

The human nervous system

4.5.2 · Biology · revision notes

How the nervous system carries information as electrical impulses, how a reflex arc works, and the required practical on reaction time. Expect ordering and labelling questions, 'explain why reflexes are useful', synapse explanations and data questions from the reaction time practical.

Key facts

- CNS = brain + spinal cord
- Effectors: muscles contract, glands secrete hormones
- Reflex = automatic and rapid; does not involve the conscious part of the brain
- Neurones carry electrical impulses
- Reflex arc: receptor → sensory neurone → relay neurone → motor neurone → effector
- Reaction time practical: shorter catch distance = faster reaction

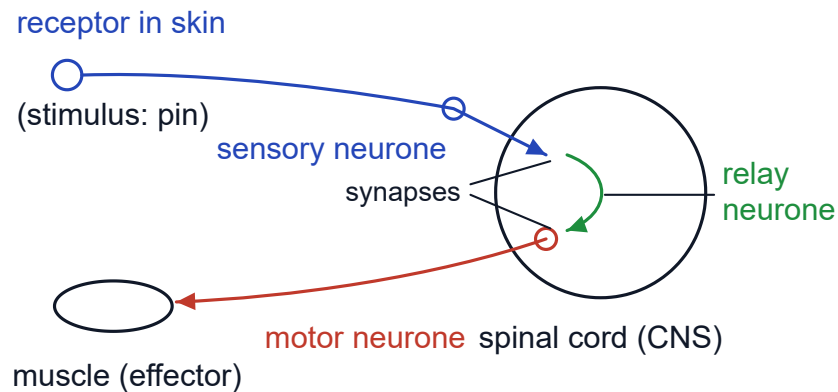
Notes

How the nervous system works

- The nervous system lets you **react to your surroundings** and **coordinate your behaviour**.
- Receptors detect a stimulus. Information passes along nerve cells (**neurones**) as **electrical impulses** to the **central nervous system (CNS)**: the **brain and spinal cord**.
- The CNS coordinates the response of **effectors**: muscles contract or glands secrete hormones.
- Stimulus → receptor → coordinator (CNS) → effector → response.

Reflex arcs

- **Reflex actions** are **automatic and rapid**. They do not involve the conscious part of the brain, so no time is spent deciding what to do.
- Reflexes protect you from harm, e.g. pulling your hand away from a hot pan or blinking when something flies towards your eye.
- Path: stimulus → receptor → **sensory neurone** → **relay neurone** (in the spinal cord or brain) → **motor neurone** → effector → response.
- Sensory neurones carry impulses from receptors to the CNS. Relay neurones link sensory and motor neurones inside the CNS. Motor neurones carry impulses from the CNS to effectors.



Reflex arc: receptor → sensory neurone → relay neurone (in spinal cord) → motor neurone → effector. The arrows show the direction of the impulse.

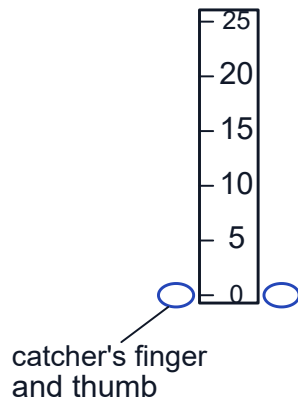
Synapses and adaptations

- A **synapse** is the tiny gap where two neurones meet.

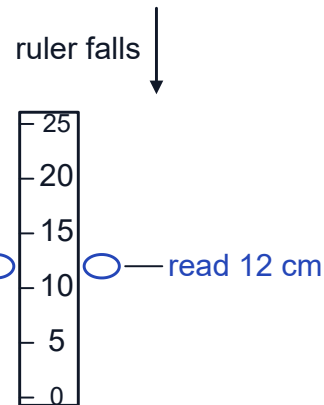
Required practical: reaction time

- Your partner holds a ruler vertically with the zero mark between your thumb and first finger. They drop it without warning and you catch it as quickly as you can.

partner holds the top, then lets go



before the drop



after the catch

Reaction time: the further the ruler falls before you catch it, the longer your reaction time.

- Record the distance the ruler fell. A **shorter distance** means a **shorter reaction time**. Convert distances to times using a conversion table.
- Repeat several times and calculate a mean. Then test a factor such as caffeine, practice, tiredness or distraction.
- Control variables: same person dropping the ruler, same hand catching, same ruler, same starting gap between finger and thumb, arm resting on the table edge.

How to answer each type of question

Describe the pathway of a reflex arc

3 to 4 marks

Grade 5

- Start at the receptor and finish at the effector.
- Name the three neurones in order: sensory, relay, motor.
- Say where the relay neurone is (the spinal cord) and what the effector does.

Example. A person touches a sharp pin and immediately pulls their hand away.
Describe the pathway taken by the nerve impulses in this reflex action.

Model answer. Receptors in the skin detect the stimulus (1). Impulses travel along a sensory neurone to the spinal cord (1). They pass to a relay neurone in the spinal cord and then to a motor neurone (1). The motor neurone carries impulses to a muscle (the effector), which contracts to pull the hand away (1).

Explain why a reflex is an advantage

2 marks

Grade 5

1. Say that reflexes are automatic and fast because the conscious brain is not involved.
2. Say how this protects the body in the context given.

Example. Blinking when an object comes towards your eye is a reflex action.
Explain why it is an advantage for this response to be a reflex.

Model answer. Reflexes are automatic / do not involve the conscious part of the brain, so they are very fast (1). The eye closes before the object hits it, so the eye is protected from damage (1).

Don't lose marks

- ✗ Saying the electrical impulse 'jumps' across the synapse. A chemical diffuses across the gap.
- ✗ Saying the brain decides what to do in a reflex. Reflexes do not involve the conscious part of the brain.
- ✗ Missing out the relay neurone, or putting the three neurones in the wrong order.
- ✗ Including an anomalous result when calculating a mean.
- ✗ Writing 'keep it a fair test' instead of naming a specific control variable.

More tips

Memory tricks

- Sensory neurones Send information in to the CNS; Motor neurones make things Move.
- Relay neurones relay the impulse across the CNS, like passing the baton in a relay race.
- Ruler drop: short distance = short time = quick reactions.
- Synapse in three words: chemical, diffuses, receptors.

Exam technique

- Use the exact names: receptor, sensory neurone, relay neurone, motor neurone, effector.
- For effectors, give the action in context, e.g. 'a muscle in the arm contracts', not just 'the arm moves'.
- In reaction time questions, look at the units and give the mean to a sensible number of decimal places.
- If asked why a result is anomalous, say it does not fit the pattern of the other results.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

State what the nervous system does

It lets you react to your surroundings and coordinates your behaviour.

Grade 4

Name the parts of the CNS

The central nervous system (CNS) is the brain and spinal cord.

Grade 4

Put the reflex arc in order

Stimulus → receptor → sensory neurone → relay neurone → motor neurone → effector → response.

Grade 5

Explain why reflex actions are fast

They are automatic and do not involve the conscious part of the brain.

Grade 5

Describe the ruler-drop reaction time practical

Catch a dropped ruler, record the distance it fell and convert it to a reaction time.

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