Respiratory System

Part 1
Respiration

- Cardiopulmonary system
- Respiratory and conducting divisions
- Three processes
  1. Breathing
  2. Exchange of gases
  3. Use of oxygen
Respiration

- Pulmonary ventilation (breathing): movement of air into and out of the lungs
- External respiration: $O_2$ and $CO_2$ exchange between the lungs and the blood
- Transport: $O_2$ and $CO_2$ in the blood
- Internal respiration: $O_2$ and $CO_2$ exchange between systemic blood vessels and tissues
Functional Anatomy

- Structures
  - Nose
  - Pharynx
  - Larynx
  - Trachea
  - Lungs
  - Bronchial tree
  - Pleurae
Figure 22.1

Nasal cavity

Nostril

Oral cavity

Pharynx

Larynx

Trachea

Carina of trachea

Right main (primary) bronchus

Right lung

Left main (primary) bronchus

Left lung

Diaphragm
Nose

- Functions
  - Provides an airway for respiration
  - Moistens and warms entering air
  - Filters and cleans inspired air
  - Resonating chamber for speech
  - Olfactory receptors
(a) Surface anatomy
Pg 5 study guide
Frontal bone
Nasal bone
Septal cartilage
Maxillary bone (frontal process)
Lateral process of septal cartilage
Minor alar cartilages
Dense fibrous connective tissue
Major alar cartilages

(b) External skeletal framework
(b) Regions of the pharynx
Pharynx

• “Throat”

• Between internal nares and larynx

• Three regions
  1. Nasopharynx
  2. Oropharynx
  3. Laryngopharynx

  Transports air
  Transports air, liquids and solids
**Nasopharynx**
- Pharyngeal tonsil
- Opening of pharyngotympanic tube
- Uvula

**Oropharynx**
- Palatine tonsil
- Isthmus of the fauces

**Laryngopharynx**
- Esophagus

**Larynx**
- Epiglottis
- Vestibular fold
- Thyroid cartilage
- Vocal fold
- Cricoid cartilage
- Thyroid gland

**Nasal cavity**
- Nasal conchae (superior, middle, and inferior)
- Nasal meatuses (superior, middle, and inferior)
- Nasal vestibule
- Nostril
- Hard palate
- Soft palate
- Tongue
- Lingual tonsil
- Hyoid bone

**Posterior nasal aperture**
- Opening of pharyngotympanic tube
- Pharyngeal tonsil

**Nasal meatuses** (superior, middle, and inferior)

**Nasal conchae** (superior, middle, and inferior)

**Nasal cavity**
- Frontal sinus
- Sphenoid sinus
- Cribiform plate of ethmoid bone

**Nasopharynx**
- Nasopharynx

**Oropharynx**
- Oropharynx

**Larynx**
- Larynx

**Trachea**
- Trachea

*(c) Illustration*
Larynx

- Cartilage framework
  - Glottis
  - Epiglottis
- Functions
  1. Provides a patent airway
  2. Routes air and food into proper channels
  3. Sound production
Body of hyoid bone
Thyroid cartilage
Laryngeal prominence (Adam’s apple)
Cricothyroid ligament
Cricotracheal ligament
Epiglottis
Thyrohyoid membrane
Cricoid cartilage
Tracheal cartilages

(a) Anterior superficial view
(b) Sagittal view; anterior surface to the right
Figure 22.5

(a) Vocal folds in closed position; closed glottis

(b) Vocal folds in open position; open glottis

- Base of tongue
- Epiglottis
- Vestibular fold (false vocal cord)
- Vocal fold (true vocal cord)
- Glottis
- Inner lining of trachea
- Cuneiform cartilage
- Corniculate cartilage
Sound Production

- Vocal folds
  - Sound = vibration of folds
- Pitch
  - Tension of the vocal cords
- Loudness
  - Air pressure
Sound Production

- Chambers of pharynx, oral, nasal, and sinus cavities amplify and enhance sound quality
- Sound is “shaped” into language by muscles of the pharynx, tongue, soft palate, and lips
Trachea

- Windpipe
  - From the larynx into the mediastinum
- Smooth muscle and connective tissue
  - C-shaped rings
Figure 22.6a

(a) Cross section of the trachea and esophagus

- Posterior
- Mucosa
- Submucosa
- Seromucous gland in submucosa
- Hyaline cartilage
- Adventitia

- Esophagus
- Trachealis muscle
- Lumen of trachea
Lungs

- Left
  - 2 lobes
- Right
  - 3 lobes
(a) **Anterior view.** The lungs flank mediastinal structures laterally.
Figure 22.7

Lungs and Bronchial Tree

- Trachea
- Superior lobe of left lung
- Left main (primary) bronchus
- Lobar (secondary) bronchus
- Segmental (tertiary) bronchus
- Inferior lobe of left lung
- Superior lobe of right lung
- Middle lobe of right lung
- Inferior lobe of right lung
Bronchial Tree

- Trachea
  - Primary bronchi
    - Right bronchus
      - Shorter
      - Branches into 3 secondary bronchi
    - Left bronchus
      - Branches into 2 secondary bronchi
Bronchial Tree

Trachea → primary bronchi → secondary bronchi → tertiary bronchi → bronchioles → respiratory bronchioles → terminal bronchioles → alveoli

Respiratory zone
Figure 22.11

Right lung

- Right superior lobe (3 segments)
- Right middle lobe (2 segments)
- Right inferior lobe (5 segments)

Left lung

- Left superior lobe (4 segments)
- Left inferior lobe (5 segments)
Bronchogram of right lung
Alveoli

- Gas exchange
- Large surface area + small diameter = high surface tension
  - Pulmonary surfactant
  - Infant respiratory distress syndrome
Squamous epithelium with an elastic membrane
(a) Diagrammatic view of capillary-alveoli relationships
Figure 22.9c

(c) Detailed anatomy of the respiratory membrane
(b) Scanning electron micrograph of casts of alveoli and associated pulmonary capillaries (300x)
Pleurae

- Thin, double-layered serosa
  - Parietal pleura
    - Thoracic wall and superior face of diaphragm
  - Visceral pleura
    - External lung surface
- Pleural fluid
  - Lubrication
Pleurae

• Three functions
  1. Reduction of friction
  2. Pressure gradient
  3. Compartmentalization
(c) Transverse section through the thorax, viewed from above. Lungs, pleural membranes, and major organs in the mediastinum are shown.
Figure 22.12

Atmospheric pressure

Transpulmonary pressure

Intrapleural pressure

Intrapulmonary pressure

Thoracic wall

Diaphragm

Lung

Parietal pleura

Visceral pleura

Pleural cavity

760 mm Hg

756 mm Hg

4 mm Hg

760 mm Hg

756 mm Hg

(0 mm Hg)

(4 mm Hg)
Questions?

Homework #5, page 9 in Homework Section
Due in lab this week