AQA Biology A-level

6.3 - Skeletal muscles

Flashcards

Name the 3 types of muscle in the body and where they are located.

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- **Cardiac**: exclusively found in heart.
- **Smooth**: walls of blood vessels and intestines.
- **Skeletal**: attached to incompressible skeleton by tendons.

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 pull in opposite directions: agonist contracts while antagonist is relaxed.

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 **endomycium**: 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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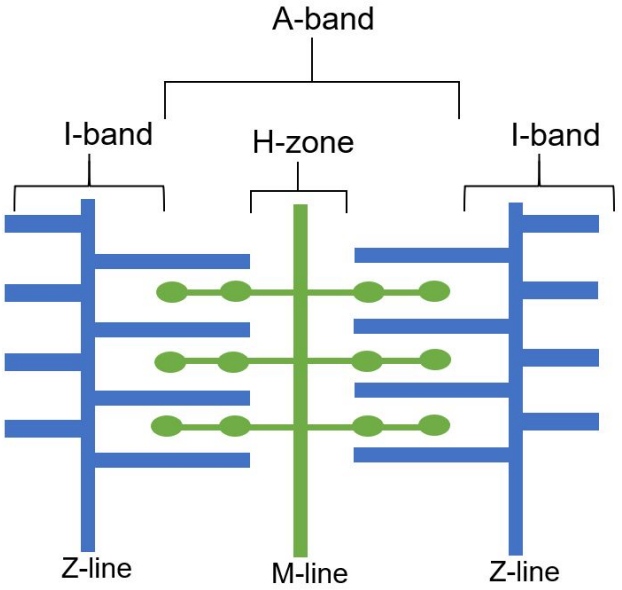
Z-line: boundary between sarcomeres

I-band: only actin

A-band: overlap of actin & myosin

H-zone: only myosin



How does each band appear under an optical microscope?

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I-band: light

A-band: dark

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.

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

1. Action potential moves through T-tubules in the 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.

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.

How does sliding filament action cause a myofibril to shorten?

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.

State 4 pieces of evidence that support the sliding filament theory.

State 4 pieces of evidence that support the sliding filament theory.

- H-zone narrows
- I-band narrows
- Z-lines get closer (sarcomere shortens)
- A-zone remains same width (proves that myosin filaments do not shorten)

What happens during muscle relaxation?

What happens during muscle contraction?

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

Explain the role of phosphocreatine in muscle contraction.

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

How could a student calculate the length of one sarcomere?

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1. View thin slice of muscle under optical microscope.
2. Calibrate eyepiece graticule.
3. Measure distance from middle of one light band to middle of another.

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.

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

- **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+}.

What is a motor unit?

What is a motor unit?

One motor neuron supplies several muscle fibres, which act simultaneously as one functional unit.