The Human Body in Health and Illness

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Chapter 24: Urinary System

Lesson 24.1 Objectives

- List four organs of excretion.
- Describe the major organs of the urinary system.
- Describe the location, structure, blood supply, nerve supply, and functions of the kidneys.
- Explain the role of the nephron unit in the formation of urine.

Lesson 24.1 Objectives (cont'd.)

- Explain the three processes involved in the formation of urine: filtration, reabsorption, and secretion.
- Describe the hormonal control of water and electrolytes by the kidneys.
- List the normal constituents of urine.
- Describe the structure and function of the ureters, urinary bladder, and urethra.

Excretion

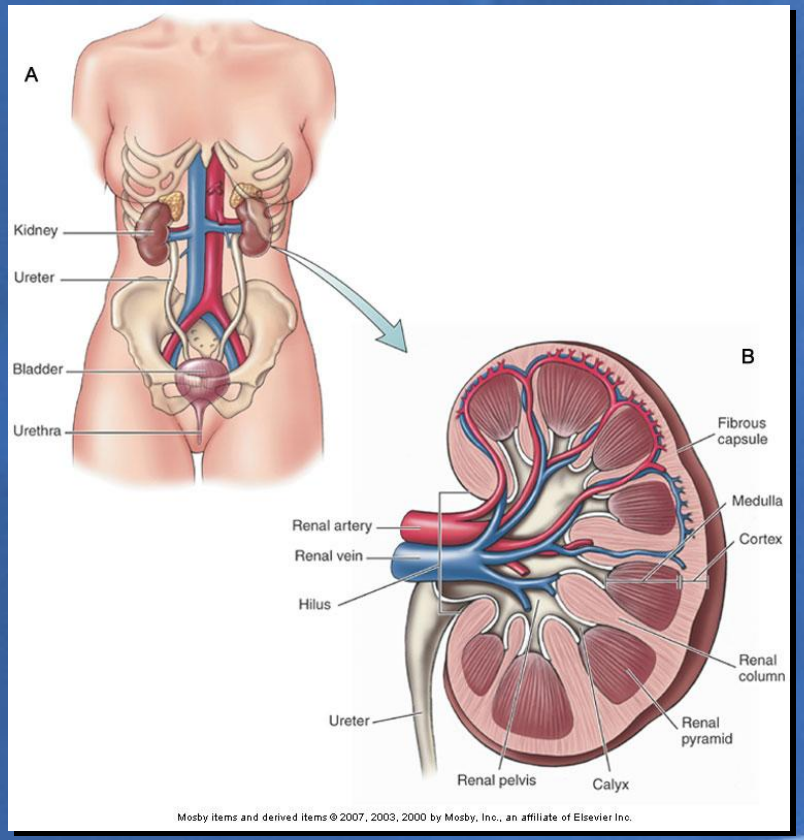
- Organs of excretion:
  - Kidneys
  - Sweat glands
  - Lungs
  - Intestines

Excretion (cont'd.)

- Urinary system organs:
  - Kidneys
  - Ureters
  - Urinary bladder
  - Urethra

Excretion (cont'd.)

