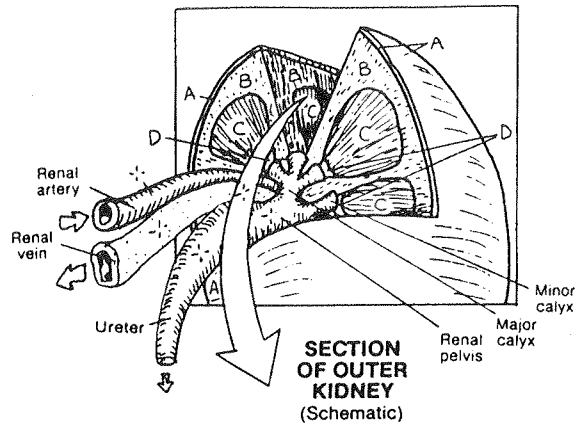


XI. URINARY SYSTEM

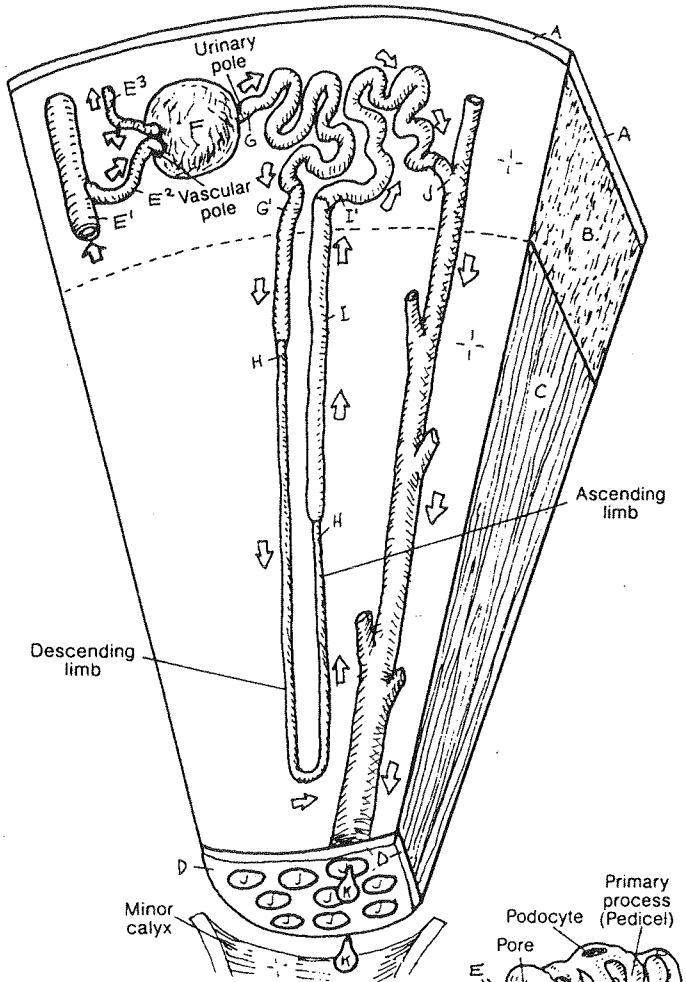
URINIFEROUS TUBULE

CN. Use red for E, yellow for K, and the same colors used on the preceding plate A-D.
(1) Complete the drawing above. (2) In the enlarged wedge-shaped section, one uriniferous tubule is shown; actually, thousands are packed in each such section. Color all directional arrows the color of the adjacent vessel. (3) In the diagram below, color the capsule space gray but not the arrows representing filtrate.



