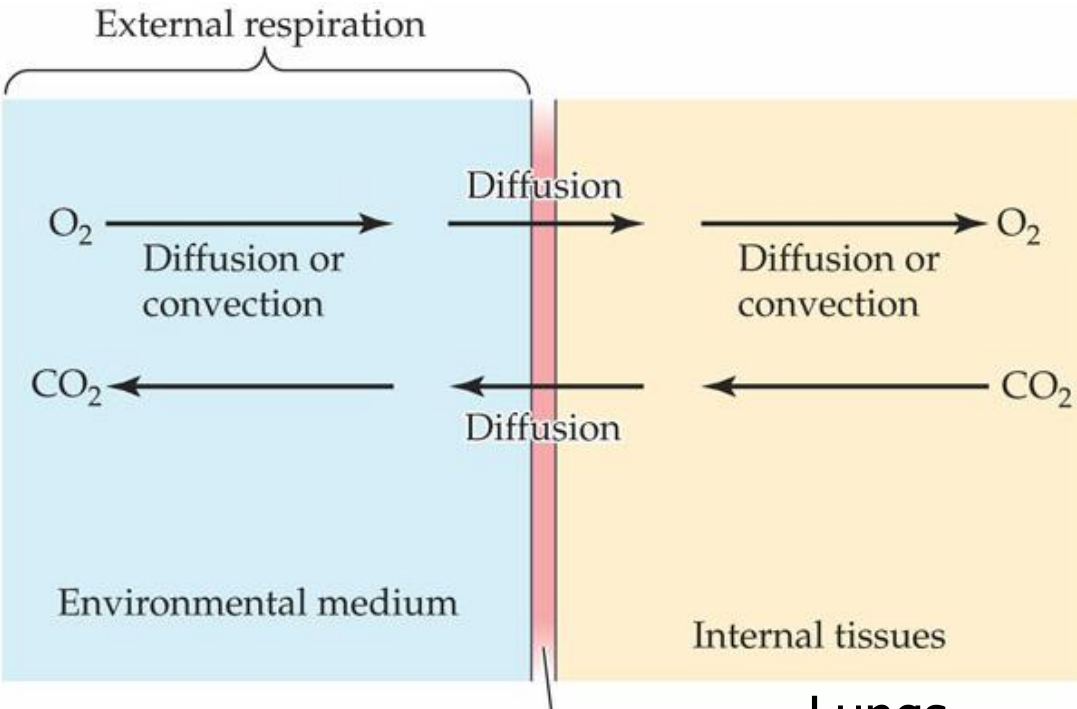
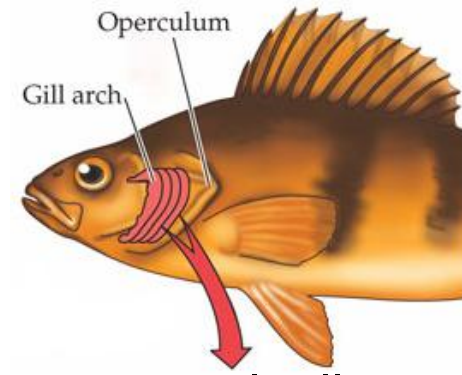
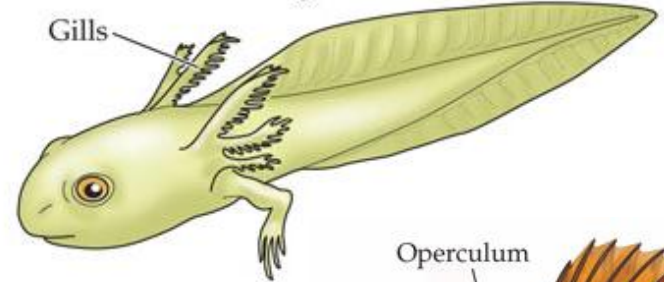


