Using Figure 15.1, identify the following:

1) The ureter is indicated by letter ________.
   Answer: B
   Diff: 1 Page Ref: 520

2) The renal pyramid is indicated by letter ________.
   Answer: D
   Diff: 1 Page Ref: 520

3) The fibrous capsule is indicated by letter ________.
   Answer: F
   Diff: 1 Page Ref: 520

4) The renal column is indicated by letter ________.
   Answer: C
   Diff: 1 Page Ref: 520
Using Figure 15.2, identify the following:

5) The loop of Henle is indicated by letter _________.
   Answer: J
   Diff: 1    Page Ref: 522

6) The collecting duct is indicated by letter _________.
   Answer: K
   Diff: 1    Page Ref: 522

7) The glomerular capsule (Bowman's capsule) is indicated by letter _________.
   Answer: A
   Diff: 1    Page Ref: 522

8) The proximal convoluted tubule is indicated by letter _________.
   Answer: M
   Diff: 1    Page Ref: 522
9) The afferent arteriole is indicated by letter _________.  
Answer: B  
Diff: 1  Page Ref: 522

10) The arcuate vein is indicated by letter _________.  
Answer: G  
Diff: 1  Page Ref: 522

11) The glomerulus is indicated by letter _________.  
Answer: O  
Diff: 1  Page Ref: 522

**Fill in the blank or provide a short answer:**

12) Each kidney is surrounded and held in place against the muscles of the trunk wall by its _________.  
Answer: renal fascia  
Diff: 2  Page Ref: 519

13) There are three regions of the kidney; the outermost region is known as the _________.  
Answer: renal cortex  
Diff: 1  Page Ref: 520

14) Renal pyramids are separated by extensions of cortex-like tissue called the _________.  
Answer: renal columns  
Diff: 2  Page Ref: 521

15) As blood flows toward the kidney, it travels from the renal artery into vessels called the _________.  
Answer: segmental arteries  
Diff: 3  Page Ref: 521

16) The process of filtration occurs in a specific structure in the nephron called the _________.  
Answer: glomerulus  
Diff: 2  Page Ref: 523

17) A urinary output of less than 100 mL per day is called _________.  
Answer: anuria  
Diff: 1  Page Ref: 524

18) The pigment resulting from the destruction of hemoglobin that gives freshly-voided urine its pale yellow color is called _________.  
Answer: urochrome  
Diff: 2  Page Ref: 524

19) A vegetarian diet is said to be a(n) _________. diet because it makes urine extremely alkaline as the kidneys excrete excess bases.  
Answer: alkaline-ash  
Diff: 2  Page Ref: 525
20) The condition that results when red blood cells are abnormally present in urine is called _________.  
   Answer: hematuria  
   Diff: 2  Page Ref: 528

21) Specific gravity is the term used to compare how much heavier urine is than _________.  
   Answer: distilled water  
   Diff: 1  Page Ref: 525

22) Another term for kidney stones, which form when urine becomes extremely concentrated, is _________.  
   Answer: renal calculi  
   Diff: 2  Page Ref: 528

23) The smooth triangular region of the bladder base that is outlined by the openings of the two ureters and the urethra is called the _________.  
   Answer: trigone  
   Diff: 2  Page Ref: 528

24) Urinary bladder inflammation often caused by bacterial infection is called _________.  
   Answer: cystitis  
   Diff: 1  Page Ref: 530

25) The involuntary sphincter that keeps the urethra closed when urine is not being passed is called the _________.  
   Answer: internal urethral sphincter  
   Diff: 1  Page Ref: 529

26) The inability to voluntarily control the external urethral sphincter is known as _________.  
   Answer: incontinence  
   Diff: 1  Page Ref: 530

27) Voiding, urination, and ________ are terms that indicate the passage of urine from the bladder.  
   Answer: micturition  
   Diff: 2  Page Ref: 530

