

The human nervous system

Revision notes • How neurones, the CNS and reflex arcs give fast, automatic responses, and the required practical on reaction time.

For AQA GCSE Combined Science: Trilogy 8464. **Higher tier** is only on the Higher paper.

The human nervous system Spec 4.5.2

Structure and function of the nervous system Spec 4.5.2.1

The nervous system enables humans to **react to their surroundings** and to **coordinate their behaviour**.

Information from receptors passes along cells called **neurones** as **electrical impulses** to the **central nervous system (CNS)**. The CNS is the **brain and spinal cord**. The CNS coordinates the response of effectors, which may be **muscles contracting** or **glands secreting hormones**.

1. Stimulus (a change in the environment)
2. Receptor detects the stimulus
3. Coordinator (the CNS) processes the information
4. Effector (a muscle or a gland)
5. Response

How the structure suits the function

Part	Adaptation	Why it helps
Receptors	Each type is sensitive to one kind of stimulus	The body only picks up the changes it needs to respond to
Neurones	Long cells that carry electrical impulses	Impulses travel quickly over long distances between receptors, the CNS and effectors
CNS	The brain and spinal cord receive information and send out a coordinated response	The right effectors respond together
Effectors	Muscles contract; glands secrete hormones	They carry out the response

Exam tip: Say that the **CNS is the brain and spinal cord**. The neurones carry the impulses, but they are **not the coordinator**.

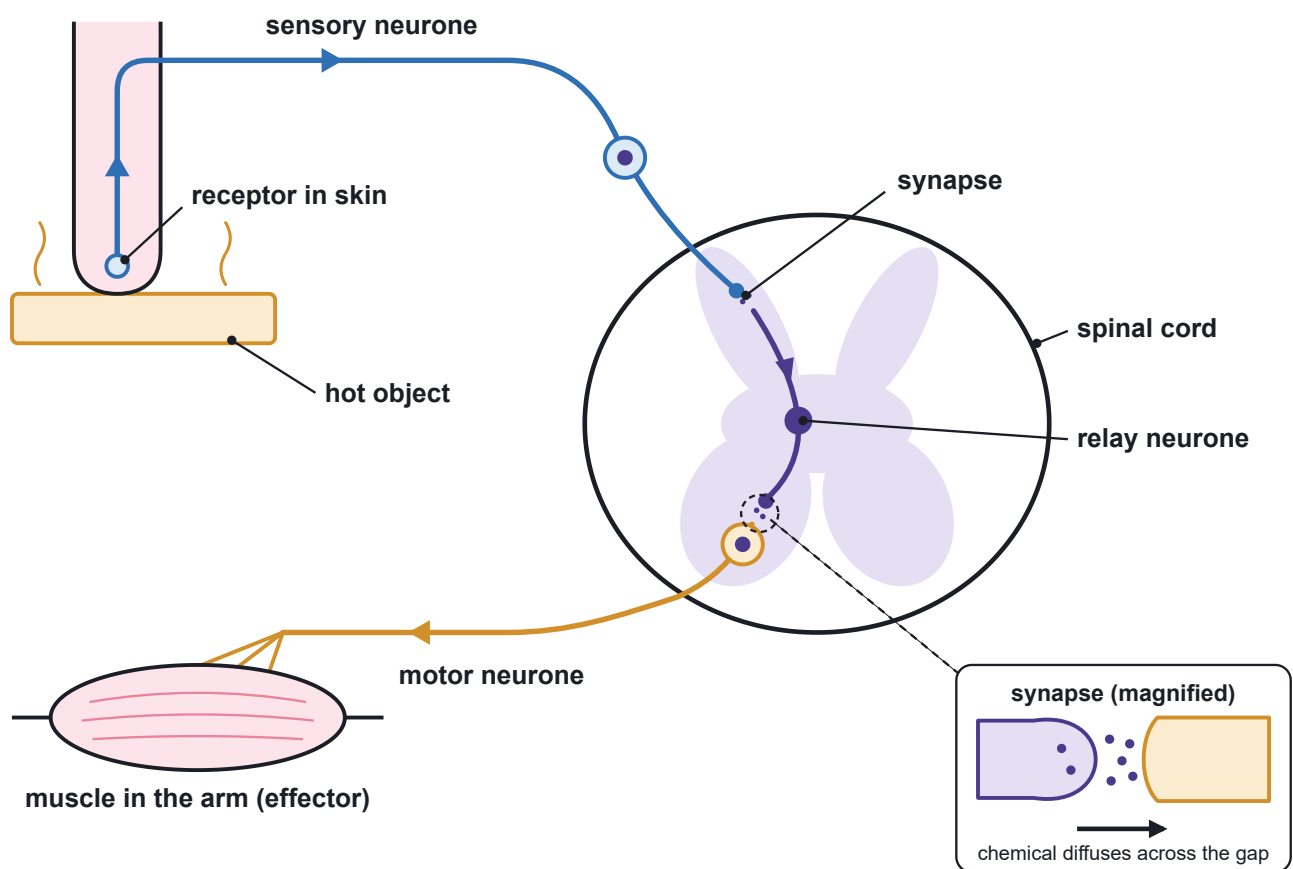
Reflex actions and the reflex arc Spec 4.5.2.1

