kidney in Canine, Feline, and Ovine(sheep)

These species all have similar renal anatomy. Their kidneys are relatively short and thick and they are the traditional kidney bean shape. They have a smooth outer surface and have a single renal papilla. The renal pelvis is large and irregular with finger like processes. The kidney of the feline is relatively bigger than the other species and is quite distinctive because the sub-capsular veins which run towards the hilum are visible

Bovine

The kidneys of the bovine do not lose their foetal lobulation. In fact the surface of each kidney is divided into approximately 12 lobules. The right kidney is flattened and ellipsoidal where as the left kidney is thicker at the caudal end than the cranial. Each kidney is surrounded by the capsula adiposa; a layer of fat.. The bovine kidney has no renal pelvis but rather the Ureters enters the kidney and divide into a cranial and caudal branch. These branches then subdivide and the papilla at the apex of the pyramids open and drain into these.

The right ureter leaves the kidney and passes along the roof of the abdomen to the pelvis in a fairly standard pattern. The left ureter however moves across the dorsal surface of its kidney to return to the midline and follow a course as if the kidney was located on the left. (both kidneys in the bovine are located on the right

Porcine (pig)

The kidneys are flattened and the renal pelvis opens into quite a large space of two major calicyes from which bud about 10 minor calyces. These attach to one renal papillae each. The kidneys have a smooth surface.

Equine

The equine kidneys not only have very different shapes compared to the rest of the domestic species but they also each have a different shape. The right kidney is described as heart shaped whilst the left is described as being pyramidal. Each organ weighs approximately 700g and both are flattened. The kidneys are basically unipyramidal and the only demarcation between what were the multiple pyramids of the foetus are the interlobar arteries.. The horse has a single renal papilla like the dog and its renal pelvis is large and irregular with 2 recesses (finger like processes). The cells of its pelvis secret mucin giving the urine its cloudy appearance .

Avian

Avian kidneys are characterized by having two major nephron types, reptilian and mammalian. The reptilian type nephrons are located in the cortex and lack loops of Henle An intermediate segment that connects the proximal and distal tubules and which is believed to represent a primitive nephron loop has been described. Reptilian-type nephrons are not capable of concentrating urine . The mammalian-type nephrons have well-defined loops of Henle that are grouped into a medullary cone , the part of the lobule that corresponds to the stem of a mushroom. Other structures in the medullary cone are collecting ducts and vasa recta, all of which enter at the wider cortical end of the cone.

Nephron Is the Functional Unit of the Kidney

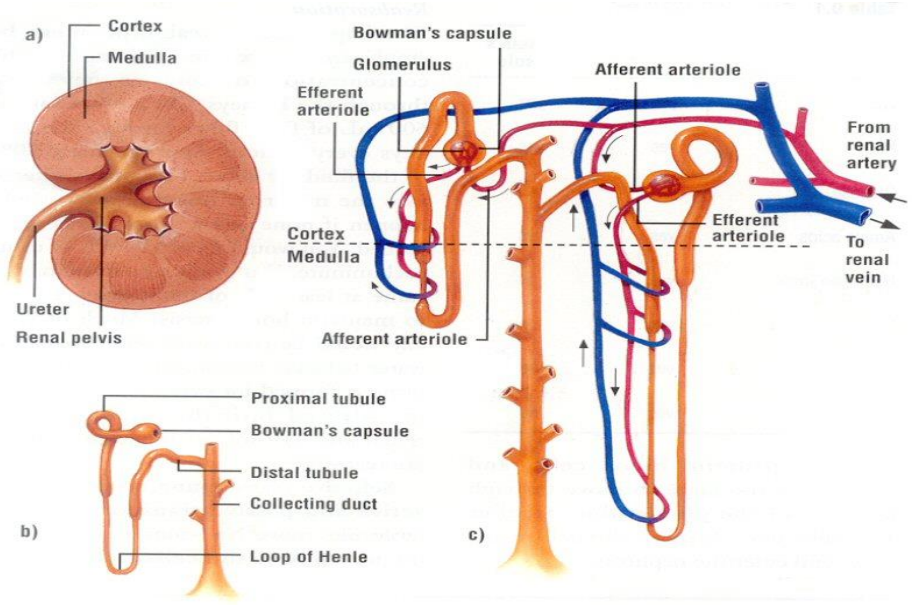
Each kidney in the human contains about 1 million nephrons, each capable of forming urine. The kidney cannot regenerate new nephrons. Therefore, with renal injury, disease, or normal aging, there is a gradual decrease in nephron number. After age 40, the number of functioning nephrons usually decreases about 10 per cent every 10 years; thus, at age 80, many people
have 40 per cent fewer functioning nephrons than they did at age 40. Each nephron contains

(1) a tuft of glomerular capillaries called the glomerulus, through which large amounts of fluid are filtered from the blood, and

(2) a long tubule in which the filtered fluid is converted into urine on its way to the pelvis of the kidney