28) About two-thirds of body fluid is found within living cells; this fluid is called the _________.  
   Answer: intracellular fluid (ICF)  
   Diff: 2  Page Ref: 531

29) Sodium ion content of the extracellular fluid (ECF) is largely regulated by an adrenal cortex hormone called _________.  
   Answer: aldosterone  
   Diff: 3  Page Ref: 533

30) Highly sensitive cells within the hypothalamus that react to changes in blood composition and cause the release of antidiuretic hormone (ADH) when appropriate are called _________.  
   Answer: osmoreceptors  
   Diff: 3  Page Ref: 532
31) The abnormal condition that results from the lack of ADH release, causing huge amounts of very dilute urine to be voided, is called __________.
   Answer: diabetes insipidus
   Diff: 2  Page Ref: 533

32) The primary urinary symptom of Addison's disease (hypoaldosteronism) is called __________.
   Answer: polyuria
   Diff: 3  Page Ref: 535

33) Arterial blood pH between 7.35 and 7.0 is called __________.
   Answer: physiological acidosis
   Diff: 3  Page Ref: 535

34) A strong acid will dissociate and liberate more __________ ions in water than a weak acid.
   Answer: hydrogen (H^+)
   Diff: 2  Page Ref: 536

35) The kidneys can help maintain a rising blood pH by excreting __________ ions and reabsorbing __________ ions by the tubule cells.
   Answer: bicarbonate; hydrogen
   Diff: 3  Page Ref: 537

36) The need to urinate frequently at night, which plagues over 50% of the elderly, is called __________.
   Answer: nocturia
   Diff: 2  Page Ref: 538

37) Untreated streptococcal infections in childhood that can lead to the kidney infection characterized by antigen–antibody complexes clogging the glomerular filters is known as __________.
   Answer: glomerulonephritis
   Diff: 3  Page Ref: 538

38) A feeling that it is necessary to void, which is experienced more regularly in the elderly, is known as __________.
   Answer: urgency
   Diff: 3  Page Ref: 538

Multiple Choice

1) Which one of the following is NOT one of the functions of the kidneys:
   A) manufacture urine
   B) convert vitamin D from its inactive to its active form
   C) dispose of metabolic waste products
   D) produce hormones that assist in digestion
   E) regulate blood volume
   Answer: D
   Diff: 1  Page Ref: 518
2) Which of the following is NOT an organ found in the urinary system:
   A) kidney
   B) ureter
   C) pancreas
   D) urinary bladder
   E) urethra
Answer: C
Diff: 1   Page Ref: 518

3) Which one of the following terms describes the location of the kidneys:
   A) suprarenal
   B) retroperineal
   C) adrenal
   D) intraperitoneal
   E) retroperitoneal
Answer: E
Diff: 1   Page Ref: 518

4) The kidneys are aided in the excretion of fluids by the:
   A) lungs
   B) skin
   C) hair
   D) lungs and skin
   E) skin and hair
Answer: D
Diff: 1   Page Ref: 518

5) The triangular regions of the kidneys that are striped in appearance and separated by the renal columns are the:
   A) renal cortex
   B) renal medulla
   C) renal pyramids
   D) renal pelvis
   E) calyces
Answer: C
Diff: 1   Page Ref: 521

6) As venous blood is drained from the kidney, which path does it follow:
   A) cortical radiate veins, arcuate veins, interlobar veins, renal vein
   B) renal vein, interlobar veins, segmental veins, arcuate veins
   C) arcuate veins, cortical radiate veins, interlobar veins, renal vein
   D) renal vein, segmental veins, interlobar veins, arcuate veins, cortical radiate veins
   E) cortical radiate veins, arcuate veins, interlobar veins, segmental veins, renal vein
Answer: A
Diff: 3   Page Ref: 521
7) The enlarged, cup-shaped closed end of the renal tubule that completely surrounds the glomerulus is called the:
   A) collecting duct
   B) proximal convoluted tubule
   C) loop of Henle
   D) Bowman's capsule
   E) distal convoluted tubule
   Answer: D
   Diff: 1    Page Ref: 521

