**Name Period**

**Chapter 11: Cell Communication**

Chapters 9, 10, and 11 form three of the most difficult chapters in the book. The special challenge in Chapter

11 is not that the material is so difficult, but that most of the material will be completely new to you. Cell communication is normally not covered in standard high school biology books, yet perhaps no other section of biology has grown as much as cell signaling in the last ten years. Take your time with this section, and you will be rewarded with a knowledge base that will be most helpful in this course and courses to come.

***Concept 11.1 External signals are converted into responses within the cell***

1. What is a *signal transduction pathway*?

2. How does yeast mating serve as an example of a signal transduction pathway?

3. What is *quorum sensing*? How is it related to *biofilms*?

4. Complete the chart of local chemical signaling in cell communication in animals.

|  |  |  |
| --- | --- | --- |
| Local Signaling Types | Description | Specific Example |
| Paracrine signaling |  |  |
| Synaptic signaling |  |  |

5. How does a hormone qualify as a *long-distance signaling* example?

**reception**:

**transduction**:

**response**:

***Concept 11.2 Reception: A signal molecule binds to a receptor protein, causing it to change shape***

7. Explain the term *ligand*. (This term is not restricted to cell signaling. You will see it in other situations during the year.)

8. The text will explain three major types of membrane receptors in Figure 11.7. This material is of fundamental importance, so we will work thorough the specific figures for each type of membrane receptor. The first example is a *G protein-coupled receptor*.

**G protein-coupled receptor**:

**G protein**:

**GDP**:

9. Describe what happens in step 2 of Figure 11.7 on p211.

10. Describe what happens in step 3 of Figure 11.7. (The yellow box at the bottom right is important!)

11. Equally important to starting a signal is stopping a signal. Step 4 stops the signal. (Failure to do so can lead to serious problems, like cancer.) Describe how the signal is halted.

12. What activates a G protein?

13. A G protein is also a GTPase enzyme. Why is this important?

14. The second type of receptors described are *receptor tyrosine kinases*. Explain what a *kinase* enzyme does.

15. How does tyrosine kinase function in the membrane receptor?

16. What is a key difference between receptor tyrosine kinases and G protein-coupled receptors?

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22. Look next at *ion channel receptors*. The figure on p213 shows the flow of ions into the cell. Ion channel receptors can also stop the flow of ions. These comparatively simple membrane receptors are explained in three steps. Explain the role of the molecules.

**ligand**:

**ligand-gated ion channel receptor**:

**ions**:

24. The ligand attachment to the receptor is brief. Label and explain what happens as the ligand dissociates.

25. In what body system are *ligand-gated ion channels* and *voltage-gated ion channels* of particular importance?

26. Intracellular receptors are found either in the \_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_ of target cells. In order to be able to pass through the plasma membrane, the chemical messengers are either \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or very small, like nitric oxide.

28. An important idea, *transcription factors*, is introduced in Figure11.8. Explain the function of transcription factors in the cell.

***Concept 11.3 Transduction: Cascades of molecular interactions relay signals from receptors to target molecules in the cell***

29. What are two benefits of multistep pathways like the one in Figure 11.9 in your book?

30. Explain the role in transduction of these two categories of enzymes.

**protein kinase**:

**protein phosphatases**:

32. What is the difference between a first messenger and a second messenger?

33. Two common *second messengers* are *cyclic AMP* (*cAMP*) and *calcium ions* (Ca2+). Explain the role of the second messenger cAMP in Figure 11.12 in the text.

34. What is the important relationship between the second messenger and *protein kinase A*?

35. Figure 11.12 explains a cellular response is initiated; how might that response be inhibited?

37. List three types of cellular responses often induced by calcium ions. Be sure to include a plant example!

38. What happens to the cytoplasmic concentration of calcium when it is used as a second messenger?

***Concept 11.4 Response: Cell signaling leads to regulation of transcription or cytoplasmic activities***

39. When cell signaling causes a nuclear response, what normally happens?

40. When cell signaling causes a cytoplasmic response, what normally happens?

41. Figure 11.16 shows a single molecule of epinephrine resulting in the formation of \_\_\_\_\_\_\_\_\_ molecules of glucose 1-phosphate!

43. How do *scaffolding proteins* enhance a cellular response?

***Concept 11.5 Apoptosis integrates multiple cell-signaling pathways***

44. What specifically happens to a cell during the process of *apoptosis*?

45. The signal for apoptosis can come from outside or inside the cell. Give one example when the signal comes from outside the cell and two examples of cellular occurrences that would prompt an apoptosis signal from inside the cell.