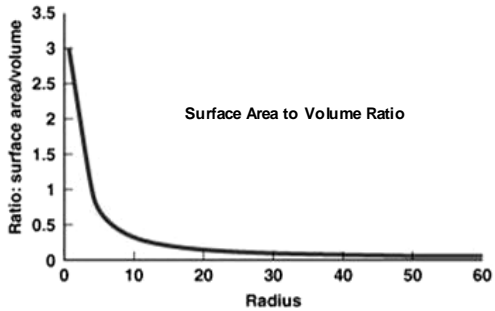


Chapter 22: External Respiration

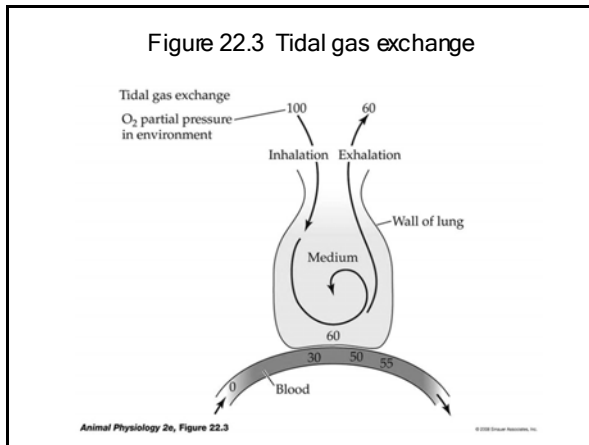


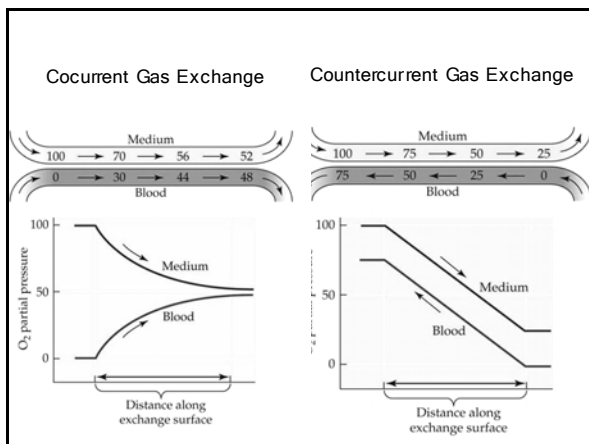
1. Surface Area to Volume Ratio
2. Fig 22.1 Generalized features of animal gas exchange
3. Evolution of Respiration
 - A. Limitations imposed by the surface area of three dimensional structures

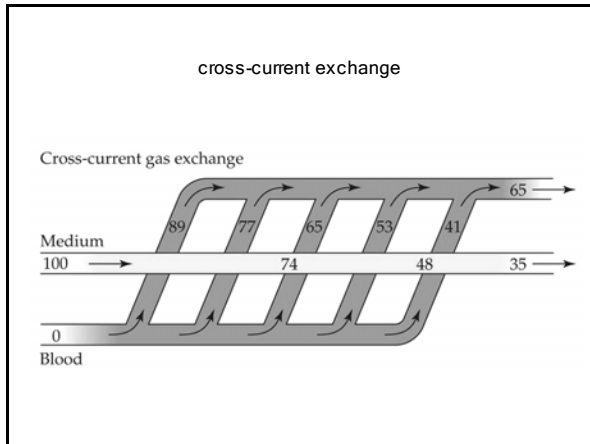
Specialized gas exchange surfaces

1. Gills (evaginations)
2. Lungs (invaginations)
3. Cutaneous
4. Tracheae

1. Ventilation of respiratory surfaces reduces the formation of static boundary layers
2. Passive ventilation
 - A. Nondirectional
3. Active ventilation
 - A. Tidal
 - B. Unidirectional







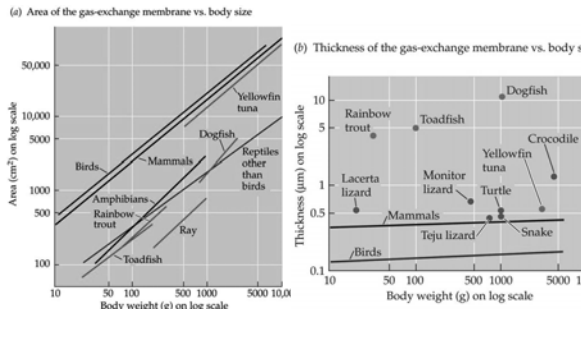
Ventilation and Gas Exchange

1. Different physical properties of air and water
2. Differences
 - A. $[O_{air}]$ 30x greater than $[O_{water}]$
 - B. Water is more dense and viscous than air
 - C. Evaporation is an issue for air breathers