8) Each kidney contains about:
   A) 100,000 nephrons
   B) 500,000 nephrons
   C) 1 million nephrons
   D) 2 million nephrons
   E) 3 million nephrons
   Answer: C
   Diff: 1    Page Ref: 521

9) Starting from the glomerular capsule, the correct order of the renal tubule regions is:
   A) proximal convoluted tubule, distal convoluted tubule, loop of Henle
   B) distal convoluted tubule, loop of Henle, proximal convoluted tubule
   C) loop of Henle, proximal convoluted tubule, distal convoluted tubule
   D) proximal convoluted tubule, loop of Henle, distal convoluted tubule
   E) distal convoluted tubule, proximal convoluted tubule, loop of Henle
   Answer: D
   Diff: 1    Page Ref: 521

10) The portion of the renal tubule that completely surrounds the glomerulus is the:
   A) collecting duct
   B) proximal convoluted tubule (PCT)
   C) glomerular (Bowman's) capsule
   D) distal convoluted tubule (DCT)
   E) loop of Henle
   Answer: C
   Diff: 2    Page Ref: 521

11) Most nephrons are located within the renal:
    A) pelvis
    B) calyces
    C) medulla
    D) pyramids
    E) cortex
    Answer: E
    Diff: 2    Page Ref: 523
12) The percentage of filtrate eventually reabsorbed into the bloodstream is closest to:
   A) 10%
   B) 25%
   C) 50%
   D) 80%
   E) 99%
   Answer: E
   Diff: 2 Page Ref: 523

13) Of the capillary beds associated with each nephron, the one that is both fed and drained by arterioles is the:
   A) peritubular capillaries
   B) pyramidal capillaries
   C) glomerulus
   D) Henle capillaries
   E) Bowman’s capillaries
   Answer: C
   Diff: 3 Page Ref: 523

14) The peritubular capillaries arise from the ________, which drains the glomerulus.
   A) afferent arteriole
   B) efferent arteriole
   C) Bowman's capsule
   D) loop of Henle
   E) glomerulus
   Answer: B
   Diff: 3 Page Ref: 523

15) The nonselective, passive process performed by the glomerulus that forms blood plasma without blood proteins is called:
   A) absorption
   B) secretion
   C) filtration
   D) tubular reabsorption
   E) glomerular reabsorption
   Answer: C
   Diff: 2 Page Ref: 523, 524

16) Uric acid, a nitrogenous waste product, results from the metabolism of:
   A) creatinine
   B) nucleic acids
   C) proteins
   D) amino acids
   E) salt
   Answer: B
   Diff: 2 Page Ref: 524
17) Which one of the following is NOT a substance typically reabsorbed by the tubules under normal healthy conditions:
   A) glucose
   B) urea
   C) amino acids
   D) sodium
   E) water
   Answer: B
   Diff: 2     Page Ref: 524

18) Which one of the following is NOT true of urine under normal healthy conditions:
   A) it is sterile
   B) it is slightly alkaline
   C) it is more dense than water
   D) it is slightly aromatic
   E) it typically contains ammonia
   Answer: B
   Diff: 2     Page Ref: 524-525; 527

19) Which one of the following substances is normally found in urine:
   A) blood proteins
   B) red blood cells
   C) hemoglobin
   D) white blood cells
   E) creatinine
   Answer: E
   Diff: 2     Page Ref: 524; 527

20) The presence of pus in urine is called:
    A) glycosuria
    B) pyuria
    C) bilirubinuria
    D) hematuria
    E) proteinuria
    Answer: B
    Diff: 2     Page Ref: 527

