The Nervous System Notes

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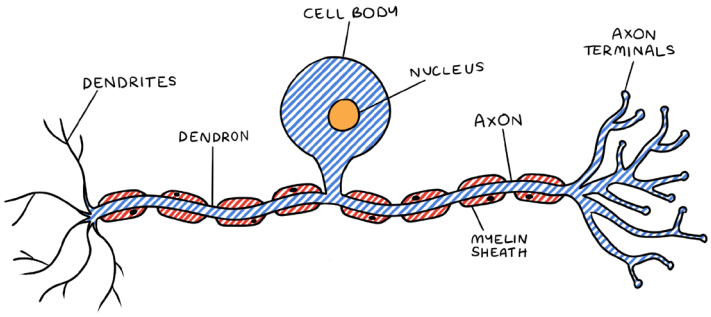
Human Nervous System Facts

1. The human nervous system is made of two parts, the central nervous system which is made up of the brain and spinal cord (CNS) and the peripheral nervous system which is made up of the nerve cells that carry information to or from the CNS.
2. Nerve cells are called neurones.
3. Information is sent through the nervous system as electrical impulses.

There are two different kinds of neurones that we study in detail for the GCSE. These are **sensory** and **motor** neurones. Each of these has a different function in the nervous system. Let's look at each 😊

Sensory Neurones

Sensory neurones: carry impulses towards the central nervous system from the sensory organs. For example, the optic nerve carries impulses from eye to brain.

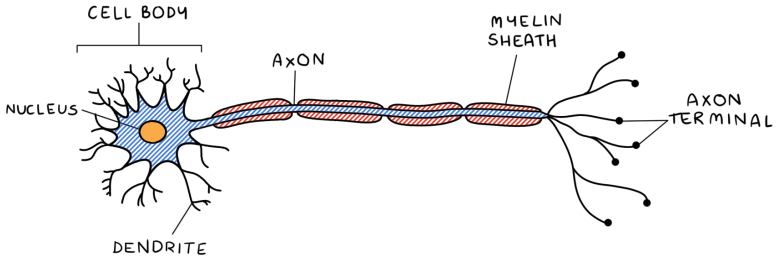


The figure shows a labelled sensory neurone.

Motor Neurones

Motor neurones: carry impulses away from the central nervous system towards the muscles or glands. For example, the brain sends an impulse to a muscle to move upwards.

The figure shows a labelled motor neurone.



A way of remembering the difference between the two is **s**ense goes with **s**ensory neurones and **m**uscles with **m**otor neurones. At GCSE it is unlikely that you will be asked to label a neurone, though it is still possible. It is more likely that you would will be asked to distinguish between the two.

Telling the Difference…

We could see an exam question where we are given a diagram of a neurone and asked to identify it as either a sensory neurone or a motor neurone. **So, how can we tell the difference?**

Sensory neurones – have their cell bodies in the **middle** of the cell.

Motor neurones – have their cell bodies at the **beginning** of the cell.

How are neurones adapted for the role of carrying nerve impulses?
1. They have a long fibre called an axon, to carry the impulse.
2. Have a myelin sheath. This insulates the axon and speeds up the transmission of the impulse.
3. They contain vesicles which store neurotransmitter molecules. These neurotransmitter molecules allow an impulse to cross a synapse.

Neurones are not all connected to each other. There are small gaps between the neurones, which are called synapses.

The Synapse

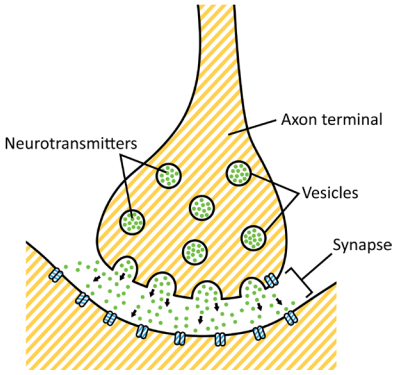
What is a synapse? Where two neurones meet there is a very small gap called a synapse.

