MCDB 1152 Activity 9 KEY

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Signal transduction is the process where an environmental signal interacts with a cell and causes that cell to respond in a specific way: new genes are expressed, glucose uptake can be altered, cytoskeletal elements can be assembled, disassembled, cell division occurs, etc.

Signal transduction requires a signal, a receptor on or in the cell, and a set or intracellular proteins that process that signal which results in a change in cell behavior (the response). If the signal is hydrophilic, the signal must bind the receptor protein on the external surface of the cell (why?). Receptors for hydrophilic signals are transmembrane proteins and include G protein linked receptors and enzyme linked receptors. If the signal is hydrophobic (such as a steroid hormone) it will diffuse through the plasma membrane and bind a receptor in the cytoplasm or the nucleus.

For this week's activity, use the Play-Doh and the white boards to build a model of both the G protein receptor system and the enzyme activated receptor system. (Use your text book and lecture notes to help you.) Be sure to represent all the structural components and molecules listed here under each system and then show how they are altered once the signal is received.

Components to consider in each system:

G-protein receptor system	**Enzyme-activated receptor system**
signal protein	signal protein
G-protein-linked receptor	enzyme-activated receptor
plasma membrane	plasma membrane
inactive and active G protein	inactive and active relay proteins
GTP and GDP	ATP and ADP
Second messenger	G protein

Overall concepts to include:

Phosphorylation cascades

inactive and active enzyme signal transduction pathway

Use your models to show how signal reception by each of the systems can lead to the release of Ca^{++} ions from the endoplasmic reticulum or to activation of gene expression in the nucleus. Demonstrate and explain your models to another student group or to your instructor.

Draw a picture of your model in the space below

See Figure 8.18 and 8.19 in your text

1. How are the G protein and the enzyme activated systems similar? Consider both structural similarities and similarities in how the systems function.

Both have a transmembrane protein(s) as a receptor, when that receptor(s) is bound by a ligand, changes occur on the cytoplasmic side of the membrane that lead to a change in cell behavior. Both bind hydrophilic signals. Both signal transduction events can eventually lead to the activation of gene expression (not in all cases). Both use G proteins during signal transduction.

2. How are the two systems different? Consider both structural differences and differences in how the systems function.

Enzyme activated-the ligand binds two receptors and activates those receptors which are enzymes that autophosphorylate each receptor. That phosphorylation leads to signal transduction on the cytoplasmic side. The G protein receptor is not an enzyme but activates an enzyme (the G protein) on the cytoplasmic side. The response for the enzyme activated receptor when bound leads to a phosphorylation cascade. The response of the G protein receptor is an increase in second messages (Ca^{++}ions is an example)

3. How could a nonfunctional protein in the signal transduction pathway result in unregulated cell division?

If the signal transduction pathway was one which when activated, signals the cell to divide, then any non functional protein in that pathway (a receptor, a G protein, a kinase, a transcription factor) could cause the cell to think that signal transduction was occurring when it was not. This constant ON position of signal transduction would cause the cell to continue to divide even in the absence of any signal.