The Body Works?
Part 2

Part of the UVic
Retirees Association (UVRA)
Elder Academy Program

Presenters: David Docherty, Ph.D., with Chris Pengilly, M.D., Mike Bassett, M.D. and Dr. Helen Martendale. Ph.D., O.D.

Presentations: in two parts

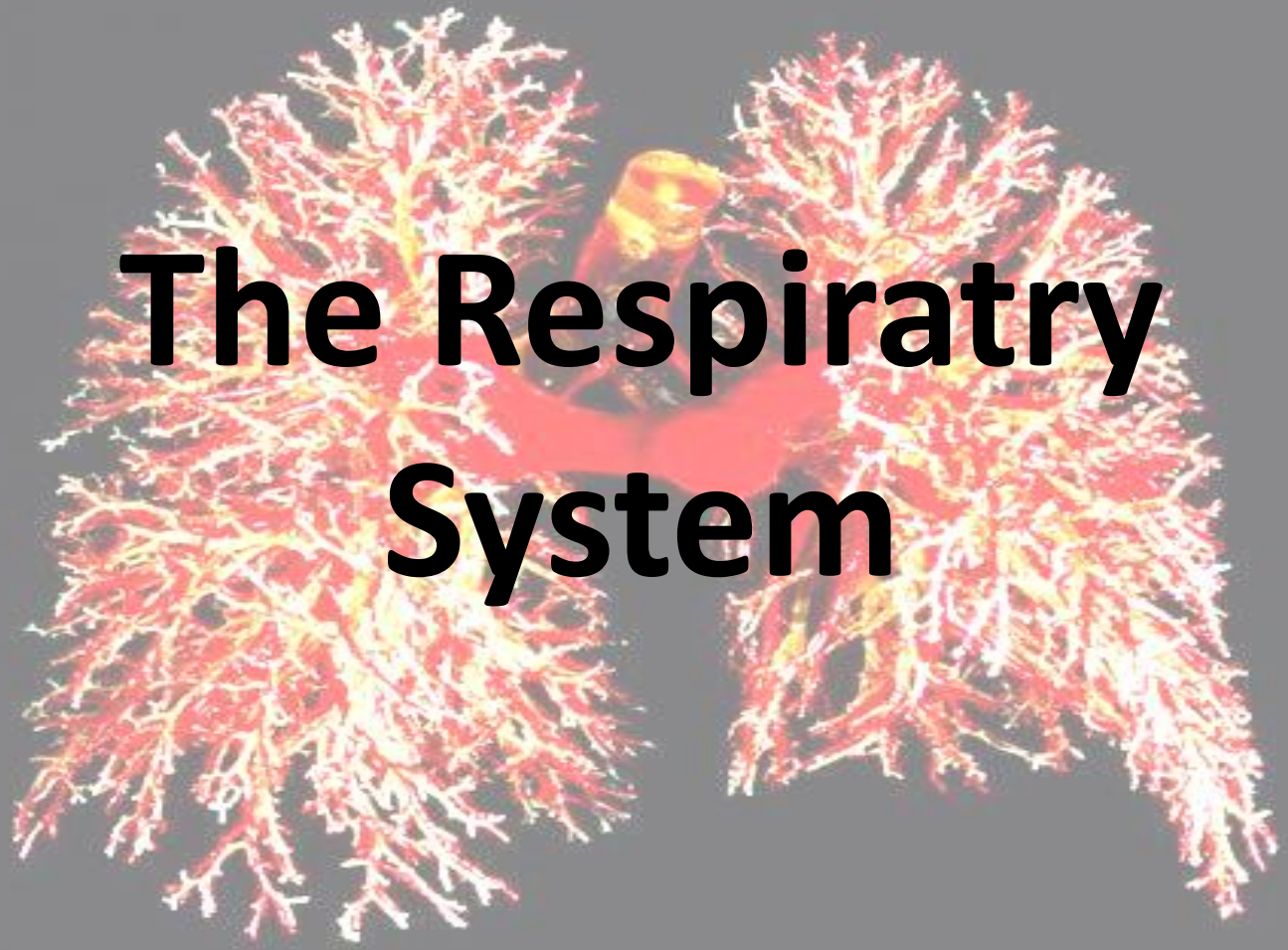
1. The anatomy and function of four new selected systems
2. Things that can go wrong and the medical interventions commonly available

Reminder: Slide presentations available:
https://onlineacademiccommunity.uvic.ca/elderacademy

4 New Systems

- ~~The Brain-Dr. Mike Bassett~~
- ~~The Endocrine System-Dr. Chris Pengilly~~
- The Respiratory System-Dr. Chris Pengilly
- The Special Senses (Vision)-Dr Helen Martendale

The Respiratry System



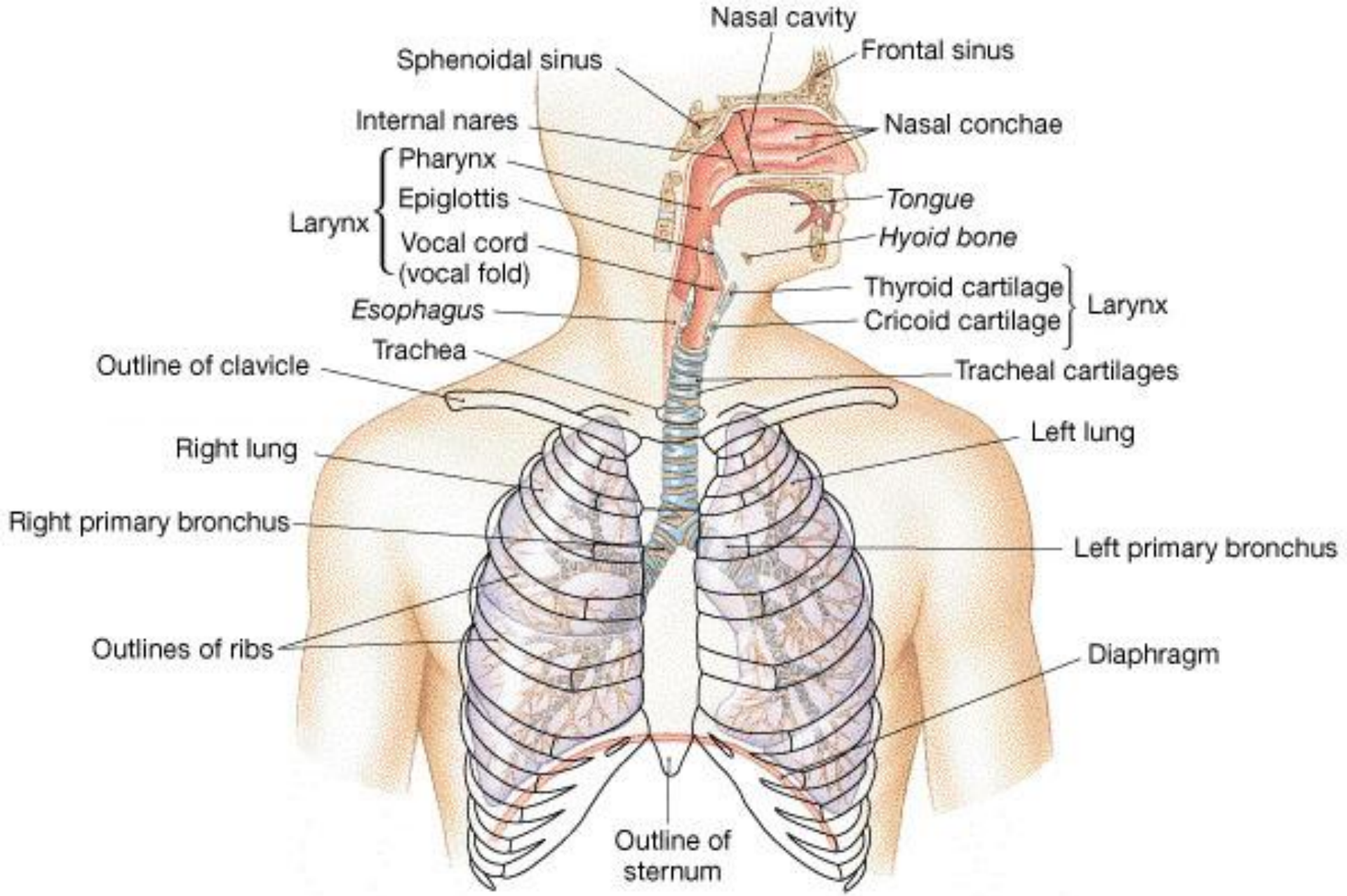
Outline of presentation

- Identify the major functions of the respiratory system
- Define the mechanics of respiration
- Describe the purpose of the main structures involved in warming, cleaning & moistening the air
- Explain the gas exchange pathway
- Medical implications

Some interesting facts

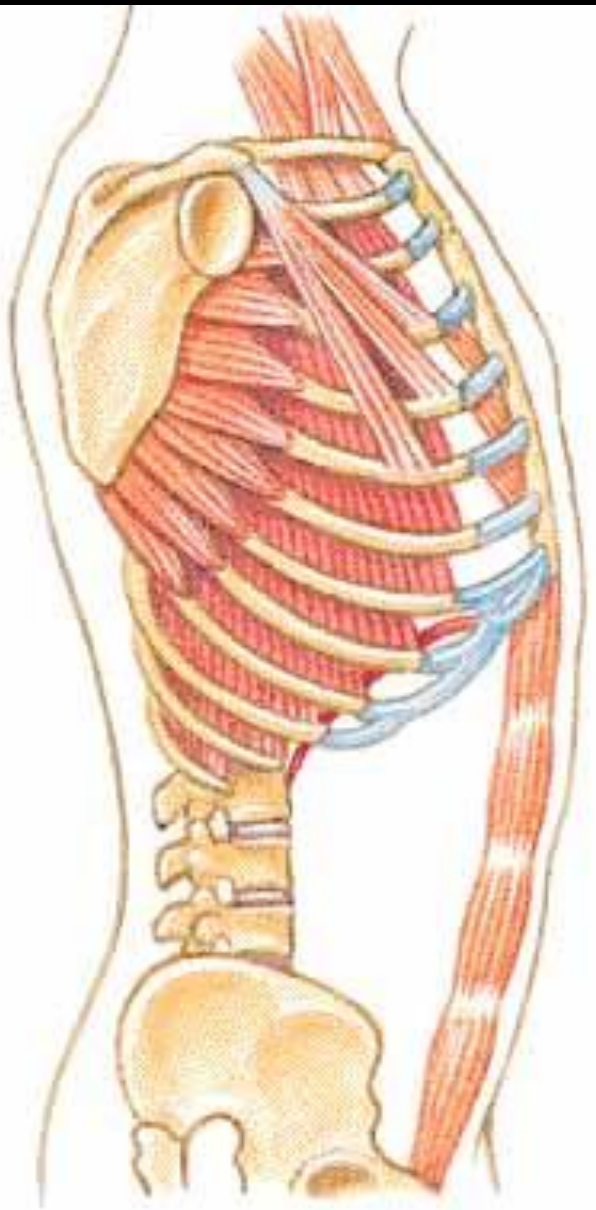
- The total length of the airways running through the two lungs is 1,500 miles or 2,400 kilometers.
- The two lungs together contain 300 to 500 million alveoli. What are alveoli?
- The total internal surface area of lungs in adult humans vary between 30-50 sq. meters and 70-10 sq. meters (equivalent to the total area of one side of a tennis court).
- If all capillaries surrounding the alveoli are unwound and placed end to end, they will cover a staggering 616 miles or 992 kilometers.

Structures of the respiratory system



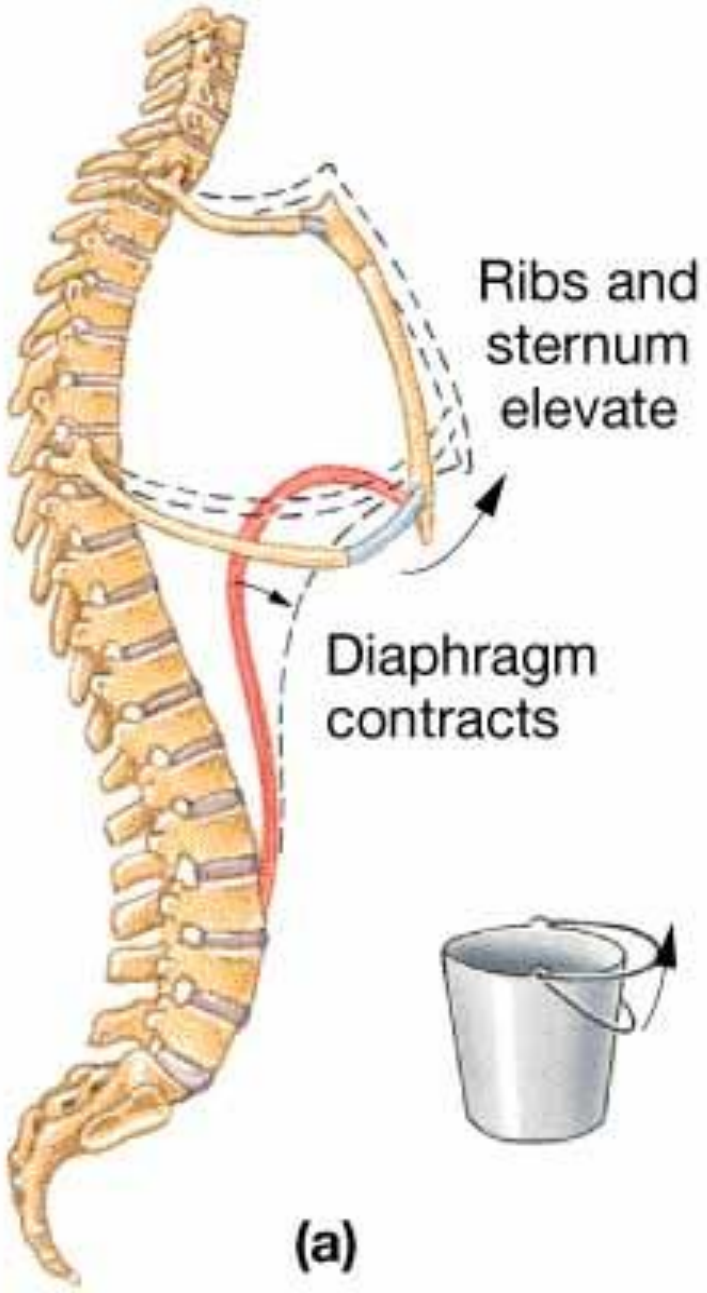
Mechanics of Respiration

Mechanics of respiration (at rest)

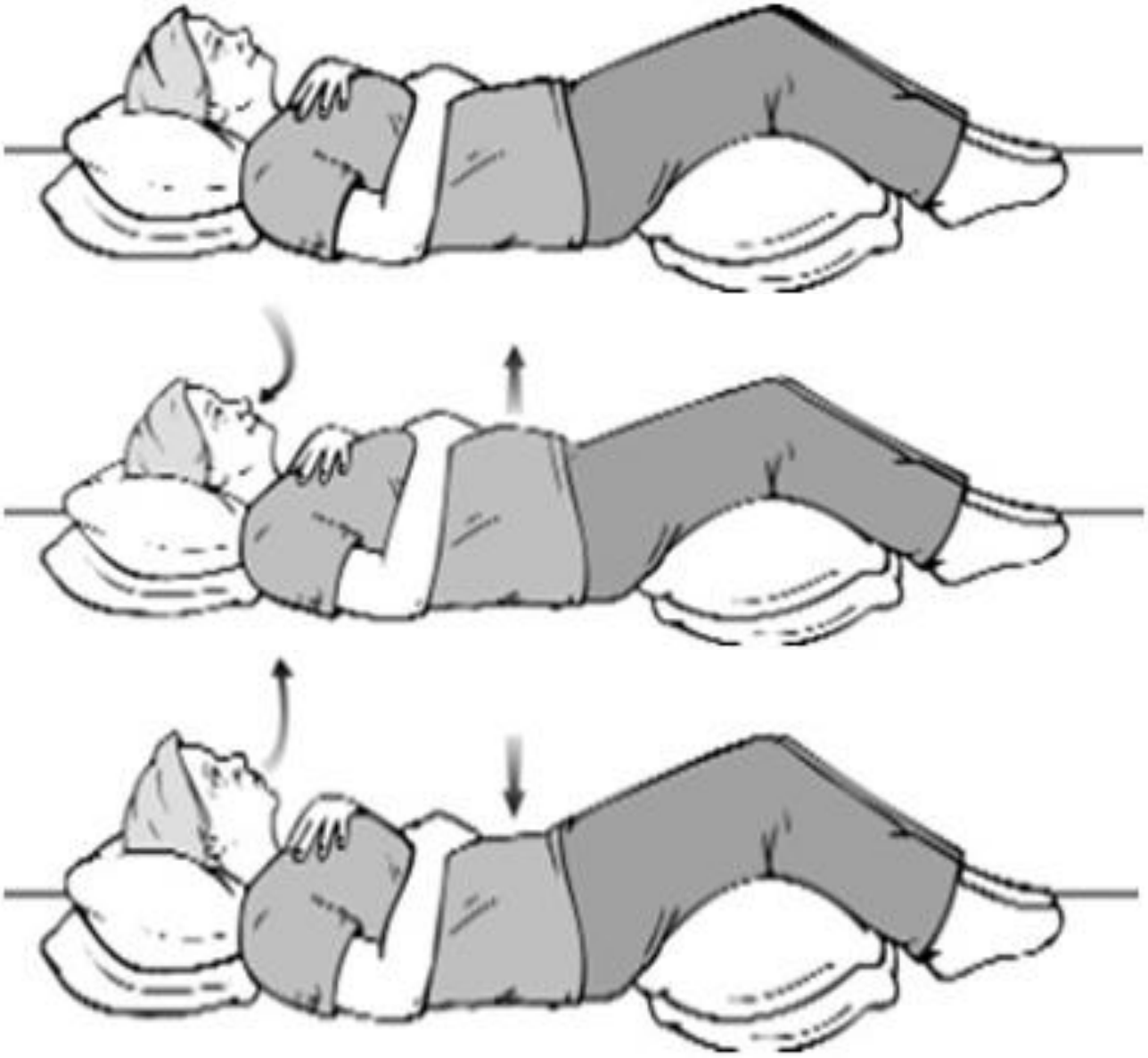


(b) At rest

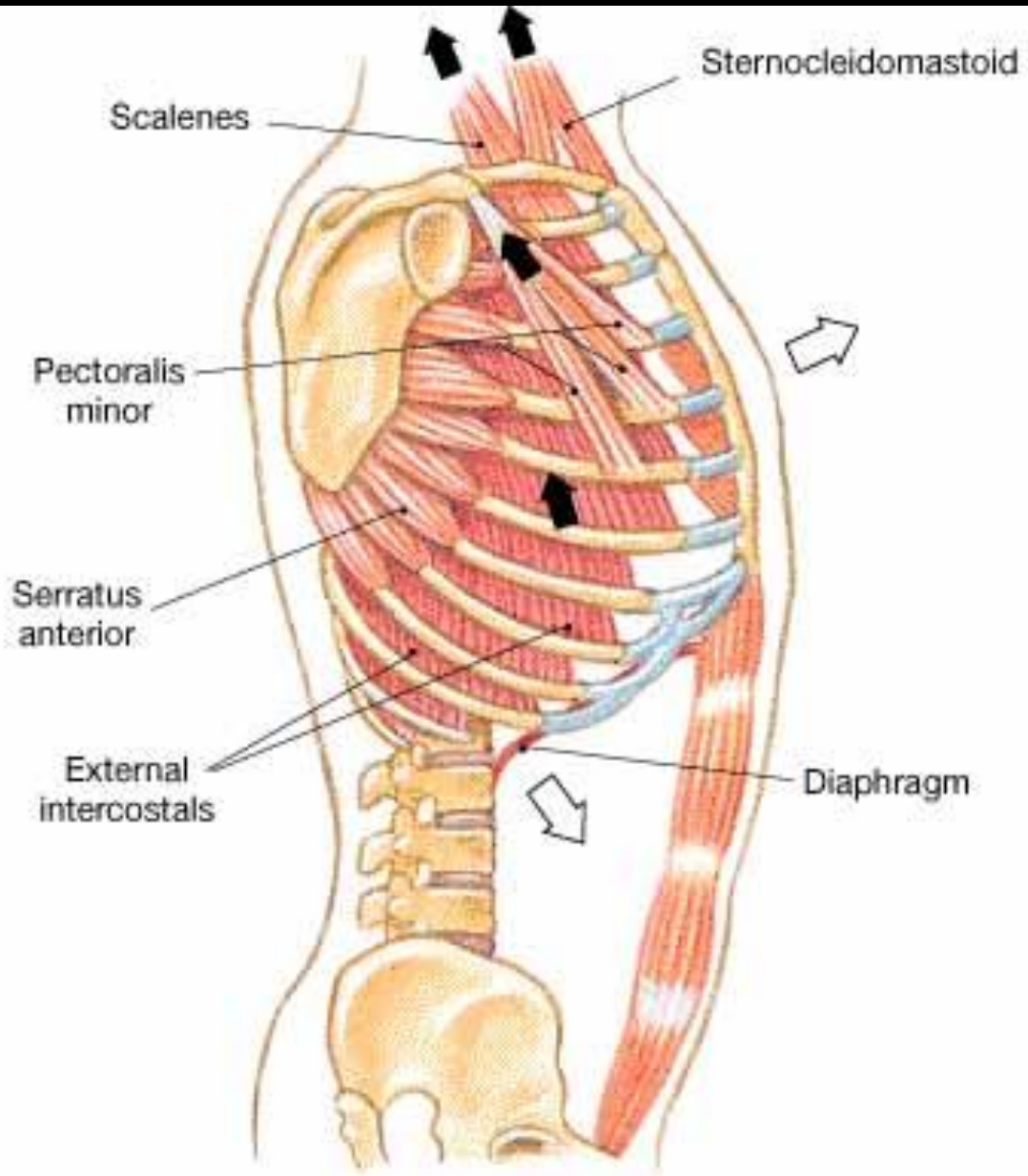
Mechanics of respiration



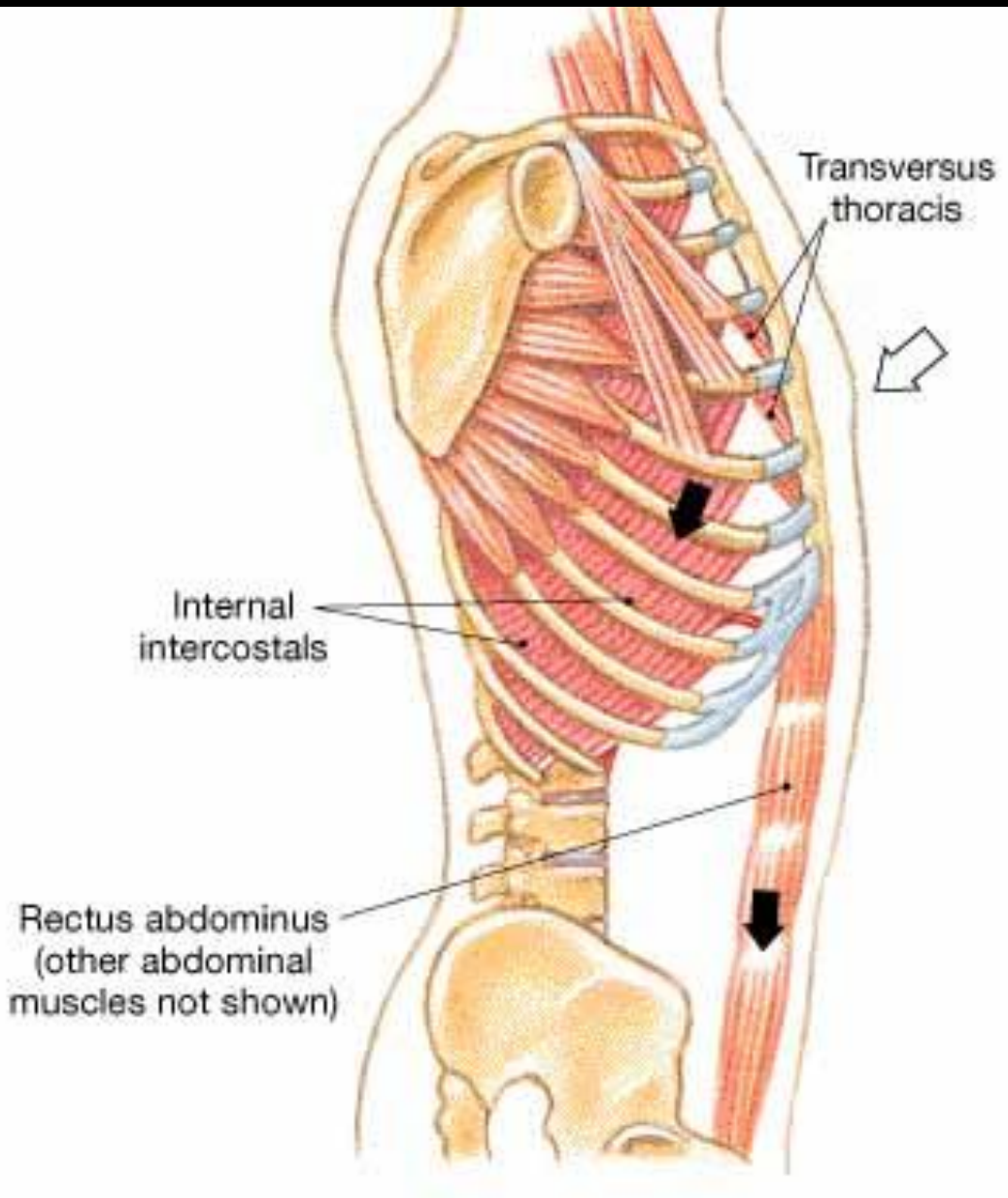
Diaphragmatic breathing



Mechanics of respiration (inhalation)



