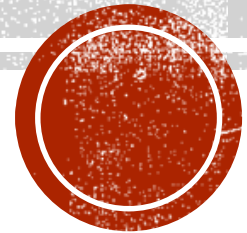


PULMONARY PHYSIOLOGY

Alexander Villareal, MD

Wisconsin Sleep Society - May 6th, 2016



DISCLOSURES

- I am an employee of The Sleep Wellness Institute Inc.
- I am NOT receiving direct or indirect payment from any other commercial entity for honorarium, travel or other expenses



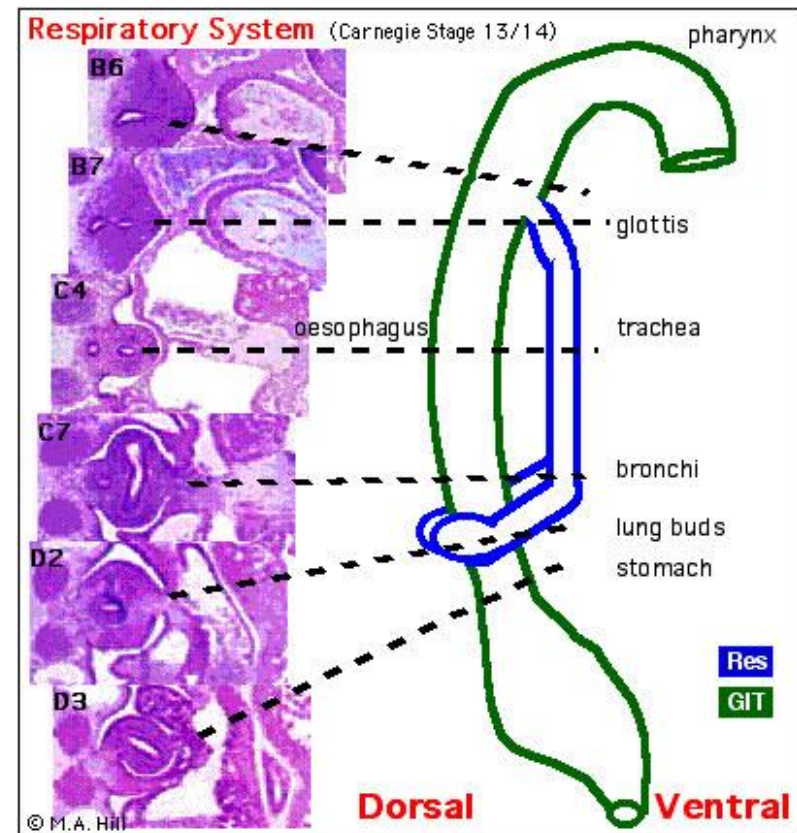
EDUCATIONAL OBJECTIVES

- To describe the anatomy of the respiratory system
- To identify the physiology of the respiratory system
- To correlate clinical findings with anatomy of the respiratory system



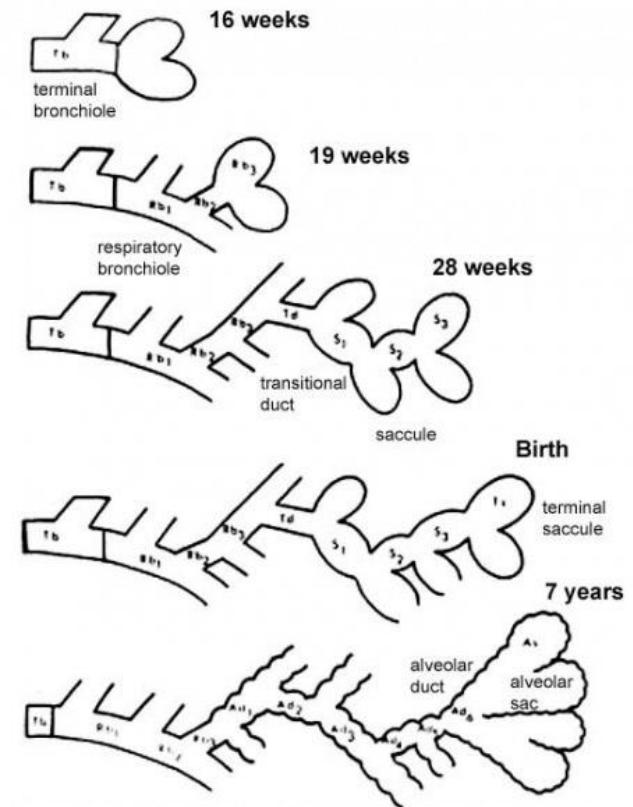
EMBRYOLOGY OF THE RESPIRATORY SYSTEM

- Association between the foregut and the early respiratory system at 4-5 weeks of development
- Excerpts of the histology sections and their approximate level are shown in the cartoon of the embryonic respiratory/gastrointestinal tracts
- initial bifurcation of foregut (oesophagus) and respiratory (trachea).
- heart (ventral) and the dorsal aortas (dorsal) to the lung buds.
- stomach below the lung buds.
- narrow pleural canals outside the lung buds.



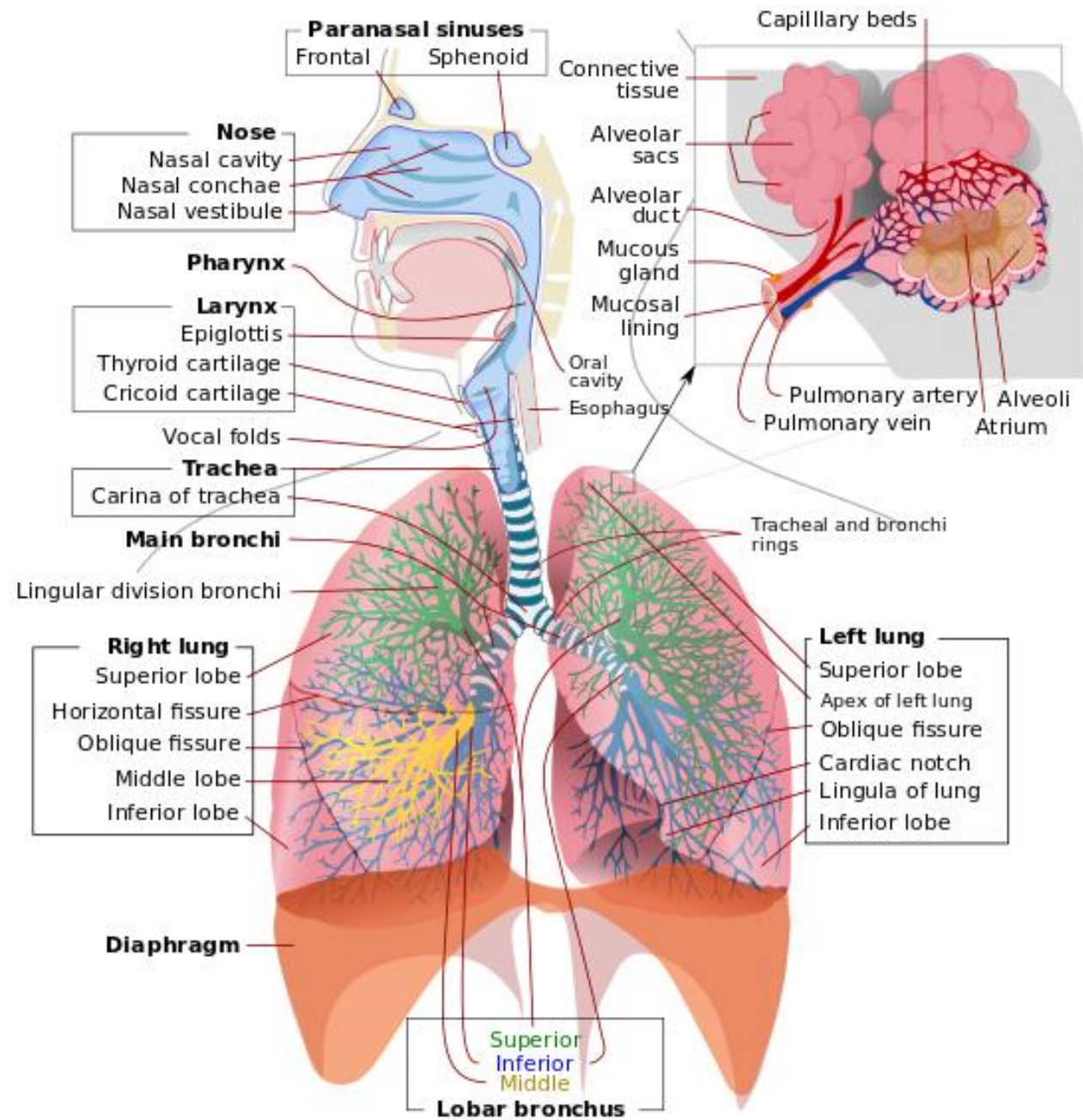
EMBRYOLOGY OF THE RESPIRATORY SYSTEM

- Week 4 - laryngotracheal groove forms on floor foregut.
- Week 5 - left and right lung buds push into the pericardioperitoneal canals (primordia of pleural cavity)
- Week 6 - descent of heart and lungs into thorax. Pleuroperitoneal foramen closes.
- Week 7 - enlargement of liver stops descent of heart and lungs.
- Month 3-6 - lungs appear glandular, end month 6 alveolar cells type 2 appear and begin to secrete surfactant.
- Month 7 - respiratory bronchioles proliferate and end in alveolar ducts and sacs.

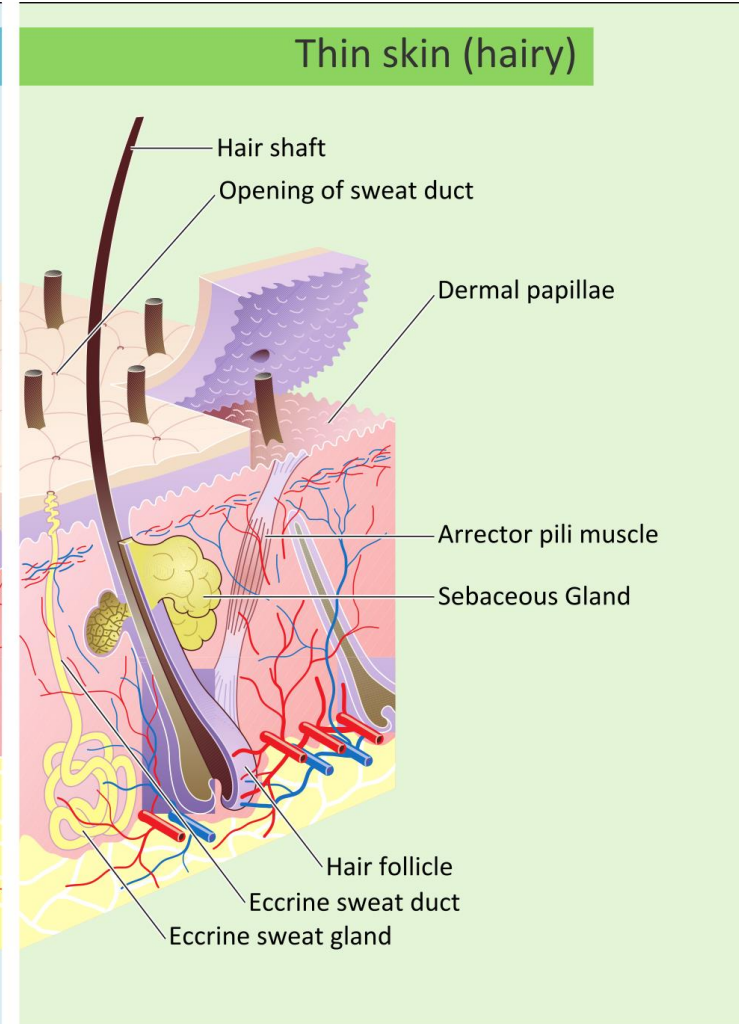
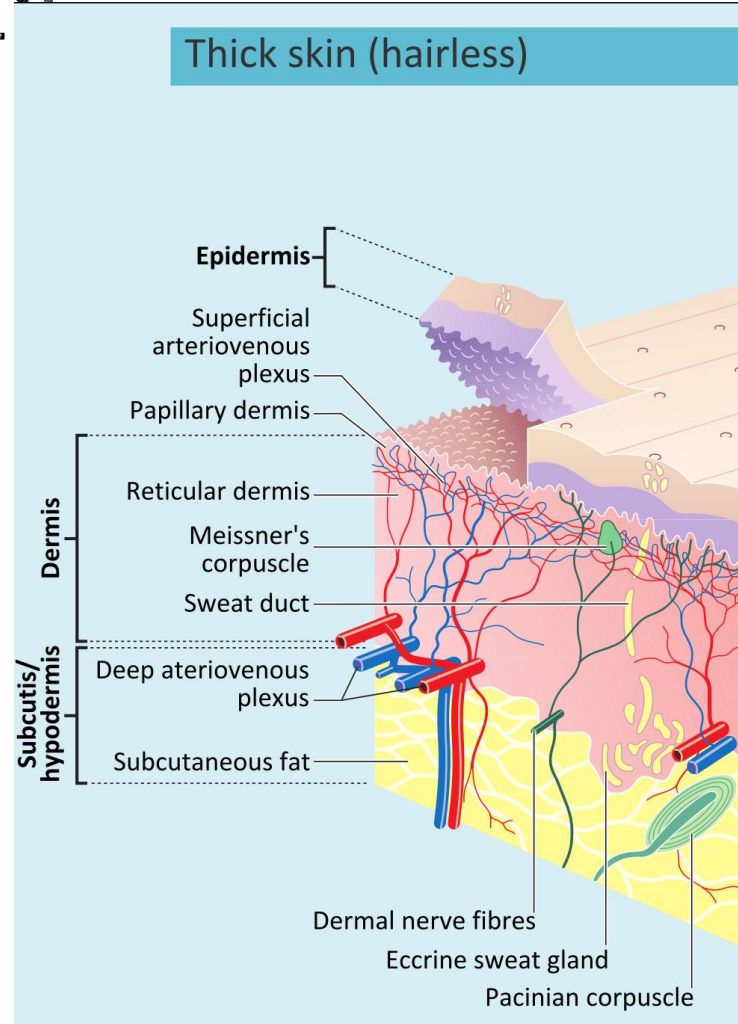


