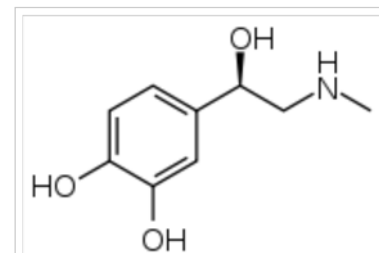


Hormone

From Wikipedia, the free encyclopedia
(Redirected from Hormones)

A **hormone** (from Greek *ὁρμή* "impetus") is a chemical released by a cell or a gland in one part of the body that sends out messages that affect cells in other parts of the organism. Only a small amount of hormone is required to alter cell metabolism. In essence, it is a chemical messenger that transports a signal from one cell to another. All multicellular organisms produce hormones; plant hormones are also called phytohormones. Hormones in animals are often transported in the blood. 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.



Epinephrine (adrenaline), a catecholamine-type hormone

Endocrine hormone molecules are secreted (released) directly into the bloodstream, whereas exocrine hormones (or ectohormones) are secreted directly into a duct, and, from the duct, they flow either into the bloodstream or from cell to cell by diffusion in a process known as paracrine signalling.

Recently it has been found that a variety of exogenous modern chemical compounds have hormone-like effects on both humans and wildlife. Their interference with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body can change the homeostasis, reproduction, development, and/or behavior the same as endogenous produced hormones."^[1]

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Hormones as signals

Hormonal signaling involves the following:^[*citation needed*]

1. **Biosynthesis** of a particular hormone in a particular tissue
2. **Storage and secretion** of the hormone
3. **Transport** of the hormone to the target cell(s)
4. **Recognition** of the hormone by an associated cell membrane or intracellular receptor protein
5. **Relay and amplification** of the received **hormonal** signal via a signal transduction process: This then

leads to a cellular response. The reaction of the target cells may then be recognized by the original hormone-producing cells, leading to a down-regulation in hormone production. This is an example of a homeostatic negative feedback loop.

6. **Degradation** of the hormone.

Hormone cells are typically of a specialized cell type, residing within a particular and are usually very hard endocrine gland, such as thyroid gland, ovaries, and testes. Hormones exit their cell of origin via exocytosis or another means of membrane transport. The hierarchical model is an oversimplification of the hormonal signaling process. Cellular recipients of a particular hormonal signal may be one of several cell types that reside within a number of different tissues, as is the case for insulin, which triggers a diverse range of systemic physiological effects. Different tissue types may also respond differently to the same hormonal signal. Because of this, hormonal signaling is elaborate and hard to dissect.^[*citation needed*]

Interactions with receptors

Most hormones initiate a cellular response by initially combining with either a specific intracellular or cell membrane associated receptor protein. A cell may have several different receptors that recognize the same hormone and activate different signal transduction pathways, or a cell may have several different receptors that recognize different hormones and activate the same biochemical pathway.

For many hormones, including most protein hormones, the receptor is membrane-associated and embedded in the plasma membrane at the surface of the cell. The interaction of hormone and receptor typically triggers a cascade of secondary effects within the cytoplasm of the cell, often involving phosphorylation or dephosphorylation of various other cytoplasmic proteins, changes in ion channel permeability, or increased concentrations of intracellular molecules that may act as secondary messengers (e.g., cyclic AMP). Some protein hormones also interact with intracellular receptors located in the cytoplasm or nucleus by an intracrine mechanism.

For hormones such as steroid or thyroid hormones, their receptors are located intracellularly within the cytoplasm of their target cell. To bind their receptors, these hormones must cross the cell membrane. They can do so because they are lipid-soluble. The combined hormone-receptor complex then moves across the nuclear membrane into the nucleus of the cell, where it binds to specific DNA sequences, effectively amplifying or suppressing the action of certain genes, and affecting protein synthesis.^[2] However, it has been shown that not all steroid receptors are located intracellularly. some are associated with the plasma membrane.^[3]

An important consideration, dictating the level at which cellular signal transduction pathways are activated in response to a hormonal signal, is the effective concentration of hormone-receptor complexes that are formed. Hormone-receptor complex concentrations are effectively determined by three factors:

1. The number of hormone molecules available for complex formation
2. The number of receptor molecules available for complex formation
3. The binding affinity between hormone and receptor.

