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Chapter 45: Hormones and the Endocrine System

Overview

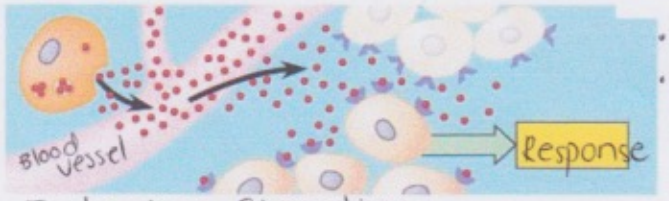
1. What is a *hormone*?
   A hormone is a molecule that communicates regulatory messages throughout the body by the bloodstream or hemolymph.
2. Why does a hormone elicit a response only with *target cells*?
   Only target cells have the receptor that matches the specific hormone.
3. The body has two long-distance regulating systems. Which involves chemical signals by hormones?
   Endocrine System
4. What is the other major communication and control system?
   Nervous System

Concept 45.1 Hormones and other signaling molecules bind to target receptors, triggering specific response pathways

5. Explain the difference between an *endocrine gland* and an *exocrine gland*. Give an example of each.
   An endocrine gland secretes hormones directly into the surrounding fluid (i.e. adrenal glands)
   An exocrine gland has ducts that carry secreted substances onto/into body surfaces or cavities (i.e. salivary glands)
6. Several types of secreted signaling molecules are discussed in this chapter. Compare the action of each of the following, and give an example.

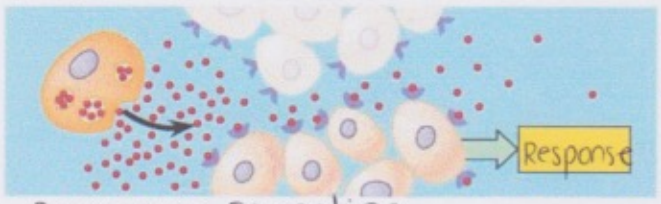
   hormones
   Signaling molecules that communicate messages throughout body (i.e. ecdysteroid)
   local regulators
   Act over short distances and reach target by diffusion (i.e. cytokines)
   neurotransmitters
   Diffuse at a very short distance across synapses (i.e. acetylcholine)
   pheromones
   Chemicals released into external environment (i.e. sex pheromones to attract mates)

7. **These figures show five different types of signals. Label and explain each one.**



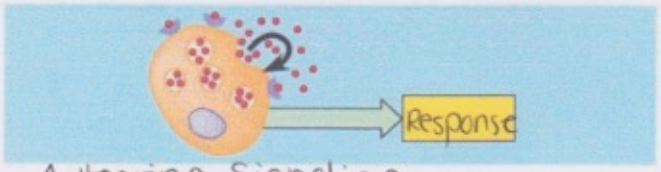
Endocrine Signaling

- Secreted molecules diffuse into bloodstream
- Response triggered in target cells anywhere in the body



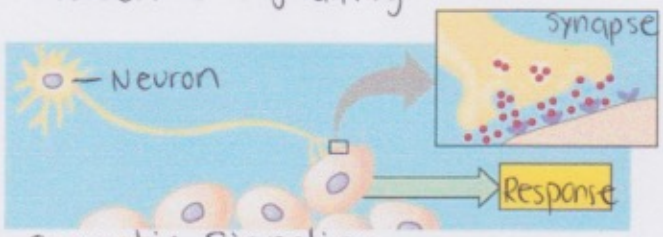
Paracrine Signaling

- Secreted molecules diffuse locally
- Response in neighboring cells



Autocrine Signaling

- Secreted molecules diffuse locally
- Response in cell that secreted molecule s



Synaptic Signaling

- Neurotransmitters diffuse across synapse
- Response in cells of target tissues

Neuroendocrine Signaling

- Neurohormones diffuse into bloodstream
- Response in target cells anywhere in the body

8. **Recall that target cells have receptors for specific hormones. Where are the receptors for lipid-soluble hormones found?**

These receptors can be found in the cytoplasm or nucleus.

