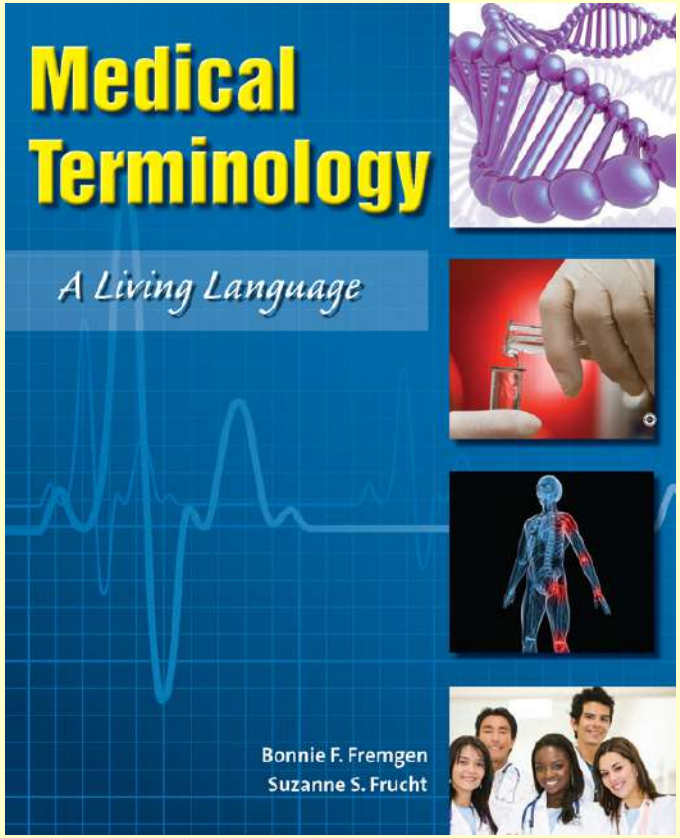
Medical Terminology
A Living Language



Chapter 9

Urinary System

PEARSON Education
Medical Terminology: A Living Language, Fourth Edition
Bonnie F. Fremgen and Suzanne S. Frucht

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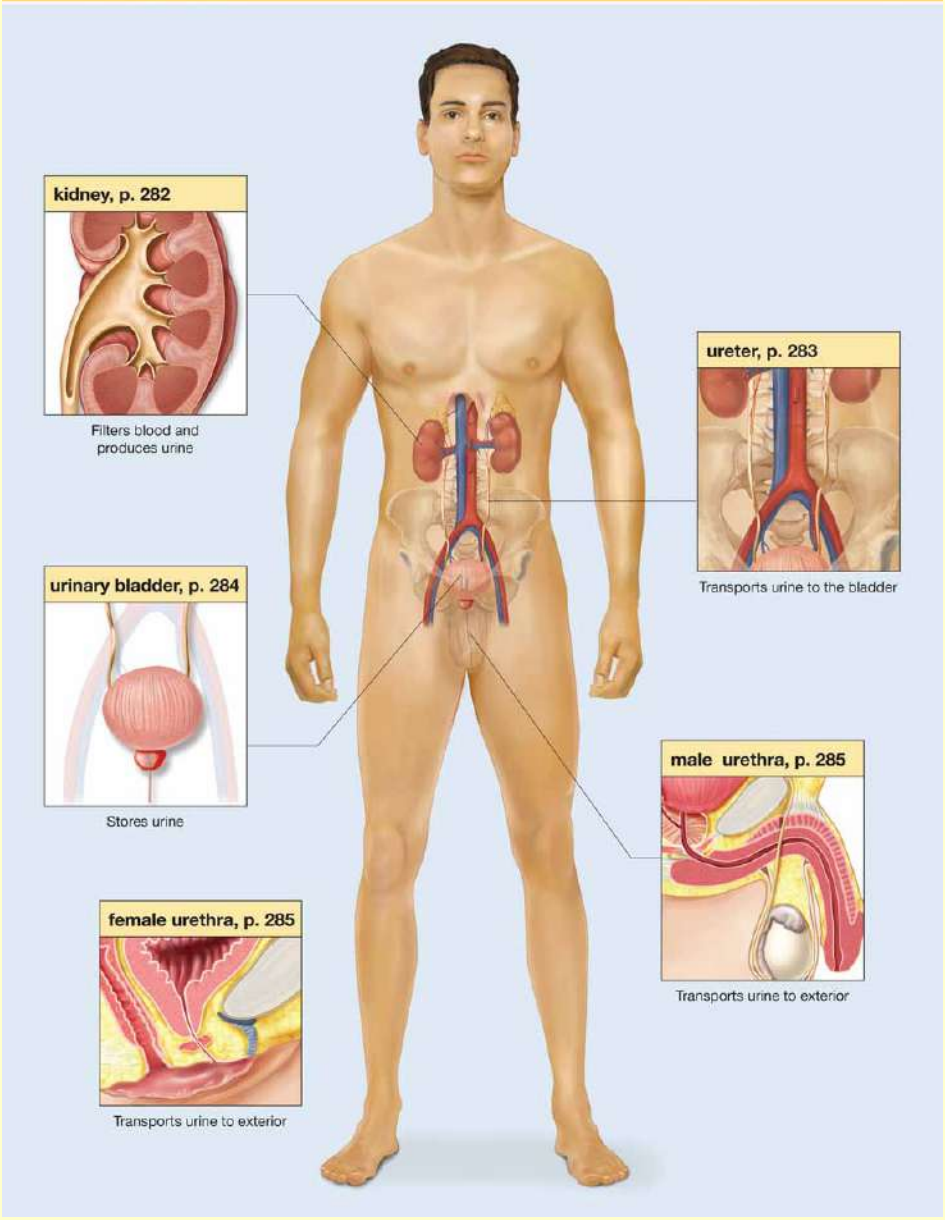
Urinary System at a Glance

- Functions of Urinary System
  - Maintain stable internal environment
  - Remove waste products
  - Adjust water and electrolyte levels
  - Maintain correct pH

Urinary System at a Glance

- Organs of Urinary System
  - Two kidneys
  - Two ureters
  - One urinary bladder
  - One urethra

Urinary System Illustrated



PEARSON Education

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Urinary System Combining Forms

- azot/onitrogenous waste
- bacteri/obacteria
- cyst/obladder
- glomerul/oglomerulus
- glycos/osugar, glucose
- keton/oketones

Urinary System Combining Forms

- lith/ostone
- meat/omeatus
- nephr/okidney
- noct/inight
- olig/oscanty
- pyel/orenal pelvis

Urinary System Combining Forms

- ren/okidney
- ur/ourine
- ureter/oureter
- urethr/ourethra
- urin/ourine
- vesic/obladder

Urinary System Suffixes

-lithstone

-lithiasiscondition of stones

-ptosisdrooping

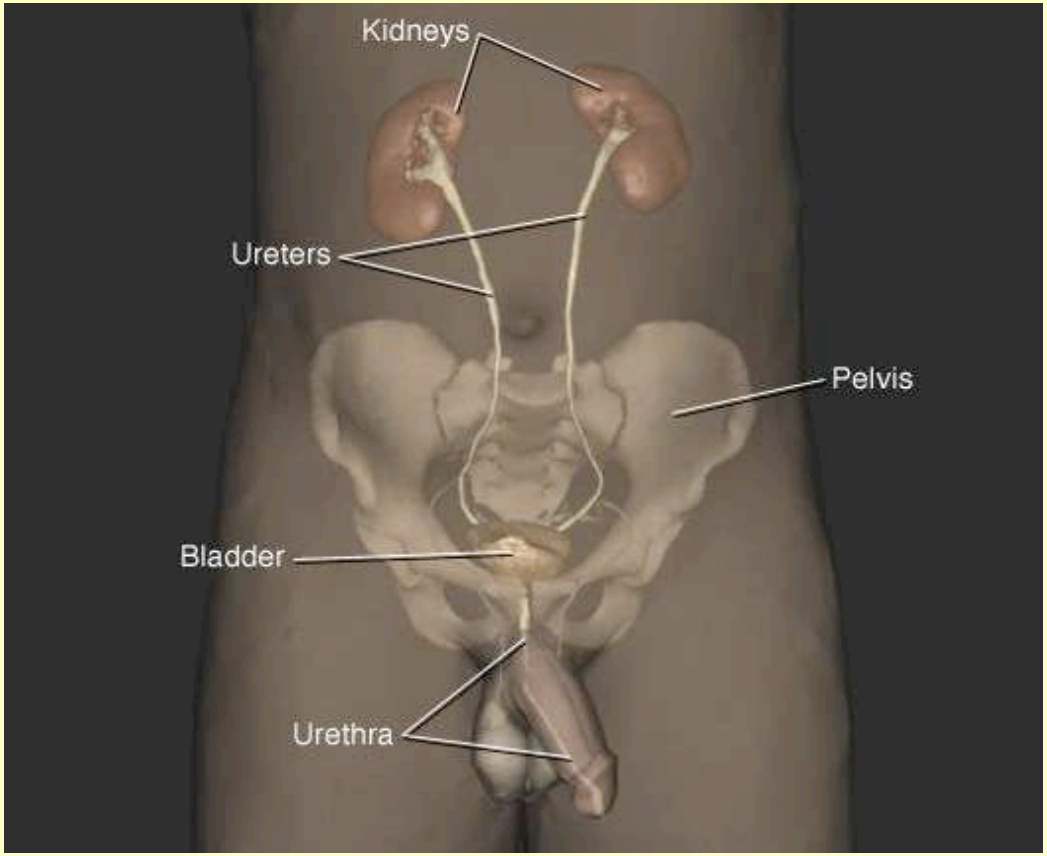
-tripsysurgical crushing

-uriacondition of the urine

Anatomy and Physiology

- Also called **genitourinary system**
- Consists of
  - Two kidneys
  - Two ureters
  - One urinary bladder
  - One urethra

Urinary System Animation



Click here to view an animation of the urinary system.

Function

- Main function is to filter and remove waste products from blood
- Metabolic processes produce waste
- Blood becomes toxic if waste builds up
- Waste materials are called **urine**
- Urine is then removed from body

Homeostasis

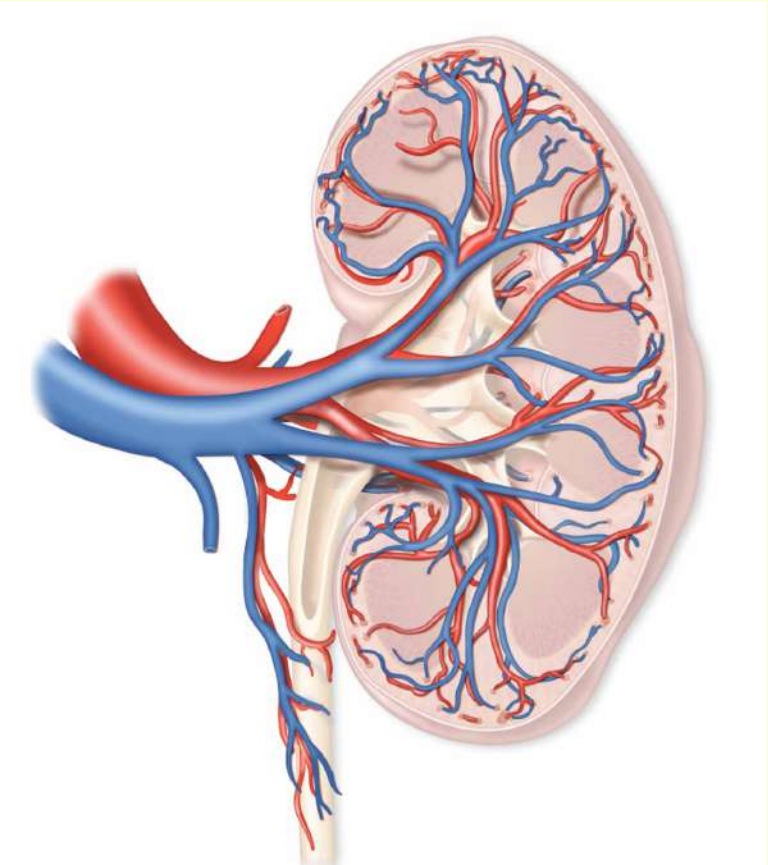
- Responsible for homeostasis
  - Maintain proper balance of water and chemicals in body
- Regulate levels of electrolytes
  - Sodium
  - Potassium
  - Chloride
  - Bicarbonate
- Maintain pH

Waste Removal

- Waste is removed through system of blood vessels and tubules
  - Called the **nephron**
  - More than 1 million make up each kidney
  - Produce urine
- Urine drains from kidney through ureters to bladder, into urethra, and then out of body

Kidneys

- Located behind peritoneum
  - **Retroperitoneal**
- Concave area on edge of center called **hilum**
  - Renal artery enters
  - Renal vein leaves
  - Ureter leaves



