Life processes: An overview

Characteristics of life

Despite the enormous range of life forms – from microbes to oak trees and human beings – all living organisms demonstrate seven characteristics. Use a mnemonic (memory aid) such as MR GREEN to help you remember them:

Movement
Respiration
Growth
Reproduction
Excretion
Excitability (sensitivity)
Nutrition

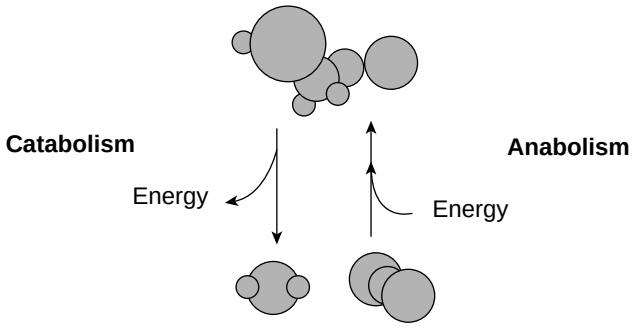
Metabolism

Living organisms are complex arrangements of chemical substances. Organisms contain inorganic molecules and ions (small, simple and without carbon; carbon dioxide is the exception), eg water. Organisms also contain organic molecules (generally more complex and always contain carbon), eg glucose.

To make complex substances from simpler ones normally requires **energy**. Organisms thus need a continual supply of energy to make organic molecules. The energy is used in forming chemical bonds within these molecules.

Metabolism is the word used to describe all the chemical reactions which occur in an organism and are necessary for life. There are two types of metabolism – **catabolism** and **anabolism**:

- Catabolism is the process by which complex substances are broken down into simpler ones, with the release of energy. Respiration is an important example of catabolism.
- Anabolism is the process by which simple substances are built up into complex ones. This type of reaction requires a supply of energy. Examples include photosynthesis and all cases of growth and repair in the bodies of organisms.



Both catabolic (breaking down) and anabolic (building up) processes occur in living things. Energy from catabolic reactions is used to drive anabolic reactions.

Humans: Nutrition

Nutrition

Nutrition is the study of food and feeding processes. Food is the material from which organisms obtain:

- the energy
- and the raw materials

to construct, maintain and repair the body.

What is in food?

Humans require a **balanced diet**. This is one which supplies the different types of food in adequate amounts and correct proportions, and provides the body with sufficient energy for its needs. A balanced diet maintains healthy active life and, where necessary, growth.

The are seven **chemical components** of a balanced diet: carbohydrates, fats, proteins, vitamins, minerals, water and fibre.

The diet must contain sufficient energy-giving food, in the form of carbohydrate and fat, to provide the body with enough energy for its needs. Too much energy-giving food will cause the individual to be overweight, while too little will cause them to be underweight.

Malnutrition is the result of not having a properly balanced diet. If the body does not receive the correct chemical components in the right proportions it cannot function efficiently.

What happens to food once it is eaten?

In humans, as in other animals, complex organic food can enter body cells **only** if it is first broken down into small, soluble molecules. In humans, the stages in this process are:

1 **Ingestion** – Food is taken into the mouth.

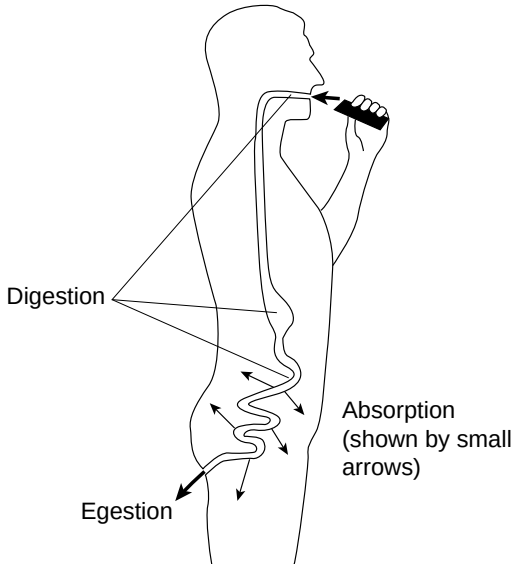
2 **Digestion** – The breakdown of complex organic foods into small, soluble molecules.

