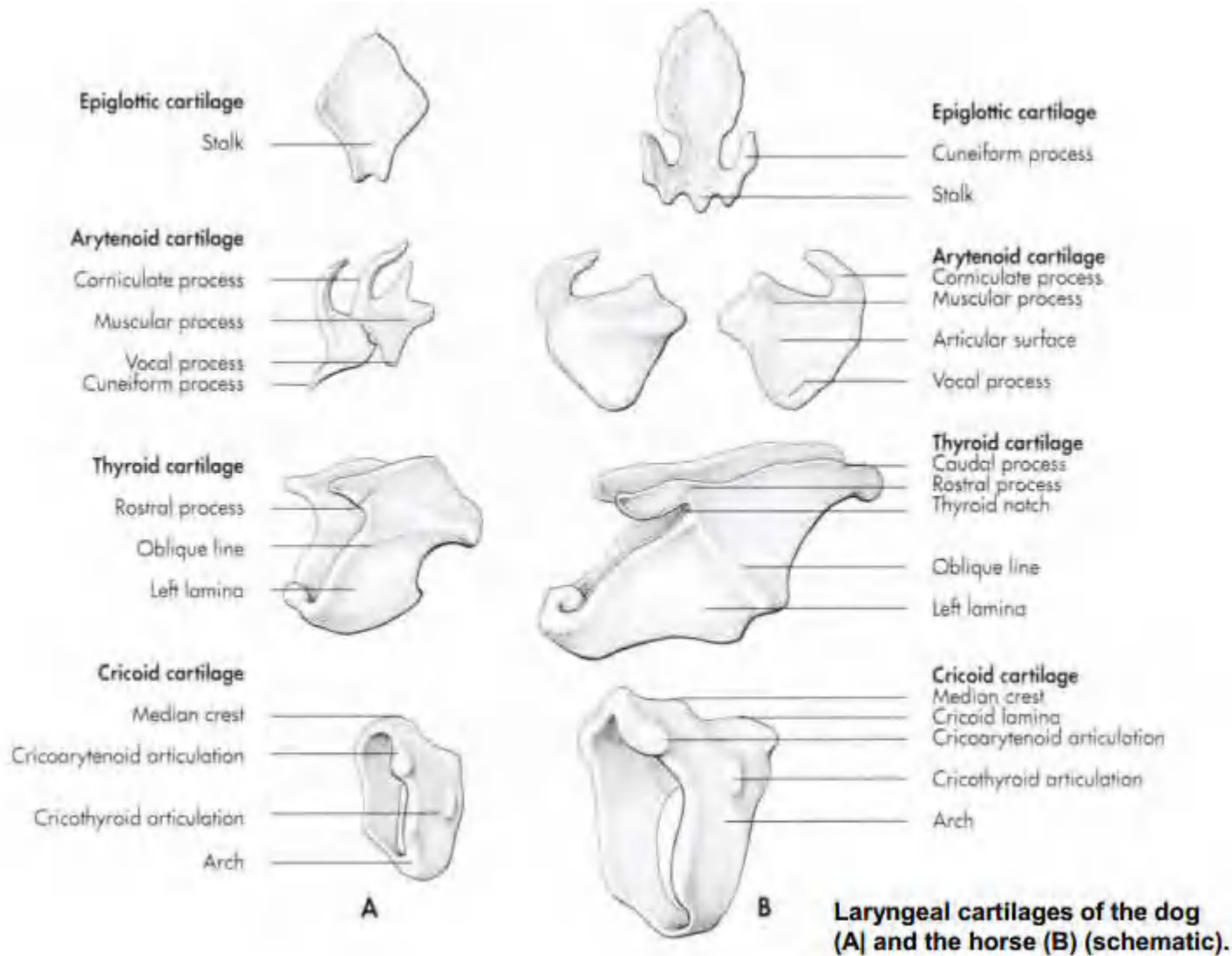
From your notes

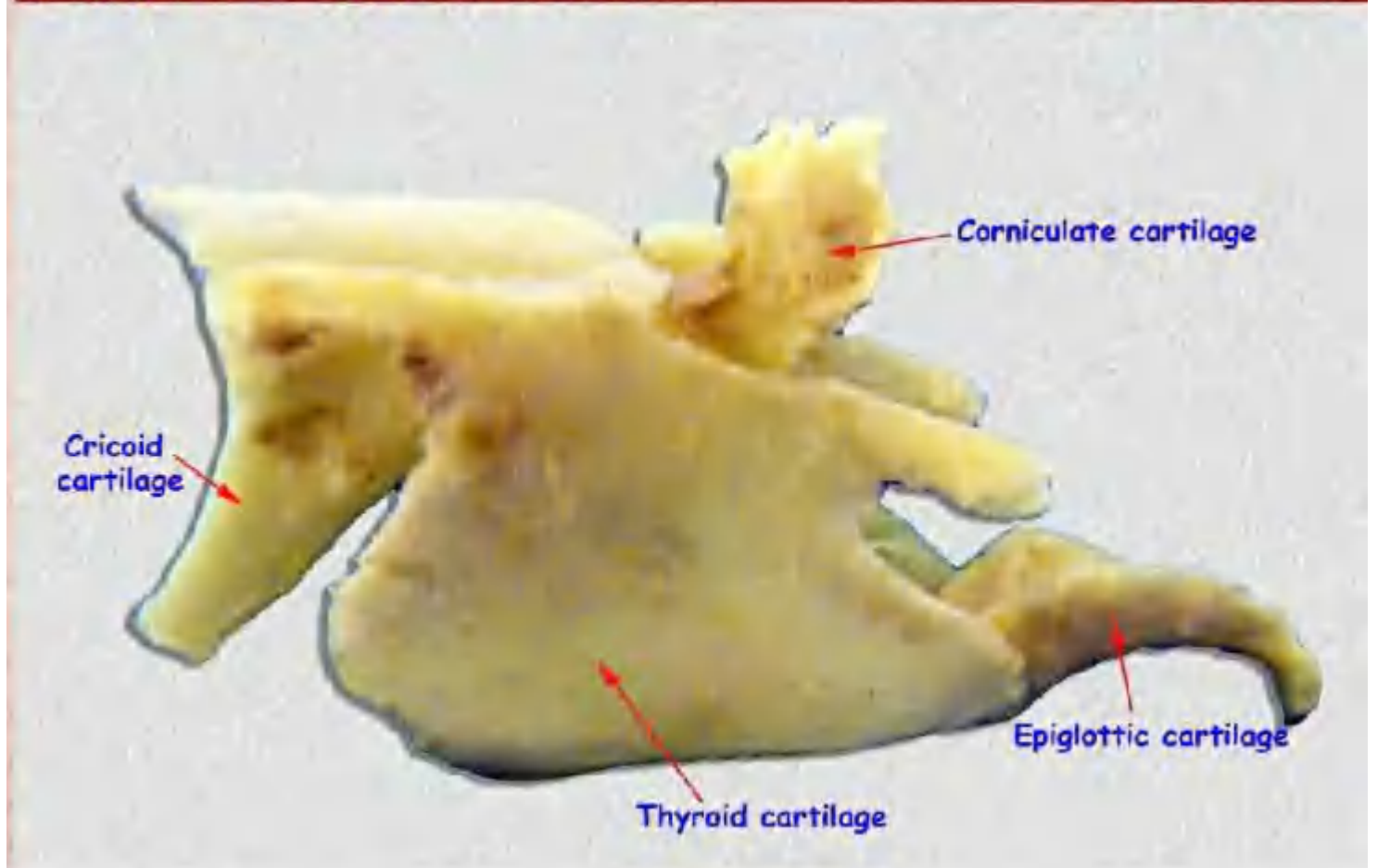
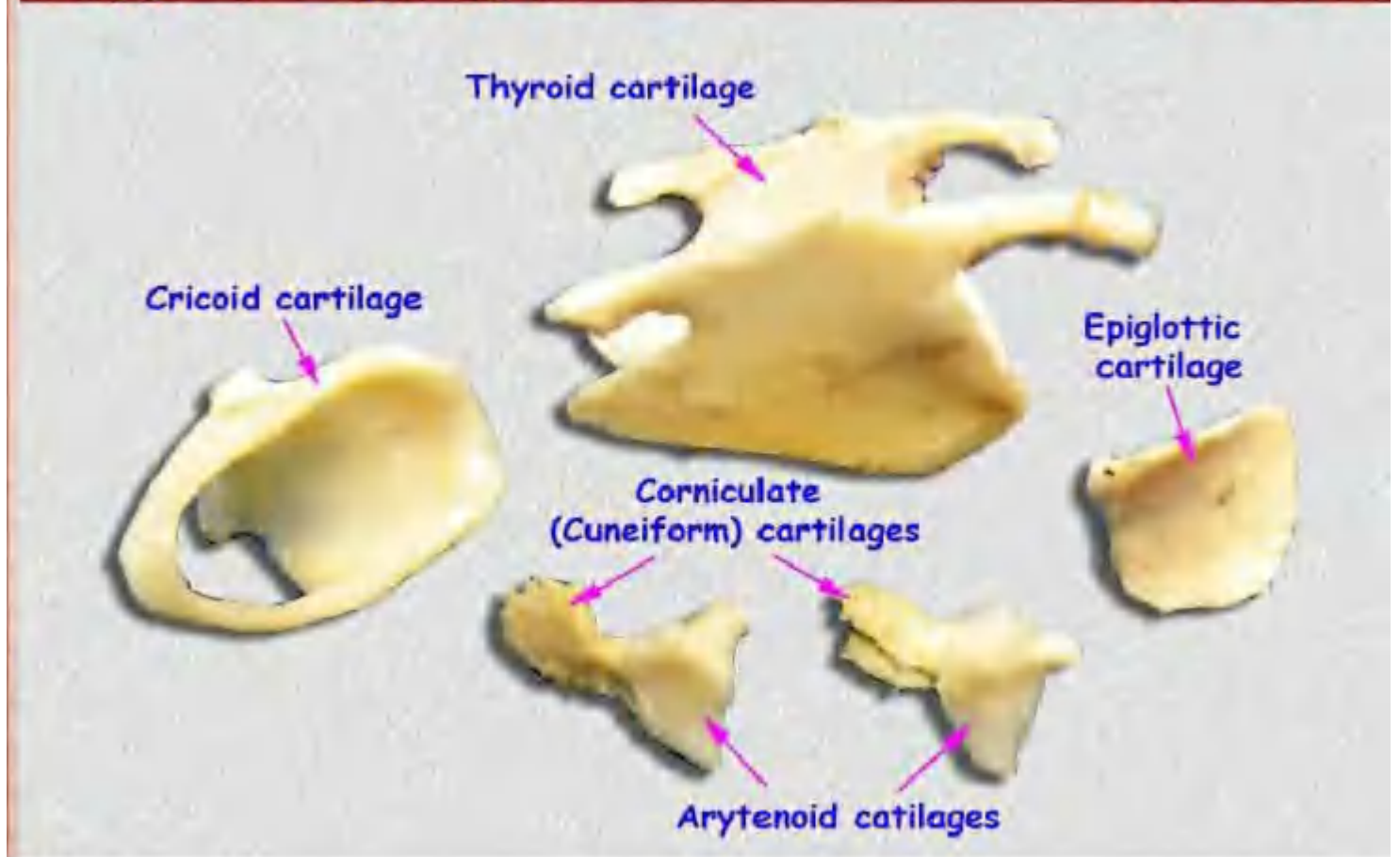
Laryngeal cartilages of the horse (schematic).

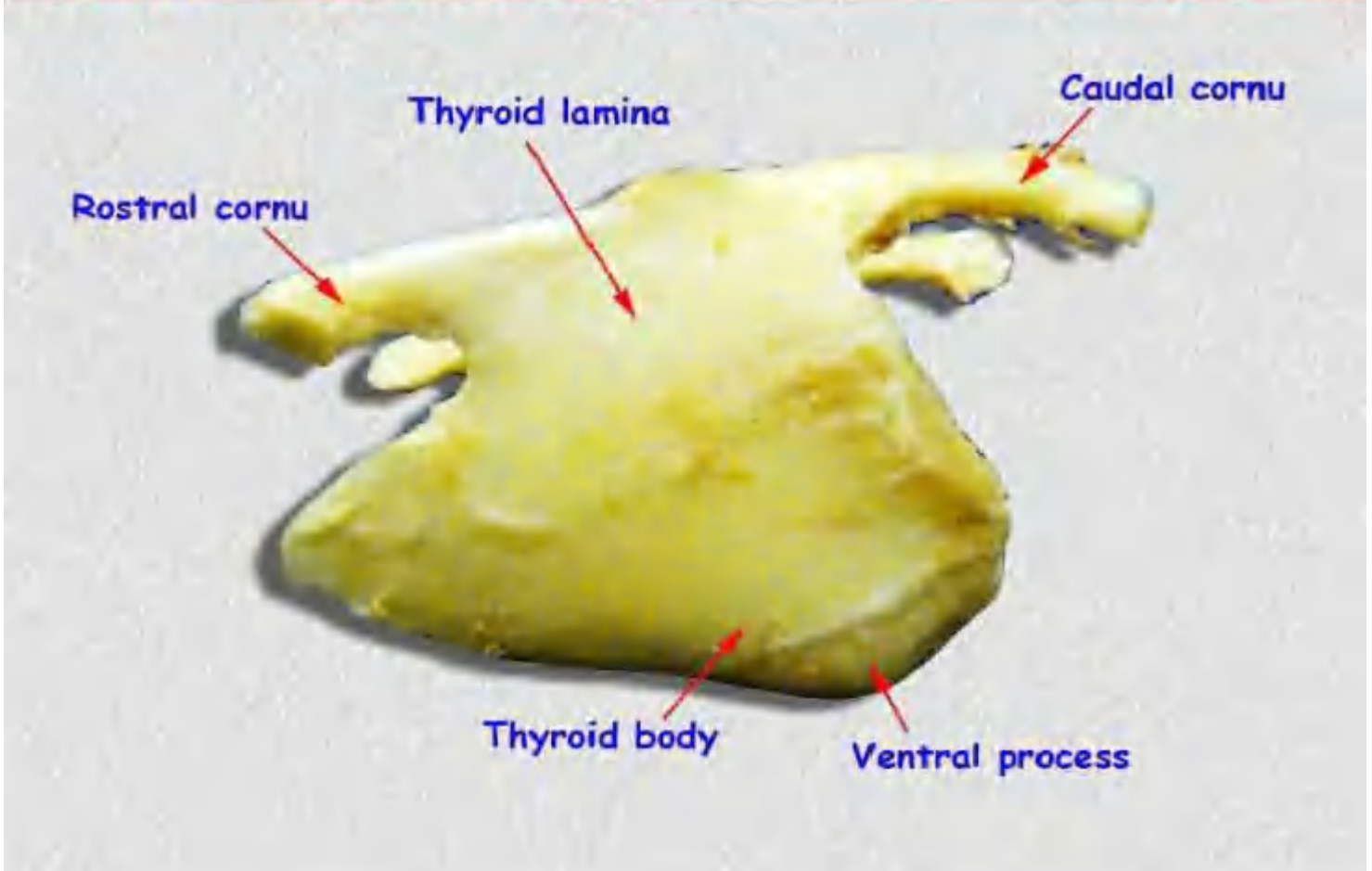


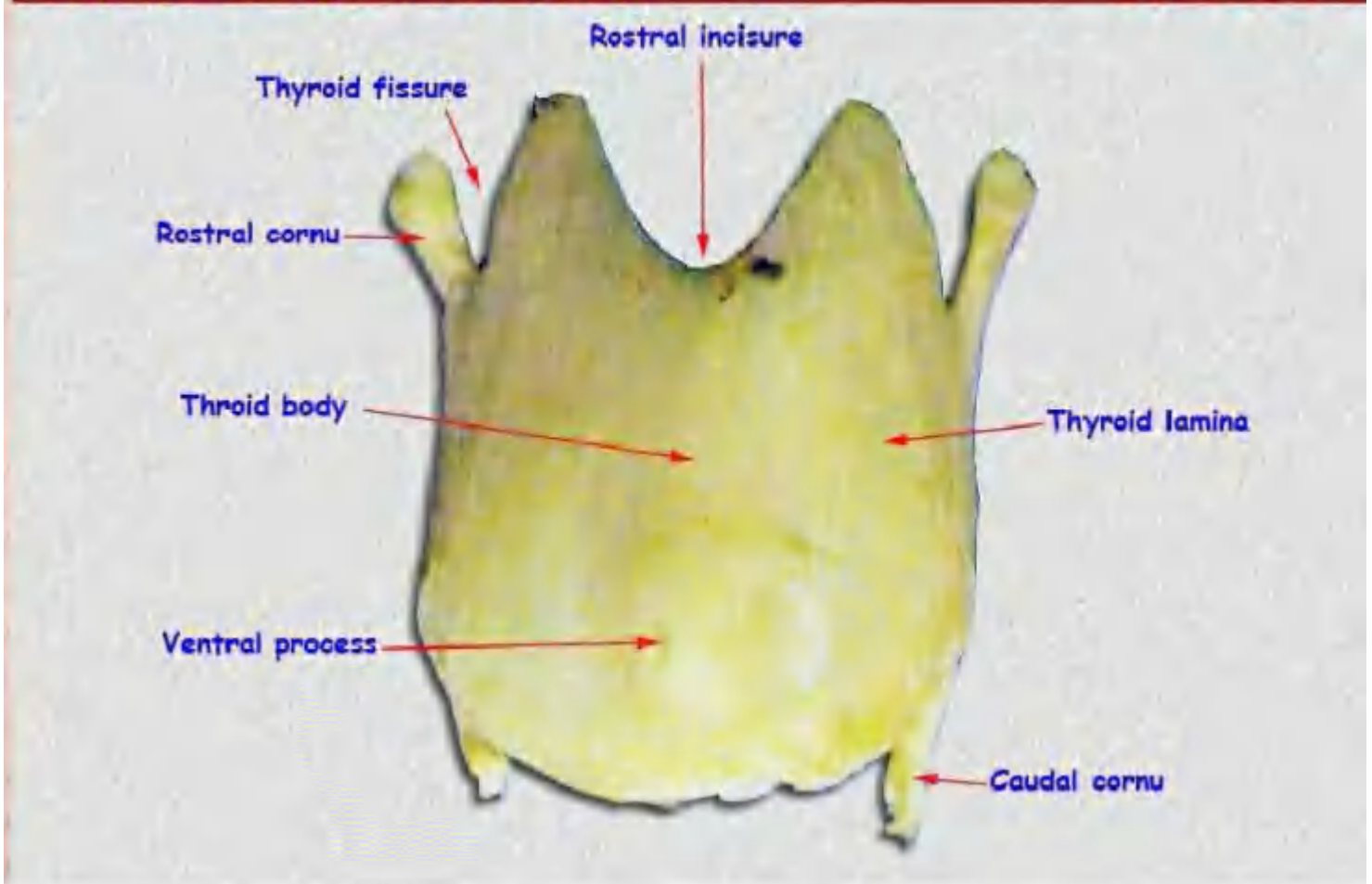
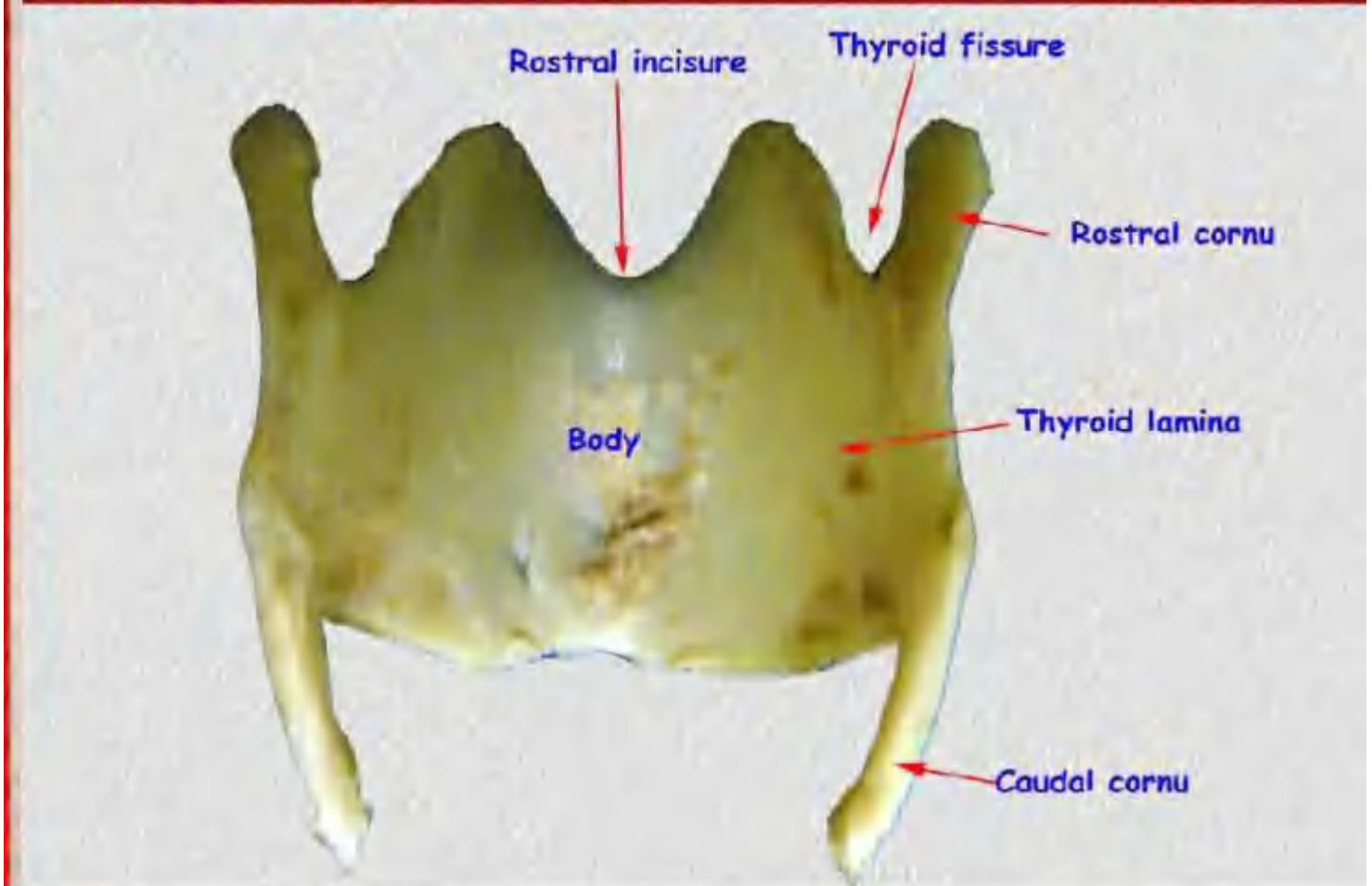
LARYNGEAL CARTILAGES