Why do we need synapses? To ensure impulses only travel in one direction.

How do impulses cross this gap? The neurone can produce chemicals called neurotransmitters to allow the impulse to "jump" across the gap.

What are neurotransmitters? Neurotransmitters are chemical messengers that carry signals across the synapse.

When they are not being used neurotransmitters are stored in the neurone in small bubbles called vesicles.



How do the neurotransmitters move across the synapse?
They diffuse across the gap and cause the next neurone to transmit an electrical impulse.

How Do Nerve Impulses Cross the Synapse?

To simplify this and make it easier to understand and learn we can break this down into stages.

Stage 1: an impulse arrives at the axon terminals.

Stage 2: this causes **vesicles** to move toward the membrane and **release neurotransmitters** into the synapse.

Stage 3: the neurotransmitters diffuse across the synapse from high to low concentration.

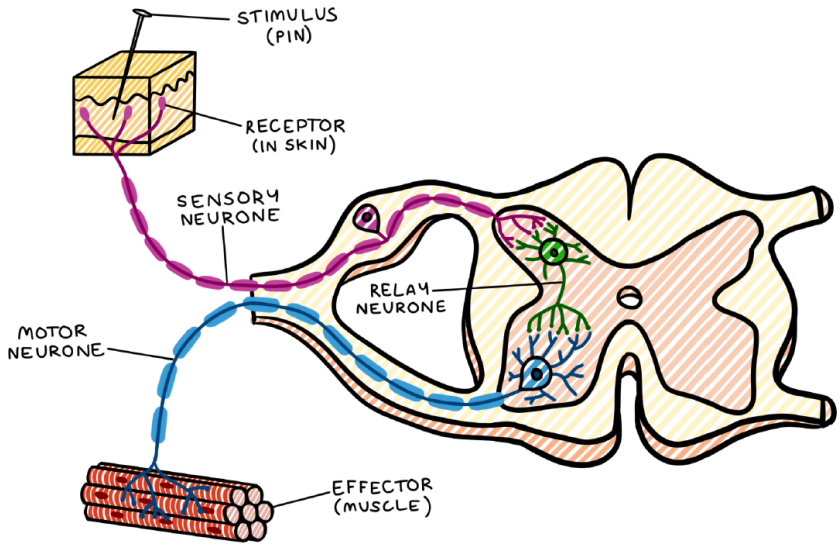
Stage 4: the neurotransmitters then bind to receptor sites on the membrane of the next neurone.

Stage 5: if enough of these neurotransmitters bind this will then **trigger a new electrical impulse** in the next neurone.

The Reflex Arc

A very popular question at GCSE, this deals with the detection of an impulse and its transmission within the nervous system. Learn the following points and you will be fully set for this question. It's a great question to get 😊

1. A stimulus is detected by a receptor, for example the skin or the eye.
2. The receptor then generates an impulse.
3. The impulse travels along the sensory neurones until it reaches the central nervous system (CNS).
4. At the CNS the impulse takes a relay neurone. This sends the impulse towards a motor neurone and not towards the brain.
5. The impulse travels along the motor neurones until it reaches an effector which can be a muscle or a gland.
6. The effector then causes a response, either contracting if it's a muscle or making a hormone if it's a gland.



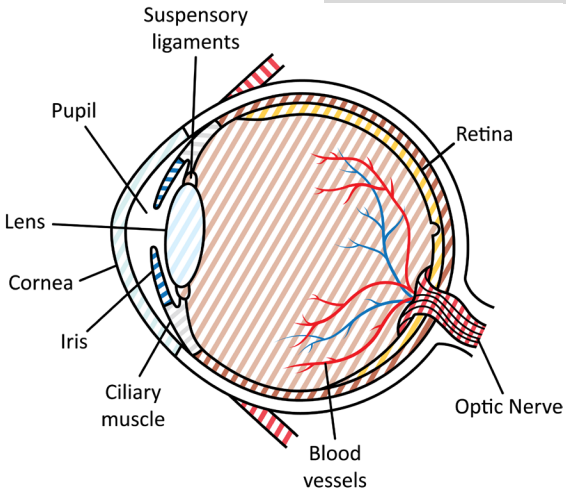
A labelled reflex arc

What is the advantage of having a reflex arc?

