

The Urinary System

- Kidneys
- Ureters
- Urinary bladder
- Urethra

- Urinary tract
 - Ureters, bladder and urethra

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The Urinary System

- Main functions of the kidneys
 - Maintain the chemical consistency of blood
 - Filter the blood
 - Send toxins, metabolic wastes, and excess water out of the body
 - Main waste products
 - Urea
 - Uric acid
 - Creatinine

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The Urinary System

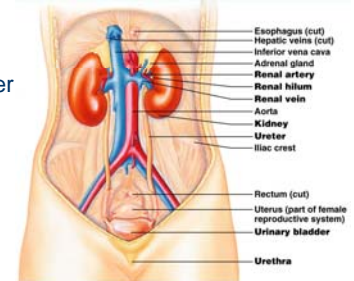
- Urinary tract
 - Transports the urine

- Process of releasing urine
 - urination
 - micturition

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Organs of the Urinary System

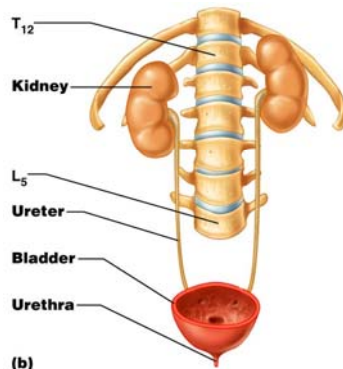
- Kidneys
- Ureters
- Urinary bladder
- Urethra



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Location of the Kidneys

- Lateral to T₁₂-L₃
- On posterior abdominal wall
- Right kidney lower than left



(b)

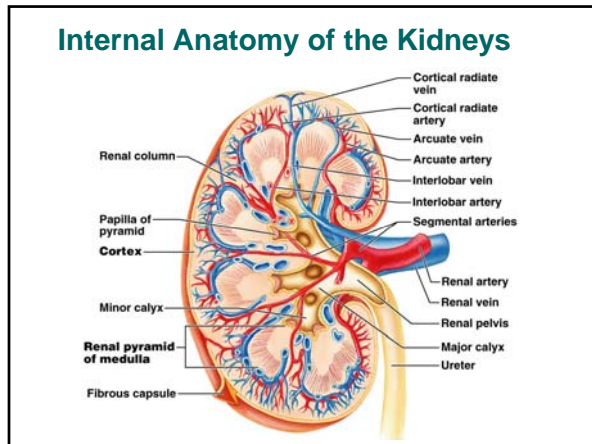
External Gross Anatomy of Kidneys

Hilus (renal hilum)

- Indentation in concave medial surface
- Vessels and nerves enter and exit

- Renal capsule surrounds the kidney

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Internal Gross Anatomy of the Kidneys

- Outer - renal cortex
- Inner – renal medulla
- Renal pyramids (cone shaped)
 - contain urine-collecting tubules
- Renal columns
 - Separate adjacent pyramids

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Internal Gross Anatomy of the Kidneys

- Each renal pyramid drains into minor calyx
- Several minor calyx unite to form a major calyx
- Major calyces drain into the renal pelvis
- Renal pelvis connects to the ureter
- **Renal arteries**
 - Branch into **segmental arteries**

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Microscopic Anatomy of the Kidneys

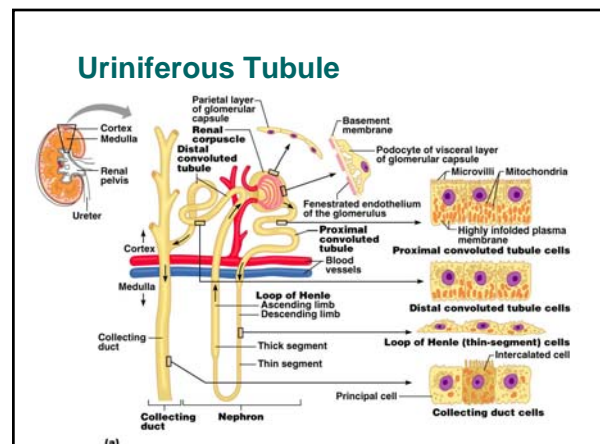
- Uriniferous tubules
 - **Nephron** (Renal corpuscle plus renal tubules)
 - **Renal corpuscle**
 - **Glomerulus**
 - Capillaries of glomerulus are *fenestrated*
 - **Glomerular** (Bowman's) **capsule**
 - Filtrate is squeezed into here
 - **Collecting duct**
 - Involved in concentrating urine

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Mechanisms of Urine Production

