**Topic Review Guide**: Cell Communication (4.1), Signal Transduction (4.2-4.4) and Feedback (4.5)

**To Think About**: How do cells communicate, transmit and receive chemical signals over short and long distance? How is the process of distance communication different from the process of communicating during cell-cell contact? What is a signal transduction pathway (STP) and why do cells use signal transduction pathways? How do STP begin? What is the role of protein modification and phosphorylation cascades in STPs? What role does the environment play in eliciting cellular responses? How are STPs used to influence cellular responses when there are changes in the environment? HOw can mutations in the receptor protein or any component of the signal pathway affect transduction of a signal? How can chemicals activate and inhibit a pathway? What are feedback mechanisms? How do positive and negative feedback mechanisms affect homeostasis?

**Watch:** AP Daily Videos [4.1 “Cell Communication”](https://apclassroom.collegeboard.org/d/hqgz9d8pm9?sui=6,4), [4.2 “Introduction to Signal Transduction”](https://apclassroom.collegeboard.org/d/ooi7e9brze?sui=6,4), [4.3 “SIgnal Transduction”](https://apclassroom.collegeboard.org/d/4i6urljygb?sui=6,4), [4.4 “Changes in Signal Transduction Pathways”](https://apclassroom.collegeboard.org/d/xcscxu7s4h?sui=6,4), [4.5 “Feedback”](https://apclassroom.collegeboard.org/d/v2tft2s9dm?sui=6,4)

**Read:** Chapter 5.6 Biology in Focus

**Supplementary Resources**: Click the links below for more information to help you learn more about concepts discussed in this lesson.

* Guided Notes [4.1](https://docs.google.com/document/d/1ujZoISMsuJG_TwxzXP7OPnD15fq69vMjqCaGh1ylYd8/edit?usp=sharing), [4.2](https://docs.google.com/document/d/1v0spMsq_PvBc8r47QzgOUlxrsJhgoo2BrXfxOmzlARM/edit?usp=sharing), [4.3](https://docs.google.com/document/d/1sQsZ9YgiesWkWtXjjxjhAgJMutw4pRq8DtlLDiZ9qA8/edit?usp=sharing), [4.4](https://docs.google.com/document/d/1u6t7TNYGzRl1PHZdyHi8Ix4O1hZQAXYLMIORUnj_7a4/edit?usp=sharing), [4.5](https://docs.google.com/document/d/1PTcd6CysreiVfHs3_9n5ybxT4OGi9mYkaId1q_wWH84/edit?usp=sharing)
* [Slideshow Presentation: Cell Communication and Applications](https://docs.google.com/presentation/d/1yYiq5jLlMD7PFtwym6bhrCPohhMDAikVC9am3naoHIs/edit?usp=sharing)
* [Mr. Andersen’s “Cell Communication” video](http://www.youtube.com/watch?v=xnGXItWrJ3k)
* [Mr. Andersen’s “Signal Transduction Pathways” video](http://www.youtube.com/watch?v=qOVkedxDqQo&list=PLFCE4D99C4124A27A&index=46)
* [Mr. Andersen’s “Effects of Changes in Pathways” video](https://youtu.be/W48Gk2Om3wI)
* [Mr. Andersen’s “Positive and Negative Feedback Loops” video](https://www.youtube.com/watch?v=CLv3SkF_Eag)
* BFW Publishers: [Principles of Life Chapter 5 Online Resources](http://bcs.whfreeman.com/hillis1e/#667501__669665__)
* Pearson BioCoach: [Membranes and Communication](http://www.phschool.com/science/biology_place/biocoach/biomembrane2/intro.html)
* McGraw Hill: [Membrane-Bound Receptors that Activate G Proteins](http://highered.mcgraw-hill.com/sites/0072507470/student_view0/chapter17/animation__membrane-bound_receptors_that_activate_g_proteins.html)
* Wiley: [Signal Transduction Pathways animation](http://www.wiley.com/legacy/college/boyer/0470003790/animations/signal_transduction/signal_transduction.htm)
* BFW Publishers: [G Linked Protein Pathways and Cancer](http://bcs.whfreeman.com/WebPub/Biology/hillis1e/Animated%20Tutorials/at0504/at_0504_sig_trans_cncr.html)
* Nature: [SciTable - Cell Signaling](https://www.nature.com/scitable/topicpage/cell-signaling-14047077)
* University of Utah: [Learn.Genetics - The Inside Story of Cell Communication](https://learn.genetics.utah.edu/content/cells/insidestory/)
* University of Utah: [Learn.Genetics - When Cell Communication Goes Wrong](https://learn.genetics.utah.edu/content/cells/badcom/)
* University of Utah: [Learn.Genetics - How Cells Communicate During Fight or Flight](https://learn.genetics.utah.edu/content/cells/fight_flight/)
* University of Utah: [Learn.Genetics - The Glycogenolysis Signaling Cascade](https://learn.genetics.utah.edu/content/cells/fight_flight/glycogenolysis/)
* Tufts University: [Quorum Sensing](https://sites.tufts.edu/quorumsensing/quorumsensing101/)
* TED-ED: [Feedback Loops](https://www.youtube.com/watch?v=inVZoI1AkC8)

