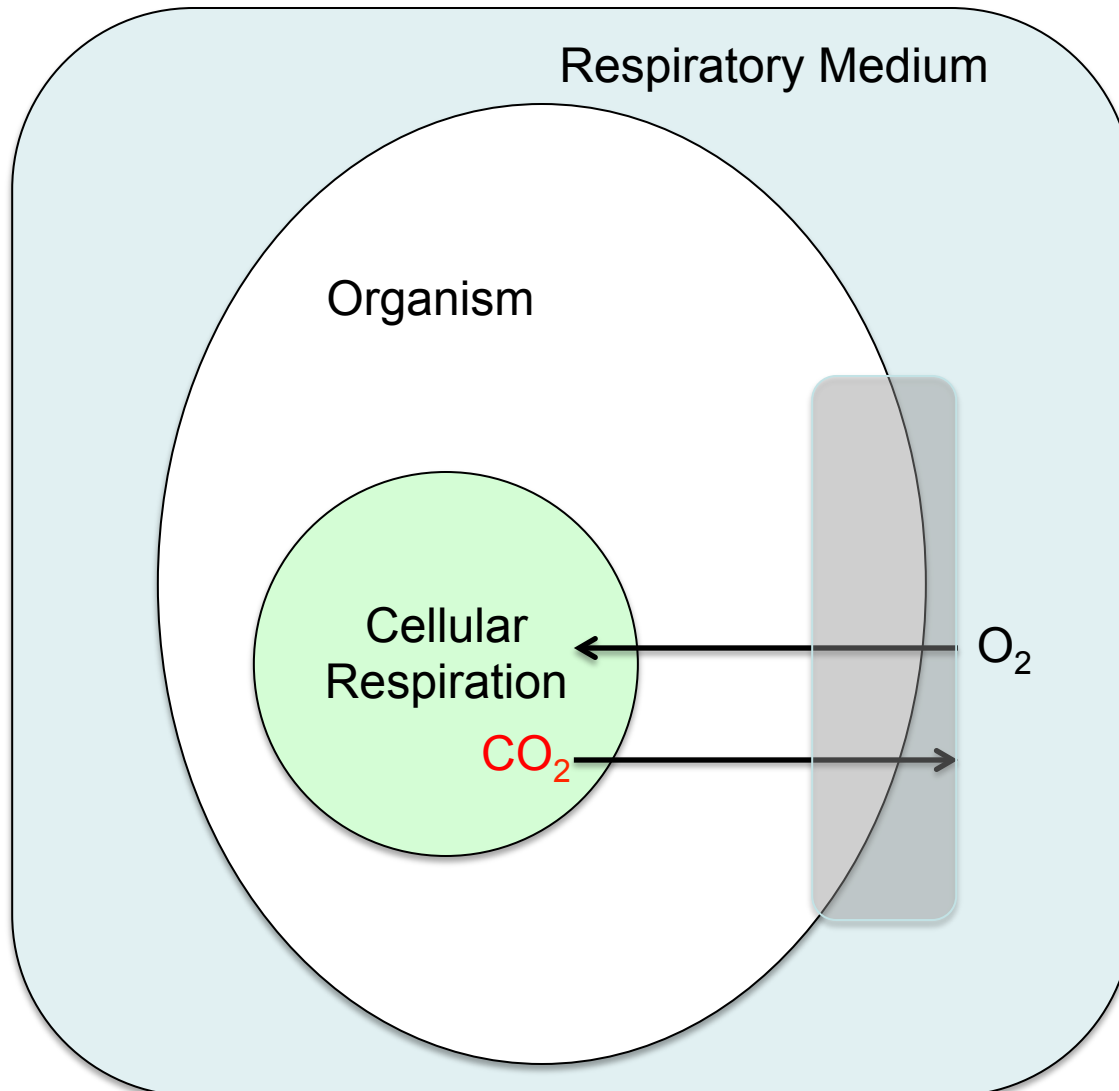


# Respiratory System Structures and Gas Exchange

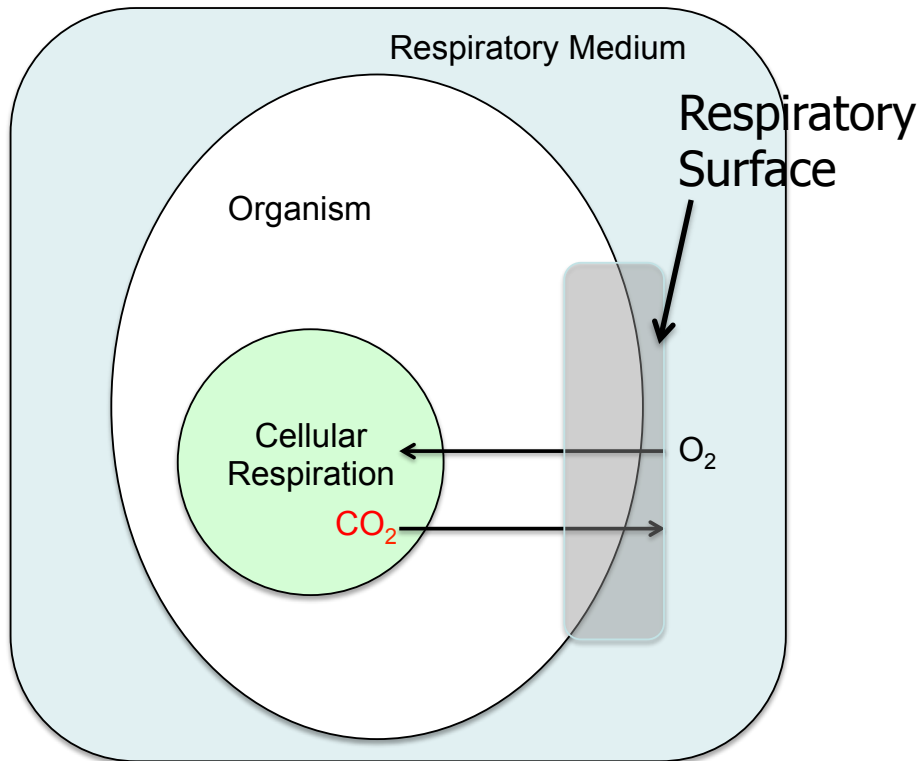
## A. Respiratory medium – the oxygen source

