3.1 The human body and movement in physical activity and sport

3.1.1 Applied anatomy and physiology

Students should develop knowledge and understanding of the key body systems and how they impact on health, fitness and performance in physical activity and sport.

3.1.1.1 The structure and functions of the musculoskeletal system

Content	Additional information
Bones	Identification of the bones at the following locations: head/neck – cranium and vertebrae shoulder – scapula and humerus chest – ribs and sternum elbow – humerus, radius and ulna hip – pelvis and femur knee – femur and tibia (students should also know that the patella sits in front of the knee joint) ankle – tibia, fibula and talus.
Structure of the skeleton	How the skeletal system provides a framework for movement (in conjunction with the muscular system): the skeletal system allows movement at a joint the shape and type of the bones determine the amount of movement (short bones enable finer controlled movements/long bones enable gross movement) flat bones for protection of vital organs the different joint types allow different types of movement

Content	Additional information
	the skeleton provides a point of attachment for muscles – when muscles contract they pull the bone.
Functions of the skeleton	support protection of vital organs by flat bones movement structural shape and points for attachment mineral storage blood cell production.
	Functions should be applied to performance in physical activity.
Muscles of the body	Identification of the following muscles within the body:
	latissimus dorsi deltoid rotator cuffs pectorals biceps triceps abdominals hip flexors gluteals hamstring group (not individual names) quadriceps group (not individual names) gastrocnemius tibialis anterior.
	Students should be taught the role of tendons (attaching muscle to bones).
Structure of a synovial joint	Identification of the following structures of a synovial joint and how they help to prevent injury:
	synovial membrane

Content	Additional information
	synovial fluid joint capsule bursae cartilage ligaments.
Types of freely movable joints that allow different movements	Identification of the types of joints with reference to the following: elbow, knee and ankle – hinge joint hip and shoulder – ball and socket.
How joints differ in design to allow certain types of movement at a joint	Understand that the following types of movement are linked to the appropriate joint type, which enables that movement to take place: flexion/extension at the shoulder, elbow, hip and knee abduction/adduction at the shoulder rotation of the shoulder circumduction of the shoulder plantar flexion/dorsiflexion at the ankle. Application to specific sporting actions is in movement analysis .
How the major muscles and muscle groups of the body work antagonistically on the major joints of the skeleton to affect movement in physical activity at the major movable joints	With reference to the shoulder, elbow, hip, knee and ankle joints: major muscle groups operating at these joints (see above) the action of prime movers (agonists)/antagonists bones located at the joint (see above) how these muscle groups work isometrically and isotonically (concentric/eccentric). The difference between concentric and eccentric (isotonic) contractions.

3.1.1.2 The structure and functions of the cardio-respiratory system

Content	Additional information
The pathway of air	Identification of the pathway of air (limited to): mouth/nose trachea bronchi bronchioles alveoli.
Gaseous exchange	Gas exchange at the alveoli – features that assist in gaseous exchange: large surface area of alveoli moist thin walls (one cell thick) short distance for diffusion (short diffusion pathway) lots of capillaries large blood supply movement of gas from high concentration to low concentration. Oxygen combines with haemoglobin in the red blood cells to form oxyhaemoglobin. Students should also know that haemoglobin can carry carbon dioxide.
Blood vessels	Structure of arteries, capillaries and veins: size/diameter wall thickness valves in veins. How the structure of each blood vessel relates to the function: carrying oxygenated/deoxygenated blood to/from the heart gas exchange blood pressure redistribution of blood during exercise (vasoconstriction and vasodilation). Students should be taught the names of the arteries and the veins associated with blood entering and leaving the heart.

Content	Additional information
Structure of the heart	Structure of the heart: atria (left and right atria) ventricles (left and right ventricles).
The cardiac cycle and the pathway of the blood	The order of the cardiac cycle, including diastole (filling) and systole (ejection) of the chambers. This starts from a specified chamber of the heart, eg the cardiac cycle starting at the right ventricle. Pathway of the blood: deoxygenated blood into right atrium then into the right ventricle the pulmonary artery then transports deoxygenated blood to the lungs gas exchange occurs (blood is oxygenated) pulmonary vein transports oxygenated blood back to the left atrium then into the left ventricle before oxygenated blood is ejected and transported to the body via the aorta. Valve names are not required but students should be taught that valves open due to pressure and close to prevent backflow.
Cardiac output, stroke volume and heart rate	Cardiac output, stroke volume and heart rate, and the relationship between them. Cardiac output (Q) = stroke volume x heart rate. Students should be taught how to interpret heart rate graphs, including an anticipatory rise, and changes in intensity.
Mechanics of breathing – the interaction of the intercostal muscles, ribs and diaphragm in breathing	Inhaling (at rest) with reference to the roles of the: intercostals rib cage diaphragm. Exhaling (at rest) with reference to the roles of the: intercostals