9. **Where are the receptors for the water-soluble proteins found? Explain this difference for the two types of hormones.**

~~W~~ Receptors for water-soluble proteins are found on the cell surface, since these proteins can not diffuse through the plasma membrane as lipid-soluble ones do.

10. Carefully read the section *Cellular Response Pathways*, and use that information to complete this table.

Hormone Type	Method of Secretion	Mode of Travel in Bloodstream	Location of Receptors	Examples
water-soluble	Exocytosis	Travel Freely	cell surface	Polypeptides (insulin)
lipid-soluble	Diffusion	Transport Protein	Inside cell	Steroids (cortisol)

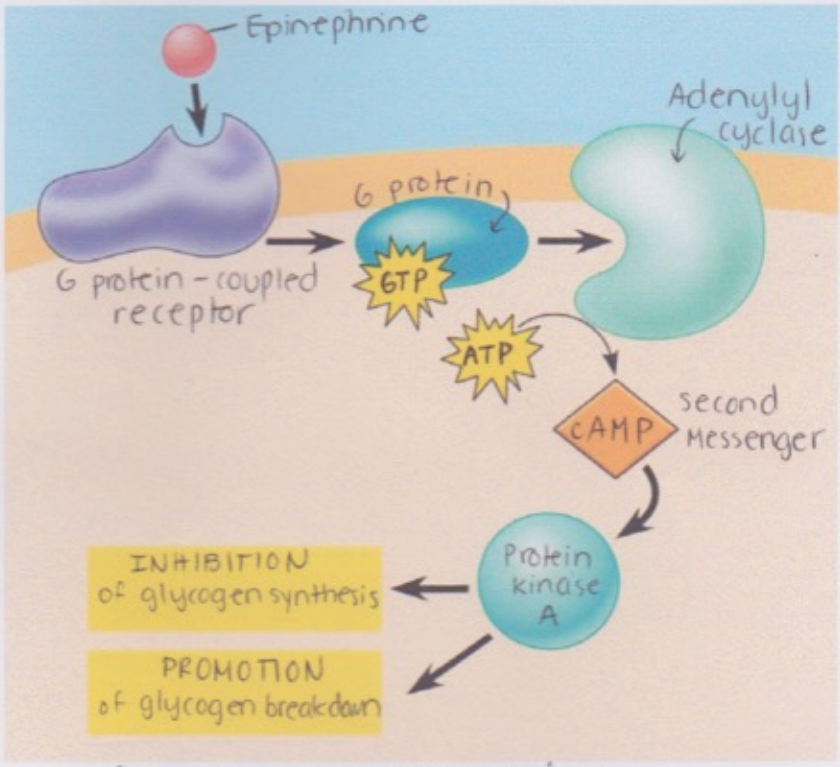
11. What endocrine gland secretes *epinephrine*?

Adrenal gland (on top of kidneys)

12. What are the two intracellular responses in the liver to epinephrine? How do these help the body deal with short-term stress?

Activation of enzyme for glycogen breakdown and inactivation of enzyme for glycogen synthesis. This allows for release of glucose into the bloodstream, providing energy.

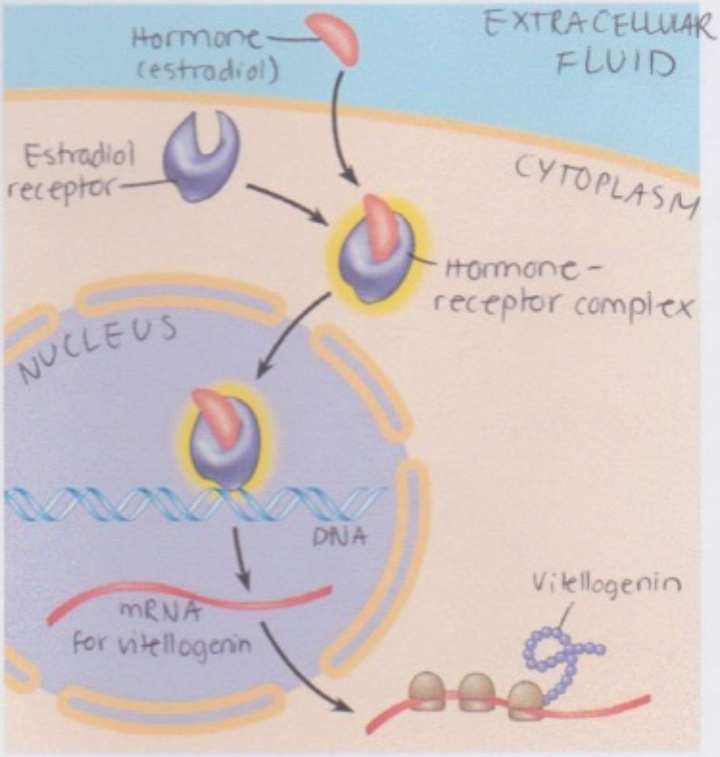
13. Use the following figure to explain the *signal transduction* pathway for *epinephrine*. (You may need to review signal transduction in Chapter 11).



SIGNAL TRANSDUCTION

After reaching the liver, epi. binds to a G protein-coupled receptor, which triggers a cascade of events. The G protein and adenylyl cyclase are activated, providing energy for the synthesis of the short-lived second messenger, cAMP. cAMP activates the protein kinase, which the activates or inactivates enzymes, leading to an appropriate response.

14. *Lipid-soluble hormones*, such as estradiol, bind to *intracellular receptors*. Explain the action of this *steroid* in the following figure.



The hormone diffuses into the cell and binds to its intracellular receptor. This complex goes into the nucleus and interacts with a specific site of DNA, altering gene transcription for a particular gene. In this case, the transcription of the vitellogenin protein was activated by estradiol.

15. One hormone can have several different effects. For example, epinephrine can cause the release of glucose from liver cells, dilate blood vessels to skeletal muscles, and constrict intestinal blood vessels. All these effects prepare the body for "fight or flight." Explain how these multiple effects are possible.

Multiple effects can be produced by one hormone if the cells have different receptors for that hormone or different signal transduction pathways/effector proteins.

16. There are some interesting effects of a couple of *local regulators* discussed in your text. Explain how the local regulator *nitric oxide (NOO)* is affected by Viagra, a drug used to treat male erectile dysfunction.

Viagra prolongs the activity of the NO response pathway, which sustains increased bloodflow to the penis.

17. Now read about *prostaglandins*, and explain why they contribute to menstrual cramps in females.

Prostaglandins can stimulate contractions of the uterine wall and cause muscles of the uterus to become excitable. Prostaglandins can also intensify the sensation of pain.

Concept 45.2 Negative feedback and antagonistic hormone pairs are common features of the endocrine system

18. Throughout this course, we have emphasized *feedback loops*. What occurs in a *negative feedback* loop?

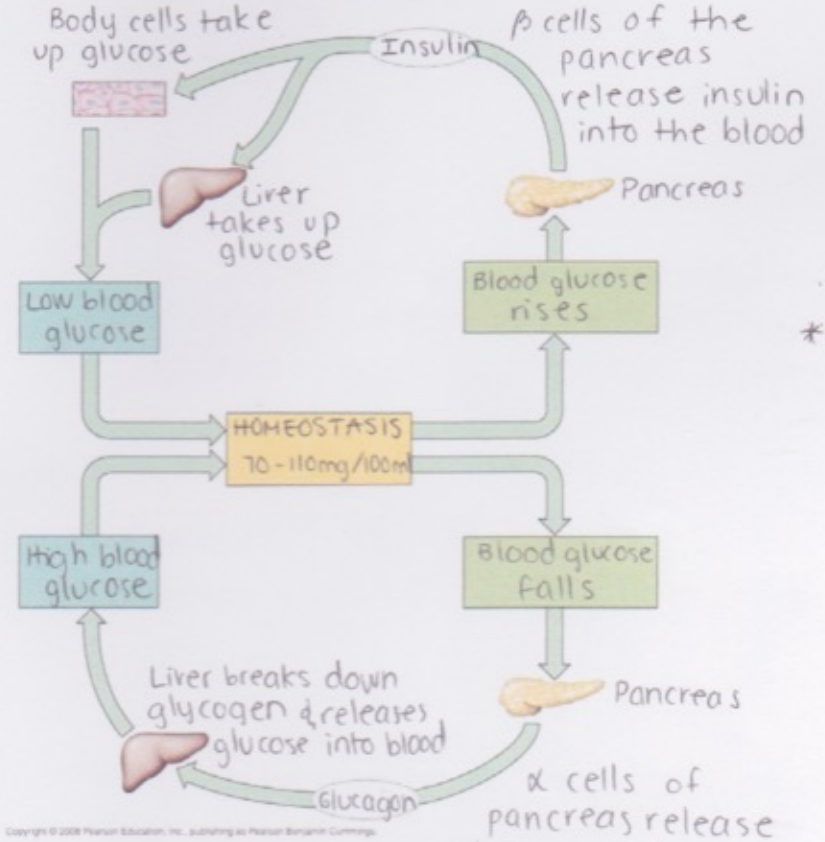
In negative feedback the response to a stimulus inhibits or reduces the initial stimulus.

