Edexcel (A) Biology A-level

7.1 to 7.2 + 7.10 + 7.13 to 7.15 - Muscles and Movement

Flashcards

What does the phrase ‘antagonistic pair of muscles’ mean?

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Muscles can only pull, so they work in pairs to move bones around joints.

Pairs of flexors & extensors pull in opposite directions: agonist contracts while antagonist is relaxed.

Describe the gross structure of the skeletal muscle system.

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Tendons (inelastic tissue) connect muscles to incompressible skeleton.

Ligaments (elastic tissue) join bones at joints (cartilage & fibrous connective tissue).

Describe the gross structure of skeletal muscle.

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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 **endomysium**: loose connective tissue with many capillaries.

Describe the microscopic structure of skeletal muscle.

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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.

Draw a diagram to show the ultrastructure of a myofibril.

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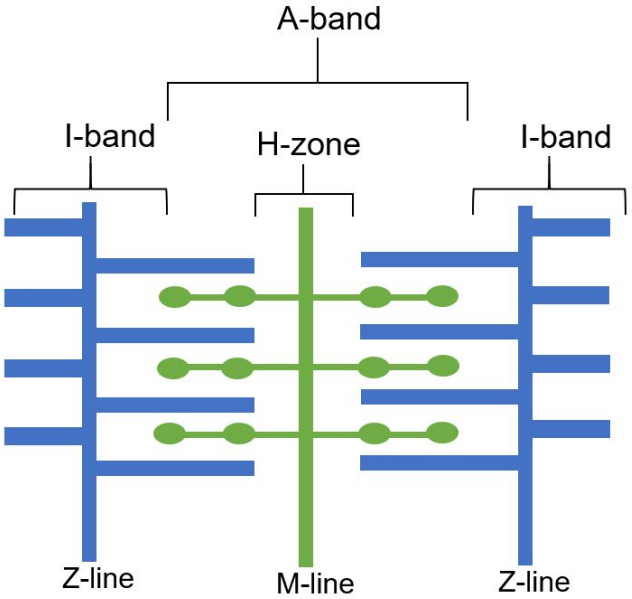
Z-line: boundary between sarcomeres

I-band: only actin

A-band: overlap of actin & myosin

H-zone: only myosin



How is muscle contraction stimulated?

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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.

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

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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 actin/myosin cross bridges can form.

Outline the ‘sliding filament theory’.

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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 and the cycle repeats.

How does sliding filament action cause a myofibril to shorten?

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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.

What happens during muscle relaxation?

What happens during muscle relaxation?

1. Ca^{2+} is actively transported back into endoplasmic reticulum.
2. Tropomyosin once again blocks actin binding site.

Where are slow and fast-twitch muscle fibres found in the body?

Where are slow and fast-twitch muscle fibres found in the body?

Slow-twitch: sites of sustained contraction e.g. calf muscle.

Fast-twitch: sites of short-term, rapid, powerful contraction e.g. biceps.

Explain the role of slow and fast-twitch muscle fibres.

Explain the role of slow and fast-twitch muscle fibres.

Slow-twitch: long-duration contraction; well-adapted to aerobic respiration to prevent lactate buildup.

Fast-twitch: powerful short-term contraction; well-adapted to anaerobic respiration.

Explain the structure and properties of slow-twitch muscle fibres.

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- **Glycogen** store: many terminal ends can be hydrolysed to release glucose for respiration.
- Contain **myoglobin**: higher affinity for oxygen than haemoglobin at lower partial pressures.
- Many mitochondria: aerobic respiration produces more ATP.
- Surrounded by many blood vessels: high supply of oxygen & glucose.

Explain the structure and properties of fast-twitch muscle fibres.

Explain the structure and properties of fast-twitch muscle fibres.

- Large store of **phosphocreatine**
- More myosin filaments
- Thicker myosin filaments
- High concentration of enzymes involved in anaerobic respiration.
- Extensive sarcoplasmic reticulum: rapid uptake & release of Ca^{2+}.

Suggest the disadvantages of exercising too much.

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- Suppression of immune system: higher cortisol levels, lower levels of white blood cells.
- Strain on muscles, joints & ligaments.
- Bursitis (swelling in the region of the joints).

Suggest the disadvantages of exercising too little.

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- Increases risk of cardiovascular disease, diabetes & Type 2 diabetes.
- Increases level of low density lipoproteins (LDLs) which are associated with atherosclerosis.

What is the difference between correlation and causation?

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Correlation indicates that there is a relationship between the pattern of two variables.

Causation indicates that the pattern of one variable is a direct consequence of another variable.

Name 2 medical technologies that enable those with injuries or disabilities to participate in sport.

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- Keyhole surgery to repair damaged joints (uses fibre optics so incision can be smaller).
- Prostheses (artificial body parts).

What are the advantages of keyhole surgery?

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- Smaller incision = shorter recovery time, less risk of infection, less blood lost.
- Fewer staff required = cheaper.

Suggest the ethical issues surrounding the use of performance-enhancing drugs by athletes.

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- Legality
- Health risks
- Fairness: some argue that competition is always unfair due to different access to training resources
- Financial advantages
- Autonomy