Modified from Dilly SA. Thorax. 1984 Oct;39(10):733-42. PMID: 6495241





SKIN



SKIN PROBLEMS

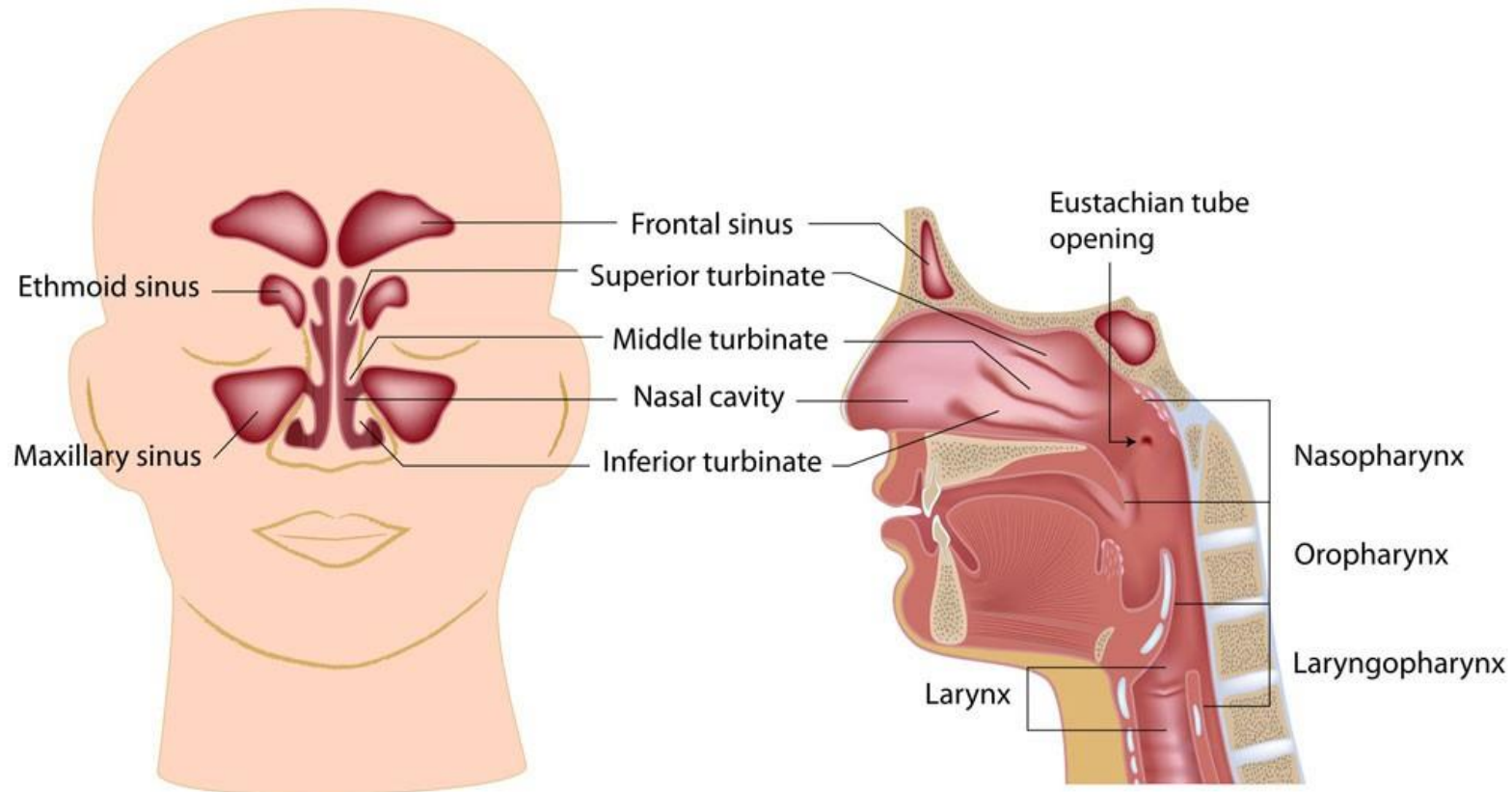


SOLUTIONS

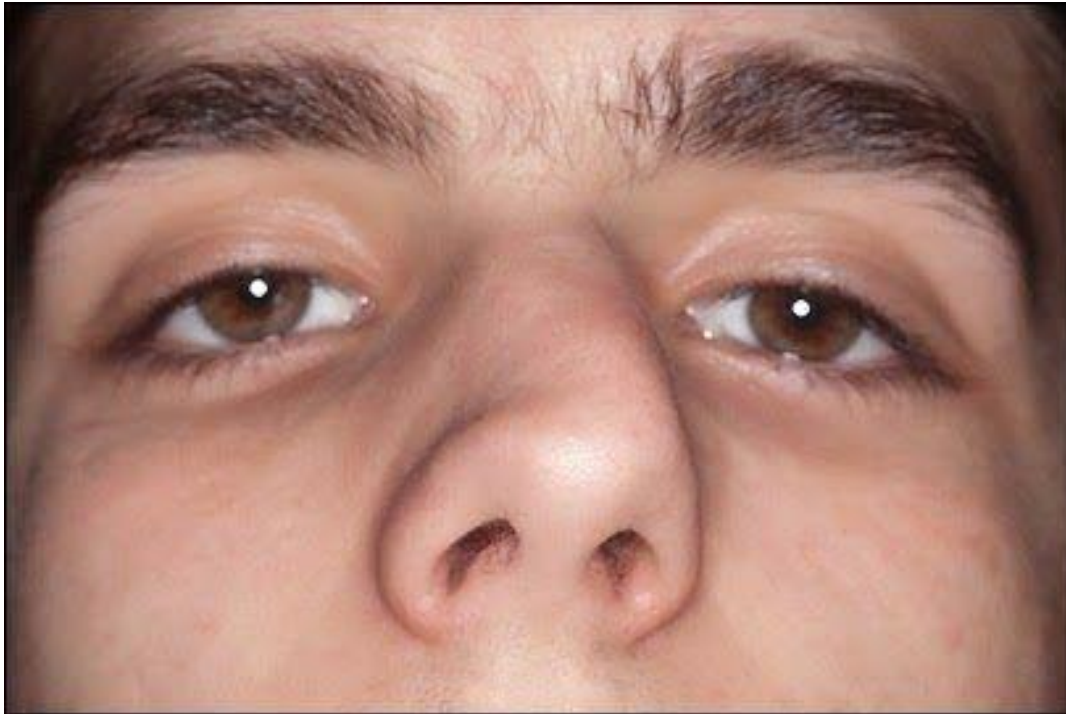


NOSE

Anatomy of the Nose



NASAL PROBLEMS



Health Matters

Nasal polyps

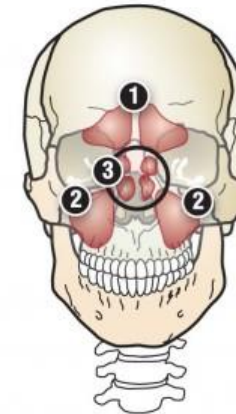
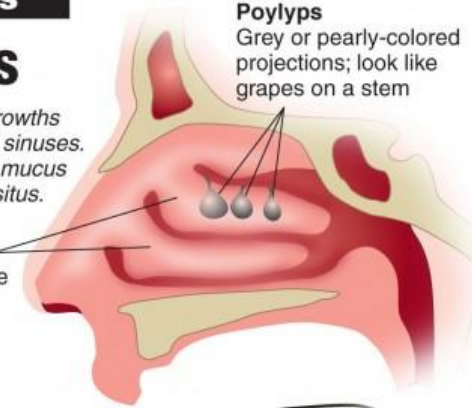
Nasal polyps are sac-like growths of inflamed tissue lining the sinuses. They can block drainage of mucus resulting in infection or sinusitis.

Ostia Small openings connect sinuses to nose

Polyps Commonly grow near ostia

Polyps

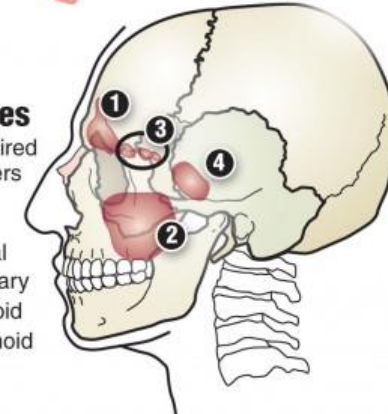
Grey or pearly-colored projections; look like grapes on a stem



Sinuses

Four paired chambers in skull

- 1 Frontal
- 2 Maxillary
- 3 Ethmoid
- 4 Sphenoid



Symptoms

- Mouth breathing
- Nasal obstruction
- Constant runny nose
- Sense of smell loss

Polyp risk factors

- Asthma
- Chronic sinus infections
- Cystic fibrosis
- Hay fever
- Allergy to aspirin

Treatment

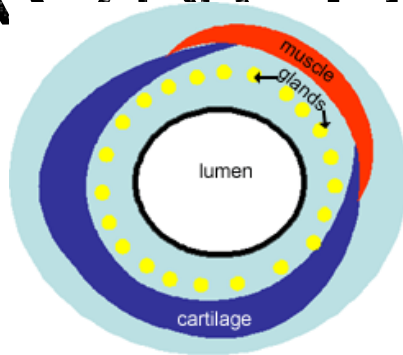
- **Drugs** can shrink small polyps
- **Surgery** removes large polyps, restores normal drainage; polyps can regrow

Source: National Institutes of Health (U.S.), Intelihealth, theasthmacenter.com Graphic: Lee Hulteng, Judy Treible