Mechanics of respiration (exhalation)



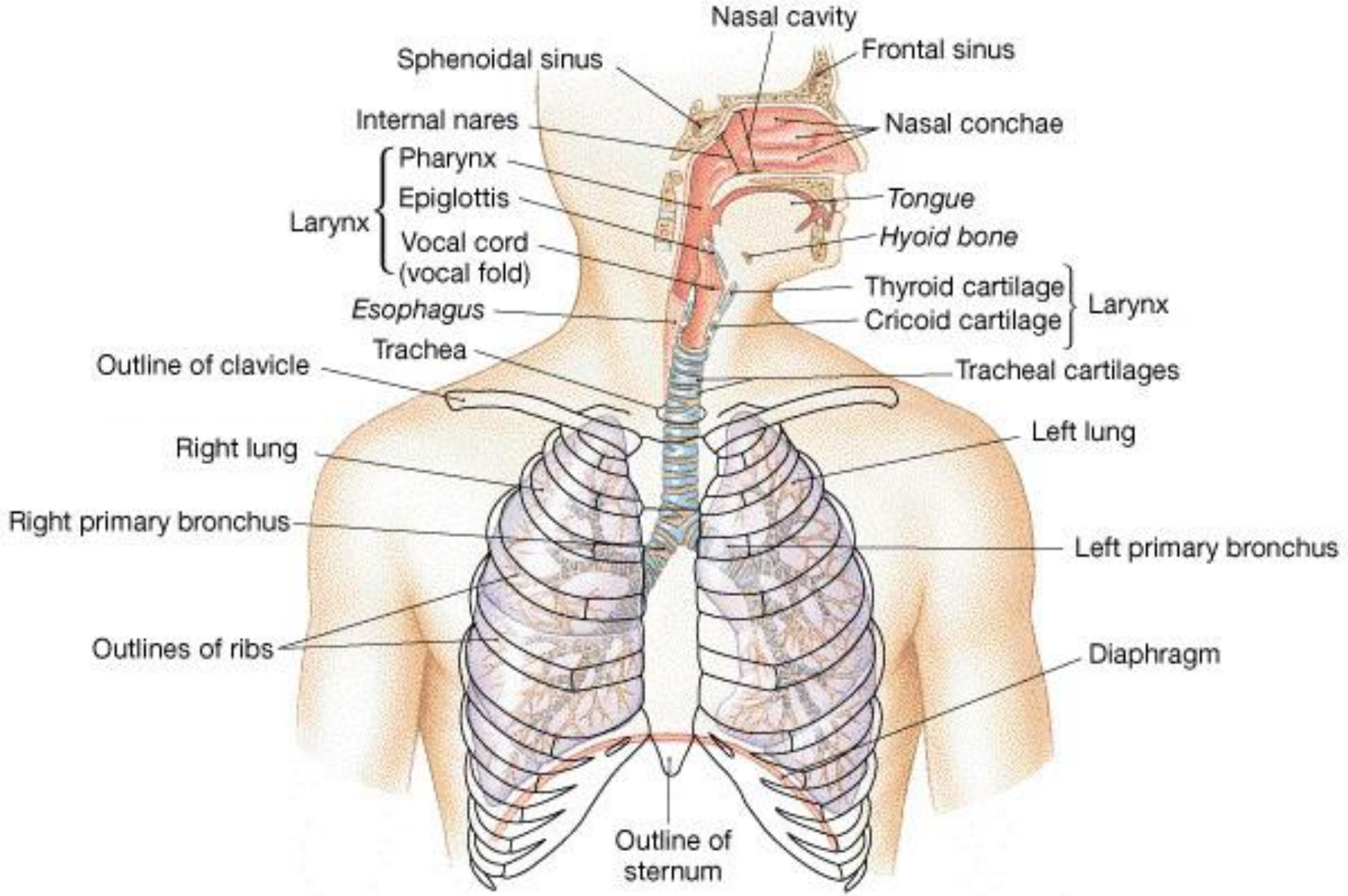
(d) Exhalation

Respiratory Movements

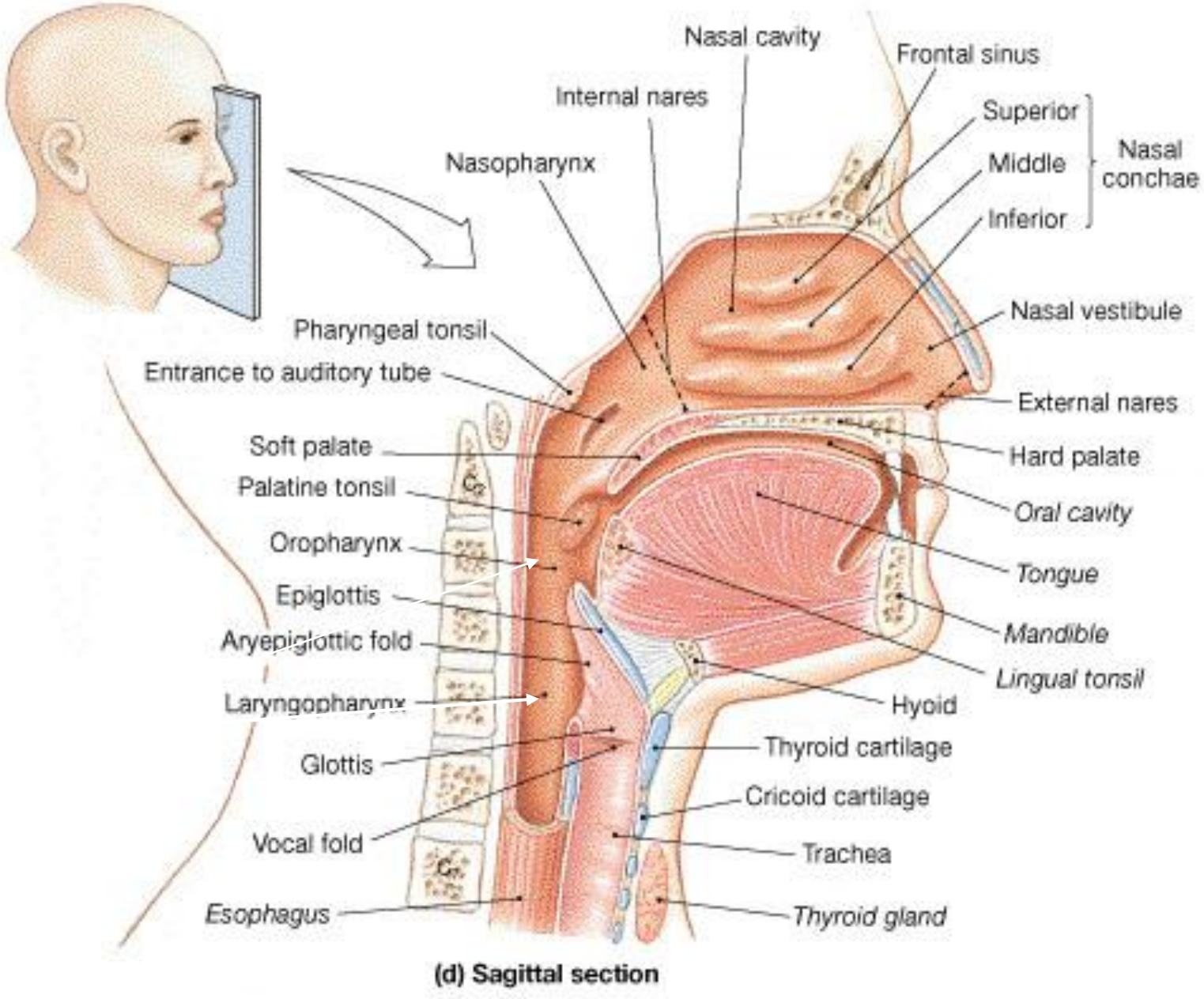
- Eupnea (quiet breathing)
  - Diaphragmatic deep breathing
  - Costal/shallow breathing
- Hyperpnea (forced breathing)