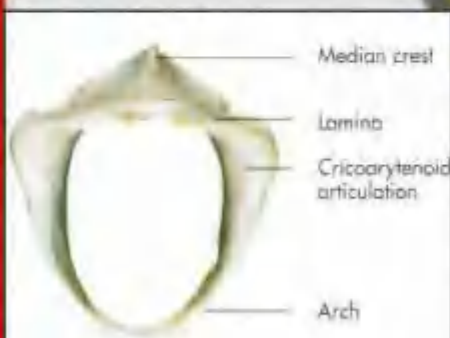
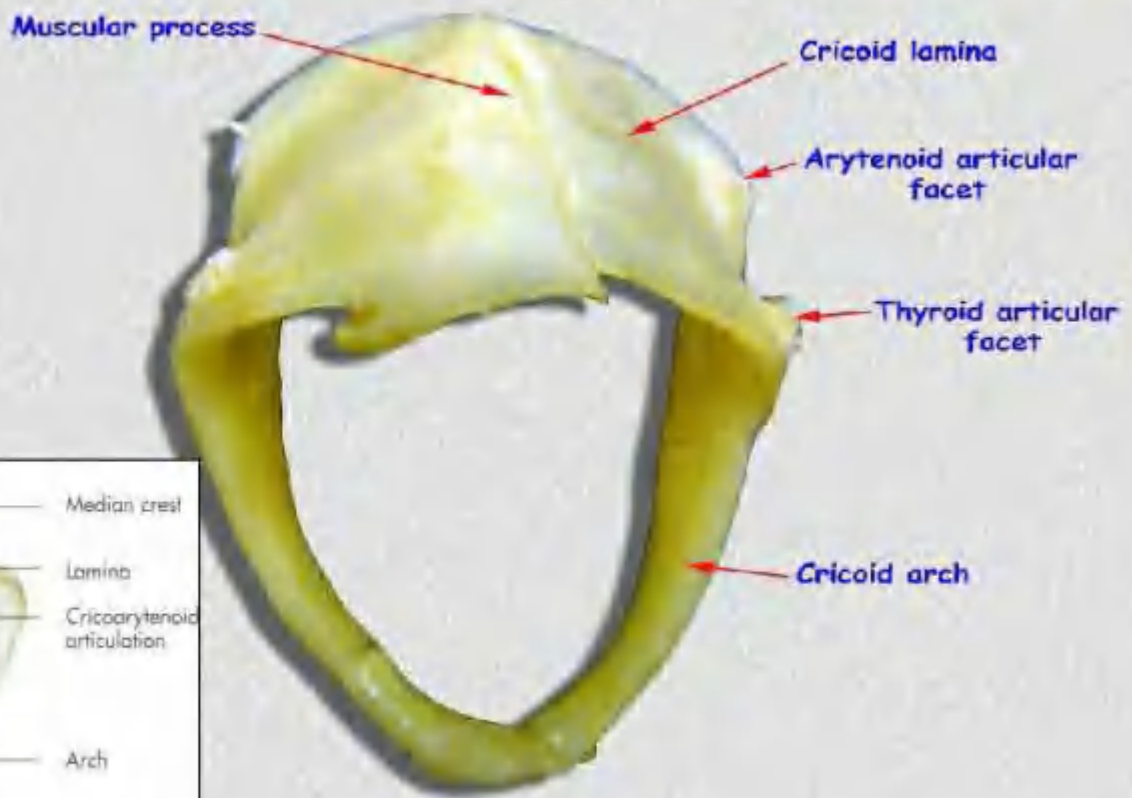
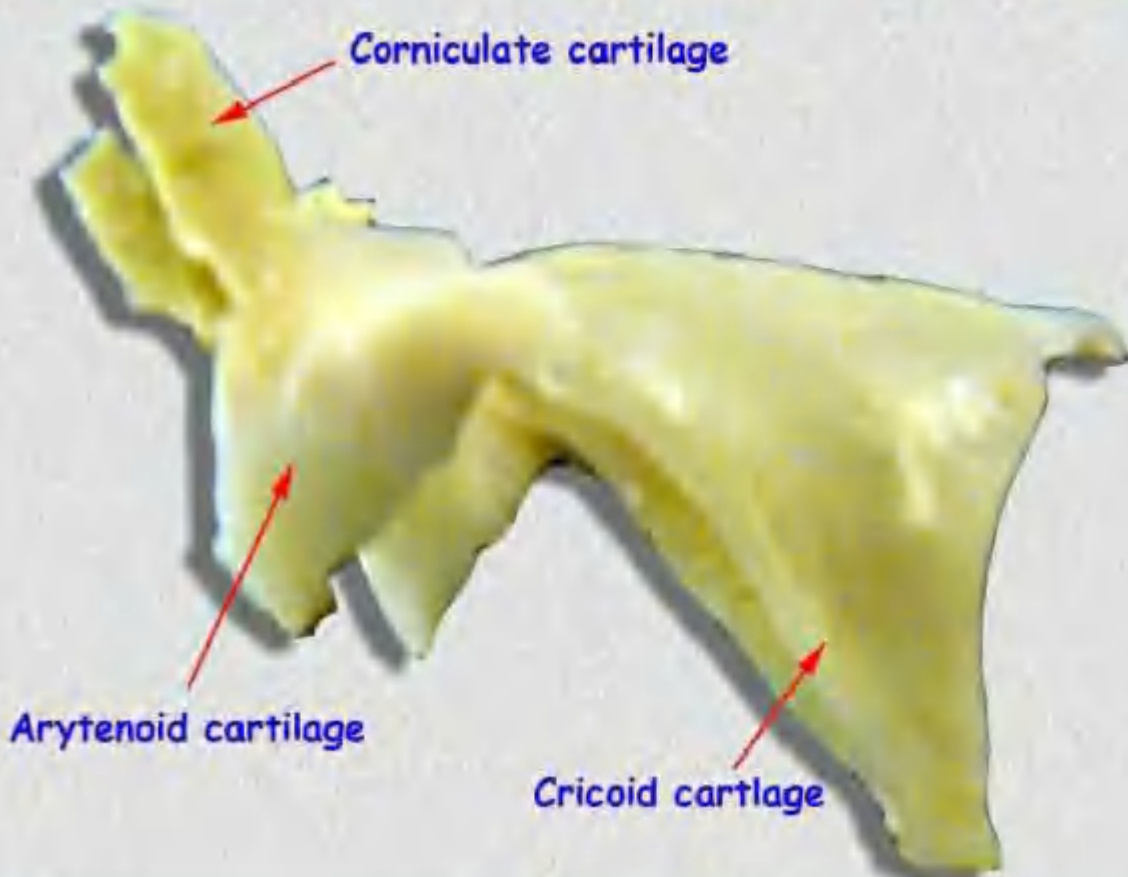




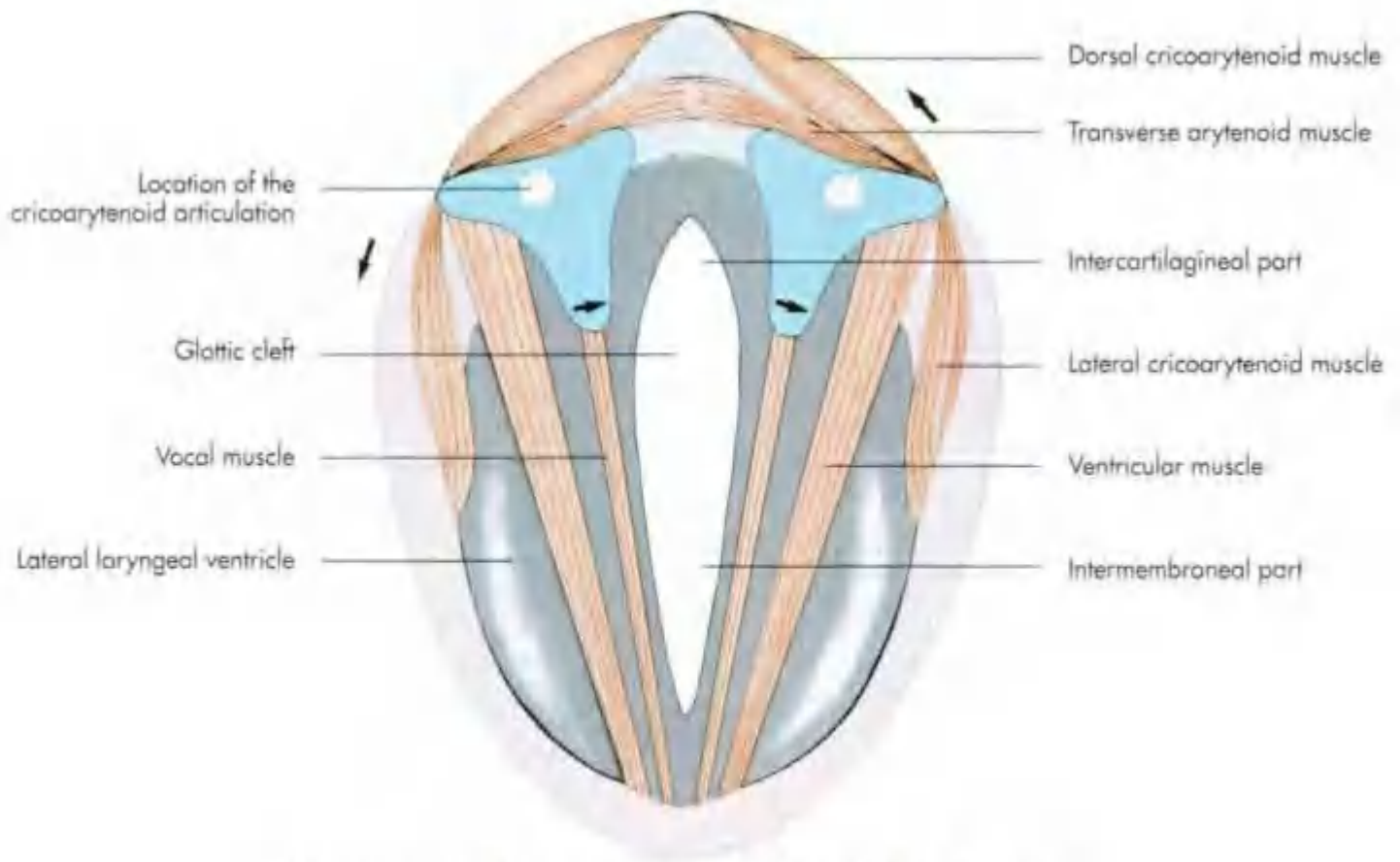






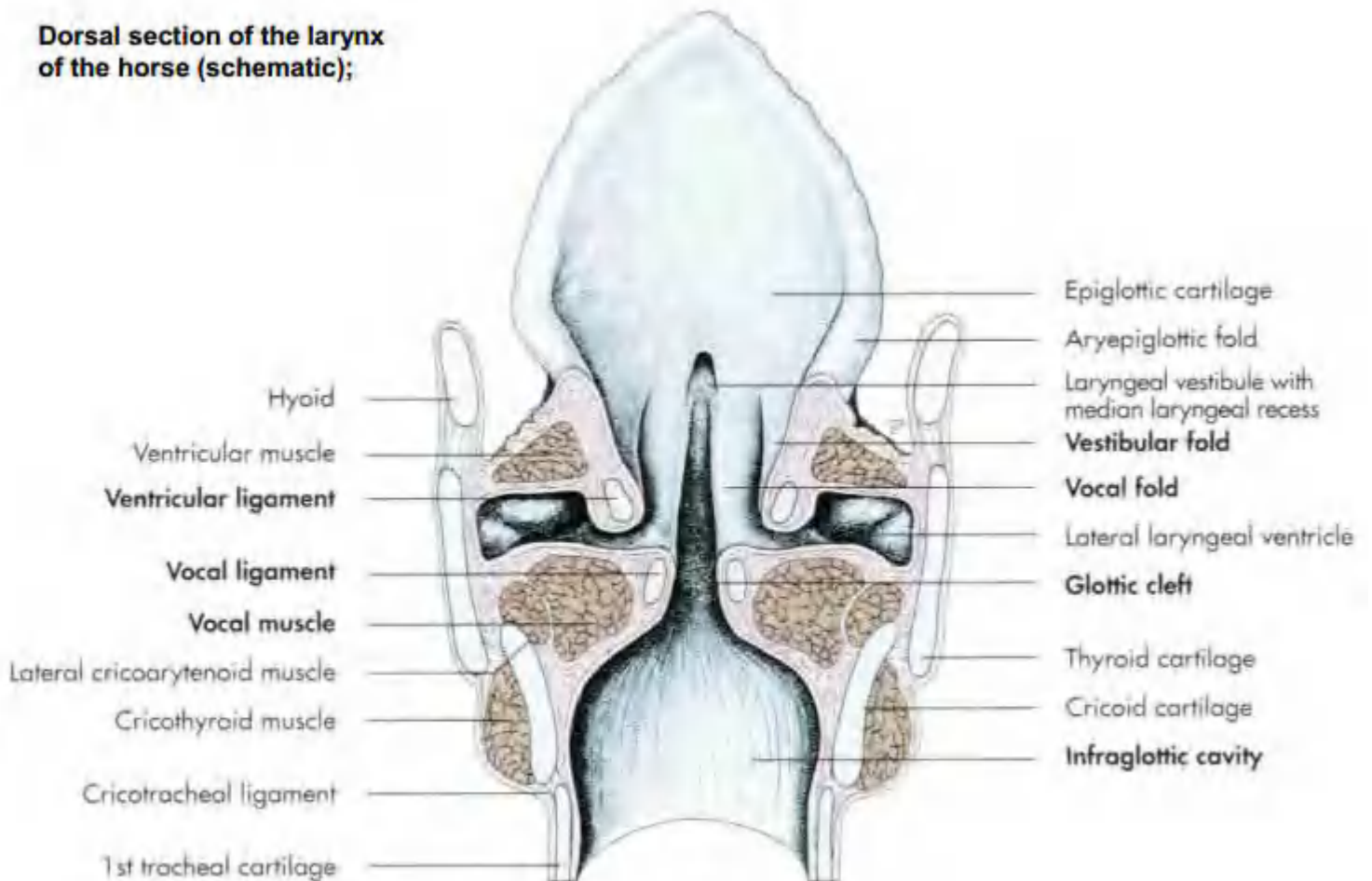


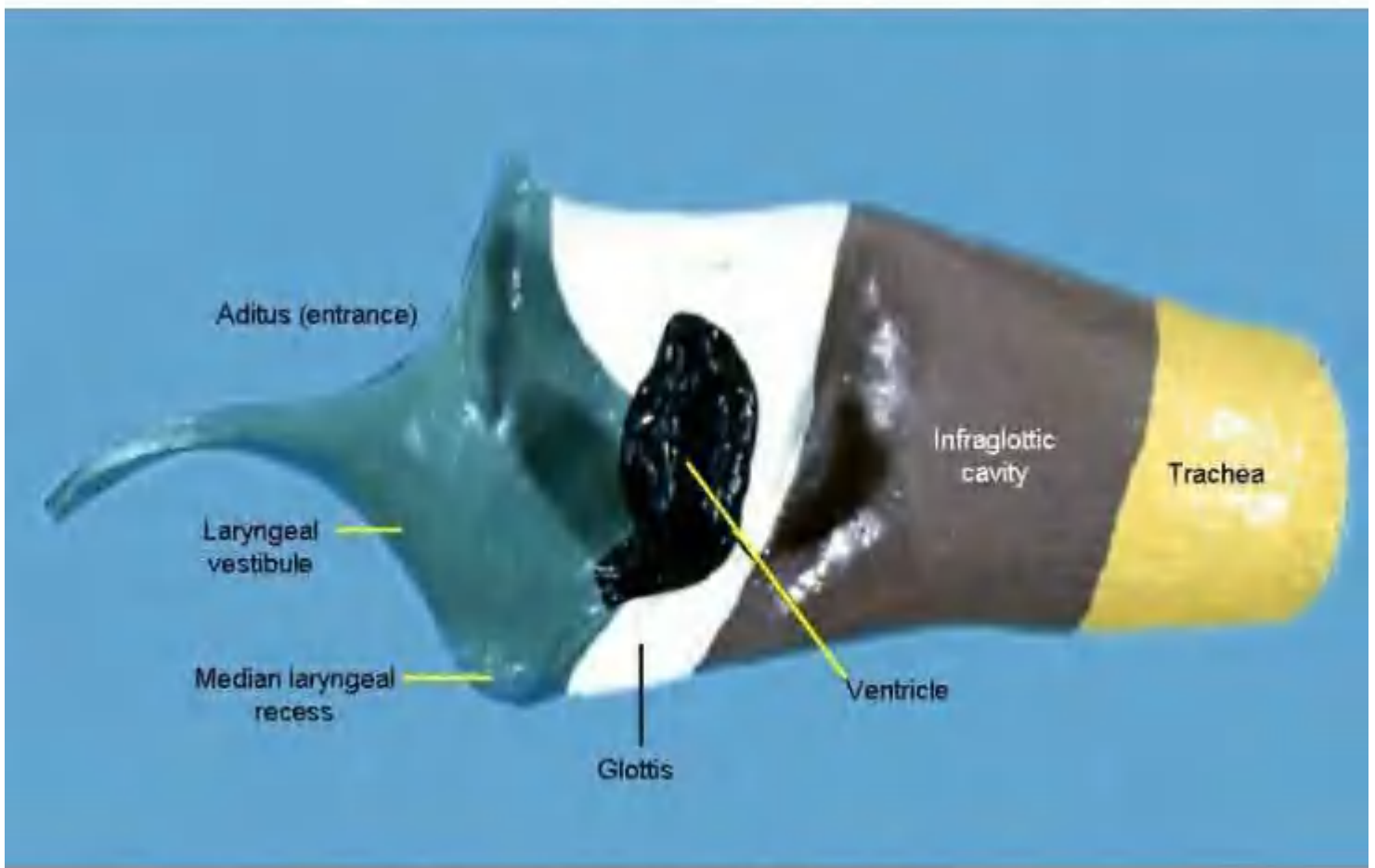
Cricoid cartilage
Horse
Cranial aspect



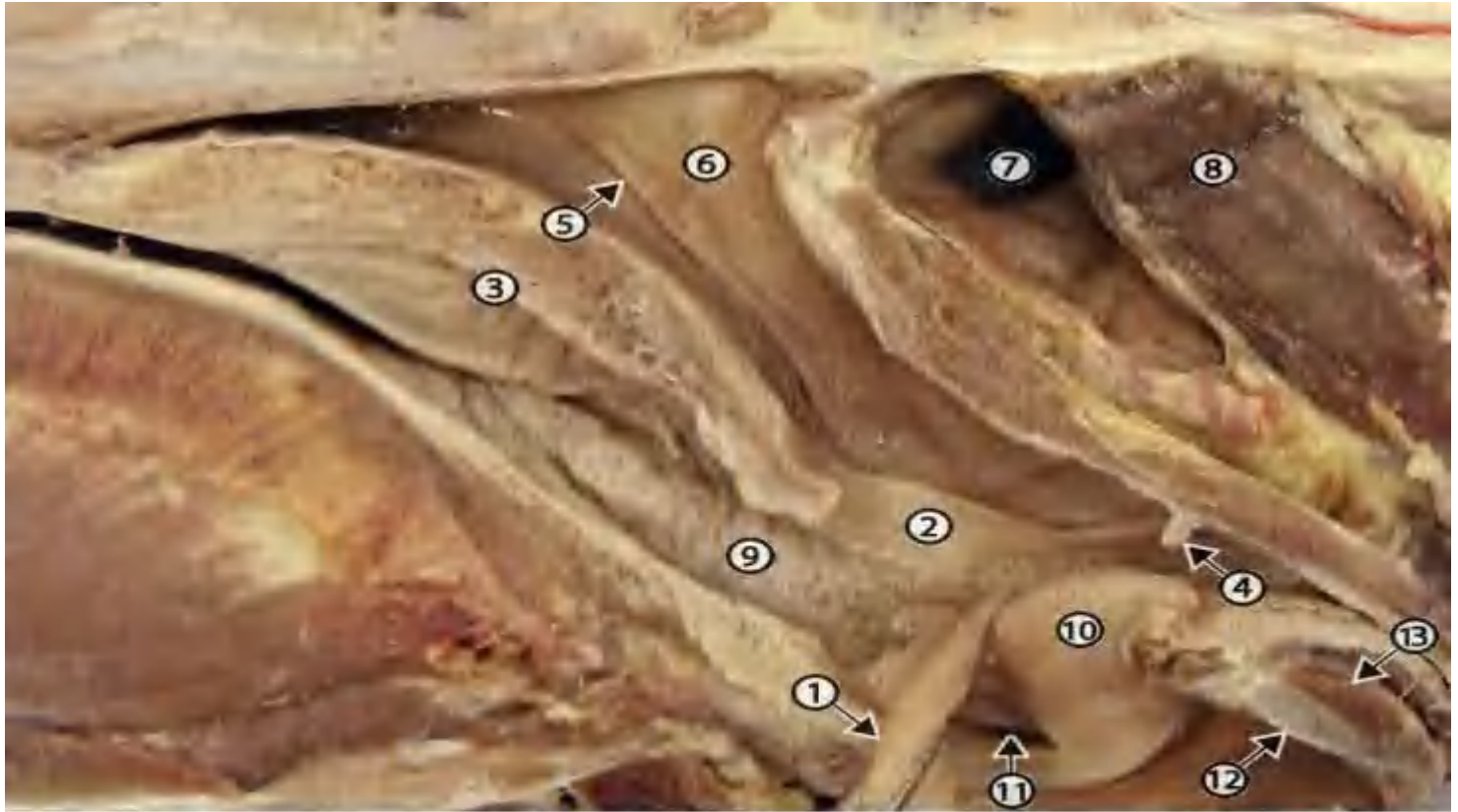
Cross section of the larynx of the horse (schematic, arrows indicating the narrowing and expansion of the glottic cleft)

Dorsal section of the larynx of the horse (schematic);

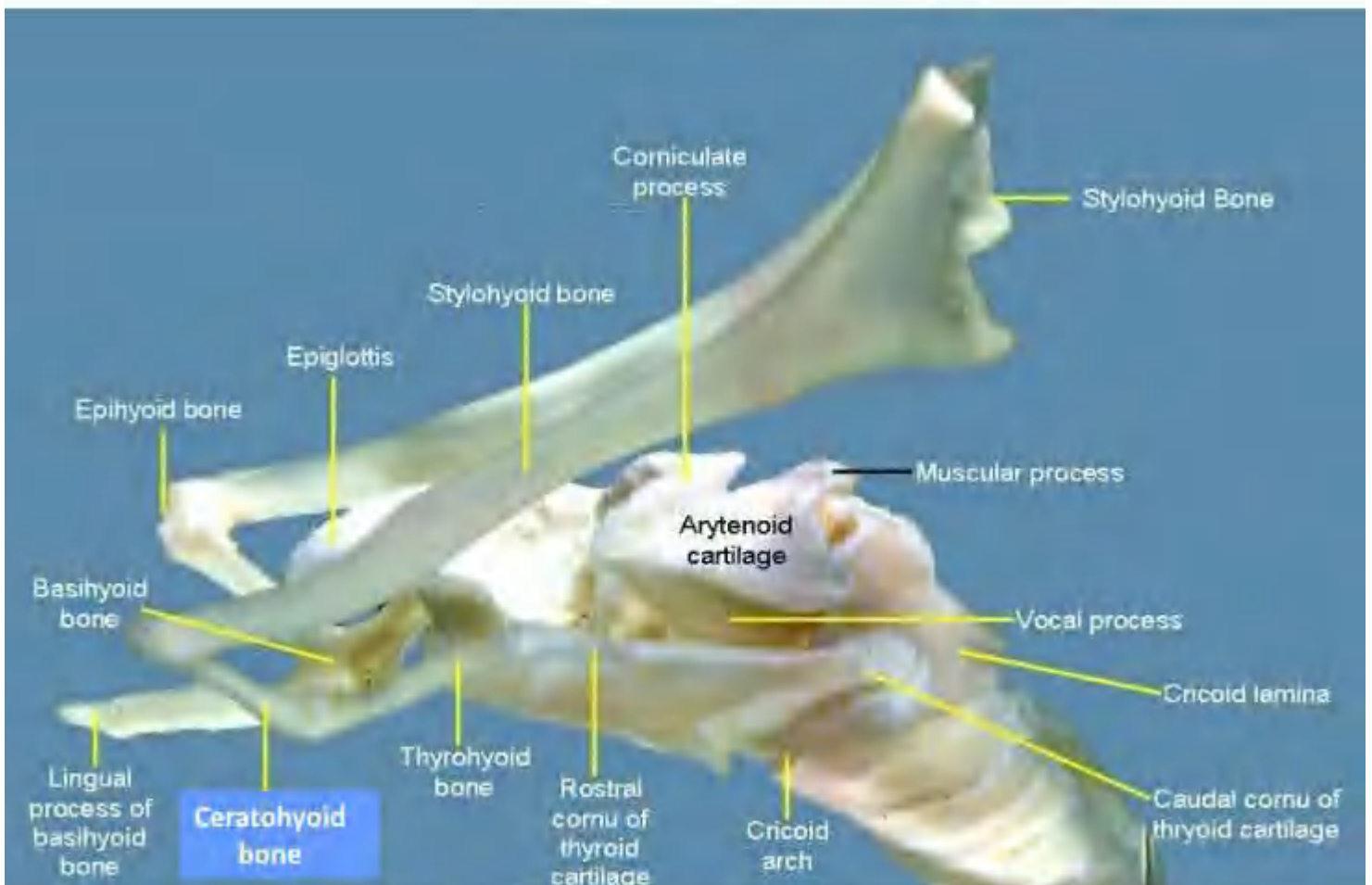




Equine split head close up view. 1, nasal septum; 2, soft palate; 3, nasopharynx; 4, orifice of auditory tube = entrance to guttural pouch; 5, interior of guttural pouch; 6, longus capitis m.; 7, palatine tonsil; 8, epiglottic cartilage; 9, entrance to laryngeal ventricle; 10, vocal fold; 11, arytenoid cartilage covered with mucosa; 12, aryepiglottic fold; 13, caudal most part of the palatopharyngeal fold; 14, cricoarytenoideus dorsalis muscle; 15, midline section of cricoid cartilage.



