

RESPIRATORY SYSTEM

Lec. 5

Comparative Anatomy

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Objectives

- ▶ Students should learn the following;
- ▶ The respiration types
- ▶ The system functions
- ▶ The system organs
- ▶ Shapes and types of respiratory organs
- ▶ Respiration system in verts.
- ▶ Breathing



Respiration

- ▶ Respiration the process of obtaining oxygen from the external environment & eliminating CO₂.
- ▶ There are 2 types of respiration;
 - ✓ Breathing; the process of inhalation and exhalation
 - ✓ Cellular respiration the exchange of gases between the air and the blood and between the blood and the body's cells
- ▶ There are 2 types of cellular respiration:
 - ▶ **Aerobic**; exchange of O₂ and CO₂ between an organism and its environment, through lungs, gills and skin
 - ▶ **Anaerobic** : O₂ is obtained by the breakdown of carbohydrate and given off carbon dioxide

Respiration

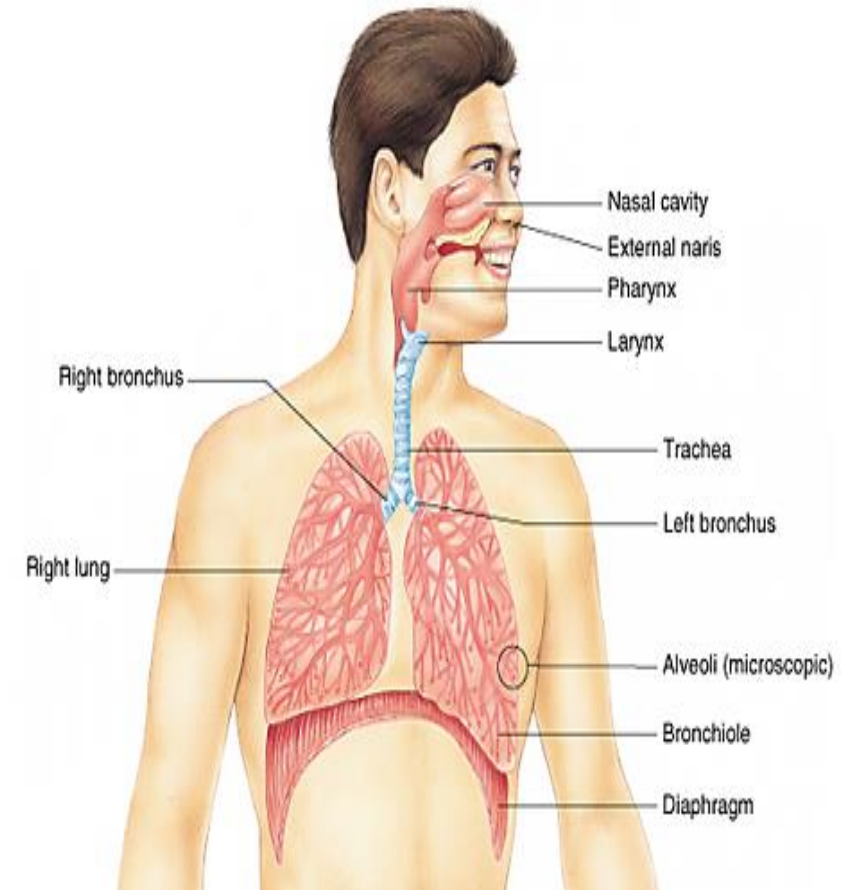
- ▶ Vertebrates have **2 phases** of respiration:

- ▶ **External respiration**

Gases exchange between the blood and the environment (Gills or lungs)

- ▶ **Internal respiration**

Gases exchange between the blood and the cells



Respiratory system Function

- ▶ Protection – from dust and microbes entering body through mucus production, cilia, and coughing
- ▶ Exchange and internal gas exchange – oxygen and carbon dioxide
- ▶ Breathing movement of air by contacting and relaxing of muscles
- ▶ Creates Sound
 - ▶ When air passes through the larynx, or “voice box. When we speak, cords in the larynx vibrate when air passing between them and creating sound.
- ▶ **Olfaction, or Smelling**
 - ▶ chemicals in the air activate nervous system receptors on the cilia and sends a signal to the brain.

Respiratory organs

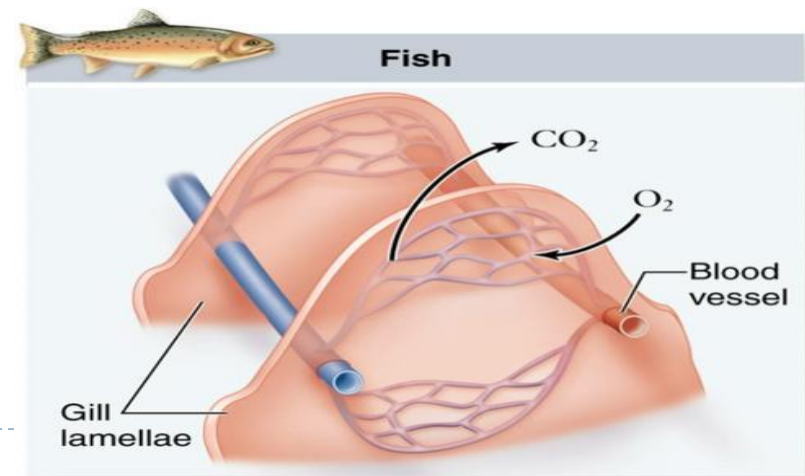
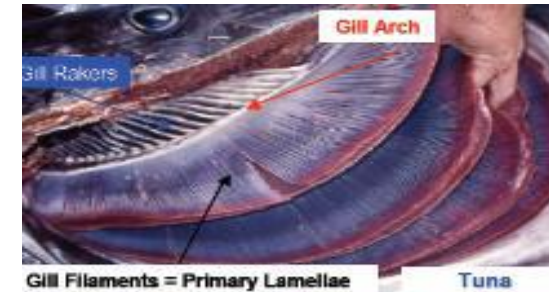
- ▶ External & internal gills
- ▶ Swim bladders (Sac)
- ▶ Cutaneous respiration
- ▶ Buccopharyngeal mucosa
- ▶ Cloaca and intestine lining
- ▶ Lungs

