The Urinary System

OBJECTIVES

After studying this chapter, you should be able to:

1. Define the function of the urinary system.
2. Name the external layers of the kidney.
3. Define the following internal parts of the kidneys: cortex, medulla, medullary pyramids, renal papillae, renal columns, and major and minor calyces.
4. Name the parts of a nephron, and describe the flow of urine throughout this renal tubule.
5. List the functions of the nephrons.
6. Explain how urine flows down the ureters.
7. Describe micturition and the role of stretch receptors in the bladder.
8. Compare the length and course of the male urethra to the female urethra.
9. Name the normal constituents of urine.

ACTIVITIES

A. Completion

Fill in the blank spaces with the correct term.

1. The urinary system consists of two ___, two ___, one ___, and one ___.
2. The kidneys are crucial in maintaining ___.
3. If kidney failure occurs, medical treatment consists of ___.
4. The elimination of wastes by the kidneys is called ___.
5. The kidneys regulate the concentration of ___ in body fluids and blood.

NAME: ____________________________ DATE: ____________
Section 2 • Chapter Exercises

6. The regulation of hydrogen ions is __ regulation.
7. The enzyme renin helps regulate __ __.
8. The liver, the skin, and the kidneys all participate in the synthesis of __.
9. The ureter leaves the kidney through the __.
10. There are ___ layers of tissue surrounding each kidney.
11. The smooth, transparent, fibrous connective tissue membrane connecting with the outermost covering of the ureter is the __ __.
12. The mass of fatty tissue is the __ __.
13. The tips of the cortex are the __ __.
14. The cortex and the renal columns make up the __ of the kidney.
15. The minor calyces collect __.
16. Urine leaves the kidney through the __.
17. The nephrons are the __ units of the kidney.
18. The innermost layer of Bowman's glomerular capsule is made up of cells called __.
19. The endothelial-capsular membrane is the site of __ __ and __ __ from the blood.
20. The part of Henle that is highly permeable to water and solutes is the __ __.
21. The kidney is supplied with blood from the left and right __ __.
22. About ___ of blood passes through the kidneys every minute.
23. The interlobar arteries are found in the __ __.
24. The nerve supply to the kidney comes from the __ __.
25. The process that transports substances out of the tubular fluid and back into the blood is __ __.
26. The bladder wall has three layers of smooth muscle known as the __ muscle.
27. Micturition is precipitated by __ __.
28. Urine in the urethra is transported by __.
29. ___ is caused by a high concentration of uric acid in the plasma.
30. ___ is an inflammation of the urinary bladder.
31. ___ can result from almost any condition that interferes with kidney function.
32. Urinary ___ is a condition in which an individual experiences an uncontrollable and continued flow of urine.
33. The kidneys produce __, a hormone that stimulates red blood cell production.

B. Matching

Match the term on the right with the definition on the left.

___ 34. helps adjust filtration pressure     a. parenchyma
___ 35. kidney cavity                      b. Bowman's capsule
___ 36. inner layer around the kidney     c. glomerulus
___ 37. outer layer around the kidney d. renal corpuscle
C. Key Terms

Use the text to look up the following terms. Write the definition or explanation.

49. Adipose capsule:

50. Arcuate arteries:

51. Bowman's glomerular capsule:

52. Calciferol:

53. Cortex:

54. Descending limb of Henle:
55. Detrusor muscle:

56. Distal convoluted tubule:

57. Endothelial-capsular membrane:

58. Erythropoietin:

59. Glomerulus:

60. Interlobular arteries:

61. Internal urinary sphincter:

62. Kidney stones:

63. Left renal artery:

64. Left renal vein:
65. Loop of Henle:

66. Major calyces:

67. Nephrons:

68. Oliguria:

69. Papillary ducts:

70. Parenchyma:

71. Peritubular capillaries:

72. Renal capsule:

73. Renal columns:

74. Renal papillae:
75. Renal plexus:

76. Renal pyramids:

77. Renin:

78. Trigone:

79. Ureter:

80. Urethra:

81. Urine:
D. Labeling Exercise

82. Label the parts of the urinary system as indicated in Figure 18-1.

Figure 18-1

A. __________________________

B. __________________________

C. __________________________

D. __________________________

E. __________________________

F. __________________________

G. __________________________
83. Label the parts of the kidney as indicated in Figure 18-2.

A. ________________

B. ________________

C. ________________

D. ________________

E. ________________

F. ________________

G. ________________

H. ________________

Figure 18-2
E. Coloring Exercise

84. Using Figure 18-3, color the proximal convoluted tubule, the distal convoluted tubule, and the loop of Henle orange; the interlobar artery and the afferent arteriole red; the interlobar vein blue; and the collecting duct yellow.