3 **Absorption** – The uptake of soluble food substances into the body across cell membranes.

4 **Assimilation** – The uptake and use of soluble food substances by cells in the body.

5 **Egestion** – The removal of undigested food from the body (not to be confused with excretion or secretion).

In humans, the alimentary canal (gut) is responsible for the ingestion, digestion, absorption and egestion of food.



Major stages in the processing of food and their rough locations in the human body

Humans: Hormonal system

The **hormonal (endocrine) system** coordinates the body's activities using chemical messengers called **hormones**. Hormones are released into the blood by **endocrine glands**. Hormones are then carried in the bloodstream and exert their effect on certain **target tissues** within the body.

The endocrine system, sometimes working with the nervous system, controls and coordinates growth, development and activity within the body. The nervous system and endocrine system are similar in two ways:

- both are triggered by a stimulus to produce a response
- both involve chemical transmission. In the nervous system this occurs only across synapses. In the endocrine system the chemical, a hormone, travels considerably further.

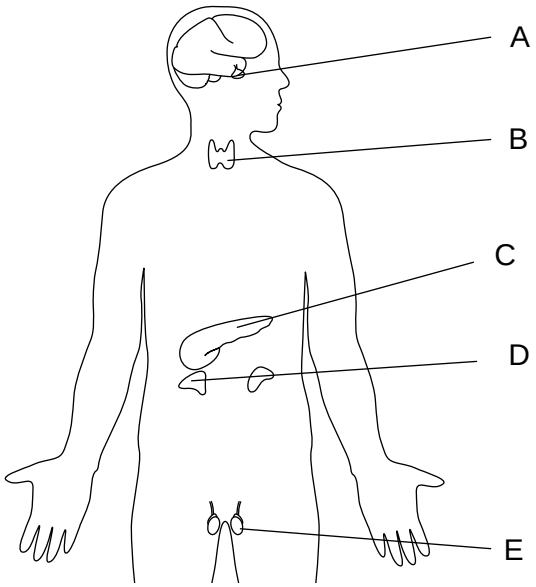
It is more usual to stress the differences between the nervous system and the endocrine system. The body's nervous system coordinates rapid responses to internal and external stimuli. The hormonal system, on the other hand, coordinates slower, longer-lasting and more widespread responses to stimuli.

Differences between nervous and hormonal action

	Nervous	**Hormonal**
1 Method of transmission	Nerve impulse passing along nerve (chemical transmission at synapse)	Hormone carried in the bloodstream
2 Speed of transmission	Rapid	Slow
3 Speed of response	Immediate	Usually slow, eg oestrogen, but may be fast, eg adrenaline
4 Duration of response	Short-lived	Longer-lasting
5 Localisation of response	Response very localised	Response sometimes widespread, eg action of adrenaline

Questions

1 The diagram below shows a man's body with five endocrine glands labelled A, B, C, D and E.



a Which gland, A, B, C, D or E, produces a hormone that controls the level of glucose (sugar) in the blood after a meal?

_____

b Which gland, A, B, C, D or E, produces a hormone that prepares the body for "fight or flight"?

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2 The table below shows the effect of some important hormones in the human body.

Some hormones and their effects

Hormone	Endocrine gland	Effect of the hormone
		Controls the body's overall rate of metabolism
		Controls the level of glucose (sugar) in the blood. Deficiency causes diabetes
		Prepares the body for action by increasing heart rate and breathing rate and diverting blood from gut to limb muscles
		Controls sexual development in the female and regulates the menstrual cycle
		Controls sexual development in the male