- ▶ *Necturus* have **external** gills with 2 or 3 pairs of gill slits throughout life



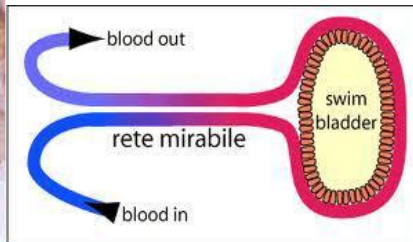
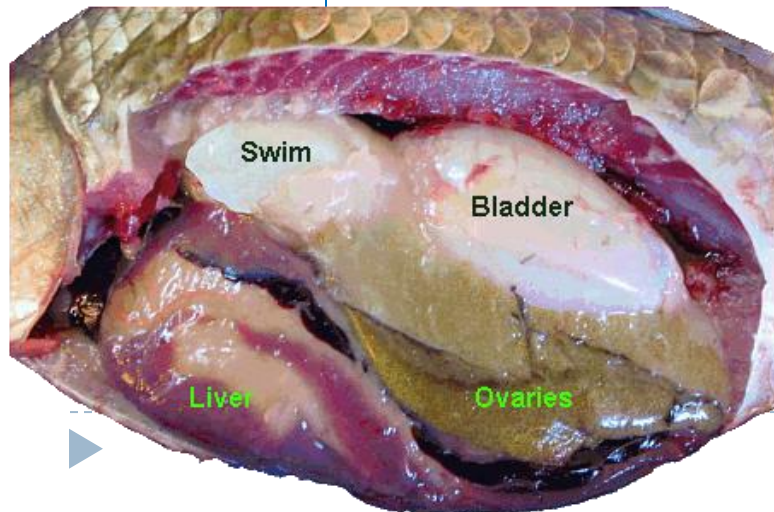
Internal and external gills

Gills consist of series of lamellae, with vascular network to trap dissolved O₂ in water



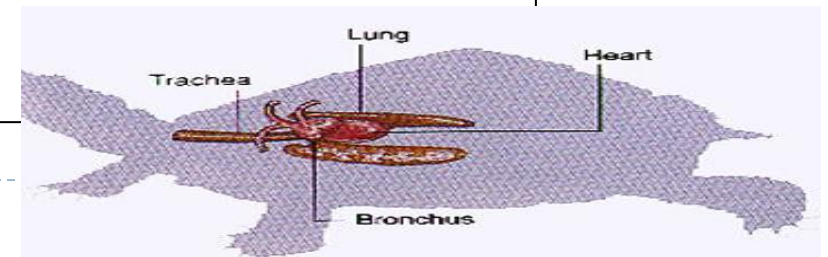
Gas (Swim) Bladders

- ▶ Usually a single sac, dorsal to the digestive system.
- ▶ Mostly found in bony fish, act as a hydrostatic organ regulate the fish's specific gravity
- ▶ Oxygen and carbon dioxide is exchanged between the bladder & the blood



Lung

- ▶ Essential respiration organ in many air-breathing animals.
- ▶ Including most tetrapods and a few fishes ex; lung fish.
- ▶ Lung fish have lungs that derived from the swim bladder, supplied with fine blood vessels.
- ▶ Lung fish sucks in air from just above the water, through the mouth or nasal openings.



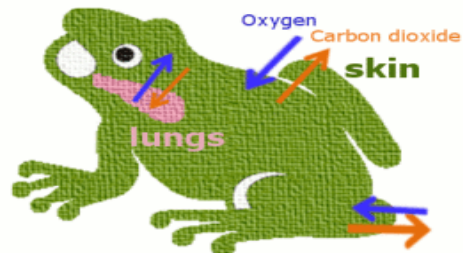
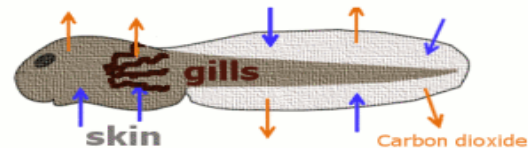
Cutaneous respiration

- ▶ is the exchanged of gases through the skin to allows the animal to breathe underwater
- ▶ The gases dissolved in the water pass through skin and directly into blood vessels.

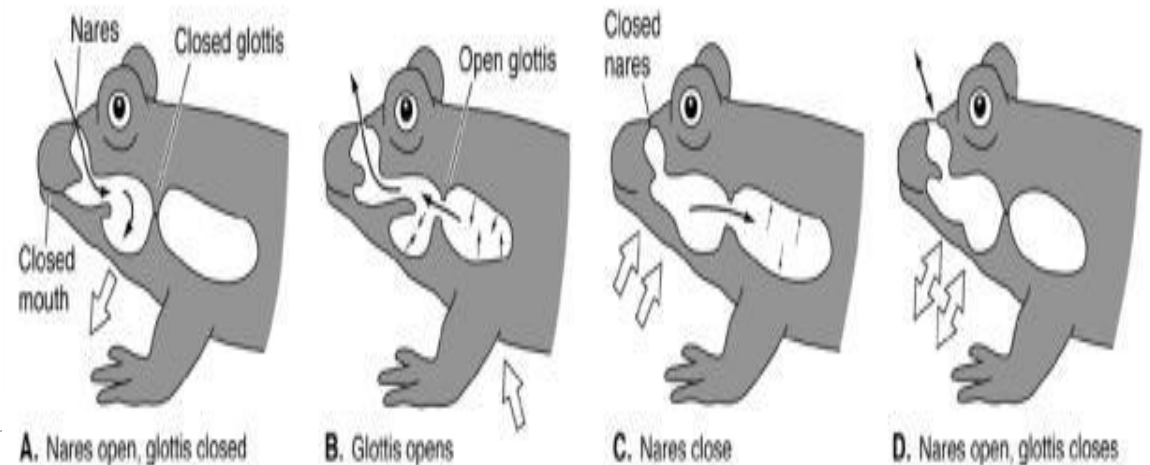
Buccopharyngeal mucosa

- ▶ Gas exchanged between the buccal cavity and the pharynx.
- ▶ Air pass through the nostrils to the buccopharyngeal cavity.
- ▶ Then the throat is contracted to push the air from the buco - cavity to the lungs, which expel the air through the throat.

