

Neurones and reflexes

Revision notes · Sensory receptors, the three types of neurone, the structure of neurones, synapses and neurotransmitters, and how a reflex arc works.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Neurones and reflexes Spec 2.13-2.14

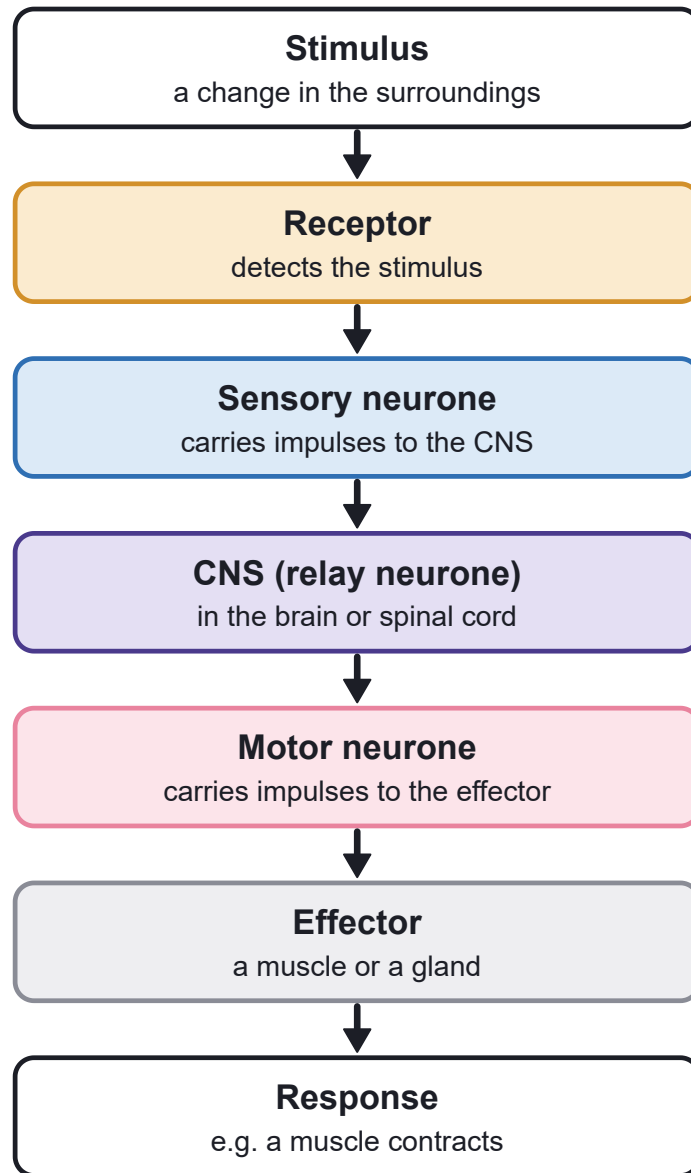
Receptors and the nervous pathway Spec 2.13

The nervous system lets an organism respond to changes in its surroundings. The brain and spinal cord make up the central nervous system (CNS). A **sensory receptor** is a cell that detects a stimulus (a change in the surroundings) and produces an electrical impulse.

1. A sensory receptor detects a stimulus.
2. A **sensory neurone** carries the electrical impulses to the CNS.
3. A **relay neurone** in the CNS passes the impulses on.
4. A **motor neurone** carries the impulses from the CNS to an effector (a muscle or a gland).
5. The effector produces a response.

The three types of neurone

Neurone	Function
Sensory neurone	Carries impulses from a receptor to the CNS
Relay neurone	Found in the CNS. Connects the sensory neurone to the motor neurone
Motor neurone	Carries impulses from the CNS to an effector



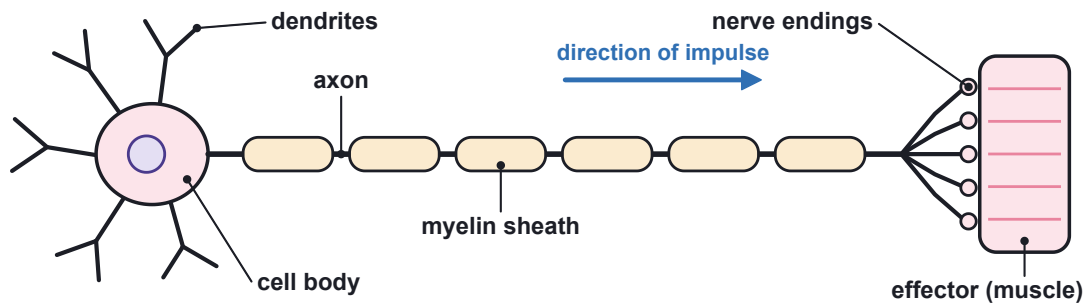
The pathway from stimulus to response.

