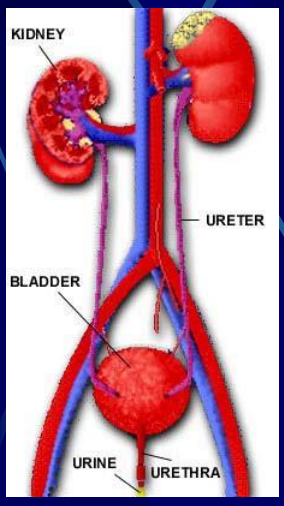
THE URINARY SYSTEM

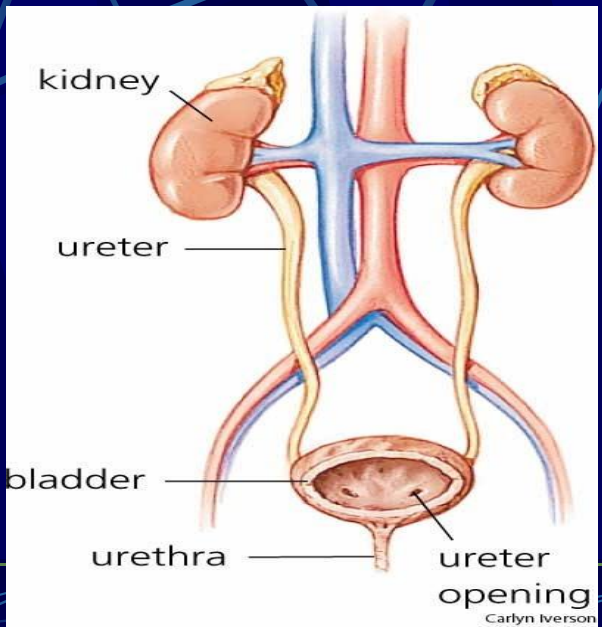


Dr P. C, Sianangama
Department of Animal Science
School of Agricultural Sciences
The University of Zambia

FUNCTIONS OF THE URINARY SYSTEM

- 1. Excretion – removing nitrogenous wastes, certain salts, and excess water from blood
- 2. Maintain acid-base balance
- 3. Secrete waste products in the form of urine
- Eliminate urine from the urinary bladder

Urinary System Anatomy



Urinary System Anatomy

- Major Organs/Parts Include
  - Kidneys
    - blood passes through and waste products and water are removed
    - urine is the combination of this liquid and waste products
  - Ureters
    - the liquid (urine) from the kidneys travel through tube-like structures called ureters to the urinary bladder
  - Urinary Bladder
    - stores urine
  - Urethra
    - tube-like structure that excretes the urine waste

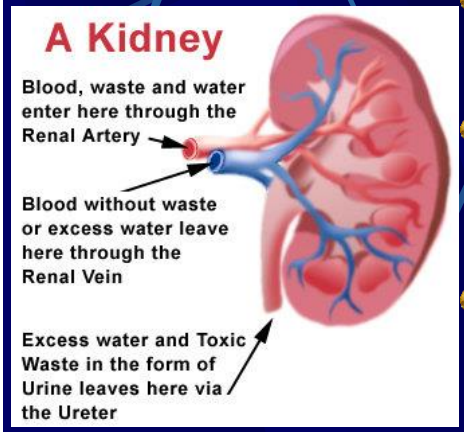
Urinary System Physiology

- Blood in the animal's body passes through the kidneys
  - Waste products are removed and water is collected to form liquid waste (urine)
- Urine containing the waste products travels through the ureters to the urinary bladder
- Urine is stored in the urinary bladder
- Urethra
  - excretes urine

KIDNEYS

- 2 bean shaped organs that are about 10.16 cm long by 5.08 – 7.62 cm wide by 2.54 cm thick.
- Left is slightly larger and higher
- Located between peritoneum and the back muscles – are protected by the lower ribs (RETROPERITONEAL)
- HILUM – indentation along concave medial border is where the lymph vessels, nerves, blood vessels, and ureter enter the kidney

