FOCUS AWARDS

# Level 3 Certificate in Personal Training (QCF)

CONTENTS

# UNIT 1 ANATOMY AND PHYSIOLOGY FOR EXERCISE AND HEALTH

**On completion of this unit the learner will be able to understand the:**

- ✓ Structure and function of the skeleton
- ✓ Joints of the skeleton
- ✓ Muscular system
- ✓ Life-course of the musculoskeletal system and its implications for special populations and exercise
- ✓ Structure and function of the respiratory system
- ✓ Structure and function of the circulatory system
- ✓ Nervous system and its relation to exercise
- ✓ Energy systems and their relation to exercise

## THE SKELETAL SYSTEM

The skeletal system consists of bone, cartilage and ligaments.

### Bone

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

**Anterior View of Skeleton**

**Posterior View of Skeleton**

## Functions of the Skeleton

| Functions | Description |
|---|---|
| **Framework** | To provide a framework which supports the body and gives it shape |
| **Movement** | Or Locomotion. Bones form joints which act as levers |
| **Protection** | Helps protect our vital internal organs from being damaged |
| **Soft tissue attachment** | Provides surfaces for the attachment of soft tissues |
| **Production** | Certain bones produce red blood cells, white blood cells, and platelets from their bone marrow |
| **Storage** | Stores minerals such as calcium and phosphorus to withstand powerful physical stresses. Fats are stored in yellow bone marrow |



## The Axial and Appendicular Skeleton

The skeletal system can be divided into two parts:

**Axial skeleton** – skull, spine, ribs, and sternum

**Appendicular skeleton** – shoulder girdle, upper limbs, pelvic girdle, and lower limbs

| Axial Skeleton | | | |
|---|---|---|---|
| **Location** | **Bones** | **No. of bones** | **Additional Information** |
| **Skull** | Cranial | 8 | Head |
| **Spine** | Vertebrae: | | |
| | Cervical | 7 | Neck |
| | Thoracic | 12 | Chest |
| | Lumbar | 5 | Lower back |
| | Sacral | 5 | Rump(fused) |
| | Coccygeal | 4 | Tail(fused) |
| **Chest** | Ribs (costals) | 12 pairs | Originate from the thoracic vertebrae and wrap around the body to form the chest. The first 7 pairs attach to sternum (true ribs). The next 3 pairs share a cartilaginous attachment to the sternum (false ribs). The final 2 pairs are free (floating ribs) |

| | | | |
|---|---|---|---|
| **Chest** | Sternum | 1 | Attachment for true ribs, false ribs and clavicle |

| Appendicular Skeleton | | | |
|---|---|---|---|
| **Location** | **Bones** | **No. of bones** | **Additional information** |
| **Shoulder** | Scapula (shoulder blade) | 2 | Plural = Scapulae. Triangular bones at the rear (posterior) of the body |
| | Clavicle (collar bone) | 2 | 'S' shaped bones above (superior) the rib cage and at the front (anterior) of the body |
| **Arm** | Humerus | 2 | Upper arm |
| | Radius | 2 | Outer and shorter bone of the forearm |
| | Ulna | 2 | Inner and longer bone of the forearm |
| **Hand** | Carpal | 16 | 2 rows of 4 bones which form the wrist |
| | Metacarpal | 10 | Palm of the hand |
| | Phalange | 28 | Finger bones |
| **Pelvis** | Ilium | 2 | Large flat bones of pelvis |
| | Ischium | 2 | Lower (inferior) rear of pelvis |
| | Pubis | 2 | Lower (inferior) front of pelvis |
| **Leg** | Femur | 2 | Longest bone in the body |
| | Patella | 2 | Kneecap |

| | | | |
|---|---|---|---|
| | Tibia | 2 | Larger and inner (medial) bone of the lower leg |
| | Fibula | 2 | Smaller and outer (lateral) bone of the lower leg |
| **Foot** | Tarsal | 14 | Bones of the ankle |
| | Metatarsal | 10 | Bones of the foot |
| | Phalange | 28 | Bones of the toes |

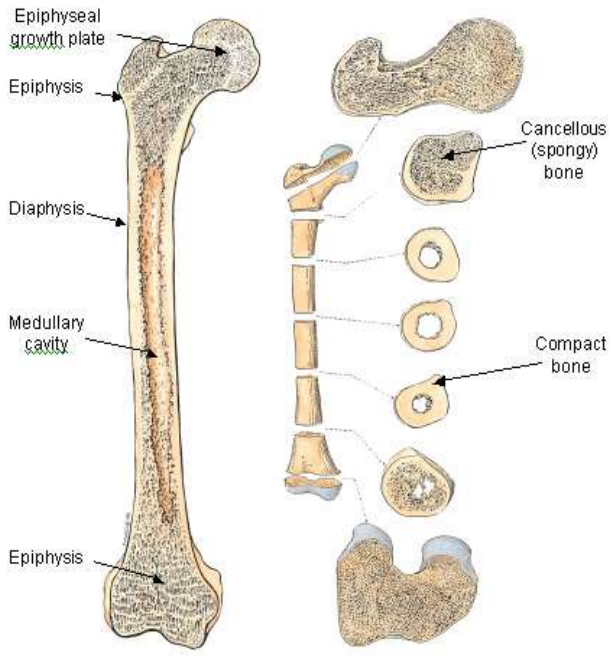


## BONE CLASSIFICATION

Bones can be classified by shape and form

| Classification | Description | Examples |
|---|---|---|
| **Long** | Are longer than they are wide. Contain mostly compact bone in the shaft (diaphysis) and cancellous bone at each end (epiphysis) | Humerus, Radius, Ulna, Femur, Tibia, Fibula, Metacarpals, Metatarsals, Phalanges |
| **Short** | As long as they are wide. Usually consist of mainly cancellous bone which makes them strong and lightweight | Carpals, Tarsals |
| **Flat** | Thin cancellous bone sandwiched between 2 layers of compact bone. Provide large areas for muscle attachment | Cranial, Scapula, Costals, Sternum, Ilium |
| **Irregular** | Their many different shapes prevent them from being classified in any other group | Vertebrae |
| **Sesamoid** | 'Seed-like'. Located within tendons at site of tension or friction to protect joint and aid leverage | Patella |

## STRUCTURE OF A LONG BONE






| | |
|---|---|
| **Epiphysis** | Expanded portion at each end of the bone |
| **Diaphysis** | Shaft of the bone |
| **Hyaline Cartilage** | Covers the bone ends |
| **Periosteum** | Tough fibrous sheath covering the entire bone |
| **Compact bone** | or 'cortical' bone which is solid, dense, and rigid |
| **Cancellous bone** | or 'spongy' bone which is light, porous, and flexible |
| **Medullary cavity** | Hollow tube down the centre of the compact bone |
| **Yellow marrow** | Stores fat |
| **Red marrow** | Aids in the production of blood cells |

## Bone Formation

Most of the skeleton begins as cartilage, very strong fibres of collagen which are gradually replaced by compact or cancellous bone. This can be living or non-living material in a human being, both of which contribute to the evolving cycle of bone formation. A number of cells play important roles in this process:

| | |
|---|---|
| **Osteoblasts** | Bone forming cells |
| **Osteoclasts** | Bone destroying cells |
| **Osteocytes** | Osteoblasts which have matured into bone cells |



### Ossification

The constant activity of osteoblasts and osteoclasts, with the addition of minerals and salts, is the process by which new bone is produced. The blood aids the process by depositing these minerals into the bone via osteoblasts. In contrast, osteoclasts occupy small depressions which have been created on the bone surface by enzymes. They dissolve collagen and minerals which are then released back into the bloodstream.

Calcium compounds must be present for ossification to take place, and ossification is complete between the ages of 18 and 30. The growth and lengthening of long bones continues throughout this time. Lengthening or elongation is achieved by the expansion of epiphyseal plates at each end of the diaphysis.

These plates expand allowing new cells to form and increase the length of the shaft at both ends. The process stops when the thickness of the epiphyseal plates decreases which occurs at different rates for different bones. Stresses of physical activity contribute to bone strength.

## Factors Affecting Bone Formation

Bone development is influenced by:

- **Nutrition**
- **Hormonal excretions**
- **Exposure to sunlight**
- **Physical exercise**

Bone health may be influenced by many factors from maternal nutrition, through toddler and pre-school years, with calcium intake playing an important role. Calcium can only reach its full bone building potential if the body has enough vitamin D. Calcium helps build and maintain bones while vitamin D helps the body absorb calcium effectively. We can get most of our vitamin D from exposure to sunlight.

Hormones are made in glands and travel around the body via the bloodstream. They are important in the balance between formation and re-absorption of bone.

Physical activity causes new bone tissue to form. The stress placed on bones during weight-bearing activity has a direct influence on bone strength.