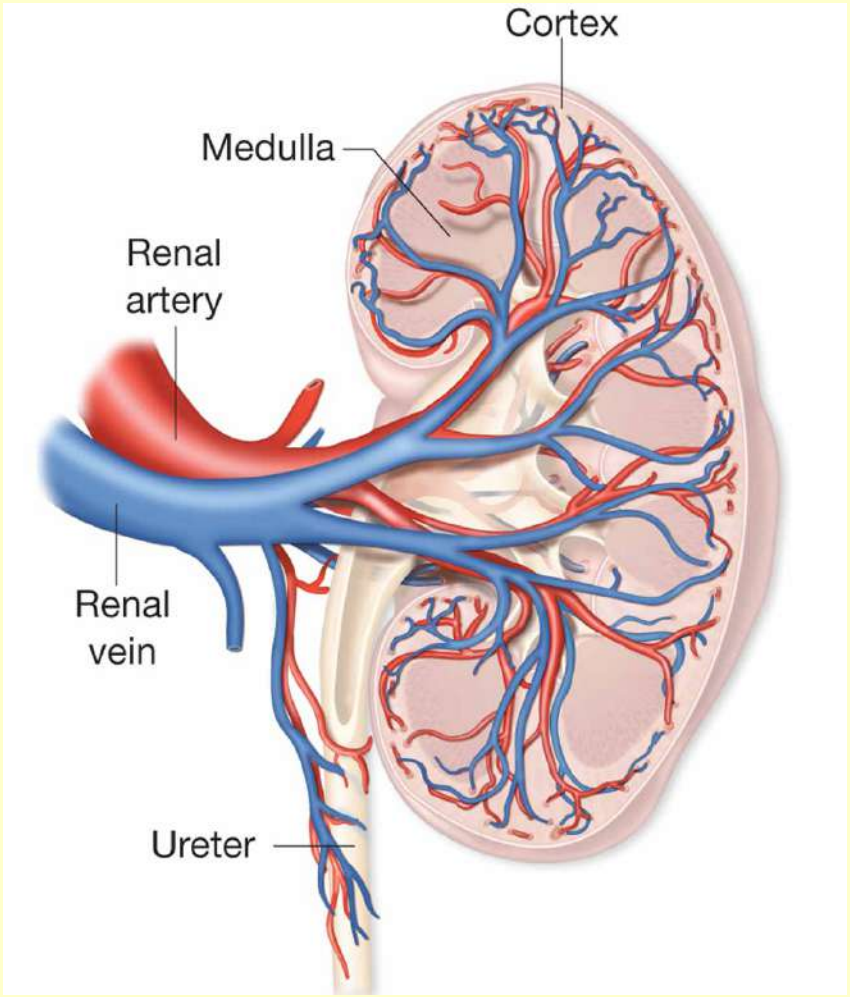
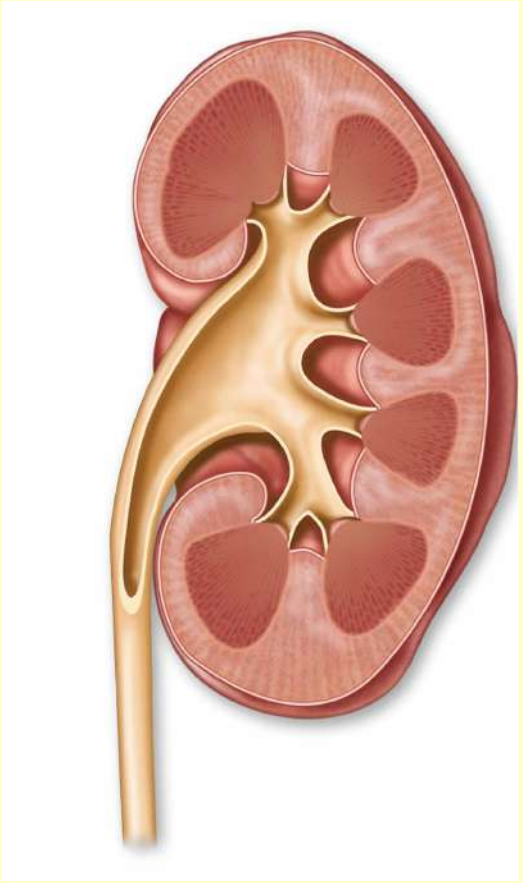


Figure 9.1 – Kidney structure. Longitudinal section showing the renal artery entering and the renal vein and ureter exiting at the hilum of the kidney.

Internal Structure of Kidneys

- **Cortex**
  - Outer portion
- **Medulla**
  - Inner portion
- **Pyramids**
  - Triangular shaped structures in medulla
- **Papilla**
  - Tip of each renal pyramid



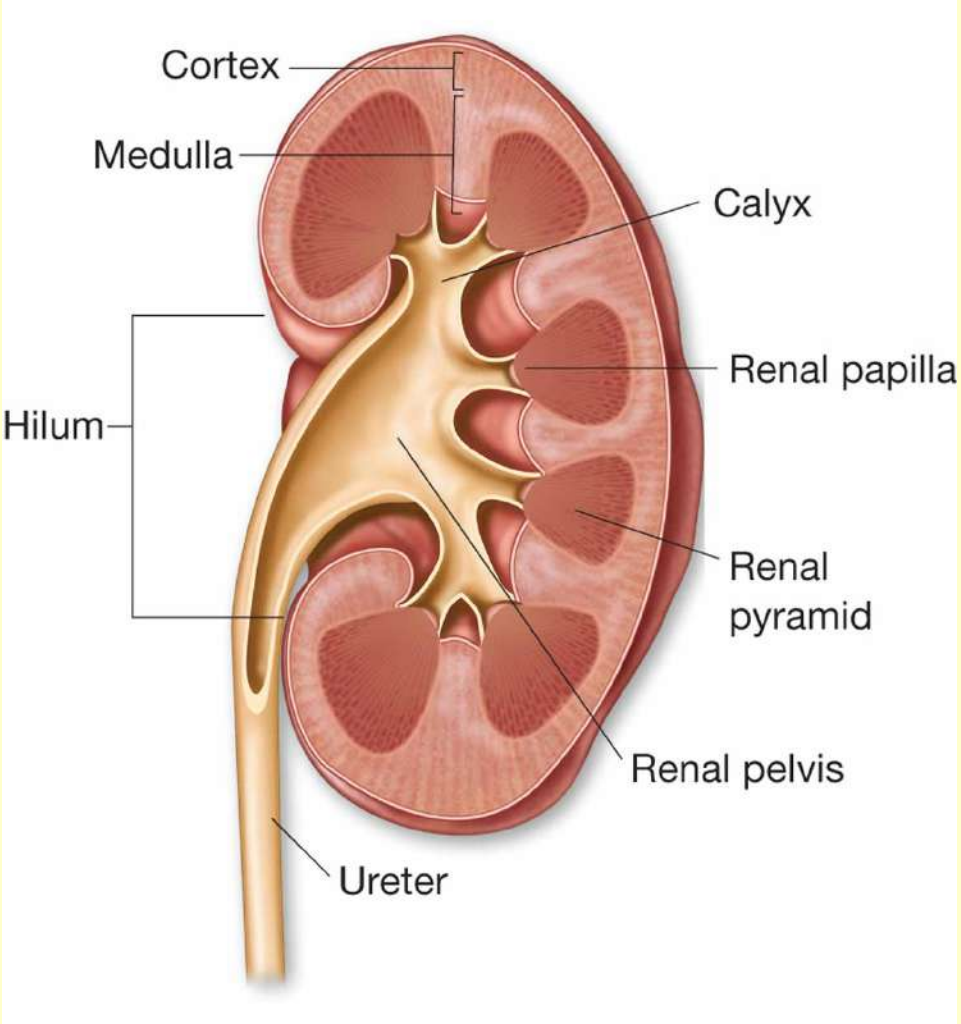
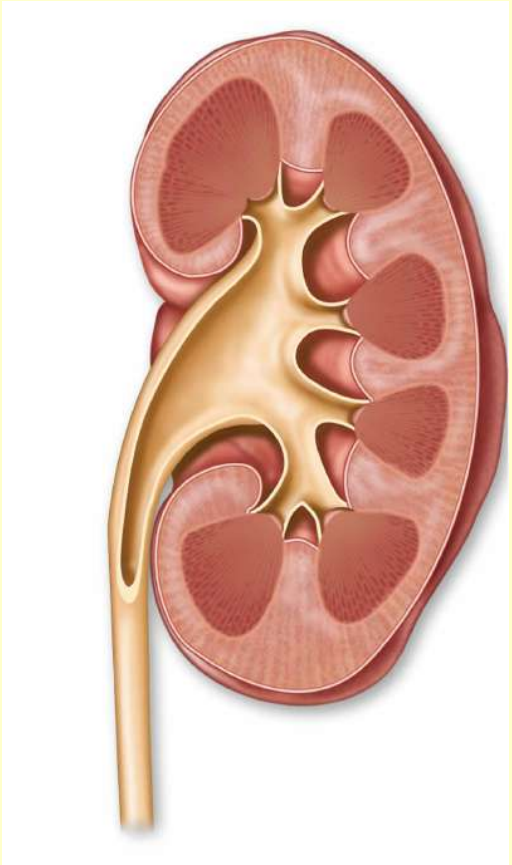


Figure 9.2 – Longitudinal section of a kidney illustrating the internal structures.

Internal Structures of the Kidneys

- **Calyx**
  - Small open area that receives urine from each papilla
- **Renal pelvis**
  - Large open area that receives urine from each calyx
  - Empties into ureter



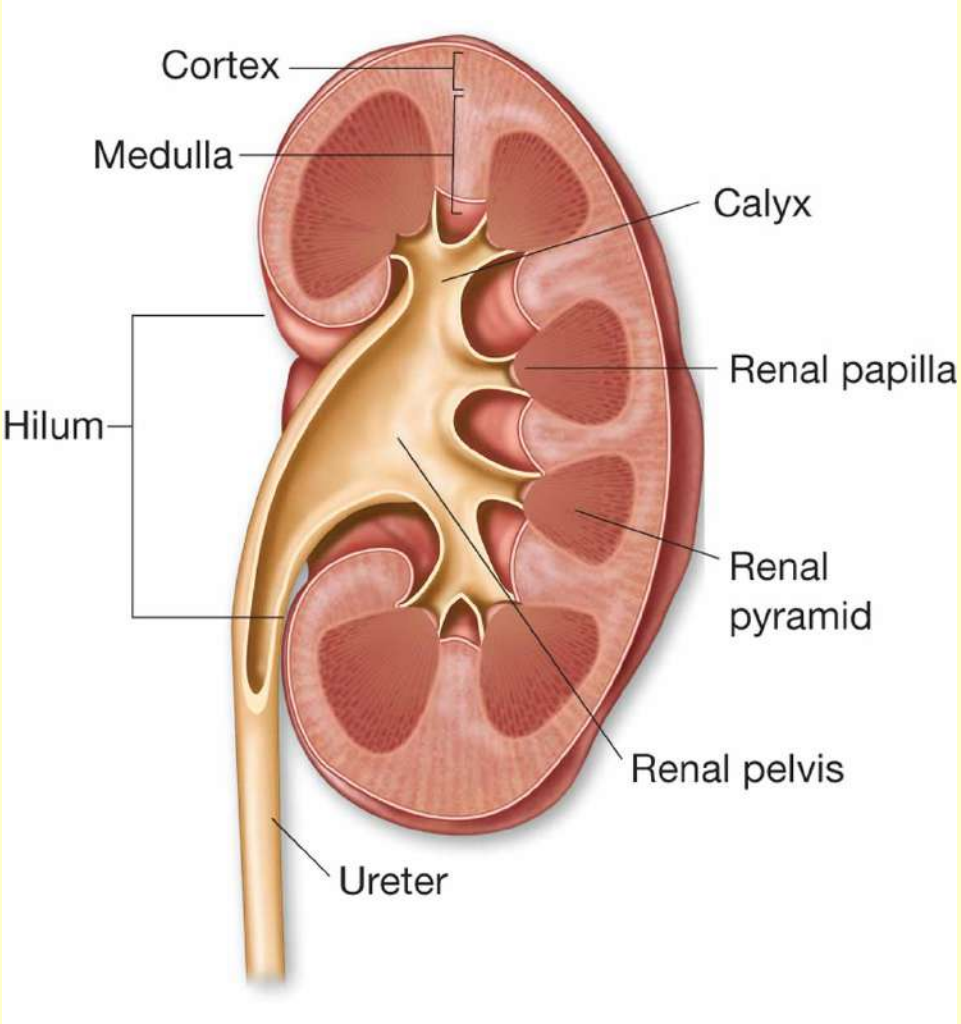


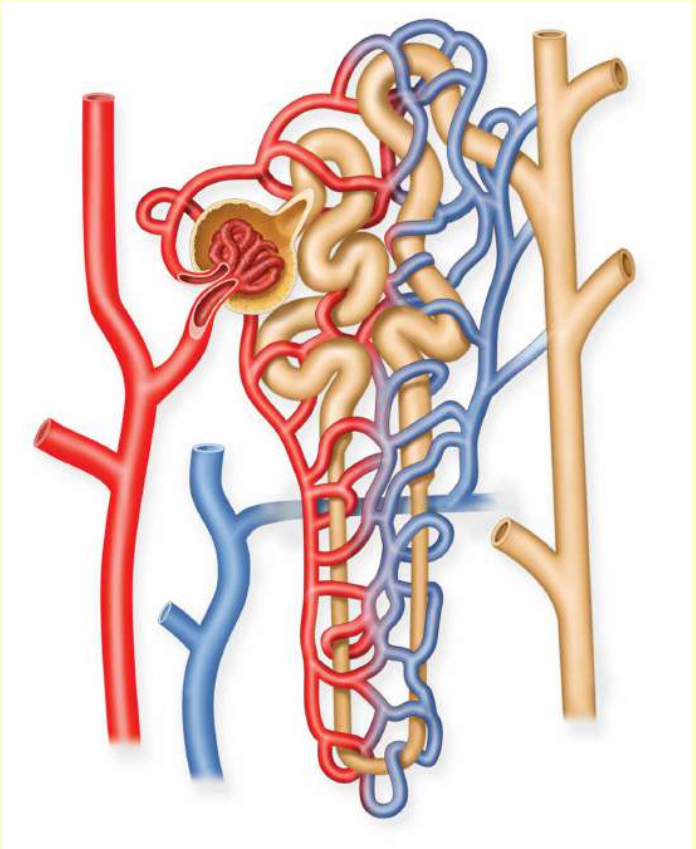
Figure 9.2 – Longitudinal section of a kidney illustrating the internal structures.

