RAG rating your knowledge

The structure and functions of the musculoskeletal system		
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 • 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 • 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 • 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.	

The structure and functions of the cardio-respiratory system		
The pathway of air	Identification of the pathway of air (limited to): • mouth/nose • trachea • bronchi • bronchioles • lungs • 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.	
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 • 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.	

<u>Anaerobic and aerobic exercise</u>		
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).	
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	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.	

during vigorous exercise and producing lactic acid		
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 of muscle soreness (DOMS). Students should be taught to evaluate the use of these methods, justifying their relevance to different sporting activities.	

The short and long term effects of exercise		
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 (24 to 36 hours after exercise)	• tiredness/fatigue • light headedness • nausea • aching/delayed onset of 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.	

Lever systems, examples of their use in activity and the mechanical advantage they provide in movement		
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) • 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 • 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 (overarm rotation).	
<u>Planes and axes of movement</u>		
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.	

<u>The relationship between health and fitness and the role that exercise plays in both</u>		
Health and fitness	Definitions of health and fitness.	
The relationship between 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.	

The components of fitness, benefits for sport and how fitness is measured and improved		
The components of fitness	Definitions of the following components of fitness: • agility • balance • cardiovascular endurance (aerobic power) • 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/sets goals • to provide variety to 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/submaximal – 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 Balance • 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 are	Understanding of how test scores are measured/ recorded (eg in seconds, levels, centimetres, numbers).	

collected for fitness testing	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.	

The principles of training and their application to personal exercise/training programmes		
The principles of training and overload	Key principles of training. SPORT to include: • specificity • progressive overload • reversibility • tedium. 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:rest 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). 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	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.	

linked to specific aims		

How to optimise training and prevent injury		
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).	
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.	

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

Effective use of warm up and cool down		
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: • maintain 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/CO2 /waste products • prevent (delayed onset of) muscle soreness/ DOMS.	