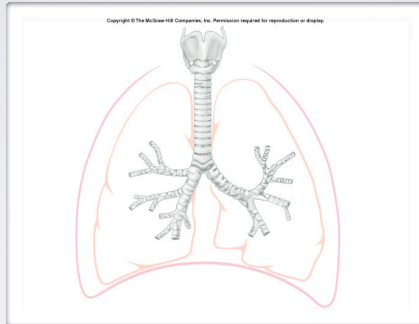
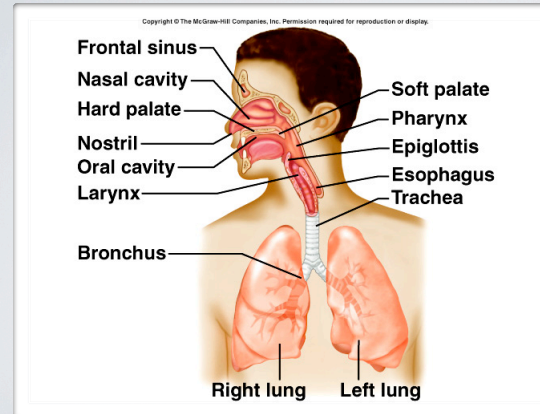


THE PULMONARY SYSTEM



Lecture 12; Holes Chapter 19

RESPIRATORY ANATOMY



Pathway of gas (air)

Nose
Nasal cavity
Pharynx
Larynx
Trachea
Bronchi
Bronchioles
(Lung tissue)

FUNCTIONAL ANATOMY

Respiratory Zone

Areas where gas exchange takes place.

Respiratory bronchioles
Alveolar ducts
Alveoli

Conducting Zone

Rigid tubes that conduct air
Clean, humidify and warm the air

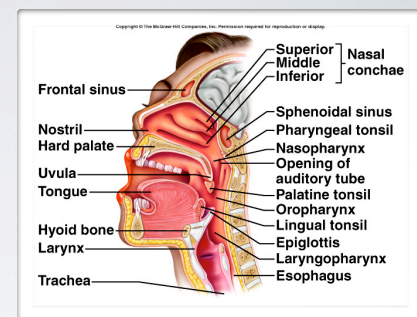
RESPIRATORY ANATOMY: NOSE

Nose

- Supported by muscle, bone & cartilage.
- Internal hairs

Nasal cavity

- Septum
- Nasal conchae: divides cavity into superior, middle and inferior passages (meatuses)
- Nasal mucosa (defense; lysosomes, mucus, defensins)

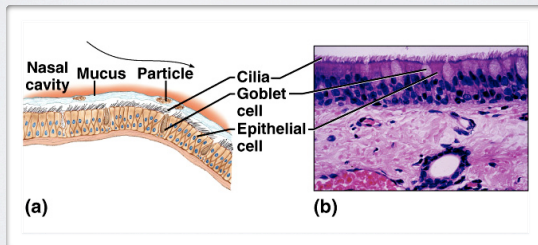


Functions

- Warms (many capillaries), cleans (sneeze), moistens air
- Resonating chamber for voice
- Olfactory receptors

NASAL MUCOSA

- Ciliated Epithelium with goblet cells
- Extensive network of blood vessels
- Evaporation of water from mucosa
- Sticky mucus: moves toward pharynx and is swallowed

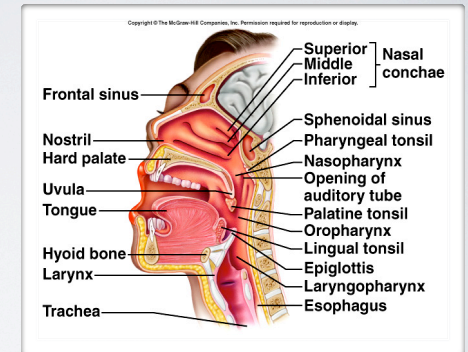


PHARYNX (THROAT)

- Extends from nasal cavity to larynx (6th vertebrae): 'throat'

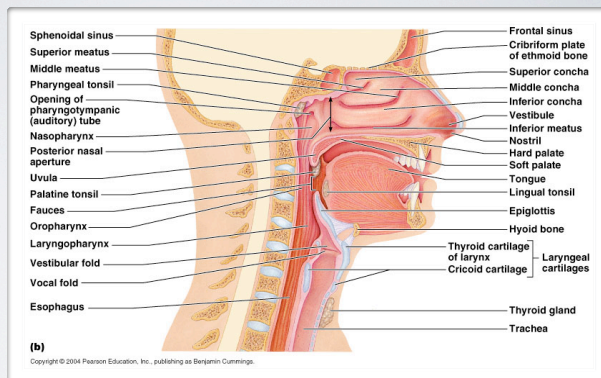
Three subdivisions

- Nasopharynx: connected to nasal cavity and middle ear - closed by Uvula when swallowing.
- Oropharynx: posterior to mouth, runs to the epiglottis
- Laryngopharynx: epiglottis to the larynx.



