OCR (A) Biology A-level

5.1.5 - Plant and animal responses

Flashcards

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What is abiotic stress?

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What is abiotic stress?

Non-living environmental factor that could harm a plant e.g. mineral deficiency, drought, depleted oxygen supply, pollution.

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How do plants respond to abiotic stress and herbivory?

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How do plants respond to abiotic stress and herbivory?

- May produce antifreeze enzymes.
- May contain bitter-tasting tannins.
- May contain bitter-tasting nitrogen compounds called alkaloids.
- Release cell-signalling pheromones to trigger defensive responses in other organisms.

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How does *Mimosa pudica* respond to being touched?

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How does *Mimosa pudica* respond to being touched?

Seismonasty (touch sensitivity) causes leaves to fold.

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What is a plant tropism?

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What is a plant tropism?

directional growth response of plants

- **phototropism**: response to light
- **geotropism**: response to gravity
- **hydrotropism**: response to water
- **thermotropism**: response to temperature
- **thigmotropism**: response to touching a surface or object

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How is leaf loss (leaf abscission) in deciduous plants controlled?

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How is leaf loss (leaf abscission) in deciduous plants controlled?

1. As leaf ages, cytokinin & auxin levels lower, ethene level increases.
2. Triggers production of cellulase enzymes, which weaken leaves by breaking down cell walls in abscission layer.
3. Leaves break from branch. Below abscission layer, suberin layer forms to prevent entry of pathogens.

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List the functions of gibberellins.

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List the functions of gibberellins.

Stimulate:

- germination
- elongation at cell internodes
- fruit growth
- rapid growth/ flowering

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How is germination stimulated?

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How is germination stimulated?

1. Seed absorbs water, activating embryo to secrete gibberellins.
2. Gibberellins diffuse to aleurone layer, which produces amylase.
3. Amylase diffuses to endosperm layer to hydrolyse starch.
4. Hexose sugars act as respiratory substrate to produce ATP as ‘energy currency’.

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List the functions of auxins.

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List the functions of auxins.

- Involved in trophic responses e.g. IAA.
- Control cell elongation.
- Suppress lateral buds to maintain apical dominance.
- Promote root growth e.g. in rooting powders.

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Explain why shoots show positive phototropism.

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Explain why shoots show positive phototropism.

1. Indoleacetic acid (IAA) diffuses to shaded side of shoot tip.
2. As IAA diffuses down shaded side, it causes active transport of H^+ ions into cell wall.
3. Disruption to H-bonds between cellulose molecules & action of expansins make cell more permeable to water. (acid growth hypothesis)
4. Cells on shaded side elongate faster due to higher turgor pressure.
5. Shoot bends towards light.

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Explain why roots show positive gravitropism.

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Explain why roots show positive gravitropism.

1. Gravity causes IAA to accumulate on lower side of the root.
2. IAA inhibits elongation of root cells.
3. Cells on the upper side of the root elongate faster, so the root tip bends downwards.

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How do hormones stimulate stomata to close?

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How do hormones stimulate stomata to close?

1. Abscisic acid binds to complementary receptors on guard cell membrane, causing Ca^{2+} ion channels on tonoplast to open. Ca^{2+} ions diffuse from vacuole into cytosol.
2. Positive feedback triggers other ion channels to open. Other ions e.g. K^{+} diffuse out of guard cell.
3. Water potential of guard cell becomes more positive. Water diffuses out via osmosis.
4. Guard cells become flaccid so stomata close.

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What is apical dominance?

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What is apical dominance?

Phenomenon where during the growth of the shoot, the growth of side shoots does not take place. Maintained by the action of auxin, abscisic acid & cytokinins.

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Explain the experimental evidence that auxins maintain apical dominance.

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Explain the experimental evidence that auxins maintain apical dominance.

Auxin production in apex maintains high levels of abscisic acid.

Inhibits growth of side shoots.