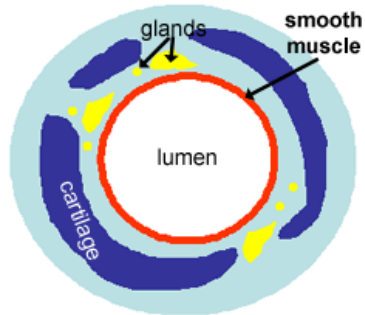
© 2009 MCT



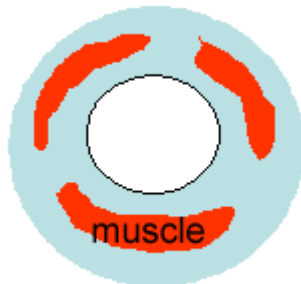
TRACHEA, BRONCHIOLES AND BRONCHI



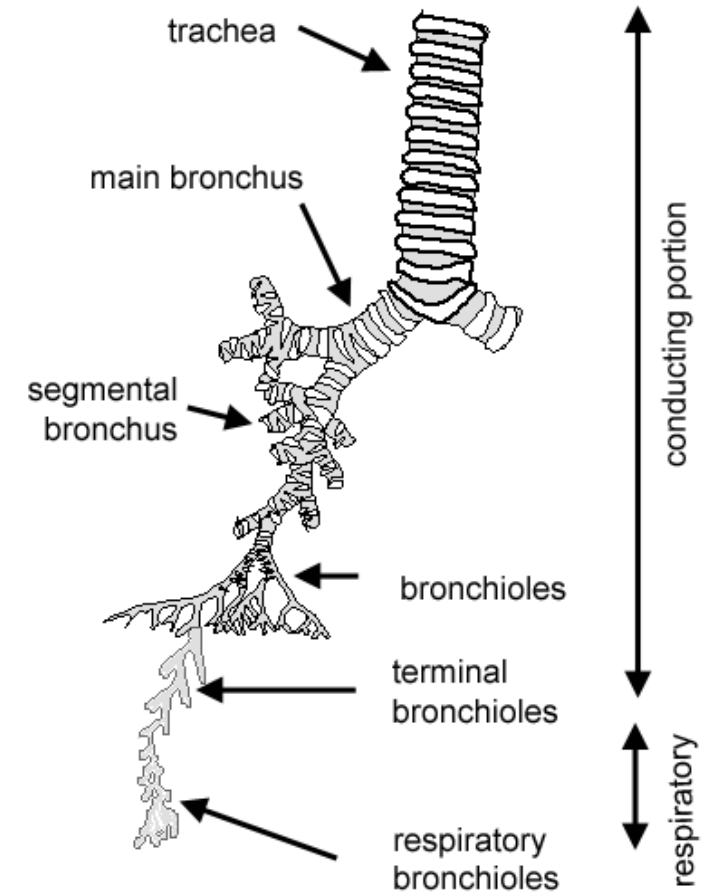
Trachea



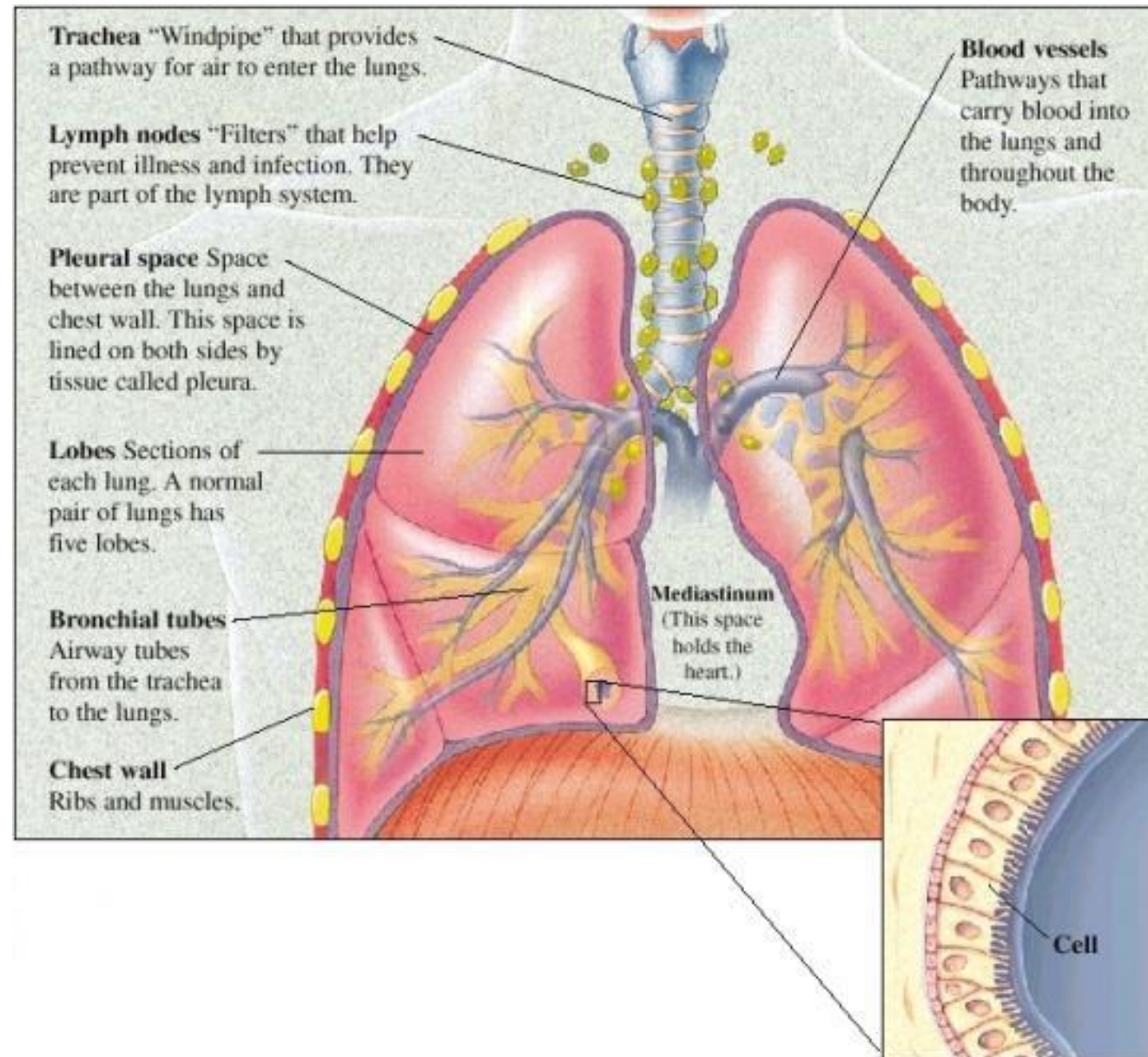
Bronchii



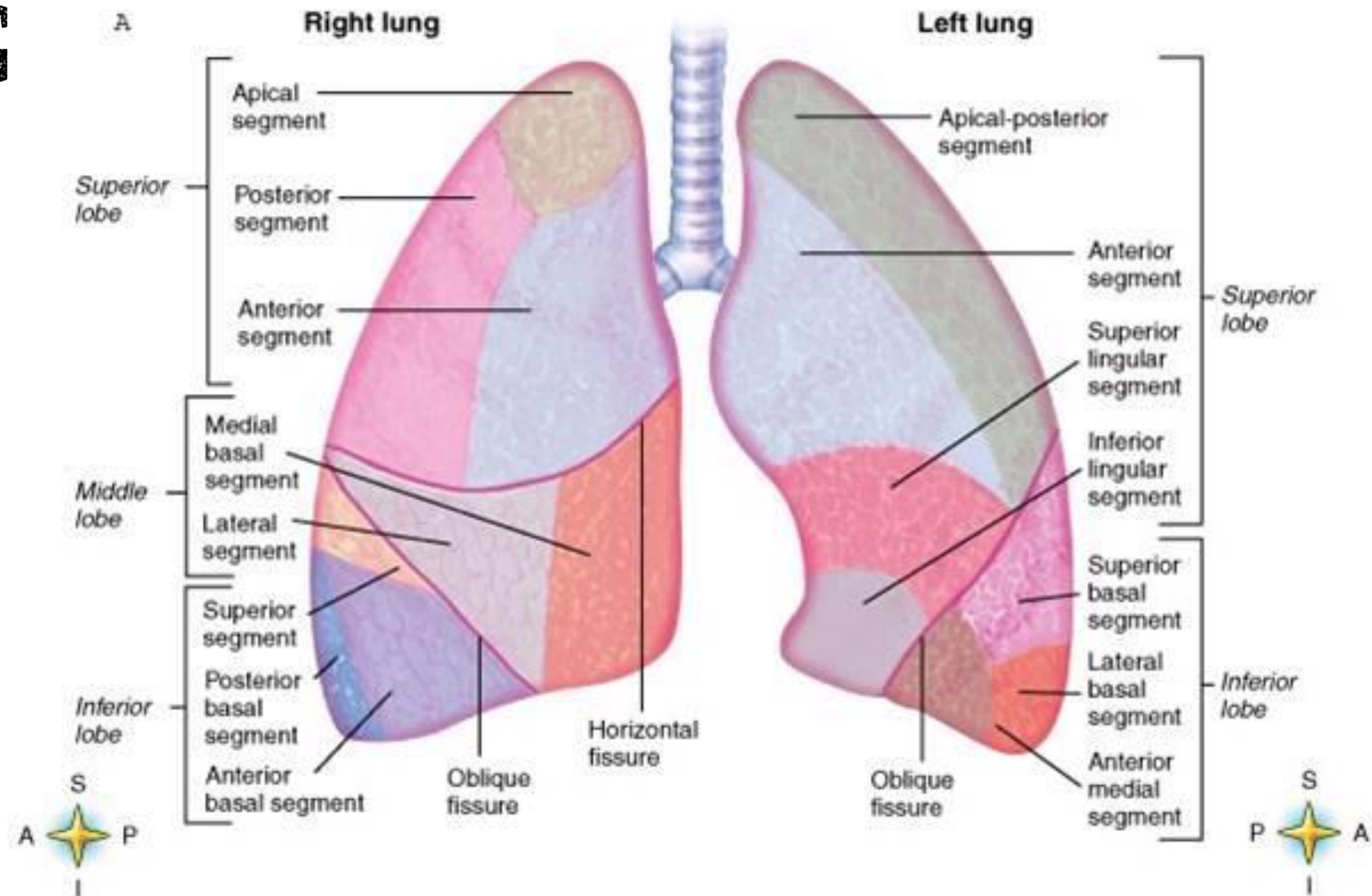
Bronchioles



LUNGS

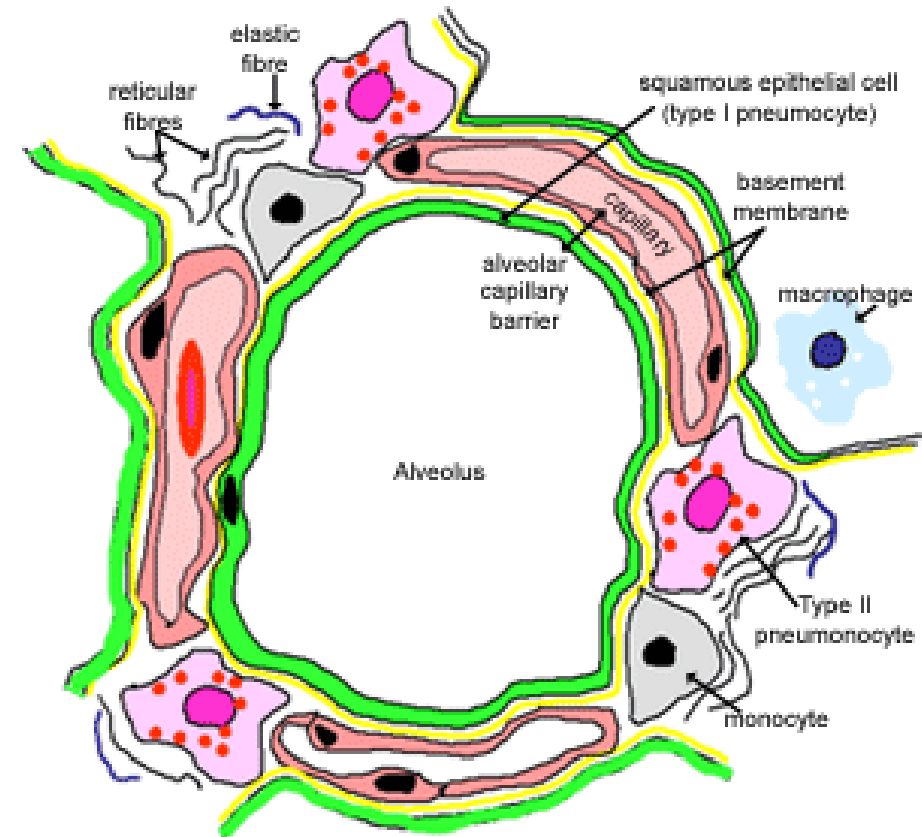


LUNG

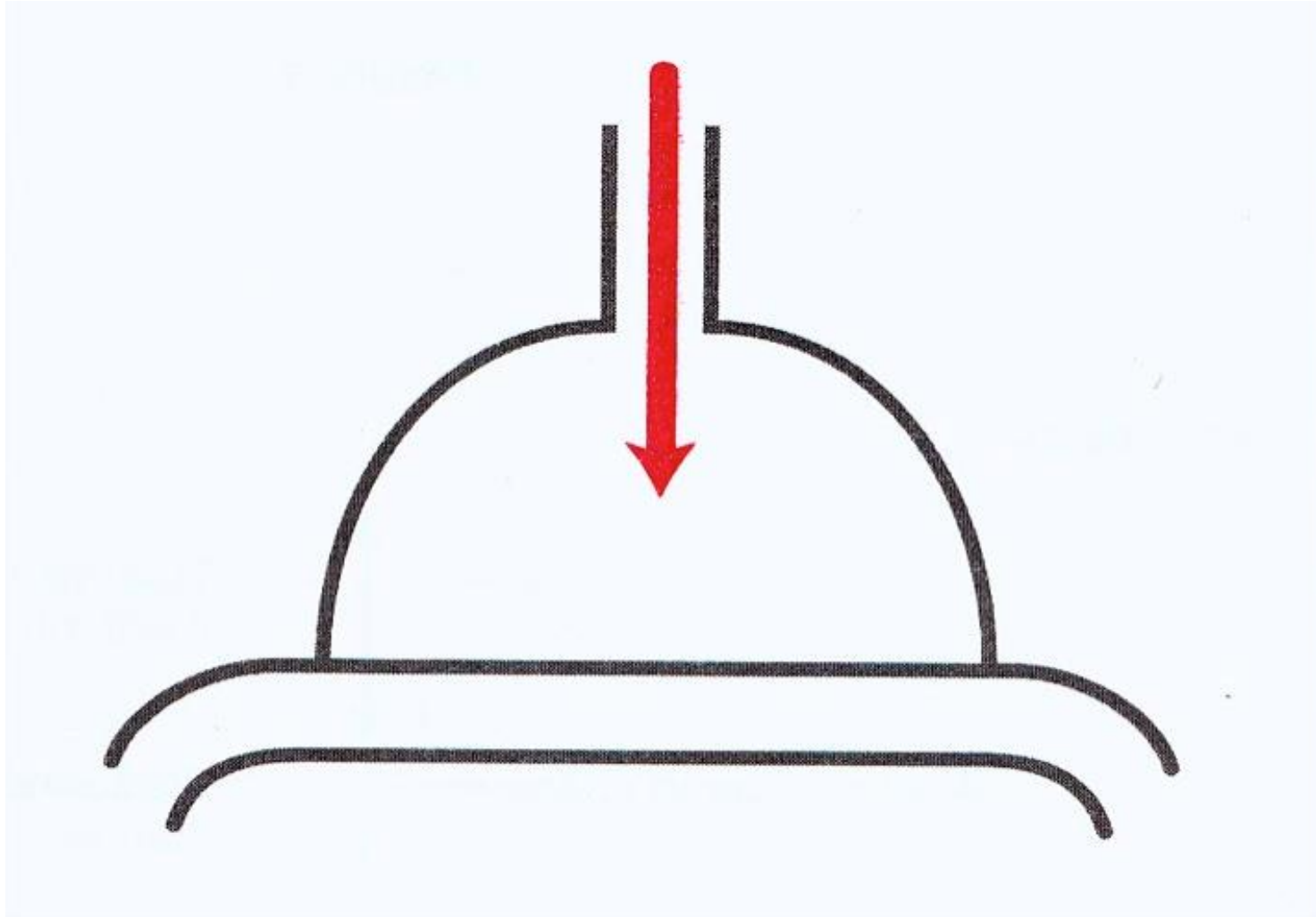


HISTOLOGY - ALVEOLI

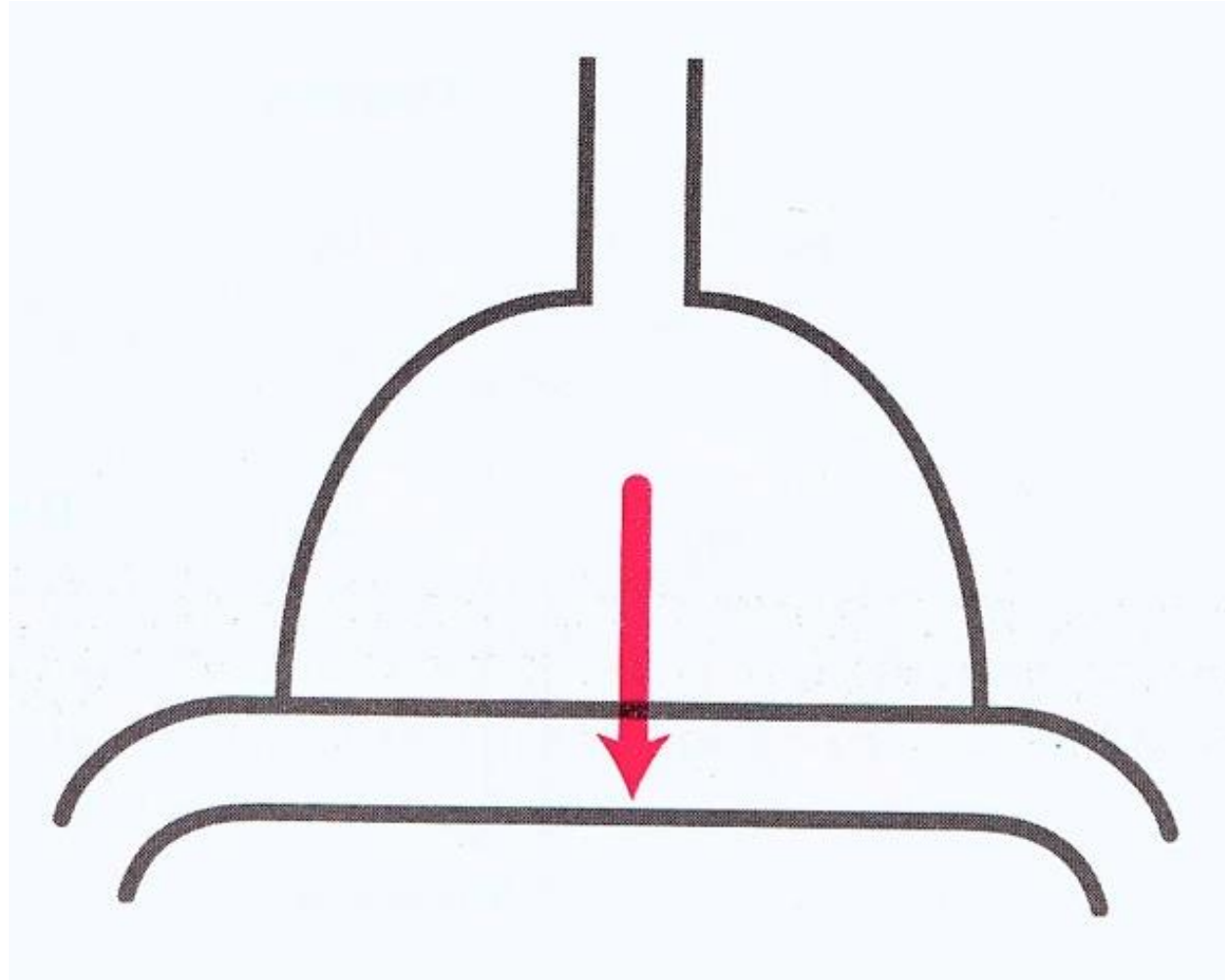
- Epithelium
 1. type I pneumocytes: large flattened cells - 95% area
 2. type II pneumocytes - 5% area & 60% number of cells. Secrete 'surfactant'
- Surfactant overcomes surface tension preventing alveoli from collapse
- Macrophages are important for ingesting bacteria and particles, and arise from monocytes, which have escaped from the blood capillaries