LARYNX ('VOICE-BOX')

- Enlarged portion of airway between the pharynx and trachea
- Prevents food entering trachea
- Houses vocal cords
- Framework of muscle, cartilage bound by elastic tissue



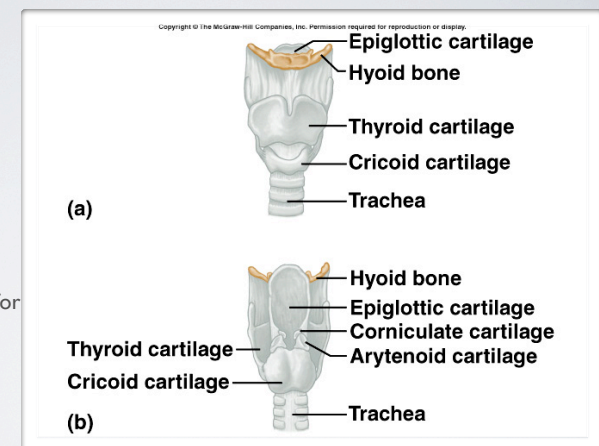
LARYNX

Cartilage of larynx:

Thyroid - (Adam's apple)
more prominent in males

Epiglottic - supports
epiglottis.

Corniculate - attachment for
muscles controlling vocal
cords



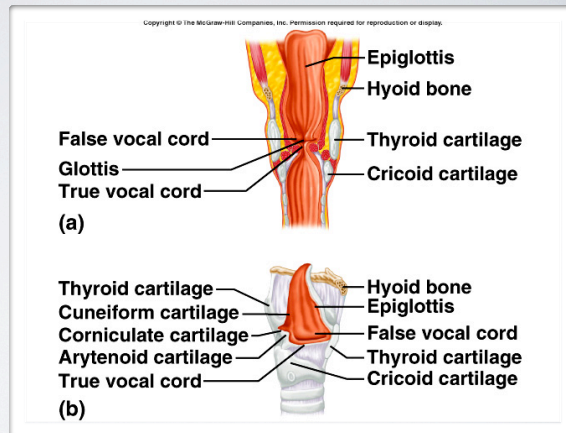
VOCAL CHORDS

Two pairs of horizontal folds of mucosa:

Upper folds = false vocal chords. Not used for speech, close during swallowing

Lower folds = true vocal chords. Air vibrates them to produce sound

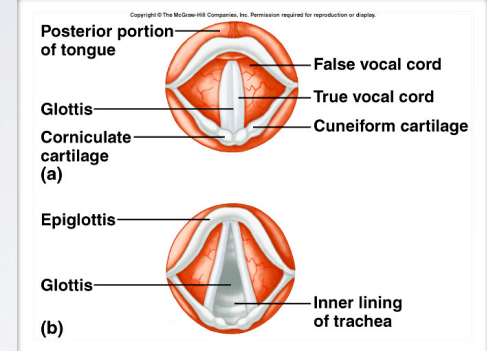
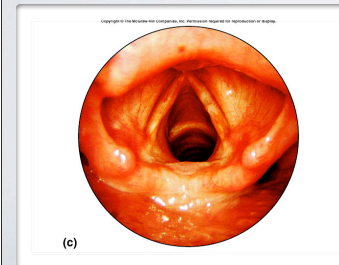
Change tension - pitch
Change flow - intensity



VOCAL CHORDS

Opening between chords = glottis

Glottis closed during swallowing - helps epiglottis.



Voice Production

Tension in cords = pitch
Force of air = volume (loudness)

TRACHEA

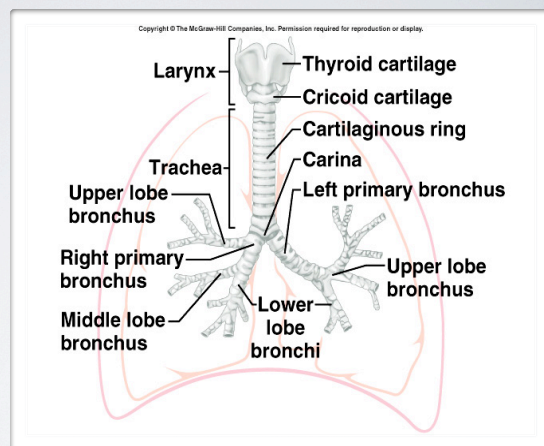
Long flexible tube

Anterior to esophagus

Runs into thoracic cavity

Splits into right & left bronchi.

