Year 12

Physical Education Studies

Functional Anatomy

Structure of a Skeletal Muscle

* Skeletal muscle attached to bones by bundles of collagen fibres known as tendons
* Links 2 bones across its connecting joint
* Striated
* Two types
  + Type I (Slow twitch)
  + Type II (Fast twitch)
* Structure
  + Epimysium surrounds skeletal muscle
  + Perimysium surrounds fascicles
  + Endomysium surrounds muscle fibres
  + Myofibrils make up skeletal muscles
  + Sarcomeres make up myofibrils

How do we produce movement?

* Human body is made up of over 600 muscles
* Skeletal muscles that are consciously controlled are attached to bones
* CNS sends a message from brain to relevant muscles to contract
* Enables the human body to respond quickly to changes in the external environment
* Origin = attached to bone that doesn’t move
* Insertion = attached to the bone at the proximal end
* When a muscle contracts it pulls on either the origin or attachment point
* Movement takes place when contraction alters the joint angle
* Muscles work in pairs
  + Agonist = Prime mover
  + Antagonist = Relaxes to allow movement
  + Reciprocal Inhibition = coordinated relaxing of muscles on one side of a joint to accommodate contraction on the other side of that joint

Structure of a Sarcomere

* Separated by Z-Line
* H-Zone = Contains myosin, no actin
* Myosin = thick
* Actin = thin
* Cross bridges = Tiny projections on myosin filaments that attach on the actin filaments, pulling the actin filaments upon contraction

Sliding Filament Theory

* Neurochemical stimulation (ACH), calcium is released into the muscle prompting a reaction
* Myosin filaments contain crossbridges. Cross bridges attach and reattach at different times along the actin pulling on them to create movement and maintain tension
* This causes the actin to move into the centre of the sarcomere, shortening the myofibril and causing the actin and myosin to be almost fully overlapped when in a fully contracted position
* As each sarcomere shortens, so does the total length of each muscle fibre
* When the contraction finishes, the myosin and actin filaments return to a relaxed position

Nervous Control of Muscular Contraction

* Message is sent from the brain in the form of an action potential down the spinal cord through to the motor neurons which innervates the required muscle fibres

The Spinal Cord

* Relays information from the brain to the body and from the body to the brain

Motor Neuron

* Responsible for carrying impulses away from the spinal cord and brain to the muscles or glands
* Consists of:
  + Cell body
  + Dendrites
  + Axon
  + Motor end plates

Motor Unit

* Consists of motor neuron and all corresponding muscle fibres it innervates
* When a motor unit is activated, all of its fibres contract
  + All or none principle
    - All the muscle fibres in a motor unit will either contract with 100% force or not at all
  + Determined by whether or not the stimulus is above or below threshold (-55mV)
  + To increase strength of contraction, brain sends more signals to recruit more motor units
* Number of muscle fibres within each unit can vary
  + More fibres = more power

Characteristics of Muscle Fibre Types – **Type IIa**

* Fast contraction speed
* Moderate force of contraction
* Moderate fatigue resistance
* Greater force than Type 1 fibres
* Stimulated by large motor neurons

Characteristics of Muscle Fibre Types – **Type IIb**

* Rapid contraction speed
* High force of contraction
* Fatigue quickly
* Greater force than type I and IIa
* Stimulated by very large motor neurons

Characteristics of Muscle Fibre Types – **Type I**

* Slow contraction speed
* Low force of contraction
* High ATP capacity
* Fatigue resistant
* Contract repeatedly
* Posses more aerobic characteristics (high levels of myoglobin, mitochondria and blood capillaries)
* Stimulated by small motor neurons

Recruitment of Muscle Fibres

* Type 1 fibres have a lower activation level than Type 2 fibres
  + Low intensity = Type I
  + High intensity = Type IIa
  + Very high intensity = Type IIb

Force Velocity

* Muscle can create more force with a slower velocity of concentric contraction
* Muscle can resist more force with a faster velocity of eccentric contraction

Types of Forces

* Isotonic
  + Constant load with change in muscle length
  + Can be:
    - Concentric – Shortening of the muscle by reduction of joint angle
    - Eccentric – Elongation of the muscle by increase of joint angle
* Isokinetic
  + Varying load with change in muscle length
* Isometric
  + Constant load with no change in muscle length

Force-Length

* Length of a muscle affects how well it creates tension
  + Max tension occurs at a length slightly greater than resting length
  + Force generation will increase when the muscle is pre stretched

Force – Time

* Electromechnical Delay
  + The time it takes for a muscle to reach peak force
  + Fast twitch fibres have lower EMD than slow twitch