**Cell Communication Review**
**Chapter 11**

1. Explain how yeast cells use cell signaling to identify a mate of the opposite sex. (The cells of opposite mating type secrete a certain signal molecule which binds to receptors on cells of the opposite mating type.)

2. Use a neurotransmitter and a hormone as examples to describe the difference between local and long-distance signaling between cells. (A neurotransmitter is involved in transmitting a nerve impulse from one neuron to the next over the very short distance of the synaptic space (local signaling). A hormone can travel in the blood to affect a cell far from the cell that produced the hormone (long-distance signaling).)

3. Describe the three stages of cell signaling (reception, transduction and response).

4. Nerve growth factor (NGF) is a water-soluble signaling molecule. Predict whether the receptor for NGF would be intracellular or in the plasma membrane. Justify your answer. (NGF cannot pass through the cell membrane, so you would expect the receptor to be in the plasma membrane.)

5. a) Describe the role of protein kinases in signal cascades. (A protein kinase is an enzyme that transfers a phosphate from ATP to a protein, activating it.)

   b) Describe the importance of protein phosphatases in signal cascades. (Protein phosphatases remove phosphate groups from proteins, deactivating them and turning off the signal.)

6. Explain the importance of the cellular response being switched off quickly in the absence of a signal. (Without the signal being switched off, the cell would continue the response even after the signal is removed.)

7. Explain why second messengers are important in some signal transduction pathways. (If the signal molecule cannot enter the cell, another molecule inside the cell must carry the signal through the cytosol.)

8. a) Identify the actual "signal" being transduced in a signal transduction pathway. (The "signal" is the fact that a signal molecule is bound to a cell-surface receptor.)

   b) Describe how this "signal" is passed from outside to inside the cell. (The signal is transduced by a series of protein which become active, thereby activating the next protein in the chain.)

9. Epinephrine stimulates the breakdown of glycogen into glucose-1-phosphate by glycogen phosphorylase. If epinephrine were mixed with glycogen phosphorylase and glycogen in a cell-free mixture in a test tube, predict whether glucose 1-phosphate would be produced. Justify your prediction. (Glucose 1-phosphate would not be produced because the activation of the enzyme requires a signal transduction pathway across the cell membrane. The enzyme is not activated by direct contact with the signaling molecule.)

10. Epinephrine initiates a signal transduction pathway that produces cAMP and leads to the breakdown of glycogen to glucose, a major energy source for cells. Other effects of the fight-or-flight response include an increase in heart rate and alertness, as well as a burst of energy. Given that caffeine blocks the activity of cAMP phosphodiesterase, propose a mechanism by which caffeine ingestion leads to heightened alertness and sleeplessness. (Caffeine blocks the activity of

phosphodiesterase, preventing the breakdown of cAMP to AMP and allowing a continued effect of epinephrine on cell metabolism.)

11. Explain how a signal molecule might result in a gene being activated. (The last protein activated in a phosphorylation cascade can be a transcription factor. The activated transcription factor can enter the nucleus to turn on a gene.)

12. Describe how a phosphorylation cascade can allow a single signal molecule to evoke a large response from a cell. (At each step of a cascade, one protein activates many proteins in the next step, amplifying the response at each step.)

13. Some diseases are caused by defective protein phosphatases. Explain how such a defective protein would affect a signal transduction pathway. (The phosphatase would be unable to dephosphorylate a particular protein. As a result, a pathway would be unable to be shut off once activated.)

14. a) Identify the structure that allows a cell to detect a specific signaling molecule. (A receptor)

    b) Explain how two cells can respond differently to the same signaling molecule. (The cells could contain different intracellular proteins which would result in a different response.)

15. Describe the importance of signaling for cells. (Signaling allows cells to respond to changes in the environment and messages from other cells.)