

**Chapter 05**  
**Control of Cells by Chemical Messengers**

**Multiple Choice Questions**

1. Receptors for intercellular messengers are most commonly

- A. Peripheral membrane proteins
- B. Integral membrane proteins**
- C. Specialized phospholipids within the membrane
- D. Nucleic acids

*Bloom's Level: 1. Remember*  
*Section 5.01*  
*Topic: Cells*

2. Activation of a receptor by a chemical messenger

- A. Occurs when the messenger binds to the ligand-binding site of the receptor
- B. Is the first step leading to the ultimate response of a cell to the messenger
- C. Requires a change in receptor conformation
- D. Both occurs when the messenger binds to the ligand-binding site of the receptor and is the first step leading to the ultimate response of a cell to the messenger are correct
- E. All of the choices are correct**

*Bloom's Level: 1. Remember*  
*Section 5.01*  
*Topic: Cells*

3. Messages, in the form of chemical signals, are sent from one cell to another with only those capable of receiving the specific chemical able to respond to them. Water soluble signals have receptors

- A. On the outside of the cell, constituting a component of the plasma membrane
- B. On the inside of the cell, beyond the boundary of the plasma membrane
- C. Which have a specific structure complementary to the molecular chemical message being sent
- D.** Both on the outside of the cell, constituting a component of the plasma membrane and which have a specific structure complementary to the molecular chemical message being sent
- E. Both on the inside of the cell, beyond the boundary of the plasma membrane and which have a specific structure complementary to the molecular chemical message being sent are correct

*Bloom's Level: 1. Remember*  
*Section 5.01*  
*Topic: Cells*

4. Which of the following are common means by which binding of an intercellular chemical messenger with a cell's receptor brings about an intracellular response?

- A. Opening or closing of specific ionic channels in the plasma membrane
- B. Activation of an intracellular second-messenger system
- C. Promoting or inhibiting the transcription of genes that code for the synthesis of cellular proteins
- D. Both opening or closing of specific ionic channels in the plasma membrane and activation of an intracellular second-messenger system are correct
- E.** All of the choices are correct

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

5. Another term for lipid soluble hormones is

- A.** Lipophilic
- B. Lipophobic
- C. Hydrophobic
- D. Hydrophilic
- E. polar

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Chemistry*

6. Lipid soluble hormones which pass through the membrane bind with receptors at the nucleus and then increase the rate of mRNA synthesis to
- A. Decrease the output of a specific protein from that cell
  - B. Increase the production of the protein transcribed from the DNA**
  - C. Allow for rRNA and tRNA biosynthesis to proceed at an increased rate
  - D. Directly trigger ribosomal sub-unit disjunction
  - E. Decrease the metabolic output of the cell to match the needs of the tissue around it

*Bloom's Level: 2. Understand*  
*Section 5.02*  
*Topic: Cells*

7. Cellular receptors are classified as either intracellular or as plasma membrane bound receptors. Which of the following is not an integrated plasma membrane receptor related description?
- A. Binding activates G proteins to, in turn, activate ion channels or enzymes
  - B. Regulation of genetic transcription**
  - C. Function as directly regulated ion channels
  - D. Represent membrane bound enzymes, i.e., tyrosine kinases
  - E. bind to and activate JAK kinases

*Bloom's Level: 2. Understand*  
*Section 5.01*  
*Topic: Cells*

8. The process whereby repeated exposure to a hormone can cause a decrease in the number of receptors for that hormone is called
- A. Competition
  - B. Inhibition
  - C. Down regulation**
  - D. Antagonism
  - E. Saturation

*Bloom's Level: 1. Remember*  
*Section 5.01*  
*Topic: Cells*

9. Cocaine lowers the levels of a chemical messenger in the brain called enkephalin. Researchers have found the number of enkephalin receptors to be higher in cocaine addicts than nonaddicted people. This is an example of

- A. Saturation
- B. Up regulation**
- C. Antagonism
- D. Affinity
- E. Down regulation

*Bloom's Level: 3. Apply*  
*Section 5.01*  
*Topic: Cells*

10. Methadone is a drug given to treat heroin addicts. It works by binding to the same receptors as heroin but with greater affinity, thereby preventing heroin from binding. This is an example of

- A. Competition**
- B. Down regulation
- C. Signal transduction
- D. Agonistic behavior
- E. None of the choices are correct

*Bloom's Level: 3. Apply*  
*Section 5.01*  
*Topic: Cells*

11. Oxytocin is a peptide hormone that causes the smooth muscle of the uterus to contract, but it has no effect on the smooth muscle cells of the small intestine. This difference in responsiveness exists because