21) Dilute urine would have a specific gravity closest to:
    A) 0.005
    B) 1.001
    C) 1.010
    D) 1.020
    E) 1.030
    Answer: B
    Diff: 2     Page Ref: 525
22) The tube connecting the renal hilus of the kidney to the bladder is the:
   A) urethra  
   B) proximal convoluted tubule  
   C) distal convoluted tubule  
   D) ureter  
   E) collecting duct  
Answer: D  
Diff: 2   Page Ref: 528

23) The noninvasive treatment for kidney stones that uses ultrasound waves to shatter calculi is called:
   A) lithotripsy  
   B) lithiasis  
   C) lithectomy  
   D) lithotomy  
   E) lithoscopy  
Answer: A  
Diff: 2   Page Ref: 528

24) The bladder is able to expand as urine accumulates within it due to the presence of:
   A) rugae  
   B) transitional epithelium  
   C) segmentation  
   D) pseudostratified epithelium  
   E) sphincters  
Answer: B  
Diff: 2   Page Ref: 529

25) Urine is transported from the bladder to the outside of the body by the:
   A) ureter  
   B) trigone  
   C) prostate gland  
   D) urethra  
   E) collecting duct  
Answer: D  
Diff: 2   Page Ref: 529

26) The average adult bladder is moderately full with _________ of urine within it.
   A) 100 mL  
   B) 500 mL  
   C) 1 liter  
   D) 2 liters  
   E) 1 gallon  
Answer: B  
Diff: 2   Page Ref: 529
27) The voluntarily controlled sphincter fashioned by skeletal muscle at the point where the urethra passes through the pelvic floor is called the:
   A) internal urethral sphincter
   B) internal anal sphincter
   C) external urethral sphincter
   D) trigone
   E) detrusor sphincter
   Answer: C  
   Diff: 2   Page Ref: 529

28) The process of emptying the bladder is referred to as voiding or:
   A) tubular secretion
   B) filtration
   C) tubular reabsorption
   D) incontinence
   E) micturition
   Answer: E  
   Diff: 2   Page Ref: 530

29) Which one of the following is NOT true of incontinence:
   A) it occurs when we are unable to voluntarily control the external sphincter
   B) it is normal in children 2 years old or younger
   C) it is normal in older children who sleep soundly
   D) it can result from pressure on the bladder
   E) it is never considered normal
   Answer: E  
   Diff: 2   Page Ref: 530

30) Enlargement of the prostate that surrounds the neck of the bladder in adult men is called __________, which may cause voiding difficulty.
   A) atrophy
   B) dystrophy
   C) hyperplasia
   D) hypoplasia
   E) eutrophy
   Answer: C  
   Diff: 2   Page Ref: 530

31) In one 24-hour period, the kidneys of an average-sized healthy adult filter approximately __________ through their glomeruli into the tubules.
   A) 10–15 liters of blood plasma
   B) 50–75 liters of blood plasma
   C) 100–125 liters of blood plasma
   D) 150–180 liters of blood plasma
   E) 200–240 liters of blood plasma
   Answer: D  
   Diff: 3   Page Ref: 524
32) In contrasting urine and filtrate by the time it reaches the collecting ducts, it could be said that:
   A) they contain essentially the same concentration of nutrients
   B) they contain essentially the same amount of water
   C) filtrate contains almost everything that blood plasma does
   D) urine contains almost everything that blood plasma does
   E) filtrate contains more unnecessary substances than urine does

   Answer: C
   Diff: 3  Page Ref: 523-524

33) Which one of the following is NOT one of the major roles of the kidneys in normal healthy adults:
   A) excretion of nitrogen-containing wastes
   B) maintenance of water balance of the blood
   C) maintenance of electrolyte balance of the blood
   D) conversion of ammonia to bicarbonate ion
   E) ensuring proper blood pH

   Answer: D
   Diff: 3  Page Ref: 531

34) In a healthy young adult female, water accounts for:
   A) one-quarter of body weight
   B) less than one-half of body weight
   C) approximately one-half of body weight
   D) three-quarters of body weight
   E) 99% of body weight

