STUDY GUIDE - *Ch.11.1* - External Signals are Converted to Responses Within the Cell **NAME:** _____
- *Ch.11.2* - Signal Reception: A Signaling Molecule Binds to a Receptor, Causing it to Change Shape

- **PHYSICALLY PRINT OUT this PDF and HANDWRITE (with a black or blue pen) your answers directly on this PDF.** *Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.*
- **Importantly, study guides are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.*
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** *AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.*
- **SCAN physical documents in color and with good resolution. Then, upload your final work as PDFs to Archie.** *Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** ***First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.*

1. Bacteria exhibit a behavior known as Quorem Sensing. What is **Quorem Sensing**?

2. a. Quorem Sensing allows for bacteria to form biofilms. What are **biofilms**?

   b. What is the **benefit** to the bacteria of forming a biofilm?

3. Let's work through the **Problem-Solving Exercise** on page 214 before we keep reading. In the graph you see four groups of the same species of bacteria, one control group and three experimental groups **plotted on the x-axis.** Remember, the **Independent Variable** is what the researcher manipulates, which is in this case the type of peptide (1 or 2) that the bacteria are being exposed to, researchers hoping these peptides are able to interfere with the bacteria's ability to communicate with each other in order to coordinate the release of their toxin. The concentration of the toxin these bacteria secrete is the **Dependent Variable**, which is **plotted, as always, on the y-axis**. Again, it is thought that the bacteria will not start secreting, in unison, their toxin until their population density (the # of bacteria in the given space) reaches a high enough value. Answer the question below:

   1.

   2. a.

      b. (***Use the specific data** - **the data & data points** - provided on the x- and y-axes, making sure to always write out units too any time you are highlighting specific quantitative values)*

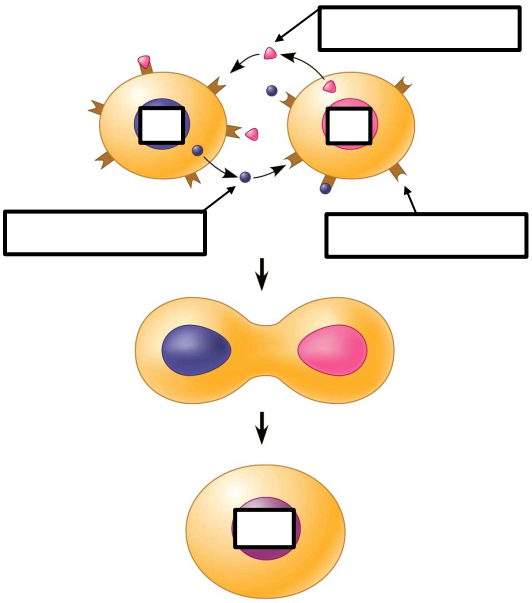
   3. a.

      b. (Again, **refer to the specific values - with units - shown on the y-axis** as you compare the results of treatment on the different bacterial experimental groups)

4. a.

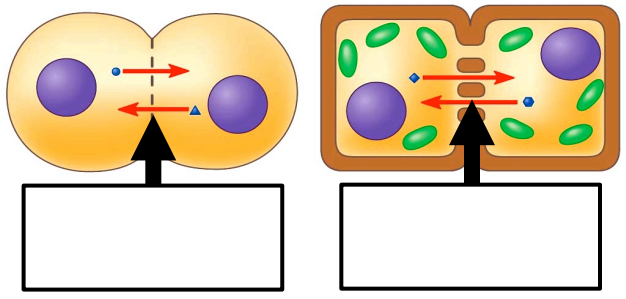
   b.

4. Cells most often communicate with each other by chemical signals. Explain how chemical signaling is involved in initiating the **mating process in yeast cells**, ensuring that non-motile yeast cells only fuse with cells of the opposite mating type to produce a/α cells that contain all the genes of both original parent cells.



5. What is meant by the term **signal transduction pathway**?

6. The fastest way to communicate between cells is when cells are in direct contact. Label the following figures and explain how the following **intercellular connections function in cell-to-cell communication**?