Tadpoles are **water breathers**

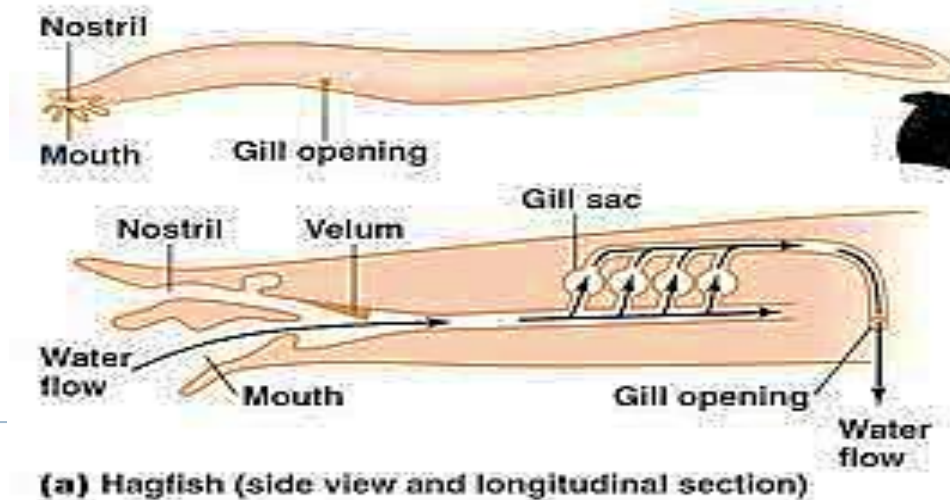
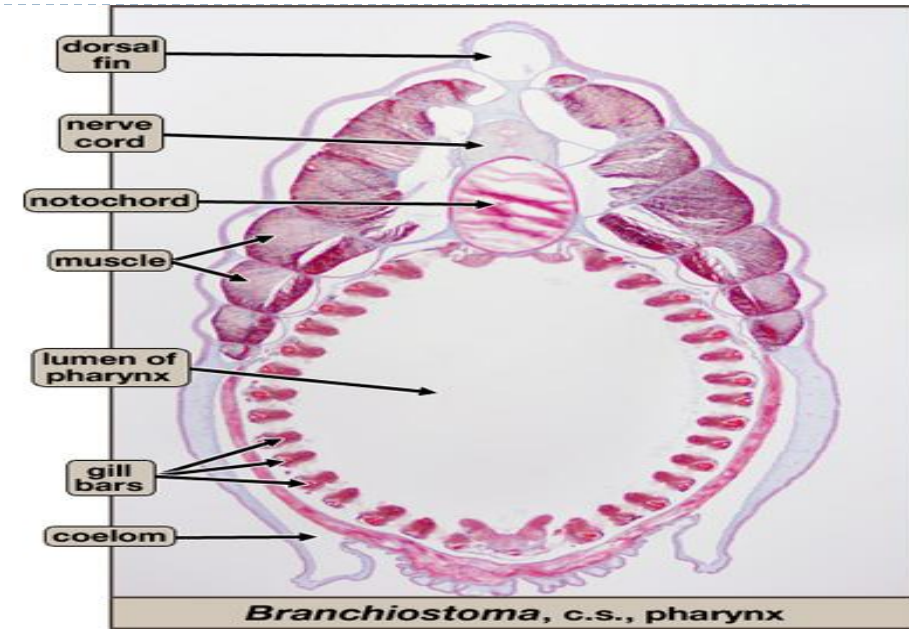


and metamorphose into **air breathing** frogs



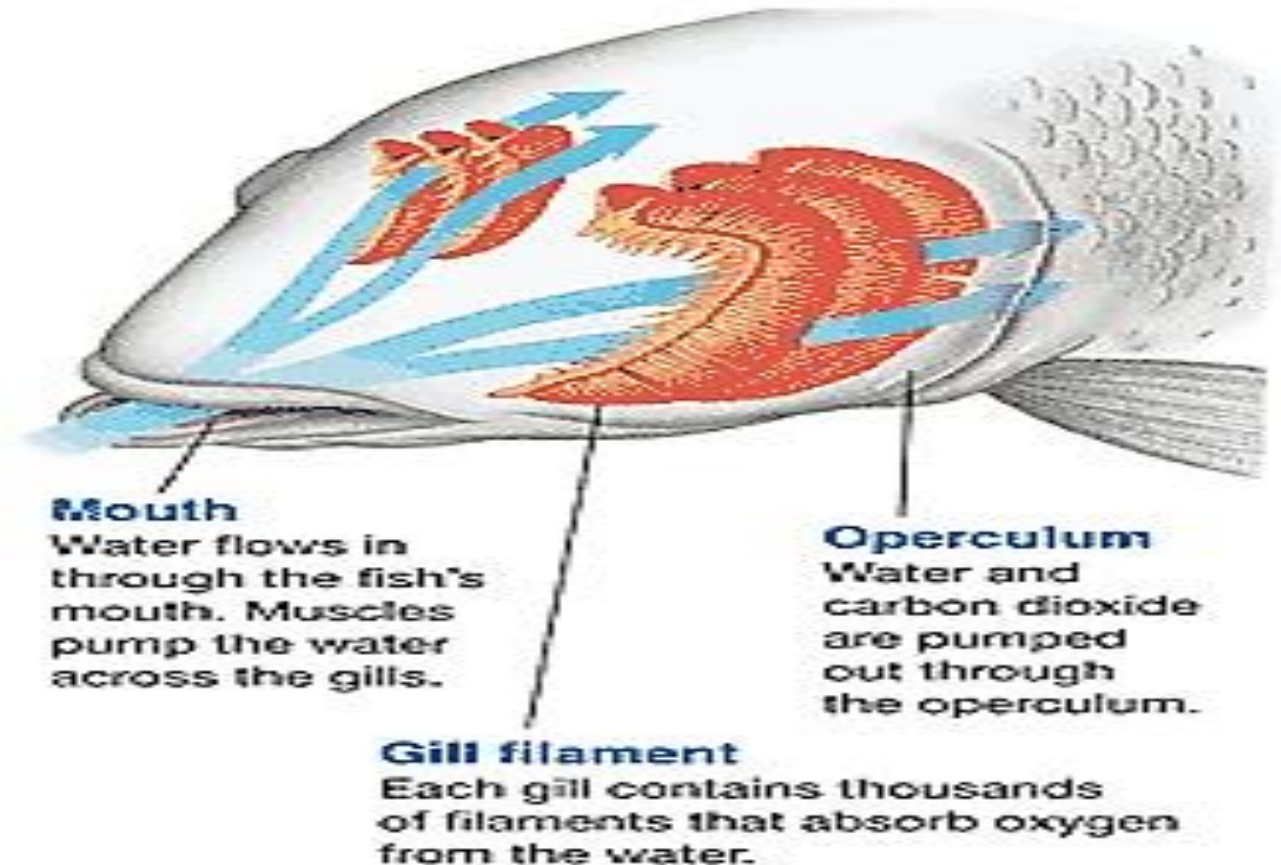
Respiration system in vert.