Respiratory Structures and Their Purpose

Structures of the respiratory system

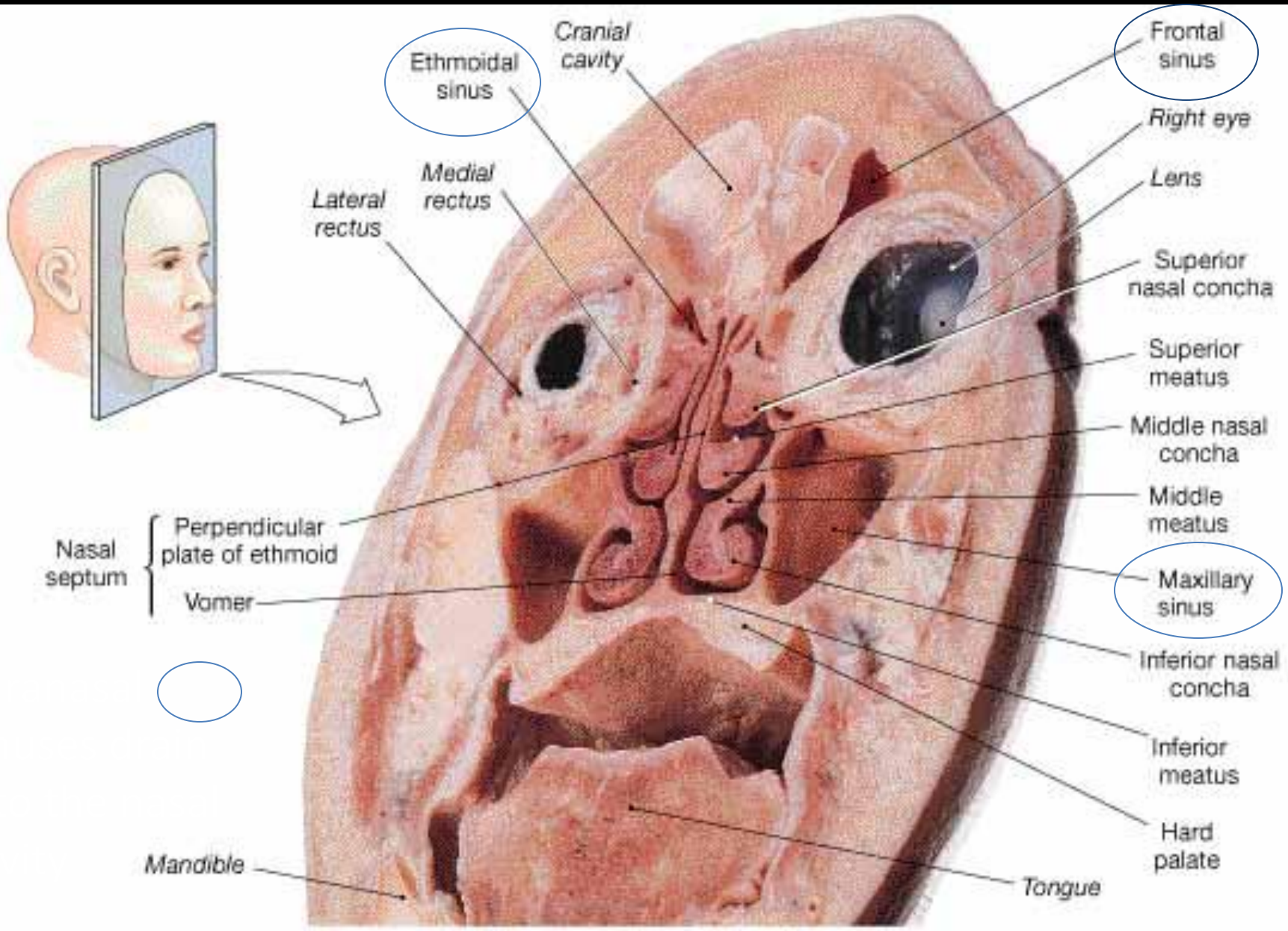


Head and neck



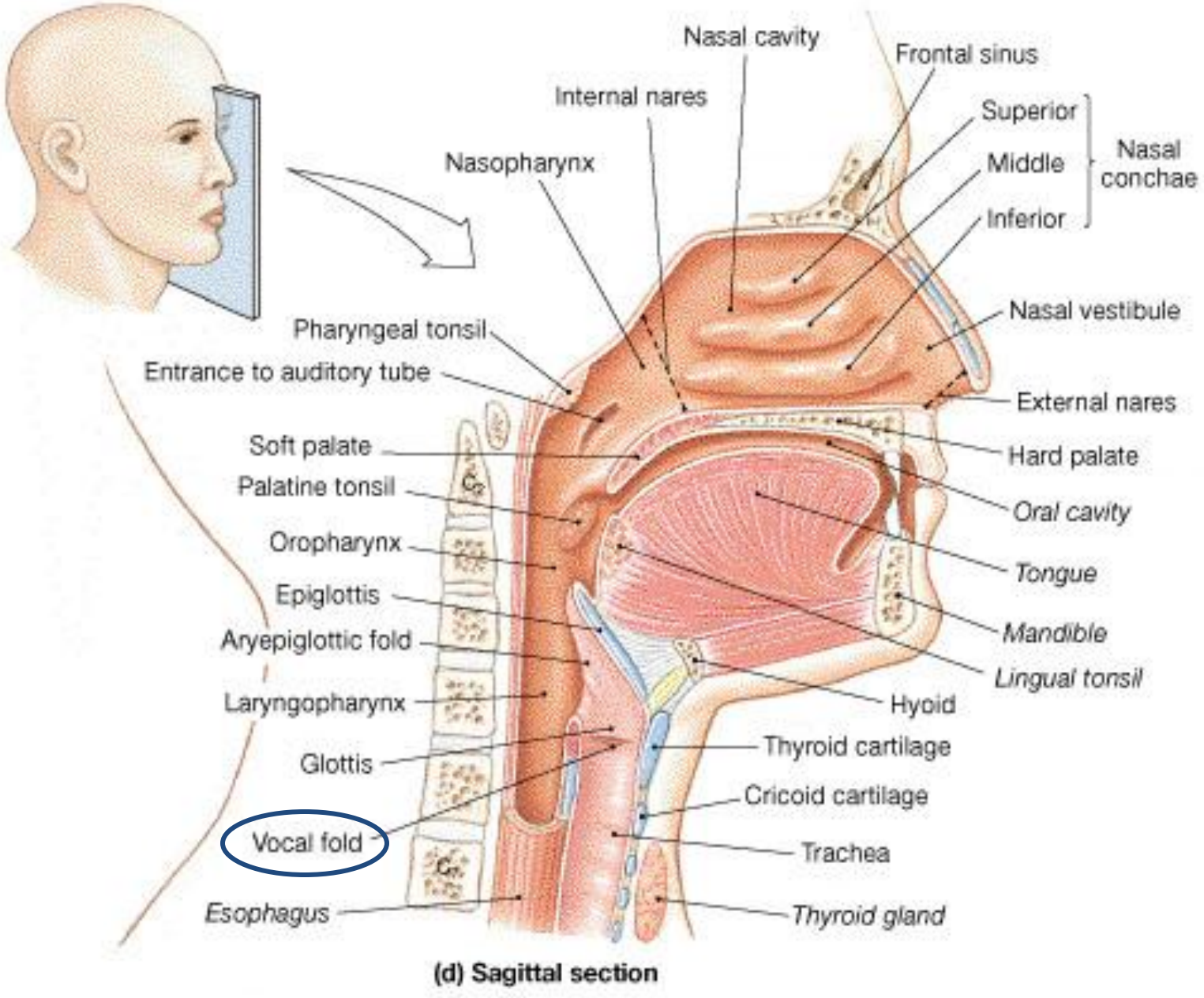
(d) Sagittal section

The conchae



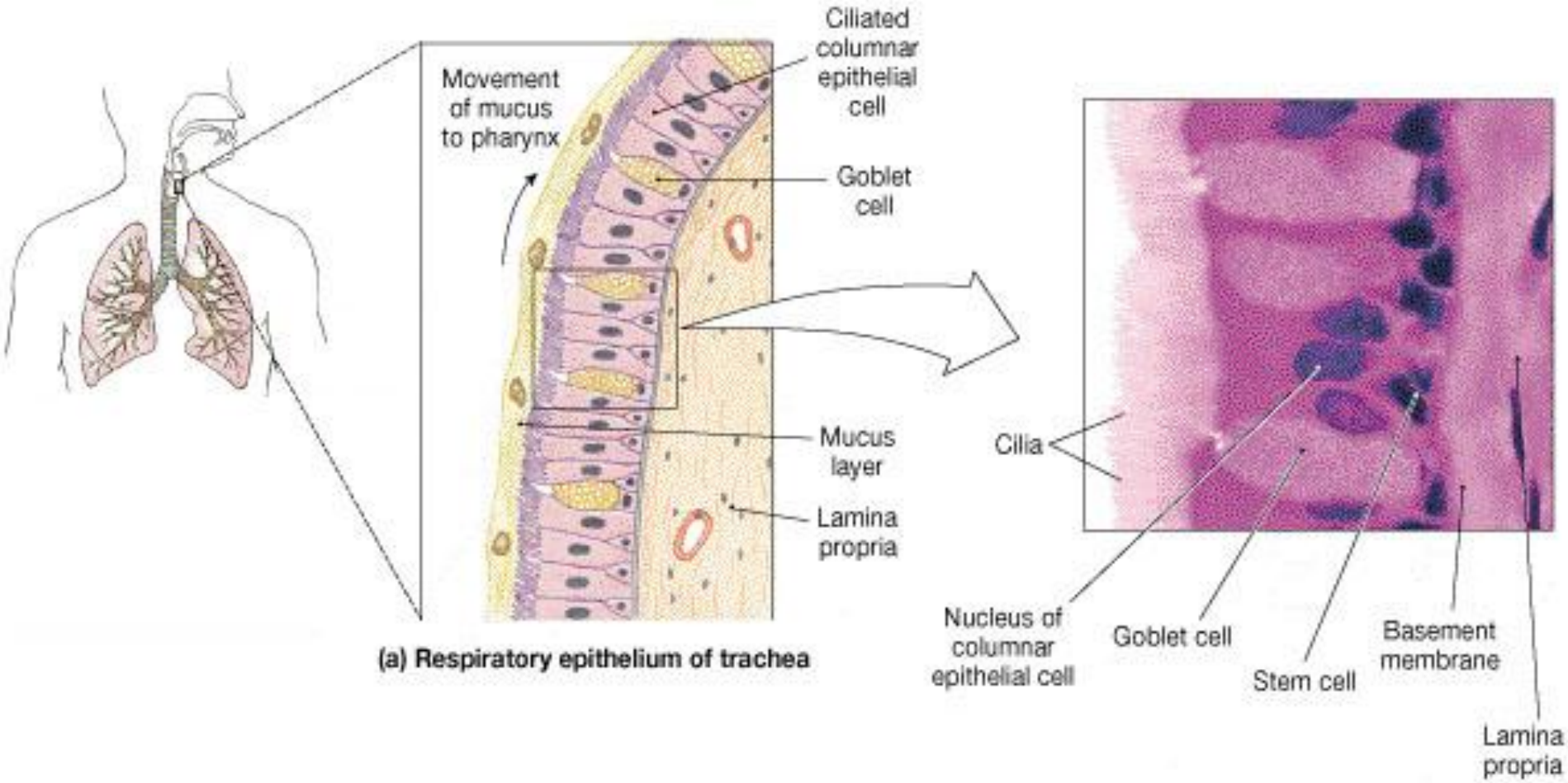
(b) Head, coronal section

Head and neck

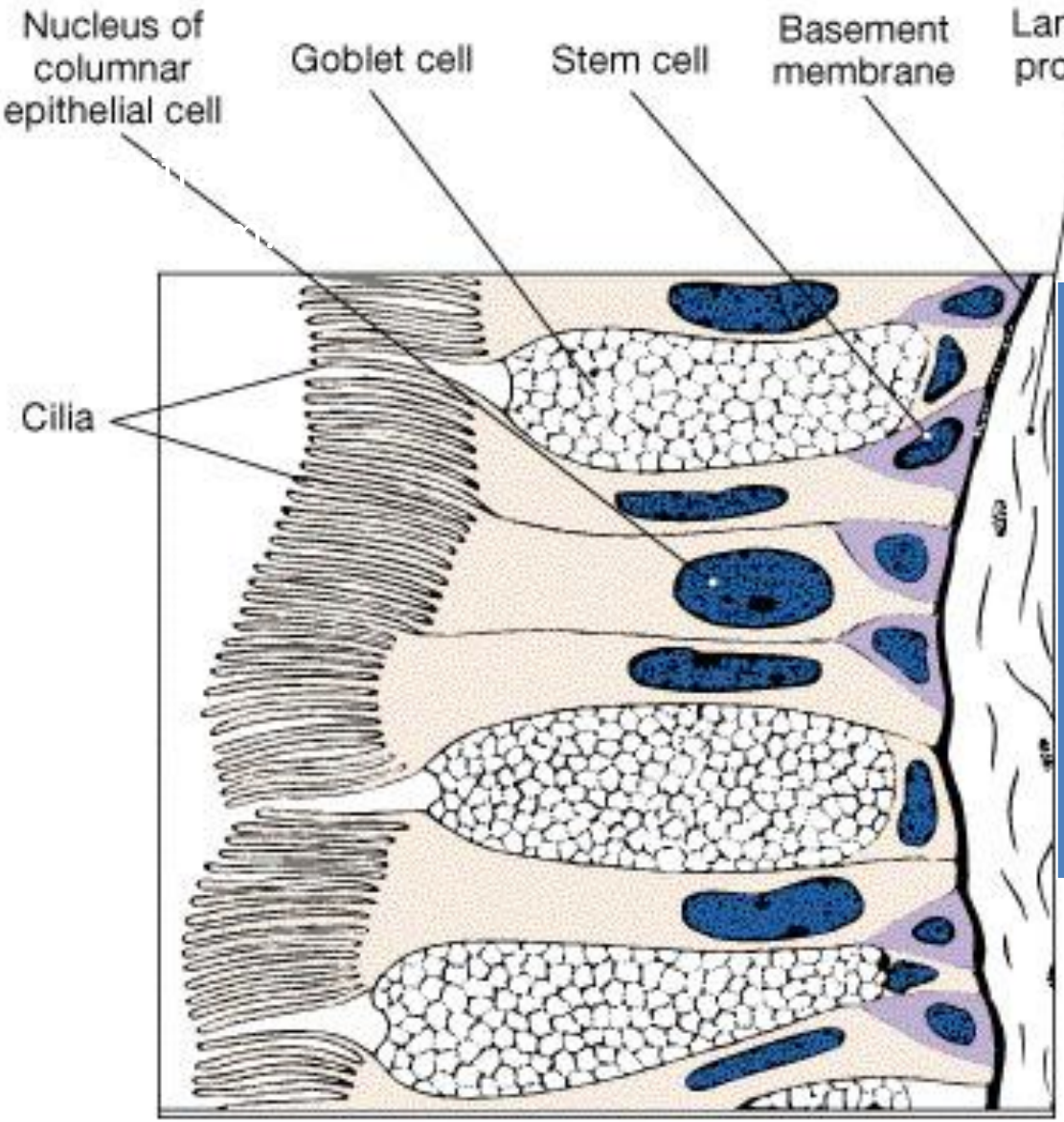


(d) Sagittal section

Respiratory epithelium



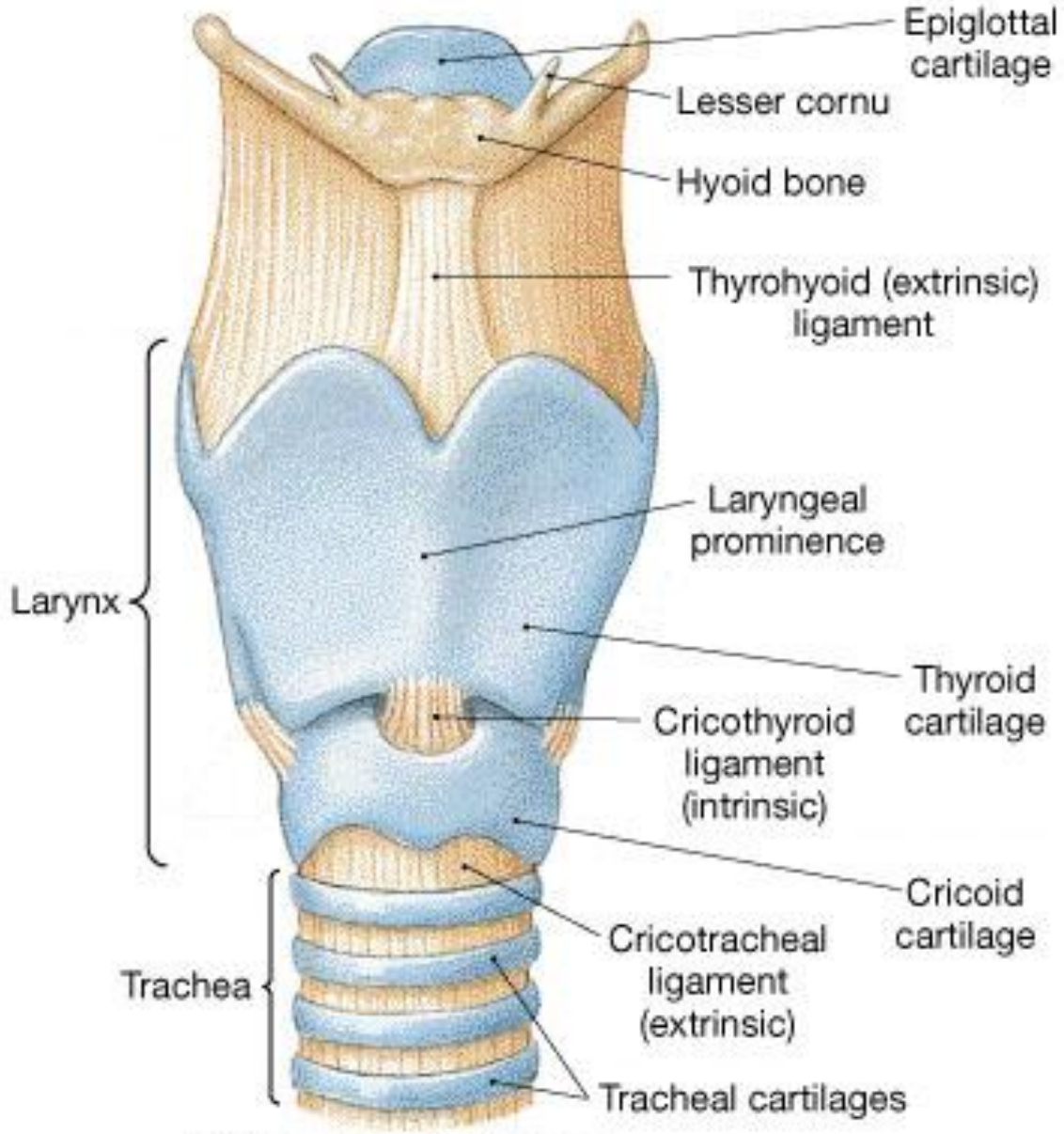
Respiratory epithelium



(b) Respiratory epithelium (LM x 932)

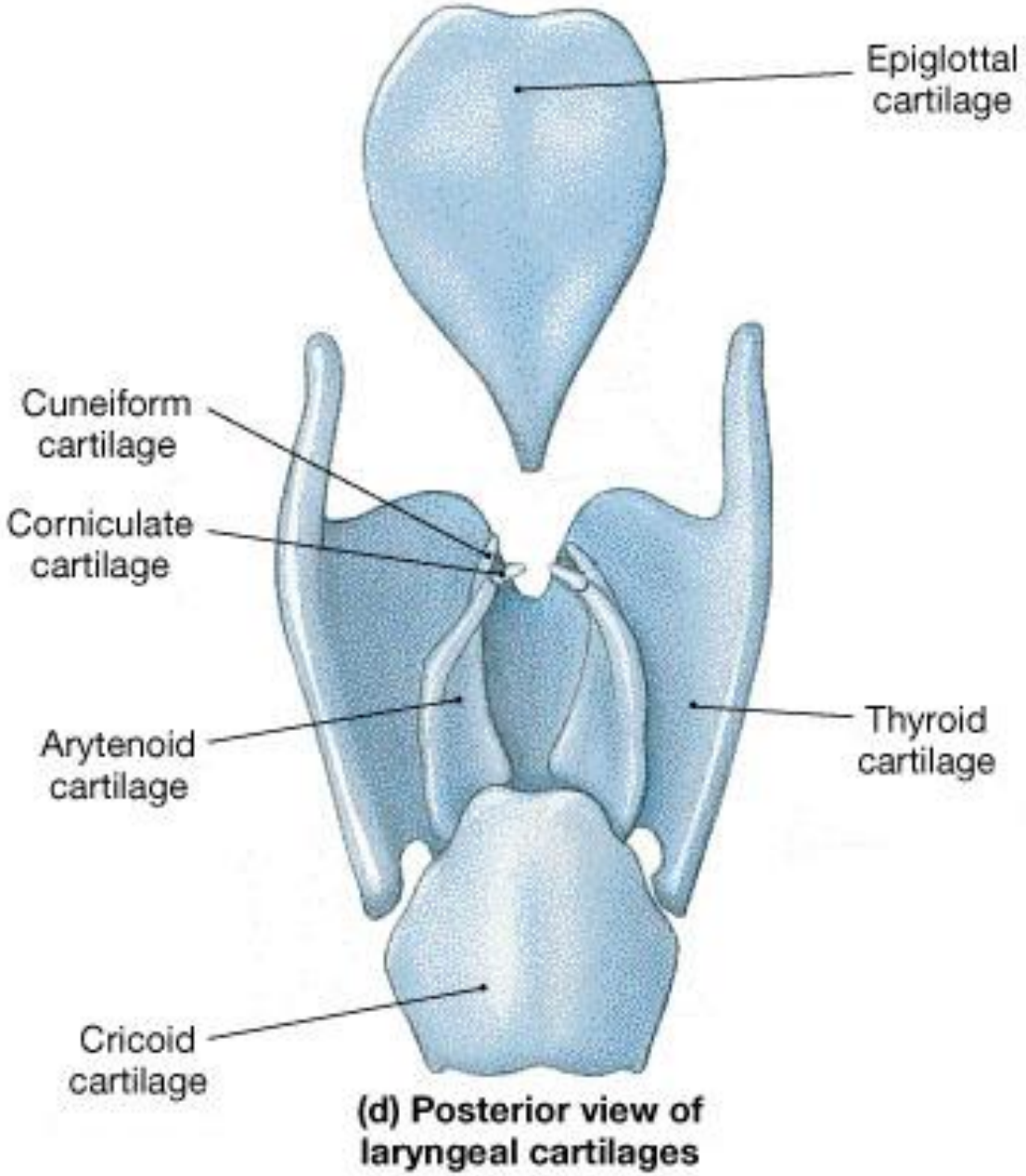
Lines most of the respiratory tract

Cartilages of the Larynx (anterior view)

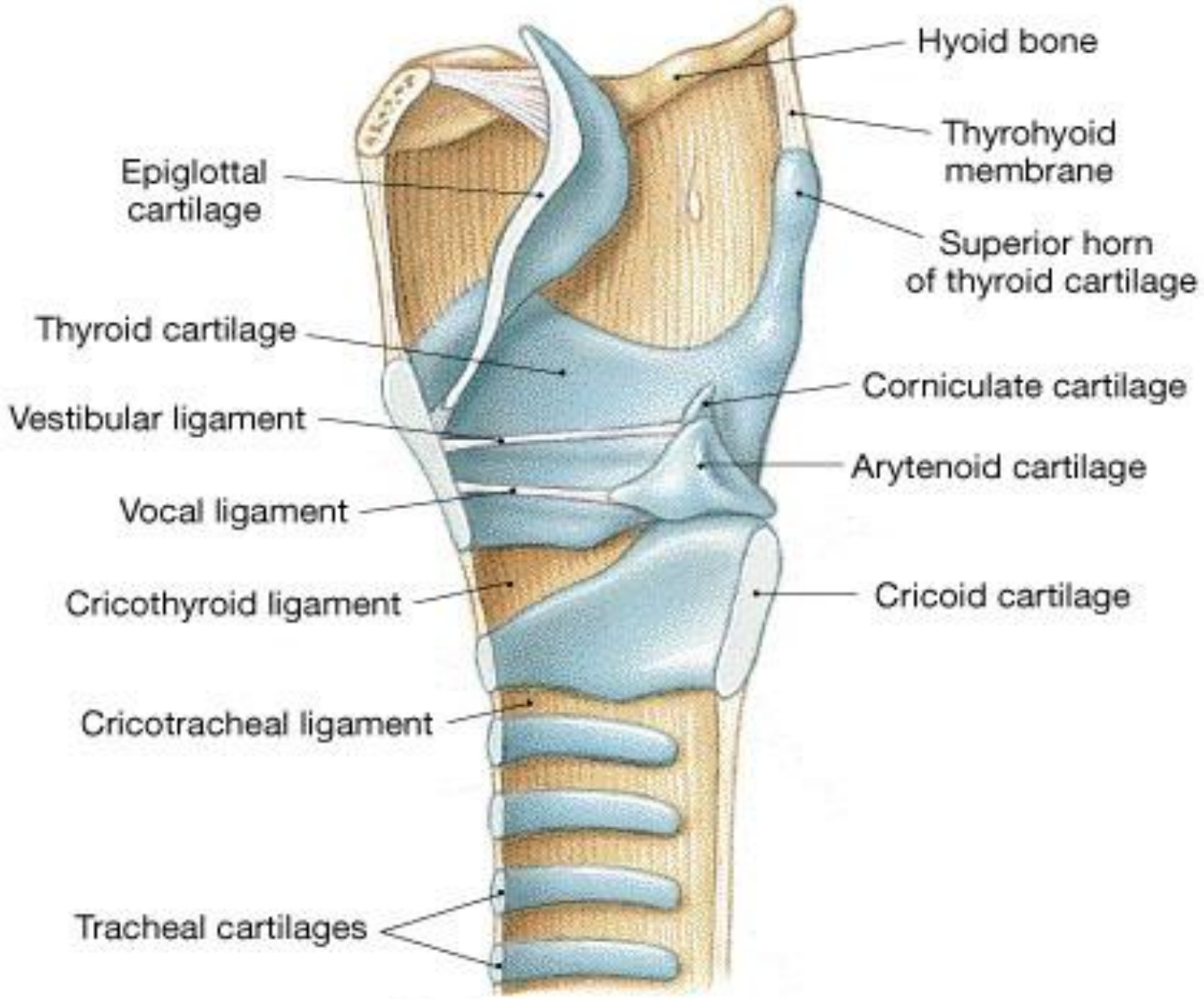


(a) Larynx, anterior view

Cartliages of the Larynx (posterior view)

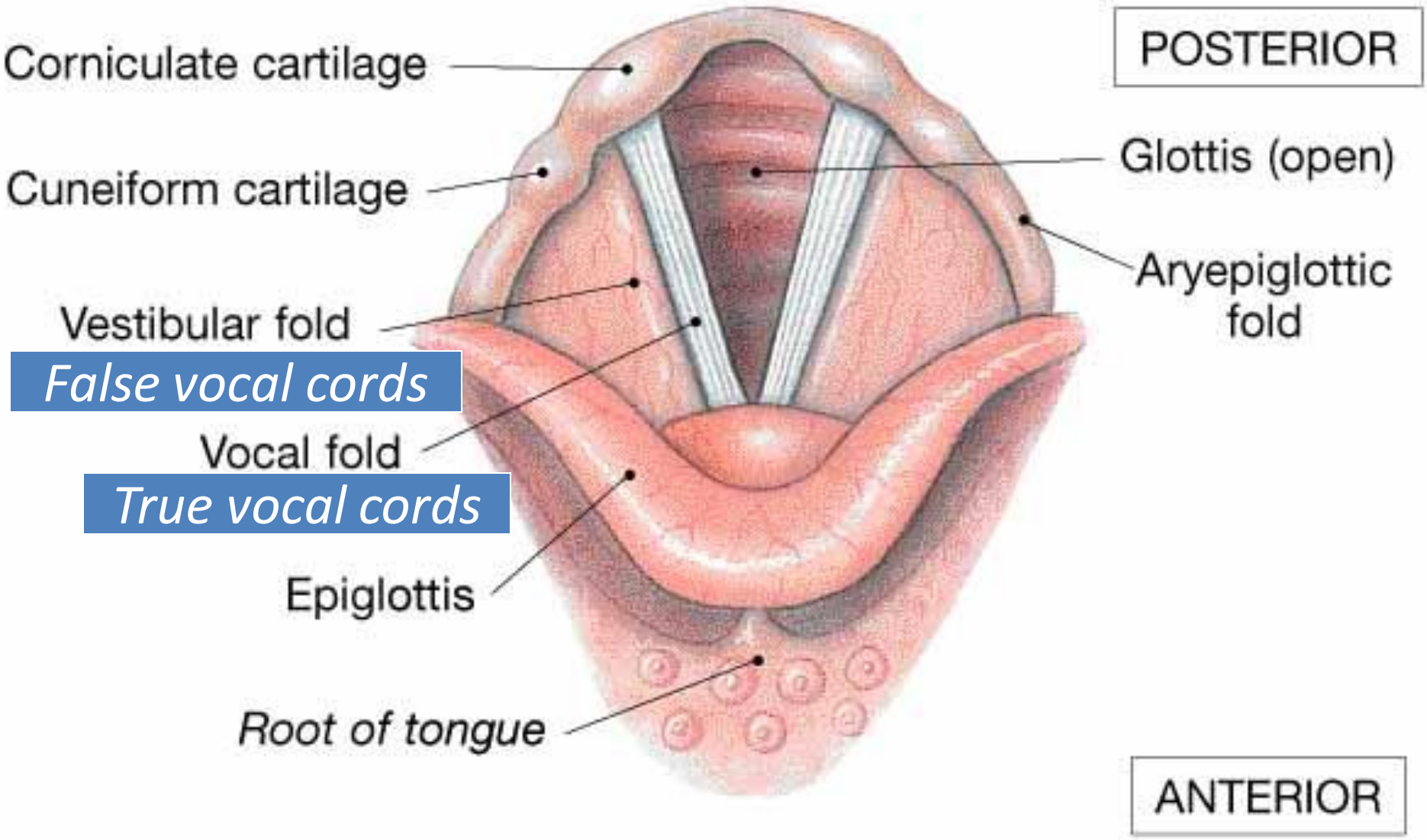


Larynx (sagittal view)

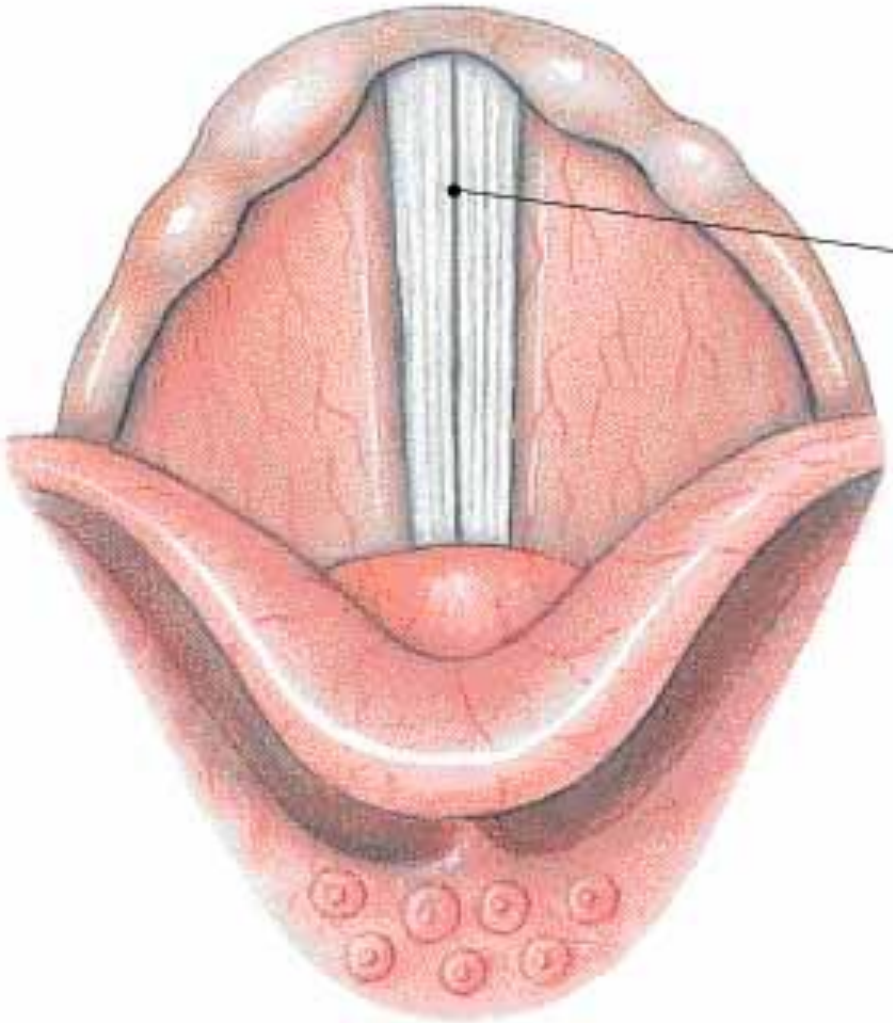


(c) Larynx, sagittal section

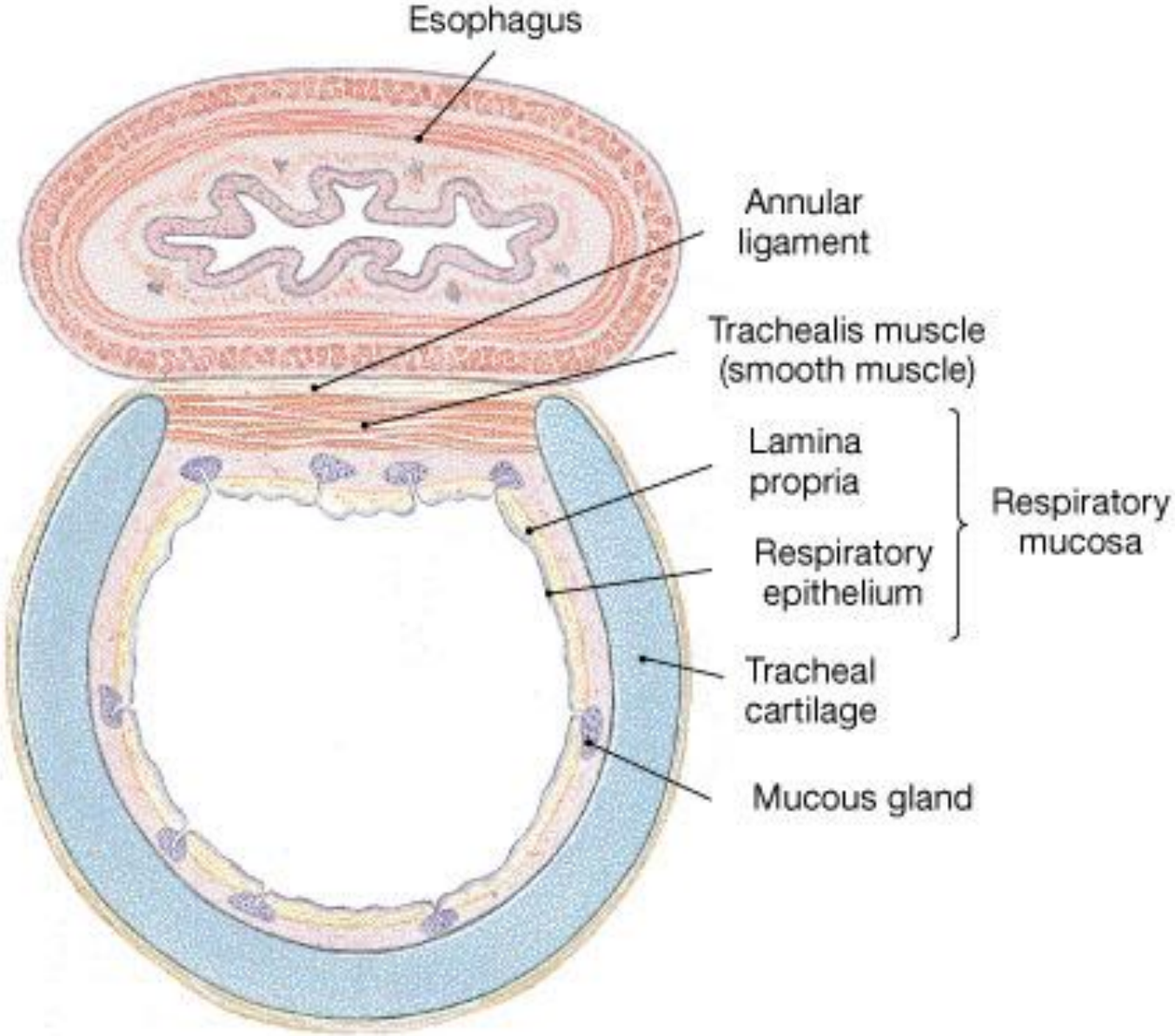
The vocal cords (open)



The vocal cords (closed)