Figure 18-3
F. Critical Thinking

Answer the following questions in complete sentences.

85. How do the kidneys help to maintain homeostasis?

86. How do the kidneys compensate for excessive perspiration?

87. Explain the part the kidneys play in the regulation of erythrocyte concentration.

88. Describe the role of the kidneys in teeth and bone development.

89. Why isn't hemodialysis a perfect substitute for kidney function?

90. Explain renal calculi and their treatment.

91. How does the endocrine system aid the kidneys to maintain homeostasis?
92. Explain why it can be said that the effects of aging on the urinary system begin as early as age 20.

93. Differentiate between a urologist and a nephrologist.

G. Crossword Puzzle

Complete the crossword puzzle using the following clues.

ACROSS
1. High uric acid in plasma
2. Cortex and renal pyramids
4. Waste elimination

DOWN
1. Kidney inflammation
2. Capillaries form interlobar vein
3. Voiding

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5. Urinary bladder inflammation  
7. Capillary network surrounded by podocytes  
8. Transports urine by peristalsis  
10. Stimulates red blood cell production  
16. Veins connecting to interlobar veins  
17. Formed by three processes in nephrons  
20. Active vitamin D  
21. Smooth triangular region of bladder  

6. Outer kidney area  
9. Functional units of kidneys  
11. Procedure that filters blood  
12. Transformed from ammonia by liver  
13. Kidney stones  
14. Inner kidney area  
15. Visceral layer of Bowman's capsule  
17. Transports urine to the bladder  
18. Three layers of bladder wall smooth muscle  
19. Stores urine  
20. Collects urine from renal pyramids

CASE STUDY

Colleen, a 28-year-old woman, is visiting her health care provider. Colleen states she has pain and burning when she urinates as well as the need to urinate very frequently. This morning she saw what appeared to be blood in her urine.

QUESTIONS

1. Why might Colleen be experiencing burning and pain upon urination as well as frequency?

2. What might be causing the problem?

3. Why are women at greater risk for this condition than men?

4. How is this condition usually treated?

5. What measures can both men and women take to prevent this disorder?

CHAPTER QUIZ

1. A scant amount of urine is called
   a. hematuria  
   b. polyuria  
   c. oliguria  
   d. pyuria  
   e. none of the above

Answer:
2. Pus in the urine is called
   a. hematuria  
   b. polyuria  
   c. oliguria  
   d. pyuria  
   e. none of the above

Answer:

3. Urine in the blood is called
   a. hematuria  
   b. polyuria  
   c. oliguria  
   d. pyuria  
   e. none of the above

Answer:

4. Hemodialysis is the same as
   a. hematuria  
   b. polyuria  
   c. oliguria  
   d. pyuria  
   e. none of the above

Answer:

5. Besides the urinary system, which system controls urine production and micturition?
   a. muscular  
   b. endocrine  
   c. nervous  
   d. integumentary  
   e. none of the above

Answer:

6. Which system besides the urinary system is involved in the production of vitamin D?
   a. muscular  
   b. endocrine  
   c. nervous  
   d. integumentary  
   e. none of the above

Answer:

7. Urea is the product of the liver breaking down
   a. water  
   b. ammonia  
   c. sugar  
   d. starch  
   e. none of the above

Answer:

8. Urine formation begins with the process of
   a. micturition  
   b. glomerular filtration  
   c. tubular reabsorption  
   d. tubular secretion  
   e. none of the above

Answer:

9. How much of the kidney can be nonfunctional and still keep the person alive?
   a. $\frac{2}{3}$  
   b. $\frac{1}{2}$  
   c. $\frac{1}{3}$  
   d. $\frac{3}{4}$  
   e. none of the above

Answer:
10. The regulation of pH is the control of which ions?
   a. hydrogen       d. sodium
   b. potassium      e. none of the above
   c. calcium

