Unit Specification

USP182 – Anatomy and physiology for exercise and fitness professionals

Unit reference number: A/617/2590

Level: 2
Guided Learning (GL) hours: 40

Overview

This unit provides the foundation knowledge of anatomy and physiology required for exercise and fitness professionals. Learners will develop their knowledge of the structure and function of the skeletal, muscular, circulatory, respiratory, nervous, digestive and energy systems, and the changes to these systems throughout the lifespan. Learners will also develop their knowledge of the effects of activity and exercise on these systems.

Learning outcomes

On completion of this unit, learners will:

LO1 Know the structure and function of the skeletal system in relation to exercise

LO2 Know the structure and function of the muscular system in relation to exercise

LO3 Know the structure and function of the circulatory system in relation to exercise

LO4 Know the structure and function of the respiratory system in relation to exercise

LO5 Know the structure and function of the nervous system in relation to exercise

LO6 Know the structure and function of the digestive system

LO7 Know the roles and function of the energy systems in relation to physical activity and exercise

LO8 Know the life course of the anatomical and physiological systems of the body

Unit content

LO1 Know the structure and function of the skeletal system in relation to exercise

Standard anatomical position and reference points
Taught content
• Basic awareness of terms – anterior and posterior, superior and inferior, superficial and deep, proximal and distal, medial and lateral

Anatomical planes of movement
Taught content
• Frontal (coronal), sagittal and transverse

Functions of the skeleton
Taught content
• Support and shape • Protection of internal organs • Muscle attachment and movement • Production of blood cells • Storage of minerals, mineral homeostasis

Names and locations of the bones of the axial and appendicular skeleton
Taught content
• Axial – cranium, cervical vertebrae (7), thoracic vertebrae (12), lumbar vertebrae (5), sacral vertebrae (5), coccyx (3-5), sternum, ribs • Appendicular – scapula, clavicle, humerus, radius, ulna, carpals, metacarpals, phalanges, ilium, ischium, pubis, femur, patella, tibia, fibula, tarsals, metatarsals, phalanges

Classifications of different bones
Taught content
• Classification based on structure and function - Long (e.g. femur, tibia) - Short (e.g. tarsals, carpals) - Flat (e.g. scapula, pelvis) - Irregular (e.g. vertebrae) - Sesamoid (e.g. patella)

Stages of bone growth
Taught content
• Stages of bone growth – development of cartilage, growth of cartilage, development of ossification centre, development of diaphysis and epiphysis, ossification (osteoblasts, osteoclasts), changes in bone growth with age, importance of calcium, factors affecting bone density (exercise, age and osteoporosis)

Structures of a long bone
Taught content
• Long bone structure – characteristics (greater length than width, slightly curved), structure (diaphysis, epiphyses, articular cartilage, periosteum, medullary, compact bone, spongy bone, bone marrow)

Structure of the spine in relation to posture and range of motion
Taught content
• Basic awareness of vertebrae structure (facet joints, spinal cord, cartilaginous discs) • Natural mild S-shaped curve of the spine (cervical and lumbar lordosis, thoracic and spinal kyphosis), primary curves of the spine, secondary (developmental) curves of the spine • Optimum position of spine and pelvis, maintenance of the natural spinal curvature (cervical, thoracic, lumbar), maintenance of posture in standing, sitting, lying positions • Normal thoracic kyphosis (20 - 45°), normal lumbar lordosis (20 - 45°), scoliosis (a right/left curve of more than 10°) • Range of motion of vertebral regions • Cervical (rotation, flexion and extension) • Thoracic (rotation, limited flexion and extension) • Lumbar (flexion, extension, hyperextension) • Sacral (no movement) • Coccyx (no movement) • Postural deviations – excessive deviations (hyperlordotic and hyperkyphotic), less than normal deviations (hyperlordotic and hypokyphotic), definitions and causes (hyperkyphosis, hyperlordosis, scoliosis), effect of pregnancy on posture (e.g. how carrying a baby affects the natural curve) • Importance of pelvic girdle for weight bearing exercise - Male and female differences (effect of pelvic width on femur Q-angle and the relation to knee injury risk)