   Answer: C
   Diff: 2  Page Ref: 531

35) Extracellular fluid is found everywhere in the body EXCEPT:
   A) within living cells
   B) blood plasma
   C) interstitial fluid
   D) cerebrospinal fluid
   E) humors of the eye and lymph

   Answer: A
   Diff: 1  Page Ref: 531

36) The main hormone that acts on the kidneys to regulate sodium ion concentration of the extracellular fluid (ECF) is:
   A) ADH
   B) renin
   C) secretin
   D) aldosterone
   E) epinephrine

   Answer: D
   Diff: 3  Page Ref: 533
37) Antidiuretic hormone prevents excessive water loss by promoting water reabsorption in the:
   A) glomerulus
   B) proximal convoluted tubule
   C) distal convoluted tubule
   D) collecting duct
   E) bladder
Answer: D
Diff: 3     Page Ref: 533

38) A simple rule concerning water and electrolyte regulation is:
   A) salt passively follows water
   B) salt actively follows water
   C) potassium passively follows sodium
   D) water passively follows salt
   E) water actively follows salt
Answer: D
Diff: 2     Page Ref: 535

39) The results of the renin-angiotensin mechanism mediated by the juxtaglomerular apparatus of the renal tubules include all of the following EXCEPT:
   A) vasoconstriction
   B) increased peripheral resistance
   C) blood volume increase
   D) blood pressure increase
   E) suppression of aldosterone
Answer: E
Diff: 3     Page Ref: 535

40) The proper pH for the blood is:
   A) 6.8–6.9
   B) 7.0–7.35
   C) 7.35–7.45
   D) 7.5–8.0
   E) 6.5–8.0
Answer: C
Diff: 2     Page Ref: 535

41) The chemical buffer system that includes carbonic acid and its salt, which ties up the H⁺ released by strong acids, is called the:
   A) phosphate buffer system
   B) protein buffer system
   C) ionic buffer system
   D) bicarbonate buffer system
   E) carbonic buffer system
Answer: D
Diff: 2     Page Ref: 536
42) The chemically buffered combination of strong acids that dissociate completely in water with weak bases such as hydroxides leads to a:
   A) weak acid and a salt
   B) weak acid and a strong base
   C) strong base and a salt
   D) weak base and water
   E) weak base and salt
   Answer: A
   Diff: 3   Page Ref: 536

43) When carbon dioxide enters the blood from tissue cells, it is converted to _________ for transport within blood plasma.
   A) sodium hydroxide
   B) ammonia
   C) carbonic anhydrase
   D) bicarbonate ion
   E) sodium bicarbonate
   Answer: D
   Diff: 2   Page Ref: 537

44) When blood pH begins to rise, the respiratory control centers in the brain are:
   A) accelerated
   B) depressed
   C) not effected
   D) shut off
   E) controlled by the kidneys
   Answer: B
   Diff: 2   Page Ref: 537

45) The most potent of all mechanisms and substances that the body uses to regulate blood pH are:
   A) the respiratory system controls
   B) the kidneys
   C) hormones
   D) the buffer system
   E) enzymes
   Answer: B
   Diff: 2   Page Ref: 537

46) Functional kidneys develop within the womb by the third month after conception from the _________ set of tubule systems.
   A) first
   B) second
   C) third
   D) fourth
   E) fifth
   Answer: C
   Diff: 3   Page Ref: 538
47) The degenerative condition in which blisterlike sacs (cysts) containing urine form on the kidneys and obstruct urine drainage is called:
   A) cystitis
   B) dysuria
   C) hypospadias
   D) epispadias
   E) polycystic kidney
Answer: E
Diff: 2 Page Ref: 538