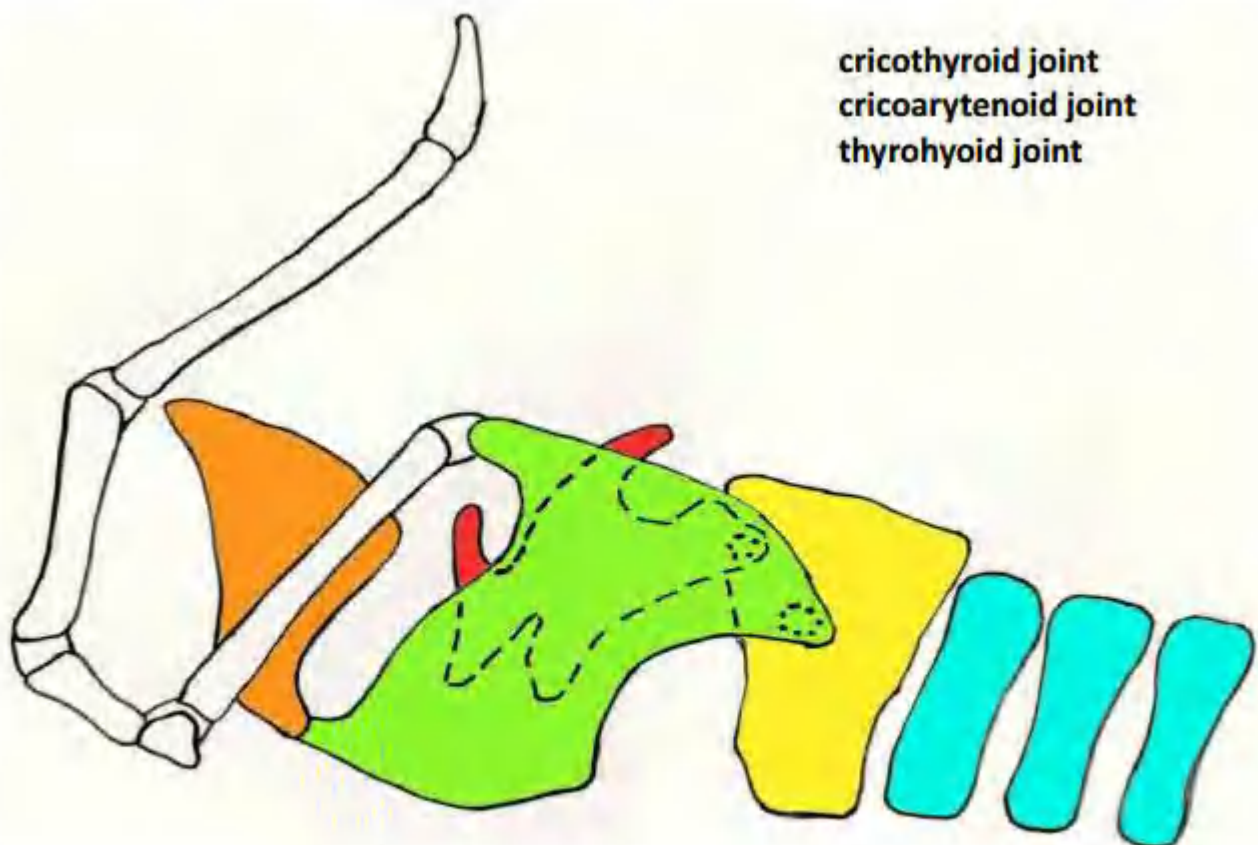
Reflection of the epiglottis (1) to expose the palatopharyngeal fold (2) which is continuous with the caudal end of the soft palate (3). Right and left palatopharyngeal folds are united caudally (4). 5, orifice of auditory tube = entrance to guttural pouch; 6, nasopharynx; 7, interior of guttural pouch; 8, longus capitis m.; 9, palatine tonsil; 10, arytenoid cartilage covered with mucosa; 11, entrance to laryngeal ventricle; 12, midline section of cricoid cartilage; 13, cricoarytenoideus dorsalis muscle..



The laryngeal cartilages are connected together, to the hyoid bone, to the sternum and to the trachea by; jointsligaments muscles and membranes

Articulations (JOINTS) of the larynx:

1. cricothyroid joint
2. cricoarytenoid joint
3. thyrohyoid joint
4. the articulation between the corniculate and the arytenoids cartilages, the arytenoids and cuneiform cartilages (dog) and the epiglottic and the cuneiform cartilages (horse) are cartilaginous.



Ligaments of the larynx:

1. hyoepiglottic ligament: connects the basal part of the lingual surface of the epiglottic cartilage to the basihyoid bone.

2. thyroepiglottic ligament: connects the base of the epiglottic cartilage with the body and laminae of the thyroid cartilage.

3. cricoarytenoid ligament: from the ventral aspect of the lamina of the cricoid cartilage to the medial surface of the arytenoids cartilage.

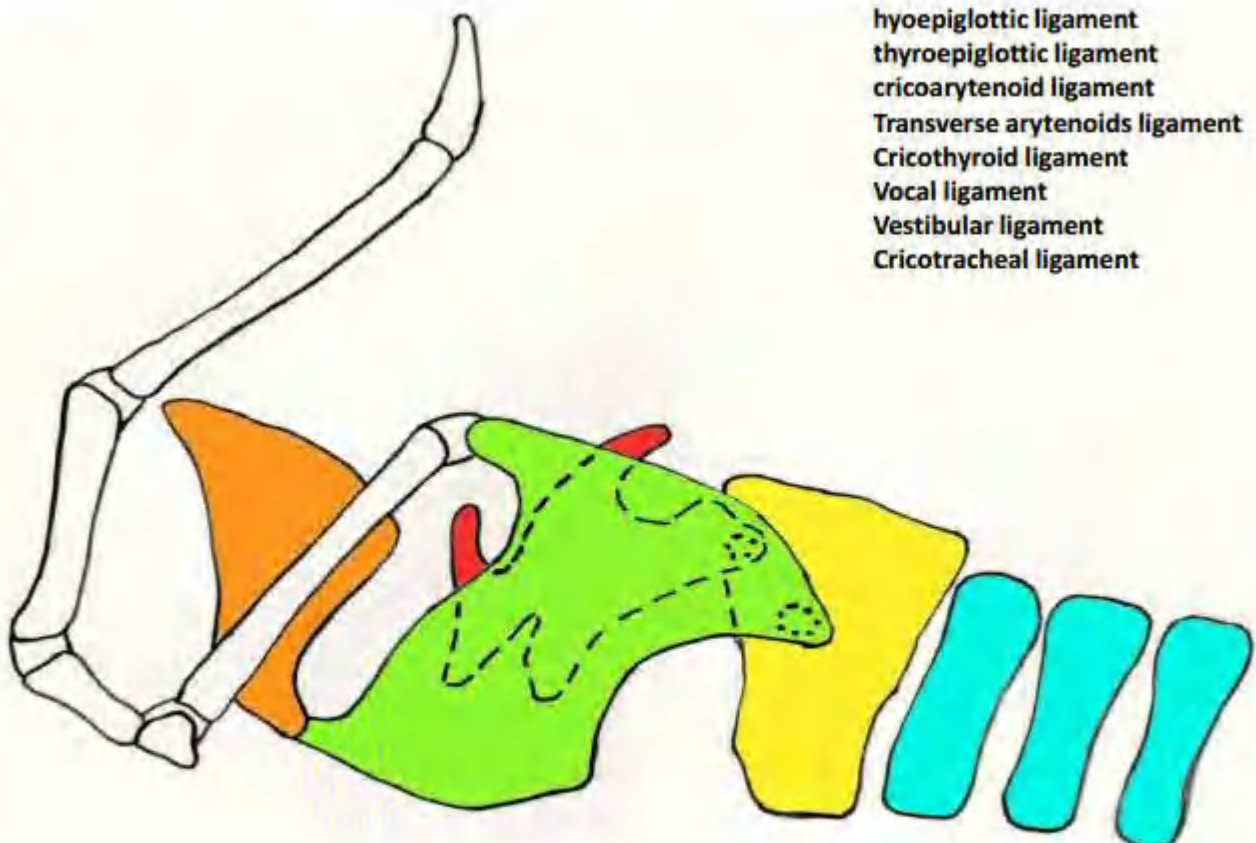
4- Transverse arytenoids ligament: between the dorsomedial angle of the two arytenoids cartilages. In pig and dog, a small piece of cartilage (interarytenoid cartilage) lies in this ligament.

5- Cricothyroid ligament: connects the rostral border of the arch of cricoid cartilage with the caudal border of the lamina and with the body of the thyroid cartilage.

6. Vocal ligament: elastic ligament extends between the vocal process of the arytenoid cartilages and the body of the thyroid cartilage on either side. It forms the basis of the vocal fold.

7- Vestibular ligament: in animals with a vestibular fold, a vestibular ligament is presented rostral to the vocal ligament.

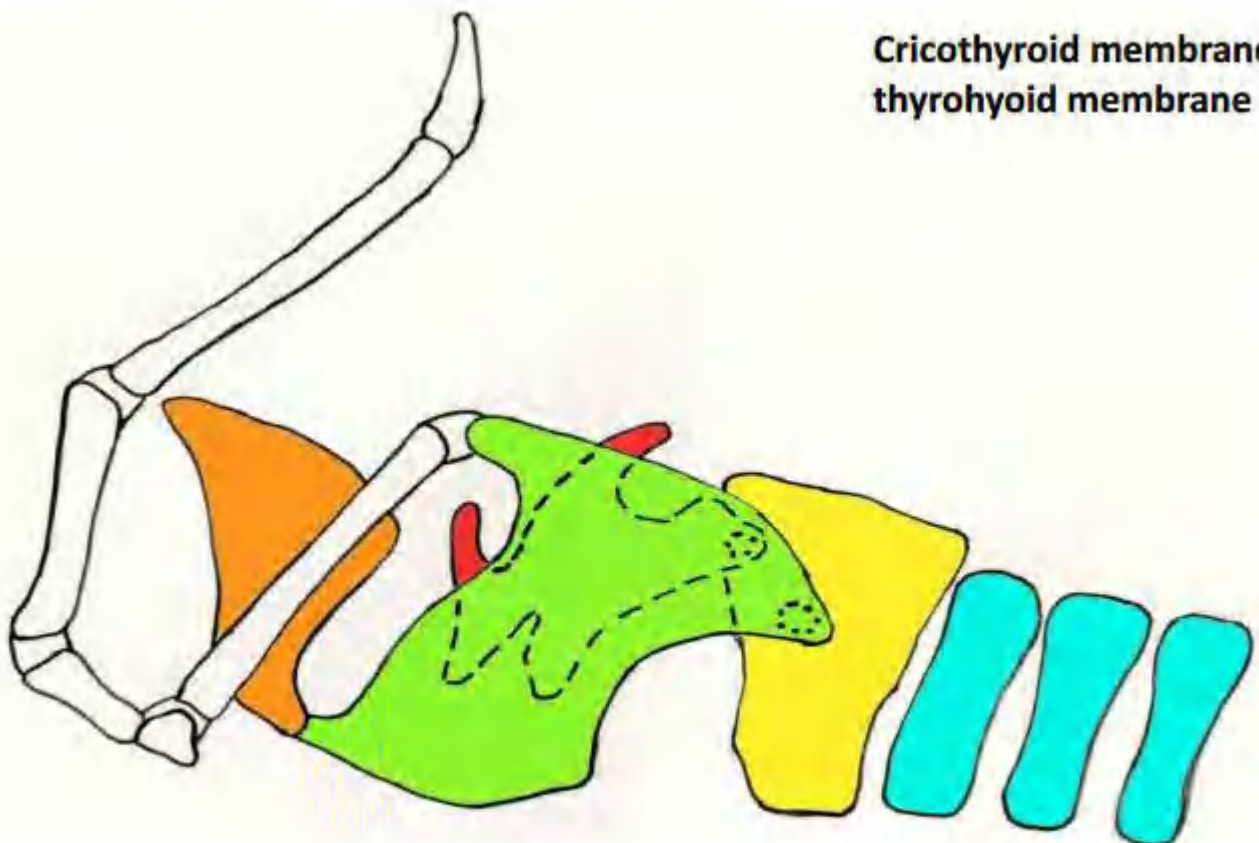
8. Cricotracheal ligament: connects the caudal border of the cricoid cartilage with the cranial border of the first tracheal ring.



Membranes of the larynx:

1- Cricothyroid membrane: connects the rostral border of the arch of cricoid cartilage with the caudal border of the lamina and with the body of the thyroid cartilage.

2. thyrohyoid membrane: connective tissue sheet from the body and lamina of the thyroid cartilage to the caudal border of the basihyoid and thyrohyoid bones. Its ventral part may be thickened and hence it is called thyrohyoid ligament.

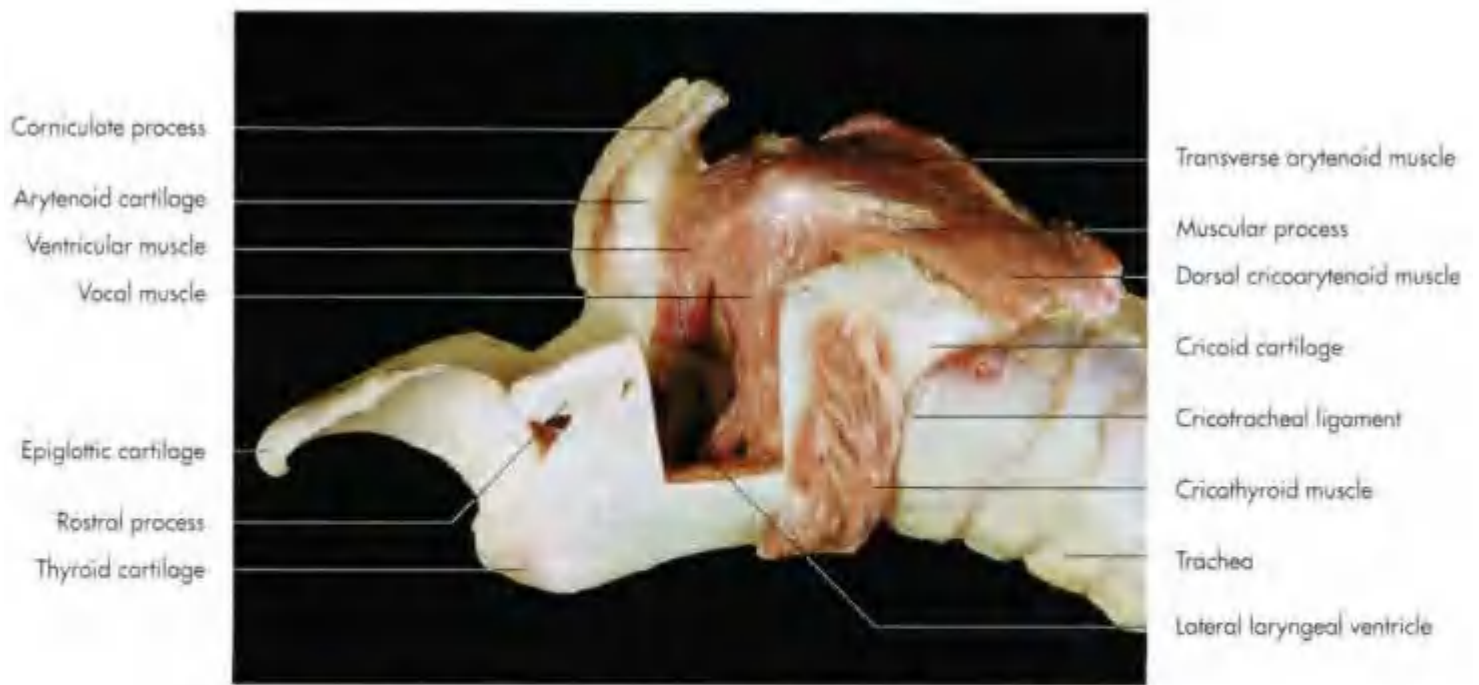




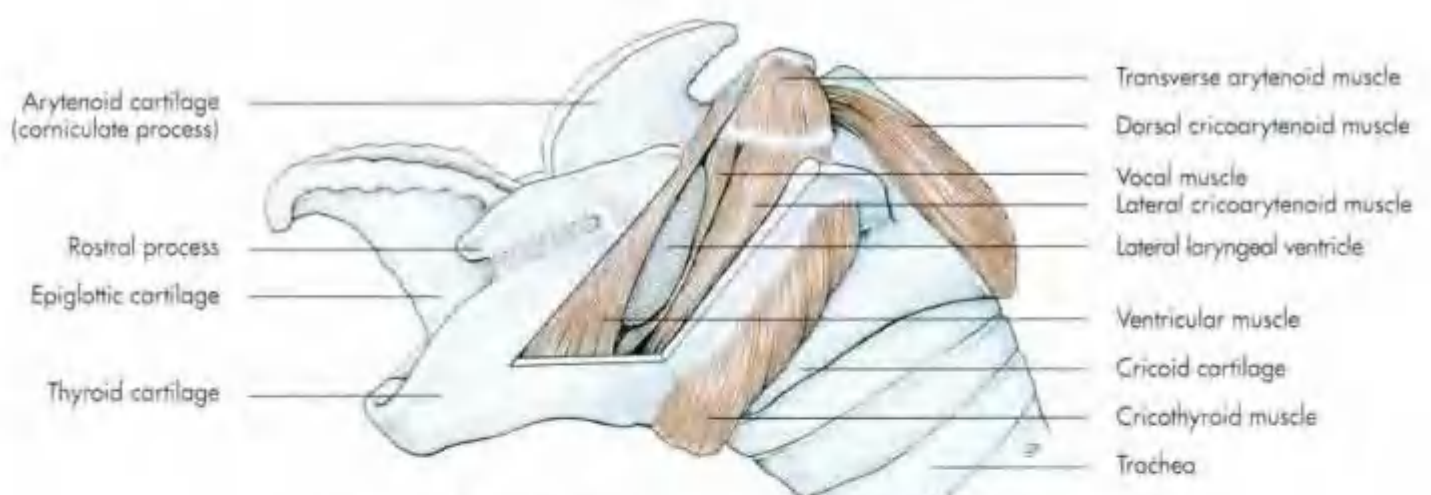
Equine laryngotomy approach through the cricothyroid ligament



Larynx of a horse, demonstrating the laryngeal muscles;