Joint classifications and structure

Taught content

- Structural and functional classification – fibrous/immovable (e.g. cranium), cartilaginous/slightly moveable (e.g. vertebrae), synovial/freely moveable (e.g. knee)
- Joint structure
    - Fibrous – immovable, have no joint cavity, are connected via fibrous connective tissue, e.g. skull bones are connected by fibrous joints
    - Cartilaginous – slightly moveable, a joint in which the surfaces are connected by discs of fibrocartilage, as between vertebrae
    - Synovial – freely moveable. Articular capsule, synovial cavity, synovial membrane, synovial fluid (lubrication), articular cartilage (shock absorption, decrease friction between bones), bursae (shock absorption), ligaments (attach bone to bone, joint stability)

Different types of synovial joints, their location, range of motion and joint actions

Taught content

- Types of synovial joint (NB: the first three are most essential at level 2; others can be explored at a deeper level at level 3)
    - Ball and socket (flexion, extension, abduction, adduction, rotation, circumduction, e.g. hip and shoulder)
    - Hinge (flexion and extension, e.g. knee and elbow)
    - Pivot (rotation e.g. atlas and axis)
    - Gliding (side to side, back and forth, e.g. between carpals and tarsals)
    - Saddle (flexion, extension, abduction, adduction, circumduction, e.g. thumb)
    - Ellipsoid (flexion, extension, abduction, adduction, circumduction, e.g. wrist)
- Joint movement potential and actions
    - Shoulder (flexion, extension, abduction, adduction, horizontal flexion/adduction, horizontal extension/abduction, internal rotation, external rotation)
    - Elbow joints – flexion, extension (awareness of radioulnar – supination, pronation)
    - Shoulder girdle (elevation, depression, protraction, retraction)
    - Spine (flexion, extension, lateral flexion, rotation)
    - Hip (flexion, extension, abduction, adduction, internal rotation, external rotation)
    - Knee (flexion, extension)
    - Ankle – plantarflexion, dorsiflexion (awareness of foot – inversion, eversion)
- Joint actions during different exercises, significance of joint type and structure for movement potential, associated joints crossed by muscles, associated muscle group contractions, analysis of different multi-joint and single joint exercises
- Movement planes in which different joint actions occur (basic awareness at Level 2, deeper learning at Level 3)

Exercise and movement considerations in relation to the skeletal system
Taught content
• The effect of exercise variables on biomechanics and kinesiology • Associated range and stability of motion/movement of synovial joint types – range norms, factors affecting stability (shape of articular surfaces, capsule, ligaments, muscle tone, gravity) • Associated injury risk to joints types and ligaments – e.g. positions of strength and weakness, shearing forces, joint alignment during movement, greater range of movement allows increased risk of injury • Effects of exercise and considerations - Short-term – synovial fluid, joint lubrication, increased circulation of blood and delivery of nutrients - Long-term – increased bone mineral density, increased joint stability and mobility, effects of appropriate or inappropriate repetitive loading on cartilage

LO2 Know the structure and function of the muscular system in relation to exercise

Different types of muscle tissue and the characteristics and functions of each type
Taught content
• Cardiac muscle (striated, involuntary, e.g. heart muscle/myocardium) • Smooth muscle (no striations, involuntary, small fibre diameter, e.g. artery walls) • Skeletal muscle (striated, voluntary, attach to bones, e.g. quadriceps)

Different skeletal muscle fibre types and their characteristics
Taught content
• Slow twitch type 1 (oxidative, red in colour, low intensity, long duration/endurance, high in mitochondria, slow contraction speed, resistant to fatigue) • Fast twitch or intermediate type 2a (pink or white in colour, intermediate contraction speed and rate of fatigue, adapt characteristics to training to become more like type 1 or type 2b fibres) • Fast twitch type 2b (white in colour, high intensity, short duration, low in mitochondria, low in myoglobin, fast contraction speed, fast to fatigue)

Structure of skeletal muscle and the sliding filament theory
Taught content
• Gross muscle structure – tendon (attach muscle to bone), epimysium, perimysium, endomysium, fascicle • Cellular structure – muscle fibres, myofibrils, myofilaments (actin, myosin), sarcomere • Sliding filament theory (myosin and actin, cross bridges, shortening of sarcomere)

