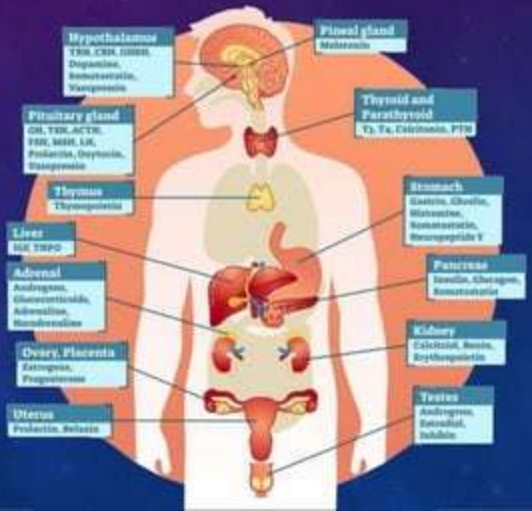
HORMONES


Hypothalamus
Pineal gland
Melatonin
Pituitary gland
Thyroid and Parathyroid
Thymus
Stomach
Liver
Adrenal
Pancreas
Kidney
Ovary, Placenta
Uterus
Testes

WHAT ARE HORMONES ?

Hormone: A chemical substance produced in the body that controls and regulates the activity of certain cells or organs. Many hormones are secreted by special glands, such as thyroid hormone produced by the thyroid gland. Hormones are essential for every activity of life, including the processes of digestion, metabolism, growth, reproduction, and mood control.

CLASSIFICATION OF HORMONES

1-Bassed on the chemical nature;

The hormones can be categorized into three groups considering their chemical nature;-

A-Protein or peptide hormones e.g. insulin, glucagon, antidiuretic hormone, oxytocin.

B-Steroid hormones e.g. glucocorticoids, mineralocorticoids, sex hormones.

C-Amino acid derivatives e.g. epinephrine, norepinephrine, thyroxine(T4), Triiodothyronine(T3)

2-Bassed on mechanism of action

Hormones are classified into two broad groups (I and II) based on the location of the stimulate the release of certain molecules, namely the second messengers which, in turn, perform the biochemical functions. Thus, hormones themselves are the first messengers.

Group I. HORMONES THAT BIND TO INTRACELLULAR RECEPTORS

Hormone(s)	Origin Major	Function(s)
Estrogens	Ovaries and adrenal cortex	Female sexual characteristics, menstrual cycle
Progestins	Ovaries and placenta	Involved in menstrual cycle and maintenance of pregnancy
Androgens	Testes and adrenal cortex	Male sexual characteristics, spermatogenesis.
Glucocorticoids	Adrenal cortex	Affect metabolisms, suppress immune system
Mineralocorticoids	Adrenal cortex	Maintenance of salt and water balance.
Calcitriol (1, 25–DHCC)	Kidney (final form)	Promotes absorption of Ca2+ from intestine, kidney and bone.
Thyroid hormones (T3 , T4)	Thyroid	Promote general metabolic rate

GROUP II. HORMONES THAT BIND TO CELL SURFACE RECEPTORS

A. The second messenger is cAMP

Hormone(s)	Origin Major	Function(s)
Adrenocorticotropic hormone (ACTH)	Anterior pituitary	Stimulates the release of adrenocorticosteroids
Follicle stimulating hormone (FSH)	Anterior pituitary	In females, stimulates ovulation and estrogen synthesis. In males, promotes spermatogenesis.
Luteinizing hormone (LH)	Anterior pituitary	Stimulates synthesis of estrogens and progesterone and causes ovulation. Promotes androgen synthesis by testes.
Chorionic gonadotropin (hCG)	Anterior pituitary	Stimulates progesterone release from placenta
Thyroid stimulating hormone (TSH)	Anterior pituitary	Promotes the release of thyroid hormones (T3 , T4)
E-Endorphins and enkephalins	Anterior pituitary	Natural endogenous analgesics (pain relievers).

Antidiuretic hormone (ADH)	Posterior pituitary (stored)	Promotes water reabsorption by kidneys.
Glucagon	Pancreas	Increases blood glucose level, stimulates glycogenolysis and lipolysis.
Parathyroid hormone (PTH)	Parathyroid	Increases serum calcium, promotes Ca^{2+} release from bone.
Calcitonin	Thyroid	Lowers serum calcium. Decreases Ca^{2+} uptake by bone and kidney.
Epinephrine	Adrenal medulla	Increases heart rate and blood pressure. Promotes glycogenolysis in liver and muscle and lipolysis in adipose tissue.
Norepinephrine	Adrenal medulla	Stimulates lipolysis in adipose tissue.

B. THE SECOND MESSENGER IS PHOSPHATIDYL INOSITOL/CALCIUM

Hormone(s)	Origin Major	Function(s)
Thyrotropin-releasing hormone (TRH)	Hypothalamus	Promotes TSH release
Gonadotropin-releasing hormone (GnRH)	Hypothalamus	Stimulates release of FSH and LH.
Gastrin	Stomach	Stimulates gastric HCl and pepsinogen secretion.
Cholecystokinin (CCK)	Intestine	Stimulates contraction of gall bladder and secretion of pancreatic enzymes.

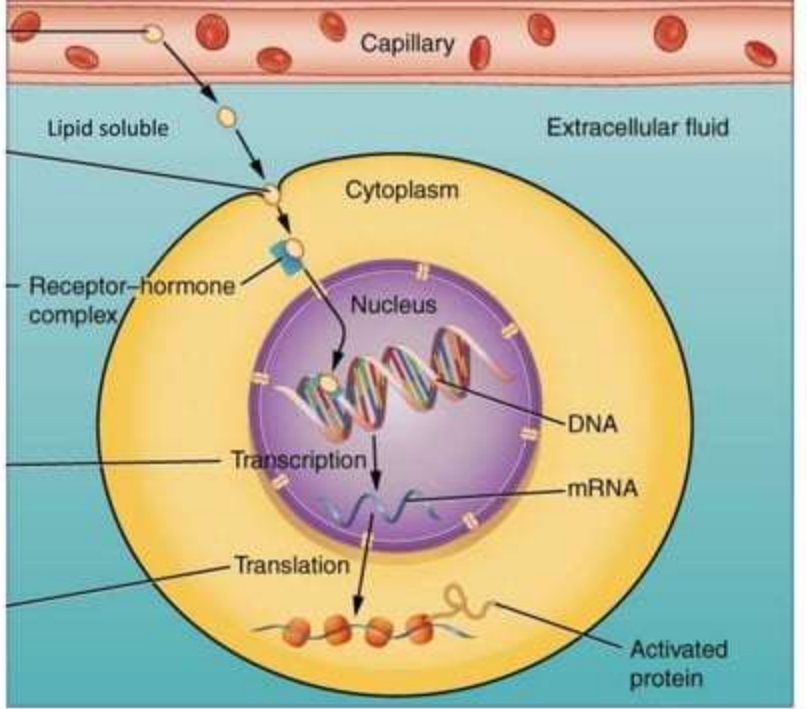
C. THE SECOND MESSENGER IS UNKNOWN/UNSETTLED

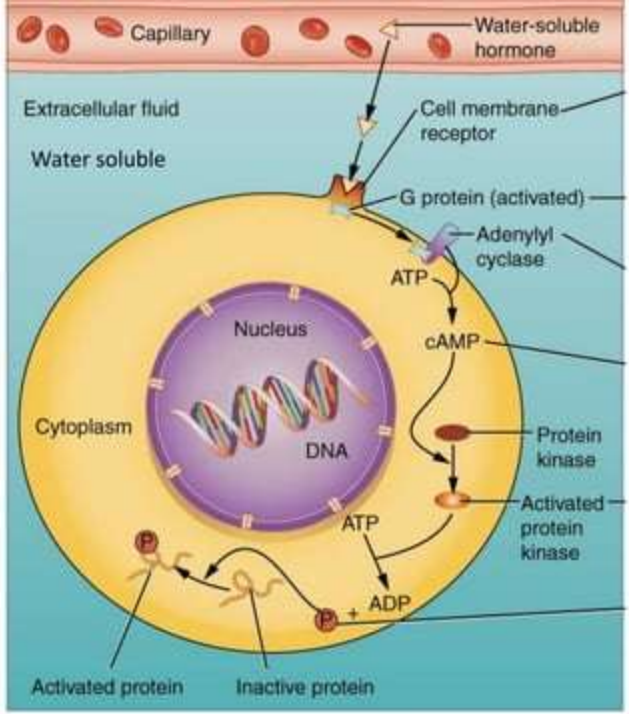
Hormone(s)	Origin Major	Function(s)
Growth hormone (GH)	Anterior pituitary	Promotes growth of the body (bones and organs).
Prolactin (PRL)	Anterior pituitary	Growth of mammary glands and lactation.
Oxytocin	Posterior pituitary (stored)	Stimulates uterine contraction and milk ejection.
Insulin	Pancreas	Lowers blood glucose (hypoglycemic effect), promotes protein synthesis and lipogenesis.
Somatomedins (insulin-like Liver growth factors, IGF-I, IGF-II)	Liver	Growth related functions of GH are mediated. Stimulates growth of cartilage.