1. Air
2. Water



# Respiratory System Structures and Gas Exchange

- B. Respiratory surface – the structure where exchange of gases with the surrounding environment occurs
1. Large surface area (A)
  2. Thin surface ( $\Delta X$ )
  3. Moist surface



## Fick's Law of Diffusion

$$Q = \frac{\Delta C * A * \beta}{\sqrt{MW} * \Delta X}$$

# Respiratory System Structures and Gas Exchange

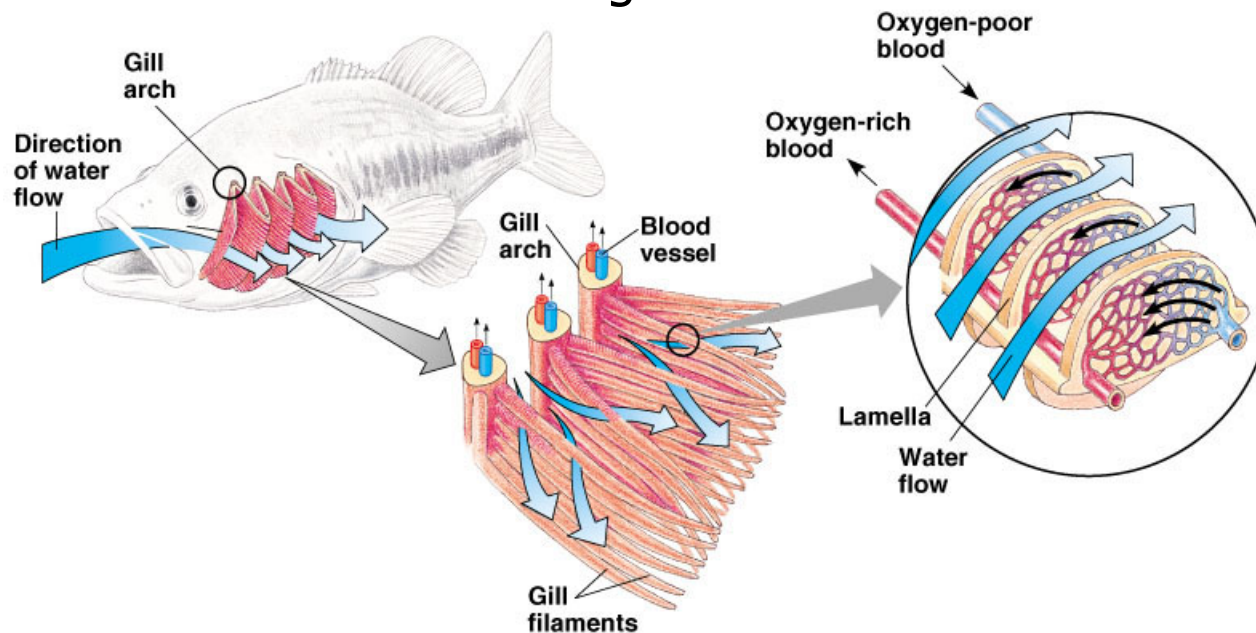
## C. Gills and Aquatic Animals

### 1. Structure of gills

- a. Outfoldings (large surface area)
- b. In water (moist surface)

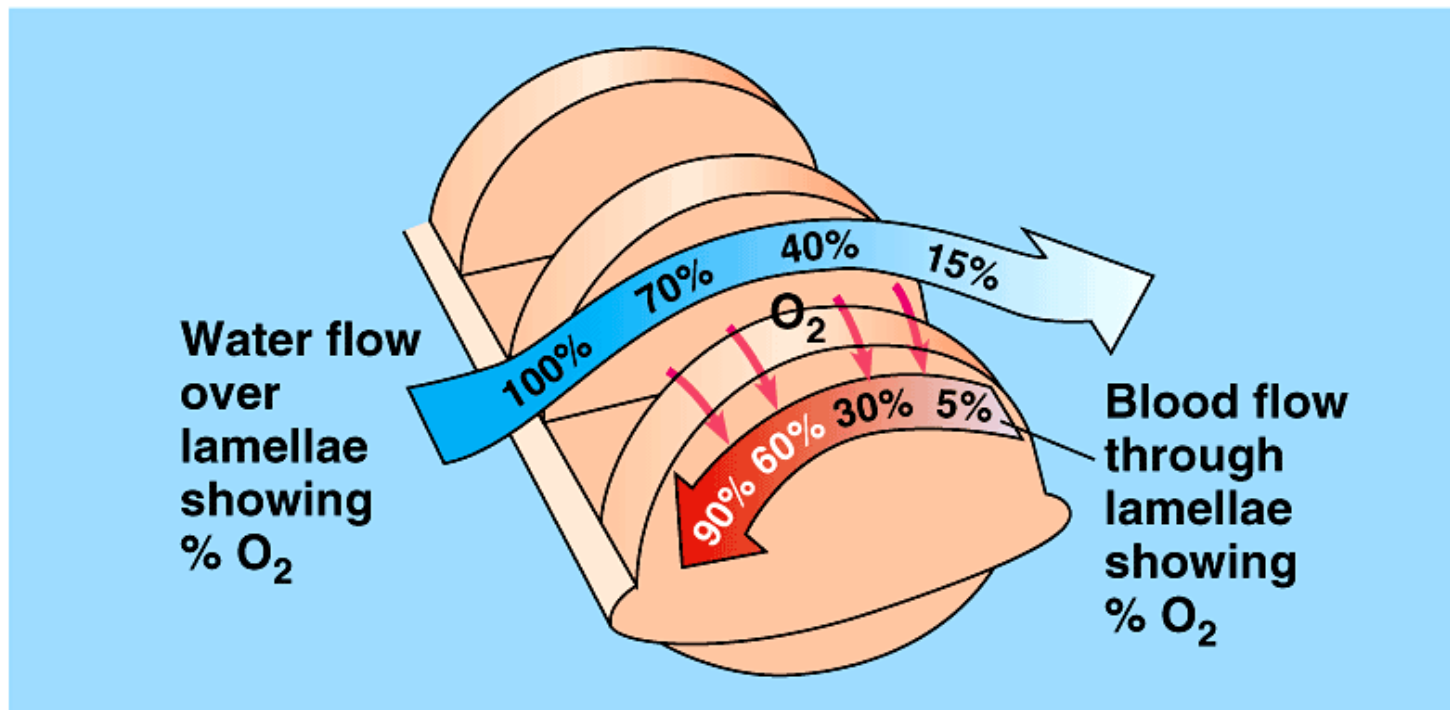
### 2. Ventilation needed to overcome low oxygen levels