Names and location of all major muscles
Taught content
• Anterior muscles – pectoralis major, anterior deltoids, medial deltoids, biceps, rectus abdominis, obliques, transverse abdominis, hip flexors, quadriceps, adductors, anterior tibialis • Posterior muscles – trapezius, rhomboids, medial deltoids, posterior deltoids, triceps, latissimus dorsi, erector spinae, gluteals, abductors, hamstrings, gastrocnemius, soleus, diaphragm, intercostals

Types of muscle action and joint actions

Taught content

- Definitions of muscle contractions (isotonic, concentric, eccentric, static/ isometric)
- Definitions of muscle roles (agonist/prime mover, antagonist, synergist/assistor, fixator)
- Contractions and muscle roles during different joint actions and exercises
    - Pectoralis major (adduction of arm, horizontal flexion of arm)
    - Deltoids (abduction of the shoulder, flexion and extension of the shoulder)
    - Biceps (flexion of the elbow)
    - Rectus abdominis (flexion of the spine)
    - External and internal obliques (lateral flexion and rotation of the spine)
    - Transversus abdominis (isometric stabilisation of the spine)
    - Hip flexors – iliacus, psoas major, rectus femoris (flexion of the hip)
    - Quadriceps – rectus femoris, vastus lateralis, vastus intermedius, vastus medialis (extension of the knee, flexion of the hip)
    - Adductors – adductor magnus, adductor longus, adductor brevis, gracilis, pectineus (adduction of the hip)
    - Anterior tibialis (dorsi flexion of the ankle)
    - Trapezius (extension of the neck, elevation of the shoulder, depression of the scapula, retraction of the scapula)
    - Triceps (extension of the elbow)
    - Latissimus dorsi (adduction of the shoulder, shoulder extension)
    - Erector spinae (extension of the spine)
    - Gluteus maximus (extension of the hip)
    - Abductors – gluteus medius, tensor fasciae latae (abduction of the hip)
    - Hamstrings – biceps femoris, semimembranosus, semitendinosus (flexion of the knee, extension of the hip)
    - Gastrocnemius (plantar flexion of the ankle, assist flexion of knee)
    - Soleus (plantar flexion of ankle with bent knee)

Muscles of the pelvic floor and pelvic girdle

Taught content

- Structure and function of the pelvic floor
    - Structure - pelvic floor muscles – levator ani (pubococcygeus, puborectalis, and iliococcygeus), coccygeus, associated connective tissues which span the area underneath the pelvis (perineum, perineal membrane, perinela pouch), pelvic cavity
    - Function – stability of the pelvis, support bladder and bowel, support uterus in women
- Pelvic girdle – associated muscles (iliopsoas, pectineus, rectus femoris, sartorius, adductors, gluteus maximus, hamstrings, gluteus medius, gluteus minimus, piriformis)

LO3 Know the structure and function of the circulatory system in relation to exercise

Location, function and structure of the heart
Taught content
• Located centrally in the chest, thorax, between lungs • Function of heart – circulation of blood, receiving and pumping blood to body and lungs • Structure of heart – myocardium, atria, ventricles, blood vessels (aorta, superior vena cava, inferior vena cava, pulmonary veins, pulmonary arteries), basic awareness of valves – atrio-ventricular valves (bicuspid valve, tricuspid valve), semi-lunar valves (aortic and pulmonary)

Blood flow through the heart chambers and different circulatory systems
Taught content
• Functional considerations – heart rate (maximal and resting), stroke volume, cardiac output • Systemic (circulation between heart and body) • Pulmonary (circulation between heart and lungs)

Structure and function of blood vessels
Taught content
• Types – arteries, arterioles, capillaries, venules, veins - Arteries and arterioles (transport blood away from the heart to muscles and organs, pulmonary arteries carry deoxygenated blood to lungs) - Veins and venules (transport blood back to the heart from tissues and organs, venous return, blood pooling, pulmonary veins carry oxygenated blood from the lungs) - Capillaries (exchange of gases and nutrients between blood and tissues or blood and alveolar air in lungs) • Structure – comparison between blood vessels (wall thickness, internal diameter, direction of blood flow, pressure, presence of one way valves) • Functions – transport blood, blood flow distribution by vasoconstriction and vasodilation