Nephron

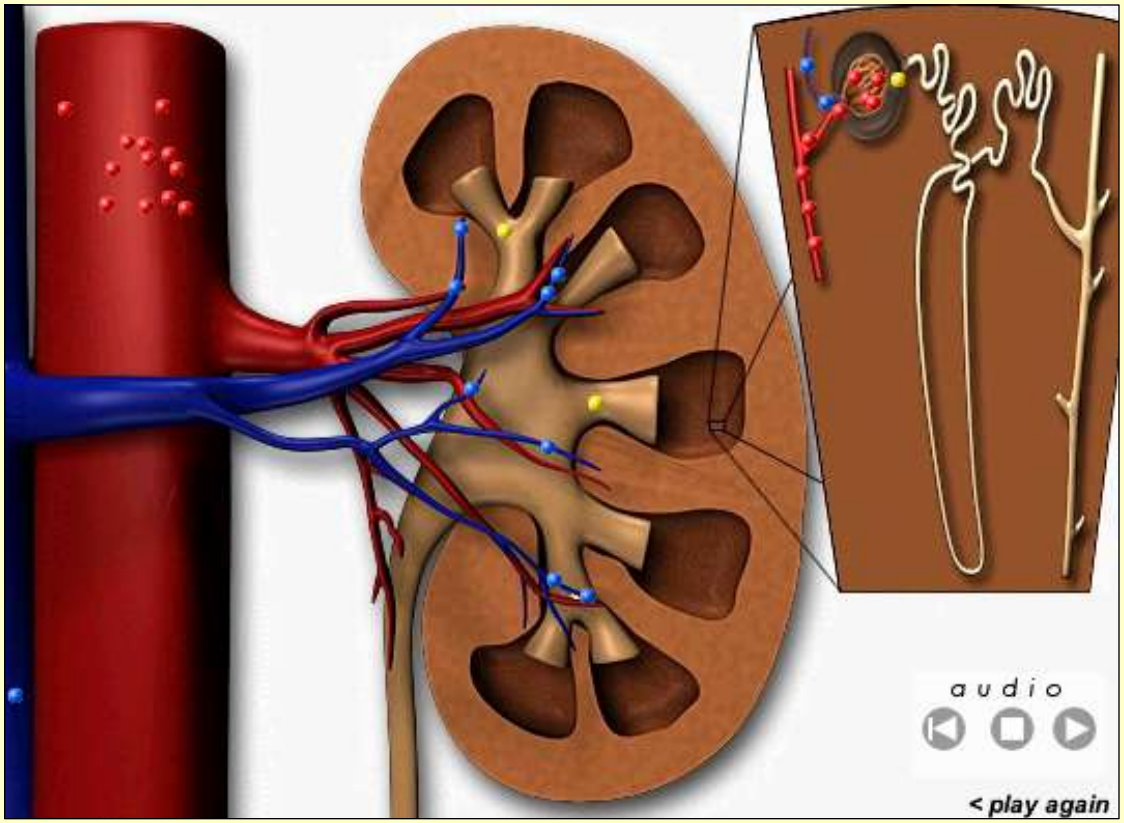
- Functional unit of kidney
- Microscopic
- More than 1 million nephrons in each kidney
- Consists of
  - **Renal corpuscle**
  - **Renal tubules**

Renal Corpuscle

- Two parts:
  - **Glomerulus**
  - **Glomerular** or **Bowman's capsule**
- Blood flows through glomerulus
- Substances filtered from blood and enter glomerular capsule



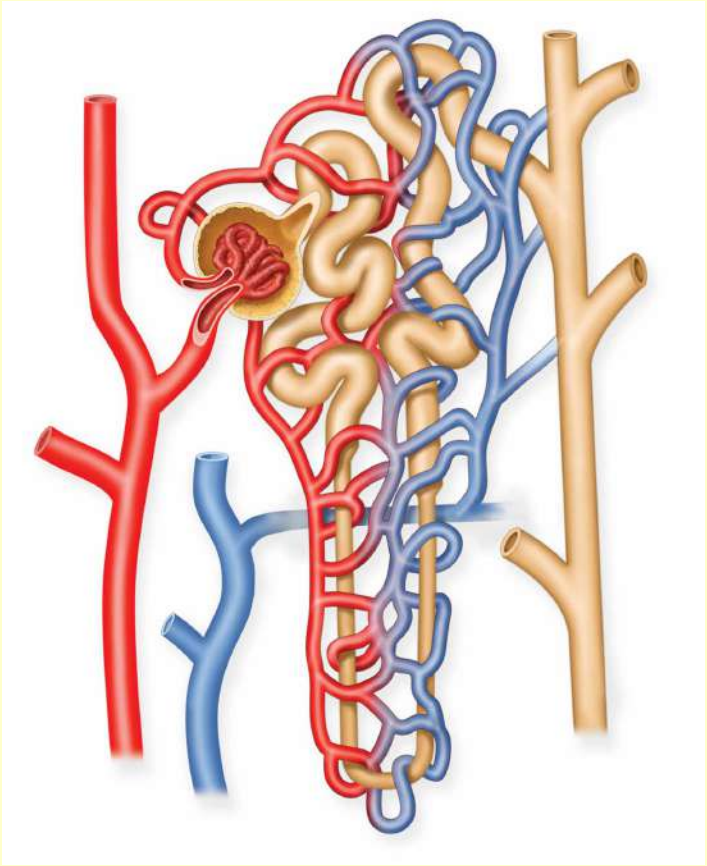
Kidney Animation



Click here to view an animation demonstrating renal blood flow.

Renal Tubules

- Four sections:
  - **Proximal convoluted tubule**
  - **Loop of Henle**
  - **Distal convoluted tubule**
  - **Collecting tubule**
- Filtrate flows through renal tubules to complete urine production process



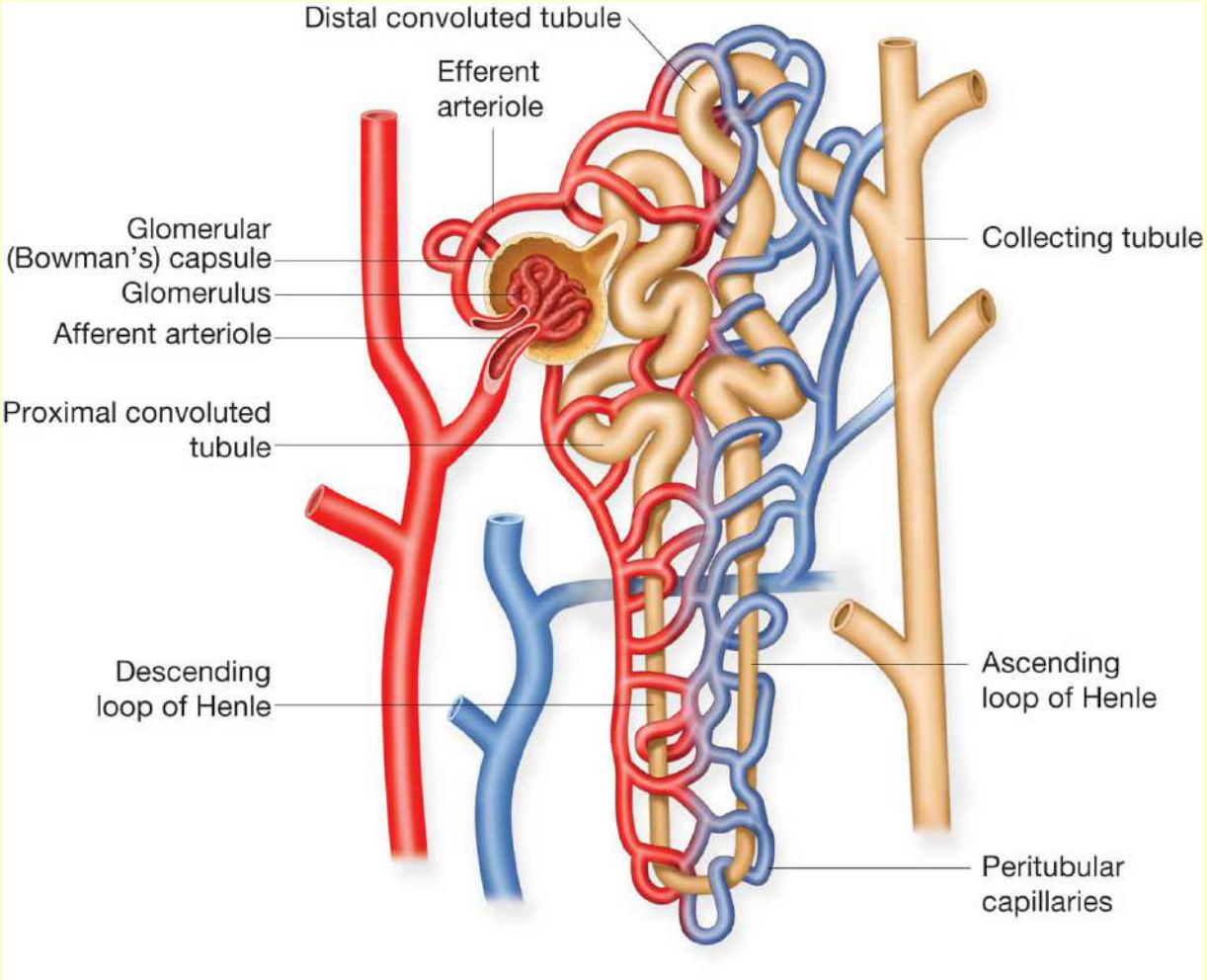
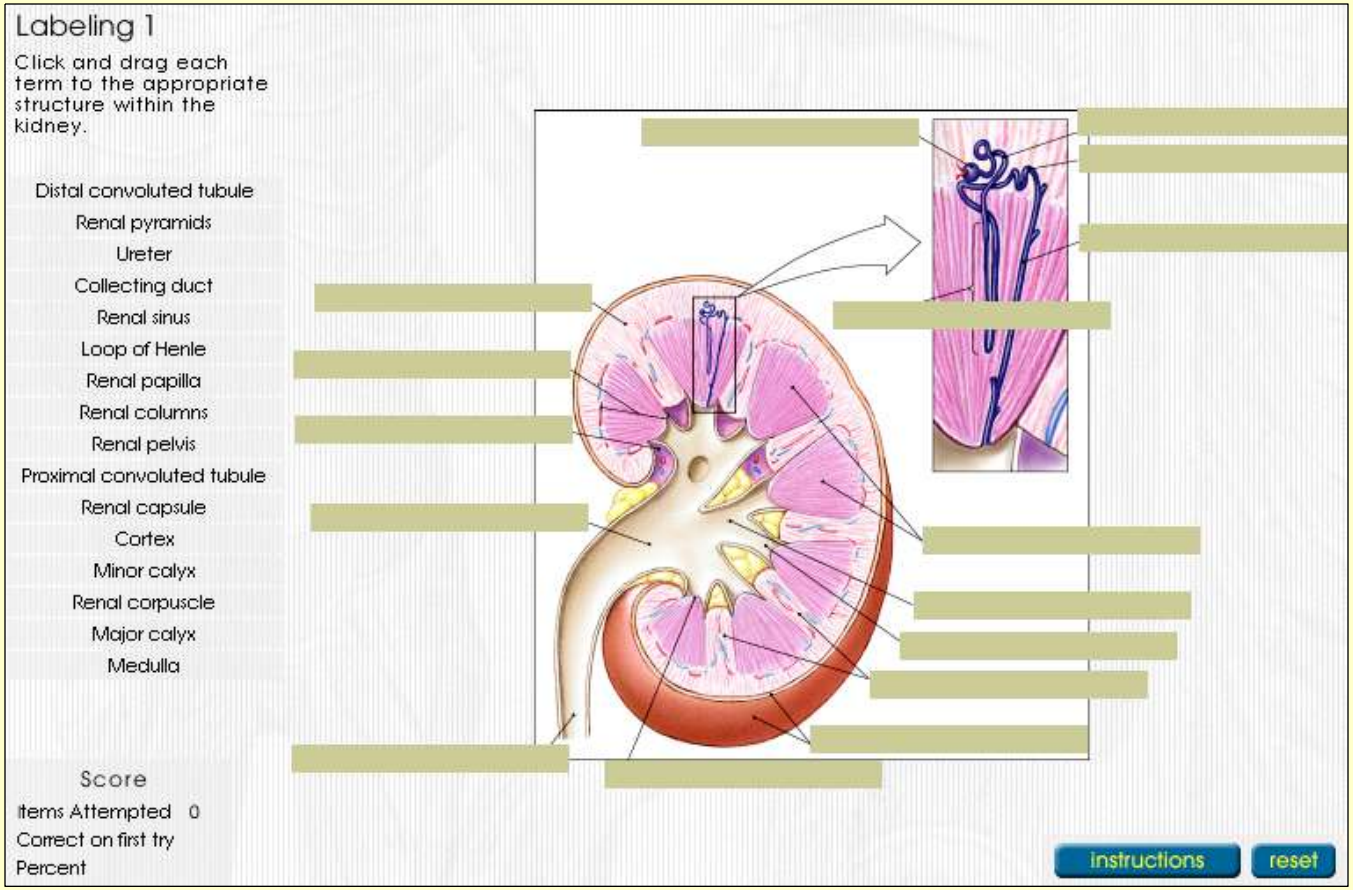


Figure 9.3 – The structure of a nephron.