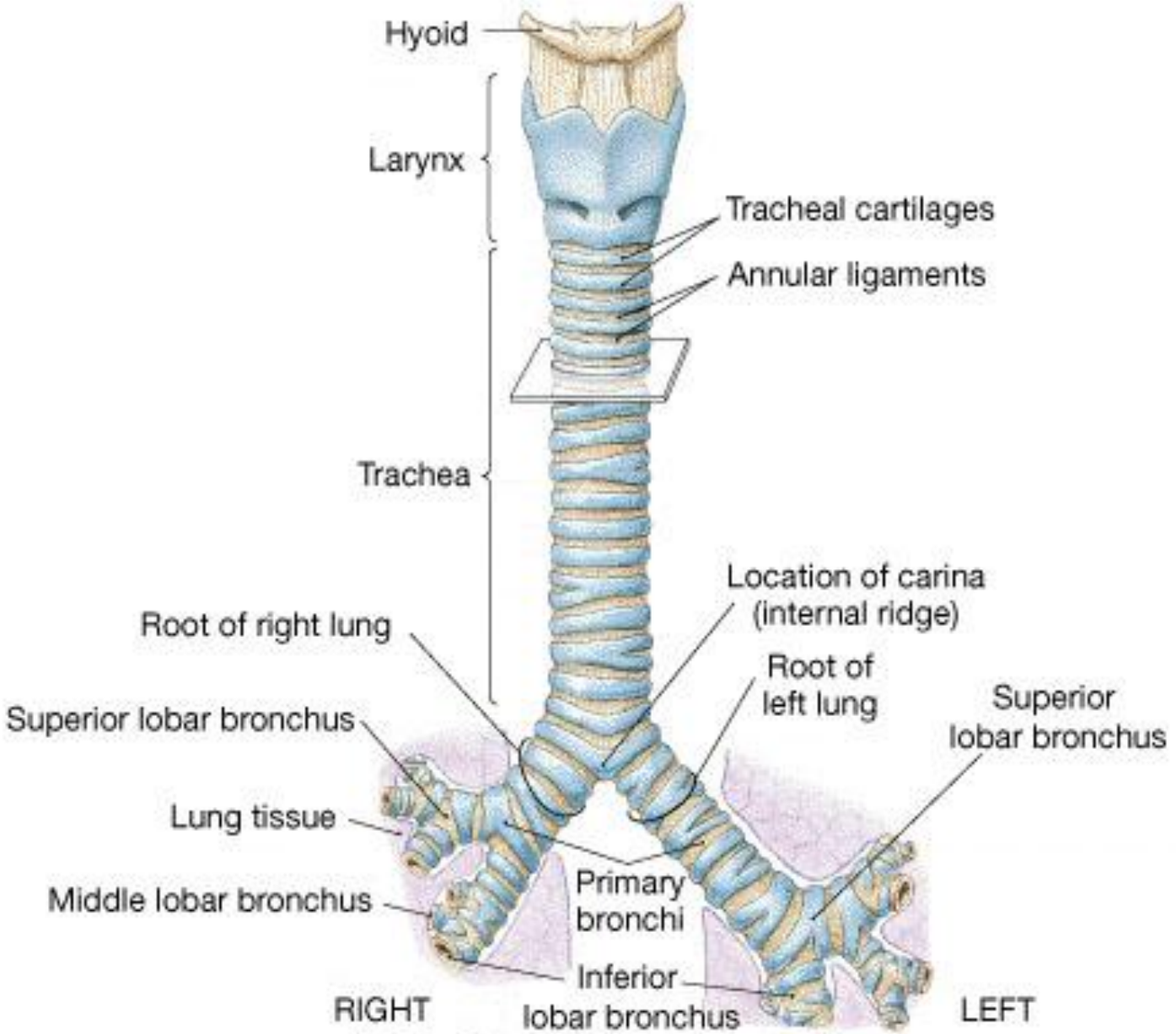


Relationship between trachea and esophagus



(b) Trachea and esophagus, transverse section

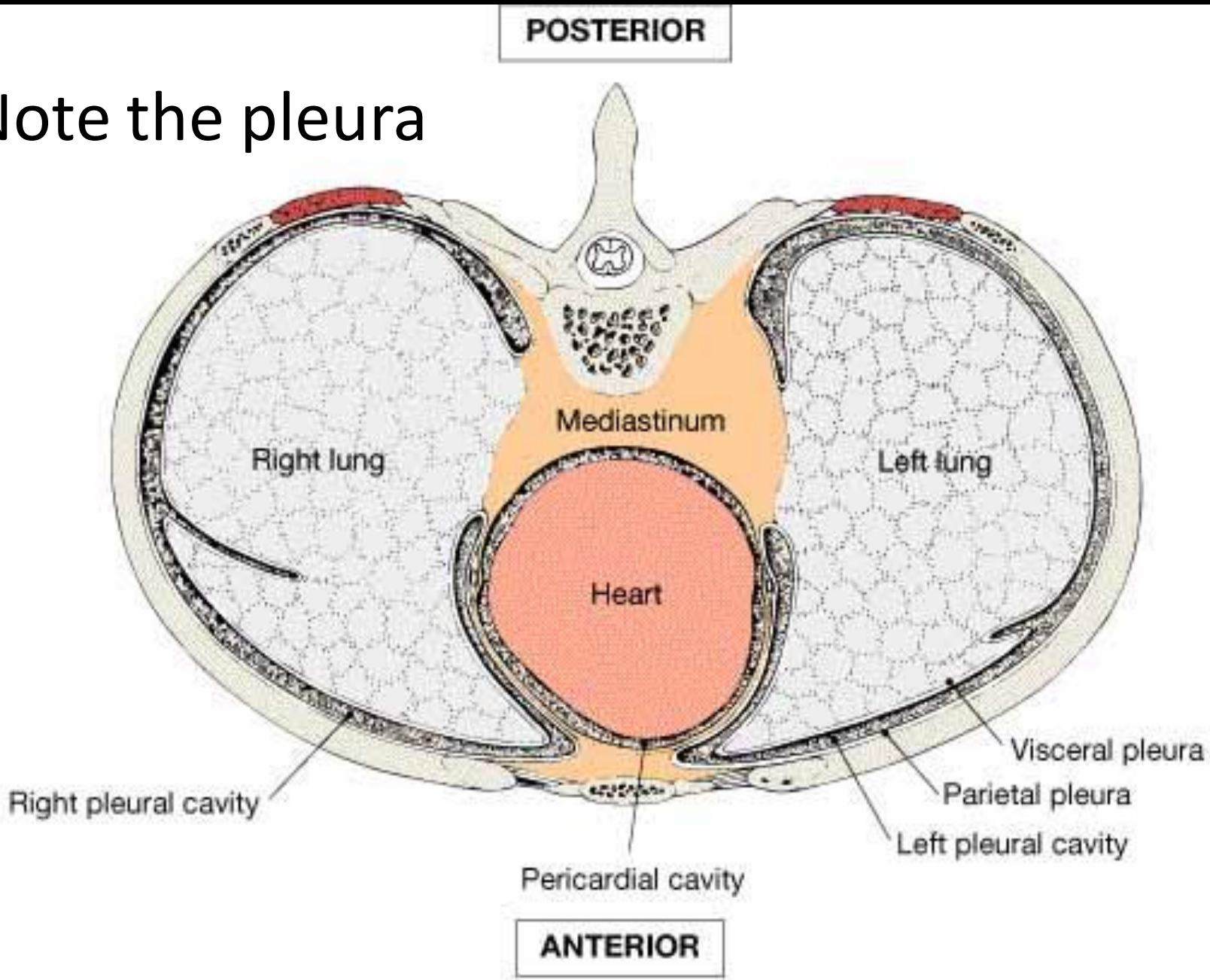
Trachea and primary bronchi



(a) Trachea and bronchi, anterior view

Bronchopulmonary segments

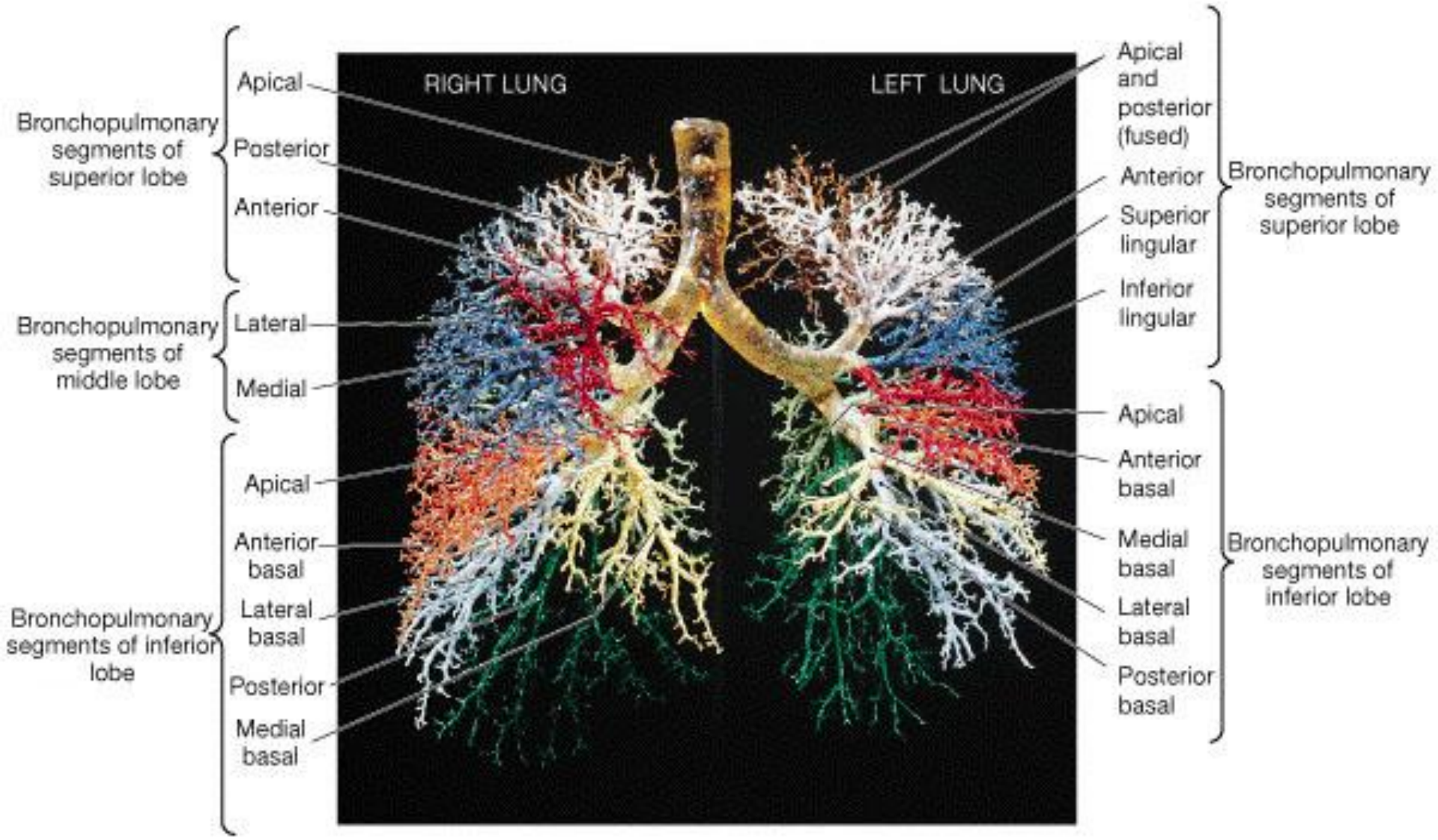
Note the pleura



Bronchopulmonary segments (colored)

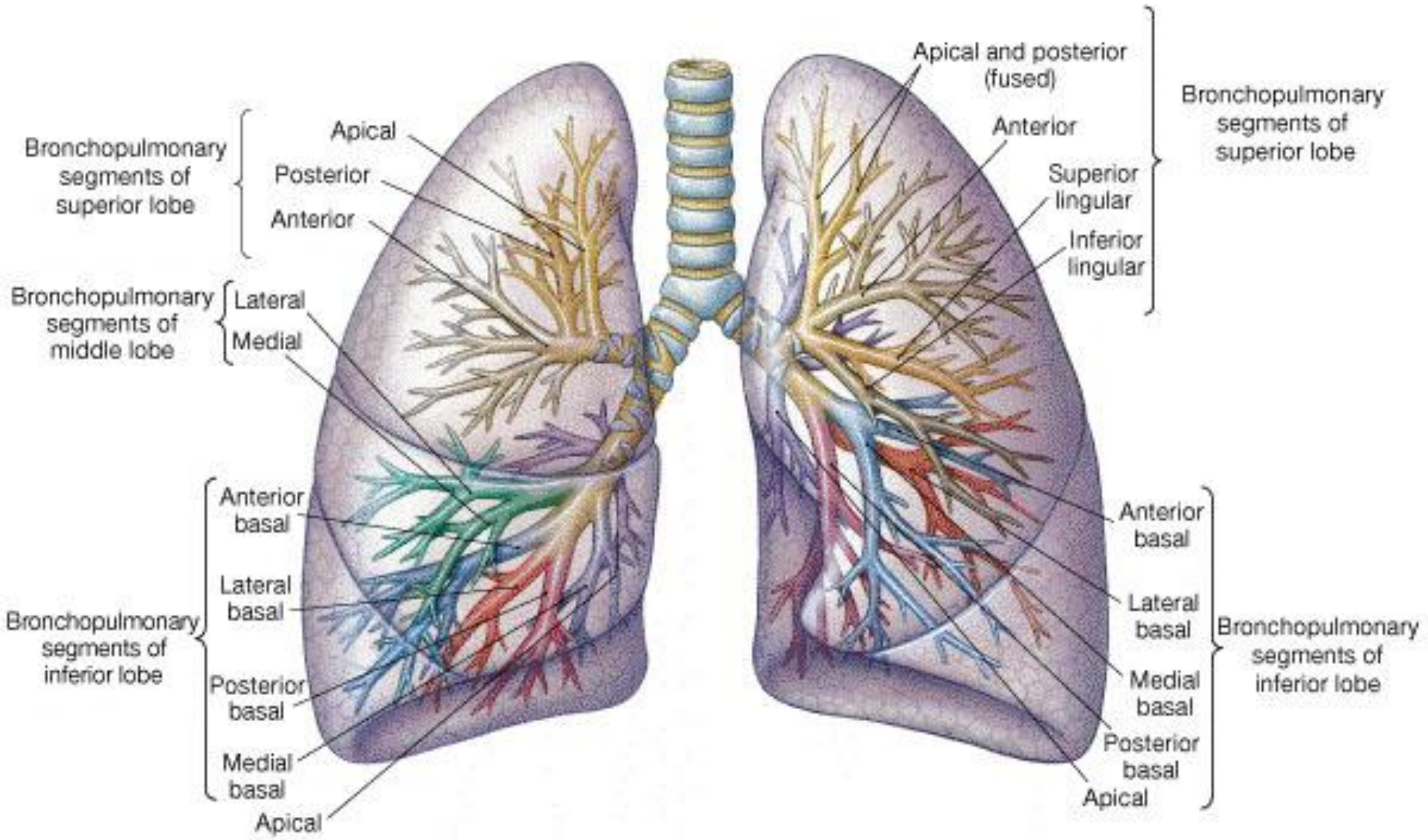
(b) Bronchopulmonary segments of left and right lungs, lateral views

