

AVIAN PHYSIOLOGY

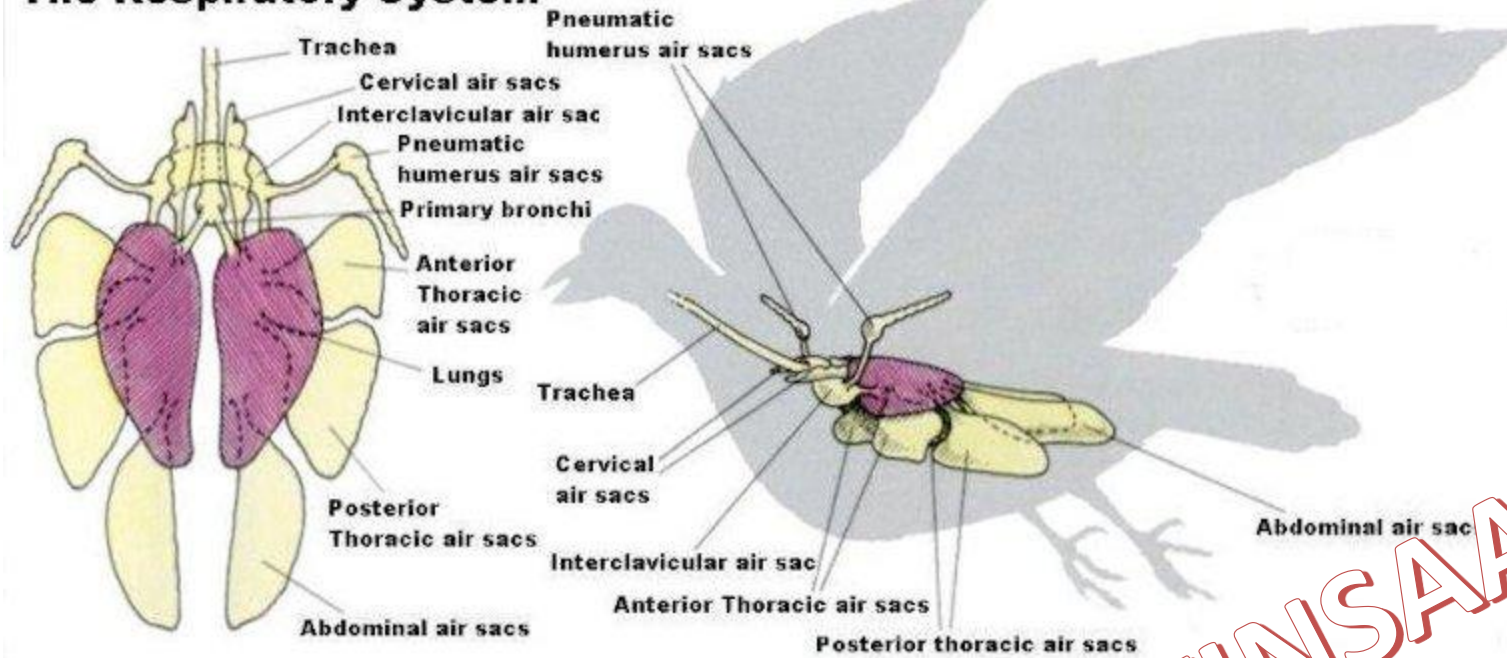
Avian Respiration

Part I

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The Respiratory System



- Delivers O_2 from air to tissues
- Removes CO_2
- Important role in thermoregulation
- Acid- base balance

