

Urinary System

Chapter 30

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Introduction

- Cells metabolize nutrients, which produce wastes
- Excretion involves the help of many body systems
- Kidneys are principal organs of the urinary system
 - Filter waste products from blood
 - Reabsorb nutrients
 - Produce urine

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Anatomy

- Kidneys
- Ureters
- Urethra
- Urinary bladder

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Physiology

- Eliminates wastes and foreign substances
- Regulates chemical composition of blood
- Regulates blood pH
- Regulates blood volume and fluid balance
- Regulates blood pressure
- Maintains homeostasis

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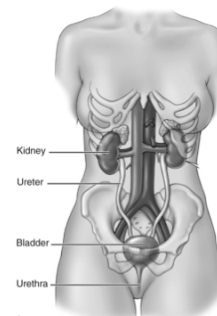
Kidneys

- Lima bean-shaped organs
- Hilus is located on the medial side
- Surrounded by a fibrous capsule and are imbedded in adipose tissue
 - Serve as barrier against trauma and spread of infection
- Process blood and make urine to be excreted from the body

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The Kidneys

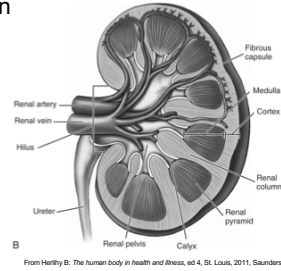


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Kidney Regions

- Cortex: Outer region
- Medulla: Inner region, contains loop of Henle



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Nephron

- Filtering units
 - Reabsorb and secrete substances in the form of urine
- Main regions:
 - Renal corpuscle
 - Renal tubules

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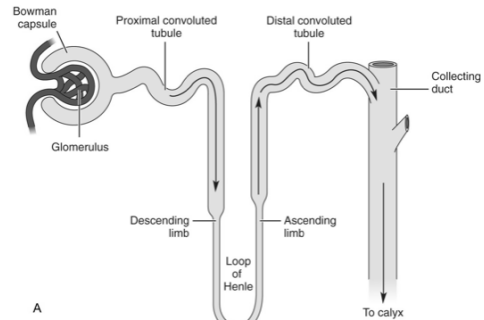
Renal Corpuscle

- Composed of Bowman capsule and the glomerulus
 - Bowman capsule surrounds glomerulus
 - Glomerulus: Cluster of blood capillaries connected by arterioles
- Filtration membrane: Its pores allow certain substances to be filtered out of the blood

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Nephron's Fluid Flow



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Renal Tubules

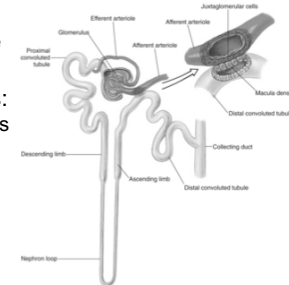
- Where collected filtrate becomes urine
- Parts of the renal tubule are:
 - Proximal convoluted tubule: Nearest to renal corpuscle
 - Loop of Henle: Consists of descending limb, hairpin turn, and ascending limb
 - Distal convoluted tubule: Farthest from renal tubule

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Juxtaglomerular Apparatus

- Monitors blood pressure and filtrate
- Contains two important structures:
 - Juxtaglomerular cells
 - Macula densa



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Juxtaglomerular Cells and Macula Densa

- Juxtaglomerular cells
 - Act as a mechanoreceptor and monitor blood pressure
 - Secrete renin when blood pressure decreases
- Macula densa
 - Act as chemoreceptors and monitor concentration of the filtrate
 - When sodium levels are high, they secrete a substance to adjust filtration rates

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Ureters

- Two slender, hollow tubes extending from the kidneys to the urinary bladder
- Transport of urine facilitated by peristalsis of ureteral walls

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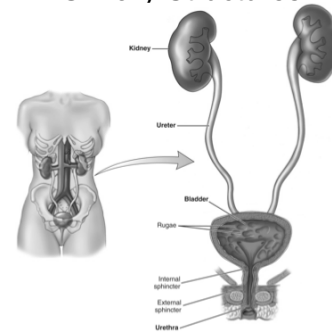
Urinary Bladder

- Expandable sac that stores urine
 - In women: Located anterior to vagina and posterior to uterus
 - In men: Located superior to the prostate
- Lining contains transitional epithelium so that it can expand and not be damaged
- Walls of the bladder contain detrusor muscle
 - Contracts during urination to force urine from the bladder

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Urinary Structures



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Urethra

- Narrow tube that removes urine or urine and semen from the body
 - Male urethra: Extends through the prostate and penis
 - Female urethra: Located between the vaginal opening and the clitoris
- Urination:
 - Release of urine from the bladder
 - Begins with voluntary relaxation of external sphincter muscle

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Urine

- 96% water and 4% dissolved wastes
- Average adult produces 1 L of urine per day
- Diuretic: Substance that promotes formation and excretion of urine

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Nephrons: Blood Flow

- Blood enters the kidneys via the renal artery
 - The renal artery narrows and becomes the afferent arteriole
- The afferent arteriole branches further and becomes the glomerulus
- Blood leaves the glomerulus, travels into efferent arterioles, then to peritubular capillaries
 - Where most reabsorption occurs

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Filtration Process

- Kidneys filter both beneficial nutrients and waste products
 - Many nutrients are reabsorbed back into the bloodstream
- This occurs in a three-step process:
 - Filtration
 - Reabsorption
 - Tubular secretions

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Filtration

- Blood enters glomerulus under high pressure
 - Water and sodium pass through the filtration membrane into Bowman capsule
 - Proteins and blood cells remain in blood

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Tubular Reabsorption

- Filtered molecules are reabsorbed back into the peritubular capillaries
 - If reabsorption is impaired, affected persons urinate frequently
- Important for electrolyte balance and homeostasis

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Tubular Secretion

- Certain molecules move from the peritubular blood into the renal tubule
 - Kidneys have another opportunity to adjust chemical composition

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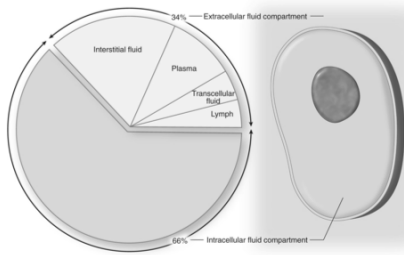
Body Fluids and Fluid Balance

- Body fluids are found in two major categories
 - Extracellular fluids: Located outside cells
 - Intracellular fluids: Located in cells
- Input of water must closely equal output of water
- Hormone secretion is important to fluid balance maintenance
 - Antidiuretic hormone (ADH): In water loss, it is secreted and kidneys reabsorb more water
 - Aldosterone: Stimulates kidneys to retain more fluids

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Fluid Distribution



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Fluid Imbalance

- Dehydration can occur when water is unavailable or by conditions, such as severe diarrhea, vomiting, and excessive sweating
- Common causes of water loss:
 - Infection, fever, severe burns

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Turgor

- Turgor is skin resiliency: To test for turgor, grasp skin for a few seconds and release
 - Skin rebounds quickly = normal turgor
 - Skin produces a tent = decreased turgor

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Edema

- Congested lymphatic vessels cannot transport fluid quickly enough
 - Pitting edema leaves depression in skin for several minutes
 - Nonpitting edema does not leave a depression

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