1.5 Hormones

Endocrines, exocrines and hormonal communication

Endocrines and exocrines

Hormonal communication is just another communication system, as is *nervous communication*. But this system involves the use of **hormones**. The system, known as the **endocrine system**, relies on blood circulation to transport its signals. Molecules called hormones are released into the blood directly by **endocrine** glands (ductless glands). However, there are two types of gland in our bodies – those with and without ducts. The duct glands, called **exocrine** glands do not release hormones, but secrete materials along a duct directly to the target location, for example, salivary glands secreting saliva which flows to the mouth.

hormone
a molecule secreted by an endocrine gland directly into the blood, which acts as a chemical messenger, carrying a signal to a target tissue or organ

Hormonal communication versus nervous communication

The following table outlines the similarities and differences between the two communication systems:

Hormonal communication	Nervous communication
chemical signal carried around the blood by hormones	electrical impulse carried by neurones
signal secreted by endocrine glands	signal initiated in receptors/the central nervous system
slower to take effect, but longer-lasting effect	much quicker response but short-lived effect
one hormone can affect several systems	one nervous signal triggers one specific, targeted response

There are two types of hormones:

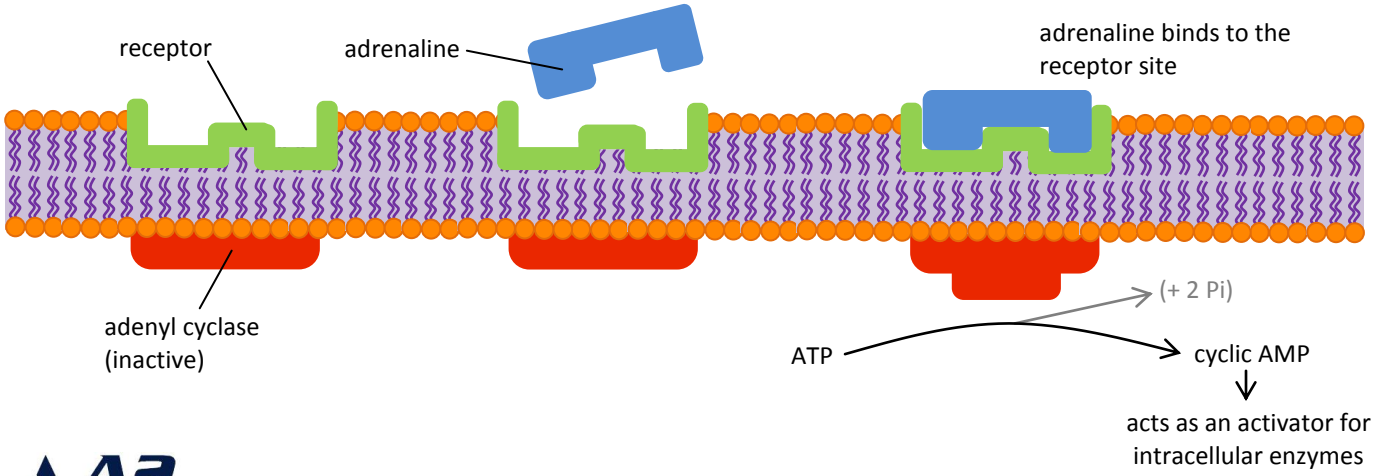
- *protein* and *peptide* hormones, and derivatives of amino acids (e.g. adrenaline, insulin and glucagon)
- *steroid* hormones (e.g. oestrogen, testosterone, androgens)

The two types work in different ways. Steroid hormones can pass through the cell surface membrane and enter the cell directly to produce a direct effect on the DNA in the nucleus, whereas the phospholipid bilayer is not permeable to proteins and so protein hormones do not enter the cell.

Cells receiving a specific (protein) hormone must have a specific complementary receptor on the surface membrane which allows the hormone to bind to the membrane. A hormone will bind to the receptor site of any cell with the correct receptor. Such cells are called **target cells**, grouped together to form a target tissue for the hormone.

Adrenaline

As hormones will affect any tissue with receptors for that hormone, it is not unusual for a hormone to trigger a number of responses in the body. For example, the hormone **adrenaline** doesn't only have one effect: it increases heart rate, increases breathing rate, causes arterial contraction, causes pupil dilation, etc. Adrenaline is a protein hormone, and therefore cannot enter the cell itself, but has to cause an effect somehow. The key is the adrenaline receptor on target cells, which is shaped in a way which is complementary to the hormone molecule itself.



Every receptor for adrenaline has an enzyme associated with it on the inner surface membrane, called **adenyl cyclase**. The adrenaline hormone is known as the **primary messenger**, which from the blood binds to the receptor site on a target tissue, activating the adenyl cyclase enzyme. The adenyl cyclase then converts ATP to **cyclic AMP** (cAMP), releasing two phosphates in the process. The cyclic AMP is the **secondary messenger** which acts as an activator for various enzymes within the cell, triggering certain effects, depending on which target tissue is being activated.

The adrenal glands

The adrenal glands are found just above the kidneys on both sides of the body, and can be separated into a medulla region and a cortex region.

Adrenal medulla

The medulla is the central part of the gland. The cells there manufacture and release adrenaline in response to stress such as pain or shock. The effects of the hormone are widespread as there are receptors for the hormone on many tissues around the body. Some of the effects are explained above.

Adrenal cortex

The adrenal cortex uses cholesterol to produce certain steroid hormones, which have a variety of roles in the body. For example, *aldosterone* helps to maintain the concentrations of sodium and potassium in the blood, and *cortisol* helps to control the metabolism of carbohydrates and proteins in the liver.