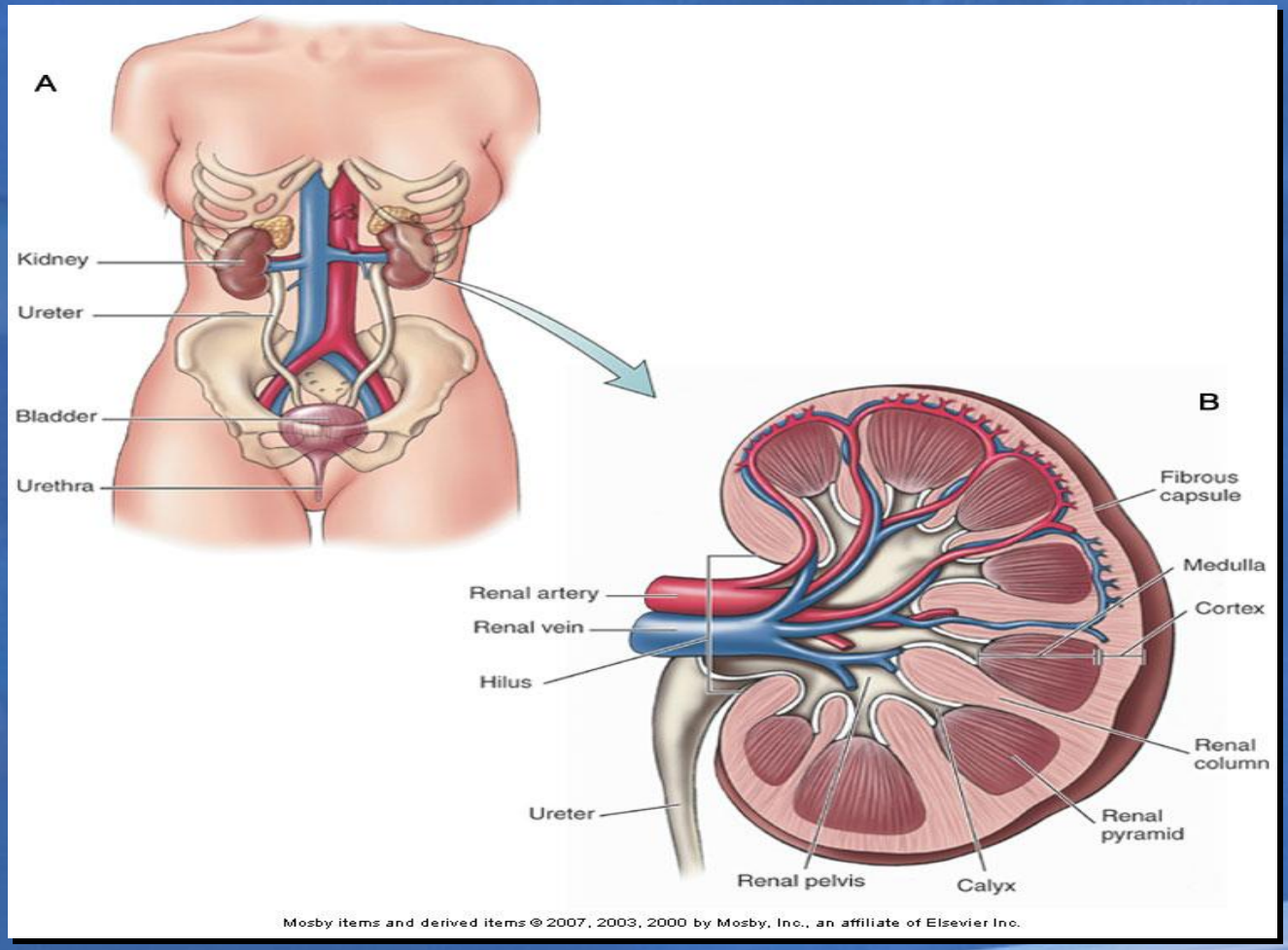
A. Organs of the urinary system.



Kidneys

- Location: retroperitoneal, high on the posterior wall of the abdominal cavity
- Structure: reddish-brown, beanlike shape, enclosed in a tough fibrous capsule; three distinct regions:
  - Renal cortex
  - Renal medulla
  - Renal pelvis

Kidneys (cont'd.)



Kidneys (cont'd.)

- Blood supply: renal artery, which arises from the abdominal aorta; renal vein, which empties into the inferior vena cava
- Nerve supply: renal nerves; primarily sympathetic nerves

Kidneys (cont'd.)

