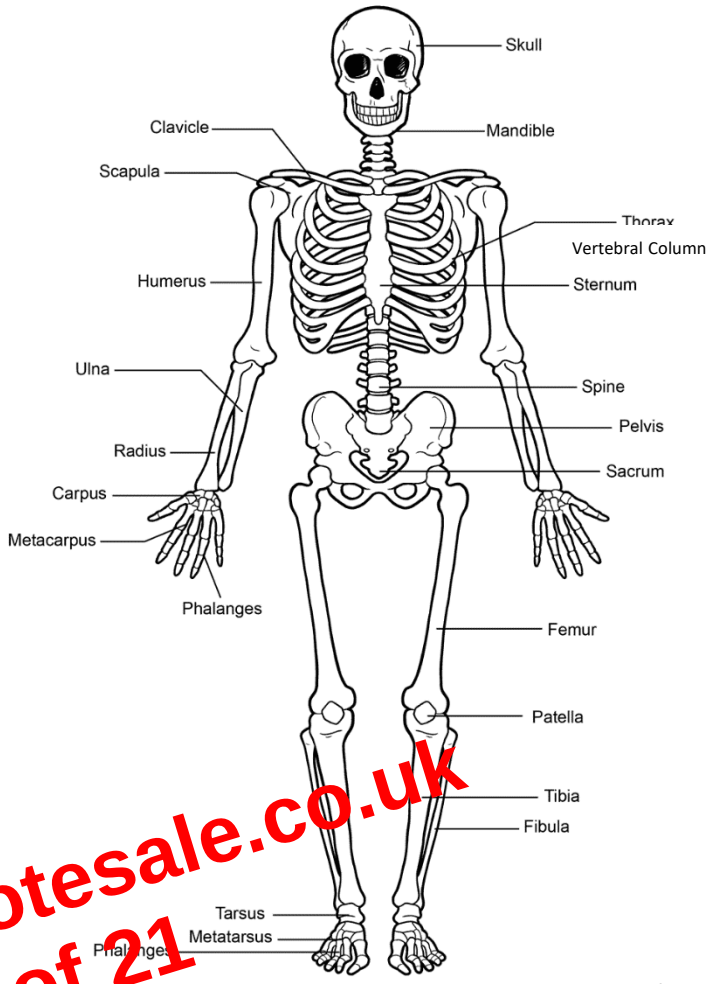
1 Applied anatomy and Physiology

1.1 Skeletal and muscular systems

The skeletal system

- Provides a shaping network
- Protects organs
- Provides place to produce RBC
- Mineral store
- **Movement**
  a) Attachment for muscles
  b) Acts as leavers and pivot points



Type of bones in Skeletal system:

Type 1: flat bones – protect internal organs and areas for muscular attachment

Type 2: long bones – act as levers and sites for blood cell production

Categories of Bones

Axial – Cranium, vertebral column, Sternum and rib cage

Appendicular – Everything else

Joints

Are an area of the body where two or more bones articulate to create movement.

Types of Joint

- Fibrous
- Cartilaginous
- Synovial (movement joints)

Common Features of Synovial Joint	Structure	Function
Ligament	Tough band of slightly elastic connective tissue	(B-B) stabilises joints during movement
Synovial Fluid	Lubricating liquid contained within joint cavity	Reduces friction and nourishes articular cartilage
Articular Cartilage	Smooth bone tissue which covers the surface of articulating bones	Absorbs shock and allows friction free movement
Joint Capsule	A fibrous sac with an inner synovial membrane	Encloses and strengthens the joint secreting synovial fluid
Bursa	A closed liquid sac found where tendons rub over bones	Reduces friction between tendon and bone

Movement analysis

ANKLE – Hinge joint
Bones: Tibia, fibula and talus
Plane of movement: Sagittal plane
***Movement 1* – Dorsi-flexion**
Agonist: Tibialis anterior.
Movement 2 – Plantar-flexion
Agonist: Gastrocnemius and soleus, contract concentrically.

KNEE - Hinge joint
Bones: Femur and tibia
Plane of movement: Sagittal plane
***Movement 1* – Flexion**
Agonist: biceps femoris and hamstring group, contract concentrically to bend the knee.
***Movement 2* – Extension**
Agonist: Rectus femoris and quadricep groups, contract concentrically to straighten knee.

