Hormone Systems

The **hormonal system** (also called the endocrine **system**) is a network of glands and organs in the body that produce **hormones**. **Hormones** are important for almost all cells in the body to work. They influence your metabolism, growth and many other functions. ... Others only influence a small number of cells in specific organs.

The **endocrine system** is a chemical messenger system comprising feedback loops of the hormones released by internal glands of an organism directly into the circulatory system, regulating distant target organs. In humans, the major endocrine glands are the thyroid gland and the adrenal glands. In vertebrates, the hypothalamus is the neural control center for all endocrine systems. The study of the endocrine system and its disorders is known as endocrinology. Endocrinology is a branch of internal medicine.

A number of glands that signal each other in sequence are usually referred to as an axis, such as the hypothalamic-pituitary-adrenal axis. In addition to the specialized endocrine organs mentioned above, many other organs that are part of other body systems have secondary endocrine functions, including bone, kidneys, liver, heart and gonads. For example, the kidney secretes the endocrine hormone erythropoietin. Hormones can be amino acid complexes, steroids, eicosanoids, leukotrienes, or prostaglandins.

The endocrine system can be contrasted to both exocrine glands, which secrete hormones to the outside of the body, and paracrine signalling between cells over a relatively short distance. Endocrine glands have no ducts, are vascular, and commonly have intracellular vacuoles or granules that store their hormones. In contrast, exocrine glands, such as salivary glands, sweat glands, and glands within the gastrointestinal tract, tend to be much less vascular and have ducts or a hollow lumen.

The word *endocrine* derives via New Latin from the Greek words ἔνδον, *endon*, "inside, within," and "crine" from the κρίνω, *krīnō*, "to separate, distinguish"

Intra-cellular Communication

Intracellular communication is an important mechanism by which cells can respond to their environment and **extracellular** cues. Cells can sense their environment and modify gene expression, mRNA splicing, protein expression and protein modifications in order to respond to these **extracellular** cues.

A major component of cell **signaling** cascades is the phosphorylation of molecules by enzymes known as kinases. Phosphorylation adds a phosphate group to serine, threonine, and tyrosine residues in a protein, changing their shapes, and activating or inactivating the protein.

Harmone acting at cell surface

Exactly how hormones exert their effects on their tar-get organs involves a number of complex processes, which will be presented simply here A hormone must first bond to a **receptor** for it on or in the target cell. Cells respond to certain hor-mones and not to others because of the presence of specific receptors, which are proteins. These receptor proteins may be part of the cell membrane or within the cytoplasm or nucleus of the target cells. A hor-mone will affect only those cells that have its specific receptors. Liver cells, for example, have cell mem-brane receptors for insulin, glucagon, growth hor-mone, and epinephrine; bone cells have receptors for growth hormone, PTH, and calcitonin. Cells of the ovaries and testes do not have receptors for PTH and calcitonin, but do have receptors for FSH and LH, which bone cells and liver cells do not have. Once a hormone has bonded to a receptor on or in its target cell, other reactions will take place.

1. **The two Messenger mechanism – Protein harmone**

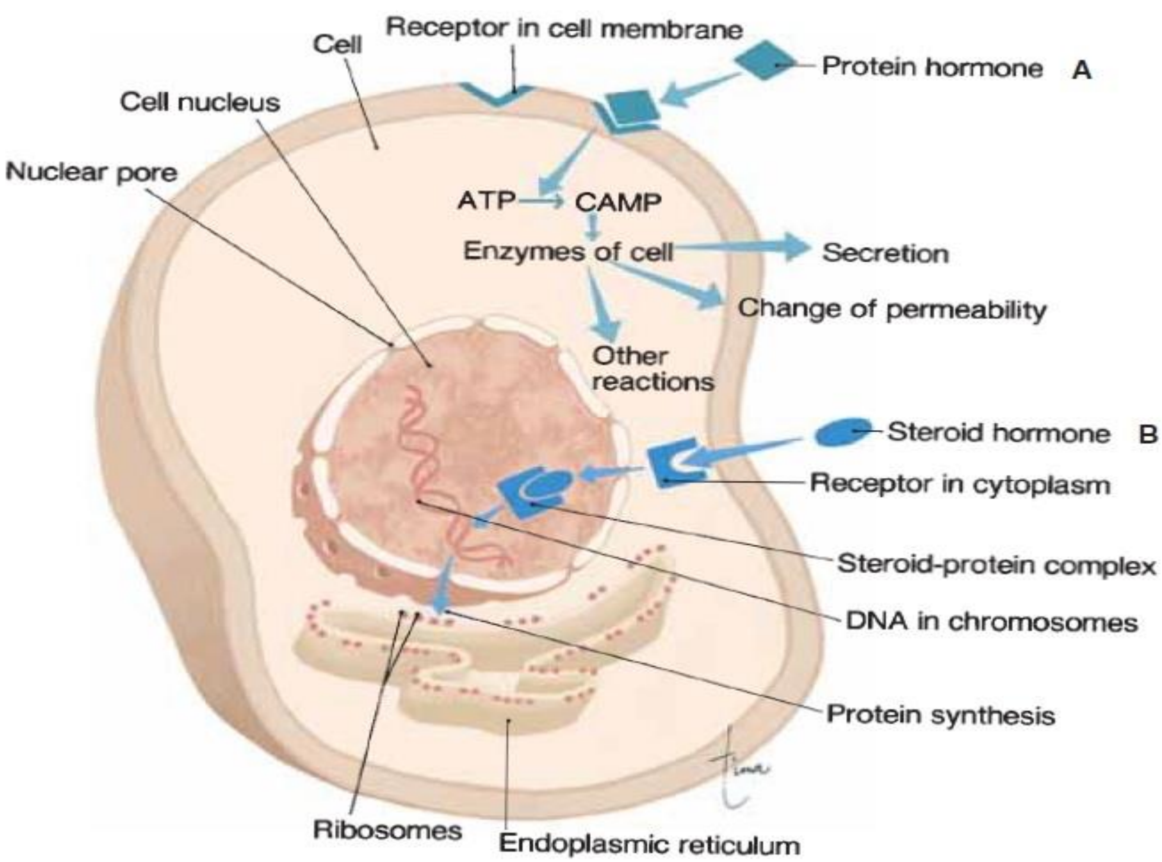
The two-messenger mechanism of hormone action involves “messengers” that make something happen, that is, stimulate specific reactions. **Protein hor-mones** usually bond to receptors of the cell mem-brane, and the hormone is called the first messenger. The hormone–receptor bonding activates the enzyme adenyl cyclase on the inner surface of the cell mem-brane. Adenyl cyclase synthesizes a substance called cyclic adenosine monophosphate (**cyclic AMP** or **cAMP**) from ATP, and cyclic AMP is the second mes-senger.