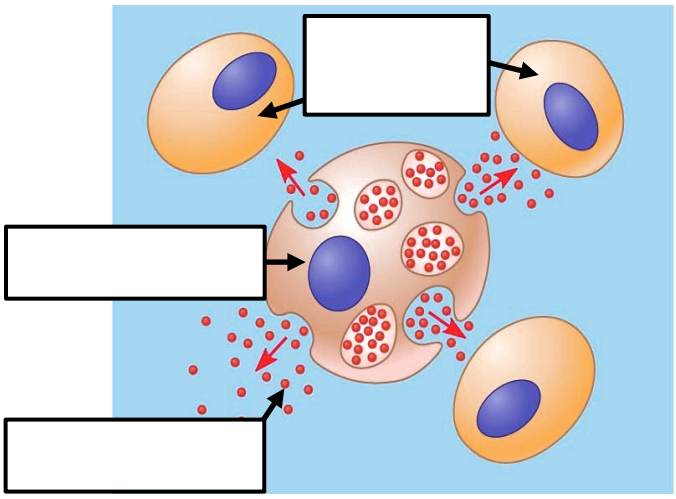


Direct Contact Between Plasma Membrane Proteins

Cell Junctions:

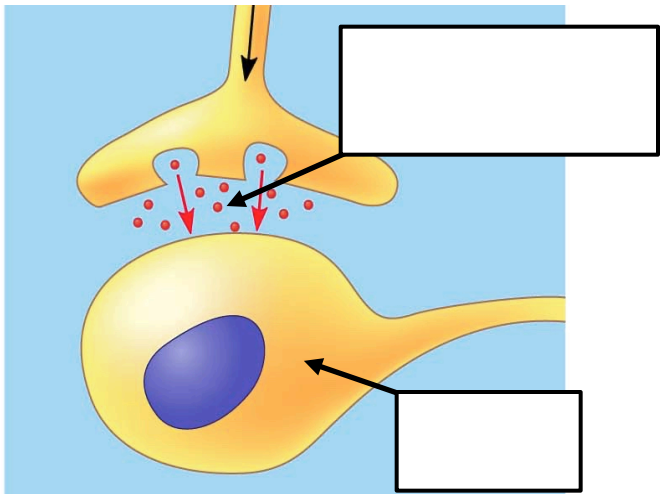
Cell-Surface Molecules:

7. "Local regulators" travel short distances and influence cells in the vicinity of a cell secreting the regulators. Label the following figures. Then, name and describe the two types of **local signaling** depicted below.



Name of Signaling Type:

Description:

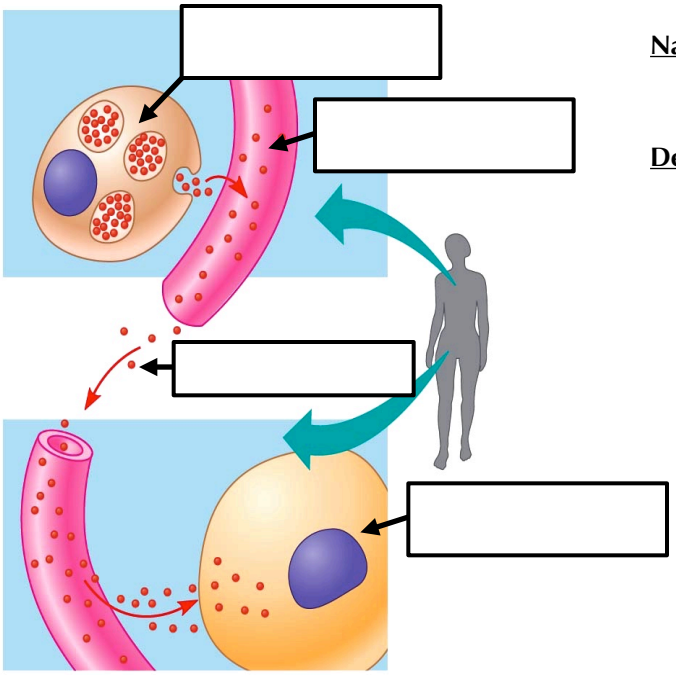


Name of Nerve Cell Signaling:

Description:

8. Cells that are far apart may also have to communicate to coordinate activities in the bodies of multicellular organisms. **Some long-distance signaling molecules are referred to as hormones**. How do **hormones** reach their target cells that may be far away from the signaling cell *(so far that the diffusion of signaling molecule through the interstitial fluid from signaling cell to the target cell alone may take too long to be useful)*?

