Respiratory system

- Respiration is the mechanism by which oxygen is delivered to the tissues and carbon dioxide is removed.
- It is essential for cell metabolism and for the maintenance of life as a whole.
- Oxygen is required to liberate energy from food.
- In brief, respiration involves the exchange of gases between cells, tissues fluid, and blood, and then between blood and the external environment (in the lungs).

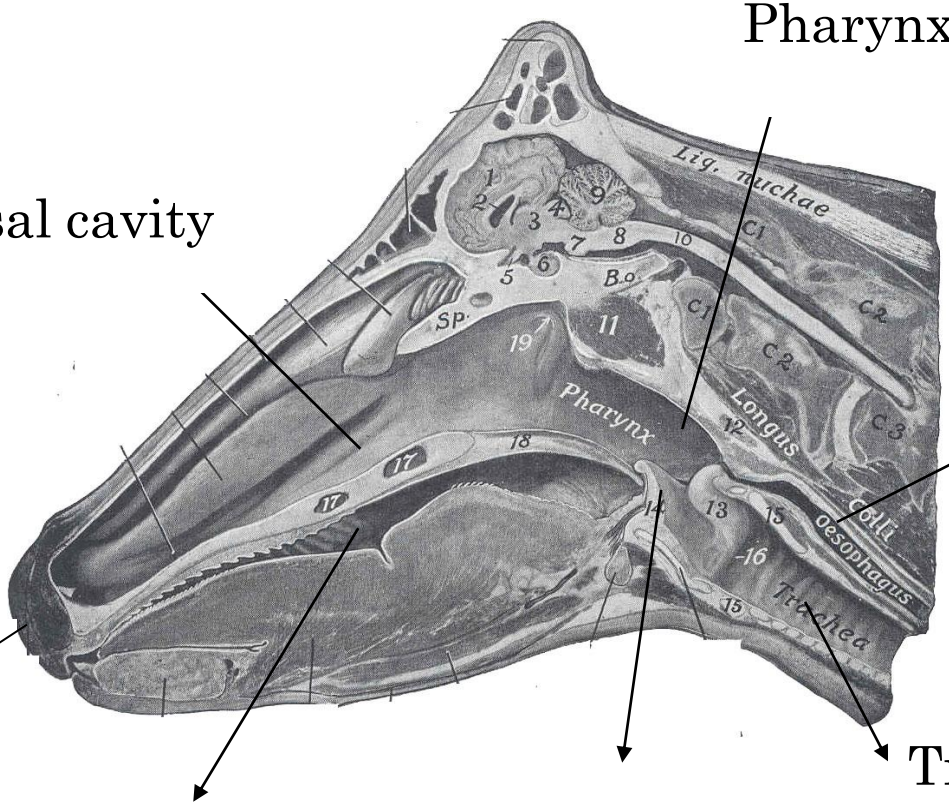
Functions of respiratory system

- **Ventilation- process of movement of air in and out of the lungs**
- **Assists in regulation of P^H of blood and other body fluids by removing appropriate level of carbon dioxide.**
- **Assists in temperature control.**
- **Phonation-production of sounds.**

Organs of respiratory system

1. Nostrils
2. Nasal cavity
3. Pharynx
4. Larynx
5. Trachea
6. Primary /principal bronchi
7. Secondary bronchi
8. Bronchioles
9. Alveolus

Organs of respiratory tract



Pharynx

Nasal cavity

oesophagus

Nostril

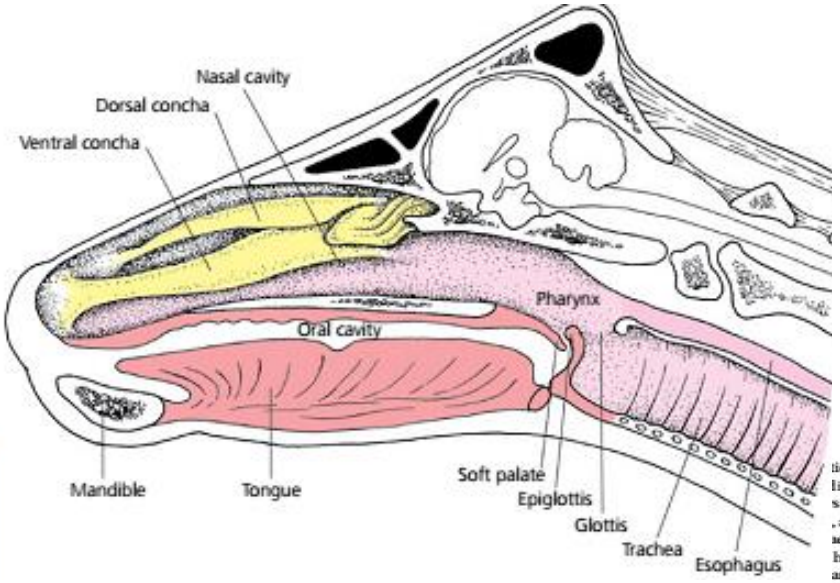
Trachea

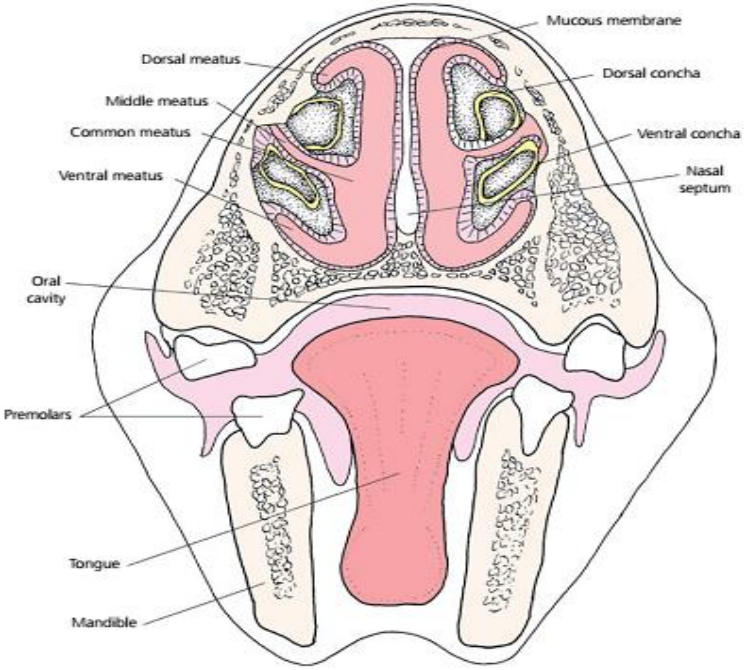
Epiglottis

Oral cavity

Nose:

- External nares-the opening
- Nasal cartilage-gives shape
- Sweat glands on the hairless rostral end-moist.
- Rostral bone in pigs-rooting habits
- Nasal cavity seperated into halves by median plane-nasal septum.
- Seperated from mouth by palates.
- The epithelium contains vascular mucous membrane (moist) and olfactory epithelium (olfactory sensation)

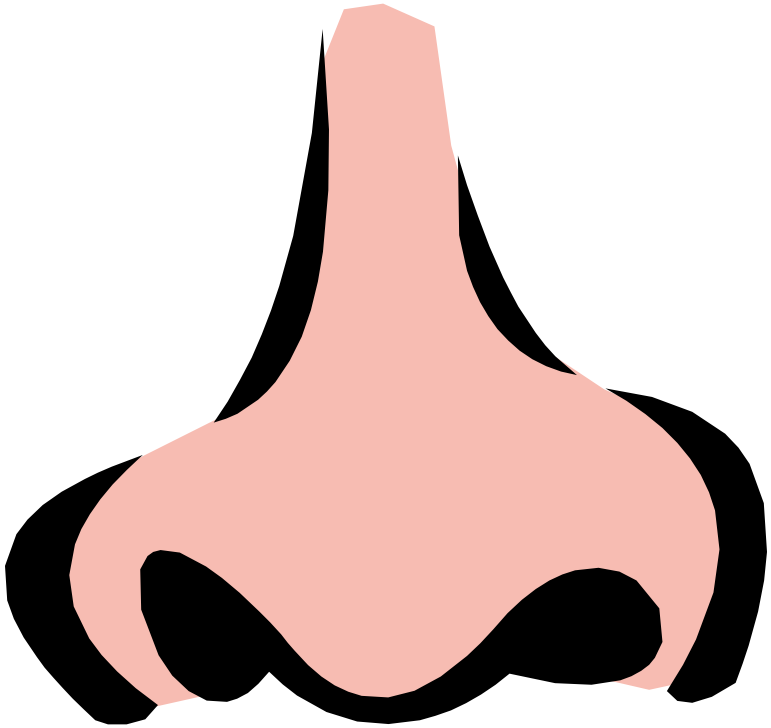


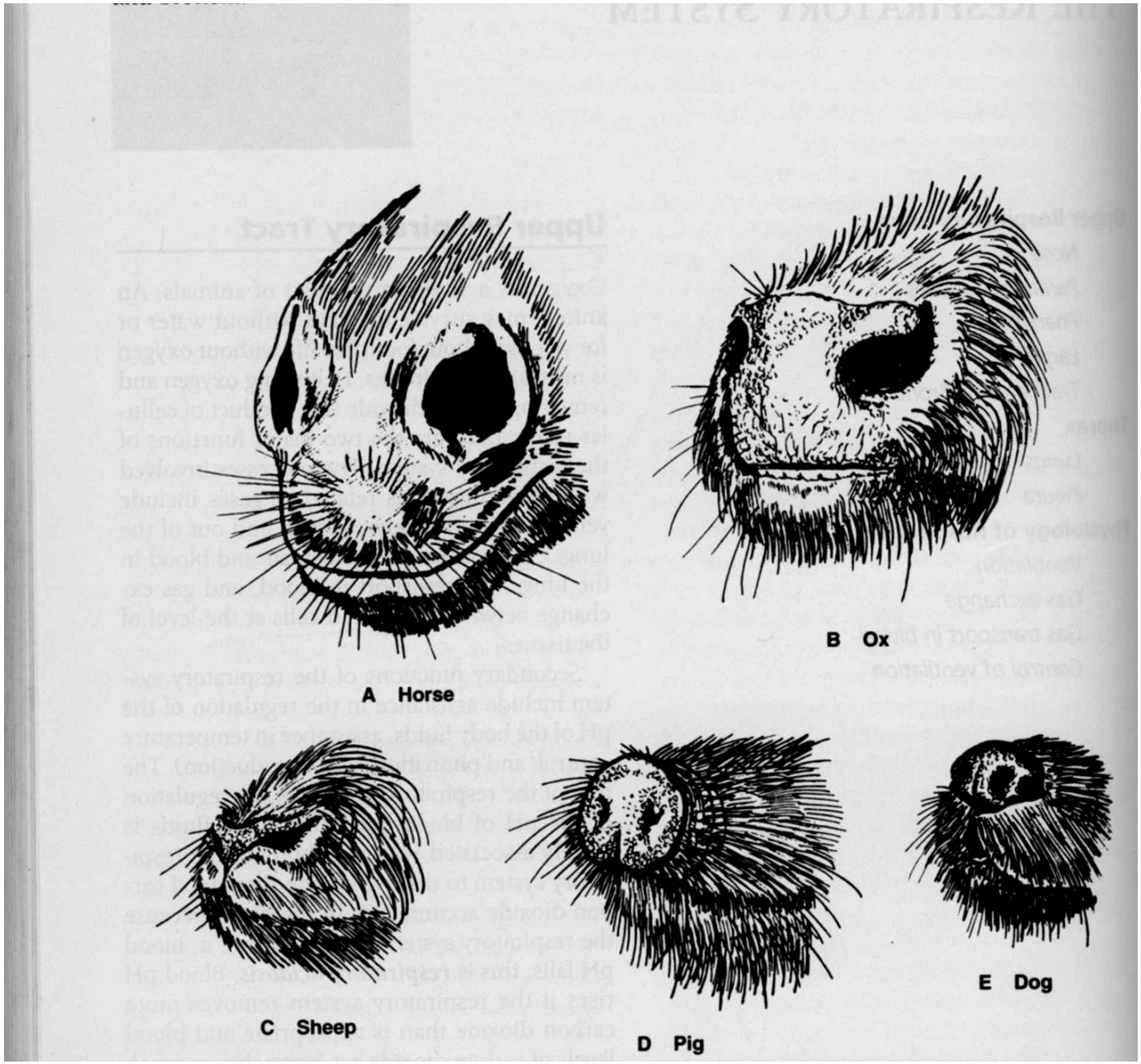


In addition, each nasal cavity contains mucosa-covered turbinate bones (conchae) that project to the interior from the dorsal and lateral walls, separating the cavity into passages known as the common, dorsal, middle, and ventral meatus.
The mucosa of the turbinates is well vascularized and serves to warm and humidify inhaled air. Another function, mainly of the conchae, that is often overlooked involves cooling the arterial blood that supplies the brain.

Nostrils

- Species Differences
  - Horse--Very Pliable and Dilatable
  - Pig--Rigid




A Horse
B Ox
C Sheep
D Pig
E Dog

Pharynx:

- Common soft tissue passage for food and air.
- Caudal to oral and nasal cavaties.
- Walls supported by straited muscles-degluttination
- Opening into the pharynx-2 caudal nares, 2 auditory tubes,oral cavity,larynx and oesophagus.

Larynx

- Box like gatekeeper to the entrance of trachea.
- Regulates the size of the airway.
- Prevent entry of other substance other than air.
- Organ of phonation-Voice box.
- Syrinx-birds

Trachea and bronchi

- Trachea extends from caudal end of larynx to bronchi.
- Formed with C shaped tracheal cartilage connected by annular ligaments.
- Trachea passes caudad as far as the base of the heart –divides into 2 principal bronchi.
- Ruminants and pigs-an additional tracheal bronchi arising cranial to principal bronchi.
- The principal bronchi divides into secondary (lobar) then tertiary bronchi.

- Divides to the extend that they are less than 1mm in diameter-cartilages disappear-called bronchioles.
- Then to alveolar ducts and alveoli.