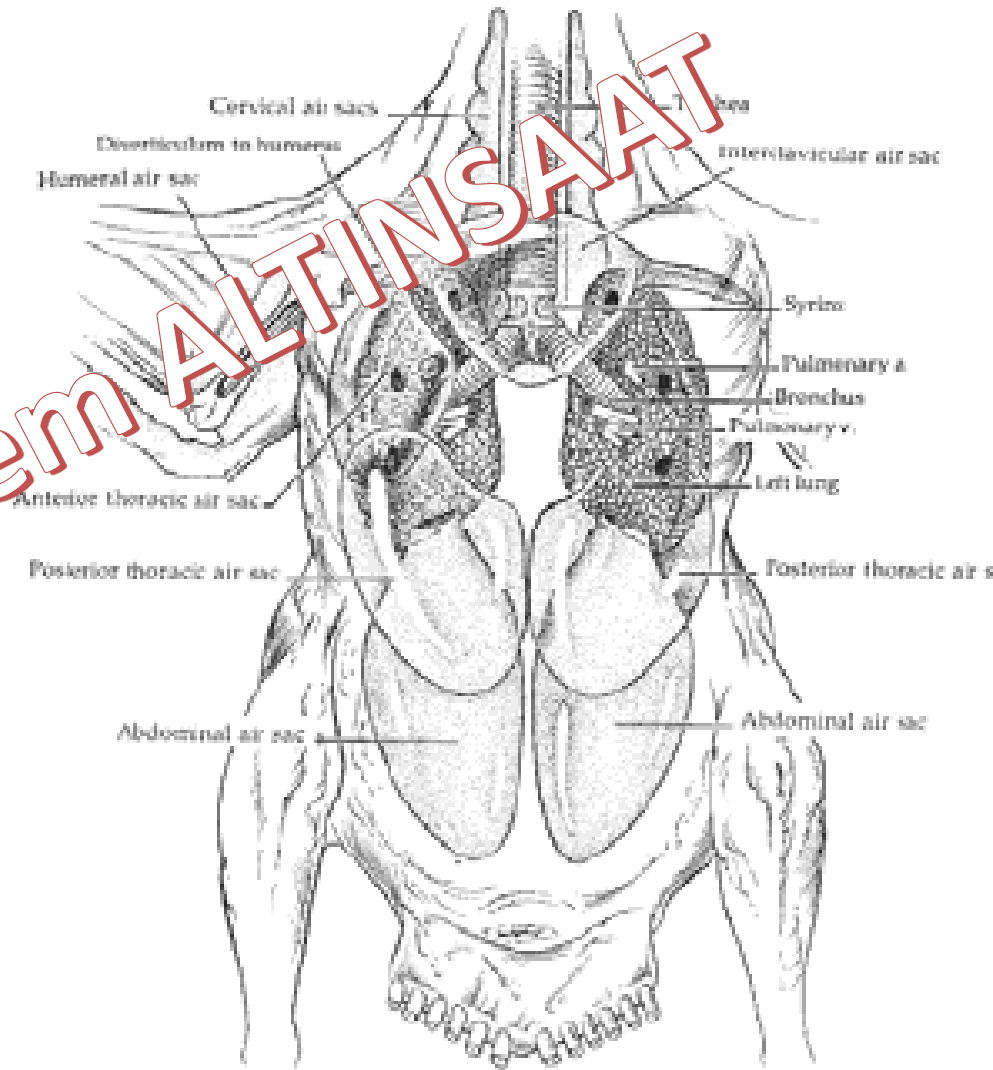
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C. Characteristics

- Air sacs permit unidirectional flow of air through the lungs.
- Air moving through bird lungs is largely fresh air
- Mammals have bi-directional air flow (back and forth)
- Air moving into mammal lung is a mixture and thus less O₂ content)

B.Components

- small lungs
- 9 air sacs(not involved in gas exchange)
- Air sacs have very thin walls with few
- blood vessels - no role in gas exchange
- act as “bellows” to ventilate lungs