Vertebrate respiratory structures and gas exchange

Gas exchange surfaces are generally thin epithelia with large surface areas



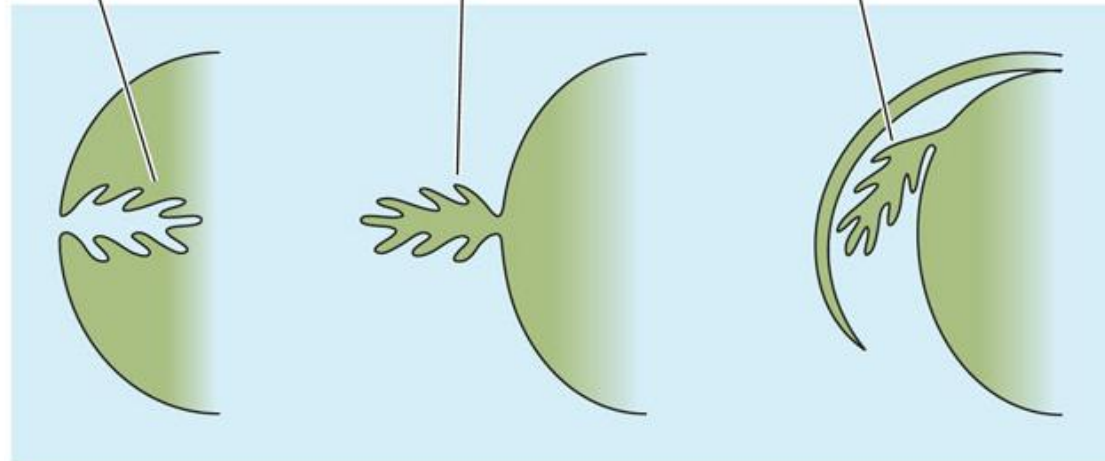
Salamander larva with gills