When apex is removed:

a) Auxin levels drop, causing abscisic acid levels to drop.

b) Cytokinins (initially concentrated near auxin reserve in bud) diffuse evenly to promote bud growth in other parts of plant = lateral buds.

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Explain the experimental evidence that gibberellins control stem elongation and germination.

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Explain the experimental evidence that gibberellins control stem elongation and germination.

Stem elongation: Tall plants have higher gibberellin concentration than dwarf plants.

Germination: Mutant seeds with non-functional gibberellin gene do not germinate unless gibberellin is applied externally. Inhibitors of gibberellin production prevent germination.

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How are auxins and cytokinins used commercially?

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How are auxins and cytokinins used commercially?

Auxins: rooting powder, growing seedless fruit, herbicides, low concentrations prevent leaf & fruit growth, high concentrations promote fruit drop.

Cytokinins: prevent yellowing of lettuce leaves, promotes shoot growth.

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How are gibberellins and ethene used commercially?

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How are gibberellins and ethene used commercially?

Gibberellins: delay senescence in citrus, elongation of apples & grape stalks, brewing beer for malt production, increase sugar cane yield, speed up seed formation in conifers, prevent lodging.

Ethene: speeds up ripening, promotes lateral growth, promotes fruit drop.

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Outline the gross structure of the mammalian nervous system.

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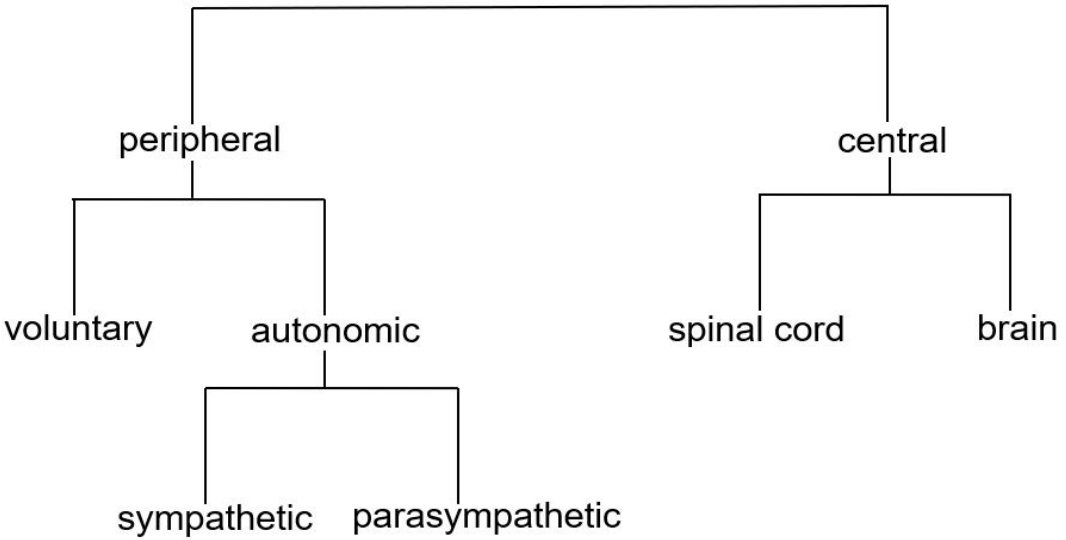
Outline the gross structure of the mammalian nervous system.



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Name the two main divisions of the nervous system.

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Name the two main divisions of the nervous system.

Structural organisation:

- **Central** nervous system (Comprised of brain & spinal cord. Specialised system of nerve cells processes stimuli & propagates impulses.)
- **Peripheral** nervous system (all neurons that are not part of the CNS).

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Name the two main divisions of the peripheral nervous system.

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Name the two main divisions of the peripheral nervous system.

Functional organisation:

- somatic (under conscious control)
- autonomic (not under conscious control)

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Name the two main divisions of the autonomic nervous system.

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Name the two main divisions of the autonomic nervous system.

Sympathetic: often stimulates effectors (fight-or-flight response), neurotransmitter noradrenaline, ganglia near CNS.