Effects of disease processes on the blood vessels and the effect on blood pressure

Taught content

- Diseases (arteriosclerosis, atherosclerosis)
- Processes (inflammation, thickening of artery walls, lesions formed by fatty plaque)
- Definition of blood pressure (BP) – pressure exerted by blood on vessel wall
    - Systolic pressure – SBP (pressure exerted during systole, ventricular contraction)
    - Diastolic pressure – DBP (residual pressure during diastole, ventricular relaxation)
    - Blood pressure classifications – see NICE guidance for current classifications for clinical blood pressure (hypertension) 140/90
    - Associated health risks of hypertension – cardiovascular disease, stroke, coronary heart disease, coronary artery disease, kidney disease, loss of vision
- Effects of exercise
    - Short term – no change in diastolic pressure; progressive increase in systolic pressure during cardiovascular (CV) training; rapid and greater increase in SBP during resistance training, beware of Valsalva manoeuvre during resistance training as this can cause a sharp severe increase followed by a sudden drop in blood pressure; reduced BP for up to 24 hours after physical activity
    - Long term – reduction in resting blood pressure, improved regulation of blood pressure

Effects and benefits of aerobic endurance exercise on the circulatory system and relation to cardiovascular fitness

Taught content

- Benefits – increased heart strength and efficiency, increased capillary network, increased stroke volume and cardiac output, increased elasticity of blood vessels, improved blood flow distribution, improved blood cholesterol profile, reduced blood pressure, improved ability to tolerate heat, reduced risk of cardiovascular diseases
- Risks – overexertion, aggravation of cardiovascular contra-indications to exercise, overtraining, overuse injuries

LO4 Know the structure and function of the respiratory system in relation to exercise

Location, function and structure of the lungs
Taught content
• Located laterally in the chest on the left and right sides, thorax • Function of lungs (external respiration, elimination of carbon dioxide, supply of oxygen) • Structure of lungs (trachea, bronchi, bronchioles, alveoli, capillaries)

Muscles involved in breathing
Taught content
• Muscles – inhalation (inspiration), exhalation (expiration), muscles involved (diaphragm, external intercostals)

Passage of air flow through the respiratory tract and gaseous exchange
Taught content
• Passage of air during breathing – upper respiratory tract (mouth, nose and pharynx), lower respiratory tract (larynx, trachea, bronchi, bronchioles), alveoli, alveolar sacs • Process of gaseous exchange – surface area for gas exchange, diffusion of gases - Gaseous exchange lungs external respiration (oxygen in alveoli passes to pulmonary capillaries and carbon dioxide in capillaries passes to alveoli) removed via exhalation - Gaseous exchange in tissues internal respiration (oxygen in capillaries passes into cells for aerobic energy production, carbon dioxide in cells moves to local capillaries for circulation back to heart and lungs for removal) • Relative composition of inhaled air (21% oxygen, 0.04% carbon dioxide), relative composition of exhaled air (16% oxygen, 4.5% carbon dioxide)

LO5 Know the structure and function of the nervous system in relation to exercise

Roles and functions of the different components of the nervous system

Taught content

- Main functions (sense changes to stimuli, information processing, response to stimuli)
- Central nervous system (CNS) components (brain, spinal cord). CNS roles (receive messages from peripheral nervous system about environment, interprets information, sends messages back to the peripheral nervous system, higher cognitive processes)
- Peripheral nervous system (PNS) components (sensory neurons, motor neurons). PNS roles (transmits information from receptors to CNS, transmits information from CNS to muscles and glands)
- Peripheral nervous system divisions (somatic nervous system, autonomic nervous system (ANS), and subdivisions of ANS (sympathetic branch, parasympathetic system)
    - Somatic system roles (control of voluntary muscle)
    - Autonomic system roles (internal organ function, control of involuntary muscle, control of endocrine glands)
    - Sympathetic division roles – speeds operations up (awareness of increase heart rate, increase breathing rate, most active during exercise)
    - Parasympathetic division roles – slows operations down – more active during rest and recovery