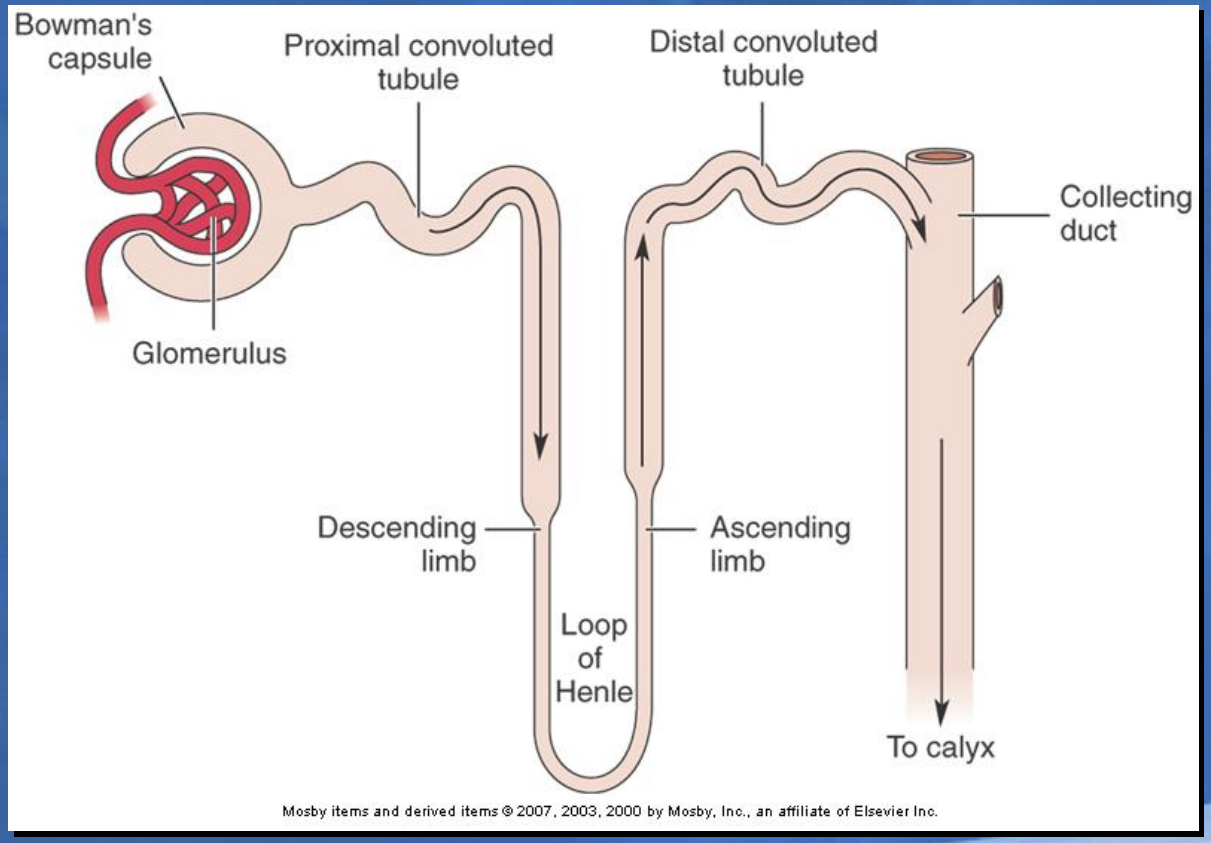
- Functions:
  - Excrete nitrogenous waste (urea, uric aid, ammonia, and creatinine)
  - Regulate blood volume by determining the amount of water excreted
  - Help regulate the electrolyte content of the blood
  - Play a major role in the regulation of acid-base balance by controlling the excretion of H^+
  - Play a role in regulation of blood pressure
  - Play a role in regulation of RBC production

Urine Making: The Nephron Unit

- Nephron: functional unit of the kidney; two parts:
  - Renal tubules: Bowman's capsule, proximal convoluted tubule, loop of Henle, distal convoluted tubule, collecting duct
  - Renal blood vessels: renal artery, afferent arteriole, glomerulus, efferent arteriole, peritubular capillaries, renal vein

