2160-3430 Excretory system laboratory module

Objectives
1) Differentiate kidney cortex from medulla, and identify the components of the renal corpuscle and nephron in each region.
2) Understand the relationships between regional structures of the corpuscle and nephron, and the functions that are carried out in each region.

Overview
The major difficulty in interpreting kidney slides is that each slide presents a thin section of an organ that contains a very large number of hollow tubes (blood vessels, nephron) and urinary spaces (renal corpuscles) arranged in three dimensions. The challenge is to interpret the two-dimensional view of the kidney sections that you see through the microscope, in terms of the three-dimensional structure of the organ.

136, 71, kidney, PAS stain. Both of these slides are stained to show carbohydrates so the basement membranes of the epithelia of tubules, renal corpuscles and the endothelia of blood vessels are obvious. Slide 136 has more cortex than medulla, slide 71 has both cortex and medulla.

Cortex: examine the slides first at low power to identify the cortical and medullary regions. The cortex will contain large numbers of renal corpuscles. Identify both parietal and visceral layers of Bowman's capsule. The parietal layer consists of simple squamous epithelium with associated basement membrane (the purple/magenta layer around the outside of the epithelial cells). This layer provides a boundary around the outside of the urinary space. The visceral layer of Bowman's capsule consists of podocytes covering the outside of the glomerular capillaries. The nuclei of some podocytes will be visible outside the capillary endothelium and its basement membrane. Locate arterioles associated with the renal corpuscle (you will not be able to differentiate afferent from efferent arterioles on these slides), and identify the urinary space. Find some renal corpuscles in which the parietal layer of Bowman's capsule merges into the wall of a proximal convoluted tubule. The most common type of tubule close to the renal corpuscles in the cortex will be proximal convoluted tubules; there will also be distal convoluted tubules, collecting tubules and collecting ducts in the cortex. Use the criteria you have been given to identify these. Look for a renal corpuscle with an associated distal convoluted tubule containing a macula densa in its wall; you may also be able to see the juxtaglomerular cells in the wall of the arterioles.

Medulla: this region consists almost entirely of tubules, ducts and blood vessels. In the papillary part of the medulla (furthest away from the cortex), locate areas in which you can identify tubules and blood vessels in both longitudinal and cross-sectional views. Capillaries have the thinnest walls, consisting of simple squamous endothelium and a thin basement membrane; there will be only 1 or occasionally 2 nuclei in a cross-sectional profile of capillaries. Loops of Henle are slightly larger in diameter than capillaries, and also consist of simple squamous epithelium. However there can be as many as 3-4 nuclei

in a cross-sectional profile of a loop of Henle. The largest tubes will likely be collecting ducts, featuring simple cuboidal epithelium.

16, kidney, H&E stain (no PAS). This slide shows cortex and medulla and may include a papilla, but the tissue is not stained to show the basement membrane. Look for renal corpuscles in the cortex. The nuclei of the squamous cells making up the capillary endothelium and the parietal layer of Bowman's capsule are obvious. Podocyte nuclei are more difficult to find; these are slightly larger and less darkly stained than capillary endothelial nuclei. Identify all the types of tubules present in the kidney. If your slide has a papilla you should be able to see several collecting ducts opening into the lumen of the calyx at the tip of the papilla.

215, kidney, vascular injection. The blood vessels in this specimen were injected with black particles to visualize the circulation through the kidney. In the cortex the knots of capillaries making up glomeruli are visible as round black clumps. The afferent or efferent arterioles associated with some glomeruli will be visible as branches from small cortical arteries (you will not be able to tell the difference between these arterioles). Look for the long, straight capillaries of the vasa recta, running in parallel in the medullary region.

13, ureter. The ureter connects each kidney to the bladder, and is lined with transitional epithelium. This epithelium changes shape and appearance when it is stretched; in what state is the epithelium on your slide? Identify the lamina propria external to the epithelium. The lamina propria consists of loose connective tissue with collagen fibres and a high elastin fibre content, which throws the epithelium into longitudinal folds giving the lumen a stellate appearance. External to the lamina propria is smooth muscle; what is its function?

89, bladder. The bladder is a sac lined with transitional epithelium, and its wall is highly folded when empty. When the bladder fills the folds in the wall become stretched and the transitional epithelium goes from a stratified cuboidal appearance to that of a squamous epithelium only a few cell layers thick. The lamina propria external to the epithelium consists of loose connective tissue with both collagen and elastin fibres. There are several layers of smooth muscle in the bladder wall.