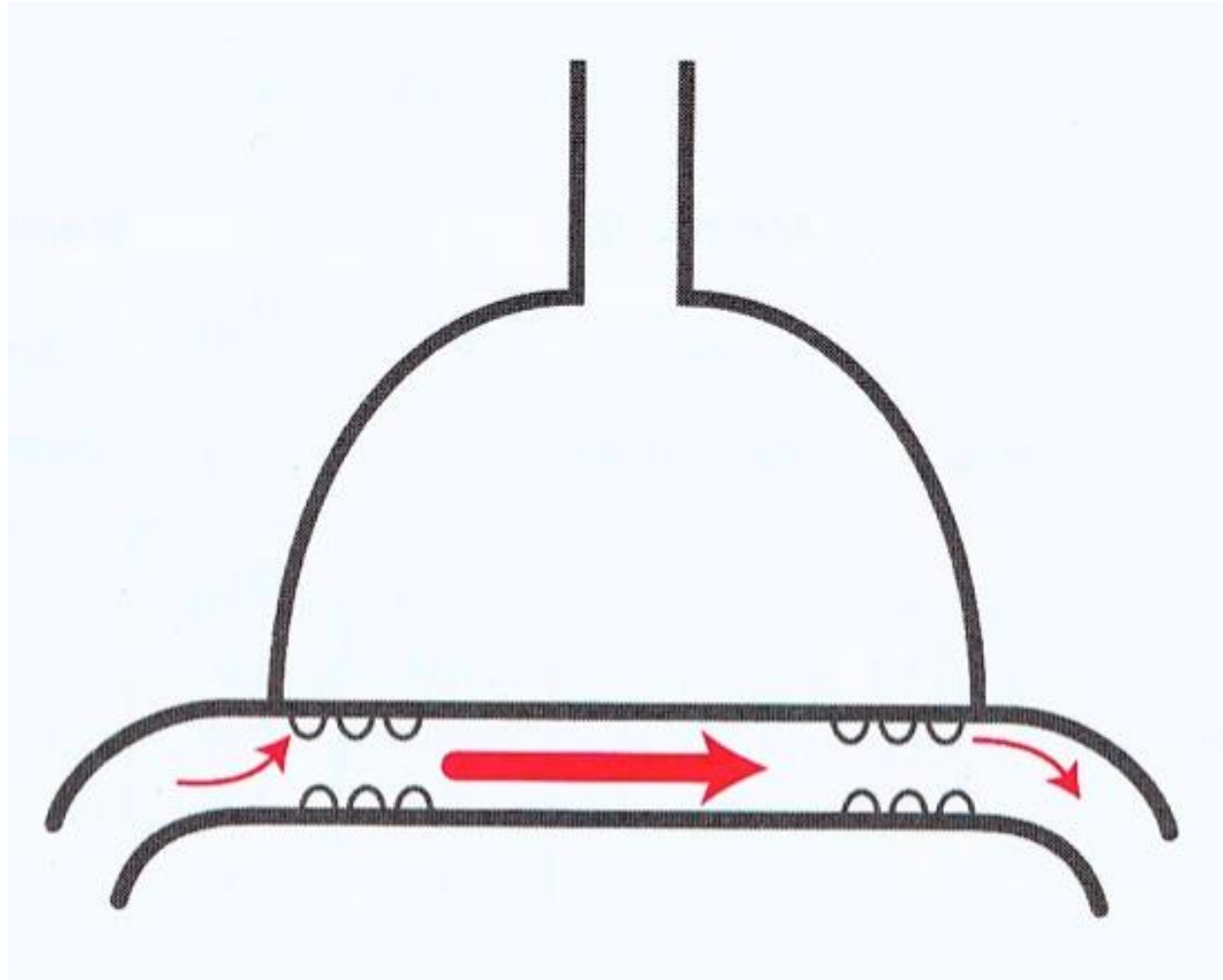
VENTILATION



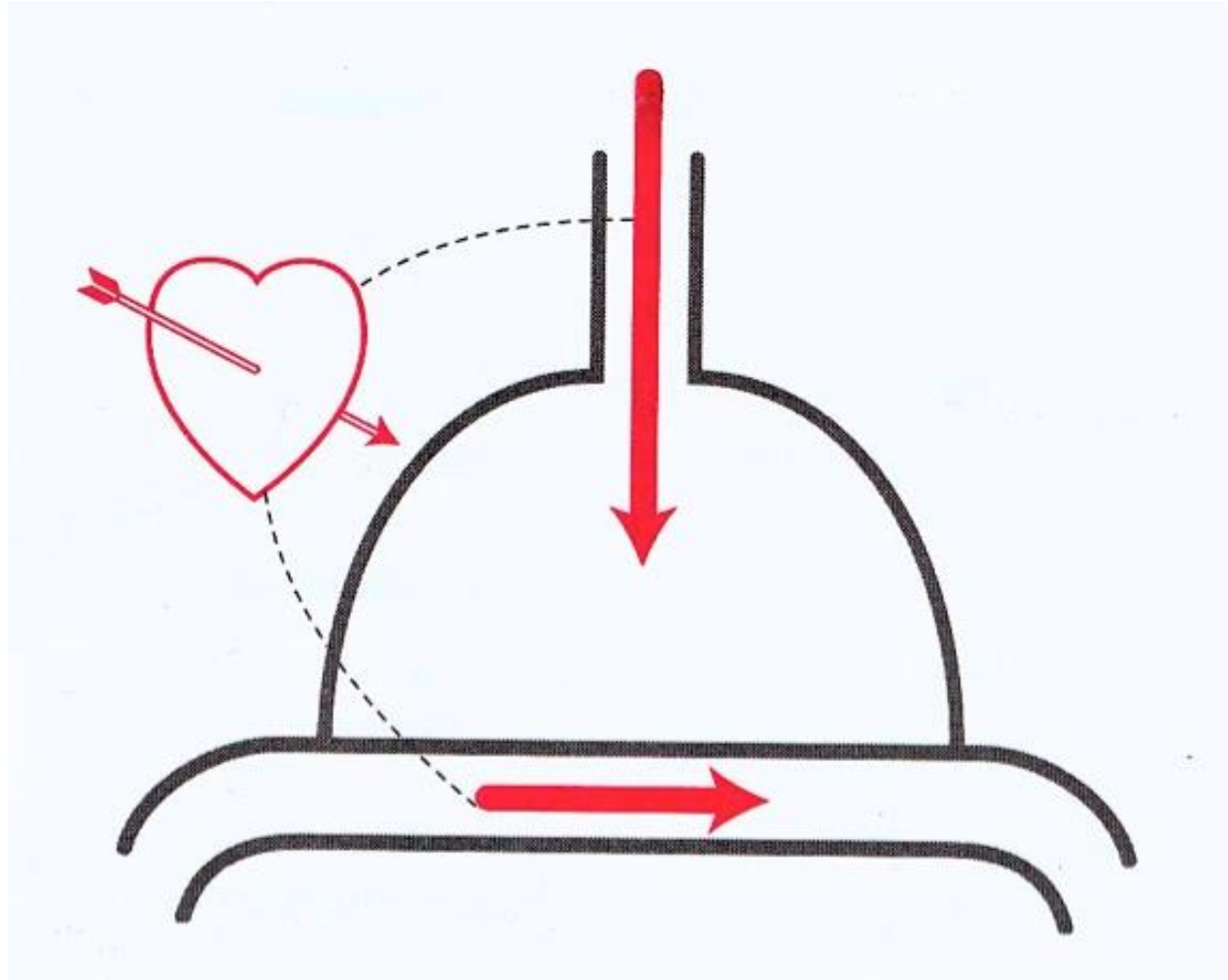
DIFFUSION



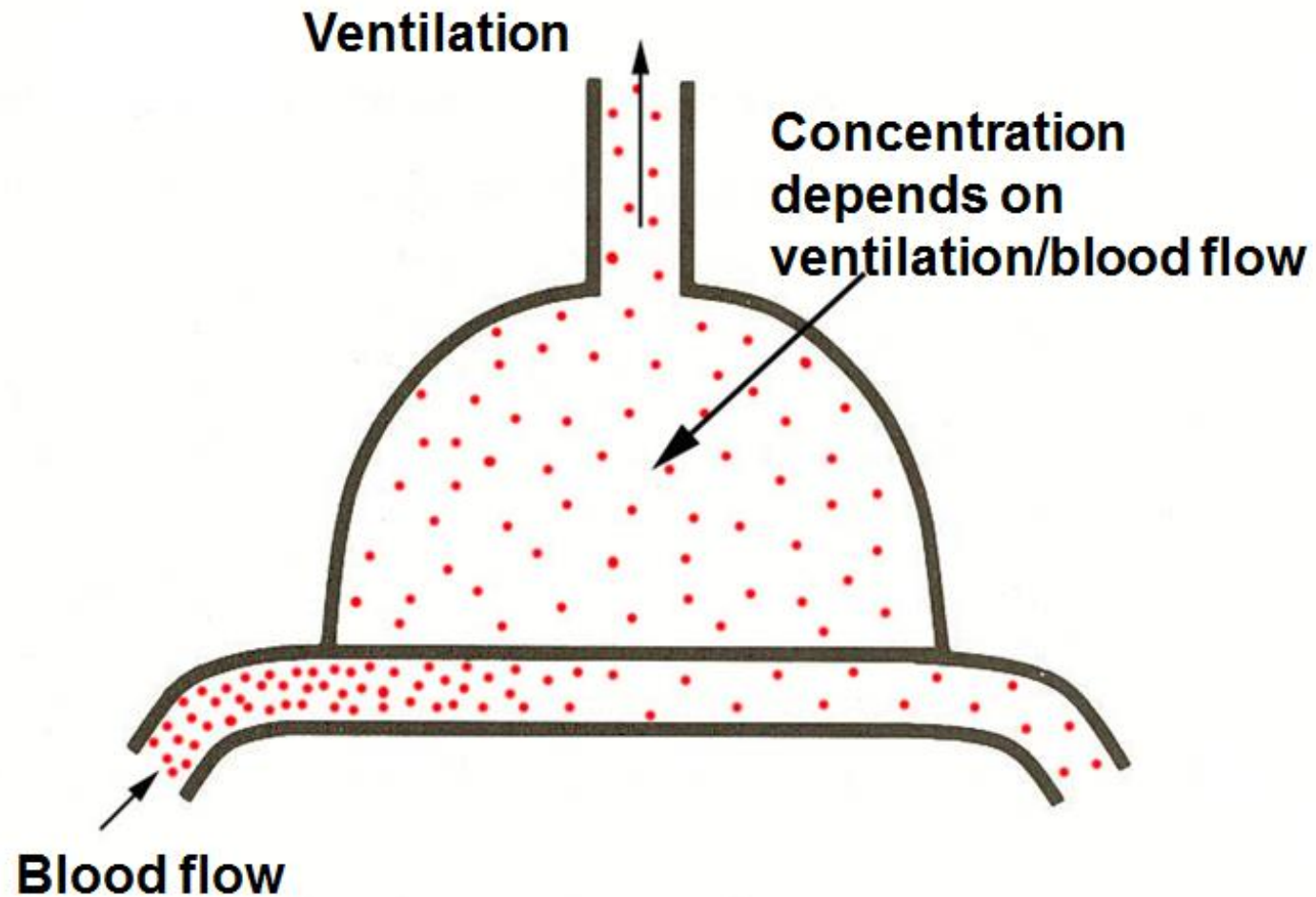
BLOOD FLOW



GAS EXCHANGE

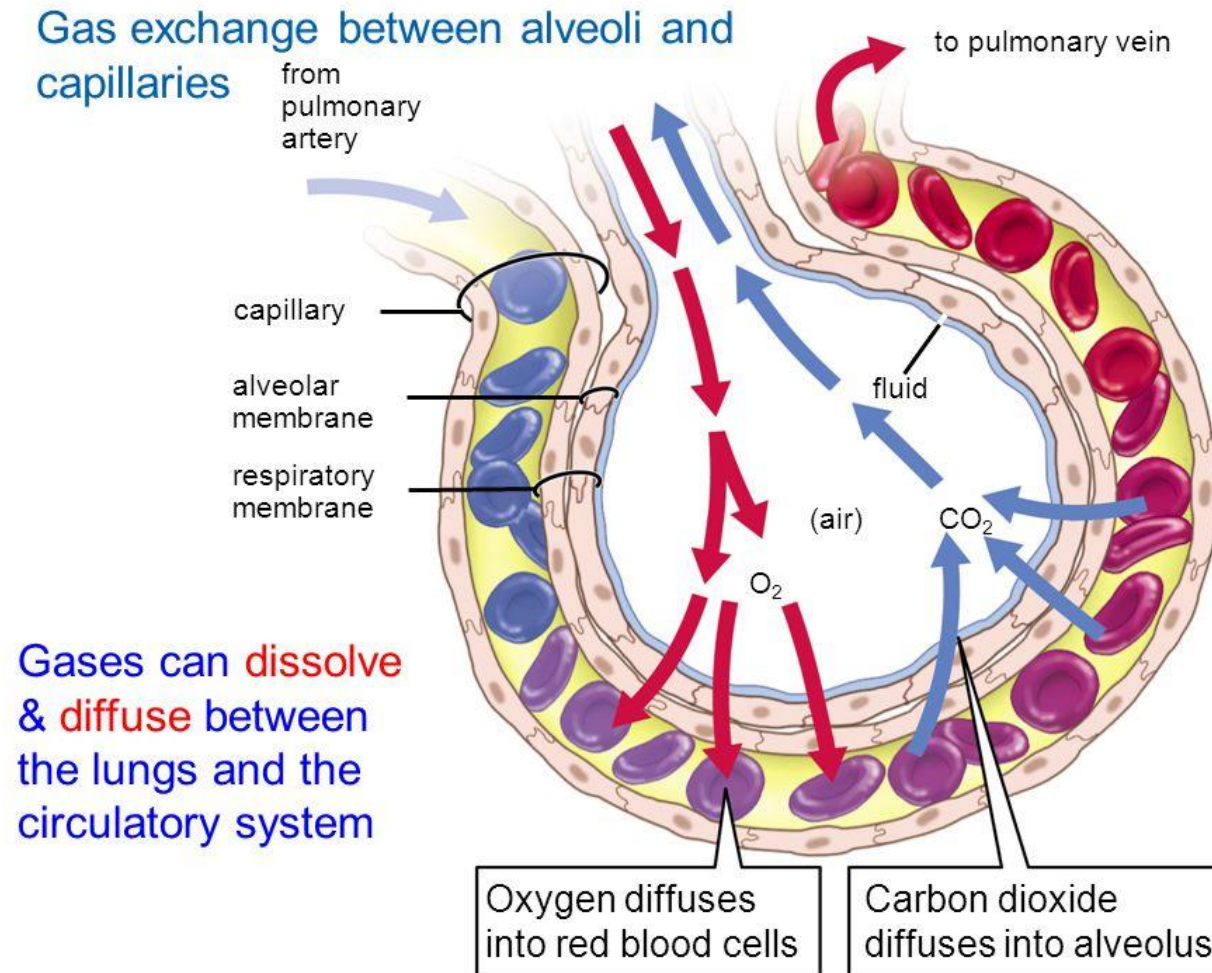


VENTILATION PERFUSION RATIO

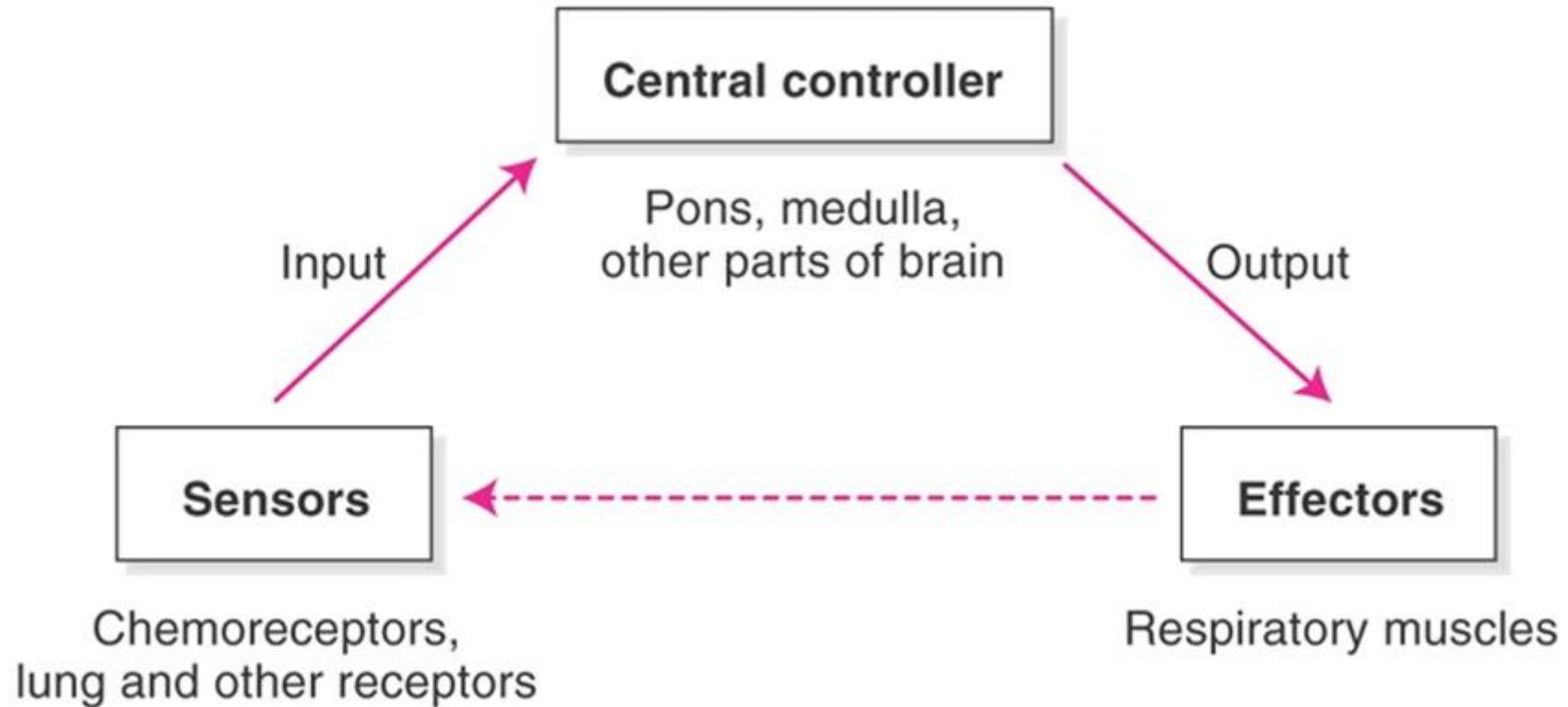


ALVEOLAR CAPILLARY GAS EXCHANGE

Gas exchange between alveoli and capillaries

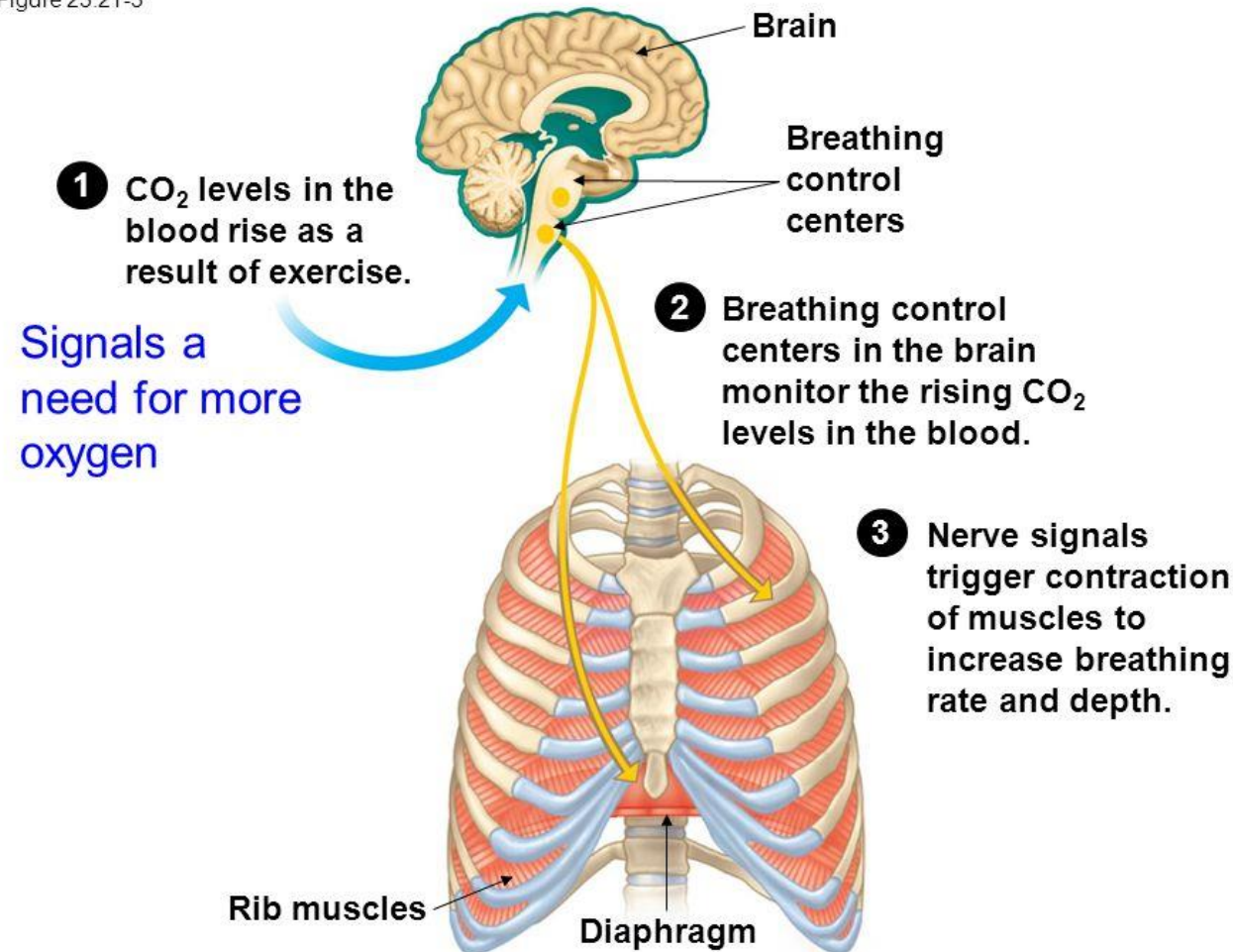


RESPIRATORY CONTROL



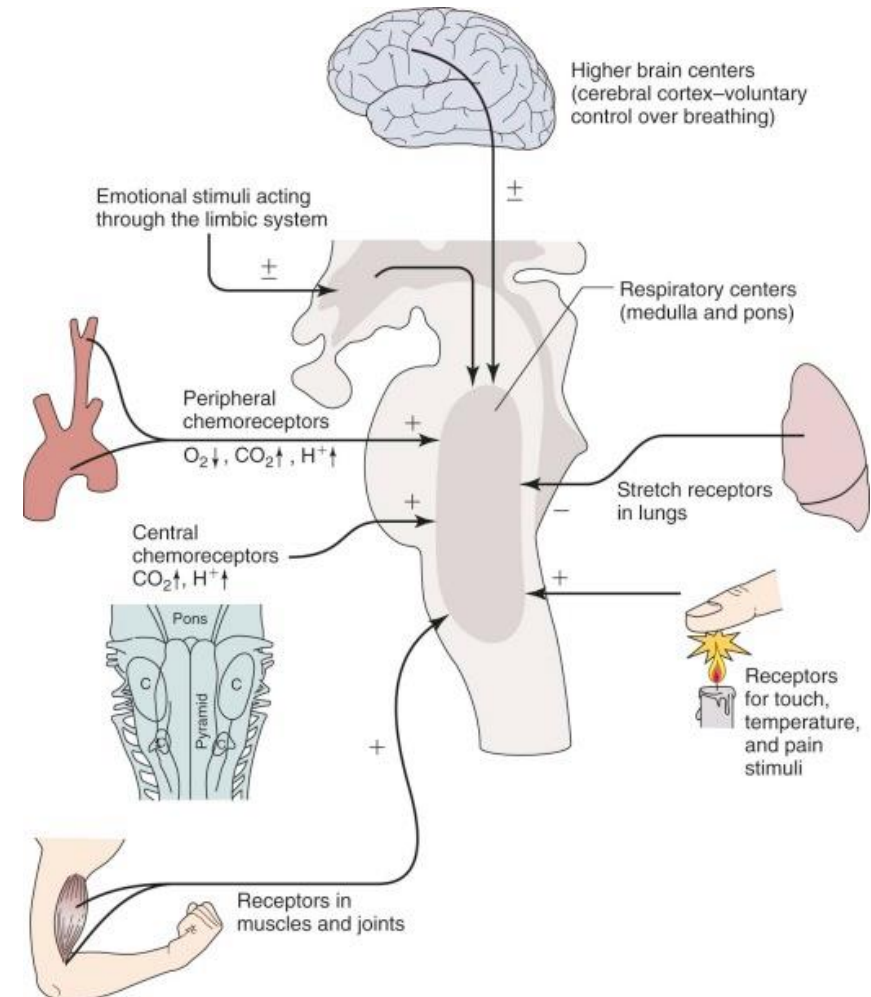
CENTRAL REGULATION OF BREATHING

Figure 23.21-3