- a. Definition – increase water flow over the gills in order to keep oxygen levels up
- b. Countercurrent exchange



# Respiratory System Structures and Gas Exchange

- C. Gills and Aquatic Animals
  - 2. Ventilation needed to overcome low oxygen levels
    - a. Definition – increase water flow over the gills in order to keep oxygen levels up
    - b. Countercurrent exchange

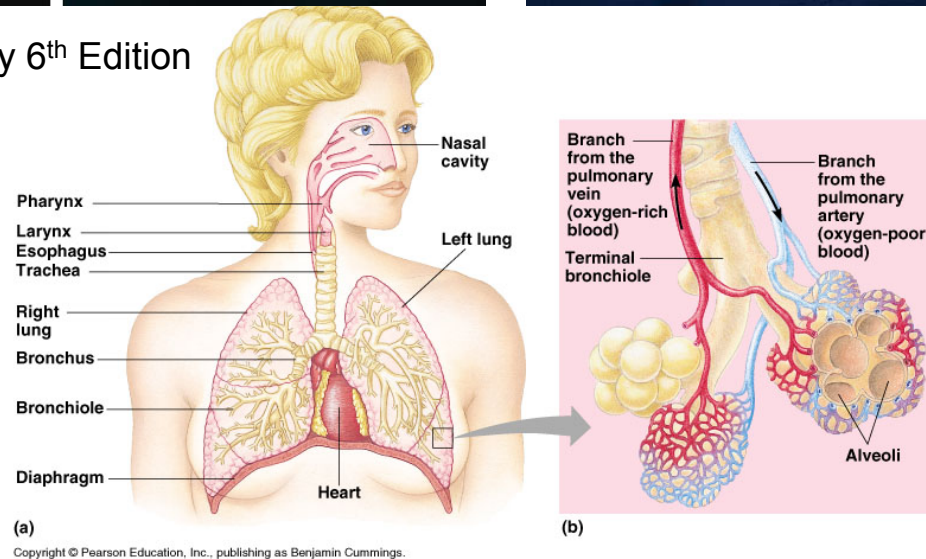


# Respiratory System Structures and Gas Exchange

## C. Lungs and Terrestrial Vertebrates



From Campbell's Biology 6<sup>th</sup> Edition



# Respiratory System Structures and Gas Exchange

- C. Lungs and Amphibians and Mammals
  - 1. Conducting zone structures
  - 2. Lungs
  - 3. Size and complexity based on metabolic needs

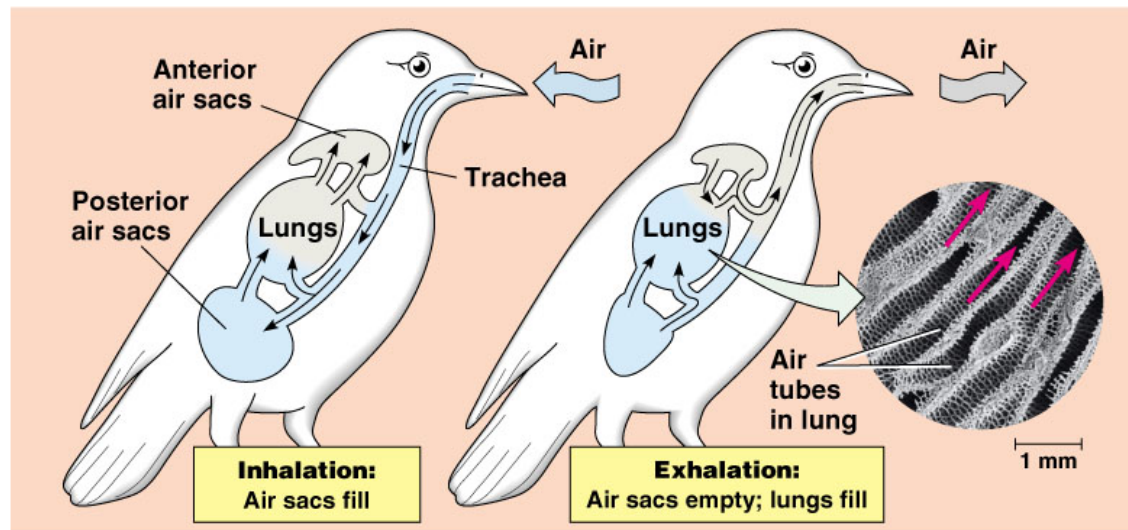


# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

### 1. Birds

- a. Nostrils
- b. Trachea
- c. Bronchi
- d. Air sacs
- e. Lungs
- f. Gas exchange at parabronchi



# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

### 1. Birds

#### g. One way ventilation

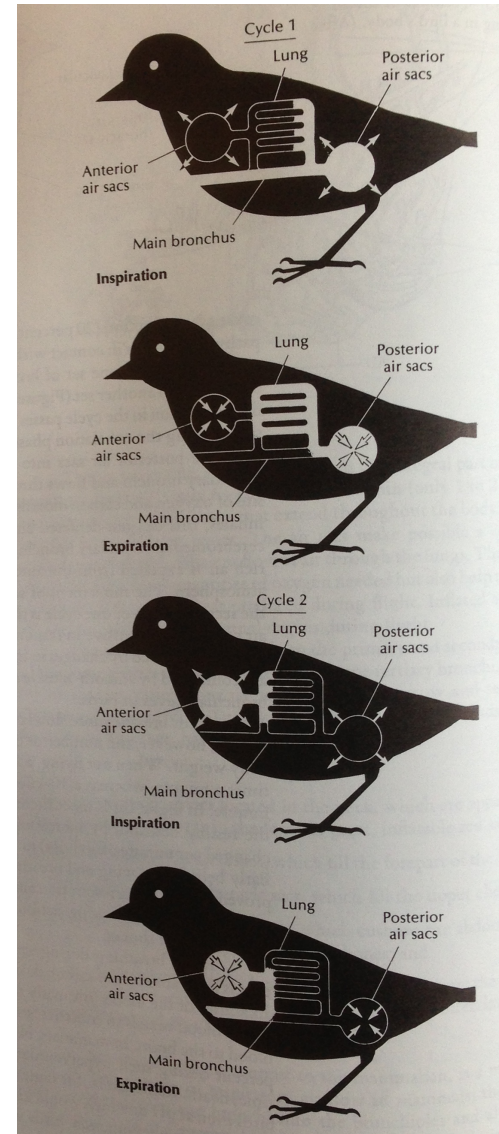


Image from Ornithology by Frank B. Gill, p 120.



