

## Laboratory Exercise

# 48

## Kidney Structure

### Materials Needed

Textbook  
Human torso model  
Kidney model  
Preserved pig (or sheep) kidney  
Dissecting tray  
Dissecting instruments  
Long knife  
Compound light microscope  
Prepared microscope slides of the following:  
Kidney section  
Ureter

### Safety

- Wear disposable gloves when working on the kidney dissection.
- Dispose of the kidney and gloves as directed by your laboratory instructor.
- Wash the dissection tray and instruments as instructed.
- Wash your laboratory table.
- Wash your hands before leaving the laboratory.

The two kidneys are the primary organs of the urinary system. They are located in the abdominal cavity, against the posterior wall and behind the parietal peritoneum (retroperitoneal). Masses of adipose tissue associated with the kidneys hold them in place at a vertebral level between T12 and L3. The right kidney is slightly more inferior due to the large mass of the liver near its superior border. Ureters force urine by means of peristaltic waves into the urinary bladder, which temporarily stores urine. The urethra conveys urine to the outside of the body.

Each kidney contains over 1 million nephrons, which serve as the basic structural and functional units of the kidney. A glomerular capsule, proximal convoluted tubule, nephron loop, and distal convoluted tubule compose the microscopic, multicellular structure

of a relatively long nephron tubule, which drains into a collecting duct. Approximately 80% of the nephrons are cortical nephrons with short nephron loops, while the remaining represent juxtamedullary nephrons, with long nephron loops extending deeper into the renal medulla. An elaborate network of blood vessels surrounds the entire nephron. Glomerular filtration, tubular reabsorption, and tubular secretion represent three processes resulting in urine as the final product.

A variety of functions occur in the kidneys. They remove metabolic wastes from the blood; help regulate blood volume, blood pressure, and pH of blood; control water and electrolyte concentrations; and secrete renin and erythropoietin.

### Purpose of the Exercise

To review the structure of the kidney, to dissect a kidney, and to observe the major structures of a nephron.

### LEARNING OUTCOMES

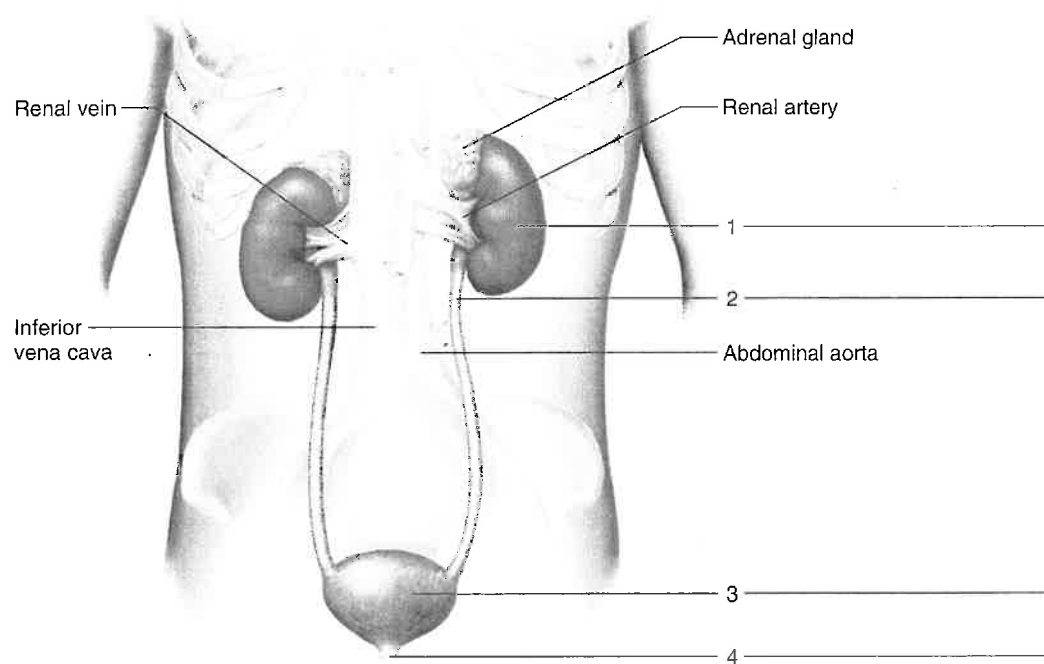
After completing this exercise, you should be able to

- 1 Locate and identify the major structures of the urinary system.
- 2 Locate and identify the major structures of a kidney.
- 3 Identify and sketch the major structures of a nephron.
- 4 Trace the path of filtrate through a nephron.
- 5 Trace the path of blood and blood pressure changes through the renal blood vessels.