The bronchial tree



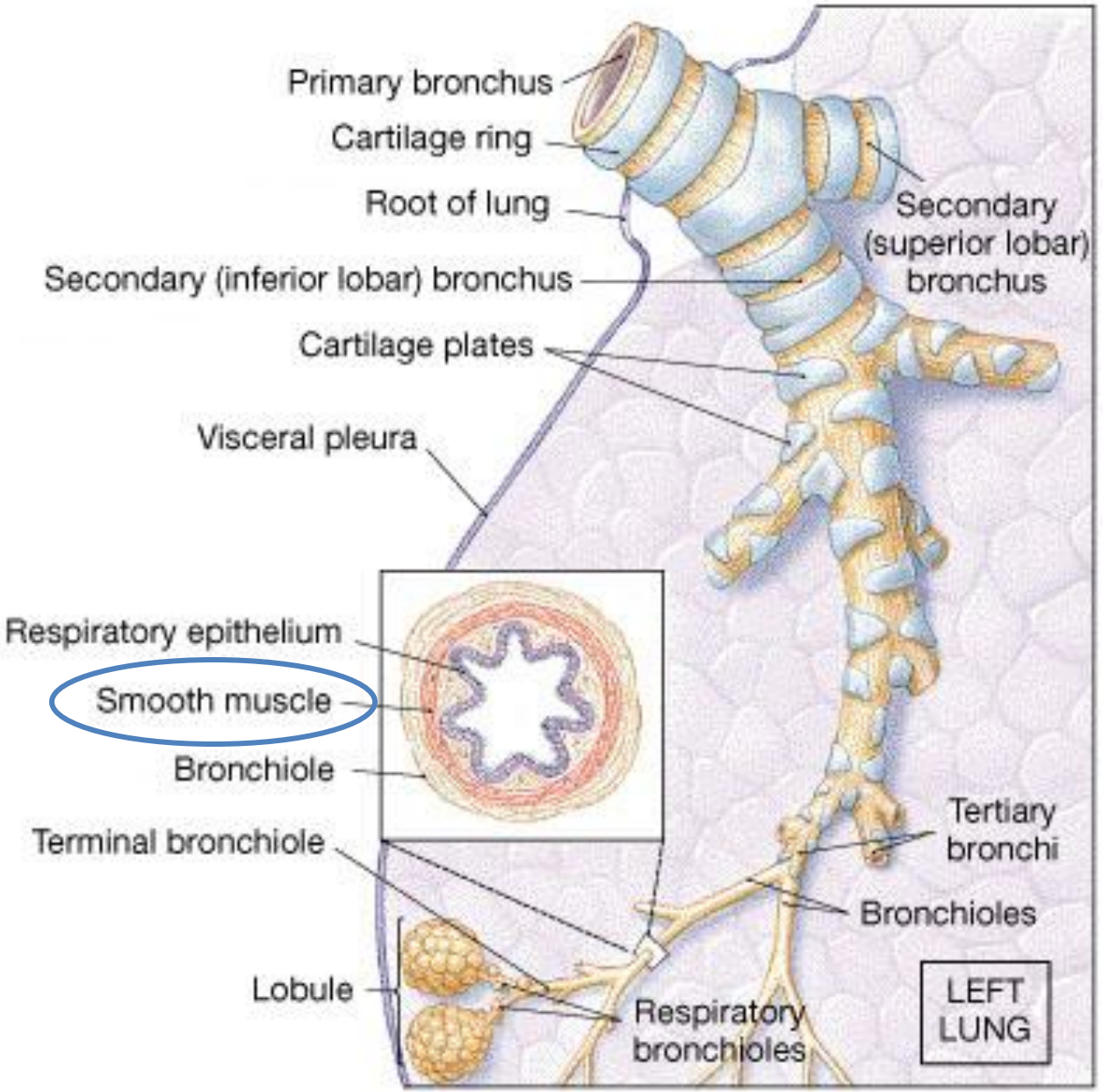
(d) The bronchial tree

Bronchopulmonary segments

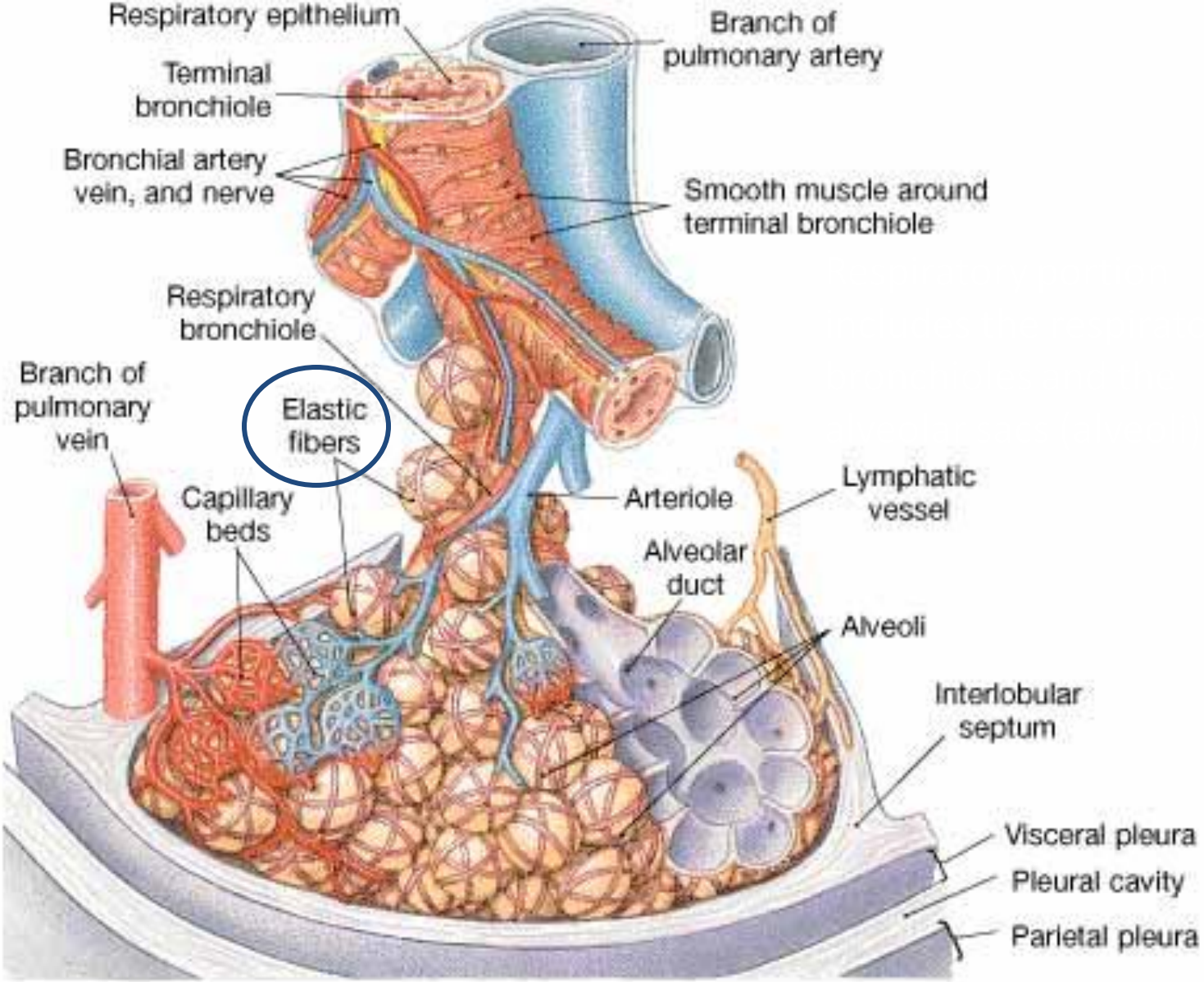


(a) Bronchial divisions and bronchopulmonary segments, anterior view

Bronchi and bronchioles

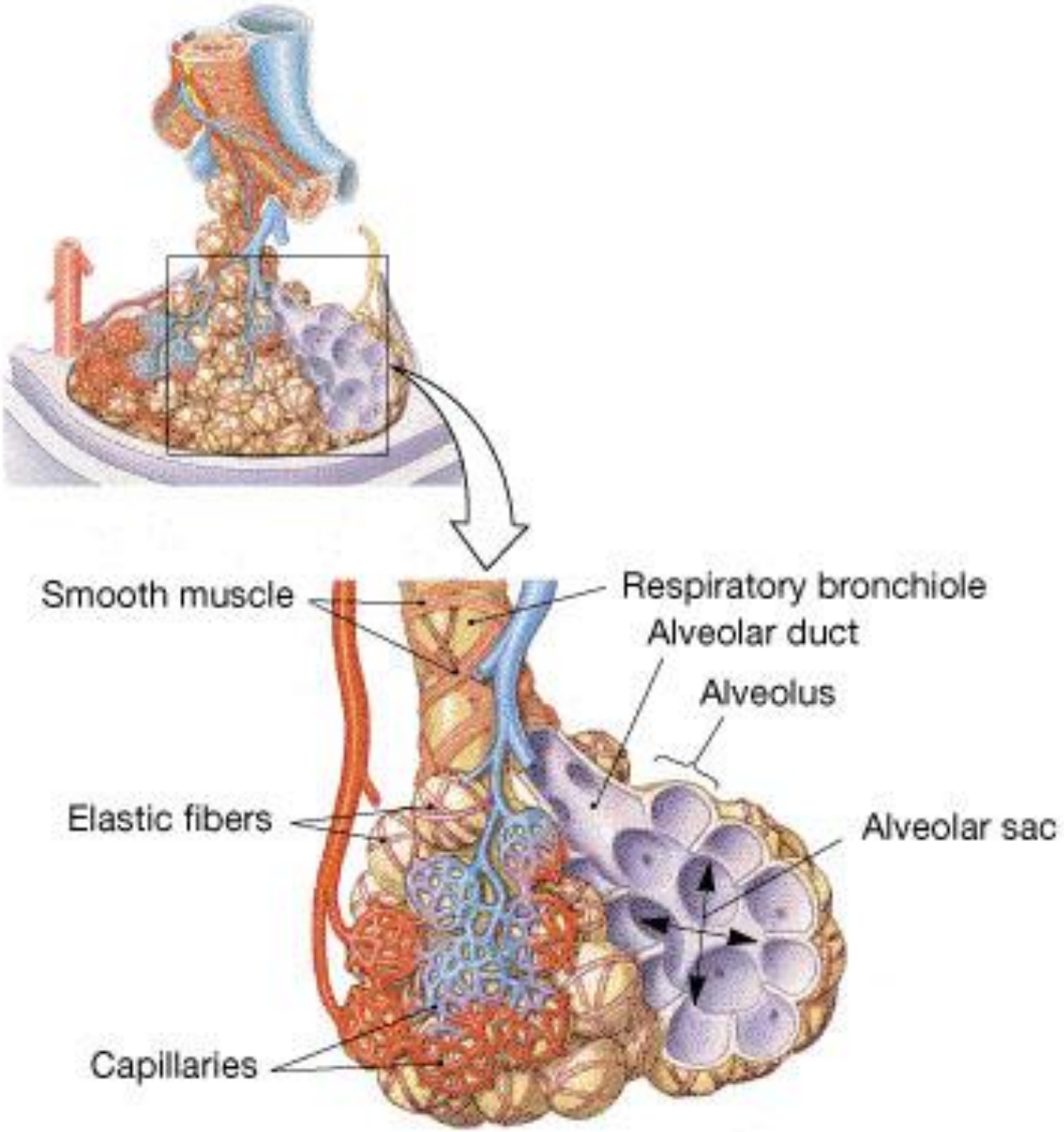


The respiratory unit



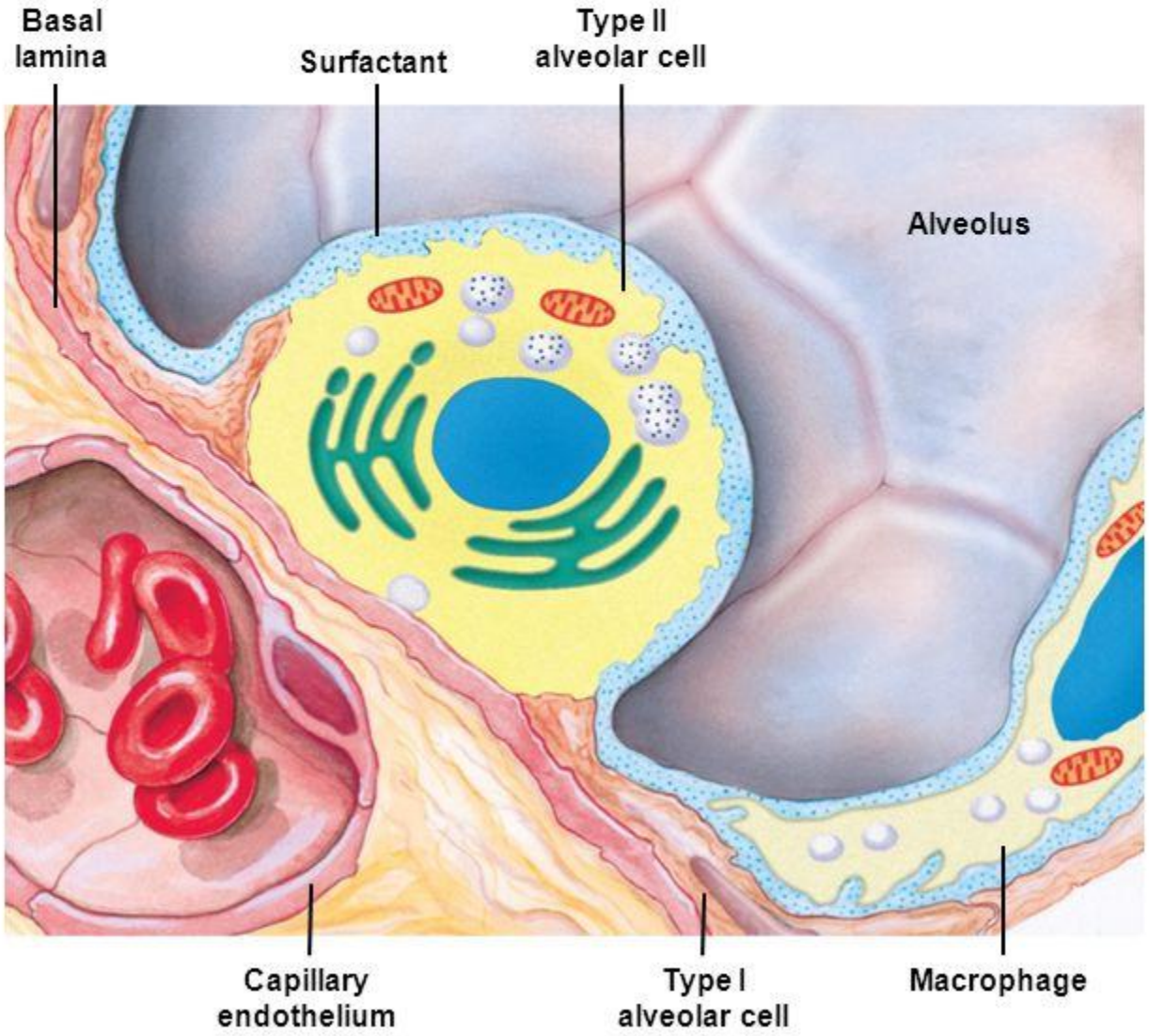
(a) Components of a lung lobule

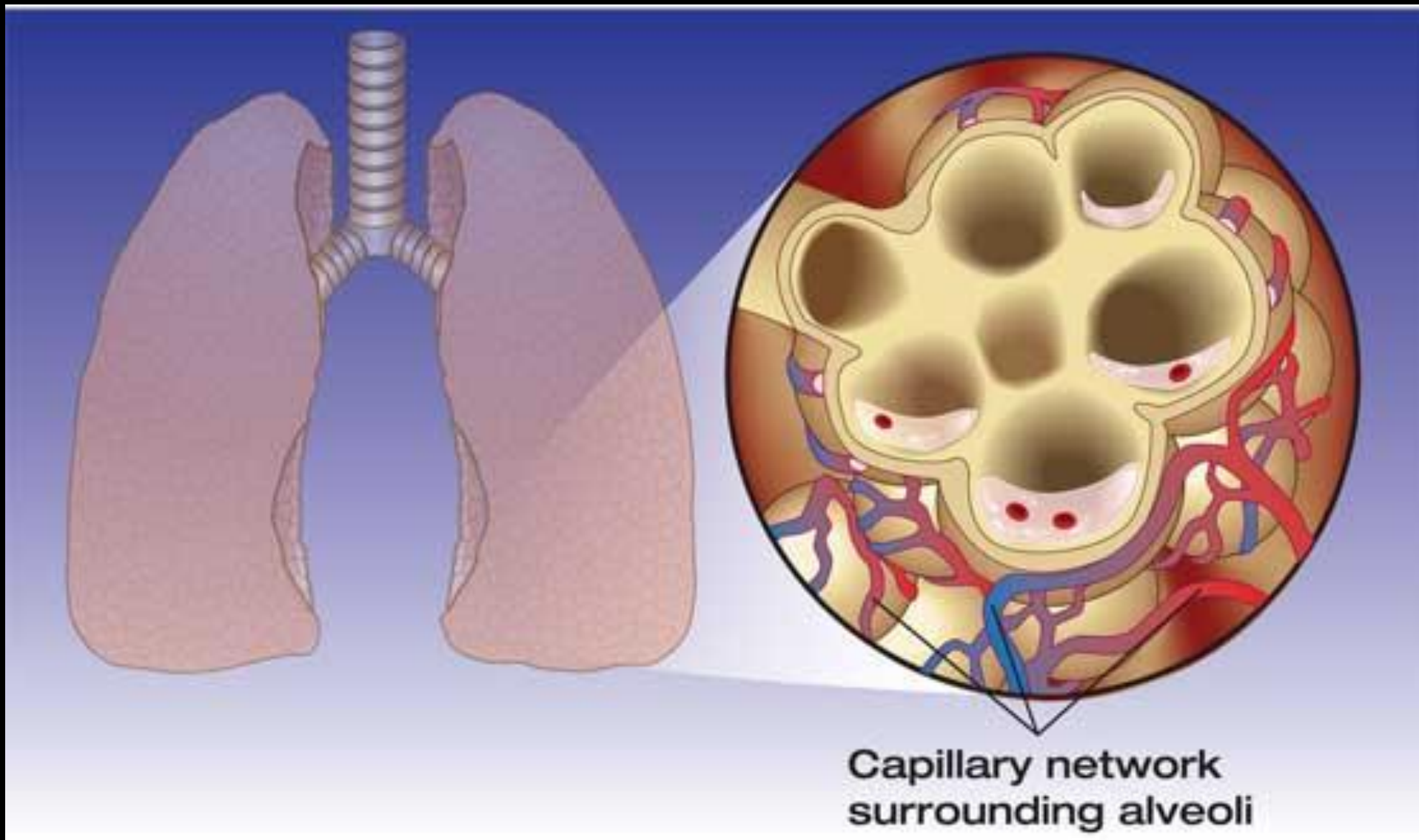
Alveolar organization



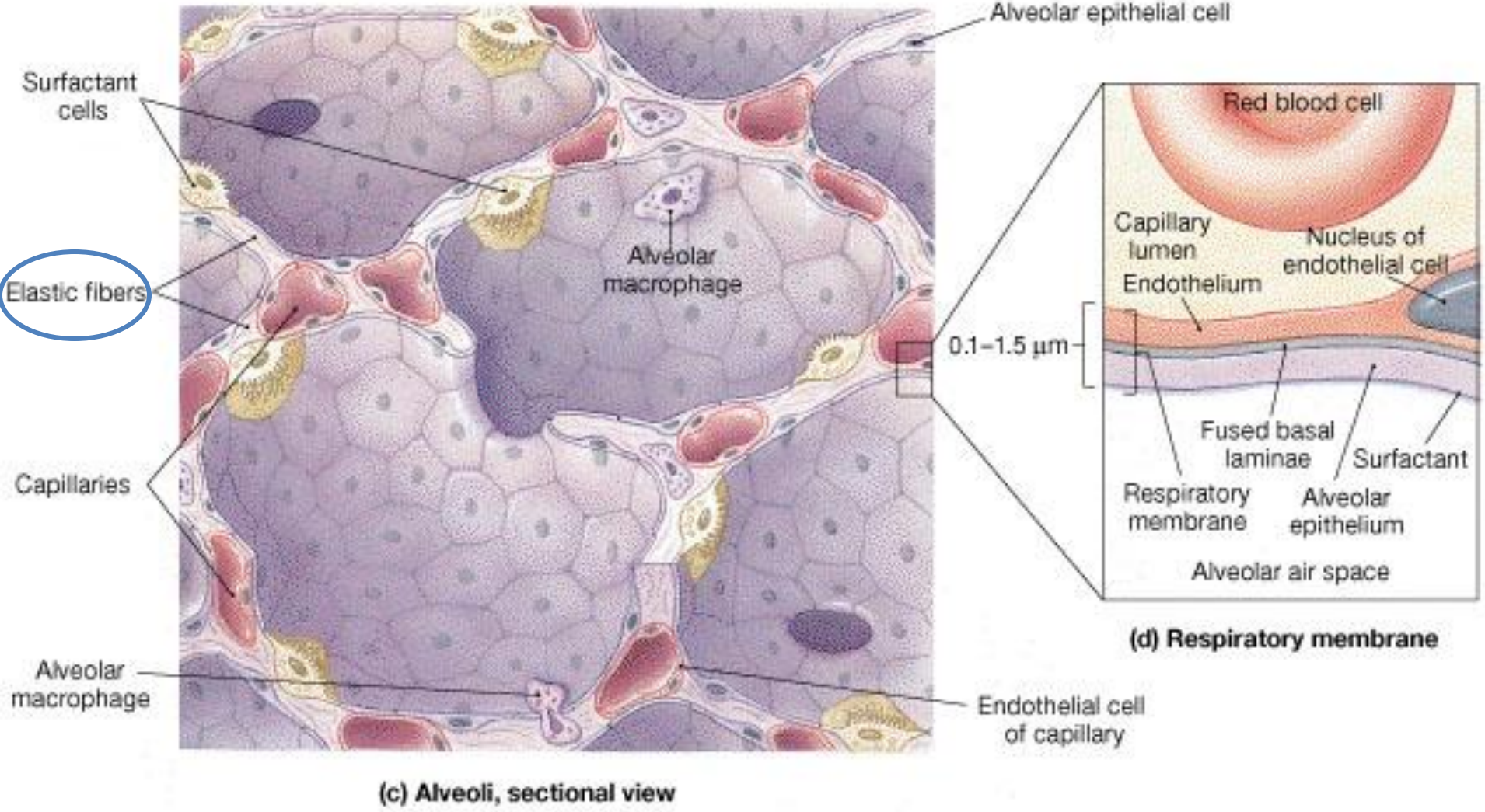
(a) Alveolar organization

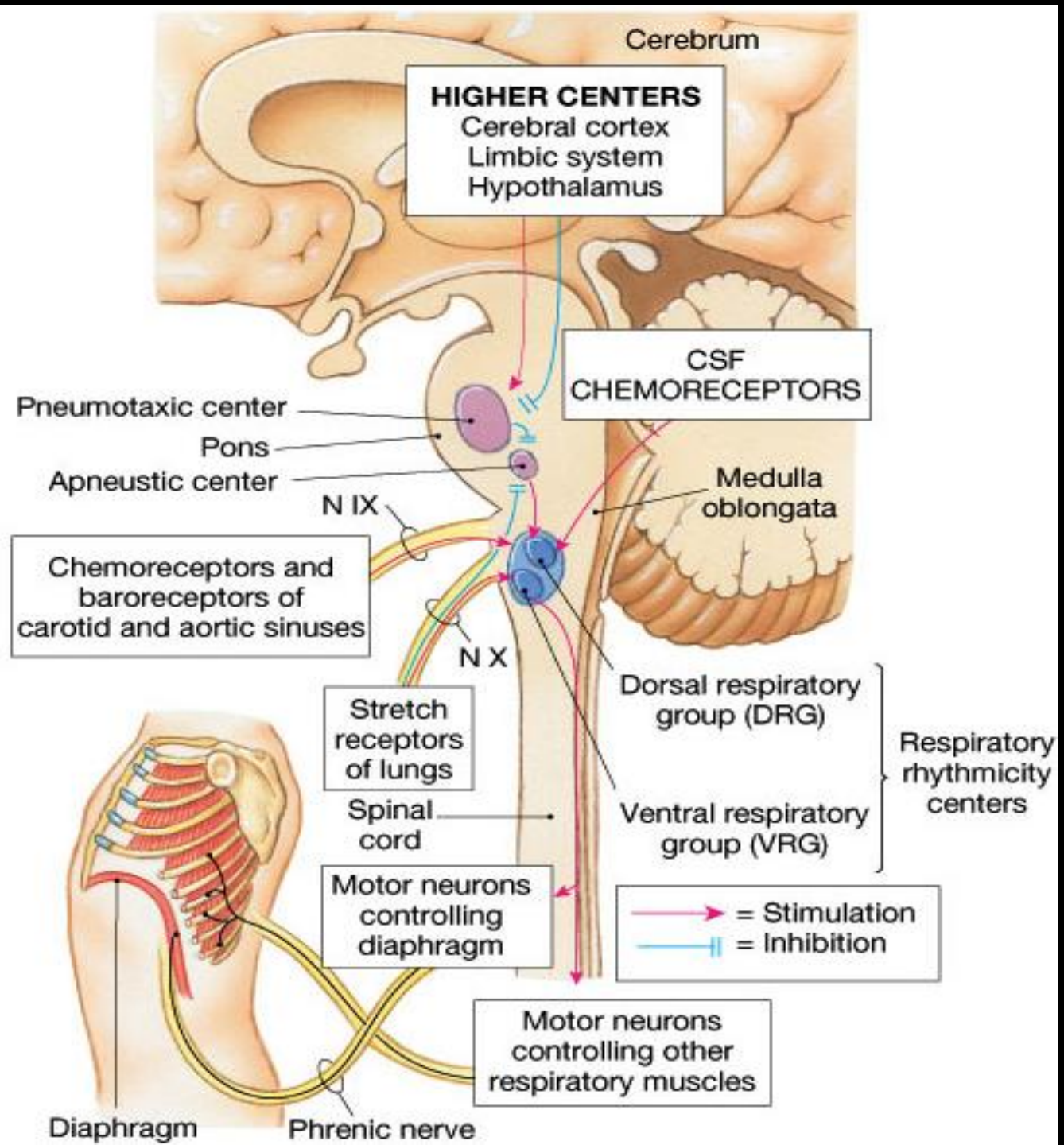
Production of Pulmonary Surfactant




Capillary network
surrounding alveoli

Alveoli sectional view





Reflex Centers and respiratory controls

Summary: Functions of the Respiratory System:

- Gas exchange between air and circulating blood (O_2 and CO_2)
- Move air to and from exchange surfaces
- Protect respiratory surfaces
- Defend respiratory system from pathogenic microorganisms
- Produce sound

https://www.youtube.com/watch?v=Cy1IfZAIojs

What can possibly go wrong?

- **asthma** – wheezing and breathlessness caused by a narrowing of the airways
- **bronchitis** – inflammation of the lung's mucous lining
- **emphysema** – disease of the alveoli
- **hay fever** – an allergic reaction to pollen, dust or other irritants
- **influenza** – caused by viruses
- **laryngitis** – inflammation of the vocal cords (larynx)
- **pneumonia** – inflammation of the lung.
- **COPD** – chronic obstructive pulmonary disorder
- **Asbestosis/Silicosis-**
- **Cystic fibrosis-**
- **Tuberculosis**
- **Lung cancer**

Medical slides from Slideshare.net

- Examination of the respiratory system is carried out by:

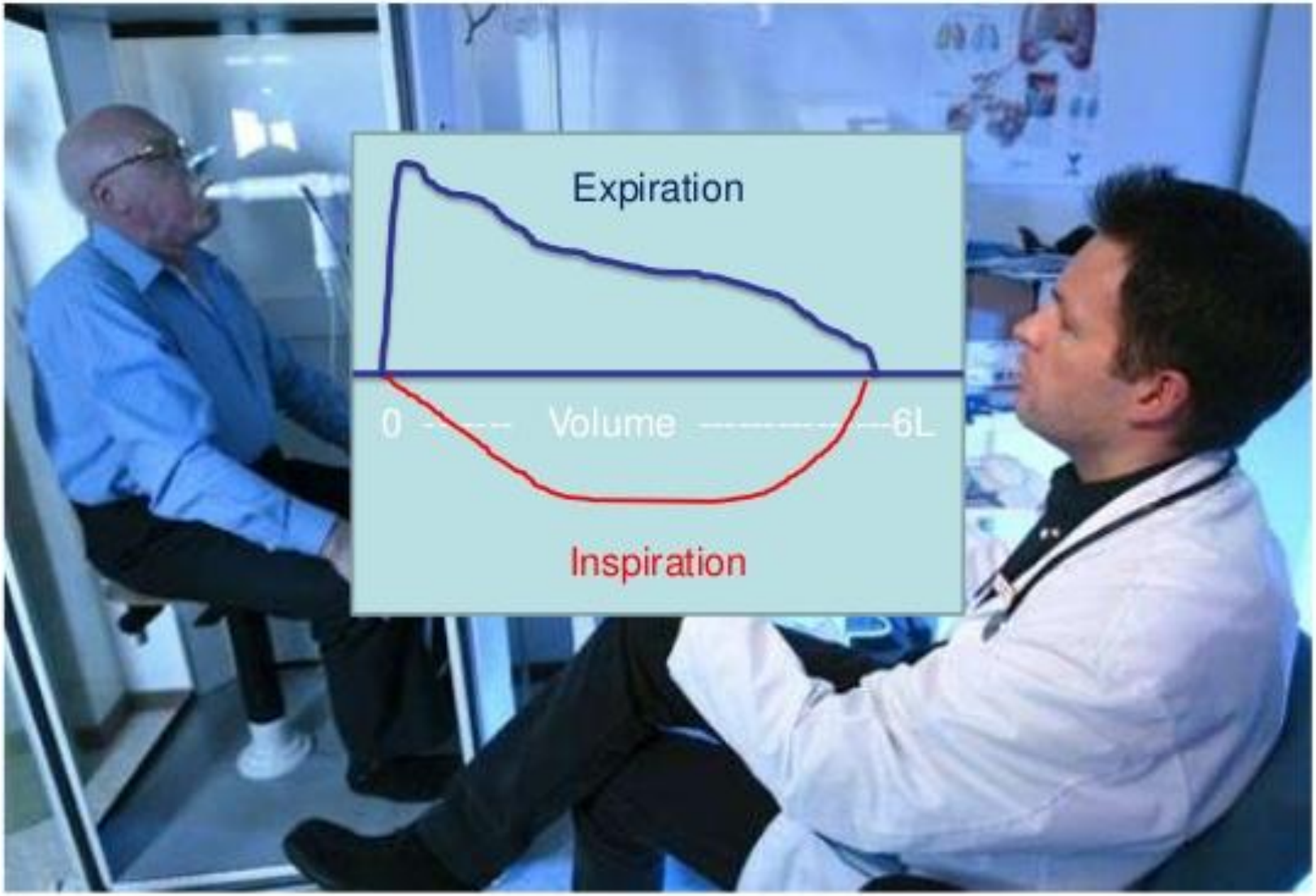
-Inspection

-Palpation

-Percussion

-Auscultation

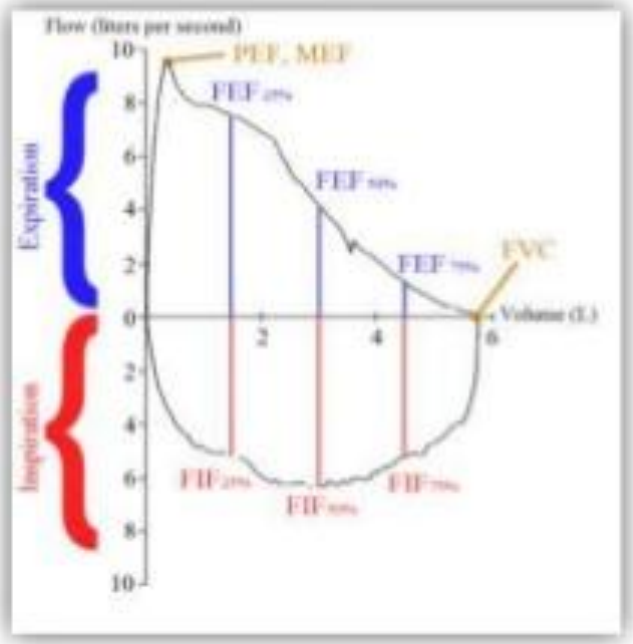
Lung Function testing:

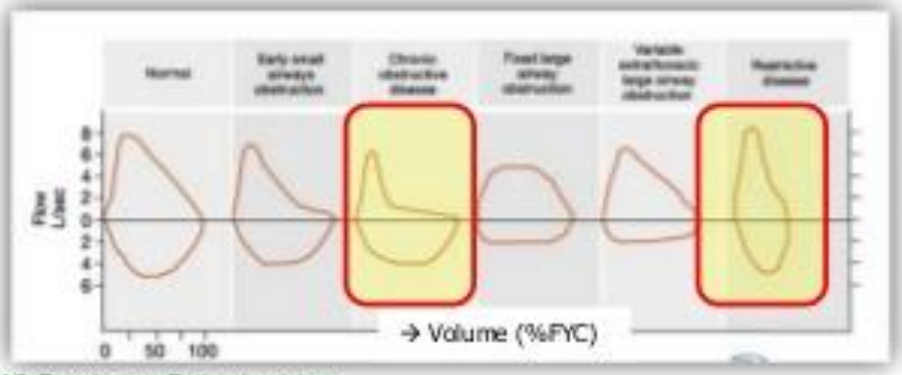


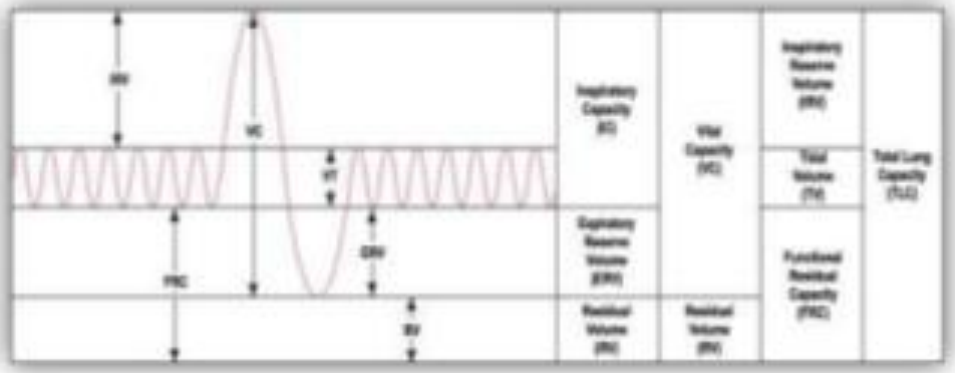
Lung Function Testing:

- Total Lung Capacity (TLC) 6L male/4.7L fem.
- Tidal Volume (TV) – 500 / 390ml
- Forced Vital Capacity (FVC) 4.8L / 3.7L
- Forced Expiratory Volume in 1 Sec - **FEV1**
- FEV1/FVC (FEV1%) - 75–80% normal.