- ▶ **Amphioxus** respire by skin which is thin structure, often manifesting complex folding, that facilitates the diffusion of gasses into and out of nearby blood vessels. Gill slits (spaces between the gill bars) aid in digestion.
- ▶ Lamprey mouth attachment organ, so they breathe through a row of seven pairs of tiny gill openings located behind their mouths and eyes where water is taken directly.
- ▶ Hagfish respire by taking in water through its pharynx, past the velar chamber, and bringing the water through the internal gill pouches, which vary in number from five to 16 pairs.



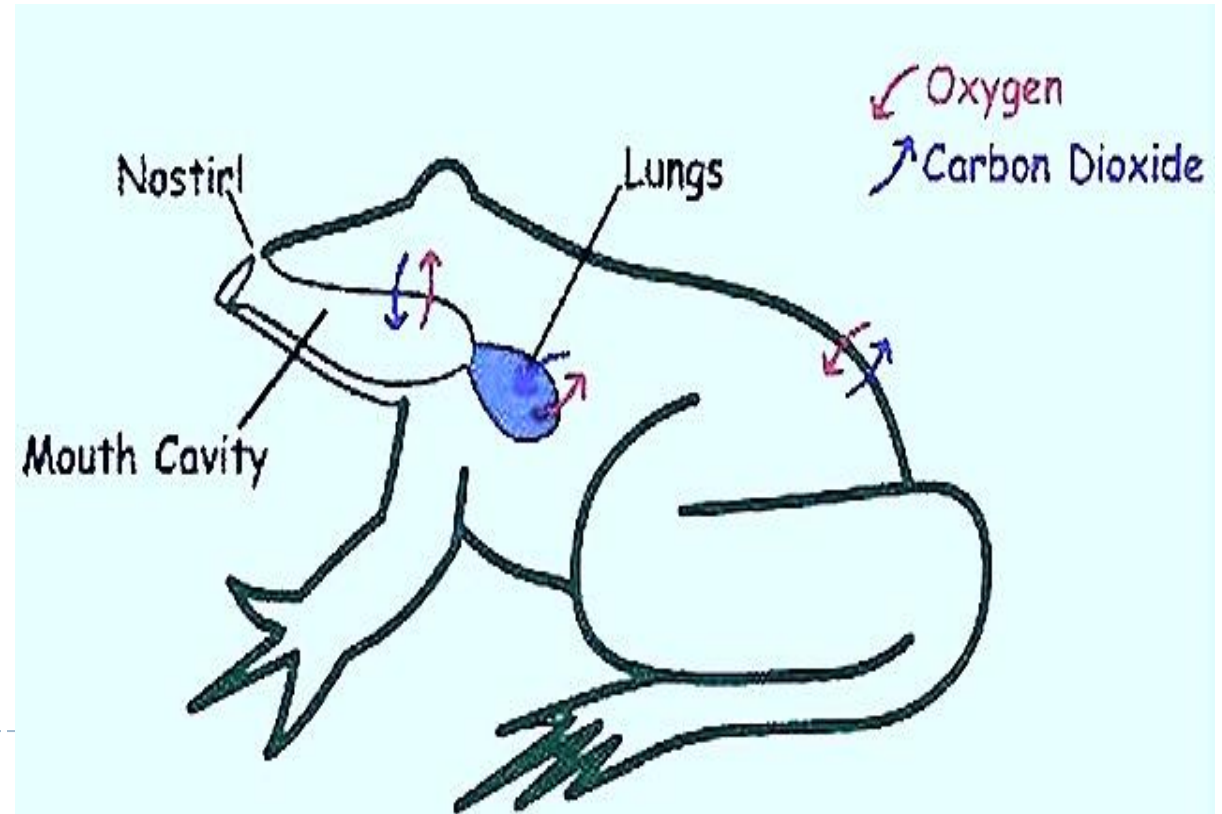
Fish respiratory system

- ▶ Fish respiratory tract consists of mouth, buccal cavity, pharynx, internal gills, pouches and external gills.
- ▶ Water flows through the mouth then the gills where oxygen is removed
- ▶ Carbon dioxide and water are then pumped out through the gill slit or operculum
- ▶ Oxygenated blood from the gills is supplied to the body