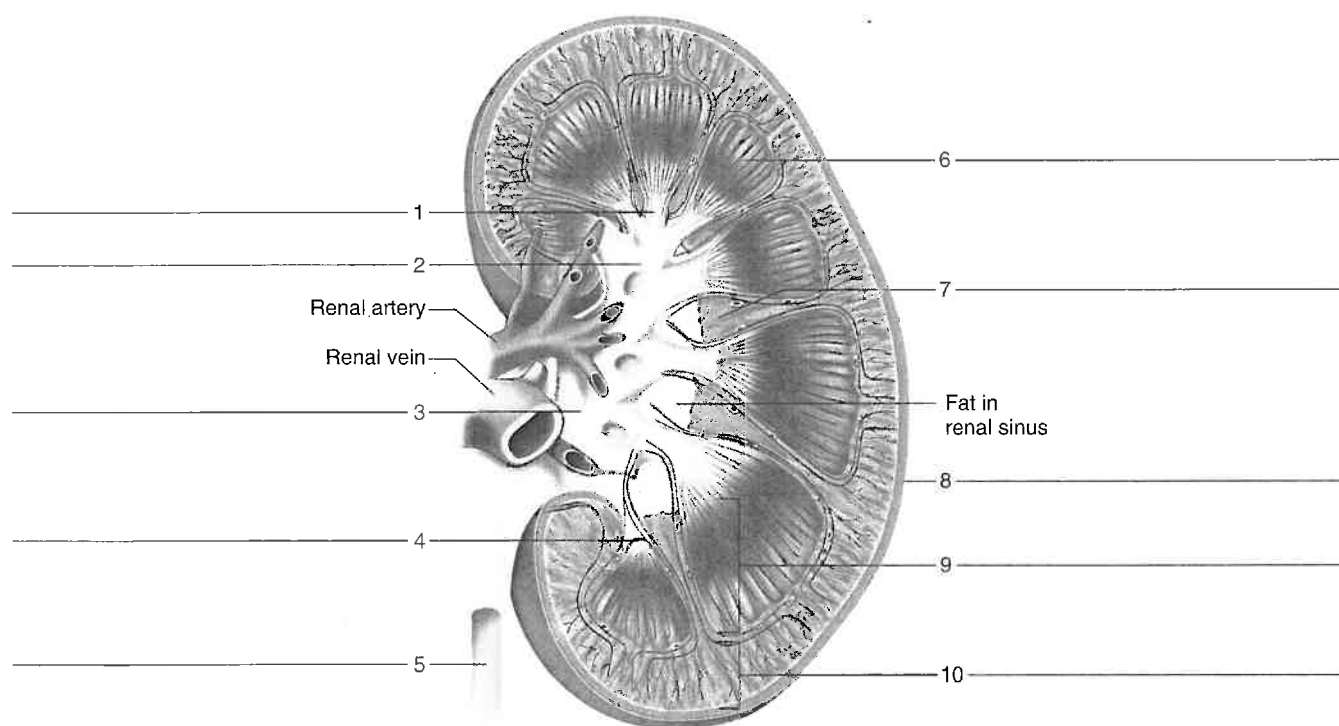
### EXPLORE

#### Procedure A—Kidney Structure

1. Review the section entitled “Kidney Structure” in chapter 20 of the textbook.
2. As a review activity, label figures 48.1 and 48.2.
3. Complete Part A of Laboratory Report 48.



