

TOPIC 11.2: MOVEMENT

Movement Systems

Skeletons are a rigid framework (internal or external) that provide a surface for muscle attachment (i.e. act as levers)

- Bones are connected to other bones by *ligaments*
- Bones are connected to muscles by *tendons*

Synovial joints are capsules surrounding articulating bone surfaces that allow for certain movements but not others

Muscles provide the force required for movement of bones

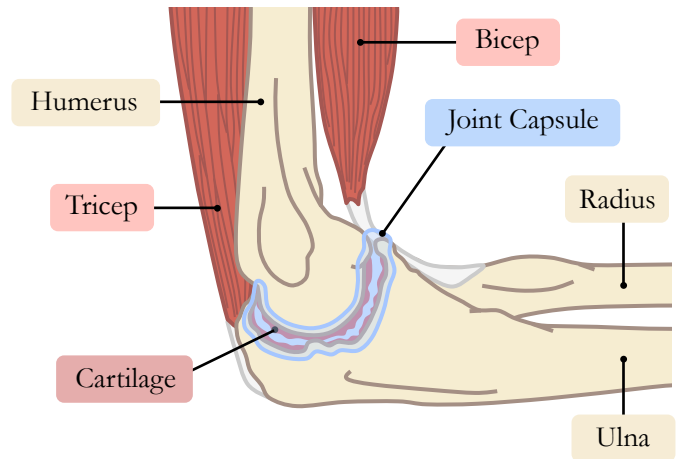
- Muscles work in antagonistic pairs (*one contracts, one relaxes*)
- **E.g.** Flexor and extensor muscles in insect hind leg

Motor neurons provide the stimulus for muscle movement and coordinate sets of antagonistic muscles

Human Elbow Joint

The human elbow joint is an example of a hinge joint

- It is capable of angular movement (flexion / extension)



Muscle Fibres

Skeletal muscles consist of bundles of fibres (formed from fused muscle cells) that have several specialised features:

- They are **multinucleated** (multiple nuclei per fibre)
- There is a large number of **mitochondria** (for ATP)
- Are surrounded by a *continuous* membrane (**sarcolemma**)
- Have a *specialised* ER network (**sarcoplasmic reticulum**)
- Contain many *striated* **myofibrils** (for contraction)

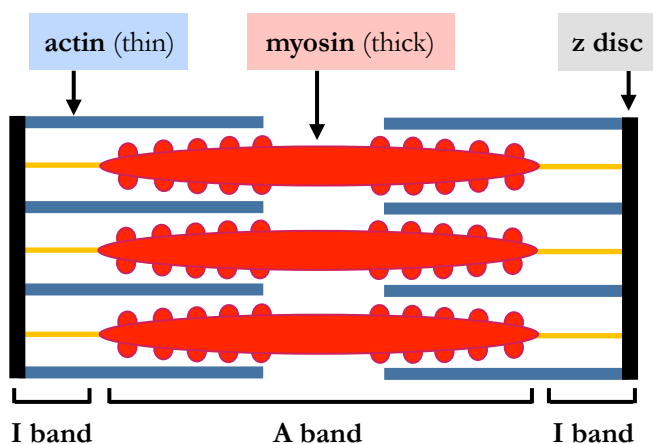
Sarcomeres

Myofibrils are made up of repeating contractile **sarcomeres**

- Sarcomeres contain two myofilaments (actin + myosin)

Myosin (thick) has protruding heads that bind to actin (thin)

- Overlapping of filaments creates a dark central **A band**
- Sarcomere peripheries form light **I bands** (actin only)



Muscle Contraction

Calcium Ion Release

- Motor neurons release acetylcholine (neurotransmitter)
- This triggers sarcolemma depolarisation, causing calcium ions to be released from the sarcoplasmic reticulum

Cross-Bridge Formation

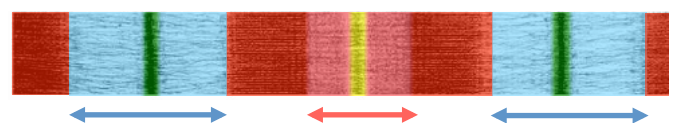
- Calcium ions bind to a complex (troponin/tropomyosin) that blocks actin from binding with the myosin heads
- Calcium ions displace this complex, allowing the actin and myosin heads to form a cross-bridge

Sliding Mechanism

- ATP binds to myosin heads and breaks the cross-bridge
- ATP hydrolysis causes myosin heads to swivel and slide along the actin fibre – this shortens the sarcomere length
- Via repeated ATP hydrolysis, skeletal muscles contract

Muscle Contraction

Fully Relaxed: Wide I bands (blue) and wide H zone (red)



Fully Contracted: Narrow I bands (blue) and H zone (red)