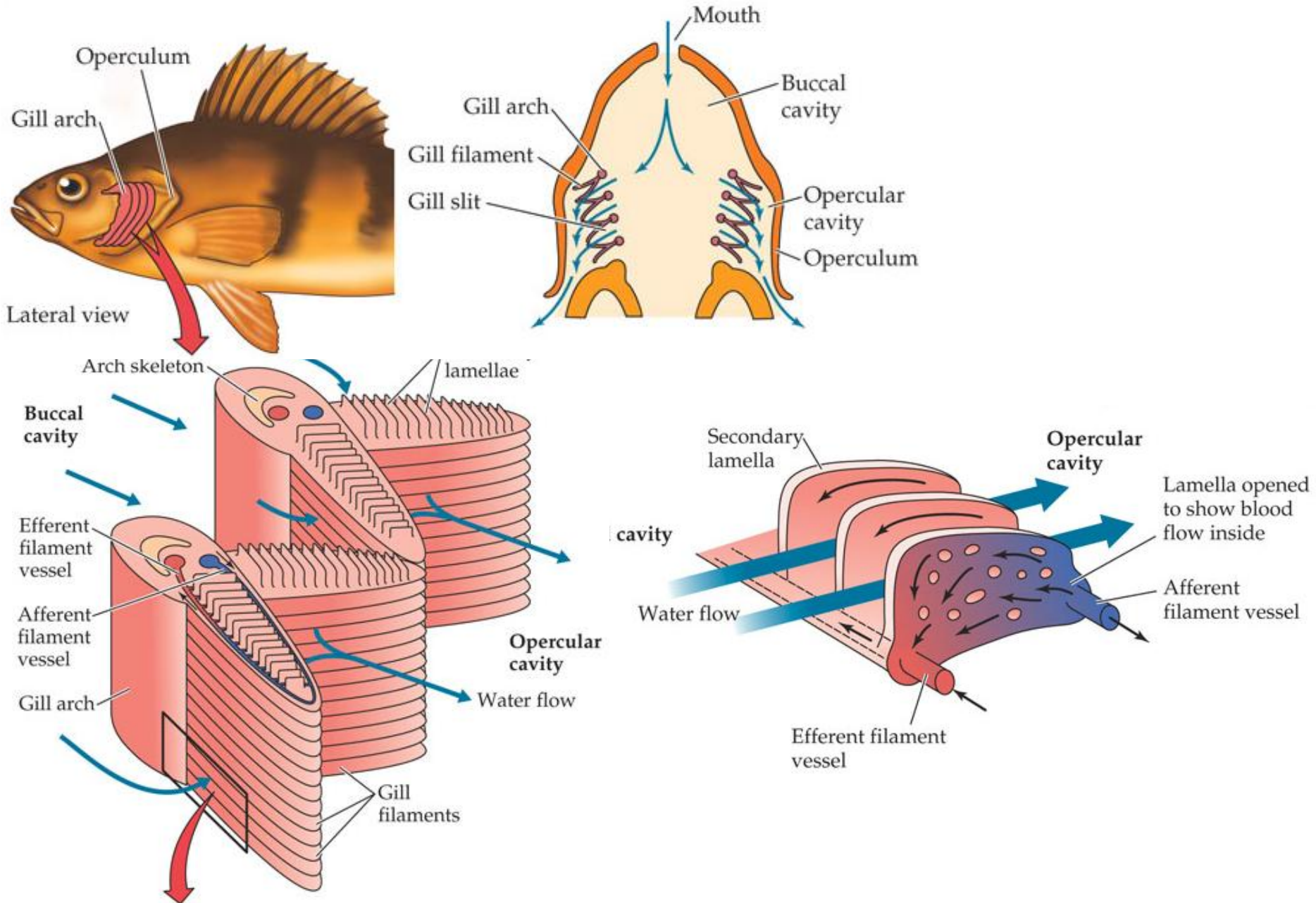
Lungs

External gills

Internal gills



Aquatic breathing – vertebrate gills



Countercurrent gas exchange

(a) Concurrent gas exchange

(b) Countercurrent gas exchange