Relationship between the nervous system and principles of muscle contraction and motor unit recruitment

Taught content

- Nervous control and nerve impulse transmission – role of the brain and spinal cord, nerve impulse, sensory neurones, motor neurones, axon terminal, action potentials
- Basic awareness of structure and function of a neuron – structure (dendrites, nucleus, cytoplasm, axon, myelin sheath, nodes of Ranvier, nerve endings), function (transmit signals to muscles)
- Motor unit recruitment – motor units (motor neuron, muscle fibre), small motor units (type I), large motor units (type II), size principle, factors affecting recruitment patterns (specific movement pattern, high and low firing threshold, skill and experience of participant), all or none law (if a stimulus is above threshold individual muscle fibres fully contract, if a stimulus is below threshold muscles fibres do not contract), strength of muscle contraction
- Muscle proprioceptors and the stretch reflex – function of muscle spindles (detect changes in muscle length), function of Golgi tendon organs (detect changes in muscle tension), stretch reflex (contraction of stretched muscle, reflex arc) inverse stretch reflex (inhibition of muscle contraction, reflex arc)
- Reciprocal inhibition – agonist muscle contraction, antagonist muscle relaxation, relevance to exercise (allows appropriate muscle contraction, can be used to promote flexibility development)

Role of exercise on neuromuscular activity and motor fitness
Taught content
• Resistance training adaptations (improved motor recruitment, improved recruitment of fast twitch fibres) • Types of motor skills training (reaction time, balance, coordination, speed, agility, spatial awareness) • Motor skills training adaptations (growth of new nervous system connections, increased frequency of nerve impulses to motor units, improved synchronous motor unit recruitment, improved intermuscular coordination, automatic performance of movement patterns) • Methods of motor skill development (short training duration, repetition, progressing movement speed, whole-part-whole, progressive layering of demands on motor skills, positive reinforcement and feedback) • Benefits of improved neuromuscular co-ordination – improved movement efficiency and economy, improved accuracy of movement patterns, improved force generation, improved stability, improved spatial awareness, automatic movement patterns

LO6 Know the structure and function of the digestive system

Structure of digestive system
Taught content
• Mouth, tongue, teeth, salivary glands (parotid, submandibular, sublingual, buccal), pharynx (epiglottis), oesophagus, stomach, small intestine (duodenum, jejunum, ileum), pancreas, liver, gall bladder, large intestine, rectum, anus

Functions of the digestive system
Taught content
• Ingestion • Mouth – mastication, food chewed and moistened, salivary amylase breaks down starch into simple sugars • Oesophagus – peristalsis pushes food towards the stomach. No chemical breakdown • Stomach – pepsin breaks protein down into smaller amino acid chains. Peptides and lipase break down short chain triglycerides into fatty acids and monoglycerides. Hydrochloric acid kills bacteria and enables enzymes e.g. pepsin to perform their actions. Food churned and broken down into chyme • Small intestine (duodenum, jejunum and ileum) – breaks down nutrients into usable components. Chemical digestion using bile to emulsify lipids (fats) and pancreatic juice containing enzymes. Transports nutrients into blood stream • Pancreas – exocrine gland, secretes pancreatic juice containing enzymes that assist breakdown of carbohydrates, protein and fat in small intestine. Role of pancreatic enzymes - trypsin, amylase, lipase • Liver – secretion of bile to emulsify fat and assist breakdown and absorption of fats • Gall bladder – located under the liver, stores and releases bile into small intestine • Large intestine – final stage of digestive process. Partial breakdown of cellulose (soluble fibre), reabsorption of the water from undigested food, undigested food fibre forms faeces and pass to the rectum • Rectum – expels faeces • Kidneys – help to keep blood composition constant. Filter blood to remove excess water and waste products, which are secreted as urine • Appendix – no known function in digestion. Vestigial part of colon with an immune system function

