

Respiratory System

Chapter 28

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Introduction

- Respiration: We inhale air, extract oxygen from it, exhale air
- Cardiovascular and respiratory systems work together
- Failure of either system:
 - Disruption of homeostasis
 - Cell death from oxygen deprivation

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Anatomy

- Nasal cavity
- Pharynx
- Larynx
- Trachea
- Bronchi
- Lungs

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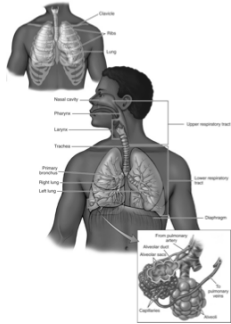
Physiology

- Exchange of gases
- Olfaction
- Sound production: Speech and non-speech sounds
- Maintains homeostasis

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Respiratory System



From Healthy B: The human body in health and illness, ed 4, St. Louis, 2011, Saunders.

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Respiratory Tract

- Divided into upper and lower tracts
 - Upper tract: Nasal cavity, pharynx, larynx
 - Lower tract: Trachea, bronchi, lungs
- Accessory structures: Ribcage, diaphragm, other respiratory muscles

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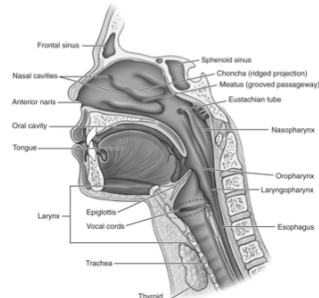
Nasal Cavity

- Anterior nares: Nostrils of the nose
- Conchae: Ridged projections inside nasal cavity
- Meatus: Grooved passageways
- Internal nares: Funnel-shaped orifices leading to pharynx
- Called "air-conditioning chambers" because air is:
 - Warmed by superficial blood vessels and moistened by mucosal secretions
 - Filtered by nasal hairs and sticky mucus

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Upper Respiratory Tract



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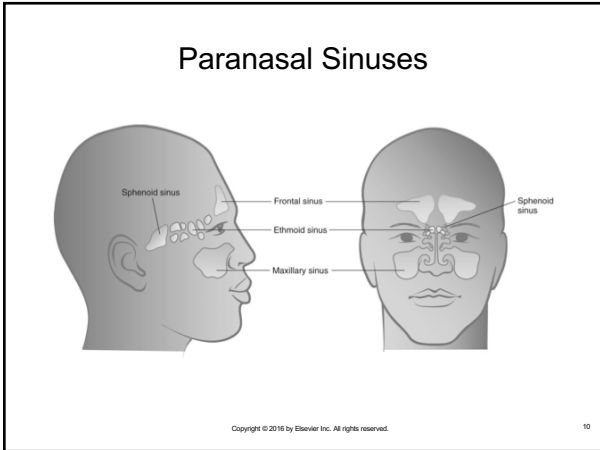
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Paranasal Sinuses

- Air-filled cavities
- Lighten the skull and acts as resonance chambers for sound
- Named for their location:
 - Frontal
 - Sphenoid
 - Ethmoid
 - Maxillary

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Pharynx

- Muscular tube extending from nasal cavity to larynx
- Three sections:
 - Nasopharynx: Upper region and begins at nasal cavity
 - Oropharynx: Portion you can see and contains tonsils
 - Laryngopharynx: Functions as a pathway for respiratory and digestive systems

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Larynx

- Connects pharynx to trachea
- Primarily segmented cartilaginous tissue connected to muscles, ligaments, and the hyoid bone
- Consists of glottis and vocal cords (vocal folds)
 - Air passing over vocal cords causes vibration, which produces sound
 - Vocal cords protect the lower airway
- Epiglottis helps move food into the esophagus

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Trachea

- Connects larynx to bronchi
- Located anterior to esophagus
- Contains half-ring cartilages that:
 - Allow esophagus to expand as food is swallowed
 - Keep tracheal wall from collapsing during pressure changes during breathing
- Carina: Highly sensitive to debris and foreign objects; violent coughing occurs when stimulated

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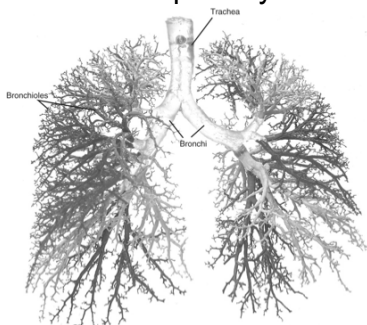
Bronchi and Bronchioles

- Bronchi: Passageways from trachea to each lung
- Right bronchus is wider and has steeper downward angle
 - Foreign objects often lodge here
- Bronchioles: Smaller branches of bronchi
 - Can change their diameter

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Lower Respiratory Tract



From Abraham P, Bonn J, Spratt J, Hutchings R: *M&M's clinical atlas of human anatomy*, ed 6, Philadelphia, 2008, Mosby.