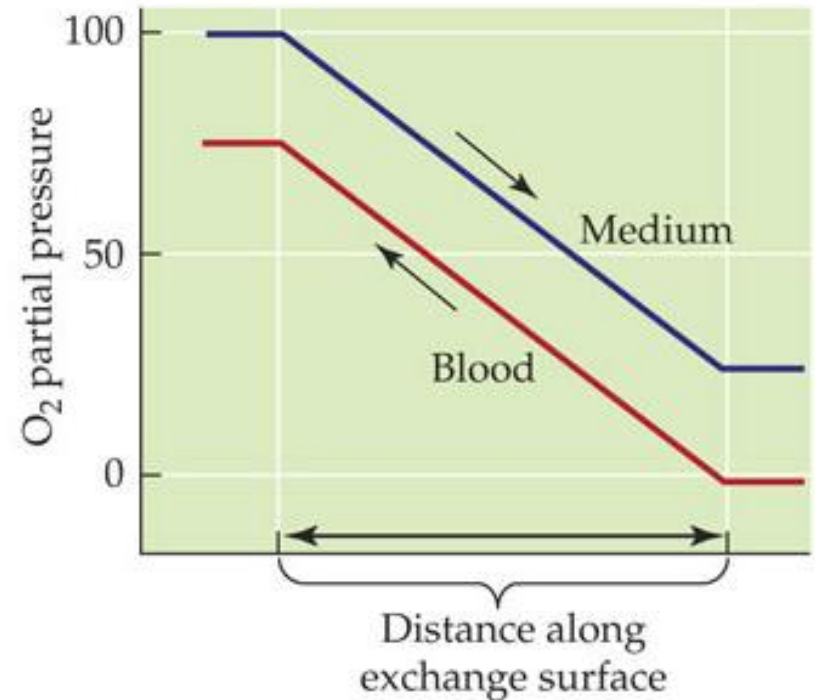
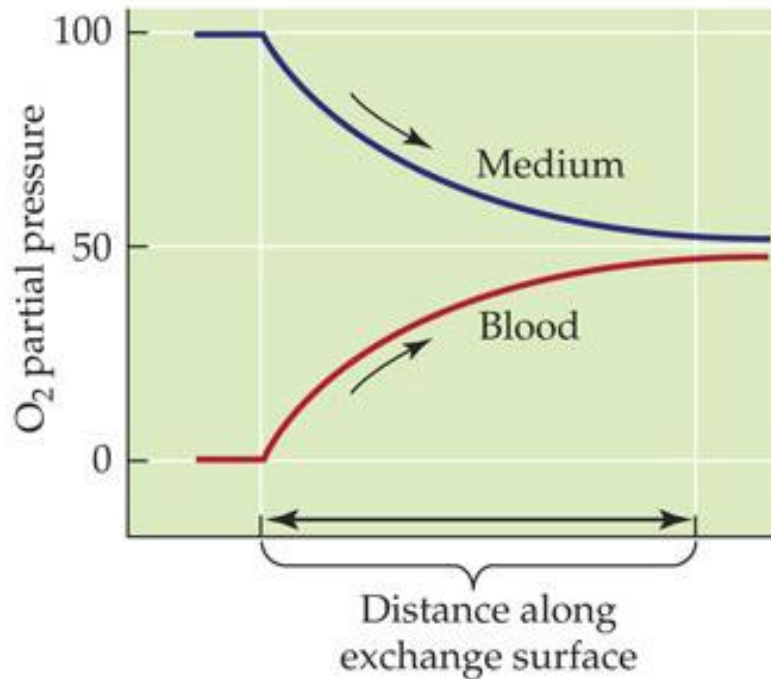
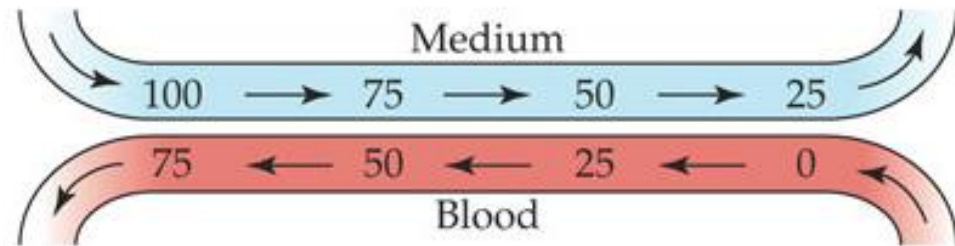
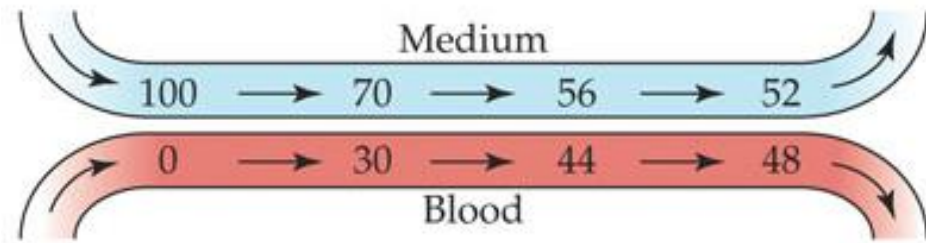
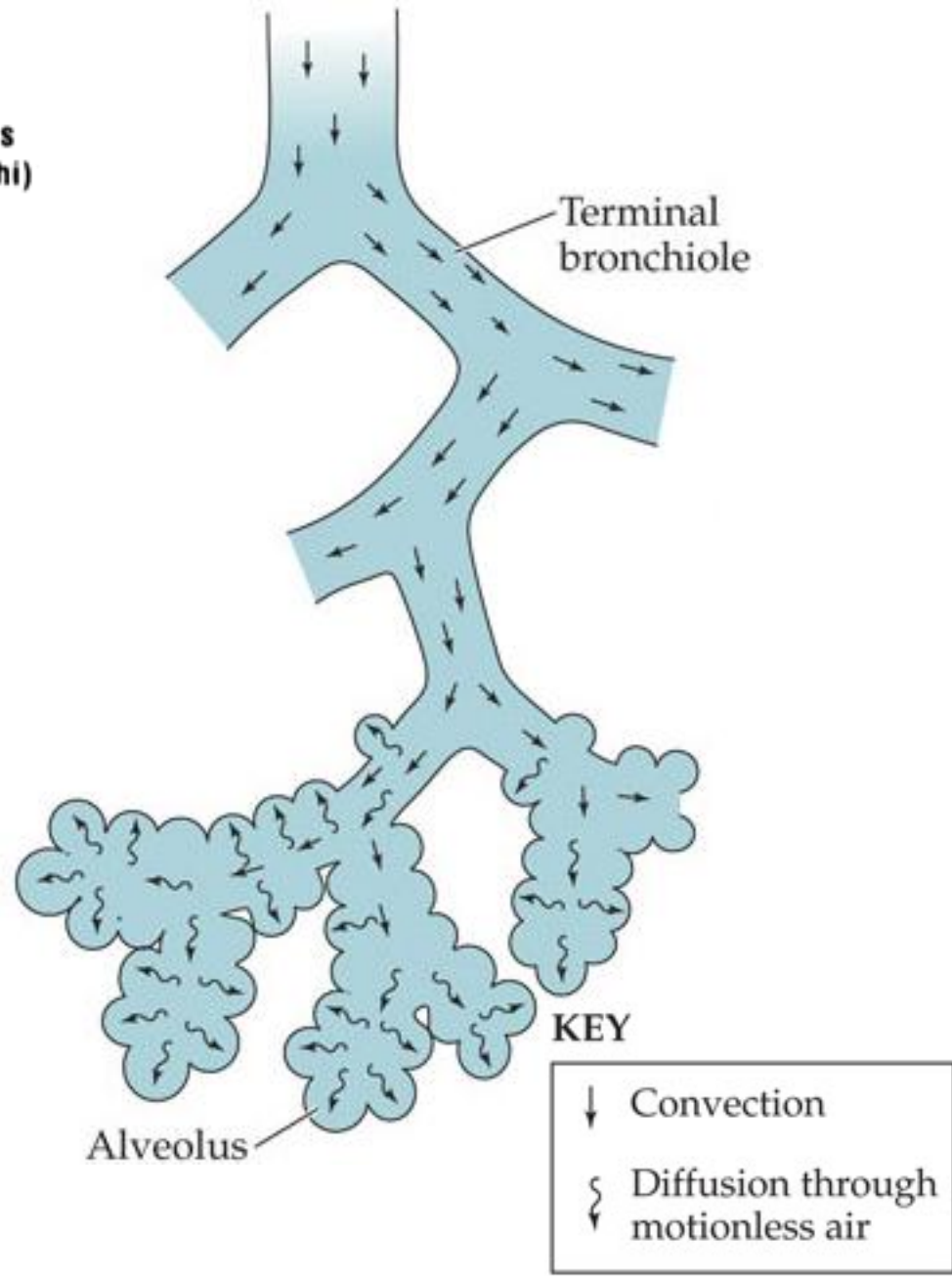