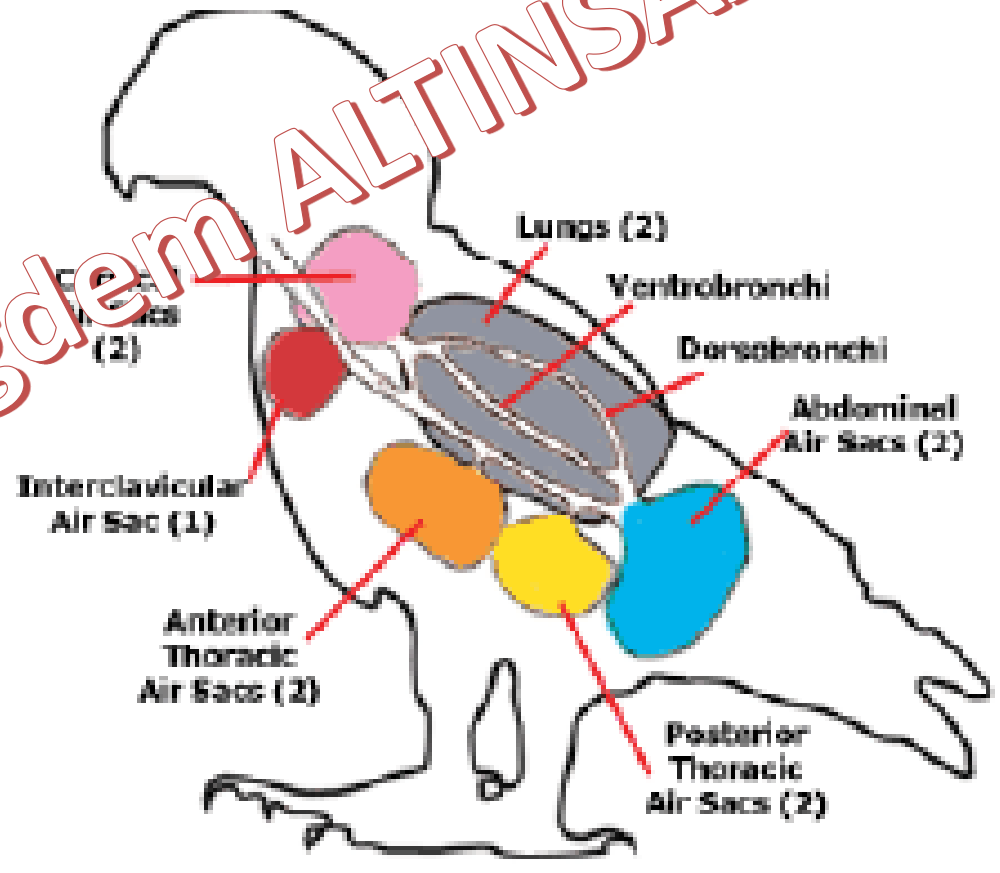
II. Anatomy of Respiratory System

A. Air Sacs

- Air sacs can be functionally divided into

- anterior
- posterior

- 1 interclavicular
- 2 cervical
- 2 anterior thoracic
- 2 posterior thoracic
- 2 abdominal



Trachea

- Breathe through the mouth or nares
- During inspiration
- enters pharynx → TRACHEA
- Trachea as long as neck or longer
- Cranes trachea coiled within keeled sternum
- Provides resonance to calls

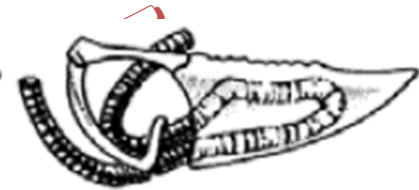
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B. Trachea

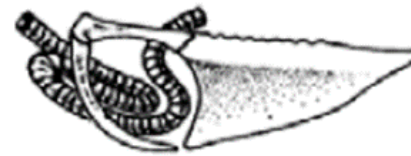
- Typical avian trachea ~ 2.5 x longer, 1.3 x wider than mammals of same size
- Larger dead space volume (4.5x)
- Compensate with larger tidal volume, lower respiratory frequency
- At syrinx trachea bifurcates into two primary bronchi