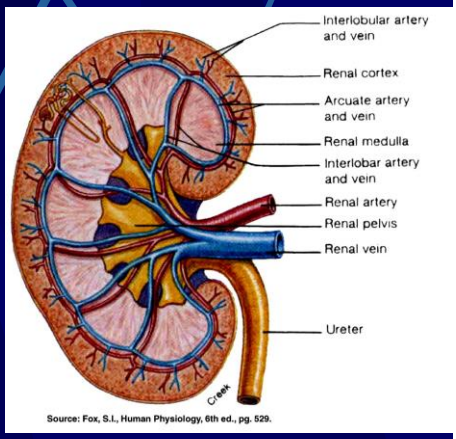
BLOOD SUPPLY TO THE KIDNEY



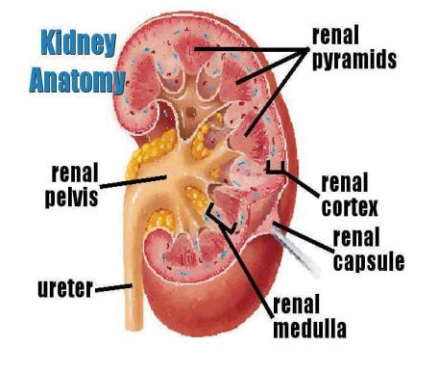
- Blood brought to kidney the renal artery – branch off the aorta
- Renal artery subdivides into smaller branches which make contact with nephrons
- Blood leaves via the renal vein which connects to inferior vena cava

STRUCTURE OF THE KIDNEY

- Kidney is divided into 2 regions:
- ***Renal cortex*** is the outer portion of the kidney
- ***Renal Medulla*** contains the tubes in which urine is formed and collected



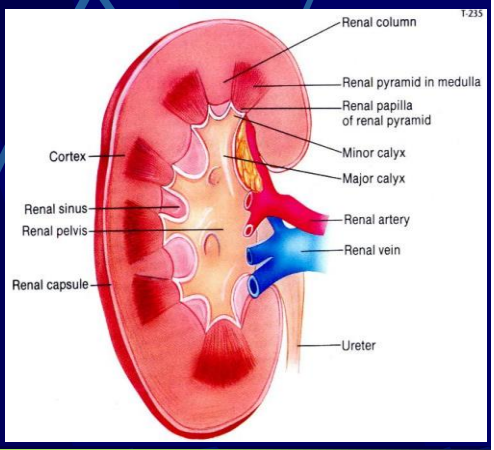
KIDNEY STRUCTURE (continued)



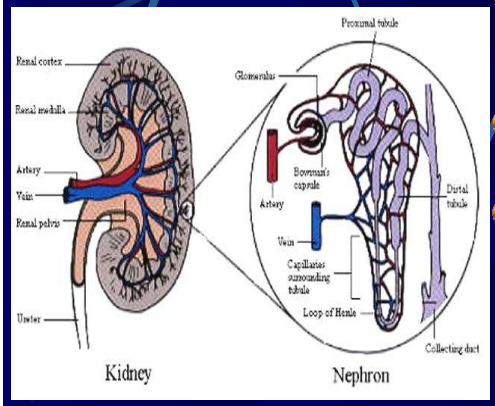
- Tubes in the medulla form a number of cone-shaped structures call ***renal pyramids***
- Tips of pyramids point toward the ***renal pelvis –*** a funnel shaped basin that forms the upper end of the ureter

KIDNEY STRUCTURE (continued)

- The base of each renal pyramid faces cortex, while apex empties into cuplike cavities (***calyces)*** which collect urine
- Urine that collects in the pelvis, then passes down the ureters to the urinary bladder.

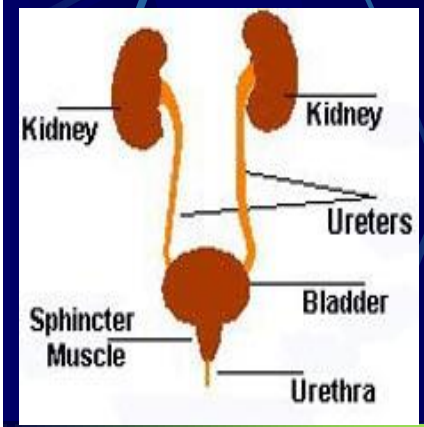


NEPHRON



- Functional unit of kidney - urine making units.
- 1 million microscopic units per kidney
- They purify blood by removing waste substances and also control the amount of water and salt in blood

