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DEPARTMENT: PHYSIOLOGY

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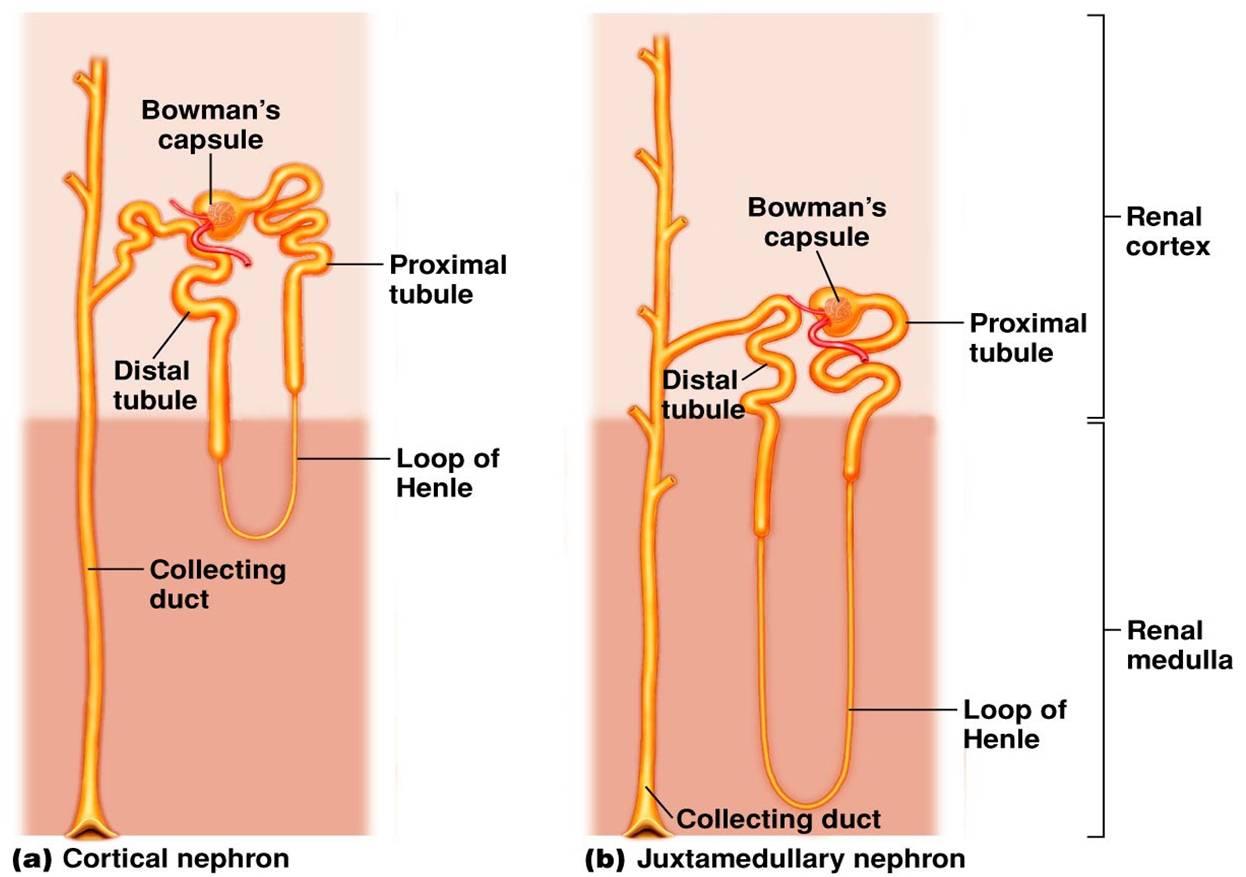
ANA 204 ASSIGNMENT

QUESTION 1: Critically examine the renal function of desert dwellers and the anatomical basis of their unique adaptation.

**The nephrons in desert mammal Camel**

**The nephrons in desert mammal Camel are equipped with well developed Henle's loop and number of juxtamedullary nephrons in kidneys is very high, about 35% (in man this number is about 15%).**

