Airway Anatomy

- Upper Airway Anatomy
- Lower Airway Anatomy
- Lung Capacities/Volumes
- Pediatric Airway Differences
Anatomy of the Upper Airway

- Nasal cavity:
  - Superior, middle and inferior turbinates
  - Hard and soft palates
- Nasopharynx:
  - Tonsils/adenoids
  - Uvula
- Oropharynx:
  - Tongue
- Laryngopharynx (hypopharynx):
  - Vallecula
  - Epiglottis
- Larynx:
  - Glottic opening
  - Vocal cords
  - Thyroid cartilage
  - Cricothyroid membrane
  - Cricoid cartilage
  - Thyroid gland
  - Esophagus
  - Trachea
Upper Airway Anatomy

- **Functions**
  - Warm, filter, and humidify air

- **Nasal cavity and nasopharynx**
  - Formed by union of facial bones
  - Nasal floor towards ear not eye
  - Lined with mucous membranes, cilia
  - Tissues are delicate, vascular

- **Adenoids**
  - Lymph tissue - filters bacteria
  - Commonly infected
Upper Airway Anatomy

- Oral cavity and oropharynx
  - Teeth
  - Tongue
    - Attached at mandible, hyoid bone
    - Most common airway obstruction cause
  - Palate
    - Roof of mouth
    - Separates oropharynx and nasopharynx
    - Anterior = hard palate
    - Posterior = soft palate
Upper Airway Anatomy

- Oral cavity and oropharynx
  - Tonsils
    - Lymph tissue
      - Filters bacteria
    - Commonly infected
  - Epiglottis
    - Leaf-like structure
    - Closes during swallowing
    - Prevents aspiration
  - Vallecula
    - “Pocket” formed by base of tongue, epiglottis
Upper Airway Anatomy
Upper Airway Anatomy

- Sinuses
  - cavities formed by cranial bones
  - act as tributaries for fluid to, from eustachian tubes, tear ducts
  - trap bacteria, commonly infected
Upper Airway Anatomy

- **Larynx**
  - Attached to hyoid bone
  - Horseshoe shaped bone
  - Supports trachea

- **Thyroid cartilage**
  - Largest laryngeal cartilage
  - Shield-shaped
  - Cartilage anteriorly, smooth muscle posteriorly
  - “Adam’s Apple”
  - Glottic opening directly behind
Upper Airway Anatomy

- **Larynx**
  - Glottic opening
    - Adult airway’s narrowest point
    - Dependent on muscle tone
    - Contains vocal bands
  - Arytenoid cartilage
    - Posterior attachment of vocal bands
Upper Airway Anatomy

- **Larynx**
  - **Cricoid ring**
    - First tracheal ring
    - Completely cartilaginous
    - Compression (Sellick maneuver) occludes esophagus
  - **Cricothyroid membrane**
    - Membrane between cricoid, thyroid cartilages
    - Site for surgical, needle airway placement
Upper Airway Anatomy

- **Larynx and Trachea**

- **Associated Structures**
  - Thyroid gland
    - below cricoid cartilage
    - lies across trachea, up both sides
  - Carotid arteries
    - branch across, lie closely alongside trachea
  - Jugular veins
    - branch across and lie close to trachea
Upper Airway Anatomy

- Base of tongue
- Epiglottis
- Vocal folds
- Trachea

A
- Base of tongue
- Epiglottis
- Hyoid bone
- Adipose tissue
- Thyroid cartilage (Adam's apple)
- Vocal cords
- Cricoid cartilage
- Cartilages of trachea
- Thyroid gland
- Lumen of trachea
Upper Airway Anatomy

- **Pediatric vs Adult Upper Airway**
  - Larger tongue in comparison to size of mouth
  - Floppy epiglottis
  - Delicate teeth, gums
  - More superior larynx
  - Funnel shaped larynx due to undeveloped cricoid cartilage
  - Narrowest point at cricoid ring before ~8 years old
Upper Airway Anatomy

Anatomy of adult airway

- Tongue
- Epiglottis (shorter)
- Hyoid bone
- Vocal cords (Narrowest)
- Thyroid cartilage
- Cricoid ring
- Trachea

Anatomy of pediatric airway

- Tongue
- Epiglottis (floppier, u-shaped)
- Hyoid bone
- Airway (more anterior and higher)
- Thyroid cartilage
- Cricoid ring (Narrowest)
- Trachea (more flexible)
Upper Airway Anatomy
Glottic Opening
Lower Airway Anatomy

- **Function**
  - Exchange $O_2$, $CO_2$ with blood

- **Location**
  - From glottic opening to alveolar-capillary membrane
Lower Airway Anatomy

Trachea

- Bifurcates (divides) at carina
  - Right main stem bronchi
    - Shorter
    - Straighter
  - Left main stem bronchi
- Lined with mucous cells, beta-2 receptors
Lower Airway Anatomy

- **Bronchi**
  - Branch into secondary, tertiary bronchi that branch into bronchioles

- **Bronchioles**
  - No cartilage in walls
  - Small smooth muscle tubes
  - Branch into alveolar ducts that end at alveolar sacs
Lower Airway Anatomy

- Alveoli
  - “Balloon-like” clusters
  - Sined with surfactant
    - Decreases surface tension ⇒ eases expansion
    - ↓ surfactant ⇒ atelectasis (focal collapse of alveoli)
Alveolar membrane

Actual site of gas exchange

gases are exchanged between the alveolar air and the blood in the pulmonary capillaries by crossing this membrane
Lower Airway Anatomy

- **Lungs**
  - Right lung = 3 lobes; Left lung = 2 lobes

- **Pleura**
  - Visceral – membrane that covers the lungs
  - Parietal – lines the inner wall of the pleural cavity
    - Highly sensitive to pain
  - Pleural space
Lower Airway Anatomy

Lymphatics
Pulmonary arteriole
Bronchiole
Terminal bronchiole
Respiratory bronchiole
Capillary network over alveoli
Alveolar duct
Alveoli
Alveolar sac (from which alveoli arise)
Visceral pleura
Elastic connective tissue
Pulmonary venule