Neurone structure Spec 2.13

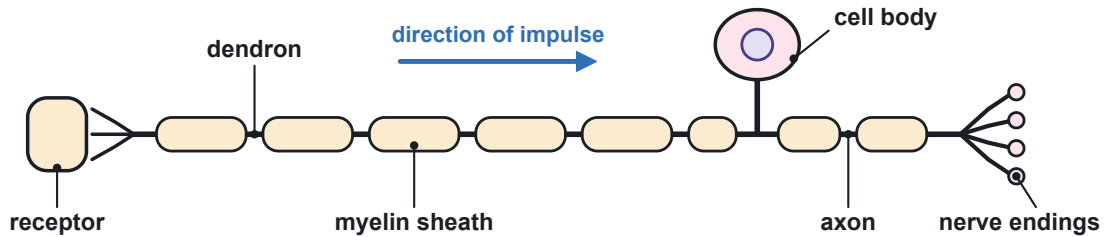
Neurones are specialised to carry electrical impulses quickly over long distances.

Axon	A long fibre that carries electrical impulses away from the cell body.
Dendron	A fibre that carries electrical impulses towards the cell body.
Myelin sheath	A fatty layer around the neurone that insulates it and speeds up the transmission of impulses.

Motor neurone



Sensory neurone



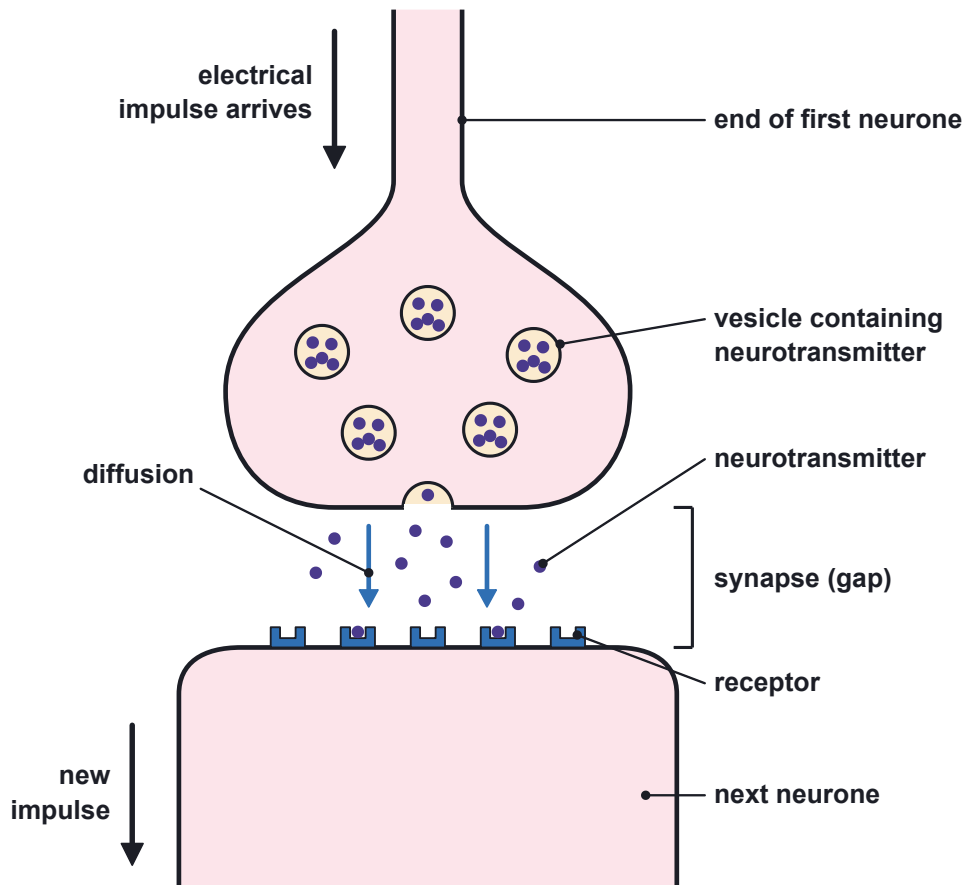
A **motor neurone** and a **sensory neurone**. The **myelin sheath** insulates the fibre and speeds up impulses.

Exam tip: Link the structure to its function. The myelin sheath is an insulator, which makes the impulse travel faster.

Synapses Spec 2.13

A **synapse** is a gap between two neurones. The electrical impulse cannot cross the gap, so a chemical is used instead.

1. An electrical impulse arrives at the end of the first neurone.
2. The neurone releases a chemical called a **neurotransmitter** into the synapse.
3. The neurotransmitter **diffuses** across the gap.
4. It binds to receptors on the membrane of the next neurone.
5. This triggers a new electrical impulse in the next neurone.



At a synapse the neurotransmitter diffuses across the gap and binds to **receptors** on the next neurone.