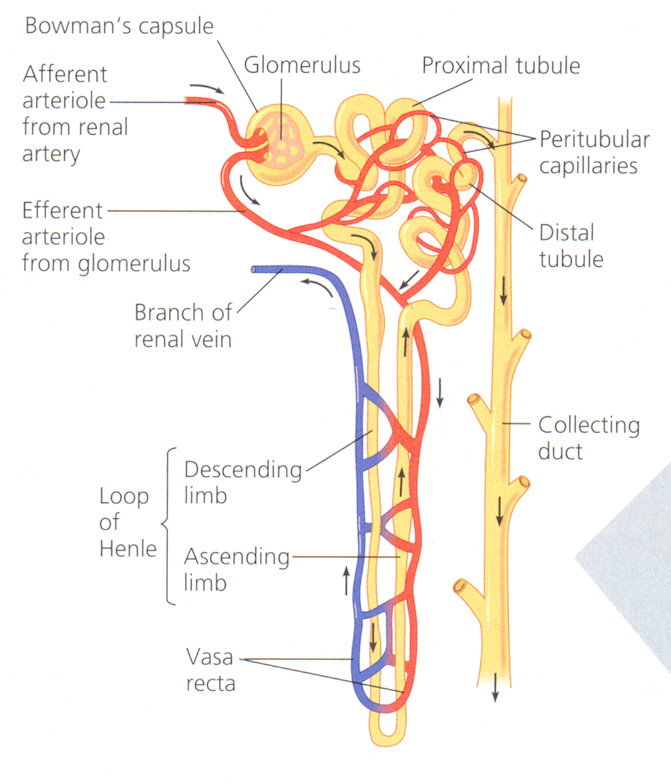
Desert mammals do not readily find water; hence they must excrete very less amount of water. They are able to produce highly concentrated urine.



From the accompanying diagram you would be able to see that the Henle's loop of juxtamedullary

(adjacent to medulla of kidney) nephron goes deep down into the medulla. This is why medulla of camel's kidney is thicker than that of other mammals, but it is most well developed in another desert mammal, the kangaroo rats.

The Henle's loops of juxtamedullary nephrons along with counter flowing blood vessels, called vasa recta, help in conservation of water.



Blood first flows along ascending limb of Henle, which is impermeable to water. Solutes can leave the filtrate and enter the blood along this stretch. When this blood flows along descending limb, water is reabsorbed from filtrate but not the solutes. Longer the Henle's loop, more amount of solute will be reabsorbed and hence more amount of water could be removed from filtrate.

### QUESTION 2: Write extensively on the clinical importance of the glomerular filtration barrier.

### **Glomerular Filtration Barrier**

### **Pathophysiology/Pathogenesis**

The glomerular filtration barrier functions as a highly organized, semipermeable membrane preventing the passage of the majority of proteins into the urine. The [glomerular filtration barrier](https://www.sciencedirect.com/topics/immunology-and-microbiology/glomerular-filtration-barrier" \o "Learn more about Glomerular Filtration Barrier from ScienceDirect's AI-generated Topic Pages) consists of the fenestrated [endothelium](https://www.sciencedirect.com/topics/immunology-and-microbiology/endothelium" \o "Learn more about Endothelium from ScienceDirect's AI-generated Topic Pages), the [glomerular basement membrane](https://www.sciencedirect.com/topics/immunology-and-microbiology/glomerulus-basement-membrane" \o "Learn more about Glomerulus Basement Membrane from ScienceDirect's AI-generated Topic Pages), and the podocyte foot processes, which are connected by a slit-diaphragm. The filtration barrier normally acts to retain protein inside the lumen of the capillaries separate from the urinary space; however, defects in the [podocytes](https://www.sciencedirect.com/topics/immunology-and-microbiology/podocyte" \o "Learn more about Podocyte from ScienceDirect's AI-generated Topic Pages) affecting the feet, tight junction (podocin, nephrin), and the slit diaphragm signalling, actin [cytoskeleton](https://www.sciencedirect.com/topics/immunology-and-microbiology/cytoskeleton" \o "Learn more about Cytoskeleton from ScienceDirect's AI-generated Topic Pages), and cell matrix interactions have been identified in causing a breakdown of this barrier.

The [glomerular filtration barrier](https://www.sciencedirect.com/topics/medicine-and-dentistry/glomerular-filtration-barrier" \o "Learn more about Glomerular Filtration Barrier from ScienceDirect's AI-generated Topic Pages) has several layers.

The first is a [glycocalyx](https://www.sciencedirect.com/topics/medicine-and-dentistry/glycocalyx" \o "Learn more about Glycocalyx from ScienceDirect's AI-generated Topic Pages) made up of [proteoglycans](https://www.sciencedirect.com/topics/medicine-and-dentistry/proteoglycan" \o "Learn more about Proteoglycan from ScienceDirect's AI-generated Topic Pages) and an adsorbed layer of [plasma proteins](https://www.sciencedirect.com/topics/medicine-and-dentistry/blood-proteins" \o "Learn more about Blood Proteins from ScienceDirect's AI-generated Topic Pages) that is located between the [endothelial cells](https://www.sciencedirect.com/topics/medicine-and-dentistry/endothelial-cell" \o "Learn more about Endothelial Cell from ScienceDirect's AI-generated Topic Pages) and the capillary lumen.