- A. Oxytocin is inactivated prior to reaching the smooth muscle cells of the intestine
- B. Intestinal smooth muscle cells do not contain the proper second messenger system
- C. Uterine smooth muscle cells contain specific receptors for oxytocin**
- D. Oxytocin is able to cross the plasma membrane of uterine cells but not intestinal cells
- E. Oxytocin is not delivered by the circulatory system to intestinal cells

*Bloom's Level: 3. Apply*  
*Section 5.01*  
*Topic: Cells*

12. Epinephrine activates the cyclic AMP pathway in liver cells. Therefore, epinephrine
- A. Probably binds a specific transmembrane receptor in these cells
  - B. Elicits its response in liver cells through second messengers
  - C. Probably binds a receptor in the nucleus of liver cells
  - D.** Both probably binds a specific transmembrane receptor in these cells and elicits its response in liver cells through second messengers are correct
  - E. Both elicits its response in liver cells through second messengers and probably binds a receptor in the nucleus of liver cells are correct

*Bloom's Level: 3. Apply*  
*Section 5.02*  
*Topic: Cells*

13. At very low concentrations, epinephrine causes an artery to vasodilate. At higher concentrations epinephrine causes the same artery to constrict. How can these different effects be explained?
- A. There is one type of epinephrine receptor that uses two second messenger systems
  - B.** There are two types of epinephrine receptors with different affinities for epinephrine that use two different second messenger systems
  - C. There are two types of receptors for epinephrine that use the same second messenger system
  - D. At higher concentrations epinephrine can pass through the plasma membrane and directly stimulate contraction within the cell

*Bloom's Level: 4. Analyze*  
*Section 5.02*  
*Topic: Cells*

14. The significance of plasma membrane receptors for chemical regulators such as hormones and neurotransmitters is that
- A. They allow the regulators to affect cell functions while preventing them from entering into the cell's cytoplasm
  - B. They permit nonpolar chemical messengers to affect cell functions
  - C.** They allow for signal amplification or a multiplier effect of the message
  - D. Both they allow the regulators to affect cell functions while preventing them from entering into the cell's cytoplasm and they permit nonpolar chemical messengers to affect cell functions are correct
  - E. All of the choices are correct

*Bloom's Level: 2. Understand*  
*Section 5.02*  
*Topic: Cells*

15. Cells can control their responsiveness to external chemical regulators by
- A. Increasing the number of their transmembrane receptors by exocytosis
  - B. Decreasing the number of their transmembrane receptors by endocytosis
  - C. Uncoupling their receptors from the second message generator
  - D.** Both increasing the number of their transmembrane receptors by exocytosis and decreasing the number of their transmembrane receptors by endocytosis are correct
  - E. Both decreasing the number of their transmembrane receptors by endocytosis and uncoupling their receptors from the second message generator are correct

*Bloom's Level: 2. Understand*  
*Section 5.01*  
*Topic: Cells*

16. A ligand that is an effective agonist for a chemical messenger
- A. May have a higher affinity than the messenger for the messenger's receptor
  - B. May achieve 50 percent saturation of the messenger's receptor at a lower concentration than that required by the messenger
  - C. Does not couple to the binding site of the messenger's receptor
  - D.** Both may have a higher affinity than the messenger for the messenger's receptor and may achieve 50 percent saturation of the messenger's receptor at a lower concentration than that required by the messenger are correct
  - E. All of the choices are correct

*Bloom's Level: 1. Remember*  
*Section 5.01*  
*Topic: Chemistry*

17. A fat cell responds to the presence of the hormone epinephrine by increasing cytosolic cyclic AMP production, which leads to the catabolism of both glycogen and fat. The best explanation for this phenomenon is:

- A. Epinephrine is binding to two types of receptors in the plasma membrane
- B. The activated receptor complex stimulates production of two different second messengers
- C. Cyclic AMP can directly activate two kinds of enzymes
- D.** Cyclic-AMP-dependent protein kinase can activate two kinds of enzymes
- E. All of the choices are correct

*Bloom's Level: 4. Analyze*  
*Section 5.02*  
*Topic: Cells*

18. Which of the following statements about G proteins is *not* correct? G proteins may

- A.** Act as second messengers
- B. Be stimulatory for second-messenger production
- C. Be inhibitory for second-messenger production
- D. Act as transducers for activated receptors by opening or closing ion channels
- E. Do none of the choices

*Bloom's Level: 2. Understand*  
*Section 5.02*  
*Topic: Cells*

19. Activation of a receptor that is coupled by G proteins to adenylyl cyclase

- A. May increase the intracellular concentration of cyclic AMP
- B. May decrease the intracellular concentration of cyclic AMP
- C. May result in stimulation or inhibition of DNA transcription
- D. Both may increase the intracellular concentration of cyclic AMP and may decrease the intracellular concentration of cyclic AMP are correct
- E.** All of the choices are correct

