

Exercise walk-through

5.2

Muscles and movement (statements 7.9–7.11)

Pearson Edexcel · International A-Level · Biology

Four stages, one purpose

Stage	Where	Yield
Glycolysis	cytoplasm	2 ATP + 2 reduced NAD
Link reaction	matrix	CO ₂ + reduced NAD
Krebs cycle	matrix	ATP + reduced NAD + reduced FAD
Oxidative phosphorylation	cristae	most ATP; O ₂ to water

Recombinant DNA: cut, paste, select

Cut : the same restriction enzyme opens plasmid and gene



Paste : complementary sticky ends sealed by DNA ligase



Transform : heat shock carries plasmids into bacteria



Select : antibiotic marker - only transformants survive

Check yourself

Your turn

Why is the human insulin gene made from mRNA before inserting into bacteria?

- ☐ A. bacteria cannot splice introns, and mature mRNA has none
- ☐ B. mRNA is more stable than DNA
- ☐ C. mRNA is double-stranded and easier to cut
- ☐ D. restriction enzymes only cut RNA

Exercises 2.1·2.3

2.1 State two structural differences between a tendon and a ligament's job. [2]

2.2 Name the two protein filaments of a myofibril. [2]

2.3 Describe the role of calcium ions in muscle contraction. [2]

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2.1 Tendon joins muscle to bone and transmits the pull; ligament joins bone to bone and stabilises the joint.

2.2 Name the two protein filaments of a myofibril. [2]

2.2 Actin (thin) and myosin (thick).

2.3 Describe the role of calcium ions in muscle contraction. [2]

2.3 Calcium binds troponin, moving tropomyosin off actin's binding sites; this allows myosin heads to attach and begin the cycle.

Exercises 3.1·3.2

3.1 Describe the sliding filament mechanism of muscle contraction from the arrival of an action potential at a muscle fibre to the relaxation of the fibre. [6]

3.2 Slow-twitch and fast-twitch fibres differ in mitochondria and blood supply. Compare the two fibre types for endurance and power events, explaining how each structural difference supports its role. [5]

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3.1 Action potential spreads along the fibre's membrane, Ca^{2+} released from the sarcoplasmic reticulum; Ca^{2+} binds troponin, exposing binding sites on actin; energised myosin heads attach, pull actin toward the centre, and the sarcomere shortens; ATP detaches the heads and re-cocks them, repeating while stimulation continues; stimulation stops, calcium is pumped back, sites close, and the fibre relaxes passively.

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3.2 Slow-twitch: many mitochondria, dense capillaries, myoglobin – support continuous aerobic respiration, so they dominate endurance muscle like marathon runners' calves. Fast-twitch: few mitochondria, thicker fibres, large glycogen store, rapid powerful contraction using anaerobic respiration – sprint and lifting muscle. Each structural difference maps to its energy route.

Exercise 3.3

3.3 A weightlifter holds a heavy bar still at arm's length. Both the biceps and triceps of the arm are contracting. Explain why both muscles contract to hold a joint still, and how this differs from the antagonistic action that bent the arm to lift the bar. [5]

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3.3 Holding still requires both muscles to contract against each other, fixing the joint angle by balancing torques. Lifting used the biceps shortening (concentric) while the triceps lengthened (relaxed), moving the joint. Holding is isometric: both muscles tense without changing length.