Reflex actions are **automatic** and **rapid**. They do **not involve the conscious part of the brain**. Reflexes are important because they protect the body from harm, for example pulling your hand away from a hot object before you have time to think.

1. A receptor detects the stimulus and an impulse starts in the sensory neurone.
2. The sensory neurone carries the impulse to the CNS.
3. At a synapse, chemicals diffuse across the gap and start an impulse in the relay neurone.
4. The relay neurone passes the impulse on, through another synapse, to the motor neurone.
5. The motor neurone carries the impulse to the effector.

6. The effector (a muscle or gland) produces the response.

Structures in a reflex arc	
Structure	Function
Receptor	Detects the stimulus
Sensory neurone	Carries impulses from the receptor to the CNS
Relay neurone	Carries impulses within the CNS, from the sensory neurone to the motor neurone
Synapse	A gap between two neurones. A chemical diffuses across the gap and starts an impulse in the next neurone
Motor neurone	Carries impulses from the CNS to the effector
Effector	A muscle (contracts) or a gland (secretes) that produces the response



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A reflex arc. The impulse goes **receptor** → **sensory neurone** → **relay neurone** → **motor neurone** → **effector**, crossing a **synapse** by chemical diffusion at each junction.

Common mistake: The reflex arc does not go through the conscious part of the brain, which is why it is fast. Do not write that the brain is never told; just say the response happens before you are aware of it.

Required practical: reaction time Spec 4.5.2.1

Required practical: Required practical activity 7 (activity 6 in Combined Science): plan and carry out an investigation into the effect of a factor on human reaction time.

Reaction time is the time taken to respond to a stimulus. A common method uses a ruler.

1. The volunteer sits with their forearm resting on the edge of a table and their hand over the edge.
 2. A partner holds a ruler vertically so that the zero mark is level with the volunteer's thumb and finger, which are about to grip it.
 3. Without warning, the partner drops the ruler.
 4. The volunteer catches it as fast as possible. Read the distance on the ruler at the top of their thumb.
 5. Repeat several times and calculate a mean for each condition.
- Independent variable: the factor you change, for example caffeine, a distraction, practice or which hand is used.
 - Dependent variable: reaction time, shown by the distance the ruler falls (a shorter distance means a faster reaction), or by a time from a computer test.
 - Control variables: the same volunteer, the same hand, the same ruler, the same drop height, and the same method of reading the result.
 - Safety: the risk is low. Make sure nobody is pressured into taking a drink or doing anything they are not comfortable with.

Repeating the test and taking a **mean** makes the results more reliable. Ignore any anomalous result when you calculate the mean.

From numbers to a graph

A student measured reaction time (in s) five times: 0.31, 0.29, 0.33, 0.30, 0.32. Calculate the mean, then say how the means for two conditions would be shown on a bar chart.

1. Add the five results: $0.31 + 0.29 + 0.33 + 0.30 + 0.32 = 1.55$
2. Divide by the number of results: $1.55 \div 5 = 0.31$
3. Draw one bar per condition, labelled on the x-axis, with bar height equal to the mean reaction time on the y-axis (in s).

Answer: Mean reaction time = 0.31 s.

Maths skill: You may be asked to turn a table of reaction times into a graph, or read values from a graph into a table. Label axes with the quantity and unit, for example 'Reaction time (s)'. Use a bar chart when one variable is a category.

Quick check

1. What is the CNS?
2. Put these in order: motor neurone, sensory neurone, relay neurone.
3. Why are reflex actions important?

Quick check answers

The human nervous system

1. The central nervous system: the brain and spinal cord.
2. Sensory neurone, relay neurone, motor neurone.
3. They are automatic and rapid, protecting the body from harm without involving the conscious part of the brain.