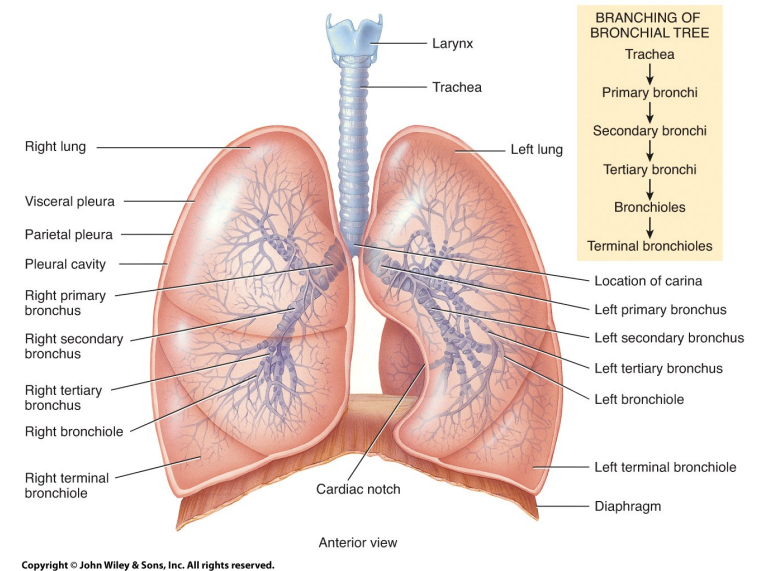
# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

### 2. Mammals

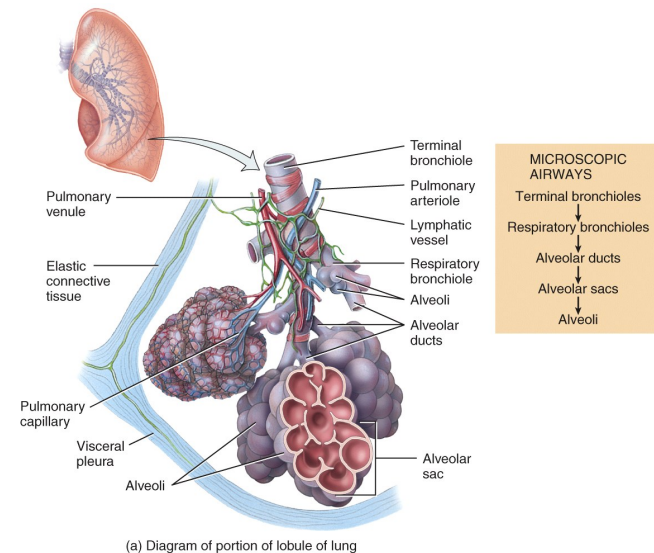
#### a. Conducting Zone

- i. Nose
- ii. Pharynx
- iii. Larynx
- iv. Trachea
- v. Bronchi
- vi. Bronchioles



#### b. Respiratory Zone

- i. Respiratory bronchioles
- ii. Alveolar ducts
- iii. Alveolar sacs
- iv. Alveoli



# Respiratory System Structures and Gas Exchange

- D. Breathing in birds versus mammals
  - 2. Mammals
    - c. Ventilation
      - i. Bi-directional
      - ii. Negative pressure system
        - a) Inhalation
        - b) Exhalation
        - c) Boyle's Law

<http://youtu.be/q6-oyxnkZC0>

# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

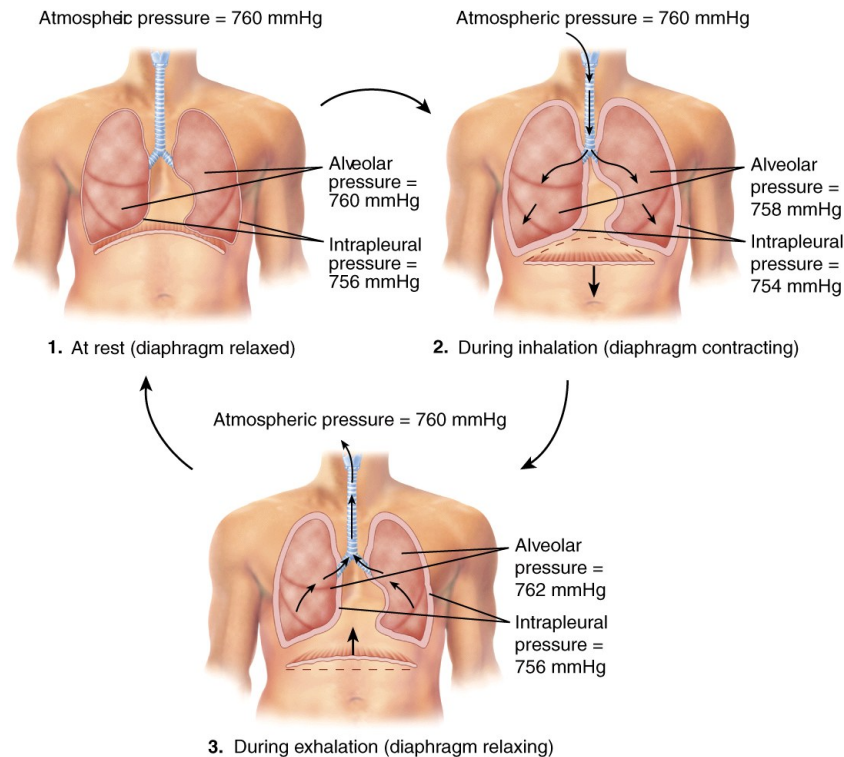
### 2. Mammals

#### c. Ventilation

##### i. Bi-directional

##### ii. Negative pressure system

#### d) Atmospheric Pressure ( $P_{\text{atm}}$ ) vs. Alveolar Pressure ( $P_{\text{alv}}$ )



# Respiratory System Structures and Gas Exchange

- D. Breathing in birds versus mammals
  - 2. Mammals
    - c. Ventilation
      - i. Bi-directional
      - ii. Negative pressure system

Show ventilation animation!

