CHAPTER 5 READING QUESTIONS

These reading questions are designed to help you focus your reading on the most important points in the chapter. They are arranged using chapter section headers so that the file can be easily edited to reflect the material covered in class.

Homeostasis Does Not Mean Equilibrium

1. What is osmotic equilibrium?
2. What is chemical disequilibrium? Give some examples of specific solutes that exist in a state of chemical disequilibrium in our body. (Fig. 5.1d)
3. How does chemical disequilibrium in the body give rise to electrical disequilibrium? What is the result of electrical disequilibrium?

5.1 OSMOSIS AND TONICITY

The Body Is Mostly Water

4. What is the physiological significance of the "70-kg man"? What is his total body water volume?
5. How does a woman's total body water content compare to a man's? (Tbl. 5.1)
6. Describe the distribution of water among the body compartments. (Fig. 5.1b, c)

The Body Is in Osmotic Equilibrium

7. Define and describe osmosis. (Fig. 5.2)
8. What is osmotic pressure? (Fig. 5.2)

Osmolarity Describes the Number of Particles in Solution

9. How does osmolarity differ from molarity? What equation converts molarity to osmolarity?

10. Contrast osmolarity and osmolality.

Comparing Osmolarities of Two Solutions

11. Distinguish between the terms isosmotic, hyposmotic, and hyperosmotic.

12. If solution A has more particles per liter than solution B, then solution A is said to be _____ osmotic to solution B, while solution B is said to be _____ osmotic to solution A. (Tbl. 5.2)

Tonicity Describes the Volume Change of a Cell

13. Contrast osmolarity and tonicity.

14. Distinguish between the terms isotonic, hypotonic, and hypertonic. (Tbl. 5.3)

15. Contrast penetrating solutes and nonpenetrating solutes. What does it mean when a solute is considered "functionally nonpenetrating"?

16. What are the rules for predicting tonicity? (Tbl. 5.4)

17. How can a solution be isosmotic and also hypotonic? (Fig. 5.3)

5.2 Transport Processes

18. What is bulk flow? Give some examples of bulk flow in the body.

Cell Membranes Are Selectively Permeable

19. What properties of a cell membrane contribute to its permeability? Give examples of substances that typically are permeable and impermeable to human cell membranes.

20. What two properties of a molecule determine whether it can diffuse across a membrane?

21. What is the difference between active transport and passive transport?

22. What are the different ways a molecule can move across a membrane? (Fig. 5.5)

5.3 Diffusion

23. Define diffusion. (Fig. 5.6)

24. List seven properties of diffusion. (Tbl. 5.6)

Lipophilic Molecules Cross Membranes by Simple Diffusion

25. Describe seven general properties of diffusion. (Tbl. 5.6)

26. Fick's law of diffusion describes simple diffusion across a membrane. (Fig. 5.7) Using words, state Fick's law.

27. What factors influence membrane permeability?

5.4 Protein-Mediated Transport

28. Why is simple diffusion not an option for most molecules in our body?

29. Differentiate between protein-mediated transport, facilitated diffusion, and active transport.

Membrane Proteins Have Four Major Functions

Structural Proteins

30. What are the three major roles of structural proteins? (Fig. 5.8)

Enzymes

31. What are membrane enzymes? How are they different in function from intracellular enzymes?

Receptors

32. What is the role of membrane receptor proteins? (Fig. 5.9)

Transport Proteins

33. Compare channel proteins and carrier proteins.

Channel Proteins Form Open, Water-Filled Passageways

34. Describe a typical channel protein. What types of molecules pass through channel proteins? (Figs. 5.10a, 5.11)

35. Distinguish between an open channel and a gated channel. (Fig. 5.10a)

36. List three types of gated channels.

Carrier Proteins Change Conformation to Move Molecules

37. Define the following terms: uniport carriers, cotransporter, symport carriers, and antiport carriers. (Fig. 5.10b)

38. Diagram the general mechanism by which carrier proteins move molecules across a membrane. (Fig. 5.12)

Facilitated Diffusions Uses Carrier Proteins

39. Compare and contrast facilitated diffusion and simple diffusion.

40. Give examples of molecules that might cross a membrane by facilitated diffusion.

Active Transport Moves Substances against Their Concentration Gradient

41. What is active transport? Why does it require the input of energy?

42. Distinguish between primary (direct) active transport and secondary (indirect) active transport.

Primary Active Transport

43. Diagram the structure and mechanism of the Na^+-K^+-ATPase as an example of primary active transport. (Figs. 5.14, 5.15; Tbl. 5.7)

