

Hormones & Cell Signaling

Part I.

Insulin is a protein hormone secreted by beta cells in the pancreatic Islets of Langerhans. Using this information, answer the following questions:

- 1) Is insulin a water-soluble or fat-soluble hormone?
- 2) How likely is it that insulin crosses the cell membrane?
- 3) How does insulin get to target cells in the liver, muscle, fat, and other body tissues?
- 4) How do insulin's target cells detect its presence?
- 5) What changes occur inside liver cells after they detect the presence of insulin?
- 6) What is the specific response of the liver cell to insulin?
- 7) After insulin is detected by a cell, how soon will cellular responses occur?

Part II.

Testosterone is a steroid hormone secreted by Leydig cells in the testis and by thecal cells in ovarian follicles. Using this information, answer the following questions:

- 8) Is testosterone a water-soluble or fat-soluble hormone?
- 9) How likely is it that testosterone crosses the cell membrane?
- 10) How does testosterone get to target cells in the testis, the ovary, the skin, and muscle? (Hint: the signal can travel in different ways to different tissues.)

- 11) How do testosterone's target cells detect its presence?
- 12) What changes occur inside muscle cells after they detect the presence of testosterone?
- 13) What changes occur inside granulosa cells in ovarian follicles after they detect the presence of testosterone?
- 14) After testosterone is detected by a cell, how soon will cellular responses occur?

Part III. Review insulin signaling and steroid hormone signaling by watching the following YouTube videos.

Insulin: <http://www.youtube.com/watch?v=FkkK5lTmBYQ>

Steroid hormone: <https://www.youtube.com/watch?v=TgNwxF3aQpE>

(The second animation describes G-protein-coupled receptors and steroid hormone receptors.)

Part IV. Label the diagrams showing the mechanisms of hormone-receptor interaction and resulting cell signaling and cellular responses.

- 15) Identify the type of hormone and type of receptor (intracellular or cell surface) and label the cell signaling and cellular response events shown below:

[Insert an UNLABELED diagram of intracellular receptor signaling here.]

16) Identify the type of hormone and type of receptor (nuclear receptor or plasma membrane receptor) and label the cell signaling and cellular response events shown below:

[Insert an UNLABELED diagram of a plasma membrane receptor signaling pathway here.]

Teaching Tips for Peer Leaders

The goal of this recitation is to give students practice answering application questions – those questions that give new information related to a familiar topic and ask students to predict answers.

Because students struggle to differentiate between intracellular and cell surface hormone receptors, the questions in Part I and Part II lead them through a method to reason out the answers and to use prior knowledge to help understand why some hormones interact with cell surface receptors while others can bind receptors in the cytoplasm.

Parts I and II. Thought questions.

Have students work in groups of 3 – 4 to answer the questions in Parts I and II. They should use their textbooks and lecture notes.

NOTE: Parts I and II will give students practice with the application skill only if you **wait to show the videos. If you show the videos first, you've downgraded this activity to just a regurgitation exercise.**

Part III. Videos

After they complete the questions, show the You Tube video of insulin signaling:

<http://www.youtube.com/watch?v=FkkK5ITmBYQ>

After showing the animation, review the location of hormone-receptor interaction, the kind of change that occurs on the intracellular domain of the receptor, and the enzyme cascade that results in a cellular response. Ask students what specific cellular response was shown in the animation.

Next, show the You Tube video of steroid hormone action:

<https://www.youtube.com/watch?v=TgNwxF3aQpE>

Start the animation around the **3:12** timepoint. Tell the students that this animation reviews G-protein coupled receptor mechanisms in the earlier segments if they want to watch that later.

Part IV. Building a Visual Summary

Have students label the unlabeled diagrams in their groups.

Project the unlabeled diagrams of hormone action on the white board, and call on students or ask for volunteers (whichever is more effective with your students) to tell you how to label them.

Emphasize that the key facts about the plasma membrane receptor are that the hormone never enters the cell, but the signal is transmitted by the receptor to molecules inside the cell. The activity of enzymes inside the cell is changed by sequential phosphorylation, ultimately resulting in a cellular response, such as glucose uptake (as shown in the insulin signaling animation.)

Notes to Faculty

Insert appropriate UNLABELED figures for questions 15 and 16 from your textbook images or your own diagrams. We used copyrighted textbook figures that could not be included here.