- KIDNEY SECTION: ***
- CAPSULE _A
 - CORTEX _B
 - MEDULLA _C
 - PAPILLA _D

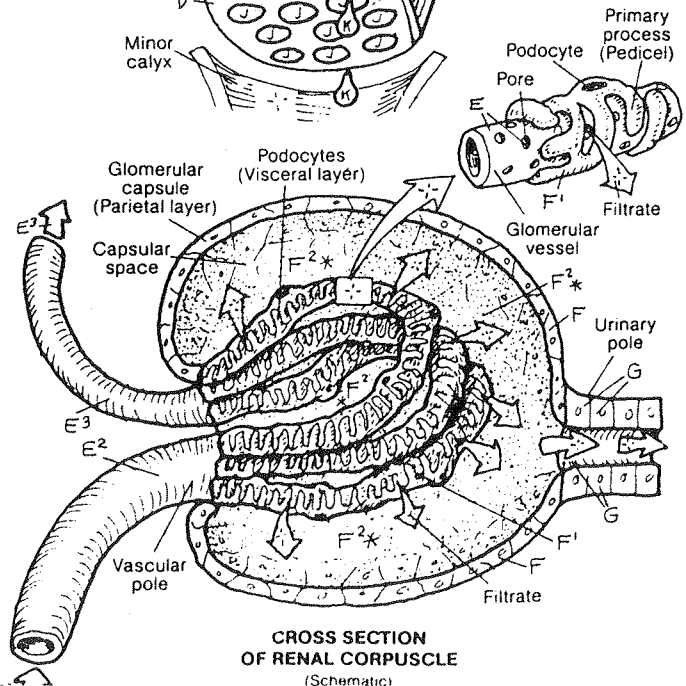
- NEPHRON: :-**
- RENAL CORPUSCLE: ***
- GLOMERULUS _E
 - GLOMERULAR (BOWMAN'S) CAPSULE: _F
 - PARIETAL LAYER _F
 - VISCERAL LAYER (PODOCYTES) _{F¹}
 - CAPSULAR SPACE _{F²*}
- PROXIMAL TUBULE: _G**
- CONVOLUTED PART _G
 - STRAIGHT PART _{G'}
- LOOP OF HENLE _H**
- DISTAL TUBULE: _I
 - STRAIGHT PART _I
 - CONVOLUTED PART _{I¹}
- COLLECTING TUBULE, URINE _K**
- BLOOD VESSELS: ***
- INTERLOBULAR ARTERY _{E¹}
 - AFFERENT ARTERIOLE _{E²}
 - EFFERENT ARTERIOLE _{E³}



The functional unit of the kidney is the nephron (one million per kidney). Each nephron and a collecting tubule constitute a uriniferous (renal) tubule; each nephron consists of a renal corpuscle and tubules leading to a collecting tubule. The renal corpuscles are in the cortex; the tubules are in both the cortex and the medulla. Each corpuscle consists of a glomerular capsule invaginated by a cluster of specialized capillary-like vessels (glomerulus). The vessel leading into each glomerulus is an afferent arteriole, a downstream, 5th-order branch of the renal artery. Its entrance into the capsule is the vascular pole. The efferent arteriole departs the vascular pole, its blood destined for the tubular capillary plexus (next plate).

The capsule is shaped like a soft, rubber, partly flat hollow ball pushed in on one side so that it has an outer and an inner layer to it. The inner layer (of cells) is called the visceral layer; the outer layer the parietal layer; the interior is the capsular space which opens into the proximal tubule (urinary pole). The visceral layer is intimately and complexly interwoven with the glomerular vessels. Each cell in the layer has the shape of a centipede, with a "body" containing the nucleus, and multiple "legs" (cell membrane-lined cytoplasmic extensions called primary processes). These processes completely encircle the glomerular vessels, leaving slits (interdigitations) among the processes. The "legs" have "feet" (called foot or secondary processes) which attach to the porous vessel wall in such a way as to leave filtration spaces among them. These highly modified, simple squamous epithelial cells of the visceral layer are called podocytes. Plasma escapes the glomerular vessel through the pores, then rushes through the filtration slits to enter the capsular space. This non-cellular plasma filtrate enters the proximal tubule.

We continue with the structure and function of the parts of the uriniferous tubule, in conjunction with the vascular system, in the next plate.



