Respiratory System (Ch. 23)
Human Anatomy lecture

I. Overview
A. Functions with cardiovascular system (= cardiopulmonary system)
   ① Deliver O₂
   ② Remove CO₂
   Also
   - Modifies air, delivers smells, produces sounds
   - Other physiological functions

B. Functionally 2 divisions
   1. Conducting division:
   2. Respiratory division:

C. Anatomically divided differently
   1. Upper respiratory tract:
   2. Lower respiratory tract:

II. Upper respiratory tract (KNOW Fig. 23.2)
A. Nose
   Nasal cavity divided by nasal septum into Left & Right nasal fossae
   External nose → formed by
   L. & R. nares (pl. = nares)

   L. & R. vestibule → .

   Internal nose
   3 prs meatuses formed by 3 prs conchae (turbinates)

   L & R posterior nasal apertures →
   (choanae)

   pharynx

Respiratory -- Page 1 of 7
• Why conchae? ➔

• L & R inferior concha has erectile tissue (swell body) ➔

B. Pharynx ( = throat)
1. Funnel-shaped passage

2. 3 Divisions (Fig. 23.2c)

   nasopharynx  posterior nares (end of hard palate) ➔
   uvula (end of soft palate)

   auditory tubes ➔

   oropharynx  uvula (end of soft palate) ➔  tip of epiglottis

   oral cavity ➔  fauces ➔

   laryngopharynx  tip of epiglottis ➔  cricoid cartilage

   air ➔  food

   larynx (anteriorly) ➔  esophagus (posteriorly)

III. Lower respiratory tract
A. Larynx (voice box) ➔ KNOW Fig. 23.4 (partially)
1. Short passageway anterior to C₄-C₆

2. 9 cartilages, several ligaments and muscles
   ① epiglottis -
   ② thyroid (Adam’s apple) –
   ③ cricoid –

   + 3 small pairs posteriorly and laterally

3. Mucosa forms 2 pairs of folds (Fig. 23.5)
   • vestibular folds (false vocal cords) –
   • vocal cords (vocal folds) –
   • glottis –
4. Lined w/stratified squamous epi.
pseudostratified ciliated col. epi.

5. When you swallow:
   - larynx elevates,
   - epiglottis hinges “down,”
   - vestibular folds close glottis

B. Trachea (windpipe) → **KNOW Fig. 23.7a**
   1. Anterior to esophagus,
   2. Tubular passage
   3. Lined w/pseudostratified ciliated col. epi.

4. Trachealis muscle (smooth) and elastic c.t. hold ends of “C” together
   5.

Why cartilage? Why C-shaped and not complete rings?
   - maintains patency
   - allows expansion
   - allows adjustment of diameter

C. Bronchial tree (Fig. 23.7a)
   1. System of branching tube/tubules (your text doesn’t include trachea)

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trachea
  ↓
L + R main (primary) bronchi –
  ↓
Secondary bronchi (lobar) –
  ↓
tertiary (segmental) bronchi –
  ↓
bronchioles –
  ↓
  ↓
terminal bronchioles
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2. As move “down” tree:
   diameter ↓
   cartilage ↓
   smooth muscle ↑
   epithelium changes to non-ciliated simple cuboidal

3. Nicotine paralyzes cilia

D. Lungs
   1. Surrounded by pleural membrane (Fig. 1-15)
      -insert sketch-

   parietal pleura
   pleural cavity
   serous fluid
   visceral pleura

Functions? ①
           ②
           ③

2. Gross anatomy **KNOW Fig. 23.9**
   - apex & base
   - costal & mediastinal surfaces
   - hilum – indented region
   - root = bronchus & neurovascular bundle
   - lobes and fissures
   - cardiac impression

3. Each lobe divided by inward extensions of visceral pleura into bronchopulmonary segments (see chap. opening art, p. 631)

4. Each bronchopulmonary segment subdivided into
5. Within a pulmonary lobule: \textbf{(KNOW Fig. 23.11)}

- bronchiole
  - terminal bronchiole
    - respiratory bronchiole
      - alveolar duct
        - alveolus
        - alveolar sacs

6. Lots of elastic fibers in c.t. surrounding all these and in walls of tubes

7. Lung receives double blood supply

  - deoxygenated
    - pulmonary A.
    - pulmonary V.
  
  - oxygenated
    - bronchial AA.
    - azygos system

E. Alveolus

1. Designed to maximize O\textsubscript{2}/CO\textsubscript{2} exchange:

2. Histology (Fig. 23.11)

   - squamous (type I) alveolar cells
   - great (type II) alveolar cells \rightarrow outnumber type I
   - Alveolar macrophages (dust cells) [WBC]

3. Alveolus jacketed by dense capillary network

   - gases must diffuse across \textbf{respiratory membrane} (Fig. 23.11c)

   Respiratory -- Page 5 of 7
- 6 layers (more than your text implies)
  1. surfactant
  2. squamous cell
  3. squamous cell basement membrane
  4. interstitial space
  5. capillary basement membrane
  6. capillary endothelial cell

4. Vital to prevent accumulation of fluid in lungs – How?

IV. Functional anatomy of breathing (Fig. 23.13)
   A. Basic physics
      $\uparrow$ volume $\Rightarrow$ $\downarrow$ pressure
      $\downarrow$ volume $\Rightarrow$ $\uparrow$ pressure

   How do you accomplish this change in thoracic volume?

   B. Normal inspiration
      1. Diaphragm – ~ 2/3
         - Increases vertical dimension of thorax $1 \rightarrow 7$ cm
      2. Ribs - ~ 1/3
         - Increases anterior-posterior (AP) and transverse dimensions

   C. Forced inspiration uses additional accessory muscles of inspiration.
D. Normal expiration is a passive process
   1. 
   2.

E. Forceful expiration
   -- internal intercostals contract:
   -- abdominal muscles contract: