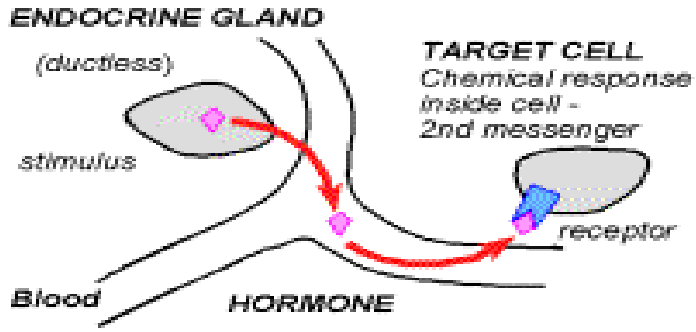
Hormones

Hormones: biologically active substances, they regulate metabolism and physiological processes. Hormones, as universal regulators of the body functioning, play an important role in the maintenance of homeostasis.



Hormone Binding to a Receptor

Functions of hormones

The hormones conduct a wide variety of functions, they influence on all essential life processes, such as:

- Growth
- Metabolism of carbohydrates, proteins and fats, development
- Immune defense
- Reproduction
- Behavior
- Adaptation to the conditions of existence.
- Hormones, as universal regulators of the body functioning, play an important role in the maintenance of homeostasis

General characteristics of hormones

- Hormones are molecules synthesized by specific tissues. Classically these tissues were called glands.

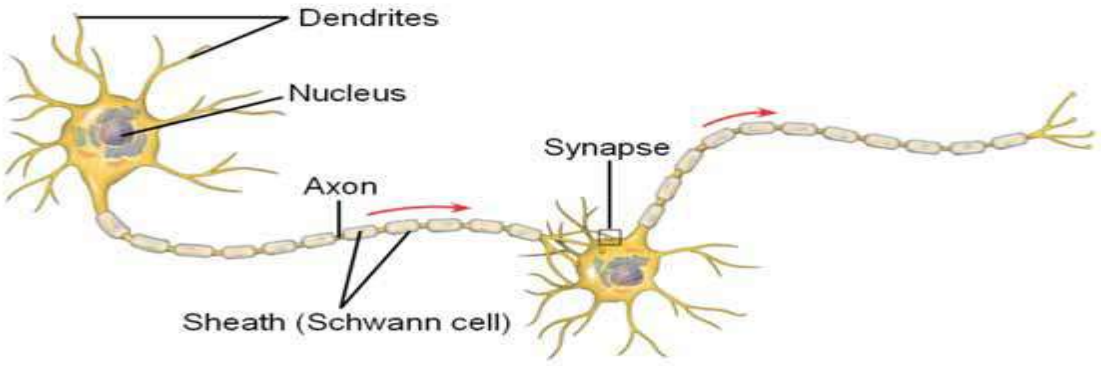
- Hormones are secreted directly into the blood which carries them to their sites of action.
- Hormones are present at very low levels in the circulatory system.
- Hormones specifically affect or alter the activities of the responsive tissue (target tissue).
- Hormones act specifically via receptors located on, or in, target tissue.

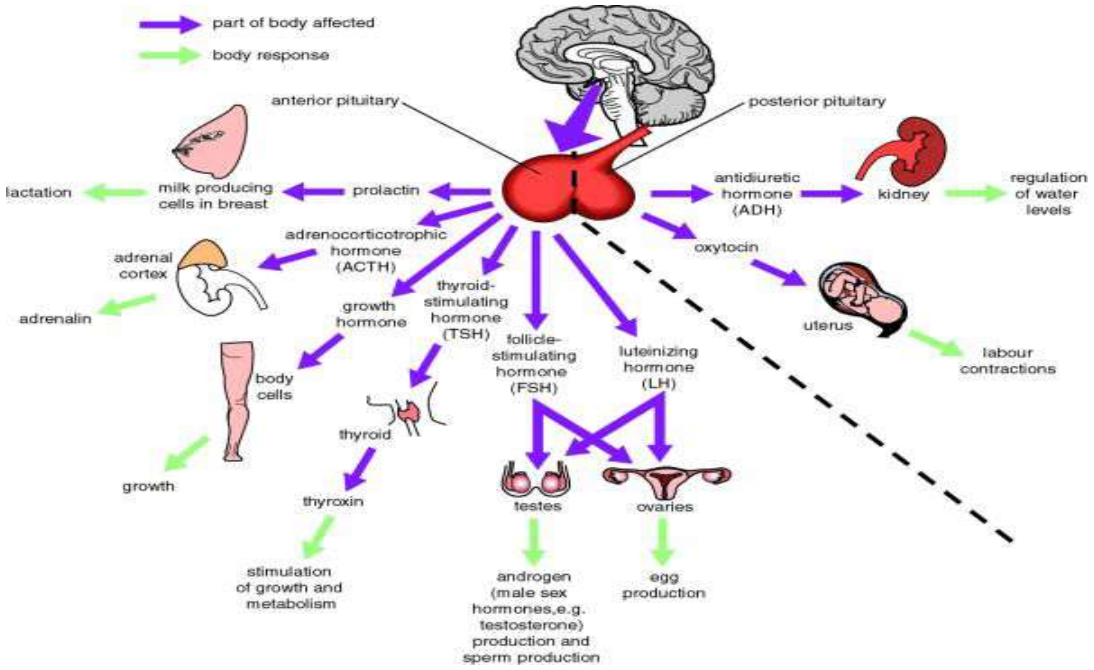
Two systems act individually and together in regulating an animal's physiology

Two systems control all physiologic processes:

1. Nervous system
2. Endocrine system

The endocrine system is one of the two coordinating and integrating systems of the body. It acts through chemical messengers - hormones –carried in the circulation.





Similarities of Hormone and Enzyme

The hormones have several characteristics in common with enzymes:

- They act as body catalysts resembling enzymes in some aspect.
- They are required only in small quantities.
- They are not used up during the reaction.

Dissimilarities of Hormone and Enzyme

They differ from enzymes in the following ways:

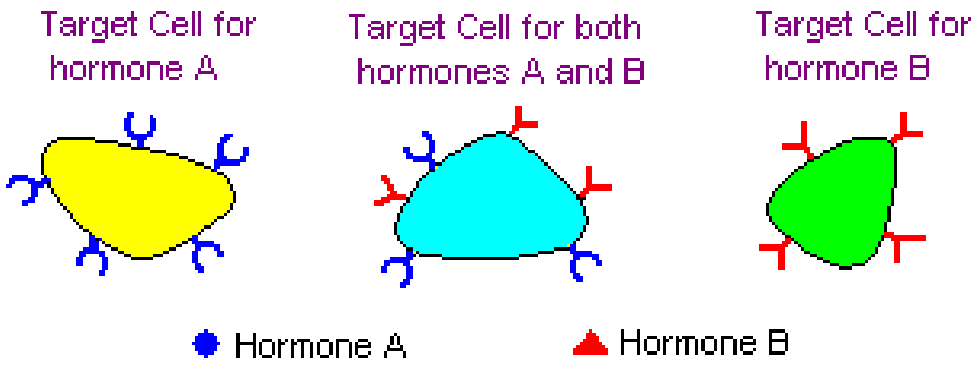
• They are produced in an organ other than that in which they ultimately perform their action.

• They are secreted in blood prior to use. Thus the circulating levels of hormones can give some indication of endocrine gland activity and target organ exposure.

• Structurally they are not always proteins. Few hormones are protein in nature, few are small peptides. Some hormones are derived from amino acids while some are steroid in nature.

Target tissues, Receptors and Target Cells

Target tissues of certain hormone are the tissue, which contains the specific receptor of that hormone. A given hormone usually affects only a limited number of cells, which are called target cells. A target cell responds to a hormone because it bears receptors for the hormone. Hormone receptors are found either exposed on the surface of the cell or within the cell, depending on the type of hormone. In very basic terms, binding of hormone to receptor triggers a cascade of reactions within the cell that affects function.



Hormone receptors have two essential qualities:

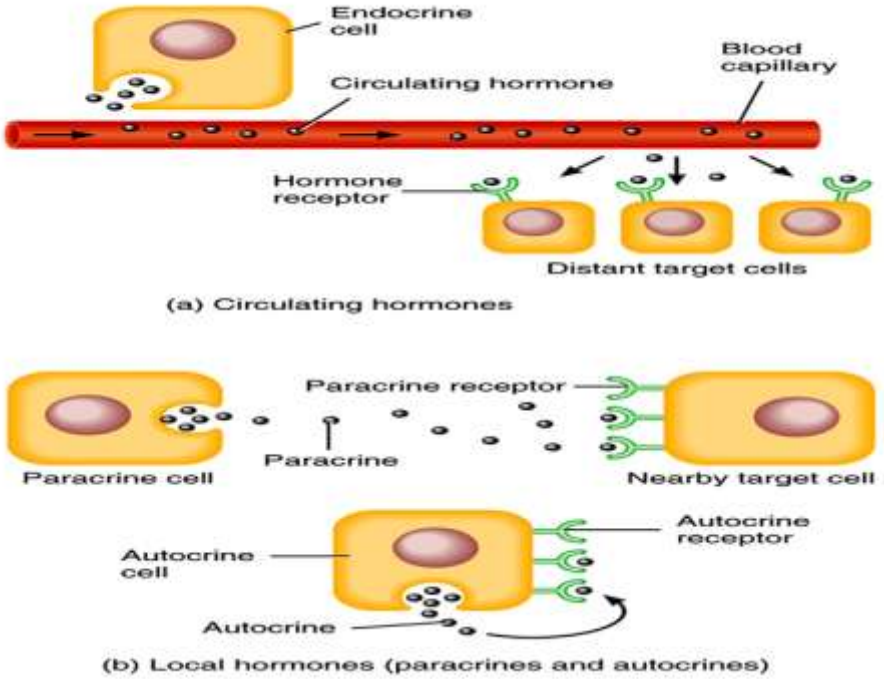
1. The receptor must be able to recognize a unique binding site within the hormone in order to discriminate between the hormone and all other proteins.
2. The receptor must be able to transmit the information gained from binding to the hormone into a cellular response.

Receptors may be:

- Intracellular receptor: (in the cytosol or in the nucleus)
- Cell-membrane receptor: (in the plasma membrane)

Hormones may be secreted into blood and affect cells at distant sites. Some hormones known to act and affect neighboring cells or even have effects on the same cells that secreted the hormone. Three actions are defined:

- **Endocrine action**: the hormone is distributed in blood and binds to distant target cells.
- **Paracrine action**: the hormone acts locally by diffusing from its source to target cells in the neighborhood.
- **Autocrine action**: the hormone acts on the same cell that produced it.



How are hormones classified by proximity of site of synthesis to site of action?

Three chasses of hormones based on proximity of site of synthesis to site of action

- **Autocrine hormones**: those that act on the same cell that synthesize it.
- **Paracrine hormones**: those that are synthesized very close to their site of action
- **Endocrine hormones**: those that are synthesized by endocrine glands and transported in the blood to target cells that contain the appropriate receptors

Classification of hormones

Hormones can be classified according to:

1. Chemical nature
2. Mechanism of action

Classification of Hormones according to chemical nature

Hormones can be classified chemically into **three major groups:**

1. **Steroid hormones**: These are steroid in nature derived from cholesterol such as adrenocorticosteroid hormones, androgens, estrogens and progesterone.
2. **Amino acid derivatives**: These are derived from amino acid tyrosine, e.g. epinephrine, norepinephrine and thyroid hormones.
3. **Peptide/Protein hormones**: These are either large proteins or small or medium size peptides, e.g. Insulin, glucagon, parathormone, calcitonin, pituitary hormones, etc.

Acronyms of some hormones

Hormones	Acronym
AdrenoCorticoTrophic Hormone (Corticotrophin)	ACTH
Arginine Vasopressin (Anti-Diuretic Hormone)	AVP (ADH)
Corticotrophin Releasing Hormone	CRH
Follicular Stimulating Hormone	FSH
Gonadotrophin Releasing Hormone	GnRH
Growth Hormone	GH (HGH)
Growth Hormone Releasing Hormone	GHRH
Luteinizing Hormone	LH
Parathyroid Hormone	PTH
Thyroid Stimulating Hormone	TSH
Thyrotrophin Releasing Hormone	TRH
Tri-iodothyronine	T_3
Thyroxine	T4

11