Content	Additional information
	rib cage diaphragm.
	Lungs can expand more during exercise (inspiration) due to the use of pectorals and sternocleidomastoid. During exercise (expiration), the rib cage is pulled down quicker to force air out quicker due to use of the abdominal muscles. Changes in air pressure cause the inhalation and exhalation.
Interpretation of a spirometer trace	Identification of the following volumes on a spirometer trace and an understanding of how these may change from rest to exercise:
	tidal volume expiratory reserve volume inspiratory reserve volume residual volume.
	Interpretation and explanation of a spirometer trace (and continue a trace on paper) to reflect the difference in a trace between rest and the onset of exercise.

3.1.1.3 Anaerobic and aerobic exercise

Content	Additional information
Understanding the terms aerobic exercise (in the presence of oxygen) and anaerobic exercise (in the absence of enough oxygen)	Definition of the terms:
	aerobic exercise anaerobic exercise.
	Summary of aerobic exercise (glucose + oxygen → energy + carbon dioxide + water). Summary of anaerobic exercise (glucose → energy + lactic acid).

Content	Additional information
The use of aerobic and anaerobic exercise in practical examples of differing intensities	Link practical examples of sporting situations to aerobic or anaerobic exercise. Identification of the duration and/or intensity of a physical activity in order to identify and justify why it would be aerobic or anaerobic, eg marathon (aerobic), sprint (anaerobic).
Excess post-exercise oxygen consumption (EPOC)/oxygen debt as the result of muscles respiring anaerobically during vigorous exercise and producing lactic acid	Definition of the term EPOC (oxygen debt). An understanding that EPOC (oxygen debt) is caused by anaerobic exercise (producing lactic acid) and requires the performer to maintain increased breathing rate after exercise to repay the debt.
The recovery process from vigorous exercise	The following methods to recover from exercise, including the reasons for their use: cool down – maintain elevated breathing rate/heart rate (blood flow), stretching, removal of lactic acid manipulation of diet – rehydration, carbohydrates for energy ice baths/massage – prevention of delayed onset muscle soreness (DOMS). Students should be taught to evaluate the use of these methods, justifying their relevance to different sporting activities.

3.1.1.4 The short and long term effects of exercise

Content	Additional information
Immediate effects of exercise (during exercise)	hot/sweaty/red skin increase in depth and frequency of breathing increased heart rate.
Short-term effects of exercise (up to 36 hours after exercise)	tiredness/fatigue

Content	Additional information
	light headedness nausea aching/delayed onset muscle soreness (DOMS)/cramp.
Long-term effects of exercise (months and years of exercising)	body shape may change improvements in specific components of fitness build muscle strength improve muscular endurance improve speed improve suppleness build cardio vascular endurance improve stamina increase in the size of the heart (hypertrophy) lower resting heart rate (bradycardia).
	Students should be taught the components of fitness to understand the long term effects of exercise.

3.1.2 Movement analysis

Students should develop knowledge and understanding of the basic principles of movement and their effect on performance in physical activity and sport.

3.1.2.1 Lever systems, examples of their use in activity and the mechanical advantage they provide in movement

Content	Additional information
First, second and third class lever systems within sporting examples	Identification of first, second and third class lever systems. Basic drawings of the three classes of lever to illustrate the positioning of: fulcrum load (resistance)

Content	Additional information
	effort.
	Draw linear versions of a lever, showing the positioning of the fulcrum, load/resistance and effort. Students do not need to be taught to draw anatomical body parts but must be able to link the correct lever to a sporting movement or action.
	Interpretation of sporting movements or actions which involve flexion or extension of the elbow and/or knee, and plantar or dorsi-flexion at the ankle.
Mechanical advantage – an understanding of mechanical advantage in relation to the three lever systems	Label the effort arm and load/resistance arm on the three classes of lever. Mechanical advantage = effort arm ÷ weight (resistance) arm.
	Labelling of the effort arm and resistance arm on lever drawings, and interpretation of the mechanical advantage of that lever.
Analysis of basic movements in sporting examples	Types of movement:
	flexion/extension at the shoulder, elbow, hip and knee abduction/adduction at the shoulder rotation of the shoulder circumduction of the shoulder plantar flexion/dorsiflexion at the ankle.
	This section links specific sporting actions to the types of movement. Applied anatomy and physiology links the joint type to the type of movement only. This should include but not be limited to the following sporting actions:
	elbow action in push-ups/football throw in hip, knee and ankle action in running, kicking, standing vertical jump, basic squats shoulder action during cricket bowling.

