

Neurones, reflexes and the nervous system

Define a sensory neurone.

Neurones, reflexes and the nervous system

Define a motor neurone.

Neurones, reflexes and the nervous system

What is the function of a relay neurone?

Neurones, reflexes and the nervous system

Where are the cell bodies of sensory, relay and motor neurones found?

Neurones, reflexes and the nervous system

What are Schwann cells and what do they form?

Impulses, synapses and receptors

What are nodes of Ranvier?

Neurones, reflexes and the nervous system

Name the order of a nervous response.

Neurones, reflexes and the nervous system

What are the CNS and the PNS?

A neurone that carries impulses from the central nervous system to an effector, a muscle or gland.

A neurone that carries impulses from a receptor to the central nervous system.

Sensory: dorsal root ganglion. Relay and motor: grey matter of the spinal cord.

It connects sensory and motor neurones inside the central nervous system.

Gaps in the myelin sheath, about 1 mm apart, where the axon membrane is exposed; in a myelinated axon depolarisation happens only here.

Cells that wrap around axons of the peripheral nervous system many times, forming the myelin sheath.

CNS: brain and spinal cord. PNS: all the neurones and nerves outside the CNS.

Stimulus, receptor, sensory neurone, CNS (coordinator), motor neurone, effector, response.

Neurones, reflexes and the nervous system

What is a reflex?

Neurones, reflexes and the nervous system

What does grey matter of the spinal cord contain?

Neurones, reflexes and the nervous system

Why does white matter look white?

Neurones, reflexes and the nervous system

Which root of the spinal cord carries sensory neurones in, and which carries motor neurones out?

Impulses, synapses and receptors

What is the resting potential of an axon and what sets it up?

Impulses, synapses and receptors

What ion movement causes depolarisation?

Impulses, synapses and receptors

What ion movement causes repolarisation?

Impulses, synapses and receptors

What is the threshold potential and the all-or-nothing principle?

Cell bodies of relay and motor neurones and synapses.

A rapid, automatic response to a stimulus that does not involve conscious thought.

Dorsal root: sensory neurones in. Ventral root: motor neurones out.

It contains myelinated axons; myelin is lipid-rich and pale.

Na^+ enters the axon through voltage-gated sodium channels.

About -70 mV. The sodium-potassium pump (3 Na^+ out, 2 K^+ in) and K^+ leak channels.

About -55 mV. Below it no action potential forms; above it every action potential is the same size.

K^+ leaves the axon through voltage-gated potassium channels.

Impulses, synapses and receptors

What is the refractory period and why does it matter?

Impulses, synapses and receptors

Define saltatory conduction.

Impulses, synapses and receptors

Why is saltatory conduction faster?

Impulses, synapses and receptors

Name the sequence at a cholinergic synapse.

Impulses, synapses and receptors

What does acetylcholinesterase do?

Impulses, synapses and receptors

Why are synapses one-way?

Impulses, synapses and receptors

What is the difference between an excitatory and an inhibitory synapse?

Impulses, synapses and receptors

How does the pupil constrict in bright light?

The action potential jumps from node of Ranvier to node along a myelinated axon, by local circuits.

Na^+ channels are inactivated, so no new action potential forms. It makes impulses discrete and one-way.

Ca^{2+} in, vesicles fuse, ACh released, ACh binds receptors, Na^+ in, postsynaptic depolarisation, acetylcholinesterase breaks ACh down.

Depolarisation occurs only at nodes, so the impulse jumps between them rather than regenerating at every point.

Only the presynaptic knob has vesicles of neurotransmitter and only the postsynaptic membrane has receptors.

Hydrolyses acetylcholine into choline and ethanoate in the synaptic cleft.

Circular muscles contract and radial muscles relax.

Excitatory: transmitter depolarises the postsynaptic membrane (Na^+ in). Inhibitory: transmitter (for example GABA) hyperpolarises it, making an action potential less likely.

Impulses, synapses and receptors

How does the pupil dilate in dim light?

Impulses, synapses and receptors

How does nicotine affect synapses?

Impulses, synapses and receptors

How does lidocaine work?

Impulses, synapses and receptors

How does cobra venom alpha toxin work?

Impulses, synapses and receptors

Why is L-DOPA given in Parkinson's disease?

Impulses, synapses and receptors

How does MDMA act at synapses?

Impulses, synapses and receptors

Of what is rhodopsin made?

Impulses, synapses and receptors

What happens to a rod cell in the dark?

It binds to acetylcholine receptors and mimics ACh, depolarising the postsynaptic membrane.

Radial muscles contract and circular muscles relax.

It binds very tightly (almost irreversibly) to ACh receptors, blocking transmission to muscles and causing paralysis.

It blocks voltage-gated sodium channels in axons, so action potentials are not conducted.

It increases the release of serotonin and prevents its reuptake, so more stays in the cleft.

It crosses the blood-brain barrier and is converted to dopamine, replacing the dopamine that is lacking.

Cation channels are open, Na^+ enters, the rod is depolarised and releases inhibitory transmitter.

The protein opsin bound to retinal.

Impulses, synapses and receptors

What happens to a rod cell in the light?

Impulses, synapses and receptors

Define habituation.

Impulses, synapses and receptors

What is the mechanism of habituation?

Plant responses

What is phytochrome?

Plant responses

Which form of phytochrome is active, and what converts it?

Plant responses

How does active phytochrome affect transcription?

Plant responses

Name three responses controlled by phytochrome.

