ANSWERS TO CHAPTER 18

CONTENT LEARNING ACTIVITY

Kidneys

A. 1. Retroperitoneal; 2. Renal capsule; 3. Renal fat pad; 4. Renal sinus
B. 1. Cortex; 2. Renal pyramids; 3. Medulla; 4. Renal pelvis; 5. Renal calyces; 6. Ureter
C. 1. Renal capsule; 2. Renal cortex; 3. Renal medulla; 4. Renal pyramid; 5. Ureter; 6. Renal calyx; 7. Renal pelvis
D. 1. Renal corpuscle; 2. Proximal tubule; 3. Distal tubule; 4. Collecting duct; 5. Loop of Henle
E. 1. Nephron; 2. Collecting duct; 3. Renal corpuscle; 4. Glomerulus; 5. Podocytes; 6. Filtration membrane; 7. Descending limb
F. 1. Abdominal aorta; 2. Renal artery; 3. Interlobar artery; 4. Arcuate artery; 5. Interlobular artery; 6. Afferent arteriole; 7. Glomerular capillaries; 8. Efferent arteriole; 9. Peritubular capillaries; 10. Renal veins

Ureters, Urinary Bladder, and Urethra

1. Ureters; 2. Trigone; 3. Urethra; 4. Transitional epithelium; 5. Smooth muscle; 6. Internal urinary sphincter; 7. External urinary sphincter

Urine Production

A. 1. Filtration; 2. Tubular reabsorption; 3. Tubular secretion
B. 1. Bowman's capsule; 2. Water; 3. Blood cells and proteins; 4. Filtration pressure; 5. Filtration membrane; 6. Increases; 7. Increases; 8. Increases; 9. Decreases; 10. Decreases
C. 1. Proximal tubule; 2. Descending limb; 3. Ascending limb; 4. Distal tubule and collecting duct
D. 1. Hydrogen ions; 2. Potassium ions

Regulation of Urine Concentration and Volume

A. 1. Small; 2. Concentrated; 3. Large; 4. Dilute; 5. Large; 6. Dilute; 7. Decreases; 8. Decreases
B. 1. Increases; 2. Decreases; 3. Increases; 4. Decrease
C. 1. Increases; 2. Decreases; 3. Increases; 4. Increases; 5. Increase; 6. Increases; 7. Increases; 8. Increases
D. 1. Increases; 2. Decreases; 3. Increases; 4. Decreases; 5. Decreases

Urine Movement

1. Stretch receptors; 2. Spinal cord; 3. Parasympathetic; 4. Contract; 5. Relax; 6. Relax; 7. Higher brain centers; 8. Irritation

Body Fluid Compartments

1. Intracellular fluid compartment;
2. Extracellular fluid compartment;
3. Intracellular fluid compartment;
4. Extracellular fluid compartment

Regulation of Extracellular Fluid Composition

A. 1. Increases; 2. Increases; 3. Increases; 4. Increases
B. 1. Increased; 2. Increased; 3. Decreased; 4. Increased; 5. Decreased; 6. Decreased; 7. Decreased; 8. Decreased; 9. Decreased; 10. Increased
C. 1. Sodium ions; 2. Sodium ions; 3. Potassium ions
D. 1. Aldosterone; 2. Aldosterone; 3. Atrial natriuretic hormone; 4. Antidiuretic hormone (ADH)
E. 1. Parathyroid hormone; 2. Calcitonin

Regulation of Acid-Base Balance

A. 1. Phosphate and protein buffer systems; 2. Protein buffer system; 3. Bicarbonate buffer system
B. 1. Bicarbonate; 2. Carbonic anhydrase; 3. Decreases; 4. Increases; 5. Increases 6. Decreases; 7. Increases; 8. Hydrogen ions; 9. Increases; 10. Increases; 11. Increases

Acidosis and Alkalosis

1. Acidosis; 2. Central nervous system; 3. Respiratory ; 4. Metabolic; 5. Alkalosis; 6. Hyperexcitability; 7. Respiratory; 8. Metabolic

QUICK RECALL

1. Excretion, blood volume control, ion concentration regulation, pH regulation, erythrocyte concentration, and vitamin D synthesis
2. Glomerulus, Bowman's capsule, proximal tubule, loop of Henle, distal tubule.
3. Filtration, reabsorption, and secretion.
4. Aldosterone: increased sodium ion reabsorption, resulting in decreased urine concentration and volume; renin: causes angiotensin II production, which stimulates aldosterone production, resulting in decreased urine concentration and volume; ADH: decreased urine volume; atrial natriuretic factor: reduces sodium ion reabsorption, resulting in increased urine volume
5. Stretch of bladder, reflex initiated, bladder contracts, and urinary sphincters relax
6. Increased osmolality of body fluid, decreased blood pressure, and dry mucosa in the mouth
7. ADH, aldosterone, and renin: decreased volume of more concentrated urine; increased blood volume and blood pressure
8. Bicarbonate buffer system, phosphate buffer system, and protein buffer system
9. Respiration rate above normal: blood pH increases; respiration rate below normal: blood pH decreases

WORD PARTS

1. renal; renin
2. nephron; glomerulonephritis
3. proximal
4. distal
5. glomerulus
6. corpuscle