How macronutrients are digested and absorbed

Taught content

- Carbohydrates are digested and absorbed as glucose/sugars
- Fats are digested and absorbed as fatty acids
- Proteins are digested and absorbed as amino acids
- Digestive enzymes and other substances
    - Salivary amylase – released in the mouth (enzyme in saliva) – breaks down carbohydrates
    - Hydrochloric acid – gastric juice released in the stomach
    - Pepsin – released in the stomach, breaks down protein
    - Lipase – released by the pancreas into the small intestine, breaks down fats
    - Amylase – released by the pancreas, breaks down carbohydrates into glucose
    - Trypsin – released by the pancreas, breaks down protein into amino acids
    - Bile acids – produced by the liver, stored in the gallbladder, released into the small intestine

Role of dietary fibre in the maintenance of gut function

Taught content

- Soluble fibre – dissolves in the water of the digestive system
    - May assist with reducing cholesterol in the blood
    - Increasing dietary intake of soluble fibre can help to reduce constipation
    - Sources – oats, fruit, vegetables, golden linseeds
- Insoluble fibre or non-starch polysaccharide (NSP) – does not dissolve in water
    - Passes through the gut without being broken down
    - Helps other foods transit through the digestive system more easily
    - Prevents digestive problems and keeps the bowels healthy
- Sources – fruit, oats, nuts, seeds, root vegetables, cereals and wholemeal bread

Timescales for digestion
Taught content
• Food will initially travel relatively quickly through the digestive system • Within 6 to 8 hours, it has usually moved its way through the stomach, small intestine, and large intestine • Once in the large intestine, partially digested food can sit for more than a day while it's broken down even more • Digestion rate can be determined by what is eaten - Meat and fish – contain complex protein and fat, can take up to 2 days to digest fully - Fruit and vegetable – contain more fibre, usually digest in less than a day - Processed foods – a few hours • Approximately 24 to 72 hours to move through the whole digestive tract (the specific time will depend on the quantity and types of foods eaten)

Importance of fluid
Taught content
• Assist with the removal of waste from the body • Enables the transport and absorption of nutrients around the body • Prevents constipation • Supports chemical reactions – chemical reactions in all cells take place in water

LO7 Know the roles and function of the energy systems in relation to physical activity and exercise

Macronutrients and their role in the production of energy
Taught content
• Carbohydrates (e.g. bread, pasta), proteins (e.g. meat, fish), lipids (e.g. cheese, butter, energy yield per gram of macronutrient) • Carbohydrates (break down into glucose, glycogen storage in muscles and liver) • Lipids (fats and oils) (break down into fatty acids in presence of oxygen, stored as adipose tissue, protection, energy store) • Proteins (break down into amino acids, growth and repair of muscle, used for energy when other nutrients are depleted)

Energy systems used during exercise and the by-products of different systems
Taught content
• Adenosine triphosphate (ATP – break down and re-synthesis, energy equation) • Energy systems (Phosphocreatine system, anaerobic lactic acid system, aerobic system – glycolysis and lipolysis) - Creatine phosphate system (high intensity activity of 6 - 10 seconds) e.g. 100 metre sprint, throwing, explosive events - Anaerobic lactic acid system (moderate to high intensity activity of up to 90 seconds) e.g. 400 metre sprint - Aerobic system (low to moderate intensity of above 90 seconds) e.g. long distance events • By-products - Phosphocreatine system (adenosine diphosphate, phosphate, creatine, all by-products re-used) - Anaerobic lactic acid system Hydrogen ions (acid) lactate ions (buffer) - Aerobic system (metabolic water, carbon dioxide) - Associated significance of by-products in muscle fatigue (limitation of mechanical and biochemical muscle contraction processes, lactate threshold, onset of blood lactate accumulation (OBLA)) - Anabolism, catabolism and excess post exercise oxygen consumption (EPOC)

Effects of exercise on the energy systems
Taught content
• The energy continuum for intensity and duration, relative percentage contributions of energy systems during different activities/sports (exercise type, exercise duration, exercise intensity) • Effect of training on the relative proportions of fuel used for exercise, glycogen sparing, ability to utilise fats at higher exercise intensities, increased lactate threshold, improved ability to tolerate and remove lactate • Effects of endurance training and advanced training methods on the use of fuel

