

Nephron Physiology and Urine Formation

1. FILTRATION, and it occurs at the renal corpuscle.

Glomerular filtration rate (GFR) is held steady at 125 mL/min (180L/day). Ah, you say, but you don't pee 180 L/day. Right, because ~99% of that filtrate is REABSORBED. Only 1.5 L of urine is produced daily. That is equivalent to 1 mL urine/minute produced by the kidneys.

2. REABSORPTION. Reabsorption is the passage of a substance from the lumen of the tubules through the tubule cells and into the capillaries. This process can involve passive or active transport.

3. SECRETION. Secretion is the passage of a substance from the capillaries through the tubular cells into the lumen of the tubule.

Component	Function
Glomerulus	Selective filtration
Proximal convoluted tubule (PCT)	Reabsorption of 80% of electrolytes and water; reabsorption of all glucose and amino acids; reabsorption of HCO ₃ ⁻ ; secretion of H ⁺ and creatinine
Loop of Henle	reabsorption of water in descending loop; Reabsorption of Na ⁺ and Cl ⁻ in ascending limb; concentration of filtrate
Distal convoluted tubule (DCT)	Secretion of K ⁺ , H ⁺ , ammonia; reabsorption of water (regulated by ADH); reabsorption of HCO ₃ ⁻ ; regulation of Ca ²⁺ and PO ₄ ²⁻ by parathyroid hormone, reabsorption of Na ⁺ (regulated by aldosterone)
Collecting duct	Reabsorption of water (ADH required)

Concentration of the Urine:

*Accomplished by the Loop of Henle and hormonal influences on the DCT and the collecting ducts.

*Descending limb is permeable to water, ascending limb is impermeable to water

- Water is reabsorbed in descending limb (concentrates urine)
- Salt is actively reabsorbed in the ascending limb (establishes ability to concentrate even further)

*Distal convoluted tubule reabsorbs even more salt (under the influence of aldosterone, a hormone released from the adrenal cortex.

*The collecting duct reabsorbs water (under the influence of antidiuretic hormone, released from the posterior pituitary gland)

Key Terms:

Transport Maximum: The maximal amount of a substance that the kidney tubules can reabsorb. For example, under normal circumstances ALL amino acids and ALL glucose are reabsorbed in the PCT. However, if there are particularly high amounts in the bloodstream, the tubules are unable to reabsorb the large amounts of the substance. This is a notable problem in diabetes, when a patient has high blood glucose.

Renal Clearance: The amount of a substance that "clears" the kidneys (ie. Shows up in the urine) once it enters the tubules. Creatinine ALL clears the kidneys unless there is kidney dysfunction. None of glucose should clear the kidneys. The clearance value for creatinine is ~125mL/min (usually the same as GFR); and 0 for glucose. Creatinine clearance is the best measure of renal function.