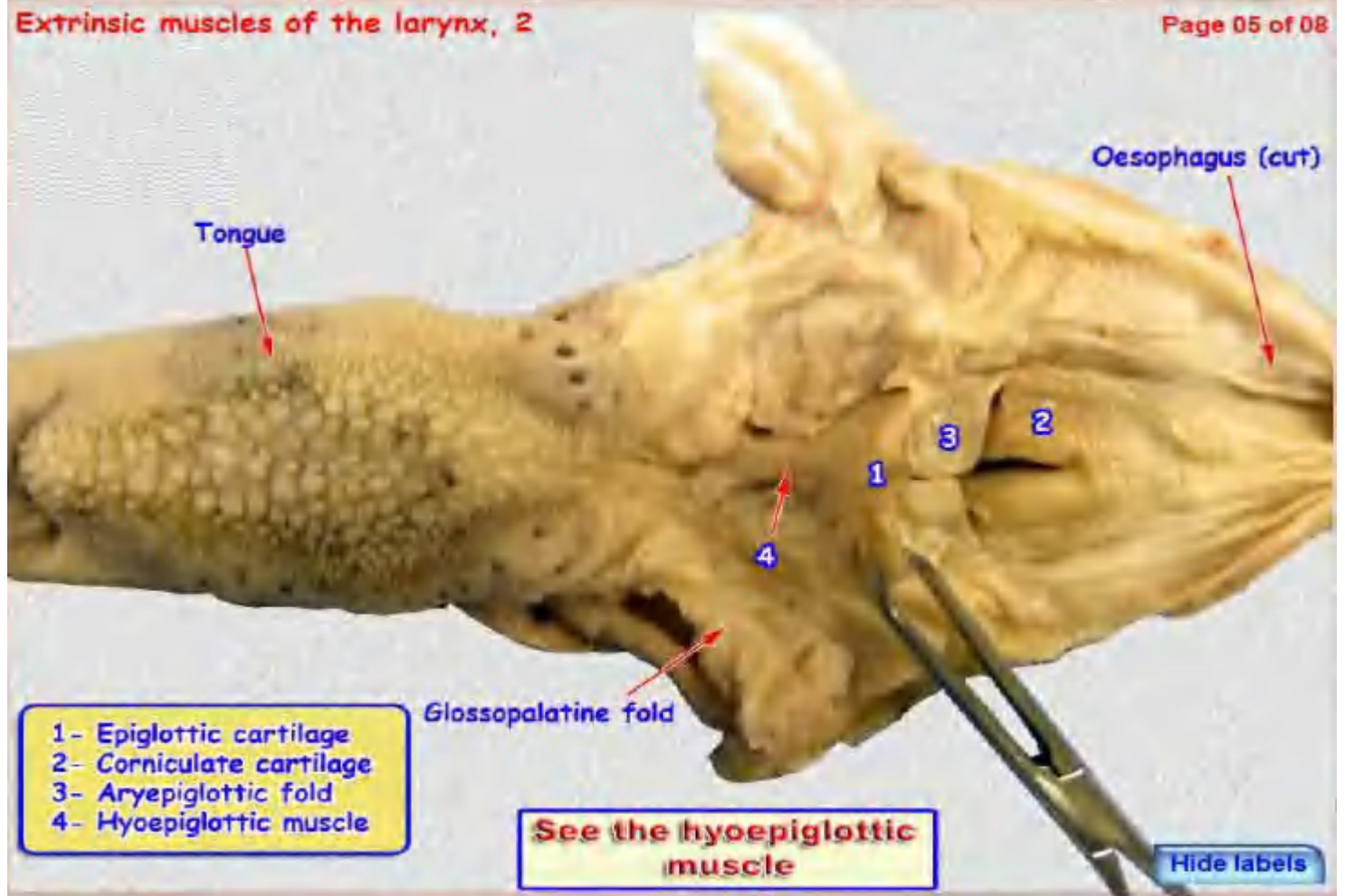
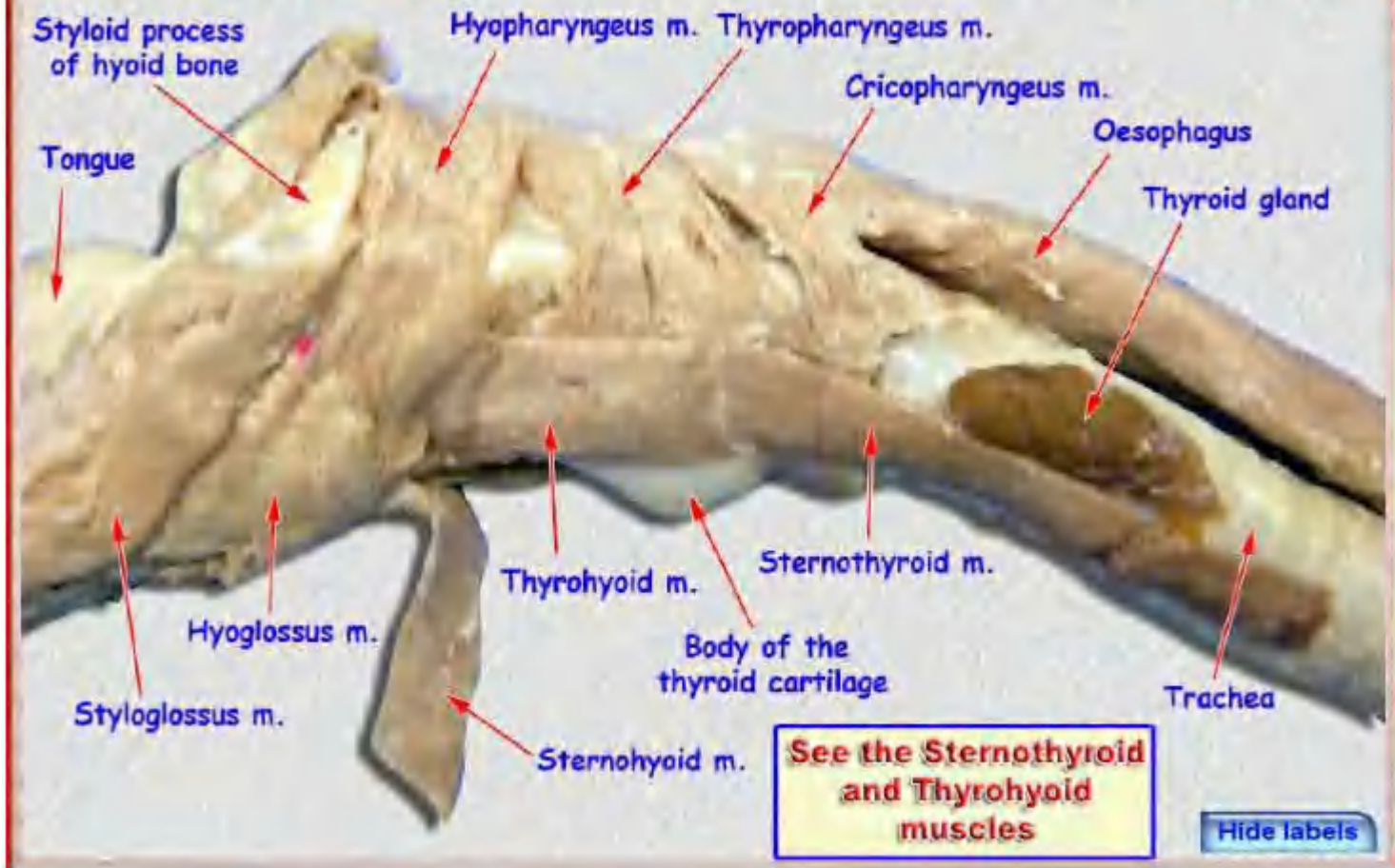


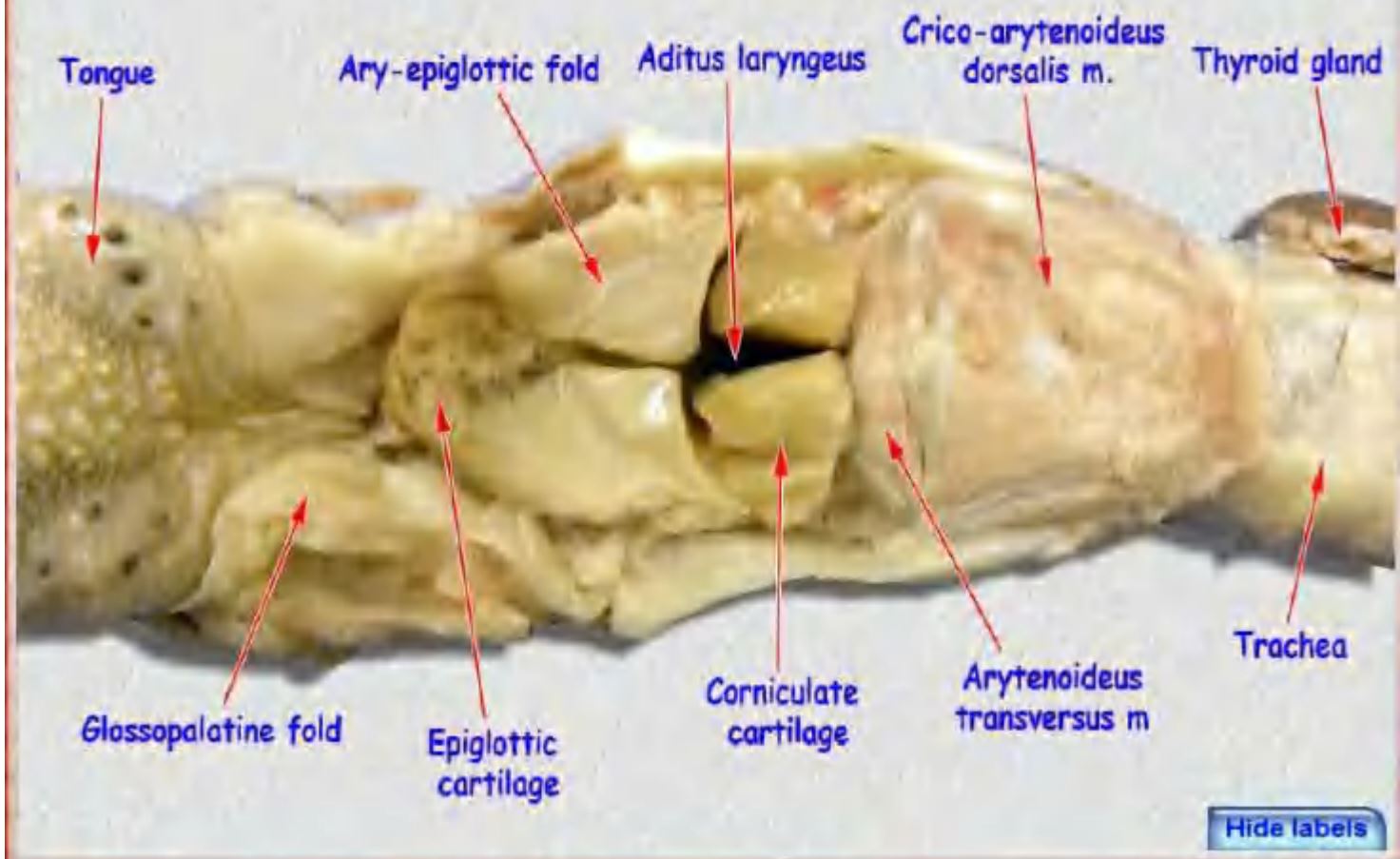
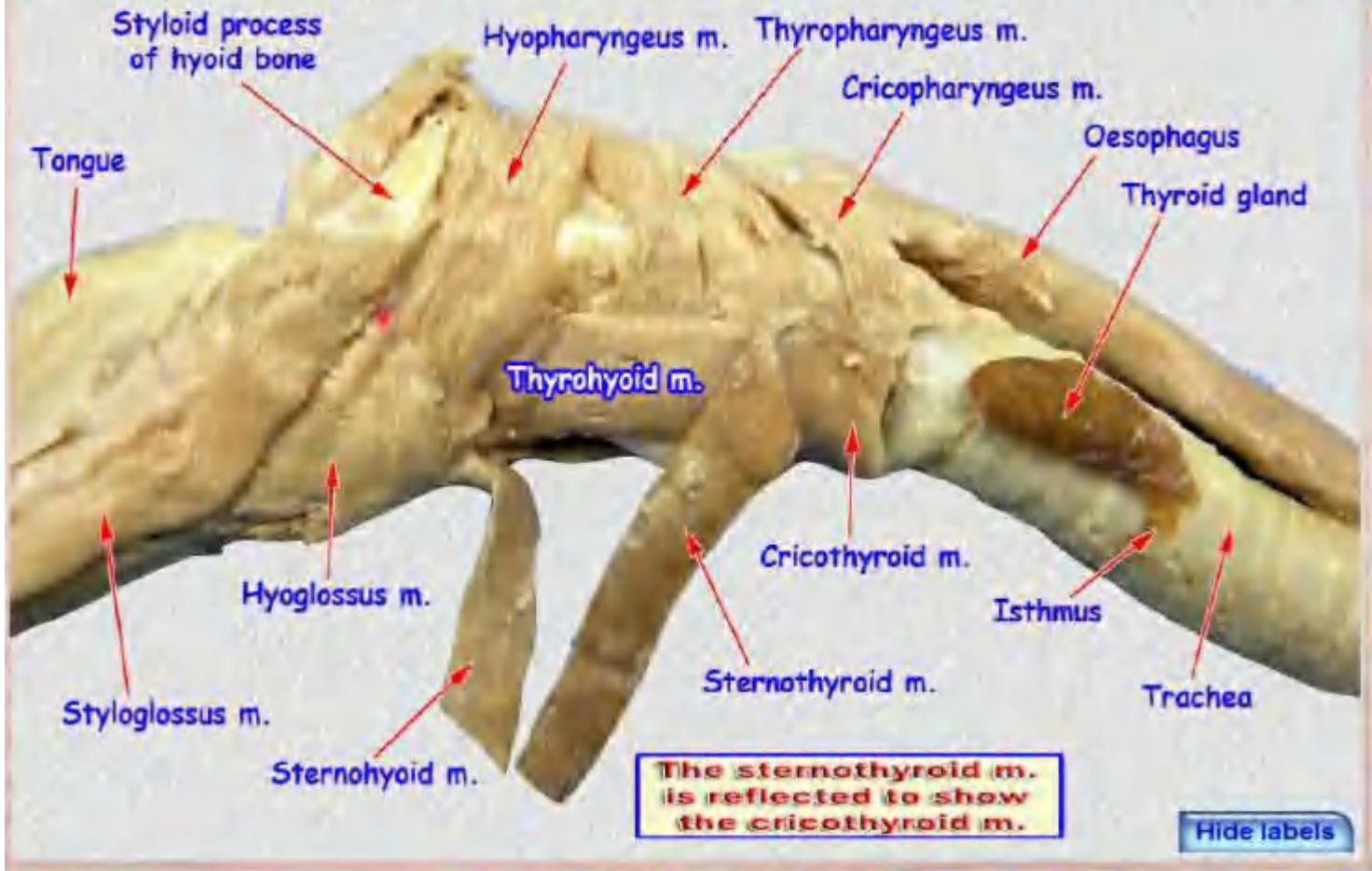
Larynx of a horse (thyroid cartilage partly removed);

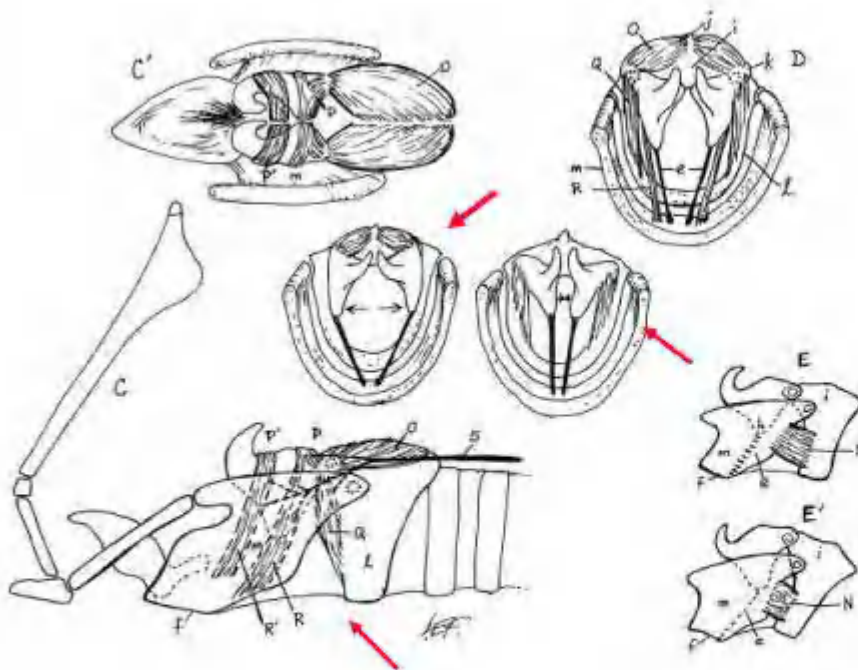
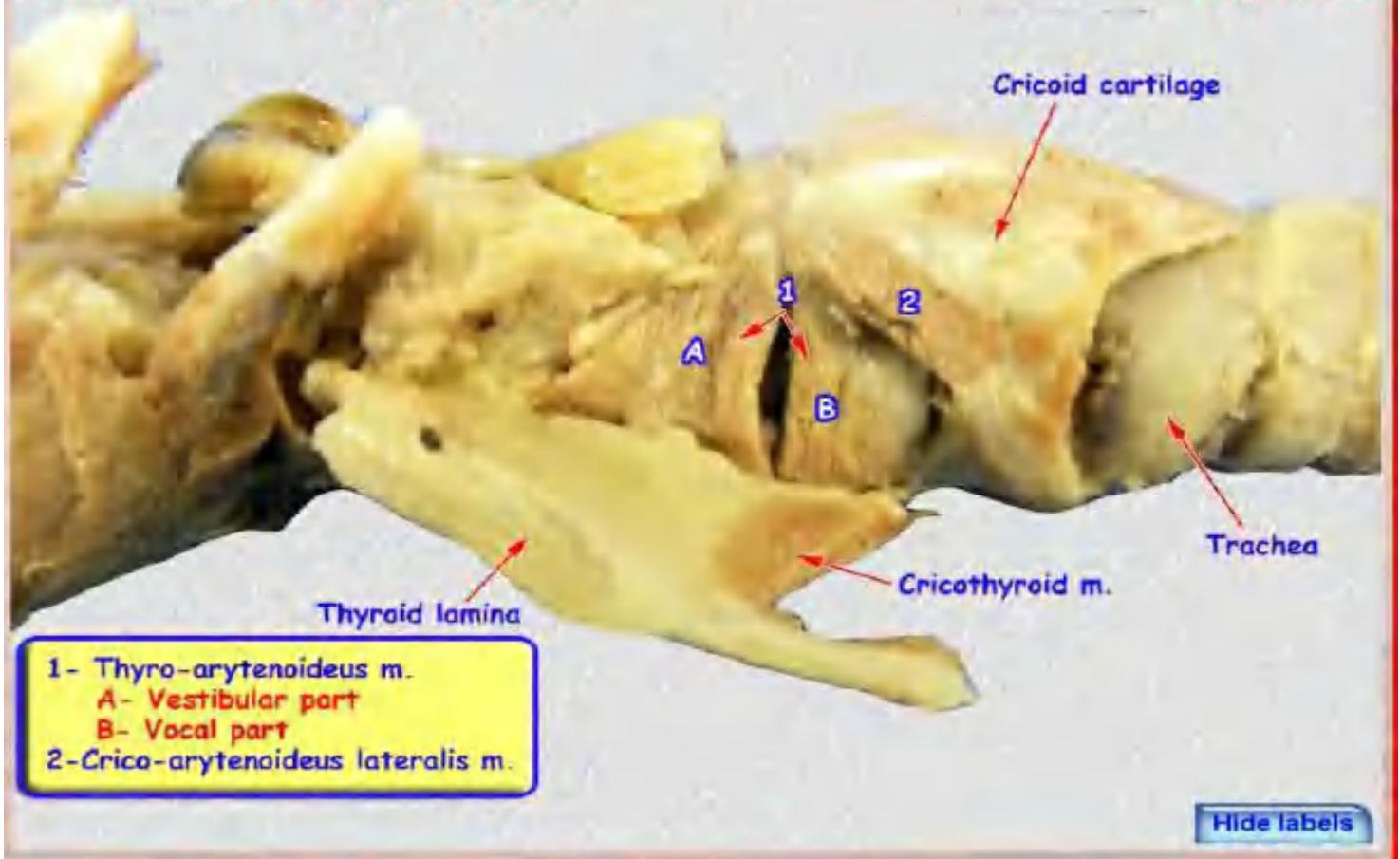


Larynx of the horse (schematic, thyroid cartilage partly removed).









INTRINSIC MUSCLES OF LARYNX

Be able to identify:

Dorsal cricoarytenoideus (abducts vocal folds => opens glottis)

Lateral cricoarytenoideus (adducts vocal folds => closes glottis)

Vocalis (parallels vocal fold and helps shorten fold)

Blood supply and innervation of the larynx:

from the laryngeal branch of the **cranial thyroid artery** which extends from the cranial end of the common carotid artery.

The nerve supply of the larynx

is provided by branches of the vagus nerve.

1. The cranial laryngeal nerve

divides into an external and internal branch. **external branch** innervates the constrictors of the pharynx and the cricothyroid muscle. **internal branch** passes into the thyroid notch to the inside of the larynx where it innervates the mucosa and usually anastomoses with the caudal laryngeal nerve.

2. The caudal laryngeal nerves

supply motor innervation to all of the intrinsic muscles of the larynx except the cricothyroid muscle. It originates in the thorax by branching off from the vagus nerve.

Larynx comparative

	Horse	Ox, sheep and goat	Camel	Pig	dog
Cuneiform cartilages	Present and articulates with epiglottic cartilage	Absent	Absent	Absent	Present embedded in the epiglottic fold
Inter-arytenoid cartilage	absent	absent	Absent	Present	present
Caudal thyroid notch	Present	Present and narrow	absent	Absent	Present
Rostral cornu of thyroid	Present	Present	Present	Absent	Present
Median laryngeal ventricle (middle)	Present	Absent	Present	Present	Absent
Lateral ventricle and laryngeal sacculae	present	absent	present	present	present
Thyroid foramen	absent	absent	present	absent	absent



Lecture notes on

The Respiratory System

TRACHEA, BRONCHIAL TREE, LUNGS and PLEURA



Quick Refernce

REMEMBER

- 1-Nostrils.
- 2-Nasal plate.
- 3-Nasal cartilages.
- 4-Nasal cavity.
- 5-Nasal conchae.
- 6-Nasal passages.
- 7-Paranasal sinuses.
- 8-Structures within the nasal cavity.
- 9-Laryngeal cartilages, joints, ligaments, cavities, membranes and muscles.