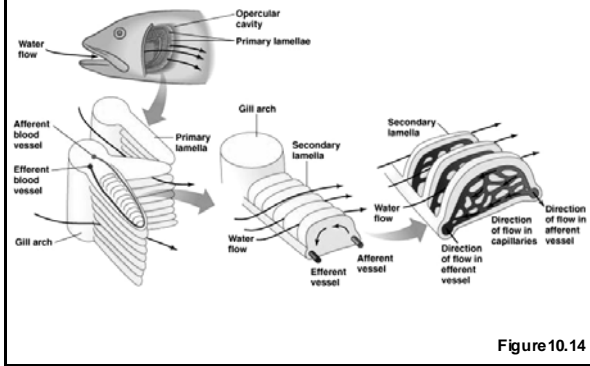
Ventilation of Gills

1. to replenish oxygen
 - A. move gill through water
 - B. move water over gill
2. Moving gill through the water limited to smaller organisms
3. Moving water over gill
 - A. ciliary action
 - B. mechanical pump

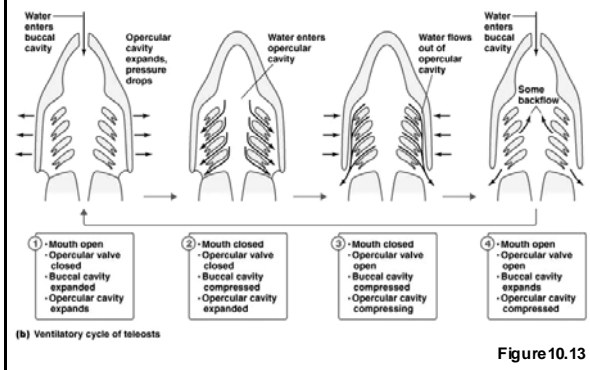
Fig 22.7 Total area and thickness of the gas-exchange membrane in the gills or lungs of vertebrates as functions of body size



Fish Gills



Bony fish gill ventilation



Ram Ventilation

1. Continuous swimming, with mouth open
2. large, fast-swimming pelagic fish
3. Most fish pump at low speed
4. Switch to ram ventilation at high speed

Water to Land

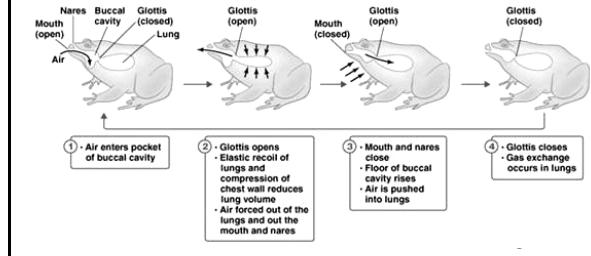
1. More O₂ in air than in water
 - A. Water = 0.5 - 1%
 - B. Land = ~ 21%
2. Mollusks, arthropods, and fish
3. Two problems at gills
 - A. no support
 - B. evaporation

Air Breathing Fish

1. Several hundred species of bony fish
2. Live in oxygen poor environments
3. Use various vascularized tissues
4. Vertebrate lungs are outpocketings of the esophagus

Amphibians

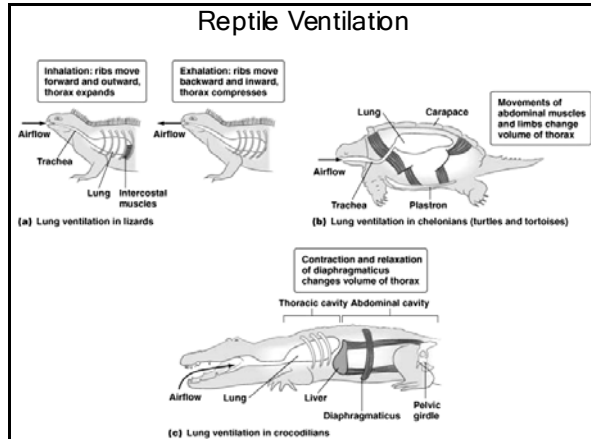
1. Cutaneous respiration
2. External gills
3. Simple bilobed lungs;



Reptiles

1. Most have two lungs
2. Can be simple or highly divided
3. Ventilation
 - A. Tidal
 - B. Suction pumps
 - C. separate feeding and respiratory muscles
4. inspiration and expiration
5. several mechanisms to change the volume

Reptile Ventilation



Mammals