1. In Obstructive diseases (COPD) FEV1 low & FVC high. So FEV1/FVC is low (<80%).
2. In Restrictive diseases (fibrosis) the FEV1 and FVC are both low proportionally and the FEV1/FVC value normal or high.







Types of pulmonary diseases

https://www.khanacademy.org/science/health-and-medicine/respiratory-system-diseases/intro-to-pulmonary-diseases/v/types-of-pulmonary-diseases

http://www.slideshare.net/vmshashi/pa7-respiratory

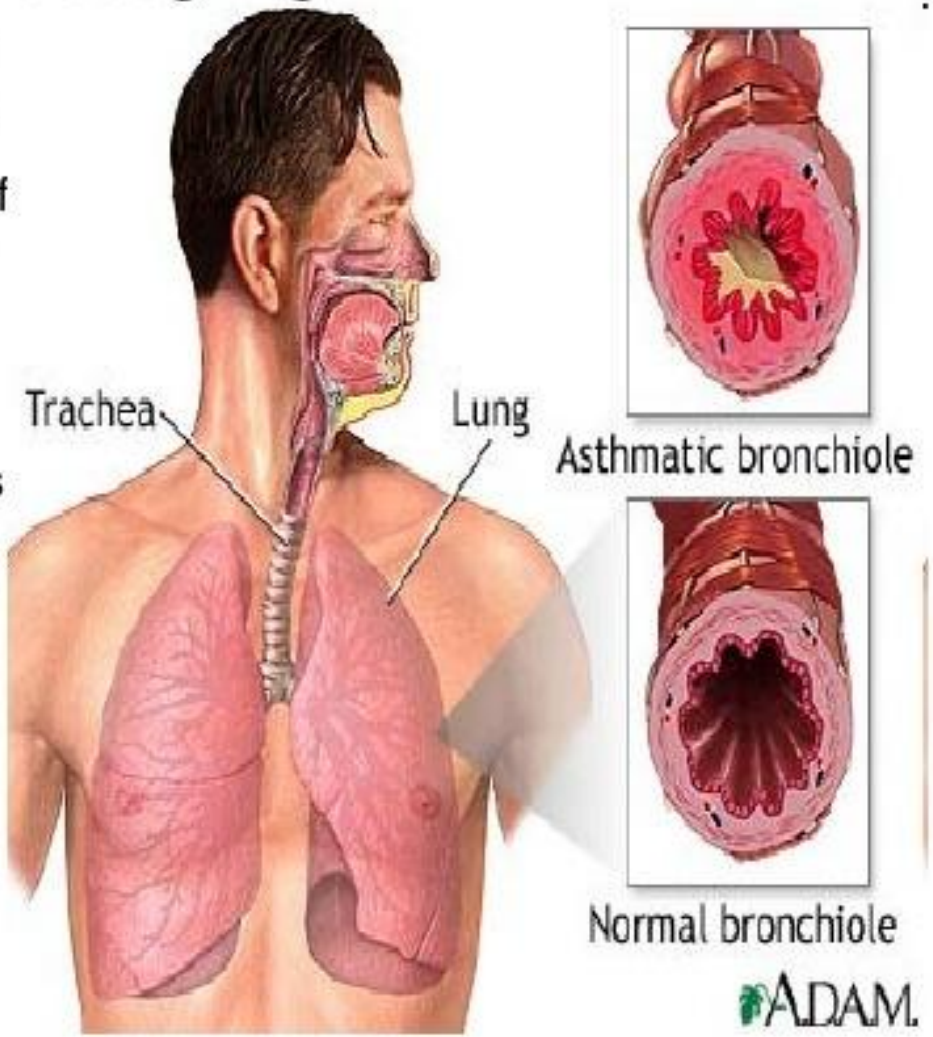
http://www.webmd.com/lung/lung-diseases-overview

Classification of Pulmonary Diseases

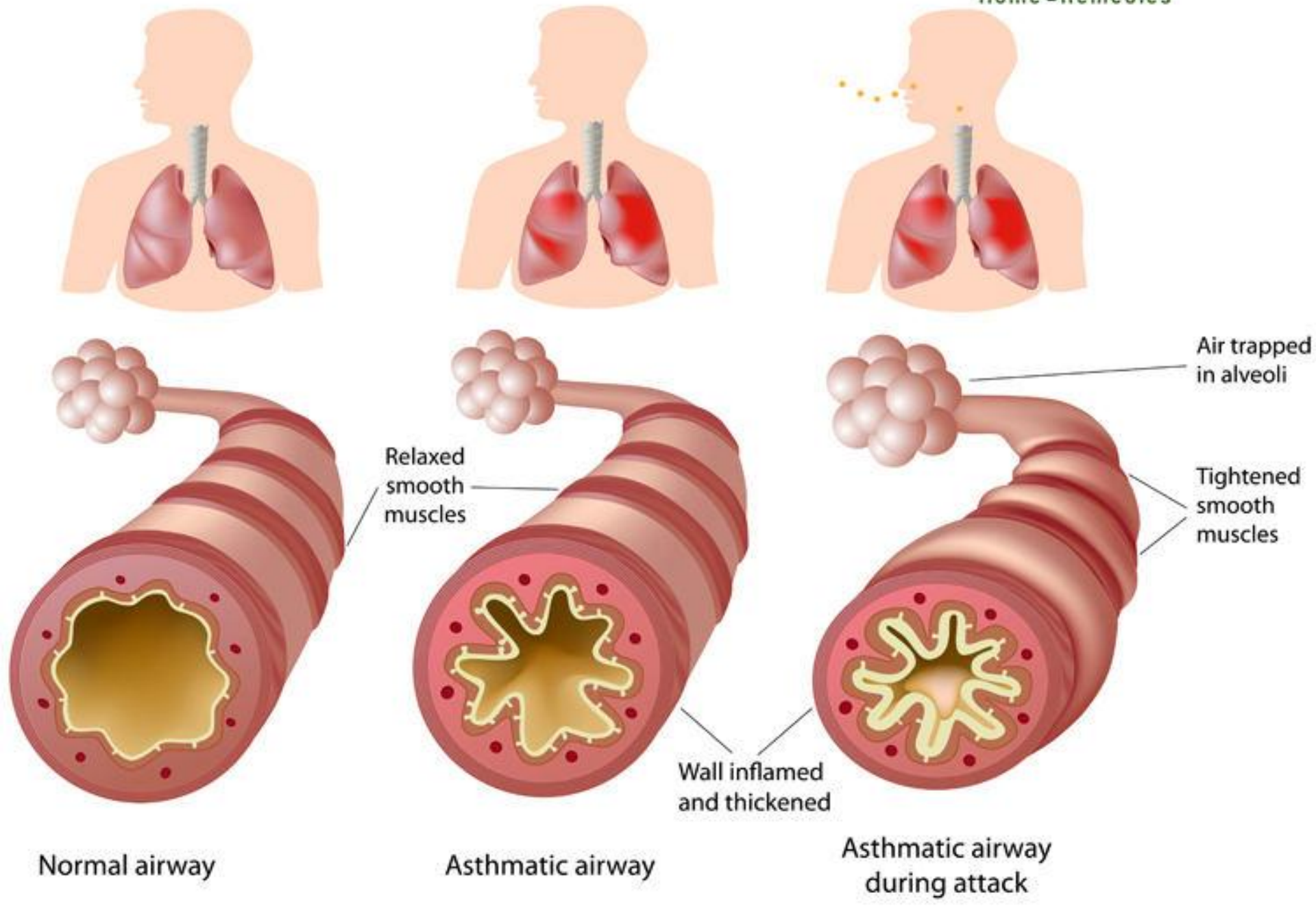
- Lung Diseases Affecting the Airways
  - Asthma
  - COPD
  - Chronic bronchitis
  - Emphysema
  - Acute bronchitis
  - Cystic fibrosis

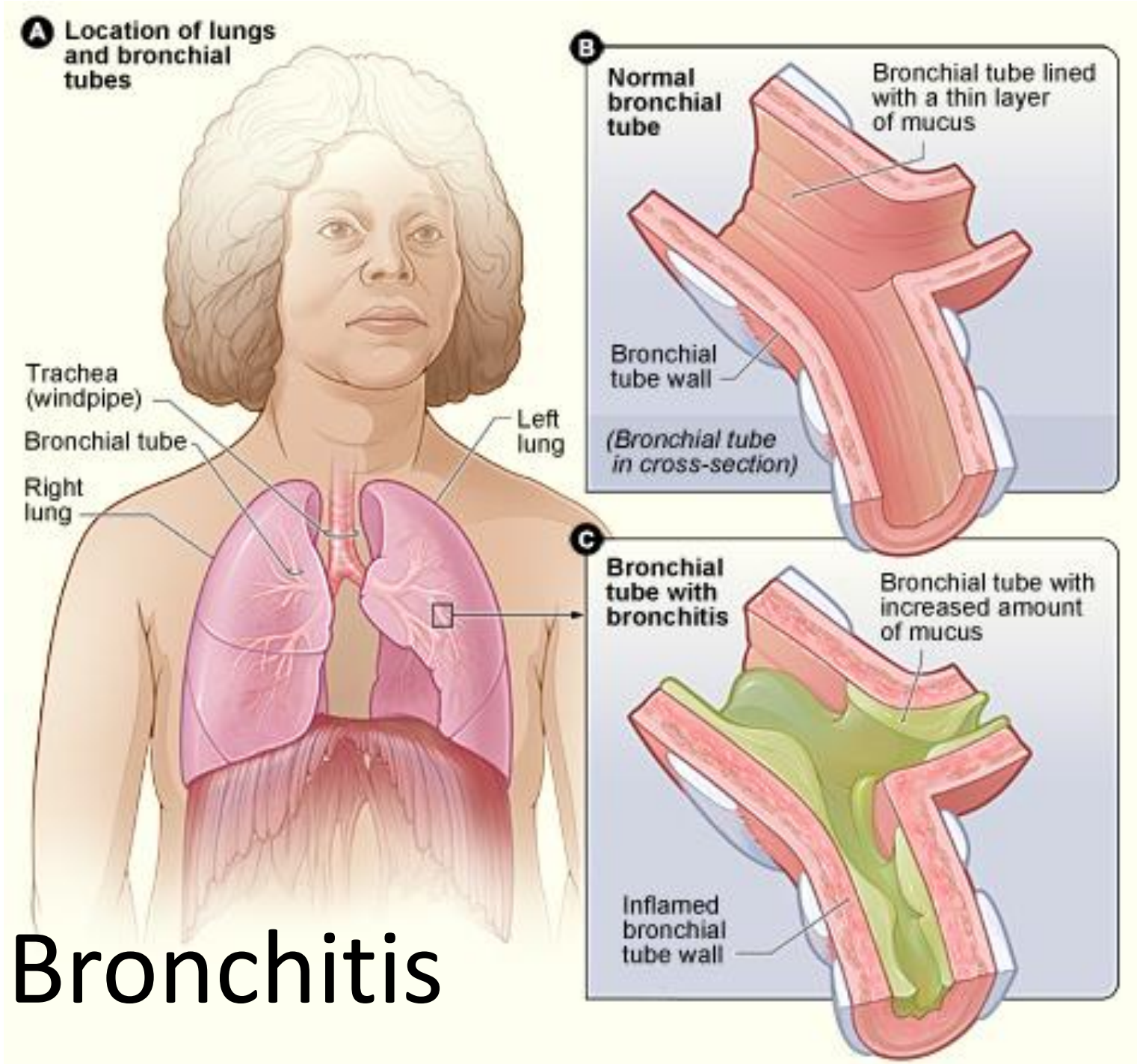
Asthma is an inflammatory disorder of the airways, which causes attacks of wheezing, shortness of breath, chest tightness, and coughing.

- Asthma is caused by inflammation in the airways. When an asthma attack occurs, the muscles surrounding the airways become tight and the lining of the air passages swell. This reduces the amount of air that can pass by, and can lead to wheezing sounds.
- Most people with asthma have wheezing attacks separated by symptom-free periods. Some patients have long-term shortness of breath with episodes of increased shortness of breath. In others, a cough may be the main symptom. Asthma attacks can last minutes to days and can become dangerous if the airflow becomes severely restricted.
- In sensitive individuals, asthma symptoms can be triggered by breathing in allergy-causing substances (called allergens or triggers).



Pathology of Asthma




A Location of lungs and bronchial tubes
Trachea (windpipe)
Bronchial tube
Right lung
Left lung
B
Normal bronchial tube
Bronchial tube lined with a thin layer of mucus
Bronchial tube wall
(Bronchial tube in cross-section)
C
Bronchial tube with bronchitis
Bronchial tube with increased amount of mucus
Inflamed bronchial tube wall

Bronchitis

PURE CHRONIC BRONCHITIS

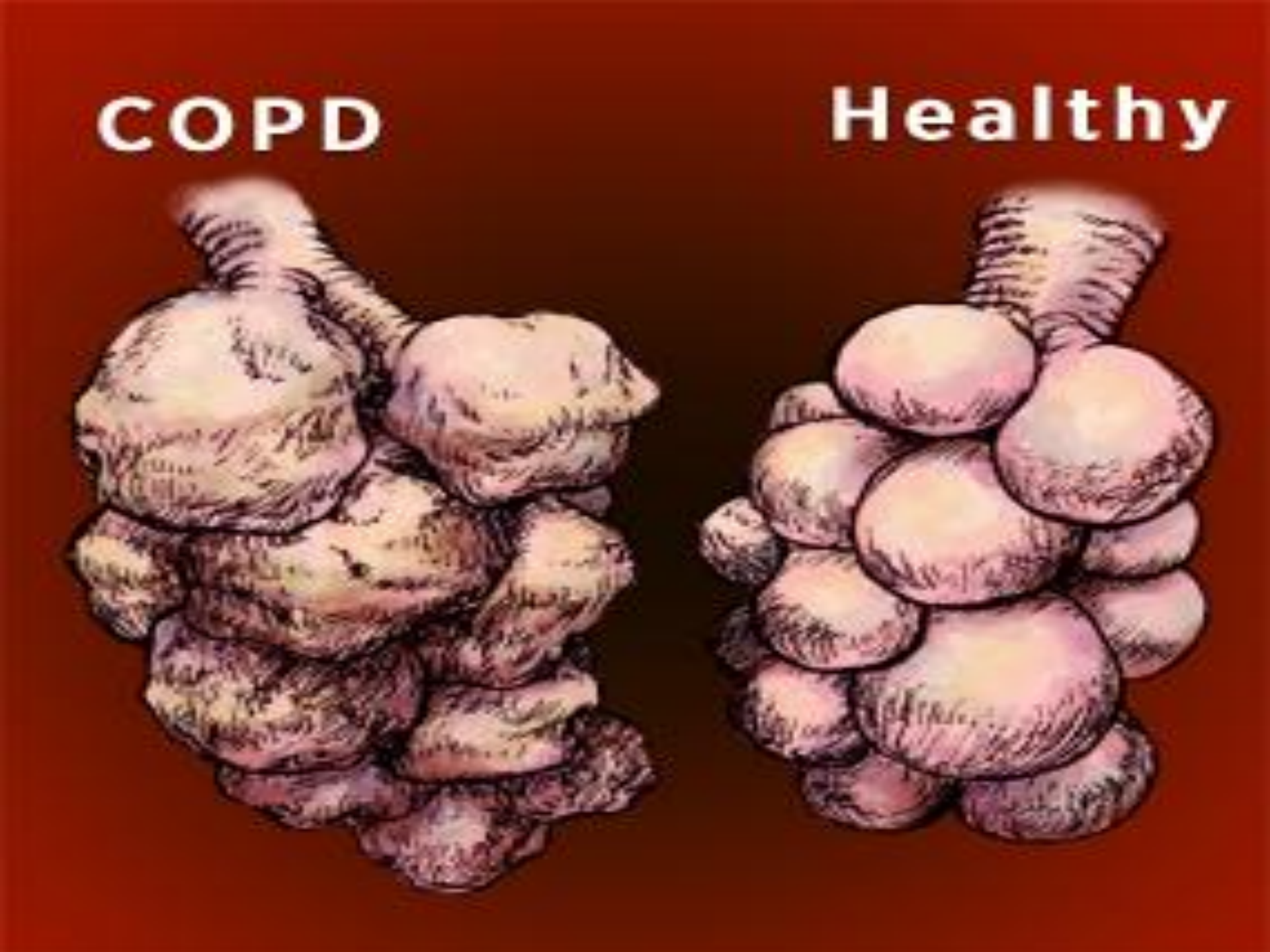
Large airways (trachea, bronchi)
- Mucus hypersecretion
- Inflammation
- (Chronic bronchitis)

Small airways (bronchioles)
- Peribronchiolar fibrosis
- Airway obstruction
- (Chronic bronchiolitis)

PURE EMPHYSEMA

Acinus (respiratory bronchiole, alveolar ducts, and alveoli)
- Loss of elastic recoil
- (Emphysema)

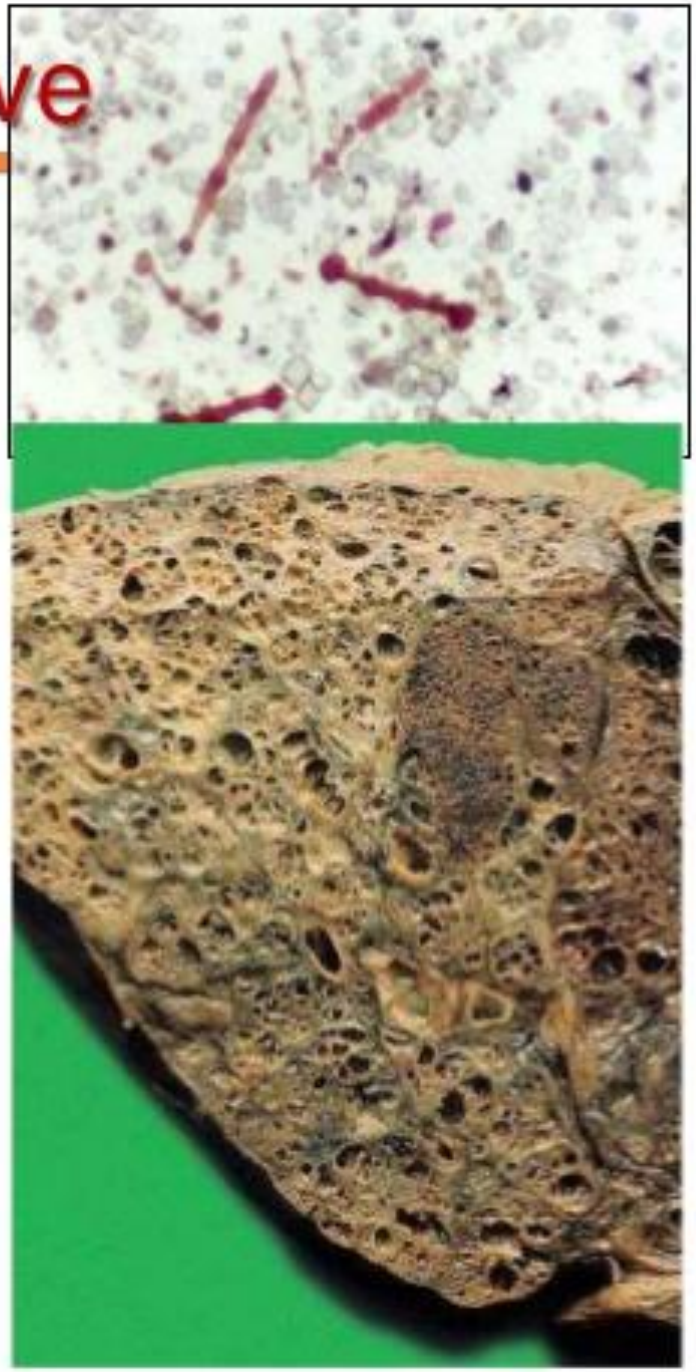
Combined → COPD (common)


COPD
Healthy

Emphysema

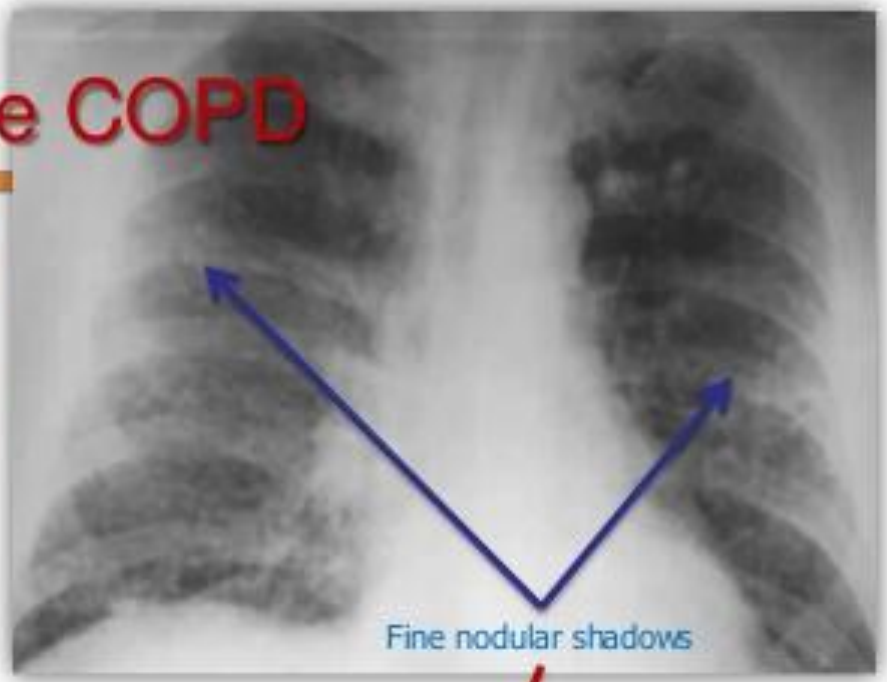
Asbestosis: Restrictive

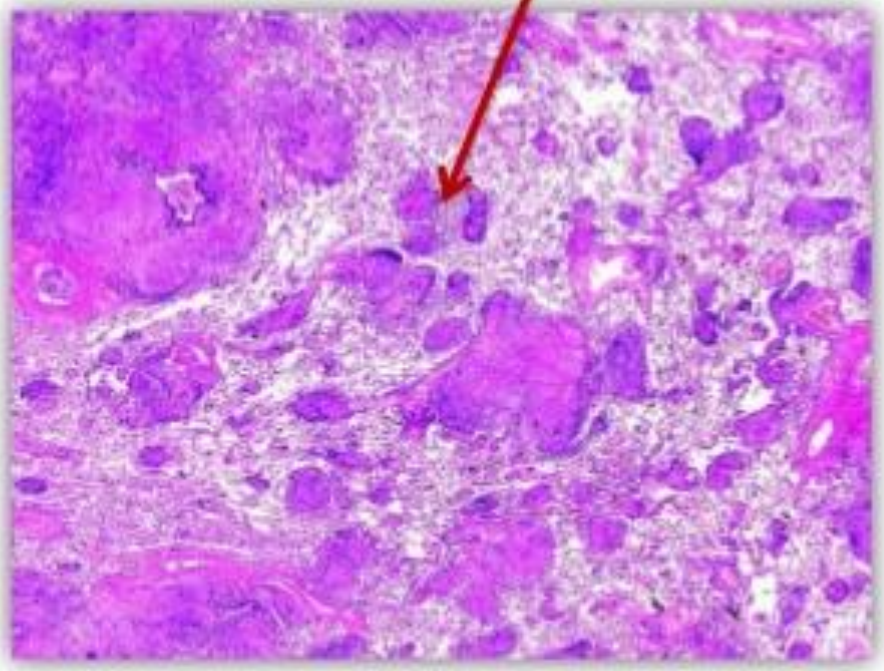
- Beaded protein covered needle like microscopic . Asbestos bodies
- Within alveoli & sputum.
- Dyspnoea, dry cough
- Diffuse fibrosis: Honey comb lung → Pulmonary failure.
- Mesothelioma – pleural cancer.