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Alveoli

- Air sacs attached to alveolar ducts
- Primary gas exchange structures of respiratory tract
- Alveoli consist of a single layer of epithelium; blood capillaries are superficial to epithelium
 - Basement membrane connects alveolus to its capillaries
- Coated with surfactants
 - Keep alveolar walls from sticking together

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Lungs

- Primary organs of respiration
- Lungs fill thoracic cavity and are separated into lobes
- Cardiac notch in left lung accommodates the heart
- Two pleural membranes
 - Visceral: Attaches to lung
 - Parietal: Attaches to mediastinum and internal chest wall
- Serous fluid present between membranes reduces friction

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Breathing

- Process of taking in air and expelling it from the lungs
- Two phases
 - Inhalation
 - Exhalation
- Occur as respiratory muscles contract and relax

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Diaphragm

- Main muscle of respiration
- It and other muscles facilitate breathing
 - Medulla oblongata
 - Nerve impulses travel to phrenic nerve
- Changes the size of the thoracic cavity

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Control of Breathing

- Voluntary breathing allows you to hold breath underwater
 - If you hyperventilate or hold breath too long, you'll be unconscious
- Breathing rate increases as body temperature increases
 - Fever, exercise
- Breathing rate decreases as body temperature decreases
 - Hypothermia, jumping into cold water
- Emotions alter breathing rate

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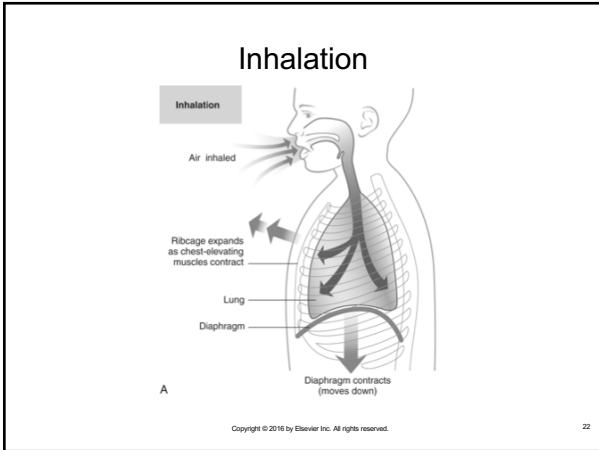
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Inhalation

- Diaphragm contracts and moves downward
- Intercostal muscles elevate ribcage
 - Pressure in lungs becomes lower compared to atmospheric pressure
- Air moves from higher pressure (atmosphere) to lower pressure (lungs)
- Compliance: Ease of thorax and lungs to stretch during inhalation
- Elastic recoil: Tendency of thorax and lungs to return to their preinhalation size

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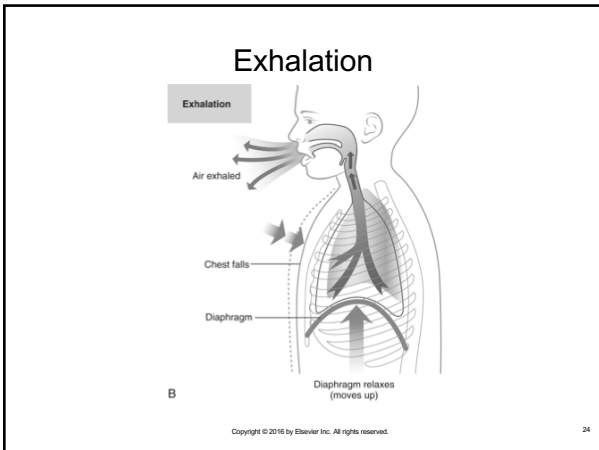
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Exhalation

- Diaphragm relaxes and moves upward
- Ribcage size decreases
 - Pressure in lungs become higher compared to atmospheric pressure
 - Air moves from higher pressure (lungs) to lower pressure (atmosphere)

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Respiration

- Supplies body with oxygen and disposes carbon dioxide
- Two processes:
 - External respiration
 - Internal respiration
- Both occur by diffusion
 - Tendency of molecules to move from area of high concentration to an area of low concentration

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External Respiration

- Oxygen diffuses from the air in the lungs, crosses the respiratory membrane, and into the blood
 - Oxygen molecules bind to hemoglobin molecules located in red blood cells
 - Carbon dioxide detaches from hemoglobin, crosses the respiratory membrane, and is released into the lung to be expelled

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Internal Respiration

- Gas exchange between blood and body tissues
- Carbon dioxide diffuses from the cells, crosses the capillary wall, and attaches to hemoglobin
 - Oxygen and carbon dioxide travel in opposite directions; oxygen crosses capillary wall, enters cell
- Carbon dioxide attaches the hemoglobin and then is transported to the lungs to be expelled

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Reflexes That Affect Breathing

- Sneeze: Forceful involuntary expulsion of air through nose and mouth to clear upper respiratory pathways
- Cough: Sudden expulsion of air to clear lower respiratory tract
- Hiccup: Intermittent diaphragmatic contractions followed by closure of vocal cords
- Yawn: Deep inhalation by opening mouth wide

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