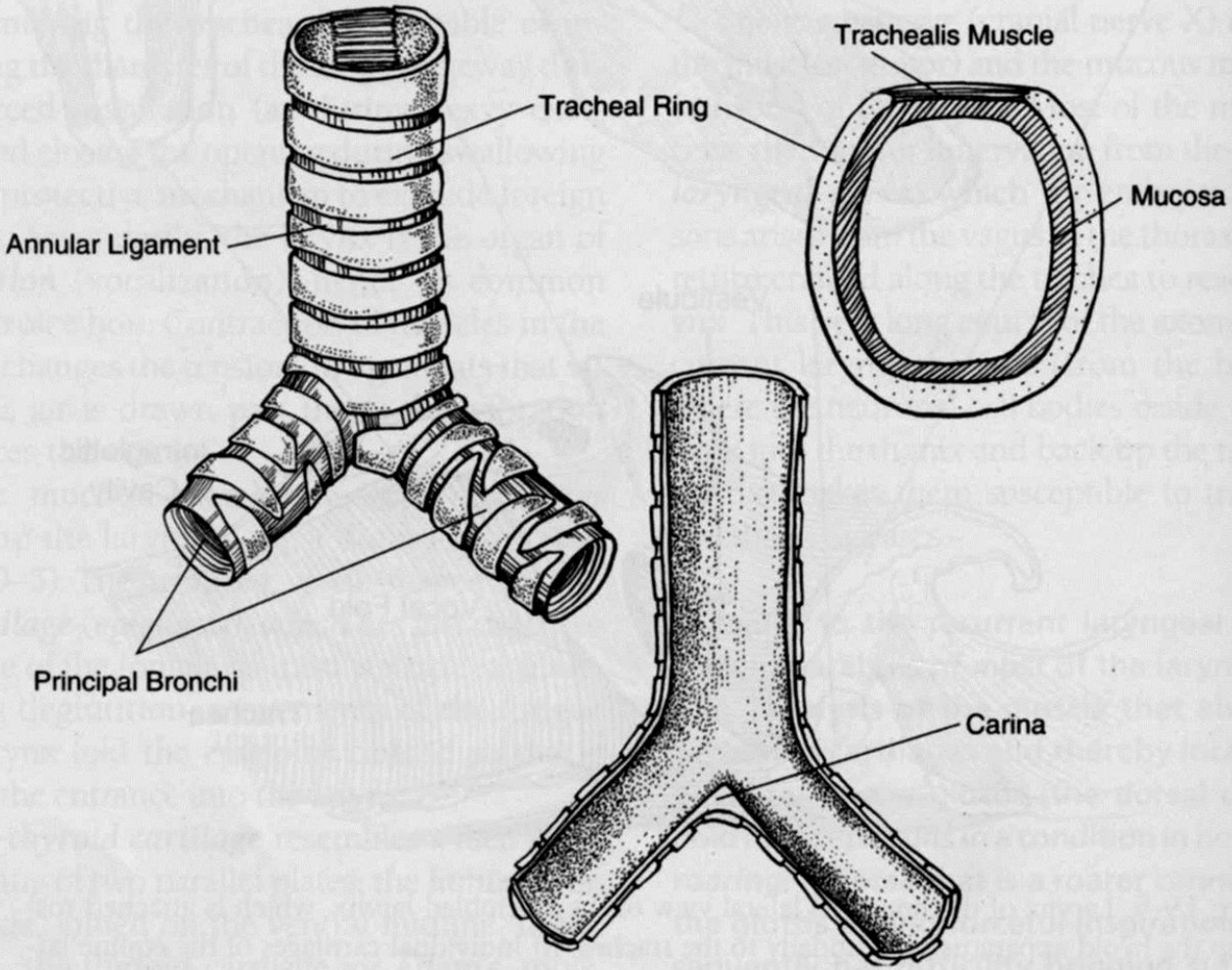
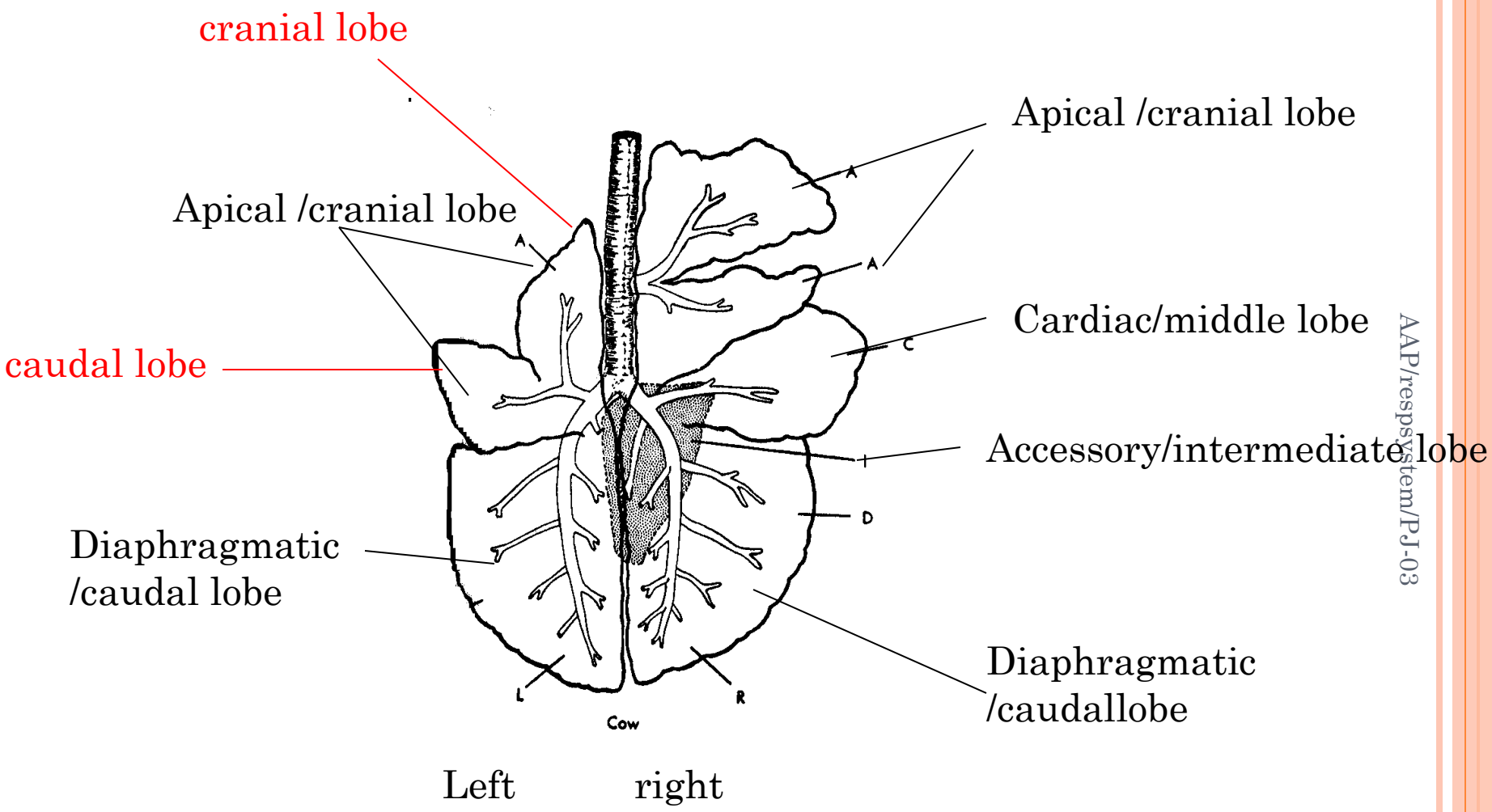


Figure 19-6. Anatomy of the trachea and principle bronchi. *A*) Ventral view. *B*) Transverse section.

Lungs

- Each lung is enclosed in a cage bounded below by the diaphragm and at the sides by the chest wall and the sternum.
- Each lung is surrounded by a serosa-pleura.
- The pleura, has two layers, separated by a thin layer of fluid.
- Two layers-parietal (lining thoracic cavity), visceral (lining the lungs)
- The junction of the two pleural sacs at the midline of the thoracic cavity is doubled layered fold called mediastinum.
- Mediastenum of cattle-solid and thick. Horse-thin often with opening.

- The lungs are divided first into right and left, the left being smaller to accommodate the heart.
- Then into lobes (three on the right, two on the left) supplied by lobar bronchi.
- In pigs and ruminants the left apical lobe has further cranial and caudal lobed.
- The left and right lungs has an indentation on the median boredr –Hilus.
- Principal bronchus, pulmonary vessels, lymphatics and nerves enters the lungs from the hilus.



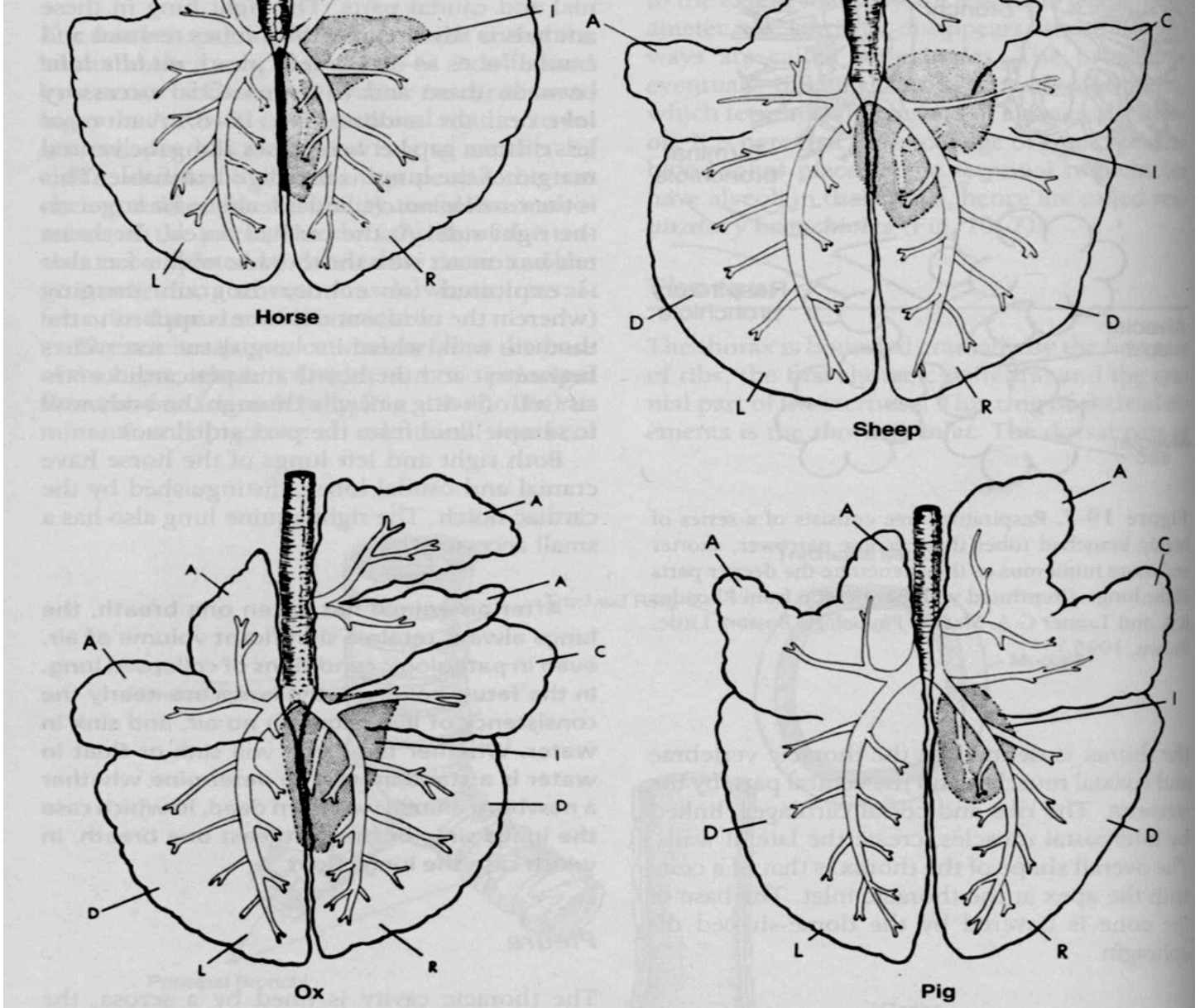


Figure 19-8. Lungs of horse, sheep, ox, and pig. L, left; R, right; A, cranial (apical); C, middle (cardiac); D, caudal (diaphragmatic); I, accessory (intermediate). (After Nickel R., Schummer A., and Seiferle E. *Lehrbuch der Anatomie der Haustiere.* Berlin: Paul Parey, 1960.)

Lung adaptation

- Environmental air vary in temperature
- Contain dust, microbes
- These should not reach alveolus
- Inspires air is filtered and cleaned

Adaptation

1. Mucus

- - thin sticky mucus secreted by epithelial cells
- - Covering whole respiratory tract

- Traps particles in air when in contact
- Facilitated by change in direction of air
- Random movement of particles

2. Cilia

- Hair cells of epithelial cells remove particles trapped
- Cilia in nose move down wards
- Cilia in trachea and below move up
- Particles are brought into mouth - swallowed

3. Length

- Length of respiratory tract-warm air.
- Maintain humidity to right level.