*Bloom's Level: 2. Understand*  
*Section 5.02*  
*Topic: Cells*

20. Second messengers

- A. Are necessary for all receptor signal transduction mechanisms
- B.** Act in the cell cytoplasm
- C. Act as intercellular messengers
- D. Always function to activate enzymes
- E. Are always proteins

*Bloom's Level: 1. Remember  
Section 5.02  
Topic: Cells*

21. Which of the following statements is true?

- A. Phosphorylation by protein kinase can stimulate or inhibit the activity of effector proteins
- B.  $\text{Ca}^{2+}$  and cyclic AMP are second messengers
- C. Phosphodiesterase converts GMP into cGMP
- D.** Both phosphorylation by protein kinase can stimulate or inhibit the activity of effector proteins and  $\text{Ca}^{2+}$  and cyclic AMP are second messengers are true
- E. All of the choices are true

*Bloom's Level: 1. Remember  
Section 5.02  
Topic: Cells*

22. Which of the following are known to be second messengers?

- A.** Diacylglycerol
- B. Phospholipase C
- C. ATP
- D. Both diacylglycerol and phospholipase C are correct
- E. All of the choices are correct

*Bloom's Level: 1. Remember  
Section 5.02  
Topic: Cells*



23. Amplification during a second messenger cascade is beneficial because amplification
- A. Takes small molecules and makes polymers out of them
  - B. Results in the production of more of the first messenger
  - C. Allows a cell to respond to more different hormones
  - D.** Allows small amounts of hormones to produce large responses in target cells
  - E. None of the choices are correct

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

24. Amplification of a second messenger cascade can take place at this level:
- A. 1 activated receptor can activate numerous G-proteins
  - B. 1 activated G-protein can activate numerous effector enzymes
  - C. 1 active effector enzyme can catalyze numerous reactions
  - D. 1 activated protein kinase can allosterically modulate numerous proteins
  - E.** All of the choices are correct

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

25. Calcium ion
- A. Concentration in the cytosol is increased by activation of phospholipase C
  - B. Concentration in the cytosol is increased by activation of membrane calcium channels
  - C. Release from the endoplasmic reticulum may be triggered by entry of calcium ion from the extracellular fluid
  - D. Both concentration in the cytosol is increased by activation of phospholipase C and concentration in the cytosol is increased by activation of membrane calcium channels are correct
  - E.** All of the choices are correct

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

26. The second messenger that causes calcium ion to be released from intracellular stores is
- A. Diacylglycerol
  - B. Adenylyl cyclase
  - C. Inositol triphosphate**
  - D. Phospholipase A
  - E. None of the choices are correct

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

### **True / False Questions**

27. First messengers may bind to a membrane receptor that then transforms to an ionic diffusion channel which promotes a change in membrane polarity.

**TRUE**

*Bloom's Level: 1. Remember*  
*Section 5.01*  
*Topic: Cells*

28. Eicosanoids are a family of ubiquitous, fatty-acid-derived, local chemical messengers.

**TRUE**

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

29. Aspirin and other nonsteroidal anti-inflammatory drugs are more specific in their effects on eicosanoid synthesis than are steroidal anti-inflammatory drugs.

**TRUE**

*Bloom's Level: 1. Remember*  
*Section 5.02*  
*Topic: Cells*

30. Two cell types having the same type of receptor for a chemical messenger will always respond to that messenger in the same way.

**FALSE**

*Bloom's Level: 1. Remember*

*Section 5.02*

*Topic: Cells*

31. Competition for receptors is strictly a pharmacological phenomenon, since naturally occurring chemical messengers do not compete with each other for the same receptor site.

**FALSE**

*Bloom's Level: 1. Remember*

*Section 5.01*

*Topic: Cells*

32. An antagonist blocks the action of a chemical messenger by binding to its receptor.

**TRUE**

*Bloom's Level: 1. Remember*

*Section 5.01*

*Topic: Cells*

33. Phosphorylation is a necessary component of any enzyme activation.

**FALSE**

*Bloom's Level: 1. Remember*

*Section 5.02*

*Topic: Chemistry*

34. The enzyme that catalyzes the production of cAMP from ATP is phosphodiesterase.

**FALSE**

*Bloom's Level: 1. Remember*

*Section 5.02*

*Topic: Chemistry*

35. Cyclic AMP activates allosteric proteins.

**TRUE**

*Bloom's Level: 1. Remember*

*Section 5.02*

*Topic: Chemistry*

36. Activated calmodulin functions to activate or inactivate cytosolic enzymes.

**TRUE**

*Bloom's Level: 1. Remember*

*Section 5.02*

*Topic: Cells*