Black swan



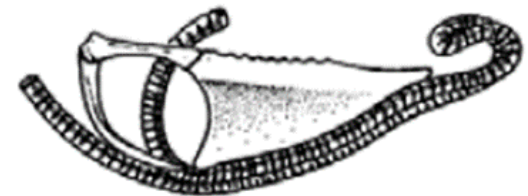
Whooper swan



White spoonbill

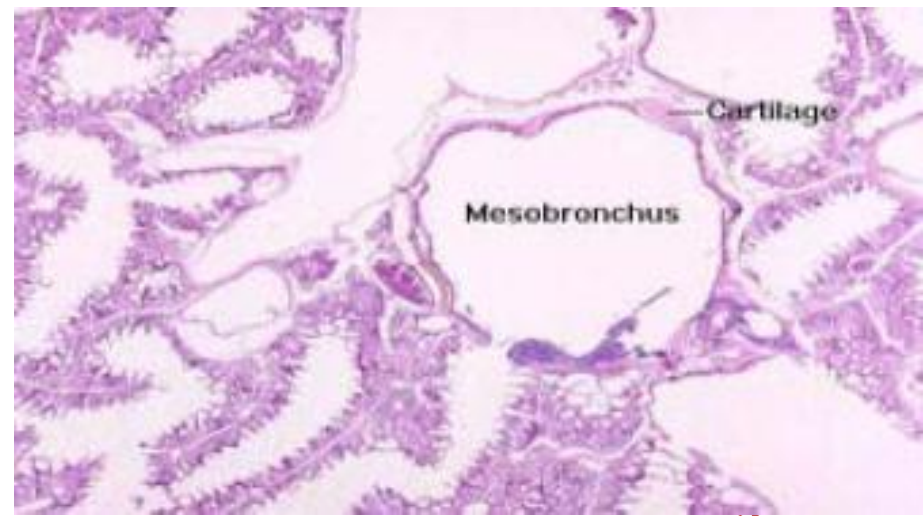


Whooping crane

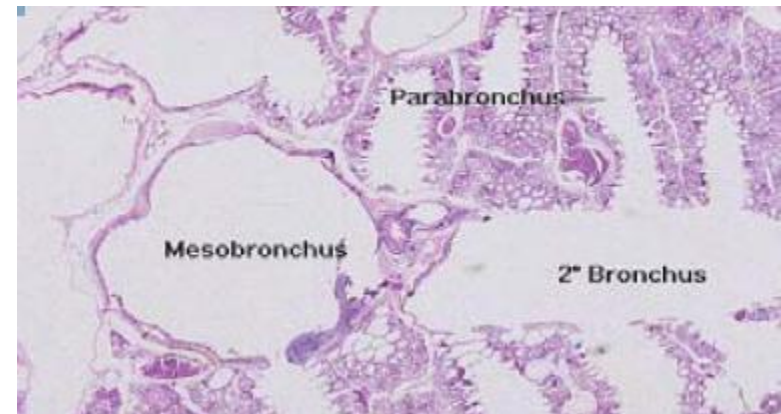


Helmeted curassow

C.Lungs and Bronchi

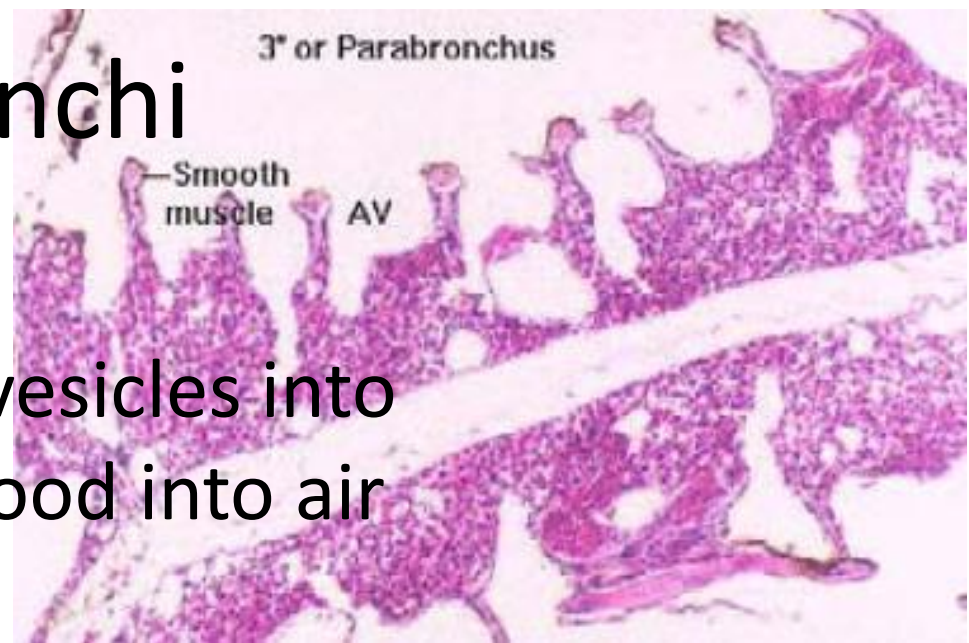


- once in lungs – mesobronchi
- mesobronchus conducts air through the middle of the lung
- gives rise to recurrent **secondary bronchi**, gives rise to **tertiary bronchi** (also called **parabronchi**).
- The **parabronchi**
 - walls are "scalloped" by the bay-like **air vesicles**, place where gas exchange occurs



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C. Lungs and Bronchi