Secondary Active Transport

44. How is the relatively high extracellular [Na^+] used to drive transport of other molecules against their concentration gradient across a membrane? Give some specific examples. (Tbl. 5.8)

45. Describe the action of the Na^+-glucose secondary active transporter (SGLT) as a representative example of secondary active transport. How does an SGLT transporter compare with a GLUT transporter? (Fig. 5.16)

Carrier-Mediated Transport Exhibits Specificity, Competition, and Saturation

Specificity

46. Give examples of how specificity applies to carrier-mediated transport. (Fig. 5.17a, b)

Competition

47. How does competition relate to specificity?

Saturation

48. Describe how the principle of saturation applies to carrier-mediated transport. Include a description of transport maximum. (Fig. 5.17c)

49. How can cells increase their transport capacity and avoid saturation?

5.5 Vesicular Transport

Phagocytosis Creates Vesicles Using the Cytoskeleton

50. Describe the process of phagocytosis. What is a phagosome? (Fig. 5.18)

Endocytosis Creates Smaller Vesicles

51. How does endocytosis differ from phagocytosis?

52. What is pinocytosis?

Receptor-Mediated Endocytosis

53. Diagram the process of receptor-mediated endocytosis. What role does clathrin play? What is an endosome? (Fig. 5.19)

54. What is membrane recycling?

Caveolae

55. Describe caveolae and list their functions.

Exocytosis Releases Molecules Too Large for Transport Proteins

56. How is exocytosis related to endocytosis? Is exocytosis active or passive? Is exocytosis constitutive or intermittent? (Fig. 5.19)

57. Give examples of molecules exported by exocytosis.

5.6 Epithelial Transport

58. Compare and contrast the apical membrane and the basolateral membrane of a transporting epithelial cell. What is the physiological significance of transporting epithelial cell polarization? (Fig. 5.20)

Epithelial Transport May Be Paracellular or Transcellular

59. Contrast paracellular transport and transcellular transport. (Fig. 5.20)

Transcellular Transport of Glucose Uses Membrane Proteins

60. Diagram the movement of glucose across a transporting epithelial cell. Include all membrane proteins, ions, and directionality of transport. (Fig. 5.21)

Transcytosis Uses Vesicles to Cross an Epithelium

61. Describe the process of transcytosis. (Fig. 5.22) When is it used? What role does the cytoskeleton play in transcytosis?

5.7 The Resting Membrane Potential

Electricity Review

62. List four electrical principles important to the understanding of physiological electricity.

The Cell Membrane Enables Separation of Electrical Charge in the Body

63. Explain what is meant by an electrochemical gradient. (Figs. 5.23, 5.24)

All Living Cells Have a Membrane Potential

64. Explain the term *resting membrane potential difference*.

The Resting Membrane Potential Is Due Mostly to Potassium

65. What is the equilibrium of a single ion?

66. Most cells are about _____ times more permeable to K^+ than to Na^+. A typical resting membrane potential is about _____ mV. (Fig. 5.25)

Changes in Ion Permeability Change the Membrane Potential

67. What two factors influence a cell's membrane potential?

68. Compare and contrast the terms depolarization, repolarization, and hyperpolarization using a graph of resting membrane potential over time. (Fig. 5.26)

69. Which four ions contribute the most to changes in membrane potential? In which fluid compartment is each ion most concentrated?

5.8 Integrated Membrane Processes: Insulin Secretion

70. Diagram the process of insulin secretion in pancreatic beta cells as a key example of integrated membrane function. (Fig. 5.26)