HORMONES HAVE THE FOLLOWING EFFECTS ON THE BODY:

- stimulation or inhibition of growth
- wake-sleep cycle and other circadian rhythms
- mood swings
- induction or suppression of apoptosis (programmed cell death)
- activation or inhibition of the immune system
- regulation of metabolism
- preparation of the body for mating, fighting, fleeing, and other activity
- preparation of the body for a new phase of life, such as puberty, parenting, and menopause
- control of the reproductive cycle
- hunger cravings

HOW HORMONES WORK ?


Capillary
Lipid soluble
Extracellular fluid
Cytoplasm
Receptor–hormone complex
Nucleus
DNA
Transcription
mRNA
Translation
Activated protein


Capillary
Water-soluble hormone
Extracellular fluid
Water soluble
Cell membrane receptor
G protein (activated)
Adenylyl cyclase
ATP
cAMP
Nucleus
DNA
Cytoplasm
Protein kinase
Activated protein kinase
ATP
ADP
P
P
Activated protein
Inactive protein

Hormones mediate changes in target cells by binding to specific hormone receptors. In this way, even though hormones circulate throughout the body and come into contact with many different cell types, they only affect cells that possess the necessary receptors. Receptors for a specific hormone may be found on many different cells or may be limited to a small number of specialized cells. For example, thyroid hormones act on many different tissue types, stimulating metabolic activity throughout the body. Cells can have many receptors for the same hormone, but often also possess receptors for different types of hormones. The number of receptors that respond to a hormone determines the cell's sensitivity to that hormone and the resulting cellular response. Additionally, the number of receptors that respond to a hormone can change over time, resulting in increased or decreased cell sensitivity. In up-regulation, the number of receptors increases in response to rising hormone levels, making the cell more sensitive to the hormone, allowing for more cellular activity. When the number of receptors decreases in response to rising hormone levels, called down-regulation, cellular activity is reduced.

Cells respond to a hormone when they express a specific receptor for that hormone. The hormone binds to the receptor protein, resulting in the activation of a signal transduction mechanism that ultimately leads to cell type-specific responses. Receptor binding alters cellular activity, resulting in an increase or decrease in normal body processes. Depending on the location of the protein receptor on the target cell and the chemical structure of the hormone, hormones can mediate changes directly by binding to intracellular hormone receptors and modulating gene transcription, or indirectly by binding to cell surface receptors and stimulating signaling pathways.

SEVERAL FACTORS MAY REGULATE THE HORMONAL ACTION, THIS FACTORS INCLUDE:

1- Rate of synthesis and secretion of hormone by neuroendocrine mechanism, feedback control mechanism or endocrine rhythm.

2- The efficacy of the transport system in plasma.

3- The efficacy of hormone-sensitive specific receptor.

4- The rate of hormone degradation.

The rate of hormone biosynthesis and secretion is often regulated by a homeostatic negative feedback control mechanism. Such a mechanism depends on factors that influence the metabolism and excretion of hormones. Thus, higher hormone concentration alone cannot trigger the negative feedback mechanism. Negative feedback must be triggered by overproduction of an "effect" of the hormone.

Hormone secretion can be stimulated and inhibited by:

- Other hormones (stimulating- or releasing -hormones)
- Plasma concentrations of ions or nutrients, as well as binding globulins
- Neurons and mental activity
- Environmental changes, e.g., of light or temperature

- One special group of hormones is the tropic hormones that stimulate the hormone production of other endocrine glands. For example, thyroid-stimulating hormone (TSH) causes growth and increased activity of another endocrine gland, the thyroid, which increases output of thyroid hormones.

- To release active hormones quickly into the circulation, hormone biosynthetic cells may produce and store biologically inactive hormones in the form of pre- or prohormones. These can then be quickly converted into their active hormone form in response to a particular stimulus.

- Eicosanoids are considered to act as local hormones. They are considered to be "local" because they possess specific effects on target cells close to their site of formation. They also have a rapid degradation cycle, making sure they do not reach distant sites within the body.
- Hormones are also regulated by receptor agonists. Hormones are ligands, which are any kinds of molecules that produce a signal by binding to a receptor site on a protein. Hormone effects can be inhibited, thus regulated, by competing ligands that bind to the same target receptor as the hormone in question. When a competing ligand is bound to the receptor site, the hormone is unable to bind to that site and is unable to elicit a response from the target cell. These competing ligands are called antagonists of the hormone.

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