Membrane - ciliated mucus lining

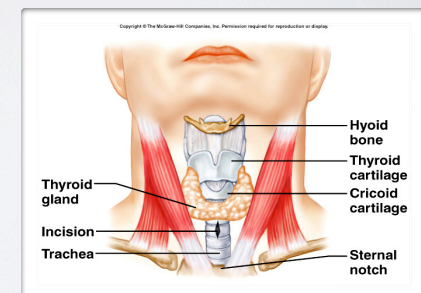
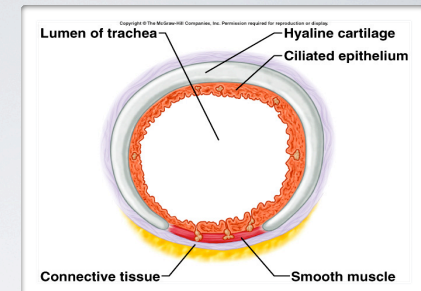


TRACHEA

20 incomplete rings of cartilage.

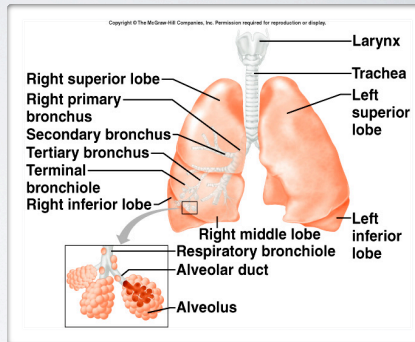
Posterior gap in the ring completed with smooth muscle and connective tissue.

Tracheostomy - George Washington & epiglottitis



BRONCHIAL TREE

Primary Bronchi (left and right)
 ↓
 Secondary (lobar) Bronchi (2 left and 3 right)
 ↓
 Tertiary (segmental) Bronchi (10 right, 8 left)
 ↓
 Intralobular bronchioles (<1mm)
 ↓
 Terminal Bronchioles (<0.5mm)
 ↓
 Respiratory Bronchioles (0.5 mm diameter)
 ↓
 Alveolar ducts
 ↓
 Alveolar sacs
 ↓
 Alveoli

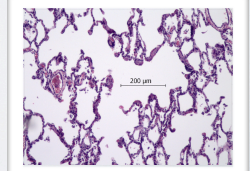
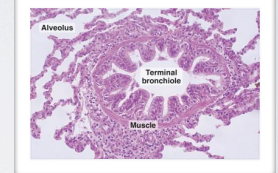
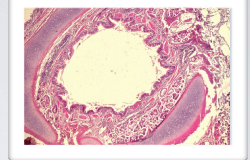


STRUCTURE OF AIRWAYS

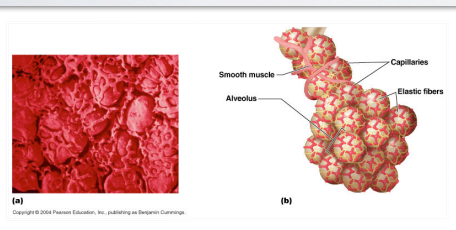
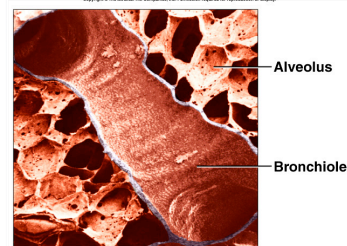
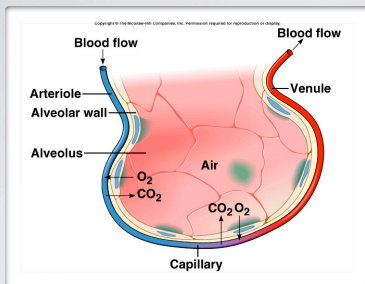
Primary Bronchi
 Secondary (lobar) Bronchi
 Tertiary (segmental) Bronchi
 → Cartilage rings (incomplete/complete)

Intralobular bronchioles
 Terminal Bronchioles
 Respiratory Bronchioles
 → Smooth muscle & elastic tissue

Alveolar ducts
 Alveolar sacs
 Alveoli
 → Epithelial cells



ALVEOLI



Squamous epithelium cells (type 1)

Surfactant secreting cells (type 2)