It reduces the amount of time that tissue is being damaged

This reduces the damage and means that you are more likely to survive.

The Eye



Structure	Function
Optic Nerve	Sends impulses to the brain.
Retina	Detects light and produces nerve signals.
Cornea	Refracts light and allows it to pass into the eye.
Iris	Controls the amount of light that enters the eye.
Lens	Focuses light on the Retina.
Pupil	Allows light to enter the eye.
Ciliary Muscle	Contracts and relaxes to control the shape of the lens.

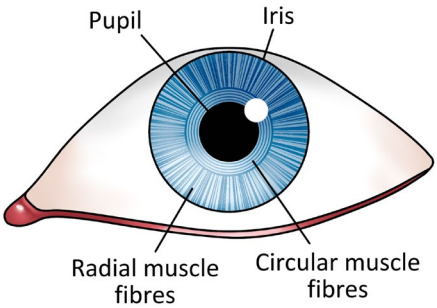
There are two main types of light receptors in the eye, **rods and cones**. Rods are our black and white vision and cones are responsible for our colour vision. There are three different types of cone cells which produce colour vision.

We don't need to know the structure of rod or cone cells, just what each one does.

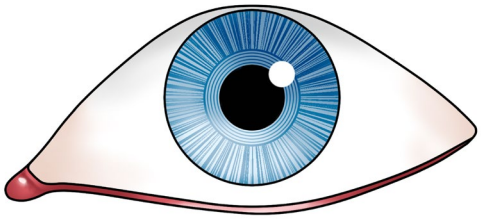
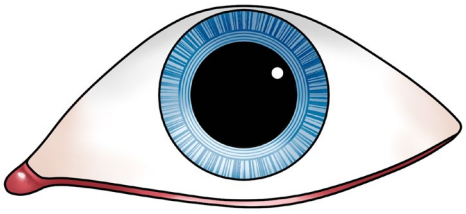
The Iris Reflex

The iris reflex is a protective response that controls how much light enters the eye by changing the size of the pupil. This helps protect the retina (the light-sensitive layer at the back of the eye) from damage due to too much light and helps us see clearly in different lighting conditions.

The figure below shows the labelled iris and pupil of the eye.



How does the iris respond to changing light conditions? Let's look at the two examples, **bright light** and **dim light** in the table below.

Bright Light	Dim Light
	
What happens in this process? • Light hits the retina. • A signal is sent to the brain via the optic nerve. • The brain sends a signal back to the eye. • **<u>Circular muscles contract, radial muscles relax</u>**. • Pupil becomes smaller (constricts). • Less light enters the eye, the retina is protected.	**What happens in this process?** • Less light hits the retina. • A signal is sent to the brain via the optic nerve. • The brain sends a signal back to the eye. • **<u>Radial muscles contract, circular muscles relax</u>**. • Pupil becomes larger (dilates). • More light enters the eye, this allows us to see better in low light conditions.

Focusing Light

The primary role of the eye is to detect light and produce nerve impulses to be sent to the brain where they are interpreted. In order to do this correctly the eye needs to focus light correctly onto the retina. The process of focusing light onto the retina is called Accommodation.

Accommodation: describes the processes of changing the shape of the lens of the eye to focus clearly on objects whether they're close up or far away.

Below we have broken this process down step by step and explained the structures involved 😊

Step 1: light enters the eye.

Light is reflected from an object and enters the eye through the cornea. The cornea is the transparent, curved front layer of the eye. The cornea refracts the light, helping to bend the light towards the retina.

Step 2: the iris expands or contracts to let more or less light into the pupil.