**Figure 48.1** Label the major structures of the urinary system. **1**



**Figure 48.2** Label the major structures in the longitudinal section of a kidney. **2**

4. Observe the human torso model and the kidney model. Locate the following:

**kidneys**

**ureters**

**urinary bladder**

**urethra**

**renal sinus**

**renal pelvis**

major calyces

minor calyces

**renal medulla**

renal pyramids

renal papillae

**renal cortex**

**renal columns**

**nephrons**

cortical nephrons (80% of nephrons)

juxtamedullary nephrons (20% of nephrons)

5. To observe the structure of a kidney, follow these steps:

- a. Obtain a pig or sheep kidney and rinse it with water to remove as much of the preserving fluid as possible.

- b. Carefully remove any adipose tissue from the surface of the specimen.

- c. Locate the following features:

**renal (fibrous) capsule**

**hilum of kidney**

**renal artery**

**renal vein**

**ureter**

- d. Use a long knife to cut the kidney in half longitudinally along the frontal plane, beginning on the convex border.

- e. Rinse the interior of the kidney with water, and using figure 48.3 as a reference, locate the following:

**renal pelvis**

major calyces

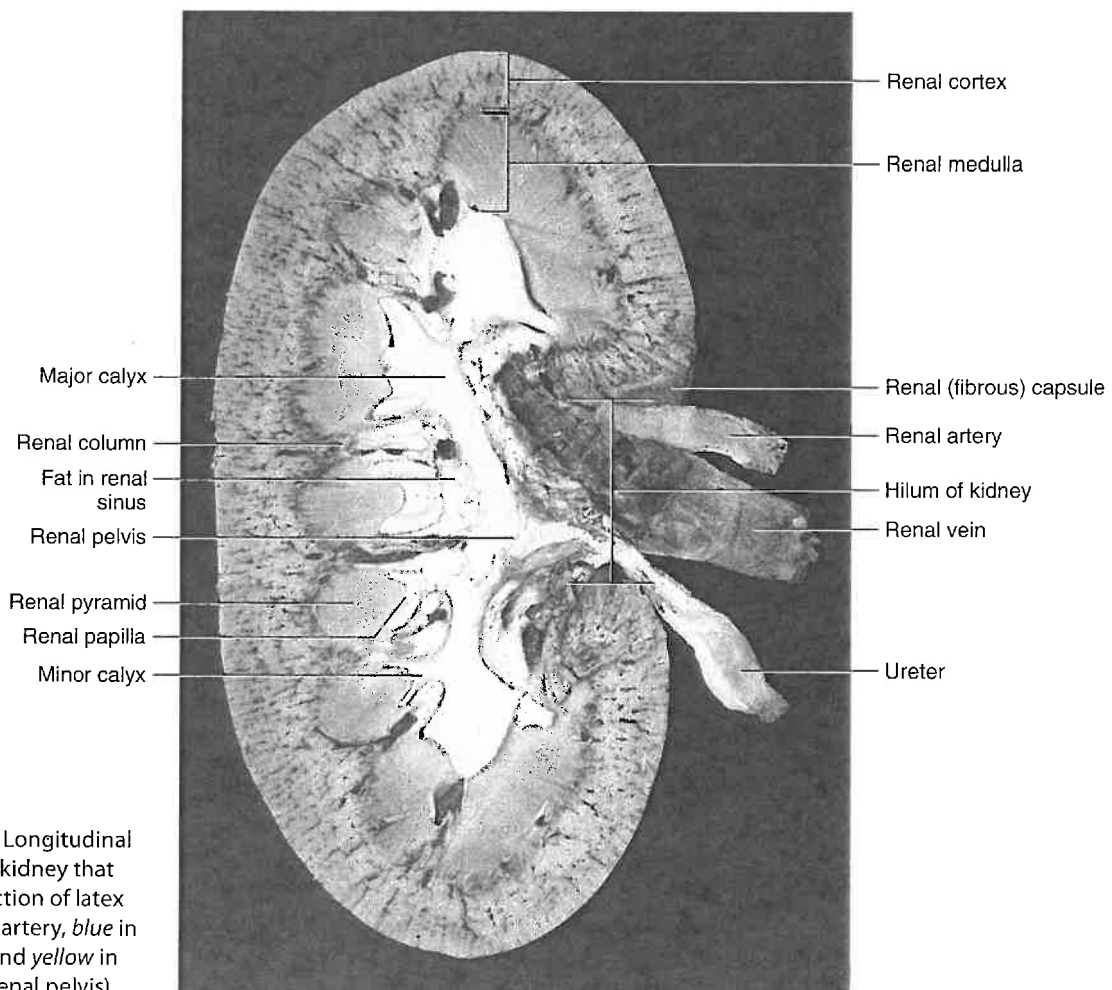
minor calyces

**renal cortex**

**renal columns** (extensions of renal cortical tissue between renal pyramids)

**renal medulla**

renal pyramids



**Figure 48.3** Longitudinal section of a pig kidney that has a triple injection of latex (red in the renal artery, blue in the renal vein, and yellow in the ureter and renal pelvis).