Silicosis: Restrictive COPD

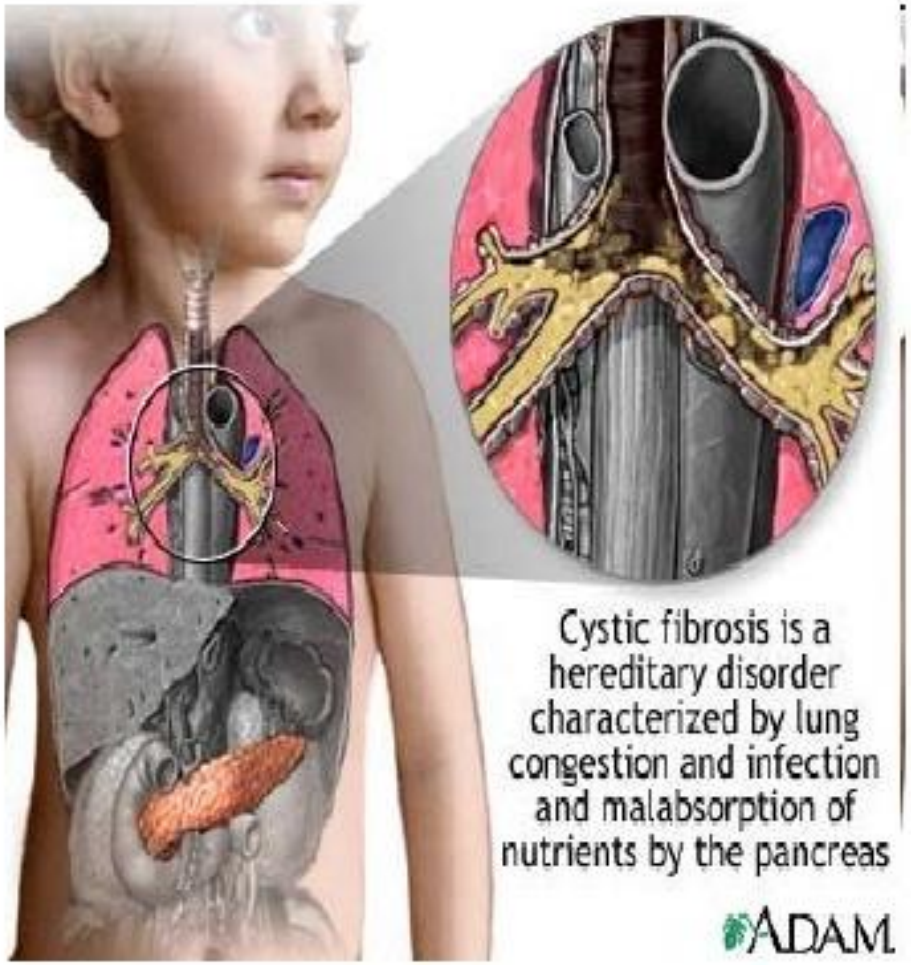
- Irreversible, fibrotic pulmonary disease due to the inhalation of large amounts of silica dust over time.
- Road, civil & mining workers.
- Toxic → Inflam → fibrosis.
- dyspnea, fatigue, weight loss, fever, and pleuritic pain.
- Multiple small, fibrotic Nodules bilateral + emphysema.
- Restrictive pattern of PFT.
- TB association common.





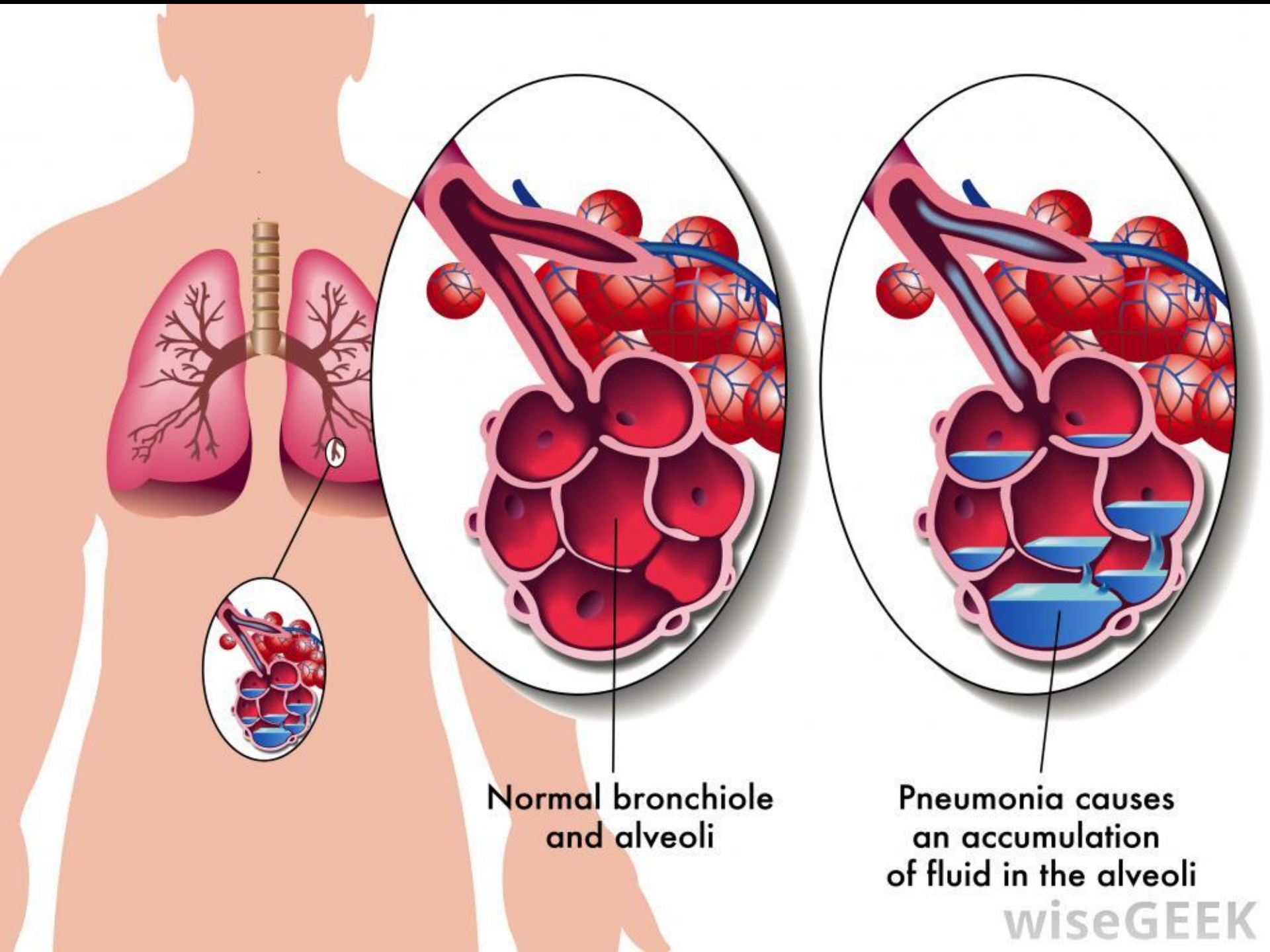
CF

- Cystic fibrosis is an inherited disease of the mucus and sweat glands. It affects mostly your lungs, pancreas, liver, intestines, sinuses and sex organs. CF causes your mucus to be thick and sticky. The mucus clogs the lungs, causing breathing problems and making it easy for bacteria to grow. This can lead to problems such as repeated lung infections and lung damage.



Classification of Pulmonary Diseases

- Lung Diseases Affecting the Air Sacs (Alveoli)
  - Pneumonia
  - Tuberculosis
  - Pulmonary edema
  - Lung cancer
  - Acute respiratory distress syndrome (ARDS)
  - Pneumoconiosis


Normal bronchiole
and alveoli
Pneumonia causes
an accumulation
of fluid in the alveoli
wiseGEEK

Causes of Pneumonia

- Pneumonia has many possible causes
- The most common are bacteria and viruses in the air we breathe. Your body usually prevents these germs from infecting your lungs. But sometimes these germs can overpower your immune system, even if your health is generally good
- Pneumonia is classified according to the types of germs that cause it, and where you acquired the infection

Pneumonia Types:

Etiologic Types:

- **Infective**
  - Viral
  - Bacterial
  - Fungal
  - Tuberculosis
- **Non Infective**
  - Toxins
  - chemical
  - Aspiration

Morphologic types:

- **Lobar**
- **Broncho**
- **Interstitial**

Duration:

- Acute
- Chronic

Clinical:

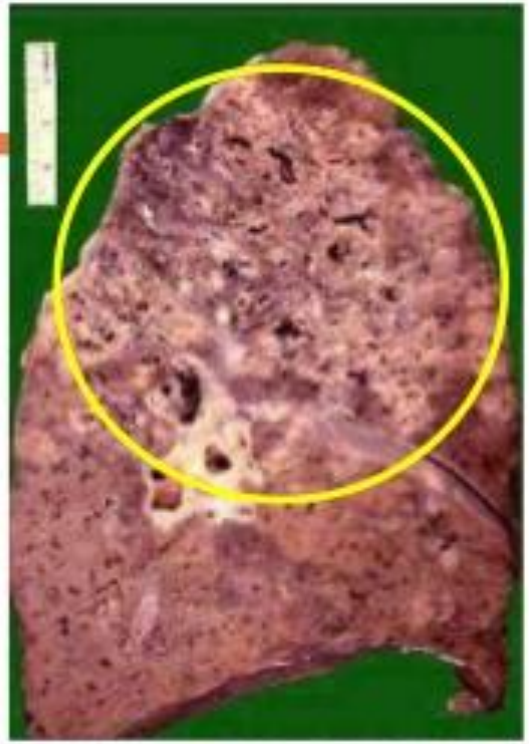
- Primary / secondary.

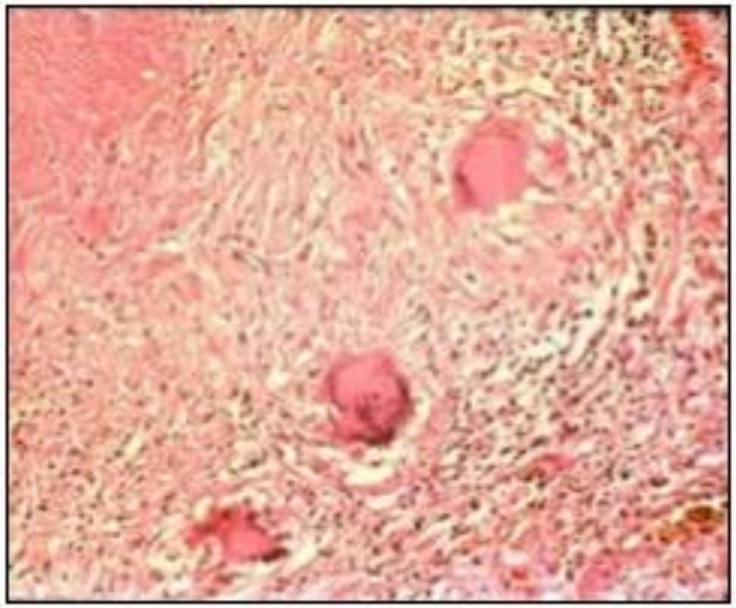
Pneumonia: Infection of lung (LRT)

- Inflammation of alveoli
- Etiology: pathogens vs defence.
- Types: Bacterial, viral, fungal, other.
- Clinical: Lobar / Broncho pneumonia.
- Symptoms: Fever, cough, dyspnoea.
- Complications: Spread → septicemia, abscess, scarring.

Tuberculosis:

- Mycobacterium tuberculosis (typical)
- Primary & Secondary,
- Chronic, Hypersensitivity to bacteria,
- Caseating Granuloma + Fibrosis.
- debilitating, weight loss.
- Upperlobe, cavity + fibrosing.
- Systemic spread, miliary spread.
- Tuberculin Test – hypersensitivity.





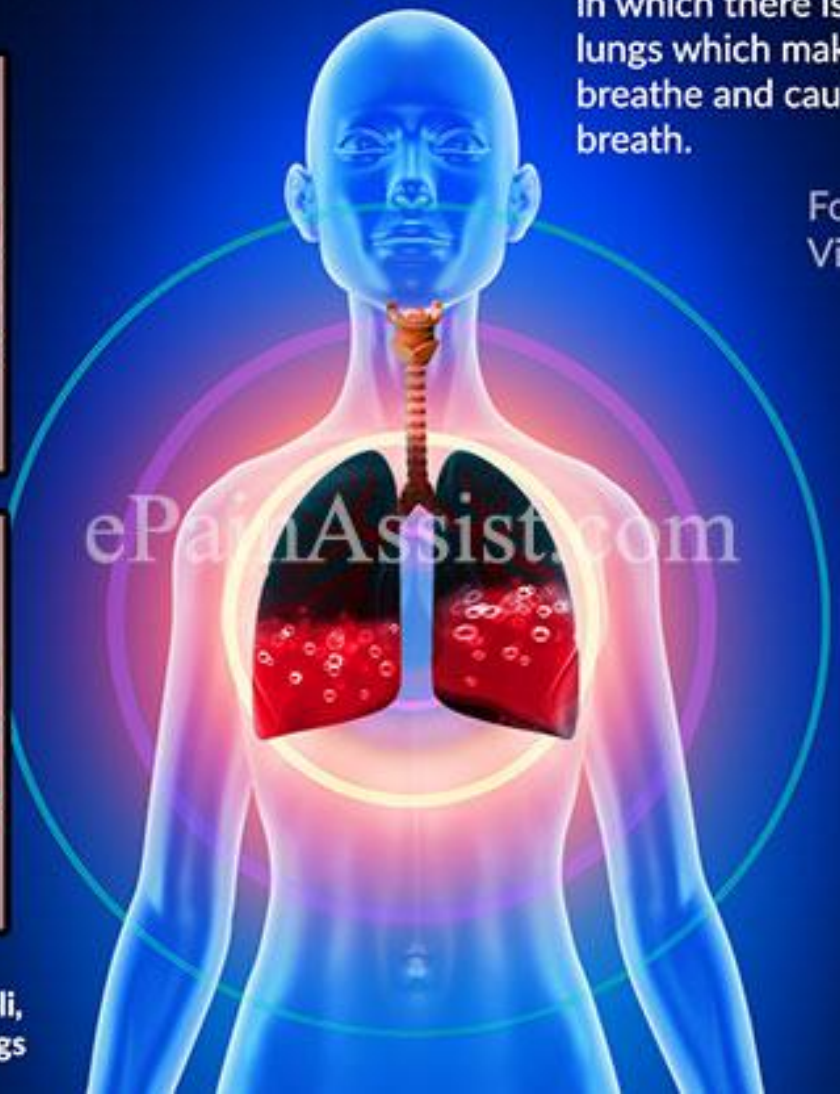
Pulmonary Edema

Clear Alveoli,
No Fluid Build-up in Lungs

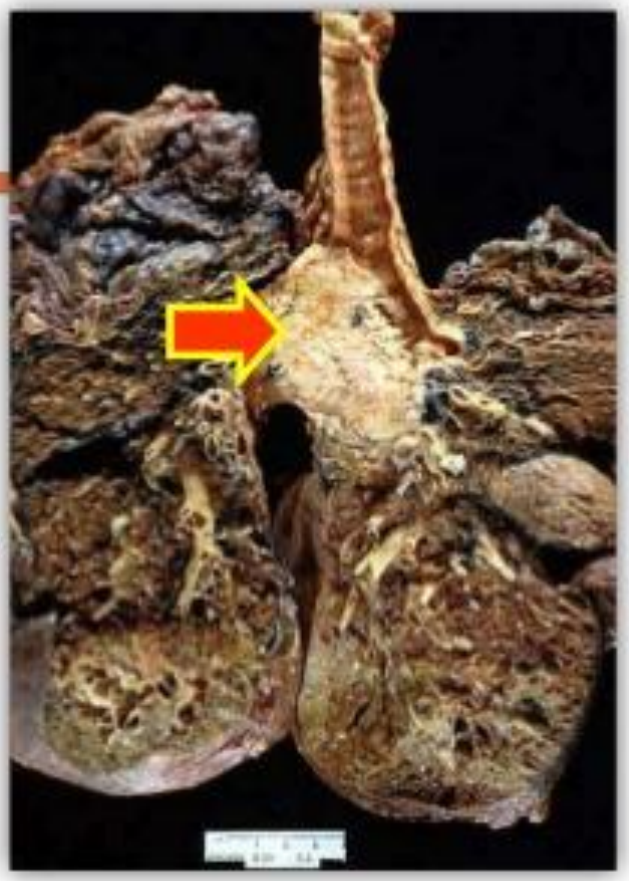
Fluid Build-up in Alveoli,
Fluid Leakage into Lungs

Pulmonary Edema is a medical condition in which there is excess fluid buildup in the lungs which makes it extremely difficult to breathe and causes severe shortness of breath.

For More Information,
Visit: www.epainassist.com



Lung Cancer Intro:



- Most common & fatal cancer (internal malignancy)
- Kills more people than colorectal, breast, and prostate cancers combined.
- Significant increase in incidence.. (developing countries*)
- Now Increasing in females > breast cancer.
- 90% of lung cancers are related to smoking..! (passive smoking in 5%)
- Mutagen sensitive genotype : P-450 enzyme
- Poor prognosis ~ 5% 5y survival *

Lung tumors Classification:

- Benign tumours – rare (Adenoma, Hamartoma)
- Malignant (common):
  - **Bronchogenic Carcinoma: (95%)**
  - Bronchial Carcinoid Tumor (5%)
  - Other Tumors (<1%)
  - Metastasis (common)
- Tumors of Pleura
  - Mesothelioma – asbestosis *

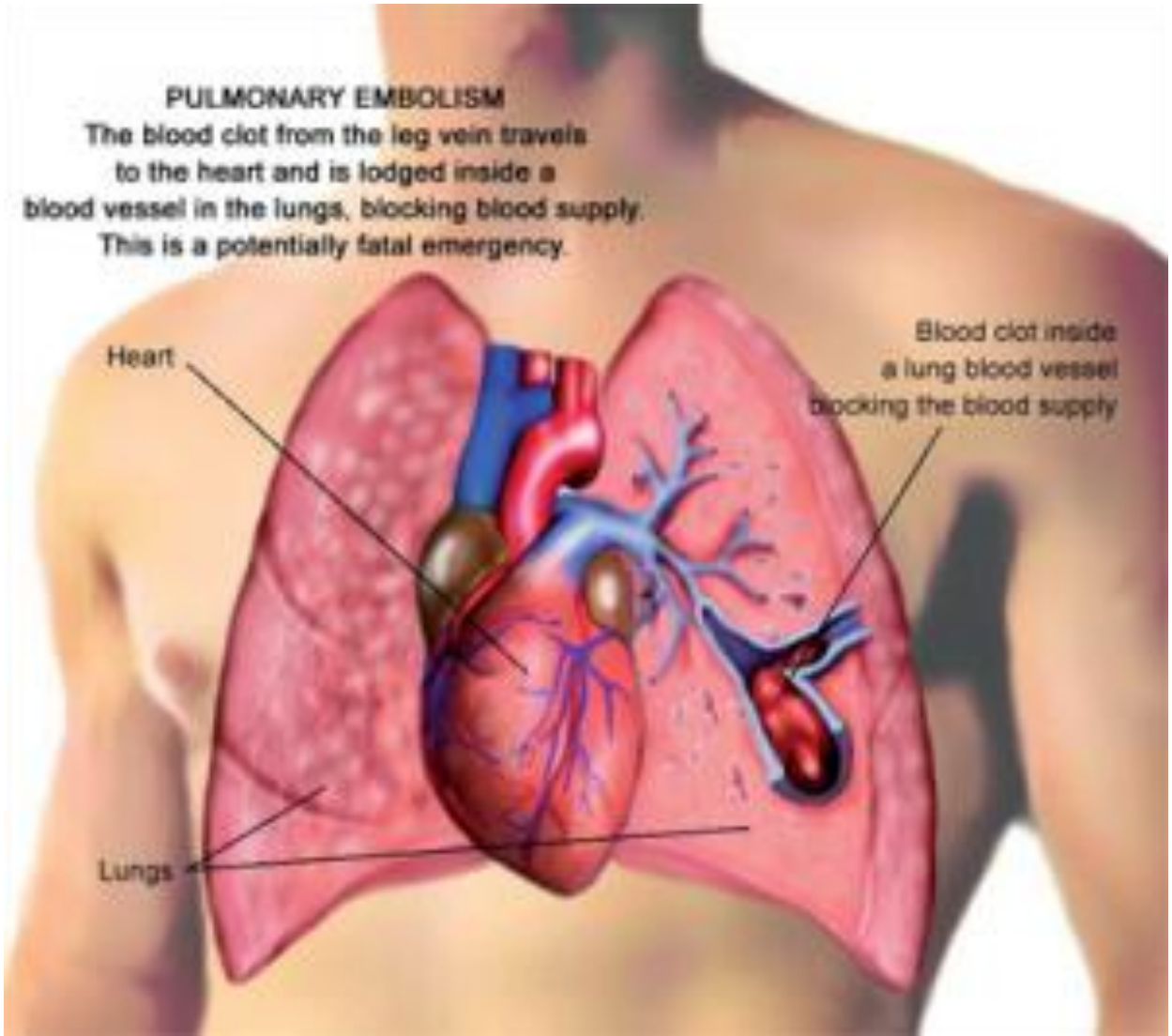
Lung Normal & in Smokers:

Pneumoconiosis

Classification of Pulmonary Diseases

- Lung Diseases Affecting Blood Vessels
  - Pulmonary embolism
  - Pulmonary hypertension