Elastic fibers
 Alveolar pores
 Alveolar macrophages

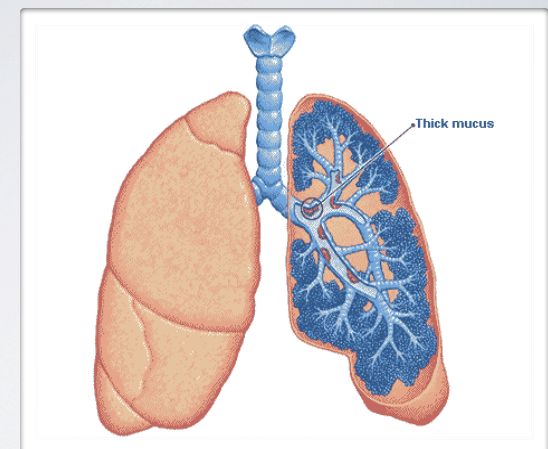
CYSTIC FIBROSIS

Over secretion of mucus.

Blocked airways

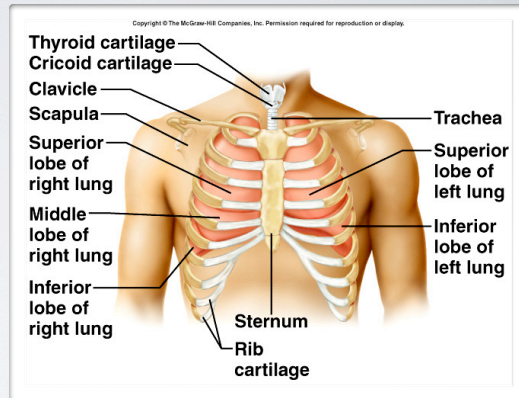
Physical Therapy

Gene Therapy



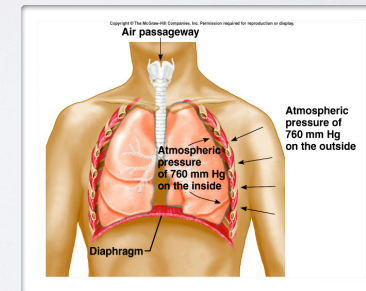
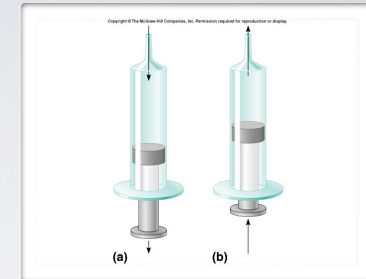
LUNGS

- Two soft, spongy cone shapes
- Right and left separated by heart and mediastinum
- Enclosed by diaphragm and thoracic cage
- Suspended by Bronchus and major blood vessels (entering at hilum)
- Surrounded by visceral pleura.
- Right lung larger than left (3 lobes vs. 2 lobes)



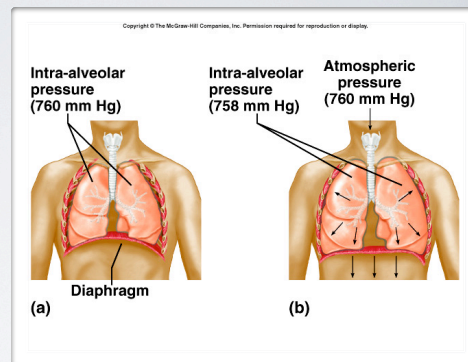
MECHANICS OF BREATHING

- Inspiration & Expiration
- Atmospheric pressure
- Pressure / volume related in an opposite or inverse way.
- Decrease pressure in lungs (intra-alveolar pressure) - air moves in.
- Diaphragm.



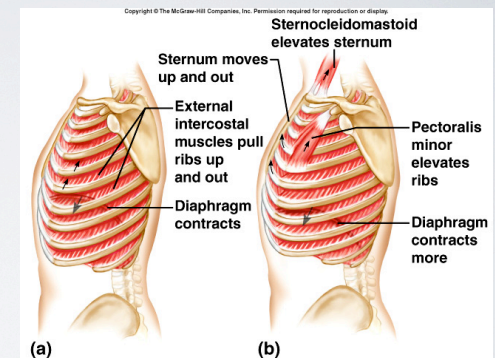
DIAPHRAGM

- Skeletal muscle.
- Anterior portion originating at ribs and sternum.
- Posterior portion originating on vertebrae.
- Central portion - tendinous connections to ant. & post.
- Forms a dome shape.
- Stimulated by Phrenic nerve.
- Diaphragm moves downward (increase volume of thorax - pressure drops)