48) Hypospadias is a condition of male children that involves:
   A) atrophied prostate
   B) opening of the urethra on the ventral surface of the penis
   C) cysts on the kidneys
   D) closing of the foreskin over the end of the penis
   E) inflammation of the glomerulus
Answer: B
Diff: 2 Page Ref: 538

49) The average output of urine for a normal healthy adult is:
   A) 500 mL/day
   B) 1000 mL/day
   C) 1500 mL/day
   D) 2000 mL/day
   E) 2500 mL/day
Answer: C
Diff: 3 Page Ref: 538

50) Control of the voluntary urethral sphincter in normal children is related to:
   A) intelligence
   B) nervous system development
   C) enzymatic regulation
   D) hormone regulation
   E) muscular development
Answer: B
Diff: 2 Page Ref: 538

51) From childhood through late middle age, one of the most common bacteria to infect and inflame the urinary tract and cause urethritis and cystitis is:
   A) streptococcus
   B) staphylococcus
   C) Escherichia coli
   D) Mycobacterium tuberculosis
   E) Clostridium botulinum
Answer: C
Diff: 2 Page Ref: 538
True/False

1) The medial indentation of the kidney where several structures such as the ureters, renal blood vessels, and nerves enter and exit the kidney is called the hilus.
   Answer: TRUE
   Diff. 1 Page Ref. 519

2) The tiny filtering structures of the kidneys are called nephrons.
   Answer: TRUE
   Diff. 1 Page Ref. 521

3) The lumen surfaces of the tubule cells within the proximal convoluted tubule are covered with microvilli.
   Answer: TRUE
   Diff. 2 Page Ref. 521

4) The region of the renal tubule closest to the glomerular capsule is the distal convoluted tubule.
   Answer: FALSE
   Diff. 2 Page Ref. 521

5) The peritubular capillary bed arises from the afferent arteriole.
   Answer: FALSE
   Diff. 3 Page Ref. 523

6) Blood proteins and blood cells are too large to pass through the filtration membrane and should not be found in filtrate.
   Answer: TRUE
   Diff. 2 Page Ref. 524

7) Tubular reabsorption begins in the glomerulus.
   Answer: FALSE
   Diff. 2 Page Ref. 524

8) Nitrogenous waste products such as urea, uric acid, and creatinine are excreted from the body in urine rather than reabsorbed.
   Answer: TRUE
   Diff. 3 Page Ref. 524

9) The pigment that gives urine its characteristic yellow color is urochrome.
   Answer: TRUE
   Diff. 2 Page Ref. 524

10) The specific gravity of urine is typically lower than the specific gravity of pure water.
    Answer: FALSE
    Diff. 1 Page Ref. 525

11) Tubular secretion, which seems to be important for removal of substances not already in the filtrate, is essentially reabsorption in reverse.
    Answer: TRUE
    Diff. 1 Page Ref. 524
12) Urine moves down the ureters into the bladder due to gravitational pull alone.
   Answer: FALSE
   Diff: 2  Page Ref: 528

13) The internal urethral sphincter is involuntary.
   Answer: TRUE
   Diff: 1  Page Ref: 529

14) The urethra, which carries urine exiting the bladder by peristalsis, is typically shorter in females than in males.
   Answer: TRUE
   Diff: 1  Page Ref: 529

15) Following the micturition reflex, it is impossible to postpone bladder emptying.
   Answer: FALSE
   Diff: 1  Page Ref: 530

16) The fluid stored inside cells is referred to as extracellular fluid (ECF).
   Answer: FALSE
   Diff: 2  Page Ref: 531

17) The movement of water from one fluid compartment to another has no effect on blood volume and blood pressure.
   Answer: FALSE
   Diff: 3  Page Ref: 532

18) Antidiuretic hormone (ADH) causes increased water loss through the urine.
   Answer: FALSE
   Diff: 2  Page Ref: 532-533

19) The most important trigger for aldosterone release is the renin-angiotensin mechanism, mediated by the renal tubules.
   Answer: TRUE
   Diff: 2  Page Ref: 535