1- Trachea: (Windpipe)

Definition

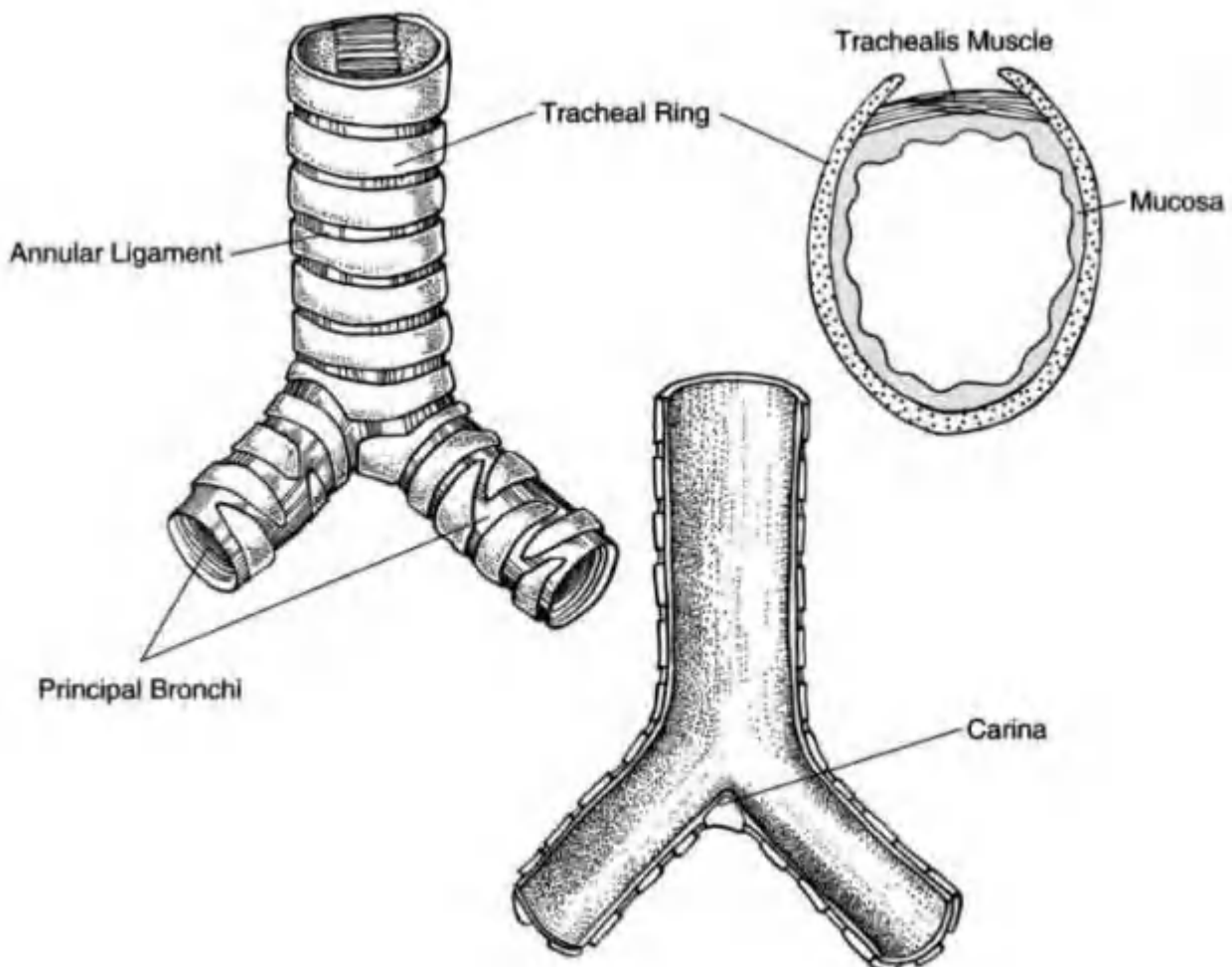
of the tracheal cartilages.

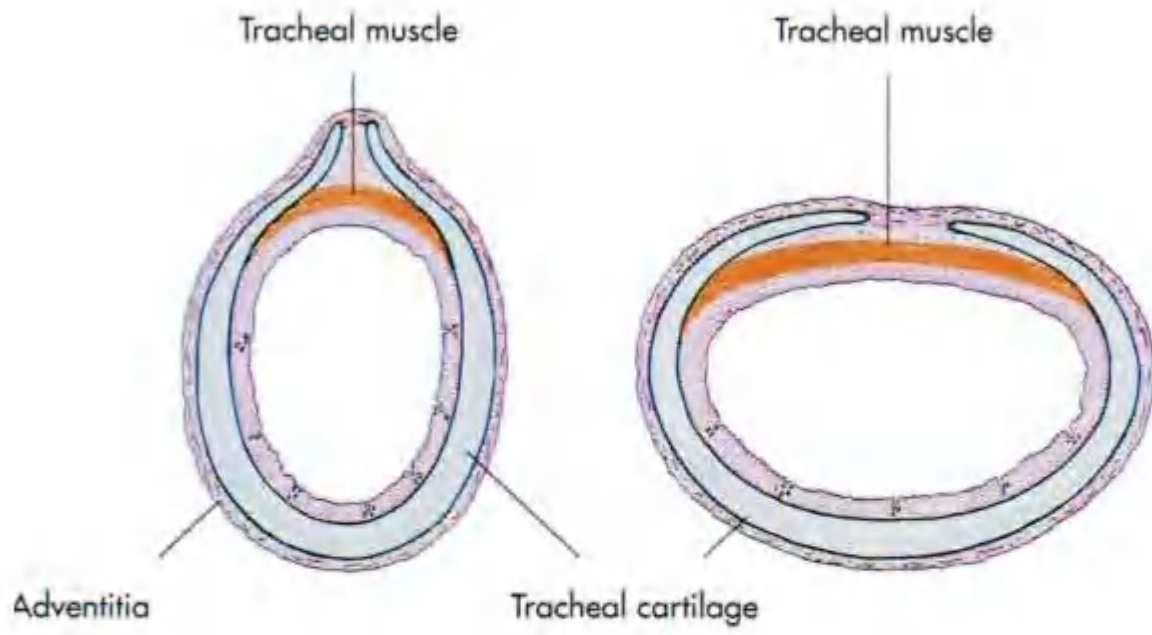
Structure of the trachea.

Relations of the trachea.

Blood supply.

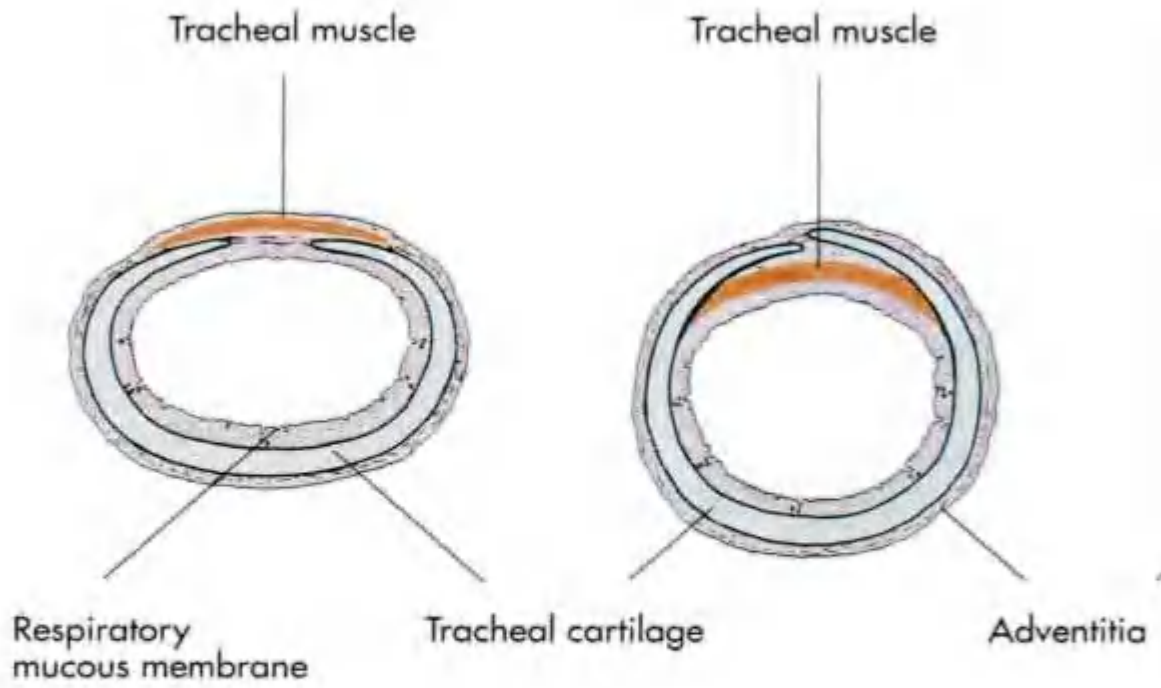
Nerve supply.





Ox

Horse



Dog

Pig

Horse	Ox-sheep and goat	Camel	Pig	Dog
Compressed dorsoventrally	Compressed laterally -oval in shape	cylindrical	cylindrical	cylindrical
48-60	48-60	80-95	29-36	42-46
The left end of the tracheal cartilage overlaps slightly the right one but caudally the two ends never meet dorsally	In ox and sheep: two ends form tracheal ridge dorsally. In goat: tracheal cartilage is U-shape	As horse	The right end overlaps the left one	The two end never meet dorsally
Transverse tracheal M.--internally	Transverse tracheal M.--internally	Transverse tracheal M.--internally	Transverse tracheal M.--internally	Transverse tracheal M.--externally

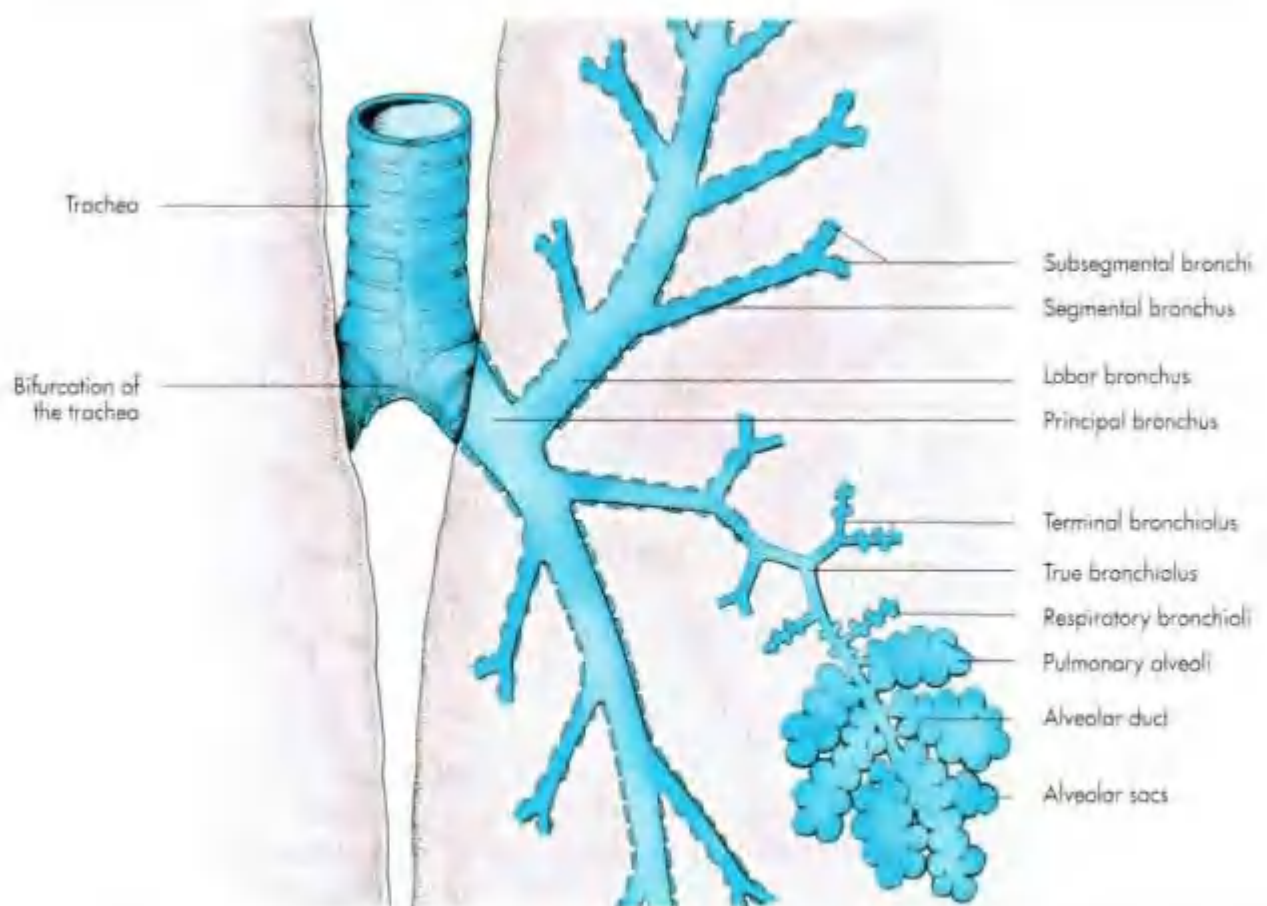


Thoracic Cage

GUESS what animals?

The bronchial tree:

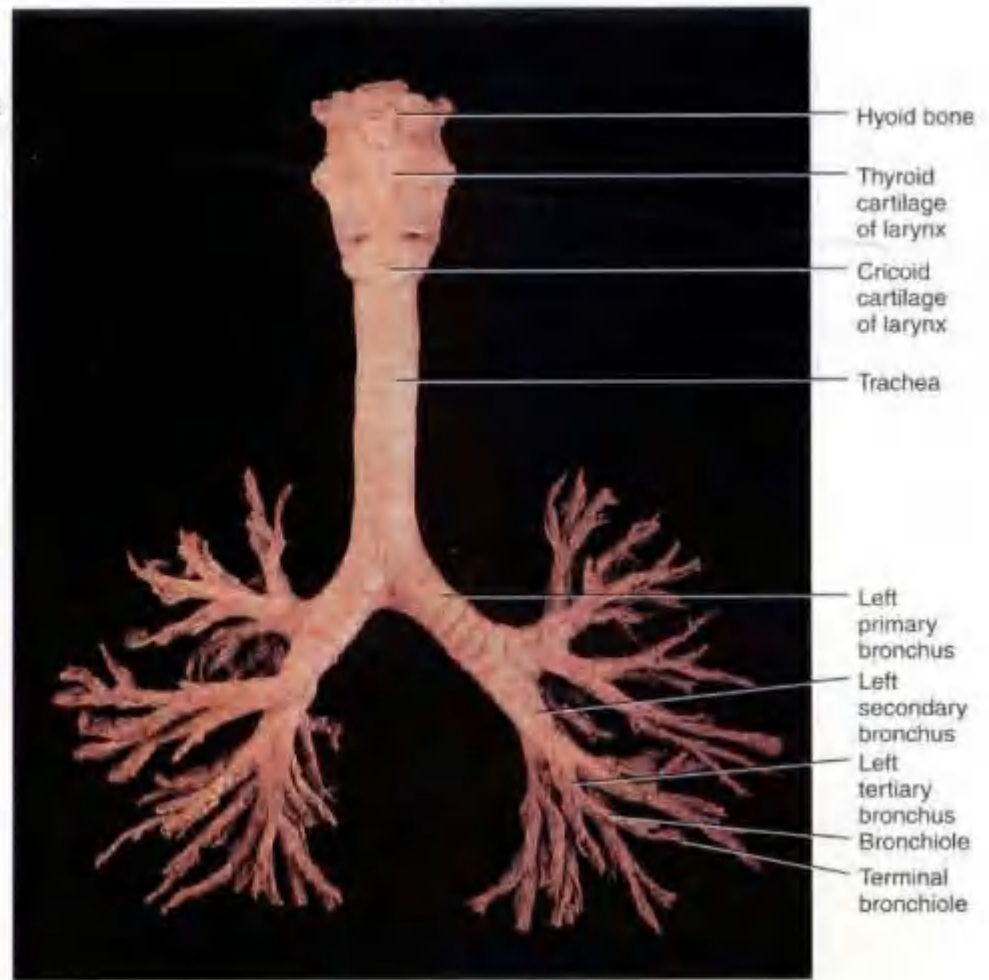
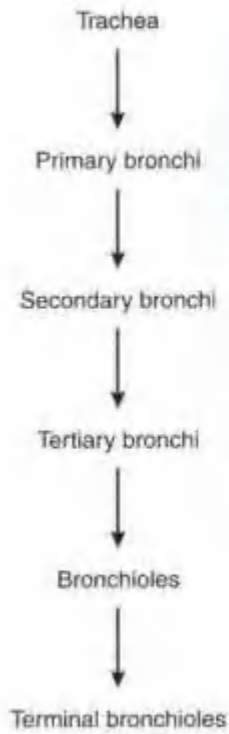
The bronchi divide within the lungs and each new generation being smaller in diameter, thus forming the bronchial tree.



Bronchial tree (schematic)

SUPERIOR

BRANCHING OF BRONCHIAL TREE

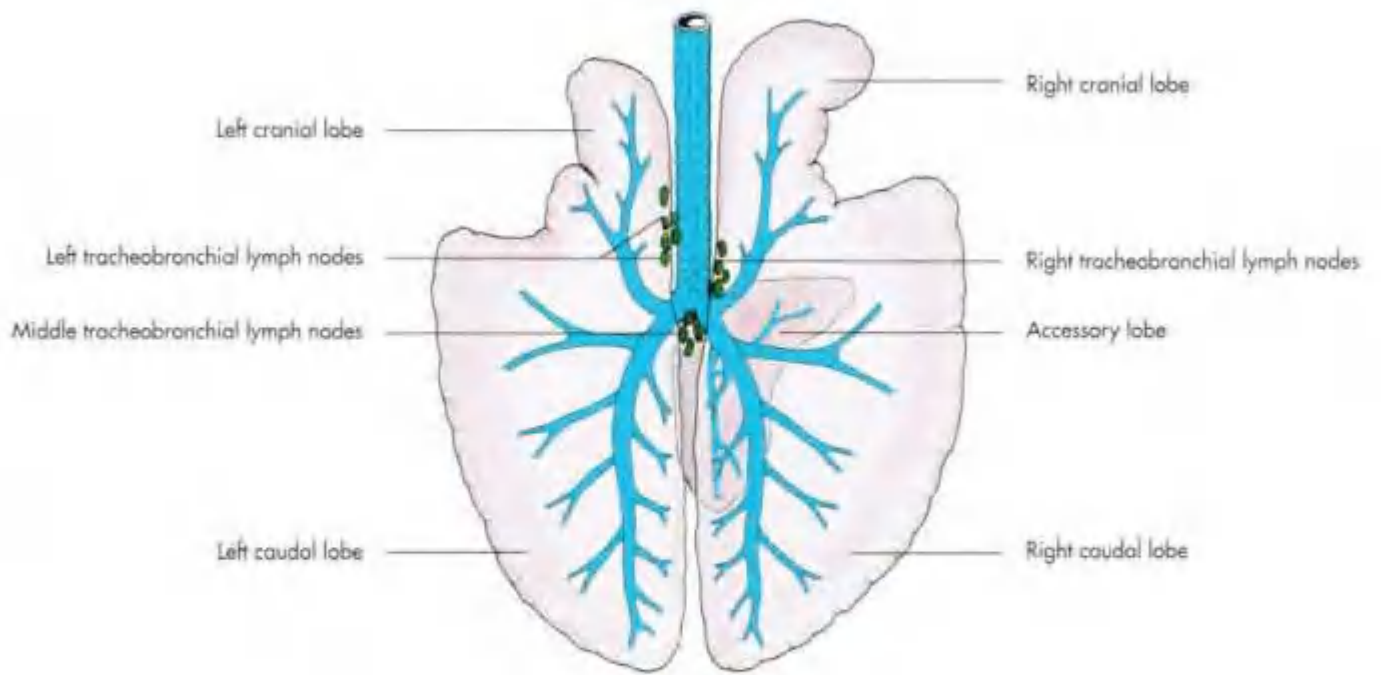


INFERIOR

Anterior view

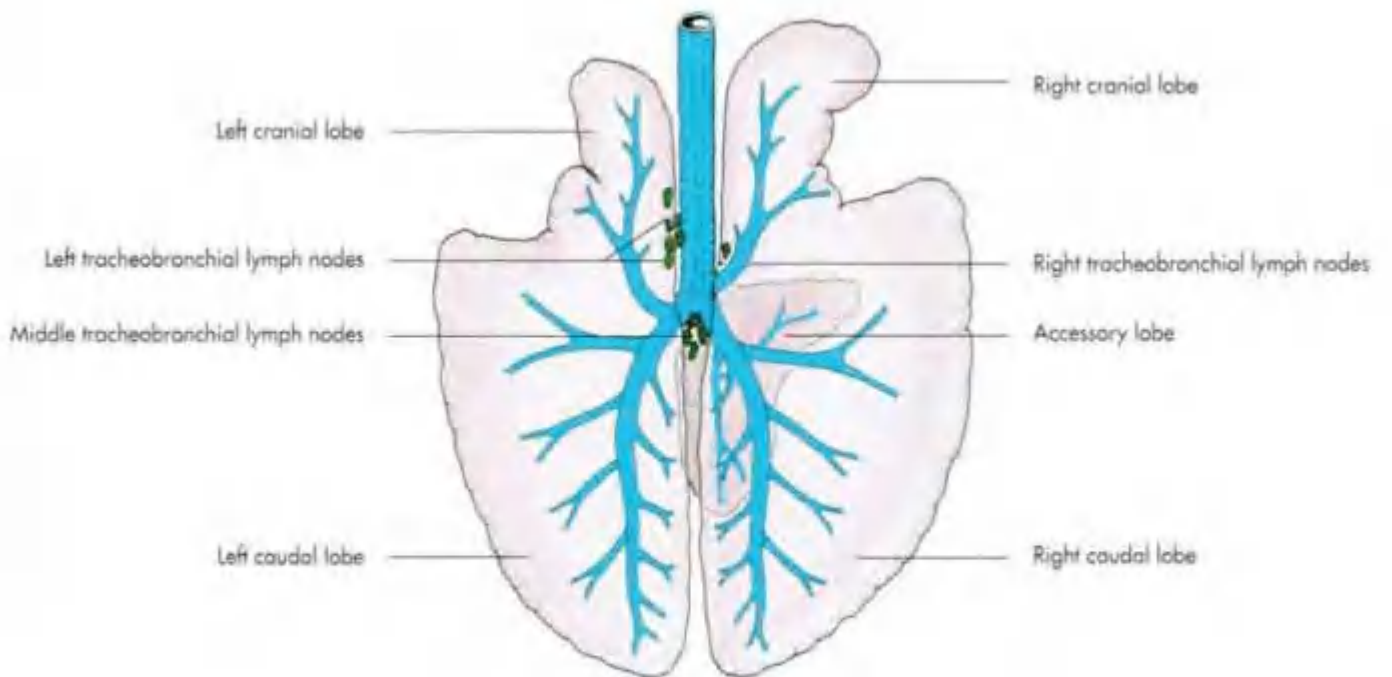
The lobation of the lungs of the different domestic mammals is listed below

Animal	Right lung	Left lung
Generalized	Four lobes Cranial lobe Caudal lobe Middle lobe Accessory lobe	Two lobes Cranial lobe Cranial part Caudal part Caudal lobe
Dog, cat and pig	As generalized form	As generalized form
Ruminants	Four lobes but cranial lobe is divided into Cranial and caudal parts	As generalized form
Horse and camel	Three lobes, middle lobe is missing	Cranial lobe not divided into cranial and caudal parts