**The Spine**

The spine develops from a single curve during foetal development into four curves, two concave, and two convex.



The cervical and lumbar regions with concave curves give the greatest range of movement.

**Neutral Spine**

A neutral spine describes the ideal position to minimise stress on the vertebrae and its ligaments. In turn, achieving this posture during physical activity will help to reduce the risks of back pain. It will also allow musculature to perform in a balanced way and maintain this optimal spinal curvature.

**Postural Abnormality**

Deviation from optimal spinal posture can be common. Pregnancy can enhance curvature of the lower spine to shift the centre of gravity backwards and compensate for the extra weight at the front. Postural abnormality can be present at birth, or can occur at any stage of life, and can be temporary or permanent.

| | |
|---|---|
| **Lordosis** | The spine curves significantly inward at the lower back |
| **Kyphosis** | Characterised by an abnormally rounded upper back |
| **Scoliosis** | A sideways curve which is often s-shaped or c-shaped |

**Connective Tissue**

Connective tissue supports, connects, surrounds, or separates different types of tissues and organs of the body. The bones of the human skeleton form the basic framework for the entire body but need a series of other structures to give the body its shape and functionality:

- **Cartilage**
- **Ligaments**
- **Tendons**

**Cartilage**

Three types of cartilage found in the body perform separate functions. It is very tough, dense, and fibrous, and these characteristics allow it to withstand great forces of torsion and compression. Despite its strength it can be worn over time or torn during trauma, and has a limited ability to heal itself as it has no blood vessels of its own.



**Hyaline (Articular) Cartilage**

The most common type:

- **Covers the ends of bones**
- **Glossy blue-white in appearance**
- **Present in synovial and cartilaginous joints**
- **Very tough**
- **Smooth and becomes slippery when lubricated with synovial fluid**
- **Reduces friction during joint movement**

**Fibrocartilage**

- **Found in intervertebral discs, joint capsules, and ligaments**
- **The strongest type of cartilage**
- **Can act as a shock absorber** in joints

**Elastic Cartilage**

- **Found in the external ear, epiglottis, and larynx**
- **Threadlike network of fibres which contain elastin**
- **Elastic properties allow it to return to original shape**
- **Also has collagen fibres to give it strength**

**Ligaments**

Ligaments are white in colour and extremely tough. Their non-elastic fibrous tissue can be either cord-like or strap-like in construction and provide stability to joints. Ligaments help to guide joints through normal movement patterns and also prevent unwanted movement. This means they can endure great tension being placed upon them, although excessive tension can cause damage which is referred to as a tear or sprain.

**Connect bone to bone**

- **Provide joint stability**
- **Aid joint movement**
- **Prevent unwanted movement**

**Tendons**

Tendons are similar to ligaments in construction. They too can be cord-like or strap-like in construction. Their role is to transmit the forces produced by muscles to allow the bones to act as levers. One tendon can be responsible for the actions of multiple muscles. Tendons are extremely tough but can be placed under excessive tension which can cause damage, referred to as a tear or strain.



- **Connect muscle to bone**
- **Transmit forces produced by muscles**

**Blood Supply**

Cartilage has a very limited blood supply which means that when damaged it is unlikely to repair. It is common for damaged cartilage to be removed as a surgical procedure. Ligaments have a limited blood supply provided from their attachment sites to bone. Therefore the healing time is slow in comparison to tendons which have a far greater blood supply gained from the surrounding soft tissues to which they are attached.

**Anatomical Terminology**

The anatomical position is the reference point in describing the relation of body parts to one another. The body is erect with the arms at the side and palms facing forward.

When describing the structures of the body it is important to use terms which encourage precision. Using the anatomical position as a starting point, the following standardised terms are designed to avoid confusion:

| | |
|---|---|
| **Anterior** | In front of/at the front of the body |
| **Posterior** | Behind/at the back of the body |
| **Medial** | Closer to the midline of the body |
| **Lateral** | Further from the midline of the body |
| **Superior** | Above another part of the body |
| **Inferior** | Below another part of the body |

## JOINTS

A joint is the location at which bones connect. This can be a junction between two or more bones and they are constructed to allow movement. Joints are classified according to how the bones connect to each other and by the degree of movement available. There are three types of joint:

- **Fibrous**
- **Cartilaginous**
- **Synovial**



### Fibrous

Immovable and interlocking bones joined by fibrous tissue that is rich in collagen fibres. E.g. bones of the skull