**Recall and Review:** Use the lectures in the videos and information from your textbook to help you answer these questions in your BILL. Before you start, mark your level of understanding so that you know where you are beginning. After you have completed the questions, then check to see what level of understanding you have achieved. If you’re still at a level N or level A, it is recommended that you stop in for office hours.

| **Essential Knowledge:**  What You Absolutely Must Know and Understand | | | | |
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| Levels of Mastery | | | | *I can describe the ways that cells can communicate with one another.*  *I can explain how cells communicate with one another over short and long distances. (Topic 4.1)* |
| **N** | **A** | **E** | **M** | **Questions You Should Be Able to Answer** |
|  |  |  |  | 1. **Describe** specific examples of each of the following ways that cells can communicate with each other: 2. No distance 3. Short distance 4. Long distance 5. Local regulators |
| **Essential Knowledge:**  What You Absolutely Must Know and Understand | | | | |
| Levels of Mastery | | | | *I can describe the components of a signal transduction pathway.*  *I can describe the role of components of a signal transduction pathway in producing a cellular response. (Topic 4.2)* |
| **N** | **A** | **E** | **M** | **Questions You Should Be Able to Answer** |
|  |  |  |  | 2.  **Describe** a signal transduction pathway.  **Create** an illustration that represents what one of these might look like, and **describe** the three major steps that occur in this pathway that allow communication to occur. |
|  |  |  |  | 3.  **Explain** the relationship between the following components of a signal transduction pathway:   * 1. Ligand (first messenger)   2. Receptor   3. Second messenger |
|  |  |  |  | 4. **Compare** the actions in a signal transduction pathway to making a phone call. How are these two things alike? |
|  |  |  |  | 5.  **Describe** how signal information is transduced into cellular responses in the cytoplasm and nucleus. |
|  | | | | |
| Levels of Mastery | | | | *I can describe the role of the environment in eliciting a cellular response.*  *I can describe the different types of cellular responses elicited by a signal transduction pathway. (Topic 4.3)* |
| **N** | **A** | **E** | **M** | **Questions You Should Be Able to Answer** |
|  |  |  |  | 6.  **Describe** how it is possible for a single molecule of epinephrine to cause a cell to release thousands of molecules of glucose from glycogen during the fight or flight response |
|  |  |  |  | 7. **Explain** how a crowd cheering at a football game is like quorum sensing in bacteria. |
| **Essential Knowledge:**  What You Absolutely Must Know and Understand | | | | |
| Levels of Mastery | | | | *I can explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway. (Topic 4.4)* |
| **N** | **A** | **E** | **M** | **Questions You Should Be Able to Answer** |
|  |  |  |  | 8.  **Explain** how mutations can affect signal transduction pathways. |
|  |  |  |  | 9. Describe how chemicals can inhibit or activate a signal pathway. |
| **Essential Knowledge:**  What You Absolutely Must Know and Understand | | | | |
| **N** | **A** | **E** | **M** | *I can describe positive and/or negative feedback mechanisms.*  *I can explain how negative feedback helps to maintain homeostasis.*  *I can explain how positive feedback affects homeostasis. (Topic 4.5)* |
|  |  |  |  | 10.  **Create** a t-chart that compares and contrasts positive and negative feedback loops. |
|  |  |  |  | 11. Using the diagram below, **explain** why the regulation of blood sugar is an example of a negative feedback loop. |

| Learn More: For more information about cell communication, use the links below:   * [Nobel Prize in Physiology and Medicine, 1923](http://www.nobelprize.org/nobel_prizes/medicine/laureates/1923/): Fredrick Grant Banting and John James Rickard MacLeod, “for the discovery of insulin.” * [Nobel Prize in Physiology and Medicine, 1994:](http://www.nobelprize.org/nobel_prizes/medicine/laureates/1994/)  Alfred Gilman, Martin Rodbell, “for their discovery of G-proteins and the role of these proteins in signal transduction in cells.” * [Nobel Prize in Physiology and Medicine, 1998:](http://www.nobelprize.org/nobel_prizes/medicine/laureates/1998/) Louis Ignarro, Robert Furchgott, and Ferid Murad, “for their discoveries concerning nitric oxide as a signaling molecule in the cardiovascular system.” * [Nobel Prize in Physiology and Medicine, 2000](http://www.nobelprize.org/nobel_prizes/medicine/laureates/2000/): Arvid Carlsson, Paul Greengard, and Eric Kandel, “for their discoveries concerning signal transduction in the nervous system." |
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