# Respiratory System Structures and Gas Exchange

- D. Breathing in birds versus mammals
  - 2. Mammals
    - c. Ventilation
      - iii. Alterations to volume to change pressure

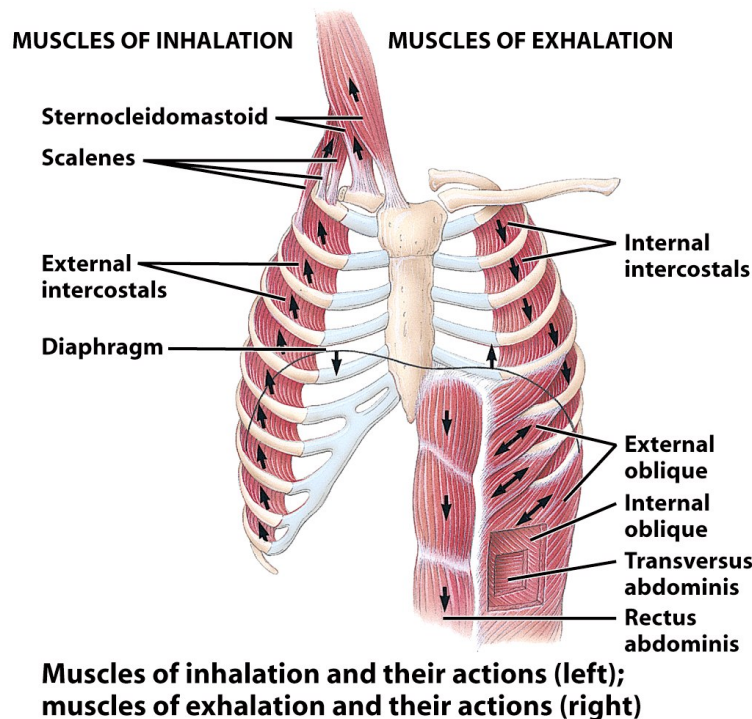


Figure 23-14a Principles of Anatomy and Physiology, 11/e  
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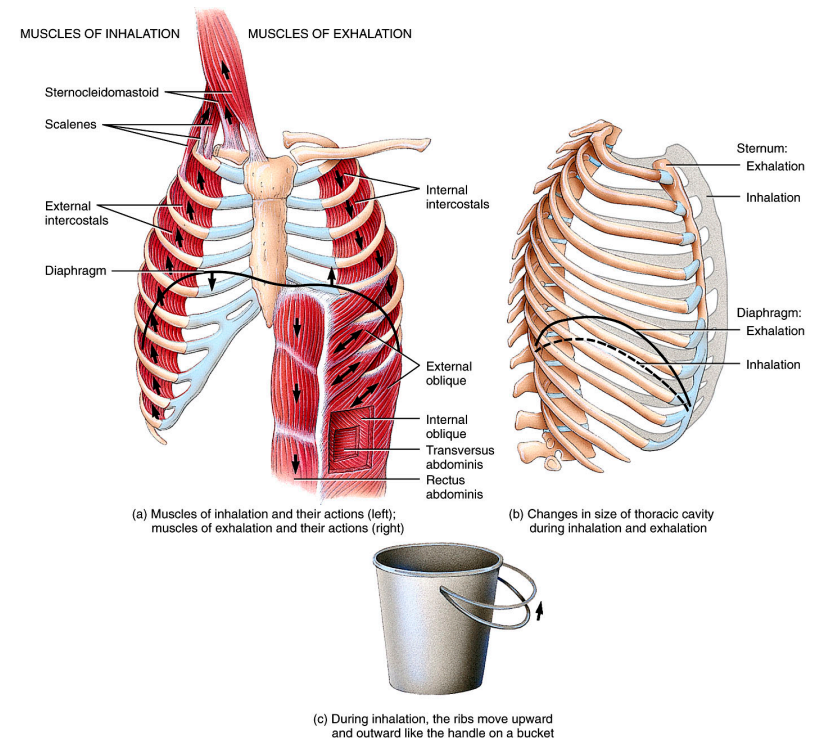


Figure 23.13 Tortora - PAP 12/e  
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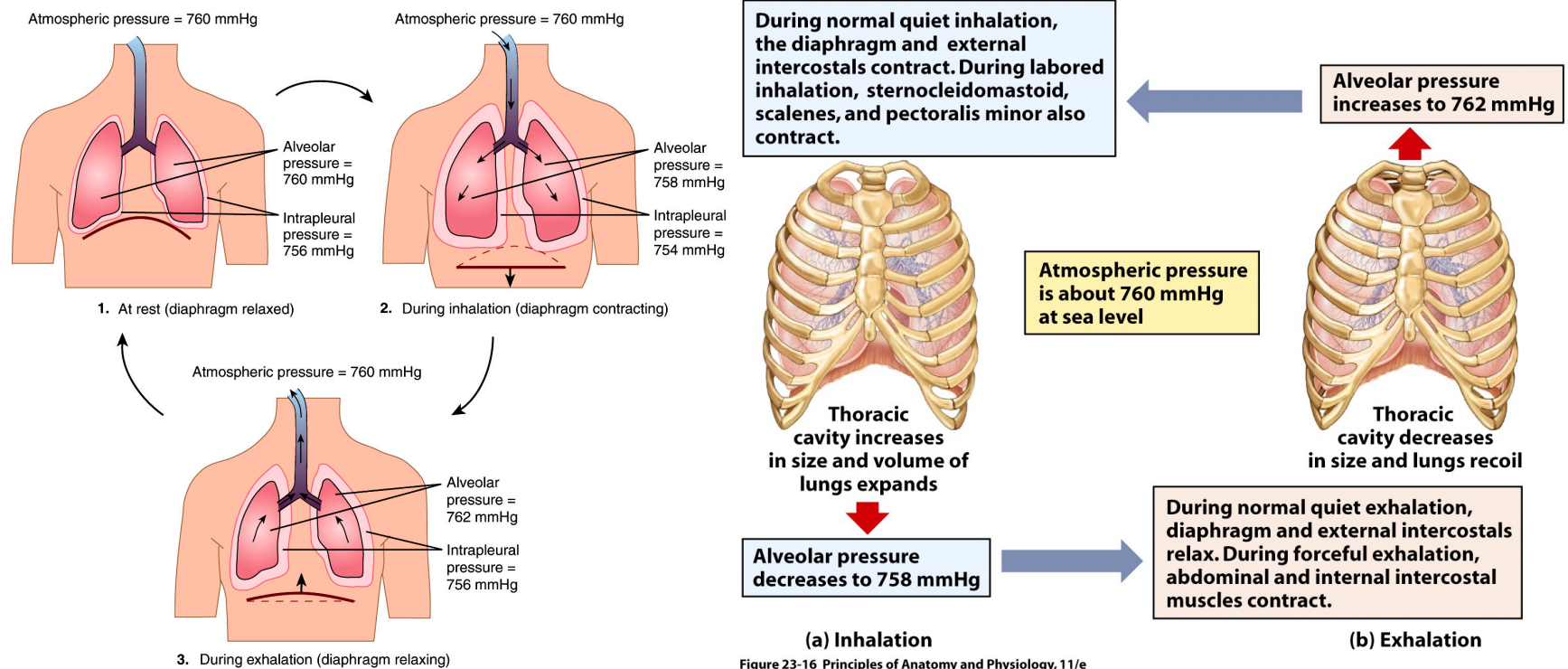
# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