LO8 Know the life course of the anatomical and physiological systems of the body

Life course of the anatomical systems and the implications of exercise for specific populations

Taught content

- Young people (13 – 18)
    - Life course – muscular hypertrophy, strength and power development, increase in bone density (growth spurts), growth plate injury risk, strengthened attachment of tendons and ligaments, cardio and respiratory differences between children, young people and adults (risks of overheating, exercise intensity), developmental stages
    - Implications for exercise – consideration to safeguarding legislation, differentiation between improvements through natural development or exercise, consideration of developing joint structures, gradual warm up and cool down, avoid heavy resistance exercises, use RPE to monitor exercise intensity, resistance training should use light weights and high reps, emphasise correct exercise technique, rest and recovery to avoid overuse and over training
- Antenatal and postnatal women
    - Life course – trimesters, weight gain, increased blood volume, reduced vital capacity of lungs, increased force at joints and tendons, postural changes (excessive lumbar lordosis), joint and ligament laxity in the lumbar spine, change in centre of gravity, weakness in abdominal and pelvic floor muscles, linea alba separation (diastasis recti), widening of sacroiliac joints and pubic symphysis, increase in anterior pelvic tilt, effects of different hormones (relaxin, oestrogen, progesterone), contra-indications listed in ACSM guidelines
    - Implications for exercise – avoid supine exercise after 16 weeks of pregnancy, avoid prone exercise, avoid prolonged motionless standing, avoid heavy isometric exercise, avoid leg adduction and abduction against resistance, avoid loaded forward flexion, avoid rapid changes of direction, avoid uncontrolled twisting or ballistic movements, avoid risk of falling or trauma, avoid high intensity or impact exercise, avoid crunching and twisting abdominal exercises
- Older adults
    - Life course – 1-2% loss in physical fitness each year, loss of neuromuscular function, risks of chronic health conditions, muscular atrophy and decreased muscular strength, decrease in bone density and bone strength, demineralisation in bones, development of osteoporosis, degradation of ligaments and tendons (osteoarthritis), postural changes (kyphosis), changes in vision and hearing, balance issues
    - Implications for exercise – undertake longer and more gradual mobility and warm up, undertake a gradually tapered cool down, exercise intensity must be at a challenging but health related level, use RPE scale to monitor intensity, emphasise correct exercise technique, increase duration of transitions, simplify exercise when required, learn new exercises at the most basic level, avoid extreme spinal flexion, consider postural stability and balance, risk of falls for frailer, older adults
- Disabled people
    - Awareness of medical conditions and physical impairments that present disabling symptoms – visual and auditory impairment, low back pain, chronic obstructive pulmonary disease (COPD), fibromyalgia, gout, osteoarthritis, rheumatoid arthritis, tendonitis, ataxia, dystonia, Huntingdon's disease, multiple system atrophies,

Parkinson's disease, Cerebral Palsy, spinal cord injury, mental illness, cancer, limb amputation, dementia, Down's syndrome, HIV/AIDS, stroke, heart attack

- Implications for exercise – consideration to equality, inclusion and safeguarding legislation, communication with relevant medical and healthcare professionals, research of exercise contra-indications, individualised exercise prescription, adaptation of exercise technique, emphasis on movement quality, stable body positioning to prevent falls, client-centred approach

Assessment requirements

1. Knowledge outcomes

Learning Outcome	Assessment Criteria	Assessment requirement
LO1 Know the structure and function of the skeletal system in relation to exercise	1.1. Describe the standard anatomical position and reference points	External theory examination
	1.2. Describe the anatomical planes of movement	
	1.3. Describe the functions of the skeleton	
	1.4. Identify the names and locations of the bones of the axial and appendicular skeleton	
	1.5. Describe the classifications of different bones	
	1.6. Describe the stages of bone growth	
	1.7. Describe the structures of a long bone	
	1.8. Describe the structure of the spine in relation to posture and range of motion	
	1.9. Describe joint classifications and structure	
	1.10. Describe the different types of synovial joints, their location, range of motion and joint actions	
	1.11. Describe the exercise and movement considerations in relation to the skeletal system	

