

LABORATORY 20 - RESPIRATORY SYSTEM - THE LUNGS (second of two laboratory sessions)

OBJECTIVES: LIGHT MICROSCOPY: Recognize the characteristics of bronchi, bronchioles and respiratory bronchioles, alveolar ducts, sacs and alveoli and be able to distinguish these structures. Understand the location, characteristics and roles of the different circulatory system components in the lungs. Observe pleura, understand macrophage system and its distribution and in the lung. Relate structure of lung to function.

ELECTRON MICROSCOPY: Recognize the structure of the alveolar walls, the distribution of the cell types and the blood-air barrier.

ASSIGNMENT FOR TODAY'S LABORATORY

GLASS SLIDES

SL 20	Lung, adult
SL 24	Lung, child
SL 112, 59	Bronchi
SL 112, 113, 59	Bronchioles
SL 112, 113, 184	Respiratory bronchioles
SL 113, 112, 59	Pleura
SL 113	Dust cells (macrophages)
SL 114	Lung, premature baby

ELECTRON MICROGRAPHS

EM 18, 19 Lung

Text J. 17-20, 21, 24, 25, 26; W. 12.14 to 12.17

POSTED ELECTRON MICROGRAPHS

20 Lung

20b Lung

20c Lung

[Lab 20 Posted EMs](#)

HISTOLOGY IMAGE REVIEW - available on computers in HSL

Chapter 19, Respiratory System

Frames: 1312-1331

SUPPLEMENTARY ELECTRON MICROGRAPHS

Rhodin, J. A.G., [An Atlas of Histology](#)

Copies of this text are on reserve in the HSL.

Respiratory system pp. 348 - 365

- A. Conducting parts of the lung start with primary bronchi and include terminal bronchioles.
1. Primary bronchi ([SL 20](#) adult, [24](#) child) (W. 12.8 to 12.10). Primary bronchi resemble the trachea; however, as the bronchus enters the lung and divide into secondary bronchi the supportive hyaline cartilage within the wall of the structure appears as separate plates instead of C-shaped structures. Another alteration is an increased abundance of bundles of smooth muscle that are distributed around the entire circumference of the wall.
 - a. [SL 20](#) ([scan](#), [low](#)) - Proximal region of primary bronchus close to bifurcation. Compare structure to that of trachea.
 - b. [SL 24](#) – [Primary bronchus](#) close to or within the lung. Six-year-old child.
 - 1) Is the muscle layer (muscularis) ([red arrows](#)) complete or in bundles?
 - 2) Locate [pulmonary artery](#) ([red arrow](#)), bronchial arteries and veins, hilar [lymph nodes](#), ([green arrows](#)) and [lung tissue](#).
 2. **INTRAPULMONARY BRONCHI** - lung of child [SL 112](#), lung of adult [SL 59](#) (J. 17-8 to 11; W. 12.10) Locate examples of bronchi ([low 1](#), [low 2](#), [med](#)) - large (primary), several orders of medium-sized and small bronchi.
 - a. Note how each of the following structures and tissues change in the different layers as branching occurs.
 - 1) Epithelium decreases in thickness
 - 2) Muscularis becomes more prominent
 - 3) Glands become less numerous (submucosa gradually disappears)
 - 4) Cartilage - decrease in size and amount
 - 5) Wall of bronchus becomes thinner
 - b. Differentiate the pulmonary artery from the pulmonary vein ([pulmonary artery, red arrow](#); [pulmonary vein, green arrow](#)). Note that the histological features you learned in the lab on the circulatory system are less useful because the pulmonary arteries have relatively thin walls. The pulmonary artery travels in the center of a lobule (bronchopulmonary segment), adjacent to the respiratory tree (bronchiole in this image), while the pulmonary vein, which runs in the connective tissue between lobules, is isolated.
 - c. Attempt to estimate size of bronchi on the basis of the characteristics of the layers of the wall.
 3. **BRONCHIOLES** - SL [112](#), [113](#), [59](#) (J. 17-12 to 17-18; W. 12.11, 12.12) – Bronchioles ([low](#), [med](#), [high](#)) branch several times becoming terminal bronchioles (described below) before the respiratory structures begin.
 - a. Epithelium - low pseudostratified ciliated columnar to simple columnar ciliated. Goblet cells absent in terminal bronchioles.
 - b. Muscle - forms prominent part of wall.
 - c. Bronchioles lack glands, submucosa, and cartilage.
 - d. Adventitia – Differentiate between pulmonary and bronchial arteries. ([pulmonary artery, red arrow](#); [bronchial artery, blue arrows](#)) ([pulmonary artery, red arrow](#); [bronchial arteries, blue arrows](#)) . As with differentiating pulmonary arteries from pulmonary veins, histological features are not very useful. Note that pulmonary arteries are larger, with a luminal diameter similar to that of the bronchiolar tree, while the bronchial arteries are much smaller, and are within the wall of the respiratory tree.
 - e. Terminal bronchioles (4th or 5th division) - These bronchioles have a small diameter, slightly folded mucosa, and simple columnar ciliated epithelium. Although many Clara cells are present, they may be difficult to identify.