19. Complete the following chart for this pair of *antagonistic* hormones.

Hormone	Secreted by	Action
insulin	β cells	Triggers uptake of glucose from blood Decreases blood glucose concentration
glucagon	α cells	Promotes release of glucose into the blood Increases blood glucose concentration

Make sure you specifically noted *alpha cells or beta cells* in the chart above.

20. On the AP Biology exam, you will be expected to explain a feedback loop. Use this figure to explain the control of blood glucose by *insulin* and *glucagon*. This is a commonly used example, and one you should know.



*negative feedback

21. What occurs in *diabetes mellitus*?

Insulin is deficient or the target tissues of insulin don't respond to the hormone normally.

22. Distinguish between *type 1 diabetes* and *type 2 diabetes*.

Type 1: immune system destroys β cells = no insulin

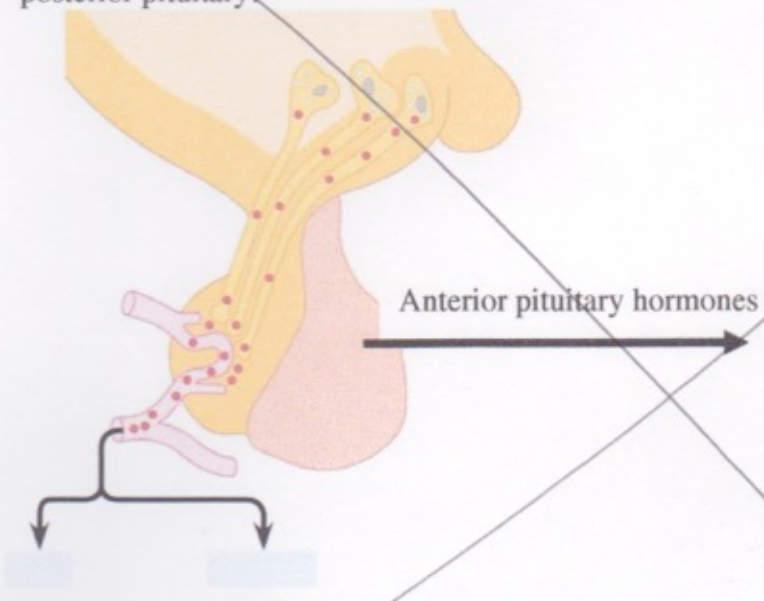
Type 2: target cells fail to respond to insulin

23. Which type of diabetes is correlated with obesity?

Type 2

Concept 45.3 The endocrine and nervous systems act individually and together in regulating animal physiology

24. The *hypothalamus* directly secretes hormones that travel to the *posterior pituitary* and regulating hormones that affect secretions of hormones by the *anterior pituitary*. On this sketch, label *hypothalamus*, *anterior pituitary*, and *posterior pituitary* and the two hormones secreted from the posterior pituitary.



25. Return to the figure above, and list the hormones secreted by the anterior pituitary.