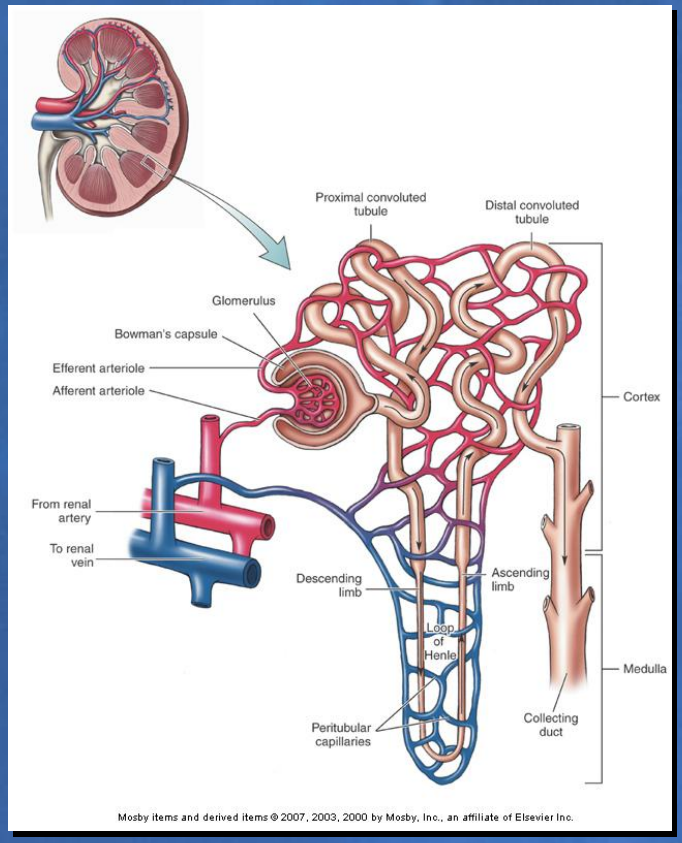
Urine Making: The Nephron Unit (cont'd.)

The nephron unit: tubular structures.



Urine Making: The Nephron Unit (cont'd.)

The nephron unit.



Urine Making: The Nephron Unit (cont'd.)

- Three processes of urine formation:
  - Glomerular filtration
  - Tubular reabsorption
  - Tubular secretion

Urine Making: The Nephron Unit (cont'd.)

- Glomerular filtration: caused by the blood pressure difference between the glomerulus and Bowman's capsule
- Glomerular filtrate: water and dissolved substances filtered into Bowman's capsule
- Glomerular filtration rate (GFR): rate at which glomerular filtration occurs

Urine Making: The Nephron Unit (cont'd.)

- Tubular reabsorption: process by which glomerular filtrate moves from the tubules into the blood of the peritubular capillaries
- Diuresis: excess secretion of urine
- Diuretics: drugs that increase the production of urine

Urine Making: The Nephron Unit (cont'd.)

- Tubular secretion: process by which very small amounts of substances from the peritubular capillaries move into the tubules
- Secreted substances: potassium ions (K^+), hydrogen ions (H^+), uric acid, ammonium ions, and drugs

