Learner Manual

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Level 2 Certificate in Fitness Instructing (Gym)

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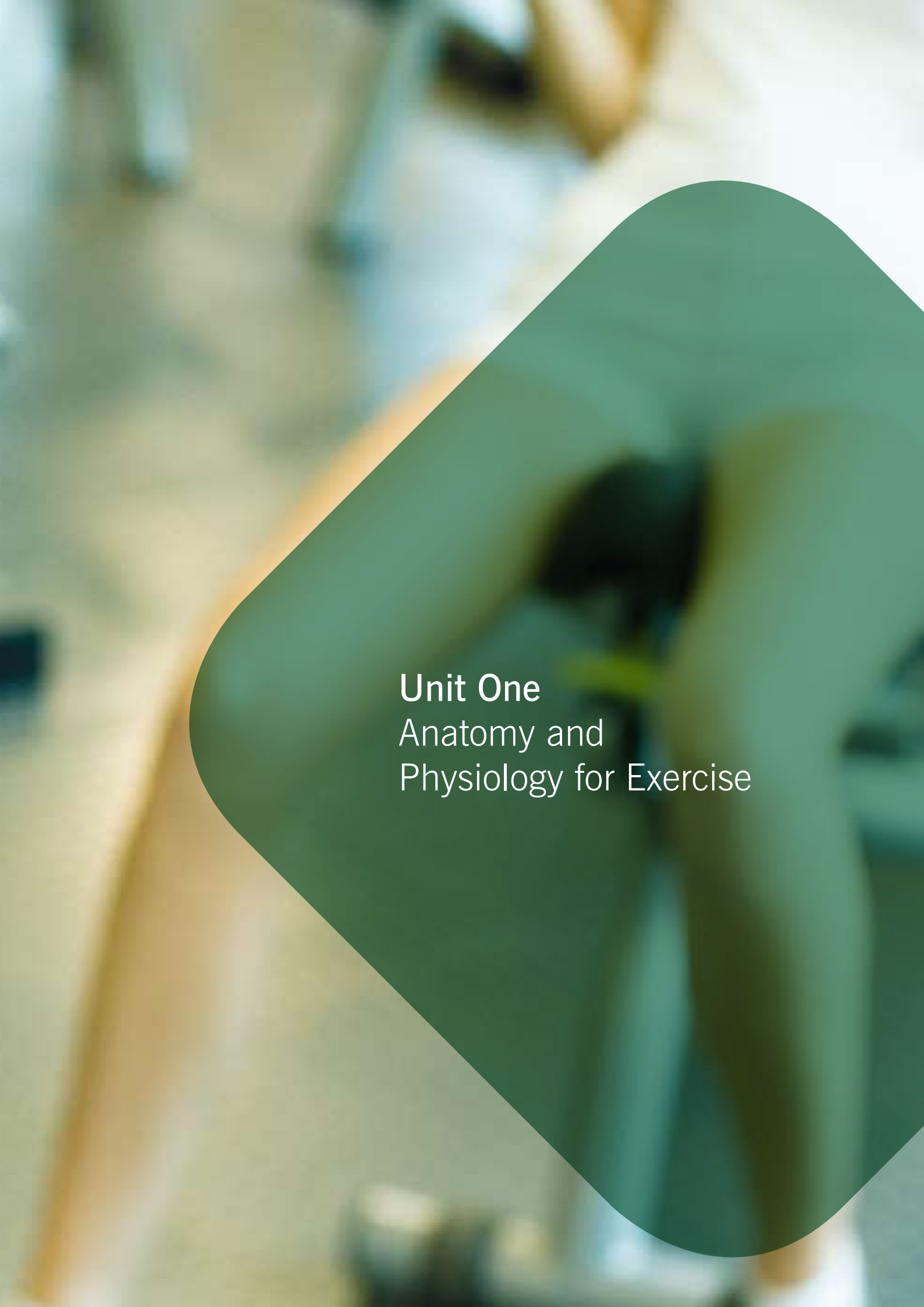

Unit One
Anatomy and Physiology for Exercise

Anatomy and Physiology for Exercise

Aim: To provide learners with a basic knowledge of anatomy and physiology and how it relates to exercise and fitness.

Learning outcomes

By the end of this unit the learner will be able to understand:

- the structure and function of the skeleton
- joints of the skeleton
- the muscular system
- the life-course of the musculoskeletal system and its implications for special populations and exercise
- the structure and function of the respiratory system
- the structure and function of the circulatory system
- the nervous system and its relation to exercise
- energy systems and their relation to exercise

Introduction

With a basic understanding of anatomy and physiology in relation to exercise the fitness instructor will gain an appreciation of the demands placed on the body when instructing physical activity. In turn this awareness will assist the instructor in designing an effective programme of exercise.

The skeletal system

The skeletal system consists of bone, cartilage and ligaments.

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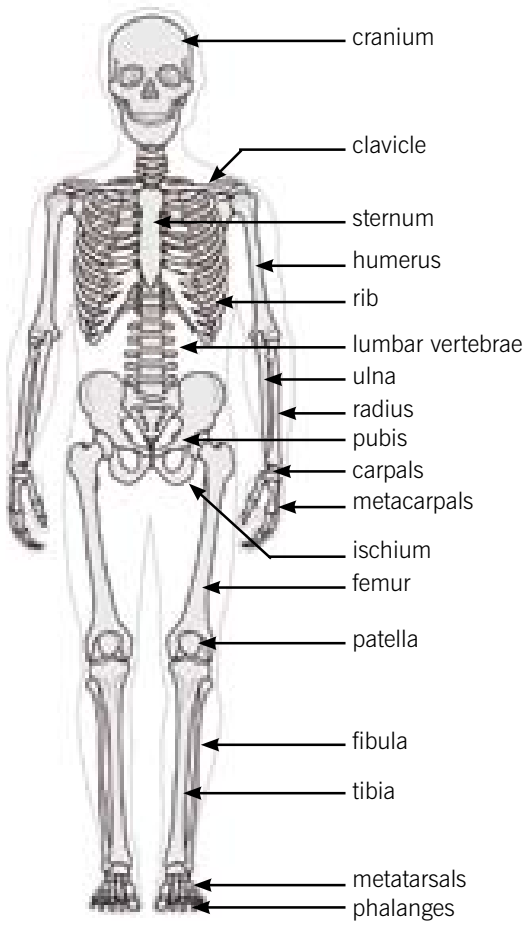
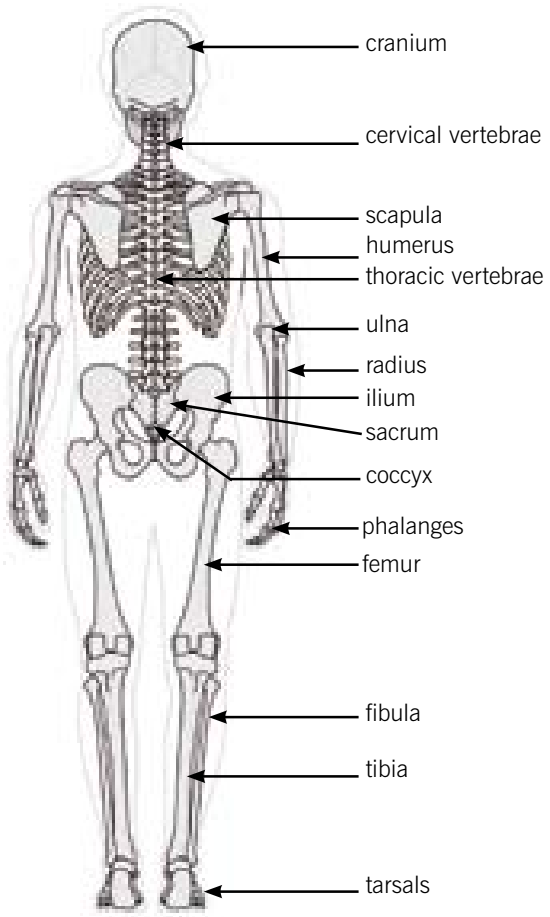
Bone

Bone is calcified connective tissue that forms most of the adult skeleton. The skeleton consists of approximately 206 bones.

Anterior Skeleton (Front)



Posterior Skeleton (Back)



Functions of the skeleton

Functions of skeleton	Description
Framework	To provide a bony framework for the body and to give it shape
Protection	To support and protect certain vital internal organs (e.g. the skull giving protection to the brain)
Locomotion	To act as biomechanical levers on which muscles can pull to produce joint motion
Soft tissue attachment	To provide surfaces for the attachment of soft tissues e.g. muscles and ligaments
Production	Certain bones produce red blood cells, granular white blood cells and platelets from their red bone marrow
Storage	To store several minerals such as calcium and phosphorus, to be released when required. Triglycerides are also stored in the adipocytes of yellow bone marrow

The axial and appendicular skeleton

The skeletal system can be broken down into:

- the axial skeleton – spine, ribs and skull
- the appendicular skeleton – upper and lower limbs, the pelvic and shoulder girdles

The following tables list the bones contained within the two components of the skeletal system.

The axial skeleton			
General area	Bones	No. of bones in body	Notes
Skull	Cranial	8	The head
Spine	Cervical vertebrae Thoracic vertebrae Lumbar vertebrae Sacral vertebrae Coccygeal vertebrae	7 12 5 5 4	The neck region Chest area Lower back Rump (fused) Used to be the tail (fused)
Chest	Ribs (costals) Sternum	12 Pairs 1	All originate from the thoracic vertebrae and pairs extend round to form the chest wall, first 7 pairs attach on the sternum. Next 3 pairs have common cartilaginous attachment to the sternum. Last 2 pairs are free (floating) Receives the clavicle and upper 10 pairs of ribs

The appendicular skeleton			
General area	Bones	No. of bones in body	Notes
Shoulders	Scapulae (shoulder blade) Clavicle (collar bone)	2 2	Held on by muscular attachments to the ribcage at the back and the clavicle at the front Maintains the scapula at a correct distance from the chest wall
Arms	Humerus Radius Ulna	2 2 2	Bone of the upper arm Inner bone of the forearm With the radius forms the elbow joint at the humerus and the wrist at the lower end
Hands	Carpals Metacarpals Phalanges	16 10 28	Form the wrist in two rows of four First metacarpal is the thumb and the rest are in the palm The fingers (3 each) and the thumbs (2 each)
Pelvis	Ilium Ischium Pubis	2 2 2	The sacrum interlocks with the pelvis and the lower limbs articulate with it
Legs	Femur Tibia Fibula Patella (kneecap)	2 2 2 2	The thigh bone is the longest bone in the body and forms the knee joint with the tibia Lower leg – weight-bearing Lies outside the tibia and forms part of the ankle joint below (non-weight-bearing) Lies within the tendons of the muscles passing over the knee joint
Feet	Tarsals Metatarsals Phalanges	14 10 28	Foot and ankle Similar to metacarpals Toes – as fingers

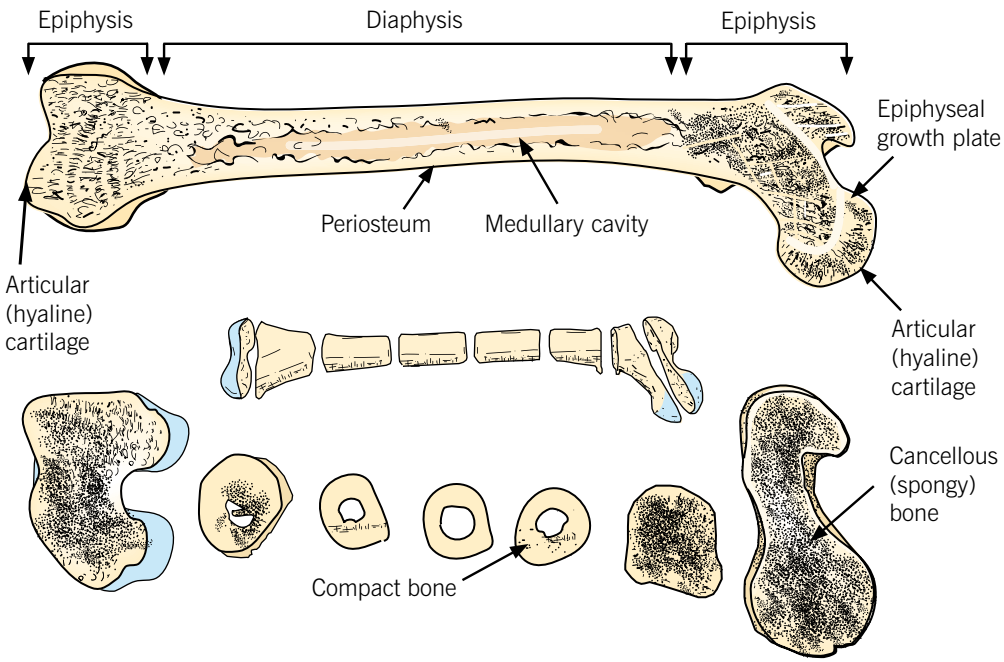
Bone classification

Bones can be classified according to their formation and shape:

Classification	Description	Examples
Long bones	Long bones have a greater length than width and consist of a shaft with normally two extremities. They contain mostly compact bone in their diaphysis and more cancellous bone in their epiphysis (and principally act as levers).	Humerus, femur, fibula, tibia, ulna, radius, metacarpals, metatarsals, phalanges
Short bones	Short bones are normally about as long as they are wide. They are usually highly cancellous, which gives them strength with reduced weight	Carpals and tarsals
Flat bones	Flat bones are thin cancellous bone sandwiched between two compact layers. They provide protection and large areas for muscle attachment	Scapula, cranial bones, costals (ribs), sternum and ilium
Irregular	Irregular bones form very complex shapes and therefore, cannot be classified within the previous groups	Vertebrae and calcaneus
Sesamoid ('seed-like')	Sesamoid bones develop within particular tendons at a site of considerable friction or tension. They serve to improve leverage and protect the joint from damage	Patella (kneecap)

Structure of a long bone

- **epiphysis** – expanded portion at each end of the bone
- **diaphysis** – the shaft of the bone
- **hyaline cartilage** – covering the bone ends
- **periosteum** – a tough fibrous sheath covering the whole bone
- **compact bone** – solid, strong and resistant to bending
- **cancellous bone** – giving the bone elastic strength to resist compression forces
- **medullary cavity** – the hollow tube down the centre of the compact bone
- **yellow marrow** – this functions for the storage of fat
- **red marrow** – this functions in the production of various types of blood cells



Bone formation

Osteoblasts - cells that help form bone

Bone is made up of minerals and is hard. Many believe that bone is not living material, but a bone in a living animal consists of both living tissue and non-living substances. Within the "alive bone" are blood vessels, nerves, collagen, and living cells including:

Osteoclasts - cells that help eat away old bone

- **osteoblasts** (cells that help form bone)
- **osteoclasts** (cells that help eat away old bone)

In addition, bone contains cells called osteocytes, which are mature osteoblasts that have ended their bone-forming careers. The non-living, but very important, substances in bone are the minerals and salts.

In the foetus, most of the skeleton is made up of cartilage, a tough, flexible connective tissue that has no minerals or salts. As the foetus grows, osteoblasts and osteoclasts slowly replace cartilage cells and ossification begins.

Ossification

Ossification is the formation of bone by the activity of osteoblasts and osteoclasts and the addition of minerals and salts

Ossification is the formation of bone by the activity of osteoblasts and osteoclasts and the addition of minerals and salts. Calcium compounds must be present for ossification to take place. Osteoblasts do not make these minerals, but must take them from the blood and deposit them in the bone. By the time we are born, many of the bones have been at least partly ossified.

In long bones, the growth and elongation (lengthening) continue from birth through adolescence. Elongation is achieved by the activity of two cartilage plates, called epiphyseal plates, located between the shaft (the diaphysis) and the heads (epiphyses) of the bones. These plates expand, forming new cells, and increasing the length of the shaft. In this manner, the length of the shaft increases at both ends, and the heads of the bone move progressively apart. As growth proceeds, the thickness of the epiphyseal plates gradually decreases and this bone lengthening process ends. In humans, different bones stop lengthening at different ages, but ossification is fully complete between the ages of 18 and 30. During this lengthening period, the stresses of physical activity result in the strengthening of bone tissue.

In contrast to the lengthening of bone, the thickness and strength of bone must continually be maintained by the body, that is, old bone must be replaced by new bone all the time. This is accomplished as bone is continually deposited by osteoblasts, while at the same time, it is continually being reabsorbed (broken down and digested by the body) by osteoclasts.

Factors affecting bone formation

Bone development is influenced by a number of factors, including:

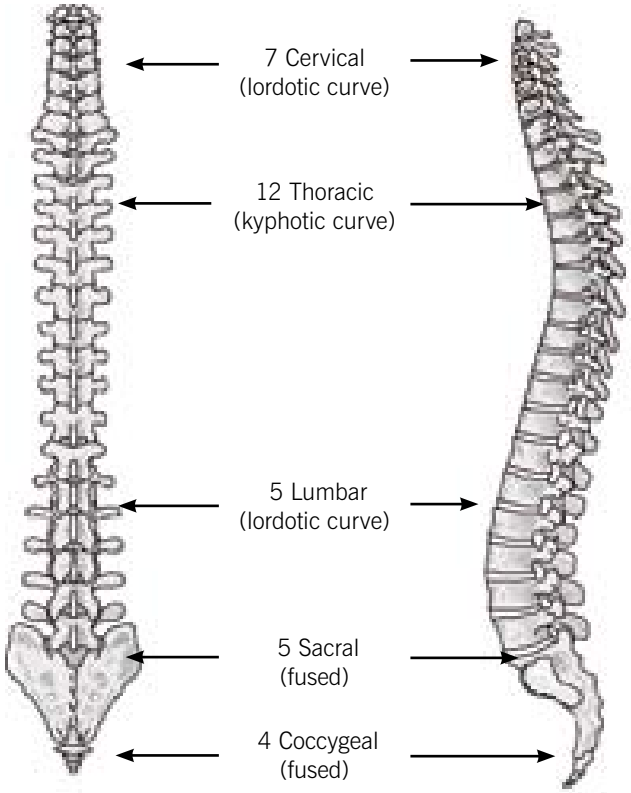
- nutrition
- exposure to sunlight
- hormonal secretions
- physical exercise

For example, exposure of skin to the ultraviolet portion of sunlight is favourable to bone development, because the skin can produce vitamin D when it is exposed to such radiation. Vitamin D is necessary for the proper absorption of calcium in the small intestine. In the absence of this vitamin, calcium is poorly absorbed, the bone matrix is deficient in calcium, and the bones are likely to be deformed or very weak.

A neutral spine is the term used to describe a slight lordosis, or arch, in the lower back

Posture and the spine

The spine is shaped in a single curve during development within the foetus. As the spine matures it develops into four curves; two convex and two concave.



Development of spinal curves

The greatest ranges of movement occur in the cervical and lumbar regions. The degree of thoracic movement is slight when compared to that of the neck and the lower back (Thompson and Floyd, 2001).

Neutral spine

A neutral spine is the term used to describe a slight lordosis, or arch, in the lower back. This position, which will vary from one individual to the next, seems to be the ideal position to decrease stress on passive structures of the body, such as the vertebrae and ligaments (McGill, 2002). This is therefore, an ideal postural position

to teach those participating in physical activity, in order to help reduce the risks of lower back pain. Lifting in this neutral spine, will help spare the stress on passive structures, and teach the abdominal and hip musculature to hold the body in this optimal position.

Common postural abnormalities

The diagrams below show some common postural abnormalities. From left to right: normal curvature of the spine, lordosis (excessive lower back curvature), kyphosis (excessive mid-back curvature) and scoliosis (a lateral deviation of the spine). These abnormalities increase stress on the spine and surrounding soft tissue structures, as well as decreasing the efficiency with which the body moves. It is thought that the normal thoracic and lumbar curves, when in a static neutral position, should be approximately 20-45 degrees. Whilst a minor lateral deviation of the spine is considered fairly normal, a curve of more than 10 degrees would be considered a scoliosis.

Normal *Lordosis* *Kyphosis* *Scoliosis*

Postural abnormalities

It is not uncommon for posture to alter during pregnancy. The extra weight on the front of the body can cause alterations to the position of the pelvis and lengthen the abdominal muscles. While a number of postural deviations may present themselves, this may cause an increased lordotic curve of the lumbar spine. Following birth, it is not uncommon for a scoliosis to develop as a result of the mother carrying the child on their hip (one side) which may cause a lateral deviation to the spine.

Connective tissue

Connective tissue is present in the body to surround, connect and stabilise the various joints. It is not innervated by the nervous system and has non-contractile properties. Connective tissue comes in three main categories:

- cartilage
- ligaments
- tendons

Cartilage

There are three types of cartilage found in the body, each fulfilling a separate function:

- hyaline (articular) cartilage:
  - the most common type
  - tough, smooth, thin and bluey-white in colour
  - found covering the bone ends to form joints
  - found in synovial and cartilaginous joints
  - becomes slippery when lubricated with synovial fluid
  - will reduce friction allowing optimal joint movement

- elastic cartilage:
  - similar to hyaline cartilage in its structure
  - more fibres than hyaline
  - most of the fibres are made up of elastin as opposed to collagen
  - it's the properties of elastin that give it the ability to spring back into shape immediately
  - found in the ear, walls of the Eustachian tube and the epiglottis, all places that require maintenance of a specific shape

- fibrocartilage:
  - thicker and stronger than the other two
  - limited distribution within the body
  - forms various shapes according to its role
  - acts like a shock absorber in cartilaginous joints

Characteristics of cartilage	
Dense	Very durable
Tough	Does not have a blood supply
Fibrous	Has a limited ability to repair itself
Withstands compression	Is dependent on regular activity for health
Can be worn or torn	

Characteristics of cartilage

Ligaments

Ligaments connect bone-to-bone

Ligaments have four main functions within the body:

- connect bone-to-bone
- enhance joint stability
- guide joint motion
- prevent excessive motion in the joint

Characteristics of ligaments	
Tough, white, non-elastic fibrous tissue	Strung together in a cord or strap-like formation
Attach bone-to-bone in all joints to provide stability	Allow normal movement and prevent unwanted movement
Withstand tension	Prolonged tension will permanently damage the fibres

Characteristics of ligaments

Tendons attach muscle to bone

Tendons

Tendons are similar to ligaments but play a slightly different role in the body. Tendon functions include:

- attaching muscle to bone
- transmitting the force produced by the muscle

General note

Blood supply is one of the major factors during the healing process of injury. It can be noted that whilst bone and muscle tissue often unite fairly easily and quickly, this is not as easily achieved with injury to ligaments and tendons because of their poor blood supply. Healing is even more doubtful for cartilage, which has even less of a nutrient supply. When torn, fibrocartilage may need surgical removal (e.g the menisci in the knee).

Anatomical terminology

The anatomical position is the descriptive starting point for many terms, and is when the body is stood upright with the arms by the side and the palms facing forward.

Structures throughout the body are often described by their position in relation to the centre midline (an imaginary line running from the head to between the feet) of the body, as follows:

- anterior — in front of the midline
- posterior — behind the midline
- lateral — away from the midline
- medial — towards the midline
- superior — upper aspect of a structure
- inferior — lower aspect of a structure
- sub — underneath

Types of joints

Joint definition: the junction of two or more bones

Classification

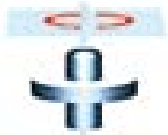
There are **three** types of joint, the degree of movement dictating the classification:

- fibrous - immovable and interlocking bones such as the plates in the skull
- cartilaginous - slightly movable bones brought together by ligaments e.g. the vertebrae
- synovial - freely movable, the most common type, having the following characteristics:
  - ends of the bone covered with hyaline (articular) cartilage
  - stabilised by ligaments
  - surrounded by a fibrous capsule
  - capsule lined by synovial membrane that secretes synovial fluid as lubrication

Synovial joints can be further broken down into **six** sub-groups:

- gliding joints
- pivot joints
- saddle joints
- ball and socket joints
- ellipsoid joints
- hinge joints

Types of synovial joint

Joint type	Diagram	Example picture	Example	Function
Ball and socket			Hip	A ball and socket joint allows for movement in almost any direction (e.g. shoulder and hip joint)
Hinge			Knee	A hinge joint allows flexion and extension of an appendage (e.g. elbow joint)
Pivot			Atlas – axis joint (C1-C2)	Pivot joints allow rotation around an axis. The neck and forearms have pivot joints. In the neck, the atlas (the uppermost cervical vertebra) rotates around the axis (second cervical vertebra). In the forearms, the radius and ulna twist around each other
Saddle			Carpometacarpal joint (thumb)	A saddle joint allows movement back and forth and up and down, but does not allow for rotation like a ball and socket joint (e.g. carpometacarpal joint)
Gliding (plane)			Acromio-clavicular joint	Gliding joints allow two bones to slide past each other (e.g. intercarpal, mid-carpal and mid-tarsal joints)
Ellipsoid			Metacarpo-phalangeal joints (knuckles)	Ellipsoid joints are similar to a ball and socket joint. They allow the same type of movement but to a lesser magnitude (e.g. metacarpophalangeal).

Types of joint movement

In order to develop a thorough understanding of the effects of exercise it is important to understand the effect that muscles have on the various joints of the body. This requires an understanding of joint movement terminology. Movement must be referred to a joint and related to the anatomical position e.g. elbow flexion, knee extension or hip abduction.

Movement terminology	
Normal terms (general)	**Description**
Flexion	Where the angle of the joint decreases or the return from extension
Extension	The angle of the joint increases or the return from flexion
Rotation	A bone rotating on its own long axis - may be medial (internal) or lateral (external)
Abduction	Away from the midline of the body
Adduction	Towards the midline of the body
Specific terms (regional)	**Description**
Horizontal flexion	Arm towards the midline of the body in the horizontal plane
Horizontal extension	Arm away from the midline of the body in the horizontal plane
Lateral flexion	Bending to the side
Circumduction	A circular or cone-shaped movement available at ball and socket joints
Elevation	Upward movement of the shoulder girdle
Depression	Downward movement of the shoulder girdle
Protraction	Forward movement of the shoulder girdle
Retraction	Backward movement of the shoulder girdle (squeezing the shoulder blades together)
Pronation	Palm of the hand facing downward
Supination	Palm of the hand facing upward
Dorsiflexion	Foot moves toward the shin
Plantarflexion	Foot moves away from the shin (tip-toe action)
Inversion	Sole of the foot faces the midline
Eversion	Sole of the foot faces away from the midline

Weight-bearing exercise increases bone density

Effects of exercise on the skeletal system

When discussing the effects of exercise it is necessary to consider:

- short term – while the individual is exercising
- long term – after a sustained period of appropriate training

Short term effects (of any movements/exercise):

- increase in synovial fluid production

In response to increased movement synovial joints will increase production of synovial fluid. This fluid acts as a lubricant to protect the joint from excess wear and tear (much like the oil in a car engine).

Long term effects (of weight-bearing exercise):

- stronger ligaments
- increased bone density

The muscular system

Muscles work to create forces across joints and cause movement.

Types of muscle tissue

Muscles work to create forces across joints and cause movement

There are **three** types of specialised muscle tissue:

Smooth and cardiac muscle are described as involuntary

- smooth muscle
- cardiac muscle (myocardium)
- skeletal muscle (striated)

Skeletal muscle is considered to be voluntary

Smooth muscle:

- has the greatest diversity throughout the body
- found in the digestive, circulatory, urinary and reproductive systems
- described as involuntary as it's controlled by the autonomic nervous system and is not under conscious control

Cardiac muscle:

- found in the heart
- involuntary
- contraction of the heart is controlled by the sinoatrial node (SAN)
- the set rhythm of the heart (on average 72bpm at rest) is called autorhythmicity

The function of the cardiac muscle is to pump blood (and oxygen) around the body.

Skeletal muscle:

- attaches across joints via tendons and bone
- controlled by the somatic nervous system, therefore it's considered to be voluntary
- produces locomotion and other body movements
- stabilises body positions, as in the maintenance of posture
- stores and transports substances within the body (glycogen)
- generates heat for warmth

Muscle properties

The **four** main properties of muscle tissue (Tortora et al, 2003) are:

- elasticity
- contractility
- electrical excitability
- extensibility

Muscle is described as being elastic, which means that it can stretch and then recoil to its original length. It can be compared with an elastic band in this respect, but like an elastic band, if the muscle is pulled too far it can tear. Muscles can also contract, pulling the muscle ends closer together. These muscle ends pull on the tendons and bones to which they are attached, allowing locomotion and other body movements.

The contraction and relaxation of skeletal muscle are in response to certain stimuli such as neurotransmitters, hormones or even changes in pH (Tortora et al, 2003). The ability to apply a large force in a short time, or a sustained force over a long duration, is possible because of the muscle's capacity to vary energy expenditure according to demand. During this production of energy, there is a large amount of heat generated. This must be distributed throughout the body and the excellent supply of blood within skeletal muscles allows this to occur. Muscles are therefore, described as being vascular, indicating a good blood supply.

There are over 700 skeletal muscles (Tortora et al, 2003) which allow for a multitude of body movements through contraction and relaxation of voluntary, striated muscle fibres. They make up more than 40% of the male body weight, though less in the body of a female.

The main constituents of skeletal muscle are:

- water **70%**
- protein (e.g. actin and myosin) **23%**
- minerals (e.g. calcium, potassium, phosphorus) and substrates (e.g. glycogen, glucose and fatty acids) **7%**

Skeletal muscle is made up of fibres:

- made up of smaller myofibrils
- within each myofibril are strands of myofilaments (actin and myosin)
- the orientation of muscle fibres depends on the location and function of the muscle
- the number of muscle fibres vary dramatically depending upon their function
- fibres grouped together in bundles are called fasciculi
- fasciculi are then grouped together to form the muscle

Muscles have a good blood supply

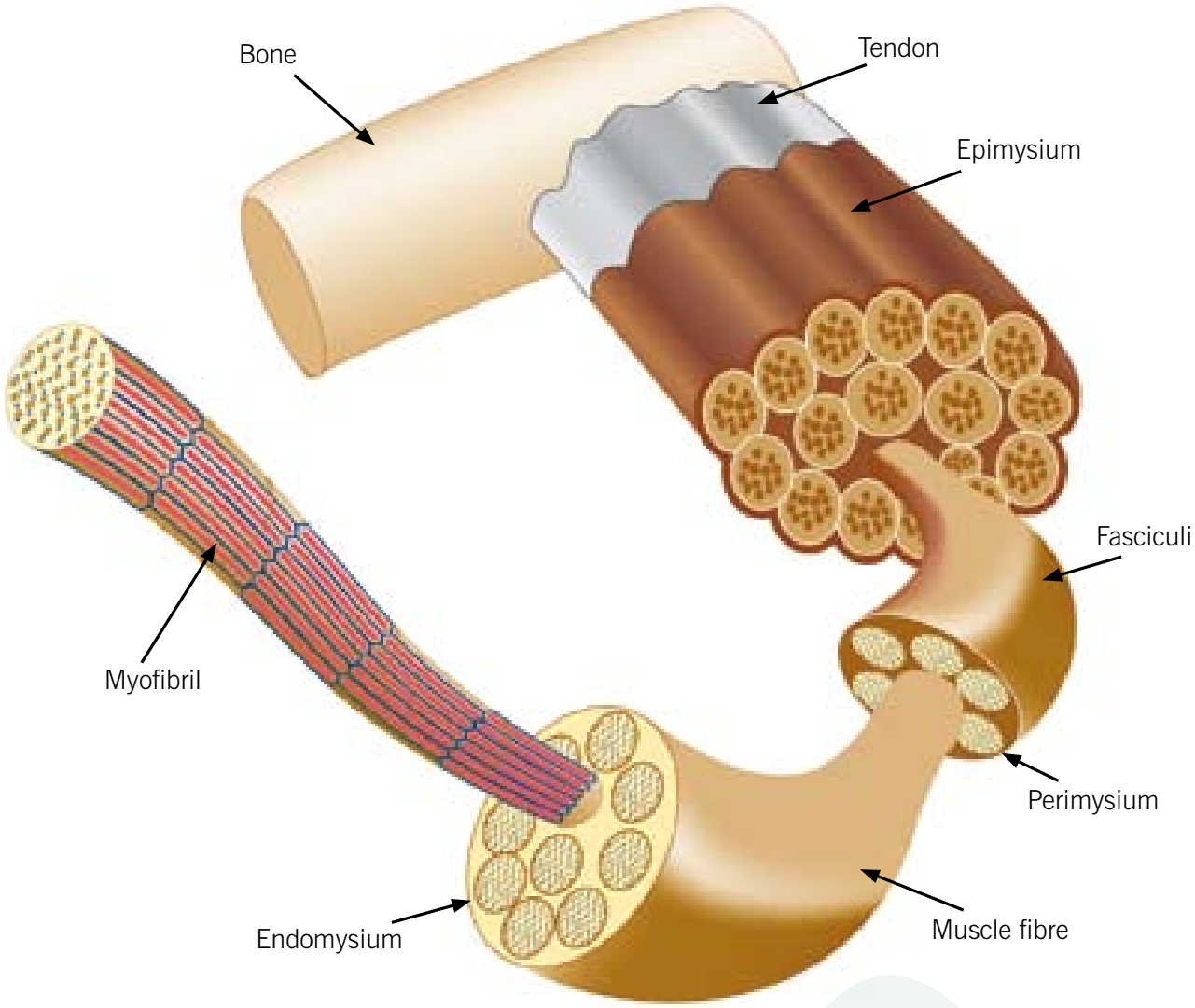
There is connective tissue throughout the various parts of the muscle:

- the endomysium surrounds each muscle fibre
- the perimysium envelops each of the fasciculi
- the epimysium, or fascia, covers the entire muscle

Connective tissue is continuous throughout the length of the muscle:

- layers of connective tissue converge to form tendons
- tendons are strong, inelastic and strap-like
- the tendon attaches to the periosteum, the sheath that surrounds the bone

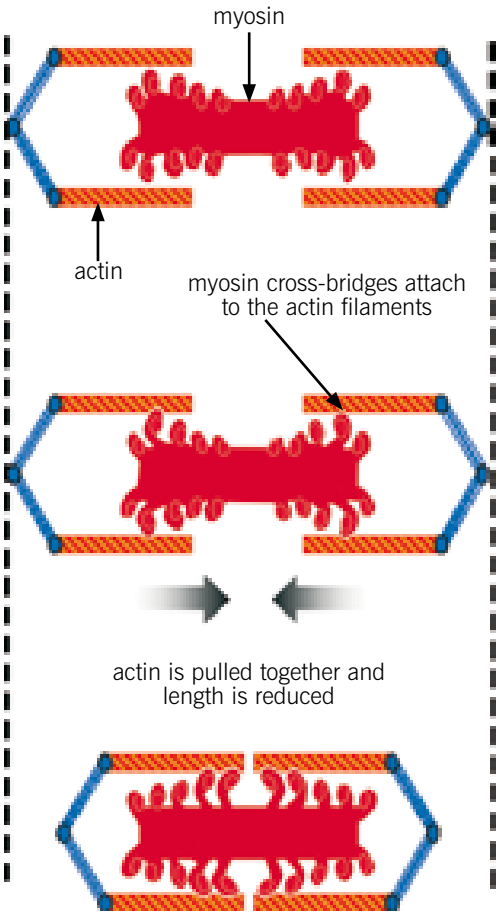
Skeletal muscle anatomy



The sliding filament theory

The ability of muscle to contract is one of its distinctive properties. This is described in relation to the structure of the myofilaments, actin and myosin, in the sliding filament theory.

Huxley originally developed the sliding filament theory in 1954, in order to explain the contraction of skeletal muscle, both physiologically and functionally. In essence, it states that the myofilaments, actin (a thin protein strand) and myosin (a thick protein strand), do not decrease in length themselves, but simply slide over each other, thus shortening or lengthening the entire muscle. This is accomplished with the unique structure of the protein myosin. The myosin myofilaments are shaped like golf clubs and form cross bridges with actin. Each myosin molecule has two projecting heads, and there are numerous myosin molecules lying next to each other. These heads will attach onto binding sites on the actin filaments which surround each myosin filament.



Sliding filament theory

Once the myosin has attached to the actin, the contraction phase can now take place. Adenosine triphosphate (ATP), the high energy molecule stored on the myosin head, provides the impetus for the myosin head to 'nod' in what is termed the 'power stroke'. It is this nodding action which 'slides' the thin actin myofilaments over the thick myosin myofilaments. The myosin head then binds with another ATP molecule, causing it to detach from the actin-binding site, the 'recovery stroke'. It is then able to attach to the next binding site, and perform the same routine.

Muscle fibre type

Skeletal muscle fibres are not all identical in structure and function. Two distinct fibre types have been identified and classified by their contractile and metabolic characteristics. The following list highlights the structural and functional features of fast and slow twitch muscle fibres, as well as examples of activities for which they are best suited (list adapted from Tortora and Grabowski, 1996):

Slow twitch (Type 1) muscle fibres contain many mitochondria and are red in colour

Fast twitch (Type 2) contain fewer mitochondria and are white in colour

Fibre type	Structural features	Functional features	Activities
Slow twitch or Type I	Smaller diameter size fibre Large myoglobin content Many mitochondria Many capillaries Red in colour	Increased oxygen delivery Produce less force Long term contractions Resistant to fatigue	Maintaining posture i.e. stabilisation Endurance-based activities
Fast twitch or Type II	Larger diameter fibre size Smaller myoglobin content Fewer mitochondria Fewer capillaries White (pale) in colour	Decreased oxygen delivery Produce more force Short term contractions Less resistant to fatigue	Rapid, intense movements

Muscle fibre type

Muscle fibre type considerations

Most skeletal muscles are a mix of fibre types. The proportion of slow and fast twitch fibres is determined by the usual role of the muscle. The muscles of the neck and back have a big role to play in the maintenance of posture and so have a high proportion of slow twitch fibres. In contrast, the muscles of the shoulders and arms are often called upon to generate considerable force and are not continually active in posture; consequently, these muscles have a higher proportion of fast twitch fibres. Leg muscles often have large numbers of both fast and slow twitch muscles, since they must both continually support the body and play a role in locomotion.

Training can increase the size and capacity of both types of muscle fibres to perform more efficiently (Seeley et al, 2000). Intense exercise, producing anaerobic metabolism, increases muscular strength and mass and results in an increase in the size of fast twitch over slow twitch fibres. Aerobic exercise increases the vascularity of muscle and has the opposite effect.

Everyone's muscles contain mixtures of fibre types but some have relatively more of one variety. These differences are genetically controlled and will significantly contribute to athletic abilities. For example, the muscles of marathon runners have a higher percentage of slow twitch fibres (about 80%), while those of sprinters contain a higher percentage of fast twitch fibres (about 60%). Interestingly, weightlifters appear to have approximately equal amounts of fast and slow twitch fibres (Marieb, 1995).

Neither fast twitch nor slow twitch muscle fibres can be easily converted to muscle fibres of the other type (Seeley et al, 2000). However, fast twitch fibres can be further divided into fast twitch oxidative (Type II A) and fast twitch glycolytic (Type II X) fibres. Type II A might be termed intermediate fibres since they take on some of the characteristics of Type I fibres. Endurance-type activities, such as running or swimming, cause a gradual transformation of some fast glycolytic (Type IIX) fibres into fast oxidative (Type IIA) fibres (Tortora and Grabowski, 1996) giving enhanced endurance abilities.

Origins and insertions

Each muscle has a recognisable end, either on a fixed bone (the origin of a muscle) or on the bone it usually moves during contraction (the muscle insertion). The origin is described as the proximal attachment i.e. the one nearest to the centre midline of the body (usually the anchor). Muscles may have more than one origin e.g. quadriceps (4), triceps (3), biceps (2). The insertion is described as the distal attachment i.e. the one furthest away from the centre midline. Usually muscles have a single insertion.

Types of muscle action

When lifting a weight muscles will be shortening, when lowering the weight muscles will be lengthening. Pause the activity in the middle, and the muscle stays the same length. However, be aware that the muscle is working throughout.

In order to help distinguish between the different types of muscular activity a number of terms are used:

- isotonic (same tone) - used to describe muscle actions involving movement i.e. concentric and eccentric
- concentric - muscle generates force and shortens
- eccentric - muscle generates force and lengthens
- isometric - muscle generates force and stays the same length
- isokinetic (same speed) - muscle actions involving movement at a constant speed

Thus during the lifting action of a bicep curl, the bicep brachii would be working concentrically. If at any point, the weight were held still, then this would represent an isometric action. Finally, as the weight was lowered (in a controlled manner) the biceps would be lengthening and thus working eccentrically.

Roles of muscles

Ultimately, efficient human movement is dependent on the coordinated activity of whole groups of muscles and will involve varying combinations of different muscle actions. In an attempt to distinguish between the diverse roles of muscle during movement, muscles can be placed into the following categories:

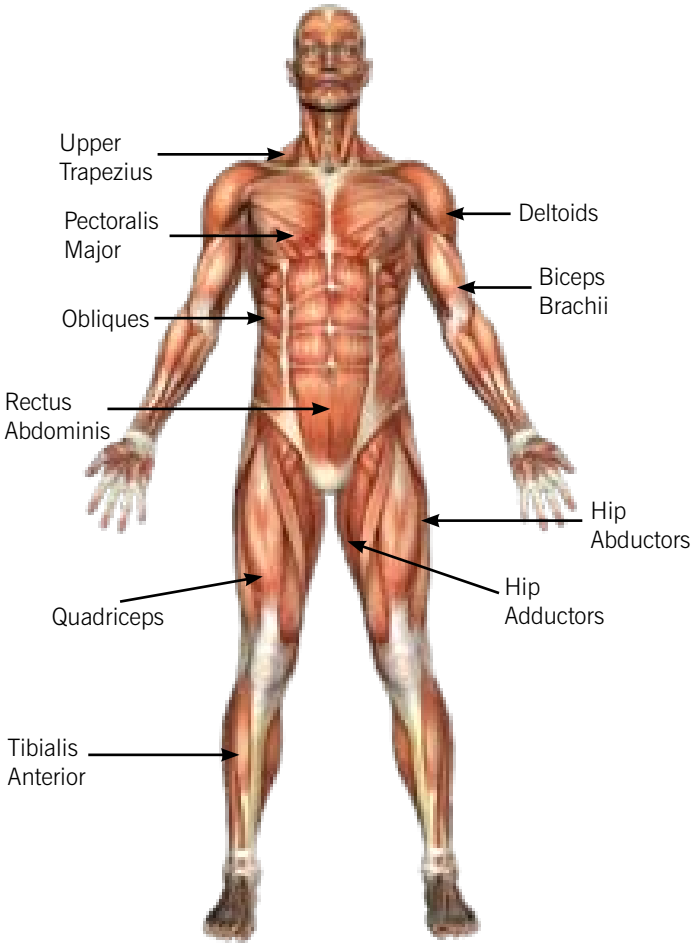
- agonist/prime mover: the muscle(s) that causes a desired action e.g. the bicep brachii during a bicep curl or the quadriceps during a leg extension
- antagonist: the opposing muscle(s) to the agonist e.g. the triceps brachii during a bicep curl or the hamstrings during a leg extension
- synergist: the muscle(s) that assists or modifies the movement of the prime mover e.g. during hip extension the hamstrings act as synergists for the gluteus maximus
- fixators: the muscle(s) that stabilises the part of the body that remains fixed e.g. shoulder girdle muscles stabilise the scapula to allow efficient movement at the shoulder joint

Muscle tone

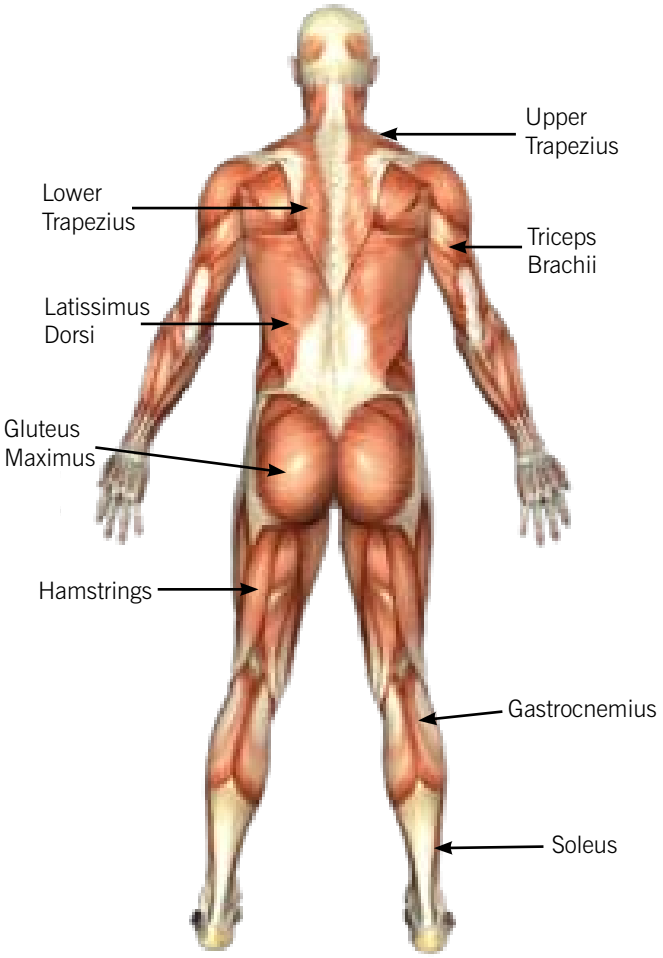
Muscle tone refers to a state in which a muscle in the body produces a constant tension over a long period of time. Essentially in 'toned' muscles many of the motor units are continually contracting out of phase to maintain an overall level of tension. Many of the muscles in our bodies are contracting throughout the day. Stabilisers in our back and abdominal regions are contracting to maintain an upright posture and this regular contraction results in their maintaining a strong muscle tone.

Muscles and muscle actions

Anterior muscles of the human body



Posterior muscles of the human body



Muscles and muscle actions

Muscle	Position	Origin	Insertion	Primary actions
Deltoids	Shoulder	Clavicle and scapula	Humerus	Abduction, flexion and extension of shoulder
Biceps brachii	Front of upper arm	Scapula	Radius	Flexion of elbow, supination of forearm, flexion of shoulder
Triceps brachii	Back of upper arm	Humerus and scapula	Ulna	Extension of elbow, extension of shoulder
Latissimus dorsi	Sides of the back	Lower thoracic vertebrae, lumbar vertebrae, ilium	Humerus	Adduction and extension of shoulder
Trapezius	Upper back	Base of skull, cervical and thoracic vertebrae	Clavicle and scapula	Elevation, retraction and depression of shoulder girdle
Rhomboids	Beneath trapezius	Upper thoracic vertebrae	Scapula	Retraction of shoulder girdle
Pectoralis major	Chest	Clavicle and sternum	Humerus	Horizontal flexion, adduction
Erector spinae	Either side of the spine	Sacrum, ilium, ribs, vertebrae	Ribs, vertebrae, occipital bone	Extension and lateral flexion of spine
Rectus abdominis	Along the centre of the abdomen	Pubis	Sternum	Flexion of spine, lateral flexion of spine
Internal obliques	Sides of the abdomen	Ribs, ilium	Ilium, pubis, ribs, linea alba	Rotation and lateral flexion of spine
External obliques	Sides of the abdomen	Ribs	Ilium, pubis	Rotation and lateral flexion of spine
Transversus abdominis	Abdomen	Iliac crest and lumbar fascia	Pubis and linea alba	Support of internal organs, forced expiration

Muscle	Position	Origin	Insertion	Primary actions
Diaphragm	Beneath rib cage	Sternum, costal cartilages and lumbar vertebrae	Central tendon of diaphragm	Depresses and aids in expiration
Intercostals	Between ribs	Ribs and costal cartilages	Superior border of next rib below	Elevates ribs and aids in expiration
Hip flexors	Through the pelvis onto front of thigh	Ilium/lumbar vertebrae	Femur	Flexion of hip
Gluteus maximus	Bottom	Ilium	Femur	Extension and external rotation of the hip
Abductors	Outside of upper thigh	Ilium	Femur Tibia/ITB	Abduction of hip Abduction and flexion of hip (TFL only)
Adductors	Inner thigh	Pubis, ischium	Femur	Adduction of hip
Quadriceps	Front of thigh	Ilium, femur	Tibia	Extension of knee and flexion of hip (rectus femoris only)
Hamstrings	Back of thigh	Ischium, femur	Tibia, fibula	Extension of hip and flexion of knee
Gastrocnemius	Calf	Femur	Calcaneus (heel bone)	Plantarflexion of ankle, flexion of knee
Soleus	Calf, beneath gastrocnemius	Tibia	Calcaneus (heel bone)	Plantarflexion of ankle
Tibialis anterior	Front of lower limb (shin)	Tibia	Metatarsal and tarsal	Dorsiflexion and inversion of ankle

Note on the pelvic floor muscles

Pelvic floor exercises can be given to help improve the tone and function of the pelvic floor muscles

The pelvic floor or pelvic diaphragm is composed of a small group of muscles and associated connective tissue which span the area underneath the pelvis. These muscles form a muscular sling-like structure running back from the pubis toward the coccyx, uniting behind the anorectal junction with some fibres inserting into the prostate, urethra and vagina.

The pelvic floor muscles are important in providing support for pelvic organs such as the bladder and the intestines, in the maintenance of continence and in facilitating the birthing process. In women these muscles can become damaged during pregnancy and birth.

Damage to the pelvic floor can contribute not only to urinary incontinence but can lead to pelvic organ prolapse. Pelvic floor exercises can be given to help improve the tone and function of the pelvic floor muscles.

The nervous system

Role of the nervous system

The CNS consists of the brain and the spinal cord

Due to the symbiotic nature of the nervous and muscular systems, the two combined are often referred to as the neuromuscular system. At its simplest level the nervous system is a communication network, which has three basic elements; sensation, analysis and response (Tortora and Grabowski, 1996):

- sensation - a vast array of sensors spread throughout the body which continually gather information about, both the internal environment (e.g. blood CO_2 levels) and the external environment (e.g. air temperature)
- analysis - sensory input represents massive amounts of information , thus the second role of the nervous system is to analyse and interpret the information being received and 'decide' on an appropriate response (many of these 'decisions' are automated – there is no voluntary control over them)
- response - the appropriate response must be initiated (e.g. muscular contraction or glandular secretion)

The nervous system consists of two primary divisions:

- the central nervous system (CNS)
- the peripheral nervous system (PNS)

Central nervous system

This consists of the following:

- brain
- spinal cord

The correct application of force in a relatively complex movement depends on a series of co-ordinated neuromuscular patterns. Such movements are regulated by neural control mechanisms linked together by pathways within the central nervous system.

The brain is made up of two main hemispheres, the cerebrum and to the rear the cerebellum. The cerebellum is the smaller of the two and acts as a memory bank for all learnt skills. It is the cerebellum that is mainly responsible for controlling the group action of muscles, though it communicates and works harmoniously with the cerebrum.

The spinal cord is composed of cervical, thoracic, lumbar and sacral segments, named according to the portion of the vertebral column through which it passes. It is the communication link between the brain and the PNS inferior to the head. It integrates incoming information and produces responses via reflex mechanisms (reflex arc).

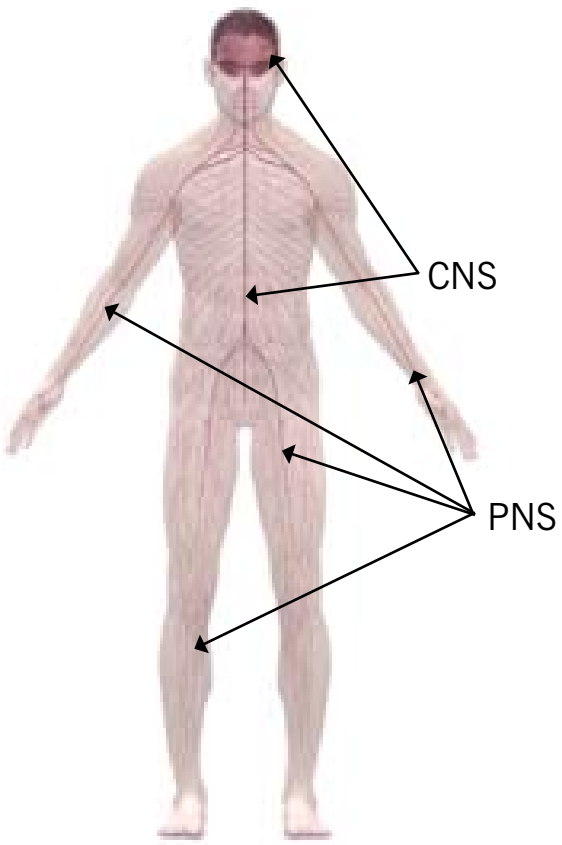
The PNS consists of all the branches of nerves that lie outside the spinal cord

Peripheral nervous system

The PNS consists of all the branches of nerves that lie outside the spinal cord. The peripheral nerves primarily responsible for muscular action are the spinal nerves.

Spinal nerves are divided into motor and sensory neurons. Sensory neurons arrive on the posterior side of the spinal cord from a variety of sensory receptors spread throughout the body. Sensory receptors in the muscles, tendons and joints relay information concerning muscle dynamics and limb movements to the CNS, giving important feedback on the position of those limbs at any time.

The motor neurons exit on the anterior side of the spinal cord. These neurons transmit impulses from the CNS to organs, muscles and glands. These impulses will cause muscles to contract and glands to secrete.



Central nervous system and peripheral nervous system

A motor unit consists of a single motor neuron and all the muscle fibres it innervates (or supplies)

Motor units and muscle fibre recruitment

A motor unit consists of a single motor neuron and all the muscle fibres it innervates (or supplies). One motor neuron may innervate between 10 and 1000 muscle fibres, depending on its location and function. When an impulse is sent down a neuron, all the muscle fibres within that motor unit will be innervated. The fact that either all the muscle fibres within a motor unit are activated, or none of them are, is referred to as the 'all or none law' (Fleck and Kraemer, 1997).

If the stimulation of a neuron is at or above a set threshold, then an impulse will be sent down the neuron causing activation of the muscle fibres. The 'all or none law' applies to individual motor units, and not the entire muscle.

A motor unit is typically made up of one type of muscle fibre (Type I, Type IIa or Type IIx) spread throughout the muscle.

A whole muscle is constructed from many motor units meaning that in a muscle there will be a mixture of all of these fibre types. It is the relative amounts of each fibre type in a muscle that defines the properties of that muscle.

The more motor units that are recruited for a task, the greater the force that will be developed. This is an adaptation to training over time. A beginner will only be able to recruit a certain number of motor units, in order to protect the muscle from developing too much force and damaging the muscle or the connective tissue. With training they are gradually able to recruit more motor units, and produce more force. Exercise can enhance neuromuscular connections, which in turn will help improve motor fitness.

Responses of the neuromuscular system to exercise

There are a number of changes that occur within the neuromuscular system as a result of exercise.

Short term responses to exercise

Vasodilation of blood vessels in muscles causes a diversion of blood to the working muscles, and away from the non-essential organs.

Long term adaptations to exercise

The properties of a muscle are changed depending on the regularity, duration and intensity with which a muscle is used. Exercise can increase the diameter of muscle (hypertrophy) as well as cause an increase in their capacity to produce energy.

Long term aerobic exercise adaptations: low intensity, long duration exercise can bring about the following changes on Type I fibres:

- an increase in the number and size of mitochondria in the muscle fibres
- an increase in the number of capillaries surrounding these fibres
- an increase in the number of aerobic enzymes, stored glycogen and triglycerides in the muscle fibres

Long term resistance training adaptations: short duration, high intensity exercise effects mainly Type II fibres:

- a decrease in nervous inhibition
- an increase in the diameter of the recruited fibres (hypertrophy) due to an increase in the myofilaments within the fibres
- an increase in the glycolytic activity of the muscle allowing more work to be performed under anaerobic conditions or high stress conditions

The life-course of the musculoskeletal system and its implications for special populations

It is important for the instructor to understand changes that the musculoskeletal system undergoes as a result of the ageing process and pregnancy. A basic appreciation of these changes will allow a better understanding of the implications for exercise when dealing with such populations.

Young people

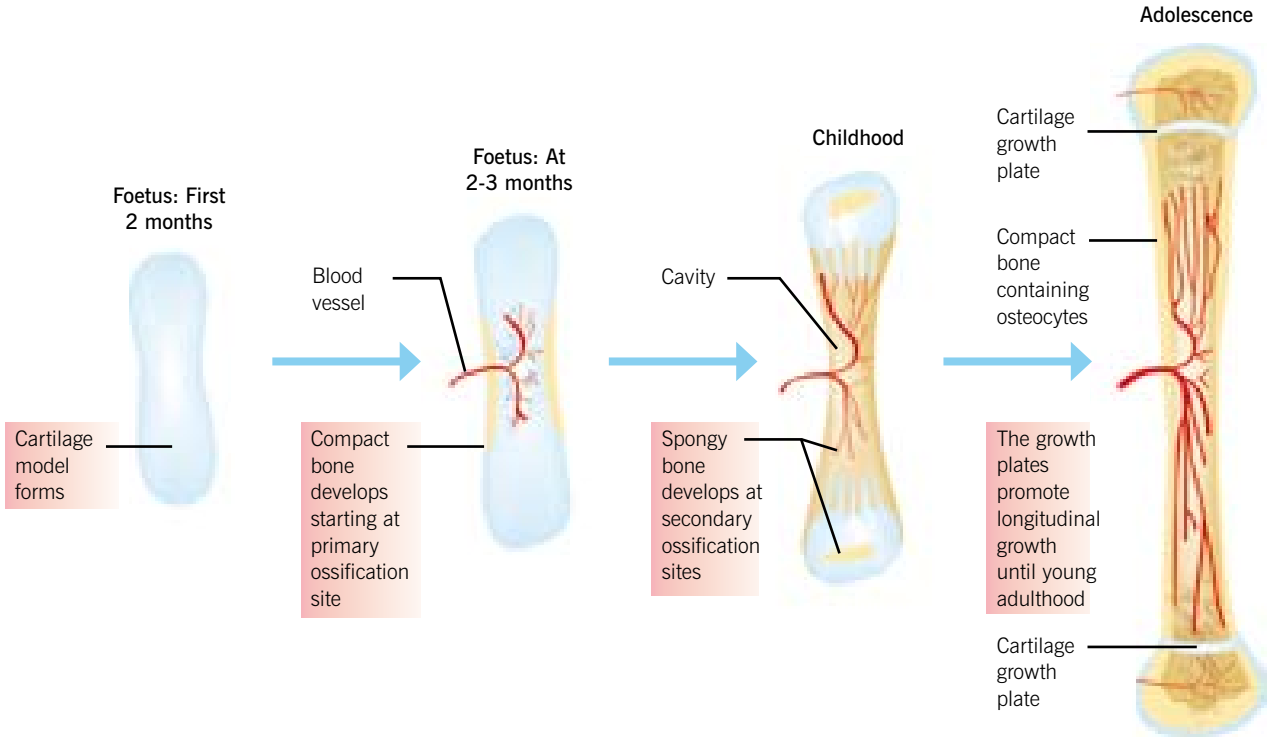
As children grow, muscle mass steadily increases. At birth approximately 25% of a child's body weight is muscle mass, and by adulthood about 40% of a person's total body mass is muscle (Faigenbaum, 2000).

During puberty an increase in hormone production results in an increase in muscle mass. Due to hormonal differences, the increase in boys will be at a greater rate than girls throughout adolescence, although, girls can be stronger at around the age of 11 because their lean body mass may, at this point, be higher than their male counterparts. Girls will also generally carry more body fat than boys during and after the growth spurt.

Growth spurt

At some stage during a child's maturation their bones will suddenly develop at a rapid rate. This is known as a growth spurt. Growth spurts happen at different rates and ages, but commonly:

- for girls: between the ages of 10 and 12, growing fastest at 12 to 13. The spurt normally ends at 18
- for boys: between the ages of 12 and 14, growing fastest at 14 to 15. They tend to end their growth spurt later at the age of 20



The development of bone throughout childhood

A concern in children is the vulnerability of growth cartilage to trauma and overuse (Micheli, 1995). These type of injuries can disrupt the bone's blood and nutrient supply resulting in permanent growth disturbances. Growth plate fractures are more common in boys than girls with the greatest incidence occurring among 14-16 year old boys and 11-13 year old girls.

Osteopenia is a condition where bone mineral density is lower than normal

Owing to the vulnerability of the musculoskeletal system, the instructor should deal with this age group with caution and avoid imparting heavy, repetitive loads when working with them. An injury that would cause a ligament sprain in an adult can be a potentially serious growth plate injury in a child.

Approximately half of all growth plate fractures occur in the lower end of the outer bone of the forearm (radius) at the wrist. These injuries also occur frequently in the bones of the leg e.g. femur, ankle, foot or hip bones. The actual fracture occurs between the shaft and the head of the bone around the growth area.

Growth plate injuries at the knee present the greatest risk of complications. Nerve and blood vessel damage occurs most frequently at this joint and therefore, injuries to the knee have a much higher incidence of premature growth arrest and crooked growth.

About 85% of growth plate fractures heal without any lasting effect. Whether an arrest in growth occurs depends on the following factors:

- severity of injury
- age of the child
- area of the body affected

Although many growth plate injuries are caused by accidents that occur during play or athletic activity, growth plates are also susceptible to other types of injury, infection, and disease.

Older adults

Skeletal changes

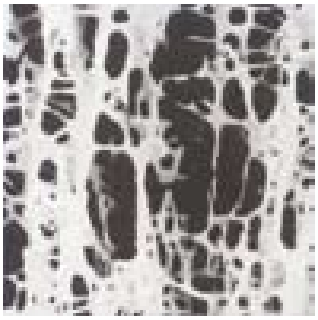
From 35 to 40 years of age there is a gradual loss of bone (Borner et al, 1988 cited in Cech and Martin, 2002).

Osteopenia is a condition where bone mineral density is lower than normal and is often a sign of ageing. It is considered by many to be a precursor to osteoporosis, a disease characterised by low bone mass and deterioration of bone tissue leading to enhanced bone fragility and a subsequent increase in the risk of fracture. Osteoporosis occurs in both males and females but is more common in females.

Bone development is dependent upon the presence of hormones. In women this is the female hormone, oestrogen, and in men it is the male hormone, testosterone. These hormones influence the formation of bone by promoting the activity of bone building cells called osteoblasts. The body replaces around 10% of its bone a year as long as osteoblasts are active (Dalgleish and Dollery, 2001). However, if osteoclast cells, which destroy or break down old bone, are more active than osteoblasts, bone mass will start to decrease.

Further effects of ageing are a reduction in joint range of movement (ROM), a thickening of ligaments, a loss of elasticity of connective tissue and muscle and wear and tear to cartilage found on bone ends, thus leading to degenerative changes in joint structures.

Healthy bone



Osteoporotic bone

Neuromuscular changes

A loss of muscle mass associated with ageing is known as sarcopenia

A large percentage of the elderly find difficulty in simply standing from a seated position due to an age-related decline in muscle functioning. Ageing leads to a decrease in the number of functioning fast twitch (FT) muscle fibres and an increase in functioning slow twitch (ST) muscle fibres. Advancing age is also associated with a loss of muscle mass, known as sarcopenia. Resistance training is highly recommended to reduce the ageing effects on the neuromuscular system.

Implications for exercise

Regular weight-bearing exercise has been shown to help maintain and build up bone mass. The stronger muscles, better balance and agility that exercise promotes can also help in fall prevention. The type of exercise should be tailored to the individual's needs and abilities. People with osteoporosis must take special care when exercising to reduce the risk of fracture due to impact or falls.

Due to the increasingly vulnerable nature of the musculoskeletal system as a result of ageing, the instructor should be cautious when dealing with this population. Although weight-bearing exercises are recommended, low impact exercise is generally favoured, to avoid unnecessary trauma to the skeletal and muscular systems.

Pre and post-natal women

During pregnancy, relaxin (a hormone released in the second trimester) softens ligaments, cartilage and the cervix, allowing greater potential movement at joints. This is especially important for the pelvic girdle and, more particularly, the pubis symphysis and the sacroiliac joint which will need to separate to some degree to

facilitate delivery. The effects of relaxin mean that joints throughout the body are potentially vulnerable and therefore, should not be overly stressed, for example, through excessive and vigorous stretching.

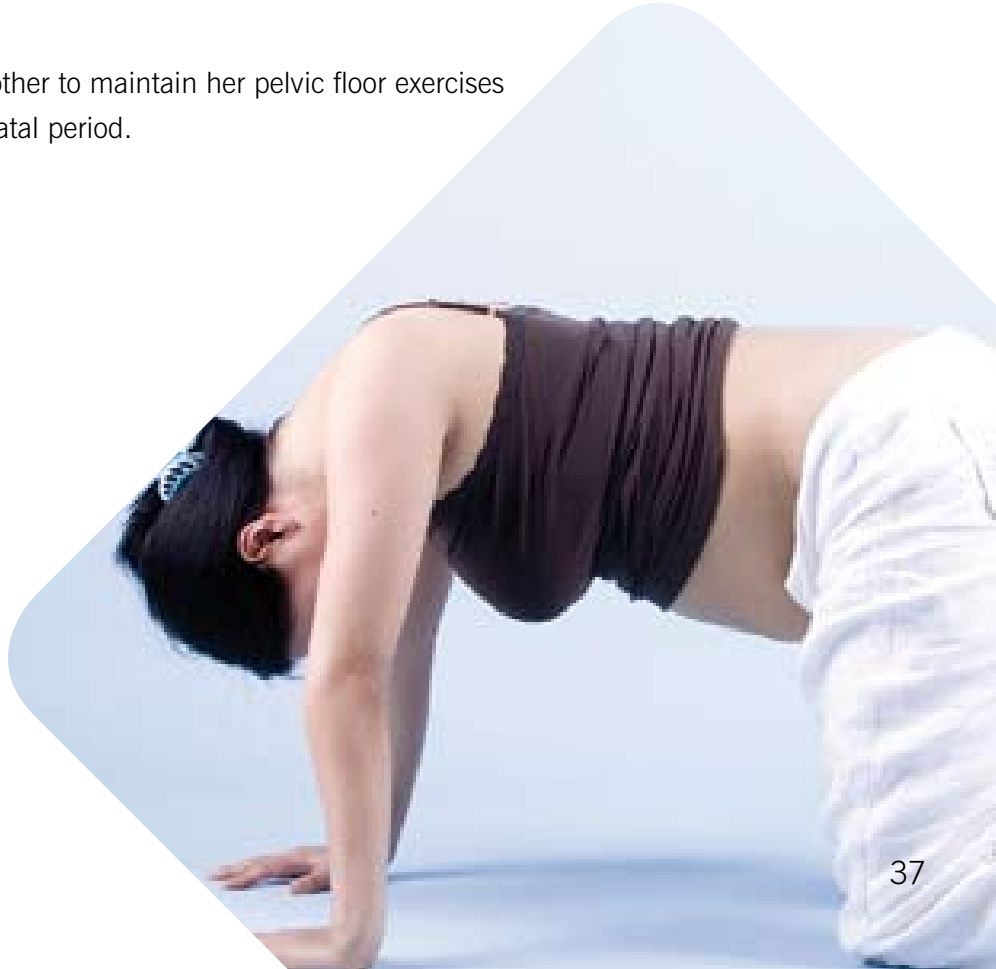
Exactly how long relaxin stays in the body post-birth is debatable and will vary between mothers. Five months is often quoted, although estimates vary from three months up to a year. In reality, the hormone can be present for as long as the mother is breast-feeding, which may be up to two years. The mother is the best judge and will know when she no longer 'feels loose'.

Throughout the pre-natal period exercises should be given to strengthen the pelvic floor muscles. As the uterus grows, these muscles become overly stressed and start to sag. This can cause several potential problems not least of which is stress incontinence (National Kidney Foundation, 2002), that is, the leaking of urine, since these muscles control the bladder.

Careful screening of every expectant mother wishing to exercise during pregnancy or shortly after should be carried out. If there is any doubt regarding the appropriateness of exercise, the mother-to-be should be referred to their GP. In any case, the mother will receive regular check ups from the GP or midwife who will, amongst other things, monitor their blood pressure and answer any health concerns they may have.

Post-birth, the American College of Obstetricians and Gynaecologists (ACOG - 1994) recommend that women should avoid all physical stress for two weeks (i.e. 'don't carry anything heavier than the baby') and not resume full daily activities for a minimum of six weeks after delivery. It is also advised that those who delivered by Caesarean section should not exercise for 12 weeks after delivery to allow proper healing time.

Note: it will be important for the mother to maintain her pelvic floor exercises for as long as possible in the post-natal period.



The respiratory system

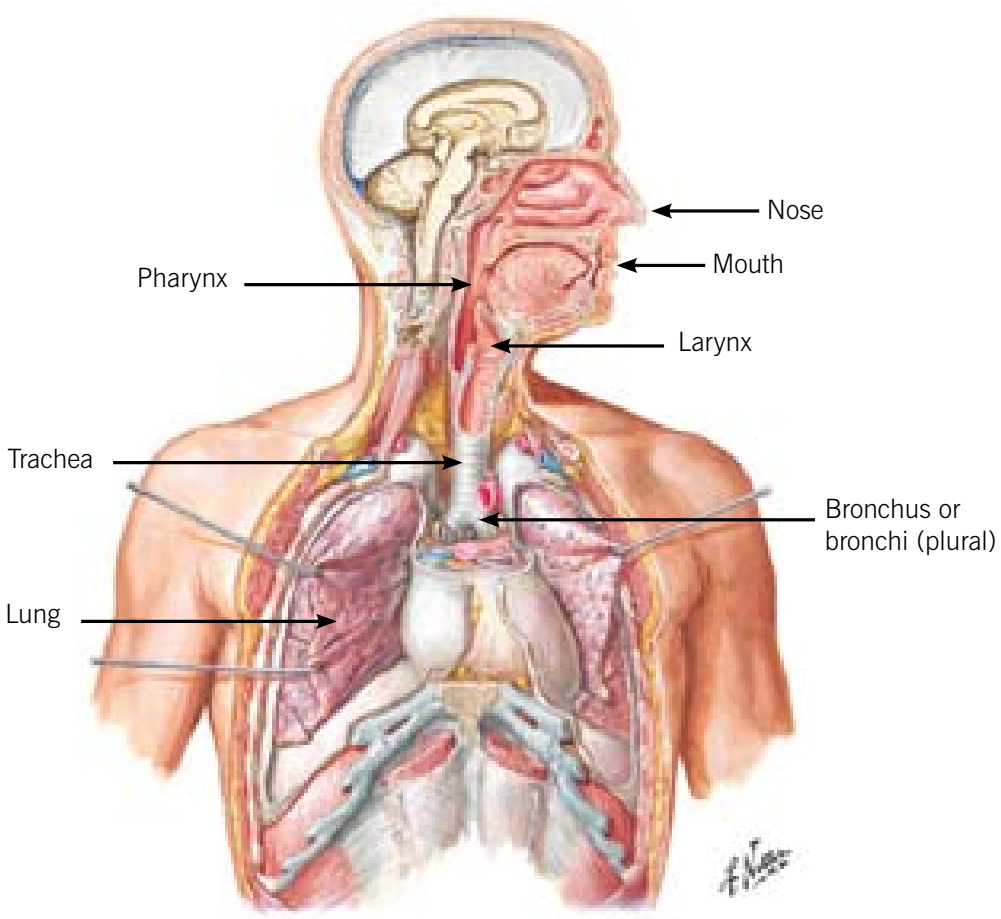
The main functions of the respiratory system are the intake of oxygen (O_2) into the body, and the removal of carbon dioxide (CO_2) from the body

The main functions of the respiratory system are the intake of oxygen (O_2) into the body, and the removal of carbon dioxide (CO_2) from the body.

Anatomy of the respiratory system

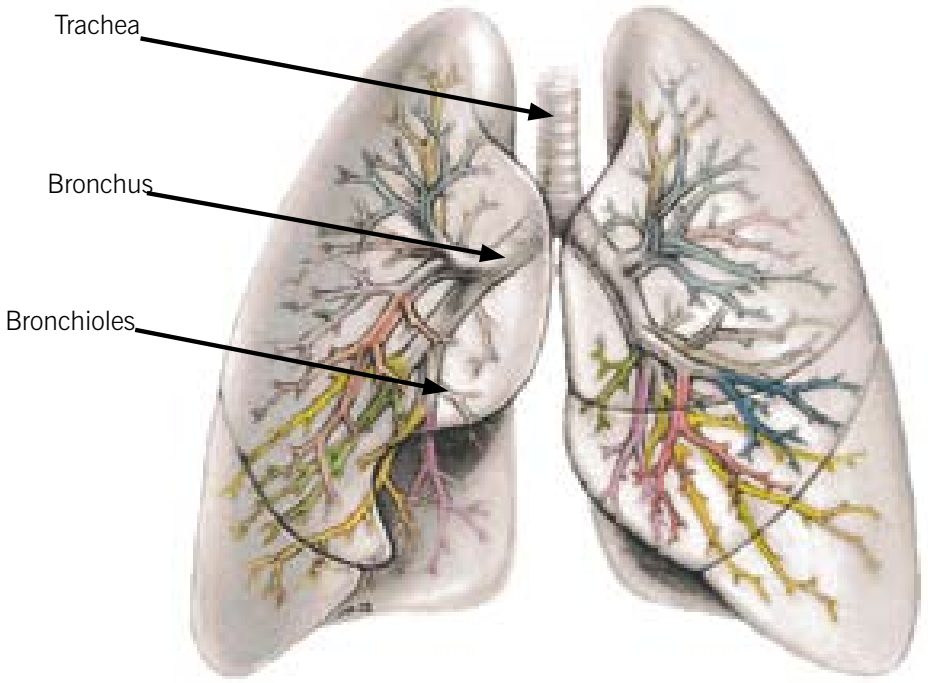
Air enters the body through the following structures:

- nose/mouth
- pharynx
- larynx
- trachea
- primary bronchi
- bronchioles
- alveoli



Passage of air

Anatomy of the lungs



Anatomy of the lungs

Terminology:

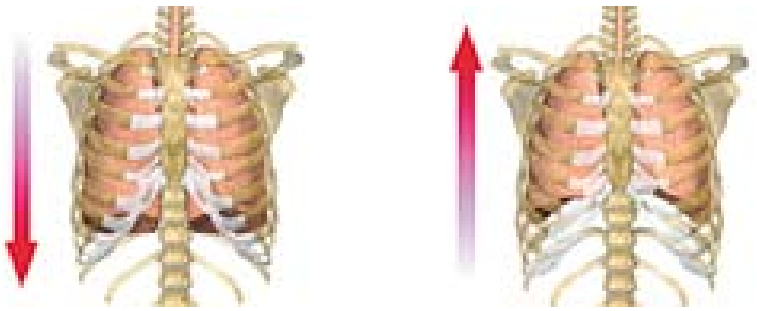
- inspiration/inhalation – drawing air into the lungs
- expiration/exhalation – expelling air out of the lungs
- external respiration – exchange of gases between the lungs and blood, O_2 from the lungs into the blood and CO_2 from the blood into the lungs
- internal respiration – exchange of gases between the cells and blood, O_2 from the blood into the cells and CO_2 from the cells into blood

Mechanics of breathing

During inspiration, contraction of the diaphragm muscle will cause the normal 'dome-shape' to flatten, increasing the chest cavity volume. This increase in volume creates a negative pressure, between the air in the lungs and that in the atmosphere. This is very much like a 'vacuum' effect, and the negative pressure, literally 'sucks' air into the lungs, until the two pressures are balanced.

During expiration the diaphragm muscle relaxes, returning upwards to its dome-shape, decreasing the chest cavity volume. This creates a positive pressure, which 'pushes' some of the air out of the lungs.

Diffusion is the movement of a gas, from an area of high concentration, to an area of low concentration



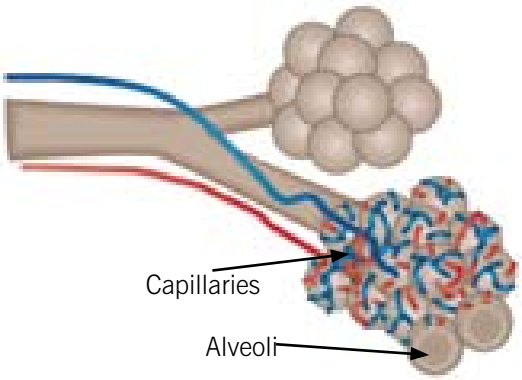
Movement of the diaphragm

Costal breathing is a shallow pattern of breathing through the chest and involves the contraction of the external intercostal muscles (Tortora and Grabowski, 2003). Diaphragmatic breathing is a deeper method of breathing, through the outward distension of the abdomen and involving the contraction and lowering of the diaphragm (Tortora and Grabowski, 2003). Diaphragmatic breathing is promoted to aid relaxation in activities like yoga, and is linked with improved health (Yeufang, 1996).

Expansion of the rib cage provides an additional increase in chest cavity size. This should only be required during times of laboured breathing, such as moderate or high intensity aerobic exercise.

The exchange of gases

O_2 is pulled down the bronchi and bronchioles into the alveoli, by negative pressure, as described above, but also because it flows down a concentration gradient. Diffusion is the movement of a gas, from an area of high concentration, to an area of low concentration. The concentration of O_2 decreases between the mouth and the lungs, thus the gas flows in this direction. CO_2 flows in the opposite direction for the same reason. Once the O_2 gets into the alveoli (the air sacs), it will continue to follow this concentration gradient and will diffuse into the bloodstream. The alveoli have minute capillaries running over and around them. Both the alveolar walls and the capillary walls are so thin that they allow gases to pass through them. O_2 passes into the blood and at the same time, CO_2 passes back into the lungs to be exhaled.



Alveoli

The O_2 binds to the haemoglobin (Hb - the protein that carries O_2, CO_2 and carbon monoxide in the blood) in the red blood cells (RBCs). At the same time CO_2 dissociates from the haemoglobin and diffuses from the blood into the lungs. The red blood cells are then pumped within the blood, via the pulmonary vein, towards the heart. This constant flow of blood past the alveoli allows the high concentration gradient to be maintained.

Composition of air

Gas	Inhaled air	Exhaled air	Difference
Nitrogen N_2	79%	79%	No change
Oxygen O_2	21%	17%	4% decrease
Carbon dioxide CO_2	< 1%	4%	4% increase
Trace gases	< 0.001%	< 0.001%	No change

Breathing stimulus

There are two different mechanisms to trigger the human body to breathe:

- rising levels of CO_2 in the blood
- stretch receptors in the respiratory muscles become stretched

Lung volumes and definitions

The study of lung function is called spirometry, and there are a number of different measurements, each of which may be affected by age, gender, size and stature:

- tidal volume (TV) – the amount of air inhaled/exhaled in one breath
- minute ventilation (MV) – the amount of air inhaled/exhaled in 1 minute
- breathing rate (BR) – the number of breaths taken in 1 minute

MV (ml/min)	= BR (per min)	x	TV (ml)
	= 12	x	500 ml
	= 6000ml/min	or	(6 l/min)

The circulatory system

The circulatory system is divided into three parts:

- the blood
- the heart
- the blood vessels

Blood

Blood is the transport medium by which nourishment and oxygen (O_2) are carried to all structures of the body and waste products, and carbon dioxide (CO_2) are removed. Blood is composed of a number of cells suspended in a liquid medium called plasma. Blood consists of the following four components:

- red blood cells
- white blood cells
- platelets
- plasma

Red blood cells

Red blood cells (erythrocytes)

The body contains approximately 240-270 million red blood cells (RBCs) in every drop of blood (Tortora and Grabowski, 2000). These cells are produced in the soft red bone marrow. RBCs contain a protein called haemoglobin (Hb), which binds to oxygen, and allows the RBC to carry O_2 in the blood and to a lesser extent CO_2. Hb is the pigment that gives RBCs, and therefore blood, its red colour. Blood volume usually consists of about 40% RBCs.

White blood cells (leukocytes)

White blood cells (WBCs) are transparent and, unlike RBCs, do not contain Hb. They are fewer in number than RBCs (700 times less) and are also produced in red bone marrow. White blood cells (WBCs) come in many shapes and forms, but are generally the cells of the immune system that fight infection. They destroy bacteria and other harmful living organisms, thus protecting the body by removing diseased or injured tissue.

Platelets (thrombocytes)

Unlike RBCs and WBCs, which are whole cells, platelets are actually cell fragments. Platelets will assist in preventing blood loss from a damaged blood vessel by forming a platelet plug (Tortora and Grabowski, 2000). They will also release chemicals which will help to promote blood clotting. This is the initial stage of repair to damaged tissues.

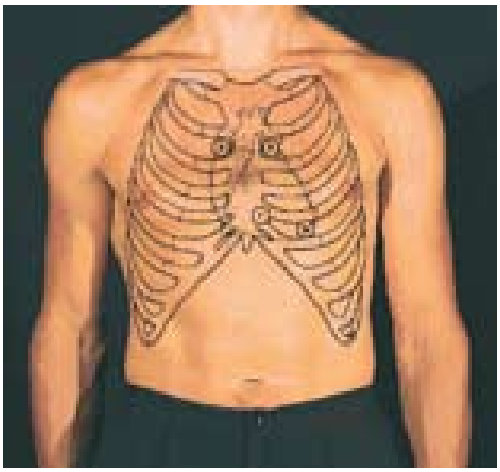
Plasma

Plasma is the straw-coloured liquid portion of the blood. It consists predominantly of water (91.5%) and solutes (8.5%) such as proteins, electrolytes, nutrients, gases, hormones, enzymes, vitamins and waste products.

The heart

The heart is in essence a muscular pump, which pushes the oxygen and nutrients around the body to the tissues. It is about the size of a man's clenched fist and lies behind the sternum, just left of centre.

The heart is made up of thick muscular walls (or myocardium), and is divided into separate left and right halves. The right half pumps blood to the lungs, while the left side pumps blood to the rest of the body. Each side of the heart is hollow and is further broken down into two smaller connected chambers. There are four chambers in total, two upper chambers (or atria) and two lower chambers (or ventricles). Atrium (pleural atria) is the Latin for 'hall', or 'entranceway' and is the chamber which blood flows into first, when entering either side of the heart. The atria receive blood via the veins from different parts of the body, and pump the blood down into the ventricles. The atria are smaller than the ventricles and do not really have to contract particularly hard. Even if the atria fail to contract properly, most of the blood in the atria will flow into the ventricles passively.



Location of the heart

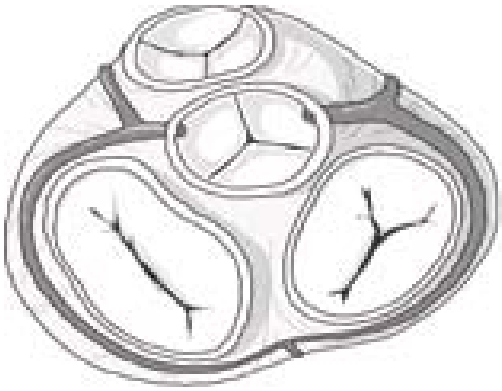
The ventricles supply the force to push the blood to its various destinations. In a cardiogram, it would be easily seen that the left ventricle has larger muscular walls than the right ventricle. This is because the left side pumps its contents to the furthest parts of the body, whereas the right side only has to pump its contents to the adjacent lungs.

The atria receive blood via the veins from different parts of the body, and pump the blood down into the ventricles

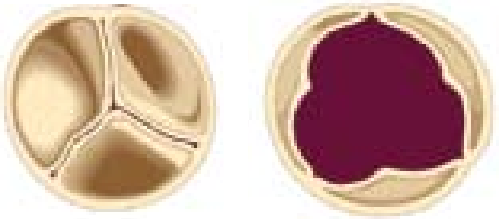
The ventricles supply the force to push the blood to its various destinations

Heart valves

There are a number of different valves around the heart, all performing slightly different tasks. There are a set of atrioventricular (AV) valves that separate the atria and ventricles, and prevent the flow of blood back into the atria during ventricular contraction. The semilunar valves prevent the flow of blood back into the right (pulmonary valve) and left ventricles (aortic valve) during ventricular relaxation. Ventricular contraction is called systole and ventricular relaxation is called diastole.



Heart valves

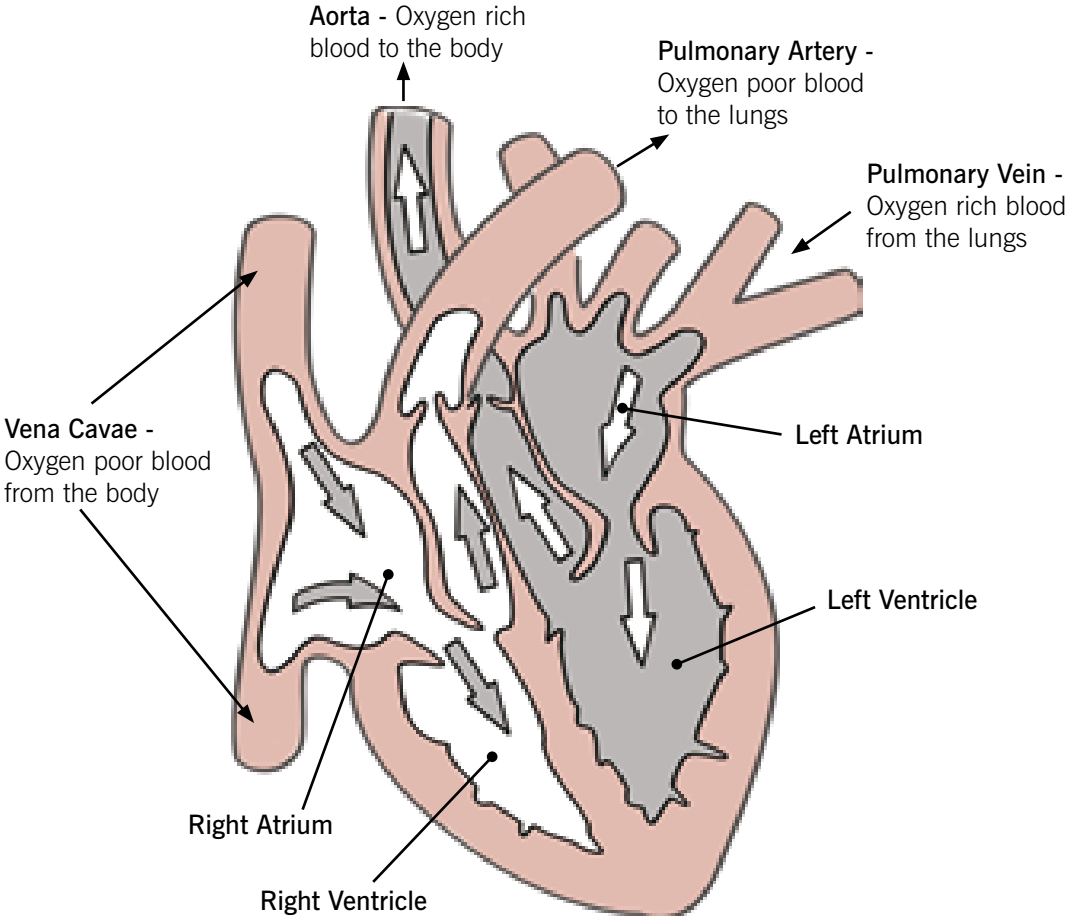


Open and closed valves

Heart circulation

The right hand side of the heart is responsible for receiving blood from the upper and lower body via the veins (venous return). The blood enters the right atrium via either the inferior or superior vena cava. The blood is saturated with CO_2, and is referred to as deoxygenated blood. It is ejected to the lungs (pulmonary circulation) via the pulmonary artery.

Deoxygenated blood is dark red in colour, but may appear bluish when viewed through blood vessel walls. It is normally coloured in blue when drawn in pictures of the heart. In the pulmonary capillaries, the CO_2 diffuses into the lungs to be expired while O_2 enters the blood. This oxygenated blood (bright red in colour) enters the left atrium of the heart via the pulmonary vein. The left ventricle then ejects the blood, and O_2, via the aorta, to the tissues of the body (systemic circulation). It is important to note that arteries always carry blood away from the heart and veins always carry blood to the heart.



The heart circulation

Heart conduction

The heart is stimulated to contract by a complex series of integrated systems. The heart's pacemaker, the sinoatrial (SA) node, initiates the cardiac muscle contraction. The SA node is located in the wall of the right atrium. The myocardium (heart muscle) is stimulated to contract, about 72 times per minute, by the SA node as part of the autonomic nervous system.

Blood vessels

Blood vessels are the transport system for the blood, from the heart to the rest of the body and back again. Although blood vessels are divided into different categories because of their shape and function, it is important to remember that they are all linked in a continuous loop. One type of blood vessel will gradually be split, or linked, to form another type of blood vessel.

Arteries squeeze blood along the passageways away from the heart

There are broadly three types of vessels that differ in construction and size, according to their function and position in the body. These are the arteries, capillaries and veins. There are two additional sub-types called arterioles and venules. These blood vessels are responsible for transporting the blood to and from the heart, and thereby delivering nutrients to and from the tissues.

Arteries

Arteries are muscular tubes with thick walls, which can contract (like all muscle) to squeeze blood along the passageways away from the heart. The large artery that leaves the left ventricle of the heart is called the aorta. This divides and subdivides gradually becoming arterioles.

The smooth muscle tissue that surrounds the artery and arteriole walls is thicker and more powerful than that surrounding the walls of veins. As blood is ejected powerfully from the heart, the arterial walls are required to stretch passively to receive the blood under high pressure and then immediately contract as in a recoil action to assist in propelling the blood further on down the line to the body. This action is called peristalsis.

There are no valves in the arteries other than those at the exit points of the ventricles to prevent backflow. Arteries and arterioles predominantly carry oxygenated blood around the body. The exception to this rule is the pulmonary arteries and arterioles, which carry deoxygenated blood to the lungs to be re-oxygenated.

Capillaries

The arteries branch off into smaller arterioles and these become smaller and thinner until they are described as capillaries. These capillaries have extremely thin walls (approximately one cell thick) and spread to all parts of the body, even the smallest area of tissue. Since the walls of these blood vessels are so thin, they allow the diffusion of nutrients and gases through their walls and into the tissue cells. Food and oxygen passes through the walls, from the blood, and into individual tissue cells to be used. Likewise the waste products, such as CO_2 and lactic acid, pass back into the blood to be carried away and excreted. Blood flows through the capillary beds slowly to allow for this exchange. There are a greater number of capillaries than of any other blood vessel type.

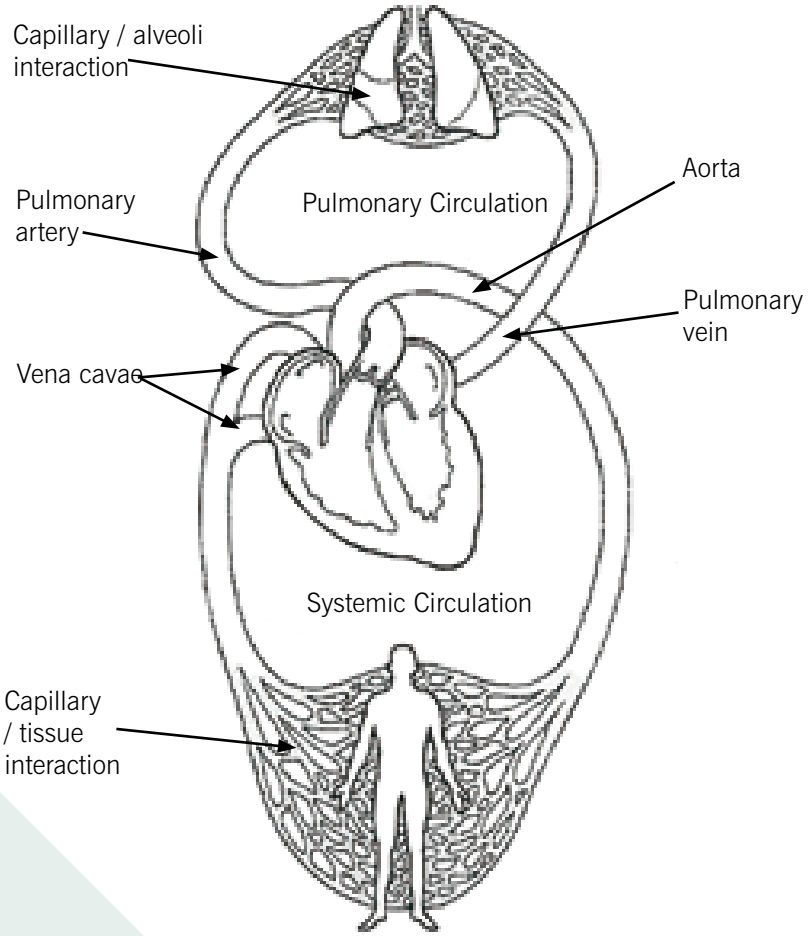
Veins carry blood back towards the heart

Veins

Once the capillaries have passed by the tissue, be it muscle or alveoli, they gradually link together to form progressively larger blood vessels called venules. These venules then eventually become larger veins. Veins are thinner walled tubes compared to arteries, with little muscular contractility, which carries blood from the tissues back towards the heart.

The smooth muscle in the walls contracts automatically in a peristaltic, or wave-like, action to assist the returning blood flow. Veins and venules predominantly carry de-oxygenated blood, which is therefore, high in CO_2. The exception to this rule is the pulmonary veins and venules, which are carrying oxygenated blood from the lungs back to the heart.

The flow of blood back to the heart is called venous return. Unlike arteries, veins carry blood under low pressure, which makes its return back up the body to the heart more difficult. All veins therefore, have a series of one-way valves that work against gravity to prevent backflow of the blood as it passes back towards the heart. This will help to prevent reversed blood flow or pooling of blood.



Overview of circulation

Venous return

This is the return of blood back to the heart, via the veins. The contributing factors that assist venous return are:

- gravity - this will assist in the return of blood from anywhere above the heart, such as the head and shoulders
- non-return valves in the veins prevent the back flow of blood and are one of the biggest factors assisting venous return
- the diaphragm is the large dome-shaped muscle of respiration in the chest cavity, which produces a suction effect on the veins below the heart
- the right atrium also helps to 'suck' the blood back. As the blood within this chamber empties into the ventricle below, the empty chamber creates a small vacuum assisting in drawing in blood from the vena cava
- smooth muscle contraction (peristalsis) - there is a pumping action of the smooth muscle tissue, this peristaltic action takes place continually
- skeletal muscle contraction - veins are assisted by the squeezing action of the nearby skeletal muscles

BUPA (2002) describes blood pressure as *"a measure of the force that the blood applies to the walls of the arteries as it flows through them"*

The blood circulation is a closed system in which the pressure varies constantly. It rises to a peak, at the height of the contraction of each heartbeat as the heart pumps blood out. It then falls to a lower level, which it reaches just before each heartbeat.

This variance of pressure is necessary for a healthy circulatory system however, *"if the pressure is consistently higher than normal at rest, this is high blood pressure, also known as hypertension."* (BUPA, 2002)

Venous return is an important mechanism to help the return flow of blood to the heart and to prevent blood pooling. Long periods of inactivity can slow the blood flow from the lower legs, which can result in blood pooling. A blood clot or DVT may then form, blocking the blood vessel. Pressure, caused for example by an airline seat pressing on the veins in the back of the knee, can contribute to reduced blood flow. A pulse lowerer as part of a cool down is thought to reduce blood pooling in the lower extremities at the end of an exercise session.

Blood pressure

BUPA (2002) describes blood pressure as *"a measure of the force that the blood applies to the walls of the arteries as it flows through them."*

Blood pressure is measured in millimetres of mercury (mmHg) and is expressed using two numbers, written as 120/80mmHg (*"one hundred and twenty over eighty"*). These two numbers represent the systolic and diastolic blood pressures respectively.

Systolic blood pressure

The systolic blood pressure (SBP) is the pressure exerted on the artery walls, when the cardiac muscle is contracting and pumping blood. This is the higher of the two numbers, and is usually noted first. It is caused by the increased volume of blood flowing through the arteries with each beat, therefore increasing the pressure within the arteries.

The systolic blood pressure (SBP) is the pressure exerted on the artery walls, when the cardiac muscle is contracting and pumping blood

Diastolic blood pressure

The diastolic blood pressure (DBP) is the pressure exerted on the artery walls, when the heart is in a relaxed state. The heart goes through this period of relaxation, or diastole, to allow the chambers of the heart to fill with blood prior to contraction.

"The DBP is the running or 'remaining' pressure between beats" (NHS, 2002), and is always smaller than the SBP.

The diastolic blood pressure (DBP) is the pressure exerted on the artery walls, when the heart is in a relaxed state

Optimal blood pressure

The ACSM define optimal blood pressure, with respect to cardiovascular risk, as being below 120 mmHg for systolic and 80 mmHg for diastolic pressure (Franklin, 2000). It should be noted that unusually low readings could be of some clinical significance.

Classifications of blood pressure

Category	Systolic (mmHg)	Diastolic (mmHg)
Low	< 100	< 60
Optimal	< 120	< 80
Normal	< 130	< 85
High normal	130-139	85-89
Stage 1	140-159	90-99
Stage 2	160-179	100-109
Stage 3	> 180	> 110

Determinants of blood pressure

Blood pressure is an expression of the arterial blood flow and the peripheral resistance the blood encounters as it flows round the body. It can therefore be expressed in the equation (McArdle, Katch and Katch, 1996):

Blood pressure = Cardiac Output x Total Peripheral Resistance

Cardiac output: the volume of blood pumped out by the heart in one minute (ml/min). The greater the cardiac output, the higher the blood pressure.

Total peripheral resistance: the resistance the blood vessels offer to blood flow; the greater the resistance, the higher the blood pressure. Peripheral resistance is increased or decreased by constriction or dilation, respectively, of the blood vessels (arterioles).

Effects of exercise on blood pressure

Short term effects: there is a linear increase in SBP with increasing levels of exertion (Franklin, 1998). In contrast, during exertion DBP may decrease slightly, due to vasodilation, or will remain unchanged (Franklin, 1998), except in hypertensives where it may rise as a result of an impaired vasodilatory response (Gordon, 1997).

It should be noted that heavy weight training and isometric exercise will significantly increase both systolic and diastolic blood pressure. When performing such exercises, it is important to avoid holding one's breath. An expiratory effort against a closed glottis, which increases pressure within the thoracic cavity and thereby impedes venous return of blood to the heart is known as the valsalva manoeuvre.

Long term effects: aerobic exercise using large muscle groups in rhythmical activity is very appropriate to reducing blood pressure over time. Durstine and Moore (2003), state that endurance training can elicit an average decrease of 10 mmHg in both systolic and diastolic blood pressure in mild and moderate hypertensives.

With the exception of circuit weight training, chronic strength or resistive training has not consistently been shown to lower resting blood pressure (Durstine and Moore, 2003). With this in mind, while resistance training can have many benefits for such groups, it is not recommended on its own as a means of decreasing blood pressure.

Control of circulatory blood flow

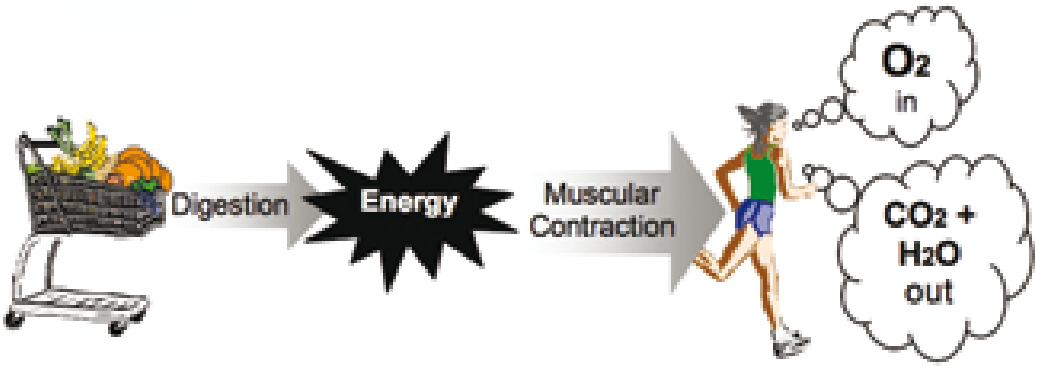
The blood vessels are able to narrow (vasoconstrict) or widen (vasodilate) because of the smooth muscle found in their walls. As a result, more, or less blood will flow through them. This enables the body to direct the flow of blood to different tissues, depending on what state the body is in and where the oxygen and nutrients are required. This also plays a part in the regulation of blood pressure. If food has just been eaten, then the blood vessels that feed the digestive system are vasodilated and blood flow is increased, whilst blood vessels feeding muscles are vasoconstricted, reducing the blood flow. During exercise the opposite happens and more blood will be routed to the muscles and less will be available to the organs and digestive tracts. Eating a large meal too close to a training session or match, will allow insufficient time for the food to be digested in the stomach, causing cramp and sometimes vomiting.

The energy systems

Energy is derived from a substance known as adenosine triphosphate (ATP)

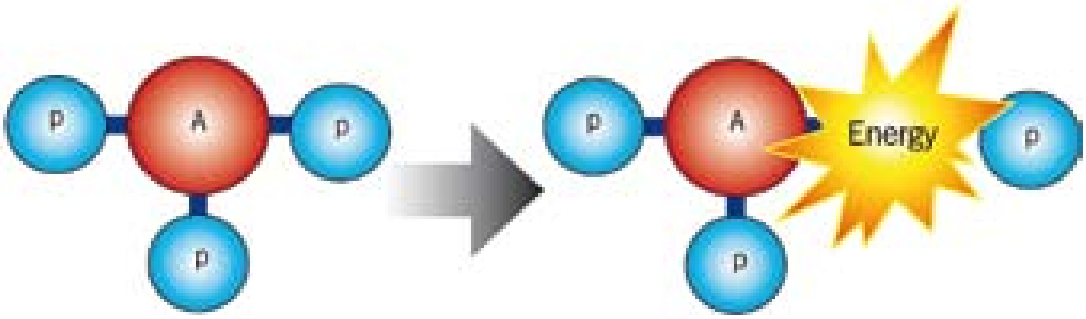
The human body, although extremely complex and still not fully understood, is in essence, a machine. Our bodies, like any machine, require energy to power locomotion or movement, produce force against objects, generate heat and to grow or repair tissue. This energy comes from one place, a substance known as adenosine triphosphate (ATP). For our purposes, ATP is the only fuel our machine (the human body) recognises and uses. It could be compared with an unleaded car not being able to use diesel fuel.

ATP is composed of one adenosine molecule bound with three phosphate molecules



In humans we convert chemical energy (food) to mechanical (movement) or heat energy. The food we eat and certain drinks we drink will provide us with energy such as carbohydrate, fat and protein with which to rebuild our very limited stores of ATP when they have been used up. The more regular aerobic exercise we undertake the more efficient and faster we will become at breaking down our food nutrients.

ATP is composed of one adenosine molecule bound with three phosphate molecules. ATP releases its energy when one of its high energy bonds is broken, and it is converted to adenosine diphosphate (ADP). When this high energy bond is broken down, energy is released (McArdle et al, 1996). There is a very limited store of ATP within the muscles and this will only last for approximately 1-2 seconds (McArdle et al, 1996).



Energy release as ATP is converted to ADP

Once the limited store of ATP has been used up, our energy systems will regenerate the ADP back into ATP, for use by the cells.

ATP stores within the muscle will only last for approximately 1 - 2 seconds

The three energy systems are the:

- creatine phosphate (or phosphocreatine/CP/anaerobic lactate) system
- lactate (or anaerobic glycolysis) system
- aerobic (or oxidative) system

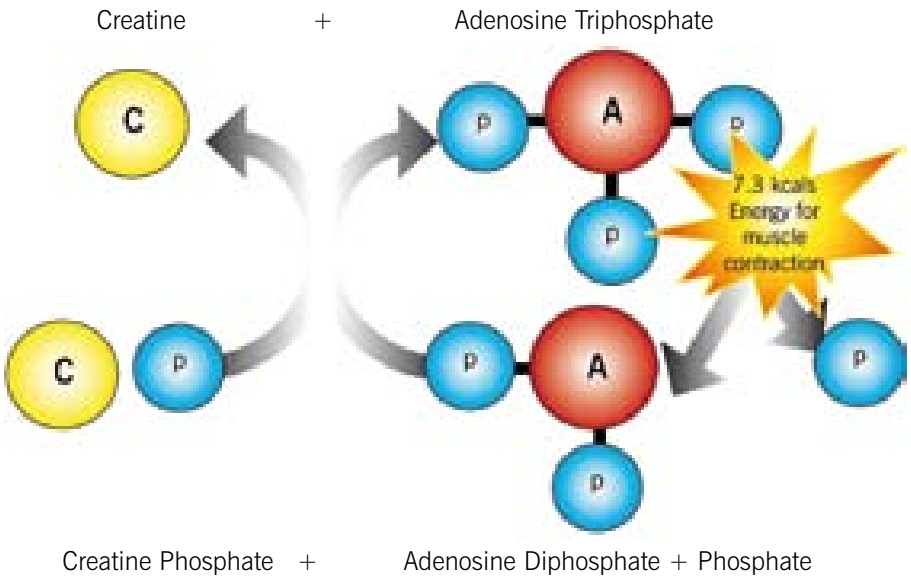
It is very important to realise that at any one time, all three systems are working together to provide the body with energy, however:

- a golf swing or shot putt would use predominately the CP system
- squash or tennis would use predominately the lactate system
- marathon running would use predominately the aerobic system

The important difference between the systems, is that one will provide little ATP but will be able to go on for a long time, whereas another system will provide a lot of ATP, but only for a short duration.

Creatine phosphate (CP) system

This system does not require O_2, fat or carbohydrate but in fact utilises chemical energy. Once the limited ATP supply in a muscle has been depleted, it can almost immediately be regenerated by another chemical substance called creatine phosphate. This compound, like ATP, has a high energy bond which when broken down by the enzyme creatine kinase, will release enough energy to yield an ATP molecule. This chemical reaction is very rapid, but will only last for a very short period of time because of limited CP stores. This system is utilised when there is an absence of sufficient O_2 (anaerobic), such as during near maximal exertion, when a muscle needs to generate a lot of force quickly.



ATP derived from the creatine phosphate system

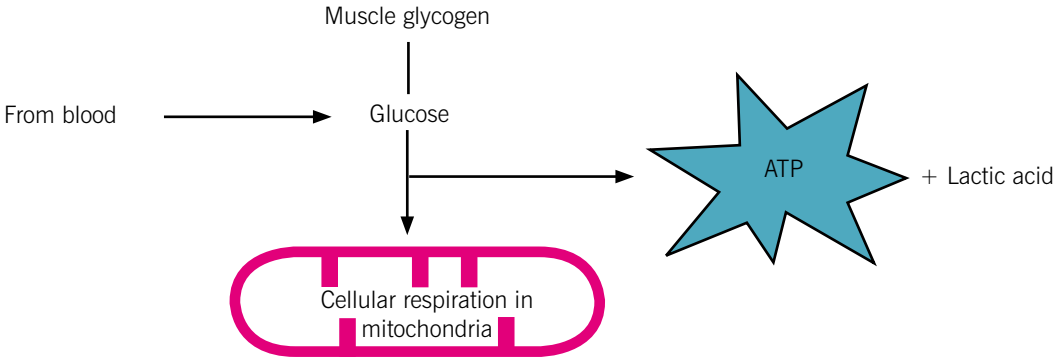
Lactate system

This system will provide a lot of the required energy in one of two instances:

- when near maximal exercise lasts longer than CP can provide
- if the intensity during aerobic activity becomes greater than the aerobic system can provide for

The conversion of glucose to lactic acid is occurring constantly within the body, and only becomes a problem when lactic acid starts to accumulate. If the lactic acid production and removal are equal then there is no problem, but if, the production of lactic acid exceeds the muscles' and cardiovascular system's ability to disperse it, there will be a build up, or accumulation, of lactic acid, which will eventually cause the cessation of activity. This is known as the onset of blood lactate accumulation (OBLA), this is associated with certain sensations such as laboured breathing (or breathlessness), 'heavy' limbs and pain, usually causing a necessity to stop.

Targeted interval training will improve the body's ability to withstand the build up of lactic acid (lactate tolerance) and/or the ability to remove it quicker, thus delaying or preventing this accumulation. Anaerobic training quickly uses up the glycogen stored in the muscles, and requires short periods (1-3 minutes) of strenuous activity followed by periods of recovery. Ideally this recovery should be active (e.g. walking between running intervals), to aid the return of blood back to the liver. Insufficient recovery, or static rest, may not allow the lactic acid to be dispersed before the commencement of the next interval.



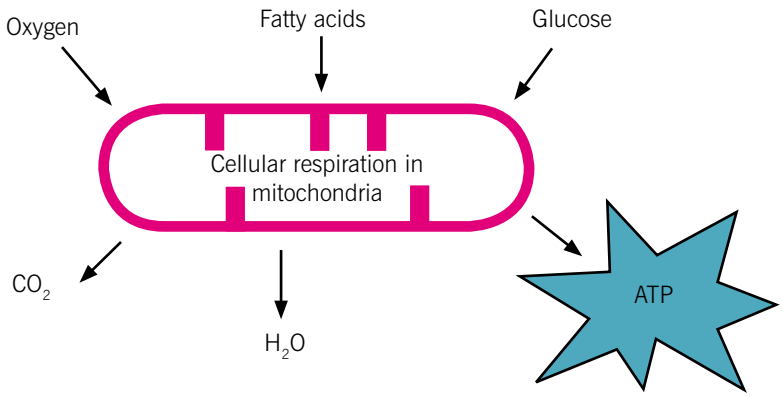
Fate of glucose

Aerobic (oxygen) system

Aerobic simply means 'with oxygen', and refers to the energy system that produces ATP from the complete breakdown of carbohydrate and fat, in the presence of O_2

Aerobic simply means 'with oxygen', and refers to the energy system that produces ATP from the complete breakdown of carbohydrate and fat, in the presence of O_2. The aerobic energy system is dominant when there is sufficient O_2 in the cell to meet the energy production requirements. This is especially true if the body is at rest.

Fat (fatty acids) and carbohydrate (glucose) are the two macronutrients that supply the body with ATP during aerobic metabolism. Whether the body is at rest, or exercising aerobically, both carbohydrate and fat are required, just in varying proportions.



Aerobic energy system

The aerobic system produces only ATP, CO_2, water and heat from the breakdown of fat and carbohydrate. The complete breakdown of one glucose molecule will regenerate 36 moles of ATP, or 263 kcal. One molecule of fat (1 glycerol and 3 fatty acids) will yield 460 moles of ATP, making it a far greater energy supply. However, carbohydrate is a preferred energy source, since although it will release less energy per molecule, it will release it a lot faster.

All three energy systems produce energy at the cellular level, but in different places within the actual cell. Aerobic energy production occurs in organelles (small cell structures) called mitochondria. The larger the mitochondria, or the more mitochondria within a cell, the greater the potential for ATP production of that cell. This would mean that an athlete could run, swim or cycle at a higher intensity for a sustained period of time, without fatigue. The CP and lactate energy system both still occur in the cells, but outside the mitochondria in the cell cytoplasm.

Oxygen uptake

The use of O_2 by the cells of the body is known as O_2 uptake or consumption. When the body is at rest, the volume of this O_2 uptake (VO_2) is approximately 3.5 millilitres of O_2 per kilogram of bodyweight per minute (ml/kg/min). This value of O_2 uptake is also known as 1 metabolic equivalent, or MET. Activities can therefore, be categorised as light, moderate or strenuous intensity, depending on the amount of O_2 uptake required or the METs. The maximal amount of O_2 a person could take in (respiratory), transport (cardiovascular) and utilise (muscular) would provide an indication of their fitness. The more O_2 taken in and used by the muscles, the higher the intensity they could work at, the fitter they would be. This maximal O_2 uptake (or VO_2 max) is generally accepted as the best way to measure someone's fitness levels, and can be directly measured or estimated using various aerobic tests.

There are a number of adaptations that occur as a result of cardiovascular training, at the correct intensity:

- increased number of red blood cells
- increased efficiency of the lungs
- increased capillarisation at the muscles

Energy pathways			
	CP system	Lactate system	Oxygen system
Oxygen dependency	Anaerobic	Anaerobic	Aerobic
Speed of energy production	Very rapid	Rapid	Slow
Substrate needed (energy source)	Stored chemical energy (phosphocreatine)	Glycogen	Glycogen and fat
Amount of energy produced	Very limited ATP	Limited ATP	Unlimited ATP
By-products of energy production	No waste products	Lactic acid	No fatiguing waste products (only CO_2 and H_2O)
Duration of energy production	Short duration (0-10 secs)	1-3 min of intense activity	Long duration
Intensity of activity	High intensity (95-100% max effort)	High intensity (60-95% max effort)	Low intensity (up to 60% max effort)
Recovery required	Quick recovery (30 sec – 5 min)	20 min – 2 hrs (breakdown lactic acid)	Time to eat and drink (to replenish fuel stores)
Predominant fibre types	Type IIb	Type IIa	Type I

Summary of energy systems

The energy continuum

	Aerobic	Anaerobic	
Weight lifting	0%	100%	100m sprint; golf & tennis swings; American football
Gymnastics 200m sprint	10	90	
Ice hockey	20	80	Basketball; baseball; 400m sprint
100m swim Tennis Hockey	30	70	Lacrosse
	40	60	
800m run Boxing	50	50	200m swim; skating
2000m row	60	40	
1 mile run 400m swim	70	30	1500m run
2 mile run	80	20	800m swim
3 mile run Skating 10 km	90	10	
Marathon	100%	0%	

Adapted from Bowers & Fox (1988)

The energy continuum

It ought to be remembered that at **NO** point in time do we solely use either aerobic or anaerobic energy sources.

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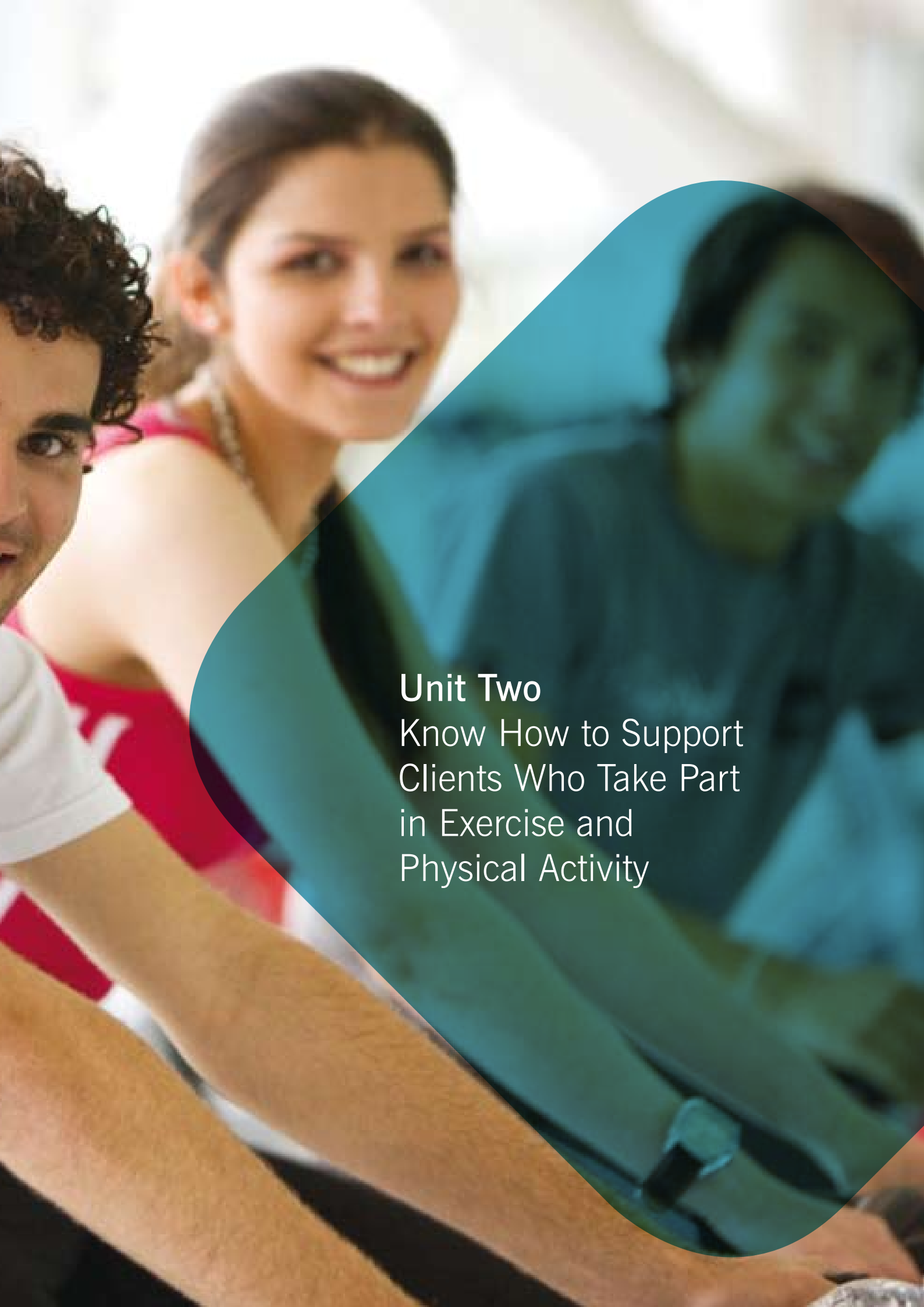


Unit Two

Know How to Support Clients Who Take Part in Exercise and Physical Activity

Know How to Support Clients Who Take Part in Exercise and Physical Activity

Aim: To provide learners with the knowledge needed to provide ongoing customer service and how to support clients taking part in exercise and physical activity

Learning outcomes

By the end of this unit the learner will:

- understand how to form effective working relationships with clients
- understand how to address barriers to exercise/physical activity that clients experience
- understand how to support clients to adhere to exercise/physical activity
- understand how to provide ongoing service to clients

Introduction

It is important for an instructor to know how to support clients who take part in exercise and physical activity. Communicating effectively with customers and implementing strategies to promote adherence to physical activity will be more likely to secure long term involvement with exercise than the training regime alone.

Forming effective working relationships with clients

Relationships: 'a relationship exists where the actions of one person will have an effect on another person or group of people'.

Maintaining an effective relationship with clients is important to promote exercise adherence

During a professional career a whole host of relationships are developed for a variety of reasons and to produce a range of outcomes. These may be with clients, colleagues and other professionals.

Maintaining an effective relationship with clients is important to promote exercise adherence, improve the reputation of the organisation the instructor is working for and help generate repeat business.

What does a professional relationship with a client involve?

Each relationship is different; however, professional relationships will flourish if they contain these characteristics:

- mutual respect
- trust
- good communication
- rapport
- feelings of safety and security
- ethical standards

How to develop and maintain the relationship

The three main aspects will be:

- communicating well
- conducting oneself well
- respecting boundaries and barriers

1. Communicating well

Communication skills are an essential feature of any health and fitness professional's role

Effective communication skills are an essential feature of any health and fitness professional's role.

There are a number of areas to consider when looking at effective communication:

Listening

Instructors should engage in active listening that involves not just listening to the spoken word but also looking for the meaning behind those words. This is not a passive activity and will require considerable effort if the underlying message is to be properly understood.

Active listening should be supported by good observation skills since non-verbal communication (i.e. facial expression, tone of voice, body posture, eye contact) will give added meaning to what is being said. We can obtain valuable information about a client's emotions, beliefs and how hard they are working by observing their posture and how they behave.

Building rapport

There are a number of areas to look at when considering how best to engage a client:

Using appropriate non-verbal behaviour

This should communicate attention and interest. It should include making regular eye contact, using nods, gestures and body movement (leaning forwards) to indicate interest and ensure an appropriate physical distance between health and fitness professional and client.

Accepting the client perspective

The instructor needs to suspend judgement and accept the validity of the client's view, even if they don't necessarily agree with it.

Demonstrating empathy

This involves active listening while attempting to make sense of what is being said and then communicating that back to the client. Empathetic comments and a positive attitude will support the client-instructor relationship whereas comments that are seen as flippant or patronising will not be conducive to the client sharing their thoughts.

Providing support

This is about showing concern and willingness to help as well as recognising and praising any positive coping strategy. The partnership relationship between the client and the health and fitness professional should also be emphasised.

Facilitating client responses and developing understanding

In order to get the most out of our interactions with clients we should consider the following aids to effective communication:

Facilitating

Words (i.e. "yes", "sure", "go on") or gestures should be used that prompt the client to keep talking. In this way, the client will feel that they are being listened to and that what they are saying is important.

Paraphrasing and summarising

The instructor uses their own words to state their understanding of what the client is saying. Such paraphrasing aids listening and indicates to the client a level of interest and concern. Summarising the information given will have similar benefits and provides the client with the opportunity to add to, disagree with or confirm the information given within the summary.

Clarifying

The instructor should not assume that their understanding of a word or a phrase is the same as the client's. As an example of clarification the client may state that they need to "…take it easy at the moment". The health and fitness professional might then ask "what do you mean by take it easy?"

The health and fitness professional should not assume that their understanding of a word or a phrase is the same as the client's

Instructors should also ensure that their own terminology does not confuse, frighten or lead to misinterpretation.

Use of silence

Give clients time to find the right words and avoid jumping in to help them out. Unearthing what really concerns the client is important. A silence can be useful in giving the client time to reflect on what has been discussed, to voice their opinion or to ask questions.

Indicating the reason for asking the question

The instructor may need to indicate why they are pursuing a particular line of enquiry particularly when discussing sensitive issues or the relevance of a subject is not obvious.

Jargon

Using overly technical or medical jargon can both frighten and confuse clients and should be avoided unless they are an advanced client and recognise the terms being used.

Premature advice or reassurance

It is tempting to jump in with "expert opinions" or advice before the full picture has been gained. For example, a full explanation of certain exercises might be given prior to a client stating that they have had problems with these exercises previously.

Ultimately, building rapport through good communication will help the client to adhere to their exercise and physical activity regime.

2. Presenting oneself and the organisation positively to clients

Using overly technical or medical jargon can both frighten and confuse clients

This is a multidimensional concept and means different things to different people. When considering conduct the instructor will need to take into account the following:

Professional appearance

Clothing and grooming need to be consistent with the image that is being portrayed and the expectations of the client group and the organisation. For example, wearing company uniform that is clean and ironed.

Punctuality and reliability

These are true marks of professionalism. If they are problematic then there is a need to develop a new strategy to ensure punctuality and reliability. Lack of punctuality suggests an 'I don't care enough to make the effort' attitude. Lateness looks bad on behalf of the instructor and the organisation.

Integrity

Integrity means being honest and living by a high moral code.

Walk the talk

It is important to live by the message that is preached.

3. Respecting boundaries and barriers

Clothing and grooming need to be consistent with the image that is being portrayed

All relationships function within a framework of boundaries or agreements. These may be expressed or assumed by both parties. The respecting of these boundaries has major implications for personal wellbeing, satisfaction and outcomes of the relationship.

Boundaries on the sports field are clear, as are the penalties for going outside of the boundaries; this distinction is not so clear cut in the relationship situation. Most professions have a code of conduct to ensure that professional boundaries are established.

Certain situations an instructor may find themselves in have the potential for a boundary violation: for example, accepting a gift from a client, giving a client a hug when they are successful or unhappy or accepting an invitation to a social event with the client.

To enable the health and fitness professional to think about the issue of professional boundaries the following phrases need to be completed:

- an instructor always…..
- an instructor never…..
- the limits of the professional role are determined by…..
- in working with the client it is the instructor's business to…..
- in working with the client it is not the instructor's business to…..
- good rules to follow to ensure the instructor does not allow clients to step over professional boundaries are…..

(adapted from J. Gavin, 2005)

To form a positive relationship and make immediate impact instructors will:

High standards will gain the confidence of the client and establish a sound reputation

Be professional:

- set the highest standards of conduct in everything they do. High standards will gain the confidence of the client and establish a sound reputation

Be patient, compassionate and sensitive:

- customers may be beginners and take a little extra time in grasping concepts
- understand customer needs, wants and expectations

Be punctual and reliable:

- be on time
- be honest

Be enthusiastic:

- enthusiasm is contagious

Have a sense of humour:

- have fun! This does not mean that sessions should be easy or ineffective
- a professional but light-hearted approach will often achieve the best results

Be motivational:

- always provide positive encouragement and feedback

Be approachable:

- customers should feel comfortable in asking for help

Be self-confident:

- self-confidence grows from experience
- avoid being over confident as this turns people off

Have integrity and maintain customer/client confidentiality:

- ensure all commitments are met
- never discuss personal information about clients with a third party unless consent is given

Develop communication skills:

- the essence of any relationship is communication. Skills include active listening, tonality and language, and body language

Be organised:

- keep a day-to-day diary
- plan ahead

Become a role model:

- 'practice what you preach' - clients look to their instructor for guidance and direction

Be adaptable:

- even the best-laid plans sometimes go awry
- develop an action plan and plan for the unexpected

Be empowering:

- empower clients to make informed decisions for themselves
- educate

Ethical issues

The meaning of ethical responsibility is to:

> *"...do nothing that will harm the client or society"*
>
> *(Ivey, Ivey and Simek-Morgan, 1997)*

Communication skills include active listening, tonality and language, and body language

The responsibility for ethics lies entirely with the fitness professional. The client who comes for training may be vulnerable and susceptible to the influence of anyone who offers help.

The code of ethics can be viewed as:

> *"...values of a profession translated into standards of conduct for the membership"*
>
> *(Gibson and Mitchell, 2003)*

The code of ethics is different to laws. Ethical codes will guide professional people in their work and help them to make ethical decisions. These codes will regulate the behaviour of professionals and breaking these codes will bring punitive measures. A professional can be charged with breaking the code of ethics without breaking the law.

Ethical codes have been summarised by nine main principles according to Koocher and Kieth-Spiegel (1998):

- professional action shall bring no harm to clients
- clients have the right to choose their own direction
- be faithful to clients, the profession, the employing organisations and ultimately to yourself
- be just and fair to all clients, thereby ensuring non-discriminatory professional actions
- be of benefit to clients by promoting their welfare
- treat all clients with dignity and respect
- be fully accountable to clients
- maintain clear and unwavering professional boundaries

Principle 1 of the REPs code of ethical practice states that:

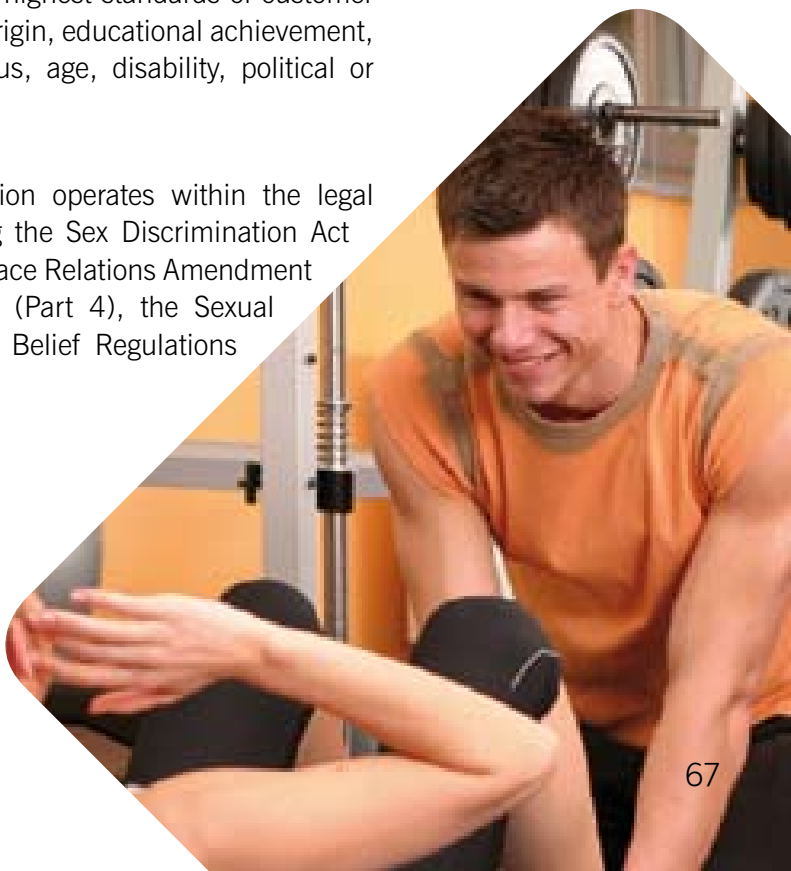
> ***'Exercise professionals will be respectful of their customers and of their rights as individuals.'***

Compliance with this principle requires exercise professionals to maintain a standard of professional conduct appropriate to their dealings with all client groups and to responsibly demonstrate:

- respect for individual difference and diversity
- good practice in challenging discrimination and unfairness
- discretion in dealing with confidential client disclosure

Valuing equality and diversity is important to ensure that all clients and prospective customers are all treated equally, fairly and with the highest standards of customer care, irrespective of: race, colour, nationality, ethnic origin, educational achievement, gender, sexual orientation, marital or parental status, age, disability, political or religious belief or socio-economic class.

This will ensure that the instructor and organisation operates within the legal framework of various pieces of legislation including the Sex Discrimination Act 1975, Race Relations Act 1976 as amended by the Race Relations Amendment Act 2000, the Disability Discrimination Act 1995 (Part 4), the Sexual Orientation Regulations 2003 and the Religion or Belief Regulations 2003.



Supporting clients to adhere to exercise/physical activity

The term 'adherence' can be explained by comparing it with the term 'adhesive'. An adhesive is used to stick one piece of paper to another piece of paper. In this case, we are looking to keep our client and their exercise habits stuck together or adhered.

It is relatively easy to start people exercising because everyone knows it is good for their health and that they should do it. When joining a health club, the environments for exercise can be very attractive to people and provide the opportunity to enjoy the facilities and mix with people. However, after a while the initial enthusiasm and enjoyment start to wear off and the individual is left to face the simple fact that exercise is hard work and can be uncomfortable. As exercise professionals it is important that instructors learn and promote methods that positively influence people to maintain their exercise programme.

Developing change

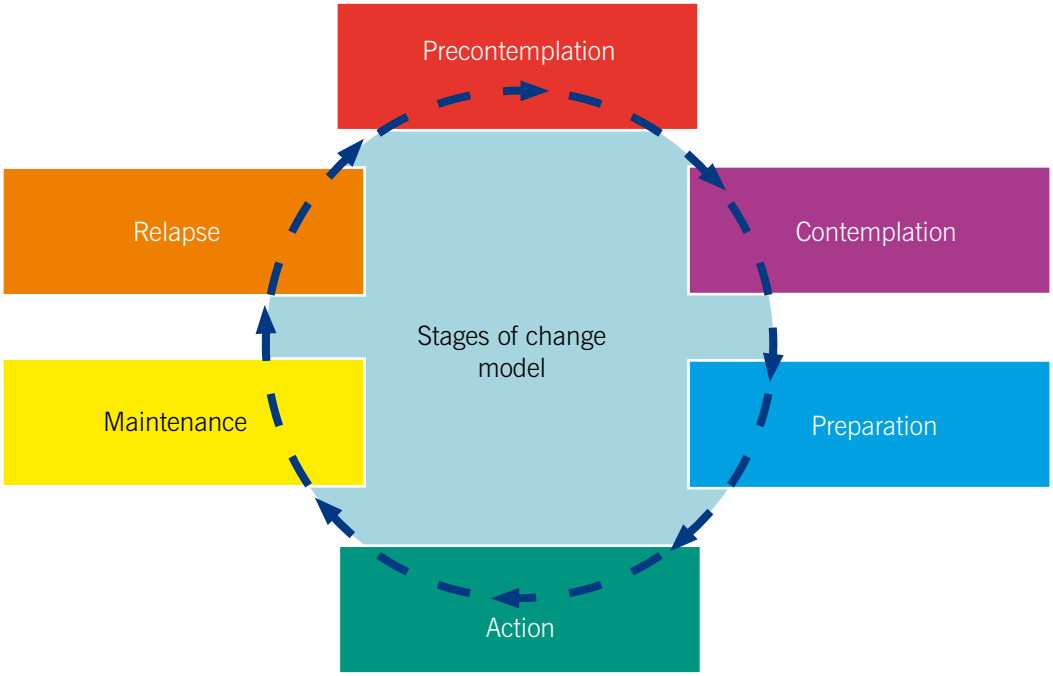
There are some people that show self-directed behaviour and a willingness to change. This is usually due to four factors:

- persuasion by authority - doctor
- observation of others - see changes in friends (more energy, fat loss)
- physiological feedback - clothes feel tight, a remark overheard
- successful performance - reached goals easily

It is important for a client to take personal responsibility for their own fitness and motivation. A client that takes responsibility over their health and fitness will become more independent and are more likely to adhere to strategies implemented to reach their fitness goals. Relying solely on other people (i.e. an instructor or doctor) may encourage the client to 'blame' other people for a lack of results or outcomes they are looking. They may also become reliant on other people to do the work for them. This may leave them unable to do anything about their health and fitness without the presence of someone they have become dependent on.

Change cycle

The stages of change model identifies the process by which a person goes through when looking to change their behaviour. It is important for an instructor to be aware of the different stages so that they can develop strategies to facilitate the client's progress throughout each step.



Adapted from Buckworth and Dishman (2002)

Pre-contemplation

This stage occurs when individuals are inactive and have no serious intention to start an exercise programme. This stage requires the instructor to develop an interest by ensuring that information is readily available. This information should use clear and simple messages in laymen's terms. The health and fitness professional should educate, offer incentives, banish myths and preconceptions; they should also ensure that they are a suitable role model and that they offer instructions on the next move.

Contemplation

This stage occurs when an individual is still inactive but is intending to start exercise within the next six months. At this stage, the instructor will be providing realistic goals, a choice of enjoyable activities, flexible packages of activity and short-term ideas to stimulate interest and uptake.

Preparation

During this stage individuals are planning to make specific changes or are experimenting with small changes. It is at this stage that the individual is ready for change.

Action

This stage is the most important in terms of giving feedback and support, as this tends to be the most difficult time. They will see and feel changes in their body and state of health but may reach a plateau and need motivating to carry on.

The trainer will need to redefine goals and offer more support to prevent relapse

Maintenance and relapse

This stage will require motivation, support, the reinforcing of goals and monitoring. This is the most unstable stage as motivation can be difficult to maintain at the required levels. The health and fitness professional may wish to encourage the use of fitness diaries to ensure adherence.

Relapse

The trainer will need to redefine goals and offer more support to prevent relapse.

Reasons for exercising

Enjoyment

Often one of the main reasons for participation in sport and exercise is enjoyment. Although there may be little initial enjoyment for a person exercising a previously inactive or sedentary body, physical activity should become increasingly enjoyable and rewarding as the level of fitness improves.

Health

People today are becoming much more aware of the benefits of health-related exercise as a means of protection against illness e.g. heart disease, hypertension and stress-related diseases. They may decide themselves to embark on an active exercise programme as part of their quest for a healthier lifestyle or they may be strongly recommended by their doctor or specialist to do so, following medical examination or illness.

Appearance/weight control

Probably the largest proportion of those joining health clubs or attending exercise sessions are aiming to enhance their appearance by improving their body composition, general muscle tone and posture.

Social / fashion status

A significant number of people take up exercise because others are doing so. It may indeed be a status symbol to be a member of a particular health club. Equally, they may simply enjoy the social aspect of a group exercise situation. Hopefully they will eventually continue the programme because they also actually start to enjoy the exercise for its own sake.

Rehabilitation

It may only be following illness or injury, when the need for rehabilitation demands participation in exercise, that a programme is commenced.

General fitness

Some take up exercise for general fitness goals. They may want to improve their cardiovascular fitness, their muscular tone/endurance/strength or lose body fat.

General well-being

Individuals occasionally wake up in the morning and realise that they feel lethargic and tired, even before the day has begun. It is often for this reason that they join a fitness facility to improve their general all-round sense of well-being.

Sport specific fitness

Any individual taking up a new sport or perhaps returning to a sport after a long absence may wish to start a fitness programme before competing. It needs to be specific in its objectives in order to prepare physically for the demands of the sporting activity or to improve levels of performance.

Dropout rates from exercise programmes

Despite the numerous reasons for starting exercise, many people do not continue their exercise programmes. This can be seen by the 'New Year rush'. People often resolve to start exercise for the New Year and regularly attend in January and February. However, by mid March motivation is waning and the gyms become a little quieter again.

People will cite the following reasons for giving up on their programmes, they will include:

- boredom
- lack of fitness gains or improvements
- poor instruction or lack of support
- lack of time
- expense
- lack of motivation
- a return to old habits of smoking, drinking or unhealthy eating

Methods of adherence

Goal setting

Goal setting can be used as a strategy to enhance motivation and commitment. According to Buckworth and Dishman (2002) goal setting is "an effective strategy for supporting exercise behaviour change." It was originally developed for use in the industrial setting; however, it is now widely used in sports and exercise environments.

Definition: a goal is what an individual is trying to achieve. It is the object or aim of an action.

Why is it important to set goals?

- persistence - it helps the individual to persist at a task over time and keep sight of what they are trying to achieve
- attention - it helps to keep an individual's attention directed to the important aspects
- effort - it helps to mobilise and direct the intensity of effort towards a certain task or outcome
- strategies - it may help individuals to develop new strategies to help achieve their desired outcomes

Why do people not set goals?

- people do not understand the importance of setting goals
- they do not know how to set goals
- fear of failure through not achieving goals
- they do not know what they want to achieve

Types of goals

Goal setting can be used for motivating ourselves in life as well as for sport and exercise. The main categories of goals are:

1. Personal goals: these relate to our personal life, such as family life, social aspects, sporting aims, health and fitness and things which give us pleasure.

2. Business/career/economic goals: these relate to the development of career and necessary financial rewards.

3. Self improvement goals: these relate to aspects of personal growth and development.

4. Performance, process and outcome goals:

- outcome goals

  Outcome goals focus on the outcome of an event or situation, such as winning a race or beating an opponent. Achieving an outcome goal depends not only on individual efforts but also on the ability and performance of the opponent.

- performance goals

  Performance goals focus on making comparisons with one's own performance. Performance goals differ from outcome goals in that they are within the control of the athlete.

- process goals

  Process goals focus on the process, or actions, that an individual must execute in order to perform well. This may be emphasising a particular technique or components within a technique.

Short term and long term goals

Goal categories	
Short term goals	These are goals which are set over a period of one day to one month. A short term goal may relate to what the PT aims to achieve in that one session, but usually relates to a period of around one month.
Medium term goals	These are goals set from a period of one to six months, however, one month and three month goals are most common.
Long term goals	These goals relate to periods from six months to over several years. People may set 'lifetime goals' which cannot be assessed until retirement. Most long term goals are set for achievement over the course of a year or a competitive season.

It is important to set both long term and short term goals. The fulfilment of short term goals will contribute to the achievement of long term goals.

Principles of goal setting

According to O'Connor (2001), there are seven principles to be considered in order to make goals realistic, achievable and motivating.

1. Say what you want not what you want to avoid

In other words, be positive in the language used with regard to goals or they will not put the individual in the right emotional state to achieve. For example 'I will avoid putting on body fat' should be replaced by 'I will improve my body fat percentage.'

2. Make goals challenging and realistic

It is important that goals are achievable. Setting a goal too high can cause problems of stress due to the worry of not achieving or overtraining in an attempt to improve performance. Goals that are too easy will diminish motivation.

3. Influence the result directly

The goal set must be under the individual's control and not rely on the actions of other people. The goal should always start with 'I' and should be in the present tense. A goal such as 'I will win this race' is not always appropriate because it relies on the performance of the other competitors; it is preferable to aim for a time.

4. Measure progress

Goals should always be time constrained with regard to a deadline. The choice is to set a specific date or a certain period of time to achieve the goal, such as a number of weeks or months. Goals should be a combination of short, medium and long term goals.

It is important to be able to measure goals in numerical terms. For example 'I want to get stronger' is not as good a goal as 'I want to improve my bench press by 25%'. It will now become clear whether the goal has been reached or not.

5. Check resources

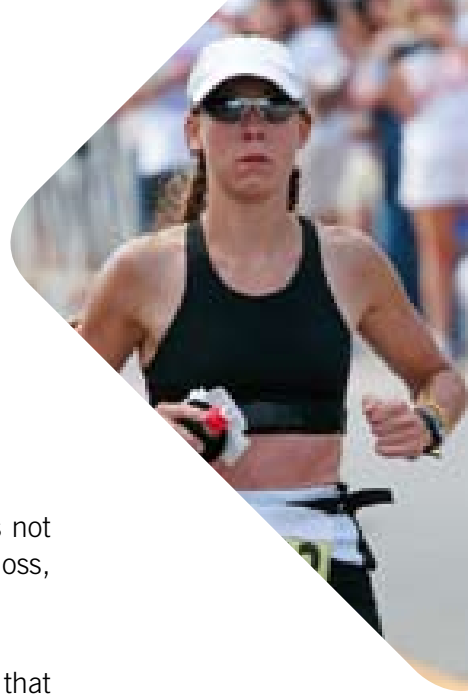
Look at what help there is available to achieve the goal. This may involve people who have an interest in the achievement of this goal, such as a coach, team mate, friend, family or partner. Resources will include facilities, books and equipment available.

6. Count the cost

What is going to be the cost of working towards this goal? This will clearly involve money, but also other costs such as time and social losses to friends and family.

7. Provide rewards

Congratulations need to be given on achieving the goal and this should be done with an appropriate reward. Do not give rewards that involve indulging in the previous, bad habits!



SMART goals

When setting goals it is useful to use the acronym SMART.

S pecific
M easurable
A greeable
R ealistic
T ime constrained

Specific - this means that goals must relate to specific aspects of fitness. It is not enough to want to get fitter the goal must be specific and state whether it is fat loss, muscle development, aerobic fitness, flexibility or core stability that is wanted.

Measurable - the goal must be quantifiable in that, it should be stated in figures that can be measured. For example, "I want to reduce body fat" is not measurable. However, if it is stated that the individual wants to reduce body fat by 3% or fit into 32" waist jeans then it does become measurable.

Agreeable - goals must be devised and agreed by both instructor and client.

Realistic - the instructor must be realistic in setting goals and take into account the external factors that may affect their success.

Time constrained - there must be a time scale to accompany the goal so the client has a deadline by which to measure their success. For example, they must achieve their goal of improving their aerobic capacity by 10% in three months time.

A sound goal will follow all these criteria. For example, if a goal was to reduce body fat by 3% in three months time. This goal is specific to one aspect of fitness; it is measurable, time constrained and achievable.

Additional factors in goal setting

Goals should be moderately difficult but realistic to achieve: unless goal setting is done carefully it could be de-motivating. If goals are set which are too hard to achieve or the time scale is too long, motivation will be lost because the client may be put off and not make the changes necessary. Over ambitious goals can place a lot of stress on an individual as they seek to achieve them - remember most people have enough stress without undue stress being added. Alternately, if goals are set too low then they will not achieve the desired effect, because once the goal has been achieved the previous behaviour of the client may be resumed.

Allow the individual input into development of goals: many psychological theories propose that, as human beings, people do not respond well to having restrictions placed on their freedom of choice and are likely to put up some resistance if constantly bombarded with commands or instructions. Clients, therefore, are more likely to feel committed to their goals if they have contributed towards their content. This will help assist them develop their own strategy for motivation and adherence.

Goals should be written down: all goals must be committed to paper with the client and the instructor keeping a copy for their records. The client should be encouraged to display the goals in a public place for themselves and their supportive others to see.

Back up the goals with imagery: the client should be encouraged to visualise how they look and feel when they have achieved their goal. The experience of mental images and emotions linked to the goal achievement make the process more real and intense.

Back the plan with determination: goals will only be achieved if there is the determination, persistence and resolve not to give up. This needs to be instilled in the client.

Have a support system: the client will experience times of weakness or doubt about their ability to achieve their goals. At these times, they will need a support network, who may be the instructor, a friend or a member of their family.

It is worth noting, that the change in behaviour may not be supported by everyone because it may result in changes in the client's relationships. For example, if the client decides to stop drinking alcohol this may result in them stopping going to pubs and losing contact with friends. It may happen that these friends will try to prevent the changes in behaviour because it is not in their interest.

Keep a diary: it is an excellent idea for the client to write down all activities related to achieving the goal. For example, details of training sessions or a record of food for the day. Writing a diary will make the client be honest with themselves and also can be used to show progression and help to motivate.

Use reminders: anything that can be done to help in achieving goals is useful. Putting up pictures of the ideal self, writing notes to ourselves or publishing motivational phrases can all help to keep the goals on track. For example, the client might have a note on the fridge saying 'think before you eat' or a note on the bathroom door saying 'go to the gym today'. These will only work for a short period of time because client's can train themselves to ignore them, so change them every four weeks.

Reviewing and revising goals

Setting and defining goals is of limited value unless there is a follow up procedure which evaluates progress and leads to the development of future goals.

Arranging sessions / appointments with clients is key to check progress of long and medium term goals and setting this in advance will help adherence. Review of short term goals may be better suited, however, to informal discussions within the health and fitness environment with suggestions to amend their programme in the short term if necessary.

Goal setting conclusion

These guidelines are not considered to be an exhaustive list but rather a framework, or reference point, to assist professionals developing a goal-setting programme.

The existence of goals may assist clients in a variety of ways that may not be totally explained by the sports psychology texts or research. Sports psychologists consider the most important use of goal setting to be enhanced motivation. Goal setting provides clients with distinct (meaningful) targets that are pertinent to their particular desires. It helps them to believe the work they invest in their sport is important, because it draws them closer towards the achievement of these goals.

Addressing barriers to exercise/physical activity that clients experience

Barriers

People may often cite a lack of fitness as being the main reason not to start an exercise programme

Why do people not take part in regular activity or exercise if they know the benefits?

Becoming more active is more a process of acquiring new behaviours than giving up old ones. Experiences need to be rewarding and positive and they must provide a sense of satisfaction and success if they are to ensure a degree of reasonably regular participation.

Helping people to identify and work through their personal barriers is important as they prepare to change. Removing a block or releasing a brake can often trigger forward movement. Barriers may present themselves in a number of forms. The following list represents some common barriers that clients put forward as a block to their participation in exercise and physical activity. Suggested strategies that an instructor may be able to advise on in an attempt to help overcome barriers are also given.

People may have tried an exercise programme in the past and failed to achieve their goals

1. Physical barriers

People may often cite a lack of fitness as being the main reason not to start an exercise programme. Any competent instructor should be able to plan an exercise programme for a beginner who is not particularly fit. Removing this barrier may be done through educating the client that anything (within reason) is better than nothing and be able to prescribe a basic fitness programme suitable to the novice and the unfit by following appropriate programming guidelines.

If the client is in poor health and does not 'pass' the screening requirements then they would need to be referred to an appropriate health professional. This in itself may remove the barrier as the appropriately trained professional may be able to design a regime suitable to their health condition that they did not feel was possible.

2. Emotional barriers

People may have tried an exercise programme in the past and failed to achieve their goals. Unless this was done under the guidance of a suitable professional then it may be that the client has followed a fitness regime from a magazine or some other source. If this is the case then the fitness professional should be able to design an appropriate programme and explain that everyone is different and that sometimes different approaches are needed to gain results for different people. Monitoring short term goals may overcome this barrier and help adherence.

Additionally, some people may feel self conscious or embarrassed. This barrier can be overcome by giving the client certain exercises that they can do at home which will keep them out of the 'spotlight' and build up their confidence. Suggesting that they take part in physical activity with a group of friends may also help them feel more at ease.

3. Motivational barriers

Consider the likes and dislikes of the client and offer a range of activities for them to choose from

Some people may not enjoy exercising and find it difficult to motivate themselves. Implementing or finding exercises that they do enjoy can be a good way to get them 'hooked' and help exercise adherence. One of the main reasons people may not exercise is that they had negative experiences in the past and don't consider exercise to be enjoyable. Consider the likes and dislikes of the client and offer a range of activities for them to choose from. This variety will also reduce boredom.

Goal setting as previously discussed can be a useful way to keep someone motivated and on track.

4. Time barriers

A system of rewards or incentives can be used to strengthen clients' motivation and adherence

Lack of time is a common excuse used for lack of participation in exercise and physical activity. This may be overcome by building physical activity in to the person's everyday life. They may, for example, choose to take the stairs instead of the lift or recommend some exercises that they can do at home which can cut back on the frequency of visits needed to the fitness environment, thus saving time.

Rewards or incentives

A system of rewards or incentives can be used to strengthen clients' motivation and adherence. Some health and fitness organisations will use a system of rewards for high attendees or people who achieve certain targets or goals. This system of positive reinforcement is valuable because it shows people that their efforts have been recognised and are now being rewarded. The reward itself, which may be as small as a free water bottle or T-shirt, is virtually irrelevant compared to the fact that they have received recognition. Certain companies may publish a list of the top ten attendees for the month and this recognition can become a strong motivator.

Any system of rewards or incentives should be applied with discretion since these often introduce competition and can lead to possible overtraining and people doing themselves more harm than good.

Other guidelines for improving exercise adherence

Change training regularly

By changing variables such as intensity, duration and frequency the fitness professional is more likely to keep the client stimulated and on programme.

Suggest training with a group

This is a highly effective method of promoting adherence for two reasons. Firstly, the social aspect of training will promote enjoyment and secondly the level of commitment is increased because the client will not want to let down their peers.

Keep a log of training sessions

This is a vital activity in changing behaviour because it will show the client how they are improving and the commitment they have made. It can be very satisfying reviewing the sessions completed and the progress made.

The decision balance sheet

The individual is asked to sit down and consider all the gains they will receive from their programme of exercise and also any losses they may experience. Hopefully, the gains will vastly outweigh the losses and as a result it will provide the impetus for them to start exercise and to continue with their programme. The decision balance sheet should be displayed in a prominent place in the home and serve as a continual motivating factor, especially in times of weakness or uncertainty.

By changing variables such as intensity, duration and frequency the fitness professional is more likely to keep the client stimulated and on programme

Social support networks

A major reason that people give up on their exercise programmes is because they feel that no one will notice or that no one cares. The aim of a social support network is to give a person the support of other people because they may not be receiving positive support from home.

Providing ongoing customer service

Definitions

Customer service

The ability to consistently meet the customers' needs, wants and expectations

The customer

Anybody whom you have dealings with (Leyland and Bailey, 1999)

Customers are the lifeblood of the health and fitness industry

Customers are the lifeblood of the health and fitness industry. Typically customers are thought of as people who buy a product or service, but as the above definition reveals, in essence everybody, from client to colleague, is a customer.

Maintaining good customer care is important for the client as it will mean they are more likely to enjoy their experience within the health and fitness environment which will encourage long term involvement in physical activity and health. It is also of benefit to the organisation as it helps secure repeat business and referrals.

Customers will ask questions, need guidance and want information. They will expect a level of instructor competence, equipment to be both safe and up-to-date and will demand fast and efficient action when required.

Good customer service incorporates the following four elements:

- expanding the definition of service
- knowing who the customers are
- forming positive relationships
- developing a customer friendly attitude

Expanding the definition of service

It is essential to give the customer what they want, and to manage their expectations of the service being offered

Leyland and Bailey (1999) state that the definition of the service offered shapes every interaction (whether good or bad) with customers. It is essential to give the customer what they want, and to manage their expectations of the service being offered. For example, a customer asks if a massage service is available, however, this service is beyond the instructor's scope of practice. Instead of saying no, the instructor could recommend or offer to enquire regarding availability elsewhere on behalf of the customer. Although the instructor didn't possess the necessary skills to provide the customer's direct needs, they still provided good customer service! Always offer options even when the customer can be given exactly what they want.

The 'extra mile' a health and fitness professional may go can make all the difference in satisfying the customer. Giving the client a call to check how they are progressing with their exercise regime or how they felt the day after a session with the instructor would be an example of exceeding customer expectations.

Leyland and Bailey (1999) also recommend expanding the definition of service to include less obvious needs such as listening and empathy.

The 'extra mile' a health and fitness professional may take can make all the difference in satisfying the customer

Knowing who the customers are

Identifying who the customers are is essential for success. Customers can be classified as either external (people who pay for products or services such as health club members) or internal (people who rely on the instructor or the instructor relies on them for support, information and products). Internal customers include managers, cleaners, receptionists, maintenance staff and other health care providers.

The customer chain is the term used to define the relationship and interplay between external and internal customers. Ultimately, this interplay will always affect the external paying customer. Imagine a paying customer (external) makes a complaint regarding there being no hot water in the showers. The instructor follows this up by notifying the maintenance team (the health club maintenance team would be classified as the internal customer generally having no contact with external customers); however, in this situation the instructor has become the internal customer and the action they take ultimately affects the external paying customer. Throughout the day and at any given instant expect to become the customer as well as the customer being someone else.

Forming positive relationships

The core of good customer service is forming positive relationships with customers. Positive relationships lead to positive experiences and happy customers. Happy customers are more likely to come back for more and, more importantly, they will spread the word!

The core of good customer service is forming positive relationships with customers

The aim of any potential relationship between customer and instructor is to build rapport. O'Conner and Lages (2004), define rapport as "a relationship of mutual respect and influence" and as revolving around the ability to see the world from the customer's point of view. Customer/instructor rapport can be established through effective communication. Positive communication involves a number of essential elements, these include:

- active listening
- body language
- tonality and use of language
- active listening:
  - ✓ nodding
  - ✓ leaning forward
  - ✓ using positive facial expressions
  - ✓ eye contact
  - ✓ developing the art of paraphrasing, reflecting, summarizing, focusing

- body language:
  - ✓ react to the senses e.g. sight, touch
  - ✓ be aware of the client's personal space
  - ✓ be warm and friendly
  - ✓ use hand gestures
  - ✓ smile
  - ✓ maintain eye contact
  - ✓ avoid crossing arms when interacting as it can appear hostile
  - ✓ avoid aggressive acts such as pointing and standing over the client

- tonality and use of language:
  - ✓ tone and pitch
  - ✓ use rhythm
  - ✓ ensure an 'honesty' in the voice
  - ✓ richness, warmth and volume to be appropriate
  - ✓ match customer words
  - ✓ use appropriate language

Developing a customer friendly attitude

Developing a friendly attitude towards customers comes from an appreciation of how important they are to a business/organisation. First impressions count; simply smiling and calling someone by their name instantly forges a positive connection with lasting impact. There is only one chance to make a good impression, so no matter how busy the instructor is, it must always be remembered that customers are the reason the business exists! Customers will not care how knowledgeable the instructor is unless the instructor shows them how much they care. The acronym C.A.R.E. illustrates the essence of developing a customer friendly attitude:

Consideration:

- always offer to help
- don't make promises unless they can be kept
- integrity and honesty – always be honest about the service provided
- consider the customers circumstances and feelings

Active listening:

- listen to the customer - show customers that they are being listened to by responding appropriately

Responsiveness:

- go the extra step - if a customer asks a question don't just pass them to someone else. Make the extra effort to respond in person
- add something extra - offer an alternative like a free fitness session or discount. A gesture of good will is a sure way to maintain a positive relationship. People love getting more than expected
- deal with complaints promptly

Empathy:

- be non-judgmental
- understand customer needs

Customer complaints

At some point, an instructor will have to deal with a customer complaint/s. The key is not to take the complaint personally and become defensive. Look at a complaint as the customer providing valuable feedback. How the problem is dealt with will have a direct bearing on how the instructor is perceived and will leave a lasting impression on the customer. Remember, the client may not just be displeased; they may be upset, confused, disillusioned or angry. In the event of a complaint, the following action should be taken:

- listen and take ownership of the complaint
- always be polite
- remain calm and never enter into an argument
- record the complaint (fill in complaint form), acknowledge receipt of the complaint and reassure the customer
- offer a point of contact, advise the client of possible solutions or alternatives, ensure the client is pacified before leaving
- inform relevant persons of the problem
- feedback to the client

At some point, an instructor will have to deal with a customer complaint/s

It is important to keep the customer informed of the progress being made when looking to deal with complaints. This is particularly true when there are delays in meeting client needs in a timely and effective fashion. Communication is the key here and customers will often become frustrated if they do not know what is happening. Keeping them informed along the way will demonstrate that the instructor and the organisation are doing something about their needs rather than ignoring them.

Dealing with an angry customer takes practice. Be assertive, empathetic and most importantly, non-confrontational. Pay careful attention to tonality of the voice, verbal and body language - be assertive but never aggressive. The following examples illustrate aggressive and assertive use of language:

- aggressive use of language:
  - *"don't … speak to me like that"*
  - *"with that attitude…… how do you expect to resolve this"*
  - *"shut up …… otherwise I will not continue this conversation"*
- assertive use of language:
  - *"I'd prefer it if…… you didn't speak to me in that way"*
  - *"I understand your frustration…… could you calm down so that we can begin to resolve this"*
  - *"if you persist to use bad language……I will be unable to continue this conversation"*

Following the organisation's procedures when dealing with complaints is essential to ensure every member is dealt with fairly and that something is being done. It is important to do this positively, so that the organisation and their employees are communicating from common ground. Otherwise this can create a negative image of the organisation in the eye of the customer.

Remember, every complaint is an opportunity!

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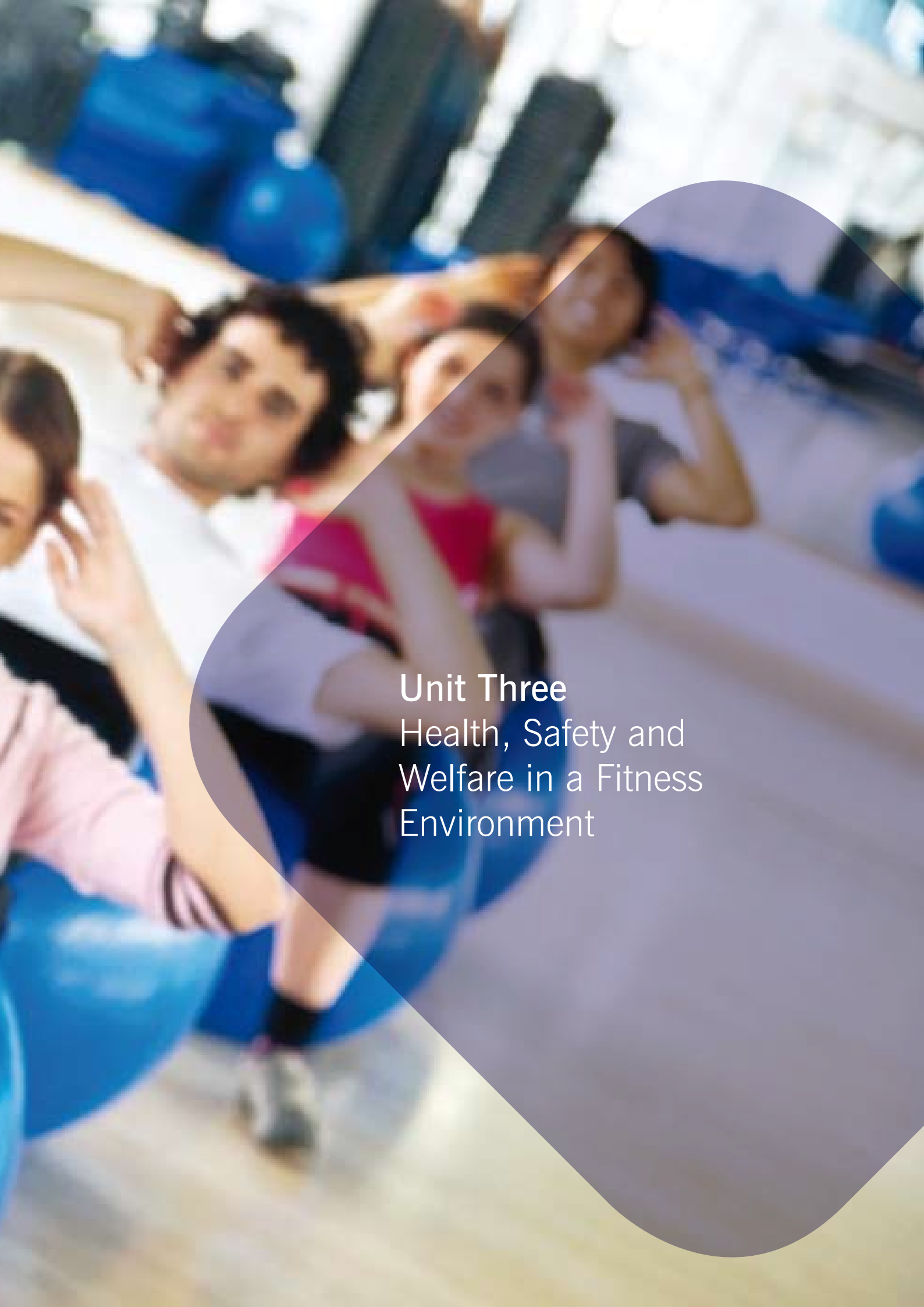


Unit Three
Health, Safety and Welfare in a Fitness Environment

Health, Safety and Welfare in a Fitness Environment

Aim: To provide learners with the knowledge and understanding that instructors need to maintain health, safety and welfare in a fitness environment, including the safeguarding of children and vulnerable adults.

Learning outcomes

By the end of this unit the learner will understand:

- emergency procedures in a fitness environment
- health and safety requirements in a fitness environment
- how to control risks in a fitness environment
- how to safeguard children and vulnerable adults

Introduction

Health and safety is of primary importance in the health and fitness industry. Instructors must be legally aware of their organisation's health and safety and duty of care policies and procedures to uphold the health, safety and welfare of their colleagues and those participating in physical activity.

Health and safety

Employers must ensure that the health, safety and welfare of employees are protected, so far as is reasonably practicable

Health and Safety at Work Act, 1974

The 'Health and Safety at Work Act 1974' is the basis of British health and safety law and sets out the duties that employers and employees have to themselves and members of the public. Employers must make every attempt to ensure maximum health and safety requirements as far as is 'reasonably practicable'. In other words, employers need not avoid or reduce a risk/s if the risk is grossly disproportionate to the measures taken to avoid or reduce it.

Health and safety responsibilities

Employer's responsibilities

Employers must ensure that the health, safety and welfare of employees is protected, so far as is reasonably practicable. In particular, employers must:

- provide and maintain equipment and work
- deal with substances, such as chemicals, safely
- provide information, instruction, training and supervision
- maintain safe and healthy workplaces with the necessary facilities
- provide a Health and Safety Policy Statement when employing five or more people
- ensure that visitors and members of the public are not put at unnecessary risk

Employee's responsibilities

Employees also have legal responsibilities. They must:

- take care of their own health and safety at work
- take care of the health and safety of others
- co-operate with their employer
- not misuse or interfere with anything provided for health and safety purposes

The Health and Safety at Work Act 1974 can be considered the umbrella which incorporates a number of health and safety regulations

Regulations

The Health and Safety at Work Act 1974 can be considered the umbrella which incorporates a number of health and safety regulations. Regulations state more specifically what is required from employers. Regulations:

- are law approved by Parliament and made under the Health and Safety at Work Act 1974
- identify the risks and set out specific actions that must be taken
- certain regulations will apply to all companies e.g. manual handling
- certain regulations are specific to certain industries e.g. visual display units

It is 'The Management of Health and Safety at Work Regulations 1999' (management regulations) that identifies in more detail what is required from employers to manage health and safety in the workplace.

Under 'The Management of Health and Safety at Work Regulations 1999' it is a legal requirement for employers to conduct a risk assessment on all work practices, equipment and working environments. The Health and Safety Executive (HSE), a governmental body responsible for health and safety defines risk assessment as, 'a careful examination of what, in your work, could cause harm to people'. Risk assessments allow employers the ability to decide if they have taken enough precautions to prevent harm or if they need to implement further measures. How to carry out a risk assessment and control various risks is covered in a later section within this unit.

Instructors must become familiar with the contents of the health and safety policy and the parts most relevant to the job. Other relevant legislation instructors need to be aware of include:

First aid:

- covers the requirements for first aid
- number of first aiders
- who are the first aiders
- first aid kit requirement
- where the nearest telephone is
- reporting accidents and information to be given

Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR):

- requires employers to report injuries and some diseases
- allows enforcing authorities to investigate serious accidents

Manual Handling: is where a person uses their body to lift, carry, push or pull a load

Manual handling:

- is where a person uses their body to lift, carry, push or pull a load
- if hazardous lifting cannot be eliminated then mechanical means need to be used
- the environment in which manual handling takes place needs to be considered
- the capability of the individual involved in manual handling needs to be taken into account

Personal protective equipment (PPE):

- many situations require PPE e.g. dealing with chemicals
- equipment should be suitable for the task
- equipment should fit properly
- equipment must carry the CE kite mark
- equipment must be kept clean and stored correctly
- employees must have appropriate training

Noise at work regulations:

- requires employers to take precautions to protect hearing from damage
- examples include gymnasiums and studios

Control of substances hazardous to health (COSHH):

- hazardous substances include anything that could cause ill health
- hazardous substances come in many forms e.g. liquid, dust, fumes, gases
- consider training requirements

Contents of the health and safety policy most relevant to an instructor

General health and safety duties

Typically within a fitness environment there will an overall advocate for health and safety often referred to as the health and safety officer. Due to the multi-faceted role and responsibilities of a Duty Manager it is not uncommon for this responsibility to lie with them on an operational level. Within each department a person will be identified as the health and safety lead responsible for ensuring that the welfare of others is maintained and that any incidents are reported and acted upon appropriately. A number of employees will be identified as first aiders providing they have attained a recognised first aid at work qualification. Ultimately, everyone has a duty of care to protect themselves and others within the workplace and responsibilities within their job description will be identified to ensure that health, safety and welfare are promoted.

Instructors will be required to conduct a number of health and safety checks during their hours of work

Instructors will be required to conduct a number of health and safety checks during their hours of work. All checks should be carried out in line with the employer's health and safety policies and procedures. All associated documentation must be filled in correctly to demonstrate evidence of health and safety compliance. Persons who fail to following current health and safety legislation may be made liable for any incidents/accidents that occur. In other words, if the duty of care/service is put into question, it may well end up in a court of law and any relevant documentation can be used as evidence either for or against. A court will consider two things:

- what the current standard working practices are within the industry
- the chain of responsibility to highlight areas of failure (negligence)

An example of negligence may involve not screening a participant prior to exercise who has known exercise contraindications i.e. diabetes, coronary heart disease. By knowing and following current health and safety legislation instructors will protect themselves from such action.

Emergency action plans (EAPs)

EAPs are responsible for a company's procedures in the event of accident or incident e.g. bomb threat, evacuation, gas leak, fire or life or death situation. EAPs are generally specific to an environment. For example, the requirement for a poolside incident will be different to gym-based incident. Staff training will be given to all employees and this is often followed with a test to demonstrate competence. EAPs cover the following requirements:

- what to do in the event of…
- what to do during…
- what to do after…

Working practices to ensure high levels of health and safety compliance for the instructor:

Written screening must be completed by all clients before participating in physical activity

Competency:

- fitness professionals must not stray from the bounds of their areas of competency, they can only do what they have been trained for

Qualifications:

- fitness professionals must have valid and current qualifications for the tasks they are performing, if not, they pose a risk to themselves and others

Public liability insurance:

- fitness professionals must be covered by employer's liability insurance if working in the place of employment or personal public liability insurance in all other environments

Register of Exercise Professionals (REPs):

- this is a regulating body for fitness professionals. It has 4 levels and fitness professionals can only register at each level if competency has been shown by way of achieving recognised industry qualifications

Risks of exercise and exercise benefits:

- death, exercise-induced asthma, diabetic coma etc, reduce risk CHD, reduced risk osteoporosis, reduce risk diabetes etc

Physical Activity Readiness Questionnaire (PAR-Q):

- written screening must be completed by all clients before participating in physical activity
- he client should fill out a Physical Activity Readiness Questionnaire, (PAR-Q see example overleaf) confirming that they are fit to exercise. If they answer "YES" to any of the questions they must get their doctor's consent before participating in any physical activity

Health screening

Ensure participants are well enough to exercise

The Physical Activity Readiness Questionnaire (PAR-Q) is a form used to determine if participants should check with their doctor before taking part in physical activity.

The PAR-Q has two purposes:

1. Build self-awareness at participant level
2. Help to inform the instructor of participant needs and concerns

Challenge of administering the written PAR-Q form

Some instructors may not have the opportunity to administer the written PAR-Q with each participant individually before the start of a session. Often, participants will show up 5 minutes late for activities and at that point it is not feasible for the instructor to stop the session to administer the PAR-Q for the late participant. If the PAR-Q is filled out at the front desk before the participant enters the facility it is a challenge to get that information to the instructor before the session starts.

By administering the PAR-Q (verbal or poster) at the start of session the participant is made aware of any conditions they may want to discuss with their doctor and they have the opportunity to let the instructor know of such conditions.

Administration options

Written PAR-Q: is generally required for activity participants. Follow instructions as indicated on the PAR-Q form. If a participant answers yes to one or more questions medical clearance is required.

Verbal PAR-Q: should be used even if written PAR-Q has been carried out to ensure all participants are fit enough to take part in the session.

Step 1: the instructor verbally asks the participants before every session "Is there anyone who has not completed a written or verbal PAR-Q in the past 12 months?" and "does anyone have any illnesses or injuries that I do not know about?"

Step 2: if any participants answer "Yes" to the question in Step 1 or if the instructor observes a new participant in the session or if it is the start of a new session for a registered programme; then the instructor should ask the new participant to complete the PAR-Q form.

PAR-Q poster: for group sessions. Page one of the PAR-Q form may be enlarged and placed prominently in the activity area. At the start of each session the instructor must ask that any participant who has not read the PAR-Q in the past 12 months read the poster. If a new participant arrives late they must be asked to read the poster. No medical clearance is required.

Each centre / facility will have its own method of health screening its participants. It is essential that all instructors are aware of these.

Other considerations

It is important that instructors have details of participant's emergency contact numbers (e.g. next of kin) and Doctor's contact details. In the event of an accident or emergency these details are vital. This can be incorporated on a PAR-Q form. It is essential that the instructor knows where these details are stored.

Physical activity readiness questionnaire (PAR-Q) and you (a questionnaire for people aged 15 - 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: tick/answer YES or NO.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	YES	NO
2. Do you feel pain in your chest when you do physical activity?	YES	NO
3. In the past month, have you had chest pain when you were not doing physical activity?	YES	NO
4. Do you lose your balance because of dizziness or do you ever lose consciousness?	YES	NO
5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?	YES	NO
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart conditions?	YES	NO
7. Do you know of any other reason why you should not do physical activity?	YES	NO

If you answered YES to one or more questions:

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES to.

- you may be able to do any activity you want - as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- find out which community programmes are safe and helpful for you.

If you answered NO to all questions:

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active - begin slowly and build up gradually. This is the safest and easiest way to go
- take part in a fitness appraisal - this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever - wait until you feel better; or
- if you are or may be pregnant - talk to your doctor before you start becoming more active

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

NO CHANGES PERMITTED. YOU ARE ENCOURAGED TO PHOTOCOPY THE PAR-Q BUT ONLY IF YOU USE THE ENTIRE FORM.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity programme or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

Name _____

Signature _____ Date _____

Signature of Parent _____ Witness _____
or Guardian
(for participants under the age of majority)

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Health commitment statement (HCS)

The Health Commitment Statement sets the standards that health and fitness centres and users can reasonably expect from each other in regards to the health of the user.

Background

The HCS is the evolution of the PAR-Q, which has existed for the past 15 years. The HCS reflects government policy and legal trends, which aim to shift responsibility for personal health from the operator to the user. The Fitness Industry Association is taking the lead in allowing operators to be more accessible while facilitating a better working relationship between fitness and medical sectors in the community. This has also provided an opportunity to align the HCS to the skills and expertise of fitness professionals established through REPs.

The HCS has been developed by Fitness Industry operators, medico-legal professionals and health providers to support the evolving requirements of users and operators.

Purpose:

- develop the current PAR-Q to simplify access to activity facilities for users
- assist the health, medical and fitness industries to work in harmony while supporting initiatives to encourage the nation to become more active
- bring health and fitness clubs in line with virtually all other sports and active leisure in relation to health matters
- demonstrate respect for members by placing responsibility where it belongs, with the individual member
- be consistent with current government policies in encouraging every individual to take responsibility for his or her own health
- offer the opportunity to clubs to maximise their membership
- be in keeping with current trends in legislation and case law
- be consistent with a more modern approach to individual responsibility in medicine and the law
- provide the opportunity for a uniform approach across the health and fitness industry, producing greater clarity and reducing costs
- offer a simple solution in plain English, which is accessible to fitness instructors, staff and members
- remove stress and anxiety from staff in relation to health of members

The HCS has been designed for users in a gym environment and with all operators in mind, allowing flexibility with its usage.

Duty of Care (law of tort in England, or delict in Scotland) and professional role boundaries in relation to special populations

Duty of care is the obligation to exercise a reasonable level of care towards an individual, to avoid injury to that individual or his/her property. Duty of care and liability with regard to a breach in duty of care is based upon the relationship between the parties, the negligent act or omission and whether the loss to the individual was reasonably foreseeable. A negligent act is an unintentional but careless act which results in loss.

Duty of care is said to be greater when working with vulnerable adults. A vulnerable adult is defined by the UK government as - "a person aged 18 years or over, who is in receipt of or may be in need of community care services by reason of 'mental or other disability, age or illness and who is or may be unable to take care of him or herself, or unable to protect him or herself against significant harm or exploitation."

Duty of care is the obligation to exercise a reasonable level of care towards an individual, to avoid injury to that individual or his/her property

Instructors have a greater duty of care to vulnerable clients and any client undergoing a 'special' physiological lifespan process that puts them at greater risk of an exercise-related event (e.g. childhood, ageing, pre and post-natal)

The acquirement of base knowledge on special populations (young people, older people, pre/post-natal women and disabled people) as part of this qualification does NOT qualify instructors to:

- be a specialist instructor in the area, or advertise as such
- instruct special population clients 1:1 or in groups on a regular and frequent or progressive basis
- plan a progressive, long-term special populations physical activity programme

Note: base knowledge is the minimum information required to enable an instructor to accommodate appropriately screened and asymptomatic special population clients within a mainstream exercise session on an occasional basis. Asymptomatic is the term used by the American College of Sports Medicine / American Heart Association (AHA / ACSM) to denote the absence of any of the specified key symptoms of disease (that are considered to put an individual at risk of an adverse event related to participation during or following exercise) identified in the PAR-Q and AHA / ACSM pre-exercise screening tools.

Where appropriate, instructor's should inform clients that they do not have the specialised qualification and training in the adaptation of exercise for special populations and only possesses basic knowledge regarding recommended guidelines. Clients should then be given the choice to stay in the session and follow the basic recommended guidelines and/or seek further guidance from an appropriate special populations qualified instructor.

Where instructors find themselves frequently working with special population clients they should endeavour to obtain the relevant qualification/s. Failure to do so could render them in breach of their duty of care. Instructors should ensure that their employers insurance policy covers their instruction, however brief, of special population clients.

Types of security procedures

Within the fitness environment, there are a number of typical security procedures in place to help protect staff and participants.

External gym security

A fitness facility's responsibility for maintaining participant's safety is not limited to the inside of the building. Customers may have to drive up, park and walk to and from the building in safety. This will require varying levels of security depending on the location of the facility, but they should consider having a complete security system and programme.

Video monitoring system (CCTV)

For outdoor security it is recommended to have a video monitoring system for outside the facility.

Monitor front door and parking area

At least one system with a camera monitoring the front door and the others monitoring the parking area should be a requirement. The monitor should be placed in the security office or at the front desk.

Monitor every exit area from the inside

For maximum security every exit door would have outdoor cameras and a monitor just inside the door, so the area could be viewed before exiting the building.

Light security

Sufficient security lighting should be available. There are a number of types of lighting that would commonly be used. Outdoor car park lighting is often run with motion detectors. They are also often run with timers that turn on and off according to the facility hours.

Security and alarm stickers

Security and alarm stickers should be placed on every door and window, even if there is no alarm system for deterrent purposes.

Effective security

Employees could be armed with non-lethal deterrents or panic alarms or carry warning devices such as whistles or personal alarm devices that can be heard inside.

Adapt to the necessary level of required security

Facility owners will want to adjust their level of security to match their environment, but remember that deterring crime is worth the effort and expense.

Indoor gym security

Access control

To protect people and property, there are many variations in ways to access control, from staffed and friendly receptions to barriers and swipe-cards and simple security coded locks. The layout, size and design of the building will largely influence what methods are chosen.

Alarms

Intruder alarm

Intruder alarms are fitted in buildings to protect against unlawful entry particularly after hours. It is possible to appoint a company to monitor and attend any alarm call outs that may occur. Trained personnel will attend with backup and dogs if necessary.

Panic alarms

Used in areas such as reception and consultation rooms covertly located so that they can be operated by the staff member threatened.

Personal alarms

Carried by individuals to attract attention and temporarily distract the attacker.

Preventing violence

In addition to the provision of personal alarms etc, procedures should be devised to minimise the risk of violence from the public e.g. elimination of handling cash, constant changes of route when transporting valuables, adequate building security for out of hours working. Consideration should be given to the fact that women working alone are particularly at risk.

Radios, pagers or mobile phones for employees

These provide effective means of communication and keep colleagues informed of people's movements and problems such as travel delays (a must for people on the road travelling between sites or to meetings).

Training for staff

Encourage staff training to keep abreast of any industry standards and changes to legislation and to be aware of any dangers that may be presented and how to handle them. Induction training is also a key must for new employees.

Keep personal information confidential

This goes without saying. Keep all confidential information and files about employees and clients confidentially locked away in an office filing cabinet where only those that need to will have access to it. Promote secure working practice.

Do not encourage lone working

Lone working may be defined as any work activity which is intended to be carried out in isolation from other workers by an individual or a small team of people. The work activity should normally last for some time.

Conclusion

It is the fitness professional's duty to ensure all aspects of the working environment are safe and that hazards have been minimised. They must be aware of their roles and responsibilities in the event of an incident. The fitness professional has a duty of care to the client in their charge and so must take all steps to assess and reduce the risks whilst the client is exercising. Further information can be sourced from the HSE website at www.hse.gov.uk

It is the fitness professional's duty to ensure all aspects of the working environment are safe and that hazards have been minimised

How to control risks in a fitness environment

Risk assessment

A risk assessment is nothing more than a careful examination of what, in the workplace, could potentially cause harm to people, so that individuals can weigh up whether they have taken enough precautions or should do more to prevent harm. The aim is to make sure that nobody gets hurt or becomes ill.

How to assess the risks in the workplace

An individual does not have to be a health and safety expert to carry out a risk assessment

The important things to decide are whether a hazard is significant and whether it is covered by satisfactory precautions so that the risk is small. Employers/employees need to check this when assessing the risks. For example, electricity can kill but the risk of doing so in an office environment is remote, provided that the 'live' components are insulated and metal casings properly earthed. An individual does not have to be a health and safety expert to carry out a risk assessment.

Five steps to risk assessment

Follow the five steps below:

1. Look for the hazards:
   - slips, trips, falls, chemicals, machinery, electricity, manual handling, noise, poor lighting, temperature

2. Decide who might be harmed and how:
   - office staff, cleaners, visitors, contractors, gym members, gym staff
   - pay particular attention to people with disabilities

3. Evaluate the risks and decide whether the existing precautions are adequate or whether more should be done:
   - provide instruction or training where necessary, reduce risk as far as is reasonably practicable

4. Record findings
5. Review assessment and revise it as necessary

Risk assessments are rated according to the risk severity and the likelihood of it occurring

Risk assessments are rated according to the risk severity and the likelihood of it occurring. The risk is rated using a numbered system from 1 to 5 (with 5 being the most severe and likely and 1 being the least severe and unlikely). The two numbers are then multiplied together to give a risk rating. Depending on the result, action may need to be taken.

Likelihood		Severity of injury/disease		Risk
5	50% (likely)	5	death	1-2 acceptable LOW
4	25%	4	major injury/disease	(no further action)
3	10%	3	off work for >3 days	3-10 tolerable MEDIUM
2	5% (possible)	2	first aid – back to work	(maintain controls)
1	2% (unlikely)	1	minor injury – near miss	11-25 danger HIGH stop

If a score of greater than 11 is recorded the associated risk is considered to be high. High risk situations need immediate action. If on the other hand the score falls between 3 and 10 the risk is said to be moderate and risk controls must be maintained.

When hazards or risks cannot be controlled personally, it would be prudent for the instructor to contact the person in charge of health and safety within their department.

Manual handling

Any job that involves heavy labour or manual material handling may include a high risk for injury on the job. Manual material handling entails lifting, but also usually includes climbing, pushing, pulling, and pivoting, all of which pose the risk of injury. Musculoskeletal disorders often involve strains and sprains to the lower back, shoulders, and upper limbs. Potentially injurious tasks may involve bending and twisting, repetitive motions, carrying or lifting heavy loads, and maintaining fixed positions for a long time. These circumstances can lead to damaged muscles, tendons, ligaments, nerves and blood vessels.

Ergonomic intervention in manual handling can decrease injuries and increase worker productivity

Ergonomic intervention in manual handling can decrease injuries and increase worker productivity.

Lifting

Lifting containers can strain the lower back musculature when done improperly. Ergonomic lifting techniques involve keeping loads close to the body and near the person's centre of gravity, using diagonal foot positions, and moving loads at waist height rather than directly from the floor.

Climbing

When climbing with a load, safe manual material handling includes maintaining contact with the ladder or stairs at three points (two hands and a foot or both feet and a hand). Bulky loads would require a second person or a mechanical device to assist.

Pushing and pulling

Manual material handling may require pushing or pulling. Pushing is generally easier on the back than pulling. It is important to use both the arms and legs to provide the leverage to start the push.

Pivoting

When moving containers, handlers are safer when pivoting their shoulders, hips and feet with the load in front at all times rather than twisting their back. The lower back is not designed to torque or for repetitive twisting.

Exercise risk assessment

The process of evaluating an exercise as high or low risk is a complex one, as it is dependent on a whole range of variables (many of which are listed overleaf). The fitness professional must take all of these into account when conducting a risk assessment of each activity. The potential risks must be weighed up against the potential benefits of the activity/exercise.

The starting point for the risk assessment must be the written screening carried out using a physical activity readiness questionnaire (PAR-Q). The fitness professional must also carry out verbal screening at the start of each session to find out if the participant has any injuries, illnesses or disabilities which may affect them or be affected by them taking part in the following physical activities. Based on this information the fitness professional can make the necessary changes to the activities in order to reduce the risks.

When gathering information such as medical status and injuries from the client, the fitness professional must be aware of their limitations e.g they are not qualified to diagnose injuries. If a participant presents with an unspecified medical condition or injury, the fitness professional should seek advice from, and/or refer to a suitably qualified health/medical professional, such as a doctor or physiotherapist.

The instructor's guide to making safe exercise choices

The following is a list of risk factors that the fitness professional needs to be aware of when evaluating an exercise and matching it to those taking part in physical activity and their goal(s).

Medical status: find out the medical status of the participant(s), and avoid any exercises that may aggravate an identified condition. For example, if someone presents with hypertension (high blood pressure), intense overhead exercises would be unsafe. Therefore, the shoulder press exercise may not be the safest way of training the deltoids and triceps under these circumstances (Durnstine and Moore, 2003).

Risk category: from the information gained from the PAR-Q and the verbal screening, assess the likelihood of the person falling into a risk category, such as special attention or medical referral. For example, if they have a family history of heart disease, a sedentary lifestyle and are carrying excess body weight, it would indicate that they may be prone to hypertension (Roitman, 2001).

Past surgery: using the pre-exercise questionnaire, highlight any past surgery that may have resulted in a weakness that would make certain exercises high risk. For example, someone who had surgery to fuse vertebrae in the lumbar spine would be at high risk from exercises like plyometric hopping or lifting, due to the increased pressure in the spine during the rotation and flexion components (Peterson and Renstrom, 2001).

Injuries: using the pre-exercise questionnaire, identify former injuries that have had little or no rehabilitative treatment. Pain is one of the causes of altered movement (Siff, 2002), as the body alters its movement pattern to keep away from the pain. For example, if somebody suffers with an ankle injury, they can change their movement by shifting their bodyweight away from the injured side during walking.

Body type: there are three main categories of body type, each one will be more suited to certain activities and less suited to others. Therefore, if a person engages in an activity to which their body type is not suited, their performance may be low, and their risk of injury high. The three main body types are:

- ectomorphs - small frame in width and depth, the side view is slender with narrow shoulders and often narrower hips. Thin without much muscle or fat (perhaps guide away from contact sports)
- mesomorphs – medium to large frame, ranging from athletic to rounded but always with depth and a certain degree of narrowness through the ribcage, waist and hips. Sometimes broad shouldered and a forceful shape. Heavily muscled (perhaps guided towards strength events)
- endomorphs – a heavy build but not necessarily large frame, rounded on all sides with a chunky middle section. Shoulders often narrower than hips. Usually covered with muscle but with excess fat

Weight and resistance: the weight of the load can change a low risk exercise to a high risk exercise. The risk of performing an exercise with excessive weight is further increased if the exercise also requires a high level of proprioception. For example, a deep squat is a good exercise if performed correctly (Cook, 2003), however, trying to perform the squat with excessive weight will place too much stress on the structures of the body and compromise technique, and therefore increase the risk.

Speed of movement: fast movements are essential in activities of daily living and sport and should therefore, be included in training. However, the client should always be in full control of their movements, this requires adequate strength and co-ordination. Compare a skilled marathon runner with a person just learning to run. The movements of the marathon runner are well coordinated which allows them to run fast with little risk, whereas the beginner is uncoordinated and so has to run more slowly in order to keep the risk low.

A group of muscles will contract initially to generate movement and the faster the movement the greater the level of contraction needed, but the opposing muscles will also have to contract in order to decelerate the movement or act as a brake. If the decelerating muscles cannot generate at least the same level of force as the accelerating muscles, then injury is likely to occur. For example, if someone forcefully concentrically contracts their hip flexors and knee extensors (quadriceps) in order to kick a ball a great distance, the hip extensors and knee flexors (hamstrings) will then have to contract eccentrically in order to decelerate the leg. If the hamstrings have not got the strength needed to perform this deceleration in a controlled manner, they will get injured.

Proprioception: free weights (including any gravity dependent external load, such as a medicine ball), while an excellent training medium, present a heightened proprioceptive challenge to participants. Such exercises, if applied inappropriately or incorrectly, therefore, represent a greater potential risk. For example, consider the dumbbell press, while preferable to a machine press in terms of the proprioceptive challenge, requires greater body awareness and technique execution and should be applied with care.

Fixed resistance machines: fixed resistance machines are based on fixed path range of motion, and often a fixed body position. If the mechanics of the machine do not allow the posture of the person performing the exercise to remain optimal and the load to be distributed correctly, then the exercise can become high risk (Slavin, 2003). For example, most bicep curl machines require the exerciser to lean over a pad, thereby compromising the integrity of the shoulder, by putting it into a protracted position. This increases the degree of risk associated with the exercise.

Nutrition: incorrect pre-exercise nutrition or post-exercise nutrition can have major implications. For example, if a person is trained after missing breakfast, any high calorie burning, and intense exercise will be high risk (McArdle et al, 1999).

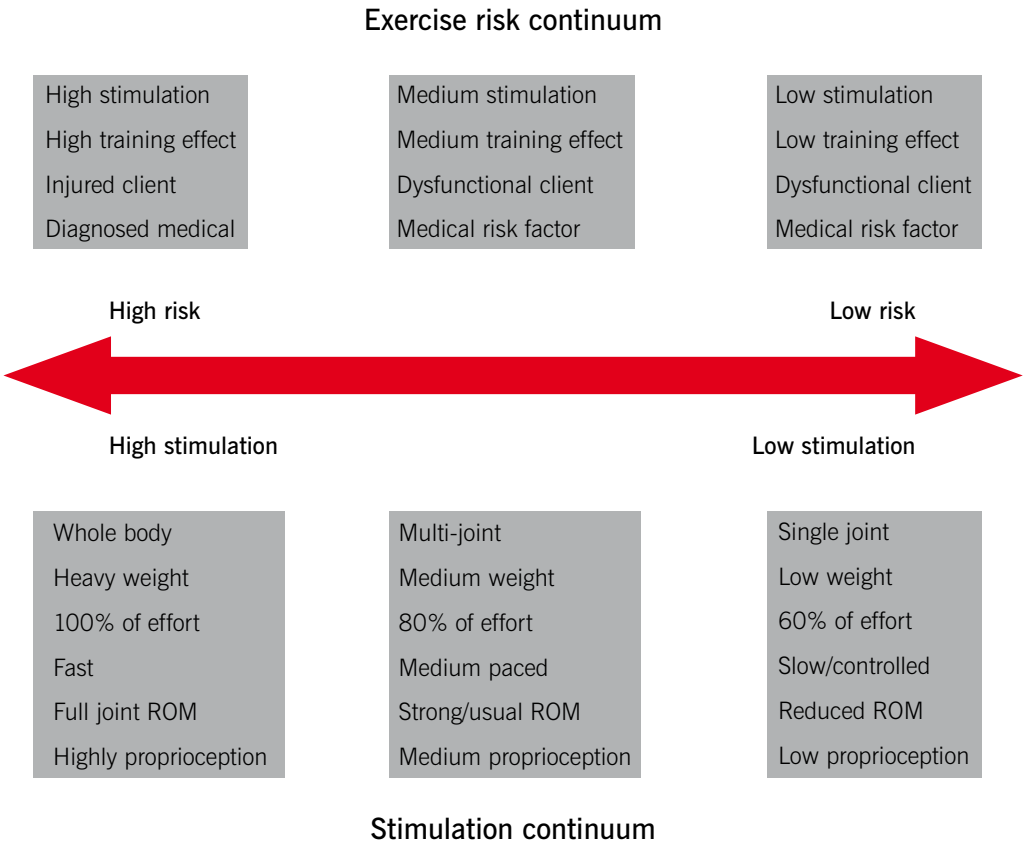
Occupation: the physical requirements of a person's job may make certain exercises high risk. For example, if a participant with a physically demanding job is trained at the end of a working day they may have high fatigue level. Alternatively, if they are trained in the early morning hours, they may arrive at work in a fatigued state. Both these situations might leave them susceptible to injury.

Stress: the person's stress level can affect the exercises they can perform. Posture and mood are intrinsically related (O'Connor and Seymour, 1994). Stress also causes a release of several hormones, including adrenaline, which have some significant side effects and can affect the client's ability to get quality sleep, to concentrate and to become motivated. The fitness professional has to be aware of these factors when programming. For example, after a stressful day, the exerciser would not be advised to do highly challenging proprioceptive exercises. An explosive lift, for example, may be high risk in this situation.

Recreational activities: recreational sports demands also have high influence on the safety of exercise selection. Often a person will not class their sport as exercising, as they enjoy it. The fitness professional is required to look at the training schedule of a participant where possible and account for such demands.

The exercise risk continuum

The table below shows the risk/benefit continuum that will help the instructor assess the risk of an exercise. These are all relative to the participant and might help the fitness professional decide which exercise to select.



Exercise risk vs. stimulation continuums

The above diagram demonstrates that there are no right exercises and no wrong exercises; nor are they simply good or bad. Fitness professionals must consider exercises as being more appropriate for some people and less appropriate for others. All relevant factors and available information (such as fitness levels, skill levels, training goal, equipment and environment) should be considered by the fitness professional when deciding whether or not an exercise is appropriate.

The fitness professional must weigh up the risks of performing the exercise in its original form against the benefits. If the risks outweigh the benefits, an alternative exercise should be selected, but if the benefits outweigh the risks, it is safe to proceed with the exercise in its original form.

Emergency procedures in a fitness environment

A fitness environment can potentially be a dangerous one. There lies a risk that at some time or other an instructor may be faced with an emergency situation. This may be in relation to those participating in physical activity, for example; injuries to members through poor exercise technique or dropping weights or heart attacks and strokes. Alternatively emergencies may arise on a larger scale that can put employees and those participating in exercise at risk collectively, such as fires or chemical spillages/leaks.

Each fitness environment will possess a set of emergency operating procedures which the instructor will need to become familiar with. This section provides information relating to typical procedures that take place in the event of an emergency and areas of concern within the fitness environment in relation to such events.

Accidents and sudden illnesses

The effects of an accident or a sudden illness may cause the body's function and structure to change.

Your role in an emergency:

General: remain calm, recognise signs and symptoms, call emergency services, total patient care, self care and deal with the aftermath.

C Calm Yourself
A Assess Situation
L Locate Assistance if Available
M Make Area Safe – General

Contacting the Emergency Services	
Location	telephone number, district, guiding landmarks etc
Incident	description of accident etc
Other services required	i.e. police, fire brigade
Number of casualties	number, sex and age
Extent of injuries	description and seriousness of injury or condition
Location	repeat location description

The Emergency Services should be called when:

- casualty is unconscious
- suspected head, neck or spine injury
- suspected fractures or severe dislocations
- severe external bleeding
- suspected internal injuries
- serious medical problems such as heart attacks, asthma and diabetic emergencies
- you feel unable to handle the situation yourself or the casualty's condition is worsening

Minimum contents of a first aid box - recommended where there are no special risks:

- guidance leaflet
- 20 individually wrapped sterile adhesive dressings of various sizes
- 2 sterile eye pads
- 4 individually wrapped triangular bandages
- 6 safety pins
- 6 medium sized and 2 large individually wrapped, sterile wound dressings
- 1 pair of disposable gloves

Other emergency situations

If you discover a fire, operate the nearest fire alarm

The following provides examples of the type of procedures an instructor may follow when confronted with an emergency situation. It is important, however, that the instructor follows the emergency operating procedures as laid down by their employer. Following such procedures calmly and correctly is important to ensure the safety of everyone within the fitness facility. Remaining calm is important to avoid inflicting panic on others and to prevent further harm. It is crucial that the procedures set by the organisation are followed as an employee can be held liable for harm caused by the work environment if certain actions are not taken. They also provide focus and clarity for the instructor during the emergency and will have been put together by a qualified professional(s), thus providing the ideal course of action to follow during an emergency situation.

Fires

1. If you discover a fire, operate the nearest fire alarm or, if no alarm is provided, shout “FIRE”.
2. If you hear a fire alarm, leave the building by the nearest available escape route and go to your assembly area. Lifts must not be used in the event of fire.
3. In the event of a fire requiring the attendance of the fire brigade or ambulance service follow the guidelines provided in the table ‘contacting the emergency services’.
4. Care of casualties - if you are not qualified in first aid yourself, send for the nearest available First Aider, who will take charge of the situation. If no qualified First Aiders are available, ensure that an ambulance is called.

A fire fighting strategy should consider:

- appointment of fire wardens, with subsequent training
- location plans of fire hoses, extinguishers and water sources
- access for emergency services
- provision of firewater lagoons

Area evacuations

Evacuation of areas in the event of fires, toxic gas emissions or security threats, for example, should be addressed in an emergency evacuation procedure. This should specify designated safe areas, assembly points and toxic gas shelters (where possible). The procedure should also identify responsible personnel whose duties during area evacuation include:

- responsibility for a specific area
- ensuring roll calls are undertaken to identify missing persons
- communication of missing persons to central emergency services

This will usually come under the role of the health and safety officer or fire warden that will have been appointed within the workplace and various departments.

Removal of substance to a safe place

The emergency spill control procedure should include the following key sections:

- spills involving hazardous materials should first be contained to prevent spread of the material to other areas. This may involve the use of temporary diking, sand bags, dry sand, earth or proprietary booms / absorbent pads
- wherever possible the material should be rendered safe by treating with appropriate chemicals
- hazardous materials in a fine dusty form should not be cleared up by dry brushing. Vacuum cleaners should be used in preference
- treated material should be absorbed onto inert carrier material to allow the material to be cleared up and removed to a safe place for disposal or further treatment as appropriate
- waste should not be allowed to accumulate. A regular and frequent waste removal procedure should be adopted

Maintaining the safety of children, disabled and older people

Employers or organisations providing services to the public should take responsibility for all people. When an employer or a service provider does not make provisions for the safe evacuation of disabled people from its premises, this may be viewed as discrimination. It is necessary to identify the needs of children, older and disabled people, where necessary, in the event of an emergency situation. Each facility will have their own procedures and plans in place when looking to maintain the safety of children, older and disabled people and the instructor should receive full training from the relevant people within their place of work. As such, the following provides some more general guidelines when assisting such populations in the event of emergencies.

Maintaining the safety of children in an emergency

In an emergency it is common to see changes and even regressions in a child's behaviour.

It is important to know that preparing for an emergency will minimise behavioural changes during the emergency itself. Preparing the children as much as possible including the rehearsal of the necessary steps that may need to be taken during an emergency while giving them age-appropriate tasks involves the children at their level of understanding and maturity.

Words and concepts that are clear and familiar to the children should be used

In an emergency, children have special needs. Allowing them to become more dependent on an adult than what is usually needed, will make them feel safe. Children express their feelings in different ways and the instructor should try to keep them calm and should not trivialise their feelings. It is important that the message they hear is 'we will overcome this together'.

The instructor should talk to the children about what is happening, listen to their feelings and give direct, short and truthful answers to the specific questions. Words and concepts that are clear and familiar to the children should be used.

The instructor should make every attempt to remain calm and positive in an emergency situation as their behaviour will directly affect that of the child concerned.

Maintaining the safety of disabled people in an emergency

The procedure adopted in any particular circumstance will vary as to the needs of the disabled person. When planning for emergency evacuations the number of disabled people, where possible, should be noted alongside their location within the premises. The evacuation plan should not rely upon the intervention of the Fire and Rescue Services to make it work. The characteristics of the building need to be considered and evacuation routes and equipment disabled people will need should be assessed. What needs to happen when an alarm goes off needs to be planned and the steps that need to be taken for disabled people should be clear for all staff involved in the emergency evacuation process and any disabled people.

Anyone with a visual impairment may be guided on level surfaces by offering an arm. On stairways the guide should descend first and the person following can then place their hand on the guide's shoulder. Many disabled people will be able to descend (or ascend) a stairway, however others may need assistance. There is equipment available for safely transporting people with mobility impairments in stairways. This type of equipment should be given serious consideration especially in high rise buildings. Lifts are normally prohibited from use during an emergency evacuation. There are types of lifts known as evacuation or fire fighting lifts, which may be used for the evacuation of disabled people. These lifts must only be operated under the direction and control of a member of staff using an agreed evacuation procedure. If it is safe to do so wheelchairs, guide dogs and other 'equipment' ought to be evacuated as well as the disabled person.

Lifts are normally prohibited from use during an emergency evacuation

Maintaining the safety of older people in an emergency

Where an elderly person is limited in their movement capability much of the same guidance as given for disabled people would apply. The number of older adults who regularly exercise has increased significantly over recent years. Ageing is associated with a gradual deterioration in both physiological and psychological functioning, which may or may not lead to a loss of independence. It may be prudent therefore to identify a member of staff to 'buddy up' with an older adult, where possible, when an emergency situation arises.

Emergency services are organisations which ensure public safety by addressing different emergencies

Role of the emergency services

Emergency services are organisations which ensure public safety by addressing different emergencies. Some agencies exist solely for addressing certain types of emergencies whilst others deal with ad hoc emergencies as part of their normal responsibilities.

There are three services which are almost universally acknowledged as being core to the provision of emergency care to the populace, and are often government run. They would generally be summoned on a dedicated emergency telephone number, reserved for critical emergency calls. They are:

- Police – providing community safety and acting to reduce crime against persons and property
- Fire and Rescue Service – reduce the risk of fire and other emergencies in all communities through a combination of prevention and protection, working in partnership with other service providers
- Emergency Medical Service – providing ambulances and staff to deal with medical emergencies

Safeguarding children and vulnerable adults

Policy content

In any profession there are accepted and established codes of behaviour. Such codes exist to safeguard the welfare of customers and to protect the service provider from allegations.

Sports coaches, fitness instructors, and active leisure facility employers and operators have codes of conduct devised by either governing bodies, educational providers, or by the facilities operator. The key principles for any 'situation when working with children, young people and vulnerable adults will always be similar in any code of practice.

Key principles:

- adults must demonstrate proper personal behaviour and conduct at all times
- adults working in the active leisure sector must keep a high level of competence by attaining qualifications and through a commitment to ongoing training that ensures safe and correct practice
- adults must develop a relationship with children, vulnerable adults and staff based on openness, honesty, mutual trust and respect
- adults must always respect and champion the rights of every individual to participate in leisure activities

The content of a 'safeguarding and protecting children and young people' policy will depend on the environment one works within, but all policies should have a policy statement which will include the key principles above.

The policy and procedures of the organisation will have a checklist for the recruitment, employment and deployment of staff and volunteers. This will identify the level of experience or qualifications required by each member of staff and this will depend on what they are employed to do, local authority guidelines and any governing bodies linked to the role. It will include applying for references and where these should come from and the applicants consent to a criminal record check being undertaken if necessary. There will also be interview protocol, what type of training they will need to attend and how regularly, appraisal and monitoring procedures and a formal complaints procedure.

The policy will also have a procedure to respond to breaches of the codes of conduct. Without this, the management of concerns about an individual's behaviour can become very difficult.

The policy may also hold slightly different codes of conduct for different groups of people e.g. sports coaches, lifeguards, gym instructors, duty managers.

Safeguarding children

People who work with children and young people in an active leisure setting on a regular basis are able to provide a link in identifying a child who has been, or is, at risk of being harmed. All those directly or indirectly involved with children's leisure activities have a responsibility to:

- review their own practice in situations to ensure that they are complying with recognised codes of conduct
- identify their own value and feeling in relation to child abuse and recognise how they might potentially impact on how they respond
- be able to recognise the signs and symptoms and indicators of abuse and the impact this has on children
- respond in an appropriate way to a child who discloses information to them
- take appropriate action if concerns are raised

Best practice when working with children and young people

The Criminal Records Bureau (CRB) and Disclosure Scotland and the Wales Council for Voluntary Action Criminal Records Unit (CRU) were set up by government to improve access to criminal record checks for organisations making decisions about the employment of staff and volunteers whose roles involve the responsibility for, or contact with, children, young people, and/or vulnerable adults.

In particular it contributes to the safeguarding and protection of children and vulnerable adults from those who may present a risk to them. The employer is able to use the Disclosure service to help establish whether a successful candidate has a recorded background that might make them unsuitable for the job role in question.

Most sport and active leisure facilities already include the requirement for a criminal records checks for those involved with or responsible for children and young people as part of their recruitment process. There will be procedures in place to update these records on a yearly or bi-yearly basis and when existing staff are being considered for a change of job role.

Checks that are provided depends on the level of check that the role requires (standard or enhanced disclosure), these checks include:

- all convictions, cautions, reprimands or formal warnings held on the Police National Computer
- information from the Protection of Children Act list
- information held by the DfES that are considered unsuitable for; and banned from, working with children

If a centre knowingly appoints a person who is banned from working with children they will be committing a criminal offence, as will the individual that is applying for a role that involves working with children.

The role and responsibilities of an instructor when working with children

It is essential that a culture of honesty, integrity and competence exists in working with children and young people. This means:

- understanding and acting upon individual responsibilities
- recognising the need to protect the rights of participation, for fun, enjoyment and achievement for all.
- reporting any suspected abuse to the child protection officer or senior manager

Acting as a role model

Not all children behave impeccably all the time. Children may try to emulate undesirable behaviour they witness and are unlikely to understand all the consequences. People working with children should always set a good example, stay positive, and encourage good behaviour from the children.

Adopting best practice

A uniform for staff working with children and young people is important. It shows professionalism and they are instantly recognisable as trustworthy members of staff to parents, carers and children alike.

Name badges are as, if not more, important than uniforms. These should be worn by all members of staff involved in children and young people within the facility. Staff are then easily identified when required, monitored or discussed.

It is important to demonstrate safeguarding behaviour at all times, this includes:

- adhering to policies and procedures
- adhering to codes of practice
- working in an open environment, avoiding spending time alone with children away from others - never offer a child a lift home if this would mean being alone with a child
- never take photographs of children and young people without the permission of the parents, carers and the facility operators. If considering taking photos of a group activity for example, ALL parents would have to give their permission in writing and if even one parent refuses permission the photos cannot go ahead. Most centres will have a policy about taking photographs of children and it is the staffs' responsibility to ensure this is advertised and upheld by staff and the public alike
- always wearing uniform if one is provided
- always wearing a name badge if one is provided

Recognising types of abuse

Even for those experienced in working with child abuse, it is not always easy to recognise situations where abuse has taken place or is potentially likely to occur.

Instructors are not expected to be experts, but they do have a responsibility to act if they have any concerns about the behaviour of an adult or a child towards another child. The term 'child abuse' is used to describe the ways in which children can be harmed. An adult may abuse a child or alternatively, a child may abuse another child. This may occur at home, school or in a community setting such as a leisure centre. Child abuse affects the physical and mental development of the child.

Child abuse can take on many forms, but it can be broadly separated into five categories:

- physical
- emotional
- sexual
- neglect
- bullying and harassment

Physical abuse

This occurs when someone causes physical harm or injury to a child. Examples include:

- hitting or shaking children
- scalding or burning children
- giving children inappropriate drugs or alcohol
- otherwise causing them deliberate physical harm

Physical abuse – indicators and signs:

- fear of parent being contacted
- aggressive or angry outbursts
- running away
- fear of going home
- flinching
- depression
- keeping arms and legs covered
- withdrawn behaviour
- unexplained bruising or injuries
- bruises which reflect hand marks
- cigarette burns
- bite marks
- broken bones
- scalds

Below is a table identifying areas of a child which could potentially be signs of physical abuse:

Common sites of accidental injury	Common sites of non-accidental injury
Crown of head	Eyes
Forehead	Ears
Nose	Nose
Bony spinal protuberances	Cheeks
Elbows	Mouth (inside and out)
Hips	Neck
Hands	Shoulders
Knees	Upper arms
Shins	Inner arms
	Chest
	Back
	Abdomen
	Genitals
	Buttocks
	Thighs

Emotional abuse

This is the ill treatment of a child that results in severe and persistent adverse effects on his or her development. Children who have suffered neglect, physical, or sexual abuse will also have suffered a degree of emotional abuse. It can also occur on its own.

Children can be emotionally abused in many ways, here are a few examples:

- making them feel worthless, unloved or unvalued
- making them feel frightened or in danger
- shouting, threatening or taunting them

Emotional abuse – indicators and signs:

- neurotic behaviour
- unable to take part
- fear of making mistakes
- sudden speech disorders
- self harm
- fear of parents being contacted
- developmentally delayed
- sudden speech disorders

Sexual abuse

This occurs when adults (both male and female) or other young people use children to meet their own sexual needs. This could include:

- fondling children in a sexual manner
- sexual intercourse
- involving children in producing or showing pornographic material

Sexual abuse – indicators and signs:

- sudden changes in behaviour
- becoming aggressive / withdrawn
- apparent fear of one person
- running away
- sexual drawings / language
- bedwetting
- self harm / suicidal
- advanced sexual knowledge / behaving beyond their age
- sexually explicit behaviour
- pain / itching / bruising in the genital area
- sexually transmitted diseases
- stomach pains
- discomfort when walking / sitting
- pregnancy

Neglect

Neglect occurs when adults fail to meet a child's basic needs, physically and / or mentally. It is likely to impact on the child's health or development. Examples of neglect include:

- failing to provide adequate shelter, food or clothing
- regularly leaving children alone or unsupervised
- failing to give access to appropriate medical care
- refusing to give a child attention

Neglect – indicators and signs:

- truancy and lateness
- regularly alone and unsupervised
- constant hunger
- unkempt state
- weight loss
- inappropriate dress

Bullying and harassment

Bullying is deliberate hurtful behaviour, usually repeated over a period of time, where it is difficult for those bullied to defend themselves. It can come in forms of verbal, written or physical abuse, such as:

- threats and gestures
- name-calling, racist taunts
- being ignored
- physical assaults

Bullying and harassment – indicators and signs:

- shyness
- insecurity
- seems 'over' sensitive
- indicators of physical and / or emotional abuse

How to respond and report suspected abuse

Child abuse is notoriously difficult to define because ideas about what is acceptable change over time and from place to place.

Dealing with evidence of abuse or an allegation is not straightforward. The adult may be shocked at what is heard and disturbed by what is seen but the adult should not do nothing – always act upon it.

Children being abused will only tell people they trust and with whom they feel safe. They do want the abuse to stop, and by listening to what the child is saying it will already be helping to protect them.

Follow the organisation's child protection guidelines if they exist – know who to refer to – this would normally be the child protection officer who is based within the centre or organisation or if they are not available then there will be a senior manager to report to.

In the event of a child approaching you with their experiences, here are guidelines on how to respond:

- stay calm, try not to display shock or disbelief and accept what is being said, listen carefully and allow the child to talk
- reassure him/her that they have done the right thing by telling you
- tell the child that you take seriously what he/she is saying
- don't panic
- don't judge e.g. *"why didn't you tell me before?"*
- don't promise to keep secrets

- don't make the child repeat the story
- don't tell people who do not need to know
- don't interrogate or ask leading questions e.g. *"did he touch you?"*
- do not approach the alleged abuser, or the parents of the child
- record in writing the details of the child, what has been said, heard or seen - include dates, times and a description of any visual bruising or injury, and details of who has been informed and what action was taken – in an incident report book
- be honest and explain that you have to tell someone else to protect the child
- maintain contact with the child if possible

It is not the job of the trusted adult to investigate the matter, only to gather enough information to pass on to the Child Protection Officer or Senior Manager and subsequently to the social services if it is deemed necessary.

In the event of bullying or harassment follow the general guidelines – listen, record, report and reassure.

It may be appropriate to involve the parents and other children to change their behaviour and improve the situation.

If the bullying incident was severe in nature (e.g. a serious assault) it should be reported in line with the 'safeguarding and protecting children and young peoples' policy.

In addition to a child making a direct disclosure of abuse to an instructor, concerns may arise in a number of other ways. These include:

- a conversation with another adult
- direct observation of a worrying incident
- signs, indicators or behaviour that suggests possible abuse
- an anonymous allegation by phone, text, email or letter

These should be recorded in the same way as disclosures using a report form and speaking to the Child Protection Officer or Senior Manager. Under no circumstances should the child involved be questioned, or the parents, or the adult(s) involved.

Safeguarding vulnerable adults

Instructors have a greater duty of care to vulnerable clients and any client undergoing a 'special' physiological life-span process that puts them at greater risk of an exercise-related event.

Everyone has the right to:

- live free from violence, fear and abuse
- be protected from harm and exploitation
- be independent – which may involve some risk
- say 'no' to anything they don't fully understand

A vulnerable adult is someone who:

- may be at risk because of mental, physical or learning disability, age or illness
- cannot always take care of him or herself
- cannot always protect themselves against harm or exploitation

There are six types of abuse:

- verbal abuse
- physical abuse
- discriminatory abuse
- neglect
- sexual abuse
- financial abuse

Indications:

- unexplained injury
- signs of fear
- signs of distress
- withdrawal
- neglect
- theft, fraud or financial exploitation

Act if it is suspected that a vulnerable person is being abused:

- talk to the person – listen carefully
- give the person your full attention
- don't promise to keep it a secret
- don't ignore it or delay in acting upon it

Make a report to the senior manager, or social services direct, or in an emergency dial 999.

Statutory agencies

The statutory agencies responsible for safeguarding children and vulnerable adults:

- child welfare agencies
- child welfare officers
- social services
- police
- childline
- child protection officer in the workplace, or appointed person, or senior management

When may it be necessary to contact statutory agencies

It is not up to an instructor to judge whether the person is being abused. It is your responsibility to act on what you've been told, heard or observed. Social services or the police will then investigate.

If an instructor cannot get hold of the right person, the appointed person or the child protection officer in the centre, they need to inform another manager and this needs to be done in the strictest of confidence.

Particularly if an instructor works alone, they may need to contact the welfare office, or social services themselves.

If there are no managers present, and it is an emergency, dial 999.

Maintaining the confidentiality of information relating to possible abuse

Keep all written reports locked away securely. This includes the incident report form.

Whoever an instructor talks to, they will need to maintain confidentiality, but do not need to take full responsibility. The senior manager or child protection officer will expect to be informed so that an instructor can begin to protect the child or vulnerable adult and be supported in what could be a difficult situation.

Confidentiality should be maintained on a 'need-to-know basis' only. Remember the child or vulnerable adult will, and should be, the centre of the whole process; their confidence, safety and security must be assured.

References

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Unit Four
Principles of Exercise, Fitness and Health

Principles of Exercise, Fitness and Health

Aim: To provide the knowledge an instructor needs to programme safe and effective exercise for a range of clients and to understand the health benefits of physical activity and the importance of healthy eating.

Learning outcomes

By the end of this unit the learner will understand:

- the components of fitness
- the health benefits of physical activity
- the effects of exercise on the body
- how to apply the principles and variables of fitness to an exercise programme
- how to safely monitor exercise intensity
- the exercise contraindications and key safety guidelines for special populations
- the importance of healthy eating

Introduction

Knowledge of the health benefits of physical activity, the importance of healthy eating together with the effects which exercise has on the body will enable the fitness instructor to design safe and effective exercises for a range of clients.

Components of fitness

If they are to design an appropriate physical activity programme it is important that the instructor has an understanding of the concepts and components of fitness, since this will help to establish more clearly the client's objectives.

Fitness can be defined in many different ways. As a concept it is difficult to provide a definitive definition, because fitness means different things to different people.

Robergs and Roberts (1997), define fitness as:

> *"A state of well-being that provides optimal performance."*

McArdle et al (2001), define physical fitness as:

> *"Attributes related to how well one performs physical activity."*

However not all clients will be seeking goals based on physical performance, so another definition of fitness that takes a different approach could be

> *"Fitness is the successful adaptation to the stresses of one's lifestyle."*
> or
> *"The ability to carry out everyday tasks with vigour and without excess stress or fatigue."*

Inevitably 'everyday tasks' will vary enormously from individual to individual. However, whatever definition is chosen there are two principal divisions which need to be considered when determining the overall fitness of a client. They are health-related, and physical fitness.

Total fitness

There are **five** main components of total fitness:

- physical fitness (health-related and skill-related)
- mental and emotional fitness – harmony with a positive mental state
- medical fitness – free from injury, disease and illness
- nutritional fitness – good nutritional intake for fuel, growth and repair
- social – healthy interaction with others

Predominantly, for an instructor, the components of physical fitness will be the focus.

Health-related fitness

There are **five** components of health- related fitness

Broadly, there are **five** components of health-related fitness, often referred to as physical fitness:

1. Cardiovascular fitness

Cardiovascular fitness is the ability of the heart, lungs and muscles to take in, transport and utilise oxygen during exercise. When you do physical activity the pulse quickens and breathing gets deeper – you are using the cardiovascular system. The cardiovascular system's efficiency will be improved through regular aerobic training.

2. Muscular strength

Muscular strength can be defined as the maximal amount of force a muscle or group of muscles can generate during one contraction.

The development of muscular strength is useful for two key reasons. Firstly, the individual is able to produce a greater maximal force when required to do so. Secondly, with enhanced levels of strength everyday sub-maximal tasks require a lesser percentage of the individual's maximal effort, thus making the task easier. Examples of activities requiring maximal strength include heavy weight lifting and lifting or moving heavy objects.

3. Muscular endurance

Muscular endurance can be defined as the ability of a muscle or group of muscles to contract repeatedly for extended periods of time without fatigue. The vast majority of everyday situations that require an individual to exert force require muscular endurance.

Activities which require muscular endurance include carrying shopping, walking up stairs, maintaining a good posture, gardening and exercise sessions involving high repetition resistance training.

4. Flexibility

Flexibility can be defined as the range of movement about a joint or series of joints. It is important that individuals develop and maintain flexibility to ensure an appropriate range of motion at all joints and a freedom of movement.

Examples of activities and sports that require flexibility include gymnastics, dance, yoga and everyday normal function.

5. Body composition

In health-related fitness body composition is used to describe the percentages of fat, bone and muscle in human bodies. The percentages of fat (body fat percentage) is of most interest because it can be very helpful in judging health in addition to body weight.

Since muscular tissue takes up less space in the body than fat tissue, the body composition, as well as body weight, determines how lean we appear. Two people at the same height and same body weight may look completely different from each other because they have a different body composition.

The National Institute of Health recommends that a healthy adult male's body should have between 13 and 17 percent fat. A healthy female's body should be composed of between 20 and 25 percent fat. Levels significantly above these amounts may indicate excess body fat. Athletes, leaner and more muscular individuals will have a body fat percentage lower than these levels. In general, most athletes experience greater performance benefits at body fat percentages between 7 and 19 percent for men, and 10 and 25 percent for women, depending on the sport.

Skill-related fitness

There are six components of skill-related fitness:

1. Speed

Speed is about quickness of movement, whether this is the legs of a runner or the arms of the shot putter. Speed is an integral part of every sport and can be expressed as any one of, or combination of, the following: maximum speed, elastic strength (power) and speed endurance.

2. Power

Power is the ability to exert maximum muscular contraction instantly in an explosive burst of movements. The two components of power are strength and speed e.g. jumping or a sprint start.

3. Reaction time

Reaction time is the ability to respond quickly to a stimulus. It is important in many sports and day-to-day activities, though it is not often measured. Simple reaction time is the time taken between a stimulus and movement e.g. sprint start. Such simple reaction time depends on nerve connections and signal pathways, is 'hard wired' in the body and cannot be improved. Another type of reaction time, choice reaction time, is the time taken between stimulus and action which requires a choice. Choice reaction time can be improved by practice and training.

4. Co-ordination

The ability to move two or more body parts under control, smoothly and efficiently.

5. Balance

The ability to control the body's position, either stationary e.g. a handstand or while moving e.g. a gymnastics move.

6. Agility

The ability to perform a series of explosive power movements in rapid succession in opposing directions e.g. zigzag running or cutting movements.

Factors which affect health and fitness

Each of the following factors will affect an individual's fitness level:

Age

Fitness is generally greatest during the 20's. Although the speed at which the effects of ageing occur can be offset by regular physical activity, it progressively results in weaker muscles, lighter bones, stiffer joints, slower reflexes and an increase in body fat.

Gender

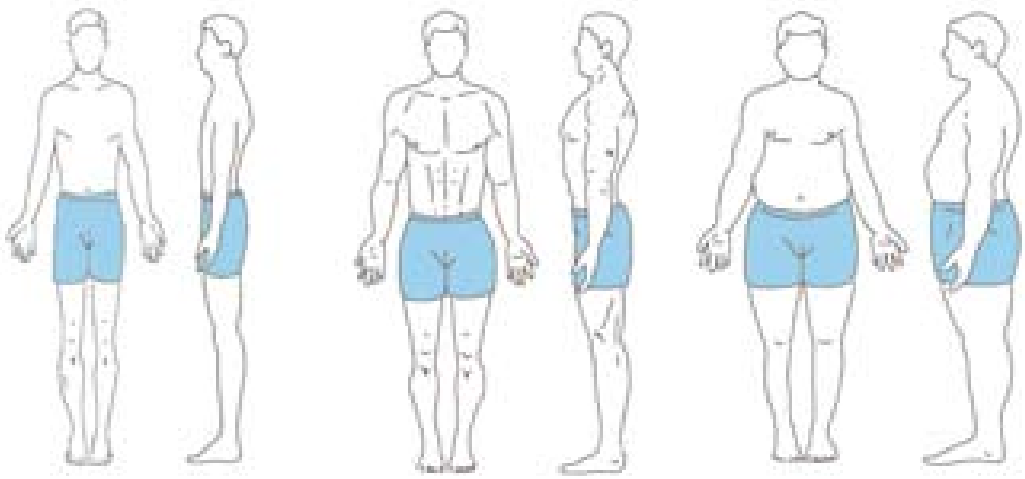
Up to puberty males and females tend to be equal in terms of general fitness. However, due to increased levels of testosterone, active males grow stronger due to greater muscle mass. Since males are generally larger than females they have larger lungs and therefore have a greater potential for transporting oxygen thereby increasing CV fitness abilities.

With longer bones and larger muscles males have the ability to move faster. Females of all ages tend to be more flexible than males. Females usually have more body fat than males.

Physique / body type

An individual's body type will have a significant impact on their ability to perform various physical tasks successfully e.g. a tall thin person may be more suited to basketball than rugby.

A simple system for assessing body type is the visual system of somatotyping. The somatotyping system suggests that there are three distinct body types: ectomorphs, endomorphs and mesomorphs (McArdle et al, 2001).



Ectomorph *Mesomorph* *Endomorph*

Ectomorphs are naturally thin with little body fat or muscle mass. Ectomorphs find it difficult to gain weight (either muscle or fat) and are well suited to weight-bearing aerobic activities such as long distance running.

Mesomorphs tend to be naturally lean and muscular, with broad shoulders and narrow waist and hips. Mesomorphs are naturally athletic and tend to be suited to a wide variety of sporting activities, especially those requiring a good power to weight ratio.

Endomorphs are naturally predisposed to fat storage. They tend to be apple or pear-shaped and carry large amounts of body fat. Endomorphs also tend to possess a reasonable degree of muscle mass, although this is often overlooked due to the predisposition for fat storage. Activities such as shot putt and hammer throwing may be suited to endomorphs.

Many individuals are not exclusively one of the body types, but rather a combination of two or more. For example, an individual with a small frame, little muscle mass and a tendency to store body fat could be considered an ectomorph with endomorphic tendencies.

An understanding of body typing may be important when discussing and cementing client objectives. An endomorph with a goal of becoming a competitive marathon runner may need to re-evaluate their objective as they are not structurally suited to this type of activity. Similarly, ectomorphs are unlikely to succeed in the field of competitive bodybuilding as they have difficulty gaining muscular size. If this is to be discussed, then it will obviously need to be done with sensitivity.

Diet

The body needs certain substances for energy, growth and repair which are provided by the food taken in. A healthy diet with quality nutrition will help ensure that the body will function at its best.

Activity level

Running and training with weights are not the only way to help with your fitness levels. Regular activities such as walking the dog, cycling and gardening, can also make significant contributions.

Physical disabilities

Although a physical impairment may prevent part of the body functioning correctly, targeted exercise can keep the rest of the body very fit. As demonstrated in the Paralympics, many disabled people are first class athletes.

Many individuals are not exclusively one of the body types, but rather a combination of two or more

Illness and fatigue

When tired or ill the ability to perform diminishes. This could be caused through working too hard with insufficient rest.

Drugs

Both medical and recreational drugs (alcohol, cigarettes) will affect an individual's fitness. When undertaking physical activity, recreational drugs should be avoided and, if taking drugs for health reasons, medical advice should be sought.

Stress

High levels of stress can lead to illness, causing health problems such as high blood pressure and heart disease.

Environment

The quality of the air taken in will determine the amount of oxygen that can be utilised. Aerobic fitness can therefore be significantly influenced by the following environmental factors:

- fumes from traffic and factories
- weather – hot, cold, humidity
- at high altitude the air is thinner and individuals will need to breathe harder to get enough oxygen in

Health benefits of physical activity

The case for physical activity

Diseases of inactivity (hypokinetic) are the main cause of death in the UK

Diseases of inactivity (hypokinetic) are the main cause of death in the UK and many developed nations (World Health Organisation, 2003). Current guidelines suggest that:

- significant health benefits can be gained by including 30 minutes of moderate activity on most, if not all, days of the week (Department of Health, 2004)
- additional health benefits can be gained through regular participation in activity that is of longer duration or of more vigorous intensity (U.S. Department of Health and Human Services, 1996)

The benefits of physical activity are summarised in the table below:

Condition	Role of physical activity
Overall mortality	Higher levels of regular activity are associated with lower mortality rates for both older and younger adults (Paffenbarger and colleagues, 1986; Blair et al, 1996)
Cardiovascular diseases	Regular physical activity decreases the risk of cardiovascular disease mortality, particularly coronary heart disease mortality (Morris et al., 1953; Morris et al., 1966)
Cancer	Both the National Cancer Institute and Cancer Research UK strongly advocate physical exercise to help reduce the risk of all type of cancers Evidence to support this is most consistent for colon cancer, which is reduced by 40–50 % among the most active individuals, compared with the least active (Nutrition Society, 2001)
Osteoarthritis	Physical activity is not associated with joint damage or the development of osteoarthritis. In those with osteoarthritis, exercise training can reduce impairment and improve function
Osteoporosis	Weight-bearing physical activity can reduce the loss of bone mass associated with age
Falling	Physical activity and strength training likely reduce the risk of falling in older adults
Obesity	Inactivity contributes to the development of obesity. Physical activity may favourably affect body fat distribution. Regular activity protects from cardiovascular disease, even in the absence of weight loss (Saris et al., 2003)
Type II diabetes	Physical activity is recommended by physicians to patients with non-insulin-dependent diabetes mellitus because it increases sensitivity to insulin. (NEJM, July 1991)
Mental health	Physical activity appears to relieve symptoms of depression and anxiety, and improve mood. Regular physical activity may reduce the risk of developing depression
Health-related quality of life	Physical activity appears to improve quality of life by enhancing psychological well-being and by improving physical function in persons compromised by poor health

Effects of exercise on the body

When any stimulus is given to the body it responds (adapts), attempting to improve itself so it is better able to cope in the future.

Exercise is a stimulus which primarily affects the cardiovascular and neuromuscular systems and so it is within these that most adaptations are experienced.

Cardiovascular and respiratory adaptations to endurance / aerobic training

Heart:

- increased size of the heart muscle (ventricular hypertrophy)
- increased strength of contraction
- increased stroke volume
- increased cardiac output
- reduced resting heart rate
- increased blood vessel size
- decreased risk of heart disease

(Wilmore and Costill, 1999)

Blood vessels and blood chemistry:

- reduced systolic and diastolic blood pressure (SBP and DBP)
- favourable change in blood lipids
- increased haemoglobin
- increased blood volume

(Wilmore and Costill, 1999)

Lungs:

- increased functional capacity during exercise
- increased diffusion of respiratory gases
- increased vital capacity

(Wilmore and Costill, 1999)

Metabolic function:

- decreased insulin resistance and improved glucose tolerance - beneficial for treatment and prevention of diabetes
- reduced body fat
- increased maximal O_2 uptake (VO_2max)

(Wilmore and Costill, 1999)

Muscular changes:

- increased capillarisation of muscles
- increased enzymatic function within muscle cells
- increase in size and number of mitochondria
- improved perception of muscle tone

(Wilmore and Costill, 1999)

Psychological factors:

- improved self mastery
- increased social interaction
- distraction from the daily routine
- decreased depression and anxiety

(ACSM, 1997)

Effects of aerobic exercise on blood pressure

Short term effects

There is a linear increase in SBP with increasing levels of exertion (Franklin, 1998). In contrast, during exertion DBP may decrease slightly, due to vasodilation, or will remain unchanged (Franklin, 1998), except in hypertensives where it may rise as a result of an impaired vasodilatory response (Gordon, 1997).

It should be noted that heavy weight training and isometric exercise will significantly increase both systolic and diastolic blood pressure.

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Long term effects

Aerobic exercise using large muscle groups in rhythmical activity is very appropriate to reducing blood pressure over time. Durstine and Moore (2003), state that endurance training can elicit an average decrease of 10 mmHg in both systolic and diastolic blood pressure in mild and moderate hypertensives.

With the exception of circuit weight training, chronic strength or resistance training has not consistently been shown to lower resting blood pressure (Durstine and Moore, 2003). With this in mind, while resistance training can have many benefits for such groups, it is not recommended on its own as a means of decreasing blood pressure.

Aerobic exercise using large muscle groups in rhythmical activity is very appropriate to reducing blood pressure over time

Blood pooling

During exercise, as the heart rate rises, there is an increased flow of blood to muscles but nevertheless venous return is maintained mainly due to the increased pumping action of the muscles. Should the activity stop suddenly however, the heart will still continue pumping blood around the body at the exercising rate for some time. Since the muscles now will have stopped working, extra blood will begin to build up or 'pool' in large muscle groups. This effect is called 'blood pooling.'

The legs are most commonly affected due to the extra influence of gravity. Common symptoms are nausea, dizziness and fainting.

Effects of exercise on bones and joints

When discussing the effects of exercise it is necessary to consider:

- short term – while the individual is exercising
- long term – after a sustained period of appropriate training

Short term responses (to any movements/exercise):

- increase in synovial fluid production

In response to increased movement synovial joints will increase production of synovial fluid. This fluid acts as a lubricant to protect the joint from excess wear and tear (much like the oil in a car engine).

Long term adaptations (to weight-bearing exercise):

- stronger ligaments
- increased bone density
- reduced loss of bone mass associated with age

Delayed onset of muscular soreness (DOMS)

This is the name given to the pain, soreness or stiffness experienced in muscles typically between 12-72 hours after exercise (Hunter, 2000).

It is particularly common following the beginning of a new exercise programme, especially if it involves increased eccentric loading (e.g. going down stairs, running downhill, downward motion of squats) or an increase in intensity. This seems to be caused by exercise-induced muscle damage followed by an inflammatory response, although the exact mechanisms are still not fully understood.

Effects of exercise on muscles

Short term:

- vasodilation (diversion of blood) to the working muscles, and away from the non-essential organs. This can result in a temporary increase in muscle diameter, sometimes called the '*pump*'
- possible DOMS

Long term:

- repetition of any activity will enhance neuromuscular connections, helping improve motor fitness by enabling greater efficiency of movement and motor unit recruitment
- dependent on the regularity, duration and intensity with which a muscle is used, the properties of a muscle are also changed

Effects of different types of exercise on muscles

Aerobic exercise and muscular endurance resistance training

Low intensity, long duration exercise can bring about the following changes on Type I fibres:

- an increase in the number and size of mitochondria in the muscle fibres
- an increase in the number of capillaries surrounding these fibres
- an increase in the number of aerobic enzymes, stored glycogen and triglycerides in the muscle fibres

Short duration, high intensity exercise affects mainly Type II fibres

Hypertrophy and strength resistance training

Short duration, high intensity exercise affects mainly Type II fibres:

- a decrease in nervous inhibition
- an increase in the diameter of the recruited fibres (hypertrophy) due to an increase in the myofilaments within the fibres
- an increase in the glycolytic activity of the muscle allowing more work to be performed under anaerobic conditions or high stress conditions

Exercises which can improve posture

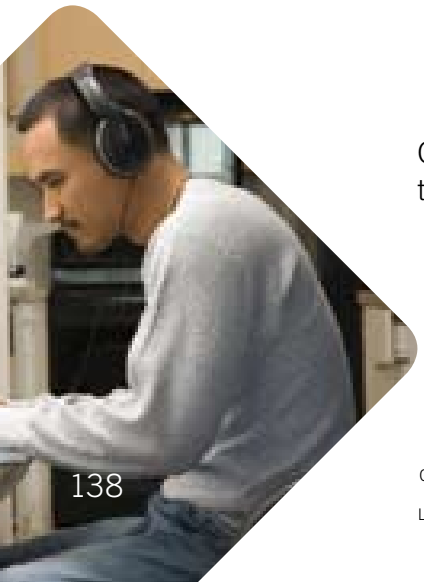
Modern lifestyles involve sitting for much longer periods of time e.g. sitting, driving, which encourages a round shouldered 'kyphotic' posture. Also work tends to involve small movements performed under tension (use of a computer keyboard, for example) resulting in shortened muscles and poor flexibility. Eventually these effects will lead to decreased function and increase the risk of injury, pain and discomfort.

The instructor should therefore endeavour to include resistance exercises, and stretches in their training programmes which help compensate for such factors.

At a fundamental level this process can be initiated by the inclusion of exercises which utilise:

- full range
- compound movement patterns
- a free-standing posture
- free weights and cables
- an equal number of push and pull exercises
- dynamic and developmental stretches

Of course care should especially be taken to ensure clients maintain good technique throughout.



Resistance training

Benefits of resistance training

Morphological factors:

- muscle hypertrophy due to increases in contractile proteins, number and size of myofibrils, connective tissues, and size of type II fibres
- increase in strength and size of ligaments and tendons
- increase in bone density and bone strength
- increase in muscle capillary density

Neural factors:

- increase in motor unit activation and recruitment
- increase in discharge (nerve impulses) frequency of motor neurons (nerve cell)
- decrease in neural inhibition (muscles protective braking mechanisms)

Biochemical factors:

- minor increase in ATP and CP stores
- increase in testosterone and growth hormone during resistance training exercises

Additional factors:

- little or no change in body mass
- increase in fat free mass / muscle mass
- decrease in fat mass and relative body fat percentage
- improved bone health
- increased strength
- increased power
- increased muscular endurance
- improved posture
- improved proprioception
- increased metabolic rate
- increased ROM
- improved immune function

Taken and expanded from Heyward, 2002

It is important to define and describe some basic terminology, used in resistance training programmes and principles.

Resistance training terminology

Repetitions

Fleck and Kraemer (1997), define a repetition (rep) as 'one complete movement of an exercise'. It is a cycle of muscular contractions, which for most exercises will be one concentric and one eccentric muscle action.

A set is a group of repetitions performed continuously without stopping

Sets

A set is a group of repetitions performed continuously without stopping (Fleck et al, 1997). The number of repetitions in a set is usually between 1 and 20, depending on the goal of the individual and what they are participating in.

Repetition maximum (RM)

1RM means the maximum weight that can be lifted once with good technique

This is the maximum number of repetitions at a given resistance that can be performed in a set with good technique (Fleck et al, 1997). 1RM means the maximum weight that can be lifted once (effectively maximal muscular strength). A 10-15RM target means that momentary voluntary fatigue should sit in between the tenth and fifteenth repetition. RM is usually used as a guide for the load or weight.

Intensity

Intensity refers to how much effort is applied to an exercise

Intensity refers to how much effort is applied to an exercise, not the amount of fatigue encountered or how hard an exercise feels (relative intensity). In the case of resistance training, 1RM would equate to maximum intensity. Intensity of an exercise can be estimated as a percentage of the 1RM. Unlike cardiovascular exercise, intensity in resistance training does not correlate with heart rate.

Volume

Training volume can mean the total number of repetitions performed in a training session or the total amount of weight lifted (load) in a session (Earle and Baechle, 2004). Fleck and Kraemer (1997), also refer to it as the total amount of work performed in a session, a week, a month, or some other time period. There is a strong relationship between the volume of training and goals, such as hypertrophy.

Compound and isolation exercises

Compound exercises are defined as multi-joint exercises, or those that involve more than one joint. Isolation exercises on the other hand involve only one joint. For example, the squat is a compound exercise that involves the hip, knee and ankle joints; the leg extension only involves the knee joint and therefore, is an isolation exercise.

Compound exercises rely on good neuromuscular co-ordination between agonists, antagonists, synergists and fixators. As more muscle groups are utilised during compound work, more weight can be lifted and functional movements can be more efficiently trained. This is especially valid for sports specific training and rehabilitation, as long as the correct technique is adhered to.

Hypertrophy

'Muscle mass', 'muscle bulk', 'building up' are just a few of the layman's terms used to describe muscle hypertrophy. Hypertrophy is simply referring to muscular enlargement and is brought on predominantly by an increase in the cross sectional area of the muscle fibres (Goldberg, Etlinger, Goldspink and Jablecki, 1975). The process of hypertrophy, to increase fibre size and therefore, muscle size, involves two main processes:

- increase in the synthesis of the actin and myosin within the myofibril (laid down on the external layers to increase the diameter)
- increase in the number of myofibrils within a muscle fibre

Moderate loads and high volume training with short to moderate rest periods are required in order to achieve hypertrophy.

Types of resistance

There are a number of methods that can be used in order to apply resistance for resistance training:

- free weights (e.g. barbells, dumbbells, medicine balls)
- resistance machines (fixed-path machines or cables)
- body weight
- manual resistance (applied by a partner or an opposing limb)
- rubber bands/dynabands
- water

Roles of muscles in movement

Agonists

Muscle that contracts to produce and control movement

Antagonists

Muscle(s) that relax whilst the agonist is contracting

Synergists

Muscle(s) that contract to assist the agonist by modifying the desired movement

Fixators

Muscles that fix another part of the body, usually a nearby joint, so that it remains stable

Warm up and cool down

Warm up

Aim of the warm up

To place the cardiovascular, respiratory and neuromuscular systems in a state of readiness for activity.

Objectives:

- raise the pulse rate
- raise the body temperature
- mobilise the major joints
- stretch muscles in an appropriate way

Warming up should not be too intense as physical performance may be impaired

The main function of the warm up is to raise the body temperature using all major muscle groups in a controlled rhythmical activity, therefore, increasing blood flow and elasticity of muscle tissue and allowing more oxygen to be carried to the working muscles. The movements chosen should mimic and prepare the body for the activity to follow. Walter et al. (1989) report that runners who 'never warm up' compared to those who 'always', 'usually' and 'sometimes warm up' have a significantly increased risk of sustaining injury.

By raising the body temperature gradually, warm up activities provide various physiological benefits:

- increased core body temperature, which will cause vasodilation, increasing blood supply and providing more oxygen to the tissues and working muscles (Alter, 1998)
- increased muscle temperature improves elasticity of intramuscular connective tissue (Lehman et al, 1970)
- metabolic activity in the muscle tissue is stimulated
- viscosity within the muscles is reduced, allowing smoother and more efficient contractions with less resistance
- muscles are able to exert greater power under sub-maximal loads (Bergh, 1980; deVries, 1980) due to increased facilitation
- slow, gradual warm up reduces lactic acid build up in the early part of exercising
- increased speed at which nerve impulses travel (Alter, 1998). This applies to motor and sensory nervous pathways, improving general proprioceptive activity (Shellock and Prentice, 1985; deVries, 1980)
- the response of the heart to more strenuous exercise is improved significantly
- connective tissue has an enhanced ability to elongate and synovial fluid is secreted, lubricating joints, which should reduce the risk of injury to soft tissue structures (Lehman et al, 1970)
- mental preparation and a rehearsal effect (Alter, 1998)

Although research relating to the effectiveness of a warm up in injury prevention is equivocal, muscle that is not properly warmed up is susceptible to injury (Zarins and Ciullo, 1983). The major criticism against the 'typical warm up' is that it does not adequately prepare the individual for the demands placed upon them in the ensuing session.

Types of warm up

Three types of warm up may be identified:

- passive warm up

  This is simply using some form of external heating, for example taking a warm shower, hot bath, using heat lamps, warm clothing or even pre-exercise massage. Heart rate can increase together with blood pressure and increased circulation around the body, but skeletal muscle will be relatively unaffected. Blood will be diverted towards the skin rather than the muscles.

- active general warm up

  This method increases body temperature as the individual engages in activities that involve large muscle groups (e.g. callisthenics, jogging). This type of warm-up increases muscle temperature more effectively than the passive method.

- active specific warm up

  Specific warm ups involve the individual going through basic movement patterns and using the same muscle groups as will later be used in the activity, only at a reduced intensity. This is an effective physiological and mental rehearsal of a performance skill. The more power necessary for the sport or activity, the more crucial the warm up phase (Holcomb, 2000).

General points

Some individuals combine all the above methods progressively. A larger number of clothes than normal are worn in the form of layers as the performer undergoes a sequence of general joint mobilising activities and jogging (unless it is hot weather), beginning with low intensity movements. As the individual becomes warmer, tracksuits are removed and the activity is progressively intensified until towards the end of the warm up sequence, the movements required for the performance skill are practised.

No hard and fast rules can be laid down regarding the intensity and duration of a warm up programme, as this varies with individuals and fitness levels. 10-20 minutes is now the suggested ideal time, however, this may seem impractical to most exercisers. Warming up should not be too intense as physical performance may be impaired. The onset of sweating is generally indicative of the effectiveness of a warm up sequence. The warm up should be adjusted according to the environment, regarding air temperature, humidity, space, etc.

Cool down

Aim of the cool down

To return the body and mind to the pre-exercise state.

Objectives:

- decrease the pulse rate
- decrease the body temperature
- stretch muscles in an appropriate way

Just as one gradually increases the amount of work prior to strenuous exercise (like a warm up) so it makes sense to gradually decrease the amount of work following an exercise session. This tapering off is called 'cooling down' or 'warming down'. Following intense activity, blood has been diverted to working muscles and there is a tendency for the blood to 'pool' in the extremities, especially in the legs. Light rhythmical activity involving the muscle groups used in the exercise session should be used in this cool down period, decreasing in intensity. This will aid venous return to the heart and help prevent pooling and consequent dizziness and nausea. These low intensity exercises disperse the lactic acid present (Bale and James, 1991; deVries, 1980).

Stretching activities during the cool down would also seem to prevent muscle soreness following exercise. Gradually bringing the body back to normal also helps psychological wind-down and promotes mental relaxation at the end of the exercise session, allowing time to consider the feeling of satisfaction and benefit that exercise can bring. Here the stretches should be static. Some tight muscles will benefit from increased flexibility through developmental stretching.

There are a number of definitions that can be used when referring to flexibility:

- a measure of the range of motion (ROM) available at a joint or a group of joints (Cotton, 1997)
- the ability to move joints through a necessary range of motion demanded by a sport (Kreamer and Gomez, 2001)
- the ability to readily adapt to changes in position or alignment; may be expressed as normal, limited, or excessive (Kendall et al, 1993)

Flexibility is determined by the shape of the bones and cartilage involved in the joint and by the length of the muscles that cross over the joint

Flexibility

Flexibility is determined by the shape of the bones and cartilage involved in the joint and by the length of the muscles that cross over the joint.

Flexibility can vary enormously from one person to another and is specific within individuals. A significant lack of flexibility can dramatically affect posture and force production at a joint. It is normally seen as causing impaired and perhaps painful performance. A high degree of flexibility or '*hypermobility*' (sometimes erroneously referred to as '*double-jointedness*') may also lead to an increased incidence of injury, but is required for success in disciplines such as gymnastics and martial arts.

Certain sports are also responsible for a reduction in joint flexibility. For example, jogging, football, boxing and hockey all involve movements where muscles are not worked through their full range. This can lead to muscle tightness and adaptive shortening.

Muscle shortening can also result from poor posture or when a body part is immobilised in a plaster cast. Improper exercise that overdevelops one muscle group whilst neglecting the opposing group, results in an imbalance that restricts flexibility, e.g. quadriceps/hamstrings.

Benefits of flexibility training
Increased range of motion
Reduced muscle tension and increased physical and mental relaxation
Reduced risk of joint sprains or muscle strains
Reduced risk of back problems
Decreased muscular soreness (DOMS) associated with other exercise activities
Decreased muscle viscosity, causing contractions to be easier and smoother
Improved co-ordination by allowing for greater ease of movement
Improvement and development of body awareness
Improved capability for circulation and air exchange
Improvements in posture

Adapted from Alter, 1998, and Fredette, 1998

Factors affecting flexibility

Age

Young people are normally more flexible than older people (Wilmore et al, 1978). Babies and infants are very flexible and start to lose this natural flexibility as soon as they start to walk (when the joints become weight-bearing and need more stability). As we get older, muscle contractility remains, whilst elasticity is lost, resulting in tighter, stiffer muscles. There is also a reduction in activity levels as we age, which will cause a decrease in flexibility.

Young people are normally more flexible than older people

Gender

Studies have shown females to be more flexible than males in most joints and to remain so throughout adult life (Getchell, 1979). The reasons for this are uncertain, but may be attributed to structural and anatomical differences or different activities and training experiences earlier in life.

During pregnancy and in the post-natal period, women produce excess amounts of a hormone called relaxin to assist the birth process. The effects of relaxin are not restricted to solely the pelvic area, but act throughout the body, allowing greater flexibility than normal. Small levels of relaxin are constantly present, and will fluctuate slightly throughout a normal menstrual cycle.

Temperature

An increase in temperature due to either direct heat or the weather can increase the elasticity of muscles and tendons and range of motion. Conversely, a decrease in temperature can result in a decrease in flexibility of as much as 20% (Wear, 1963).

Exercise and resistance training

Active people tend to be more flexible than those with a sedentary lifestyle (Getchell, 1979). Although a comprehensive resistance training programme may increase ROM (Leighton, 1964), resistance training exercises with a limited ROM and higher loads may actually decrease ROM (deVries, 1974).

Heredity

Flexibility can be an inherited characteristic, as well as an acquired one. Some people are born with a naturally excessive ROM. This can create a greater potential for injury (i.e. joint dislocation) and it may be necessary to concentrate on strengthening the muscles acting over the joint in order to increase stability.

Fashion

Individuals who constantly wear high heels may find that the muscles of the lower limb (gastrocnemius, soleus) adaptively shorten over a period of time, therefore causing reduced ROM at the ankle joint.

Methods of stretching

There are several methods of stretching muscles:

Method of stretching	Type of stretching	Example
Active stretching	Static	Standing chest stretch
	Dynamic	Leg swings
	Ballistic	Toe touches
Passive stretching	Static	Wall chest stretch
		Supine partner hamstring stretch

Active

Active stretching is accomplished using antagonist muscles and without assistance from an external force or object (Alter, 1998). It involves actively contracting one muscle or muscle group in order to stretch its opposing muscle group. For example, pectorals actively contract to stretch posterior deltoids and tibialis anterior actively contracts to stretch gastrocnemius.

Passive

This is where another body part or external factor, such as a wall or a partner, is used to facilitate the stretch. For example, a lying hamstrings stretch where the hands are held behind the thigh or on the calf. This method is used to increase joint range and muscle length. A training partner can assist by gently pressing parts of the subject's body through full range. Great care and communication is required between partners using this method and so it is not recommended for beginners.

Types of stretch

Ballistic

This form of stretching involves quick, repetitive bouncing or bobbing actions. It is undertaken in order to increase the stretch beyond the muscle's normal range using momentum and body weight. It is generally considered unacceptable for the average exerciser, due to the muscular damage that may occur as a result of the stretch reflex. These stretching exercises can produce muscle soreness and even losses in resilience and elasticity. However, they are sometimes necessary as a more radical method of stretching adhesions and stubborn fibrous tissue in physiotherapy and rehabilitation.

Dynamic

This is similar to ballistic stretching, however, the limb movements do not end with bouncing or jerky movements, but instead, are performed under control (Alter, 1998). These stretches should mimic the movements of the following sport or activity and act as a kind of rehearsal.

- perform 8-10 repetitions of each stretch under control, gradually increasing the ROM

Static maintenance

Static maintenance stretching is where the muscle is taken to the end of its normal range and held without bouncing. These are short stretches, held for 10-15 seconds (Moffat, 1988), and are used to maintain the normal length of the muscle. Following repeated contractions during exercise, the muscle becomes shorter and thicker and a maintenance stretch is used to return the muscle to its normal length.

- take the stretch to the point of bind, maintaining good alignment and posture
- hold for 10-15 seconds until the tension within the muscle has reduced
- repeat the stretch if desired

Static developmental

These stretches are used to develop the length of the fibres themselves, thereby increasing range of movement at a joint. The following guidelines should be observed:

- take the stretch to the point of bind, maintaining good alignment and posture
- hold for 10-15 seconds, until the tension within the muscle has reduced
- relax and passively increase the ROM of the stretch until tension is felt again
- again hold for 10-15 seconds, until the tension within the muscle has reduced
- again increase the ROM of the stretch until tension is felt again
- hold until the tension reduces, then slowly return the limb to its normal position
- repeat the stretch if desired

When to stretch?

Stretching should form an integral part of the warm up and cool down, although stretching can be performed at any time of the day, appropriate to the individual. Individuals can be advised to stretch at home, watching TV, or at the office, in order to balance out periods of immobility in positions of poor posture.

Stretching should form an integral part of the warm up and cool down

Dynamic stretching can be more easily prescribed as part of the warm up, using exercises that will mimic the general movement of the following session. Dynamic stretches should be performed after some kind of pulse raising/temperature raising warm up (Alter, 1998). In the cool down part of the session, some kind of static stretching is advised. This may be static maintenance, static developmental, or a form of passive stretch.

Warm up	Cool down
Static stretching	Static stretching (maintenance or developmental)
Dynamic stretching	
Ballistic stretching	

For most individuals stretching will provide many of the benefits previously mentioned. However, there are certain individuals or groups for whom flexibility training may be likely to cause injury, or where the possible concerns outweigh the potential benefits. The table below shows a list of reasons why flexibility training may be contraindicated (adapted from Alter, 1998, Fredette, 1998, and Minor and Kay, 1997).

Contraindications for flexibility training
• any developmental, excessive, uncontrolled or ballistic stretching should be avoided during pregnancy, due to the softening effects of relaxin • if the movement is limited by a bony block • avoid stretching a fracture site for approximately 8-12 weeks post-fracture • any sharp pain occurring during a stretch • any uncontrolled muscle cramping occurring during a stretch • any infected joint or nearby tissue • any acute inflammation, except for the majority of arthritic clients • a local haematoma (bruise), resulting from an overstretch injury • a client suffering with certain vascular or skin diseases

Principles and variables of fitness in an exercise programme

When designing an exercise programme, there are several fundamental principles that an instructor must understand and apply.

Training principles

There are **six** main training principles:

1. Specificity

Any change or adaptation in the body's muscles, organs and systems will be very specific to the type of training (stress) undertaken. This is the principle of specificity and means that if a participant wants to improve their running, they should run. Swimming will elicit very generalised improvements in their cardiorespiratory system, which may improve the running fitness. However, for the best results, that person should undertake running training.

2. Progressive overload

To evoke an adaptation response the stimulus must be large enough to challenge the individual.

For example, improvements in range of movement can only be achieved by working at or beyond the current limits i.e. it should stretch the muscle and the client should feel this as a mild tension.

Muscles only get stronger when they are required to work harder than normal. For an adaptive response, the following examples can be used as progressions:

- increase weight used
- increase number of repetitions
- increase number of sets
- decrease rest between sets

3. Reversibility

Cessation of the stimulus which caused the adaptation to occur will result in a gradual decline. This principle states, therefore, that any improvements in fitness can only be maintained by regular exercise.

4. Adaptability

As previously mentioned, the body will react in accordance with the type of overload to which it is subjected. For example, high weight low repetition exercise can lead to an increase in strength and intense exercise, lasting less than 10 secs can cause adaptations in the ATP-CP system, making it more efficient. Lower intensity longer duration activities help train the efficiency of the aerobic energy system.

5. Recovery

An important concept to grasp is that adaptations occur, not during the activity, but in the time following it. Therefore, scheduled rest periods are a vital part of any exercise programme. This will include not only rest periods between exercises/sets within individual sessions, but between the sessions themselves as well.

6. Individuality

Although many clients may have similar general goals e.g. lose weight, get fitter, each is an individual with different physiological abilities e.g. ROM, current strength, CV level.

For a programme to be both safe and effective these factors must be considered. It should therefore, be designed specific to both a client's needs and their abilities. For example, a client may have a restricted ROM at their hips so the programme may include additional stretching exercises in this region. If a client has a goal of running a marathon, weight-bearing CV exercise could be seen as more appropriate than cycling or rowing.

Conversely, a client may be quite large so low impact, non-weight-bearing exercise would be a safer alternative to high impact activities. Although free weight exercises are generally the best choice, sometimes a beginner client may find them too challenging and be unable to maintain correct technique. In this instance, it may be safer to begin with some resistance machine exercises until their conditioning improves.

Fitness variables

The basic fitness variables can be summarised using F.I.T.T.

F - Frequency - how often

I - Intensity - how hard

T - Time - how long

T - Type - the type of training (e.g. strength, endurance)

Frequency

Frequency refers to the number of training sessions per week, month or year

Frequency refers to the number of training sessions per week, month or year. A typical example for a beginner may be to start with a three times a week schedule with a day's rest in between. Competitive athletes may train up to twelve times a week. The number of exercise sessions per week should reflect current fitness level, time available, any other commitments like family, and goals.

Intensity

This is an important aspect to be considered when designing an exercise programme. It is normally monitored using % of 1RM, RPE or heart rate however there are additional factors that can influence the intensity:

Lever length: a lever arm (sometimes referred to as a moment arm) is the perpendicular distance between a force's line of action and an axis of rotation (e.g. a pivot).

Changing the lever arm can have an impact upon exercise intensity and may be used as a progression.

This may sound complex, but in practice the concept is fairly simple. During a bicep curl the force's line of action runs vertically and the forearm runs perpendicular to this, thus acting as the lever arm. Using this example, someone who has a longer forearm than the next person would have an increased lever arm during a bicep curl.

In some cases, it is possible to increase the lever arm in order to increase exercise intensity. When performing a stiff-legged deadlift whilst holding a medicine ball to the chest; raising the ball above the head during this exercise will increase the lever arm and thus exercise intensity (see picture below). This principle may explain why the most successful power lifters tend to have shorter levers.

Speed: by increasing the speed of an exercise, intensity is increased e.g. a 100m sprint is a more intense activity than a marathon. Olympic lifts, such as the clean and jerk, where the objective is to lift the weight with maximum effort as quickly as possible is more intense than performing a bench press at a moderate tempo.

Gravity: gravity is the attraction between the Earth and an object on its surface or within its gravitational field. Gravity is a force applied to us at all times, which is evident to see with postural decline synonymous with ageing. It can be increased by adding external weight through the use of free weights, which in turn will increase intensity. An increase in body mass will also increase the effects of gravity.

Range of movement: moving through a full range of movement during exercise is important, although there are potential risks to the connective tissues and joints when approaching end ranges particularly where momentum is involved. It is common place to see people lifting weights in the gym, for example, with an inappropriate load or too much weight. In this situation, it becomes more difficult to achieve a lift through a full range of movement as we are generally not as strong at the end range. By decreasing the load, the exercise is less intense, thus enabling the lifter to move through a fuller range. Sometimes less is more.

Time

The amount of time dedicated to the session is largely dependent upon the type of exercise, fitness level and the amount of time the client is willing to dedicate to exercise. When planning for cardiovascular training it is normally measured in minutes, whereas resistance training is usually measured in reps and sets.

Type

The mode or type of training may also be manipulated, as long as the specificity of the adaptation does not move away from the training goal. This can be done by changing the aerobic exercise from running to cycling, for example, or the resistance exercise from a lateral raise to a shoulder press. Changing the type of exercise or activity performed can be used to progress a programme and provide variety.

The amount of time dedicated to the session is largely dependent upon the type of exercise, fitness level and the amount of time the client is willing to dedicate to exercise

General FITT guidelines

Training goal	Strength	Hypertrophy	Endurance	Health	Cardio-vascular
Frequency	1-2 x per week per muscle group	1-2 x per week per muscle group	2-3 x per week per muscle group	5 + sessions weekly	3 + sessions weekly
Intensity	High >85% 1RM	Moderate 67-85% 1RM	Low <67% 1RM	Low 6/7 RPE	Med High 60-90% MHR
Time reps / duration	1-5	6-12	13+	30 mins +	20 mins +
Recovery between sets	3-5 mins	1-2 mins	30-60 seconds	N/A	1-10 mins dependent on energy system
Sets per exercise	2-6	3-6	2-3	1	2 upwards (as intervals)

Adapted from Baechle and Earle (2000)

It is worth noting that group activity sessions such as exercise to music and aqua sessions are unlikely to elicit maximal strength gains due to the nature of the sessions involved, but are more likely to improve muscular endurance and cardiovascular fitness.

Group activity session such as exercise to music and aqua sessions are unlikely to elicit maximal strength gains

When selecting a weekly workout frequency, the instructor also needs to consider the training age of the client.

The table below (Baechle and Earle, 2000) provides a simple illustration of how the instructor can manipulate the variable of frequency as the client's training age / experience increases.

Training Status	Frequency guidelines (sessions / week)
Beginner	2-3
Intermediate	3-4
Advanced	4-7

Total sessions per week for different training ages

Principles of a progressive training programme

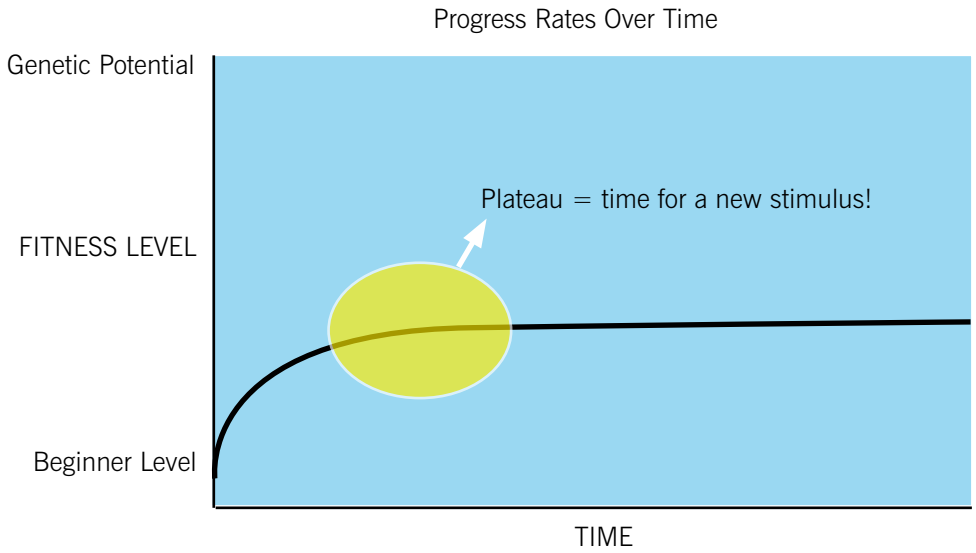
Progression and periodisation

To avoid any plateaus or decreases in performance, the principles of progression and periodisation should be applied. Progression means that when an overload is applied it should be gradual and sufficient enough to elicit an adaptation, but it should not be excessive. Excessive stimulus is counterproductive since it will lead to overreaching and maybe overtraining. Excessive post-training muscular soreness, lasting up to 7-11 days after resistance training, is a prime example of excessive stimulus being applied.

To avoid any plateaus or decreases in performance, the principles of progression and periodisation should be applied

Periodisation is the planned progression and manipulation of the training variables over a prolonged period of time. Varying the intensities and types of training in phases or cycles can cause greater improvements in performance and decrease the risks of overtraining and injury.

The human body is a master adapter, and given the right conditions it will adapt at a reasonable pace to any new stimulus. Once the client's physiology has adapted to the workout stimulus, the onus is on the instructor to make appropriate programme modifications. If appropriate modifications are not made, the client's progress is likely to plateau. In the medium to long term, progress stagnation is likely to cause dissatisfaction. Modifications to an exercise programme should be progressive and designed to build on the foundations set by previous sessions.



Each individual has a genetic potential that defines how far their fitness could progress if training, nutrition and recovery were optimised. The de-conditioned novice has a large adaptation potential because they are starting from a point far below their genetic limits. Fleck and Kraemer (1997), in fact, contend that almost any programme will work for an untrained individual, as they have a great adaptation potential and are unfamiliar with any exercise stimulus. It is as a result of this adaptation potential that beginners tend to make rapid progress initially once exposed to the exercise stimulus.

The initial progress that beginners achieve often leads many instructors to assume that their programme design skills are perfectly adequate. Unfortunately, the initial gains are relatively short lived, and gains start to slow down. It is important that the fitness professional appreciates that a new stimulus needs to be introduced at this point, and structures an appropriate response to keep progress moving in a positive direction.

Overtraining

As previously mentioned, any exercise programme requires a balance between overload and recovery. Should the overload stimulus exceed the body's ability to adapt either injury or overtraining may result.

The instructor should therefore be alert to the signs and symptoms of overtraining which include:

- sudden poor co-ordination
- lack of ability to concentrate
- reduction in performance
- irritability, over sensitivity to criticism
- reported disrupted sleep patterns
- general lethargy
- susceptibility to colds, illness

Should the instructor suspect the individual to be overtraining, their programme should be regressed to enable them to recover fully.

Planning exercise for health reasons

The Health of the Nation Report (1994) revealed that 80% of the population were classified as inactive. The research showed obesity and coronary heart disease (CHD) to be on the increase. Both of these conditions can be positively managed by regular exercise, however, it was only in the 1992 Allied Dunbar Survey (ADS) that inactivity was identified as a serious risk factor for CHD.

The Health Education Authority (now called The National Institute for Health and Clinical Excellence) produced the Active for Life Campaign after having completed extensive research on the nation's physical activity in 1992.

The findings from HEA 1995 and ADS 1992 (relate to men and women, ages 16 to 74 years):

- most adults believe they do enough exercise to keep fit
- 70% of men and 80% of women are not active enough to benefit their health
- 90% of adults believe that it is fairly important to exercise regularly yet only 40% do it
- 80% were not aware of how much to do
- 2/3 of women and 1/3 of men found it difficult to walk briskly up a slight slope for a while
- 1/3 of men and 1/2 of women aged between 65 and 74 do not have sufficient muscle strength or power to lift 50% of their body weight, making everyday movements difficult – such as getting up from a chair without using their arms

Amount of exercise

As individuals vary, there is no single recommendation. For several years, recommendations have highlighted the need for vigorous activity at 60% - 90% of maximum heart rate, for twenty minutes, three times a week. These recommendations are still valid in terms of health and fitness benefits but most people will not keep to them. This is generally because the work rate is seen as too high and the recommendations as too prescriptive. It may suit those who are maintaining an active lifestyle but is unlikely to appeal to those who are just thinking about, or are preparing to change their lifestyle in relation to their activity levels.

Exercise and exercise success need redefining to include small increases in everyday lifestyle activity. The two recommendations (listed below) provided by the American College of Sports Medicine (ACSM) are aimed at appealing to the majority of the population who do not take part in regular activity. They need to be encouraged to make moderate physical activity part of their daily routine.

To reduce mortality (ACSM, 1998):

Frequency	5-7 times a week
Intensity	50-90% of MHR
Time	30 minutes in total
Type	rhythmical use of large muscles

It should be stressed that 50% of MHR is acceptable and often advisable. The activity should make the person warm and slightly out of breath. Also, activity can be broken down into smaller sessions of not less than eight minutes at a time, for example, three sessions of ten minutes.

To maximise aerobic fitness and reduce mortality (ACSM, 1990):

Frequency	3-5 times a week
Intensity	60-90% of MHR
Time	20-60 minutes
Type	continual, rhythmical use of large muscle groups

Definitions

Light activity:

Little or no exertion normally does not cause a noticeable change in breathing.

Moderate activity:

Requires sustained, rhythmic muscular movements at least the equivalent of brisk walking and leaves a person feeling warm and slightly out of breath.

Vigorous activity:

Requires sustained, large muscle movements at 60 to 70% or more of maximum heart rate, a level that makes a person sweaty and out of breath.

Examples of levels of intensity of activities:

Moderate	Vigorous
Cycling for pleasure	Running at 5 mph
Step machine	Hockey, squash and tennis
Rowing	Hard cycling
Fly fishing	Circuit training
Walking briskly	Hill walking
Cricket	Skipping
Golf	Stair climbing
Swimming	Cross country skiing
Gardening	Rock climbing
Mowing the lawn	
Badminton	

Benefits

It is important to help people to understand that the benefits are not all physical but can be psychological, social and maybe even spiritual.

It cannot be guaranteed that everyone will experience all the benefits. However, being physically active will counter the effects of inactivity and therefore, can only be seen in a positive light.

Student Task

List as many benefits of physical activities you can think of:

Social	Physical	Psychological

Monitoring exercise intensity

Monitoring exercise intensity is necessary to both the safety and effectiveness of the exercise session. It can provide useful information to both determine the success of the session in the short term, and provide a benchmark against which future sessions can be progressed to and compared against.

Monitoring exercise intensity is necessary to both the safety and effectiveness of the exercise session

Methods

- heart rate
- rate of perceived exertion
- talk test

Heart rate

This is traditionally the most common method of monitoring exercise intensity and whilst very useful, some misconceptions have arisen surrounding this technique.

The main methods used for determining heart rate are to manually measure the pulse in the wrist or neck, or to use a heart rate monitor. The latter method is preferred as a more accurate method, particularly with high heart rates.

Estimating maximum heart rate:

Many people are familiar with the equation for estimating maximum heart rate (HR_{max}) which is:

220 beats per minute (bpm) – age (ACSM, 2000).

So, for a 36 year old, the estimated HR_{max} would be 220 bpm – 36 which is 184 bpm. However, what is less well known is that this calculation has an error range of plus or minus 11 bpm (ACSM, 2000; Howley, 2000), so in reality the estimated age related HR_{max} using this calculation would be somewhere between 173 bpm and 195 bpm (184 plus or minus 11). The information derived from this calculation should, therefore, only be used as a guideline.

The only way of truly determining an individual's HR_{max} is to exercise them to exhaustion and measure their heart rate at this intensity, although common sense should be used as to which clients are suitable for this.

The only way of truly determining an individual's HR_{max} is to exercise them to exhaustion

Heart rate zones:

Once an individual's HR_{max} has been determined, the instructor can decide on what proportion of this represents an effective aerobic training intensity. Research indicates that an exercise intensity equivalent to 60% - 90% of HR_{max} is appropriate for most clients (ACSM, 1993).

Example:

Maximum heart rate = 194

Multiply 194 by 0.6 and 0.9 to get the lower and upper limits of the target heart rate zone:

194 x 0.6 and 194 x 0.9 = a target heart rate zone of 116 to 175 beats per minute (bpm)

Beginners should exercise at the lower end of their range and increase intensity slowly as the body becomes more conditioned to exercise. It should be noted that with very unfit clients 50% of HR_{max} may have an aerobic training effect (ACSM, 1997).

A major myth associated with aerobic training zones and heart rates is that lower training heart rates represent a 'fat burning zone'. No such direct relationship between an individual's heart rate and their metabolism of fat whilst exercising exists. Some individuals have been recorded as metabolising fat at up to 97% of their HRmax, whilst others stopped metabolising fat at 54% of their HRmax. The point here is that individual's respond very differently to exercise, and any attempt to provide standard calculations or zones can be very problematic.

Rate of perceived exertion (RPE):

This method was developed by a Scandinavian physiologist called Gunnar Borg and is a scale of how hard an individual feels they are working when they exercise. The response of the client should take into account all of the symptoms of exertion such as breathing, muscular fatigue and the subjective feeling of effort. The classic Borg scale given below rates effort between 6 and 20.

RPE has been related to heart rate with some accuracy.

Heart rate	RPE	Classification
< 90 bpm	< 9	Very light
~ 100 – 110 bpm	10 - 11	Light
~ 120 – 130 bpm	12 - 13	Moderate
~ 140 – 160 bpm	14 - 16	Heavy
> 160 bpm	>16	Very heavy

Talk test

Though probably not as accurate as the previous methods, the Talk Test is nevertheless a simple method of gauging intensity that doesn't require any equipment or learning. According to NHS guidelines the follow guidelines can be used to monitor exercise intensity

- light activity
  Breathing lightly and talking easily, but heart rate has increased

- moderate activity
  Still talking comfortably, but breathing is deeper and quicker, body warming up

- vigorous activity (heavy increasing to very heavy)
  Breathing more deeply and harder, talking with a little more difficulty

As it increases from here, breathing becomes increasingly difficult, there is a shortness of breath and an inability to carry on a conversation.

Other subjective methods which could be used include observations such as sweating/redness, technique, and talking. However whilst these may provide some general indication of fatigue, particularly if the client's response is well known, there is no direct research-based evidence on their validity.

Contraindications to exercise and key safety guidelines for special populations

Contraindications exist whenever there is an increased risk of harm in any given activity and may exist regardless of age. If any contraindications should be identified during the client screening process (PAR-Q, Health Commitment Statement or similar) appropriate action should be taken. This is normally by means of a GP referral. The instructor is then given guidance on any action the medical authority deems appropriate.

50 is the current internationally recognised age at which there is significant reduction in the safety margins relating to exercise

Special considerations when designing a programme may need to be given to certain population groups within the exercise environment.

Key safety guidelines when working with older people

This guidance relates to clients aged 50 and over. 50 is the current internationally recognised age at which there is significant reduction in the safety margins relating to exercise and when pre-exercise screening is essential to ensure exercise professionals meet their duty of care.

These best practice guidelines are for 50+ individuals who:

- are asymptomatic (i.e. determined by the pre-exercise completion and interpretation of one of the two recommended 50+ pre-exercise screening tools namely: Revised PARQ (PARQ-R) or the AHA/ACSM Health/Fitness Facility Pre-participation Screening Questionnaire)
- have little or no recent and frequent experience of the particular exercise modality

Relaxation of these guidelines for highly trained, recently and frequently, physically active asymptomatic individuals in a particular exercise modality is at the clients own risk. However, the instructor needs to be mindful that regardless of the older adult's fitness levels and outward appearance, the ageing process is underway.

40 is the approximate age at which the ageing process begins and 50 is the age at which the progressive losses in the musculoskeletal/CV/neuromuscular systems means that adaptation of exercise needs to be considered.

40 is the approximate age at which the ageing process begins

Highly trained individuals in the 50+ age range are a very small and elite group accounting for approximately 1% of the 50+ population.

Ageing is not a disease. It is a natural, universal, complex and highly individual process characterised by progressive losses and declines in the function of most physiological and psychological systems and impacts on fitness and safety during exercise. Eventually these losses lead to increased frailty and inability to respond to stress and disease.

Functional status at any age depends not only on age but also on the rate of ageing, health, gender, lifestyle (including our physical activity levels), behaviour and socio-economic influences.

Potentially serious disease is increasingly prevalent with increasing age, and activity levels remain low or decrease with increasing age.

The losses in each of the body systems (N.B. from the age of 40) result in a corresponding 1-2% loss per year in physical capacity in:

- muscular strength (fewer, smaller and weaker fibres)
- power (fewer fast twitch, smaller, weaker and slower)
- bone density (thinner, more brittle bones and less ability to withstand fracture)
- aerobic endurance (fewer capillaries, less elastic vessels and reduced intake, uptake and utilisation of oxygen)
- balance and co-ordination (less sensory input and less postural stability, less co-coordination and less ability to prevent a trip turning into a fall)
- flexibility, agility and later mobility and transfer skills (stiffer joints, reduced range and ease of movement and less ability to perform activities of daily living (ADLs) e.g. get up and down from floor / chairs safely

In addition there are:

Sensory declines including:

- reduced motor learning (slower motor learning)
- reduced visual and aural acuity (sight and hearing difficulties)

Cognitive declines including:

- poorer short term memory

To be safe (i.e. to reduce/minimise the risk of adverse, age-related cardiovascular and articular system events to a minimum) the following guidelines should be followed for adults age 50+:

- current International guidance (ACSM/AHA) recommends that all people over the age of 50 should complete a recommended pre-exercise health screening questionnaire (PARQ-R or AHA/ACSM) to establish whether they are asymptomatic and ready to participate or whether they should seek further medical assessment prior to participating in an exercise programme

- spend longer warming up and warm up more gradually than younger clients (i.e. to ensure a total of 15 minutes) and begin with moderate shoulder circles before increasing the shoulder ROM and progressing to arm circles. Clients should be advised to do this by taking responsibility for themselves e.g. by walking to the session or by coming early and warming up before the session

- build-in a longer, more gradually tapered cool down after the aerobic training. Clients should be advised to do this by taking responsibility for themselves e.g. by keeping going for a few minutes after the rest of the class have stopped and/or are changing to the next activity (i.e. to prevent/minimise the potential for adverse cardiovascular events)

- keep the intensity of all training components to a challenging but health-related level i.e. without pain or strain and within their individual 'personal best training zone' by using the talk-test and educating clients on the use of the RPE scale as a means of monitoring and regulating exercise intensity, as required (N.B. it should be challenging)

In addition, where appropriate, instructors should encourage 50+ clients to:

- ensure correct technique as it is even more important for injury prevention with this client group
- take more time during transitions e.g. floor to standing
- simplify exercise. When correct technique cannot be maintained and risk is increased e.g. when any weight-bearing steps involving laterally crossing one leg over the other (e.g. grapevine) are included in a group session, the instructor should use their professional judgement (including the clients current physical activity history) before giving suitable alternatives to the older person e.g. adapt the grapevine by bringing the feet together, and with turns of more than 90 degrees, breaking it down into stages can prevent dizziness until fitness improves
- learn new exercises with the easiest position and/or the lightest resistance and progress slowly initially
- avoid extreme spinal flexion (i.e. full or half curl-ups from supine) and make abdominal training more challenging and safer for the vertebrae by keeping the neck long, and if lifting off the floor, supported by the arm

Key safety guidelines when working with pre and post-natal clients

This information relates only to normal, healthy, adult women experiencing a normal, healthy, singleton pregnancy, or who have had a normal, healthy birth, and who have had previous normal, healthy pregnancies and births.

In most cases, exercise is safe for both mother and baby. Exercise at the appropriate intensity for the individual concerned is not associated with adverse pregnancy outcome.

Women who have not exercised prior to pregnancy should begin with 15 minutes continuous aerobic activity, increasing gradually to 30 minutes continuous low-moderate intensity aerobic activity.

Pregnant women should maintain adequate hydration during exercise, avoid exercising in very hot or humid conditions, consume adequate calories, and restrict exercise sessions to no longer than 45 minutes, according to recommended guidelines.

Heart rate should not be used to monitor exercise intensity during pregnancy. Women should be advised to exercise according to how they are feeling and encouraged to use the talk test to monitor appropriate, individual intensity.

Pregnant women should avoid:

- exercising in the supine position after 16 weeks of pregnancy. The inclined position is unlikely to be a successful alternative to flat supine
- exercising prone
- prolonged, motionless standing
- heavy, uncontrolled, isometric or prolonged resistance work above the head
- leg adduction and abduction against a resistance
- isometric exercises
- loaded forward flexion
- rapid changes of direction or position
- uncontrolled twisting
- exercise with a risk of falling or abdominal trauma
- excessive and uncontrolled de-stabilisation techniques

Women who have not exercised prior to pregnancy should begin with 15 minutes continuous aerobic activity

Pregnant women should maintain adequate hydration during exercise

Pregnant women should immediately stop exercising if they experience:

- dizziness, faintness or nausea
- bleeding or leakage of amniotic fluid
- abdominal or contraction type pain
- unexplained pain in the back, pelvis, groin, buttocks or legs
- excessive shortness of breath, chest pain or palpitations

Other pre and post-natal exercise considerations

- hormonal and postural changes make pregnant women vulnerable to injury, joint misalignment, muscle imbalance and motor skills decline, especially if they are genetically hypermobile. These changes may start from very early on in pregnancy and gradually become more significant as pregnancy progresses.

- women in the child-bearing period are habitually forward flexed with shoulder girdle protraction, thoracic kyphosis, long, weak upper back extensors, and short tight pectoral muscles and are prone to neck and shoulder pain.

- instructors should be aware that women in the childbearing period are vulnerable to injury, nausea, dizziness and fainting. Instructors should therefore have up-to-date first aid skills.

- certain conditions, such as air embolism, thrombosis and haemorrhage, have elevated risk during the first weeks post-birth. Women should not begin exercising post birth until they have received the permission of their health care professional, usually at the post-partum 6 to 8 week check.

- the physiological and postural changes of pregnancy persist post-birth for several months, making women vulnerable to injury and long-term physical health problems such as pelvic floor dysfunction. This has particular significance for exercise involving impact, twisting and rapid, ballistic or aggressive movements, which should be avoided for at least 6 months and introduced progressively.

- high intensity or impact exercise in pregnancy and post-birth carries the risk of long-term pelvic floor muscle (PFM) support and control dysfunction.

- ideally, post-birth, women should be encouraged to re-educate posture, joint alignment, muscle imbalances, stability, motor skills, transversus abdominis (TA) muscle recruitment and pelvic floor muscle function before progressing to more vigorous exercise.

- "sit up", "crunch" or "oblique cross-over" type exercises are not an appropriate choice for abdominal muscle re-education post birth.*

- *for at least 12 months post-birth the rectus abdominis is mechanically weaker (Coldron, 2007). Excessive oblique's training may cause downward pressure through the pelvic floor (O'Dwyer, 2008) and anatomically will probably cause a lateral pull on a weaker linea alba. TA and PFMs are unlikely to be recruiting effectively to provide adequate abdominal compression and support.

- babies should not be used as resistance or a weight for exercise and should be excluded from the immediate exercise area.

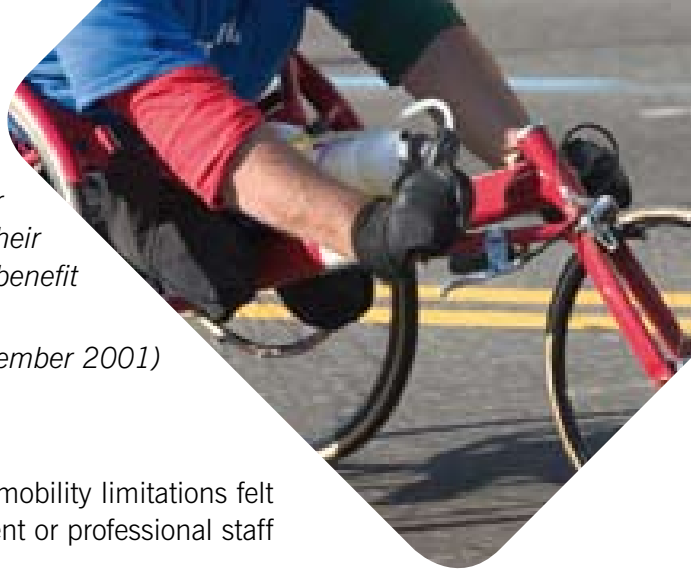
- a woman should be referred to a health professional if she is experiencing any of the following symptoms post-birth:

  - stress incontinence or pelvic floor muscle weakness
  - "dragging" pain or a feeling of heaviness in the lower abdominal or pelvic floor area
  - groin, low back pain or difficulty walking, even if mild and intermittent
  - abdominal muscle weakness, excessive abdominal doming, abdominal muscle separation or softness/sinking at the umbilical mid-line, umbilical hernia

Key safety guidelines when working with disabled people

Many disabled people find they experience barriers to accessing sufficient physical exercise for psychological, physical or social reasons.

It is widely recognised that regular and planned physical activity in a safe and supportive environment may not only help disabled clients in the same range of ways as for non-disabled clients, but it may also reduce the risk of gaining additional disabling conditions, improve the ability to perform activities of daily living that might previously have been difficult, and maintain or even improve independence.



"Joining a fitness centre is an excellent way for persons with disabilities and health limitations to maintain their physical function after rehabilitation or to improve their overall health in a supervised setting where they can benefit from the assistance of a qualified fitness professional."

(Fitness Management, September 2001)

However:

A recent study has shown that the majority of subjects with mobility limitations felt that fitness centres typically do not have the type of equipment or professional staff needed to assist them properly (Rimmer et al., 1999).

The Disability Discrimination Act (DDA) (1995)

It is unlawful to refuse to serve a disabled person, provide a lower standard of service, or offer a less favourable service to a disabled person. Service providers must make "reasonable adjustments" to their facilities and services so that they are accessible to disabled people. Adjustments to buildings and services must be made in expectation of attendance by disabled people; it is not reasonable for disabled people to be asked to wait until adjustments have been made. This may include providing extra help when required, but does not include automatically providing an additional service that is not required.

Exemption from the DDA is justified for the following reasons:

- if by meeting the needs of the disabled person the health and safety of any person, including the disabled person, is endangered
- if by serving the disabled person the service provider is unable to serve others (not including a delay or inconvenience to others)
- if the disabled person is unable to enter into a legally enforceable agreement, or give informed consent
- if providing a service to disabled people on the same terms as to other people means that it would not be possible to offer the service at all, or if a higher charge would have to be made to others

The Inclusive Fitness Initiative (IFI)

IFI provides guidance and support to operators interested in welcoming disabled people into their facilities, and to disabled people interested in getting active. This guidance is provided in line with their policies.

Physical disabilities

When considering the limitations and additional safety guidelines which may be required to programme design for a disabled client, the instructor needs to appreciate that, because of the various kinds of disabilities, describing specific components of an exercise prescription for each condition can be difficult.

It is unlawful to refuse to serve a disabled person, provide a lower standard of service, or offer a less favourable service to a disabled person

Some physical disabilities are classified as progressive e.g. multiple sclerosis. This means that the condition will worsen over time. Progressive disorders require careful

monitoring to ensure that the exercise programme is not causing the condition to worsen (exacerbation).

Sometimes physical disabilities exhibit asymmetrical weakness e.g. stroke, cerebral palsy. If there is a difference in strength between the left and right side of the body the instructor should aim to improve the affected side as much as possible without neglecting the side which is unaffected. However, if the nerves controlling the affected side have been partially or completely damaged, the ability to improve in the affected muscles is greatly reduced.

Spasticity

Spastic muscles are very tight or rigid. Since many individuals with physical disabilities will have some degree of spasticity, flexibility training is critical. However, before incorporating any flexibility in a programme the instructor should seek authorisation from a suitably trained medical authority on how to stretch a spastic muscle without causing injury.

Neurological conditions

For example: muscular dystrophy.

Muscles can become progressively weaker as a result of the decline in CNS functioning. To help offset this, the programme should try to work on general fitness levels. However, should there be any rapid decline in function the client should immediately be referred to their GP for guidance.

Damage to sensory nerves

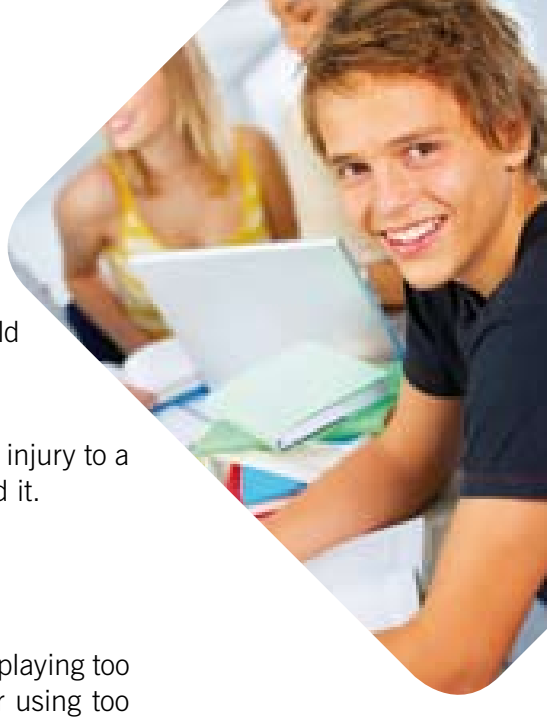
This occurs with many types of physical disabilities. Since this may result in an inability to detect pressure against the skin, left untreated, this can result in a pressure sore. It is generally recognised that the use of a wheelchair increases the risk of developing pressure sores, and so the client will already be aware of the importance of frequent checks. However, the instructor should also make the client aware that the use of gym equipment may also bring similar associated risks and so extra checks should be made.

Depression

Depression is a common secondary condition resulting from an individual's physical and psychological challenges of living with a disability. Occasionally, depression can cause a person to drop out of the programme.

It should be noted that these are only some of the common conditions the fitness professional who works with disabled people will experience and if they in any way doubt their abilities to work safely and effectively with anyone they should refer to a medical authority for guidance.

Key safety guidelines when working with young people



Growth plate fractures

Most injuries to the growth plate are fractures; they make up 15% of all childhood fractures, with the greatest incidence among 14 - 16 year old boys and 11 – 13 year old girls.

The growth plate is the weakest area of the growing skeleton so a serious injury to a joint is more likely to damage the growth plate than the ligaments around it.

Preventative measures to avoid 'growth-related injuries':

- it is extremely important to avoid excessive training. These include playing too much of one sport, playing the wrong sport for their body type or using too heavy a weight in weight training
- it is important to remember the gender differences and the differing stages of development within the same sex
- inappropriate size matching in pairs should be avoided
- avoid too many high impact moves on the spot
- always teach an appropriate warm up and cool down
- always provide appropriate equipment for the activity e.g. correct size, weight

Flexibility in relation to children

Caution should be taken when teaching any stretch exercise especially when children are in the growth spurts. These are really vulnerable times and there is an increased injury risk as the soft tissue around the joints is already stretched as muscle growth does not keep up with bone growth rates.

Younger children will not have gained enough motor skills to develop their flexibility with good technique and therefore risk injury by not understanding stretching to the point of 'mild tension'. Consequently, it is imperative that stretching should only be encouraged to the point of mild tension.

The cardiorespiratory system in relation to children

Children are naturally 'aerobic' and have seemingly endless amounts of energy. However, if you watch a child through 20 minutes of continuous vigorous exercise, they will naturally take bouts of rest or slow down to a lesser intensity for short periods of time. This natural process allows the body to 'cool off' as children heat up quicker than adults. This resting period will decrease as the child grows and develops.

Most injuries to the growth plate are fractures; they make up 15% of all childhood fractures

It is important that, when planning a cardiovascular training session with children, the terms 'moderate / vigorous intensity' should mean: slow jog / fast jog.

The cardiorespiratory function develops through childhood. Instructors must however, be very aware that there are major risk factors when training children at high intensities.

Lung volume and peak flow rates: these steadily increase until full growth. For example, maximum ventilation increases from 40L/min at five years of age to more than 110L/min as an adult. This means that children have higher respiratory rates than adults, 60 breaths/min compared to 40 breaths/min for the equivalent level of exercise.

The measure of the amount of ventilation (passage of air in and out of the lungs) required for each litre of oxygen consumed (VE/VO_2) is also higher in children, which means that children have inferior pulmonary functions.

Cardiovascular function: children have smaller heart chambers and lower heart volumes than adults. This results in a lower stroke volume than adults both at rest and during exercise. Chamber size and blood volume gradually increases with body growth. Children compensate for this smaller stroke volume by having higher maximal heart rates than adults.

For an older child their maximum heart rate could be more than 215 beats/min compared to a 20 year old whose maximum heart rate will be around 195-200bpm.

Children's higher heart rates cannot fully compensate for the lower stroke volume and so cardiac output (volume of blood pumped from the left ventricle in one minute) is lower than adults.

Children's arterial/venous oxygen difference is greater and this suggests that a greater percentage of the cardiac output goes to the working muscles than in an adult and is another way that children compensate for their lower stroke volume.

Aerobic capacity: one would expect the aerobic capacity of a child to increase with age due to the lung and heart capacity increasing. This is true in absolute terms. VO_2max measured in L/min increases from 6 – 18 years for boys and 6 – 14 years for girls. However, when VO_2max is normalised by body weight little change is observed with age. There is a slight decline after puberty in girls because of the increase in body fat rather than muscle mass, with VO_2max slightly increasing at puberty for boys as a result of the increase in muscle mass.

Any absolute difference in VO_2max does not limit endurance performance. Instead children lack technique and end up with poor economy in activities such as running. Children have shorter limbs and a smaller muscle mass which results in lower mechanical power. In the growth spurts they have disproportionately long legs, meaning that they are biomechanically out of balance and are potentially less coordinated.

Body temperature and dehydration

Physiologically children have an inferior cooling mechanism due to low blood volume and high skin temperature. They are sensitive to heat stress because they expend more energy per kilogram of bodyweight than an adult during exercises.

Adolescents are at risk of dehydration when exercising due to overheating. In the cold, they lose heat more quickly due to their relatively large surface area compared to their mass.

The implications for the instructor are:

- give regular water breaks
- the warm up component may need to be less intense and shorter than an adults
- the cool down component may need to be shorter than an adults
- active rests may have to be given in-between bouts of vigorous activity

Anaerobic exercise

The anaerobic capacity for both boys and girls increases with age, but is not fully developed until around 20 years of age. Due to their lack of muscle mass and smaller livers children have less glycogen stored per gram of muscle and have fewer stores of creatine phosphates than an adult. They therefore, are unable to generate as much anaerobic work.

This means that the natural fatigue mechanisms from intense work that adults possess do not exist to the same degree with children. This, along with the fact that they overheat more than adults are the major risk factors that instructors need to be aware of when training young adolescents at high intensities.

An adolescent would not normally require any power training in their programme, but sometimes, as part of their sport, it can be considered appropriate. Preadolescents and adolescents should avoid power lifting, body building, and maximal lifts until they reach physical and skeletal maturity (American Academy for Pediatrics, 2008).

Gymnasium equipment

The resistance machines in most gyms are designed 'adult sized' and have weight increments that are generally too large for young people. Since free weights allow much smaller weight increases and their safe and effective use is not dependent on the size of the exerciser they are a much better choice.

Technique

Since their 'body awareness' and co-ordination are not generally as well developed as that of an adult, adolescents require much closer supervision than adults, especially when undertaking any sort or strength programme. The instructor should therefore begin any programme with non-complex, low resistance exercises which, where possible, duplicate every day activities. Children should only progress once proper technique is perfected.

Importance of healthy eating

An understanding of the basic principles of nutrition is important for anyone who may be involved with training members of the public, since a diet built on sound advice will have a beneficial effect on both health and performance.

The risk of poor nutrition

In an era when vast sums of money are spent on health care it is important that all avenues are investigated in understanding how to achieve optimal health and how to manage ill health when it appears. There is no doubt that the food we eat and physical activity, or lack of it, plays a significant role in both preventing and managing health problems. The following list of commonly occurring, modern day health complications and diseases have all been shown to have a root cause or risk factor associated with food and diet:

- obesity
- heart disease
- stroke
- some cancers
- metabolic syndrome
- diabetes
- hypertension
- high cholesterol
- asthma
- some types of arthritis
- menstrual irregularities
- infertility
- eczema

Professional role boundaries in offering nutritional advice

This qualification will allow the instructor to offer generalised advice on the components of a healthy diet for a 'normal healthy individual' to improve their nutrition. Where an instructor is faced with more serious diseases and ill health beyond their scope of practise, it is vital that they refer the client on to an appropriately qualified and registered dietician or nutritional therapist. These professionals will be able to analyse and test correctly to determine specific nutrient deficiencies and also prescribe food and supplementation accurately to overcome and promote optimal health.

Nutrient groups

Nutrients are substances found in our food, which the body is able to use for building material and fuel. There are five nutrient groups:

- carbohydrate (CHO)
- protein
- fat
- vitamins
- minerals

Carbohydrate

This nutrient is divided into three categories.

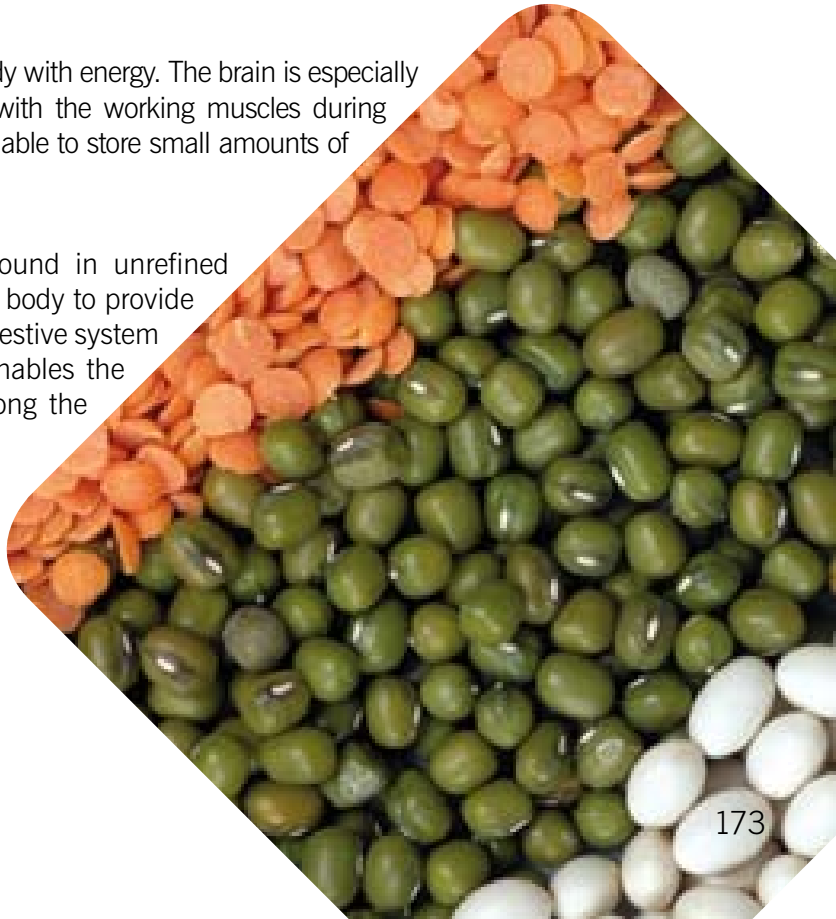
Category	Food examples	
Sugars – simple structures, the most common of which is glucose	fruit fruit juice dried fruit table sugar	honey jams confectionery
Starches – complex structures made mostly from long chains of saccharides joined together	bread pasta rice cereals, grains and beans	potatoes sweet potatoes vegetables
Fibre – the indigestible parts of starch which help to keep the digestive system healthy	fruit vegetables whole grains and cereals beans	

Dietary carbohydrates

Functions of carbohydrate

The primary role of carbohydrate is to provide the body with energy. The brain is especially dependent on glucose as a source of fuel, along with the working muscles during more intensive exercise. For this reason, the body is able to store small amounts of carbohydrate within both the liver and the muscles.

Dietary fibre is a tough substance, which is found in unrefined starchy foods and cannot be broken down by the body to provide fuel. This indigestible material stays within the digestive system where it helps to provide bulk, which in turn enables the smooth passage of food and waste products along the digestive tract.



Protein

Proteins are made from building blocks called amino acids. There are 20 of these amino acids, which the body uses to make the many proteins that it requires. There are two categories of foods which can provide these important building blocks. Examples can be found in the table below:

Category	Food examples
Animal sources - an excellent source of protein containing plenty of amino acids in favourable amounts	meat poultry fish dairy produce eggs
Plant sources – a poorer source of protein containing fewer amino acids and in smaller amounts	grains cereals nuts beans

Dietary protein

Functions of protein

The amino acids gained from the diet, alongside those which the body is able to make for itself, are finally used to build many different proteins. These proteins in turn fulfil many functions, ranging from helping to transport important substances in the blood, to allowing growth and repair of human tissue. Protein is particularly important to aid recovery after heavy and intensive training.

Fat

Dietary fats occur in three basic categories, each of which are important to the body in order to maintain health and performance. Examples are given in the table below:

Category	Food examples	
Saturated fat – mostly found in animal sources but also present in select plant sources, important for the body's cells and the nervous system	meat eggs dairy produce	poultry skin coconut oil palm oil
Monounsaturated fat – found in animal and plant sources, helps to protect from heart disease	meat olive oil	peanut oil avocados
Polyunsaturated fat – found in fish and plant sources, important for cells and proper brain function	oily fish sunflower seeds	sunflower oil flax seed

Dietary fats

Functions of fat

Fats fulfil many vital functions within the body and form an important aspect of a balanced diet for the reasons listed. Fats:

- form an important component of cell membranes or walls
- help the body to use the fat soluble vitamins – A,D,E, and K
- provide insulation under the skin
- provide protection for the internal organs
- provide energy and a means of energy storage
- make up the greater percentage of the brain and the spinal cord

Vitamins and minerals

Minerals occur naturally within the soil and are drawn into plants via their root systems. Vitamins are formed by plants and can be obtained in the diet by eating the appropriate plants, or by eating products from the animals that have eaten those plants. Thus a diet rich in fruit and vegetables will also be rich in vitamins and minerals. The golden rule is variety and colour, since the brighter and deeper the colour, the greater the overall nutrient content. Variety of choice is important since this will increase the range of both vitamins and minerals found within the diet.

Collectively both vitamins and minerals are vital for normal growth, repair and daily functioning of the body. Examples are given in the table below:

Food sources	Nutrients
Plant sources fruit and vegetables nuts whole grains and cereals	Variety and colour will ensure a range of nutrients
Animal sources meat eggs dairy produce	provide fat soluble vitamins A,D,E and K provide vitamin B6, B12 and folic acid provide zinc provide iron provide calcium

Dietary vitamins and minerals

Water

Whilst not considered to be a nutrient, adequate water is also essential for health and performance. Water is found both inside and outside of the body's cells, and there must be sufficient quantities present in order to support life. The amount of water required will depend on varying factors, notably:

- environmental temperature
- body temperature
- humidity
- physical activity
- respiration rate

The functions of water:

- the formation and maintenance of blood plasma
- the effective passage of substances in and out of cells
- enables life sustaining reactions to occur within the body

UK National Food Guidelines

National food guidelines in the UK are given in an attempt to provide information to the public, in order to promote a healthy diet. It serves as a useful guide to ease the confusion that often arises when trying to plan a menu. We tend to follow what is called 'The Eatwell Plate.' This simple guidance model in its current form was introduced in 2007, though earlier versions existed prior to this. It provides an alternative illustration of the similar basic guidelines around food and nutrition found within the US pyramid. Whilst the illustration itself is very simplistic and provides less descriptive guidance than the pyramid, the guideline documents behind the national model provide some more directed advice.

The Eatwell Plate is also supported by 8 specific healthy eating tips as stated by the Foods Standards Agency.

1. base your meals on starchy foods
2. eat lots of fruit and vegetables (5 portions per day)
3. eat more fish (2 portions a week, 1 oily)
4. cut down on saturated fat and sugar
5. try to eat less salt, no more than 6g a day
6. get active and try to be a healthy weight
7. drink plenty of water (6-8 glasses per day)
8. don't skip breakfast

The specifics of the national food model provide the following targets:

Adult males:	2550 calories per day
Adult females:	1950 calories per day

The total amount of calories should be divided across each of the macronutrients to achieve the following ratios:

- minimum of 50% calories from carbohydrates
- maximum of 35% calories from fats
- minimum of 55g of protein per day (9-12% calories)

The different macronutrients contain calories and useable energy. The values vary slightly, but are usually referred to with the following approximate figures:

• carbohydrates	4 calories per gram
• proteins	4 calories per gram
• fats	9 calories per gram
• alcohol (not a nutrient)	7 calories per gram

In trying to eat according to the national guidelines some may find incessant calorie counting a challenge and may prefer instead to guide themselves less intensely by following the suggested portion sizes. The following table provides some guidelines as to what counts as a typical portion. Please note that manufacturers can vary what they call a 'portion' in their favour to ensure their label information fits better with current nutrition trends. Be sure to read labels carefully. Later in the course we will investigate food labelling more fully.

Food group	Portion guide
Fruit	Small fruit – 2 satsumas, 2 plums, 2 kiwi, 7 strawberries, 14 cherries Medium fruit – 1 apple, 1 banana, 1 pear, 1 orange Large fruit – half grapefruit, one 5cm slice of melon, 1 large slice of pineapple Dried fruit – about 30g, one large heaped tablespoon of raisins or sultanas, handful of banana chips Fruit juice – 150ml glass of unsweetened juice
Vegetables	Green veg – 2 broccoli spears, 4 heaped table spoons of kale, spinach, or green beans Salad veg – 3 sticks of celery, 5cm piece of cucumber, 1 medium tomato, 7 cherry tomatoes Cooked veg – 3 heaped tablespoons carrots, peas, corn or cauliflower
Bread, rice, pasta and potatoes	1 slice of bread Handful of rice or pasta Handful of breakfast cereal 1 small to medium potato
Meat, fish, eggs and beans	Lean meat the size of a deck of cards 1 large egg Side of fish the size of a standard chequebook Handful of beans, nuts or seeds
Milk and dairy	Small cup of milk 150ml of yoghurt Piece of cheese size of small matchbox
Food and drinks high in fat or sugar	Limit these foods to no more than 8% of total intake

Weight management

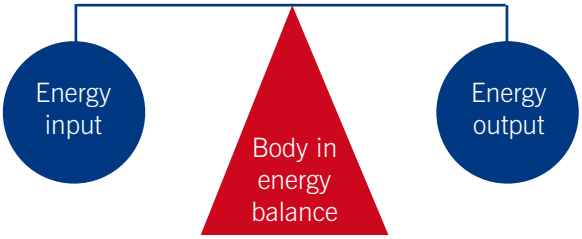
The term weight management refers to the actions taken by an individual to achieve or maintain an acceptably healthy level of body fat. At the very heart of this process lies the concept of energy balance.

Energy balance

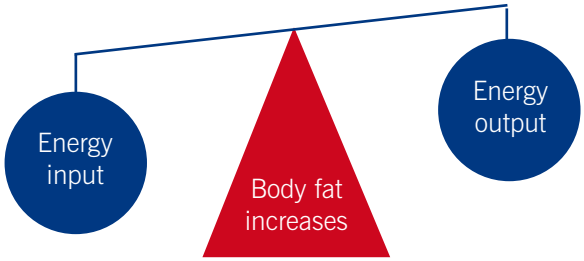
Energy intake	Energy output
• the type and amount of food eaten • drinks containing energy, including alcohol	• resting metabolic rate (RMR) - the amount of energy used whilst at rest • the amount of energy used through activity and exercise

The concept of energy balance

Energy input and energy output can be adjusted in order to meet individual goals. When energy intake exceeds energy output, body fat and therefore body weight, will increase. The opposite is true when seeking to lose weight.



The body in a state of energy balance



Energy imbalance promoting an increase in body fat

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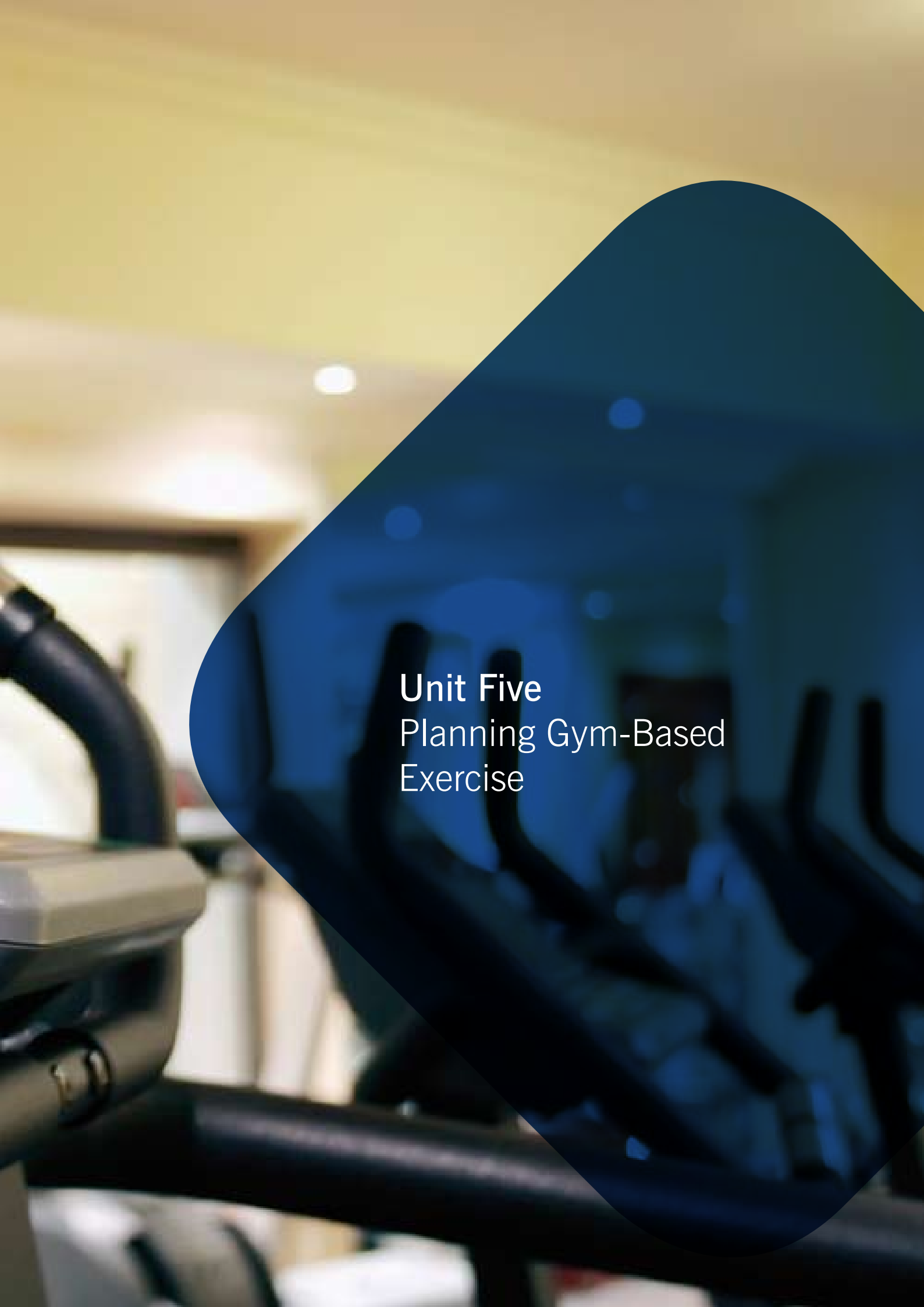


Unit Five
Planning Gym-Based Exercise

Planning Gym-Based Exercise

Aim: To provide the learner with the skills and knowledge required to plan and prepare a gym-based exercise programme with apparently healthy adults – both individuals and groups.*

Learning outcomes

By the end of this unit the learner will be able to:

- collect client information to plan gym-based exercise
- use client information to plan gym-based exercise
- plan gym-based exercise with clients
- collect and use information to plan a gym-based exercise programme
- plan a safe and effective gym-based programme with clients

Introduction

Planning prior to the delivery of a gym-based session is essential to ensure a safe and effective session is carried out. Planning will enable the gym instructor to ascertain the client's goals and will, therefore, provide a reference for the construction of programmes suitable to the client's needs and levels of fitness.

* This may include young people in the 14-16 age range, provided they are part of a larger adult group and also covers working with individual older adults, ante and post-natal clients and disabled clients provided the relevant contraindications and key safety guidelines are observed.

Collecting client information to plan gym-based exercise

Introduction

Most newcomers to exercise are apparently healthy individuals seeking to become fitter and lose weight. For most of these individuals, becoming more active is safe and desirable (ACSM, 2001). Furthermore, individuals who remain physically active are less likely to develop several major chronic diseases such as heart disease, obesity and diabetes. A recent report by the Chief Medical Officer (2004) stated that:

Physically active adults have a 20-30% reduced risk of premature death

> *"Physically active adults have a 20-30% reduced risk of premature death and up to a 50% reduced risk of developing major chronic diseases such as coronary heart disease, stroke, diabetes and cancers."*

However, for some individuals exercise can actually have the opposite effect. A diagnosed hypertensive may, be at risk during physical activity as a result of their elevated blood pressure. Consequently, the likelihood of a life-threatening event is increased. It's prudent, therefore, that gym instructors understand the potential risks that exercise poses to some individuals.

Using industry accepted techniques such as questionnaires, diaries and oral questioning a client health and fitness profile can be established. Decisions are then made on each client's readiness for exercise, so the most appropriate action can be taken (Kordich, 2004). In the event of a client being deemed unsuitable for immediate exercise, they can be referred to an appropriate health care professional such as a General Practitioner (GP). Such a client will need to obtain medical clearance prior to starting an exercise programme.

Using industry accepted techniques such as questionnaires, diaries and oral questioning; a client health and fitness profile can be established

It is stressed that instructors are not qualified to diagnose any medical conditions or rehabilitate from injury (unless they have a relevant professional qualification). This is beyond the gym instructor's scope of practice.

Stages of planning - consultation

A consultation is generally performed as a face to face discussion with the client. The process allows the instructor to collate specific information about the client, and to subsequently derive a picture of what the client's lifestyle is like, and what they want and need as a unique individual. Armed with this information the instructor can then decide on the type of programme to meet the client's objectives.

The consultation period allows the instructor to screen the client, gather general information and assess their objectives:

Screening tools should be used to identify individuals who require further medical evaluation

Stage 1: Screening the client

Instructors have a legally bound duty to minimise the risks and maximise the benefits (also to protect themselves from litigation) of exercise participation. Screening tools should be used to identify individuals who require further medical evaluation before embarking on an exercise programme. Hence, there is a need to identify those individuals that are a higher health risk status and take the most appropriate action. Typically a Par-Q will be completed by the client and client consent obtained by the gym instructor before proceeding.

Physical Activity Readiness Questionnaire (PAR-Q)

The Physical Activity Readiness Questionnaire (PAR-Q) developed by the Canadian Society for Exercise Physiology is a popular screening tool. When used in its unadulterated form, the seven question PAR-Q is effective in identifying medical contraindications to exercise. If the client answers 'yes' to any of the questions then medical clearance should be sought from their GP before exercise begins.

Informed consent

Client consent prior to fitness testing and participation in a gym-based session must be obtained by the gym instructor

Client consent prior to fitness testing and participation in a gym-based session must be obtained by the gym instructor. It can, however, only be given once the client has a full understanding of the facts, implications and future consequences of participating in an exercise programme and having a health and fitness appraisal.

In simple terms, this means that the gym instructor should clearly explain the screening process including the method by which physical measurements will be taken, why they will be taken and the effects these tests and the subsequent exercise sessions will have on the client's body systems. Informed consent should be given verbally by the client after the explanation has been given by the instructor.

The majority of gyms will also provide informed consent forms that the client will need to complete and sign. This ensures that the client is fully aware that participating is entirely voluntary.

Criteria for medical referral and factors which may affect safe exercise participation

There are four criteria for referring a client to their GP:

Instant medical referral:

- any diagnosed metabolic, pulmonary or cardiovascular disease
- signs or symptoms of a pulmonary or cardiovascular disease

Several measurements require special attention and potential temporary deferral:

- high blood pressure, current smoker and positive family history of CHD
- minor injuries such as sprains and strains

Doubt or uncertainty:

- doubt or uncertainty regarding any aspect of the client's health. The instructor should play safe and refer

Client preference or doubt:

- if the client expresses a desire to be medically referred before starting an exercise programme, again the instructor should play safe and refer

Referring a client to another health care professional

If a referral has been identified, the client will need to seek medical clearance (GP or physiotherapist, for example) before carrying on. However, it is important the client is kept in the loop and doesn't just disappear out of the door never to return. In other words, some form of follow up procedure is needed. Furthermore, networking with other health care professionals is recommended if instructors are to best serve their clients.

Standard referral letters can be drafted (with the client's consent) or contact can be made direct. Any letter should contain results and comments on areas of concern that have been identified through testing. Other health care professionals are likely to feel assured of the instructor's ability if this professional approach is adopted. On a final note, schedule an alternative appointment with the client and follow this up with a phone call.

Stage 2: Information gathering

Client information can be gathered in a number of different ways, each with their own advantages and disadvantages.

Questionnaires

A questionnaire can be a useful way to collect information about a client. Questionnaires are easily adaptable and do not have to be completed face to face. They can, for example, be given to a client prior to the consultation with the gym instructor, which may save time. This would indicate that questionnaires are well suited to people with limited time. Sometimes a client may need better explanation of a question(s) and so sometimes questionnaires lend themselves to being completed face to face with the instructor. The use of questionnaires may, therefore, be more appropriate to an advanced exerciser who has a good understanding of general exercise principles. They can also appear impersonal.

Interviewing

Interviewing the client is likely to be carried out during the consultation process and allows the instructor to ask questions directly to the client in a face to face meeting. This is an excellent way to build an initial rapport with a client. A face to face meeting can sometimes be daunting for a less confident individual and the instructor should handle the questions they ask with sensitivity. Provided the instructor is personable and adapts their communication style to suit the client, interviewing should be carried out for every client, provided it is not carried out as an 'interrogation'.

A questionnaire can be a useful way to collect information about a client

Observations

General observation of the client can be a useful way to collect information. For example, it may be possible to detect whether a client has poor posture which may better inform the instructor's exercise selection. This, may however, require a certain amount of experience if the instructor is to identify any significant observations that would help them to make programme design decisions. It is important to avoid drawing attention to a client through 'staring' or highlighting observations to other members of staff or public, but provided this is carried out in a subtle manner the instructor can apply this to every client.

The following information will need to be obtained during the consultation process:

Lifestyle considerations: the general way of life and habits of a client will impact on their health, body composition, fitness levels, energy levels, motivation, and ability to adhere to a training programme. The instructor should enquire regarding the following lifestyle factors:

- occupation – hours, manual or sedentary, postures adopted
- leisure activities – active or inactive, postures adopted
- activity levels – sedentary, limited, moderately or highly active, frequency
- nutritional habits – types of food and drinks, frequency of consumption
- alcohol consumption – estimated amounts and frequencies
- smoking habits – smoker or non-smoker, amounts, how long etc

Time available: when designing an exercise programme, the gym instructor needs to recognise that the duration and frequency of the workouts must ultimately be dictated by the time available to the client. The exercise schedule should slot comfortably into the client's lifestyle otherwise exercise adherence and client retention is likely to suffer. This is particularly true with novice clients who have not yet developed a strong 'regular exercise' mentality.

Training status: all clients are unique, and as such it is important that the instructor takes the time to question the client about their current training status. A client that is a beginner to resistance exercise will respond in a very different way to a client that has several years of training behind them. The following information should be obtained when evaluating training status:

- length of (recent) regular participation in previous training programmes
- type of training programme (e.g. resistance, cardiovascular)
- level of intensity involved in previous training programmes
- degree of exercise technique experience (i.e. the knowledge and skill to perform resistance training exercises correctly)

The 'training age' of the client i.e. how long they have been training combined with their experience with different exercise modalities, will determine the type of programme the gym instructor can produce. Training a complete novice (training age of zero) will be completely different from training a client with a history of five years structured and progressive resistance and aerobic training. It is important however, to appreciate that years of exercise experience in the gym does not automatically qualify an individual to be considered an advanced exerciser. It is common to find individuals that have been training for years, but have not really progressed beyond the low-intermediate stage in terms of fitness, results and technical competence. Often this is due to a lack of knowledge rather than a lack of application.

When designing an exercise programme, the gym instructor needs to recognise that the duration and frequency of the workouts must ultimately be dictated by the time available to the client

Likes and dislikes: when questioning a client about their previous exercise history, it is useful to obtain an overview of their exercise likes and dislikes. This information can be used to influence the programme design process.

Appropriate use of client likes and dislikes require the trainer to consider two key issues:

Issue 1: Does the client dislike certain exercises simply because they are not good at them i.e. they have an area of weakness?

This is often the case with areas of dislike. It is human nature to avoid the things that we are not good at, while continuing to apply our efforts into the things we already excel at. While performing well at a select group of exercises may do wonders for boosting the client's confidence in the gymnasium environment, it can unfortunately further exaggerate any existing physical imbalances they may have.

All clients are unique, and as such it is important that the instructor takes the time to question the client about their current training status

Issue 2: Will the client only adhere to the exercise programme if they are allowed to continue performing the exercises they like, while avoiding the exercises they don't?

Once the likes and dislikes of the client have been established during the consultation stage, it is important that the instructor discusses the issue of programme balance with the client. If the client can be educated as to the merits of a balanced approach to resistance training, they are more likely to accept a programme that contains less of their current favourite exercises, and more of the ones that they have traditionally avoided.

Objectives: the following are a range of common client objectives. Resistance training exercises will be included in the training programmes that are designed to meet these objectives, although some are clearly far more resistance-based than others:

- muscular strength
- muscular endurance
- fat loss
- health
- hypertrophy
- posture
- aerobic conditioning

Clients with limited knowledge of the components of fitness may need to have their interpretation of their own objective clarified by the instructor. For example, a novice client that indicates they want to get stronger may not fully appreciate the type of training that is required to develop genuine muscular strength. They may also fail to realise that the more advanced muscular goals of hypertrophy, strength and power require a significant background in resistance training in order to perform safely and effectively.

Stage 3: Physical measurements

Physical measurements can be taken, which helps to give an understanding of the fitness level of the client, so that the instructor can design the appropriate training regime. Some individuals may feel uncomfortable having physical measurements taken and so it is important for the instructor to be sensitive in their approach and respect the privacy of the client. It is possible that some clients will feel embarrassed by certain tests. It may be prudent, for example, to avoid taking skinfold or certain girth measurements on someone who is notably overweight. Weighing that person and calculating their BMI may be more appropriate.

Where possible, an appropriate environment should be used for physical tests relating to body composition and girth measurements. Ultimately, the client should feel comfortable and the tests should only go ahead after the process has been fully explained by the instructor and informed consent given by the client.

Test appropriateness

Tests should be selected that match the needs, goals and capabilities of the client. Not all tests are suitable for all clients. For example, a previously sedentary client will need to develop cardiorespiratory fitness. Selecting a test therefore, to measure muscular power through a vertical jump would be totally inappropriate and potentially high risk. In this case, since fitness levels are low a submaximal cardiorespiratory test would be more suitable.

Test validity and reliability

To accurately assess the client's health and fitness status, tests should be selected that are valid, reliable and objective (Heyward, 1998). The following test guidelines should be followed to ensure test validity and reliability:

- equipment - equipment used should be of good quality, regularly inspected and well maintained

- client - before testing begins, clients should be instructed to follow a series of guidelines or pre-test procedures. It is imperative for test accuracy and thus validity that the instructor ensures each client arrives in a 'neutral state' (variables reduced to a minimum). Failure to do this will void the test. This can be achieved by listing the pre-test procedures on the back of an appointment card handed to the client on the initial booking. Be sure the client has followed the guidelines prior to testing. Consider the following:

  - consumption:
    - avoid heavy meals less than three hours prior to the test
    - avoid drinking excessive alcohol during the day before the test and altogether on the day of the test
    - avoid drinking coffee, tea, cola or any caffeinated beverage two hours prior to the test
    - avoid smoking for at least two hours prior to the test

  - action:
    - avoid exercising or any form of strenuous physical activity on the day of the test
    - have a good night's sleep the evening before the test
    - avoid using a jacuzzi, sauna or sunbed less than two hours prior to the test

Physical measurements can be taken, which helps to give an understanding of the fitness level of the client, so that the instructor can design the appropriate training regime

- medical:
  - avoid or cancel the assessment if they have a temperature or feel unwell
  - bring any current medication e.g. inhalers
- clothing:
  - wear appropriate clothing e.g. trainers

- timing - time of day can influence the results since client temperature, hydration levels and activity levels change throughout the day. A female client's phase of menstrual cycle can influence the accuracy of results due to fluctuation in body temperature and fluid levels. If possible, the time of day should be kept constant. If not, this must be recorded and taken into account

- environment - temperature (and humidity) affects the heart rate response to exercise. Ideally, environmental factors should be kept constant from one assessment to another. If this is not possible, temperature should at least be recorded and taken into account

Customer service

The highest levels of professional service should be demonstrated at all times throughout the appraisal process. Good duty of care involves informing the client of the sensations and feelings to be felt with each test and making sure the client is comfortable at all times.

Indications for stopping testing

During test administration instructors must stay vigilant at all times. Tests should be stopped immediately and clients referred in the following circumstances:

- onset of angina-like symptoms
- significant drop (20mmhg) in systolic blood pressure or a failure of the systolic blood pressure to rise with an increase in activity
- excessive rise in blood pressure: systolic pressure >260 mmHg or diastolic pressure >115 mmHg
- signs of poor perfusion: light-headedness; confusion; ataxia; pallor; cyanosis; nausea; or cold, clammy skin
- failure of the heart rate to increase with increased exercise intensity
- noticeable change in heart rhythm
- client requests to stop
- physical or verbal manifestations of severe fatigue
- failure of the testing equipment

General indications for stopping exercise testing low-risk adults (ACSM, 2001)

Anthropometric testing and body composition

In simple terminology, a person's body weight can be divided into two compartments, fat mass (FM) and fat-free (FFM), or lean mass. This is the principle behind body composition assessment. Fat mass includes internal and external fat (adipose tissue). Fat-free mass includes muscle, bone, and internal organs. These structures added together make our total weight.

Previously height / weight tables were calculated to give sensible guidelines for clients who want to achieve a healthy weight. However, these tables are severely limited in the information they provide as they give no assessment of how total weight is composed. In other words, they do not assess the proportion of total weight that is fat.

Total weight indications are a useful starting point in assessing health status, but the composition of a client's body must also be assessed. Instructors and testers must understand the difference between weight loss and fat loss, and the ideal level clients should be looking to achieve.

1. Body Mass Index

The Body Mass Index (BMI) is worked out using the following equation:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Weight (kg)}}{\text{Height}^2\text{ (m)}}$$

Example: If a 70 Kg man (2.2lbs = 1 Kg) stands 68 inches tall (2.54 cm = 1 inch), then:

$$\text{BMI} = \frac{70\text{ Kg}}{1.72\text{m}^2} = \frac{70}{2.98} = 23.5\text{ kg/m}^2$$

As BMI uses weight only and does not consider body composition, it is useless for measuring fat loss. However, it can be used as a quick method to give some idea of whether or not a client is overweight. The BMI values for obesity are:

Classification of overweight and obesity by Body Mass Index (BMI)			
		Obesity class	BMI (kg/m^2)
Underweight			<18.5
Normal	**Acceptable**		18.5 – 24.9
Overweight	**Special Attention**		25 - 29.9
Obesity	**Medical Referral**	I	30 – 34.9
		II	35 – 39.9
Extreme Obesity		III	>40

National Institute of Health (1998)

This method is particularly inaccurate for body builders and strength athletes who have a higher than normal amount of muscle mass. Body builders with very low levels of fat are often classified as 'obese' by this method. BMI should not be used as a means of monitoring changes in body composition.

Weight method of assessment:

- calibrated scales
- client to remove shoes and heavy clothing
- make sure all re-tests are scheduled for the same time of day

Height method of assessment:

- check calibration of equipment
- client to remove shoes and stand tall
- take the highest part of the head as the score (be aware that height decreases as the day goes on)

2. Circumferential measurements

Circumferential measurements are quick and easy to take. The operator requires little skill. Formulae exist to convert circumferential measurements to body composition (hence % body fat and LBM) but these are not especially accurate.

Circumferential method of assessment:

- take measurement at exact location
- keep tape in one plane
- if possible, take measurements under clothing (if not, record details of clothing)
- take the average of three readings

Circumferential sites:

Arm – with the subject's arm relaxed, a horizontal measurement is taken at the mid-point between the acromion process and the olecranon process.

Chest – with the subject standing erect, a measurement is taken at the maximum circumference.

Note: when taking this measurement on females, it may be more appropriate to ask the client to place the tape in the correct position at the front of their body, with the instructor taking the measurement from the side of the client.

Waist – with the subject's abdomen relaxed, a horizontal measurement is taken at the level of the narrowest part of the torso above the umbilicus. The measurement is taken after a normal expiration.

Abdomen – with the subject's abdomen relaxed, a horizontal measurement is taken at the level of the umbilicus, the navel. The measure is taken after a normal expiration.

Hips – with the subject standing straight, a horizontal measure is taken at the maximum circumference.

3. Waist : hip ratio

The pattern of body fat distribution is recognised as an important predictor of the health risks of obesity (Van Itallie, 1988).

Fat stored in the abdominal region (as opposed to the legs, hips and arms) is considered to be a greater risk factor for CHD. This seems to be because abdominal fat is more easily mobilised and is transported directly to the coronary arteries.

Health risk increases with waist : hip ratio, and standards for risk vary with age and gender. For example:

Classification	Male	Female
High risk	> 1.0	> 0.85
Moderate risk	0.90 – 1.0	0.80 – 0.85
Low risk	< 0.90	< 0.80

Adapted from Van Itallie (1988)

In preference to the waist : hip ratio many now favour the simpler and more reliable method of waist circumference measurement. Waist circumference is independent of height.

Lowered risk
Men < 94 cm (< 37 inches)
Women < 80cm (< 32 inches)

Risks of morbidity (disease) greatly increase with the following levels (these denote the recognised action levels whereby intervention becomes necessary).

High risk
Men > 102 cm (> 40 inches)
Women > 88cm (> 35 inches)

N.I.H. (1998) Clinical guidelines on the identification, evaluation, and treatment of overweight and obese adults

Cardiovascular fitness testing

Oxygen is breathed in and transported to working muscles to be used for energy production. During exercise more work is performed, and more work means more energy is needed, thus increasing the demand for oxygen. Eventually a point is reached where the cardiorespiratory system cannot supply enough oxygen to meet the increased energy needs. A point of 'maximum oxygen uptake' has been reached and is universally expressed as VO_2max (ml·kg-1·min-1). Functionally, VO_2max reflects the ability of the lungs, heart, blood and vascular system to transport oxygen and the ability of the tissues to extract and use oxygen (Laukkanen et al., 2002). A person's VO_2max is a good indicator of how aerobically fit they are. In other words, an aerobically fit adult will be better able to take in, transport and utilise oxygen.

Compared to unfit individuals, aerobically trained adults also live longer and enjoy a better quality of life (Blair et al., 2001, Vita et al., 1998, Wang et al., 2002). It is important to assess aerobic fitness because most adults are considerably less fit than they believe (Allied Dunbar National Fitness Survey, 1992).

There are many tests that can be used to test cardiovascular fitness. The Rockport walking test (below) is easy to implement and is appropriate for beginners to the gym environment who have a low level of fitness.

Rockport walking test

In this test, the client should walk as fast as possible for 1 mile. After they have completed the mile, their pulse rate should be taken immediately. If the instructor does not have a heart rate monitor, this can be done manually by counting the number of beats for a period of 30 seconds and then multiplying that by 2 to get the client's heart rate. The time it took to complete the mile should be recorded. The instructor will also need to know the client's age and bodyweight (taken prior to the test) in order to calculate the client's estimated VO_2max.

The following calculation can be used to estimate the client's VO_2max (Kilne et al., 1987):

132.853 – (0.0769 x weight) – (0.3877 x age) + (6.315 x gender) – (3.2649 x time) – (0.1565 x heart rate)

Compared to unfit individuals, aerobically trained adults also live longer and enjoy a better quality of life

Where:

- weight is in pounds (lbs)
- gender: male = 1 and female = 0
- time is expressed in minutes and 100ths of minutes
- heart rate is in beats / minute
- age is in years

This score can then be measured against the norms in the table below. It is expected that, with appropriate training between each test, improvements should be noted.

Fitness categories for males, based on VO_2max expressed in ml·kg-1·min-1					
Age (years)	**Low**	**Fair**	**Average**	**Good**	**High**
20–29	≤24	25–33	34–42	43–52	≥53
30–39	≤22	23–30	31–38	39–48	≥49
40–49	≤19	20–26	27–35	36–44	≥45
50–59	≤17	18–24	25–33	34–42	≥43
60–69	≤15	16–22	23–30	31–40	≥41
AHA, American Heart Association (American Heart Association, 1972)					

Fitness categories for females, based on VO_2max expressed in ml·kg-1·min-1					
Age (years)	**Low**	**Fair**	**Average**	**Good**	**High**
20–29	≤23	24–30	31–37	38–48	≥49
30–39	≤19	20–27	28–33	34–44	≥45
40–49	≤16	17–23	24–30	31–41	≥42
50–59	≤14	15–20	21–27	28–37	≥38
60–69	≤12	13–17	18–23	24–34	≥35
* AHA, American Heart Association (American Heart Association, 1972)					

Measuring resting heart rate

Resting heart rate (RHR) is the amount of times the heart beats every minute at rest

Resting heart rate (RHR) is the amount of times the heart beats every minute at rest. Resting heart rate averages about 60-80 (Heyward, 2002) and is measured in beats per minute (bpm). Men average about 70 bpm, whilst women average about 75 bpm (Cotton, 1997). Generally, lower readings indicate higher levels of aerobic fitness. However, hereditary factors also play a very significant part, so do not rely on RHR as a reliable indicator of fitness.

In middle-aged, sedentary individuals, the resting heart rate can exceed 100 bpm, whilst in contrast, highly trained endurance athletes can have resting rates between 28-40 bpm (Wilmore and Costill, 1999). The table below lists the different RHR categories:

Resting heart rate (bpm) references		
	Men	**Women**
Normal	60 - 80	60 - 80
Average	70	75
Special attention	90	90
Medical referral	100	100

Adapted from Heyward (2002) and Cotton (1997)

Bradycardia: a RHR of less than 60 bpm is called bradycardia. Causes include:

- high levels of fitness
- hypothermia (low body temperature)
- hypothyroidism (low thyroid function)
- hyperkalaemia (level of potassium in the bloodstream is higher than normal)
- myocardial infarction (damage or death of heart tissue)
- genetics
- certain drugs (beta blockers)

Tachycardia: a RHR of greater than 100 bpm is called tachycardia. Causes include:

- exposure to alcohol, caffeine, or nicotine
- stress, anxiety or arousal
- heart failure
- pulmonary embolism
- hypovolaemia (abnormal decrease in blood volume/blood plasma)
- hypermetabolic states (such as fever or a raised body temperature)
- certain drugs (adrenaline, ephedrine, atropine)
- poor cardiovascular fitness levels

Resting heart rate – method of assessment

1. Ensure that that your client has rested for 5 to 10 minutes in a seated or supine position, prior to measuring heart rate

2. Locate the correct site of the carotid or radial artery. These are the most commonly used sites, although RHR can be taken at any arterial site (such as the temporal, femoral, brachial, and dorsalis pedis)

3. Use the tips of the middle and index fingers. Do not use your thumb; it has a pulse of its own and may produce an inaccurate count

4. When palpating the carotid site, do not apply heavy pressure to the area. Baroreceptors in the carotid arteries detect this pressure and cause a reflex slowing of the heart rate

5. Allow 30-60 seconds for your client to get used to your measurement. Many clients will feel slightly apprehensive at the beginning of this check, which may affect results if taken immediately

6. If you start a stopwatch simultaneously with the pulse beat, count the first beat as zero. If the stopwatch is already running, count the first beat as one

7. Count pulse for 60 seconds, record the result and repeat

8. If your results are significantly different, repeat for a third reading

9. Ensure all pre-test procedures are followed, and ascertain whether there is any identifiable cause of tachycardia or bradycardia

10. The ideal time to take RHR is first thing in the morning, before getting out of bed. Clients can be instructed to take their own RHR and to monitor any changes

(Adapted from Franklin 2000)

Anatomical sites of peripheral pulse (adapted from Latin, 1998)

Carotid: the common carotid artery sites are located on both sides of the front of the neck. Each are in the groove formed by the larynx (Adam's apple) and the sternocleidomastoid muscles (muscles on the side of the neck) just below the mandible (lower jawbone).

Taking the carotid pulse

Radial: the radial artery runs deeply on the anterolateral (thumb side) aspect of the forearm and becomes superficial near the distal head of the radius (directly in line with the base of the thumb).

Taking the radial pulse

Muscular endurance fitness testing

There are a variety of tests to measure muscular endurance. With individuals relatively new to resistance training there are a number of safety factors, which would indicate the preference of muscular endurance tests to strength tests.

The importance of safety

For beginners without a background in exercise, it may not be advisable to test a client to exhaustion at any number of reps. There are several important reasons why:

- an all-out test is hard work, painful and can put some clients off further resistance training
- an all-out test may result in delayed onset muscle soreness (DOMS). This may also put some clients off further training
- if the client focuses on going to maximum, good form will almost certainly be lost. In the early days of resistance training, good technique is much more important than maximum exertion
- a beginner is at particular risk of injury if exercising to maximum. This particularly applies to ligaments and tendons, which take longer to gain strength than muscles. This comes through training. Using heavy free weights before this co-ordination is developed, is potentially dangerous

Press up test:

- client assumes the normal press up position, with the body rigid and straight, and arms shoulder width apart
- the client must lower himself or herself to 90 degrees of elbow flexion
- the test is the total number of completed press ups to exhaustion
- an alternative press up version where the client raises from a position where the knees are in contact with the ground is available for those who cannot complete the above version

Press up norms										
Age										
Percentile	20-29		30-39		40-49		50-59		60-69	
Sex	M	F	M	F	M	F	M	F	M	F
90	41	32	32	31	25	28	24	23	24	25
80	34	26	27	24	21	22	17	17	16	15
70	30	22	24	21	19	18	14	13	11	12
60	27	20	21	17	16	14	11	10	10	10
50	24	16	19	14	13	12	10	9	9	6
40	21	14	16	12	12	10	9	5	7	4
30	18	11	14	10	10	7	7	3	6	2
20	16	9	11	7	8	4	5	1	4	-
10	11	5	8	4	5	2	4	-	2	-

90 = well above average, 70 = above average, 50 = average,

30 = below average, 10 = well below average.

(Canada Fitness Survey, 1986)

Abdominal curl test:

- ensure a matted area is available to cushion the lumbar spine
- client lies on their back, knees bent to 90 degrees with arms straight and palms down
- the test is scored on the number of times the client can raise the shoulder blades off the mat (trunk at 30° of spinal flexion), so that the fingers touch a line equal to three inches away from the resting position

Abdominal curl norms										
Age										
Percentile	20-29		30-39		40-49		50-59		60-69	
Sex	M	F	M	F	M	F	M	F	M	F
90	75	70	75	55	75	50	74	48	53	50
80	56	45	69	43	75	42	60	30	33	30
70	41	37	46	34	67	33	45	23	26	24
60	31	32	36	28	51	28	35	16	19	19
50	27	27	31	21	39	25	27	9	16	13
40	24	21	26	15	31	20	23	2	9	9
30	20	17	19	12	26	14	19	0	6	3
20	13	12	13	0	21	5	13	0	0	0
10	4	5	0	0	13	0	0	0	0	0

90 = well above average, 70 = above average, 50 = average, 30 = below average, 10 = well below average.

(Canada Fitness Survey, 1986)

Flexibility testing

Flexibility is judged by the movement available at a joint and can be described as the ability to lengthen a muscle without causing structural damage (Kibler, 2000). This will be affected by a number of factors including the individual's muscle mass, bone structure, adipose tissue and skin (Prentice 1999).

There are a number of tests used to measure flexibility. The instructor should use their observational skills to assess any significant flexibility issues where possible although they can be difficult to ascertain without measurement.

Sit and reach test: this test is relatively safe to perform unless the participant has experienced low back injury previously, particularly a prolapsed disc. If this is the case, they should be referred to their doctor or specialist for further evaluation. This test assesses the flexibility of the hamstrings and lower back.

The sit and reach box: method of assessment

1. Ideally, this test should be performed after the client has performed an aerobic test and is already warmed up. Otherwise, take the client through a warm up

2. Ask the client to remove shoes and any items of clothing that will restrict the movement

3. Position the client with his/her feet flat against the board. His/her legs and back should be straight

4. Ask the client to reach forward slowly and smoothly maintaining a straight back for as long as possible

5. Record the distance at the point the client starts to bend his/her back. This is a measure of hamstring flexibility

6. Ask the client to continue to reach forward as far as possible bending his/her back. Record the furthest point. This is a measure of hamstring and lower back flexibility

(Adapted from Franklin, 2000)

Stage 4: Programme design

Now that the consultation process has taken place and physical measurements have been taken, it is important to revisit the client's original objectives and agree SMART goals based on the needs and potential of the individual and their level of competence while adhering to good practice in the industry. Consideration ought to be given, when establishing goals, to the factors under 'stage 2: information gathering' as already discussed. Once the SMART goals have been agreed and the instructor is armed with the information collected, it is possible to plan a safe and effective training regime.

The instructor should consider the variables of sets, repetitions, rest, intensities and frequencies in order to design a training programme. When learning about programme design, it is important to start off with guidelines that can be used as a blueprint for programme construction.

Programme objective guidelines:

Training Goal	Strength	Hypertrophy	Endurance	Health	Cardio-vascular
Intensity	High	Moderate	Low	Low (aerobic)	60-90% MHR
Load as % of 1 RM	>85%	67-85%	<67%	N/A	N/A
Reps / duration	1-5	6-12	12+	30 mins +	20 mins +
Recovery between sets	3-5 mins	1-2 mins	30-60 seconds	N/A	N/A
Sets per exercise	2-6	3-6	2-3	1	1
Frequency per muscle group	1-2 x per week	1-2 x per week	2-3 x per week	5 + sessions weekly	3 + sessions weekly

Adapted from Baechle and Earle (2000)

When selecting a weekly workout frequency, the instructor again needs to consider the training age of the client. The table below (Baechle and Earle, 2000) provides a simple illustration of how the instructor can manipulate the variable of frequency as the client's training age / experience increases.

Training status	Frequency guidelines (sessions / week)
Beginner	2-3
Intermediate	3-4
Advanced	4-7

Total sessions per week for different training ages

It should be noted that these frequencies are based on resistance training sessions per week (not aerobic, flexibility sessions etc), and that these are guidelines only. Exceeding the maximum recommended frequency on a regular basis would be inadvisable, as the client's ability to recover from the load would be compromised.

Programme design for aerobic training

There is no definitive guide to designing aerobic training programmes, as there are very few 'hard and fast' rules. However, the information in this section will serve as a starting point; add to this a pinch of imagination, and fitness instructors will be able to prescribe aerobic fitness programmes to meet a variety of client's exercise objectives.

As discussed previously, aerobic fitness is defined as the ability to take in, transport and utilise oxygen. Central to any physical adaptation, is the understanding and application of training principles; in particular the principle of overload and specificity. These state that a minimum intensity of effort is necessary and the stimulus must be specific to the objectives if a fitness/performance adaptation is to occur. In other words, the oxygen system must be stressed in a manner that raises breathing and heart rate. It is noted, that any programme of physical activity will eventually plateau; therefore, consideration should be given to the long term plan if results are to be continued. If training consisted of doing the same activity over and over again, training would become very boring and the physiological adaptations would diminish. In essence, nothing in training happens by accident, but by design (Bompa, 1999).

aerobic fitness is defined as the ability to take in, transport and utilise oxygen

In general, aerobic training can be grouped into three main headings:

1. Long slow duration (LSD) training

LSD training is what is traditionally thought of as aerobic training. It involves working for extended periods of time (usually 10+ minutes) at fairly low intensities (50-70% MHR). The intensity of LSD training can vary throughout the session and ideally suits the deconditioned or those individuals starting and exercise programme (McArdle et al., 2001). Benefits of LSD training include all of the physiological adaptations discussed previously. For intermediate and advanced exercisers, LSD training has traditionally formed the majority of training for endurance-based sports such as the marathon. However, whilst LSD is still beneficial, performed exclusively it will eventually stagnate fitness improvements.

LSD training will also lack specificity in relation to many sporting activities. A football player has to perform at various levels of intensity and move in many different directions for 90 minutes. Therefore, it doesn't make sense to continually perform LSD training in a straight line as adaptations are specific to the type of stimulus applied.

2. Interval training

Interval training involves structured periods of work and recovery, and is an effective method to fully develop the aerobic energy system. Intervals can vary from a few seconds to several minutes (McArdle, 2001). Exercising at higher intensities (which is the case in most sports and activities) can only be maintained for a couple of

minutes, due to oxygen supply being outstripped by oxygen demand. Therefore, to maintain a higher intensity of exercise, the lactic acid energy system chips in to provide the remainder of the energy needed.

Interval training involves structured periods of work and recovery

One benefit of interval training, that is of importance to many athletes and sportsmen/women, is that it develops the individual's ability to tolerate high levels of lactic acid, and the rate at which it is removed from the muscles. Consideration should be given to the following guidelines when prescribing an interval programme:

- interval intensity
- interval duration
- interval recovery period
- number of intervals including recovery periods

Consider the following examples; an intermediate exerciser is prescribed the following aerobic interval training session: 3 min work interval followed by 3 min recovery performed 2-5 times. For an advanced exerciser it might look like this: 3 min work interval followed by 90 second rest interval and performed 4-6 times. These examples clearly demonstrate the difference in fitness levels needed to perform, especially the ability to recover after each work interval.

3. Fartlek training

Fartlek is a Swedish term meaning 'speed play' and involves the random interplay of different speeds. Fartlek training can be considered an unstructured form of interval training where the total amount of work is performed (around 30-40 minutes), but instead of working at one intensity (as in LSD training) the intensity is changed sporadically. This is an excellent way of performing interval training and can be a lot of fun, particularly if performed outside, for example, in a park.

Prescribing aerobic exercise

The following table shows current guidelines for aerobic training for both maintaining heath and improving aerobic fitness:

	Maintaining health	Improving fitness
Frequency	5 x per week	3 x per week
Intensity	Moderate	Vigorous
Time	>30 minutes	>20 minutes
Type	Rhythmical exercise using large muscle groups	

Adapted from American College of Sports Medicine (1998)

Aerobic training has been demonstrated to be beneficial when performed at an intensity of 60-90% of maximum heart rate (MHR). Moderate intensity exercise is defined as an intensity which causes a person to become slightly out of breath without undue fatigue. For the majority of unfit clients this would represent an activity such as a brisk walk or gentle cycle, and is associated with the lower end of 60-90% MHR; although, it is dependent on individual fitness levels. Perhaps a more useful way of monitoring intensity during aerobic exercise is to use rating of perceived exertion (RPE). Using the RPE scale, moderate intensity exercise is perceived as 'light' or an RPE of 11. It is interesting to note, that around 65% of men and 75%

of women do not do enough activity to meet the guidelines of 30 minutes of moderate intensity activity, 5 times per week! (ACSM, 1998).

Vigorous exercise causes individuals to become out of breath, and start to sweat. For these reasons, vigorous exercise would correlate to the top end of 60-90% MHR. However, it again, is dependent on individual fitness levels. As with moderate intensity exercise, the instructor can utilise the RPE scale to monitor vigorous intensity. Vigorous intensity is classed as 'somewhat hard' to 'hard' or RPE of 13 – 14. Vigorous activity causes greater improvements in fitness levels, although, it is not necessary to confer health benefits (ACSM, 2001).

Training beginners

Beginners should perform moderate intensity activities that do not cause undue fatigue, discomfort or muscle soreness. Beginners should initially train 3-4 times per week building towards the guidelines of 5 times per week. The duration of the sessions should aim towards 30 minutes of continuous exercise. Clients who are particularly unfit might not be able to continuously work for 30 minutes, in which case they should be encouraged to work for as long as they can, working towards 30 minutes using an interval type approach. It is important to note, that beginners will demonstrate improvements in fitness quite quickly and may plateau in as little as three weeks (Hickson et al., 1981). It is, therefore, important that the fitness professional increases the exercise stimulus accordingly.

An example of how cardiovascular training could appear on a programme is as follows:

Cardiovascular training			
CV machine	Time	Variables	Aerobic training zone
Treadmill	30 min	1% incline speed 7.5kph	Long slow duration

An excellent way of introducing a vigorous intensity is the application of interval training

Training intermediate and advanced exercisers

Once an exerciser can complete 30 minutes of moderate intensity activity 5 times per week it is time to progress their training by manipulating the training principles. The most obvious change would be to increase the intensity of exercise within each session. For example, if the person had been working for 30 minutes at 60% MHR, it would be sensible to increase the intensity to 70% MHR. In addition, the instructor could also increase exercise building towards an hour. It is crucial that the fitness professional does not attempt to progress the client too fast. This approach will only de-motivate the client and possibly lead to an overuse injury because of the increase in training volume.

As the client's fitness levels improve the instructor can continue to increase the intensity up to 'vigorous' in parallel with the manipulation of exercise duration. An excellent way of introducing a vigorous intensity is the application of interval training. The client should be encouraged to work at a moderate intensity with periods of high intensity. The long term goal is to work towards being able to complete a whole session at a vigorous intensity. Finally, it is beneficial to mix LSD, interval and fartlek training due to the variety of training stimuli this would present.

Student Task

Design two weekly schedules of aerobic training for a sedentary beginner and advanced client who wish to improve their health and aerobic fitness respectively. Include details of frequency, intensity, duration and type of training.

Sedentary beginner

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

Advanced client

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

Student Task

The beginner client from before has completed your weekly schedule for 4 weeks and has progressed well. You need to design a further 6 weeks of training for the same person that must take into account their improved fitness levels. Again, remember to give details of how you are going to change the frequency, intensity, duration and type of training that you are prescribing.

	M	T	W	T	F	S	S
1							
2							
3							
4							
5							
6							

Muscular endurance programme design

When constructing a resistance training programme, the exercises selected and the order in which these exercises are performed will profoundly influence the effectiveness of the subsequent workouts. In order to ensure effectiveness, the following typical programme design rules provide useful guidelines.

Key programme design rules include:

- promote muscular balance
- train large muscles first
- complex and high skill exercises first
- synergists and fixators last

Rule 1

Exercise selection - promote muscular balance

With respect to resistance training programme design, balance refers to working all of the major muscle groups equally (Heyward, 1998). This practice ensures that the body will progress as a unit rather than a collection of isolated muscles.

With respect to resistance training programme design, balance refers to working all of the major muscle groups equally

When selecting exercises to be included in resistance training programmes, the instructor should make a concerted effort to include exercises that promote postural enhancement, co-ordination, proprioception and core strength.

The number of exercises to be selected will depend on the objective of the workout and the training age of the client. The instructor must also consider the time available for the workout as ascertained during the consultation stage. A rough guideline for the number of resistance exercises to be selected per workout is 4-10.

Rule 2

Exercise order - train large muscles first

If multiple muscle groups are to be trained within the same workout the large muscle groups should be trained first. The consideration here is that large muscle groups require the most energy to train effectively, and by performing these exercises early in the workout while fresh the client can obtain the greatest training effect for the large muscles (Fleck and Kraemer, 1997). Effectively loading the large muscle groups (i.e. musculature of the hips, thighs, upper back and chest) will accelerate the progress of the client as a whole (e.g. fat burning potential, functional muscular fitness).

Rule 3

Exercise order - perform complex or high skill movements first

Complex and multi-joint exercises require more energy and greater neuromuscular co-ordination to perform safely and effectively (as compared to isolation exercises). As a result of this, compound exercises are best performed early in the workout when the client is free from both neural and metabolic fatigue. This is especially true for beginners who potentially have a limited capacity to perform exercise prior to fatigue, as well as poorly established or non-existent motor patterns (technique) for the exercises.

Rule 4

Exercise order - train synergists and fixators last

If synergists are trained prior to the agonists in a workout then the fatigue that they will accumulate renders them ineffective at performing their synergistic role when it comes to training the agonist.

Examples of poor exercise order would be:

Training the triceps brachii (e.g. cable pushdown, lying barbell extensions) prior to training any upper body pressing exercise (e.g. bench press, shoulder press).

Training the biceps brachii (e.g. barbell / dumbbell curls) prior to any upper body pulling or rowing exercise (e.g. lateral pulldowns, bent over rows, chins).

This type of inappropriate exercise order would result in an ineffective workout for the larger muscles of the torso (e.g. pectoralis major, latissimus dorsi, deltoids), limiting the potential of the client to make progress / gains in these areas.

As the name suggests fixators contract in a predominantly isometric manner to fixate or stabilise part of the body to give the agonist a solid platform to work from. The musculature of the core takes on a fixation role in the majority of free standing, free weight exercises; especially those that are compound or multi-joint in nature (e.g. squats, deadlifts, overhead presses, bent over rows). Training the core prior to the rest of the body in a resistance training session may be inappropriate as fixator fatigue would decrease the ability of the body to keep the spine in a safe alignment during exercise. Note this may sometimes be suitable for advanced exercisers or as part of a warm up to 'wake up' the stabilising muscles provided low intensity and volumes are used.

Student Task

The ability to produce an appropriate exercise order is one of the fundamental prerequisites of successful programme design.

Re-order the following list of exercises in accordance with the basic programme design rules.

1. barbell bicep curl
2. wide grip bent over row
3. barbell squat
4. dumbbell shoulder press
5. lateral pulldown
6. lying barbell tricep extension
7. plank
8. stiff-leg deadlift
9. barbell bench press
10. dorsal raise

Exercise	Muscles involved	Joint action(s)	Compound / isolation?
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Resistance training for beginners

Novice clients require a logical and structured introduction into the world of resistance training. This will allow them to 'walk before they can run', and develop a solid foundation that can be built upon as they progress. The de-conditioned beginner will often present with the following general issues:

- poor technique
- poor proprioception
- lack of muscular strength and endurance
- poor aerobic conditioning
- low tissue tolerance
- weak connective tissue
- poor posture
- poor core strength

The instructor should appreciate these issues and programme accordingly so the client can make improvements and safely progress towards their objectives.

Technique and proprioception

Good technique can be viewed as the ability of an individual to consistently perform the desired movement / exercise pattern without external feedback (e.g. verbal, visual or physical correction from the instructor).

Proprioception is a component of fitness that informs an individual where all the components of their musculoskeletal system are, and what they are doing relative to one another in space and time (Siff, 2003). Proprioception is often referred to as motor skills.

Proprioception is a component of fitness that informs an individual where all the components of their musculoskeletal system are, and what they are doing relative to one another in space and time (Siff, 2003)

Put simply, proprioception can be viewed as a sense of positional awareness that is achieved without external feedback. For example, a client with good proprioception is able to know they have adopted a neutral spine position during a bent over row without having to check in a mirror. In this instance, the proprioceptive elements of the neuromuscular system will provide continuous feedback, informing the central nervous system (and therefore the client) of the position of the spine and other joints during the performance of the exercise.

Individuals that are new to resistance training tend to present with limited proprioception and poor exercise technique. This is commonly due to a sedentary lifestyle and a lack of previous exposure to the exercise stimulus. The novice programme should take into account these issues while simultaneously trying to address them. A lack of proprioception and 'well grooved' movement patterns can generate issues for the safety of the exercising client, as well as adversely affecting the overall effectiveness of the workout. A general rule of resistance training is that good technique should always be established prior to the progression of intensity. Improper technique often occurs when the client attempts an exercise with a load that exceeds their current strength capabilities (Fleck and Kraemer, 1997).

It is advisable that the beginner initially concentrates on compound, multi-joint, free-standing exercises such as squats, deadlifts, bent over rows, overhead presses. This ensures that clients develop functional movement patterns that are transferable into everyday situations, as well as developing generally sound exercise technique. It is also advisable for the beginner to initially perform their resistance exercises within the muscular endurance repetition range i.e. 12+ repetitions per set. This allows the performance of higher repetitions while using relatively low resistance - a combination conducive to the safe learning of techniques.

Programme aims for beginners

A resistance-based programme designed for a de-conditioned novice client should meet certain criteria. On a basic level the instructor should ensure that the programme adheres to the programme design rules. The programme should also meet and achieve the following objectives:

- improve proprioception
- improve posture
- increase tissue tolerance for exercise
- improve core strength
- enhance function
- provide variety
- provide a sense of achievement

Improvements in proprioception, posture, core strength and general function can be developed by selecting appropriate resistance exercises, and persevering with them over a period of time. The emphasis should be on compound free-standing exercises performed with good technique. If the client is allowed to gradually progress using these exercises then their tissue tolerance for resistance-based exercise will also steadily increase. This will lay the foundations to allow higher levels of load to be applied to the client further into their training cycles.

For variety the beginner level training programme can also include a limited number of isolation exercises and fixed path resistance machines. As well as providing variety, the inclusion of these exercises allows the client to feel a sense of achievement at the end of a workout. The theory here being that because these exercises require little technical competence or co-ordination, the beginner can feel that they have performed them well and therefore, gained some benefit.

Student Task

Design the main session of a resistance training programme for a 31 year old female client. She is new to the gym and has no injuries or illnesses that will prevent her from performing any exercises that you select.

Your programme should include 8-10 resistance exercises, an appropriate set and rep scheme, a recovery period between sets and a weekly workout frequency. The main session should last for 35-40 minutes.

Your training programme should follow the basic programme design rules and should achieve the beginner programme objectives.

Assume your client has performed a thorough warm up prior to your main session.

Exercises training phase 1	Sets x reps	Recovery	Muscles used
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Frequency	This session should be performed		x per week

Criteria	✓ or ×
Programme is balanced	
Shows an effective order of exercises	
Improves proprioception	
Improves posture	
Improves core strength	
Enhances function	
Provides variety	
Provides a sense of achievement	
Fits within the client's available time	

Programme variables

Unfortunately, many individuals do not make the long term fitness gains that they desire. Often this is because they have a tendency to stick to workouts that lack variation.

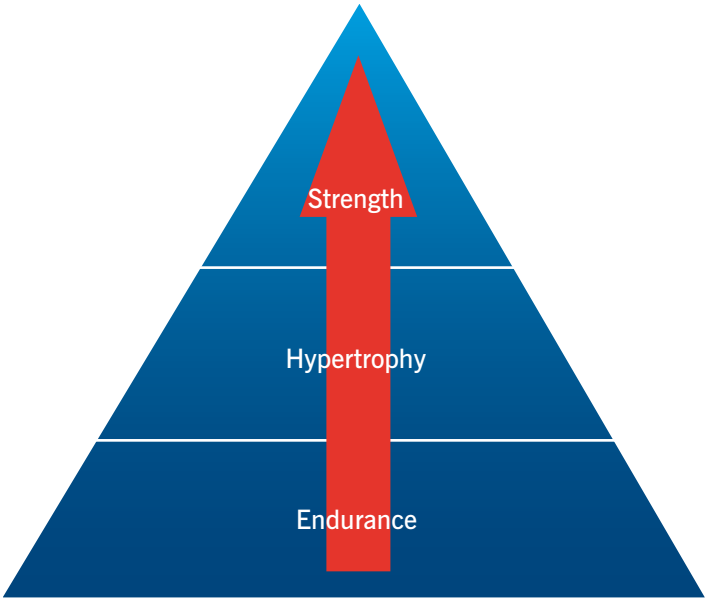
When the time comes to change a resistance training programme, the instructor has a wide variety of variables that can be manipulated. These include:

- number of exercises
- number of sets
- target repetition range
- recovery periods between sets
- workout frequency
- movement speed – slow to fast
- different exercises
- stable to unstable
- simple to complex
- split routines

Basic resistance progression

In order to physically progress a client over a prolonged period of time it is important that the instructor develops a long term training plan.

When planning to take a client from novice level through to the more advanced and intensive forms of resistance training, the following basic progression pyramid should be adhered to.



As discussed previously, the objective of the client does not always suit their current level of physical preparedness. A thorough examination of the client's previous exercise experience, training routines and adherence patterns will provide an indication of their suitability to perform certain types of resistance training.

The basic pyramid approach to resistance training progression over time will only apply if the client's goals include training towards strength and or hypertrophy. Many clients will not want to focus on these aspects of muscular fitness, in which case the pyramid approach may not be applicable. If this is the case, then the fitness professional has various options.

Firstly, there is scope for intensity progression within each training objective. For example, if a client wants to focus predominantly on muscular endurance, the guideline of 12+ repetitions per set can be subdivided into smaller repetition ranges. Successive training phases might progress from 18-20, 15-18, 12-15 reps per set. This would provide small increments in intensity while still remaining within the muscular endurance repetition range. A second option would be to keep the repetition range the same, but amend other programme variables (see previous list). Increasing the movement complexity from phase to phase while working with the endurance repetition range is one of many possible options.

Student Task

Assume you have inherited a client from another gym. They have been performing predominantly fixed path resistance machines, and they are using the muscular endurance repetition range.

During the consultation they inform you that they do not want to significantly progress the intensity of their sessions, as they are happy to focus on muscular endurance as an objective. As a result of this you decide to progress the movement complexity as the client moves through the training phases.

Devise a sequence of exercise progressions from the following fixed path machines that will increase the movement complexity as you progress.

Seated chest press	Seated machine row	Leg press

A further option might be to suggest that the client increases the exercise intensity (i.e. moves up the pyramid from endurance to hypertrophy), without significantly increasing the volume of exercise performed. As genuine hypertrophy training requires a significant increase in training volume, increasing the intensity without additional volume will provide variety of stimulus without resulting in significant muscle growth.

Student Task

Progress your initial workout by designing a new programme for your novice client. She has performed your previous workout for 8 weeks and has made good progress. Her personal technique is strong and she has expressed an interest in including more free weight exercises.

Your new programme should provide your client with a new challenge while still achieving the beginners programme objectives.

The workout should be significantly different so that your client feels she is getting value for money and it should be a logical progression in terms of intensity, volume and technical difficulty. The main session should last 40-45 minutes.

Exercises training phase 2	Sets x reps	Recovery	Muscles used
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Frequency	This session should be performed		x per week

Criteria	✓ or ×
Programme is balanced	
Shows an effective order of exercises	
Improves proprioception	
Improves posture	
Improves core strength	
Enhances function	
Provides variety	
Provides a sense of achievement	
Fits within the client's available time	

Programme design for hypertrophy

As with any training objective, hypertrophy requires a long term strategy in order to ensure progression over time. The first priority is for the instructor to ensure that the client has achieved a suitable level of physical preparedness prior to embarking on a hypertrophy programme. This can be achieved by thoroughly assessing the training age of the client, then selecting a suitable starting level and working up the basic progression pyramid pictured previously.

Strength endurance

The initial step up in volume and intensity from an endurance based programme may prove excessive for those new to hypertrophy training. This is where the fitness professional can apply logic and the basic principles of progression to the programmes they design for their clients. Rather than jumping straight into full-on hypertrophy training after an endurance phase, the instructor can schedule a training phase that eases the client in to the rigours of hypertrophy training. This half-way-house between endurance and hypertrophy can be referred to as strength endurance. The guidelines for strength endurance are listed in the table below.

Characteristic	Guideline
Intensity	Moderate
Load as % of 1RM	67-85%
Rep range	6-12
Rest between sets	1-2mins
Sets per exercise	2-4
Frequency per muscle	1-2 x per week
Exercises per muscle	2-3

Guidelines for strength endurance

Note that the overall volume per muscle should only be moderate, therefore, there should be an inversely proportional relationship between exercises selected and sets per exercise. For example, if three exercises are selected for an individual muscle group, it would be advisable to perform no more than 1-2 sets per exercise when training for strength endurance.

Changing the stimulus

Since the body has a tremendous ability to adapt to an exercise stimulus the instructor needs to plan ahead to ensure that the programme changes progressively on a relatively regular basis. Approximately every 4-8 weeks the instructor should look to modify the programme variables in such a way as to generate a new exercise stimulus for the client. If planned correctly, this practice should help ensure physical progress as well as minimising the risk of retention problems through boredom. Care should be taken to ensure that the progressions in volume and intensity from one programme to the next are both progressive and manageable e.g. conducting a strength endurance phase in between endurance and full-on hypertrophy phases.

Approximately every 4-8 weeks the instructor should look to modify the programme variables in such a way as to generate a new exercise stimulus for the client

Hypertrophy guidelines

As the client moves from muscular endurance to hypertrophy the training programmes change significantly. The general guideline for muscular endurance programmes is to perform whole body routines built around compound exercises. When training for endurance it is not uncommon to repeat the same workout two to three times per week. When training for hypertrophy the number of sets performed per muscle group is far greater than for muscular endurance. Baechle et al (2000), suggest that multiple exercises (i.e. 3 or more per muscle group) is the most effective strategy for increasing hypertrophy. The training intensity (expressed as % of 1RM) is also significantly higher for hypertrophy than it is for muscular endurance. It can therefore, be stated that a key feature of hypertrophy training is high volume combined with moderate to high exercise intensities.

Characteristic	Endurance	Hypertrophy
Intensity	Low	Moderate
Load as % of 1RM	<67%	67-85%
Suggested rep range	12+	6-12
Rest between sets	30-60 seconds	1-2 mins
Sets per exercise	2-3	3-6
Frequency per muscle	2-3 x per week	1-2 x per week
Workout type	Whole body	Split routine

Comparison between endurance and hypertrophy guidelines

Split routines

Inevitably, when progressing from the initial use of whole body routines towards hypertrophy there will come a time when the trainer cannot fit the volume of work required into the time available. The vast majority of clients do not have the time, or the physical resilience to train for hours on end, and so a different approach to resistance training needs to be employed.

The split routine is a system employed by bodybuilders, strength athletes and recreational trainers the world over. Split routines involve moving away from the whole body approach by splitting the body up in to two or more groups of muscles. These groups of muscles can then be trained on separate days in a cyclical fashion.

The following are examples of popular hypertrophy training splits:

Option A – the 2-way split						
Mon	**Tue**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Lower body		Upper body		Lower body		

Option B – the 2-way split (increased frequency)						
Mon	**Tue**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Lower body	Upper body		Lower body	Upper body		

Option C(a) – the 3-way split						
Mon	**Tue**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Back and biceps		Legs and deltoids		Chest and triceps		

Option C(b) – the 3-way split						
Mon	**Tue**	**Wed**	**Thurs**	**Fri**	**Sat**	**Sun**
Chest and biceps		Legs and deltoids		Back and triceps		

Programme design for flexibility

Dynamic stretching

The principles of flexibility as part of a warm up and cool down have already been discussed. As a brief recap dynamic stretches tend to mimic movements that are likely to be performed in the following exercise session. Typically 3-5 whole body dynamic stretches are sufficient as part of a warm up. 10-15 repetitions of each stretch under control should be performed, gradually increasing the range of movement.

Static maintenance

Static maintenance stretching is adopted to maintain the normal length of the muscles and are, typically, performed at the end of an exercise session. Static maintenance stretches take the muscle to the end of its normal range and hold it there without bouncing. These are short stretches, held for 10-15 seconds (Moffat, 1988), and are used to maintain the normal length of the muscle. Following repeated contractions during exercise, the muscle becomes shorter and thicker and a maintenance stretch is used to return the muscle to its normal length. At the end of a session, the number of stretches should be sufficient to have covered the major muscles of the body worked during the main session.

Protocol:

- take the stretch to the point of bind, maintaining good alignment and posture
- hold for 10-15 seconds until the tension within the muscle has reduced
- repeat the stretch if desired

Static developmental

These stretches are used in flexibility training to develop the length of the fibres themselves, thereby increasing range of movement at a joint. The following guidelines should be observed:

- take the stretch to the point of bind, maintaining good alignment and posture
- hold for 10-15 seconds, until the tension within the muscle has reduced
- relax and passively increase the ROM of the stretch until tension is felt again
- again hold for 10-15 seconds, until the tension within the muscle has reduced
- again increase the ROM of the stretch until tension is felt again
- hold until the tension reduces, then slowly return the limb to its normal position
- repeat the stretch if desired

Group training

Introduction

Group training is an increasingly common sight on the gym floor. Small group classes provide an excellent medium in which to develop rapport with clients and can ultimately increase opportunities to gain personal training clients. These type of sessions involve small groups being led by a gym instructor and can be a useful adjunct to a client's programme. Examples include 10-15 minute abdominal classes or 'mini' circuits.

The benefits of group sessions

Benefits to the instructor:

- relatively easy to plan
- less physical to teach than some other forms of group exercise
- can be an additional revenue stream to either gym instruction or personal training
- exercise participants are the perfect target audience to market other health related products and services to

Benefits to the clients:

- a social atmosphere in which to train
- motivational encouragement helps exercise adherence
- variety of exercises that provides a sense of achievement
- exercise options that cater to all levels of ability thus providing greater accessibility

The disadvantages of group sessions

- difficult to effectively monitor the entire group's exercise intensity
- lack of one on one instruction
- observation can be difficult with larger groups
- can be difficult to achieve all clients session objectives
- possibility of competition between participants resulting in poor technique or intimidation of individuals

Components of a group session

Every type of session must consist of an appropriate warm up, main conditioning phase and a cool down.

1. Preparatory stage

Thoroughly preparing a group session is the first step in ensuring success. Preparation is more than just the selection of moves. Preparation also includes:

- knowing the class time
- knowing the class type
- finding out the type of participants who will attend
- ensuring the room or area is safe and free of any obstacles
- checking all equipment is in good working order
- planning not only the exercises but also any equipment needed
- having modification, alternative and progression moves prepared in case participants are having difficulty
- a risk assessment

New participants must be given a PAR-Q to screen all new group members. Once all participants are assembled thank everyone for coming and conduct a small tour of the exercises. This gives the instructor the opportunity to demonstrate exercises, supply teaching points and offer alternative exercises if necessary.

2. The warm up

When all of the participants are assembled and in position address the group with a quick review of what is expected during the session and how each participant might feel at different stages throughout the session.

The group address can be done in a motivational and inspiring manner, thus having a beneficial psychological impact upon participants in terms of increased enthusiasm and group 'energy'. At this point, it is also suitable to conduct a verbal screening such as, "As I've explained all of the exercises we are doing today and the demands these exercises will place on your body; has anyone picked up an injury since last session, that may inhibit your participation in some way? No, ok then lets' go!" Verbal screenings reinforce the PAR-Q's that have already been completed, by taking into account any changes that may occur to the participant on a day to day basis. If someone answers 'yes' to this question however, start the rest of the class off with a simple dynamic stretch that everyone can repeat whilst the likelihood of the individual's inclusion is assessed, or appropriate exercise alternatives to suit their individual needs recommended.

Ideas for warm ups:

- dynamic stretches
- multi-directional lunges
- multi-directional lunges with reaches
- jogging on the spot
- jogging around the exercise perimeter (clearly marking out a route and avoiding any trip hazards)
- jogging combinations e.g. wide strides, cross-over strides, short strides, long strides, heavy feet, light feet
- jogging with shoulder to overhead height alternate punches e.g. straight up in the air, punches out to the side and rotational upper cut
- jogging with waist to shoulder height alternate arm movements e.g. hammer curls, lateral raises and upper cuts
- jogging combinations of strides and arm movements e.g. wide strides with lat raises, cross-over strides with upper cuts and short strides with overhead punches

3. The main conditioning component

The main conditioning component of a small group session may focus on a specific aspect of fitness and have set aims and goals. Where small gym based session are concerned duration would usually last no longer than 15-30 minutes.

Ideas for resistance and equipment:

- resistance bands
- bodyblades
- manual resistance
- fast feet ladders
- skipping ropes
- bosu's
- dumbbells
- bodyweight
- cones
- 6 and 12 inch hurdles
- steps
- stability balls

4. The cool down

The cool down should consist of 3 to 5 minutes of continuous rhythmic movements of light to moderate intensity, similar to some of those used in the warm up. This will aid the return of blood to the heart and return the body to a steady state.

Ideas for cool downs:

- multi-directional lunges
- multi-directional lunges with reaches
- slow lunge walking
- bodyweight squats
- bodyweight squats with anterior arm reaches, overhead posterior arm reaches, overhead sideways reaches (both sides), arms together rotational reaches at shoulder height (both sides)
- slow walking
- static stretches of all the muscle groups that have been overloaded during the conditioning phase

Safety considerations for group training sessions

Safety must be maximised at all time, not only to comply with instructor insurance guidelines, but primarily to make sure all participants feel comfortable and secure about their workout environment.

Types of participant and exercise stations

Group training provides the fitness instructor with a wide range of flexible opportunities to create sessions which can incorporate both the unfit and inexperienced participants with those who are more experienced and able to work at higher intensities. It is important that alternatives and adaptations are offered to meet the individual needs of all participants. With all things being equal however, the instructor is also able to tailor the session towards a particular client group which can have a concentrated marketing effect that highlights the specific in-groups' needs of a target population. Instructors may wish to run different types of circuits for example, a 'weight-loss special' or an 'over 50's' or maybe even a 'post-pregnancy tummy reviver' or a 15 minute abdominal session.

Resistance and recovery for group training

As the resistance increases, the number of repetitions will decrease shortening the set duration. This usually varies between 20-60 seconds, depending on the training outcome required. This variable is entirely under the instructors' control and can be varied or remain constant throughout the conditioning phase of the class.

For a typical circuit approach, the recovery period is the length of rest time between sets of exercises. This will depend on the intensity at which the participants are required to work. The higher the intensity during the work sets, the longer the recovery period will have to be to accommodate the next intense exercise set. Where recovery periods are of a short duration, the overall intensity of the class will be higher. With long recovery periods, the overall intensity of the workout will be less. The instructor can manipulate the length of the recovery periods to assist in achieving the specific aims of the workout.

The following are suggested recovery periods:

- 0 – 10 seconds for general conditioning and cardiovascular conditioning
- 60 – 120 seconds for strength and power
- 20 – 60 seconds for the older or de-conditioned participant

Work / rest ratio for group training

The work/rest ratio can also be used to assist in achieving the aims of the workout and can be easily adapted if the requirements or the participants of the group change.

The following considerations must be addressed:

- the duration of the class
- total number of stations in the circuit
- ability level of the class
- equipment available
- emphasis of the circuit

Work time	Rest time	Ratio	Class emphasis
60 secs	No recovery	1:0	Aerobic endurance (advanced)
60 secs	10-30 secs	2:1	Aerobic endurance (beginners)
60 secs	60-120 secs	1:1/1:2	Muscular strength
45 secs	15 secs	3:1	Aerobic and muscular endurance (intermediate)
30 secs	30 secs	1:1	Aerobic and muscular endurance (beginners)

Exercise sequence

When designing group sessions for beginners or a mixed group the general rule is to alternate exercises so as not to overload one particular area of the body or muscle group; for example, lunges to abdominal curls rather than lunges to step ups. This helps to prevent unnecessary muscle fatigue. Consideration must also be given to the sequence of exercises from the last exercise station to the first.

Alternatively, if the group is advanced the aim of the session maybe to overload a particular area of the body and select certain muscle groups. In this case, prime movers may well be utilised.

Types of group training sessions

Group training provides the instructor with a wide range of flexible approaches to enable them to vary the type and structure of each session appropriate to the environment, participants and overall aim of the session.

Timed circuit

A timed circuit is the most commonly used method of small group sessions. The circuit is laid out and an equal number of clients are positioned at each station. The clients will start and finish each exercise station on a given signal from the instructor. As we are referring to small group sessions here, consideration will be needed for the available space in the gym.

The time selected will generally be between 15 and 45 seconds. This is referred to as the 'work time'. The time between stations is referred to as the 'rest time'. So with less fit clients select a shorter work time and a longer rest time.

As clients progress, the times can be altered to longer work time and shorter rest time to bring about overload. The timing can be controlled by the instructor using a stopwatch, or by a timing station in the circuit.

Work times are often different for each time around the circuit during the class i.e:

First circuit	30 second stations
Second circuit	45 second stations
Third circuit	35 second stations

The aim here is to achieve a 'curve effect' with intensity.

Mat based session

Using a matted area of a gym can be a useful way to teach group floor-based sessions. These could include a number of abdominal exercises or stretches that can be executed easily and with minimal disruption to other members due to the relatively small space being occupied.

Cardiovascular session

Another effective method of group training would be through the use of cardiovascular equipment. An example here could include a group induction with 3 members using bikes followed by an introduction to interval training for the remainder of the session.

The options are endless and with a bit of imagination, gym instructors can help create a niche for themselves, raising their profile and increasing their chance of gaining personal training clients should they wish to pursue this route.

Exercise leadership in a group training session

Leadership styles in business have many parallels with exercise leadership and can be split into two different areas. Those which focus upon leadership characteristics and those which focus upon the relationships between the leader and the group. Autocratic and democratic leadership styles are dualities that emphasise the operational behaviours of the leader towards the group.

The autocratic leader will display leader-centred characteristics that will require closely supervised, leader defined, actions or decisions that necessitate others to follow (Russell, 2001). Democratic leadership is group-centred decision making that reflects the needs of the group (Bass, 1990). In fact, different types of groups react more favorably to different leadership characteristics. Beginner groups for example, with little experience of exercise do take comfort from being directed at every conceivable moment. Whereas training experienced fitness professionals, once a template containing the outcomes of a session are presented, this type of group are often enthused by the freedom to co-create their exercise session.

The skill for the instructor is to adapt their leadership style to suit the group participants to help ensure continued involvement in group sessions and better results.

Teaching position

It is essential that the instructor maintains observation of the entire group at all times throughout the session to ensure that errors in exercise technique are identified and corrected. When planning the layout for the class, consideration must be given as to where the instructor will be best positioned in order to effectively observe the group. A common error novice instructors commit when first teaching group sessions is to get stuck in the middle of the group and to train individual participants at one station at a time. This makes it very difficult for the instructor to recognise poor technique promptly. In general, the instructor needs to move around the group carefully observing the entire group whilst motivating and interacting with the participants.

Monitoring exercise intensity

The intensity of the session can be monitored using a variety of tools such as:

- heart rate monitors
- manual pulse checks
- rate of perceived exertion (RPE)
- talk test
- observation

Within most group classes, the instructor has to rely on their teaching and observation skills in order to manage exercise intensity. Questioning the group to discover the individual perceived exertion levels will provide a variety of scores dependent on the exercise that is being performed, the fitness level of the client and the effort level that is being applied. The instructor therefore, must utilise their observation skills to identify losses in form and technique and physiological changes due to over exertion. At this point, reinforcing the exercise alternatives may encourage individuals to reduce the intensity of their exercises.

The talk test is another valuable tool to manage the group session. When questioning participants for feedback, if there is no response from the group, it may suggest that the intensity of the class is too high. The level of breathing rate can also be detected and utilised to manage workout intensities. If the participants are gasping for breath between responses this may also indicate too high exercise intensity. Similarly, if the groups are able to comfortably respond, this may indicate a too low workout level.

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Unit Six
Instructing Gym-Based Exercise

Instructing Gym-Based Exercise

Aim: This unit covers the skills and knowledge a fitness instructor needs to instruct and supervise gym-based exercise to apparently healthy adults.*

Learning outcomes

By the end of this unit the learner will be able to:

- provide gym-based exercise
- prepare self and equipment for gym-based exercise
- prepare clients for gym-based exercise
- instruct and supervise clients undertaking gym-based exercise
- bring a gym-based exercise session to an end
- reflect on providing gym-based exercise
- support clients taking part in gym-based exercise

Introduction

Instructional skills form the cornerstone of a gym instructor's professional practice. Even the most knowledgeable of fitness professionals will struggle to provide the best service to gym members if they lack the ability to instruct clients in gym-based exercise effectively.

* This may include young people in the 14-16 age range, provided they are part of a larger adult group and also covers working with individual older adults, pre and post-natal clients and disabled clients provided the relevant contraindications and key safety guidelines are observed.

Session preparation

After a client has been through their initial consultation and appraisal the instructor should spend some time in preparation for the first fitness session. Preparation time should be spent ensuring that the fitness professional is ready to instruct a gym-based session and that the client is also ready to partake in the physical activity session.

Preparing oneself and equipment for gym-based exercise

It is important that the instructor has prepared both programme plans and the exercise environment prior to the beginning of an exercise session with a client. Preparing the exercise environment includes making sure exercise equipment is safe and available for use with suitable alternatives in mind in case another gym user is utilising the equipment at the time it is needed. When these elements are in place the instructor will be able to focus more on the client and adapting to their needs during the exercise session rather than having to write on the programme card, prepare and seek out equipment and other components of administrating a session.

The exercises and thus the equipment used will already have been planned during the programme design stages and will need to be appropriate to the client needs and capabilities. The client's objectives, health, current fitness and lifestyle will all dictate what the exercise programme will be like. Areas of greater need agreed between the instructor and client should be reflected in the time, volume and intensity given to the activities that help address these specific areas. The gym equipment and resources available to the instructor may also largely determine the scope of exercise and training possible.

The instructor should also ensure that all equipment, based on the exercises selected in the client's programme, should be checked thoroughly prior to their use to help promote a safe gym-based environment and prevent any accidents during the session itself.

Part of the time spent preparing to deliver an exercise session should be devoted to appearance. Ensuring that the organisation's dress code is adhered to is important as is making sure that clothes are clean and presentable. This will help promote a positive image of the instructor and the organisation.

Preparing the client for gym-based exercise

Once the fitness professional is ready and the client has arrived, the following steps are usually followed before taking the client through the main component of the session.

1. Welcoming the client

On arrival the client should be welcomed and made to feel at ease. It is also necessary for the instructor to inform the client of the facility's emergency procedures including the location of fires exits, the nearest first aid box, who, in the facility, is trained to deliver first aid and where the nearest phone can be located.

2. Explain the purpose and value of the exercises

Following this, the fitness professional should proceed to explain the purpose and value of the exercises to the client. The physical and technical demands should be described. Educating the client in this manner will help their understanding and they will be more likely to adhere to the programme as they recognise the purpose of each component of the session. This explanation should include the warm up and cool down. The instructor should then seek confirmation from the client that they are happy to undertake the programme that has been constructed.

Occasionally during the introduction to a new fitness programme it may become apparent that the client is uneasy about certain exercises that have been planned. Naturally these concerns should be discussed to see how a solution can be negotiated. Sometimes it may turn out that the client's worries were misplaced and they are happy to carry on with the programme planned once a full understanding has been reached. Alternatively, it may be necessary to adapt or change planned exercises before the instructor can begin the exercise session. These kind of last minute alterations to a planned programme are less likely if the original appraisal and consultation was thorough. However, if they do become necessary exercise alterations should be in line with the client's goals and preferences.

3. Build an early rapport

In the early dialogue with the client the instructor should build rapport and gauge their state of readiness and preparation for the session, both mentally and physically. The client may express enthusiasm and excitement at the prospect of the gym session or may indicate that work or family life has thrown up barriers and distractions. These points must be taken into account when considering the physical demands that the planned session will put the client through and adjustments made if necessary.

4. The warm up

Prior to beginning the main session routine it is imperative that a client fully understands the importance of taking adequate time to warm up. A proper warm up will bring about many physiological benefits that will not only reduce the chance of injury during a session, but more importantly will lead to better performance in the early part of the main session workout. This will help maximise the performance from the client and lead over time to improved results. If the client understands the necessity of these components, they are more likely to include them in the future.

As the instructor offers explanation as to the purpose and values of the different components of the session, they should reinforce how the session they are about to undertake meets the client's objectives. Safe and effective activities for warming up have already been covered, but to recap briefly a warm up will usually consist of a pulse raiser followed by some dynamic stretches (combined with static stretches if necessary). The CV machines and dynamic stretches found in the appendix can be used to deliver the warm up in a safe and effective manner. If a client is unable to perform some of the more complex dynamic flexibility exercises (i.e. some clients may find it difficult to perform a lunge with a rotation) then more straight forward dynamic exercises should be used (e.g. a squat to overhead swing). If all dynamic flexibility exercises prove too difficult for the client to perform correctly, static stretches may be more appropriate.

Instructional skills

Instruction means 'giving information on how to perform something' and is vital to good gym instruction. Good instructional skills allow instructors to maximise the safety and effectiveness of a workout. This success is achieved through the instructor's ability to communicate and interact successfully. Communicating effectively will depend on developing a series of verbal and visual skills. These include a large vocabulary of verbal instructions, imagery, tone of voice, hand signals, facial expressions, and of course demonstrating great exercise technique. Through practise, instructors can develop the necessary skills needed for awesome instruction.

Verbal	Visual
Instructions	Demonstration
Motivation/praise	Observation
Teaching points	Body language
Voice intonation	Teaching position
Correction	Facial expression
Cueing	Eye contact

Key instructional skills

Verbal instruction

Terminology

Using words is one of the most 'powerful tools' an instructor can possess. Generally, the instructor should describe exercises using simple terminology e.g. 'chest lifted' instead of 'maintain neutral spine'. It is useful for the instructor to spend time building a repertoire of non-technical words for exercises used. This will keep the instructions precise, user-friendly and easy to understand.

Motivation

Drives virtually everything we do, and is essential if clients are to successfully reach their goals. If fitness professionals are to be able to motivate their clients, they need to be highly motivated themselves. This means motivation must come from within, and can be achieved through the instructor portraying confidence, exuding plenty of enthusiasm and being passionate about what they do. Being able to motivate is particularly important when dealing with new clients or when exercising clients out of their comfort zone.

Motivational terminology should be appropriate to enforce exercise technique, or when attempting to complete a set or workout. Phrases such as 'well done', 'good job', 'two more and you can do it' can all be used to help clients succeed. Motivational language must be kept 'positive' and instructors should avoid the use of negative terminology, as negative criticism can be devastating to a client's confidence.

It is very satisfying to be told that a goal was reached, or a rewarding performance was delivered. Whilst worthy praise should never be withheld, it is also important not to offer praise flippantly for every completed set or exercise. The instructor needs to build a relationship with the client of performance expectation followed by reward and praise when it is clearly earned. Praise offered when below par performance has been delivered will only serve to devalue commendations when real effort and high performance have been given. When praise is withheld until such times as it is diligently earned it will have value and meaning to the client and serve as a reward and motivation for future performance.

Teaching points

These are used to reinforce a visual demonstration. Their application allows instructors to express, correct and fine-tune clients' exercise technique. To use teaching points effectively the fitness professional must first be fully versed in exercise technique. In general, teaching points can be logically broken down into two categories: those that set an exercise up and those that allow for proper execution. For example, during the 'set up' phase for the squat exercise, teaching points such as 'stand with feet hip distance apart,' 'chest lifted' and 'look forward' will allow a strong foundation to be established. Whereas, during the 'execution' phase, teaching points such as 'heels down,' 'drive the ground away' and 'look forward' will reinforce what is required for successful movement.

Teaching points should be concise and to the point. However, it pays to get creative. For example, 'headlights up' referring to the hip area may help clients visualise and focus on the relevant body part by relating it to an object or possibly an activity, often leading to greater exercise understanding.

Teaching points when used appropriately allow for easier instruction, however, avoid their overuse as too many teaching points can confuse, due to there being too many variables for the client to concentrate on. It is much better to use teaching points sparingly. As with motivation, teaching points should be kept positive at all times to build confidence.

Voice intonation

The way an instructor says something is more important than what they say. Voice intonation is the way information is put across and is essential for successful gym instructing. For example, training for hypertrophy, strength or power is physically demanding, and using words such as 'explode' or 'let's drive' would be appropriate, but only if spoken with passion, commitment and at the appropriate volume. Likewise, the level of intonation may need to be moderated if working with a complete beginner, elderly or another component within an exercise session e.g. flexibility. This will ensure that the instructor communicates in a way that is appropriate to the individual and their surrounding environment.

Methods to develop voice intonation:

- practise varying the tone
- practise varying the speed
- practise varying the volume
- develop a wide variety of instructions

Visual instruction

Demonstration

All instructors must be fully competent in exercise technique. All demonstrations should be given correctly. A good clear demonstration allows the client the opportunity to fully observe the exercise to be performed. For effectiveness, position clients so they are able to see all the major joints in motion. For example, during the bent over row exercise the best viewing position would be to the side of the demonstrator. All the major joints, and more importantly, the low back, can be viewed successfully. In general, perform between 5-8 repetitions in a slow, controlled manner (unless power training) before listing the main teaching points. The client should be allowed to ask questions before they have a go.

Observation

The instructor will also need to consider their position of observation in relation to the client's physical execution by adopting a similar strategy to the above. Other considerations include a change in client body position. For example, if a client is performing an exercise on the floor such as a crunch, it makes sense to kneel down to maintain interaction and client care. Standing up could be portrayed as being dominating and also lessens the ability to monitor technique.

Body language

Is the art of non-verbal, visual communication and gives clues to a person's current emotional and mental state. For example, crossing the arms creates a barrier to effective communication, and is associated with boredom and lack of interest. Whereas, open arms and hand gestures create an environment of openness, integration and a feeling of energy. Eye contact and facial expression are also useful communication tools and can be used to praise and motivate.

An instructor's body language can alter the client's mood and emotional state, thus influencing the outcome of a training session. No matter how an instructor may be feeling, they should stand and move in the way they want their clients to act.

Instructing new exercise

A large percentage of a gym instructor's time, when instructing, will be spent inducting gym members to ensure that they know how to use gym equipment and perform exercises that are new to them.

Introducing new exercises to individual clients

The instructor should develop a clear process by which they teach new exercises to a client. The following acronym can be used to help provide a logical sequence of instruction:

Name the exercise – its purpose and the major muscles/areas of the body used.

Adjustments – demonstrate how to make any adjustments to the equipment being used (e.g. seat height, weight, speed).

Silent demonstration – this will allow the client to concentrate on the technique of the exercise without any distractions (5-8 repetitions should be sufficient).

Teaching points – the instructor should run through the main teaching points and may wish to provide a further demonstration of the exercise while discussing the main technique points.

Your turn – at this stage the client should attempt the exercise while being monitored closely by the instructor.

For beginners to the gym environment, it is important to develop their coordination by building exercises/movements up gradually. Attempting to complete the full exercise initially, may prove too taxing for the client, which will at best lead to poor technique and at worst put them at risk of injury. Breaking the exercise down into manageable 'chunks' before building it back up again can be a useful strategy to employ.

Example 1 – beginners often find it difficult to coordinate the movements needed when rowing. One way to approach this may be to instruct the client how to produce the correct movement/rhythm of the legs firstly, by omitting the movements of the arms. Once the client is happy with this movement, the instructor may ask the client to perform the arm movements, without the use of the legs before integrating the upper and lower limbs together. The coordination issues in this example should be overcome fairly quickly within the session.

Example 2 – when teaching a client to lunge for the first time it may not be appropriate to expect them to complete the full exercise with good technique. This can be overcome by initially asking the client to take a long step forward. Once they have found their balance a simple split squat (commonly referred to as a static lunge) may be performed where the client lowers their body into the end position of the lunge and back up again, performing several repetitions prior to returning to the start position. Once the client has developed their balance, strength and coordination during the split squat, they may then be ready to precede this movement with a step forward and finish the repetition by stepping back out of the lunge to the start position. It may take several days for a client to coordinate a movement such as the lunge.

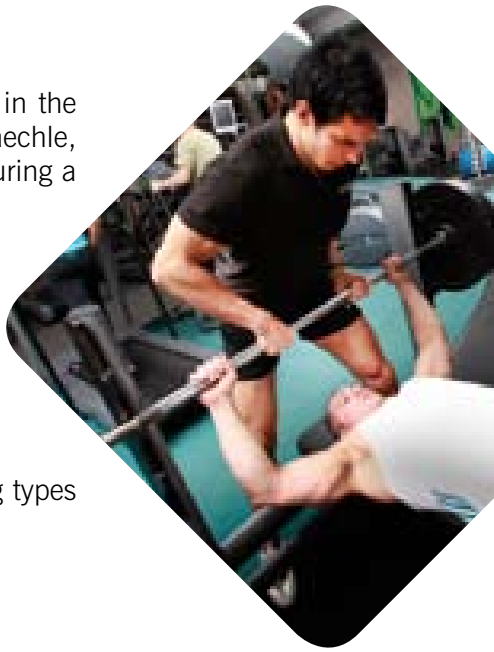
Managing group inductions

Logistically, managing group inductions can be quite challenging for the gym instructor. Consideration needs to be given to not only the group being inducted, but the surrounding environment as well. The purpose and structure of the induction should be made clear to the group from the outset and the instructor should inform the group to be mindful of their surroundings to ensure that their safety takes priority. Emphasis should be placed on the importance of being aware of exercisers around them and the equipment they are using. They should also be encouraged to stay close to the group, pay attention to the instructor and to refrain from performing exercises or using machines when they have not be inducted on them or been given permission by the instructor.

The N.A.S.T.Y acronym also works well within a group environment. It is sometimes helpful for the instructor to use an individual from the group to reinforce teaching points and technique. For example, after following the first four stages of N.A.S.T.Y the instructor may choose a volunteer from the group to have a go at the exercise while the instructor reinforces key teaching points and technique prior to letting other members from the group attempt the exercise. It is imperative that the instructor is happy that every member of the group knows how to use the equipment and exercises demonstrated.

Due to time constraints and depending on the size of the group it may not be possible for every member of the group to practice every exercise or machine demonstrated, but the instructor should try to make sure that all clients have participated at some stage during the induction. It is imperative that the instructor manages the group effectively and maintains their attention by manoeuvring them into appropriate viewing positions so that all members of the group are able to view demonstrations and listen to the various teaching points.

Spotting



Spotting refers to the use of a person, such as a personal trainer, to assist in the execution of an exercise to help protect the athlete from injury (Earle and Baechle, 2000). Correct spotting is paramount to ensure the safety of an individual during a resistance training programme.

The three main functions of a spotter are:

- to assist the client if in difficulty
- to apply high intensity training techniques
- to ensure correct technique

Earle and Baechle (2000) recommend one or more spotters for the following types of free-weight exercises:

- overhead exercises (e.g. shoulder press)
- exercises with the bar on the back (e.g. back squat, step up, lunge)
- exercises with the bar racked on the anterior deltoid or clavicles (e.g. front squat)
- exercises with the bar over the face (e.g. bench press, flyes, lying triceps extension)

They also recommend that spotters ARE NOT used during power exercises such as the clean, the snatch and the jerk. This is because spotting this type of exercise is too dangerous for both lifter and spotter.

Fleck and Kraemer (1997) describe a number of factors to consider when spotting:

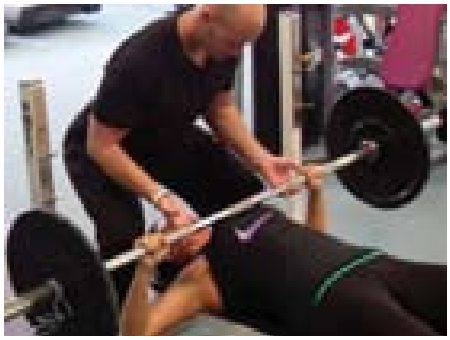
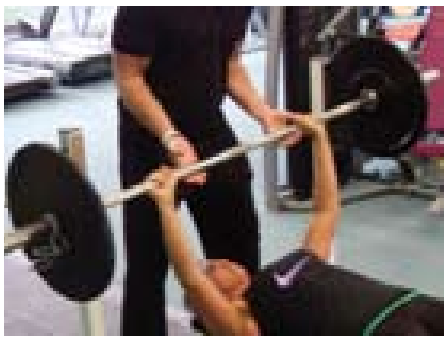
- the spotter should be strong enough to assist the client if required
- during the performance of certain exercises (such as heavy back squats), more than one spotter may be required to ensure the safety of the client
- spotters should know the correct exercise technique and amending technique for the exercise they are spotting
- spotters should know how many repetitions the client is attempting to lift
- spotters should be attentive at all times to the client and the performance of their technique
- spotters should summon help if an accident or injury occurs

Earle and Baechle (2000) additionally recommend the following when spotting:

- when spotting over-the-face barbell exercises, the spotter should hold the bar with an alternated grip, usually inside the client's grip
- when spotting over-the-face dumbbell exercises, spot as close to the dumbbells as possible or in a few cases (dumbbell pullover and lying overhead dumbbell triceps extension) the dumbbell itself. Note that many individuals prefer to be spotted under the elbows during supine dumbbell exercises
- when spotting overhead/bar on back/bar on front exercises, the spotter should be at least as tall and strong as the lifter and be performing the exercise in a power rack with the correct pin placement
- out-of-rack exercises such as the lunge and step up are only recommended for skilled athletes and experienced spotters since these can result in serious injury

Other recommendations when spotting would be to:

- establish a solid base of support
- maintain a neutral spine, especially when lifting
- ensure good communication between spotter and client. This should be done prior to the exercise being executed
- when passing dumbbells they should be passed one at a time by the ends to allow the client to safely grip the handle (as demonstrated below)


Student Task

Firstly, using the exercises below develop a list of non-technical dialogue or imagery to encourage better exercise execution.

Secondly, decide on the most appropriate instructor position to observe each exercise.

Exercise	Non-technical dialogue	Instructor position
Squat		
Lateral raise		
Abdominal crunch		
Leg curl		

Monitoring the safety and intensity of exercise

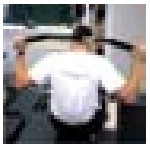
Monitoring safety

Monitoring the safety of exercise is a critical part of a gym instructor's role. All good practice in relation to postural alignment should be followed and maintained. If a client is unable to maintain good technique/posture, the instructor should stop the exercise and offer a suitable alternative or regression for the exercise.

Student Task

Study the exercises on the following pages. Your task is to identify the following:

1. what the aim of the exercise is
2. what the potential dangers are
3. the type of client the exercise would be most appropriate for
4. the type of client the exercise would be inappropriate for
5. two or more alternative exercises or ways of modifying the current exercise in order to lower the risks and make it safer, whilst still working the same muscles

Exercise	Aim	Potential dangers	Alternative/adaptation
Dumbbell flye 			
Stiff leg deadlift 			
Lat pulldown 			
Tuck jump 			
Squat 			
Press up 			

Monitoring progress

Within each individual exercise session the instructor needs to be able to determine progress made and whether or not a client is ready to move forward, stay where they are or be regressed. There a several methods of monitoring exercise performance in a gym environment that can provide valuable data to make judgements on the need or readiness for progress.

- rating of perceived exertion (RPE)
- heart rate
- observation
- performance markers

When RPE scores and peak heart rate are recorded during exercise the instructor can determine whether the desired intensities are being achieved and adjust any of the exercise variables necessary to raise or lower these scores to the desired levels. Observation of client form and technique in conjunction with the strain or effort on the face, sweating and redness can provide reliable indicators of current performance especially when the instructor who has become familiar with how an individual client looks at different levels of intensity. The fitness professional can also use performance markers such as the total number of repetitions in conjunction with the RPE on the final repetition to guide their judgement on whether progress is required. Other performance markers that can be utilised alongside intensity indicators are distance covered, weight or load, number of sets and repetitions or the time taken to completion.

Monitoring individual progress can be a little trickier when there is more than one individual being trained in a paired training session or in a group exercise setting. However, it is still important in these situations to be able to identify client performance indicators, such as those described above, to be able to optimise the workout and progress and regress as needed. If this is not done on an individual basis then individuals may be pushed too hard or too little within the same exercise session while another client is experiencing the correct stimulus for optimal gains.

Session conclusion

Cool down

At the end of the exercise session it is important that the instructor makes time within the allotted session to cool the client down and carry out flexibility work where required. This will help to emphasise the importance of the wind down part of any programme. It has become all too common in the fitness world for instructors to focus so much on the main session that they run out of time to deliver the cool down and they place full responsibility on the client to complete the cool down on their own when their session has finished. It is much more likely that a client will begin to drop the cool down when the instructor doesn't value it as part of delivering a session with a client. The cool down is beneficial for both the instructor and the client for a variety of reasons:

- control the client's return to rest
- address client flexibility limitations
- enhance mental and physical relaxation
- gain feedback information about the session
- provide the client with feedback on their performance
- discuss other lifestyle factors
- reinforce teaching points and future goal achievement

A typical cool down should be adapted to match the demands of the session just completed. If the session emphasised legs, then little time need be spent on stretching out upper body muscles. Consideration also needs to be given on the intensity of the last few minutes of the main workout. If the session finished on some high intensity intervals, the cool down may start at a moderate to vigorous level and diminish from there as the body is slowed to stop. If the session ended with some relatively simple core exercises, it may be that the body has already begun to cool down and some basic, controlled mobility and stretching may suffice.

The cool down exercises may also be determined based on a client's current health requirements. A pregnant client will only require minimal static stretching applied to muscle groups likely to shorten and tighten during the pre-natal state such as hip flexors, lumbar erectors and pectorals. An elderly client with arthritic knees may need to avoid static stretching of the quadriceps due to discomfort, but will likely benefit from controlled mobilisation of the joint at the end of a session. The emphasis is upon personalising the cool down in line with client needs. The gym and the equipment used should always be left in a suitable condition for clients, members or other instructors to use.

Closing the session

The cool down is an ideal time to give feedback to the client based on their performance during the session. This should be kept positive, yet honest. It is relatively easy to provide honest and valuable feedback to a client when they have done well and the comments are going to be positive and praiseworthy of client performance. The more difficult skill is to offer constructive and non-offensive criticism when client performance has been below par and has not reached the required intensity, skill or stimulus. Tonality of voice, perspective and the words chosen can all affect how the feedback will be received. The following two examples are used to contrast a poorly worded feedback statement about a set of lunges and a positive and building feedback statement:

> *"You didn't manage to get the last 3 repetitions intended for the last set of the lunge exercise. You lost neutral spine and your knee was buckling inwards towards the last few repetitions. Grit your teeth and let's make the set count next time."*

> *"Great to see your effort during that set. Let's see if you can reach those last three repetitions in the next one. If you focus on keeping your chest lifted and your knee tracking in line with your toes you will perform better."*

Both statements provide feedback that is honest and accurate, but the first is more likely to reduce motivation and commitment to achieve. The second statement draws the focus away from the already completed poor performance and highlights the needs and expectations in the following set and the instructor's confidence in their ability to reach the objective.

Praising and highlighting areas where the client clearly showed willing, effort and good performance during the session is strongly recommended to help motivate the client and promote adherence to their programme.

The client should then be offered the opportunity to:

- reflect on the session overall – whether they enjoyed the session and how hard they felt it was, where they felt their strong points and weaknesses were
- ask questions – at this stage the client may still be unsure why they are performing certain components of the programme or may ask the instructor about their perception of how well the client performed
- provide feedback – they may express that they found some of the session too difficult and that they would be unlikely to perform it alone or they may offer feedback as to the type of motivation used by the instructor
- identify further needs – taking part in the exercise session may lead the client to open up in regard to other objectives or they may ask for further assistance from the instructor at a later date to help them remember the programme they have just completed

Ultimately, the instructor should make sure that the client understands how to continue with their programme of gym-based exercise without direct supervision. If the client still remains unsure then an appropriate follow up appointment should be arranged by the fitness professional.

Finally the instructor should ensure that the environment is left in a condition acceptable for future use. They should educate the client in terms health, safety and cleanliness to ensure that:

- machines, benches and mats are wiped clean after use
- freeweights are tidied away and placed in their correct place
- any mats, handles and other accessories are clean, tidied away and placed in their correct place
- any damage has been reported to the appropriate individual

Review and reflect

Following a gym-based session, at a suitable time after the client has left, the instructor should reflect on the session. The instructor can review both their own performance and that of the client within the session and feedback received from the client regarding how they found the workout. A reflective gym instructor will be able to look objectively at a session to identify successes and areas for development in future sessions with clients. Reflection upon a session may include:

- how well the exercises met client needs
- how effective and motivational the relationship with the client was
- how well the instructing style matched the clients' needs

The instructor that honestly evaluates their instruction will more effectively iron out inconsistencies in their teaching style and improve their ability to make future sessions more effective, in turn improving their personal practice. This makes reflective practice important as an instructor may not recognise their full potential unless they take the time to reflect on their practice accordingly.

Exercise archive

The list of exercises presented in this archive is by no means an exhaustive one, but details some of the most common exercises performed in the gym environment and indicates the primary muscles worked, key teaching points, alternative options and some progressions and regressions.

Note that in order to successfully complete this qualification, there must be evidence that the learner has instructed participants to use a minimum of three of the following types of cardiovascular equipment:

- upright cycle
- recumbent cycle
- treadmill
- stepper
- rowing machine
- elliptical trainer
- cross trainer

Learners must also show they have planned and instructed for a minimum of four exercises from each of the following:

- resistance machine lifts
- free weight lifts
- body weight exercises

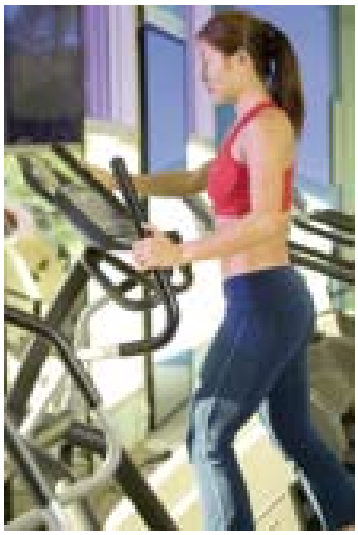
Joint / movement	Resistance machine	Free weight	Body weight
Shoulder flexion	Seated chest press (neutral grip)	Front raise (DB)	
Shoulder extension	Seated row (low pulley) Seated row (neutral grip)	Single arm row Bent arm pullover (DB)	
Shoulder abduction	Shoulder press	Shoulder press (DB) Lateral raise (DB) Upright row (BB)	
Shoulder adduction	Lat pull down (in front of chest) Assisted pull up		Chins
Shoulder horizontal flexion	Bench press Seated chest press (BB grip) Pec dec	Bench press Flyes (DB)	Press up
Shoulder horizontal extension	Seated row (BB grip)	Prone flye (DB)	
Elbow extension	Tricep pushdown (high pulley) Tricep press	Supine tricep press (BB) Single arm tricep press (DB)	Press up
Elbow flexion	Bicep curl (low pulley) Seated bicep curl	Bicep curl (BB) (DB)	
Hip extension	Leg press Total hip	Lunge (BB, DB optional) Dead lift (BB) (DB)	Lunge
Hip adduction	Seated adductor Total hip		
Hip abduction	Seated abductor Total hip		
Knee extension	Seated knee extension Leg press	Lunge Dead lift (BB) (DB) Squat (DB) (BB)	Lunge Squat
Knee flexion	Lying thigh curl Seated thigh curl		
Trunk flexion	Ab machine		Abdominal curl
Spinal extension	Lower back machine	Dead lift (BB) (DB)	Back raise

Cardiovascular machines

Cardiovascular equipment: Exercise bike	
	**Teaching points:** • standing at the side of the exercise bike, seat height should be positioned level with the hips • sit tall, facing forward, abdominals supporting the back • pedal without rocking from one side to the other • keep hips, knees and ankles in line • maintain 70-90rpm (intermediate / advanced), 50-70 (beginner)
Primary muscles worked: lower body	**Alternative options:** The recumbent exercise bike can be used if preferred and it is often easier to use with participants with back problems

Cardiovascular equipment: Treadmill	
	**Teaching points:** • maintain a position in the centre of the belt • take a good stride • look forward, standing tall • strike the belt with a heel-to-toe action • swing the arms • keep the knees soft throughout
Primary muscles worked: whole body	**Alternative options:** The treadmill can be used with an incline if desired.

Cardiovascular equipment: Rowing machine	
	**Teaching points:** • abdominals tight, back straight • wrists in line with forearms • follow this sequence of movement - legs, arms, arms, legs • try not to lean too far back • keep the chain level with the • middle of the body • maintain 25-35spm (intermediate or advanced), 20-25spm (beginner)
Primary muscles worked: whole body	**Alternative options:** N/A

Cardiovascular equipment: Cross trainer	
	**Teaching points:** • stand tall, keep looking forward • feet flat on the plates • hips, knees and ankles in line • keep the knees and elbows soft • maintain 60-80 (intermediate or advanced), 50-60 (beginner)
Primary muscles worked: whole body	**Alternative options:** The cross trainer can be used with just the lower body action if desired

Dynamic flexibility

Squat to overhead arm swing

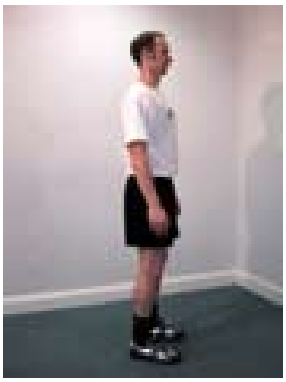
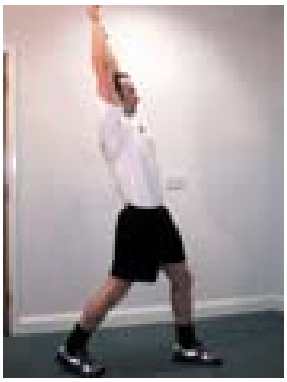
Primary muscles	• quadriceps • gluteus maximus • latissimus dorsi • soleus
Teaching points	• squat down by bending the ankles, knees, and hips • swing the arms down and back as descending into the squat position • keep chest lifted throughout • return to standing position with the arms stretched overhead • repeat

Squat to overhead arm swing with rotation

Primary muscles	• quadriceps • gluteus maximus • obliques • soleus • iliopsoas
Teaching points	• squat down by bending the ankles, knees, and hips • swing the arms down and back as descending into the squat position • keep chest lifted throughout • return to standing position with the arms stretched overhead while rotating the upper body to one side • alternate the side of rotation to with each rep

Lunge with rotation

Primary muscles	• quadriceps • gluteus maximus • obliques • iliopsoas
Teaching points	• stand in an upright position with the feet hip width apart • lunge forward while simultaneously rotating the torso towards the lunging side leg • push back strongly off the lead foot and return to the starting position • Note: during the lunge ensure that the lead foot remains on the floor

Posterior lunge with overhead reach		
 	**Primary muscles**	• latissimus dorsi • rectus abdominis • iliopsoas • gastrocnemius
	Teaching points	• stand in an upright position with the feet hip width apart • take a small step back while both arms reach overhead • ensure the lunging side heel makes contact with the floor • do not lean back excessively through the lower back • push back strongly off the posterior foot and return to the starting position

Standing dynamic pectoral stretch		
 	**Primary muscles**	• standing dynamic pectoral stretch • pectoralis major • rhomboids • mid trapezius
	Teaching points	• stand upright with the feet hip width apart • pull the arms back into a press up position • push the arms forward while allowing the thoracic spine to round slightly • repeat the above varying the angle of retraction

Guidelines for dynamic stretching:

- dynamic stretches should only be employed during the warm up phase of a workout
- stretches should be selected that target either the whole body, or in the case of split routines, the stretches should target the specific areas that will be stressed during the workout
- stretches should be selected that replicate the movement patterns that will be employed during the workout (rehearsal effect)
- no more than 8-10 repetitions of each stretch are required. A greater number may prematurely fatigue the client
- 2 – 3 different dynamic stretches are generally sufficient to prepare the body for gym-based exercise
- the movement speed should be controlled and the movements should appear fluid
- for clients with poor co-ordination, complex dynamic stretches can be broken down into their component parts

Free weights

Dead lifting weights

On all of the free weight exercises contained in this guide, it is assumed that weights have been safely lifted into the start position by using safe and effective lifting and passing techniques.

- start with feet as close to the weight as possible (if lifting a barbell, toes should be just under the bar)
- bend from the knees and hips, keeping the abdominals tight and back straight
- keep looking forward
- extend the knees and hips, keeping the weight as close to the body as possible
- this same technique should adopted when lifting dumbbells

Upper body

Free weights: Bench press (BB)

Teaching points:

- lie on the bench with upper body and head supported by the bench
- grip the bar firmly with hands outside shoulder width and keep the wrists straight
- barbell should be level with the chest
- extend the arms without locking out and return the bar to mid-chest level without resting on the chest

Primary muscles worked:
pectorals, deltoid, triceps brachii

Alternative options:
This exercise can be performed with dumbbells

Free weights: Flyes (DB)

Teaching points:

- grasp two dumbbells
- lie with upper body and head fully supported by the bench
- support dumbbells above the chest with the elbows and wrists slightly flexed
- lower the weights directly to the side to about bench level
- bring dumbbells back together above the chest

Primary muscles worked:
pectorals, biceps brachii

Alternative options:
This exercise can be performed on an inclined bench

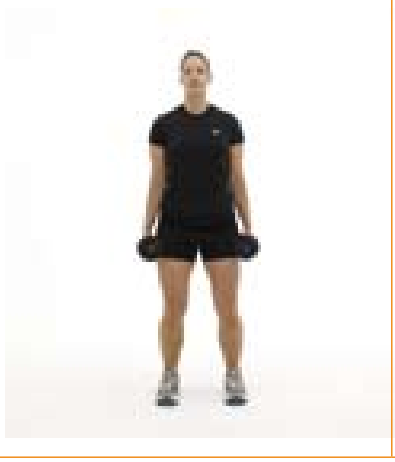
Free weights: Shoulder press (DB)

Teaching points:

- stand with feet a comfortable distance apart, knees soft and a neutral spine
- position dumbbells to each side of shoulders with elbows below wrists
- press dumbbells up until arms are extended overhead but not locked out
- lower and repeat

Primary muscles worked:
deltoids, triceps brachii

Alternative options:
This exercise can be performed using a barbell

Free weights: Lateral raise (DB)		
		**Teaching points:** • stand with feet shoulder width apart or slightly wider • place the dumbbells on the front or side of the thighs • maintain neutral spine and slightly flexed elbows • raise the dumbbells to shoulder height • the dumbbells should be rotated to keep them parallel to the floor • return to the start position
Primary muscles worked: deltoid		**Alternative options:** N/A

Free weights: Upright row (BB)		
		**Teaching points:** • standing with feet just outside hip width apart • lift the barbell with a close overhand grip (maintain two thumb widths apart) • keeping the barbell close to the body, lift up towards chest height • keep the elbows higher than the barbell • lower the barbell to the original position without locking out the elbows
Primary muscles worked: deltoids, biceps brachii, trapezius		**Alternative options:** This exercise can be performed using resistance bands or dumbbells

Free weights: Front raise (DB)		
		**Teaching points:** • feet apart and neutral spine • grasp dumbbells in both hands to the front of the thighs • raise the weights directly in front of the body to shoulder height, keeping the elbows slightly flexed
Primary muscles worked: anterior deltoid	**Alternative options:** This exercise can be performed with arms working alternately	

Free weights: Single arm row (DB)		
		**Teaching points:** • place the knee and the same side hand on top of a bench, with the hand under the shoulder and the knee beneath the hip • maintain a neutral spine and ensure that the hips and shoulders are level • place the other leg out to the side to stabilise • raise the dumbbell directly up towards the armpit keeping the elbow close to the body • lower back down under control ensuring elbows don't lock out • NB all movement comes from the arm – there should be no twisting of the body
Primary muscles worked: latissimus dorsi, posterior deltoid, trapezius, biceps brachii	**Alternative options:** This exercise can be performed free standing in a split stance	

Free weights: Bent arm pullover (DB)

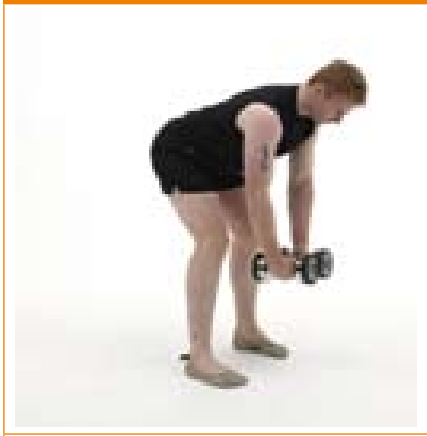
Teaching points:

- lie with the upper body and head fully supported by the bench
- grasp one dumbbell with both hands from behind and position over chest with elbows bent approximately 90° and into the side of the body
- with elbows bent, lower dumbbell over and just behind head until upper arm is approximately parallel to the torso
- return and repeat

Primary muscles worked:
latissimus dorsi

Alternative options:
This exercise can be performed using a barbell

Free weights: Prone flyes (DB)



Teaching points:

- stand with feet a comfortable distance apart and bend forward at the hips
- maintain a neutral spine whilst holding the forward position
- hold the dumbbells in a neutral grip below the body with elbows slightly bent
- raise the dumbbells directly out to the side until level with the shoulders

Primary muscles worked:
trapezius, rhomboids

Alternative options:
N/A

Free weights: Barbell biceps curl

Teaching points:

- standing with the feet hip width apart, holding a barbell with an under-hand, shoulder width grip at arms length
- with elbows tucked tightly into the sides of the body curl the barbell up towards the chest
- pause briefly, then slowly lower to the start position without locking out the elbows

Primary muscles worked:
biceps brachii

Alternative options:
This exercise can also be performed in a seated position with dumbbells

Lower body

Back squat

Start *Finish*

Teaching points:

- place bar across fleshy part of the upper back
- feet shoulder width apart
- brace abdominal and back muscles
- initiate squat by flexing from the knees and hip
- lower slowly to a comfortable position
- from the bottom position push the ground away keeping the chest lifted throughout to maintain a neutral spine
- breathe out through the sticking point
- keep knees in line with toes and heels down throughout exercise

Primary muscles worked:
quadriceps – knee extension,
hamstrings – hip extension,
gluteus maximus – hip extension

Alternative options:
Dumbbell squat

Forward lunge

Start *Finish*

Teaching points:

- stand erect with a pole/ bar placed across the upper trapezius
- place the feet greater than a normal stride apart with feet hip width distance apart and toes facing forward
- keep chest lifted and brace abdominals and back muscles
- lunge forward using alternate legs, flexing the knees until leading leg knee is roughly at a right angle, while the trailing leg knee should avoid contact with the floor
- at the bottom push the ground away keeping the chest lifted to maintain a neutral spine and return to starting position
- keep knees in line with toes and front heel down throughout exercise

Primary muscles worked:
quadriceps – knee extension,
hamstrings – hip extension,
gluteus maximus – hip extension

Alternative options:
Dumbbell lunge

Deadlift

Teaching points:

- with barbell resting on the floor, place feet under the bar so shins are lightly touching
- bend at hips and flex the knees, grasp bar with a pronated grip slightly wider than shoulders. Chest out, head up, and maintain a neutral spine
- lift bar from floor by raising the hips and shoulders
- as bar passes the knees drive the hips forward to stand up straight, keep the shoulders back throughout
- on return to the start position tilt forwards from the hip, thus driving the hips backwards. As the bar descends past the knees allow them to flex until reaching the starting position
- keep chest lifted and maintain a neutral spine throughout

Primary muscles worked:
quadriceps – knee extension

hamstrings – hip extension

gluteus maximus – hip extension

erector spinae – spine extension (isometric)

mid traps & rhomboids – shoulder girdle retraction (isometric)

Alternative options:
Use an alternate grip or perform using dumbbells

Resistance machines

Seated chest press (neutral grip)

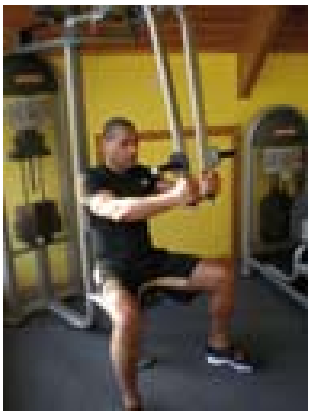
Teaching points:

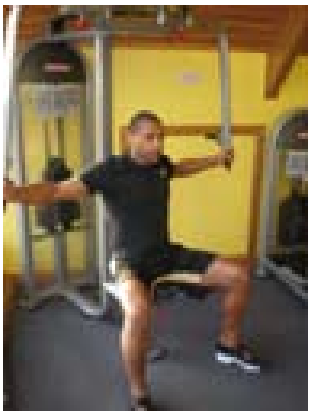
- set the seat height so that the handle is at armpit level
- maintain neutral spine
- grip handles firmly and keep the wrists straight
- push out to extend the arms without locking out the elbows
- slowly lower the weight, keeping the elbows level with hands
- return to start position

Primary muscles worked:
pectorals, deltoids and triceps brachii

Alternative options:
This exercise can be performed lying on a bench with a barbell (see free weights section)

Pec dec





Teaching points:

- sit in the machine with back on pad
- place forearms on padded lever with elbows in line with the chest
- squeeze elbows together then return to start position
- maintain a neutral spine throughout

Primary muscles worked:
pectorals and anterior deltoids

Alternative options:
This exercise can be performed lying supine on a bench using dumbbells (see freeweights section)

Seated row

Teaching points:

- adjust the seat height so that it allows the chest to rest against the support pad
- maintain a neutral spine
- keeping the elbows close to the body and the wrists straight
- pull the weight towards the abdomen
- pause briefly, then slowly return the weight to the start position

Primary muscles worked:
latissimus dorsi, deltoid and trapezius

Alternative options:
This exercise can be performed in a seated position using a low pulley cable system

Shoulder press

Teaching points:

- sit in the machine with a neutral spine and adjust the seat so that the handles are at shoulder height
- grasp the handles and push the weight upwards, keeping the wrists straight and in line with forearm
- pause briefly at the top, then slowly lower the weight, until the hands are at ear level
- the maintenance of a neutral spine is of particular importance throughout this exercise

Primary muscles worked:
deltoid, trapezius and triceps brachii

Alternative options:
This exercise can be performed with dumbbells

Lat pull down

Teaching points:

- adopt a natural over-hand grip (just wider than shoulder width)
- sit into the machine directly under the cable pulley and lock the thighs under the pad (if necessary)
- with the arms above the head, lean back slightly, so that the sternum is now directly under the pulley
- whilst maintaining a neutral spine, pull the bar down towards the sternum keeping the forearms completely vertical
- pause briefly then return to the start

Primary muscles worked:
latissimus dorsi, trapezius and biceps brachii

Alternative options:
This exercise can be performed with an under-hand narrow grip

Assisted chin ups

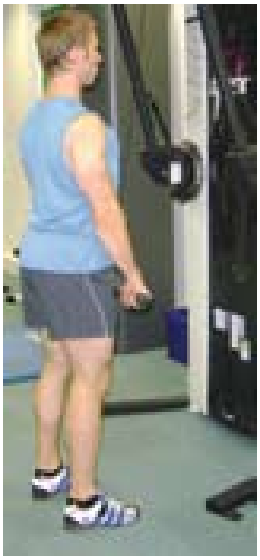
Teaching points:

- grasp a chinning bar with an overhand grip
- hands wider than shoulder width
- pull the body up so that the chin is level with the bar

Primary muscles worked:
latissimus dorsi and biceps brachii

Alternative options:
This exercise can be performed with an underhand grip

Triceps press / triceps pushdown - high pulley



Teaching points:

- stand facing a cable column with a hip width stance
- attach a short bar onto the cable and adopt an over-hand grip
- keeping a neutral spine
- with the elbows at the side, and arm parallel to the floor, straighten the arms so that the bar rest on the upper thigh
- moving the elbows, return the bar to the start position

Primary muscles worked:
triceps brachii and trapezius

Alternative options:
This exercise may be performed in a triceps press resistance machine in a seated position

Biceps curl - low pulley

Teaching points:

- grasp low pulley cable bar with a shoulder width under hand grip
- stand close to pulley
- with elbows to side, raise bar until forearms are vertical
- lower until the arms are fully extended but not locked out

Primary muscles worked:
biceps brachii

Alternative options:
This exercise may be performed in a bicep curl resistance machine in a seated position

Lower body

Leg press

Teaching points:

- sit on machine with back on padded support
- place feet on platform hip width apart, set seat so that knees are at a 90° angle
- grasp handles at the side
- push platform away by extending knees and hips without locking out
- return to start position

Primary muscles worked:
quadriceps, gluteals, hamstrings, gastrocnemius and soleus

Alternative options:
Dumbbell squat

Seated knee extension

Teaching points:

- set the back rest so that the back is supported and the knee is at the pivot point
- adjust the shin pad so that it is just above the shoe laces
- sit in the machine, with the back against the rest, lightly gripping the handles
- lift your toes towards the knees
- extend the knees under control to full extension keeping the toes to the ceiling
- pause briefly, then slowly lower to the start position

Primary muscles worked:
quadriceps

Alternative options:
This exercise can be performed one leg at a time

Hamstring curl

Teaching points:

- set the heel pad so that when the knee is at the pivot point the pad is on the Achilles tendon, just above the training shoe
- maintain neutral spine
- clasp the handles at the side and with the toes pointing upwards
- flex at the knee until reaching a 90 degree angle

Primary muscles worked:
hamstrings

Alternative options:
This exercise can be performed in a lying thigh curl machine

Seated abductor

Teaching points:

- sit in machine with heels on bars and pads on outsides of the knees
- maintain neutral spine
- pull in on lever to position legs together
- release lever into position and grasp bars to sides.
- move legs away from one another by abducting the hips
- return and repeat

Primary muscles worked:
abductors

Alternative options:
This exercise may be performed in a total hip machine

Seated adductor

Teaching points:

- sit in machine with heels on bars and pads on insides of the knees
- maintain neutral spine
- pull in on lever to position legs apart
- release lever into position and grasp bars to sides
- squeeze knees together by adducting the hips
- return and repeat

Primary muscles worked:
adductors

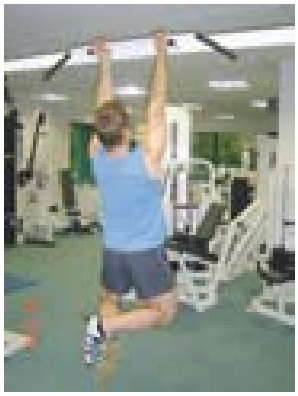
Alternative options:
This exercise can be performed on a total hip machine

Bodyweight

Chin up – *pronated grip, just wider than shoulder width* **Pull up** – *supinated shoulder width grip*	
Primary muscles	• latissimus dorsi and posterior deltoid – shoulder extension • mid trapezius and rhomboids – shoulder girdle retraction • lower trapezius – shoulder girdle depression • biceps brachii – elbow flexion
Teaching points	• grasp handles using a pronated grip • gently cross feet • brace abdominals and back muscles to maintain a neutral spine • breathe in and pull body towards bar (resist the use of momentum) • pause briefly (chin inline with bar), then slowly breathe out and lower to start position
Alternative options	• lat pull-down

Chin-up start

Chin-up finish



Pull-up start

Pull-up finish

Chin-up and Pull-up exercises

Press ups	
Primary muscles	• pectorals • triceps brachii • deltoids
Teaching points	• start in a prone position with arms extended and feet in contact with ankles, knees, hips, shoulders and head in good alignment • brace the abdominals and lower chest towards the floor by flexing at the elbow joints • pause briefly and reverse the movement by extending at the arms and returning to the start position
Alternative options	• can be performed on the knees which will reduce the intensity of the exercise

Start

Finish

Abdominal crunches	
Primary muscles	• rectus abdominis
Teaching points	• start in a supine position on the floor with fingers behind the ears, knees bent and feet flat on the floor • maintaining contact between the low back and floor, raise shoulders off the floor by flexing at the trunk • keep head in neutral alignment and pause briefly • lower back down to the start position
Alternative options	• a seated crunch machine can be used • the exercise can be performed with different arm positions – e.g. with hands on the knees

Start

Finish

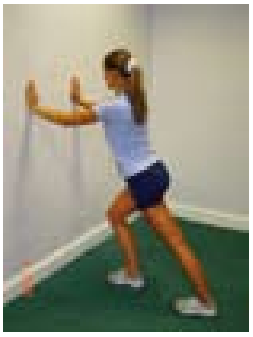
Back extensions	
Primary muscles	• erector spinae
Teaching points	• start in a prone position on the floor with feet in contact with the ground and fingers behind the ears • keeping feet in contact with the floor, raise the chest off of the floor keeping head in neutral alignment • return to start position
Alternative options	• a back extension machine can be used • hands can be placed by the side to reduce the intensity of the exercise

Start

Finish

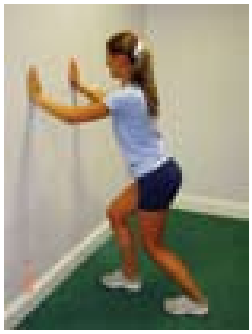
Static flexibility

Stretch: Standing gastrocnemius



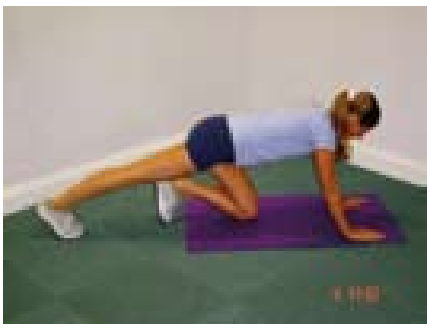
Teaching points:
- adopt a stride stance in front of a wall
- hands contact the wall at shoulder height
- keep head upright and look forward

Stretch: Standing soleus



Teaching points:
- adopt a stride stance in front of a wall with both knees bent
- hands contact the wall at shoulder height
- keep the head upright and looking forward

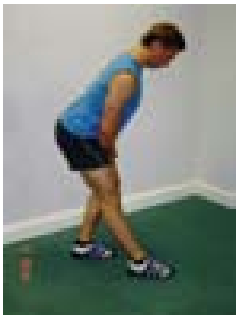
Stretch: Kneeling gastrocnemius

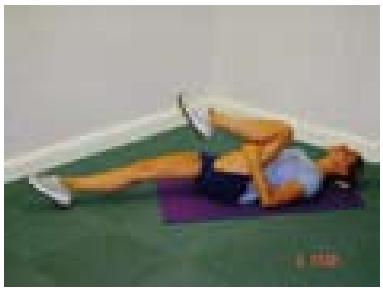


Teaching points:
- adopt a press up position
- rest on one knee on mat with the opposite leg straight
- maintain a neutral spine position

Stretch: Lying hamstring

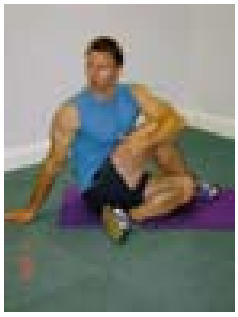
Teaching points:
- lay face up on the exercise mat
- flex the hip and keep the opposite leg slightly flexed (so that the foot is fixed to the floor)
- place the hands around the thigh and lever the leg into a stretch
- hold the stretch for an appropriate duration

Stretch: Standing hamstring	
	**Teaching points:** • adopt a stride stance with the back leg bent and stretching side leg straight • flex forward at the hips, whilst maintaining a neutral spine • push hips back and up for added intensity • hold the stretch for an appropriate duration

Stretch: Lying gluteal	
	**Teaching points:** • lay face up on an exercise mat • flex the knee, hip and place the hands around the thigh • use the arms to lever the hip into increased hip flexion • hold the stretch for an appropriate duration

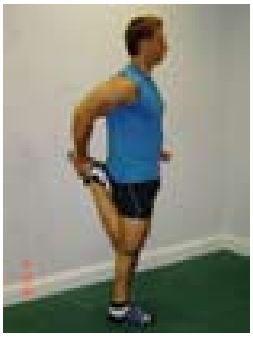
Stretch: Lying gluteal (alternative)	
	**Teaching points:** • lay face up on an exercise mat • flex both knees and hips then place the stretching side lateral ankles just past the knee • place the hands around the thigh of the other leg • hold the stretch for an appropriate duration

Stretch: Lying gluteal and abductor	
	**Teaching points:** • lay face up on an exercise mat, flex the hip and knee to ninety degrees, then internally rotate hips • place one hand on the involved leg, the opposite arm is flexed to ninety degrees at shoulder height • rotate head towards flexed arm • hold the stretch for an appropriate duration

Stretch: Seated gluteal	
	**Teaching points:** • adopt a seated position with legs crossed • lift the top thigh up towards the chest with the opposite side arm • stretching side hand is in contact with the floor for support • hold the stretch for an appropriate duration

Stretch: Kneeling adductors	
	**Teaching points:** • adopt a kneeling position on an exercise mat • trunk is positioned horizontal to the ground with both arms in contact with the floor • shoulder distance apart • involved leg is then abducted for the stretching position • hold the stretch for an appropriate duration

Stretch: Lying quadriceps	
	**Teaching points:** • lay face down on an exercise mat • flex the knee • same side hand holds onto the distal end of the lower limb • hold the stretch for an appropriate duration

Stretch: Standing quadriceps	
	**Teaching points:** • stand upright • flex the knee • same side holds the foot, bringing it closer to the buttock • point the involved knee down to the floor • keep body upright, and eyes fixed forward

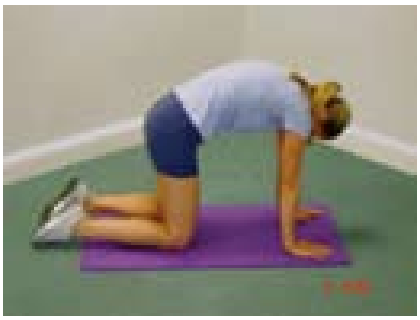
Stretch: Kneeling hip flexor

Teaching points:
- adopt a kneeling stride stance
- place both hands on the supporting knee
- tilt pelvis forward to stretch the hip flexors of the leg behind
- hold the stretch for an appropriate duration

Stretch: Sphinx (rectus abdominis)

Teaching points:
- lay face down on an exercise mat
- raise the trunk up off the floor
- position the elbows underneath shoulders for the stretch
- hold the stretch for an appropriate duration

Stretch: Box erector spinae



Teaching points:
- all fours position
- keep in line with shoulders, knees in line with hips
- lift back towards the ceiling
- hold the stretch for an appropriate duration

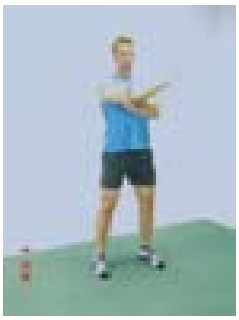
Stretch: Standing latissimus dorsi

Teaching points:
- stand with an upright posture
- place arms overhead hands clasped together
- reach towards the the ceiling to feel the stretch
- hold the stretch for an appropriate duration

Stretch: Wall standing pectorals

Teaching points:
- adopt a stride stance, side on to a wall, with the leading leg being nearest to the wall
- same side arm is abducted and the elbow flexed resting on the wall
- flex the knee of the leading leg to feel the stretch
- hold the stretch for an appropriate duration

Stretch: Standing deltoid



Teaching points:
- keep an upright posture
- maintain a neutral spine
- bring the arm across the body
- hold onto the fleshy part of the arm
- hold stretch for an appropriate duration

Stretch: Trapezius/rhomboids

Teaching points:
- keep an upright posture
- knees soft
- neutral spine
- arms flexed at 90 degrees
- fingers interlocking, palms facing out
- push shoulder blades apart
- hold stretch for an appropriate duration

Stretch: Standing bicep brachii

Teaching points:
- stand upright with feet shoulder width apart
- abduct, extend, and pronate both arms to feel a stretch

References

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www.activeiq.co.uk

Westminster House, The Anderson Centre,
Ermine Business Park, Huntingdon, PE29 6XY

T: 01480 467950 F: 01480 456283
E: info@activeiq.co.uk