# Hormones. Concept, biological role and classification of hormones.

Hormones (from the Greek hormaino - to induce) are biologically active substances secreted by endocrine cells into the blood or lymph to regulate biochemical and physiological processes in target cells.

Hormones are involved in maintaining the homeostasis of the internal environment of the body, occupying an intermediate position between the nervous system and the action of enzymes that directly regulate the rate of metabolism. Hormones cause either a rapid (urgent) response by increasing the activity of existing enzymes or a slow response associated with de novo synthesis of enzymes.

The endocrine system works in close relationship with the nervous system as the neuroendocrine system.
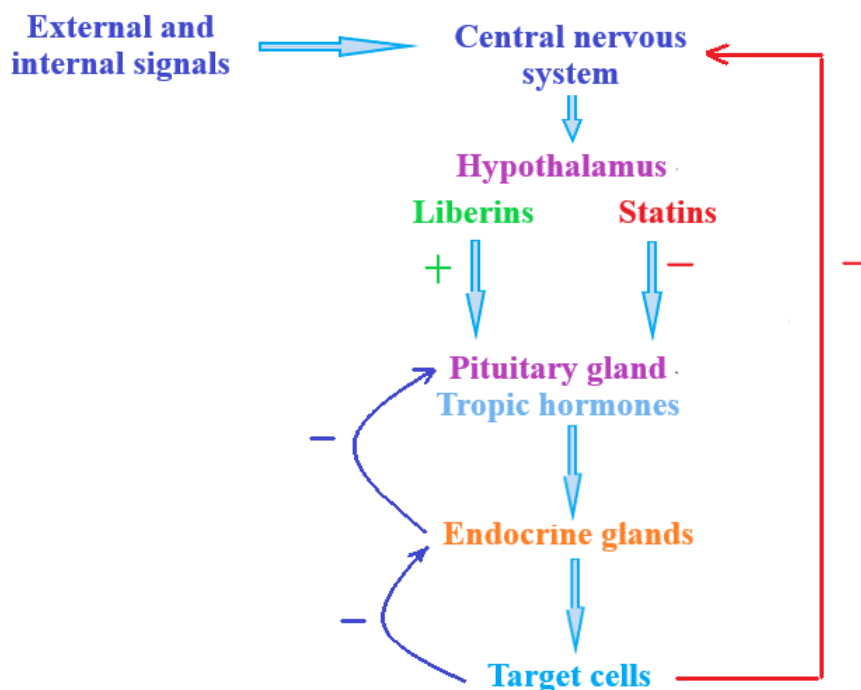
Scheme of interrelation of regulatory systems of the organism
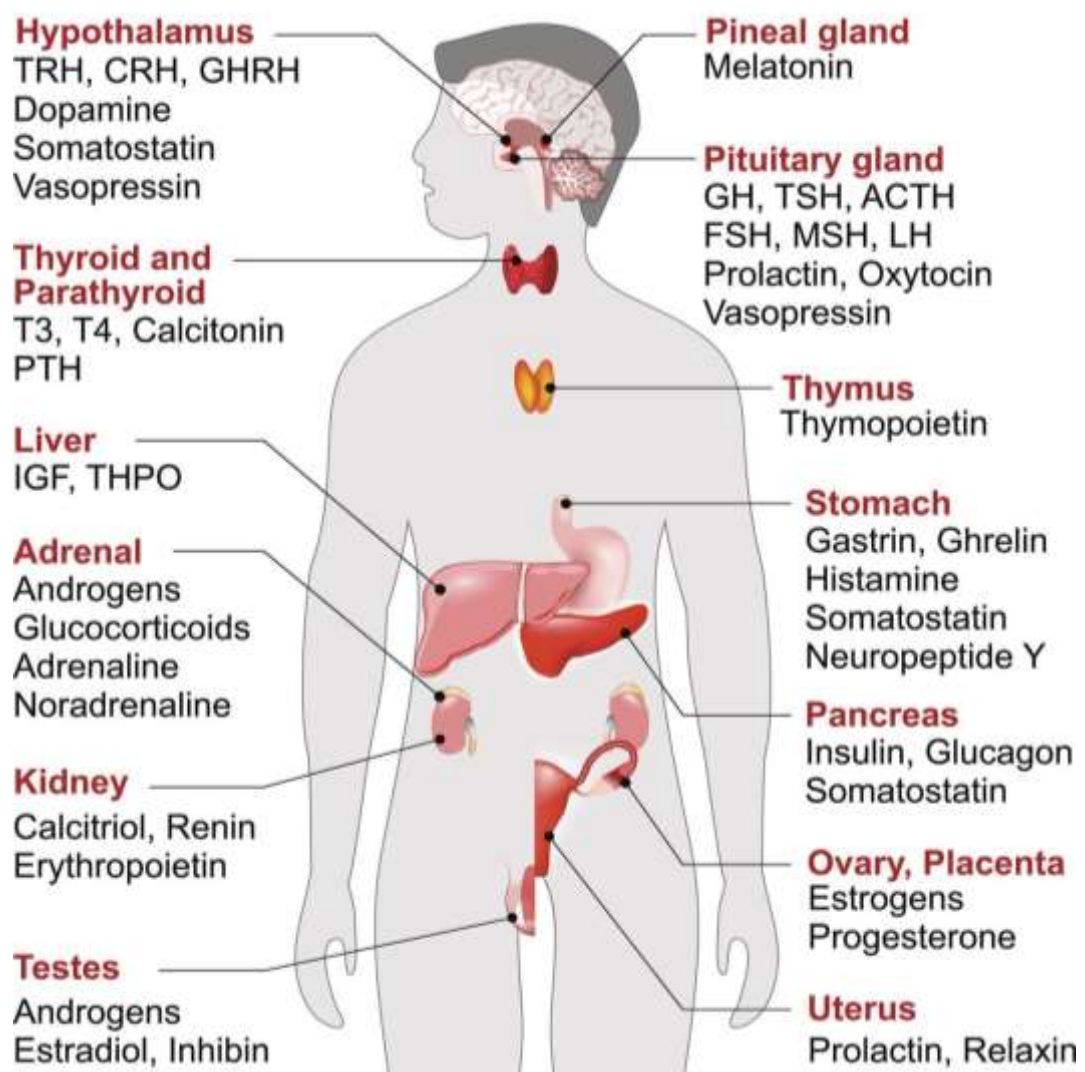
Hormones are characterised by:

- ✓ specificity of action;
- ✓ high biological activity;
- ✓ local and remote action;
- ✓ relatively short half-life (less than 1 h).

Classification of hormones

There are different classifications of hormones.

Hormones are classified according to where they are produced:

1. *hypothalamus* (corticoliberin, thyreoliberin, gonadoliberin, somatoliberin, melanoliberin, prolactostatin, somatostatin, melanostatin)

2. *pituitary* (somatotropic, lactotropic, adrenocorticotropic, thyrotropic hormones, melanocyte stimulating, vasopressin, oxytocin, follicle stimulating, luteinising)

3. *pineal gland* (melatonin);

4. *peripheral endocrine glands* (insulin, glucagon, cortisol, thyroxine, adrenaline, aldosterone, estradiol, estriol, testosterone, calcitonin, parathormone, calcitriol).

Hypothalamus
TRH, CRH, GHRH
Dopamine
Somatostatin
Vasopressin

Thyroid and Parathyroid
T3, T4, Calcitonin
PTH

Liver
IGF, THPO

Adrenal
Androgens
Glucocorticoids
Adrenaline
Noradrenaline

Kidney
Calcitriol, Renin
Erythropoietin

Testes
Androgens
Estradiol, Inhibin

Pineal gland
Melatonin

Pituitary gland
GH, TSH, ACTH
FSH, MSH, LH
Prolactin, Oxytocin
Vasopressin

Thymus
Thymopoietin

Stomach
Gastrin, Ghrelin
Histamine
Somatostatin
Neuropeptide Y

Pancreas
Insulin, Glucagon
Somatostatin

Ovary, Placenta
Estrogens
Progesterone

Uterus
Prolactin, Relaxin

1. ***Hormones that do not penetrate the cell and interact with membrane receptors*** (peptides, protein hormones, adrenaline). The signal is transmitted within the cell by intracellular mediators (secondary messengers). The main end effect is a change in enzyme activity;

2. ***Hormones that enter the cell*** (steroid hormones, thyroid hormones). Their receptors are located inside the cells. The main end effect is a change in the amount of enzyme proteins through gene expression;

3. ***Membrane acting hormones*** (insulin, thyroid hormones). The hormone is an allosteric effector of membrane transport systems. Binding of a hormone to a membrane receptor leads to a change in the conductance of membrane ion channels.

By localisation of hormone receptors:

1. ***inside or on the surface of the plasma membrane*** (receptors for peptide hormones, catecholamines, eicosanoids);

2. ***in the cell cytoplasm and nucleus*** (steroid hormone receptors, thyroid hormone receptors).

By affecting metabolism and physiological functions:

1. ***protein metabolism*** (somatotropin, adrenocorticotropic, thyrotropic hormone, insulin, thyroxine)

2. ***carbohydrate and lipid metabolism*** (somatotropin, adrenocorticotropic, thyrotropic hormones, insulin, thyroxine, epinephrine, glucagon);

3. ***water and salt metabolism***; calcium and phosphorus metabolism (aldosterone, vasopressin; calcitonin, parathormone, calcitriol);

4. ***reproductive function*** (gonadotropic hormones, estradiol, estriol, progesterone, testosterone, prolactin, oxytocin).

This classification is conditional, as the same hormones can have different functions. For example, adrenaline is involved in the regulation of lipid and carbohydrate metabolism and also regulates blood pressure,

heart rate and smooth muscle contraction. Estrogens not only regulate reproductive function, but also affect lipid metabolism and induce the synthesis of blood clotting factors.
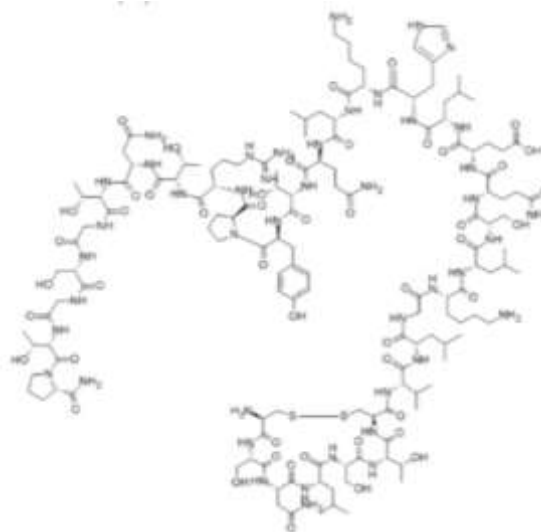
By solubility:
1. **hydrophilic** (peptide hormones, amino acid derivatives);

2. **hydrophobic** (steroid hormones).

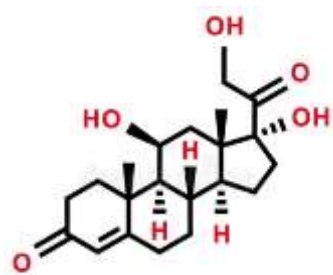*Hormones are divided into 3 groups according to their chemical structure:*
1. **Amino acid derivatives** (epinephrine, norepinephrine, thyroxine, triiodothyronine);

Epinephrine

2. **Peptide hormones** (pituitary hormones, calcitonin, parathormone, insulin, glucagon);

3. **Steroid hormones** (cortisol, aldosterone, estradiol, progesterone, testosterone, calcitriol).

CORTISOL