URETERS

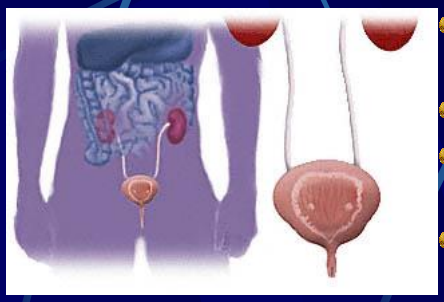


- One tube from each kidney (38.1 to 45.7 cm long)
- Carry urine from renal pelvis of kidney to bladder
- 2.54 cm of the ureter enters the bladder at an angle
- A full bladder compresses the ureter and prevents the backflow of urine
- Smooth muscle tube with mucus membrane lining

URETERS (continued)

- Urine enters the ureters every 10 to 30 seconds in spurts due to peristaltic movement and gravity

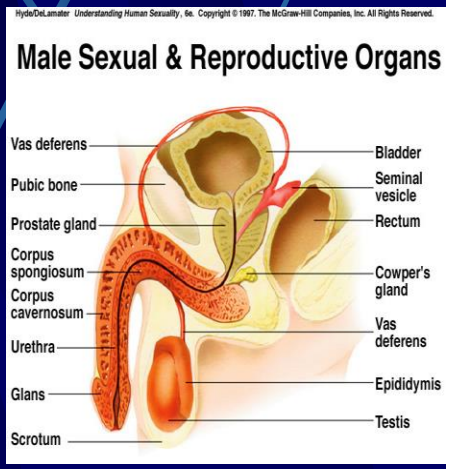
URINARY BLADDER



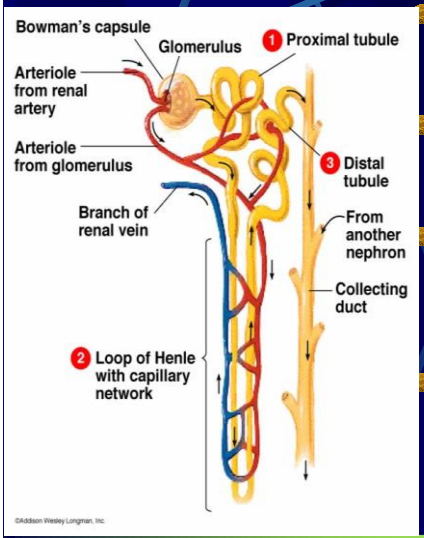
- Muscular sac that receives and stores urine
- Made of elastic fibers and involuntary muscle
- Lines with rugae
- Stores urine – usually about 500 cc
- Emptying urine (voiding) is involuntary but controlled through nervous system (voluntary)
- **Micturate** – empty bladder (void, urinate.)

URETHRA

- Canal for the excretion of urine from the body.
- Urine leaves through URETHRA to outside opening – URINARY MEATUS
- Female – 2.54 to 3.81 cm long; (urinary or urethral meatus) located between the clitoris and the vagina
- Male – 20.32 cm long, passes from the urinary bladder through the prostate gland and the penis to the meatus located at the end of the penis – carries both urine and semen



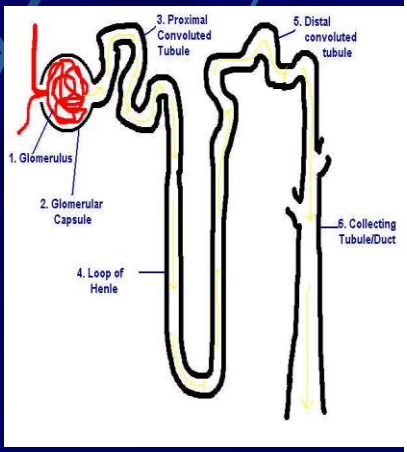
NEPHRON



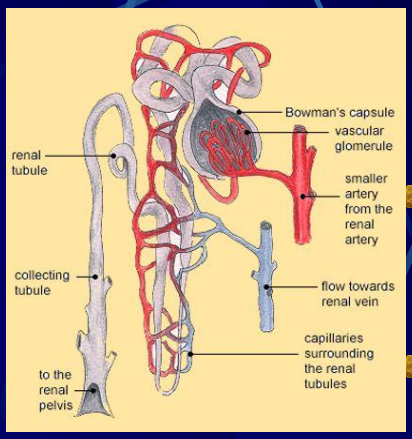
- Renal corpuscle is subdivided into Bowman's capsule and the glomerulus
- Bowman's capsule – cup-shaped top of the nephron that surrounds the glomerulus
- Blood flows into the glomerulus through the afferent arterioles and leaves the glomerulus through the efferent arterioles
- In the Glomerulus the high-pressure, leaky capillaries ooze a fluid (glomerular filtrate) similar to blood plasma minus most proteins