- B. Respiratory structures of the lung SL [112](#), [113](#), [184](#) (J. 17-14, 15, 16, 18; W. 12.12, 12.13).
1. RESPIRATORY BRONCHIOLES ([med](#)) Characteristics of respiratory bronchioles include:
 - a. Cuboidal or low columnar epithelium with or without cilia.
 - b. Smooth muscle bundles intermixed with elastic fibers.
 - c. Absence of contraction folds in wall.
 - d. Adventitia with small branch of pulmonary artery.
 - e. The presence of pulmonary alveoli as interruptions in the wall of this structure is the distinguishing characteristic. The alveoli in the respiratory bronchioles are adjacent to regions of cuboidal epithelium ([between pairs of red arrows](#)). The number of alveoli increase until the tube is entirely lined by alveoli and the structure is then called an alveolar duct.
 2. ALVEOLAR DUCTS and SACS (W. 12.12) Differentiate between [alveolar ducts \(between pairs of red arrows\)](#) (elongated structures composed of alveoli) and [alveolar sacs](#) (clusters of alveoli opening into an alveolar duct). Alveolar ducts are randomly oriented and may appear in either longitudinal or cross section, with walls composed of pulmonary alveoli.
 3. PULMONARY ALVEOLI - Observe the alveoli in [SL 184 \(elastin in alveolar wall\)](#) (There are three different sections on this slide stained to show elastin.) (W. 12.13). Examine the details of the alveolar walls. Use [SL 113](#) for cellular detail. In the light microscope capillary beds, and macrophages may be identified. Can you see the portions of the Type I cells that lie between the capillaries and the air space? What separates adjacent alveoli?
 4. Electron microscope - Study [EM 19](#) and identify all structures indicated. Compare E.M 19 with electron micrographs in the following, J. 17-20, 17-21, 17-24 to 26; W. 12.14 to 12.19). Study [EM 18](#) (immature lung). Note especially 18-6 (alveolar Type II cell) 18-5 and 7 (lamellar bodies) and 18-8 (macrophage or "dust" cell).
- C. Review SL [112](#) and [59](#) for blood vessel, lymphatic, and nerve distribution.
1. Identify the following vessels in either of these two images from SL [112](#) and [59](#) and in other images viewed previously: pulmonary arteries and veins, bronchial arteries and veins.
 2. Find lymphatic vessels in the connective tissue trabeculae within the lung or in the pleura.
 3. Look for nerves and small groups of ganglion cells.
- D. Lung (3-year-old child, elastic tissue stain) [SL 184 \(elastin in lung\)](#). In the section of lung, note the distribution of elastic tissue (W. 12.17) in all structures and review all conducting, respiratory and vascular components of the lung. Observe the wide distribution of elastic tissue in the lung. What would occur if there was extensive breakdown of this elastic network?
- E. PLEURA - [SL 113](#), [112](#), [59](#) (W. 12.23). Note its composition, its blood vessels and its lymphatics.
- F. The MACROPHAGE SYSTEM of the lung.
1. Dust cells - [SL 113](#) - Look for free macrophages in the alveoli ([green arrows](#)). What do they contain? What is their origin? What is the ultimate fate of these cells?
- G. LUNG from a premature baby (7 months) [SL 114](#).
1. Compare expanded and unexpanded alveoli (latter look glandular).
 2. Compare other features to mature lung, including ducts, blood vessels and lymphatics.

OBJECTIVES FOR LABORATORY 20: RESPIRATORY SYSTEM II - LUNG

1. Using the light microscope or digital slides, identify:

- Bronchus (no need to differentiate between primary, secondary, intrapulmonary)
- Bronchiole
 - Bronchiole
 - Terminal
 - Respiratory
- Alveolar ducts
- Alveolar sacs
- Alveoli
- Pulmonary artery
- Bronchiol artery
- Pulmonary vein
- Visceral pleura
- Dust cells

2. On electron micrographs, identify:

- Type I pneumocytes (type I alveolar cells)
- Type II pneumocytes (type II alveolar cells)
 - Lamellar bodies
- Basal lamina
- Endothelial cells
- Components of connective tissue (fibroblast, elastic fibers, etc.) if present
- Macrophage (dust cells)

REVIEW

1. How do pulmonary arteries and veins differ with regard to their distribution within the lobules of the lung?
2. Name all structures through which a molecule of oxygen must pass from the lumen of the alveolus to the blood.
3. Are lymphatics found in the connective tissue septa between lobules? Where do they drain?
4. What is surfactant? What is its function and cellular origin?
5. What cellular defense mechanisms are present in the respiratory system to combat airborne infection?