4. Protection

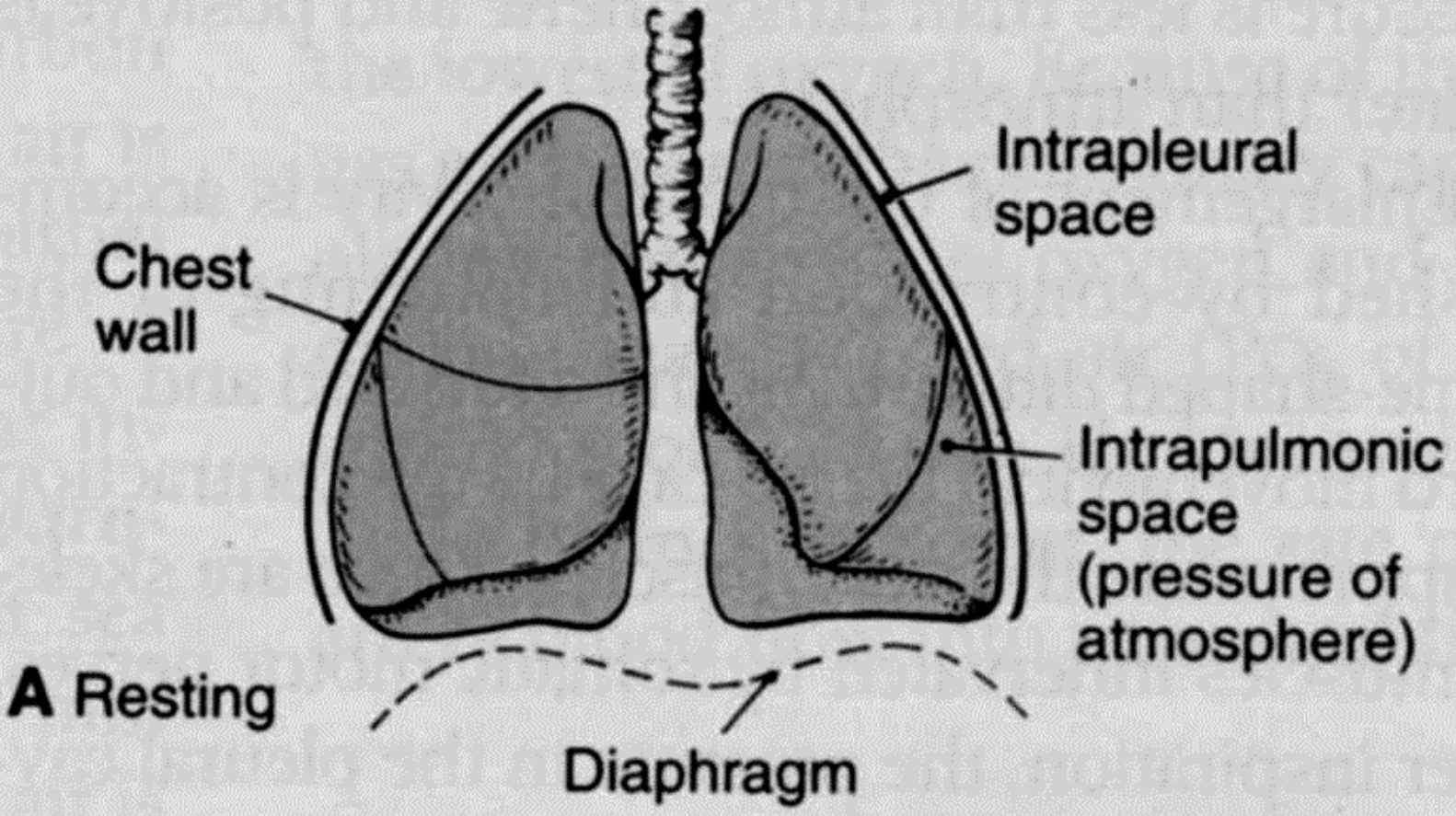
- Entry of food and water into trachea is prevented by epiglottis