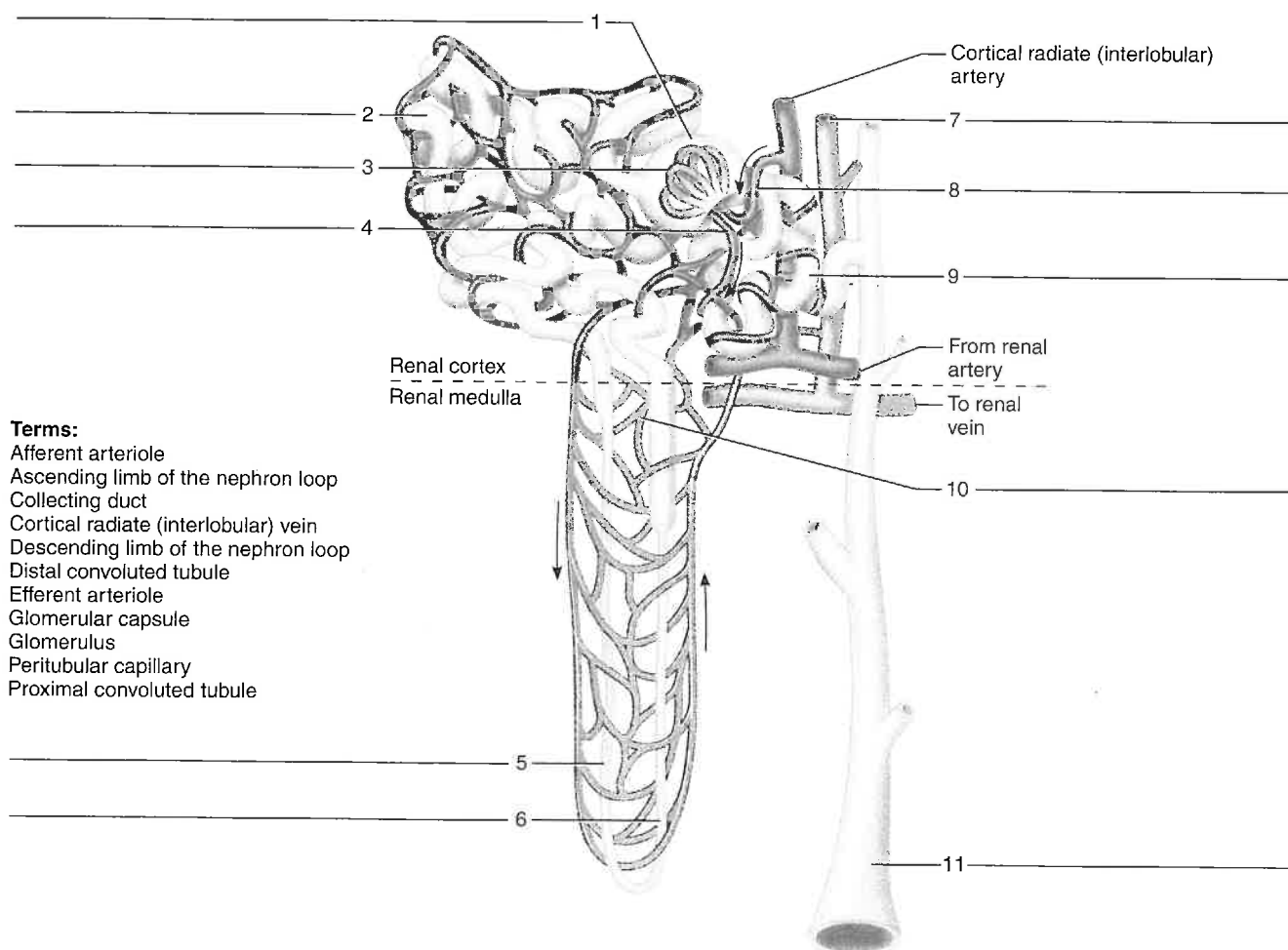
## EXPLORE

### Procedure B—The Renal Blood Vessels and Nephrons

1. Review the sections entitled “Renal Blood Vessels” and “Nephrons” in chapter 20 of the textbook.
2. As a review activity, label figure 48.4.
3. Complete Part B of the laboratory report.
4. Obtain a microscope slide of a kidney section, and examine it using low-power magnification. Locate the *renal capsule*, the *renal cortex* (which appears somewhat granular and may be more darkly stained than the other renal tissues,) and the *renal medulla* (fig. 48.5).
5. Examine the renal cortex, using high-power magnification. Locate a *renal corpuscle*. These struc-

tures appear as isolated circular areas. Identify the *glomerulus*, the capillary cluster inside the corpuscle, and the *glomerular capsule*, which appears as a clear area surrounding the glomerulus. Also note the numerous sections of renal tubules that occupy the spaces between renal corpuscles (fig. 48.5a).

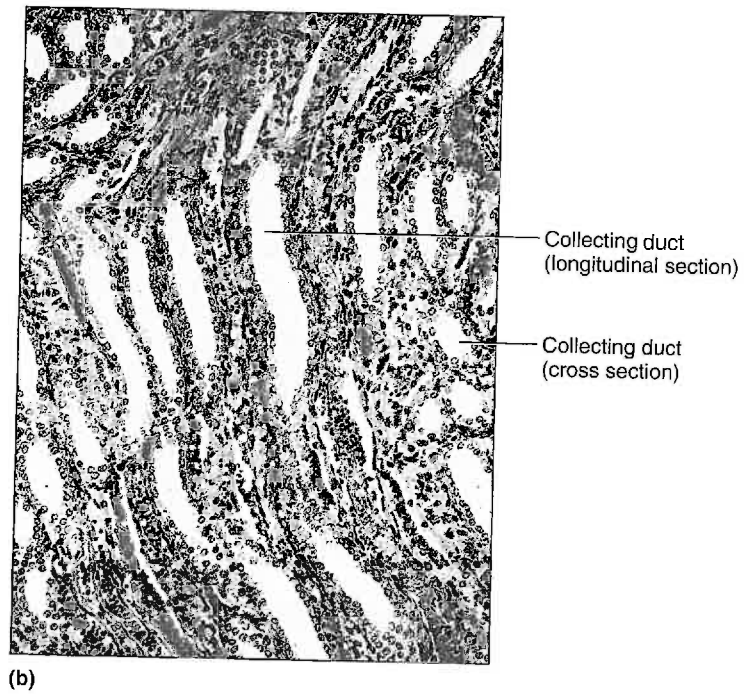
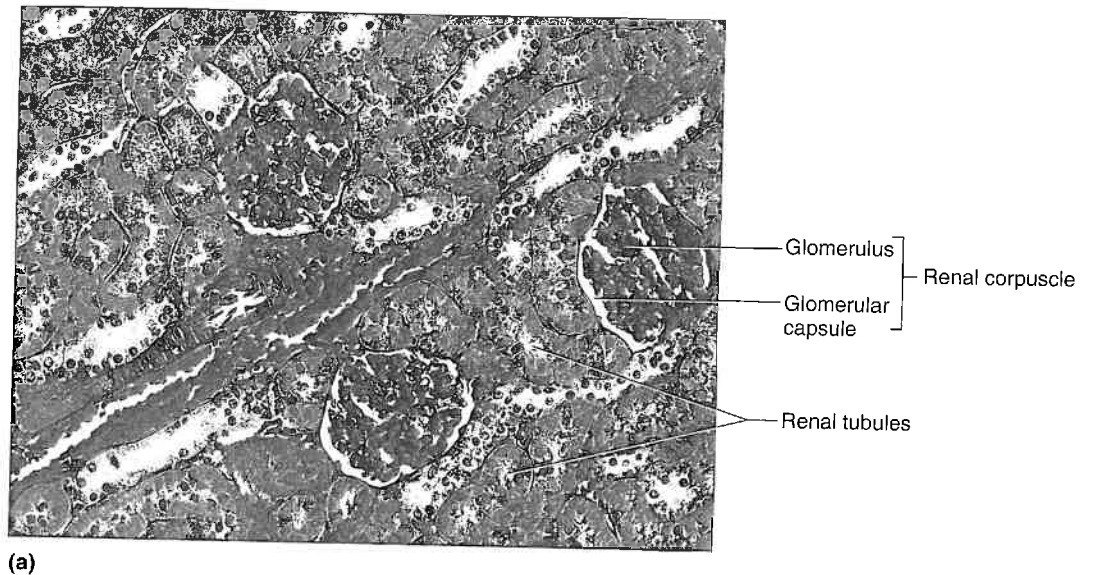
6. Prepare a labeled sketch of a representative section of renal cortex in Part C of the laboratory report.
7. Examine the renal medulla, using high-power magnification. Identify longitudinal and cross sections of various collecting ducts. These ducts are lined with simple epithelial cells, which vary in shape from squamous to cuboidal (fig. 48.5b).
8. Prepare a labeled sketch of a representative section of renal medulla in Part C of the laboratory report.



