

## The Formation of Urine

- Urine formation depends on three functions:
  - Filtration is accomplished by the movement of fluids from the blood into the Bowman's Capsule
  - Reabsorption involves the transfer of essential solutes and water from the nephron back into the blood
  - Secretion involves the movement of materials from the blood back into the nephron
- For a detailed diagram and summary, see Fig. 1 on p. 350 and Table 2 on p. 351

### Filtration

- Blood running through the afferent arteriole into the glomerulus is under high pressure (65 mmHg compared to 25 mmHg normally found in capillary beds)
- Most dissolved solutes (see Table 1, p. 349 for a list) pass through the walls of the glomerulus into the Bowman's capsule

### Reabsorption

- On average, 600 mL of fluid flows through the kidneys every minute
- About 20% (or 120 mL) is filtered into the nephron
- If all of that fluid left in urine, dehydration would be a constant danger
- Fortunately, only 1 mL of urine is formed for every 120 mL, meaning that 119 mL of fluids and solutes are reabsorbed
- Selective reabsorption occurs by both active and passive transport
- Carrier molecules move  $\text{Na}^+$  ions across the cell membranes of the cells that line the nephron
- Negative ions ( $\text{Cl}^-$  and  $\text{HCO}_3^-$ ) follow the positive  $\text{Na}^+$  ions by charge attraction
- Many mitochondria supply energy needed for active transport
- Reabsorption occurs until the threshold level of a substance is reached
- Excess (like NaCl) remains in the nephron and is excreted with urine
  
- Other molecules are actively transported from the proximal tubule
- Glucose and amino acids attach to specific carrier molecules, which shuttle them out of the nephron and into the blood
- The amount of solute that can be reabsorbed is limited
- Ex - individuals with high blood glucose will excrete some in their urine
  
- The solutes that are actively transported out of the nephron create an osmotic gradient that draws water in from the nephron
- A second osmotic force, created by the proteins not filtered into the nephron, also help reabsorption
- The proteins remain in the blood stream and draw water from the interstitial fluid into the blood
- As water is reabsorbed from the nephron, the remaining solutes become more concentrated
- Molecules like urea and uric acid will diffuse from the nephron back into the blood

### Secretion

- Secretion is the movement of wastes from the blood into the nephron
- Nitrogen containing wastes, excess  $H^+$  ions, and minerals like  $K^+$  ions are examples of substances secreted
- Drugs (like penicillin) can also be secreted
- Cells loaded with mitochondria line the distal tubule, providing energy for active transport

Homework

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