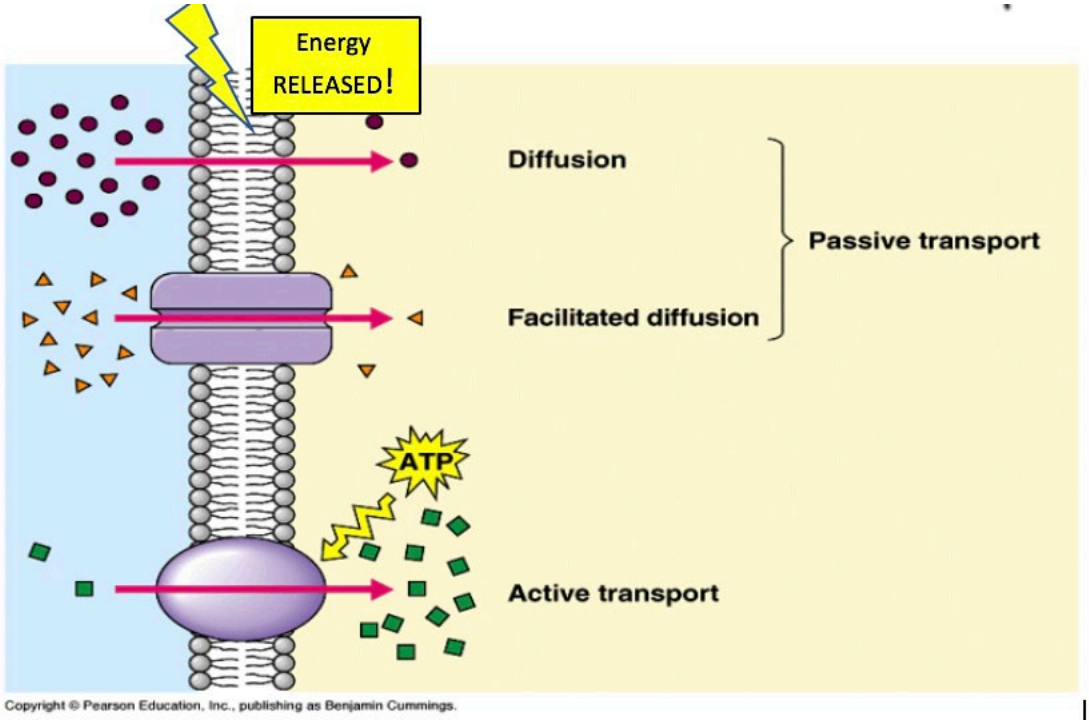
NAME: DATE: AP BIOLOGY: U4L2

Signal Transduction Pathway

Do Now:



1. Use the diagram above to explain the difference between diffusion and facilitated diffusion. In your explanation, include a description of the polarities of the molecules.

2. Pancreatic amylase is a digestive enzyme that breaks down large starch molecules in the digestive process. Pancreatic amylase is unable to break down lipids. Which of the following best explains why pancreatic amylase is able to break down starches, but not lipids?
   a. Lipids are too hydrophobic to be broken down by enzymes.
   b. Lipids are too small to bind to enzymes.
   c. Enzymes only bind to their specific substrates.
   d. Enzymes denature in the presence of lipids

Explain your response to question #2:

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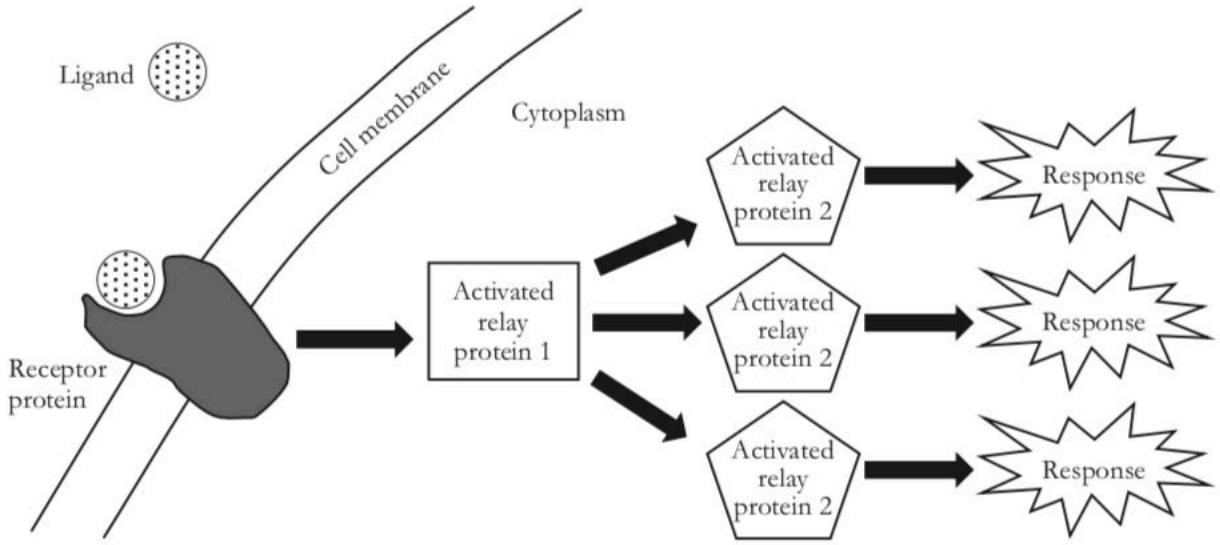
Guiding Question: How do cells receive, transduce and respond to signals?