- **Filtration**
 - Filtrate of blood leaves kidney capillaries
- **Reabsorption**
 - Most nutrients, water, and essential ions reclaimed
- **Secretion**
 - Active process of removing undesirable molecules

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The Nephron

- **Nephron**
 - Functional filtration unit of the kidney
 - Filters blood and modifies “filtrate” that is squeezed out from the glomerulus
- The nephron consists of:
 - 1) Renal corpuscle
 - 2) Proximal convoluted tubule (PCT)
 - 3) Nephron loop (Loop of Henle)
 - 4) Distal convoluted tubule (DCT)

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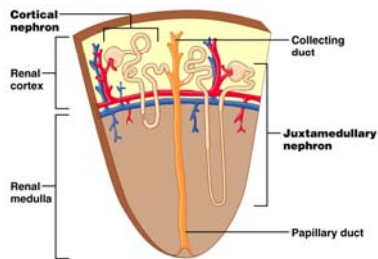
Tubular Section of Nephron

- Filtrate proceeds to renal tubules from glomerulus
 - Proximal convoluted tubule (PCT)
 - Loop of Henle
 - Distal convoluted tubule (DCT)
- Purpose of tubules
 - Resorb material & water

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Collecting ducts

- Collecting ducts
 - Receive urine from distal convoluted tubules



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Microscopic Blood Vessels

- Nephrons associated with *two types of capillary beds* (a portal system)
 - **Glomerulus**
 - Fed and drained by arterioles
 - Afferent and efferent arterioles
 - **Peritubular capillaries**
 - Arise from efferent arterioles
 - Low-pressure, porous capillaries
 - Absorb solutes from tubules

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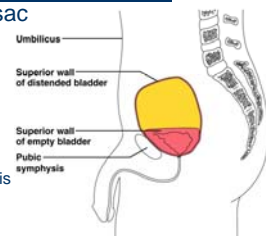
Ureters

- Long, thin, paired muscular tubes
- Carry urine from kidneys to urinary bladder
- Oblique entry into bladder prevents backflow of urine

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Urinary Bladder

- A collapsible muscular sac
- Stores and expels urine
 - Full bladder – spherical
 - Expands into the abdominal cavity
 - Empty bladder
 - lies entirely within the pelvis

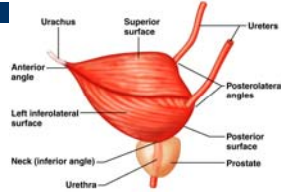


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Urinary Bladder

- **Prostate gland**

- In males
 - Lies directly inferior to the bladder
 - Surrounds the urethra



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Urethra

- **Internal urethral sphincter**

- Involuntary smooth muscle

- **External urethral sphincter**

- Voluntarily inhibits urination
- Relaxes when one urinates

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Urethra

- In females

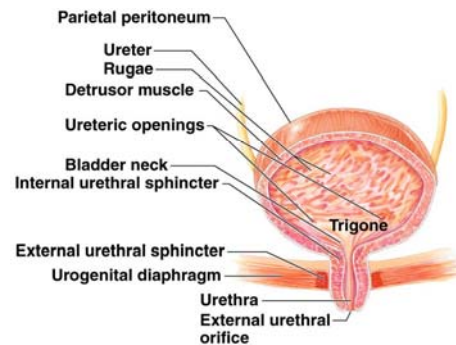
- Length of 3–4 cm
- **Urinary tract infections**
 - More common in females (short urethra)
 - Burning sensation during micturition

- In males – 20 cm in length – three named regions

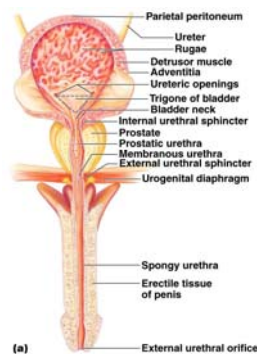
- **Prostatic urethra**
 - Passes through the prostate gland
- **Membranous urethra**
 - Through the urogenital diaphragm
- **Spongy (penile) urethra**
 - Passes through the length of the penis

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Female Urinary Bladder and Urethra



Male Urinary Bladder and Urethra



Flow of Filtrate / Urine

1. Filtrate is squeezed out of glomerulus
2. Proximal convoluted tubule
3. Loop of Henle
4. Distal convoluted tubule
5. Filtrate travels through the collecting duct
 - When filtrate leaves collecting duct – Urine
6. Minor calyx
7. Major calyx
8. Renal pelvis
9. Ureter
10. Urinary bladder
11. Urine exits the body via the urethra