Plant responses

What is auxin (IAA) and where is it made?

A decrease in response to a repeated stimulus that is harmless.

Retinal changes from cis to trans, rhodopsin splits, cation channels close and the rod is hyperpolarised, releasing less transmitter.

A light-sensitive plant pigment that exists as Pr and Pfr, detecting red and far-red light.

Fewer Ca^{2+} channels open in the presynaptic knob, so less neurotransmitter is released.

Pfr enters the nucleus and affects transcription factors, changing which genes are transcribed.

Pfr. It forms from Pr in red light (660 nm) and reverts in far-red light (730 nm) or slowly in the dark.

A plant growth substance made in the tip of the shoot that promotes cell elongation.

Seed germination, stem elongation and flowering.

Plant responses

Describe the acid growth mechanism.

Plant responses

How does auxin cause phototropism?

Plant responses

What do gibberellins do?

Plant responses

Where do gibberellins act in a germinating cereal grain?

Plant responses

In core practical 18, what shows that amylase has been made?

Plant responses

Why is a boiled embryo used as a control in core practical 18?

Plant responses

How is the area of a clear zone calculated?

The brain and hormonal control

State two differences between nervous and hormonal control.

It is moved to the shaded side, so cells there elongate more and the shoot bends to the light.

Auxin increases H^+ pumped into the cell wall; low pH loosens cellulose links; water enters and the cell elongates.

On the aleurone layer, switching on the gene for amylase.

Stimulate stem elongation and seed germination.

Boiling denatures enzymes, so it shows that the clear zone depends on living tissue.

A clear zone around the grain half on starch agar after flooding with iodine.

Nervous: fast, short-lived, along neurones.
Hormonal: slower, longer-lasting, carried in the blood.

Area = πr^2 , with r half the diameter.

The brain and hormonal control

Which part of the brain links the nervous and endocrine systems?

The brain and hormonal control

Give an example of a response using both nervous and hormonal control.

The brain and hormonal control

What do the cerebral hemispheres do?

The brain and hormonal control

What are the functions of the hypothalamus?

The brain and hormonal control

What does the pituitary gland do?

The brain and hormonal control

What is the function of the cerebellum?

The brain and hormonal control

What does the medulla oblongata control?

The brain and hormonal control

How does CT work?

Fight or flight: nervous impulses stimulate the adrenal glands to release adrenaline.

The hypothalamus, which controls the pituitary gland.

Regulates temperature, water balance, hunger and thirst; controls the pituitary gland.

Conscious thought, memory, language, voluntary movement and sensory processing.

Coordinates movement, balance and posture.

Secretes hormones that control other glands (anterior); releases ADH and oxytocin (posterior).

X-rays rotate around the head; absorption is measured and a computer builds cross-sectional images.

Involuntary actions: heart rate, breathing rate, blood pressure.

The brain and hormonal control

How does MRI work?

The brain and hormonal control

What is fMRI used for?

The brain and hormonal control

How does PET work?

The brain and hormonal control

Which chemical imbalance is associated with Parkinson's disease?

The brain and hormonal control

Which chemical imbalance is associated with depression?

The brain and hormonal control

How do SSRIs act?

Gene technology

What is recombinant DNA?

Gene technology

What does a restriction endonuclease do?

To show active areas of the brain by detecting changes in blood oxygen.

A magnetic field and radio waves make hydrogen nuclei emit signals that differ between tissues.

A lack of dopamine, as dopamine-producing neurones die.

A radioactive tracer (such as a glucose analogue) is injected; gamma rays from active areas are detected.

They block reuptake of serotonin, so it remains in the synaptic cleft longer.

Low serotonin activity at synapses.

Cuts DNA at a specific recognition sequence, often leaving sticky ends.

DNA made by joining DNA from two different sources, such as a gene and a plasmid vector.

Gene technology

What are sticky ends?

Gene technology

What does DNA ligase do?

Gene technology

Why is cDNA used to make a gene for expression in bacteria?

Gene technology

How do bacteria take up plasmids?

Gene technology

How can a gene be put into a plant?

Gene technology

How can a gene be put into an animal?

Gene technology

What is the purpose of a marker gene?

Gene technology

Give an example of a drug made by a GM microorganism.

Joins sugar-phosphate backbones by forming phosphodiester bonds.

Short single-stranded overhangs at a cut that can base-pair with complementary sticky ends.

Treatment with calcium chloride and a brief heat shock makes the membrane permeable.

It is made from mRNA by reverse transcriptase and has no introns.

Microinjection into the nucleus of a fertilised egg, or viral vectors.

Agrobacterium tumefaciens (Ti plasmid) or a gene gun.

Human insulin made by bacteria or yeast.

It identifies the cells that have taken up the recombinant DNA, for example antibiotic resistance or GFP.

Gene technology

How can an animal make a human protein as a drug?

Gene technology

What is a microarray?

Gene technology

What does fluorescence at a microarray spot show?

Gene technology

Define bioinformatics.

Gene technology

State two benefits and two risks of GMOs.

Gene technology

Why are patents on GM seeds a concern?

A slide with thousands of single-stranded DNA probes used to find which genes are active.

The gene is joined to a mammary gland promoter, so the protein is secreted in the milk.

Using computer science and statistics to store, analyse and interpret biological data.

mRNA from that gene was present, so the gene was being transcribed.

Seeds are costly for farmers and may have to be bought each year.

Benefits: higher yield, better nutrition.
Risks: gene transfer to wild plants, harm to biodiversity.