Parasympathetic: often inhibits effectors (rest/digest response), neurotransmitter acetylcholine, ganglia far from CNS.

Act antagonistically to regulate response of effectors.

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Describe the gross structure of the human brain.

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Describe the gross structure of the human brain.

2 hemispheres joined by band of nerve fibres (corpus callosum). Divided into lobes.

- **Parietal lobe** at the top of the brain: movement, orientation, memory, recognition.
- **Occipital lobe** at the back of the brain: visual cortex processes signals from the eye.
- **Temporal lobe** beneath the temples: processes auditory signals.

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Identify the location and function of the cerebellum.

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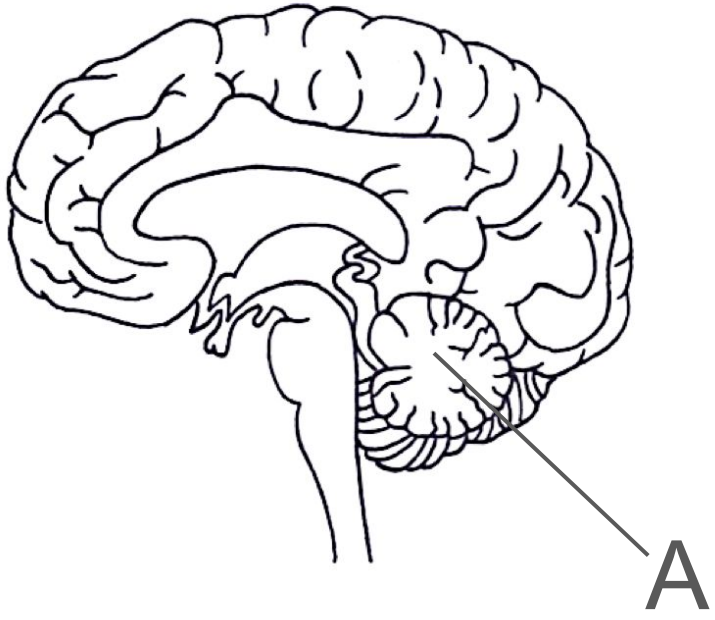
Identify the location and function of the cerebellum.

- Controls execution (not initiation) of **movement** e.g. timing, balance, coordination, posture.
- Possible role in cognition e.g. attention & language.



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Identify the location and function of the medulla oblongata.

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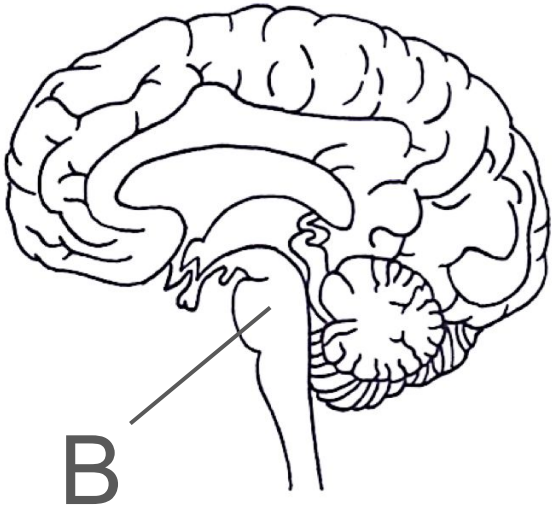
Identify the location and function of the medulla oblongata.

Controls a range of autonomous functions, including breathing and heart rate (location of cardioacceleratory/ deceleratory centres).



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Identify the location and function of the cerebrum.