### 2. Mammals

#### c. Ventilation

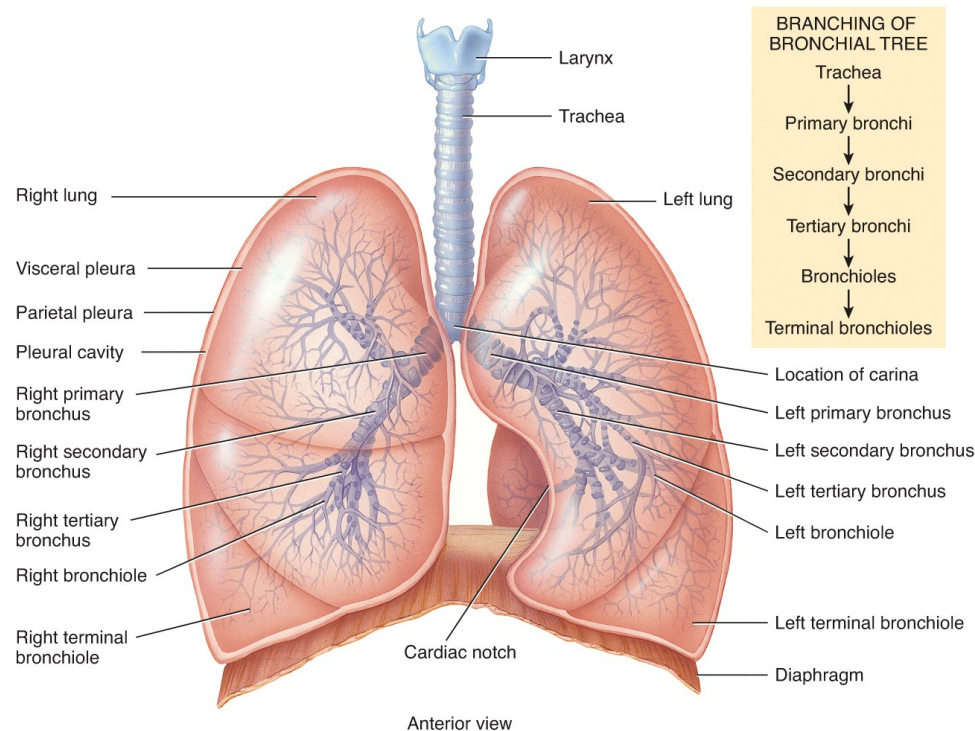
#### iii. Alterations to volume to change pressure



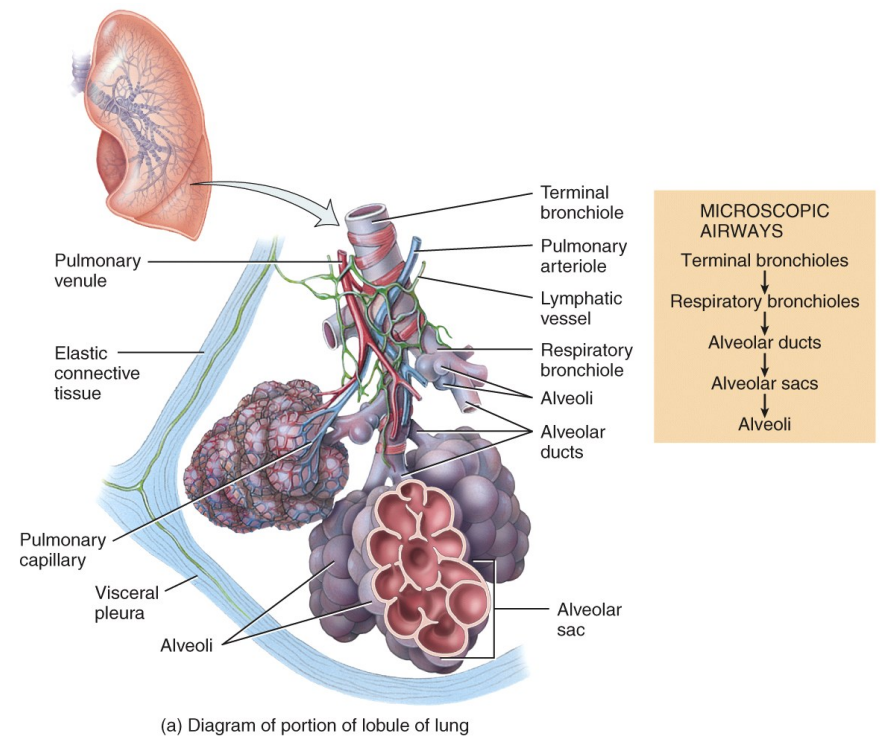


# Respiratory System Structures and Gas Exchange

- D. Breathing in birds versus mammals
  - 2. Mammals
    - d. Airway Structure and Function
      - i. Path of Airflow