The glomerulus contains a network of branching and anastomosing glomerular capillaries that, compared with other capillaries, have high hydrostatic pressure (about 60 mm Hg). The glomerular capillaries are covered by epithelial cells, and the total glomerulus is encased in Bowman's capsule. Fluid filtered from the glomerular capillaries flows into Bowman's capsule and then into the **proximal tubule**, which lies in the cortex of the kidney , From the proximal tubule, fluid flows into the loop of Henle, which dips into the renal medulla. Each loop consists of a descending and an ascending limb. The walls of the descending limb and the lower end of the
ascending limb are very thin and therefore are called the thin segment of the loop of Henle. After the ascending limb of the loop has returned partway back to the cortex, its wall becomes much thicker, and it is referred to as the thick segment of the ascending limb. At the end of the thick ascending limb is a short segment, which is actually a plaque in its wall, known as the macula densa. the macula densa plays an important role in controlling nephron function. Beyond the macula densa, fluid

enters the **distal tubule**, which, like the proximal tubule, lies in the renal cortex. This is followed by the connecting tubule and the cortical collecting tubule, which lead to the cortical collecting duct. The initial parts of 8 to 10 cortical collecting ducts join to form a single larger **collecting duct** that runs downward into the medulla and becomes the medullary collecting duct. The collecting ducts merge to form progressively larger ducts that eventually empty into the renal pelvis through the tips of the renal papillae. In each kidney, there are about 250 of the very large collecting ducts, each of which collects urine from about 4000 nephrons.



juxtaglomerular apparatus (JGA) -

A specialized collection of two cell types, macula densa cells and juxtaglomerular cells, located at the juncture of the afferent and efferent arterioles with a portion of the distal convoluted tubule of the nephron of the kidney; the two cell types participate in the negative feedback regulation of

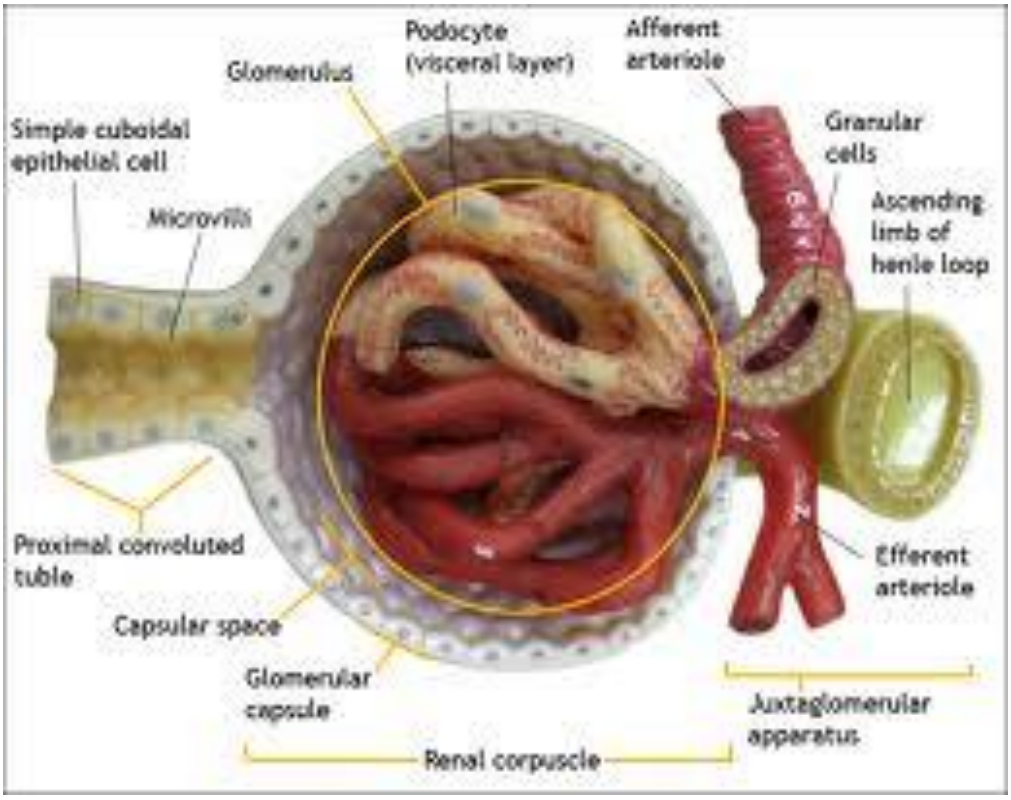
(1) systemic blood pressure and blood volume via the renin-angiotensin system,

(2) local control of glomerular filtration rate (GFR), i.e., "tubuloglomerular feedback," by nitric oxide (NO) production,

(3) hematopoiesis via the production of erythropoietin by cells of the peritubular capillary endothelium of the kidney.

macula densa cells - Specialized chemoreceptor cells in the wall of the distal convoluted tubule at the JGA of the nephron of the kidney which respond to changes in solute concentration (especially sodium levels) in the urine in the distal convoluted tubule and to oxygen levels in the blood passing to the glomerulus; this sensory information is conveyed to the juxtaglomerular cells which will adjust their output of renin accordingly.

juxtaglomerular cells - Specialized smooth muscle cells which act as mechanoreceptors which stretch in response to increases in the blood pressure of the afferent arteriole; they also synthesize and secrete the enzyme renin which serves to activate the inactive precursor, angiotensinogen (made by the liver), into angiotensin I; renin secretion is increased by a fall in plasma Na^+ concentration, and by prostaglandins, sympathetic ANS activity, circulating epinephrine and a decrease in afferent arteriolar blood pressure; renin secretion is decreased by a rise in plasma Cl^- concentration, angiotensin II, ADH (antidiurectic hormone) and increased blood pressure.



renin-angiotensin-aldosterone system

Renin a proteolytic enzyme synthesized, stored, and secreted by the juxtaglomerular cells of the kidney; it plays a role in regulation of blood pressure by catalyzing the conversion of the plasma glycoprotein angiotensinogen to angiotensin I. This, in turn, is converted to angiotensin II by an enzyme that is present in relatively high concentrations in the lung. Angiotensin II is one of the most potent vasoconstrictors known, and also is a powerful stimulus of aldosterone secretion ,angiotensin acts directly on the kidneys to cause salt and water retention, which causes a long-term increase in arterial blood pressure