Pulmonary embolism

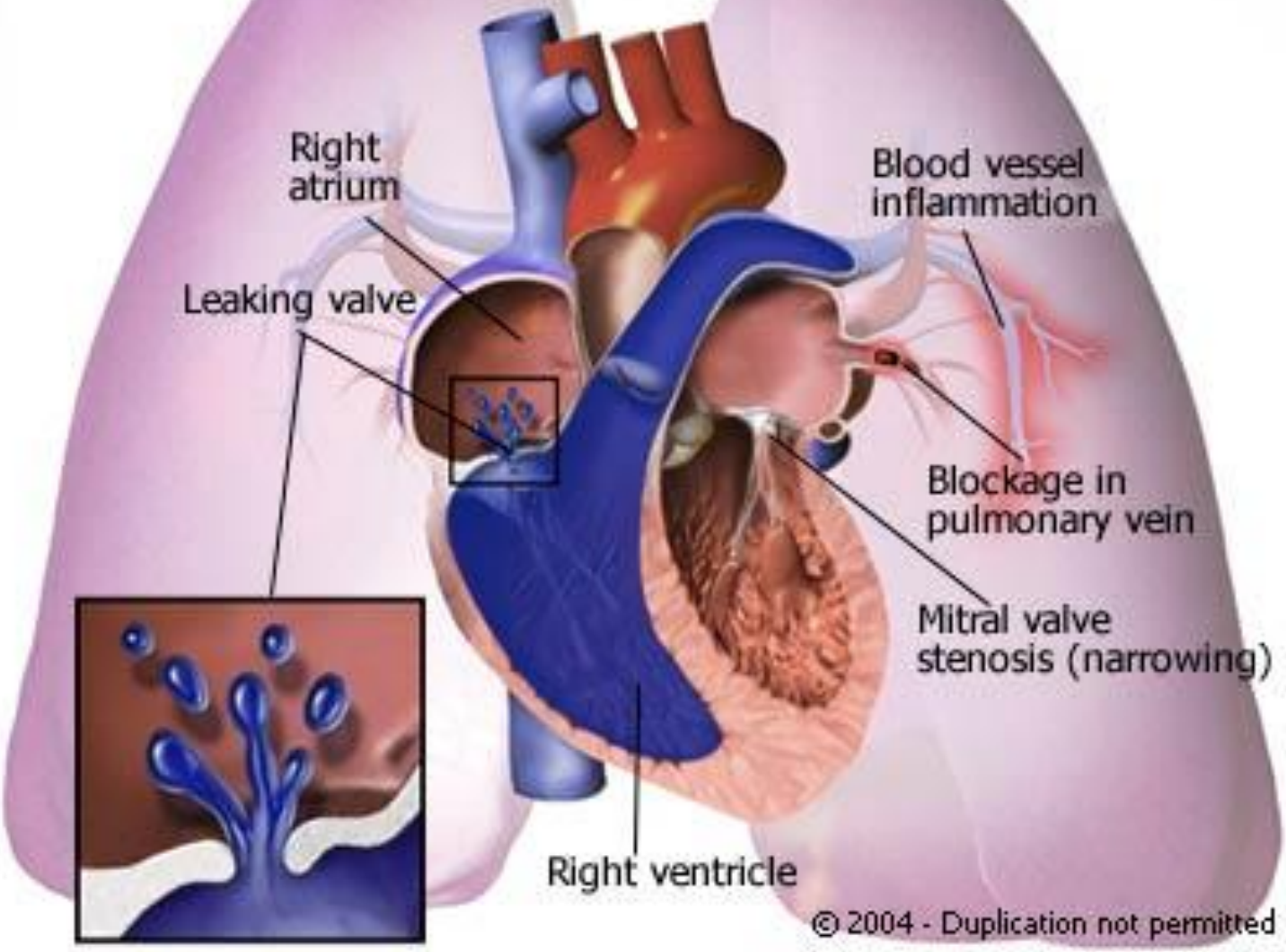


Symptoms of a PE

- Chest pain with respirations
- S3 or S4 heart sounds
- EKG-non specific- T or ST abnormalities
- SOB-crackles, friction rub, ↓ breath sounds
- Dyspnea, hemoptysis, CP in<20% pts.
- Mild temp with sweating
- Shock: Tachycardia, hypotension, skin cold/clammy
- N & V
- Feeling of anxiety, impending doom, restlessness

Pulmonary Hypertension

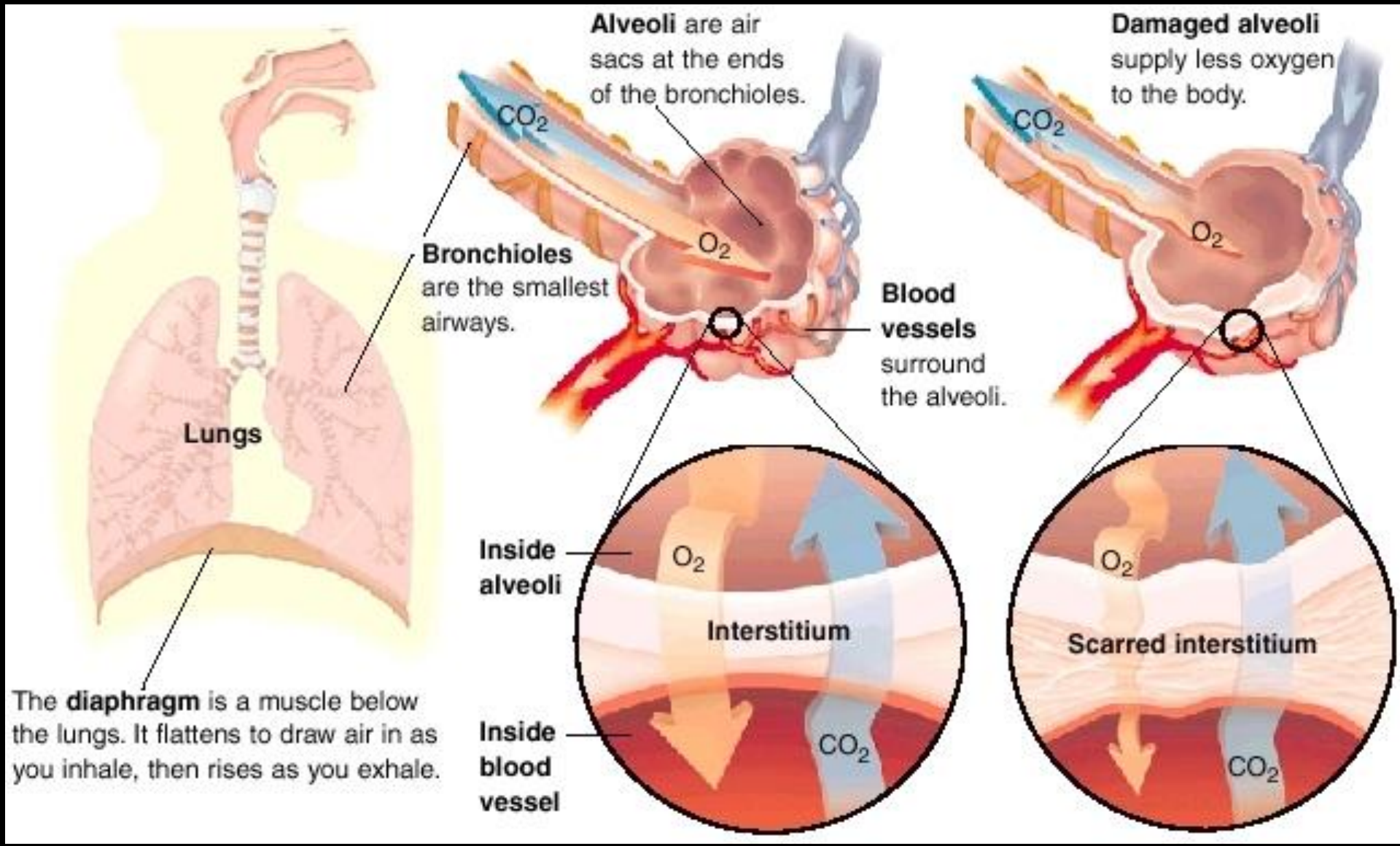
Can be caused by a number of factors, all of which force the heart's right side to work harder to pump blood to the lungs. The right chambers may enlarge as they struggle to function, and blood is often forced backward through the tricuspid valve.



Classification of Pulmonary Diseases

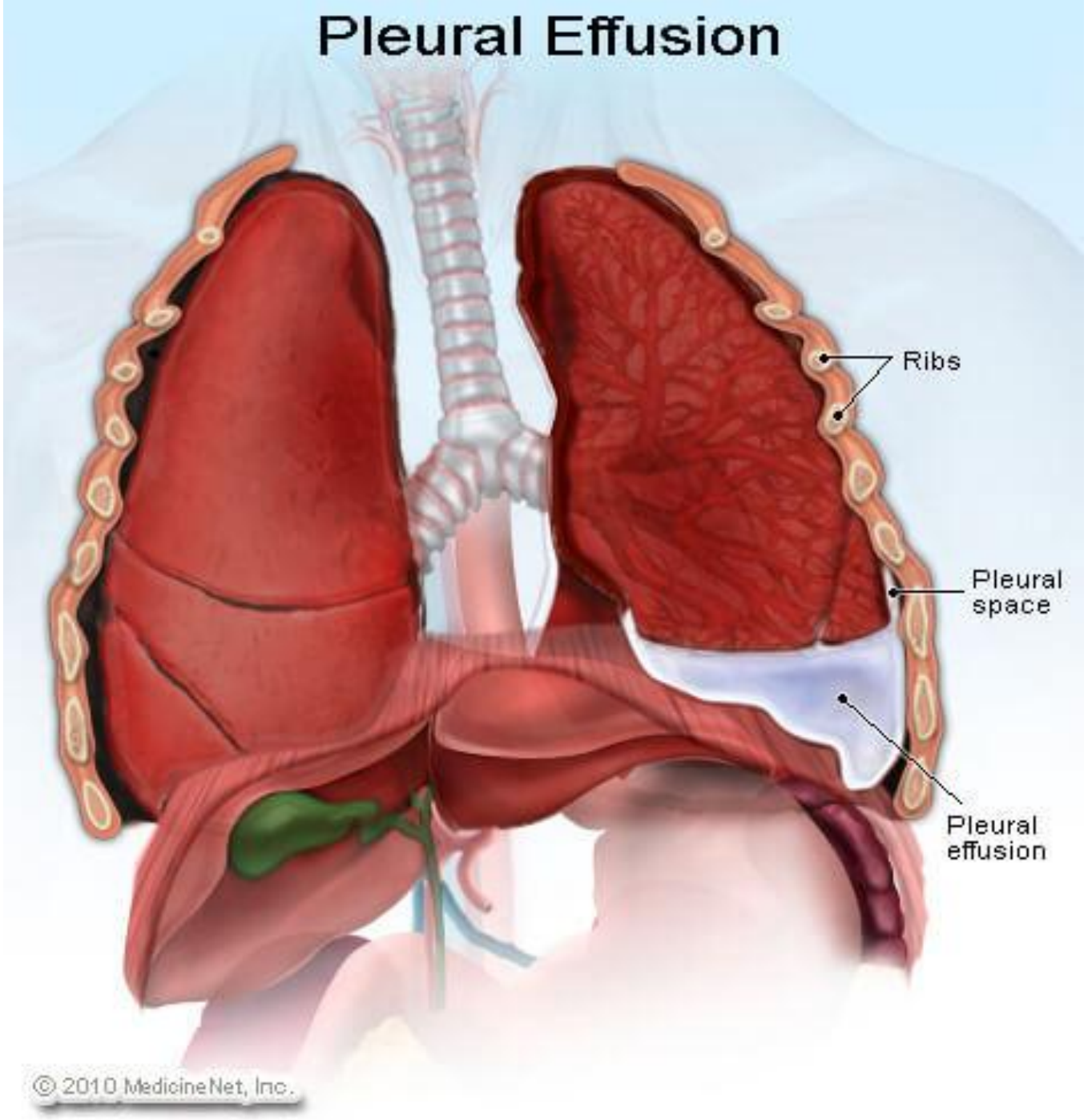
- Lung Diseases Affecting the Interstitium (Diffuse Lung Disease)
  - Interstitial lung disease
  - Pneumonias and pulmonary edemas

Interstitial lung disease

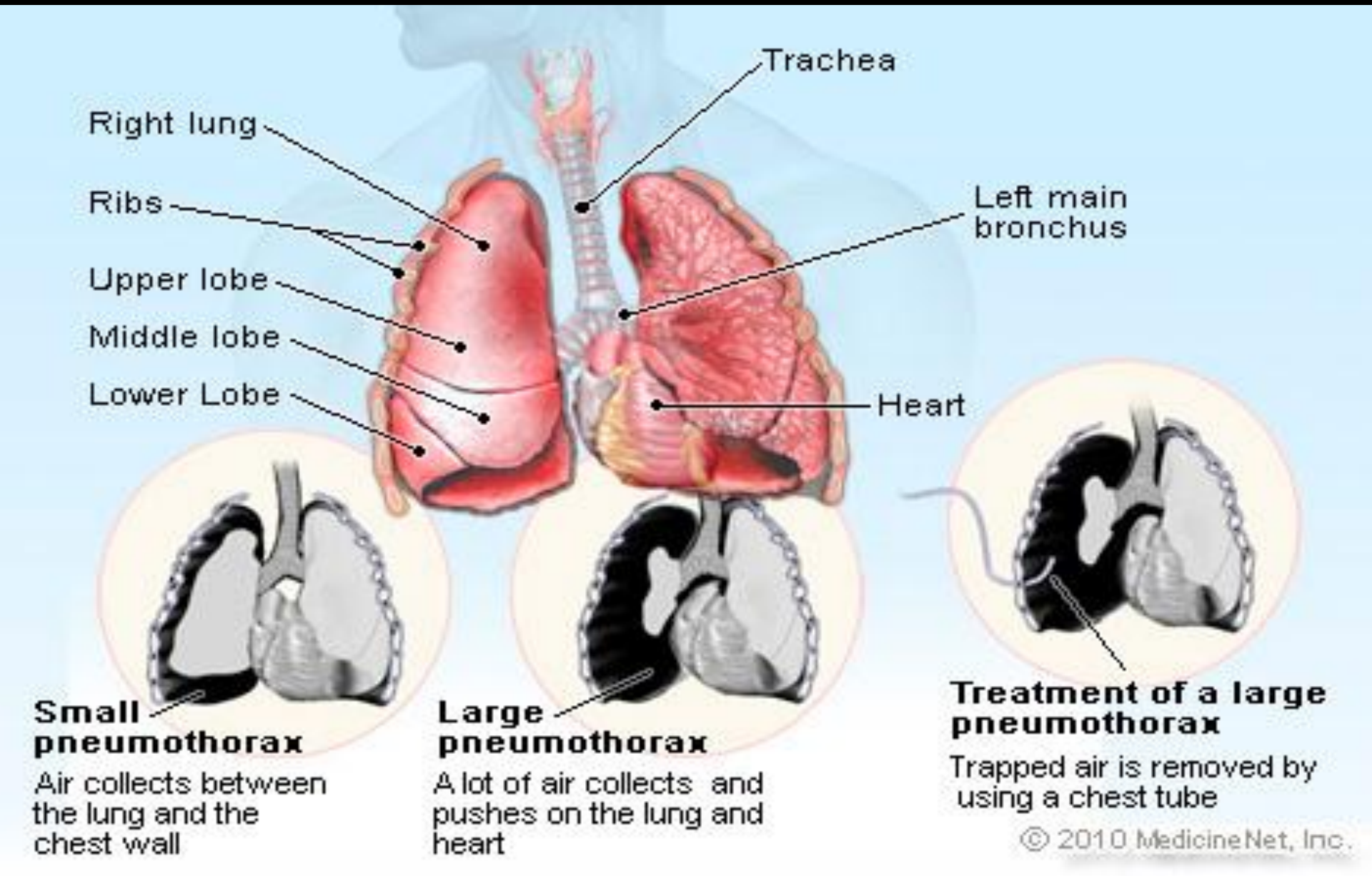


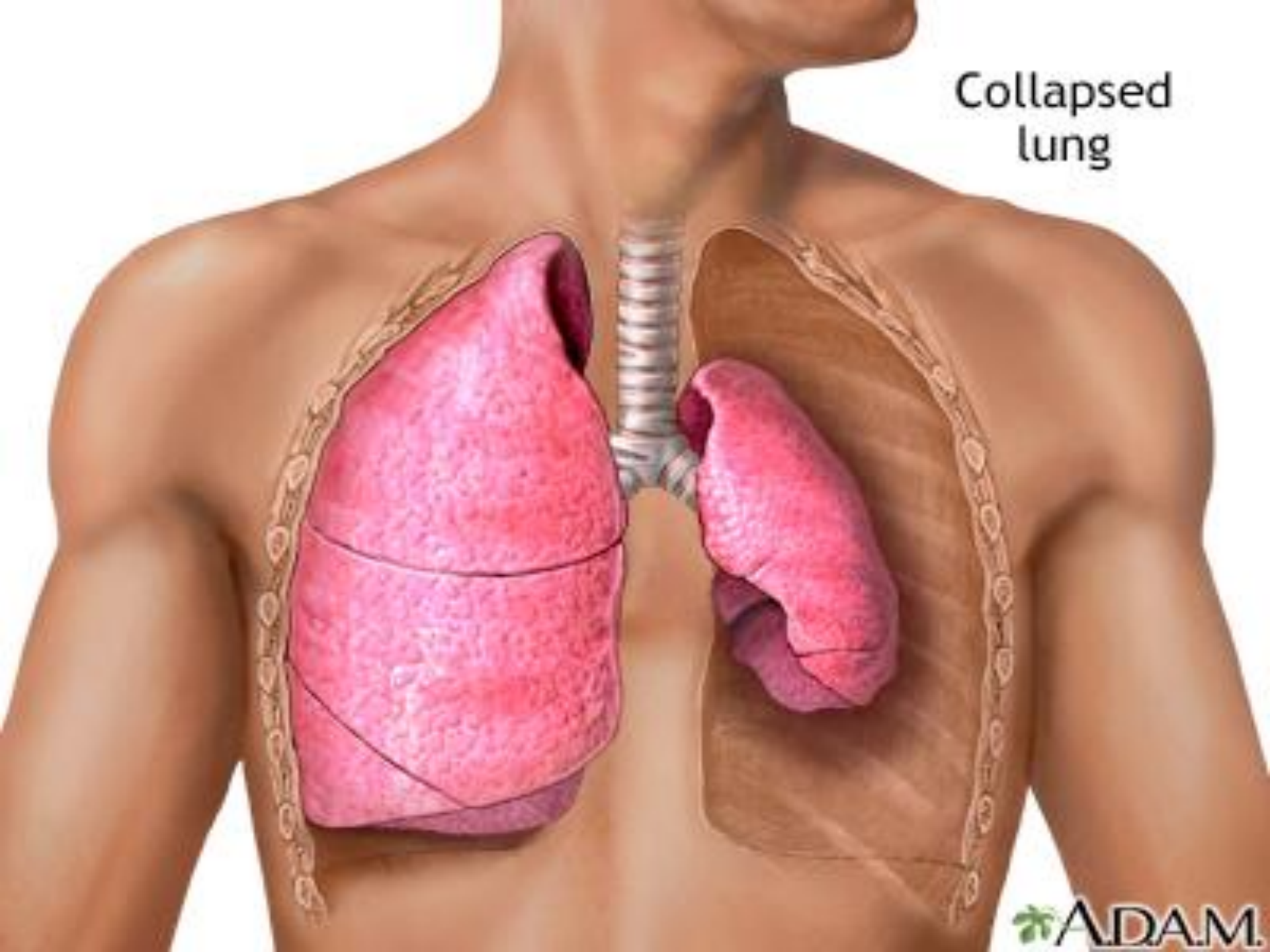
Classification of Pulmonary Diseases

- Lung Diseases Affecting the Pleura
  - Pleural effusion
  - Pneumothorax
  - Mesothelia cancer (rare)

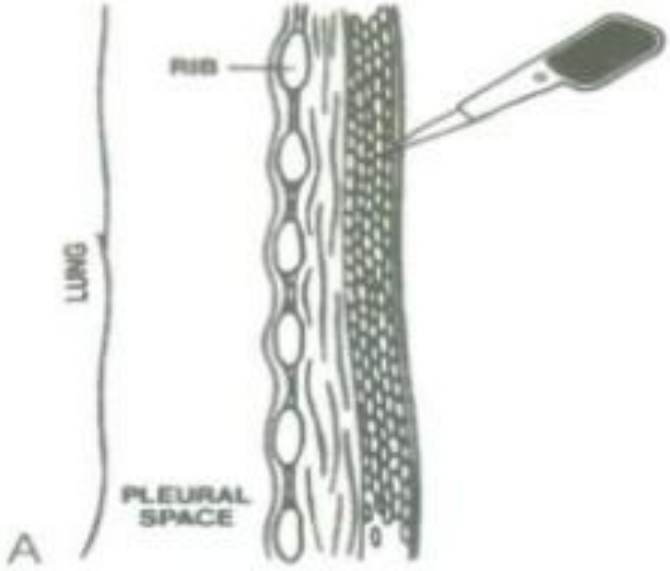

Pleural Effusion
Ribs
Pleural space
Pleural effusion
© 2010 MedicineNet, Inc.

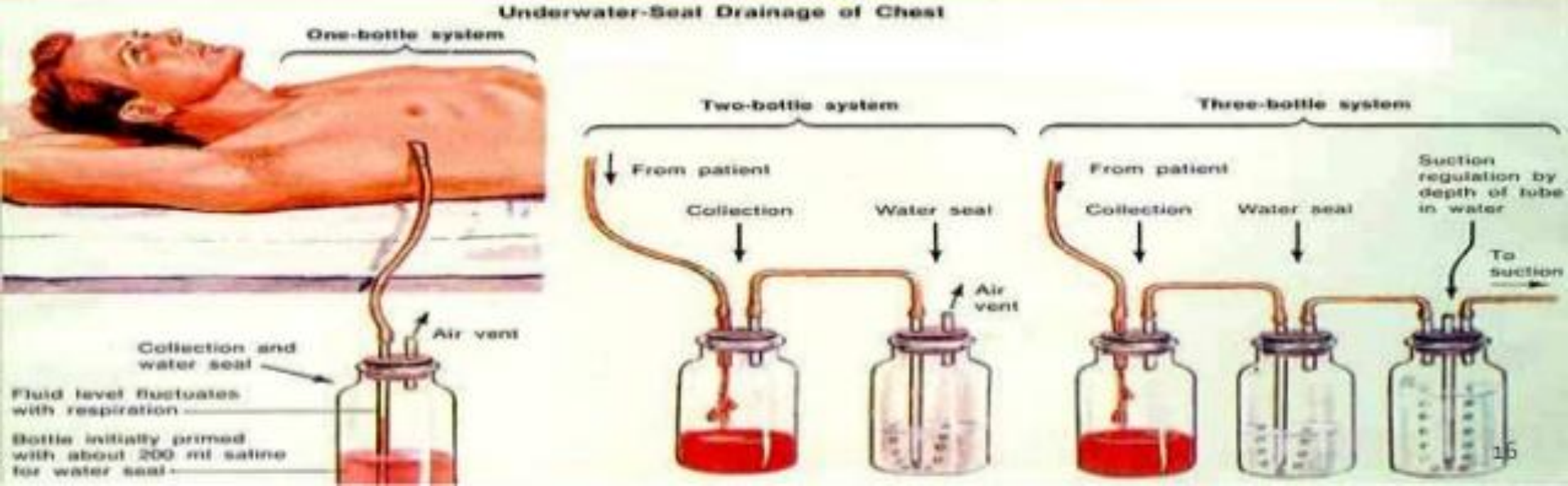
Pneumothorax




Collapsed
lung
A.D.A.M.

Treatment


RIB
LUNG
PLEURAL SPACE
A


Underwater-Seal Drainage of Chest
One-bottle system
Collection and water seal
Air vent
Fluid level fluctuates with respiration
Bottle initially primed with about 200 ml saline for water seal
Two-bottle system
From patient
Collection
Water seal
Air vent
Three-bottle system
From patient
Collection
Water seal
Suction regulation by depth of tube in water
To suction

Classification of Pulmonary Diseases

- Lung Diseases Affecting the Chest Wall
  - Obesity
  - Neuromuscular disorders (e.g. Amyotrophic lateral sclerosis)


Questions?