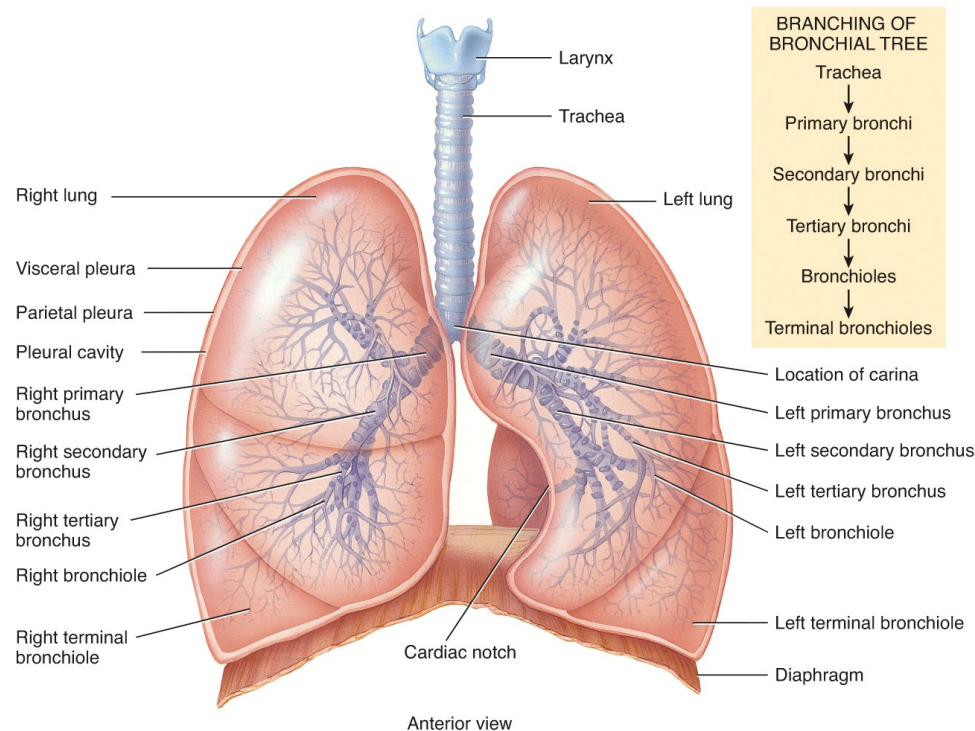
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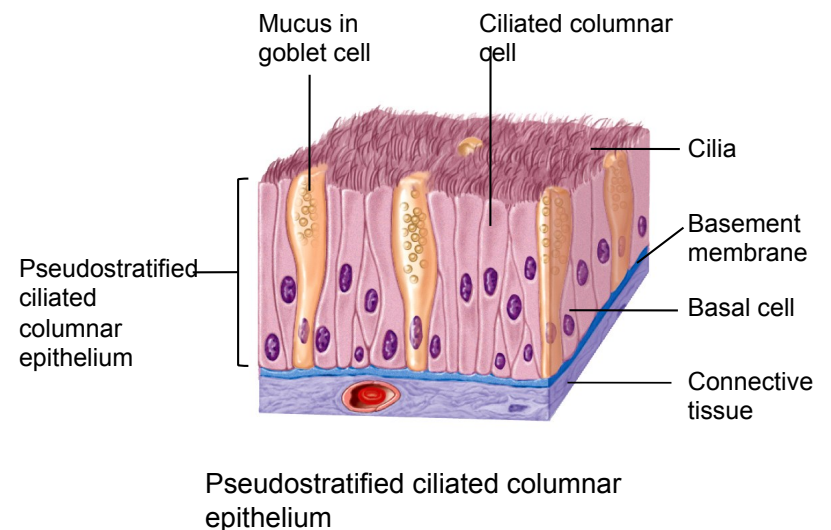
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# Respiratory System Structures and Gas Exchange

- D. Breathing in birds versus mammals
  - 2. Mammals
    - d. Airway Structure and Function
      - ii. Structures that filter the air



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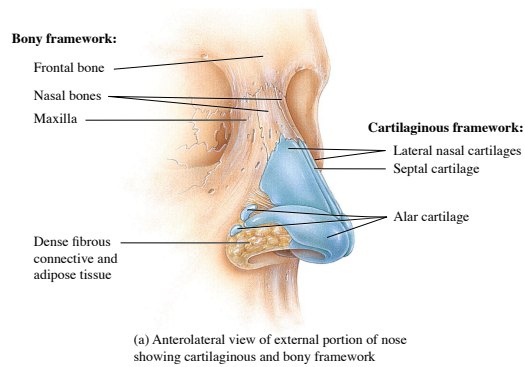
# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

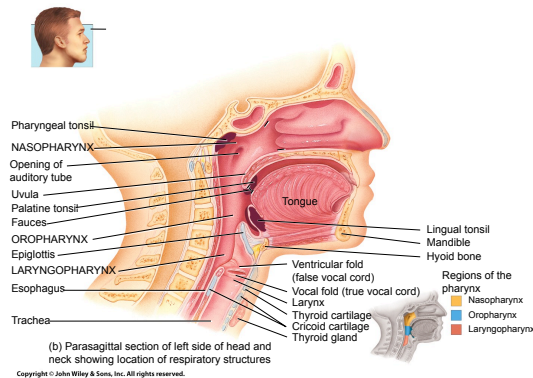
### 2. Mammals

#### d. Airway Structure and Function

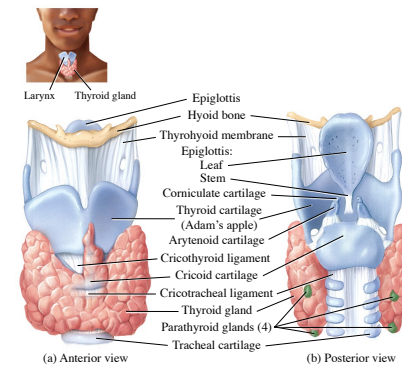
#### iii. Structures that keep the airways patent