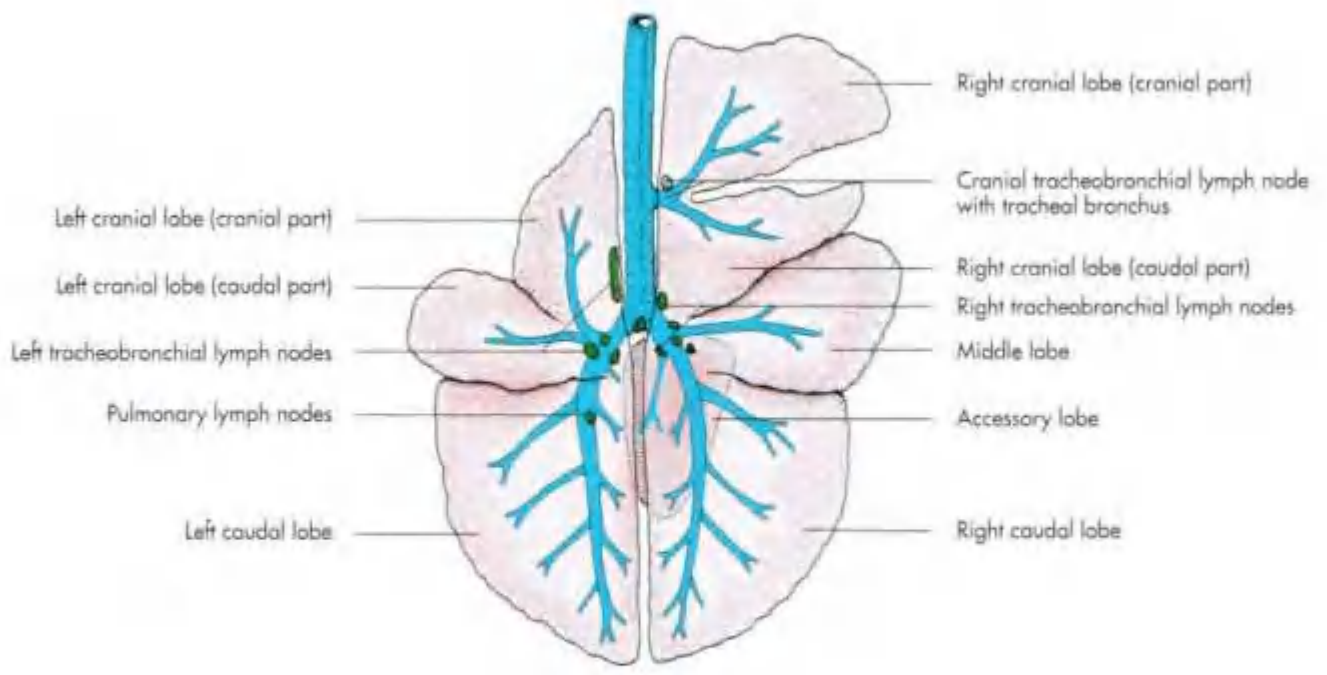
Horse

Lung lobes, bronchial tree and lymph nodes



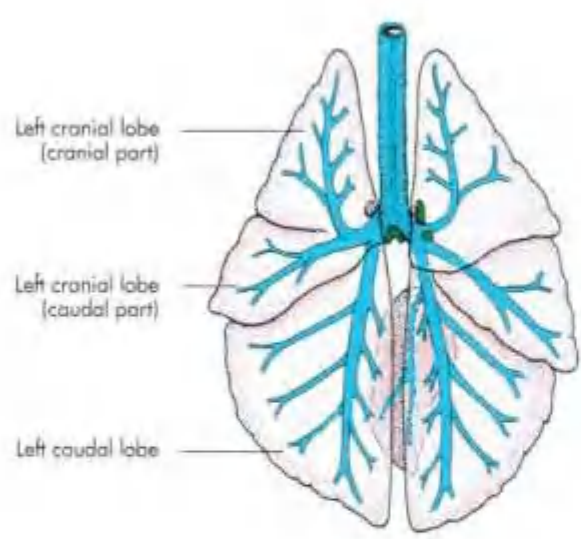
Camel

Lung lobes, bronchial tree and lymph nodes

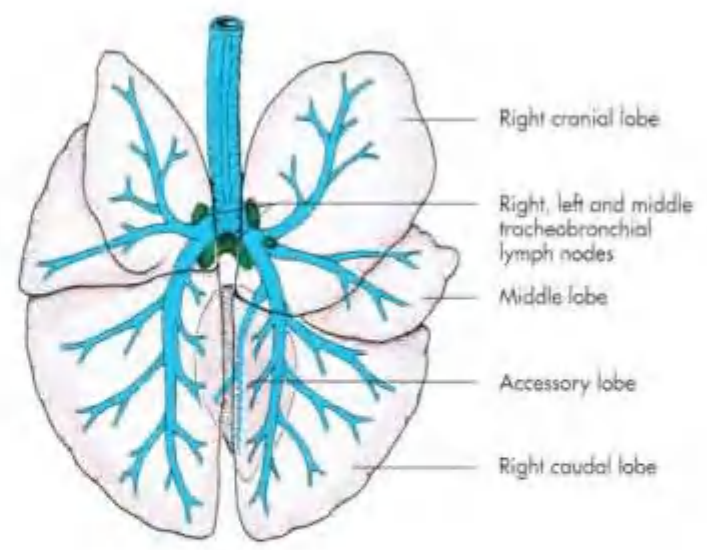


Ox

Lung lobes, bronchial tree and lymph nodes

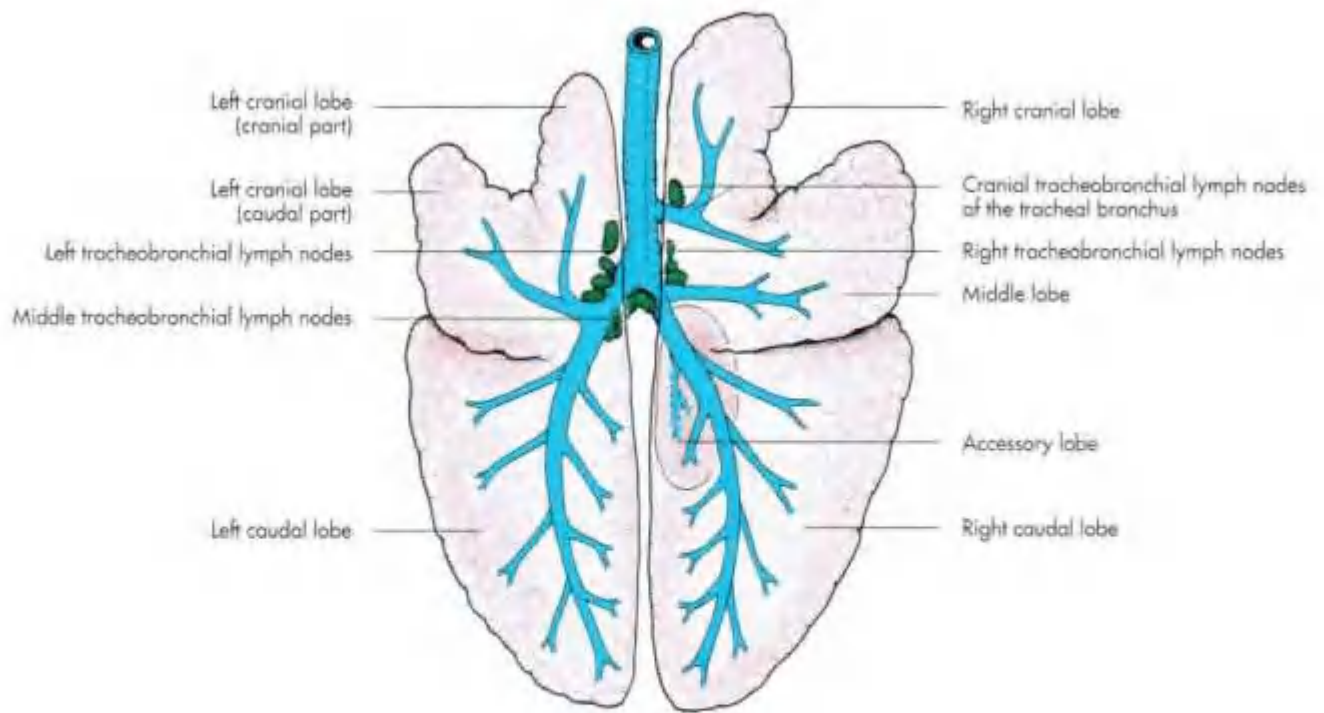


Cat



Dog

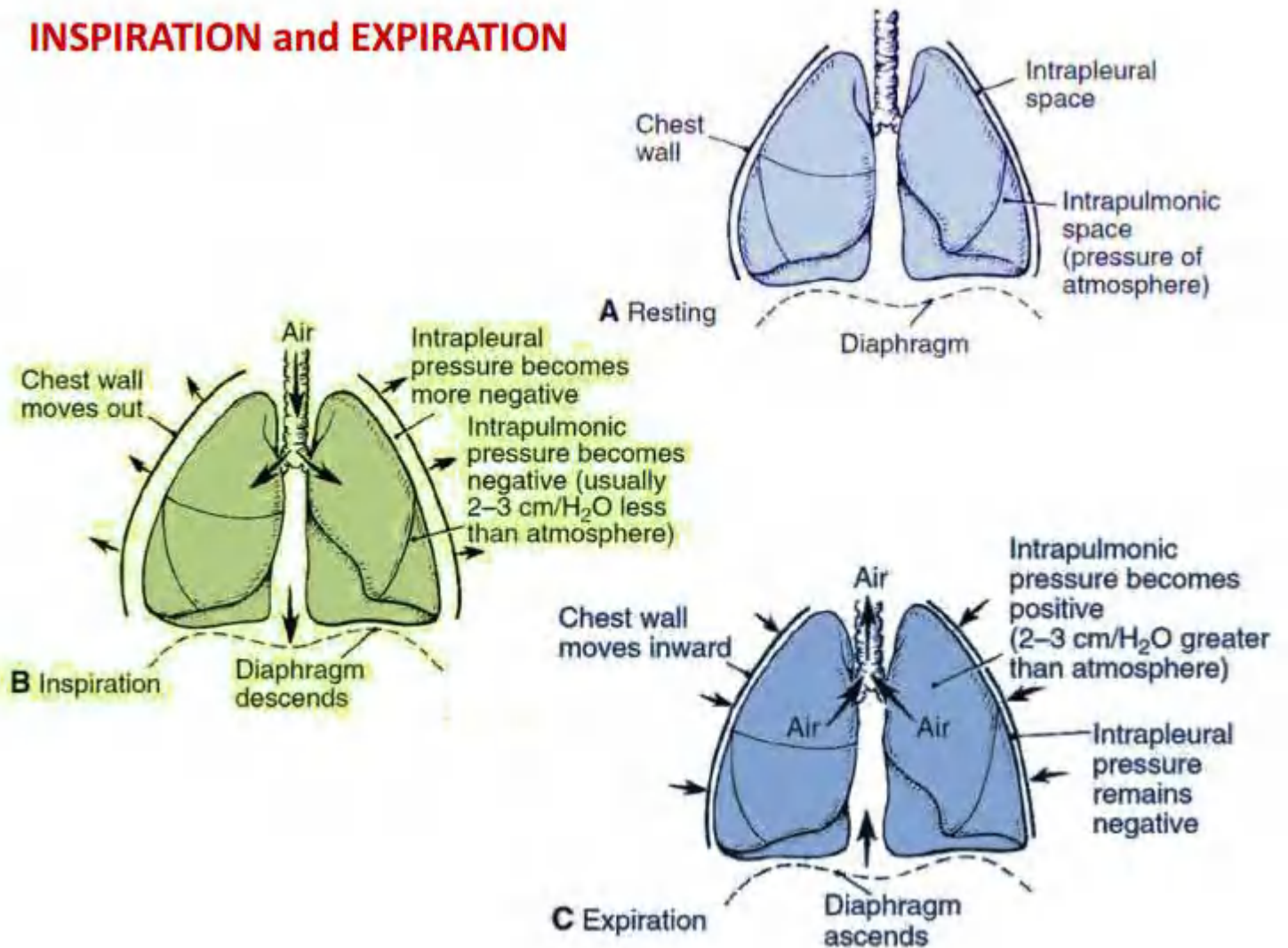
Lung lobes, bronchial tree and lymph nodes (schematic, dorsal aspect)

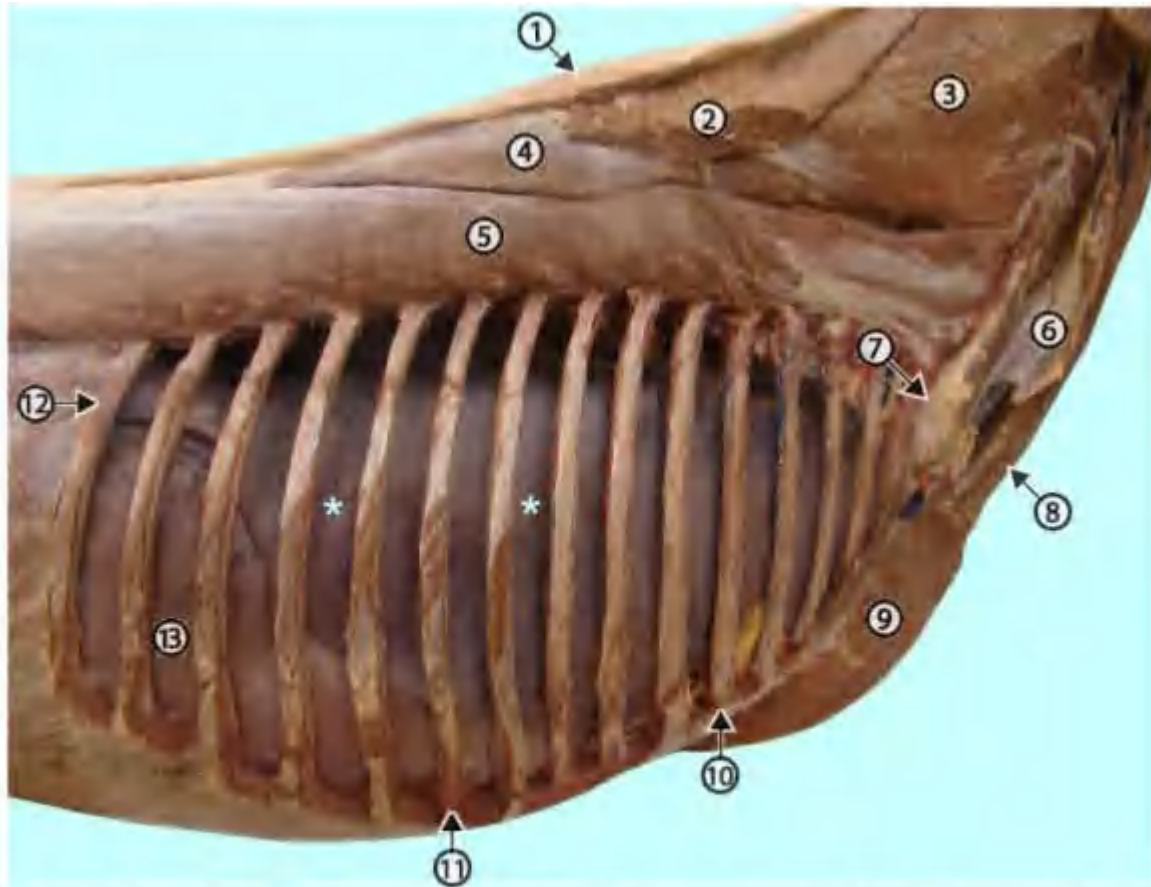


Pig

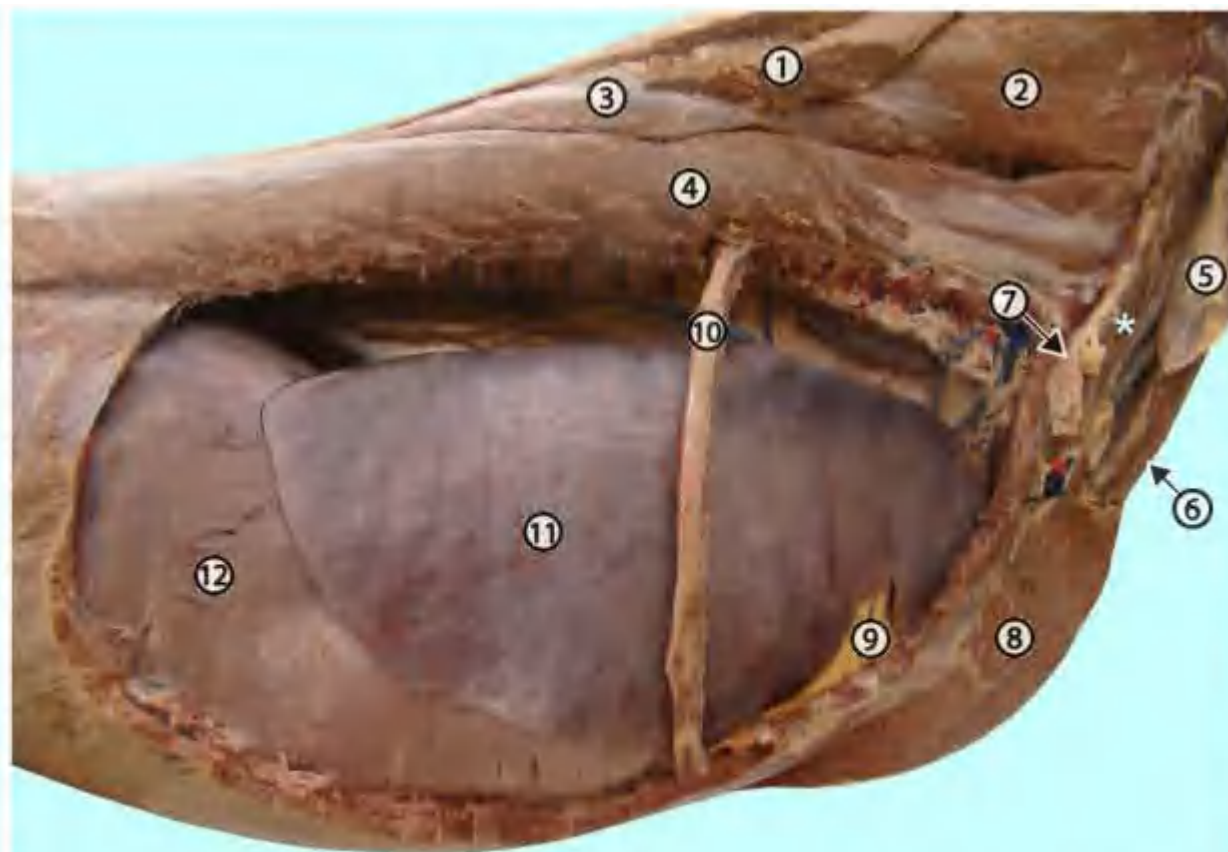
Lung lobes, bronchial tree and lymph nodes

INSPIRATION and EXPIRATION





Deeper dissection after removal of iliocostalis, serratus ventralis and intercostal muscles. 1, supraspinous ligament; 2, rhomboideus m.; 3, splenius m.; 4, spinalis and semispinalis thoracis m.; 5, longissimus thoracis m.; 6, omohyoideus m. reflected; 7, roots of brachial plexus; 8, sternocephalicus m.; 9, cut surface of the origin of the pectoral muscles; 10, rib 5; 11, rib 10; 12, rib 15 (of 18); 13, diaphragm; asterisk, collapsed right lung.