NEPHRON (continued)

- Next 4 segments are known as the renal tubule
- Proximal convoluted tubule – filtrate flows here where the majority of reabsorption takes place via active transport
- Next is the Loop of Henle - note it consists of a straight descending limb, a hairpin loop, and a straight ascending limb
- The Distal Convoluted tubule is a major site of secretion of ions (potassium)



NEPHRON (continued)



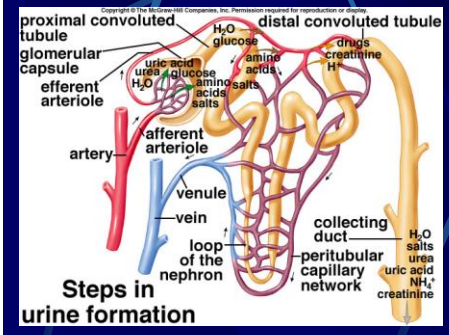
- Collecting tubule – straight part of the renal tubule Urine from the collecting tubules exits from the pyramids and enter the calyces and renal pelvic.
- The renal corpuscles and both proximal and distal convoluted tubules are in the cortex of the kidney
- The medulla contains the loop of Henle and collecting tubules.

URINE FORMATION IN THE NEPRON

- 1 – Filtration
- 2 – Reabsorption
- 3 – Secretion.

4 - Excretion

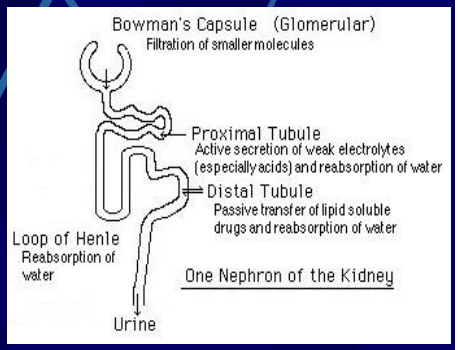
FILTRATION



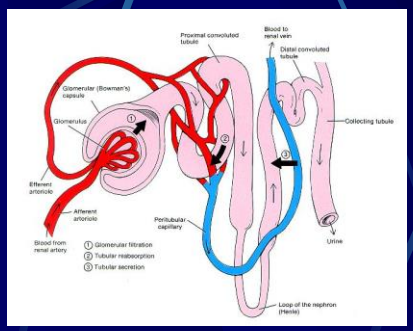
- First step in urine formation
- Blood from renal artery enters glomerulus
- High blood pressure in glomerulus forces fluid (FILTRATE) to filter into Bowman's capsule
- Filtrate does not contain plasma proteins or RBCs – they're too big
- Bowman's capsule filters out 125cc of fluid/min – 7500 cc/hr - 180 liters/day
- As filtrate continues through nephron, 90% of water is reabsorbed.

REABSORPTION

- H_20 and useful substances are reabsorbed (moves substances out of the urine into the blood)
- Begins in the proximal convoluted tubules and continues in the loop of Henle, distal convoluted tubules, and collecting tubules
- If blood levels of certain substances are high (glucose, amino acids, vitamins, sodium) then those substances will not be reabsorbed (THRESHOLD)



