Due in Lab

- PreLab #3
- HW #5 – Respiratory labeling (HW page 9)

Activity: Cell Mediated Immunity – HW #4

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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
Nasal cavity  
Nostril  
Oral cavity  
Pharynx  
Larynx  
Trachea  
Carina of trachea  
Left main (primary) bronchus  
Right main (primary) bronchus  
Left lung  
Right 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
Figure 22.2a

- Epicranius, frontal belly
- Root and bridge of nose
- Dorsum nasi
- Ala of nose
- Apex of nose
- Naris (nostril)
- Philtrum
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
Figure 22.3c

- Cribiform plate of ethmoid bone
- Sphenoid sinus
- Posterior nasal aperture

**Nasopharynx**
- Nasal conchae (superior, middle, and inferior)
- Nasal meatuses (superior, middle, and inferior)
- Nasal cavity

**Nasopharynx**
- Pharyngeal tonsil
- Opening of pharyngotympanic tube
- Uvula

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

**Laryngopharynx**

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

- Trachea
- Eosophagus
- Hard palate
- Soft palate
- Tongue
- Lingual tonsil
- Hyoid bone

(c) Illustration

Figure 22.3c
Figure 22.3b

(b) Regions of the pharynx

- Pharynx
  - Nasopharynx
  - Oropharynx
  - Laryngopharynx
Pharynx

- “Throat”
- Between internal nares and larynx
- Three regions
  1. Nasopharynx
  2. Oropharynx
  3. Laryngopharynx

Transports air
Transports air, liquids and solids
Larynx

- Cartilage framework
  - Glottis
  - Epiglottis
- Functions
  1. Provides a patent airway
  2. Routes air and food into proper channels
  3. Sound production
Figure 22.4a

(a) Anterior superficial view

- Body of hyoid bone
- Thyroid cartilage
- Laryngeal prominence (Adam’s apple)
- Cricothyroid ligament
- Cricotracheal ligament
- Thyrohyoid membrane
- Epiglottis
- Cricoid cartilage
- Tracheal cartilages
Figure 22.4b

Epiglottis

Thyrohyoid membrane

Cuneiform cartilage

Corniculate cartilage

Arytenoid cartilage

Arytenoid muscles

Cricoid cartilage

Tracheal cartilages

Body of hyoid bone

Thyrohyoid membrane

Fatty pad

Vestibular fold (false vocal cord)

Thyroid cartilage

Vocal fold (true vocal cord)

Cricothyroid ligament

Cricotracheal ligament

(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
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 cartilage rings
(a) Cross section of the trachea and esophagus

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

**Posterior**

**Anterior**

- Esophagus
- Trachealis muscle

**Lumen of trachea**
Lungs

- Left
  - 2 lobes
- Right
  - 3 lobes
(a) Anterior view. The lungs flank mediastinal structures laterally.
Lungs and Bronchial Tree

Trachea

Superior lobe of right lung

Middle lobe of right lung

Inferior lobe of right lung

Superior lobe of left lung

Left main (primary) bronchus

Lobar (secondary) bronchus

Segmental (tertiary) bronchus

Inferior lobe of left 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
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
Figure 22.8a

- Alveolar duct
- Alveoli
- Respiratory bronchioles
- Terminal bronchiole
- Alveolar sac
Squamous epithelium with an elastic membrane
Elastic fibers (a) Diagrammatic view of capillary-alveoli relationships

Smooth muscle

Terminal bronchiole

Respiratory bronchiole

Alveolus

Capillaries

(a) Diagrammatic view of capillary-alveoli relationships
(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.
Atmospheric pressure

Thoracic wall

Diaphragm

Lung

Intrapleural pressure

Transpulmonary pressure

760 mm Hg

756 mm Hg

= 4 mm Hg

Intrapulmonary pressure

760 mm Hg

756 mm Hg

(−4 mm Hg)

Parietal pleura

Visceral pleura

Pleural cavity
Questions?

If you woke up breathing congratulations! You have another chance