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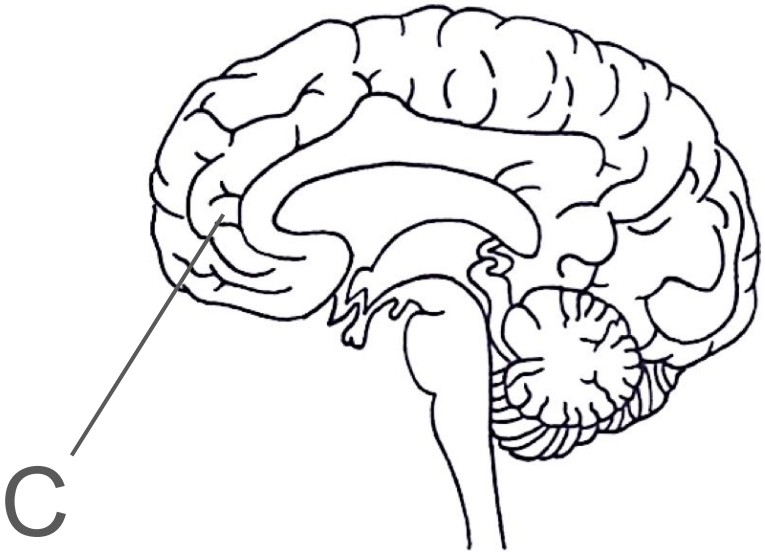
Identify the location and function of the cerebrum.

Uppermost part of the brain is organised into lobes which control voluntary functions e.g. initiating movement, speech, thought.



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Identify the location and function of the hypothalamus.

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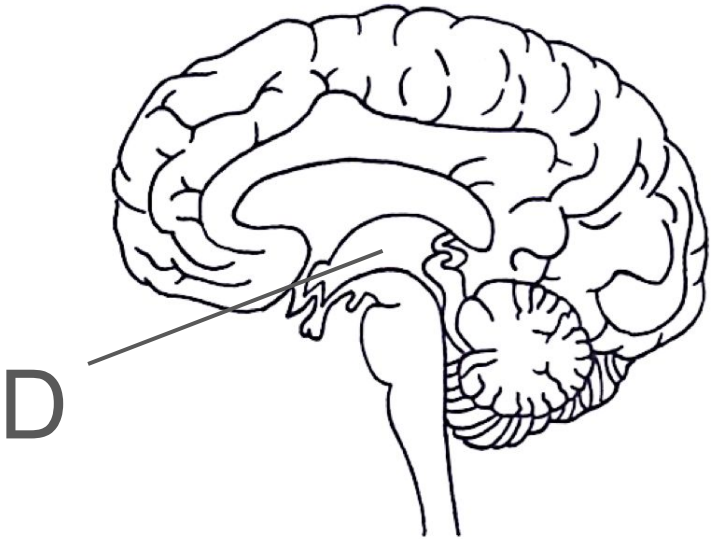
Identify the location and function of the hypothalamus.

Includes anterior **pituitary gland** (secretes metabolic & reproductive hormones).

Involved in thermo & osmoregulation.



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Outline what happens in a simple reflex arc.

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Outline what happens in a simple reflex arc.

receptor detects stimulus → sensory neuron → relay neuron in CNS coordinates response → motor neuron → response by effector.

Survival benefit: rapid response to potentially dangerous stimuli since only 3 neurons involved, instinctive.

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Describe the knee jerk reflex.

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Describe the knee jerk reflex.

Important for maintaining posture & balance.

1. Tapping patellar tendon stimulates stretch-mediated receptors.
2. Impulse travels sensory → motor (**no interneuron**). Quadriceps contract. Inhibits antagonistic hamstring contraction.

Diagnostically useful: multiple kicks = symptom of cerebellar disease, lack of reflex = nervous problems.

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Describe the blinking reflex.

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Describe the blinking reflex.

Brain stem reflex. Consensual response: both eyelids close rapidly when just 1 cornea is stimulated by bright light / touch.

Sensory neuron of trigeminal nerve → spinal nucleus of trigeminal nerve → interneurons → facial motor nerve → effector muscle orbicularis oculi.

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What is the ‘fight or flight’ response?

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What is the ‘fight or flight’ response?

If brain perceives threat, it stimulates stress responses involving adrenaline.

Triggers physiological changes to prepare body: pupil dilation, inhibition of digestive system, higher heart rate & stroke volume, greater blood flow to brain for mental awareness, faster metabolic rate.