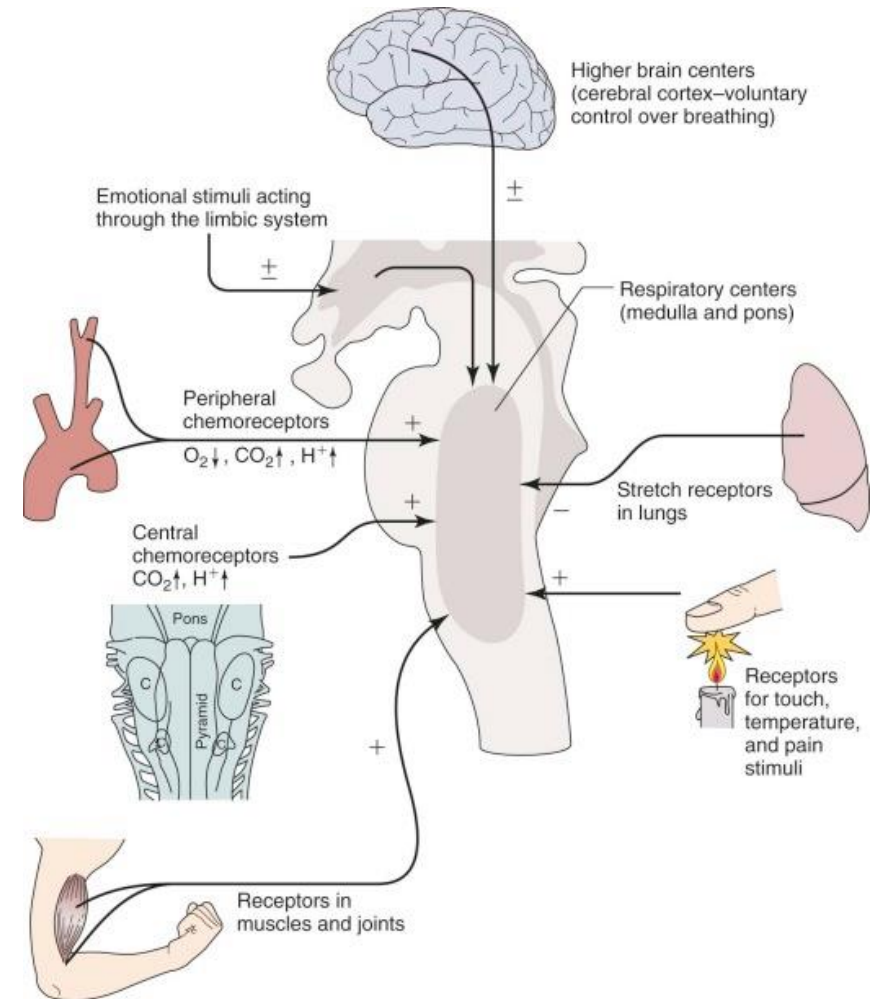
PRIMARY MODULATORS OF BREATHING

- Primary central chemoreceptors (C) are located near the ventral surface of the medulla.
- The ventral medullary surface & retrotrapezoid nucleus are extremely sensitive to changes in H^+
- CO_2 crosses the blood-brain barrier.
- $CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$
- $\uparrow H^+$ activates brain chemoreceptors $\rightarrow \uparrow$ ventilation
- Primary peripheral chemoreceptors (carotid and aortic bodies) \rightarrow sensitive to PO_2 & PCO_2 (less).