9. Label the following figure. Then name the type of signaling shown below and explain how these **long distance signals** are sent.



Name of Signaling:

Description of Signaling Process:

10. Some cells (target cells) are able to receive and respond to a signaling molecule secreted by another cell while other cells can't. What **determines the ability of a cell to respond to a signaling molecule**?

11. The hormone **epinephrine stimulates the breakdown of the storage polysaccharide glycogen** in liver and skeletal muscle cells, releasing the **simple** sugar glucose-1-phosphate, which can be converted by the liver into glucose and be secreted into the blood stream as fuel for body cells. Describe **Sutherland's research findings** and state the inferences he made based on his work.

    Findings:

    Inferences:

12. When external signal molecules reach a cell and are recognized by a specific receptor, the signal carried must be "transduced" or changed into another form inside the cell before the cell can respond. Briefly explain and label the figure below showing the **three steps of a signal transduction pathway**. MEMORIZE THIS WELL!

    1. **Name:**

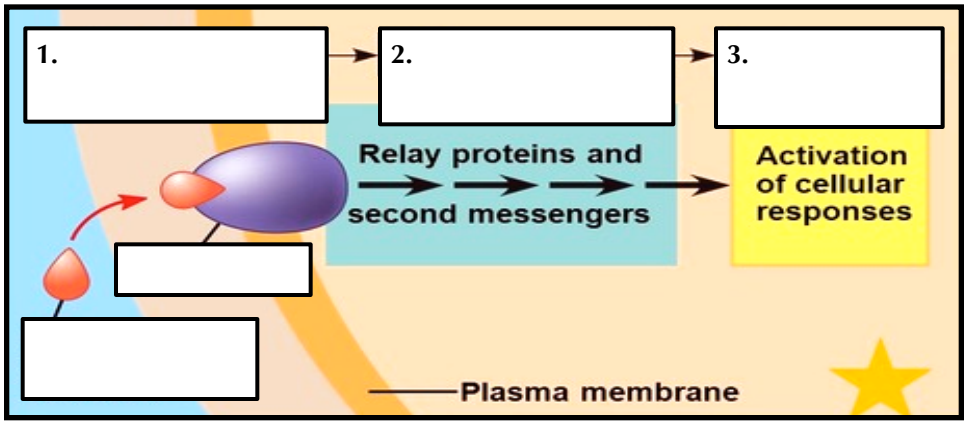
       Description of Event:

    2. **Name:**

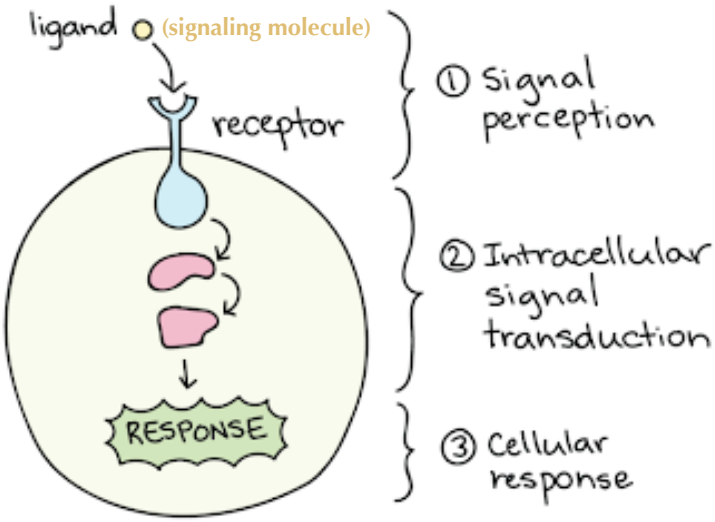
       Description of Event:

    3. **Name:**

       Description of Event:



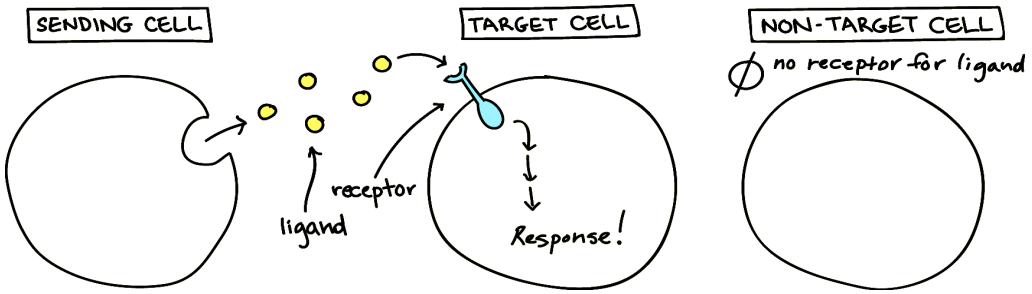
13. Let's refer back to the research of Dr. Sutherland & the figure to the right. In liver cells, glycogen phosphorylase acts in which of the three stages of the signaling pathway associated with an epinephrine-initiated signal? *(Check your answer by going to the **Ch.11.1 Concept Check Question #2** answer in Appendix A)*



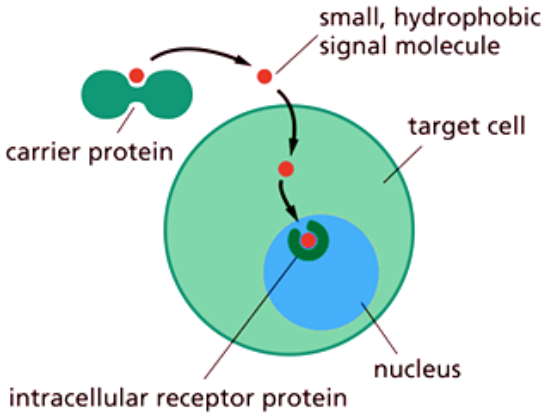
14. When Dr. Sutherland's team mixed epinephrine with glycogen phosphorylase and glycogen in a cell-free mixture, in a test tube, no glucose-1-phosphate was generated Why not? *(Check your answer by going to the **Ch.11.1 Concept Check Question #3** answer in Appendix A)*

15. Define the term **ligand.**

NOTE: Most signal receptors are PLASMA MEMBRANE proteins. Their ligands are water-soluble (hydrophilic). These receptors transmit information from the extra-cellular environment to the inside of the cell by **changing shape or changing shape and combining together when bound by ligands**.

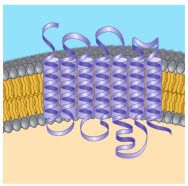


NOTE: Other signal receptors, however, are located INSIDE the cell in either the cytoplasm or the nucleus. **For ligands to pass through plasma membranes and reach receptors inside the cell**, these ligands must be hydrophobic.

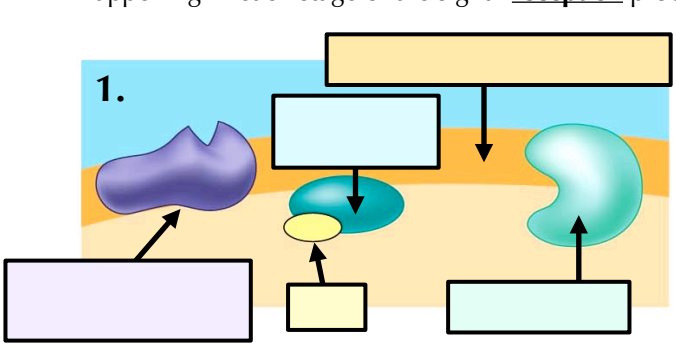


16. a. Study Figure 11.8 well. What is a **G protein-coupled receptor**?

b. What is its basic structure?



17. Memorize what happens when we use a G-Protein-Coupled Receptor for signal transduction. Once you feel you understand, label the following drawing of **G-Protein-Coupled Receptor functioning** and describe what is happening in each stage of the signal **reception** process.