Hormones That Work on the Kidneys

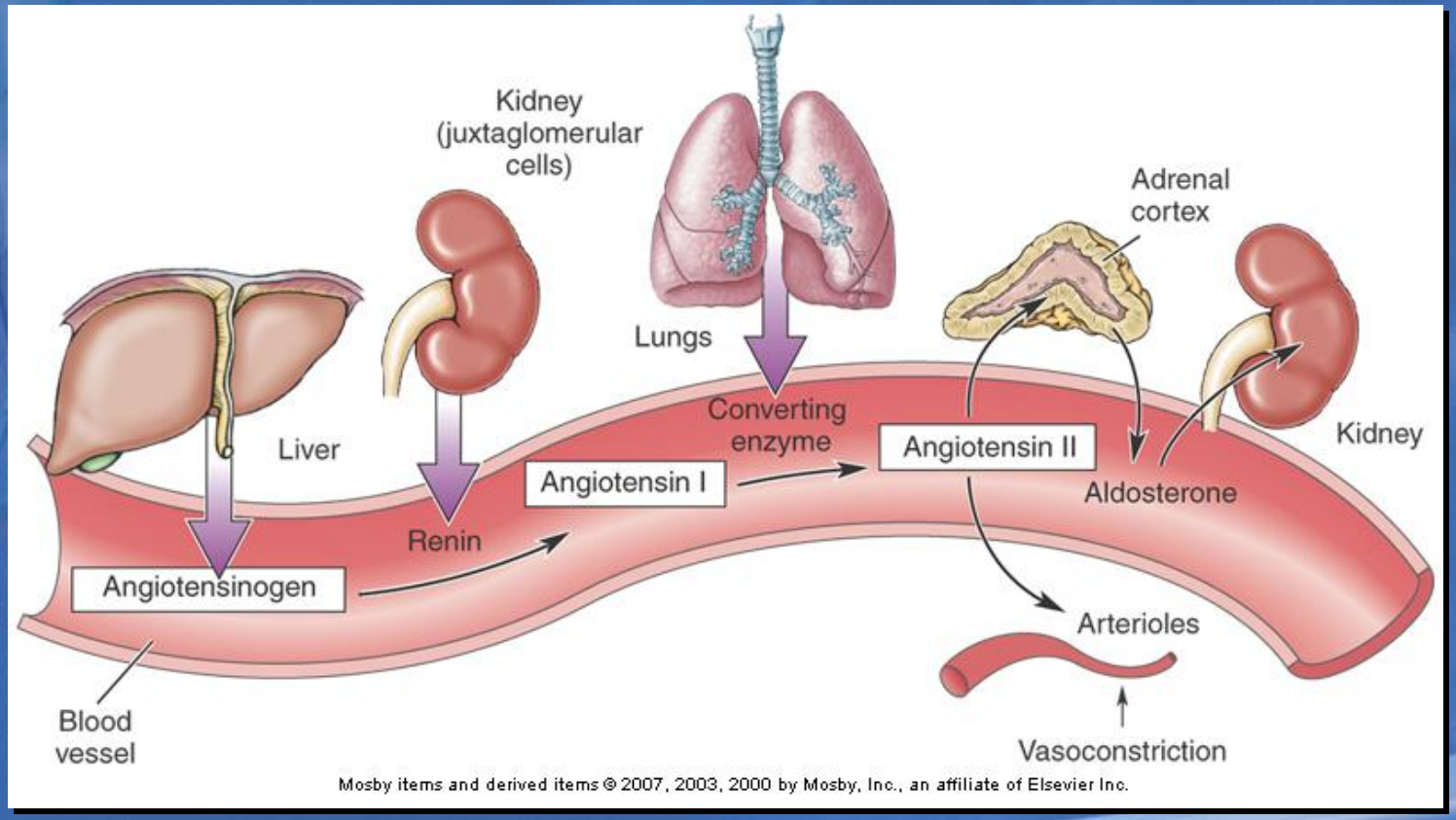
- Aldosterone
- Antidiuretic hormone (ADH)
- Natriuretic peptides
  - Atrial natriuretic peptide (ANP)
  - Brain natriuretic peptide (BNP)
- Parathyroid hormone

Hormones That Work on the Kidneys (cont'd.)

- Aldosterone:
  - Stimulates the reabsorption of sodium and water
  - Stimulates the excretion of potassium
  - Acts primarily on the distal tubule
  - Increases blood volume and blood pressure
  - Release is stimulated by angiotensin II

Hormones That Work on the Kidneys (cont'd.)

The renin-angiotensin-aldosterone system.



Hormones That Work on the Kidneys (cont'd.)

- Antidiuretic hormone (ADH):
  - Stimulates the reabsorption of water
  - Works primarily on the collecting duct
  - Plays a role in determining blood volume and blood pressure
  - Release is stimulated by a decrease in blood volume and an increase in the concentration of solutes in the plasma

Hormones That Work on the Kidneys (cont'd.)

- Natriuretic peptides: cause natriuresis, excretion of sodium (Na^+); decrease the secretion of aldosterone by the adrenal cortex
  - Atrial natriuretic peptide (ANP): secreted by the walls of the atria of the heart in response to an increase in the volume of blood
  - Brain natriuretic peptide (BNP): secreted by the walls of the ventricles in response to elevated ventricular pressure

Hormones That Work on the Kidneys (cont'd.)