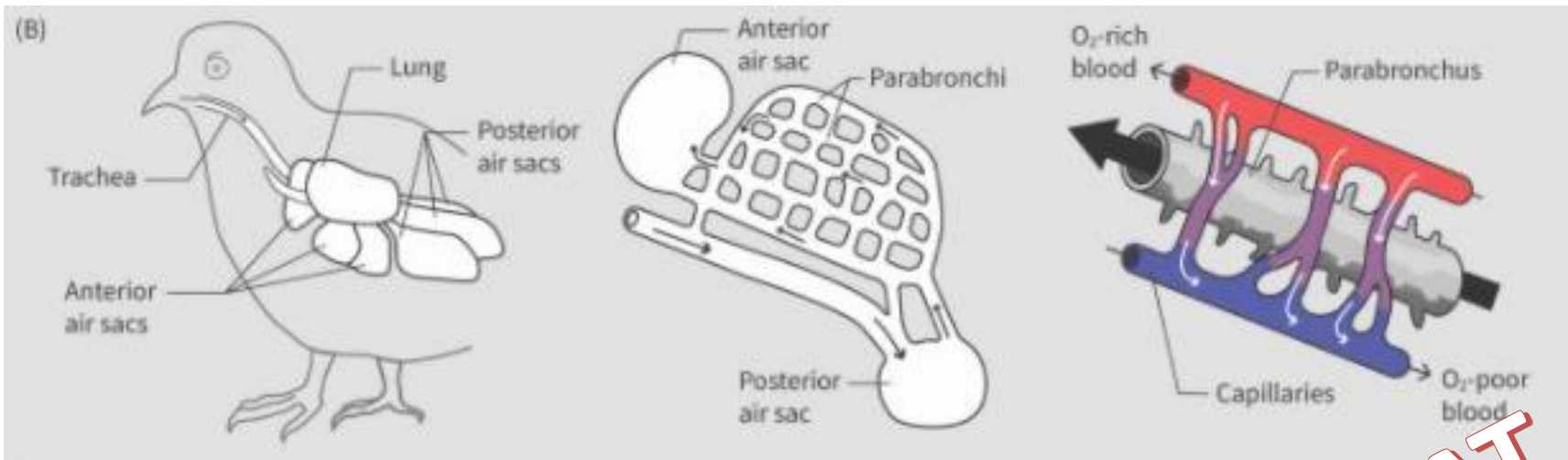


- O₂ diffuses from air vesicles into blood & CO₂ from blood into air vesicles
- Air and blood travel at right angles – cross current flow
- **Cross-current flow** is very efficient!
- *a latticework of capillaries, found in the lungs of birds, which produces a flow of blood at right-angles to the air flow.*

(B)



- In birds a series of flexible air sacs work together with the lung.
- Within the lung there are parallel small tubes called parabronchi.
- Blood flow through the air capillaries is arranged in a cross-current pattern relative to the air flow across the parabronchi.



