

## The Kidneys and Urinary System

Function: Maintain constancy of the extracellular fluid (ECF)  
(2/3 of our fluid is intracellular, 1/3 is extracellular - small compartment, susceptible to fluctuations. Of the ECF 1/4 is plasma and 3/4 interstitial fluid.)

The kidneys perform a variety of functions that serve to maintain constancy in the ECF:

1. osmolarity
2. volume of the ECF (critical for blood pressure maintenance)
3. electrolyte composition of the ECF (including acid/base balance)
4. waste removal (obligatory water loss = 0.5 liters per day, if urine was isoosmotic it would take 3.5 liters to eliminate the waste accumulated in one day)

The kidneys performs its functions by **filtering** all blood, forming an ultrafiltrate similar to interstitial fluid. Then it uses a combination of active transport/passive diffusion and different permeabilities of segments of the kidney tubules to **reabsorb** critical electrolytes and water while **secreting** other chemicals in the formation of final urine. Hormones such as ADH and aldosterone as well as neuronal inputs help regulate the process.

### Structure of kidney

renal capsule, renal cortex, renal medulla, renal pelvis, ureter, renal artery and vein, renal pyramids, renal columns, renal papilla, minor and major calyces, nephron, collecting duct.

nephron anatomy: Bowman's capsule (glomerular capsule); proximal convoluted tubule; loop of Henle: descending thin limb, ascending thin and thick limbs; distal convoluted tubule, afferent and efferent arterioles; glomerulus, peritubular capillaries, and vasa recta.

### Filtration

Due to large pores (**fenestrae**) the glomerular endothelium is 100x more permeable than other capillary beds. **Freely filtered**: amino acids, glucose, bicarbonate, phosphate, sodium, potassium

Pores do not let large proteins or blood cells pass. (20% of plasma entering glomerulus stays as filtrate)

180L/day of ultrafiltrate that is isotonic to plasma is formed and enters the proximal convoluted tubule. Normally we reabsorb 99% of this. This is fortunate since the entire body only contains about 42 liters of water.

Nephron Segment	Activity
Bowman's capsule	filtration due to positive pressure
proximal convoluted tubule	reabsorption 65% of Na and water, 100% glucose, 100% amino acids
descending thin limb of the loop of Henle	reabsorption (20% of water)
ascending loop of Henle: thin limb & thick limb	sodium reabsorbed
distal convoluted tubule	reabsorption of sodium & secretion of potassium no water movement
collecting duct	water and urea reabsorbed (water movement controlled by ADH)