MASTERY LEARNING ACTIVITY

1. A. The renal corpuscle and proximal and distal tubules are found in the renal cortex, whereas the collecting duct and loop of Henle enter the medulla. The renal pelvis is an enlarged urinary channel that between the calyces and the ureter. The Hilum is the indentation on the kidney where the renal arteries, veins, nerves, and ureter attach to the kidney.
2. A. The glomerulus is a tuft of coiled capillaries. Bowman's capsule, the loop of Henle and collecting duct are tubules that contain fluid removed from the blood in the glomerulus by filtration.
3. C. The functional unit of the kidney is the nephron; the nephron is the location of filtration, reabsorption, and secretion which are the three steps in urine formation.
4. C. The inner layer of Bowman's capsule surrounds the glomerulus and is lined with specialized cells called podocytes. The walls of the glomerular capillaries, the podocytes, and the basement membrane between them make up the filtration membrane.
5. A. Filtrate passes into Bowman's capsule, and sequentially through the proximal tubule, loop of Henle, distal tubule, and collecting duct.
6. D. Filtration, reabsorption, and secretion are the three processes in urine formation.
7. B. The renal arteries give rise to interlobar arteries, which give rise to arcuate arteries, which in turn give rise to interlobular arteries and then to afferent arterioles.
8. D. The urinary bladder is located in the pelvic cavity. The walls of the urinary bladder are composed of smooth muscle, and it is lined with transitional epithelium. The urinary bladder is connected to the kidneys by ureters, and to the outside of the body by the urethra.
9. D. Constriction of afferent arterioles reduces blood pressure in the glomerulus, and also reduces filtration pressure. Cardiovascular shock results from a drop in blood pressure, which also reduces filtration pressure. Elevated blood pressure increases filtration pressure.
10. A. The proximal tubule reabsorbs 65% of the filtrate volume. This reabsorption is not regulated by hormones, but occurs because of such factors as active transport of sodium ions, amino acids, and glucose from the proximal tubules.
11. C. This is an important fact to know if you are to understand renal physiology. Sodium (and chloride) ions move out of the tubules by active transport, and water passively follows by osmosis because of the resulting osmotic gradient.
12. D. Potassium is secreted into the distal tubule by active transport. Potassium is also removed from the proximal tubule by active transport.
13. D. By the time filtrate reaches the distal tubule, it has a lesser concentration of solutes than blood. As the filtrate passes through the distal tubule and collecting duct, water moves out by osmosis, and the filtrate becomes more concentrated.
14. E. As aldosterone secretion increases, potassium secretion and sodium reabsorption increase. As sodium moves from the urine back into the blood, chloride and water passively follow. This increases the blood volume and decreases urine volume.
15. C. Juxtaglomerular cells are involved in the secretion of renin. ADH and oxytocin are secreted by the posterior pituitary, and aldosterone is secreted by the adrenal cortex.
16. E. When blood osmolality decreases, this inhibits the secretion of ADH. As a consequence, the permeability of the collecting tubules decreases and less water is reabsorbed, producing a larger volume of less concentrated urine.
17. D. Extracellular fluid tends to be higher in sodium, chloride, and bicarbonate ions than intracellular fluid. Extracellular fluid includes interstitial fluid, blood plasma, and lymph, and has a fairly constant composition throughout the body.
18. D. Decreased ADH secretion results in increased water loss in the urine. As blood volume decreases, sodium concentration increase. The other changes listed decrease blood sodium concentration.
19. D. All of these factors trigger the sensation of thirst.
20. C. When blood carbon dioxide levels increase, the carbon dioxide combines with water to produce carbonic acid. The carbonic acid dissociates to form hydrogen ions and bicarbonate ions. The increase of hydrogen ions lowers the pH, i.e. increases the acidity of the blood.

FINAL CHALLENGES

1. Reduced blood pressure in the afferent arterioles increases renin secretion by the juxtaglomerular apparatus. Renin causes angiotensin II to be produced. Angiotensin II increases aldosterone secretion. The decreased urine production from the increased aldosterone causes an increased blood volume and blood pressure. Through baroreceptors the increased blood pressure inhibits ADH secretion.

2. Urine production increases for several reasons. First, the increased fluid intake increases blood volume, blood pressure, and glomerular capillary pressure. Dilation of the afferent arterioles by the caffeine also increases glomerular capillary pressure. As a result, filtration pressure increases, producing a greater amount of filtrate and urine. Second, inhibition of ADH secretion decreases the permeability of the collecting ducts to water, so a larger amount of filtrate passes through as urine.

3. Excess aldosterone leads to increased sodium and water reabsorption. Because of the water increase, blood volume increases, causing a rise in blood pressure. Eventually, however, the increase in blood volume is opposed by mechanisms that regulate blood volume/pressure. The increased sodium in the extracellular fluid stimulates the thirst center, resulting in excessive drinking followed by excessive urine production. Diarrhea is a symptom associated with hyposecretion of aldosterone. When aldosterone is absent or in low quantities, sodium reabsorption from the intestines is very poor, and the intestinal contents have a higher concentration than blood, water is retained, and diarrhea results.

4. If only water is lost, blood concentration increases and stimulates ADH secretion. The ADH increases the permeability of the collecting ducts to water, increasing water reabsorption and reducing the effectiveness of the diuretic. If sodium is also lost, blood osmolality does not increase, and the ADH response does not occur.

5. The overdose of alkaline antacid tablets raises blood pH, producing metabolic alkalosis. By secreting fewer hydrogen ions, a more alkaline urine is formed, and hydrogen ion concentration in the blood increases, compensating for the alkalosis. Respiration rate also decreases to compensate. Reduced respiration increases plasma CO_2 levels, which reduces the pH through the production of carbonic acid.