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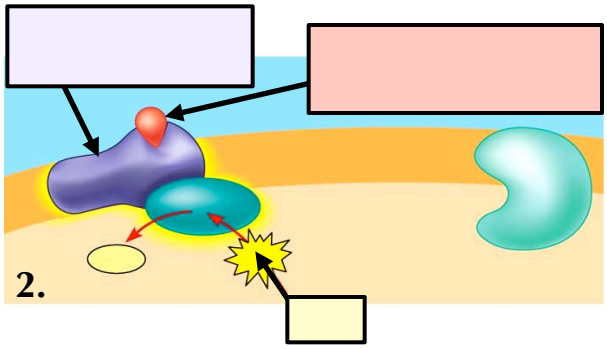

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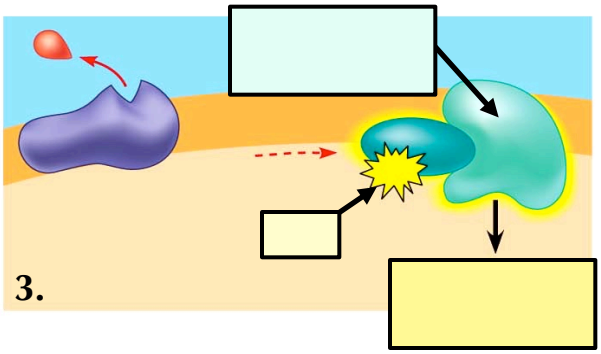

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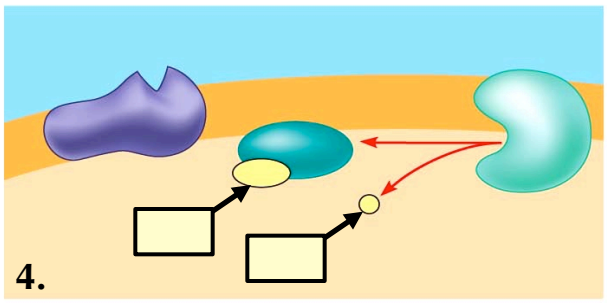


Description:

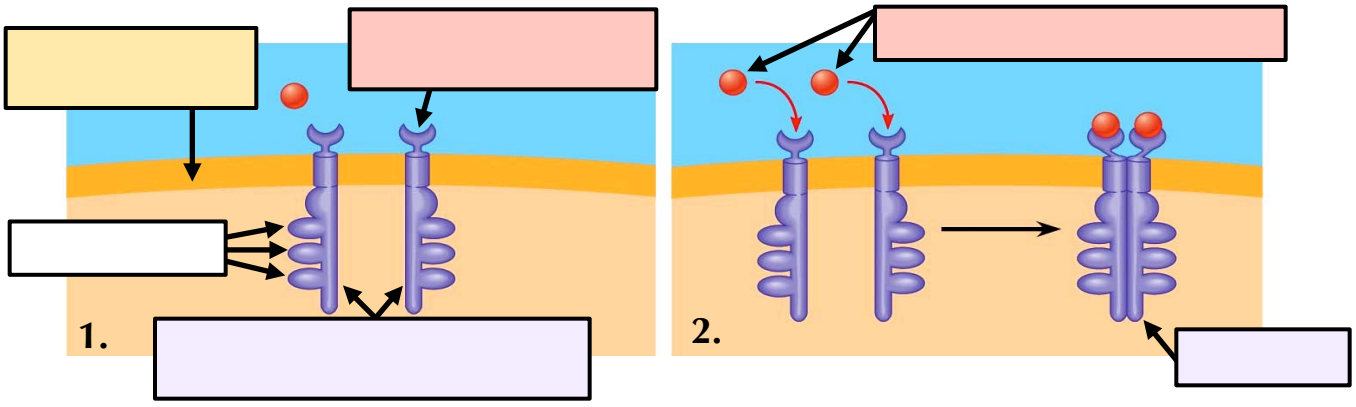
18. Assuming you have it all memorized now, let's see if, as a self-quiz, you can fill in the following summary paragraph about **G-Protein-Couled Receptors** from memory alone first!