3.1.2.2 Planes and axes of movement

Content	Additional information
Identification of the relevant planes (frontal, transverse, sagittal) and axes (longitudinal, transverse, sagittal) of movement used whilst performing sporting actions	Planes (frontal, transverse, sagittal) and axes (longitudinal, transverse, sagittal) should be related to sporting actions. Teaching of these planes/axes should include but not be limited to the following sporting actions: front somersault/forward roll/running action 360° twist (ice skating spin)/discus thrower rotating in circle effort cartwheel.

3.1.3 Physical training

Students should develop knowledge and understanding of the principles of training and different training methods in order to plan, carry out, monitor and evaluate personal exercise and training programmes.

3.1.3.1 The relationship between health and fitness and the role that exercise plays in both

Content	Additional information
Health and fitness	Definitions of health and fitness.
The relationship between health and fitness	Decreased fitness because of ill health, ie poor health can result in an inability to train, lowers fitness. Increased fitness despite ill health, ie unhealthy but able to train, increases fitness.

3.1.3.2 The components of fitness, benefits for sport and how fitness is measured and improved

Content	Additional information
The components of fitness	Definitions of the following components of fitness: agility balance cardiovascular endurance (aerobic power)

Content	Additional information
	coordination flexibility muscular endurance power/explosive strength (anaerobic power) reaction time strength (maximal, static, dynamic and explosive) speed.
Linking sports and physical activity to the required components of fitness	Understand and justify why the components of fitness (as stated above) may or may not be needed when performing certain physical activities and sports.
Reasons for and limitations of fitness testing	Reasons for fitness testing: to identify strengths and/or weaknesses in a performance/the success of a training programme to monitor improvement to show a starting level of fitness to inform training requirements to compare against norms of the group/national averages to motivate/set goals to provide variety in a training programme.
	Limitations of fitness testing: tests are often not sport specific/too general they do not replicate movements of activity they do not replicate competitive conditions required in sports many do not use direct measuring/sub-maximal – therefore inaccurate/some need motivation/some have questionable reliability they must be carried out with the correct procedures to increase validity.
Measuring the components of fitness	Knowledge of the main procedures of the tests used to measure the following components of fitness: agility – Illinois Agility Test balance – Stork Stand Test

Content	Additional information
	cardiovascular endurance (aerobic power) – Multi Stage Fitness Test coordination – Wall Toss Test flexibility – Sit and Reach Test muscular endurance – Sit-Up Bleep Test power/explosive strength (anaerobic power) – Vertical Jump Test reaction time – Ruler Drop Test maximal strength – One Rep Max Test speed – 30 Metre Sprint Test strength – Handgrip Dynamometer Test.
	Testing procedures refers to 'how each test is carried out' and includes reference to how the test is organised (when applicable) in relation to the following:
	the facilities and the equipment needed to set it up the procedures that have to be followed – the tasks and the rules the measurements that are used to score the performance the way conclusions are drawn from the scores/results.
	Evaluate whether or not these tests are relevant to performers in different sporting activities.
Demonstration of how data is collected for fitness testing	Understanding of how test scores are measured/recorded (eg in seconds, levels, centimeters, numbers). Definitions of the terms qualitative and quantitative, in relation to the collection of fitness testing data. Understanding that the quantitative data collected during fitness testing can be compared to national averages.

3.1.3.3 The principles of training and their application to personal exercise/training programmes

Content	Additional information
The principles of training and overload	Key principles of training. SPORT to include:
	specificity progressive overload reversibility tedium.

Content	Additional information
	Key principles of overload. FITT to include: frequency intensity time type. Students should be taught the terms and what they mean.
Application of the principles of training	How the principles of training can be applied to bring about improvements in fitness. Application of the principles to sporting examples.
Types of training	Understand the distinctions between different types of training. Circuit training – consider space available, equipment available, number of circuit stations, work:rest ratio, the content/demand of the circuit can be altered in order to improve different components of fitness. Continuous training – sustained exercise at a constant rate (steady state) without rests, involving aerobic demand for a minimum of 20 minutes, eg running, swimming, rowing, cycling. Fartlek training – varying speed, terrain and work:recovery ratios. Interval training/high intensity interval training – periods of exercising hard, interspersed with periods of rest or low intensity exercise. Static stretching – a way to stretch to increase flexibility, held (isometric) for up to 30 seconds, using correct technique, advisable to avoid over stretching. Weight training – choice of weight/exercise depends on fitness aim, eg strength/power training or muscular endurance, the importance of safe practice/lifting technique, the need for spotters. Plyometric training – use of plyometric exercises, eg bounding, depth jumping, to increase power. Basic physiological understanding (eccentric contraction followed by larger concentric contraction).