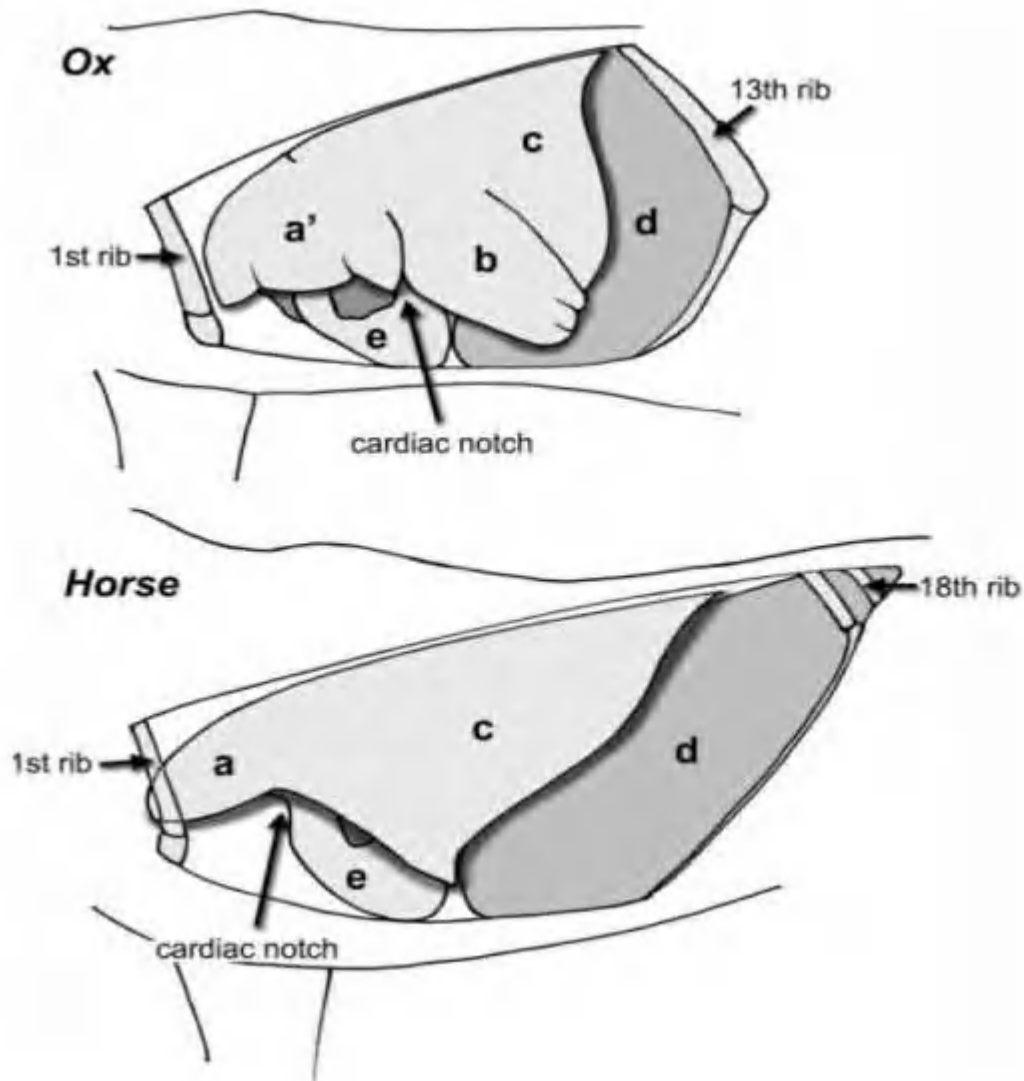


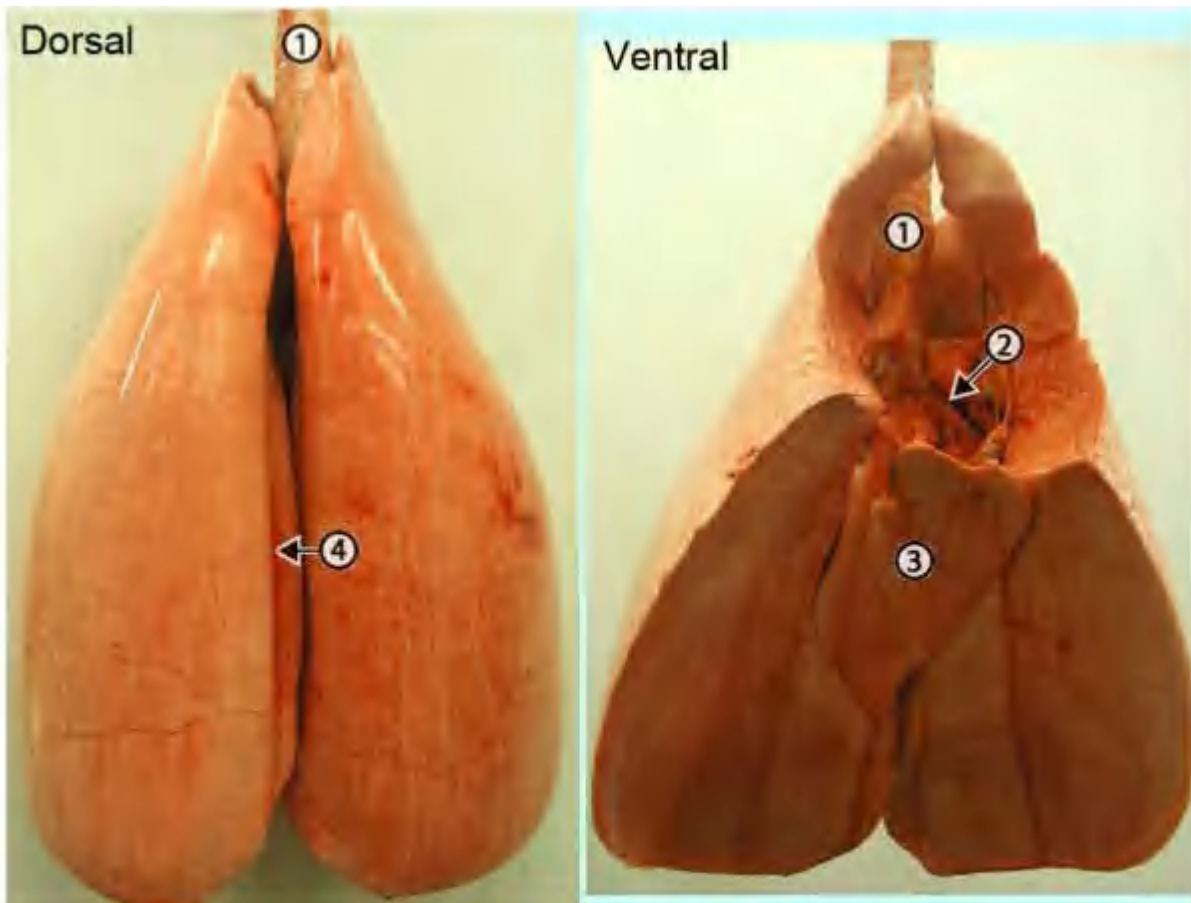
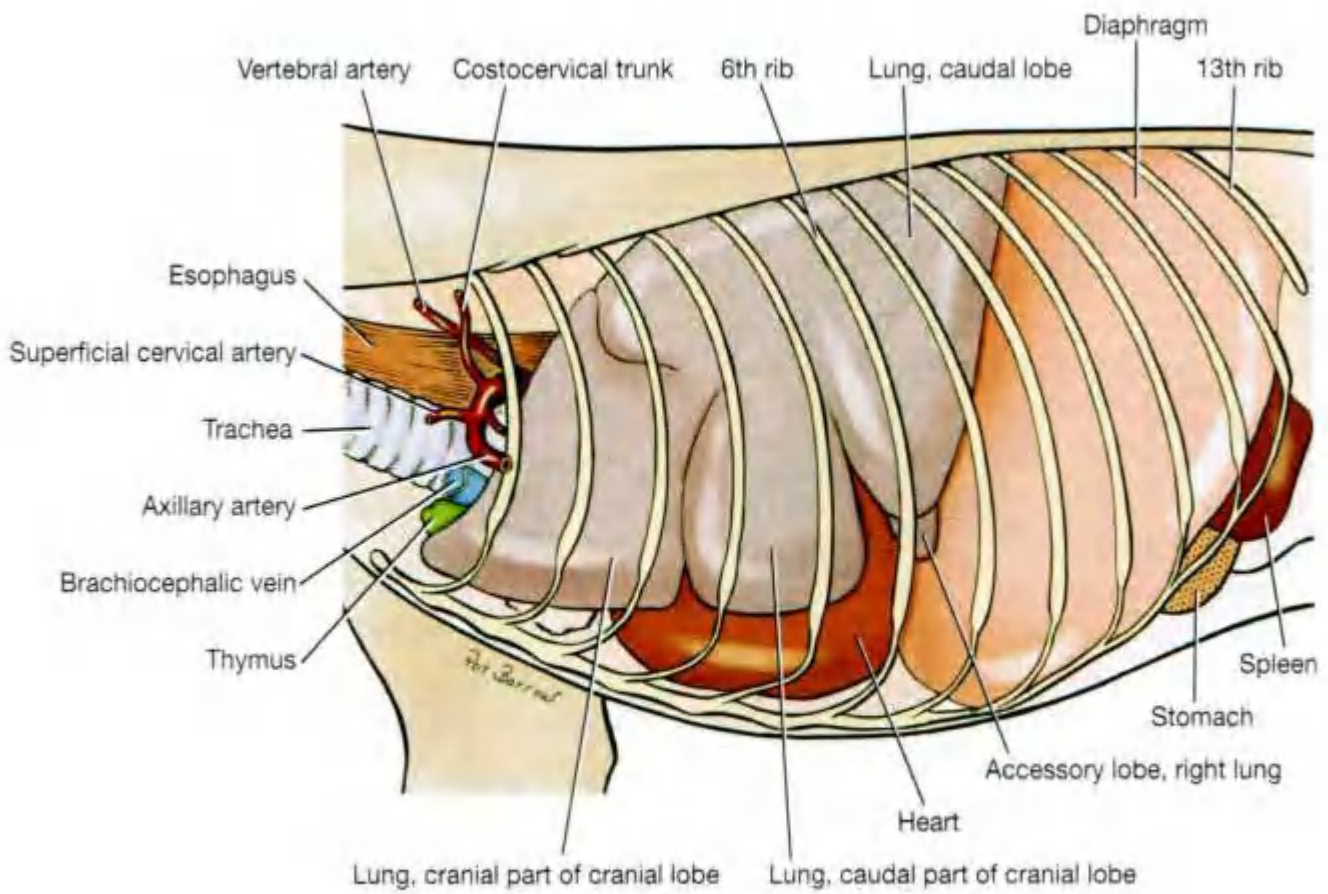
Exposure of the lung by removal of ribs. 1, rhomboideus m.; 2, splenius m.; 3, spinalis and semispinalis thoracis m.; 4, longissimus thoracis m.; 5, omohyoideus m. reflected; asterisk, scalenus m.; 6, sternocephalicus m.; 7, roots of brachial plexus; 8, cut surface of the origin of the pectoral muscles; 9, cardiac notch exposing fat filled pericardium; 10, rib 7; 11, collapsed right lung; 12, diaphragm.



- 1 Thymus
- 2 Cranial vena cava
- 3 Rib 1
- 4 Vagosympathetic trunk
- 5 Costocervical trunk
- 6 M. longus colli
- 7 Cut dorsal end of rib 7
- 8 Intercostal vessels lying caudal to rib 7
- 9 Sympathetic trunk
- 10 Aortic lymph nodes
- 11 Tendinous centre of the diaphragm
- 12 Rib 13
- 13 Caudal lobe of the left lung
- 14 Basal border of the left lung
- 15 Costal part of the diaphragm
- 16 Left ventricle
- 17 Paraconal interventricular groove
- 18 Cut cartilage of rib 4
- 19 Right ventricle
- 20 Cranial lobe of the left lung

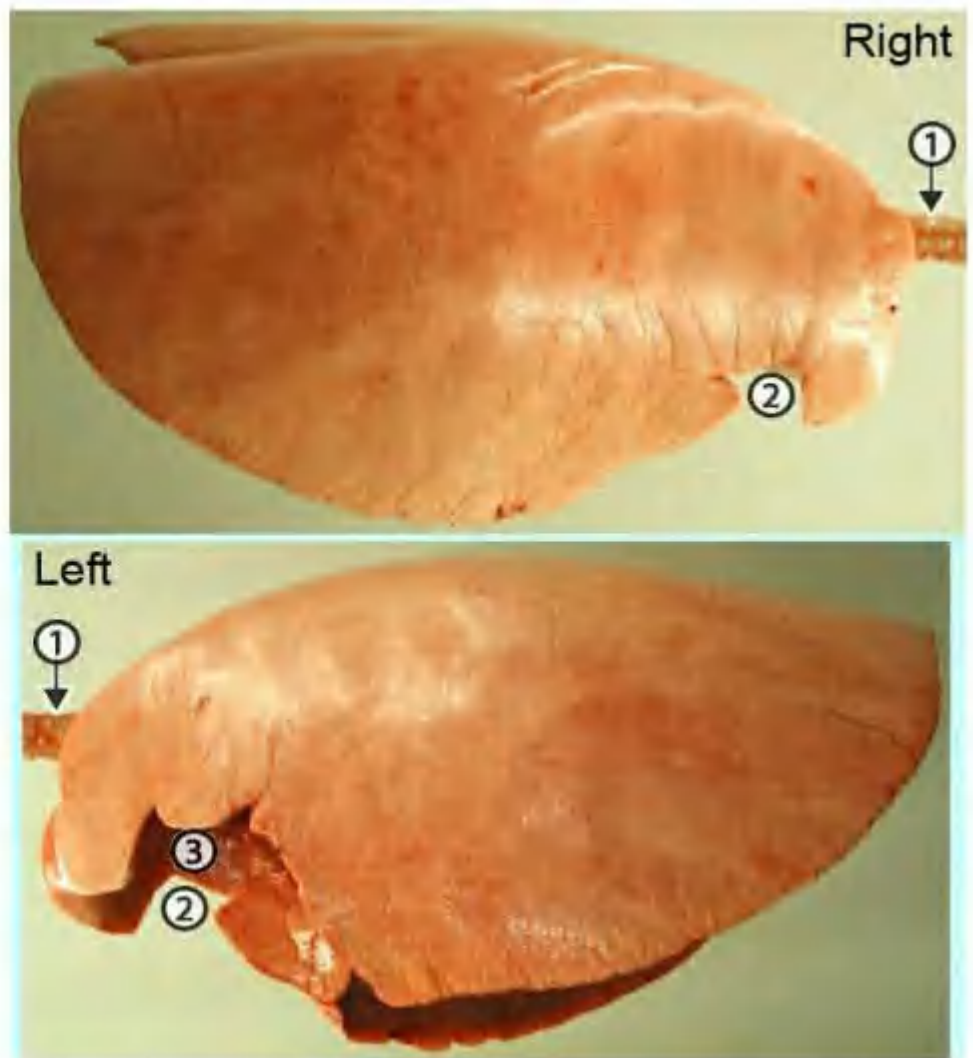
Left view of the thorax of a horse. Ribs 2–12 and the associated soft tissues have been removed to expose the thoracic viscera. The left side of the pericardial sac has been removed to partially expose the heart.



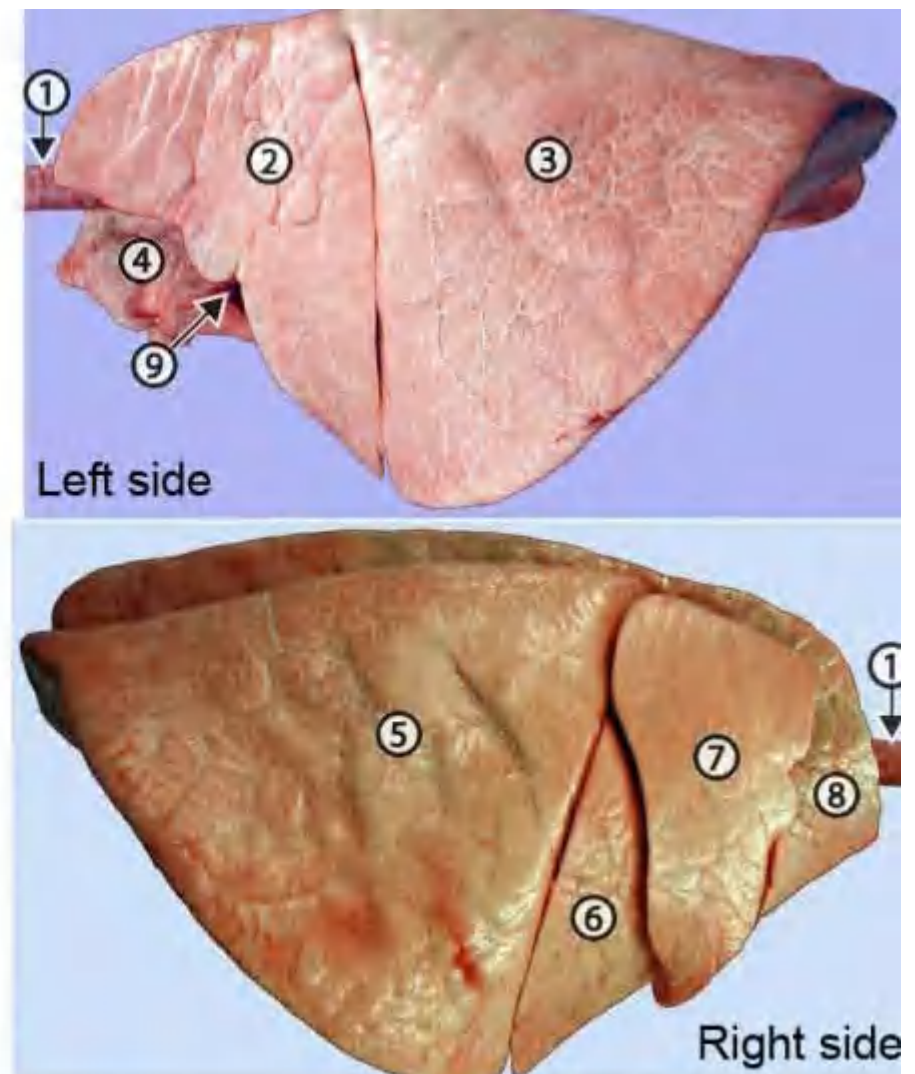


Inflated fresh equine lungs. 1, trachea; 2, left primary bronchus; 3, accessory lobe of right lung; 4, aortic impression (groove).

Inflated equine lungs.
 1, trachea;
 2, right cardiac notch;
 3, left cardiac notch
 (larger because the left
 heart has greater
 contact with the chest
 wall).



Inflated fresh bovine lungs.
 1, trachea;
 2, left cranial lobe;
 3, left caudal lobe;
 4, right cranial lobe;
 5, right caudal lobe;
 6, middle lobe;
 7, caudal part of right cranial
 lobe;
 8, cranial part of right cranial
 lobe;
 9, general location of the cardiac
 notch.

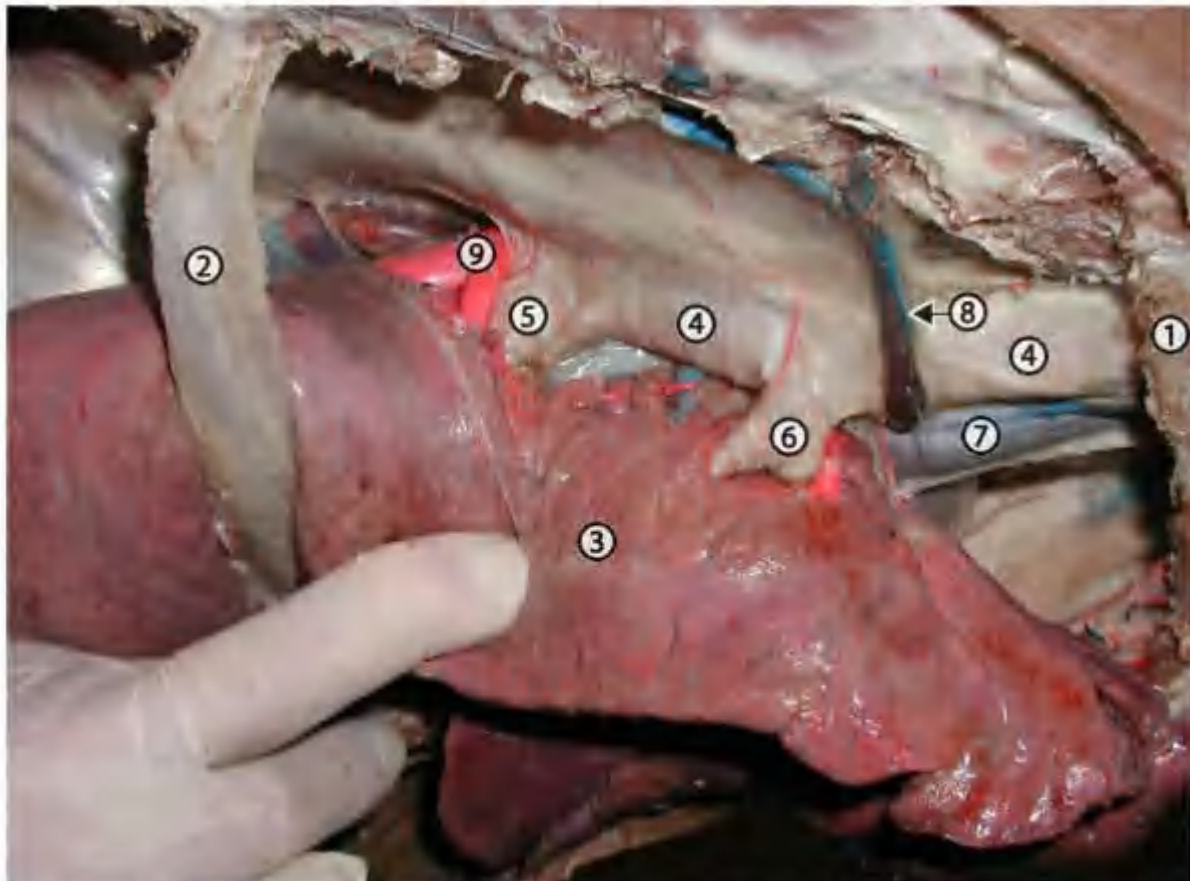




Lungs of ox



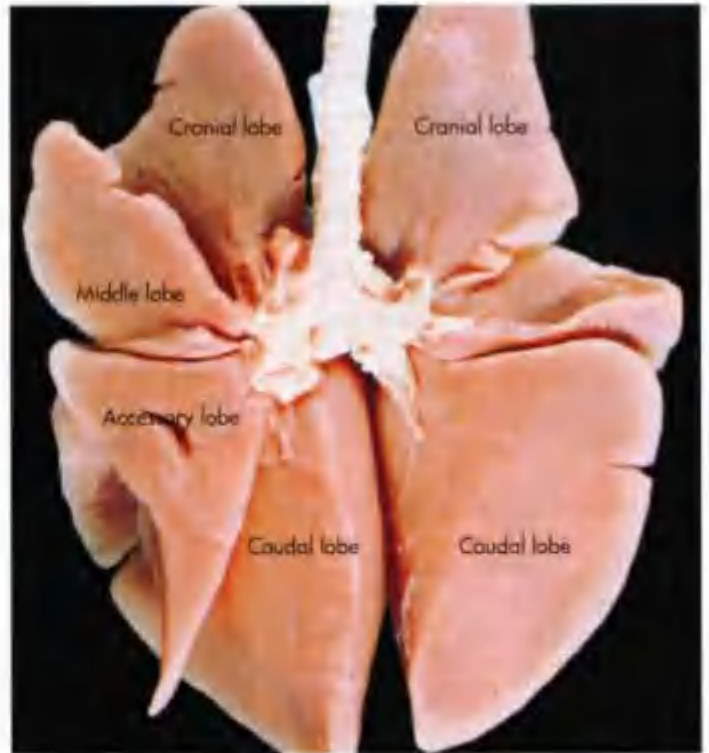
Lungs of camel



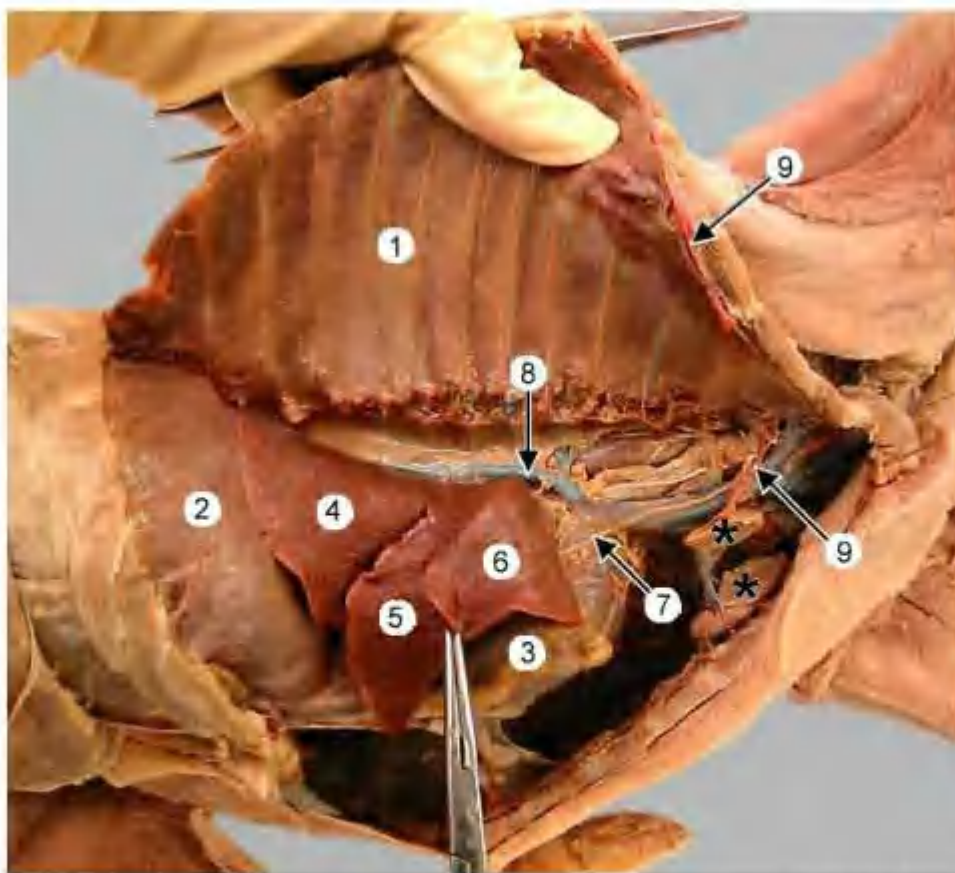
Reflection of a bovine lung (3) to expose the bronchi on the right side. 1, first rib; 2, rib six; 4, trachea; 5, right primary bronchus; 6, tracheal bronchus; 7, cranial vena cava; 8, right azygous vein; 9, a pulmonary vein.