RENAL ARTERY_A

RENAL VEIN_B

THE KIDNEY_C

CAPSULE_C

CORTEX_C

MEDULLA_E

RENAL PELVIS_F

URETER_G

URINE_H

BLADDER

THE NEPHRON_J

BOWMAN'S CAPSULE_K

PROXIMAL TUBULE_L

LOOP OF HENLE_M

DISTAL TUBULE_N

COLLECTING DUCT_J

ARTERY_{A'}

ARTERIOLE_{A''}

AFFERENT ARTERIOLE_P

EFFERENT ARTERIOLE_Q

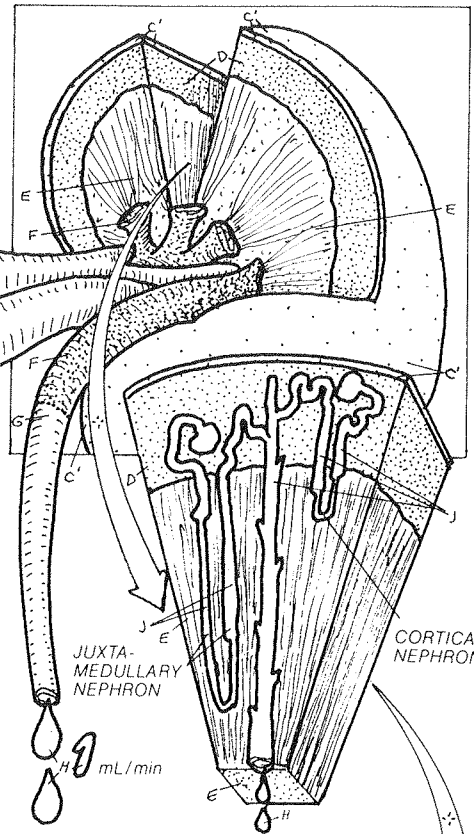
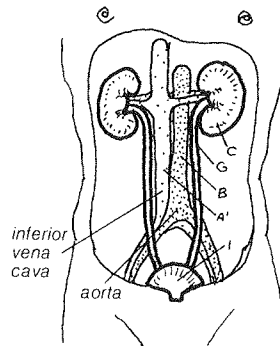
PERITUBULAR CAPILLARY_R

VASA RECTA_{R'}

The kidney fabricates urine from the blood that passes through it. Each minute 1300 mL of blood enter the kidneys through renal arteries, 1299 leave via renal veins, and the difference, 1 mL, leaves as urine.

1300 mL/min

1299 mL/min
(both kidneys)



JUXTA-MEDULLARY NEPHRON

CORTICAL NEPHRON

1 mL/min

Each kidney has about 1 million tubular nephrons; functional units which produce urine from a filtrate of blood. Each nephron contains a filtering part, Bowman's capsule, followed by a long tubular part consisting of: proximal tubule, loop of Henle, distal tubule, and collecting duct. Fluid in Bowman's capsule is protein-free plasma. Fluid at the end of the collecting duct is urine.