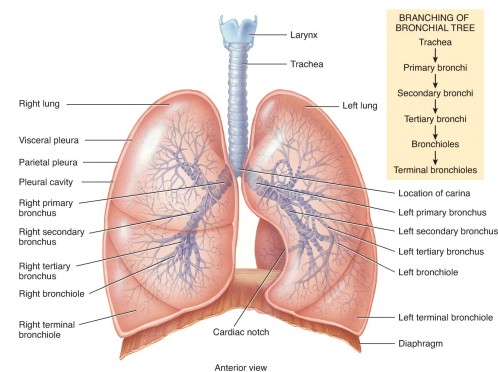
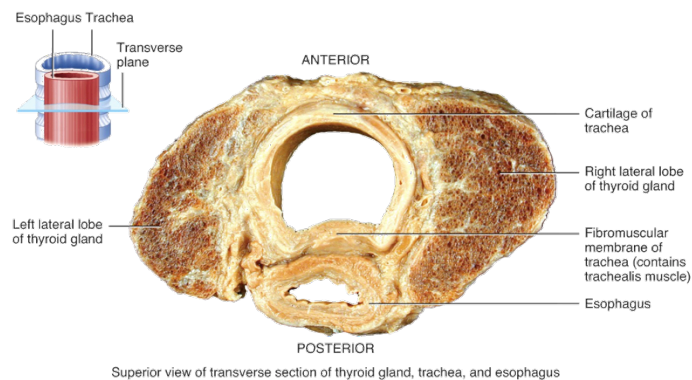
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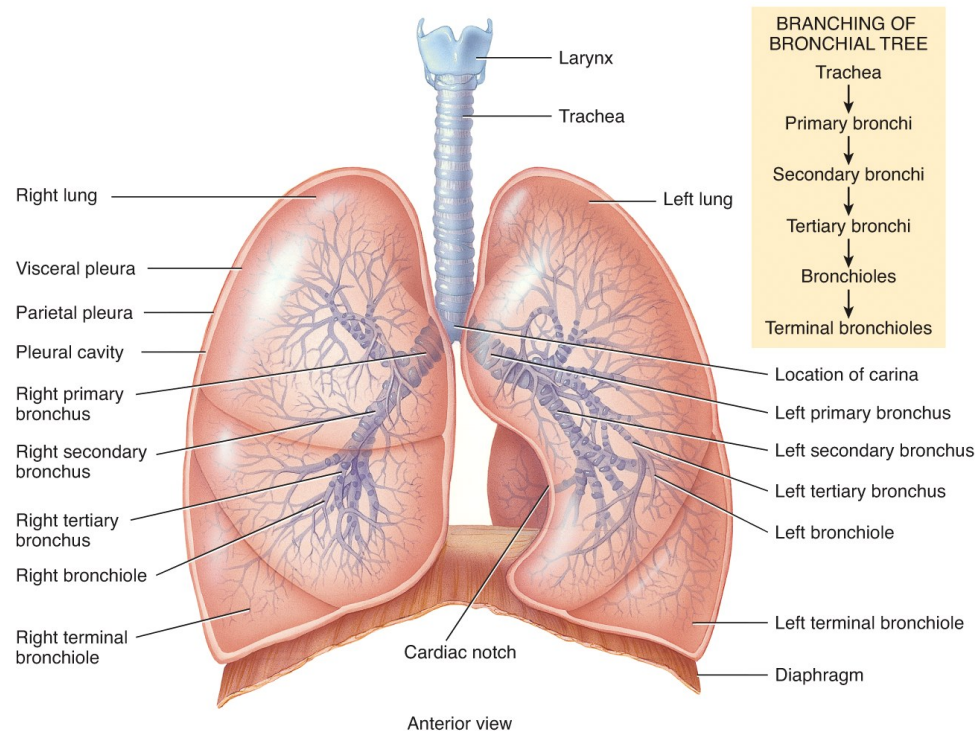
# Respiratory System Structures and Gas Exchange

## D. Breathing in birds versus mammals

### 2. Mammals

#### d. Airway Structure and Function

#### iv. Structures that allow for alteration of airflow



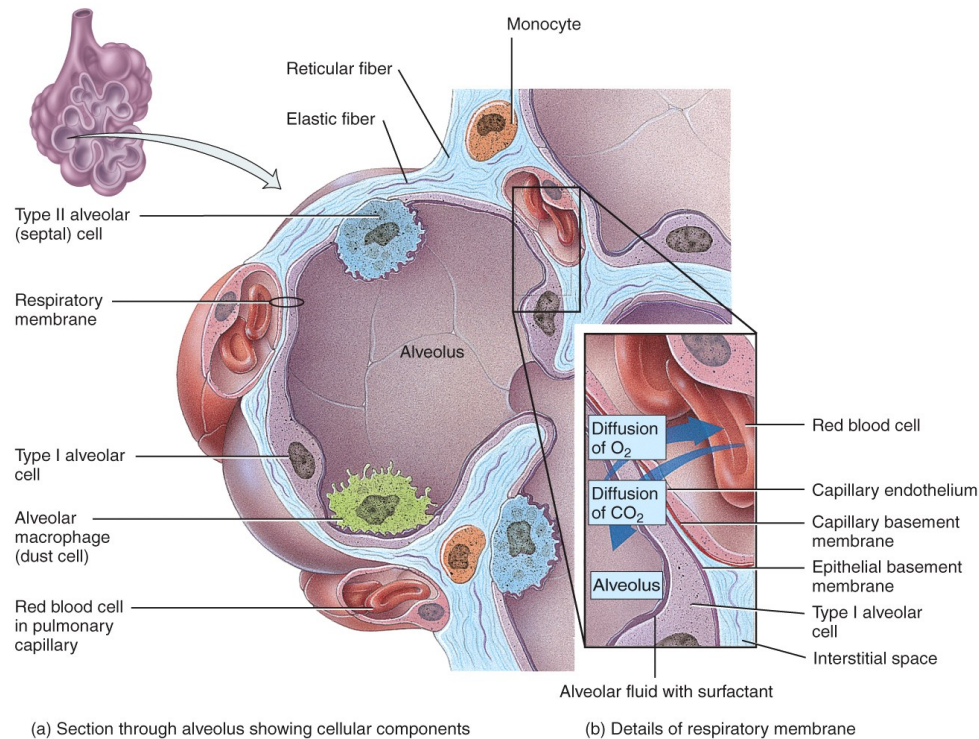
$$\text{Flow} = \frac{\Delta P}{R}$$

$$R = \frac{\pi \mu L}{r^4}$$



# Respiratory System Structures and Gas Exchange

- D. Breathing in birds versus mammals
  - 2. Mammals
    - d. Airway Structure and Function
      - v. Structures that allow for gas exchange



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