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Use the secondary messenger model to explain how adrenaline works.

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Use the secondary messenger model to explain how adrenaline works.

1. Adrenaline 1st messenger. Hormone-receptor complex forms.
2. Conformational change to receptor activates G-protein.
3. Activates **adenylate cyclase**, which converts ATP to **cyclic AMP** (cAMP).
4. cAMP 2nd messenger. Activates **protein kinase A** pathway.
5. Results in **glycogenolysis**.

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Describe the 3 types of muscle tissue.

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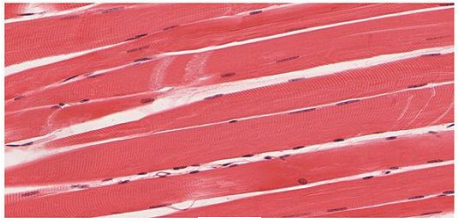
Describe the 3 types of muscle tissue.

A: Striated skeletal muscle consists of multinucleated cells. Antagonistic muscle pairs enable movement.

B: Smooth involuntary muscle enables walls of blood vessels & intestines to contract.

C: Cardiac muscle consists of branched uninucleated cells. Myogenic contraction = heartbeat.



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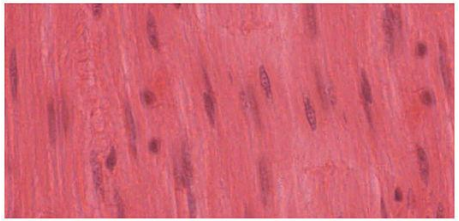

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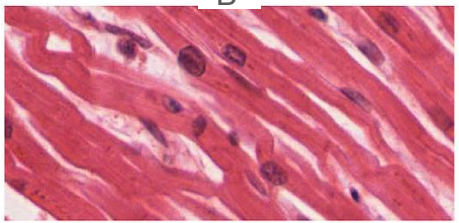

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Describe the gross structure of skeletal muscle.

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Describe the gross structure of skeletal muscle.

Muscle cells are fused together to form bundles of parallel muscle fibres (**myofibrils**).

Arrangement ensures there is no point of weakness between cells.

Each bundle is surrounded by **endomycium**: loose connective tissue with many capillaries.

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Describe the microscopic structure of skeletal muscle.

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Describe the microscopic structure of skeletal muscle.

Myofibrils: site of contraction.

Sarcoplasm: shared nuclei and cytoplasm with lots of mitochondria & endoplasmic reticulum.

Sarcolemma: folds inwards towards sarcoplasm to form transverse (T) tubules.

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Draw a diagram to show the ultrastructure of a myofibril.

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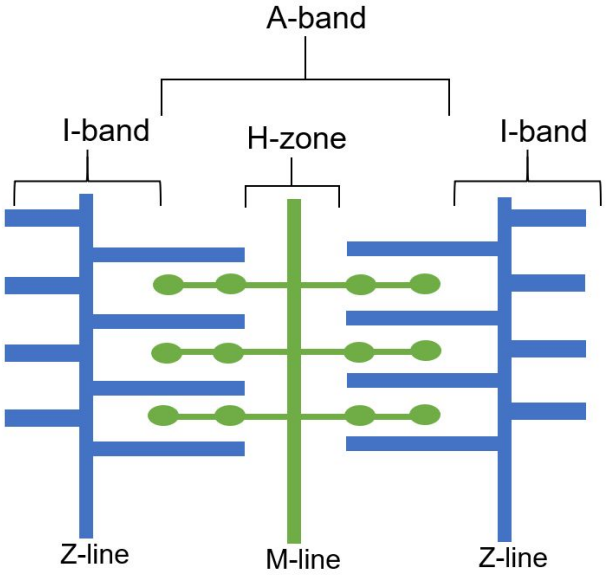
Draw a diagram to show the ultrastructure of a myofibril.

Z-line: boundary between sarcomeres.

I-band: only actin (appears light under optical microscope).