Learning Outcome	Assessment Criteria	Assessment requirement
LO2 Know the structure and function of the muscular system in relation to exercise	2.1. Describe the different types of muscle tissue and the characteristics and functions of each type	External theory examination
	2.2. Identify the different skeletal muscle fibre types and their characteristics	
	2.3. Describe the structure of skeletal muscle and the sliding filament theory	
	2.4. Identify the names and location of all major muscles	
	2.5. Describe the types of muscle action and joint actions	
	2.6. Describe the muscles of the pelvic floor and pelvic girdle	

Learning Outcome	Assessment Criteria	Assessment requirement
LO3 Know the structure and function of the circulatory system in relation to exercise	3.1. Describe the function and structure of the heart	External theory examination
	3.2. Describe the blood flow through the heart chambers and different circulatory systems	
	3.3. Describe the structure and function of blood vessels	
	3.4. Describe the effects of disease processes on the blood vessels and the effect on blood pressure	
	3.5. Describe the effects and benefits of aerobic endurance exercise on the circulatory system and relation to cardiovascular fitness	

Learning Outcome	Assessment Criteria	Assessment requirement
LO4 Know the structure and function of the respiratory system in relation to exercise	4.1. Describe the structure and function of the lungs	External theory examination
	4.2. Identify the muscles involved in breathing	
	4.3. Describe the passage of air flow through the respiratory tract and gaseous exchange	

Learning Outcome	Assessment Criteria	Assessment requirement
LO5 Know the structure and function of the nervous system in relation to exercise	5.1. Describe the roles and functions of the different components of the nervous system	External theory examination
	5.2. Describe the relationship between the nervous system and principles of muscle contraction and motor unit recruitment	
	5.3. Describe the role of exercise on neuromuscular activity and motor fitness	

Learning Outcome	Assessment Criteria	Assessment requirement
LO6 Know the structure and function of the digestive system	6.1. Identify the structure of digestive system	External theory examination
	6.2. Describe the functions of the digestive system	
	6.3. Describe how the macronutrients are digested and absorbed	
	6.4. Describe the role of dietary fibre in the maintenance of gut function	
	6.5. Identify timescales for digestion	
	6.6. Describe the importance of fluid	

Learning Outcome	Assessment Criteria	Assessment requirement
LO7 Know the roles and function of the energy systems in relation to physical activity and exercise	7.1. Identify the macronutrients and their role in the production of energy	External theory examination
	7.2. Describe the energy systems used during exercise and the by-products of different systems	
	7.3. Describe the effects of exercise on the energy systems	

Learning Outcome	Assessment Criteria	Assessment requirement
LO8 Know the life course of the anatomical and physiological systems of the body	8.1. Describe the life course of the anatomical systems and the implications of exercise for specific populations	External theory examination

External theory examination

Knowledge and understanding of this unit will be assessed through an external theory examination. This will consist of a multiple-choice question paper.

The external theory examination will test knowledge and understanding from across the theory content of LO1 – LO8. Learners should use the unit content section of this unit and listed assessment criteria to aid revision.

Resources

The special resources required for this unit are access to a real or realistic working environment which supports learners and helps them to apply their knowledge of anatomy and physiology to an exercise, fitness and health context within a gym environment.

Learners should have the opportunity to apply their knowledge in the planning and instruction of safe and effective exercise programmes for a range of clients. To include:

- Aerobic and anaerobic systems
- Muscle balance
- Heart rate response to exercise
- Long and short term physiological response to exercise
- Energy demands of different activities
- Tailoring exercise to meet individual needs and goals

Best practice should be encouraged by giving learners the opportunity to access current research and guidelines that inform exercise science (e.g. NICE, ACSM, BASES, BHFNC, Department of Health).

Document History

Version	Issue Date	Changes	Role
v1.0	28/09/2018	First published	Qualifications Manager
v2.0	18/10/2018	Amendment to the assessment criteria headings following technical review	Qualifications Administrator
v3.0	26/11/2018	Removal of assessment criteria verbs from learning outcomes	Qualification Administrator