Cyclic AMP activates specific enzymes within the cell, which bring about the cell’s characteristic response to the hormone. These responses include a change in the permeability of the cell membrane to a specific substance, an increase in protein synthesis, activation of other enzymes, or the secretion of a cel-lular product.

In summary, a cell's response to a hormone is deter-mined by the enzymes within the cell, that is, the reac-tions of which the cell is capable. These reactions are brought about by the first messenger, the hormone, which stimulates the formation of the second messen-ger, cyclic AMP. Cyclic AMP then activates the cell's enzymes to elicit a response to the hormone

2. **Action of Steroid harmone**

Steroid hormones are soluble in the lipids of the cell membrane and diffuse easily into a target cell. Once inside the cell, the steroid hormone combines with a protein receptor in the cytoplasm, and this steroid-protein complex enters the nucleus of the cell. Within the nucleus, the steroid-protein complex activates spe-cific genes, which begin the process of **protein syn-thesis**. The enzymes produced bring about the cell's characteristic response to the hormone.



Properties of Harmone receptors

Receptors are high affinity, high specificity binding sites which appear to be located largely, if not entirely, on the plasma membrane of cells. Receptors are proteins intimately associated with and influenced by lipids. Receptor sites and degrading sites appear to be readily distinguishable entities. The binding of hormone to receptor is distinct and has been dissociated from subsequent steps leading to hormonal response. There is no direct relationship between receptor occupancy and the magnitude of target response to hormone. So called 'spare' receptors can be viewed thermodynamically as enhancing target tissue sensitivity to hormone.

The binding of hormone to receptor appears to be a point at which regulation of tissue sensitivity can be influenced either through altering the affinity for hormone or the number of receptors. One factor apparently involved in the regulation of receptor levels is the hormone itself. Receptors have been used to develop assay procedures which have significantly complemented the bioassay and radioimmunoassay. Finally, the measurement of receptor levels in disease has provided new insights into pathophysiology.

Biosynthesis and Turnover of Membrane receptors

In all eukaryotic cells secretory proteins and cell surface receptors are synthesized on ribosomes attached to the rough endoplasmic reticulum (ER). The growing Polypeptide chain is extruded from the ribosome and transported in an unfolded state through a protein- lined channel in the ER membrane into the ER lumen; it is never exposed to the cytosol. Secretory proteins are completely transported into the ER lumen; membrane proteins become anchored in the ER membrane *via* one or more ∼23 amino acid hydrophobic segments that form membrane- spanning a- helixes. Once synthesis is complete, newly introduced Polypeptides in the membrane and lumen of the ER must be folded, matured, sorted, and transported. Secretory or membrane proteins undergo many modifications during their transit to the cell surface:

(i) cleavage of signal sequences
(ii) formation and rearrangement of disulfide bonds
(iii) other protein folding steps, including formation of muluchain proteins

Membrane turnover is a critical mechanism that maintains cell surface area. In cells that have expanded cell surfaces such as those lining the airways of the lungs or the nutrition-absorbing cells of the gut, maintaining cell surface area is essential for their normal function.