- Parathyroid hormone (PTH):
  - Secreted by the parathyroid glands
  - Plays an important role in the regulation of two electrolytes
  - Stimulates the renal tubules to reabsorb calcium and excrete phosphate
  - Release stimulated by low plasma level of calcium

Characteristics of Urine

- Amount (volume): average 1500 ml/24 hours
- pH: average 6.0
- Specific gravity: slightly heavier than water (1.001 to 1.035)
- Color: yellow (amber, straw colored, deep yellow in dehydration, pale yellow with overhydration)

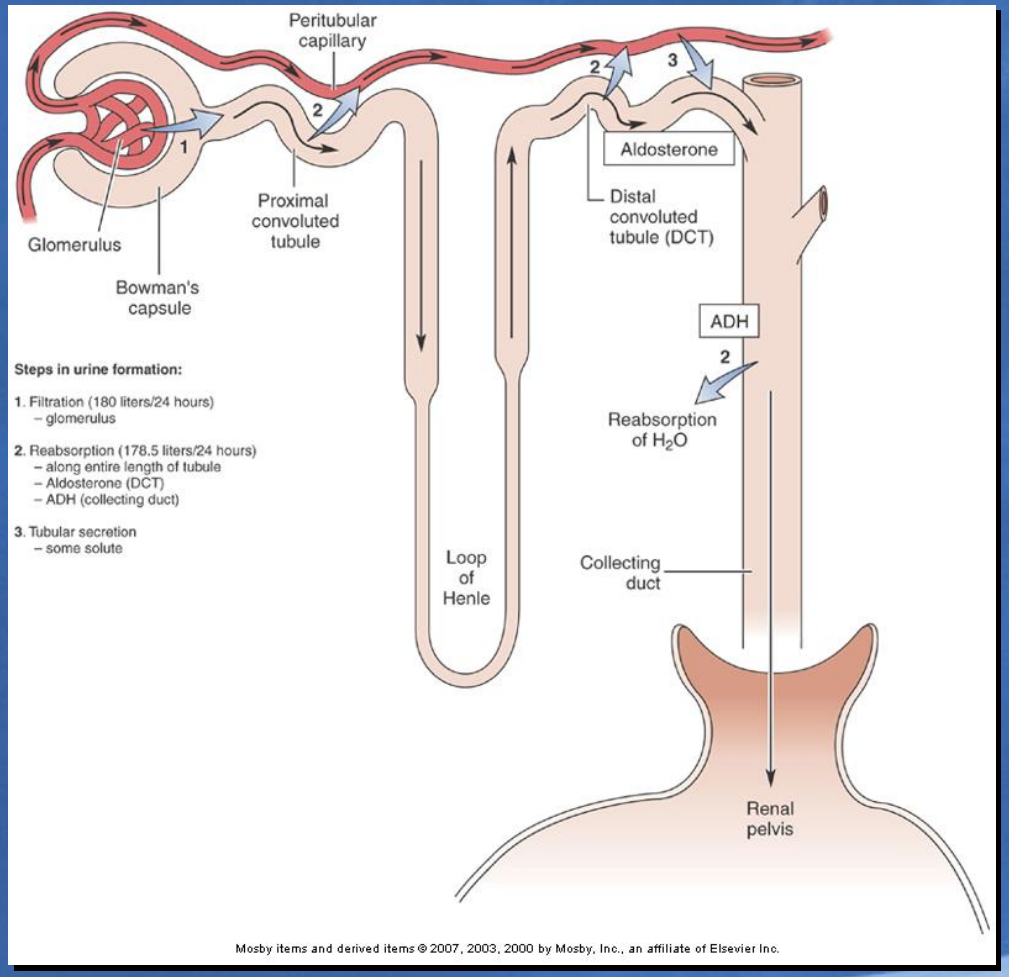
Characteristics of Urine (cont'd.)