A-band: overlap of actin & myosin (appears dark under optical microscope).

H-zone: only myosin.



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How is muscle contraction stimulated?

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How is muscle contraction stimulated?

1. Neuromuscular junction: action potential = voltage-gated Ca^{2+} channels open.
2. Vesicles move towards & fuse with presynaptic membrane.
3. Exocytosis of acetylcholine (ACh), which diffuses across synaptic cleft.
4. ACh binds to receptors on Na^{+} channel proteins on skeletal muscle cell membrane.
5. Influx of Na^{+} = depolarisation.

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Explain the role of Ca^{2+} ions in muscle contraction.

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Explain the role of Ca^{2+} ions in muscle contraction.

1. Action potential moves through T-tubules in sarcoplasm = Ca^{2+} channels in sarcoplasmic reticulum open.
2. Ca^{2+} binds to troponin, triggering conformational change in tropomyosin.
3. Exposes binding sites on actin filaments so actinomyosin bridges can form.

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Outline the ‘sliding filament theory’.

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Outline the ‘sliding filament theory’.

1. Myosin head with ADP attached forms cross bridge with actin.
2. Power stroke: myosin head changes shape & loses ADP, pulling actin over myosin.
3. ATP attaches to myosin head, causing it to detach from actin.
4. ATPase hydrolyses ATP→ADP(+Pi) so myosin head can return to original position.
5. Myosin head re-attaches to actin further along filament.

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How does sliding filament action cause a myofibril to shorten?

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How does sliding filament action cause a myofibril to shorten?

- Myosin heads flex in opposite directions = actin filaments are pulled towards each other.
- Distance between adjacent sarcomere Z lines shortens.
- Sliding filament action occurs up to 100 times per second in multiple sarcomeres.

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Explain the role of creatine phosphate in muscle contraction.

CC BY NC ND

Explain the role of creatine phosphate in muscle contraction.

Phosphorylates ADP directly to ATP when oxygen for aerobic respiration is limited e.g. during vigorous exercise.

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State the name and location of the 2 nodes involved in heart contraction.

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State the name and location of the 2 nodes involved in heart contraction.

Sinoatrial node (SAN): within the wall of the right atrium.

Atrioventricular node (AVN): near lower end of right atrium in the wall that separates the 2 atria.

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Name the receptors involved in changing heart rate and state their location.

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Name the receptors involved in changing heart rate and state their location.

Baroreceptors (detect changes in blood pressure): carotid body.

Chemoreceptors (detect changes in pH e.g. due to increase in CO_2 concentration): carotid body & aortic body.

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How does the body respond to an increase in blood pressure?

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How does the body respond to an increase in blood pressure?

1. **Baroreceptors** send **more impulses to cardioinhibitory centre** in the **medulla oblongata**.
2. More impulses to SAN down vagus nerve via **parasympathetic nervous system**.
3. Stimulates release of **acetylcholine**, which decreases heart rate.

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How does the body respond to a decrease in blood pressure?

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How does the body respond to a decrease in blood pressure?

1. **Baroreceptors** send **more impulses to cardioacceleratory centre** in the **medulla oblongata**.
2. More impulses to SAN via **sympathetic nervous system**.
3. Stimulates release of **noradrenaline**, which increases heart rate and strength of contraction.

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How does the body respond to an increase in CO_2 concentration?

CC BY NC ND

How does the body respond to an increase in CO_2 concentration?

1. **Chemoreceptors** detect **pH decrease** and **send more impulses to cardioacceleratory centre** of **medulla oblongata**.
2. More impulses to SAN via **sympathetic nervous system**.
3. **Heart rate** increases, so rate of blood flow to lungs increases= rate of **gas exchange** and **ventilation** rate increase.

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Describe the structure of a neuromuscular junction.

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Describe the structure of a neuromuscular junction.

Synaptic cleft between a presynaptic motor neuron and a skeletal muscle cell. Acts as end of neural pathway & always stimulates an excitatory response.

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