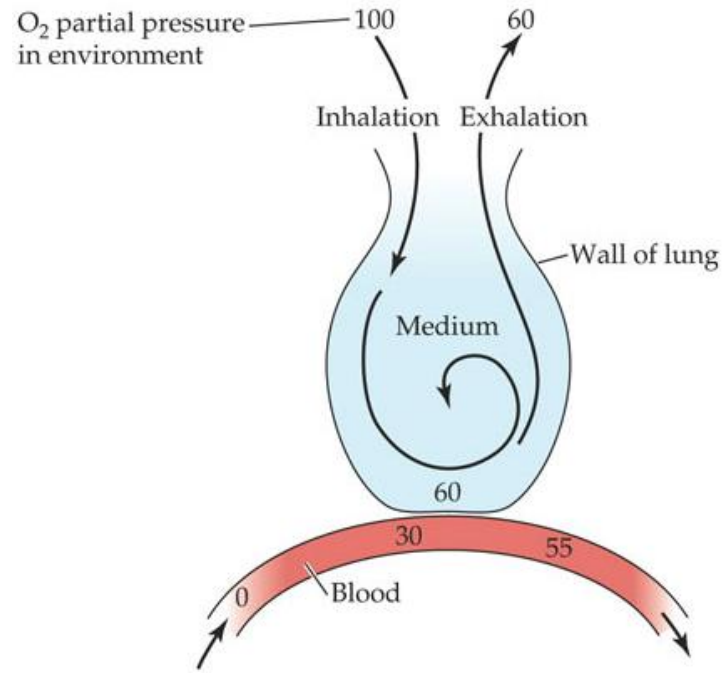
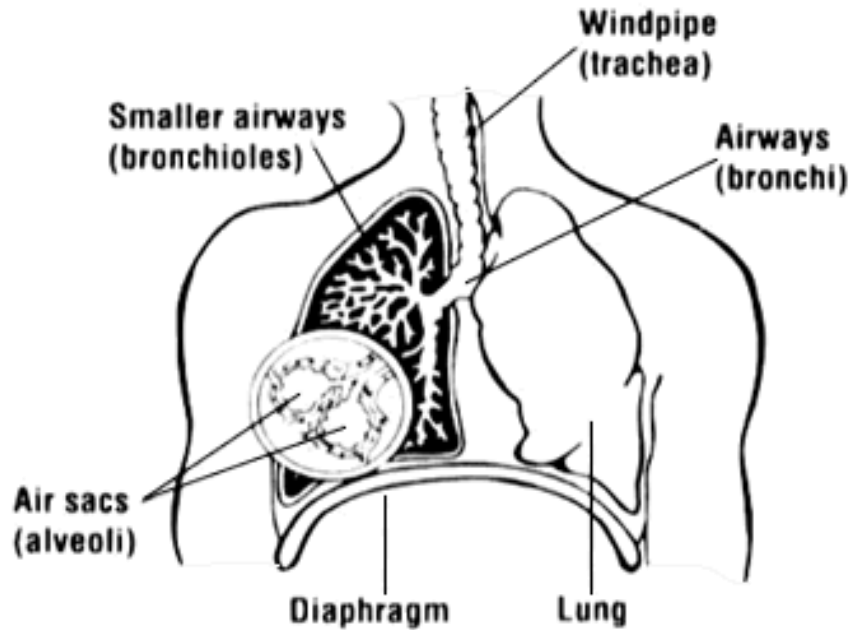




Photo M. Lutcavage

Aerial breathing – vertebrate lungs





Bird lungs – unidirectional flow