Read the following information and answer questions 1-2: 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 pathway to those responses is very similar.

Model 1 – Basic Signal Transduction Pathway



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1. 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

2. Based on the diagram above, propose a definition for "Transduction" in the context of the signaling transduction pathway.

3. In the pathway, activated relay protein 1 activates relay protein 2. This is an example of signal amplification. Propose a definition for "amplification" in the context of the signaling transduction pathway and explain why amplification might be beneficial.

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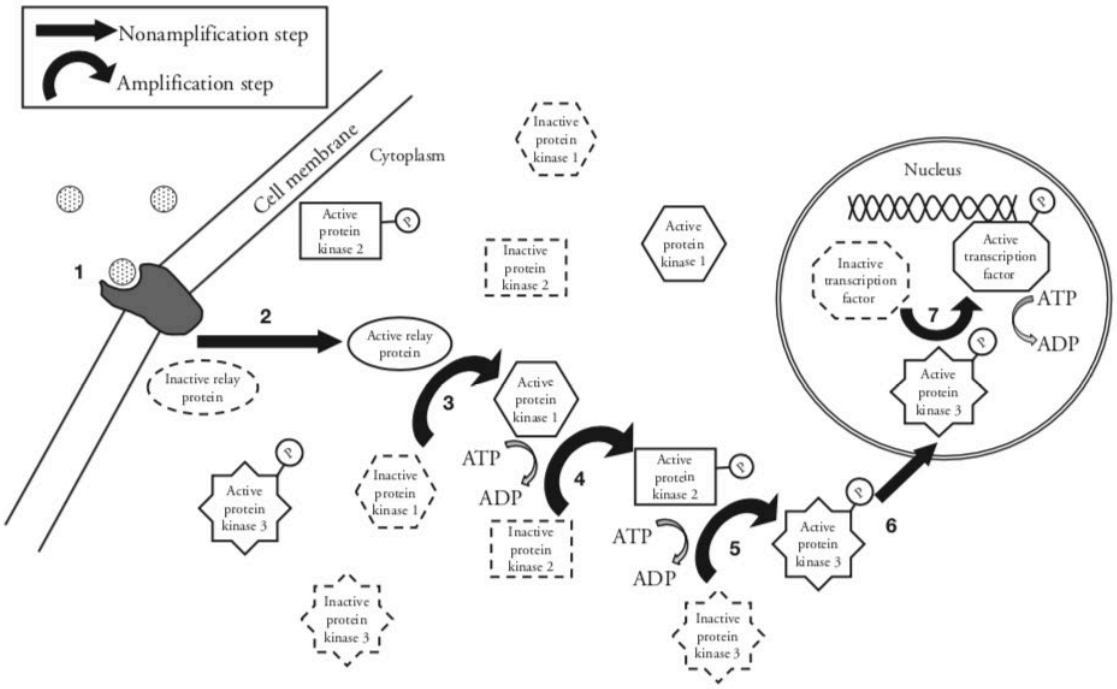
Model 2 – Phosphorylation Cascade



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4. Use the model to describe how protein kinases are activated.

5. Phosphorylation is a process that adds a phosphate group onto a protein to "activate" it – that is, to change its shape enough that it can function properly.
    a. Which step(s) in the phosphorylation cascade illustrated in Model 2 include phosphorylation?

    b. Where do the phosphate groups come from that are added to the proteins during phosphorylation?

6. Identify the step(s) in Model 2 that represent reception, transduction, and response for the phosphorylation pathway.
    a. Reception:

    b. Transduction:

    c. Response:

7. Predict how the protein kinases could be deactivated.

8. Protease phosphatases are enzymes that remove phosphate groups from proteins. Complete the illustration in Model 2 by adding at least two protein phosphatases (PP) to show how proteins are returned to inactive status.

9. Within an organism it is critical that signals between cells are very specific. For example, if the ligand in Model 2 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? *(Hint: Consider the structure of the ligand and the receptor protein.)*

10. Using your responses from 1-10, respond to the guiding question: **How do cells receive, transduce, and respond to signals?**

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Exit Ticket

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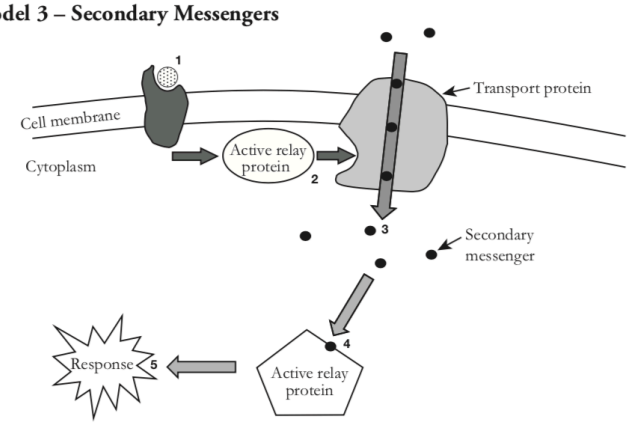
1. The figure above represents a generalized hormone-signaling pathway. Briefly **explain** the role of each numbered step in regulating target gene expression.

Model 3 – Secondary Messengers



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2. Model 3 above represents how some signals trigger secondary messengers to enter the cell. **Describe** how secondary messengers enter the cell.

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