TOPIC: INTRODUCTION TO THE ENDOCRINE SYSTEM

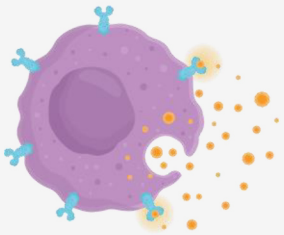
Types of Chemical Messengers

- *Recall*: Nervous system uses electrochemical signals; endocrine system uses chemical messengers.
- Two parts of any chemical signal:

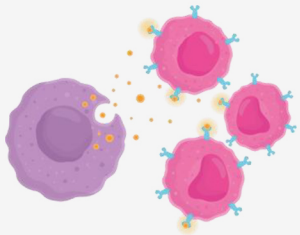
  1. Chemical messenger (_____). **2. Receptor**: binds to messengers to _____ a response.

- Chemical messengers can be described by how widely they initiate a _____.

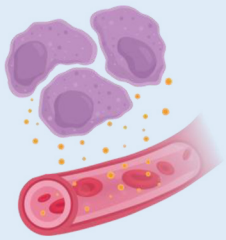
- Autocrine: _____ distance;
  - Receptor is on the _____ cell.



- Paracrine: short distance;
  - Receptor is within the same _____ .



- Endocrine: _____ body;
  - Uses _____ distributed by the _____.



EXAMPLE

The body uses two systems for communication: the nervous system and the endocrine system. Fill in the table below contrasting the two systems.

	Nervous System	Endocrine System
Speed	_____	_____
Mechanism	Action potential + neurotransmitters	_____
Length of stimuli	_____	Long
Location of action	_____ locations	_____ locations

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PRACTICE

For a nerve impulse to travel from one neuron to another, the signal must be transmitted across a synapse. At the synapse, the axon releases a neurotransmitter that then diffuses across the synapse and activates receptors on the subsequent dendrite. While this is an example of a nervous signal using a neurotransmitter, the action of neurotransmitter at a synapse is sometimes also considered an example of what other type of signaling?

a) Endocrine. b) Autocrine. c) Paracrine. d) Intracellular.

PRACTICE

Epinephrine (also known as adrenaline) is produced by your adrenal cortex during stressful situations. The adrenal cortex is part of the adrenal gland, located just superior to the kidneys. One of the targets for adrenaline is the heart, where it increases the heart rate. Based on this description, what type of signaling molecule is adrenaline?

a) Endocrine. b) Autocrine. c) Paracrine. d) Intracellular.

PRACTICE

Between the statements below, which one correctly describes a significant difference between how the endocrine and nervous systems function?

a) Chemical messengers of the endocrine system diffuse across a synapse, while in the nervous system they travel in the blood.

b) The nervous system is faster acting than the endocrine system.

c) The endocrine system uses both chemical and electrical signals; the nervous system only uses chemical signals.

d) Signals transmitted by the endocrine system travel shorter distances than those of the nervous system.

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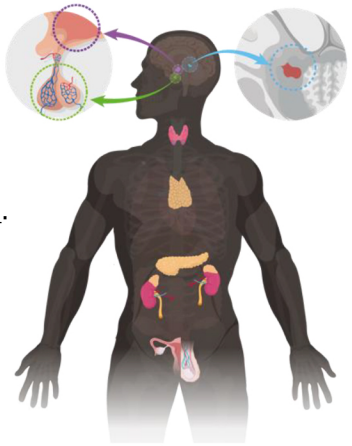
Components of the Endocrine System

- **Glands**: structures specialized for _____ substances.
  - Endocrine glands: release _____ into blood.
  - Many _____ organs also release hormones.
- **Hormones**: chemical messengers that circulate in _____.
- **Target cells**: cell with a specific _____.



Endocrine Glands:
Hypothalamus,
Pineal Gland,
Pituitary Gland,
Thyroid Gland,
Parathyroid Gland,
Thymus,
Adrenal Gland,
Pancreas,
Gonads (Ovaries & Testes)

- Hormones help control a variety of bodily functions:

Growth & Development	Reproduction	Electrolyte Balance	Metabolism	Activate Body Defenses
				

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EXAMPLE

The table below lists several hormones and a short description of their specific function in the body. Using this information, for each hormone, consider whether the hormone plays a role in each of the five major body functions listed. If the hormone does play a role, place a checkmark in the correct column.

Hormone	Function	Growth & Development	Reproduction	Electrolyte Balance	Metabolism	Body Defenses
Insulin	Lowers blood sugar					
Estrogen	Secondary sexual characteristics and regulates menstruation					
Antidiuretic Hormone	Decreases urine production/increases fluid in blood					
Cortisol	Increases blood sugar for stress response					
Growth Hormone	Initiates cell division					

PRACTICE

True or False: if false, choose the answer that best corrects the statement.

