ANAT 2160/BIOL 3430 Respiratory system Laboratory Module

Objectives:
1) Understand how the wall structure of the airways in the lung conducting system, and in particular the structure of the mucosa, varies by region.
2) Determine the structure of the respiratory portion of the lung, and how this structure supports gas exchange.

Overview:
Functionally, the respiratory system is organized to maximize the surface area and to minimize the air-to-blood diffusion distance to provide the most efficient gas exchange possible. The respiratory system has two components, a set of airways (the conducting portion), and a gas exchange area (the respiratory portion). Most of the conducting portion is lined with respiratory epithelium (pseudostratified, cilated columnar epithelium with goblet cells) and the airways have supporting tissues organized into a mucosa (containing the epithelium, lamina propria and muscularis mucosa) and a submucosa. Review the features of each of these layers and determine how their structures change in different regions of the conducting system as you examine the following slides. These exercises cover both extrapulmonary and intrapulmonary aspects of the airways and the respiratory portion of this system.

The conducting portion of the system starts with the nasal cavity (respiratory epithelium and olfactory epithelium), continuing through the nasopharynx, oropharynx (oral epithelium), past the epiglottis (both types of epithelia), the larynx (mostly respiratory epithelium except on the true vocal cords), and many branches of extrapulmonary and intrapulmonary airways (from the trachea to the terminal bronchioles, all lined with respiratory epithelium). The transition from conduction to gas exchange occurs at the respiratory bronchioles.

108, lip. This is a sagittal section through the lip, so it contains epithelia from the outer (skin) side and the inner (oral) side. The tissue lining the nares and the vestibule of the nasal cavity, where the air enters this cavity, is histologically similar to the skin of the lip. The stratified squamous epithelium of the skin features a keratinized superficial layer (the stratum corneum) and hair follicles. The epithelium lining the oral cavity is non-keratinized, stratified squamous epithelium and there are no hair follicles. This type of epithelium lines the entire oral cavity. What features of oral epithelium make it more suitable for withstanding exposure to mixed food and air than respiratory epithelium? Note the secretory portions of small salivary glands deep to the oral epithelium.

202, trachea. Use this slide to examine the features of the respiratory epithelium lining the airway; the form of this tissue type in the trachea is similar to respiratory epithelium linning the nasal cavity. Note that the nuclei of the ciliated columnar epithelial cells are in two rows (in some places more). The apical portions of the goblet (mucus-secreting) cells are wider than those of the surrounding ciliated cells, and mucus is contained in granules in the pale-staining cytoplasm of these cells.

28, 29, epiglottis. Sections on these slides were cut sagittally from the free tip of the epiglottis, so different epithelial types appear on the two surfaces. The epiglottis is a flap valve that covers the laryngeal airway during swallowing. Thus the epithelium facing the oral cavity is oral epithelium, while the epithelium on the surface facing the airway is respiratory. Identify both types of epithelium on both slides. The core of the epiglottis is elastic cartilage. Slide 28 was stained with hematoxylin and eosin, therefore does not show fibres in the elastic cartilage; these elastic fibres are shown clearly in slide 29, stained with Verhoff's elastic fibre stain. In slide 29, the mucus in goblet cells in the respiratory epithelium appears as yellowish granules toward the apical surface. On which side of the epiglottis are submucosal mucous glands present? The epithelia may be split off from the lamina propria on either slide.

56, 135, 202, trachea. Examine all the layers of the airway wall on these slides to identify and characterize the epithelium, lamina propria, muscularis mucosa, submucosa, glands, perichondrium, hyaline cartilage and trachealis muscle. These components stain differently depending on the slide, so you will need to move between slides to get the best view of each layer.

59, 70, 142, lung. These slides show the intrapulmonary portions of the conducting system as well as the respiratory portion. Most of the area of these tissue sections consists of alveoli; these will be the finest subdivisions, but in each section there are also examples of all levels of airway branching from bronchi (characterized by cartilage pieces and glands in the lamina propria and submucosa), large and small bronchioles (no cartilage, no glands), and terminal bronchioles. To analyze these slides, start with the largest openings you can see by eye and identify what level of airway branching they represent. Then look progressively at smaller and smaller airways until you have identified as many levels of the conducting system as you can find. Look for examples of terminal bronchioles branching into respiratory bronchioles to clearly understand the transition between conducting and gas exchange regions. It will be difficult to get a good view of details of the alveolar septae, but you should be able to identify the thin, flat nuclei of squamous Type 1 pneumocytes, the larger and more rounded nuclei and cytoplasm of Type II pneumocytes, and numerous septal capillaries (hint: look for erythrocytes). Some of the round or obliquely cut hollow structures in these slides will be blood vessels; these will be lined not by respiratory epithelium but by a simple squamous endothelium, and may have erythrocytes and pink-staining plasma in their lumens. However, during preparation of the slides, blood may have leaked into the airways so some of these may also appear to have erythrocytes in the lumen. You may also see scattered macrophages ("dust cells") in the lung, particularly in clusters among the alveoli, as indicated in the exercise on connective tissue.