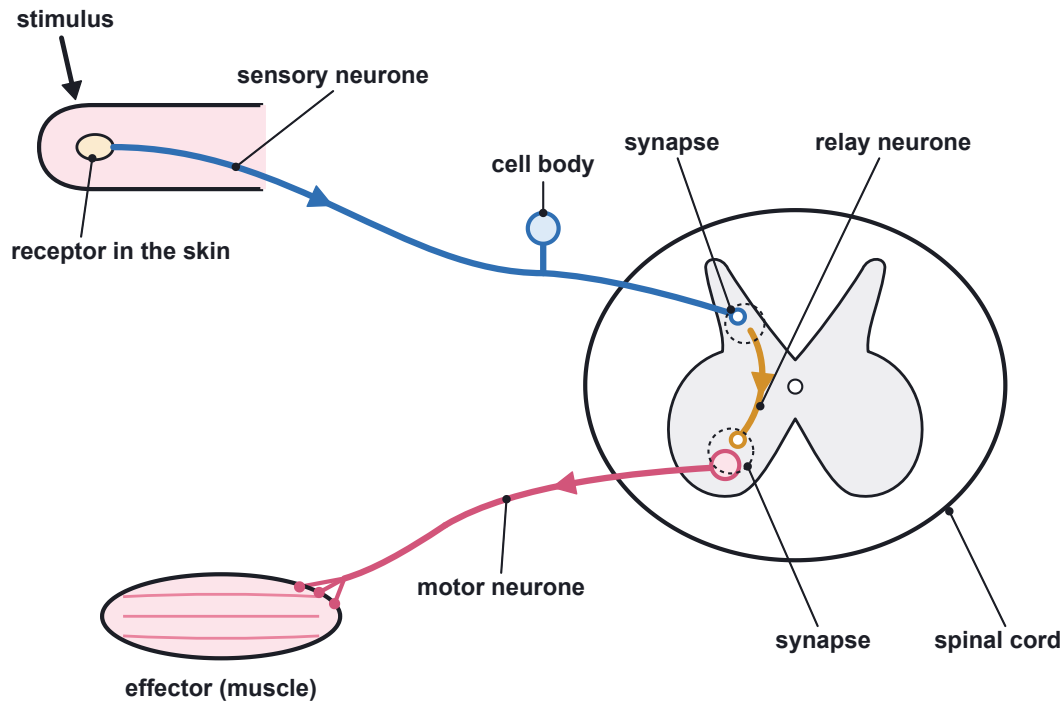
Common mistake: The impulse itself does not cross the synapse. A neurotransmitter diffuses across and starts a new impulse in the next neurone.

Reflex arcs Spec 2.14

A **reflex** is a fast, automatic response to a stimulus that does not involve conscious thought. The pathway it follows is called a **reflex arc**. Reflexes protect the body from harm.

1. The stimulus is detected by a receptor (for example, a pain receptor in the skin).
2. A sensory neurone carries impulses to the CNS.
3. At a synapse the impulses pass to a relay neurone in the CNS.
4. At another synapse the impulses pass to a motor neurone.
5. The motor neurone carries the impulses to an effector, such as a muscle.
6. The effector produces a response, such as the muscle contracting to pull the hand away.

The impulses do not have to travel to the conscious part of the brain before the response, so the reflex is very fast.



A reflex arc: receptor, **sensory neurone**, **relay neurone**, **motor neurone**, effector. Impulses cross a **synapse** between each pair of neurones.

Investigating reaction times Spec 2.13, 2.14

The suggested practicals ask you to investigate human responses to external stimuli, reaction times and the speed of transmission of electrical impulses in the nervous system.

Exam tip: Ruler-drop test: one person holds a ruler vertically with the zero level with the top of the other person's open thumb and finger. They drop it without warning and the other person catches it. Record the distance it fell. A shorter distance means a faster reaction time.

- Independent variable: the factor you change, such as hand used, practice or a distraction.
- Control variables: the same person dropping the ruler, the same ruler, the same starting position and the same person catching.
- Repeat several times and calculate a **mean**. This reduces the effect of random errors and lets you spot anomalous results.
- A reaction time is the time between a stimulus and a response.

Typical results: practice usually makes the response quicker, and distractions usually make it slower.

Mean distance

A student catches a ruler five times. The distances it fell were 20, 17, 15, 14 and 12 cm. Calculate the mean.

1. add the results: $20 + 17 + 15 + 14 + 12 = 78$

2. divide by the number of results: $78 \div 5$

Answer: 15.6 cm

Maths skill: If you plot reaction time against a variable on a scatter diagram, look for a correlation. Points sloping down show a negative correlation: as one variable rises, the other falls.

Quick check

- 1 . Name the three types of neurone in a reflex arc, in order.
- 2 . What does the myelin sheath do?
- 3 . What is a synapse?
- 4 . How does an impulse cross a synapse?
- 5 . Why are reflexes important?

Quick check answers

Neurones and reflexes

1. Sensory neurone, relay neurone, motor neurone.
2. It insulates the neurone and speeds up the transmission of impulses.
3. A gap between two neurones.
4. A neurotransmitter is released, diffuses across the gap and triggers a new impulse in the next neurone.
5. They are fast and automatic, so they protect the body from harm.