Fenestrated endothelial cells form the next layer. Next is the thick [glomerular basement membrane](https://www.sciencedirect.com/topics/medicine-and-dentistry/glomerulus-basement-membrane" \o "Learn more about Glomerulus Basement Membrane from ScienceDirect's AI-generated Topic Pages) (GBM), which is synthesized by [podocytes](https://www.sciencedirect.com/topics/medicine-and-dentistry/podocyte" \o "Learn more about Podocyte from ScienceDirect's AI-generated Topic Pages) and endothelial cells and has an inner layer composed of [collagen type IV](https://www.sciencedirect.com/topics/medicine-and-dentistry/collagen-type-4" \o "Learn more about Collagen Type 4 from ScienceDirect's AI-generated Topic Pages) and [laminin](https://www.sciencedirect.com/topics/medicine-and-dentistry/laminin" \o "Learn more about Laminin from ScienceDirect's AI-generated Topic Pages) sandwiched between layers of heparin sulphate. Podocyte foot processes line the epithelial side of the GBM; the [intercellular junctions](https://www.sciencedirect.com/topics/medicine-and-dentistry/cell-junction" \o "Learn more about Cell Junction from ScienceDirect's AI-generated Topic Pages) between adjacent foot processes are closed by the slit diaphragm, a specialized intercellular junction that acts as a molecular sieve and the final component of the filtration barrier. The slit diaphragm comprises several proteins, including [nephrin](https://www.sciencedirect.com/topics/medicine-and-dentistry/nephrin" \o "Learn more about Nephrin from ScienceDirect's AI-generated Topic Pages), CD-associated protein (CD2AP), [podocin](https://www.sciencedirect.com/topics/medicine-and-dentistry/podocin" \o "Learn more about Podocin from ScienceDirect's AI-generated Topic Pages), the [tight junction protein ZO-1](https://www.sciencedirect.com/topics/medicine-and-dentistry/protein-zo1" \o "Learn more about Protein ZO1 from ScienceDirect's AI-generated Topic Pages) (zonula occludens 1), [P-cadherin](https://www.sciencedirect.com/topics/medicine-and-dentistry/p-cadherin" \o "Learn more about P Cadherin from ScienceDirect's AI-generated Topic Pages), [catenins](https://www.sciencedirect.com/topics/medicine-and-dentistry/catenin" \o "Learn more about Catenin from ScienceDirect's AI-generated Topic Pages), and the [calcium channel](https://www.sciencedirect.com/topics/medicine-and-dentistry/calcium-channel" \o "Learn more about Calcium Channel from ScienceDirect's AI-generated Topic Pages) [TRPC6](https://www.sciencedirect.com/topics/medicine-and-dentistry/trpc6" \o "Learn more about TRPC6 from ScienceDirect's AI-generated Topic Pages) (transient receptor potential cation channel, subfamily C, member 6), each of which is required for slit diaphragm integrity. Slit diaphragm proteins are supported by the highly dynamic [podocyte](https://www.sciencedirect.com/topics/medicine-and-dentistry/podocyte" \o "Learn more about Podocyte from ScienceDirect's AI-generated Topic Pages) [actin](https://www.sciencedirect.com/topics/medicine-and-dentistry/actin" \o "Learn more about Actin from ScienceDirect's AI-generated Topic Pages) [cytoskeleton](https://www.sciencedirect.com/topics/medicine-and-dentistry/cytoskeleton" \o "Learn more about Cytoskeleton from ScienceDirect's AI-generated Topic Pages) that in turn is anchored to an [integrin](https://www.sciencedirect.com/topics/medicine-and-dentistry/integrin" \o "Learn more about Integrin from ScienceDirect's AI-generated Topic Pages) complex that fastens each podocyte foot process to the GBM.

**GLOMERULAR FILTRATION AND REMAN BLOOD FLOW**

### Determinants of Ultra Filtrate Composition

The [glomerular filtration](https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/glomerulus-filtration" \o "Learn more about Glomerulus Filtration from ScienceDirect's AI-generated Topic Pages) barrier determines the composition of the plasma ultra filtrate. It restricts the filtration of molecules primarily on the basis of size. In general, molecules with a radius smaller than 20 Å are filtered freely, molecules larger than 42 Å are not filtered, and molecules between 20 and 42 Å are filtered to various degrees. For example, serum [albumin](https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/albumin" \o "Learn more about Albumin from ScienceDirect's AI-generated Topic Pages), an anionic protein that has an effective molecular radius of 35.5 Å, is filtered poorly. Because the filtered albumin and other small proteins normally are reabsorbed avidly by the proximal tubule, almost no protein appears in the urine of persons with normal [renal function](https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/kidney-function" \o "Learn more about Kidney Function from ScienceDirect's AI-generated Topic Pages).