Kidney Labeling Exercise



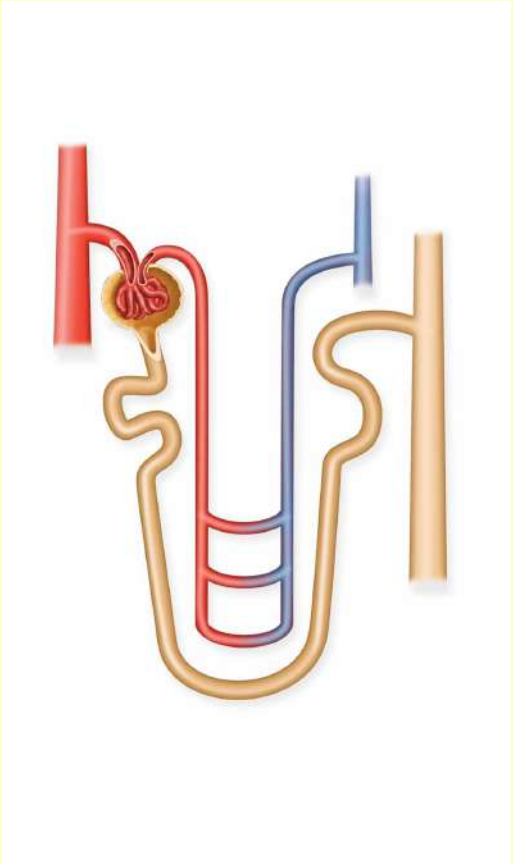
Click here to review kidney internal structures in a labeling activity.

3 Stages of Urine Production

- Urine is produced as filtrate moves through renal tubules
- Three stages:
  - **Filtration**
  - **Reabsorption**
  - **Secretion**

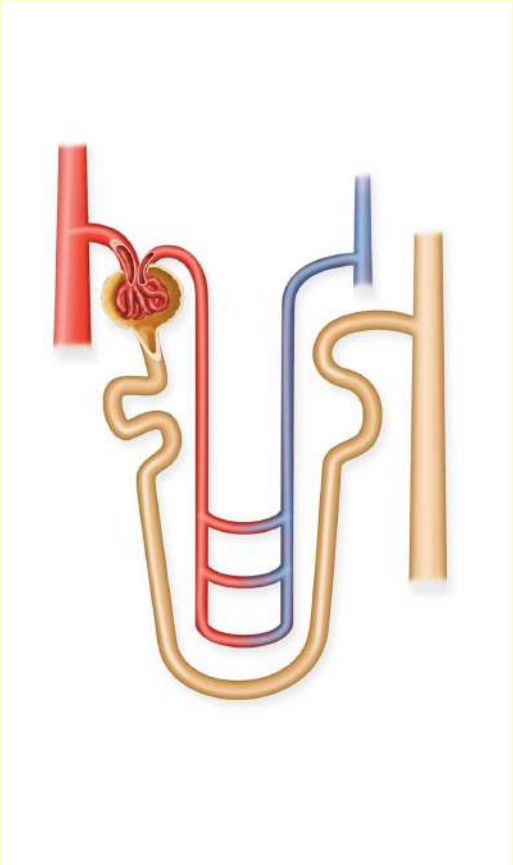
Filtration

- Between glomerulus and Bowman's capsule
- Filtrate is produced
  - Water
  - Glucose
  - Amino acids
  - Wastes
- Filtrate enters renal tubules



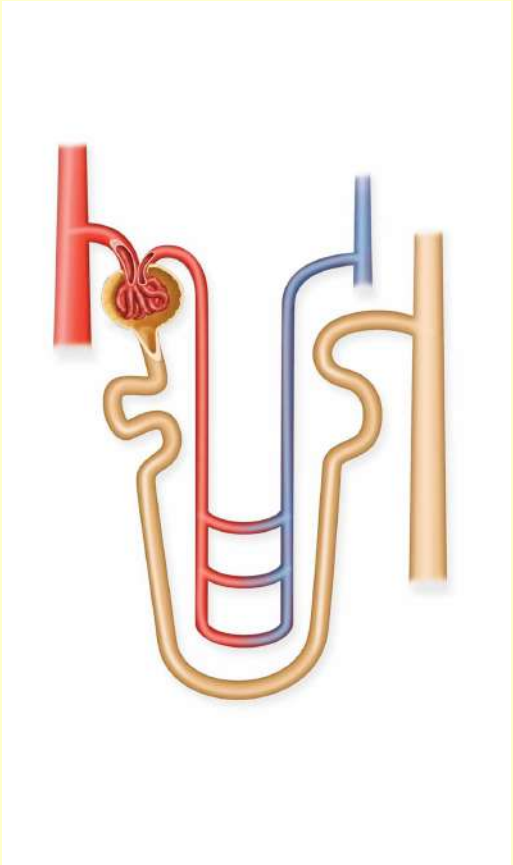
Reabsorption

- As filtrate moves through renal tubules
  - Water & desirable molecules are reabsorbed
  - Returned to blood in peritubular capillaries
  - Waste & undesirable molecules remain in renal tubules



Secretion

- As filtrate moves through renal tubules
  - Additional waste products removed from blood in peritubular capillaries
  - Added to filtrate in renal tubules



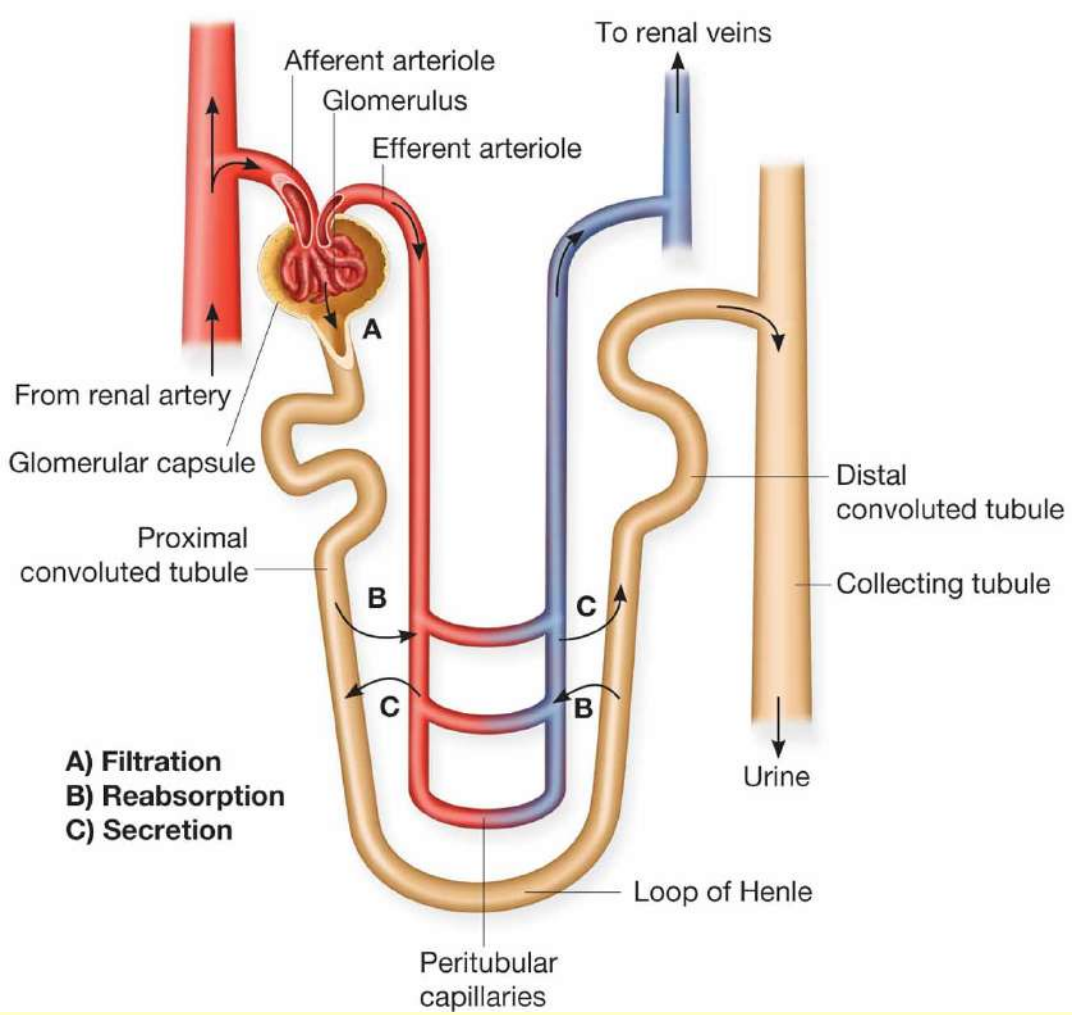
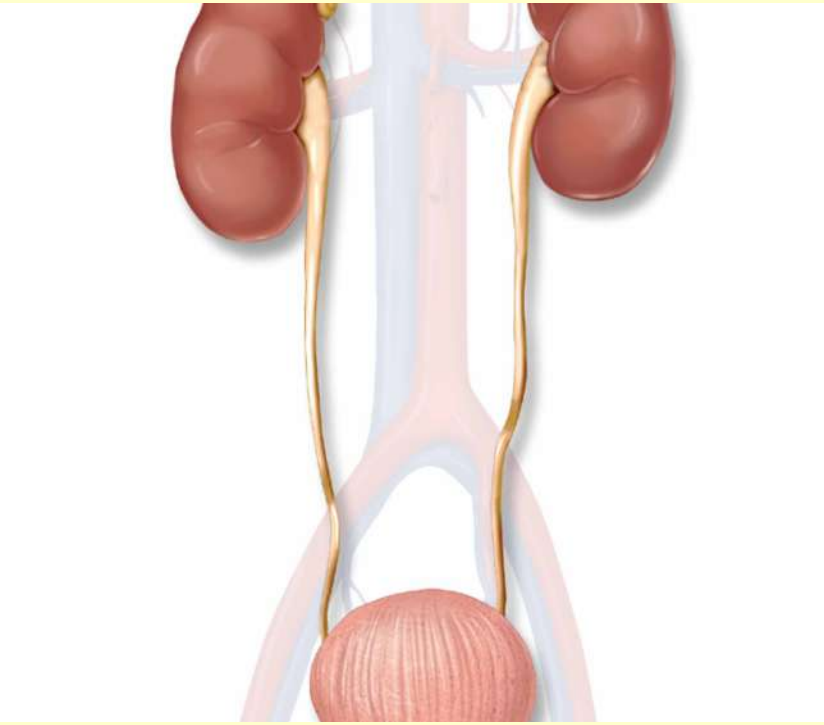


Figure 9.7 – The three stages of urine production: filtration, reabsorption, and secretion.