SECRETION

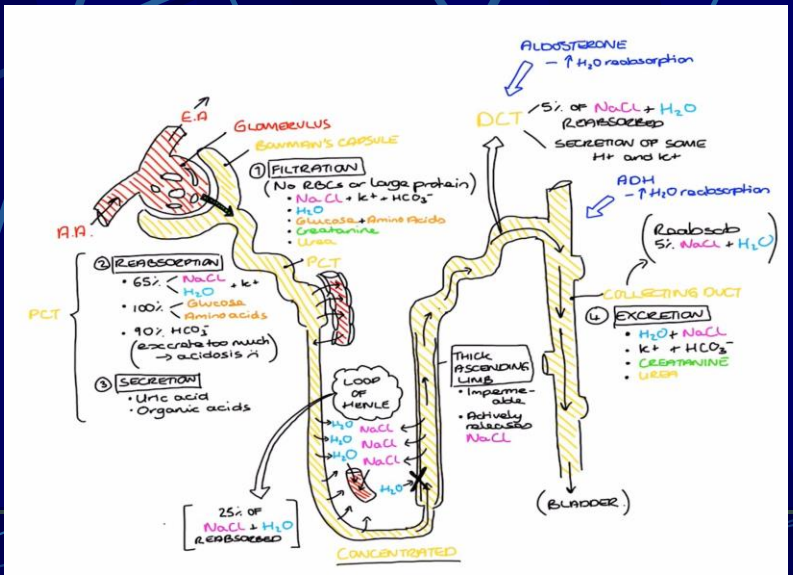


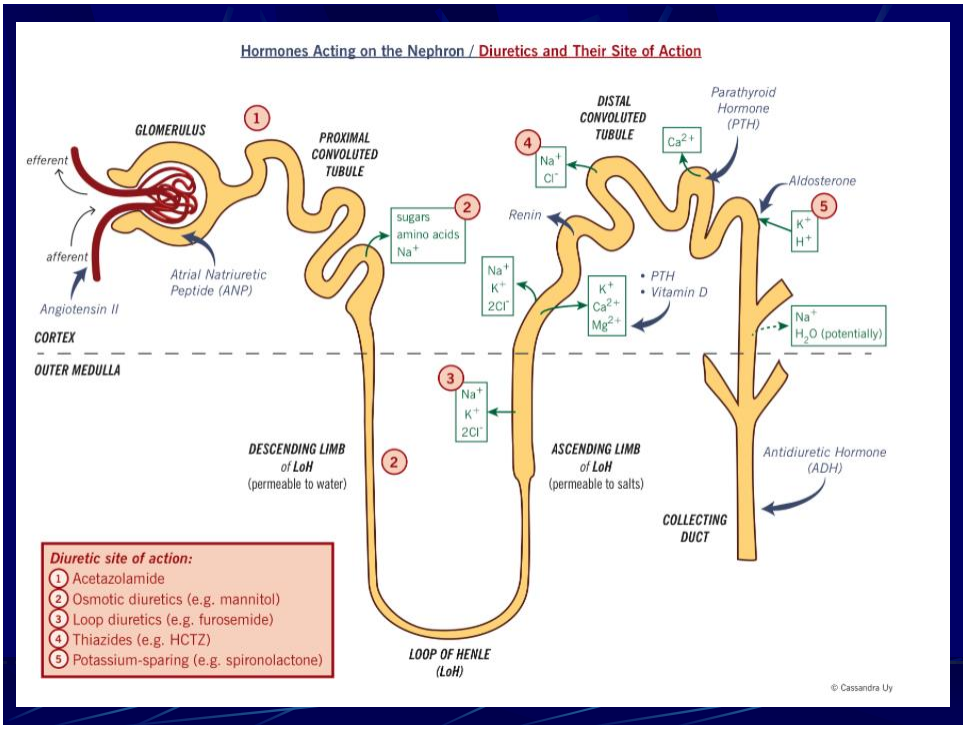
- Opposite of reabsorption – (moves substances out of the blood into the urine)
- Secretion transports substances from blood into collecting tubules
- Substances include creatinine, hydrogen ions, potassium ions, and some drugs
- Electrolytes are selectively secreted to maintain acid-base balance

