The Nervous System
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- Reaction times
- Stimuli
- Parts of the nervous system
- Negative feedback
- Summary activities
Why do we have a nervous system?

To make us nervous before we take exams?

So that our little brother can get on our nerves?

To help us react to our surroundings and co-ordinate our behaviour?

Scientists would say that the last answer is correct, but people use the word ‘nerves’ in many different ways.
Measuring your reaction time

How many targets can you hit in 30 seconds?

How fast is your reaction time?
Try to hit as many targets as possible in 30 seconds.

Press "start" to begin.
Reflexes and reaction times

**Reaction times** are how long it takes for the muscles to respond from the start of a stimulus. In sprint races, reaction times can determine who wins the race.

In 1991, Leroy Burrell beat team mate Carl Lewis’s world record for the 100m sprint. But who was quickest?

<table>
<thead>
<tr>
<th>Runner</th>
<th>Sprint time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carl Lewis</td>
<td>9.764</td>
</tr>
<tr>
<td>Leroy Burrell</td>
<td>9.783</td>
</tr>
</tbody>
</table>

Why did Burrell win the race?
On the starting blocks

In order to understand, you need to know the reaction time of each runner. Sprint races are timed from the moment the starter’s gun is fired.

The actual gun is normally silent – the ‘bang’ comes from speakers behind the starting blocks.

This prevents the runner located furthest from the starter from hearing the start signal last.

Pressure sensors in the starting blocks record when a sprinter sets off.
How does the pressure on a pressure sensor vary at the start of a race?
Why did Burrell win the race?
How can pressure-time graphs identify false-starts?

Scientists have found that it is physically impossible to react in less than 0.1 seconds. If a runner’s reaction time is less than 0.1 seconds then they must have deliberately started before the signal was heard.

The diagram shows a pressure-time graph with two different lines: one indicating a normal start and the other indicating a false start. The pressure is measured on the y-axis and time (in seconds) on the x-axis. The signal is marked as "bang" and the time intervals are marked in increments of 0.05 seconds.
**Is there a correlation?**

**Does the fastest starter always win?**

These results are from the 1992 Barcelona Olympic Games:

<table>
<thead>
<tr>
<th>Runner</th>
<th>Reaction time (s)</th>
<th>Race time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christie (UK)</td>
<td>0.139</td>
<td>9.960</td>
</tr>
<tr>
<td>Fredericks (NAM)</td>
<td>0.138</td>
<td>10.02</td>
</tr>
<tr>
<td>Mitchell (USA)</td>
<td>0.143</td>
<td>10.02</td>
</tr>
<tr>
<td>Surin (CAN)</td>
<td>0.124</td>
<td>10.04</td>
</tr>
<tr>
<td>Burrell (USA)</td>
<td>0.165</td>
<td>10.09</td>
</tr>
<tr>
<td>Adeniken (NGR)</td>
<td>0.183</td>
<td>10.10</td>
</tr>
<tr>
<td>Stewart (JAM)</td>
<td>0.154</td>
<td>10.12</td>
</tr>
<tr>
<td>Ezinwa (NGR)</td>
<td>0.172</td>
<td>10.26</td>
</tr>
</tbody>
</table>
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Receptors detect stimuli

Many things happen around us all the time. We are aware of some of these things because we have special receptors which can detect certain types of stimuli.

Receptors are often found in sense organs. They are very specialized, and so can only detect one type of stimuli within a certain range. Other animals have different receptors, and so can detect things which we cannot:

- rattlesnakes can detect the infrared radiation being given off by their prey
- dog whistles can be heard by dogs, but the pitch is too high for human sound receptors.
Which sense detects each external stimulus?

senses
chemicals in food
There are two types of light receptor cells in human eyes:

- **rods**, which are sensitive to light at low intensities
- **cones**, which are sensitive to colour and light at high intensities.

These receptors might look complicated, but like most animal cells they have a nucleus, cytoplasm and cell membrane.
Sensory confusion

Some people experience confusion with their senses. This sometimes happens after the brain is damaged by an accident or stroke, or people might be born with the condition.

For instance, some people might feel sounds as touch on their skin, or taste a particular taste when they see a certain object.

Travel sickness might be due to the messages from different sense organs becoming confused.

For example, the eyes might tell the brain that you are reading a book, while the balance receptors in your ears might tell the brain that you are on a journey.
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What are nerves?

A nerve is a bundle of many nerve fibres enclosed within a protective sheath.

Nerve fibres are the long axons of neurones together with any associated tissues.
The two parts of the nervous system

The central and peripheral nervous systems

Do you know what the central nervous system and peripheral nervous system are?
Press on each of the buttons in turn to find out more and see a diagram.

Press "start" to begin.
The brain processes information which arrives from the body through the neurones. It then co-ordinates the response.

- **Cerebral hemisphere** – the outer layer of the brain, which initiates conscious actions such as voluntary movements
- **Cerebellum** – fine tunes muscle control
- **Brainstem** – co-ordinates reflexes

**Reflexes** are involuntary actions which are not under the conscious control of the brain. Reflexes are quick because they require less processing of information.
What is the central nervous system?
Neurones are specialized cells that convey information in the form of nerve impulses. Press on the labels to find out more about each part of the neurone.
Sensory and motor neurones

Press a button to find out more about two different types of neurone.
What is a synapse?

How do nerve impulses move across a synapse?

Nervous impulses can be transmitted from one neurone to another. This transfer occurs at a junction called a **synapse**.

Press "play" to find out more.
What happens when you see your friend in the street?

1. You notice the friend.
2. You decide to wave.
3. You raise your arm.
4. You move your arm to wave.
5. A neural impulse is sent to your arm muscles.

Even a simple response, such as waving to a friend, requires many different steps. Drag these sentences into the correct order.

Press "start" to begin.

An electrical impulse passes along a motor neurone to your arm muscles (the effector).
How fast are electrical signals?

Nerve impulses travel at up to 100 metres per second.

How long would it take you to run this distance? How long would it take to drive it?

You can carry out a simple experiment on the speed of transmission by standing in a circle and holding hands.

Close your eyes. Time how long a squeeze takes to be passed along the circle, from the start to the finish.

How accurate is this experiment?
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Negative feedback

Our bodies are well adapted to maintain and regulate internal conditions, such as body temperature or blood sugar levels.

If conditions start to change, our receptors will detect this. A system of **negative feedback** will reverse any changes. For example, if body temperature becomes too low:

- temperature receptors send an impulse to the brain
- an impulse is sent from the brain to the effectors – in this case, tiny muscles in the skin
- action is taken to reverse the changes: the muscular wall of the blood vessels contract, ultimately reducing the amount of heat lost from the body.
Light receptors in the eye can be damaged by excess light, but if there is too little light they cannot work. Negative feedback is used to regulate the amount of light entering the eye.

Press "start" to find out more.
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Glossary of keywords: the nervous system

**axon** – A long, thin projection within a neurone which carries electrical impulses very quickly.

**brainstem** – Part of the central nervous system, which co-ordinates reflexes.

**cell body** – The main part of a cell, which contains the cytoplasm and nucleus.

**central nervous system (CNS)** – The system that co-ordinates the body's responses to stimuli. It includes the brain and spinal cord.
Anagrams relating to the nervous system

How quickly can you unscramble words about the nervous system?

Press "start" to begin.

start

clue

60
Do quizzes make you nervous? See how much you can remember about the nervous system.

Press "start" to begin.