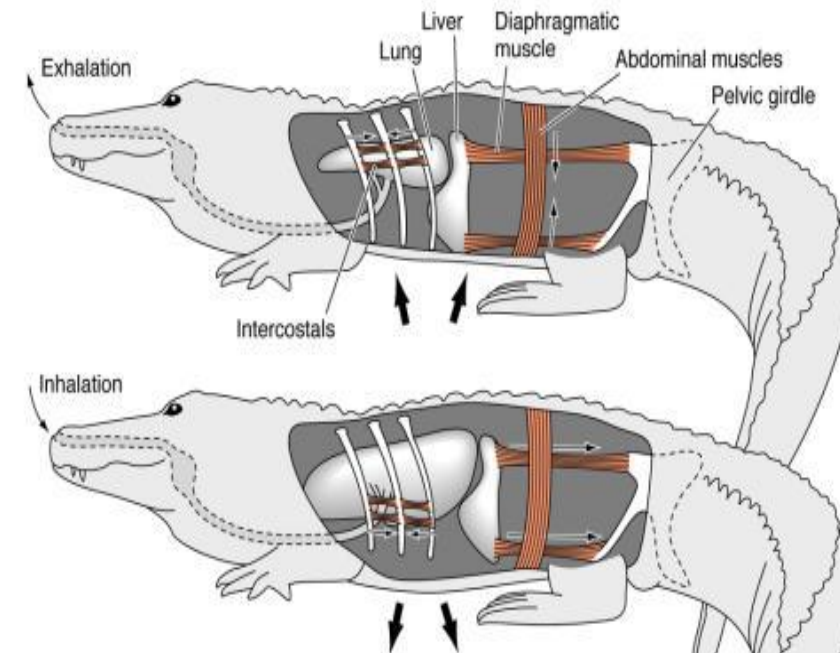
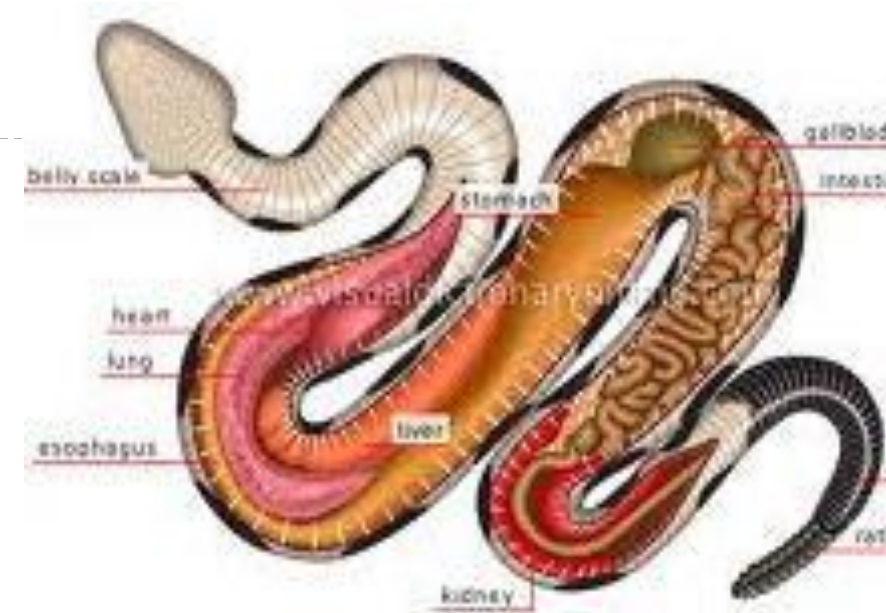
Respiration system in amphibian

- ▶ Respiration is performed by the skin, bucco-pharyngeal lining, lungs and by gills (only in larval stage).
- ▶ Air enters the respiratory tract through the external nostrils
- ▶ Air leaves also through the external nostrils after providing oxygen.
- ▶ Lungs are simple, thin-walled elastic sacs, the inner surface have septa enclosing the alveoli.