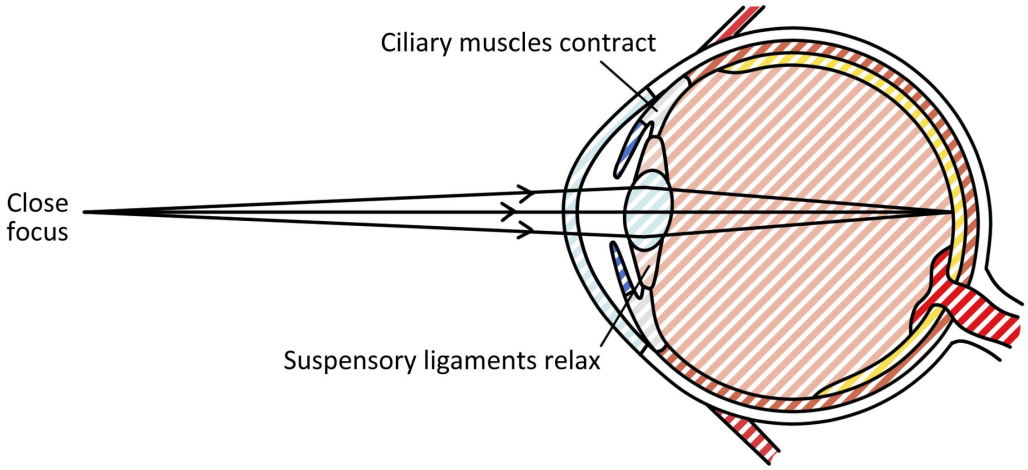
When we are in bright light, the pupil gets smaller to reduce the amount of light entering the pupil. In dim light, the pupil gets larger to let more light into the pupil. This adjustment is called the pupil reflex.

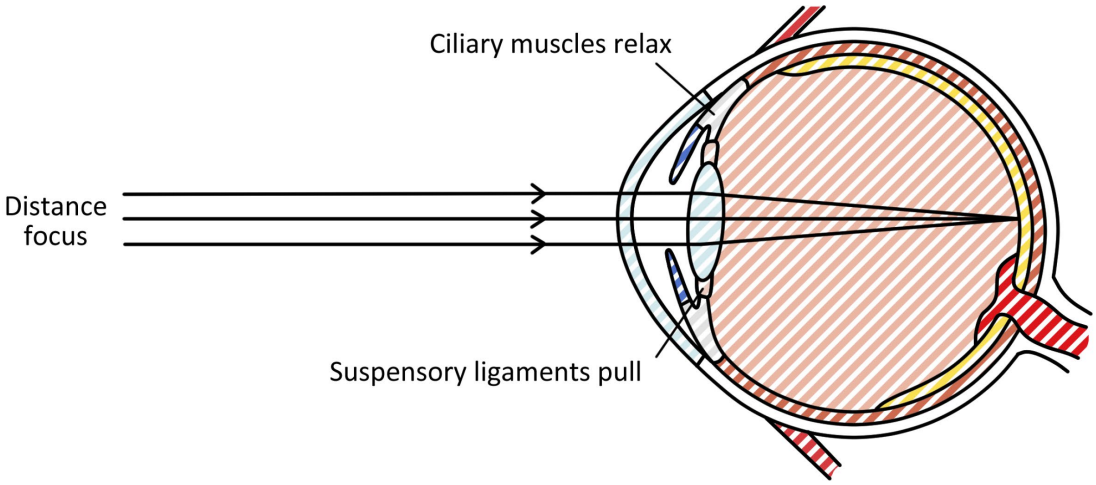
Step 3: light passes through the lens.

The lens can change shape to focus the light onto the retina. What shape it is depends on where the object is.

To focus on near objects:

1. The ciliary muscles contract.
2. The suspensory ligaments relax allowing the lens to stretch.
3. The lens becomes thicker and more curved to bend light more to focus onto the retina.



To focus on distant objects:

1. The ciliary muscles relax.
2. The suspensory ligaments pull.
3. The lens becomes thinner and less curved, bending light less to focus on the retina.