Muscles – General - Solutions

Skeletal Muscular Tissue

COMPONENTS	LAYERS / FEATURES	CHARACTERISTICS		
		LOCALIZATION	FUNCTION	GENERAL CHARACTERISTICS
	Epimysium	Surrounds the entire muscle	Separates muscle from surrounding organs and tissue	- Made of a dense layer of collagen fibres - Connected to deep fascia (dense connective tissue layer)
	Perimysium	Surrounds fascicles (bundles of muscle fibres)	Divides the skeletal muscle into compartments	- Made of collagen and elastic fibres - Contains blood vessels and nerves that stimulate the muscle fibres
	Endomysium	Surrounds individual muscle fibres	Interconnects adjacent muscle fibres	- Made of elastic connective tissue - Contains capillary networks, myosatellite cells (embryonic stem cells used to repair muscles), and nerve fibres

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Skeletal muscle fibre (cell)	Sarcolemma/ transverse tubules	- Sarcolemma is the cell membrane of a muscle fibre – surrounds the sarcoplasm - Transverse tubules (T tubules) are continuous with the sarcolemma and run into the muscle fibre	- Depolarizes to signal muscle contraction - T tubules help to distribute the change in membrane potential quickly	- Have a transmembrane potential - Sarcolemma and T tubules can generate action potentials(can be excited or depolarized)
	Sarcoplasm	Is the cytoplasm of the muscle fibre	Contains cytosol, mitochondria, sarcoplasmic reticulum, and other organelles	n/a
	Myofibrils	Are cylindrical structures inside the muscle fibre whose ends are anchored to the sarcolemma	Can actively shorten and are responsible for muscle fibre contraction	Consists of bundles of protein filaments (myofilaments) – these include thin and thick filaments
	Sarcoplasmic Reticulum	Is related to the smooth ER and surrounds each myofibril	Release Ca^{2+} into the sarcoplasm to stimulate muscle contraction	Contains ion pumps which can remove Ca^{2+} from the sarcoplasm to stop contraction

Types of Muscles

TYPES	CELL/FIBRE STRUCTURE	LOCALIZATION	FUNCTION	GENERAL CHARACTERISTICS
Skeletal	- Contain organized myofibrils and sarcomeres - Not branched - Larger in size than cardiac fibres - Contain multiple nuclei located near the sarcolemma	Found in skeletal muscles	- Produce skeletal movement - Maintain posture and body position - Support soft tissue - Guard entrances and exits - Maintain body temp - Store nutrients	- Have striated appearance - Can undergo tetanic contraction and wave summation - Contract with neural stimulation
Cardiac	- Contain organized myofibrils and sarcomeres - Relatively small in size - Branched - Contain centrally located nucleus	Found only in the heart	- Cause contraction of the heart and pumps blood throughout the body	- Have striated appearance - Contract without neural stimulation – Innervation alters pace and force of contraction - Cannot undergo tetanic contraction
Smooth	- Long and slender – larger than skeletal and cardiac fibres - Contain centrally located nucleus - No T tubules - Lack myofibrils and sarcomeres – myosin filaments are scattered throughout the sarcoplasm	Found in organs	- Regulate blood flow, movement of materials along internal passageways - Elevate hairs on the skin - Alter the size of the bronchioles	- Are nonstriated - Contraction causes fibre to twist like a corkscrew - Cannot undergo tetanic contraction - Contract without neural stimulation – Contractions can be altered by hormones or neural stimulation

Muscular Contraction – Frequency of Stimulation

TYPES		DURATION	CHARACTERISTICS	
			PHASES	**GENERAL CHARACTERISTICS**
			Latent period	- Contractile cycle has not yet begun as Ca^{2+} are just released into the sarcoplasm - No tension is produced
			Contraction phase	- Tension rises to a peak - Ca^{2+} binds to troponin and alters tropomyosin, exposing myosin binding sites - Cross-bridge interactions are occurring between myosin heads and actin
			Relaxation phase	- Ca^{2+} levels fall - Tropomyosin blocks myosin binding sites - Cross-bridge interactions decrease as myosin separates from actin
	Incomplete	Summation of twitches (stimulus arrives before the relaxation phase has ended during each twitch)	n/a	- Tension production rises and levels off but does not reach maximum tension - Tension is roughly 4 times that of treppe
	Complete	Continuous (high frequency of stimulation eliminates relaxation phase)	n/a	- Tension reaches maximum tension (tetanus) - Sarcoplasmic reticulum does not have enough time to reabsorb Ca^{2+} - Continuous contraction of muscle fibres