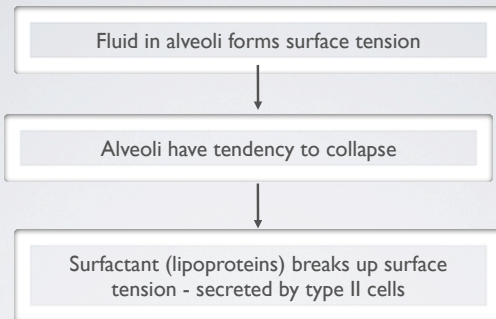


EXTERNAL INTERCOSTAL MUSCLES

- Skeletal muscles between ribs.
- Raises ribs and sternum.
- Increases thoracic volume
- Pressure drops.
- Air moves in to lung.
- Movement of lung with thorax
- Visceral Pleura - Parietal Pleural
- Inter-pleural space - surface tension. Lung recoil.
- Accessory muscles - scalenes, pectoralis minor, sternocleidomastoids.



SURFACE TENSION & THE ALVEOLI



Preemies don't express surfactant

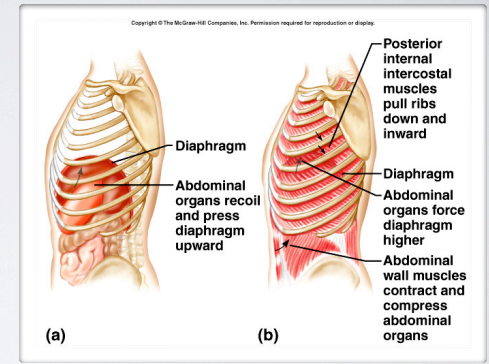
EXPIRATION

Elastic recoil of the lung.
Elastic tissue
alveolar surface tension

Decompression of Abdominal contents
as diaphragm rises during relaxation.

Passive process during quiet breathing.

Increased breathing requires active
muscle contraction:
Internal intercostals
Abdominal

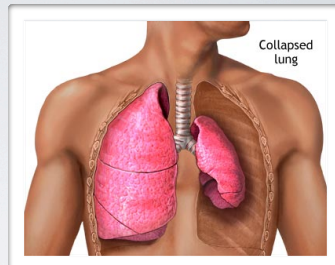


PNEUMOTHORAX

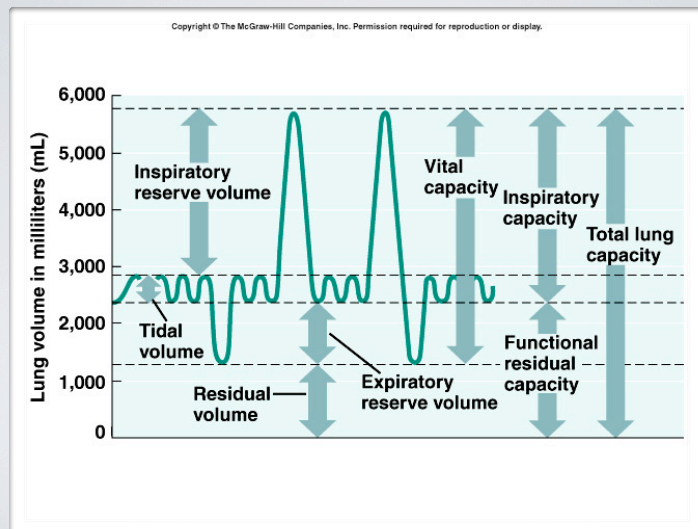
Lungs held to thorax wall by
intrapleural pressure

Punctured pleural space - gas
enters and surface tension drops

Lungs collapse



LUNG VOLUMES



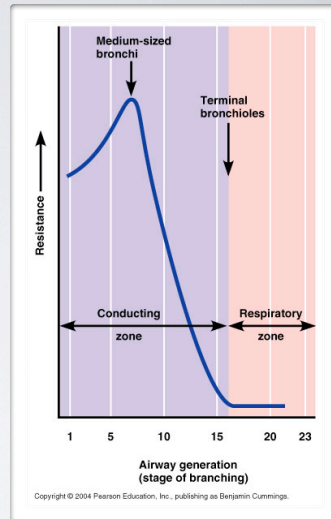
AIRWAY RESISTANCE

Narrower the tube, higher the resistance

Higher resistance, lower the flow at given pressure

Resistance falls as bronchial tree descended

Asthma, physical blockage (tumors)



LUNG COMPLIANCE

Change in volume for a given pressure

Distensibility of the lung and thoracic cage

Surface tension in alveoli

Factors affecting compliance:

scar tissue
decreased flexibility of rib cage
decreased surfactant production