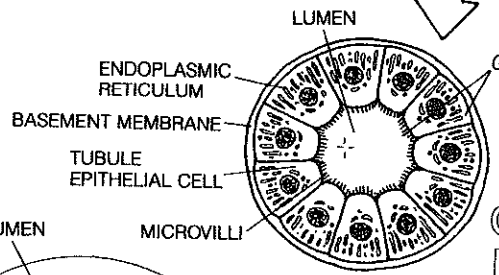
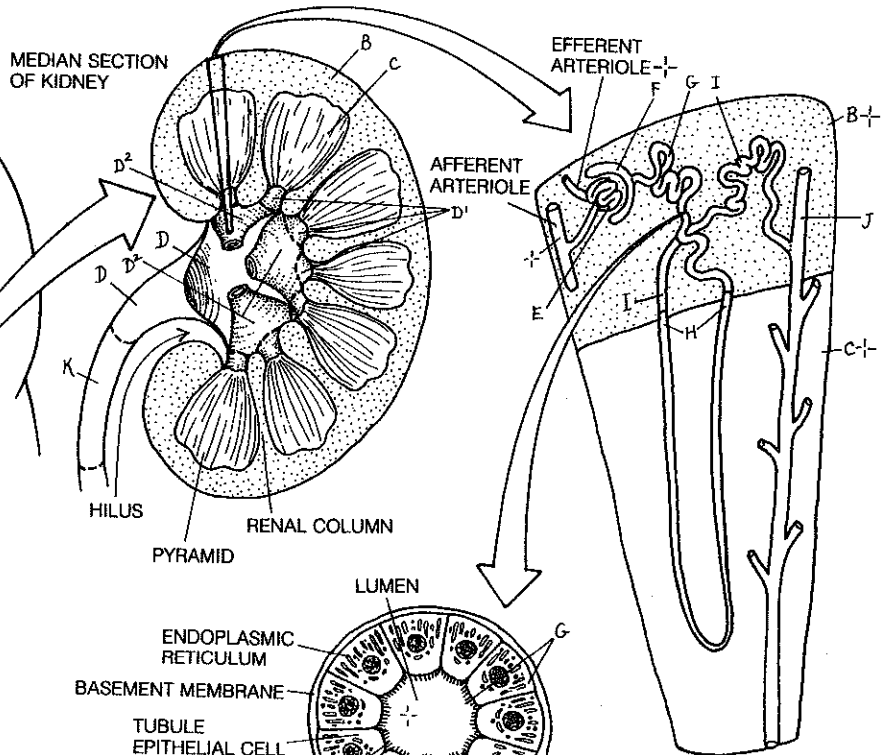
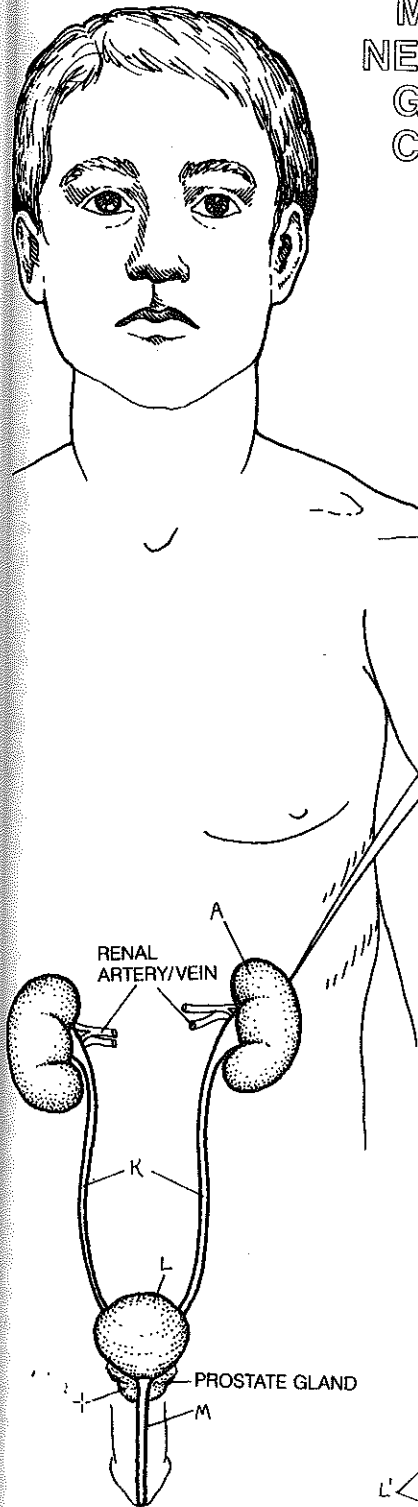


URINARY SYSTEM.