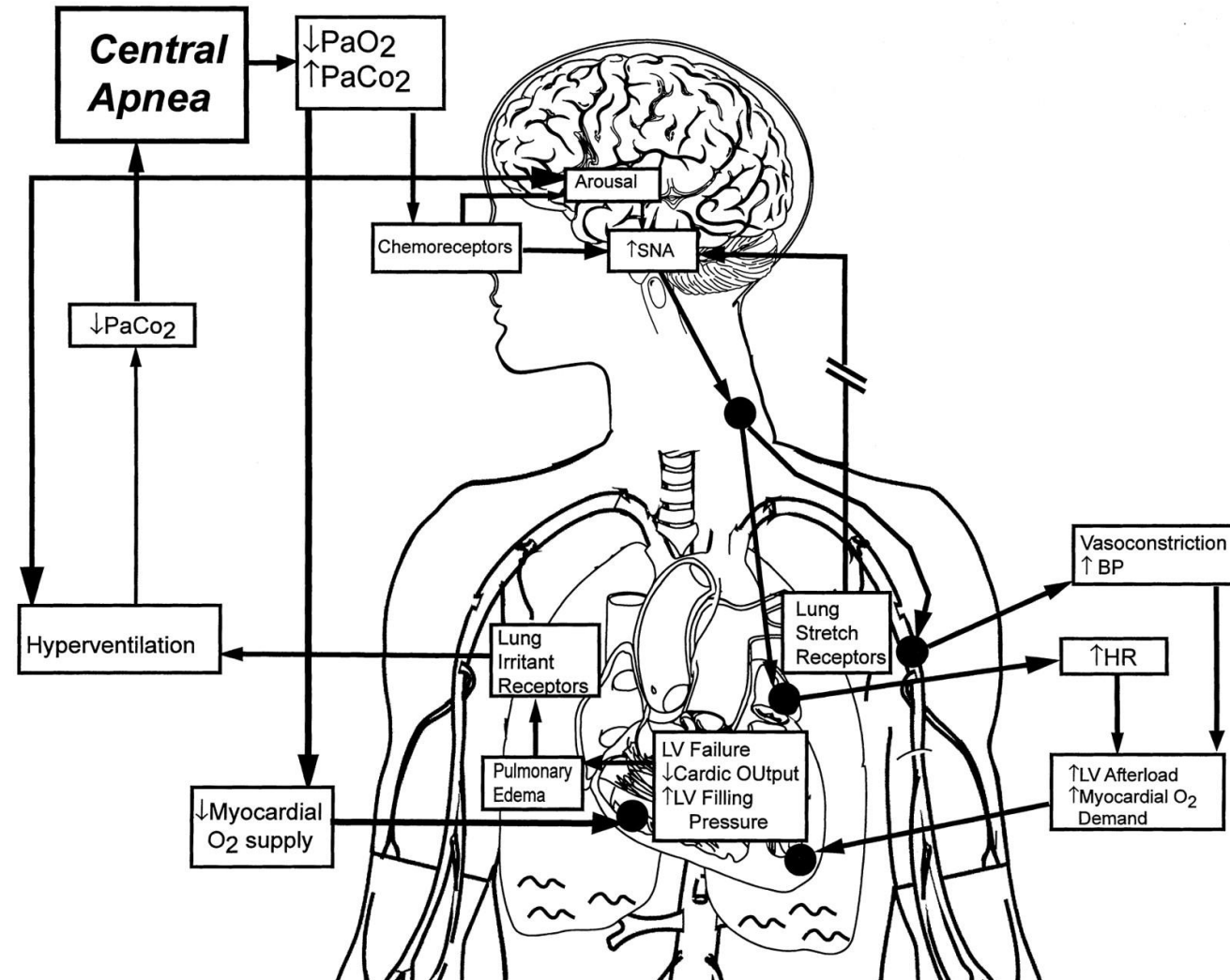


SECONDARY MODULATORS OF BREATHING

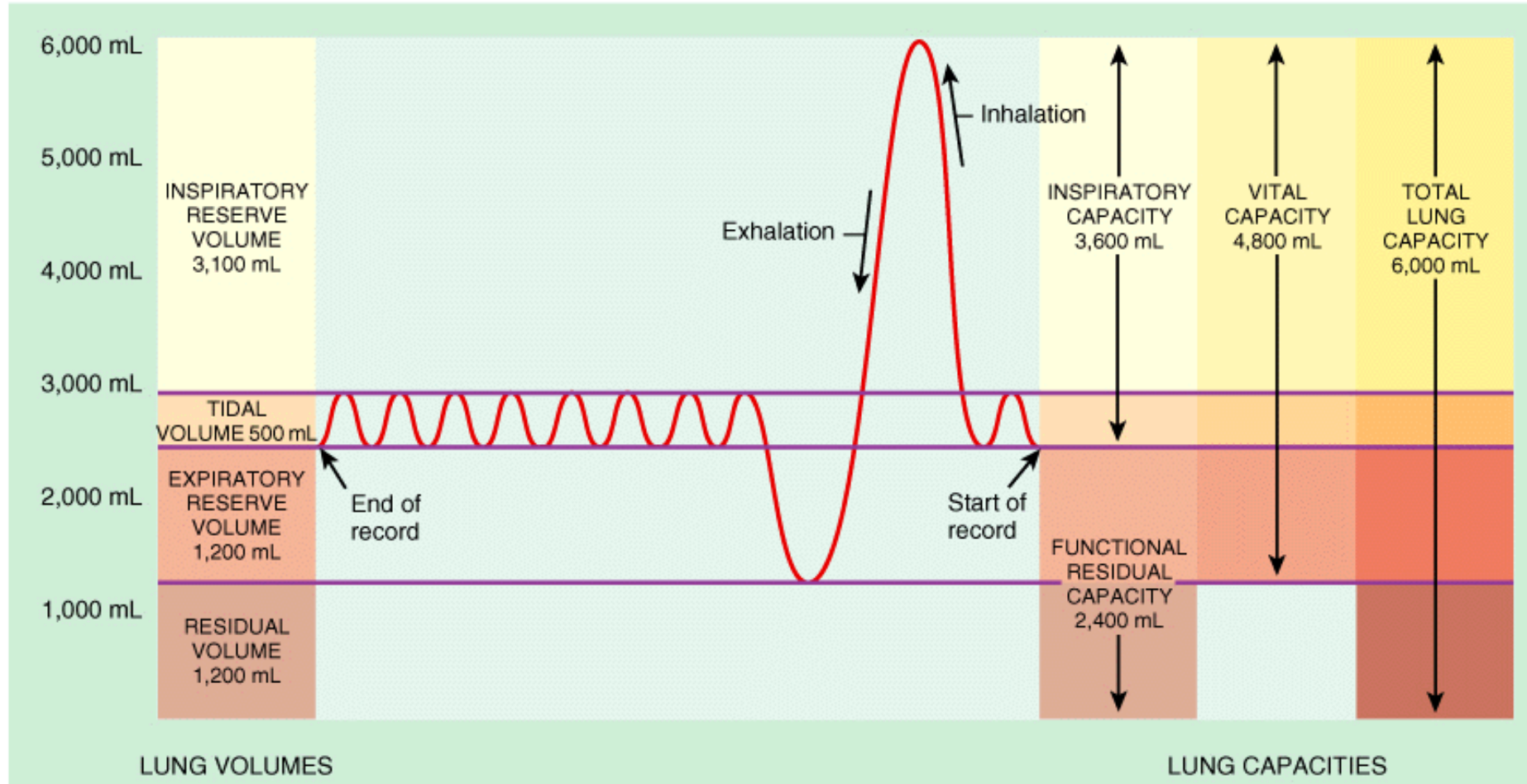
- The cerebral cortex is responsible for voluntary control of breathing
 - Sends signals through the corticospinal and corticobulbar tracts.
- Receptors in the lung react to lung volume and irritants
 - Send feedback through the vagus nerve.
- Proprioceptors in muscles and tendons stimulate breathing, as evidenced by passive movements that increase respiratory rate



