

Water-Soluble Hormones vs Lipid-Soluble Hormones

Hormones are chemicals (sometimes described as "**chemical messengers**") that are produced and released by glands that form the endocrine system. There are many different hormones (see the list of hormones) that can be grouped together in different ways, e.g. according to which gland they are secreted by and which system(s) of the body they affect.

Some hormones dissolve in water (water soluble hormones) while other hormones dissolve in fats (fat-soluble hormones).

How do water-soluble hormones work?

1. The hormone molecule attaches ("binds") to a receptor molecule protruding from the surface of the target cell.
2. Binding of the hormone to the receptor causes ("triggers") a chemical reaction ("response") inside the cell **without the hormone molecule itself ever entering the cell.**
3. **ACTIVATION:** The chemical reaction activates enzymes inside the cell.
4. The enzymes adjust the biochemical activity of the cell so that the speeds ("rates") of processes carried-out by the cell are either increased or decreased. That is, certain processes happen faster or slower **due to the instruction the cell received by the attachment of the hormone to the receptor.**

Water-Soluble Hormones are also known as Non-steroid Hormones

- Dissolve in water (rather than oils / fats)
- Are formed from amino acids - which are themselves the structural units of proteins and are soluble in water.
- **Cannot** pass through the target cell membranes (which include fatty components).
- Affect cells by binding to receptors on the surface of the target cell. (The shape of the receptor molecule in the cell membrane must match the shape of the "signaling molecule", e.g. a water-based hormone or sometimes a carefully designed drug, so that the receptor and the signaling molecule can fit together.)

How do lipid-soluble hormones work?

1. The hormone molecule passes through the cell membrane then attaches ("binds") to a receptor that can move around inside the cell.
When the hormone binds to the receptor the combination of these two parts is called the "**hormone-receptor complex**".
2. The hormone-receptor complex moves to the nucleus of the cell.
3. After it has entered the cell nucleus the hormone-receptor complex binds to a region of DNA (deoxyribonucleic acid).
4. **ACTIVATION:** The binding of the hormone-receptor complex to the appropriate part of the cell's DNA causes gene's to **switch "on" or "off"** (in non-technical terms!) the activity of enzymes that, in turn, control the biochemical activity of the cell.

Lipid-Soluble Hormones are also known as Steroid Hormones.

- Dissolve in fats rather than in water
- Are usually formed from **cholesterol** (cholesterol molecules being important components of cell membranes) ...
- ... therefore fat-soluble hormones can pass through cell membranes (see also functions of cell membranes).
- Affect cells by binding to receptors inside the target cell.

A key difference between water-soluble and fat-soluble hormones is that:

- Water-soluble hormones bind to receptors on the surface of the target cell, while
- Fat-soluble hormones bind to receptors inside the target cell.

Hence water-soluble hormones can affect cells *without actually entering the target cell* while fat-soluble hormones first pass through the cell membrane, then go on to enter the nucleus of the cell in order to adjust its biochemical activity.

Examples of Non-steroid Hormones:

- **Adrenalin** (= adrenaline, epinephrine*)
- **Noradrenalin** (= noradrenaline, norepinephrine*)
- **Thyroid-stimulating hormone (TSH)** (= thyrotropin)
- **Human Growth Hormone (HGH)**

Examples of Steroid Hormones:

- "**Sex hormones**" more accurately "sex steroids" or "gonadal steroids", including:
 - **Testosterone**
 - **Progesterone**
 - **Oestrogen** (= estrogen)
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