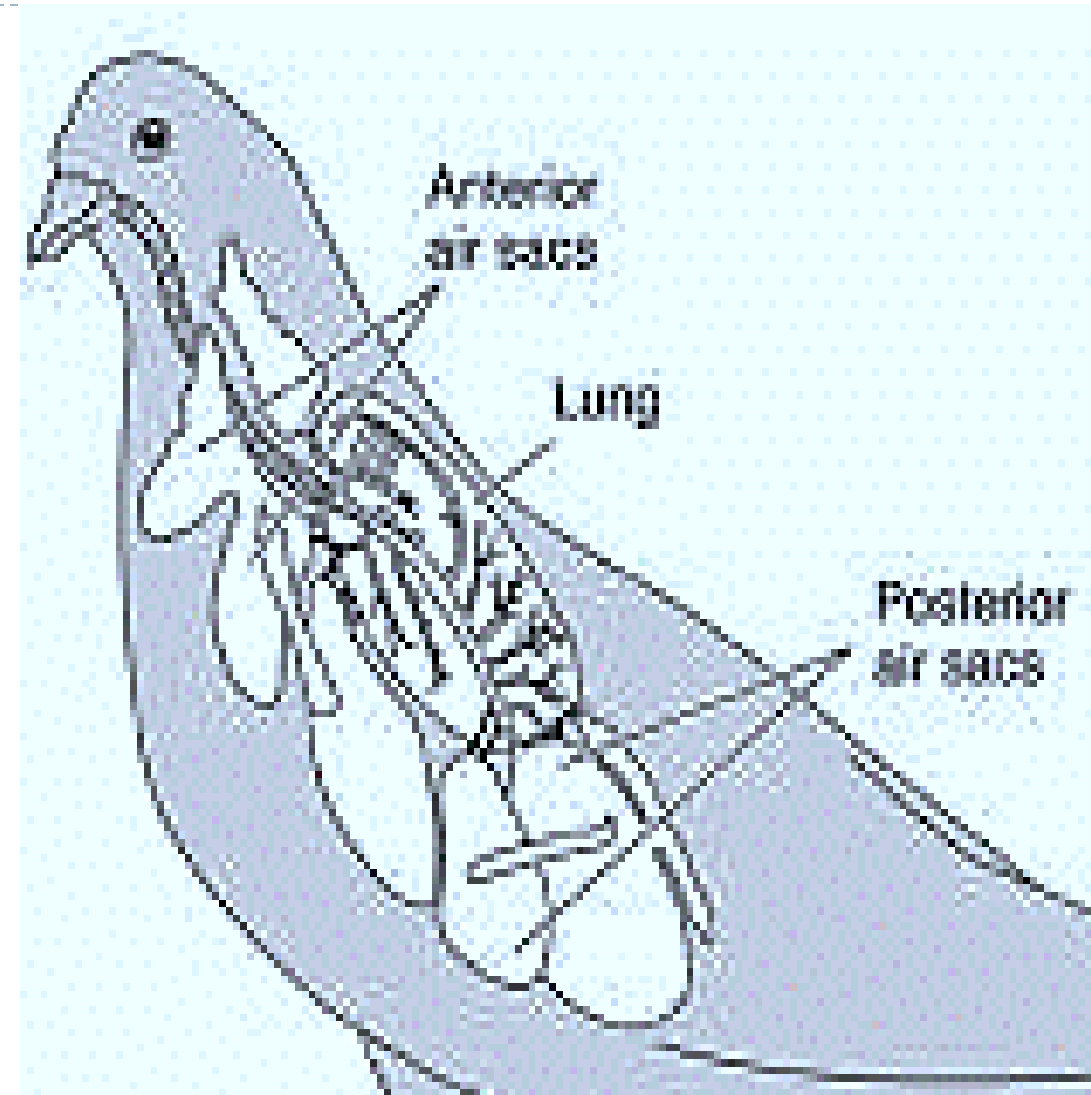
Reptile respiration

- ▶ In snakes, lungs are simple sacs, left lung is reduced or lost in most.
- ▶ Crocs have well developed lungs as adults with numerous alveoli.
- ▶ Posterior portion of lungs often less divided and less vascularized in crocs
- ▶ Turtle rib cage cannot expand, internal muscles contract and expand to aspirate the lungs.
- ▶ Cutaneous exchange is lost only during hibernation through thin membranes of their cloaca.



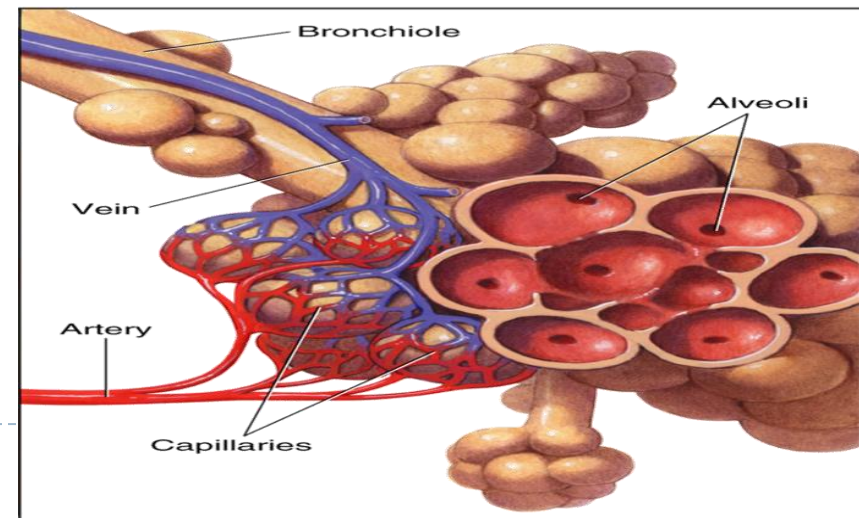
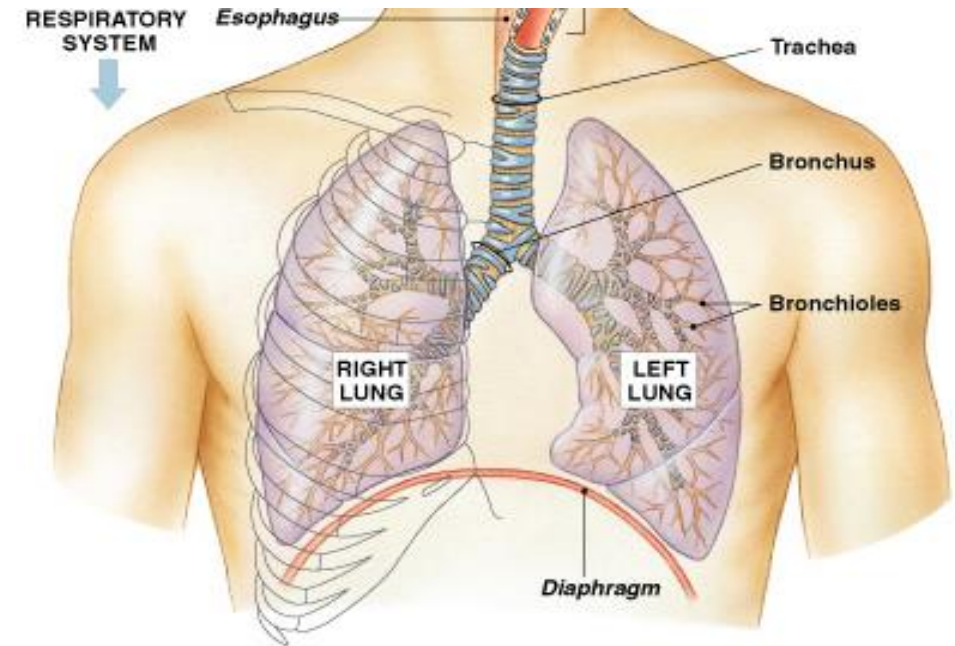
Bird respiratory system

- ▶ Consist of trachea, small paired lungs, no diaphragm, muscular aspiration. No cutaneous respiration.
- ▶ Have a series of fine tubular passages called parabronchii with tiny tubes called air capillaries.
- ▶ During inhalation: Air enters trachea to primary bronchus, latero, ventro, dorso bronchi.
- ▶ Many air sacs attached to lungs; air enters posterior then anterior air sacs.
- ▶ Air sacs hold great volumes of air to enables them to fly high where there is less oxygen