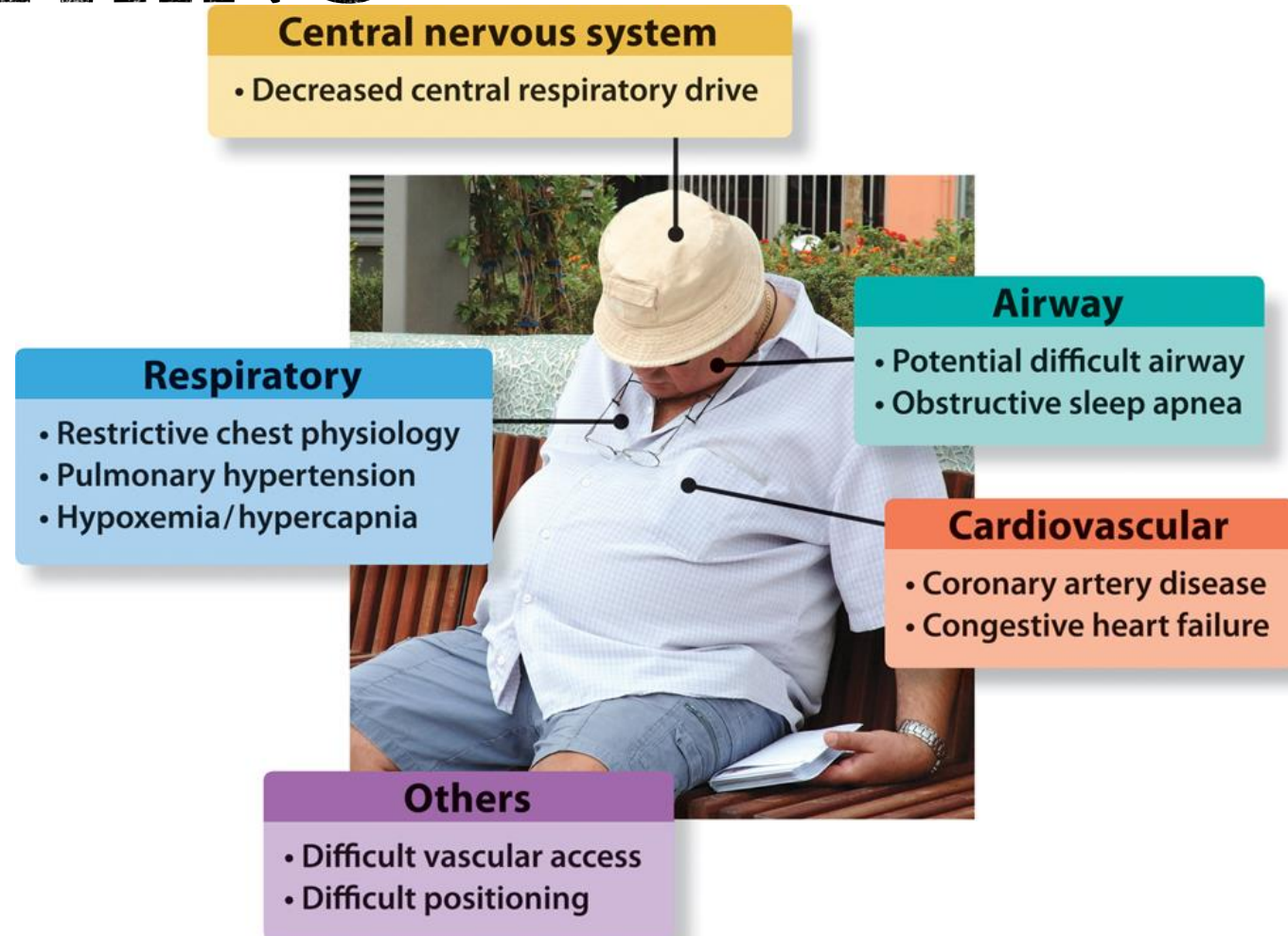
CENTRAL SLEEP APNEA



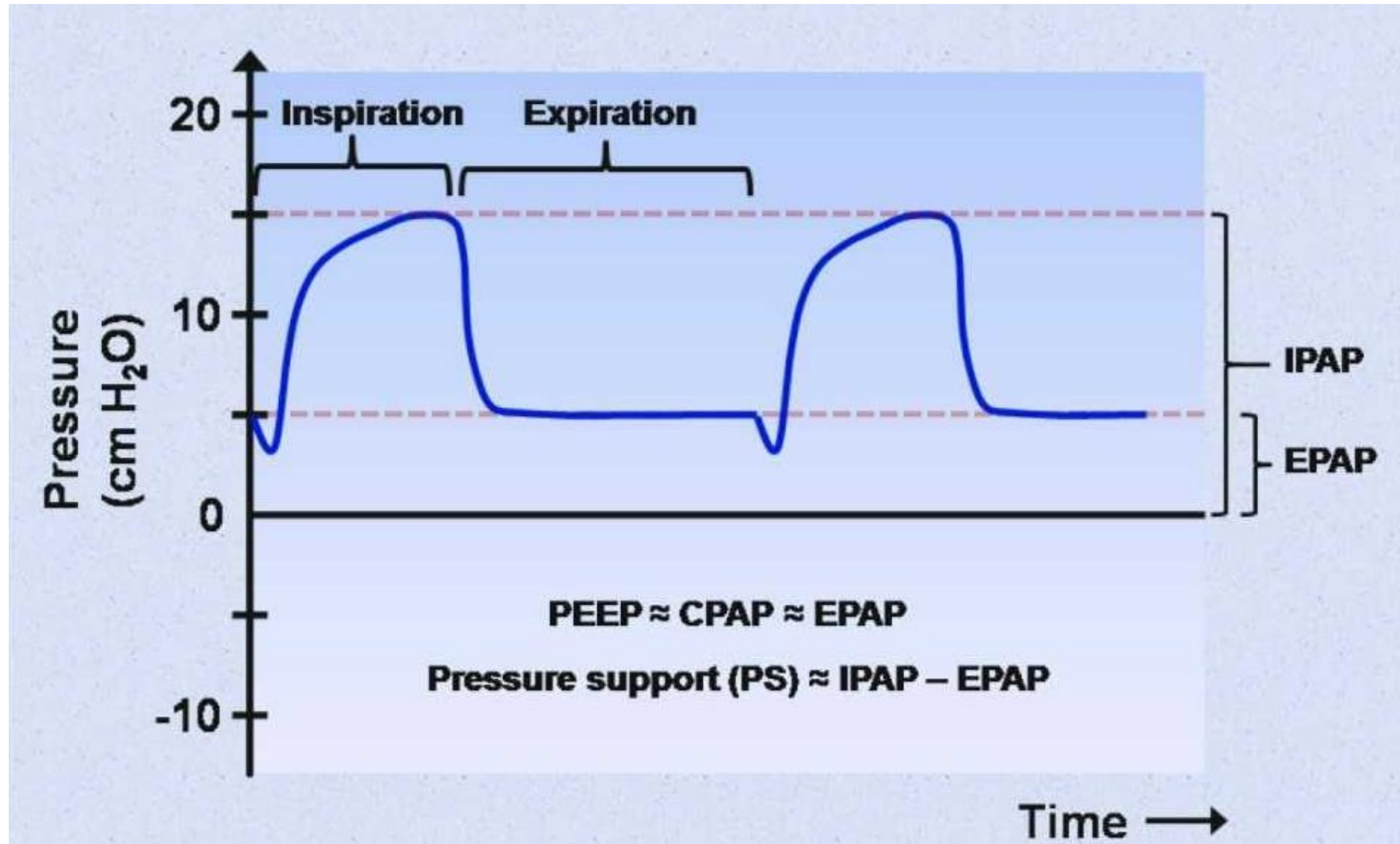
LUNG VOLUMES AND CAPACITIES



EFFECTS OF OBESITY ON BREATHING



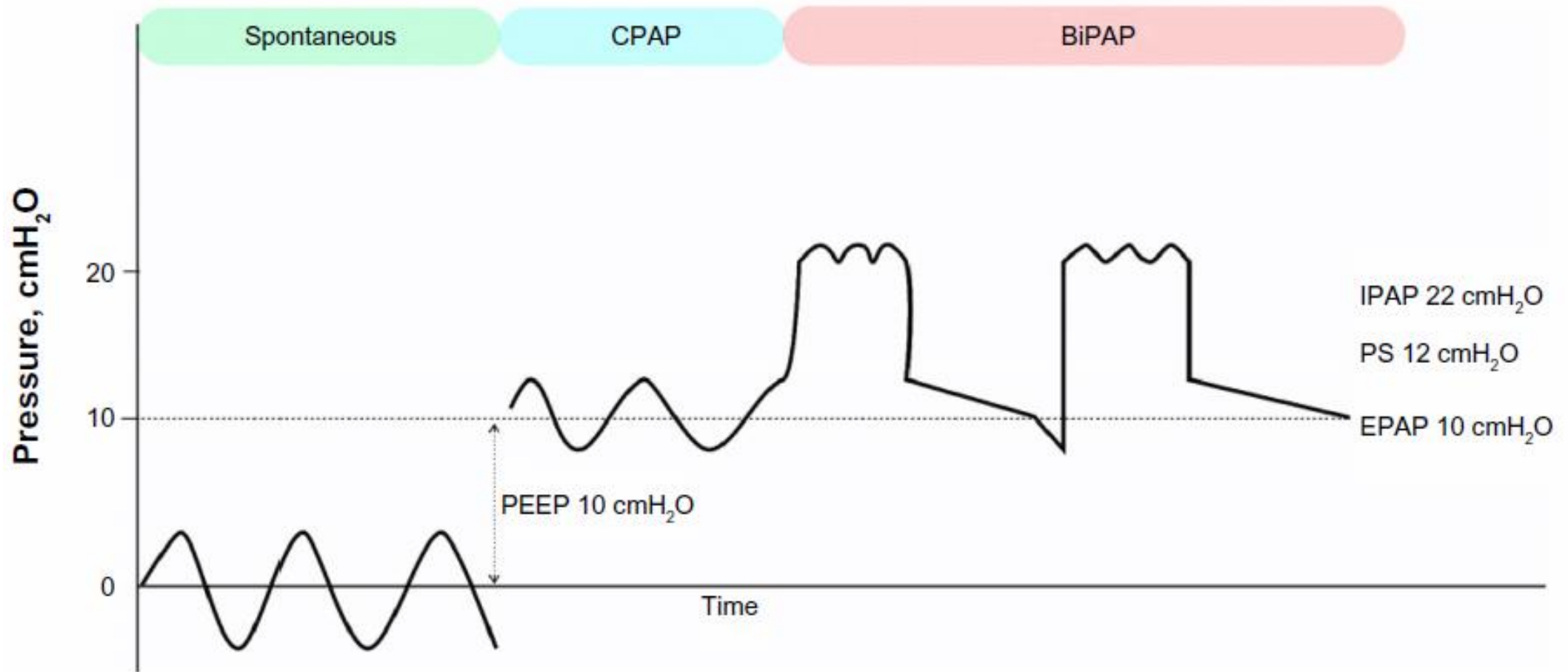
POSITIVE AIRWAY PRESSURE



CPAP



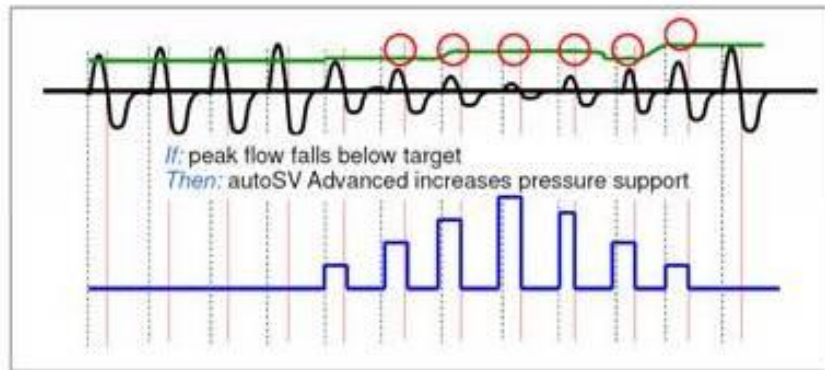
CPAP VS. BPAP



ADAPTIVE SERVO VENTILATION

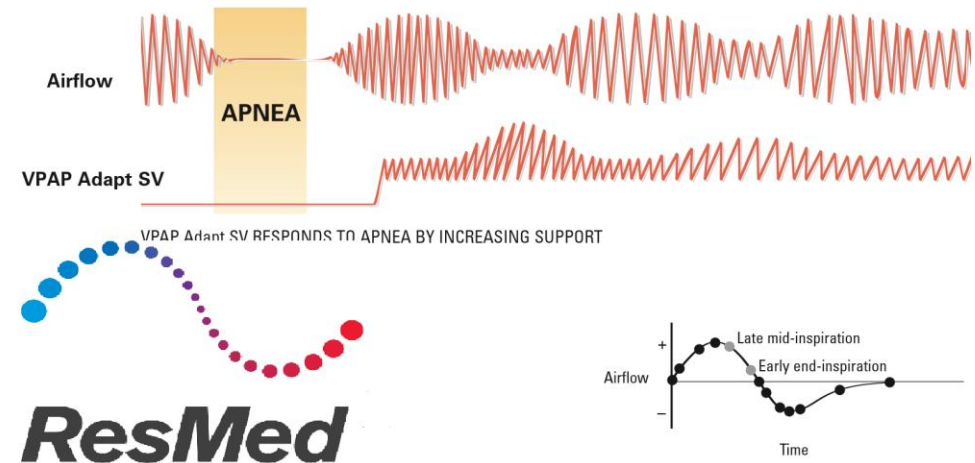
PHILIPS

Servo ventilation algorithm: Decreased peak flow



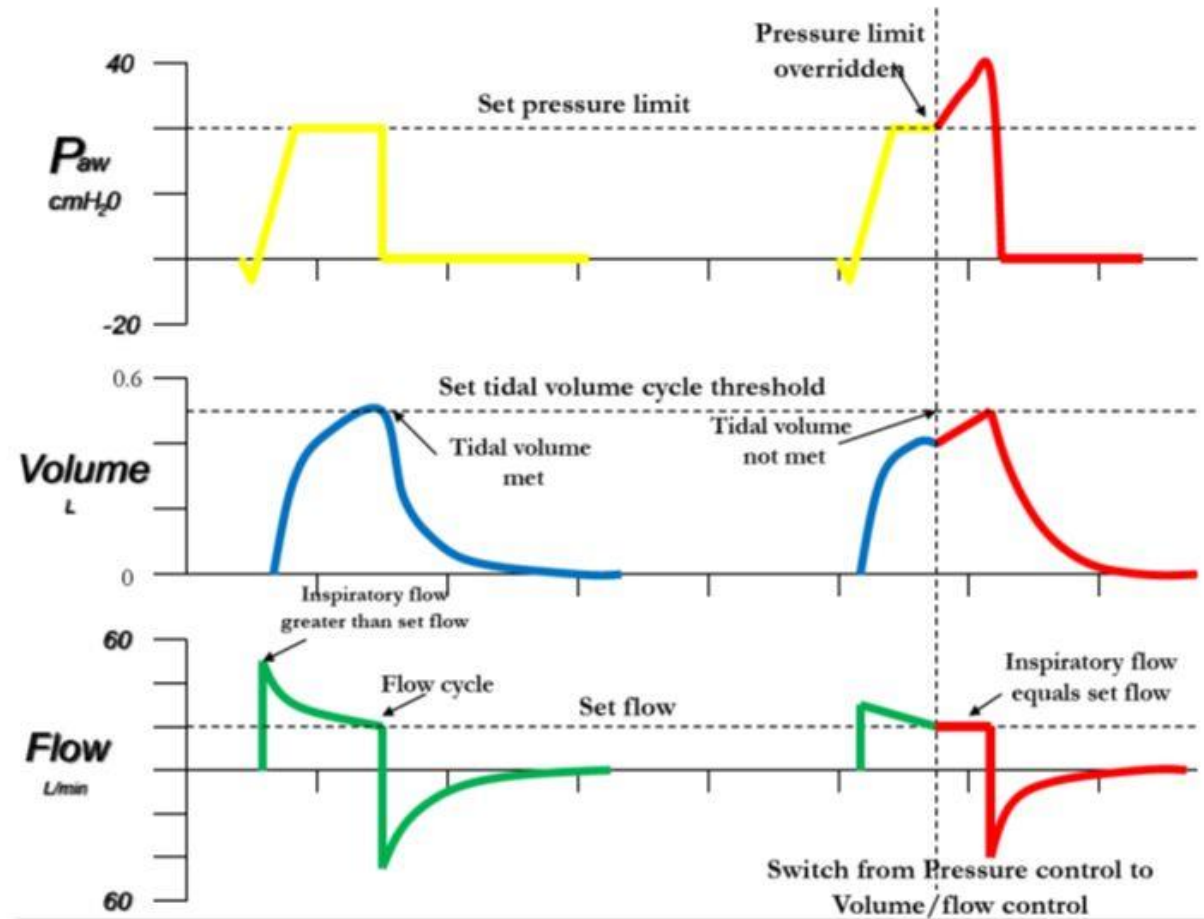
○ = Missed peak flow target (sdb)

Dynamic pressure support inversely proportionate to peak flow value