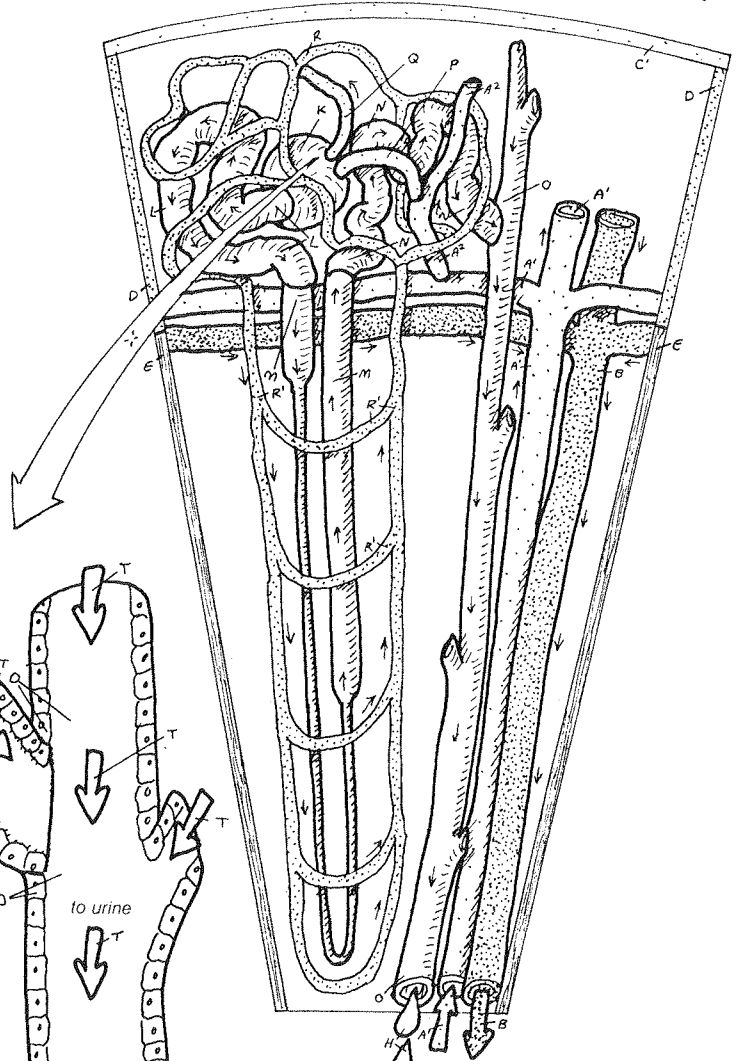
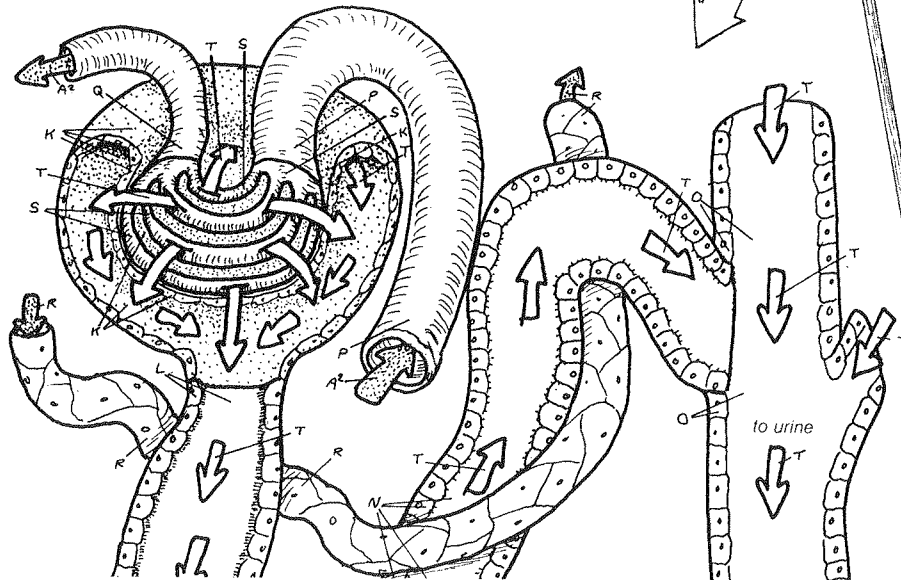
Blood supply to the nephrons (seen on the right) consists of two capillary beds in series. The afferent arteriole conveys blood to the glomerulus (seen below) lying in Bowman's capsule. Blood then flows through the efferent arteriole, and empties into the peritubular capillaries to supply the proximal and distal tubules in the cortex. The medulla is supplied by branches of the efferent arteriole from juxtamedullary nephrons. These branches, the vasa recta, plunge into the medulla and following the loop of Henle, make hairpin turns and return to the cortex.

GLOMERULUS_S

FILTRATE_T

BOWMAN'S CAPSULE_K

Fluid filters through the glomerulus into Bowman's capsule of the nephron. The filtrate then continues through the tubules on its way to the collecting duct. During this process, nutrients and most of the fluid are withdrawn; and the composition of the remaining fluid is further modified until it becomes urine at the end of the collecting duct.



to urine