- Some abnormal constituents of urine:
  - Albumin: (albuminuria) indicates an increased permeability of the glomerulus; sometimes induced by exercise or pregnancy
  - Glucose: (glycosuria) usually indicates diabetes mellitus
  - Red blood cells: (hematuria) bleeding in the urinary tract; indicates inflammation, trauma, or disease

Characteristics of Urine (cont'd.)

- Some abnormal constituents of urine (cont'd.):
  - Hemoglobin: (hemoglobinuria) indicates hemolysis
  - White blood cells: (pyuria) indicates infection within the kidney or urinary tract
  - Ketone bodies: (ketonuria) usually indicates uncontrolled diabetes mellitus
  - Bilirubin: (bilirubinuria) usually indicates disease involving the liver and/or biliary tree

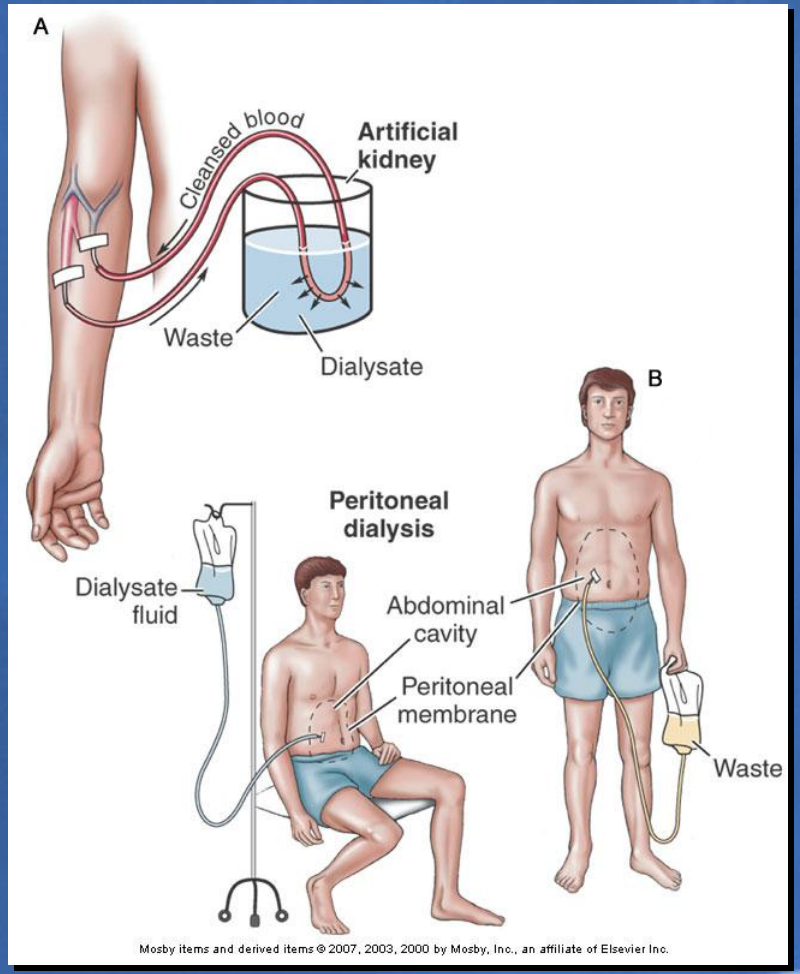
Characteristics of Urine (cont'd.)



When the Parts Don't Work

- Nephrotic syndrome: excretion of large amounts of protein in the urine, causing hypoalbuminemia
- Glomerulonephritis: autoimmune reaction to streptococcus
- Acute tubular necrosis (ATN): consequence of renal tubular damage
- Uremia and dialysis: urine in the blood can be prevented by dialysis, an artificial method of cleansing the blood

When the Parts Don't Work (cont'd.)



Your Plumbing

- Urinary tract:
  - Ureters: connect the kidneys and bladder
  - Urinary bladder: temporary reservoir for storage of urine
  - Urethra: tube that carries urine from the bladder to the outside
- Urination: process of expelling urine from the bladder; also called micturition or voiding
- Micturition reflex: gives rise to a sense of urgency

Your Plumbing (cont'd.)

Organs of the urinary tract.