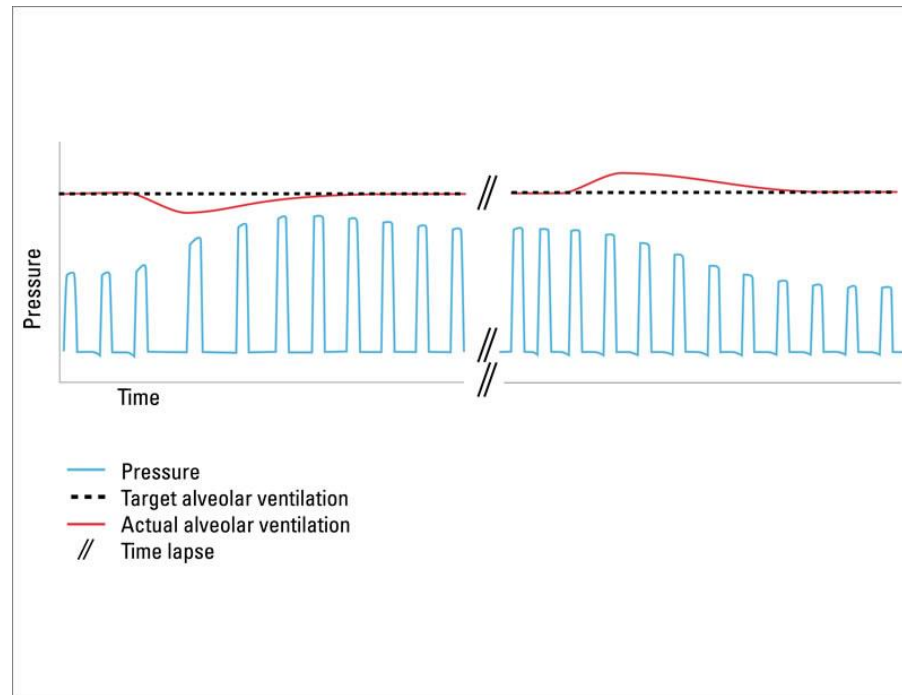
VAPS

Volume Assured Pressure Support

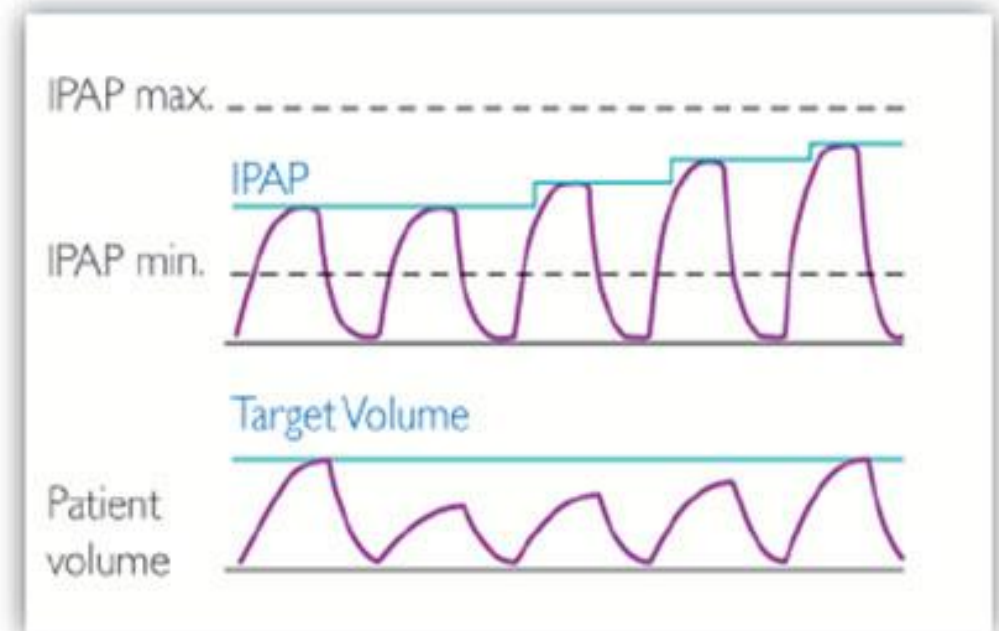


VAPS

IVAPS - ResMed



AVAPS - Philips



SUMMARY

- Nasal problems affect interface selection
- CPAP → OSA
- BPAP → OSA / hypoventilation
- BPAP ST / VAPS → hypoventilation (abnormal breathing drive)
- Greater weight ≠ bigger lungs in obese
- ASV → Central sleep apnea / Cheyne Stokes Respiration
- Understanding anatomy and physiology will make you a better technologist!



THANK YOU

JarOfQuotes.com

MAYBE YOU NEED A
LITTLE BREATHER

- THE DEAD MILKMEN (BEIGE SUNSHINE)