URINARY OUTPUT

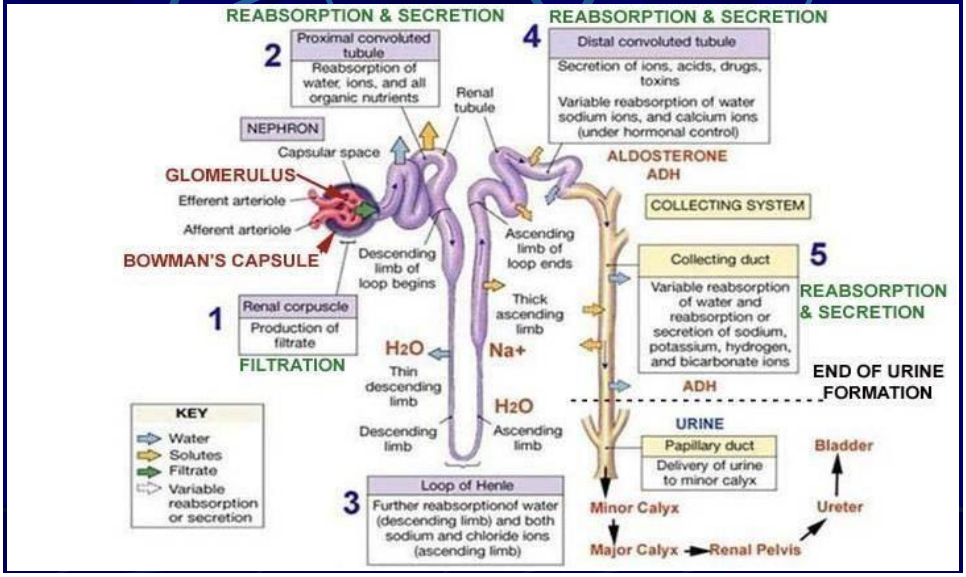
- Average urine output = 1500 ml/day
- Anuria – absence of urine
- Oliguria – scanty amounts of urine
- Polyuria – an unusually large amount of urine
- Nocturia – frequent urination at night

Nephron Functions





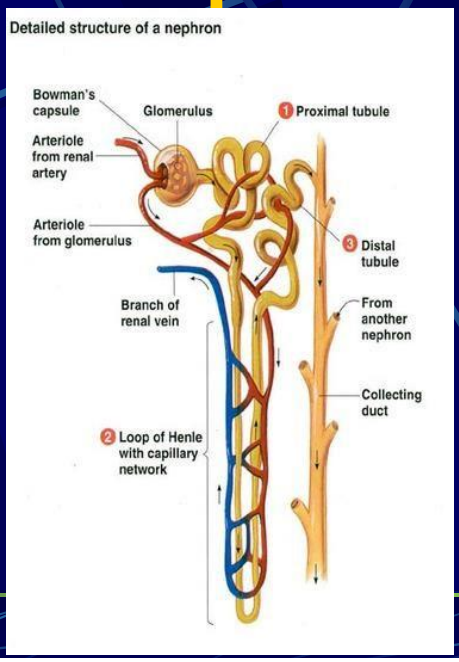
Nephron Components and Function



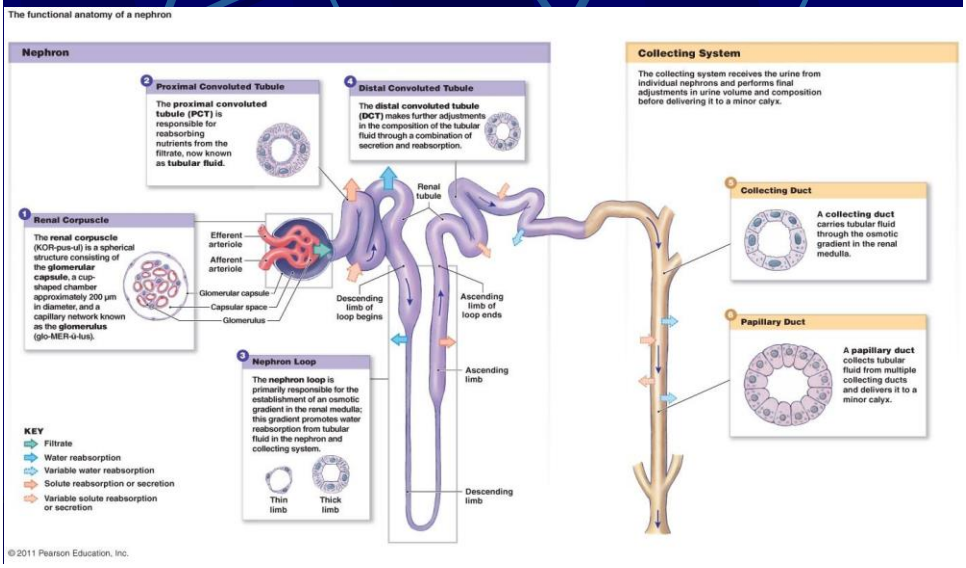
Urinary System Anatomy

- Poultry
  - Do not have a urinary bladder or urethra
    - ureters are directly connected to the cloaca
      - where solid and liquid wastes are excreted

Nephron



Functional Nephron



Nephron at work