Ureters

- Urine drains from renal pelvis into ureters
- Extend from renal pelvis to urinary bladder
- Lined with mucous membranes



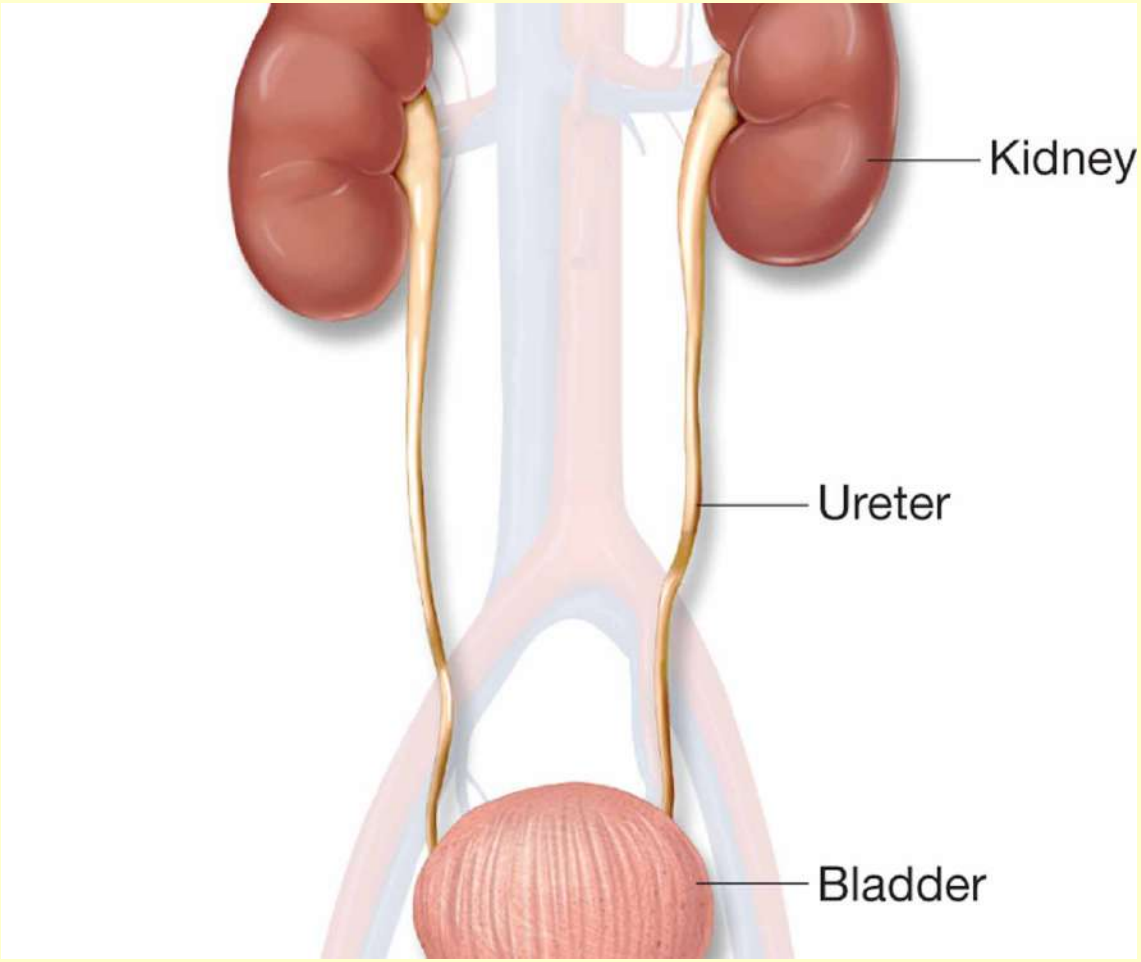
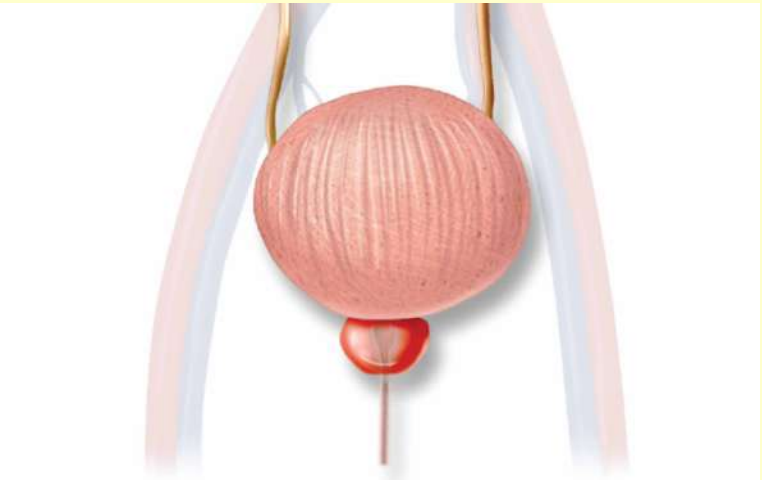


Figure 9.4 – The ureters extend from the kidneys to the urinary bladder.

Urinary Bladder

- Elastic muscular sac
  - Smooth muscle tissue
  - Lined with mucous membrane
  - Folded into rugae
- Lies in base of pelvis
  - Behind pubic symphysis



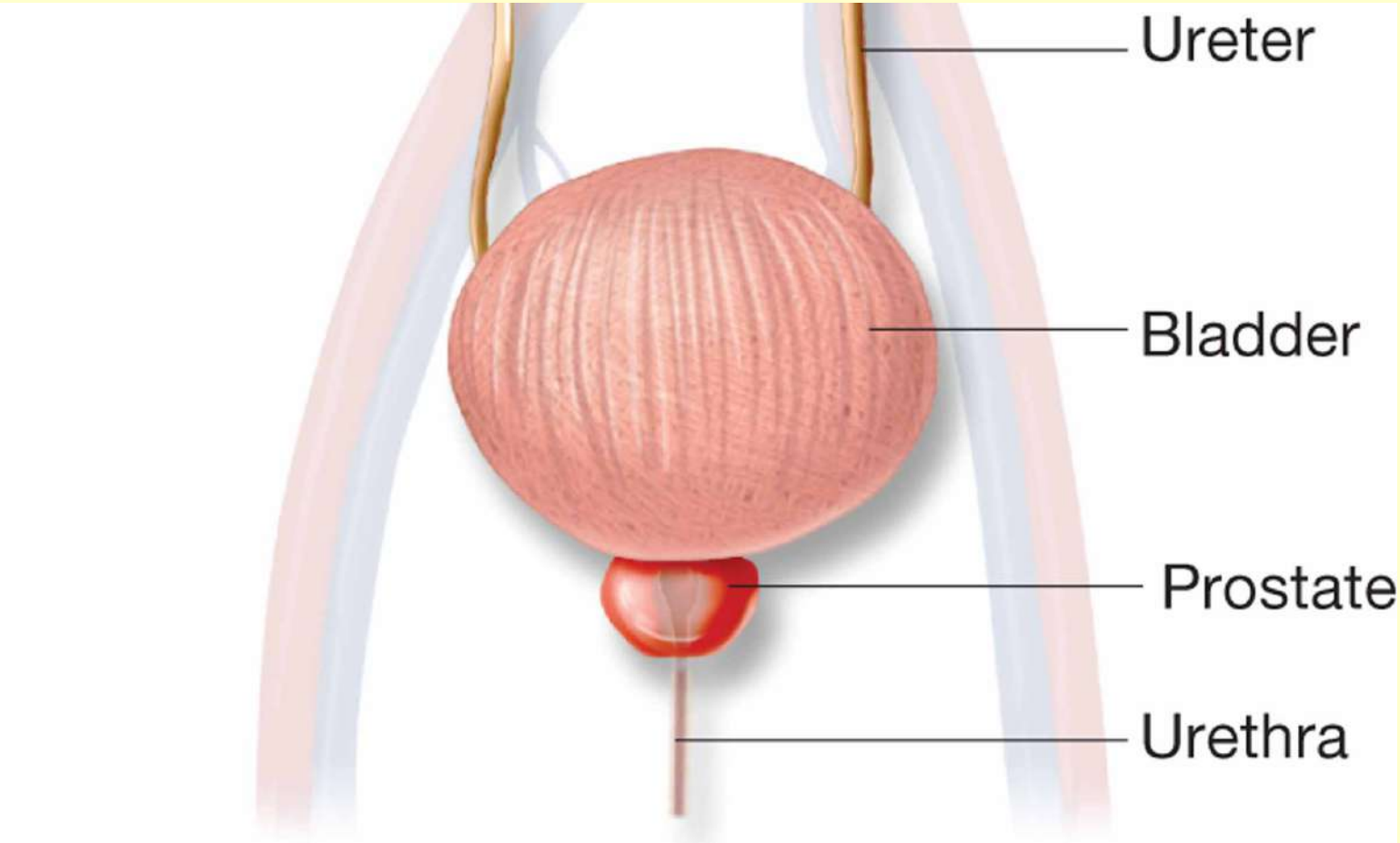


Figure 9.5 – The structure of the urinary bladder.

Urinary Bladder

- Receives urine from ureters
- Stores urine
  - Holds 250 mL of urine
- Excretes through urethra
- Involuntary muscle action causes:
  - Bladder to contract
  - Internal sphincter to relax
- Voluntary muscles control external sphincter

Urethra

- Tubular canal lined with mucous membrane
  - 1½ inches long in females
  - 8 inches long in males
- Carries urine from bladder to outside of body
- External opening is called urinary meatus
- Releasing urine from body is called
  - Micturition
  - Voiding
  - Urination

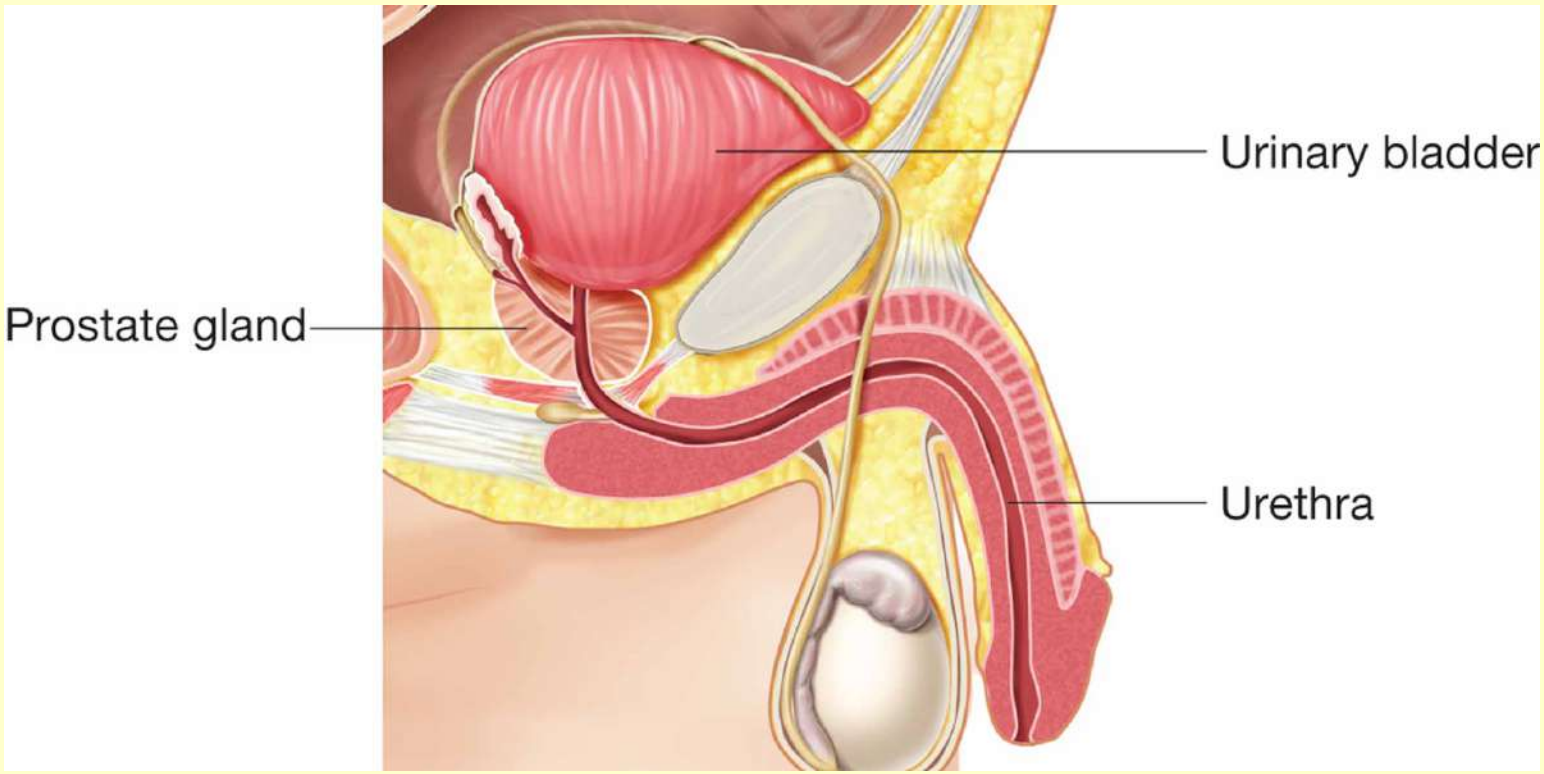


Figure 9.6A – The male urethra extends from the urinary bladder in the floor of the pelvis through the penis to the urinary meatus.