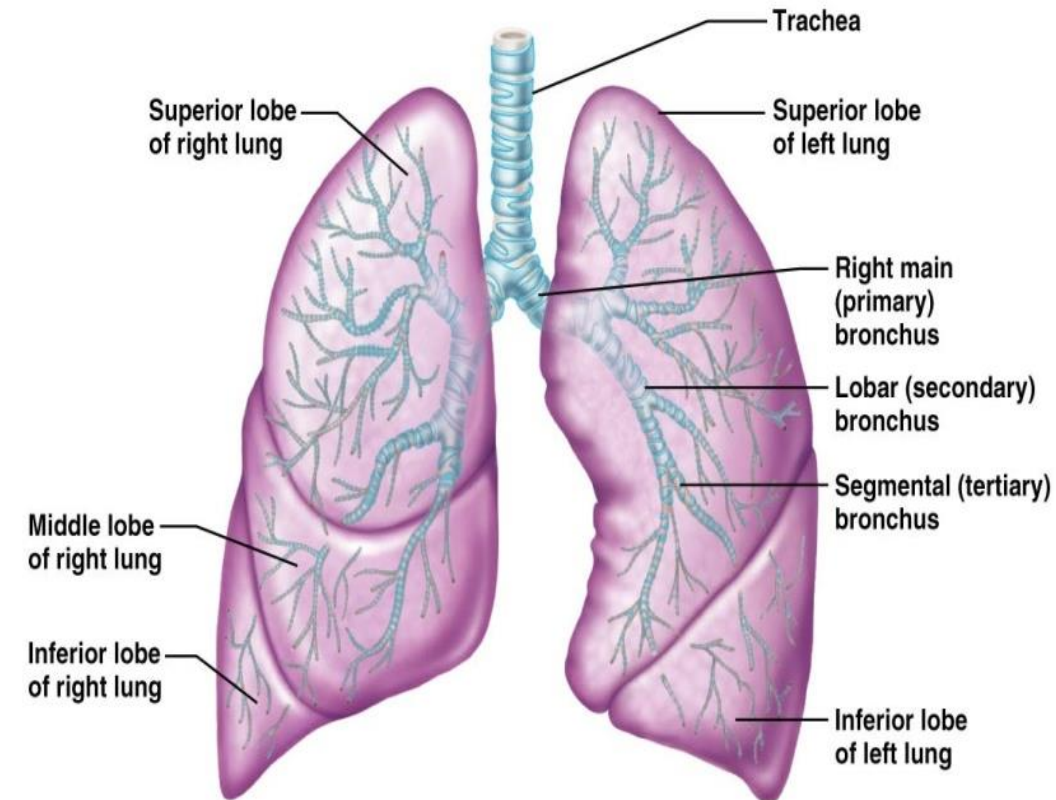
Respiration system of Mammals

- ▶ Air enters through nostrils, (Nasal hairs are the first particle filtration system)
- ▶ Air flow from the pharynx enters the larynx, continues into trachea, bronchial tree, bronchioles, and alveoli
- ▶ Alveoli is a thin sac where all gases exchange takes place.
- ▶ Trachea made of 15–20 C-shaped tracheal cartilages (hyaline) strengthen and protect airway
- ▶ Ends of each tracheal cartilage contacts esophagus



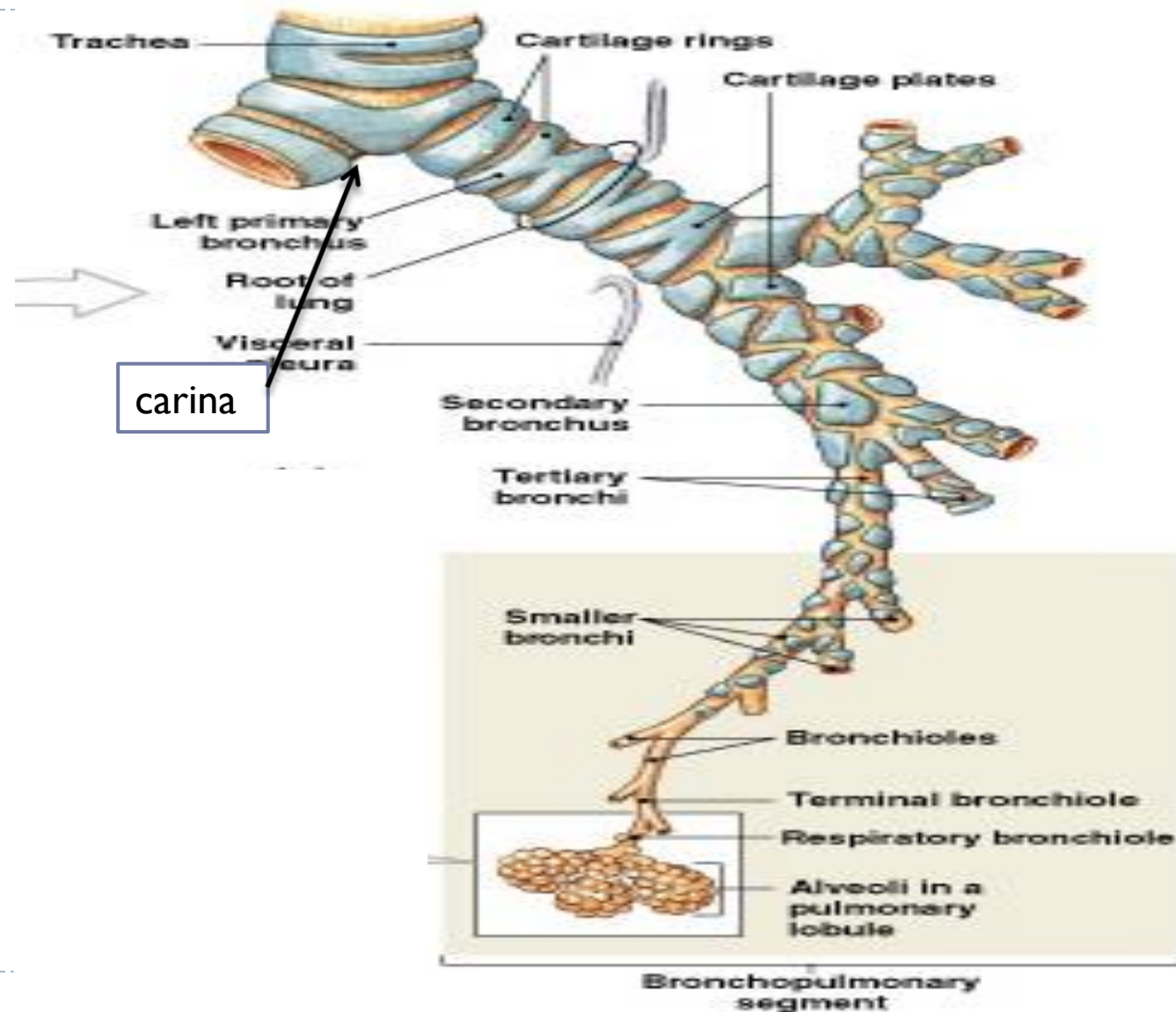
Lungs

- ▶ Each lung rests on superior surface of diaphragm (muscular partition separating the abdominal and thoracic cavities)
- ▶ Right lung is wider and has 3 lobes separated by deep fissures.
- ▶ Left lung is longer and has 2 lobes.
- ▶ Approximately 300 million alveoli, provide great surface area for gas exchange.
- ▶ Volume of thoracic cavity changes creates changes in pressure (expansion or contraction of diaphragm or rib cage)
- ▶ Air flows from area of high pressure to area of low pressure