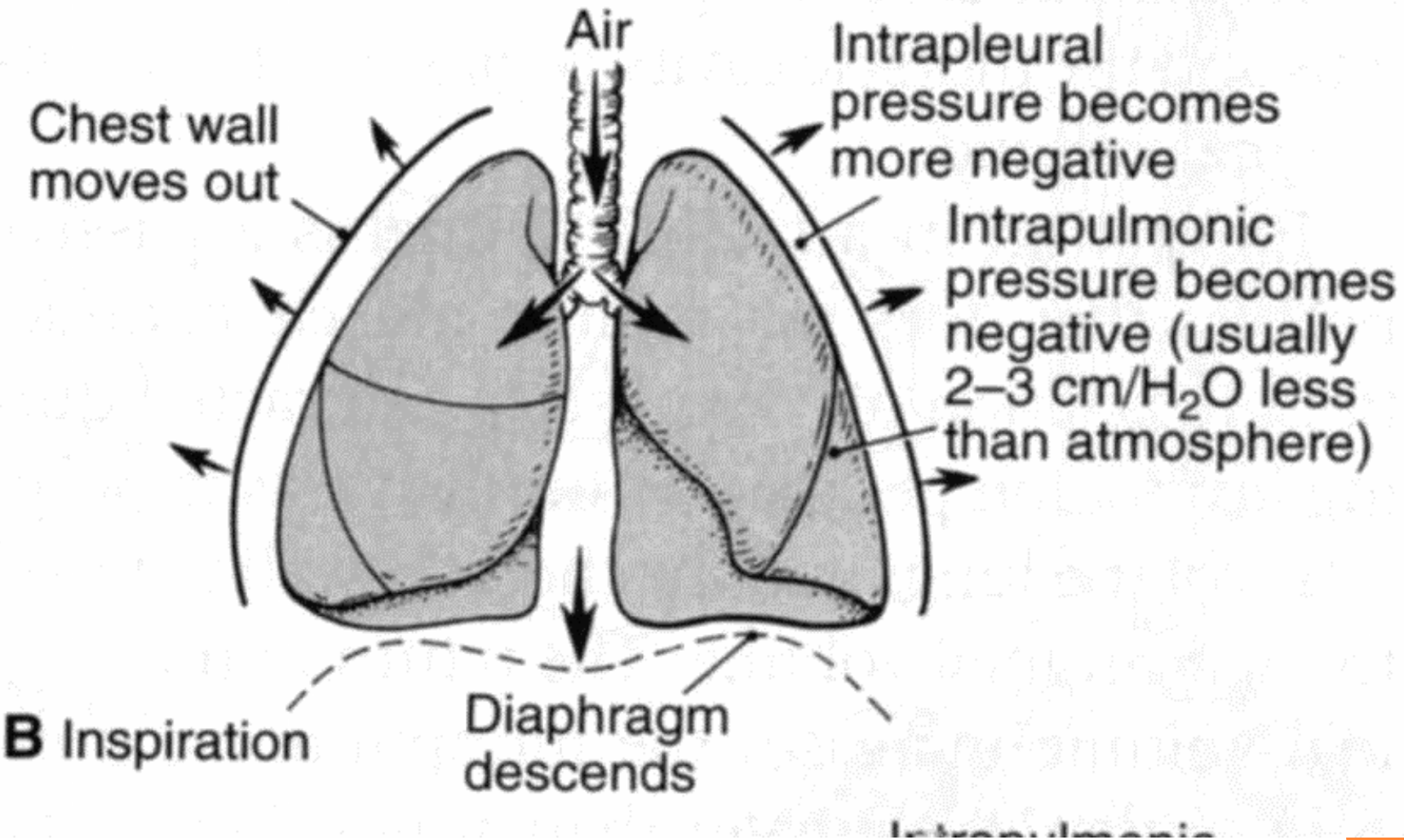
Mechanism of breathing

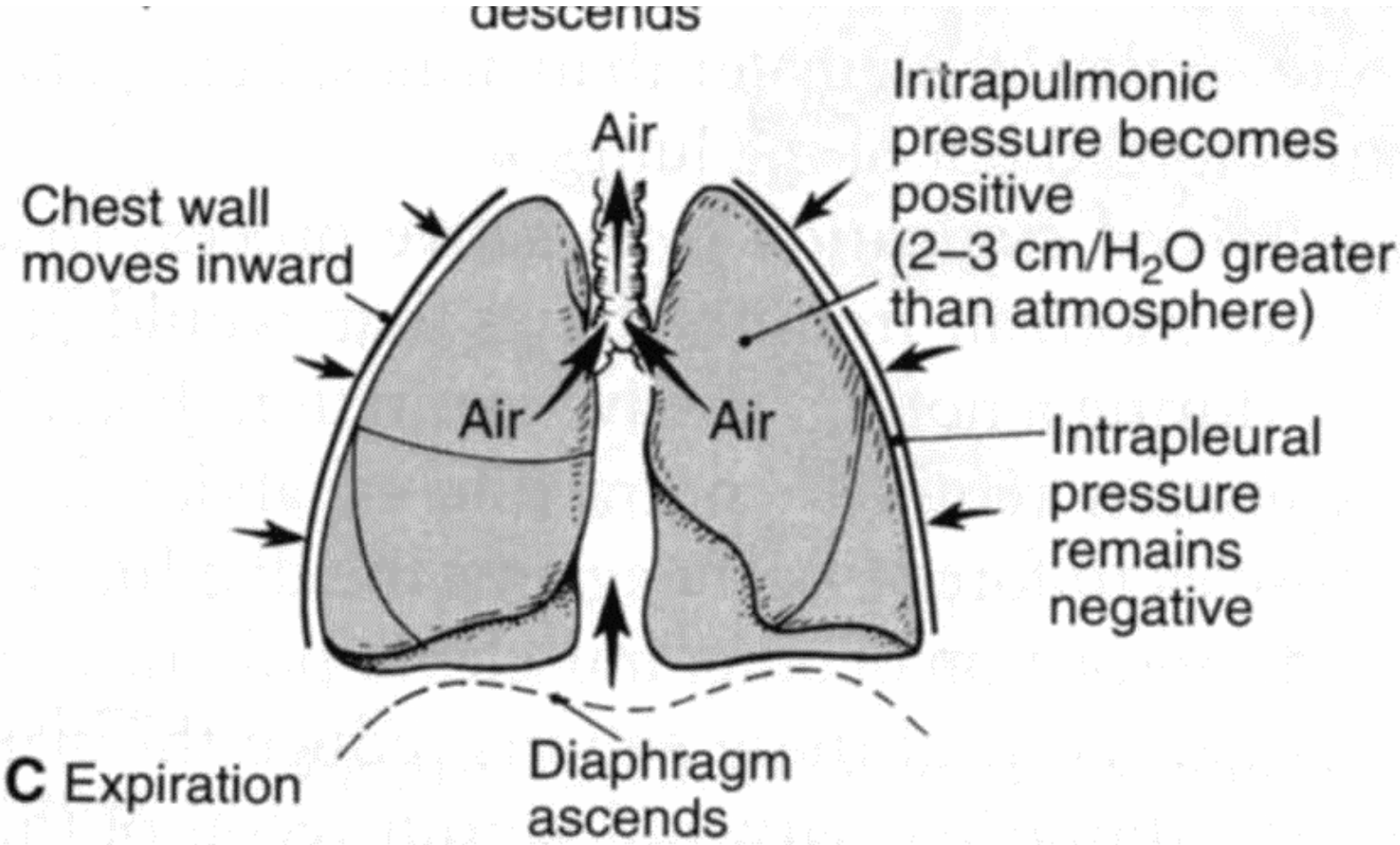
- Inspiration & expiration.
- Potential space between the two pleural surfeces-filled with minimum fluid .
- The pressure inside the pleural cavity is always slightly negative to the atmospheric pressure.
- Negative pressure exerts pulling force-keeps lungs expanded.

- Expiration and inspiration brought out by Boyle's law.
- Change in pressure and volume of gas.
- Change in volume of thoracic cavity by intercostal muscles and diaphragm.
- Increased volume-contraction of i/c muscles and diaphargm.
- Inspiration-decrease in intrapulmonic pressure.
- Expiration-increase in intrapulmonic pressure.

Inspiration involves an enlargement of the thorax and lungs, with an accompanying inflow of air. The thorax enlarges by contraction of the diaphragm (the musculo tendinous separation between the thorax and abdomen) and by contraction of external intercostal muscles(muscles located between the ribs). Diaphragmatic contraction enlarges the thorax in a caudal direction, and external intercostal muscle contraction enlarges the thorax in a craniad and outward direction. Under normal breathing conditions, inspiration requires greater effort than expiration, and sometimes expiration might seem to be passive. Expiration can become quite an active process, particularly during times of accelerated breathing and also when there are impediments to the outflow of air. The internal intercostal muscles contract to assist in expiration. Other skeletal muscles can aid in either inspiration or expiration, such as the abdominal muscles. When contracted, these muscles force the abdominal viscera forward to press on the diaphragm, which in turn decreases thoracic volume.