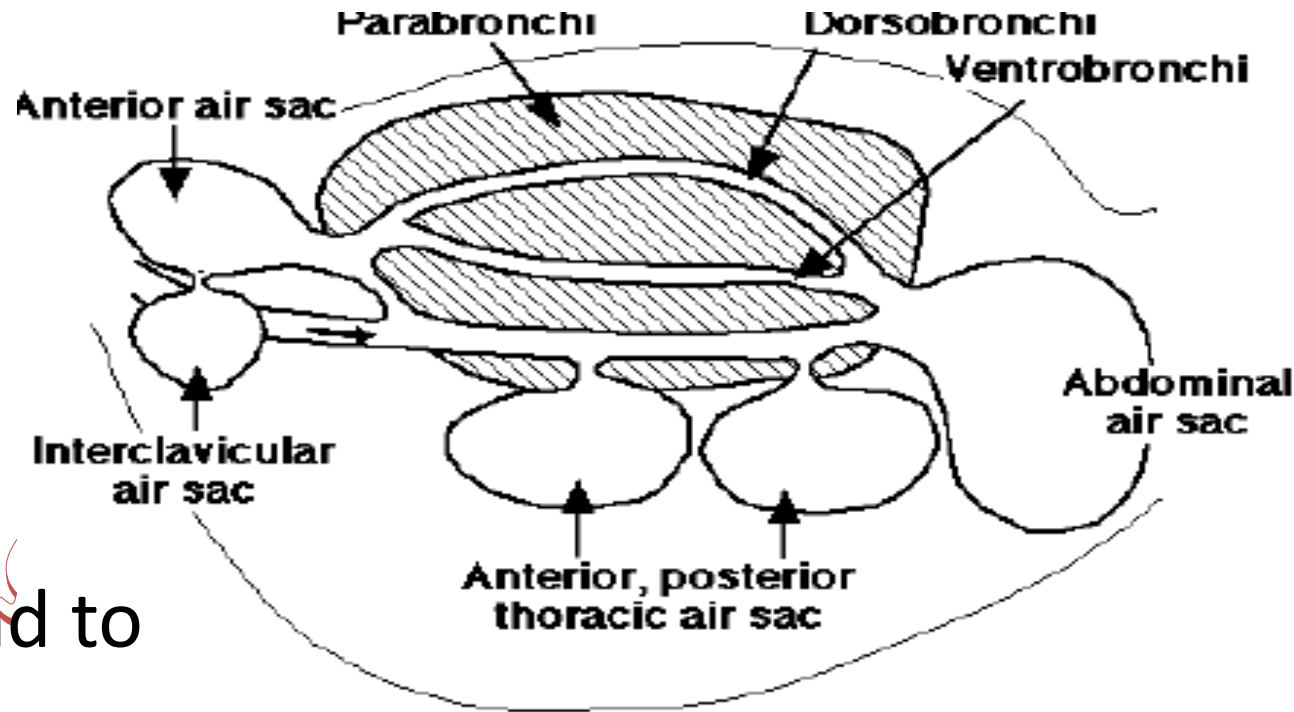
- the air carrying the oxygen is moving through the respiratory structures (parabronchi), which are positioned perpendicular to the movement of blood around the parabronchus.

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- In mammalian lungs, air enters via mouth and nares, and then enters trachea.
- The trachea branches into primary bronchi which branches into successively smaller tubes. The bronchioles, the smallest tubes terminate in sacs called alveoli where gas exchange

- Most gas exchange in the respiratory system structures in animals takes place in counter-current arrangement.
- In short, this means that the medium that delivers the oxygen (air or water) and the structures that the oxygen is delivered to are moving in directions opposite to one another. An example of this is a fish gill system



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- Parabronchi lead to larger
- Dorsobronchi lead to mesobronchi
- Inhalation/Exhalation

1. Inhalation – air flows through trachea and bronchi into posterior air sacs

2. Exhalation – air moves from posterior airsacs and into lungs

3. Second Inhalation – air moves from lungs into anterior air sacs

4. Second Exhalation – air moves from anterior air sacs out



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