20) A person with arterial blood pH above 7.45 is said to have acidosis.
   Answer: FALSE
   Diff: 1  Page Ref: 535

21) The kidneys help maintain acid-base balance of the blood by excreting bicarbonate ions.
   Answer: TRUE
   Diff: 2  Page Ref: 537

22) When blood pH becomes too acidic, the tubule cells of the kidneys excrete bicarbonate ions and retain hydrogen ions.
   Answer: FALSE
   Diff: 3  Page Ref: 537

23) Sexually transmitted diseases (STDs) are primarily infections of the reproductive tracts but may also cause urinary tract infections.
   Answer: TRUE
   Diff: 1  Page Ref: 538
24) Incontinence is often the final outcome of the urinary system during the aging process.
Answer: TRUE
Diff: 2  Page Ref: 538; 540

Matching

Identify the substances within the urine and their possible causes with the name of the associated condition:

1) RBCs in the urine due to trauma or infection
   Diff: 2  Page Ref: 528
   A) proteinuria
   B) uremia

2) Hemoglobin in the urine due to hemolytic anemia or a transfusion reaction
   Diff: 2  Page Ref: 528
   C) dysuria
   D) hemoglobinuria
   E) hematuria

3) Glucose in the urine due to diabetes mellitus
   Diff: 2  Page Ref: 528
   F) bilirubinuria
   G) anuria

4) Bile pigment in the urine due to hepatitis
   Diff: 2  Page Ref: 528
   H) glycosuria
   I) pyuria

5) Pus containing WBCs and bacteria in the urine due to urinary tract infection
   Diff: 2  Page Ref: 528

6) Proteins in the urine due to pregnancy or excessive exercise
   Diff: 2  Page Ref: 528

1) E   2) D   3) H   4) F   5) I   6) A
Identify the urinary structure with its associated description:

7) Cup-shaped extensions of the pelvis
   Diff: 2 Page Ref: 521
   A) pyramids

8) Outer, lighter region of the kidney
   Diff: 2 Page Ref: 520
   B) calyces
   C) renal cortex
   D) renal columns

9) Vessels supplying each kidney with blood to be filtered
   Diff: 2 Page Ref: 521
   E) renal pelvis
   F) renal vein
   G) renal artery

10) Cortex-like extensions that separate the pyramids
    Diff: 2 Page Ref: 521
    H) renal medulla
    I) renal pyramids

11) Darker, reddish-brown internal area of the kidney
    Diff: 2 Page Ref: 521

12) Triangular regions with a striped appearance
    Diff: 2 Page Ref: 521

13) Flat, basinlike cavity medial to the hilus of the kidney
    Diff: 2 Page Ref: 521

13) E
Identify these organs of the urinary system with their associated descriptions:

14) Tube that drains urine from the kidney to the bladder  
   A) bladder  
   Diff: 2  Page Ref: 528  
   B) ureter  

15) Muscular sac suitable for temporary urine storage  
   C) urethra  
   Diff: 2  Page Ref: 528  

16) Transports urine and sperm in males  
   Diff: 2  Page Ref: 530  

17) In males, this organ is surrounded by the prostate  
   Diff: 2  Page Ref: 528  

18) Contains an area called the trigone formed by the openings of the ureters and urethra  
   Diff: 2  Page Ref: 528-529  

19) Inflammation of this organ is called cystitis  
   Diff: 2  Page Ref: 529-530  