Answer:

11. The active form of vitamin D is
   a. calcium       d. sodium
   b. calciferol    e. none of the above
   c. chloride

Answer:

12. The innermost layer of the kidney is the
   a. renal sinus   d. renal fascia
   b. hilum        e. none of the above
   c. renal capsule

Answer:

13. The part of the kidney consisting of connective tissue and fat is the
   a. renal sinus   d. renal fascia
   b. hilum        e. none of the above
   c. renal capsule

Answer:

14. The part of the kidney that anchors it is the
   a. renal sinus   d. renal fascia
   b. hilum        e. none of the above
   c. renal capsule

Answer:

15. The millions of microscopic collecting tubules make up the
   a. nephron       d. cortex
   b. parenchyma    e. none of the above
   c. pyramids

Answer:

16. In the ducts of the pyramids, urine is directly collected by the
   a. nephrons      d. ureter
   b. minor calyces e. none of the above
   c. major calyces

Answer:

17. Podocytes make up which layer of Bowman's glomerular capsule?
   a. visceral       d. cortex
   b. parietal       e. none of the above
   c. outer

Answer:
18. The visceral layer of Bowman's capsule and the endothelial capillary network make up a(n)
   a. vein                               d. tubule
   b. capsule                            e. none of the above
   c. endothelial-capsular membrane

Answer:

19. The papillary ducts empty into the
   a. renal capsule                      d. pyramids
   b. renal pelvis                       e. none of the above
   c. renal fascia

Answer:

20. Those materials in the blood responsible for the acid or alkaline components of the blood are
   a. salts                               d. plasma
   b. sugars                             e. none of the above
   c. electrolytes

Answer:

21. The renal artery divides into several branches that enter the parenchyma. In the renal columns they are called
   a. interlobar arteries                 d. efferent arteries
   b. arcuate arteries                   e. none of the above
   c. interlobular arteries

Answer:

22. Glomerular capillaries unite and form the
   a. interlobar arteries                 d. efferent arteries
   b. arcuate arteries                   e. none of the above
   c. interlobular arteries

Answer:

23. The peritubular capillaries form the
   a. arcuate vein                        d. efferent vein
   b. interlobular vein                  e. none of the above
   c. interlobar vein

Answer:

24. The kidney's nerve supply comes from the
   a. central nervous system              d. sympathetic system
   b. peripheral nervous system           e. none of the above
   c. parasympathetic system

Answer:

25. The process responsible for regulating pH in the blood is called
   a. tubular secretion                   d. tubular reabsorption
   b. glomerular filtration              e. none of the above
   c. micturition

Answer:
26. Increased blood pressure is a result of
   a. tubular formation  
   b. glomerular filtration  
   c. tubular reabsorption  
   d. tubular secretion  
   e. none of the above

Answer:

27. The daily production of urine depends on
   a. fluid intake  
   b. temperature  
   c. humidity  
   d. emotional state  
   e. all of the above

Answer:

28. The detrusor muscle consists of how many layers?
   a. 1  
   b. 2  
   c. 3  
   d. 4  
   e. none of the above

Answer:

29. The stretch receptors in the bladder begin to send messages when there is how much urine in the bladder?
   a. 700–800 mL  
   b. 500–600 mL  
   c. 400–600 mL  
   d. 200–400 mL  
   e. none of the above

Answer:

30. Which of the following can become acute following strep throat?
   a. cystitis  
   b. gout  
   c. glomerulonephritis  
   d. glycosuria  
   e. none of the above

Answer:

31. By age 80, what proportion of the kidney's glomeruli have ceased to function?
   a. $\frac{1}{4}$  
   b. $\frac{1}{3}$  
   c. $\frac{1}{2}$  
   d. $\frac{2}{3}$  
   e. $\frac{4}{5}$

Answer:

32. Which form of polycystic kidney disease is characterized by lower back pain and high blood pressure?
   a. adult  
   b. childhood  
   c. congenital  
   d. pancreatic  
   e. renal

Answer:

33. Which of the following species of bacterium commonly causes UTIs?
   a. *S. aureus*  
   b. *M. tuberculosis*  
   c. *S. pneumoniae*  
   d. *E. coli*  
   e. none of the above

Answer: