YMCA Level 2 Award in Anatomy, Physiology and Fitness Principles for EMD UK Professional Membership (610/3661/4)

Operational start date: 01/02/2024

Qualification Specification

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Qualification Specification

Contents

Introduction

YMCA Awards is part of Central YMCA – the world's first YMCA – a national charity that has been helping people make positive changes in their lives since 1844.

We're experts in education, health, and wellbeing with over 20 years of experience developing UK-regulated and globally recognised qualifications.

We work closely with industry experts, employers, and training providers to make sure that our products and services deliver life-changing opportunities. With over half a million qualifications awarded, 300,000 people have advanced their career with YMCA Awards.

Aim

YMCA Level 2 Award in Anatomy, Physiology and Fitness Principles for EMD UK Professional Membership (610/3661/4)

By completing this qualification, learners who have studied non-regulated or licensed group exercise programmes will gain the additional knowledge required to meet the minimum requirements for EMD UK membership. EMD UK is the national governing body for group exercise.

Scope of practice for each non-regulated or licensed group exercise programme is outlined by EMD UK in the relevant scope of practice guidelines.

Progression opportunities

This qualification can lead to further training at the same level to gain employment to deliver a broader range of exercise genres and increase scope of practice. For example:

- **Occupational entry qualifications** (this means they meet the agreed industry prerequisites to enter the sport and physical activity sector as an employed or self-employed Gym Instructor, Group Exercise Instructor and/or Personal Trainer, depending on the qualification completed).
    - YMCA Level 2 Certificate in Exercise and Fitness: Group Exercise Instructor (610/2791/1)
        - freestyle exercise to music
        - studio resistance training
        - step exercise to music
        - water-based exercise
        - circuit training
        - group indoor cycling
        - fitness walking.
    - YMCA Level 2 Diploma in Exercise and Fitness: Group Exercise Instructor (Professional Studio Instructor) (610/3583/X)
    - YMCA Level 2 Diploma in Exercise and Fitness: Gym Instructor (610/2784/4)
    - YMCA Level 2 Diploma in Exercise and Fitness: Gym Instructor and Personal trainer (610/2789/3)
- **Technical specialisms** (to perform additional roles within the workplace):
    - YMCA Level 2 Award in Mental Health Awareness and Understanding Approaches to Support Individuals (603/7146/8)
    - YMCA Level 2 Award in Safeguarding Adults and Adults at Risk (610/0822/9)
    - YMCA Level 3 Award in Emergency First Aid at Work (603/1902/1)
    - YMCA Level 3 Award in First Aid at Work (603/1903/3)

Completion of an occupational entry qualification can lead to further training at a higher to specialise or further increase scope of practice.

Stakeholder engagement

This qualification is partially mapped against the following Chartered Institute for the Management of Sport and Physical Activity (CIMSPA) professional standards:

Qualification	CIMSPA professional standard(s)
YMCA Level 2 Award in Anatomy, Physiology and Fitness Principles for EMD UK Professional Membership (610/3661/4)	• Core Group Exercise Instructor

Entry requirements, prerequisites, and availability

Learners must be aged 16 plus at the point of certification.

Before starting this qualification, learners must have previously completed a non-regulated or licensed group exercise programme enabling them to deliver pre-choreographed group exercise classes.

Learners can take these qualifications in:

Location	Regulated by
England	Ofqual
Wales	Qualifications Wales
Other UK regions and outside of the UK	Ofqual

Reasonable adjustments and special consideration

In making these qualifications available, YMCA Awards has made every attempt to make sure that there are no unnecessary barriers to achievement. You can find full details of our reasonable adjustment and special consideration policy on our website.

ymcaawards.co.uk/centres/policies-and-procedures

Grading and structure

This qualification is graded Pass or Refer.

A Pass grade demonstrates that a learner has been assessed as fully competent against all assessment criteria within the qualification.

A Refer indicates that a learner has been assessed as not yet competent against one of more of the assessment criteria of the unit and/or qualification. This is a failing grade and learners will require reassessment to achieve the qualification.

YMCA Level 2 Award in Anatomy, Physiology and Fitness Principles for EMD UK Professional Membership (610/3661/4)

To achieve a Pass, learners must achieve two mandatory units:

UN	Unit title	Level	GLH
H/6507/417	Fundamentals of anatomy and physiology for exercise and fitness professionals	2	53
L/650/9760	Principles of physical activity, exercise, and fitness	2	14

The table below shows the guided learning hours (GLH) and total qualification time (TQT) for each qualification.

Qualification	GLH	TQT
YMCA Level 2 Award in Anatomy, Physiology and Fitness Principles for EMD UK Professional Membership (610/3661/4)	67	114

Find out more about GLH and TQT on our website:

ymcaawards.co.uk/qualifications/glh-and-tqt

Assessment overview

The table below provides details of the two assessment tasks.

Assessment task	Details	Unit(s) assessed

1. Questions/ answers on anatomy and physiology	Learners need to answer questions designed to assess their knowledge of:
	• Anatomical terminology.
	• Classification, structure, and function of the:
	  ○ skeletal system
	  ○ muscular system
	  ○ respiratory system
	  ○ nervous system
	  ○ circulatory system
	  ○ endocrine system
	  ○ digestive system
	  ○ energy systems.
	• Lifespan changes which affect the body system, health, and wellbeing.
	• Effects of exercise on the anatomical and physiological systems.
	All questions must be answered correctly.
	This assessment is available digitally (auto-marked) through YMCA Awards' online system. Centres wishing to create their own questions or use their own platform must seek prior approval from YMCA Awards.
		Fundamentals of anatomy and physiology for exercise and fitness professionals (H/6507/417)

Assessment task	Details	Unit(s) assessed
2. Worksheet	Learners will be required to provide short answers to a series of worksheet questions. Further information can be found in the YMCA Level 2 Award in Anatomy, Physiology and Fitness Principles for EMD UK Professional Membership Learner Assessment Record (LAR). The estimated time required by an assessor to mark and provide feedback for this assessment is 30 minutes per learner.	Principles of physical activity, exercise, and fitness (L/650/9760)

Using this document

The following pages provide the unit content for this qualification. Each unit includes learning outcomes, assessment criteria and relevant content for delivery. These are set out below.

Learning outcome ('the learner will')	
Assessment criteria ('the learner can') What a learner is expected to know, understand or be able to do following their learning.	**Relevant content** (additional delivery guidance) Suggestions on depth and breadth of content to cover.

At the end of each unit, the assessment specification outlines how we expect to measure or confirm the learner has met the standard set in the learning outcomes and assessment criteria.

Qualification content

Fundamentals of anatomy and physiology for exercise and fitness professionals (H/650/7417)

Unit aim

To provide the essential foundation knowledge of the structure and function of the body systems relevant to exercise and fitness instruction.

Learners will be able to apply their knowledge to support the planning of safe and effective exercise sessions.

Content

1. Understand anatomical terminology	
1.1 Identify terms of location	Definition of terms and anatomical examples of: • superior and inferior • anterior and posterior • medial and lateral • proximal and distal • superficial and deep.

1.2 Identify planes of movement	• Three planes which divide the body.
	• Joint actions and exercise examples in each plane:
	  ○ Frontal (coronal) plane:
	  – Passes from side to side at right angles to the sagittal plane.
	  – Divides the body into front and back sections.
	  – Related terminology – anterior and posterior.
	  – Joint actions include abduction and adduction.
	  – Exercise examples include side leg lifts (abduction), lateral raises, jumping jacks.
	  ○ Sagittal vertical plane:
	  – Passes from front to rear dividing the body into two symmetrical halves, left and right.
	  – Joint actions include flexion and extension.

	– Exercise examples include knee raises, leg curls, walking, running, forward lunge, biceps curl and bench press. ○ Transverse: – Any horizontal plane of the body that is parallel to the diaphragm. – Divides the body upper and lower. – Joint actions include rotation, pronation, and supination. – Exercise examples – spine rotations, oblique curls/crunches, twisting movement such as boxing jabs.

2. Understand the classification, structure, and function of the skeletal system	
2.1 Summarise the classification (types) of bones	• Function and examples of each type of bone. • Bones classified by their shape and function: ○ long – femur ○ short – tarsals ○ flat – scapula ○ sesamoid – patella ○ irregular – vertebrae.
2.2 Outline the structure of bones	• Different types of bone tissue: ○ compact and spongy/cancellous tissue • Long bone structure ○ articular cartilage at ends of bones (where joints are formed) ○ epiphysis ○ diaphysis ○ periosteum ○ epiphyseal plates (growth plates) ○ medullary cavity ○ hyaline cartilage ○ compact bone ○ cancellous bone ○ yellow and red bone marrow.

2.3 Name and locate major bones:
• axial
• appendicular.
	• Axial:
	  ○ cranium
	  ○ cervical vertebrae
	  ○ thoracic vertebrae
	  ○ lumbar vertebrae
	  ○ sacral vertebrae
	  ○ coccyx
	  ○ sternum
	  ○ ribs.
	• Appendicular:
	  ○ scapula
	  ○ clavicle
	  ○ humerus
	  ○ ulna
	  ○ radius
	  ○ carpals
	  ○ metacarpals
	  ○ phalanges
	  ○ ilium
	  ○ ischium
	  ○ pubis
	  ○ femur
	  ○ patella
	  ○ tibia
	  ○ fibula
	  ○ tarsals
	  ○ metatarsals.

2.4 Outline the structure and function of the spine	Structure of the vertebral column: • Regions - cervical, thoracic, lumbar, sacral and coccygeal. • The number of vertebrae in each spinal section. • Four natural curves (two kyphotic, two lordotic). • Function of curves. • The roles that lordotic and kyphotic curves play in posture and achieving a ‘neutral spine’. • Potential ranges of movement in different spinal regions, including joint actions.

2.5 Outline abnormal degrees of curvature of the spine and their implications for exercise	• Curvatures that deviate from optional posture/alignment and their implications on movement:
	  ○ scoliosis
	  ○ hyper lordosis
	  ○ hyper kyphosis
	  ○ flat back
	  ○ sway back.
	• Factors that may contribute to sub-optimal spinal curvatures:
	  ○ muscle imbalances
	  ○ genetic conditions
	  ○ lifestyle factors
	  ○ medical conditions
	  ○ pregnancy.

2.6 Describe the functions of the skeleton	Functions and examples: • Muscle attachments and levers – muscles attach to bones (levers) and exert a force to pull on the bones to create movement at joints (fulcrum). • Protection of internal organs, e.g. brain is protected by cranium, heart and lungs are protected by the rib cage. • Production of red and white blood cells in the bone marrow. • Skeletal framework provides body shape and a foundation structure. • Storage of calcium and other minerals.

2.7 Summarise the stages of bone development, growth, and repair	• Process of bone growth – ossification.
	• Stages of bone growth – from foetal, birth, through to adolescence and older age.
	• Remodelling process.
	  ○ The roles of osteoblasts, osteoclasts and osteocytes.
	  ○ The role of calcium, vitamin D and hormones.
	• Ageing /lifespan process – when bones stop growing in length, when bones lose calcium, including the effects of menstrual cycle and menopause, osteopenia/osteoporosis.
	• Factors that affect growth:
	  ○ exercise – weight bearing
	  ○ age
	  ○ lifestyle factors – smoking, nutrition, alcohol etc
	  ○ sunlight
	  ○ hereditary factors.

2.8 Summarise the classification of joints	Examples of different classifications and differences in function and movement potential: • fibrous – immoveable • cartilaginous – slightly moveable • synovial – freely moveable.
2.9 Outline the structure of freely movable joints: • types • ligaments.	• Structure of a synovial joint – joint capsule, synovial membrane, synovial fluid, ligaments, tendons, and cartilage (hyaline and fibrocartilage). • Types – hinge, saddle, gliding, pivot, condyloid, ball and socket. • Structural differences of different types of joint and how this affects movement potential. • Function of ligaments: non-elastic, prevent/limit unwanted movement, attach bone to bone, joint stability. • Function of tendons. • Function of cartilage.

2.10 Describe the function of joints:
• joint actions at specific joints
• related planes of movement
• mobility
• stability.
	• The movement potential at different types of synovial joint (see types within 2.9 above).
	• Joint actions available at specific joints:
	  ○ flexion and extension, e.g. knee
	  ○ adduction and abduction, e.g. hip
	  ○ rotation, e.g. between axis and atlas
	  ○ circumduction, e.g. shoulder
	  ○ horizontal flexion and horizontal extension, e.g. shoulder
	  ○ elevation and depression, e.g. shoulder girdle
	  ○ lateral flexion and lateral extension, e.g. spine
	  ○ pronation and supination, e.g. forearm – radioulnar joint
	  ○ plantar flexion and dorsi flexion, e.g. ankle
	  ○ protraction and retraction, e.g. shoulder girdle.
	  ○ inversion and eversion.
	• Movement planes in which different joint actions happen:
	  ○ frontal (coronal), sagittal and transverse planes.
	• Factors affecting joint mobility and stability:
	  ○ structure – see different types of joint
	  ○ location e.g. hip and shoulder different functions
	  ○ flexibility of surrounding tissues (laxity of ligaments)
	  ○ injury (damage to articular surfaces).

3. Understand the classification, structure, and function of the muscular system	

3.1 Summarise the types and properties of muscle tissue	Different types of tissue, properties, and examples:
	• Skeletal – striated:
	  ○ voluntary - conscious control, controlled by somatic nervous system, found in consciously controlled skeletal muscles.
	• Smooth:
	  ○ involuntary – unconscious control, controlled by autonomic nervous system, found in structures not under conscious control, e.g. blood vessels, digestive system.
	• Cardiac – heart:
	  ○ involuntary – striated, unconscious control, initiated by the sinoatrial node (SA node).

3.2 Summarise the structure of skeletal muscles	• Structure:
	  ○ muscle comprises (or consists of, made up from) water (70%), protein (23%), minerals and substrates (7%):
	  – fascia
	  – connective tissue
	  – muscle fibres
	  – fasciculi
	  – epimysium
	  – endomysium
	  – perimysium
	  – myofibrils
	  – myofilaments
	  – sarcomeres
	  – actin and myosin
	  – mitochondria (cells) and their role.
	  ○ muscle attachments (and examples):
	  – aponeurosis
	  – direct to bone
	  – muscles cross joints, attach to bones via tendons.

3.3 Describe skeletal muscle fibre types and their characteristics	• Different types of muscle fibres and characteristics:
	  ○ slow twitch type I - slow oxidative
	  ○ fast twitch type 2a (intermediate) – fast oxidative glycolytic
	  ○ fast twitch type 2b – fast glycolytic.
	• Relationships with:
	  ○ energy systems – aerobic and anaerobic
	  ○ different types of training.
	• Factors that influence fibre type:
	  ○ genetics
	  ○ ageing
	  ○ types of exercise.

3.4 Name and locate the major skeletal muscles:
• upper
• lower
• anterior
• posterior.
	Location of:
	• Shoulder girdle:
	  ○ pectoralis major
	  ○ trapezius
	  ○ rhomboids.
	• Arms and shoulders
	  ○ biceps
	  ○ triceps
	  ○ deltoids.
	• Back:
	  ○ latissimus dorsi
	  ○ erector spinae.
	• Pelvic girdle and hip:
	  ○ hip flexors (iliopsoas)
	  ○ gluteals
	  ○ adductors
	  ○ abductors.
	• Legs:
	  ○ quadriceps
	  ○ hamstrings
	  ○ tibialis anterior
	  ○ gastrocnemius
	  ○ soleus.
	• Abdominals:
	  ○ internal and external obliques
	  ○ transversus abdominus
	  ○ rectus abdominus.

3.5 Outline the joint actions produced by major skeletal muscles: • upper • lower • anterior • posterior.	• Related function and joint action produced by concentric and eccentric contraction of specific muscles. • See 2.10 and 3.4.

3.6 Describe the roles of skeletal muscles	• Roles - agonists (prime movers), antagonists, synergists, fixators:
	  ○ Examples in relation to exercises and movements.
	• Functions and properties of muscles:
	  ○ Contract to create movement or assist in the stabilisation of joints.
	  ○ Generate heat (shivering).
	  ○ Keep the body upright by resisting the force of gravity:
	  – posture.

3.7 Describe the process/principles of muscular contraction	Interrelationship with nervous system:
	• All or none law.
	• Sliding filament theory, the role of actin and myosin, the role of ATP, motor neuron impulses, motor unit recruitment.
	• Stretch (myotatic) reflex and inverse stretch reflex.
	• Size principle of motor unit recruitment.
	• Other principles of muscle work (biomechanics and kinesiology):
	  ○ Muscles only pull (apply force) on bones (levers), they cannot push, contract in direction of fibres.
	  ○ Cross joints (fulcrum) and create movement.
	  ○ Work in pairs/groups
	  ○ Muscles roles (see previous points).

3.8 Outline the types of muscular contraction	• Types of contraction:
	  ○ Concentric and eccentric (isotonic).
	  ○ Isometric.
	• The effects of gravity on muscle work and the effects of fixed resistance/pulley equipment on muscle work.
	• Advantages and disadvantages of isotonic/isometric movement in relation to everyday activity, activity for health and within an exercise and fitness session, to include:
	  ○ Causes and effects of delayed onset muscle soreness (DOMS).
	  ○ Valsalva effect; functionality and effects on blood pressure.

3.9 Outline the structure and function of the pelvic floor muscles	• Structure:
	  ○ Deep and superficial layers.
	  ○ Fast and slow-twitch muscle fibres.
	  ○ Muscle attachments.
	• Function:
	  ○ Stability for the pelvic girdle.
	  ○ Support for organs and growing foetus during pregnancy.
	  ○ Controlling continence.
	  ○ As lower part of inner cylinder – stability (along with diaphragm, abdominals, back muscles).
	  ○ Counteract changes in abdominal pressure.

4. Understand the classification, structure, and function of the cardiovascular system	

4.1 Summarise the structures of the cardiovascular system	• Heart – myocardium (cardio):
	  ○ muscular pump
	  ○ two halves – right (deoxygenated blood) and left (oxygenated blood)
	  ○ four chambers - right and left ventricles, right and left atria
	  ○ valves (prevent back flow) – bicuspid, tricuspid, aortic, pulmonary.
	• Blood vessels (vascular):
	  ○ Comprise: arteries, arterioles (smaller versions of arteries) veins, venules (smaller versions of veins) and capillaries (smallest of the blood vessels):
	  – Capillaries:
	  ▪ Are the smallest blood vessels (one blood cell thick).
	  – Veins:
	  ▪ Carry blood towards the heart at low pressure.
	  ▪ Deoxygenated blood in all except the pulmonary veins.
	  ▪ Have thinner, less muscular walls.
	  ▪ Have a series of one-way (non-return) valves to prevent backflow of blood and require the assistance of skeletal muscle to help venous return.

	▪ The vena cava has two branches (inferior and superior) and returns blood from the body back to the right atrium. ▪ The pulmonary veins return blood back to the left atrium. – Arteries: ▪ Carry blood away from the heart at high pressure. ▪ Oxygenated blood in all arteries except the pulmonary arteries. ▪ Are pressurised and have thick, smooth, muscular walls. ▪ The aorta is the largest/major artery that carries blood from the left ventricle to the body. ▪ The pulmonary arteries carry blood from the right ventricle to the lungs.
4.2 Describe the function of the cardiovascular system	• Location/size of the heart: ○ Behind the sternum, just to the left of centre. ○ Size of a clenched fist. • Functions: ○ Circulation of: – blood (deoxygenated/oxygenated) and nutrients, hormones, medications. • Terminology – definitions of: ○ Stroke volume – the amount of blood pumped in one beat. ○ Cardiac output – the amount of blood pumped in one minute. ○ Heart rate – beats per minute, pulse monitoring points, e.g. radial artery. • The effects of exercise on the above.

4.3 Outline the flow of blood around the systemic and pulmonary systems	• Systemic circulation– flow around heart and body:
	  ○ From heart to body - aorta, arteries, arterioles, capillaries:
	  – gaseous exchange at muscular levels (mitochondria).
	  ○ From body to heart – venules, veins, superior/inferior vena cava, right atrium (systemic).
	• Pulmonary circulation – flow around heart and lungs:
	  ○ From lungs to heart – pulmonary vein, left atrium, left ventricle (pulmonary).
	  ○ From heart to lungs – right ventricle, pulmonary artery:
	  – gaseous exchange in lungs.
	• Interrelationship with respiratory system and muscular system – gaseous exchange.

4.4. Outline blood pressure:
• classifications
• systolic/ diastolic.
	The body's need for blood pressure.
	Definitions:
	• Blood pressure as a measure of force in the artery walls.
	• Systolic blood pressure:
	  ○ The pressure in the arteries (contracting/pumping phase).
	• Diastolic blood pressure:
	  ○ The pressure in the arteries (resting/filling phase).
	Classifications:
	• Systolic and diastolic readings:
	  ○ optimal, normal blood pressure classifications
	  ○ hypotension, pre-hypertension and hypertension (different stages).
	• Current and up-to-date guidelines regarding blood pressure detailed from the following bodies:
	  ○ World Health Organization (WHO)
	  ○ National Institute for Health and Care Excellence (NICE)
	  ○ American College of Sports Medicine (ACSM).
	• Effects of exercise on blood pressure:
	  ○ Linear increase.
	  ○ Issues when working with hypertensive clients.
	  ○ When exercise is contraindicated.

5. Understand the classification, structure, and function of the respiratory system	

5.1 Summarise the structure of the respiratory system	Respiratory tract – upper and lower:
	• upper:
	  ○ nose and mouth
	  ○ pharynx
	  ○ larynx
	• lower:
	  ○ trachea (windpipe)
	  ○ lungs:
	  – bronchus (bronchi)
	  – bronchioles
	  – alveolus (alveoli) (capillaries) and location of gaseous exchange.
	How the alveoli and capillaries link the respiratory and cardiovascular systems.

5.2 Outline the function of the respiratory system	• The position of the lungs within the thoracic cavity
	• Function:
	  ○ Intake of oxygen.
	  ○ Removal of carbon dioxide.
	  ○ Gaseous exchange.
	  ○ Diffusion: the movement of molecules from an area of greater concentration to an area of lesser concentration.
	• The passage of air through respiratory tract during inhalation (inspiration) and exhalation (expiration):
	  ○ nose and mouth
	  ○ pharynx
	  ○ larynx
	  ○ trachea
	  ○ bronchi
	  ○ bronchioles
	  ○ alveoli.
	• Terminology:
	  ○ External respiration – the exchange of gases between the lungs and the blood.
	  ○ Internal respiration – the exchange of gases between the blood and the cells of the body.

	○ The process of respiration: – Take in air from the atmosphere – inhalation/inspiration. – Gaseous exchange alveoli. – Pass oxygen into the circulatory system. – Remove carbon dioxide from the circulatory system via exhalation. ○ Composition of air during: – inhalation – exhalation. ○ Average respiratory rate – 12-20 breaths per minute: – factors affecting respiratory rate and efficiency: ▪ exercise ▪ stress ▪ age ▪ chronic health conditions.
5.3 Outline the mechanism and control of breathing	• Respiration is controlled by the respiratory centre located in the brain. • The function and location of each muscle involved in inhalation and exhalation. • Natural breathing: ○ intercostals (internal and external): – Inspiration externals contract and lift the ribs up. – Expiration externals relax and the ribs lower. ○ Diaphragm: – Inspiration contracts and descends. – Expiration relaxes and ascends.
5.4 Outline the process of gaseous exchange	• Gaseous exchange of oxygen and carbon dioxide in the body. • The role of the alveoli and capillaries in gaseous exchange: ○ Oxygen (alveoli) moves from the lungs to the bloodstream (capillaries). ○ Carbon dioxide passes from the blood (capillaries) to the lungs (alveoli) to be exhaled. • The process of the diffusion of gases from areas of high concentration to areas of low concentration.

6. Understand the classification, structure, and function of the nervous system	

6.1 Summarise the structure and divisions of the nervous system	Main divisions:
	• Central nervous system (CNS):
	  ○ The brain and spinal cord.
	• Peripheral nervous system (PNS):
	  ○ Motor and sensory nerves that branch out from the spinal cord.
	• PNS is divided into:
	  ○ Somatic nervous system
	  ○ Autonomic nervous system (ANS)
	  ○ Two sub-divisions of autonomic nervous system (ANS).
	  – sympathetic (speeds up processes)
	  – parasympathetic (slows down processes).

6.2 Describe the functions of the nervous system	• Communication and control system of body.
	• Works collaboratively with the endocrine system.
	• Maintaining homeostasis.
	• Three key roles:
	  1. Sensory – detects changes in the body's internal environment and gathers information about the external environment.
	  2. Interpretation – analyses and interprets the changes sensed and selects the appropriate response.
	  3. Motor output – responds to the changes by signalling the required action, e.g. the secretion of hormones from the endocrine glands, or by initiating muscle contraction.

6.3 Outline the role of each subdivision of the peripheral nervous system:
• somatic
• autonomic.
	• Somatic nervous system:
	  ○ voluntary muscle actions.
	• Autonomic nervous system:
	  ○ Involuntary actions such as: digestion and/or control of blood pressure etc.
	  ○ Two divisions autonomic nervous system (ANS):
	  – sympathetic (fight or flight, war) – speed up
	  – parasympathetic (rest and digest, peace) – slow down

6.4 Outline the structure of nerves	• Structure:
	  ○ axons
	  ○ dendrites
	  ○ cell body
	  ○ nucleus
	  ○ myelin sheath.

6.5 Outline the process of a nerve impulse	• Interrelationship with the muscular system:
	  ○ how nerve impulses are conducted
	  ○ the role of ATP
	  ○ the 'all or none' law,
	  ○ motor neuron impulses, motor unit recruitment.

6.6 Outline the function of:
• motor units
• proprioceptors
• muscle spindles
• Golgi tendon organs.
	• Motor unit comprises one motor nerve and all the muscle fibres it causes to contract:
	  ○ The number of these muscle fibres can vary from one or two to 1000:
	  – A stimulus must be strong enough to trigger an action potential to pass down the motor neuron.
	  – All muscle fibres within a single motor unit will be maximally innervated by the action potential or none will.
	  – The size principle of motor unit recruitment. Motor units are recruited in order of size, from small to large.
	• Proprioceptor is a sensory organ which receives stimuli from within the body to give detailed and continuous information about the position of the limbs and other body parts.
	• Muscle spindle is a proprioceptor located within the body of a skeletal muscle that primarily detect changes in the length of the muscle.
	• Golgi tendon organ (GTO) is a proprioceptor located within a tendon that detects how much tension is being transferred into the muscle.
	• Interrelationship of proprioceptors with exercise:
	  ○ Stretching (lengthening) – PNF and developmental stretching.
	  ○ Muscle contraction – the more motor units activated, the greater the strength of contraction.

7. Understand the classification, structure, and function of the endocrine system

7.1 Summarise the structure of the endocrine system:

- major glands
- hormones.

Structure:

- Comprised of several glands that produce and secrete hormones:

Gland	Hormone (to include)	Action/role (to include)
Adrenal	Epinephrine (adrenaline) Norepinephrine (noradrenaline)	Initiates stress response – fight or flight
Pancreas	Insulin	Lowers blood sugar levels
	Glucagon	Raises blood sugar levels
Ovaries	Oestrogen	Female 'characteristics' Breast development
	Progesterone	Menstrual cycle/egg production Promote fat storage
Testes	Testosterone	Male 'characteristics' include increased muscle, bone mass, and the growth of body hair.

8. Understand the structure and function of the digestive system	
8.1 Describe the function of the digestive system	• Breakdown of food into nutrients such as carbohydrates, fats and proteins so they can then be absorbed into the bloodstream for energy, growth and repair.

8.2 Summarise the function of each of the main structures within the digestive system	Digestive system structures:
	• Mouth (tongue, teeth, salivary glands):
	  ○ Mastication (mechanical breakdown of food, i.e. chewing).
	  ○ Moistening (softening of food with saliva).
	  ○ Salivary amylase breakdown carbohydrates.
	• Pharynx (throat):
	  ○ Permits the passage of swallowed solids and liquids into the oesophagus, i.e. swallowing.
	• Epiglottis:
	  ○ Prevents food entering respiratory tract.
	• Oesophagus:
	  ○ Involuntary contraction – peristalsis to move food toward the stomach.
	• Stomach:
	  ○ Acts as a food reservoir whilst it is being further broken down:
	  – Pepsin (released in the stomach to break down protein).
	  – Hydrochloric acid produced to kill bacteria ingested with food.
	• Pancreas:
	  ○ The function of the **pancreas** as an exocrine gland which secretes:
	  – An enzyme-rich fluid which is needed to aid **digestion** in the small intestine.
	  – Further enzymes to assist with the additional breakdown of food:
	  ▪ Lipase released by the pancreas to break down fat.
	  ▪ Amylase released in the pancreas to breakdown carbohydrates into glucose.
	  ▪ Trypsin released by the pancreas to break down protein into amino acids).

	• Liver:
	  ○ Bile acids produced from the liver are secreted into the small intestine and play an important role in digesting fat.
	• Gallbladder and bile ducts:
	  ○ Stores bile.
	• Small intestine:
	  ○ Where the absorption of digested nutrients into the blood steam occurs.
	• Large intestine (colon):
	  ○ Absorbs water and uses fibre to solidify any unabsorbed products to enable peristalsis to expel the resultant stool(s) via the rectum.

8.3 Describe the digestive process	• How the main nutrient groups are broken down and absorbed.
	• The transport, storage, and metabolised forms of each macronutrient.
	• The inability of the body to absorb or use large particles of food, therefore using a process of digestion to break these down into smaller components which can be more easily absorbed and transported.
	• Macronutrient digestive end products:
	  ○ Carbohydrates are digested and absorbed as sugars.
	  ○ Fats are digested and absorbed as fatty acids.
	  ○ Proteins are digested and absorbed as amino acids.
	• Digestive enzymes – location of release and affected nutrients:
	  ○ Carbohydrate – mouth – salivary amylase.
	  ○ Protein – stomach – pepsin.
	  ○ Fat – released from the pancreas into the small intestine – lipase.
	  ○ Protein – released from the pancreas into the small intestine – trypsin.
	• The role of fibre in the digestive process:
	• Soluble fibre may reduce cholesterol in the blood and can reduce constipation.
	• Sources of soluble fibre (fruit, vegetables, oats, golden linseeds).
	• Insoluble fibre or non-starch polysaccharide (NSP) passes through the gut without being broken down and keeps the bowels healthy.

	• Sources include root vegetables, nuts and seeds, oats, fruit, cereals and wholemeal bread.
	• The importance of fluid intake:
	  ○ Chemical reactions in all cells take place in water.
	  ○ Assisting the removal of waste from the body.
	  ○ Transportation and absorption of nutrients around the body.
	  ○ Preventing constipation.
	• Timescales for the digestive process to take place:
	  ○ Initially, food will travel relatively quickly through the digestive system.
	  ○ Takes about 6 to 8 hours for food to pass through the stomach and small intestine. Food then enters the large intestine (colon) for further digestion, absorption of water and, finally, elimination of undigested food.
	  ○ In the large intestine, partially digested food can sit for more than a day while it's broken down even more depending on type of food eaten:
	  – Meat and fish can take as long as two days to fully digest due to the complex protein and fat molecules.
	  – Fruit and vegetables which contain fibre move through the digestive system in less than a day.
	  – Processed foods can be digested in a matter of hours.
	  ○ Can take 24 to 72 hours to move through the digestive tract.
	  ○ The exact time of digestive processes will depend on the amounts and types of foods eaten and other factors such as gender, metabolism and any digestive issues that could slow down or speed up the process.

9. Understand the classification, structure, and function of the energy systems	

9.1 Describe the three energy systems	• Definitions of terms:
	  ○ aerobic – with oxygen
	  ○ anaerobic – without oxygen.
	• Three energy systems:
	  ○ creatine phosphate (CP) or phosphocreatine (PC)
	  ○ anaerobic glycolysis/lactic acid
	  ○ aerobic.
	• The energy systems resynthesise adenosine triphosphate (ATP) which is the energy currency of the body but is stored in limited amounts.

9.2 Summarise the role of the energy systems in the resynthesis of adenosine triphosphate:
• anaerobic alactic (ATP-CP)
• anaerobic lactic (glycolytic)
• aerobic.
	• Anaerobic - creatine phosphate or phosphocreatine (ATP-PC or alactic system):
	  ○ ATP and creatine phosphate (CP) are present in very small amounts in the muscle cells – so limited stores.
	  ○ Can supply energy very quickly because oxygen is not needed for the process - but only lasts up to 10 seconds.
	  ○ No lactic acid is produced in the process (alactic) so no harmful waste products.
	  ○ By-product creatine (non-fatiguing) is replenished (after around three to five minutes rest).
	  ○ Activities -high intensity, very short duration.
	• Anaerobic lactic acid (glycolytic) system:
	  ○ Uses carbohydrates (glucose) stored in the muscles as glycogen without oxygen.
	  ○ Energy is produced quickly – lasts around 2 minutes if trained.
	  ○ Fatiguing by product - lactic acid (muscle burn/oxygen deficit)
	  ○ Activities - moderate to high intensity, short duration
	• Aerobic system (with oxygen):
	  ○ Uses carbohydrates (glucose/glycogen) and fats to replenish ATP with oxygen.
	  ○ Because oxygen is required for the process, energy production takes longer but can continue for a much longer duration. So slower to engage but can continue for a longer duration.
	  ○ Because of the presence of oxygen, no lactic acid is produced.

	○ Waste products - CO_2, and water (removed easily and non-fatiguing). ○ Activities - low to moderate intensity, long-term duration. ○ Role of mitochondria (only in aerobic energy production): – Cellular structure which turns the energy in food into fuel that the cell can use for energy (ATP). ○ Role of each macronutrient in energy production. • Metabolism or metabolic processes (chemical processes) comprises catabolism and anabolism: ○ Catabolism – breakdown of nutrients for energy production (destructive/breaks down). ○ Anabolism – body uses energy released by catabolism to remake ATP (constructive – rebuilds). • The effects of exercise on energy systems**:** ○ How each energy system works in conjunction with the others (not insolation) to produce energy in a range of activities. ○ How exercise variables result in the adaptation of the relative contribution of each energy system. ○ Predominant system depends on intensity and duration: – The effects of intensity (increased intensity would increase the contribution of the anaerobic systems). – The effects of duration (longer-duration activities would require increased input from the aerobic energy system because the anaerobic systems cannot function effectively for long periods). – Excess post-exercise oxygen consumption (EPOC). - the amount of oxygen the body needs to remove lactic acid and repay the oxygen debt (and return to normal after exercise). – Interrelationship between energy systems and efficiency of cardiovascular, respiratory and muscular systems.

10. Understand lifespan changes which affect the body system, health, and wellbeing	

10.1 Outline the effects of different lifespan changes to the body systems:
• young people (13-18)
• antenatal and postnatal period
• older adults (50 plus).
	• All body systems change in response to the lifespan, particularly:
	  ○ Young people in the 13-18 age range, to include:
	  – Skeletal development (endomorphs, ectomorphs, mesomorphs).
	  – Growth and development of the spine.
	  – Maturation of the skeletal system (13-18 years).
	  – Growth plates and injury risk.
	  – Percentage (%) muscle mass changes from birth.
	  – Age at which bone growth complete.
	  – Body fat differences in adolescence.
	  – Obesity levels increasing and body mass index (BMI) measures.
	  ○ Ante and post-natal, to include:
	  – Skeletal system changes including potential postural changes.
	  – Hormone changes – effect of relaxin and other hormones including human chorionic gonadotropin (HGC), progesterone and oestrogen.
	  – Changes affecting balance.
	  – Considerations for exercise including warning signs – suitable exercise pre 16 weeks and post 16 weeks together with considerations for postnatal.
	  ○ Older people (50 plus), to include:
	  – Ageing and the musculoskeletal system.
	  – Hormone changes, including effects of menopause.
	  – Loss of bone mass and effects of exercise.
	  – Changes in osteoblast/osteoclast activity.
	  – Implications of reduction in bone-mineral density and connective tissue:
	  ▪ osteopenia/osteoporosis and gender differences
	  ▪ osteoarthritis
	  ▪ hyaline cartilage wear and tear
	  ▪ increase risk of falls and fractures
	  ▪ joint degeneration

	▪ reduced range of motion. – Sarcopenia – loss of muscle mass and effects on strength. – Cardiovascular disease (CVD) risk and ageing between genders (men at greater risk from younger age and women after menopause). – Exercise considerations and risks. **NB**: Additional qualifications are required to work with the groups in this section.

11. Understand the effects of exercise on body systems	
11.1 Describe the effects which exercise has on the body systems	• Short-term effects: ○ Muscle temperature and body temperature increases. ○ Increased flow of the synovial fluid into the joints. ○ Speeding up the frequency of nerve impulses to motor units. ○ Increased breathing rate and heart rate. ○ Increased dilation of capillaries within the muscle. ○ Increased blood pressure. ○ Increased pliability of muscle (more flexible/stretchier). ○ Delayed onset muscle soreness (DOMS) may be experienced (one to two days after training). • Long-term effects: ○ Stronger heart. ○ Increased stroke volume. ○ Reduced resting heart rate. ○ Improved efficiency of cardiovascular system. ○ Improved bone mineral content and bone density. ○ Reduced risk of osteoporosis. ○ Improved release of synovial fluid into the joints. ○ Improved joint mobility and range of motion. ○ Stronger ligaments and tendons. ○ Improved joint stability. ○ Improved posture and joint alignment. ○ Hypertrophy. ○ Increased muscle strength and endurance. ○ Improved muscle tone and shape.

	○ Improved synchronous recruitment of motor units. ○ Improved capillarisation of muscles and greater potential for delivery of oxygen and nutrients and removal of waste products improves endurance. ○ Increased size and number of mitochondria. ○ Enhanced neuromuscular connections and improved motor skills. ○ Improved skill-related fitness (motor fitness): – power. – speed – reaction time – agility – coordination – balance.

Principles of physical activity, exercise, and fitness (L/650/9760)

Unit aim

To provide essential foundation knowledge regarding the role of physical activity, exercise, and different training approaches to develop fitness and health.

Content

1. Understand exercise, physical activity, health and fitness	

1.1 Outline the components of health/total fitness	• Definitions and brief descriptions of:
	  ○ The components of total fitness and health:
	  – emotional
	  – social
	  – nutritional
	  – mental
	  – medical
	  – spiritual
	  – physical.
	  ○ The health-related components of physical fitness:
	  – cardiovascular endurance
	  – muscular strength
	  – muscular endurance
	  – flexibility
	  – body composition.
	  ○ The skill-related components of physical fitness:
	  – agility
	  – speed
	  – coordination
	  – reaction time
	  – balance
	  – power.
	  ○ The interrelationship between the components of total fitness and those of physical fitness.

	○ The interrelationship between the components of total fitness in relation to overall health and wellbeing.
1.2 Explain the differences between physical activity, exercise, health, and fitness	• Definitions and examples of**:** ○ Physical activity – any bodily movement that requires energy expenditure. ○ Exercise – planned and structured physical activities used to improve one or more components of fitness. ○ Health – WHO definition. ○ Fitness: – components of fitness (definitions): ▪ health-related components (see above) ▪ skill-related (see above). – ACSM guidelines for each component. ○ National UK guidelines for physical activity and health for different ages - Chief Medical Officer (CMO). ○ The dose-response relationship for physical activity – more is better, move more often. ○ The importance of evidence-based practice.
1.3 Explain exercises and approaches to develop the components of physical fitness: • health-related • skill-related.	• Definitions of each component of fitness (as above). • Why each component is needed – benefits and effects for fitness, health, and skills: ○ Purpose and methods of training flexibility. ○ Purpose and methods of training muscular fitness. ○ Purpose and methods of training cardiovascular fitness. ○ Purpose and methods of training skill-related components. • How to train each component for fitness and health. • Application of ACSM International guidelines for each component. • Application of FITT-VP principles (frequency, intensity, time, type, volume, progression) for each component. • Differences between programming exercise for physical fitness and for health benefits. • How individual goals will affect application and approach. • Goal setting: ○ Linked to group needs, wants and motivators. ○ SMART (specific measurable achievable realistic targeted).

1.4 Outline the benefits and effects of different types of exercise on the body systems, including their role in the prevention of health conditions	• Different group exercise class types/genres:
	  ○ kettlebell
	  ○ suspension
	  ○ aqua
	  ○ circuits
	  ○ dance based
	  ○ body conditioning etc.
	  ○ yoga, Pilates, tai chi
	  ○ walking, running etc.
	  ○ small groups, large groups, one-to-one (PT)
	• Gym-based exercise:
	  ○ resistance training (machines, free weights, body weight)
	  ○ CV machines training
	  ○ core exercise
	  ○ functional
	  ○ flexibility training etc.
	• Components of fitness trained in different genres and approaches.
	• Benefits of training each component of fitness (see above).
	• Effects of training each component of fitness (see above):
	  ○ health and wellbeing benefits
	  ○ physiological benefits
	  ○ psychological benefits.
	• Benefits of different environments:
	  ○ gym based
	  ○ studio based
	  ○ water based/pool
	  ○ sports hall
	  ○ outdoors and different outside spaces, e.g. park, beach, rural, urban
	  ○ home based or confined space.
	• How to select the most appropriate exercise/exercise modes to meet the needs/goals of the individual/group.
	• How to communicate the health-related benefits of exercise to clients.

1.5 Describe factors that affect exercise and fitness	• individual factors:
	  ○ age
	  ○ gender
	  ○ hereditary factors
	  ○ body type
	  ○ muscle fibre type
	  ○ motivation
	  ○ medical health.
	• lifestyle factors:
	  ○ healthy or unhealthy eating
	  ○ smoking or non-smoking
	  ○ alcohol or no alcohol
	  ○ inactivity/activity
	  ○ sleep
	  ○ stress.

2. Understand how to structure and design an exercise session	

2.1 Outline how to structure an exercise session	• Structure:
	  ○ warm-up or preparatory phase
	  ○ main component to focus on components of fitness
	  ○ cooldown or closing phase.
	• Selection of exercises for each phase:
	  ○ discipline and genre specific
	  ○ session aims and goals.
	• Realistic timings and sequences for sessions, including:
	  ○ The duration and intensity of components relating to individual factors:
	  – age
	  – health conditions
	  – impairments and disabilities etc.

2.2 Describe the structure and purpose of a warm-up (preparatory phase)	• Importance and purpose of a warm-up – why needed.
	• A short activity or exercise undertaken prior to a more intensive exercise or activity intended to gradually prepare the body systems for the movement/activities to follow:
	  ○ Musculoskeletal, cardiovascular, respiratory, nervous and energy systems
	• Physiological effects of warm-up – link with anatomy physiology and body systems.
	• Outline of how to design a warm-up:
	  ○ Mobility, warming, muscle lengthening.
	• Factors affecting warm-up design:
	  ○ type of session – group or one-to-one
	  ○ individual factors
	  ○ temperature and environment.

2.3 Describe the structure and purpose of a main component for developing specific components of fitness	• How to design the main component to train:
	  ○ cardiovascular fitness
	  ○ muscular fitness
	  ○ flexibility
	  ○ functional.
	• Physiological effects of different types of training
	  ○ link with anatomy physiology and body systems
	  ○ effect of speed of movement on posture, alignment, and intensity.
	• How different types of exercise session train each component – genre specific.
	• Components of fitness excluded in some training approaches and the appropriate advice to give:
	  ○ yoga
	  ○ Pilates
	  ○ Tai chi
	  ○ walking
	  ○ dance based
	  ○ gym based.
	• How to programme exercise to develop specific fitness components (see 1.1-1.7).

	• Overview of specific fitness training techniques:
	  ○ Cardiovascular exercise approaches - steady state, interval, fartlek:
	  – heart rate
	  ○ Resistance exercise approaches - a range of training systems, exercise equipment, fixed and free weights:
	  – exercises to target major muscles/muscle groups.
	  – the importance of muscle balance.
	  ○ Functional exercise: movement patterns, muscle actions and components of fitness which mirror a client's functional requirements.
	  ○ Flexibility exercise: static, ballistic, dynamic and proprioceptive neuromuscular techniques (including the myotatic/stretch reflex) to facilitate increased range of motion.

2.4 Describe the structure and purpose of a cooldown (ending phase)	• Importance and purpose of a cooldown – why it is needed.
	• Return to pre-activity state:
	  ○ muscle lengthening
	  ○ prevent blood pooling and support venous return.
	• Physiological effects of cooldown – link with anatomy physiology and body systems.
	• Brief outline of how to design a cooldown:
	  ○ pulse lowering, muscle stretching.
	• Factors affecting cooldown design:
	  ○ type of session – group or one-to-one
	  ○ individual factors
	  ○ temperature and environment.

2.5 Outline how to apply the principles and variables of training to session and programme design	• Principles and variables of fitness/training: ○ FITT-VP principles - frequency, intensity, time, type, volume, progression. • Adaptation, modification, and progression for all session components. • Implications of specificity, progressive overload, reversibility, adaptability, individuality, recovery time.

Appendix 1: Information sources

Please note: While the information sources listed are available at the point of development/publication; access to specific website pages will change over time, as will the relevance of information.

Information sources and organisations:

- American College of Sports Medicine (ACSM): www.acsm.org/.
- Association for Nutrition: www.associationfornutrition.org/.
- Beat Eating Disorders: www.beateatingdisorders.org.uk/.
- British Diabetic Association- Diabetes UK: www.diabetes.org.uk.
- British Heart Foundation: www.bhf.org.uk.
- British Nutrition Foundation: www.nutrition.org.uk/.
- CIMSPA: www.cimspa.co.uk/.
- Department of Health: www.dh.gov.uk.
- Drinkaware: www.drinkaware.co.uk.
- EMD UK: https://emduk.org/
- National Institute of Health and Care Excellence (NICE): www.nice.org.uk/.
- National Library of medicine: www.ncbi.nlm.nih.gov/pmc/articles/PMC3943438/.
- National Library of Sports Medicine: pubmed.ncbi.nlm.nih.gov/18049985/.
- NHS Choices: www.nhs.uk/Livewell/Goodfood/Pages/eatwell-plate.aspx.
- NHS Eatwell: www.nhs.uk/live-well/eat-well/.
- The Eatwell Guide: www.gov.uk/government/publications/the-eatwell-guide.
- World Health Organisation (WHO): www.who.int/.

Textbooks:

- American College of Sports Medicine. (2022). 11th edition. *ACSM's Guidelines for Exercise Testing and Prescription*. USA: Wolters Kluwer.
- Bean, Anita. (2022). 9th edition. *The Complete Guide to Sports Nutrition*. London, UK: Bloomsbury Publishing.

Guidance for training providers

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