Essay

1) Identify and describe the three major processes involved in urine formation.
   Answer: Filtration is a nonselective, passive process with the glomerulus acting as the filter. The filtrate formed is essentially blood plasma without blood proteins, which are too large to pass through the filtration membrane into the renal tubule. Reabsorption is the process by which the body reclaims substances within the filtrate that it wants to keep. Most reabsorption is an active process using membrane carriers. Substances that are typically reabsorbed include amino acids, glucose, and ions. Most reabsorption occurs in the proximal convoluted tubules. Secretion is the opposite process. With secretion, substances such as hydrogen ions, potassium ions, and creatinine are removed from the peritubular capillaries into the tubules to be eliminated in urine.
   Diff: 2  Page Ref: 524
2) Describe the normal characteristics of freshly-voided urine in a healthy adult.
   Answer: Urine is a pale, straw-colored liquid that progressively becomes a darker yellow color
   as it becomes more concentrated. The yellow color is a result of the presence of
   urochrome pigment, a by-product of hemoglobin breakdown. Urine is more dense
   than water with a specific gravity of 1.001 to 1.035. Urine is sterile and slightly
   aromatic and has an acidic pH of around 6. Urine normally contains sodium and
   potassium ions, urea, uric acid, creatinine, ammonia, and bicarbonate ions, as well as
   other ions the body needs to dispose of.
   Diff: 2  Page Ref: 524-525; 527

3) Describe and explain urethral control and concepts related to incontinence.
   Answer: The urethra contains two sphincters. The internal urethral sphincter is involuntary
   and is formed from a thickening of smooth muscle at the bladder-urethra junction.
   The second sphincter is the external urethral sphincter, made from skeletal muscle
   and under voluntary control. Control of the external urethral sphincter often develops
   at around 2 years of age. Prior to that time, the child is simply not able to control
   urination and is incontinent. Other causes for incontinence include emotional
   problems, pressure on the bladder, such as with pregnancy, stroke, spinal cord injury,
   and the aging process.
   Diff: 2  Page Ref: 538; 540

4) Contrast the roles of the ureters and urethra in the urinary system.
   Answer: The ureters are tubes that connect the kidneys to the bladder. Each ureter transports
   urine to the bladder. Both gravity and peristalsis aid in the movement of urine.
   The urethra is a tube that transports urine from the bladder to the outside of the body.
   The passage of urine from the bladder into the urethra is controlled by two sphincters:
   the internal, involuntary sphincter and the external, voluntary sphincter.
   Diff: 1  Page Ref: 528-530

5) Explain the renin–angiotensin mechanism.
   Answer: The renin–angiotensin mechanism is the most important trigger for the release of
   aldosterone. It is mediated by the juxtaglomerular (JG) apparatus of the renal tubules.
   The JG apparatus consists of modified smooth muscle cells that are stimulated by low
   blood pressure within the afferent arteriole or changes in solute content of the filtrate.
   The JG cells respond to these changes by releasing renin into the blood. Renin
   catalyzes reactions that lead to angiotensin II production, which then acts directly on
   the blood vessels to cause vasoconstriction as well as aldosterone release. Aldosterone
   then causes the reabsorption of sodium and water, leading to increased blood volume
   and blood pressure.
   Diff: 3  Page Ref: 535
6) Describe the bicarbonate buffer system and explain its importance in regulating pH changes.
Answer: The bicarbonate buffer system is one of three major chemical buffer systems in normal humans. The buffer systems each help to maintain pH within the body’s fluid compartments, and since they act within a fraction of a second, they are the first line of defense in resisting abnormal pH changes. The bicarbonate buffer system is a mixture of carbonic acid and sodium bicarbonate. Carbonic acid is a weak acid which remains relatively intact in the presence of a strong acid. Its salt, sodium bicarbonate, acts as a weak base in the presence of a strong acid, such as hydrochloric acid, tying up the $\text{H}^+$ released and forming carbonic acid. Because the strong acid is changed to a weak acid, the pH of the solution is lowered slightly. If a strong base like sodium hydroxide is added to a solution containing the bicarbonate buffer system, sodium bicarbonate will not dissociate further, but carbonic acid will. More hydrogen ions will be released to bind with the hydroxyl ions, with the net result being the replacement of a strong base by a weak one. The pH of the solution will then rise slightly.

Diff: 3  Page Ref: 536–537