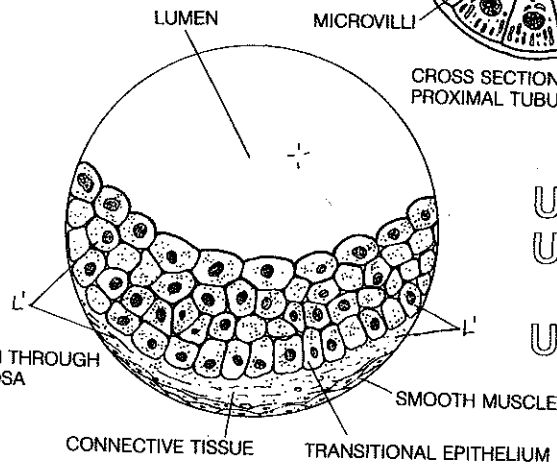
KIDNEY^A
CORTEX^B
MEDULLA^C
NEPHRON^D
GLOMERULUS^E
CAPSULE^F

RENAL PELVIS^G
MINOR CALYX^{D'}
MAJOR CALYX^{D''}

PROXIMAL CONVOLUTED
TUBULE^G/LOOP^H
DISTAL CONVOLUTED
TUBULE^I



COLLECTING DUCT^J



URETER^K
URINARY BLADDER^L
MUCOSA^{L'}
URETHRA^M

URINARY SYSTEM

The urinary system consists of a group of organs concerned with the conservation of body water and the acid-base balance of body fluids, as well as the excretion of undesired molecules.

Color titles A through D² and the related structures in the figure at the left and in the median section of the kidney.

The principal organ of the urinary system is the *kidney* (Latin: *renes*; Greek: *nephros*). An individual normally has two kidneys, located on the posterior (back) wall of the abdominal cavity, partly protected by the curve of the 11th and 12th ribs. Many people have lived normal lives with only one kidney, but it is impossible to live without at least one unless supported by a blood-filtration (dialysis) unit.

In this median section of the kidney you see the four major divisions: an outer layer, the *cortex* (Greek: "bark"); a middle belt of conical pyramids, the *medulla* (Latin: "marrow"); an inner area containing the cuplike *calyces* (singular, *calyx*; Greek: *kalix*, "cup") with the *renal pelvis* (Greek: "basin"); and the concavity known as the *hilus* (Latin: "a trifle"), where the renal artery enters the kidney and where the ureter and renal vein exit.

Color the heading Nephron, titles E through J, and the related structures. Leave the lumen of the tubule uncolored.

The basic structural and functional unit of the kidney is the nephron. Each kidney has about one million nephrons. The nephron is a tubule, highly modified at one end to filter blood. The filtration occurs in a globular cluster of highly specialized capillaries called a *glomerulus*, which is enclosed by a thin *capsule*. The capsule is comprised of a single layer of squamous epithelium and has the shape of a partly deflated ball pushed in on one side by the glomerulus so that the capsule largely surrounds the glomerulus. The interface between glomerulus and capsule is characterized by numerous pores in the capillary and slits in the epithelial capsule, enhancing filtration of blood plasma. Blood enters the glomerulus from the afferent arteriole, a sixth-order branch of the renal artery, and large quantities of fluid filter out of the blood into the capsule, forming a glomerular filtrate. Only water, ions, and small molecules are normally found in the filtrate. Proteins and the various "formed elements" (cells) of the blood do not pass through the glomerular-capsular barrier

except in disease states (one reason why urine tests are valuable in diagnosis).

Each capsule opens into a duct called the *proximal convoluted tubule*, and the filtrate passes into it. Both the capsule and the proximal tubule are located in the cortex. The proximal tubule enters the medulla as the descending segment of the *loop of Henle*. The ascending segment of the loop enters the cortex to become the *distal convoluted tubule*, which then empties into a *collecting duct*.

The efferent arteriole leaving the capsule divides into a network of peritubular capillaries (not shown), which pass around all the parts of the tubule before emptying into a vein that will take the blood out of the kidney. As the filtrate passes through the nephron, approximately 99 percent of it is reabsorbed by the cells in the tubule wall and passed on into the peritubular capillaries. At the same time, various substances are secreted into the filtrate, including hydrogen and ammonium ions to reduce blood acidity. These tubular reabsorptions and secretions are carefully regulated by osmotic and hormonal mechanisms to maintain body homeostasis.

The collecting duct does not function in tubular reabsorption or secretion. It passes through the medulla, joining with others to form a larger collecting duct, which opens at the base of a renal pyramid. Here the urine (no longer called filtrate) is caught by the *minor calyces*, ducted into the *major calyces*, through the renal pelvis, and into the ureter.

Color titles K through M and the related structures. Leave the lumen uncolored.

The *ureters* conduct urine to the urinary bladder. Their epithelial lining is similar to that of the urinary bladder (see below). Smooth muscle, along with fibrous tissue, is found in the walls of the ureters and contributes to the expulsion of urine by peristaltic contractions.

The *urinary bladder* is situated in the front part of the pelvis. It is a fibromuscular sac lined with transitional (stratified, cuboidal) epithelium and has the capacity to distend in response to increasing volumes of urine or to contract in response to decreasing volumes. A tube called the *urethra*, lined with transitional epithelia in the upper portion and stratified columnar epithelia in the lower portion, exits from the base of the bladder and conveys urine to the outside of the body. The urethra is about 4 centimeters long in females but about 20 centimeters in males because of its convoluted course (see Plate 109).