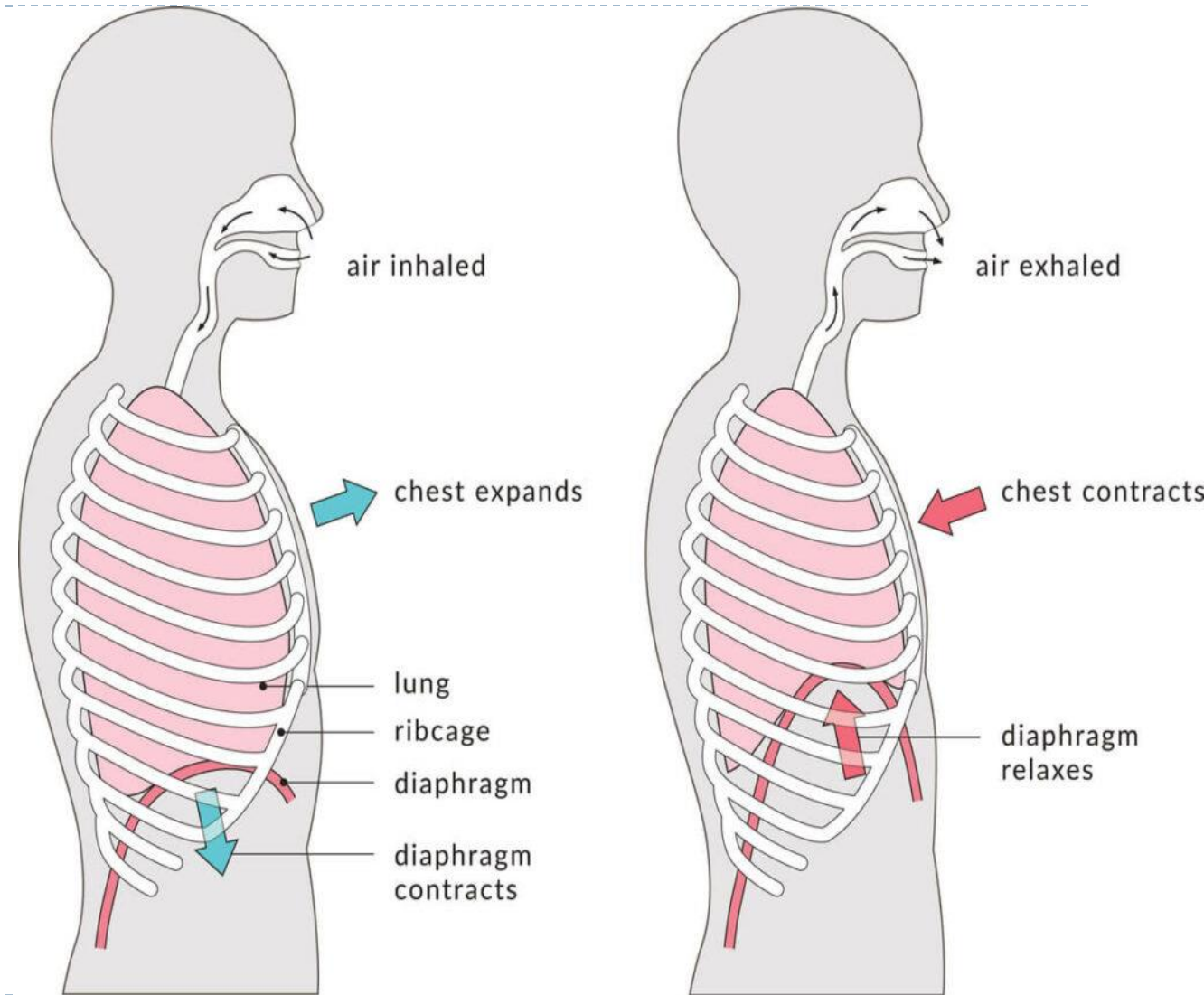
Lungs of mammals

- ▶ Right and left primary bronchi are separated by the carina
- ▶ Right primary bronchus larger in diameter than the left
- ▶ Each primary bronchus (R and L) branches into secondary bronchi, each supplying one lobe of the lungs (5 total)
- ▶ Secondary bronchi branches into tertiary bronchi which branches into multiple bronchioles end with alveoli
- ▶ Approximately 300 million alveoli



Breathing

- ▶ Changes to the volume and air pressure in the lungs trigger pulmonary ventilation.
- ▶ During normal inhalation, the diaphragm and external intercostal muscles contract and the ribcage elevates.
- ▶ As the volume of the lungs increases, air pressure drops and air rushes inside lungs.
- ▶ During normal exhalation, the muscles relax., the lungs become smaller, the air pressure rises, and air is expelled.



References

- ▶ For further reading please see:
- ▶ **Charles K. Weichert (2017). Elements of chordate anatomy. 3rd edition. The McGraw–Hill Companies, New york.**
- ▶ **Comparative anatomy | Definition, Examples, & Facts | Britannica**<https://www.britannica.com › science › comparative-anatomy>
- ▶ ***Kardong, Kenneth V. (2019). Vertebrates: comparative anatomy, function, evolution (8th edition). New York.***
- ▶ **De Iuliis, G., & Pulerà, D. (2019). *The dissection of vertebrates*. 3rd edition. Academic press. Elsevier, London.**
- ▶ **Kenneth, S. S. (2017). *The unity of form and function*. 8th edition. The McGraw–Hill Companies,. New york.**
- ▶ **Comparative Anatomy. www.health.zone/**