HIP – Ball and Socket joint
Bones: Pelvic girdle and femur
Plane of movement: Sagittal, Frontal and Transverse
Movement 1 – (S) Flexion
Agonist: Iliopsoas (leg goes up towards body)
Movement 2- (S) Extension
Agonist: gluteus maximus (leg straighten)
Movement 3- (F) Adduction
Agonist: Adductor longus (brevis and magnus) (leg moves into midline)
Movement 4 – (F) Abduction
Agonist: Gluteus Medius and maximus (leg moves away from midline)
Movement 5 – (T) Medial rotation
Agonist: Gluteus Medius and minimums
Movement 6 – (T) Lateral rotation
Agonist: Gluteus maximus

SHOULDER – Ball and Socket
Bones: Humours and scapular
Plane of movement: Sagittal, Frontal and Transverse
Movement 1 – (S) Flexion
Agonist: Anterior deltoid
Movement 2- (S) Extension
Agonist: Posterior deltoid
Movement 3- (F) Adduction
Agonist: Latissimus dorsi
Movement 4 – (F) Abduction
Agonist: Middle deltoid
Movement 5 – (T) Medial rotation
Agonist: Teres Major
Movement 6 – (T) Lateral rotation
Agonist: Teres minor
Movement 1 – Horizontal Flexion
Agonist: Pectoralis major
Movement 2 – Horizontal Extension
Agonist: Posterior deltoid and teres minor

Muscle Fibres		
Type 1: Slow Oxidative Store oxygen in myoglobin. Can work aerobically. Resistant to fatigue, allowing them to keep going. i.e. marathon running	**Type 2A: Fast Oxidative Glycolytic** produce a large amount of force quickly, can resist fatigue. i.e. 800-1500m	**Type 2B: Fast Glycolytic** produce a large amount of force quickly. But fatigues quickly. Uses phosphocreatine (ATP-PC) system as energy source (anaerobically). i.e. long jump

Motor unit and skeletal muscle contraction

Skeletal muscle structure

Muscle surrounded by a layer of connective tissue: **epimysium.**
Epimysium consist of mainly collagen fibres: providing smooth surface over which muscles can glide.
Each bundle of muscle fibres is surrounded by **perimysium.**
Bundles of muscle fibres split into myofibrils which are connected by **endomysium** tissue.
Each connective tissue is connected to one another; allowing movement.

Motor neurone: a nerve cell which conducts nerve impulses to group of muscle fibres.
Motor unit: motor neurone and muscle fibres stimulated by the electrical impulse travelling down the axon.

Skeletal muscles can only contract when stimulated by electrical impulses sent from CNS.

Nutrition

Correct pre, during and post event nutrition can help performer maximise food stores.

PC stores

- Load creatine, phosphagen and protein
- Inc efficiency of ATP-PC system and Fast OBLA

Glucose and Glycogen

- Carbo load before event
- Use pre, during and post event snacks
- Maximise efficiency of glycolytic and aerobic systems and slow EPOC

Work : Relief ratios

Based on predominant energy system and exercise intensity w : r ratios can maximise recovery:

Speed and Explosive

- W : R ratio should be 1 : 3
- Gives sufficient time for resynthesise of ATP and PC stores

Lactate Tolerance and high-intensity muscular endurance

- 1 : 2 ratio
- Give enough time for recovery to continue training but encourages lactic acid accumulation
- Inc tolerance and buffering

Aerobic capacity/endurance

- 1 : 1 or 1 : 0.5
- Promotes adaptation
- Delays OBLA and muscular fatigue

Intensity of training

- Monitor HR to make sure training intensity is specific to energy system and muscle fibre types.
- Helps w/ progressive overload to create appropriate adaptations

a) **High-intensity:**

- inc muscle mass
- ATP and PC storage capacity
- Boosts efficiency of fast EPOC
- Inc lactic acid tolerance
- Inc buffering capacity
- Delays OBLA
- Reduced demand for slow EPOC

a) **Low-moderate**

- Inc aerobic capacity
- Inc respiratory and cardiovascular efficiency
- Early move to aerobic energy production dec lactic acid build up
- Delays OBLA
- Maximises oxygen delivery post exercise during EPOC

Environmental effects on the body systems

Altitude – cardio and respiratory systems

Inc in altitude = dec barometer pressure (partial pressure of O2 decreases)

Effects on performance

- Diffusion gradient of O2 in the alveoli is reduced: rate of O2 diffusion is decreased.
- Hb saturation is reduced
- O2 transportation is less efficient

Hence:

- BR frequency inc (at rest and during exercise)
- Blood volume decreases as blood plasma volume dec by 25% to inc density of RBC (attempt to maximise O2 transport)
- SV decreases during sub-maximal exercise; inc HR to maintain and Q (which is slightly higher)
- Max Q, SV and HR dec during max intensity exercise

Aerobic capacity is reduced; greater demand on anaerobic energy systems; inc lactic acid production at any sub-maximal intensity and early fatigue.

Safety:

- Inc substitution
- Inc work : relief ratios