Responding to the Environment

Nervous and Hormonal Communication

Animals increase their chances of survival by responding to changes in their external environment

They respond to changes in their internal environment

This ensures the conditions are always optimal for their metabolism

Plants increase their chances of survival by responding to changes in their environment

*A **stimulus** is a change in the internal or external environment*

***Receptors** detect stimuli*

They can be cells or proteins on a cell surface membrane

Different receptors detect different stimuli

***Effectors** are cells that bring about a response to a stimulus to produce an effect*

Effectors include muscle cells and cells found in glands

Receptors communicate with effectors via the nervous system or the hormonal system

The nervous system send information as electrical impulses

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*A **neuron** is a complex network of cells*

The nervous system is made up of neurons

There are three main types of neurone:

***Sensory neurons** transmit electrical impulses from receptors to the central nervous system*

***Motor neurons** transmit electrical impulses from the central nervous system to effectors*

***Relay neurons** transmit electrical impulses between sensory neurons and motor neurones*

A stimulus is detected by receptor cells

An electrical impulse is sent along a sensory neurone

When an electrical impulse reaches the end of a neuron neurotransmitters take the information across to the next neuron

This then send an electrical impulse

Nerve impulses from the photoreceptors are carried from the retina to the brain by the optic nerve

*The **optic nerve** is a bundle of neurons*

The eye contains a blind spot

This is where there are no photoreceptors

Therefore it is not sensitive to light

Photoreceptors convert light into an electrical impulse

Light enters the eye and hits photoreceptors

It is absorbed by light-sensitive pigments

Light bleaches the pigments

This causes a chemical change

The membrane's permeability to sodium is changed

A generator potential is created

If it reaches the threshold a nerve impulse is sent along a bipolar neuron

***Bipolar neurons** connect photoreceptors to the optic nerve*

This takes impulses to the brain

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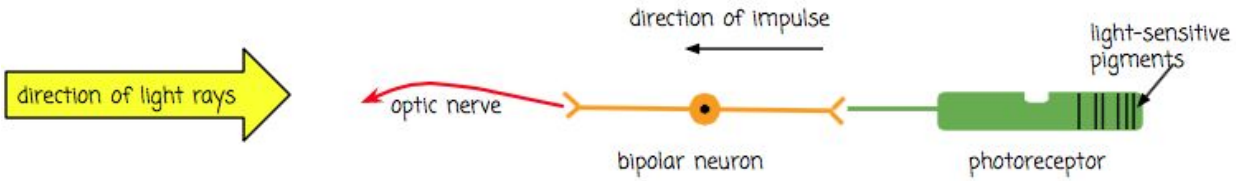


The human eye has two types of photoreceptors

Rods and cones

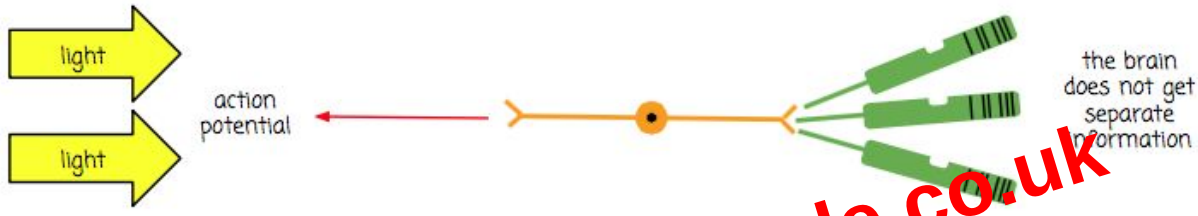
Rods are mainly found in the peripheral part of the retina

Cones are found packed together in the fovea

Rods give information in monochromatic vision - black and white

Rods give low visual activity as many rods join the same neurone

This means light from two objects close together cannot be told apart



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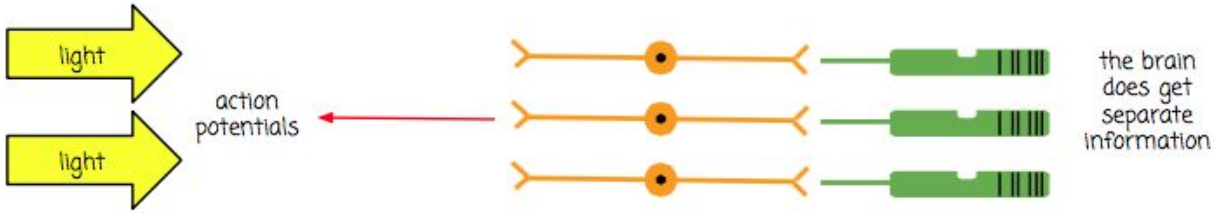
Cones give high visual activity as cones are close together

Only one cone joins one neurone

When light from two point hits two cones, two action potentials go to the brain

You can distinguish two points that are close together as two separate points



Neurones

Neuronal cell membranes are polarised at rest

In a neuron's resting state the outside of the membrane is positively charged compared to the inside

There are more positive ions outside the cell than inside

The sodium-potassium pumps move potassium ions into the neurone

The membrane is permeable to potassium ions

They diffuse back out through potassium ion channels

This makes the outside of the cell positively charged compared to the inside

Neuronal cell membranes become depolarised when they're stimulated

A stimulus triggers sodium ion channels to open

If the stimulus is big enough it will trigger a rapid change in potential difference

This triggers action potential

The stimulus excites the neuron cell membrane

This causes sodium ion channels to open

The membrane become more permeable to sodium

Sodium ions diffuse into the neurone down the sodium electrochemical gradient

This makes the inside of the neurone less negative

Depolarisation occurs if the potential difference reaches the threshold

The sodium ion channels close and potassium ion channels open

The membrane is more permeable to potassium

The potassium ions diffuse out of the neuron, down the potassium ion concentration gradient

This starts to get the membrane back to its resting potential

Hyperpolarization occurs when potassium ion channels are slow to close

There's a slight 'overshoot'

This means too many potassium ions diffuse out of the neuron

The potential difference becomes more negative than the resting potential

Resting potential is reached when the ion channels are reset

The sodium-potassium pump returns the membrane to its resting potential

This is maintained until the membrane's excited by another stimulus

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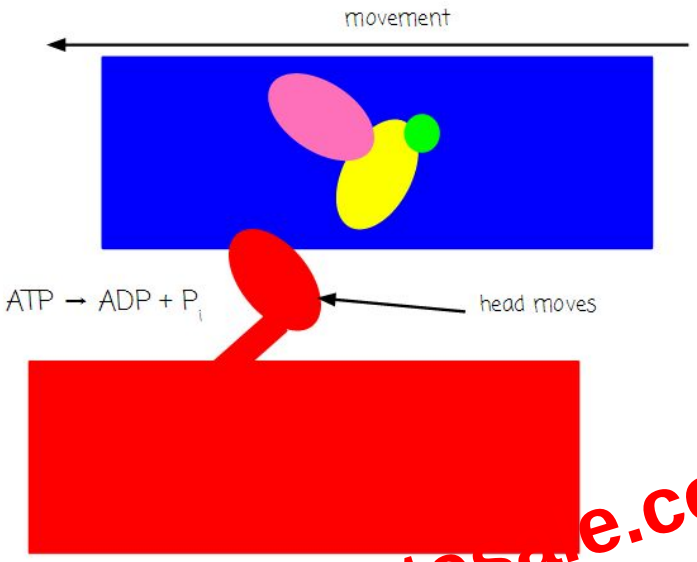
This provides energy needed for muscle contraction

The energy released from ATP moves the myosin head

This pulls the actin filament along in a rowing action



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ATP provides the energy to break the actin-myosin cross bridge

This means the myosin head detaches from the actin filament after it has moved

The myosin head then reattaches to a different binding site further along the actin filament

A new actin-myosin cross bridge is formed

The cycle is repeated

Many actin-myosin bridges from and break very rapidly

This pulls the actin filament along

This shortens the sarcomere

This causes the muscle to contract

The cycle will continue as long as calcium ions are present and bound to troponin