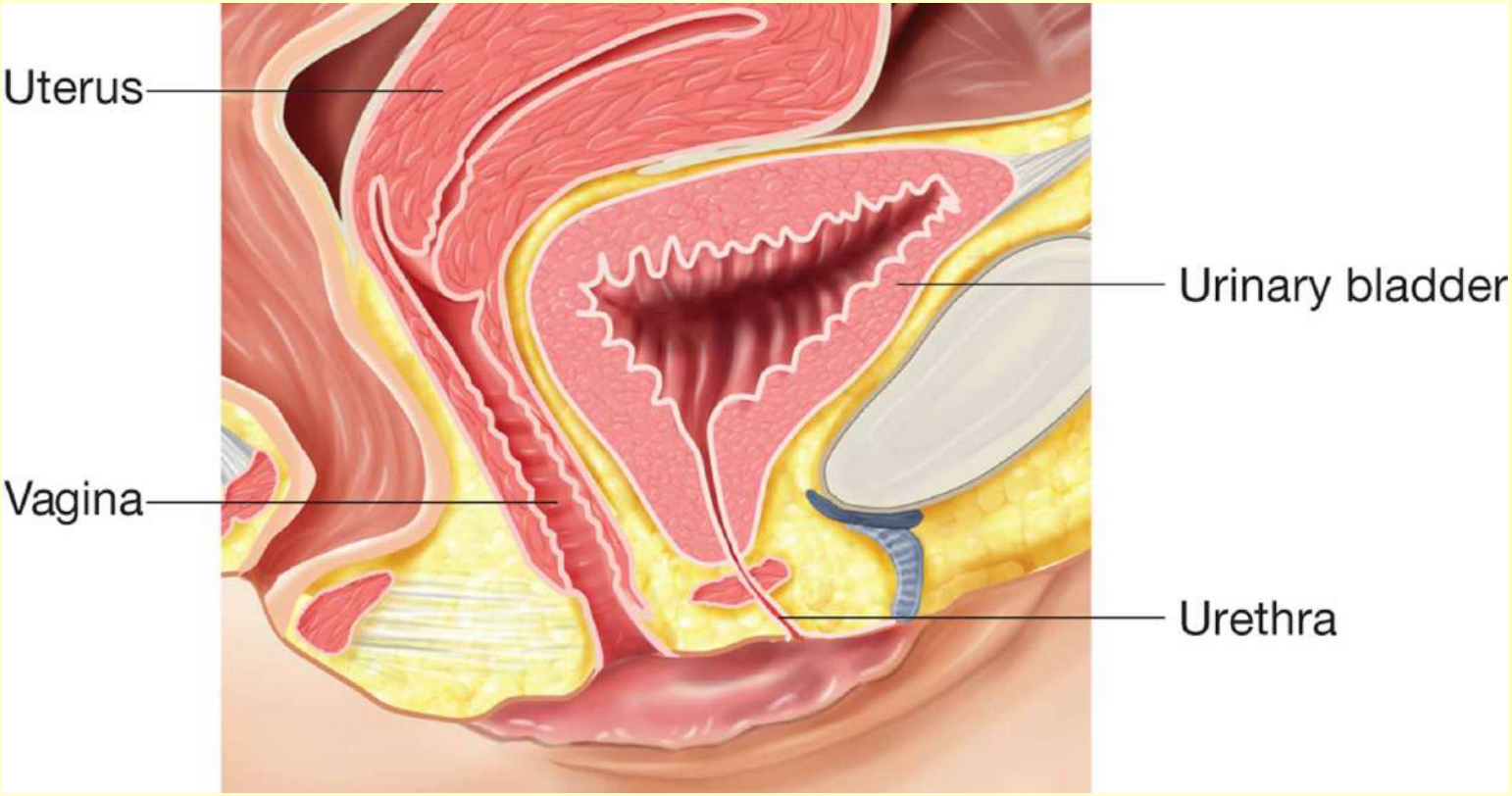


Figure 9.6B – The much shorter female urethra extends from the urinary bladder to the floor of the pelvis and exits just in front of the vaginal opening.

Urine

- Normally straw colored to clear
- 95% water
- Contains:
  - Excess water
  - Excess electrolytes
  - Toxins
  - Nitrogen wastes
- Normal 24-hour output 1,000 to 2,000 mL
- Acidic, specific gravity varies
  - 1:001 to 1:030

Table 9.1 Values for Urinalysis Testing

ELEMENT	NORMAL FINDINGS
Color	Straw colored, pale yellow to deep gold
Odor	Aromatic
Appearance	Clear
Specific gravity	1.005–1.030
pH	5.0–8.0
Protein	Negative to trace
Glucose	None
Ketones	None
Blood	Negative

Table 9.2 Abnormal Urinalysis Findings

ELEMENT	IMPLICATIONS
Color	Color varies depending on the patient's fluid intake and output or medication. Brown or black urine color indicates a serious disease process.
Odor	A fetid or foul odor may indicate infection. For instance, a fruity odor may be found in diabetes mellitus, dehydration, or starvation. Other odors may be due to medication or foods.
Appearance	Cloudiness may mean that an infection is present.
Specific gravity	Concentrated urine has a higher specific gravity. Dilute urine, such as can be found with diabetes insipidus, acute tubular necrosis, or salt-restricted diets, has a lower specific gravity.
pH	A pH value below 7.0 (acidic) is common in urinary tract infections, metabolic or respiratory acidosis, diets high in fruits or vegetables, or administration of some drugs. A pH higher than 7.0 (basic or alkaline) is common in metabolic or respiratory alkalosis, fever, high-protein diets, and taking ascorbic acid.
Protein	Protein may indicate glomerulonephritis or preeclampsia in a pregnant woman.
Glucose	Small amounts of glucose may be present as the result of eating a high-carbohydrate meal, stress, pregnancy, and taking some medications, such as aspirin or corticosteroids. Higher levels may indicate poorly controlled diabetes, Cushing's syndrome, or infection.
Ketones	The presence of ketones may indicate poorly controlled diabetes, dehydration, starvation, or ingestion of large amounts of aspirin.
Blood	Blood may indicate some types of anemia, taking of some medications (such as blood thinners), arsenic poisoning, reactions to transfusion, trauma, burns, and convulsions.

Word Building with cyst/o

–algia	cystalgia	bladder pain
–ectomy	cystectomy	excision of bladder
–gram	cystogram	record of bladder
–ic	cystic	pertaining to bladder
–itis	cystitis	bladder inflammation
–lith	cystolith	bladder stone

Word Building with cyst/o

–ostomy	cystostomy	new opening in bladder
–otomy	cystotomy	incision into bladder
–pexy	cystopexy	surgical fixation of bladder
–plasty	cystoplasty	surgical repair of bladder
–rrhagia	cystorrhagia	rapid bleeding from bladder
–scope	cystoscope	instrument to examine inside bladder

Word Building with lith/o

–tripsy	lithotripsy	surgical crushing of stone
–otomy	lithotomy	incision to remove stone

Word Building with nephr/o

–ectomy	nephrectomy	removal of kidney
–gram	nephrogram	record of kidney
–itis	nephritis	inflammation of kidney
–lith	nephrolith	kidney stone
–logist	nephrologist	kidney specialist
–malacia	nephromalacia	kidney softening

Word Building with nephr/o

–megaly	nephromegaly	kidney enlargement
–oma	nephroma	kidney tumor
–osis	nephrosis	abnormal condition of the kidney
–ptosis	nephroptosis	drooping kidney
–ostomy	nephrostomy	new opening into kidney

Word Building with nephr/o

–otomy	nephrotomy	incision into kidney
–pathy	nephropathy	kidney disease
–pexy	nephropexy	surgical fixation of kidney
–lithiasis	nephrolithiasis	condition of kidney stone
–sclerosis	nephrosclerosis	kidney hardening

Word Building with pyel/o

–gram	pyelogram	record of renal pelvis
–itis	pyelitis	inflammation of renal pelvis
–plasty	pyeloplasty	surgical repair of renal pelvis

Word Building with ren/o and ur/o

–al	renal	pertaining to the kidney

–logist	urologist	urine specialist
–emia	uremia	urine blood condition

Word Building with ureter/o

–al	ureteral	pertaining to ureter
–ectasis	ureterectasis	ureter dilation
–lith	ureterolith	ureter stone
–stenosis	ureterostenosis	narrowing of ureter

Word Building with urethr/o

–al	urethral	pertaining to urethra
–algia	urethralgia	urethra pain
–itis	urethritis	inflammation of urethra
–rrhagia	urethrorrhagia	rapid bleeding from urethra
–scope	urethroscope	instrument to view inside urethra
–stenosis	urethrostenosis	narrowing of urethra

Word Building with urin/o

–meter	urinometer	instrument to measure urine
–ary	urinary	pertaining to urine

Word Building with –uria

an–	anuria	condition of no urine
bacteri/o	bacteriuria	bacteria in the urine
dys–	dysuria	difficult or painful urination
glycos/o	glycosuria	sugar in the urine
hemat/o	hematuria	blood in the urine
keton/o	ketonuria	ketones in the urine

Word Building with –uria

noct/i	nocturia	nighttime urination
olig/o	oliguria	scanty urination
poly–	polyuria	frequent urination
protein	proteinuria	protein in the urine
py/o	pyuria	pus in the urine

Urinary System Vocabulary

anuria	complete lack of urine production and lack of urine excretion
azotemia	nitrogenous waste in the bloodstream
calculus	stone formed within an organ from mineral salts
catheter	flexible tube inserted into the body; commonly through urethra into bladder
diuresis	increased formation and secretion of urine
enuresis	involuntary discharge of urine; also called bed-wetting at night

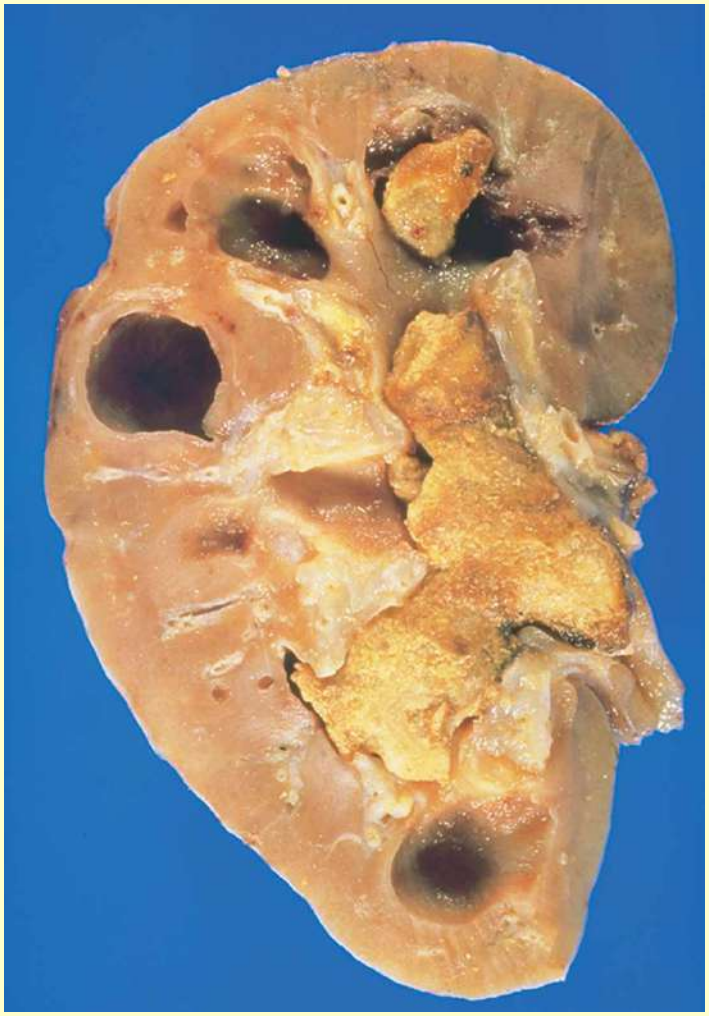


Figure 9.8 – Sectioned kidney specimen illustrating extensive renal calculi.

(Dr. E. Walker/Science Photo Library/Photo Researchers, Inc.)

Figure 9.9 – Healthcare worker draining urine from a bladder catheter bag.

Urinary System Vocabulary

frequency	greater urge to urinate; no increase in total volume of urine
hesitancy	decrease in force of urine stream, often with difficulty initiating the flow
micturition	another term for urination
nephrology	diagnosis and treatment of diseases and conditions of the kidney
renal colic	pain caused by a kidney stone
stricture	narrowing of a passageway in the urinary system

Urinary System Vocabulary

uremia	accumulation of waste products in the bloodstream
urgency	feeling the need to urinate immediately
urinary incontinence	involuntary release of urine
urinary retention	inability to fully empty the bladder
urology	diagnosis and treatment of diseases and conditions of the urinary system
voiding	another term for urination

Kidney Pathology

acute tubular necrosis (ATN)	damage to renal tubules due to toxins in the urine; results in oliguria
diabetic nephropathy	damage to glomerular capillaries due to high blood sugar of diabetes mellitus
glomerulonephritis	inflammation of the kidney; more permeable to protein and blood cells
hydronephrosis	distention of renal pelvis due to accumulation of urine in the kidney

Kidney Pathology

nephrolithiasis	presence of calculi in the kidney; solidification of salts in the urine
nephrotic syndrome (NS)	damage to glomerulus; protein appears in the urine
nephroptosis	downward displacement of the kidney; floating kidney
polycystic kidneys	formation of multiple cysts within the kidney; destroys normal kidney tissue

Kidney Stone Video

Click here to view a video on the topic of kidney stones.