Intrapleural space
Chest wall
Intrapulmonic space (pressure of atmosphere)
A Resting
Diaphragm


Air
Chest wall moves out
Intrapleural pressure becomes more negative
Intrapulmonic pressure becomes negative (usually 2–3 cm/H_2O less than atmosphere)
B Inspiration
Diaphragm descends


descends
Air
Intrapulmonic pressure becomes positive (2–3 cm/H_2O greater than atmosphere)
Chest wall moves inward
Air
Air
Intrapleural pressure remains negative
Diaphragm ascends
C Expiration

Gaseous exchange

- Relies on simple diffusion.
- Diffusion gradients are maintained by ventilation (breathing), which renews alveolar air, maintaining oxygen concentration near that of atmospheric air and preventing the accumulation of carbon dioxide
- The flow of blood in alveolar capillaries which continually brings blood with low oxygen concentration and high carbon dioxide concentration.
- Haemoglobin in blood continually removes dissolved oxygen from the blood and binds with it.

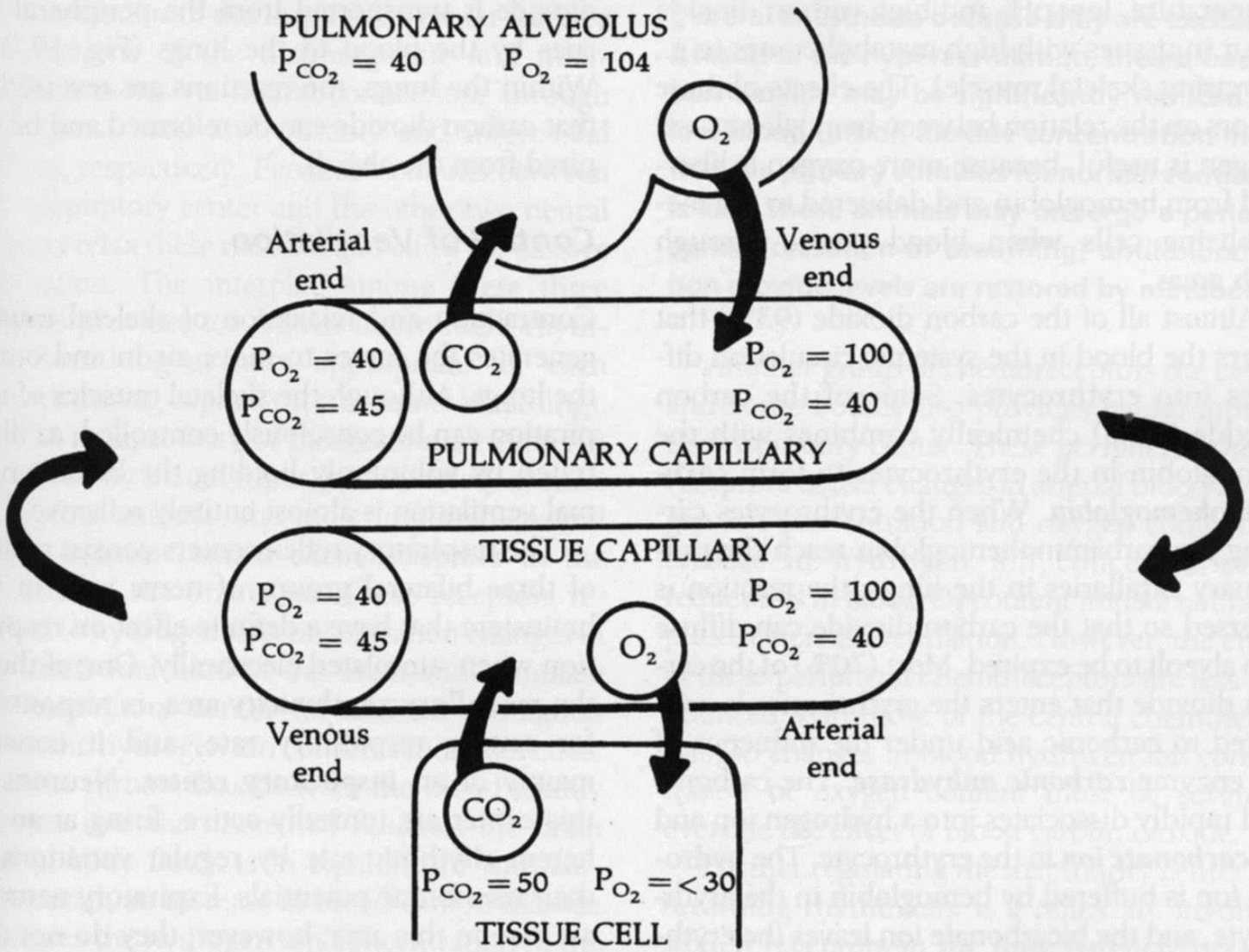


Figure 19-11. Direction of diffusion of oxygen (O_2) and carbon dioxide (CO_2), as shown by *ar-*

Types of breathing

- *1. Costal/Thoracic respiration*: In this type of respiration thoracic muscles are mainly involved and the movement of the rib cage is more prominent. It is seen in dogs and cats.
- 2. *Abdominal respiration*: This type of respiration is seen in ruminants viz cattle, goat, sheep and yak. Here the abdominal muscles are involved and movement of the abdominal wall is noticed
- *3.Costo- abdominal respiration:* In this type of respiration muscles of both thorax and abdomen are involved so the movement of the ribs and the abdominal wall are noticed.

Clinical terms

- *Eupnea* – normal quiet respiration
- *Dyspnea* – difficult/laboured breathing
- *Apnea* – Absence of breathing
- *Hypernea* – increased depth of breathing.
- Panting-Increased rate of breathing/ventillation-mechanism to dissipate heat-reduced tidal volume-not much change in gasseous exshange.
- *Polynea* – rapid shallow breathing
- Anoxia/Hypoxia-Absence or defficiency of oxygen in the tissues.
- Atelectasis-collapse or airless state of lungs.