Target cells can be defined as cells that possess a receptor that binds a particular hormone.

a) True.

b) False: target cells are cells with a direct cellular connection with a gland.

c) False: target cells are defined as the cells that hormones are chemically attracted to.

d) False: the target cell produces and releases hormones into the blood.

PRACTICE

Ghrelin is a hormone produced in the stomach with target cells in the anterior pituitary. Its release is associated with feelings of hunger, and its release is lowest immediately after eating. Considering this, why do you think the stomach is not usually considered as an organ of the endocrine system?

a) As described, ghrelin is part of a paracrine and not endocrine signal.

b) While stomach contributes to endocrine function, the stomach's primary role is not endocrine signaling.

c) The stomach is an example of an exocrine gland, not an endocrine gland.

d) Endocrine glands send signals to target cells, not other endocrine glands.

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PRACTICE

Which statement below correctly identifies the difference between the endocrine system and other body systems?

a) The organs of most other systems are typically connected or in close proximity, while the endocrine system is distributed throughout the body.

b) The organs of other systems are embryologically linked, while the endocrine organs develop from separate germ layers.

c) The organs of other body systems only receive signals from the either the parasympathetic or sympathetic nervous system, while the endocrine system receives signals from both.

d) Organs of the endocrine system are the only organs in the body that produce hormones.

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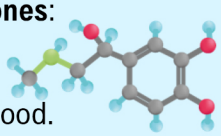
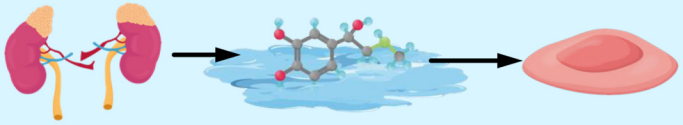
Hormones

- *Recall*: **Hormones**: chemical messengers used by the endocrine system for _____-body signaling.
- Hormones can be grouped by their _____ structure.

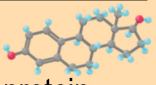
_____ _____ - **Based Hormones**:



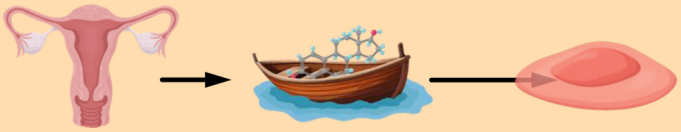
- _____ soluble.
  - Transport: _____ in the blood.
  - Cell membrane: _____ cross.
  - Receptor location: on the cell _____.
- E.g., Most non-sex hormones.



Steroid Hormones: synthesized from _____.



- _____ soluble.
  - Transport: bound to _____ protein.
  - Cell membrane: _____ cross.
  - Receptor location: _____ the cell.
- E.g., Estrogen & Testosterone.



Note: Exceptions exist — thyroid hormone.

EXAMPLE

Shown below are two hormones interacting with a target cell. Based on the image, decide which side shows a steroid hormone and which side shows an amino acid-based hormone. Indicate what led you to make your decision:

Type of hormone:

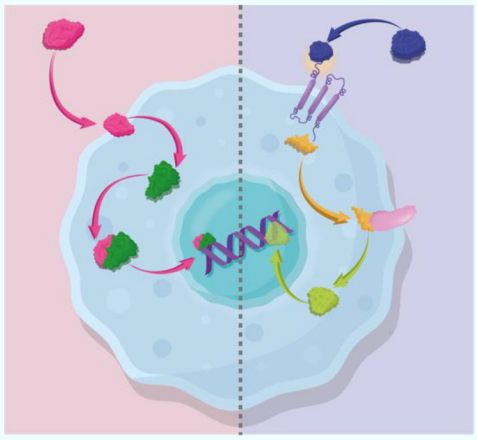
_____

Reasoning:

_____

_____

_____



Type of hormone:

_____

Reasoning:

_____

_____

_____

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PRACTICE

Insulin operates by activating a receptor on the outside of the target cell. Based on your knowledge of hormone types, do you expect insulin to be an amino acid-based hormone or a steroid hormone, and why?

a) Amino acid-based because it does not pass through the cell membrane of the target cell.

b) Steroid because it does not pass through the cell membrane of the target cell.

c) Amino acid-based because it is not water-soluble.

d) Steroid because it is water-soluble.

PRACTICE

Why do steroid hormones use a transport protein?

a) Transport proteins allow steroid hormones to cross the cell membrane leading to a cellular response.

b) Transport proteins stabilize the hormones, so they don't react chemically with the blood.

c) Transport proteins make steroid hormones temporarily lipid soluble.

d) Transport proteins make steroid hormones temporarily water soluble.