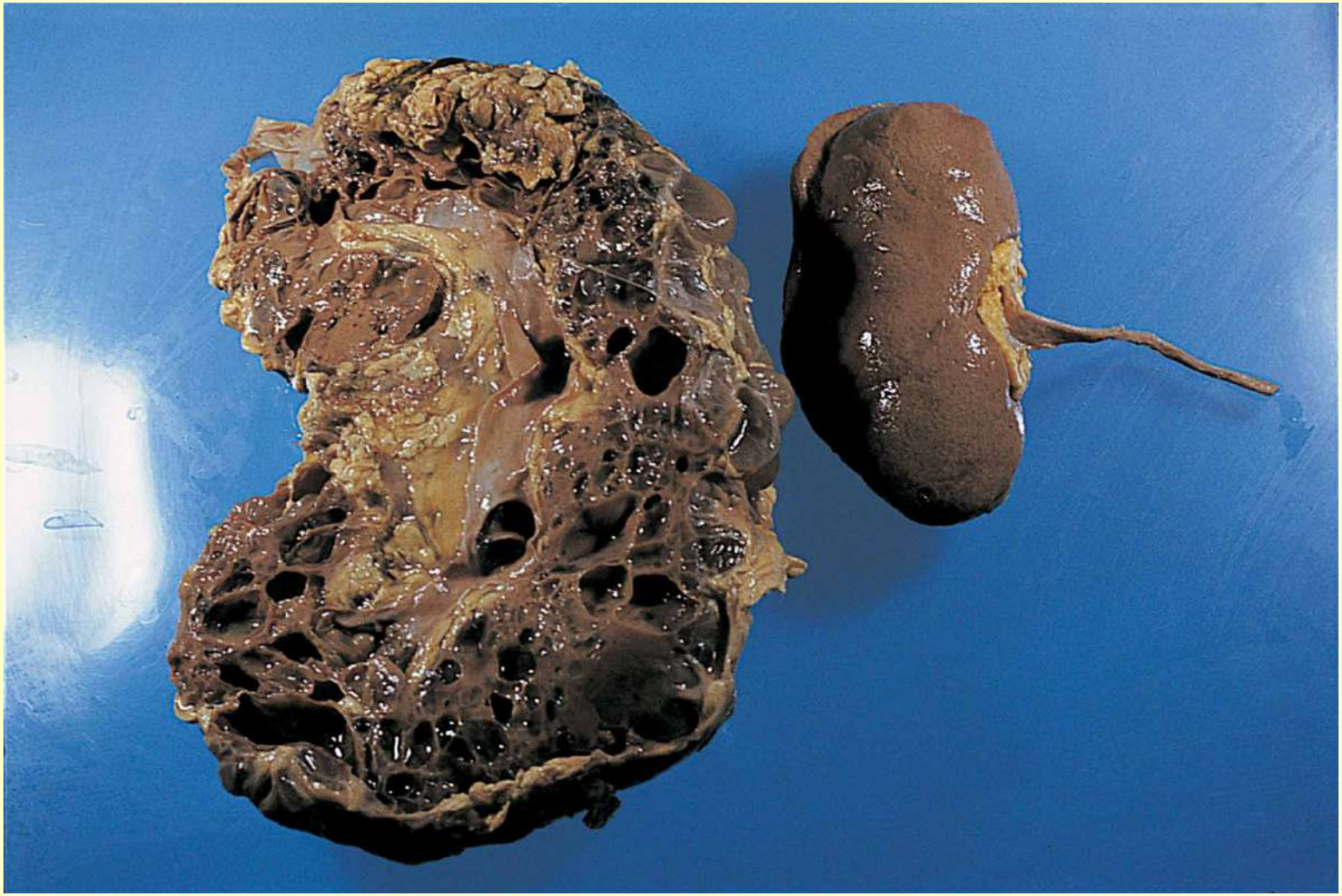
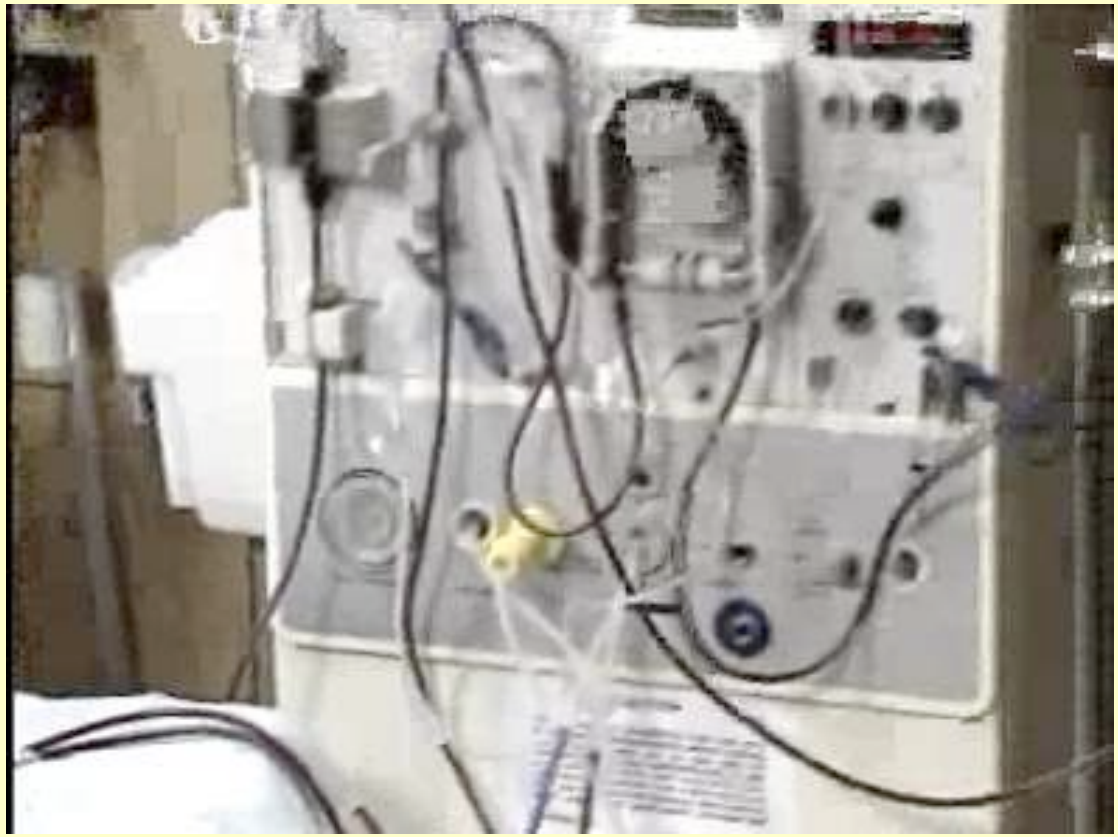


Figure 9.10 – A polycystic kidney on the left compared to a normal kidney on the right.

Kidney Pathology

pyelonephritis	inflammation of renal pelvis and kidney; common type of kidney disease
renal cell carcinoma	cancerous tumor of renal tubule cells
renal failure	inability of kidneys to filter wastes; results in uremia
Wilm's tumor	malignant kidney tumor; most often found in children

Renal Failure Video



Click here to view a video on renal failure.

Urinary Bladder Pathology

bladder cancer	cancerous tumor arising from cells lining bladder; symptom is hematuria
bladder neck obstruction (BNO)	blockage of bladder outlet; often caused by enlarged prostate gland
cystocele	protrusion of the urinary bladder into wall of vagina

Urinary Bladder Pathology

interstitial cystitis	inflammation and irritation of bladder
neurogenic bladder	loss of nervous control; leads to retention
urinary tract infection (UTI)	infection of any organ of urinary system; usually from bacteria; begins with cystitis and may ascend into ureters and kidneys

Clinical Laboratory Tests

blood urea nitrogen (BUN)	blood test to evaluate kidney function by measuring level of nitrogenous waste (urea) in the bloodstream
clean catch specimen (CC)	urine sample obtained after cleaning off the urinary meatus and collecting sample in midstream
creatinine clearance	test of kidney function; amount of creatinine in bloodstream is compared to amount in the urine

Clinical Laboratory Tests

urinalysis (U/A, UA)	physical, chemical, and microscopic examination of urine
urine culture & sensitivity (C&S)	test for bacterial infection; attempt to grow bacteria on a culture medium in order to identify it; then determine which antibiotics it is sensitive to

Urinalysis Video

Click here to view a video on urinalysis.

Diagnostic Imaging

cystography	contrast dye is placed in bladder and then X-ray is taken; outlines bladder
excretory urography (EU)	dye is injected into bloodstream; X-ray traces the dye as it moves through organs of the urinary system
intravenous pyelogram (IVP)	injecting a dye into a vein and then taking an X-ray to outline the renal pelvis

Diagnostic Imaging

kidneys, ureters, bladder (KUB)	abdominal X-ray showing the kidneys, ureters, and bladder; does not use dye
retrograde pyelogram (RP)	dye is inserted through the urethra to outline the bladder, ureters, and renal pelvis
voiding cystourethrography (VCUG)	dye is placed in the bladder; X-ray taken to visualize the urethra while patient is voiding

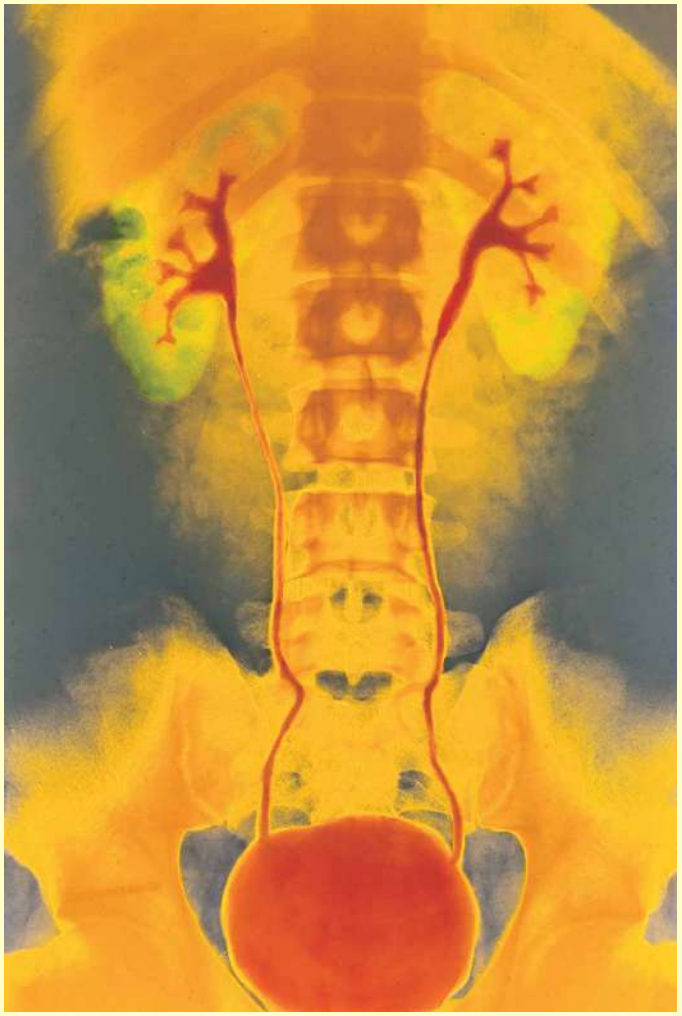


Figure 9.11 – Color enhanced retrograde pyelogram X-ray. Radiopaque dye outlines urinary bladder, ureters, and renal pelves. *(Clinique Ste. Catherine/CNRI/Science Photo Library/Photo Researchers, Inc.)*

Endoscopic Procedures

cystoscopy (cysto)	visual examination of the urinary bladder using a cystoscope

Medical Treatments

catheterization (cath)	insertion of a tube through urethra and into the urinary bladder
extracorporeal shockwave lithotripsy (ESWL)	use of ultrasound waves to break up renal calculi
hemodialysis (HD)	use of artificial kidney machine to filter the blood
peritoneal dialysis	removes wastes using chemically balanced solutions placed into peritoneal cavity

Catheterization Video

Click here to view a video on catheterization.

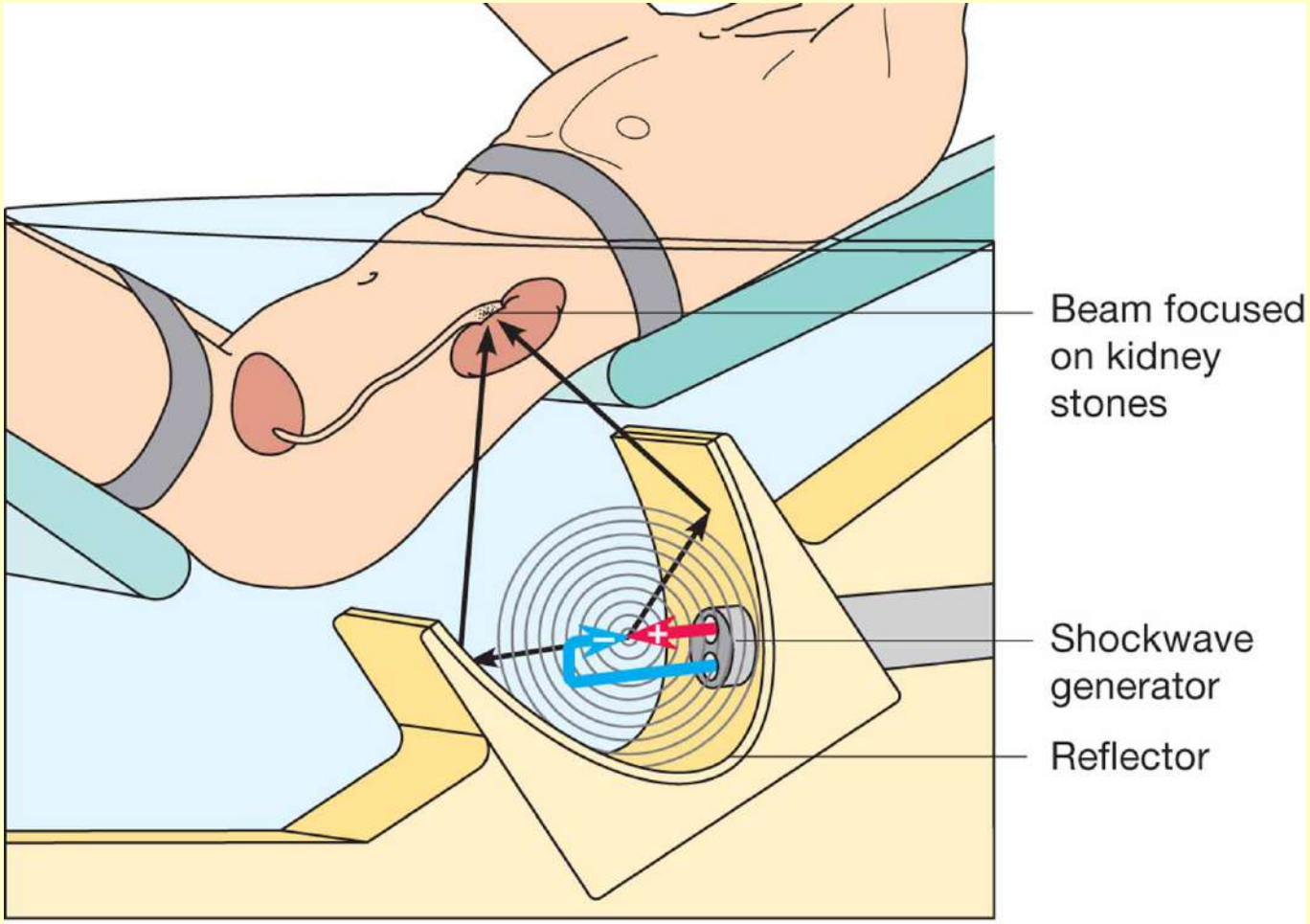


Figure 9.12 – Extracorporeal shockwave lithotripsy, a non-invasive procedure using high frequency sound waves to shatter kidney stones.