Lungs of a pig



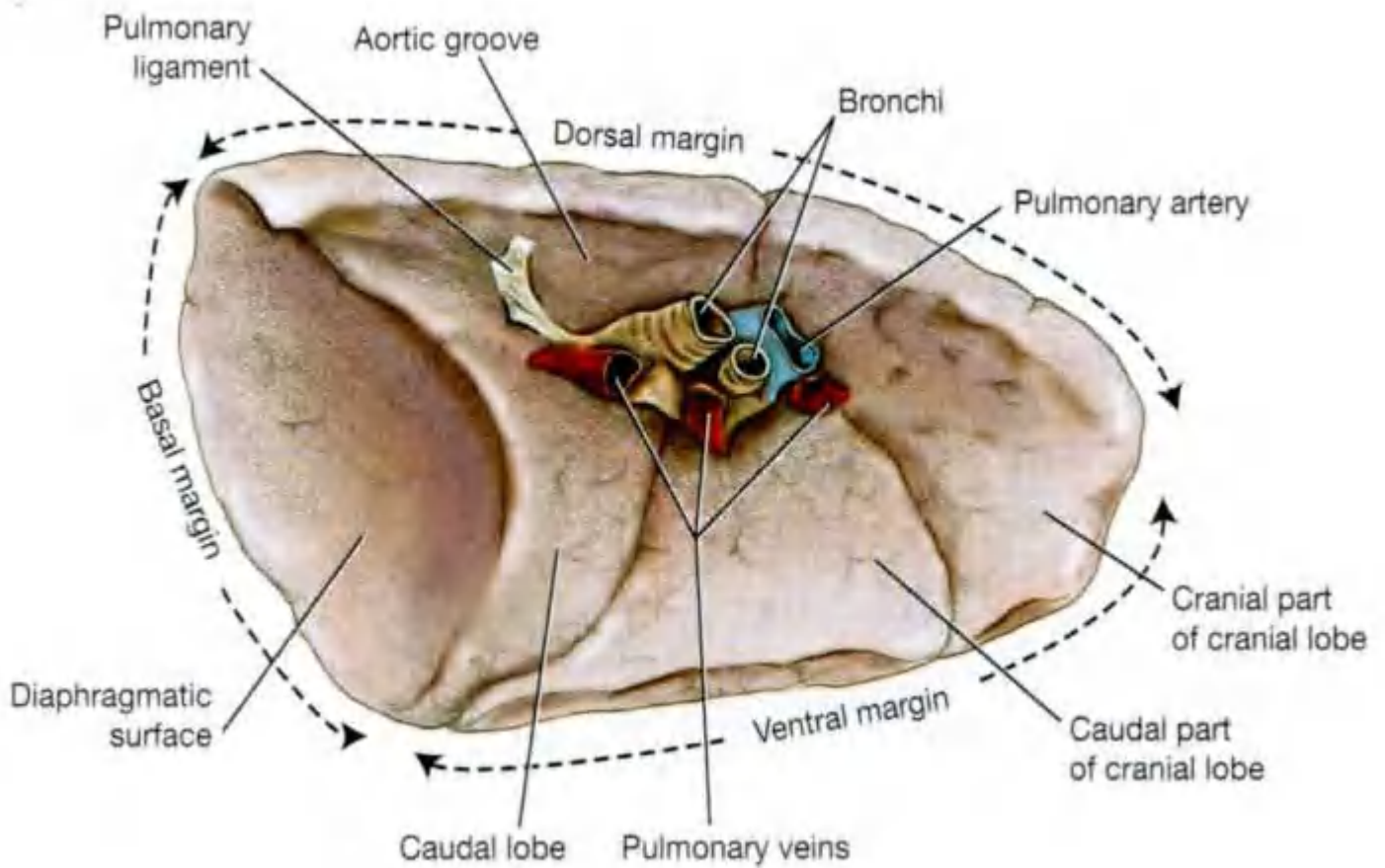
Trachea and lung of a cat



Cat dissection, right **pleural cavity**. The elevated thoracic wall (1) is covered by (transparent) **costal parietal pleura**. The diaphragm (2) is covered by **diaphragmatic parietal pleura**. The mediastinum, including the heart (3), is covered by **mediastinal parietal pleura**. The caudal (4), middle (5), and cranial (6) lobes of the right lung are covered by **visceral (pulmonary) pleura**. The right lung is reflected to reveal: phrenic n. (7), thymus (asterisk), azygos vein (8), and the internal thoracic a. (9).

The lung (pulmo)

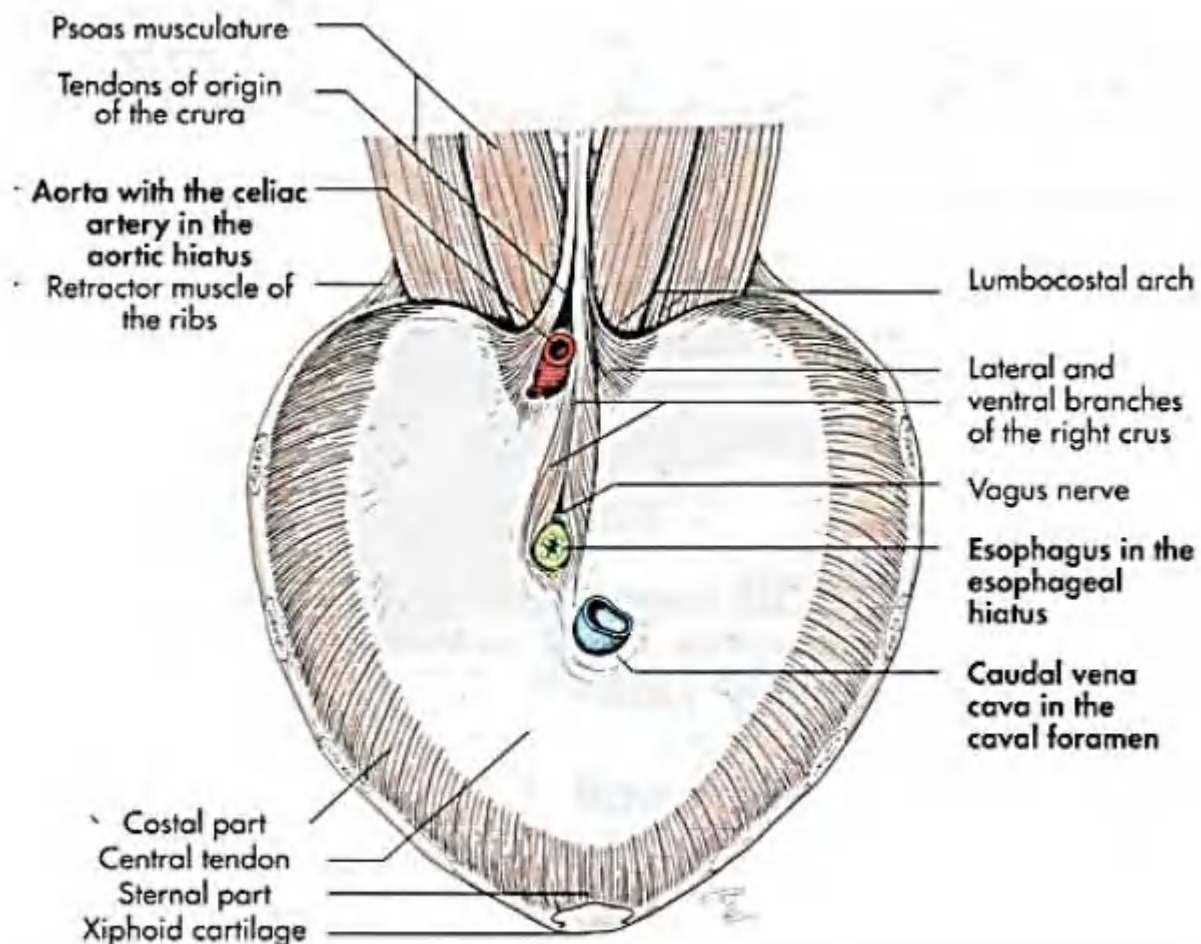
- Position
- Shape (apex, base, surfaces, borders).
- Cardiac notch.
- Pulmonary hilus.
- Fixation (Pulmonary root and ligament).
- Blood supply.
- Lymphatics.
- Nerve supply.



Clinical terms related to the respiratory system:

rhinitis, sinusitis, laryngitis, laryngoscopy, laryngotomy, tracheotomy, bronchitis, bronchoscopy, bronchography, pneumonia, pleuritis etc.....

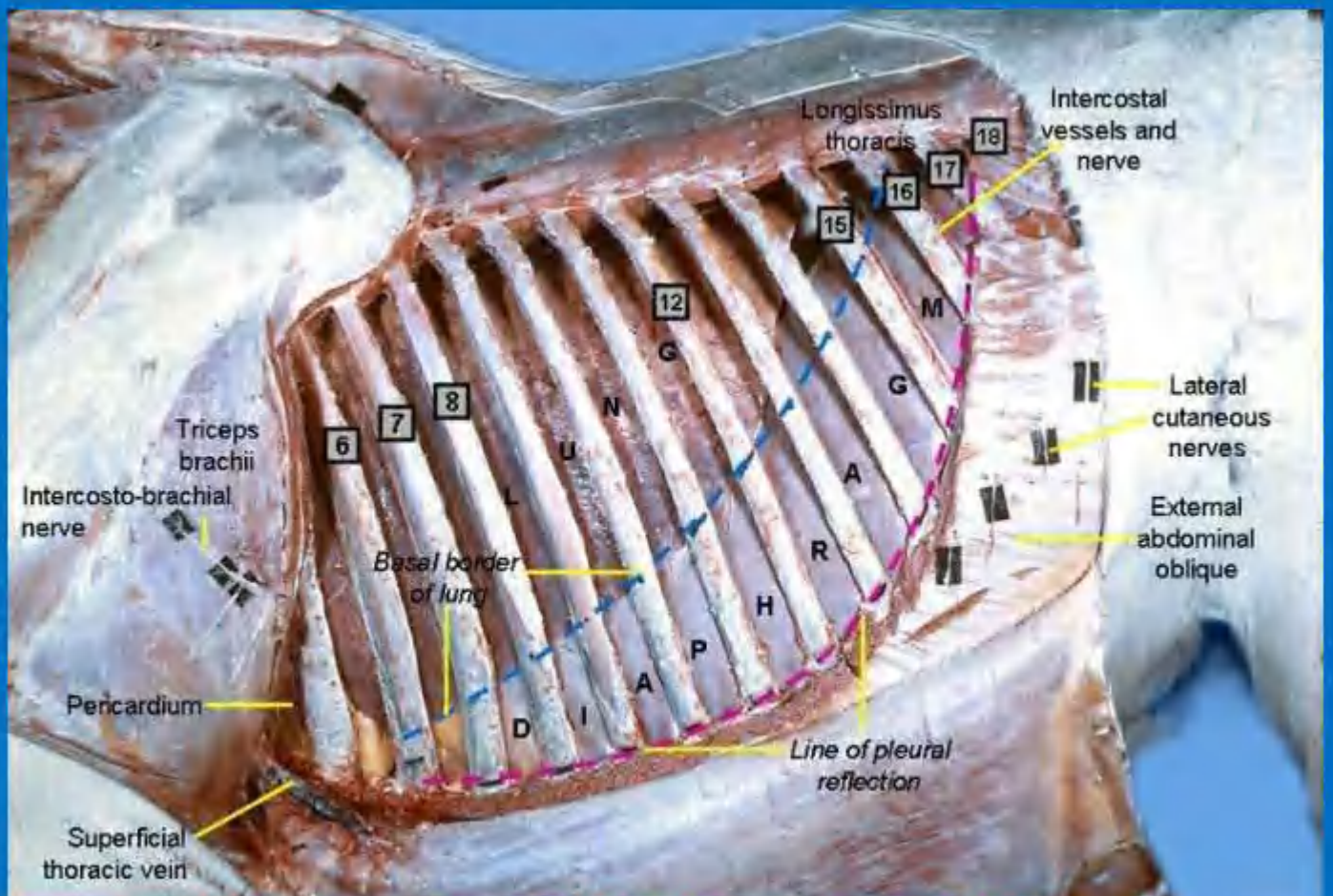
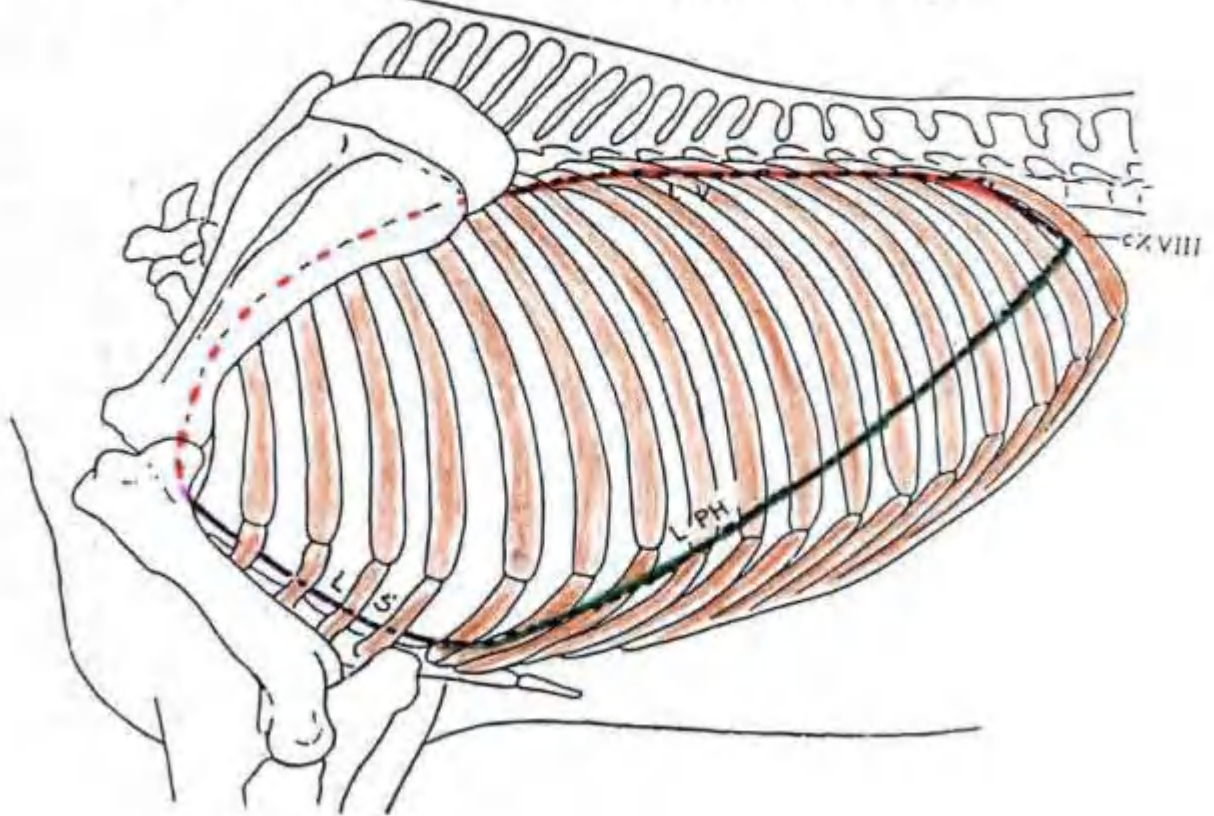
Item	Horse	Ox	Sheep and goat	Camel	Dog	Pig
Lobes						
R.	3	4	4	3	4	4
L.	2	2	2	2	2	2
Cranial (apical lobe)						
R	Undivided	Divided	Divided	Undivided	Undivided	Undivided
L	Undivided	Divided	Divided	Undivided	Divided	Divided
Inter lobar fissure	Not deep	Deep	Deep	Not deep	Very deep reach to the principal bronchus	Moderate
Tracheal bronchus	Absent	Present about 8-10 cm cranial to the bifurcation	Present about 2-3 cm cranial to the bifurcation	Present just cranial to the tracheal bifurcation	As horse	As sheep and goat
Lobulation (pulmonary lobules)	indistinct	Distinct	indistinct	distinct	distinct	As ox and camel
Fringes of the pleura (Dantella)	absent	absent	absent	Present where pleura is reflected on the basal border of the lung	absent	absent



Diaphragm of horse

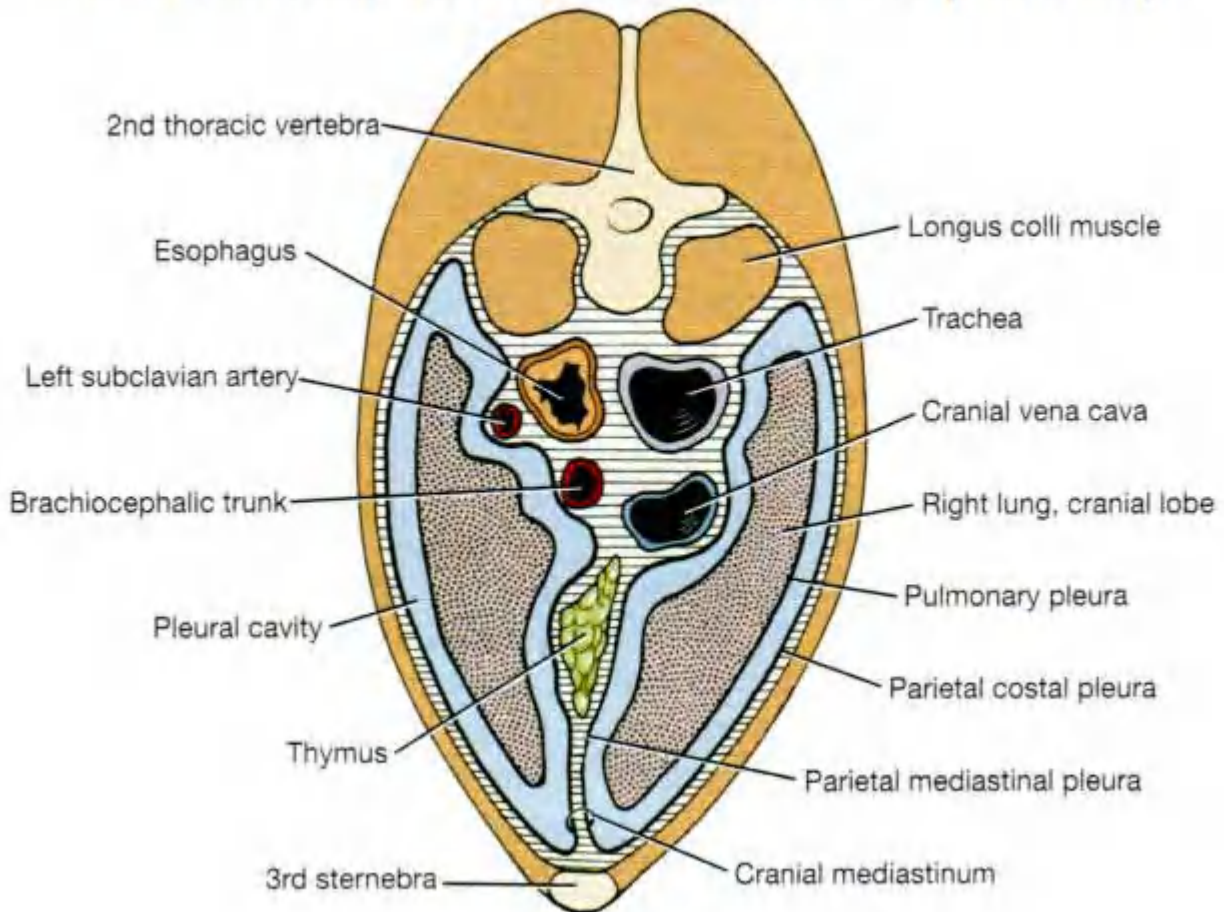
Lines of pleural reflection, diagrammatic

(L.V. vertebral line ; L.S. sternal line ; L.PH. diaphragmatic line)

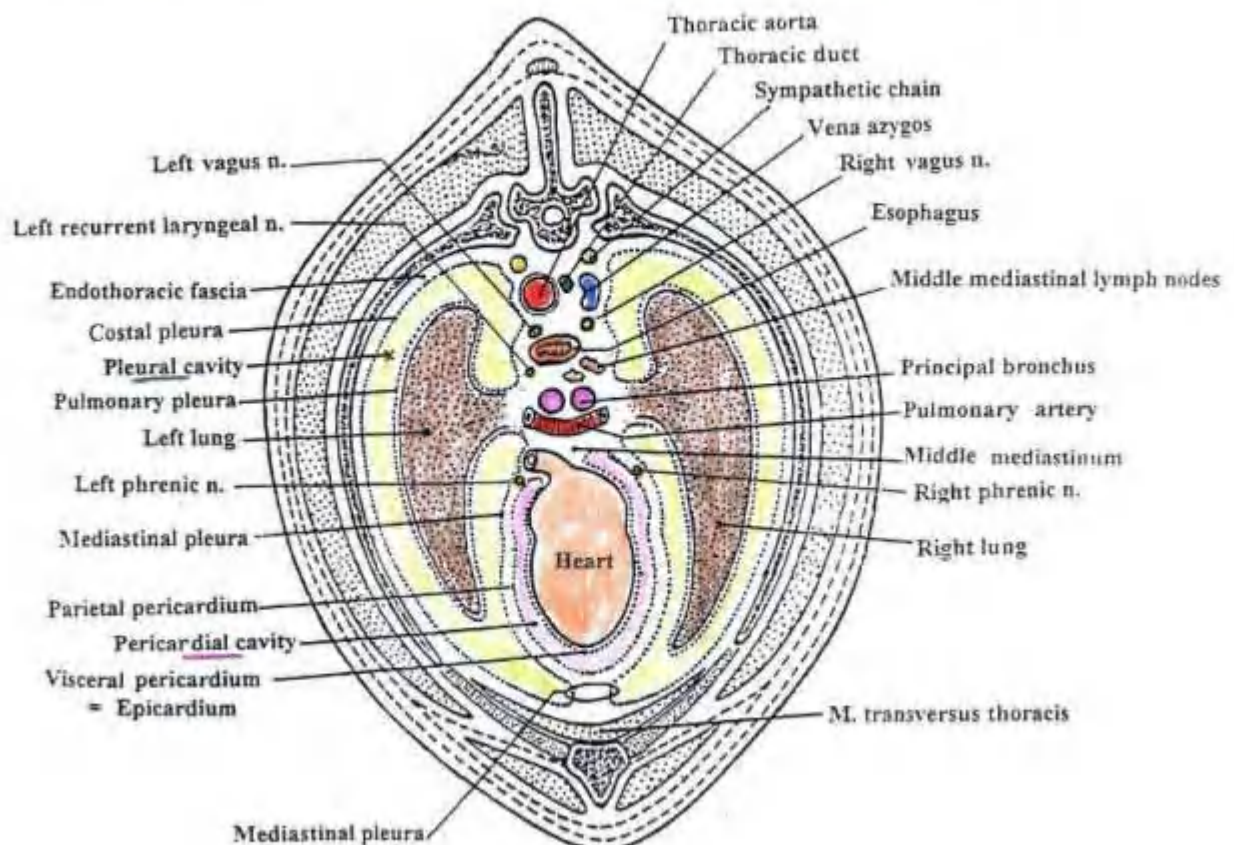


Lines of pleural reflection

1- PRECARDIAC MEDIASTINUM (cranial):



2- CARDIAC MEDIASTINUM (Middle):



3- POSTCARDIAC MEDIASTINUM (Caudal):