The **G-protein-linked receptor** is located in the _____ of a cell. The **G-protein**, however, is located on the _____ side of the plasma membrane. When GDP is attached to the G-protein, the messenger is considered _____. When a signal molecule binds to the _____ side of the G-protein-linked receptor, the receptor is _____ and changes _____. G-protein now binds, causing _____ to replaces GDP, making this messenger _____. The G-protein carrying the GTP leaves the receptor and _____ to an **enzyme**, altering the enzyme's _____ and, therefore, _____. This enzyme can then trigger further **cellular responses** inside the cell.

19. a. What is a **kinase**?

b. Where does the transferred phosphate group usually come from?

20. Memorize what happens when we use a Receptor Tyrosine Kinase for signal transduction. Once you feel you understand, label and describe each stage of **Receptor Tyrosine Kinase functioning**.



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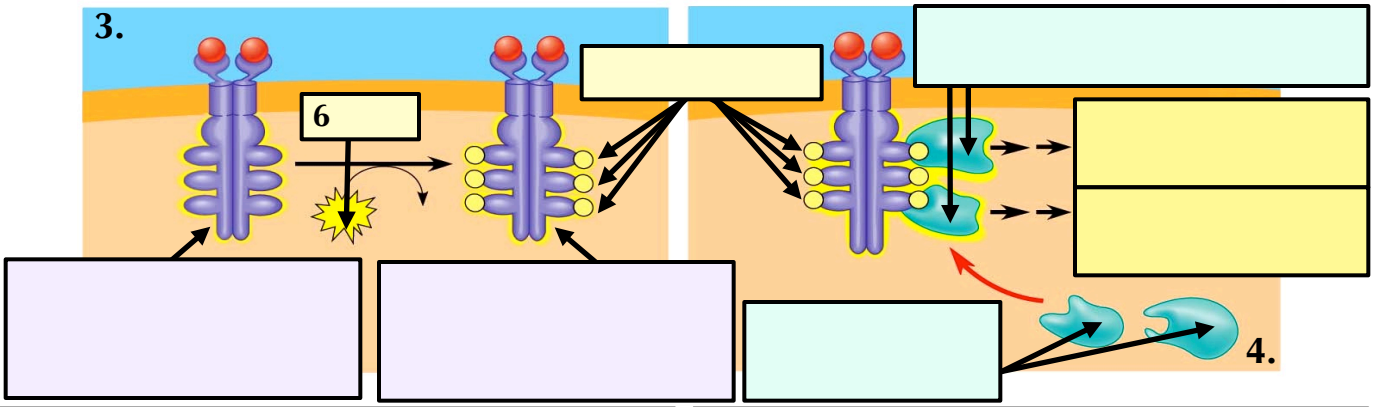

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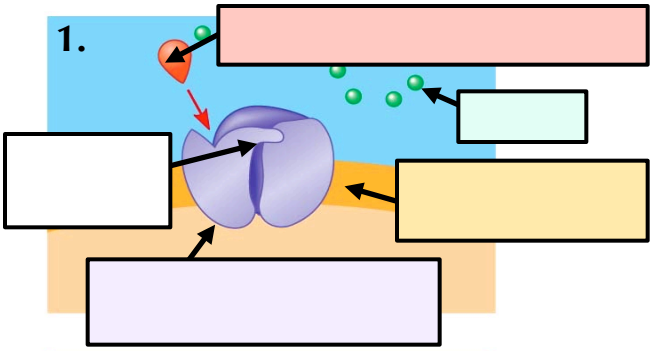
21. Assuming you have it all memorized now, let's see if you can fill in the following summary paragraph about **Tyrosine Kinase receptors** from memory as a self-quiz!

Receptor tyrosine kinases are plasma membrane proteins that behave as enzymes too. A tyrosine kinase receptor is different from a G-protein-linked receptor in that it can trigger _____ pathways at the **same** time. When two _____ _____ are in their receptor sites, the two receptor molecules join together, a process referred to as _____, activating the **enzymatic parts** of the polypeptides. The cytoplasmic side of the receptors then function as a _____ , converting ATP into ADP, attaching _____ to tyrosine amino acids. **Relay proteins** next bind to the phosphorylated tyrosines and undergo a change in _____, triggering **transduction pathways** that leads to **cellular responses.**

22. Memorize how ligand-gated ion channels work. Once you feel you understand, label and describe each stage of **Ligand-Gated Ion Channel functioning**.