The number of hormone molecules available for complex formation is usually the key factor in determining the level at which signal transduction pathways are activated, the number of hormone molecules available being determined by the concentration of circulating hormone, which is in turn influenced by the level and rate at which they are secreted by biosynthetic cells. The number of receptors at the cell surface of the receiving cell can also be varied, as can the affinity between the hormone and its receptor.

Physiology of hormones

Most cells are capable of producing one or more molecules, which act as signaling molecules to other cells, altering their growth, function, or metabolism. The classical hormones produced by cells in the endocrine glands mentioned so far in this article are cellular products, specialized to serve as regulators at the overall organism level. However, they may also exert their effects solely within the tissue in which they are produced and originally released.

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.

A recently identified class of hormones is that of the "hunger hormones" - ghrelin, orexin, and PYY 3-36 - and "satiety hormones" - e.g., cholecystokinin, leptin, nesfatin-1, obestatin.

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.

Effects of hormones

Hormones have the following effects on the body:

- stimulation or inhibition of growth
- 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

A hormone may also regulate the production and release of other hormones. Hormone signals control the internal environment of the body through homeostasis.

Chemical classes of hormones

Vertebrate hormones fall into three chemical classes:

- Peptide hormones consist of chains of amino acids. Examples of small peptide hormones are TRH and vasopressin. Peptides composed of scores or hundreds of amino acids are referred to as proteins. Examples of protein hormones include insulin and growth hormone. More complex protein hormones bear carbohydrate side-chains and are called glycoprotein hormones. Luteinizing hormone, follicle-stimulating hormone and thyroid-stimulating hormone are glycoprotein hormones. There is also another type of hydrophilic hormone called *nonpeptide* hormones. Although they don't have peptide connections, they are assimilated as peptide hormones.
- Lipid and phospholipid-derived hormones derive from lipids such as linoleic acid and arachidonic acid and phospholipids. The main classes are the steroid hormones that derive from cholesterol and the eicosanoids. Examples of steroid hormones are testosterone and cortisol. Sterol hormones such as calcitriol are a homologous system. The adrenal cortex and the gonads are primary sources of steroid hormones. Examples of eicosanoids are the widely studied prostaglandins.
- Monoamines derived from aromatic amino acids like phenylalanine, tyrosine, tryptophan by the action of aromatic amino acid decarboxylase enzymes.

Pharmacology

Many hormones and their analogues are used as medication. The most commonly prescribed hormones are estrogens and progestagens (as methods of hormonal contraception and as HRT), thyroxine (as levothyroxine, for hypothyroidism) and steroids (for autoimmune diseases and several respiratory disorders). Insulin is used by many diabetics. Local preparations for use in otolaryngology often contain pharmacologic equivalents of adrenaline, while steroid and vitamin D creams are used extensively in dermatological practice.

A "pharmacologic dose" of a hormone is a medical usage referring to an amount of a hormone far greater than naturally occurs in a healthy body. The effects of pharmacologic doses of hormones may be different from responses to naturally occurring amounts and may be therapeutically useful. An example is the ability of pharmacologic doses of glucocorticoid to suppress inflammation.

Important human hormones

See: List of human hormones

See also

- | | | |
|---------------------------|-----------------------|---------------------|
| ■ Endocrinology | ■ growth regulators | ■ Cytokine |
| ■ Endocrine system | ■ Autocrine signaling | ■ Growth factor |
| ■ Neuroendocrinology | ■ Paracrine signaling | ■ Hormone disruptor |
| ■ Plant hormones or plant | ■ Intracrine | |

References

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2. ^ Beato M, Chavez S and Truss M (1996). "Transcriptional regulation by steroid hormones". *Steroids* **61** (4): 240–251. doi:10.1016/0039-128X(96)00030-X (http://dx.doi.org/10.1016%2F0039-128X%2896%2900030-X) . PMID 8733009 (http://www.ncbi.nlm.nih.gov/pubmed/8733009) .
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External links

- The Hormone Foundation (http://www.hormone.org)
- Article on hormones and their receptors (http://www.biomedcentral.com/1471-2164/10/307/)
- HMRbase: A database of hormones and their receptors (http://crdd.osdd.net/raghava/hmrbase/)
- MeSH *Hormones* (http://www.nlm.nih.gov/cgi/mesh/2011/MB_cgi?mode=&term=Hormones)

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Categories: Hormones | Physiology | Endocrinology | Cell signaling | Signal transduction

| Greek loanwords

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