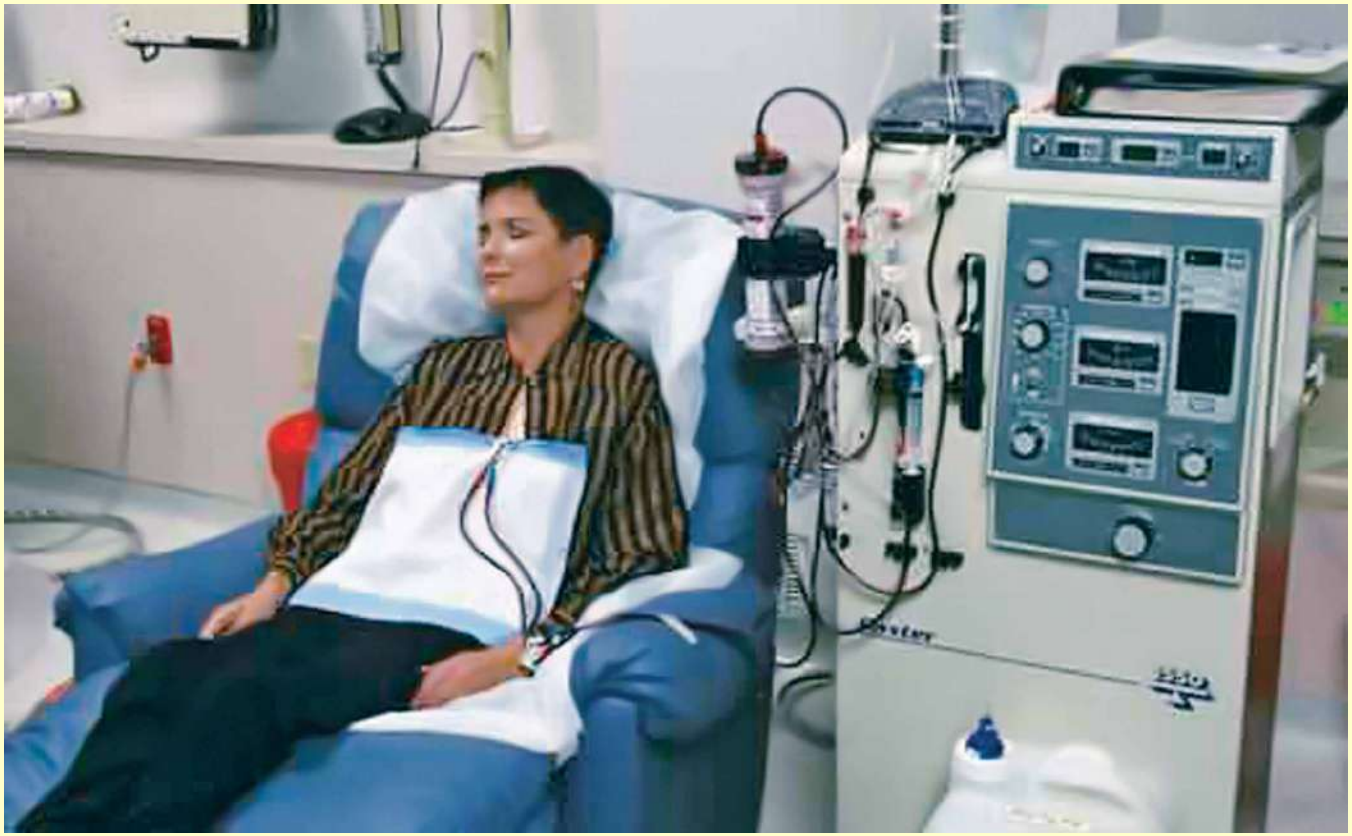


Figure 9.13 – Patient undergoing hemodialysis. Patient's blood passes through hemodialysis machine for cleansing.

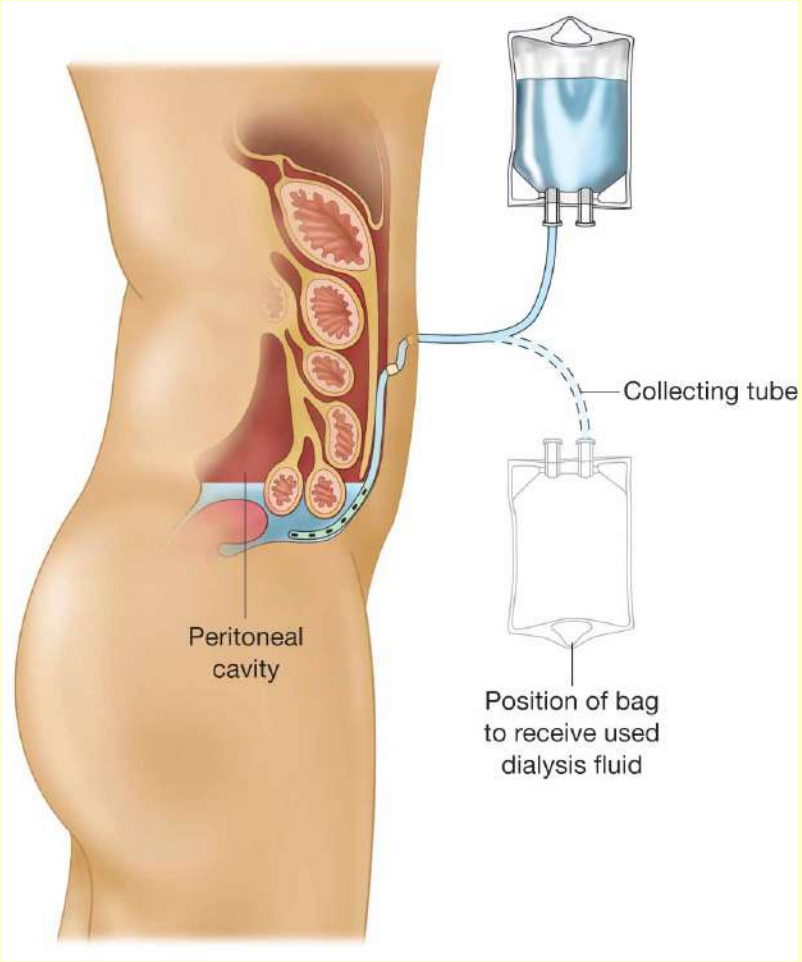


Figure 9.14 – Peritoneal dialysis. Chemically balanced solution is placed into the abdominal cavity to draw impurities out of the bloodstream. It is removed after several hours.

Peritoneal Dialysis Video

Click here to view a video on peritoneal dialysis.

Surgical Treatments

lithotripsy	crushing a stone in the bladder or urethra
meatotomy	incision into the meatus
nephrolithotomy	incision to directly remove stones from the kidney
renal transplant	surgical placement of a donor kidney

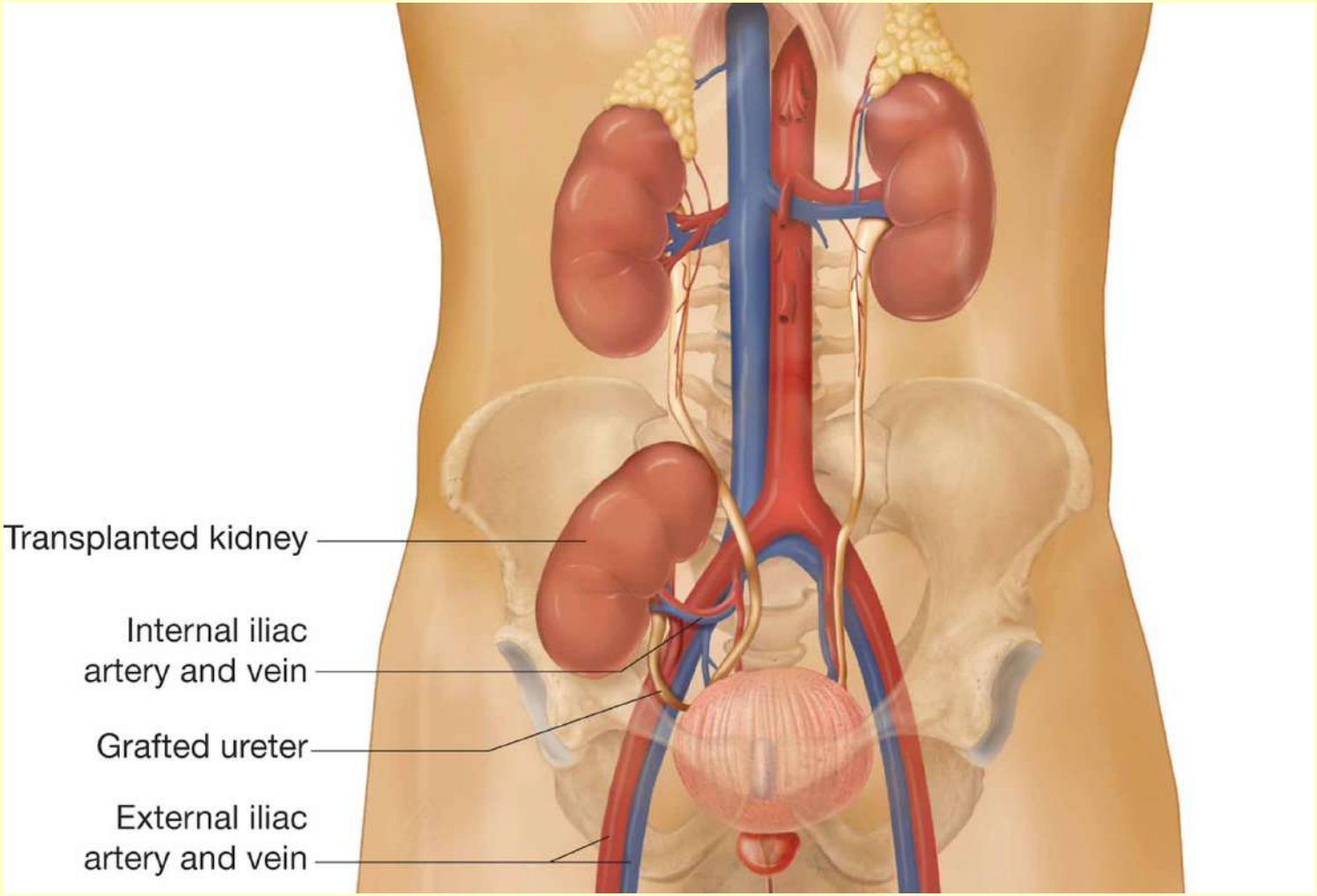


Figure 9.15 – Figure illustrates location utilized for implantation of donor kidney.

Urinary System Pharmacology

antibiotic	treats bacterial infections	Cipro, Macrobid
antispasmodic	prevent or reduce bladder muscle spasms	Ditropan, Prostigmine
diuretics	increases volume of urine	Lasix, Aldactone

Urinary System Abbreviations

AGN	acute glomerulonephritis
ARF	acute renal failure
ATN	acute tubular necrosis
BNO	bladder neck obstruction
BUN	blood urea nitrogen
cath	catheterization

Urinary System Abbreviations

Cl^-	chloride
CRF	chronic renal failure
C&S	culture and sensitivity
CAPD	continuous ambulatory peritoneal dialysis
CC	clean catch urine specimen
cysto	cystoscopy
ESRD	end-stage renal disease

Urinary System Abbreviations

ESWL	extracorporeal shockwave lithotripsy
EU	excretory urography
GU	genitourinary
HCO_3^-	bicarbonate
HD	hemodialysis
H_2O	water
I&O	input and output

Urinary System Abbreviations

IPD	intermittent peritoneal dialysis
IVP	intravenous pyelogram
K^+	potassium
KUB	kidney, ureter, bladder
mL	milliliter
Na^+	sodium
NS	nephrotic syndrome

Urinary System Abbreviations

pH	acidity or alkalinity
RP	retrograde pyelogram
SG, sp.gr.	specific gravity
U/A, UA	urinalysis
UC	urine culture
UTI	urinary tract infection
VCUG	voiding cystourethrography