#### Terms:

Afferent arteriole  
Ascending limb of the nephron loop  
Collecting duct  
Cortical radiate (interlobular) vein  
Descending limb of the nephron loop  
Distal convoluted tubule  
Efferent arteriole  
Glomerular capsule  
Glomerulus  
Peritubular capillary  
Proximal convoluted tubule

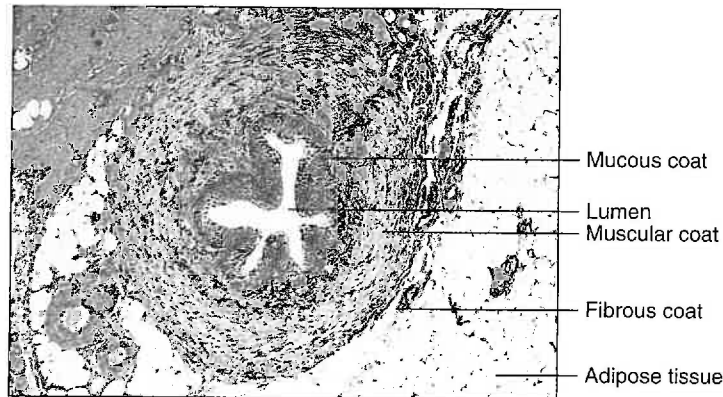
**Figure 48.4** Label the major structures of the nephron and the blood vessels associated with it, using the terms provided. 3



**Figure 48.5** (a) Micrograph of a section of the renal cortex (220 $\times$ ). (b) Micrograph of a section of the renal medulla (80 $\times$  micrograph enlarged to 200 $\times$ ).

## Procedure C—Ureter Structure

1. Review the section entitled “Ureters” in chapter 20 of the textbook.
2. Obtain a microscope slide of a cross section of a ureter, and examine it using low-power magnification. Locate the *mucous coat* layer next to the lumen. Examine the middle *muscular coat* composed of longitudinal and circular smooth muscle
3. Examine the mucous coat using high-power magnification. The specialized tissue is transitional epithelium which allows changes in its thickness when unstretched and stretched.
4. Prepare a labeled sketch of a ureter in Part D of the laboratory report.



**Figure 48.6** Cross section of a ureter (75 $\times$ ).