Content	Additional information
	Any training (and practice) method must take account of the following: the training purpose(s), training thresholds/training targets/training zones (see calculating intensities below) rest/recovery.
Identification of the advantages and disadvantages (the effects on the body) of training types linked to specific aims	The advantages and disadvantages (the effects on the body) of each type of training method stated above. Students should be taught to select and evaluate appropriate training methods for various (aerobic and anaerobic) fitness needs and make links to sporting activity, eg continuous training is fully appropriate to marathon runners.

3.1.3.4 How to optimise training and prevent injury

Content	Additional information
Calculating intensities to optimise training effectiveness	Definition of training threshold. Calculate the aerobic/anaerobic training zone: calculate maximum heart rate (220 minus age) calculate aerobic training zone (60–80% of maximal heart rate) calculate anaerobic training zone (80–90% of maximal heart rate). For circuit training, altering the time/rest/content of the circuit will determine the fitness aim. How to calculate one repetition maximum (one rep max) as part of weight training and how to make use of one rep max, with reference to: strength/power training (high weight/low reps – above 70% of one rep max, approximately three sets of 4–8 reps) muscular endurance (low weight/high reps – below 70% of one rep max, approximately three sets of 12–15 reps).

Content	Additional information
Considerations to prevent injury	The training type/intensity should match the training purpose (eg aerobic or anaerobic). Where applicable, the following factors should be taken into account in order to prevent injury: a warm up should be completed over training should be avoided, eg appropriate weight appropriate clothing and footwear should be worn taping/bracing should be used as necessary hydration should be maintained stretches should not be overstretched or bounce technique used should be correct, eg lifting technique appropriate rest in between sessions to allow for recovery.
Specific training techniques – high altitude training as a form of aerobic training	How high altitude training is carried out: train at high altitude there is less oxygen in the air and oxygen carrying capacity is reduced the body compensates by making more red blood cells to carry oxygen. Students should be taught to evaluate the benefits and the limitations of altitude training for different sports performers. Students do not need to be taught how to calculate intensities for altitude training.
Seasonal aspects	Names of the three training seasons: pre-season/preparation competition/peak/playing season post-season/transition. An understanding of what each of the seasons entails (aims): pre-season/preparation – general/aerobic fitness, specific fitness needs competition/peak/playing season – maintain fitness levels, work on specific skills post-season/transition – rest and light aerobic training to maintain a level of general fitness. An understanding of the benefits of each season to the performer.

Content	Additional information
	Students should be taught to apply and justify the characteristics of the seasonal aspects to different sporting activities.

3.1.3.5 Effective use of warm up and cool down

Content	Additional information
Warming up and cooling down	The constituent parts of warming up and cooling down. Warming up should include: gradual pulse-raising activity stretching skill based practices/familiarisation mental preparation increase amount of oxygen to the working muscles. Cooling down should include: maintaining elevated breathing and heart rate, eg walk, jog gradual reduction in intensity stretching. Students should be taught to understand and justify appropriate elements of a warm up and a cool down for different sporting activities. The benefits of warming up: effect on body temperature range of movement increased gradual increase of effort to full pace psychological preparation practice of movement skills through the whole range of movement injury prevention. The benefits of cooling down: allowing the body to recover the removal of lactic acid/CO_2 /waste products prevent (delayed onset) muscle soreness/DOMS.

3.1.4 Use of data

Students should develop knowledge and understanding of data analysis in relation to key areas of physical activity and sport.

3.1.4.1 Demonstrate an understanding of how data are collected – both qualitative and quantitative

Content	Additional information
Quantitative data	Quantitative data deals with numbers.
Methods for collecting quantitative data	Questionnaires. Surveys.
Qualitative data	Qualitative data deals with descriptions.
Methods for collecting qualitative data	interviews. observations.

3.1.4.2 Present data (including tables and graphs)

Content	Additional information
Presenting data	How to present data in tables. How to plot basic: bar charts line graphs. How to label x and y axes on bar charts and line graphs.

3.1.4.3 Analyse and evaluate data

Content	Additional information
Analysis and evaluation of data	Interpretation of data presented in basic: tables bar charts line graphs pie charts.