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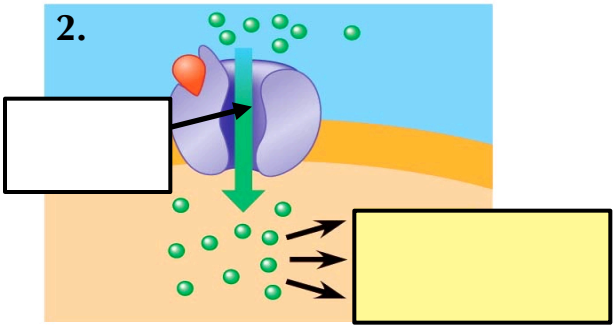

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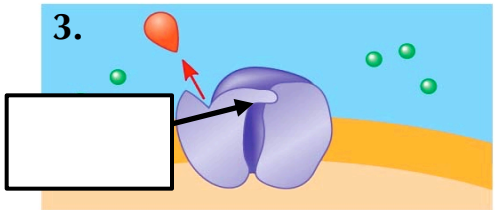

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23. Assuming you have it all memorized now, let's see if you can fill in the following summary paragraph about **gated ion channel receptors** from memory to review it all one more time!

Gated Ion Channels are plasma membrane receptors with a region that act as a " _____. " **The channel opens or closes depending on the binding of either a ligand molecule on the extracellular side or electrical signals, such as a change in voltage (also referred to as a change in membrane potential). See Ch.7 to review!** Gated ion channels that are controlled by electrical signals, instead of ligands, are, more specifically, called _____. If the door is closed, certain _____ are blocked from entering the cell. When the door is open, a specific **ion** does enter or exit the cell. **Rapid changes in ion concentration may directly affect the activity of cells.**

(Note that the ligand that activates a ligand-gated ion channel and the ion solute that then diffuses through the channel are NOT the same entities)

24. *Think:* Why are the **changes in all types of receptors due to ligand binding only temporary**?

25. *Think:* How does the **concentration of ligand** in the extracellular fluid influence receptor activation?

NOTE: Receptor malfunction is associated with many diseases!

- Receptors can have the **wrong shape** due to DNA gene mutations that change the primary sequence of one or more of the polypeptides that make them up. **A receptor stuck in the ON shape**, even in the absence of ligand binding, **activates a signal transduction pathway when one should not be. A receptor stuck in the OFF shape**, may not contain a correct ligand binding or correct relay protein binding site, and so **may not be able to activate a necessary signal transduction pathway.**

- Sometimes, **mutations in the DNA regions that control gene expression** (the on or off switches of a gene, affecting how often a gene gets transcribed into mRNA or not) can result in the **wrong amount of receptor** being produced. **If TOO MUCH receptor is made**, even if it's made correctly, the **cell may respond too easily or too much** to even small concentrations of ligand in the extracellular fluid. Other times, **if TOO LITTLE of a particular receptor is made,** the cell **does not respond enough or at all to ligands** present.

- Of course, receptors are **not** the only proteins involved in signal transduction pathways. **Errors in the shape (thus behavior) or quantity/concentration of any of the relay or target proteins or these protein's activators or inhibitors can also cause a cell to have abnormal behaviors** (even if the receptors are functioning normally).

26. What would be the consequence if a cell made a defective Tyrosine Kinase Receptor that was unable to dimerize after ligand binding? *(Check your answer by going to the **Ch.11.2 Concept Check Question #2** answer in Appendix A)*

27. a. Where would you expect most **water-soluble ligands** to bind to receptors, and **why**?

Where do they bind?

Why?

b. What is 'different' about the **messengers that target intracellular receptors** (HINT: *Think of the structure of the cell membrane and how this relates*)

28. Many intracellular receptors for hydrophobic ligands play a role in **BOTH** transduction and cell response since they are able to act as **BOTH** receptors, but also transcription factors. Briefly define the term **transcription factor.**

29. Label the diagram and explain the 5 steps involved in a **steroid hormone,** like the sex hormone testosterone (made from cholesterol), interacting with an intracellular receptor.

Description:

Description:

Description:

Description:

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