

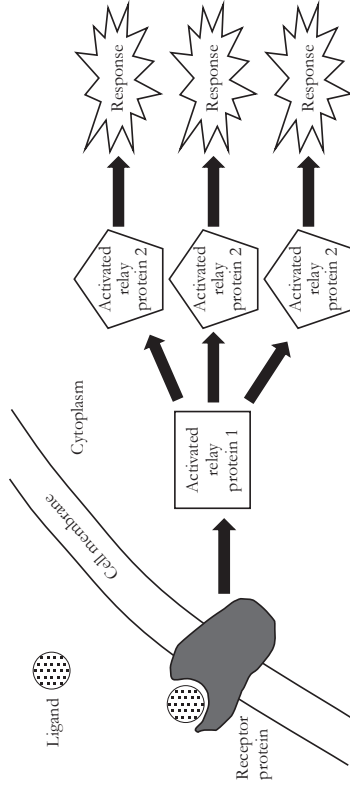
Signal Transduction Pathways

What happens inside of a cell when a signal has been received?

Why?

When cells release signal molecules (ligands) to send a message, and the message is received, a whole host of events take place inside the cell. The ultimate goal is a response—a gene is turned on, a protein is manufactured, an enzyme is activated, the cell divides or dies, etc. There are many responses that could occur, but the pathways to those responses are very similar.

Model 1 – Basic Signal Transduction Pathway



1. According to Model 1, does the signal transduction pathway occur inside or outside of a cell?
2. Compare the shape of the ligand in Model 1 to the shape of the receptor protein.



3. The four steps in the signal transduction pathway are listed below. Label the diagram above with the Roman numerals to indicate where on the diagram each step is taking place.

- I. Signaling
- II. Reception
- III. Transduction
- IV. Response

4. Based on the diagram in Model 1 and your labels, propose a definition for “transduction” in the context of the signal transduction pathway.

5. Amplification often occurs during the transduction step in the signal transduction pathway.

- a. Define “amplification” as it is used in everyday language.

- b. Explain how the signal in Model 1 was amplified.

6. List several possible responses that could occur due to a signal being received by a cell. (*Hint:* There are several listed in the *Why?* box.)

7. Once the response is achieved in a cell, what would need to occur to stop the response?

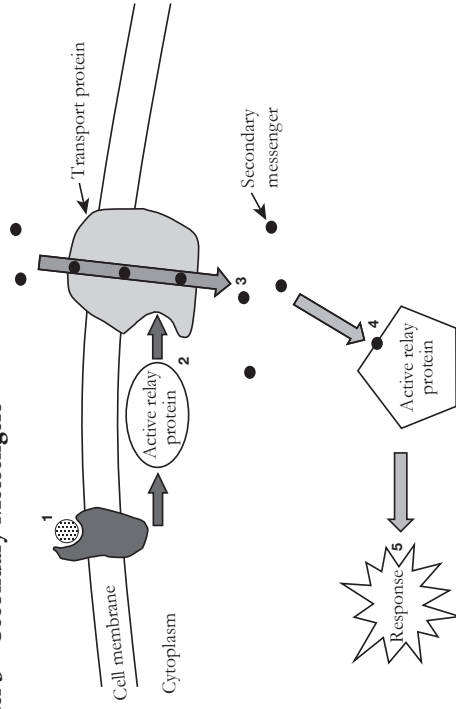


Read This!

Signal transduction pathways are as varied as the species on Earth, but each of them follow the same basic steps. Reception may occur by the ligand attaching to a receptor protein or the ligand may travel through the cell membrane by diffusion. Transduction may occur by one protein or by several proteins activating each other in a cascade. Keep this in mind as you continue working through this activity.

Extension Questions

Model 3 – Secondary Messengers



19. Consider the signal transduction pathway in Model 3. What event begins the process of producing a cellular response?

20. Locate the secondary messenger molecules in Model 3.

a. Describe the type of diffusion that is used to get the secondary messengers into the cell.

b. What activates or opens the transport protein channel that allows the secondary messengers to enter the cell?

Read This!

Relay molecules and secondary messengers have essentially the same jobs in signal transduction pathways. However, relay molecules are almost always proteins that require activation. They are large and do not diffuse through the cell quickly. Secondary messengers on the other hand are small, water soluble molecules that can diffuse quickly. They may or may not need activation before they are able to move the signal on to the next step in the process. Cyclic AMP (cAMP) and calcium ions (Ca^{2+}) are common secondary messengers in human systems.

21. Within an organism it is critical that signals between cells are very specific. For example, if ligand A is meant to activate immune system cells to reproduce in response to an infection, it should not also cause other cells to grow as if they had received a growth hormone. When a ligand is released, what prevents all of the cells in the body from being affected?