### Cartilaginous

Slightly moveable bones joined together by cartilage, e.g. vertebrae of the spine

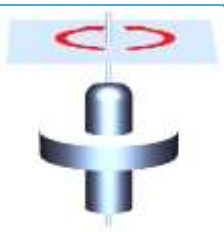
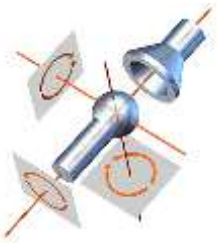
### Synovial

Freely moveable, these are the most common type of joint in the body. All synovial joints have common characteristics:

- **Ends of bones are covered with hyaline cartilage**
- **Surrounded by a fibrous capsule**
- **Capsule lined by a synovial membrane that secretes synovial fluid for lubrication**
- **Enclosed by ligaments for stability**

There are six types of synovial joints:

- **Gliding or Plane joints**
- **Hinge joints**
- **Pivot joints**
- **Condyloid or Ellipsoid joints**
- **Saddle joints**
- **Ball and socket joints**

| Joint type | Mechanical diagram | Example | Function |
|---|---|---|---|
| **Gliding or Plane** |  | Acromio-clavicular<br><br>Acromio-clavicular | Allow two bones to slide past each other |
| **Hinge** |  | Knee<br><br>Knee | Bones can only move though flexion and extension |
| **Pivot** |  | Atlas-axis<br><br>(C1-C2)<br><br>Atlas-axis | Allows rotation around an axis |
| **Ball and socket** |  | Hip<br><br>Hip | Allows movement in almost any direction. The greatest amount of joint movement in the body |
| **Condyloid or Ellipsoid** |  | Metacarpo-phalangeal<br><br>(knuckles)<br><br>Metacarpo-phalangeal | Similar to ball and socket joint but allow a lesser degree of movement |
| **Saddle** |  | Carpo-metacarpal<br><br>(thumb)<br><br>Carpo-metacarpal | Similar to ball and socket/saddle joints without rotational movement |

**Joint Movements**

| Terminology | Description |
|---|---|
| Spine | |
| **Flexion** | Decrease in the angle of the joint |
| **Extension** | Increase in the angle of the joint |
| **Lateral flexion** | Bend to the side |
| **Rotation** | Rotate about the long axis of the bone |
| Shoulder and Hip | |
| **Flexion** | Decrease in the angle of the joint |
| **Extension** | Increase in the angle of the joint |
| **Abduction** | Move away from the mid line of the body |
| **Adduction** | Move towards the midline of the body |
| **Medial rotation** | Movement around the longitudinal axis of the bone towards the centre of the body |
| **Lateral rotation** | Movement around the long axis of the bone away from the centre of the body |
| **Circumduction** | Circular or cone-shaped movement |
| Shoulder girdle | |
| **Elevation** | Upward movement |
| **Depression** | Downward movement |
| **Protraction** | Forward movement |
| **Retraction** | Backward movement |
| Knee | |
| **Flexion** | Decrease in the angle of the joint |
| **Extension** | Increase in the angle of the joint |
| **Medial rotation** | Movement around the longitudinal axis of the bone towards the centre of the body |

| | |
|---|---|
| **Lateral rotation** | Movement around the longitudinal axis of the bone towards the centre of the body |
| Ankle | |
| **Plantar flexion** | Move foot away from shin |
| **Dorsiflexion** | Move foot towards shin |
| **Inversion** | Move foot towards midline of body |
| **Eversion** | Move foot away from midline of the body |
| Elbow | |
| **Flexion** | Decrease in the angle of the joint |
| **Extension** | Increase in the angle of the joint |
| **Pronation** | Palm of hand facing downward |
| **Supination** | Palm of hand facing upward |
| Wrist | |
| **Flexion** | Decrease in the angle of the joint |
| **Extension** | Increase in the angle of the joint |
| **Ulnar deviation** | Bend wrist towards little finger |
| **Radial deviation** | Bend wrist towards thumb |



## Effects of Exercise on the Skeletal System

There are both short term and long term effects of exercise on the skeletal system. Short term is the period while exercising and long term indicates the effects of appropriate exercise sessions over a sustained period of time.

- **Short term effect- increase in synovial fluid production**
- **Long term effects- stronger ligaments and increased bone density**

### The Muscular System

Muscles have the ability to contract, producing movement in the body or maintaining the position of parts of the body.

### Types of Muscle Tissue

There are three types of muscle tissue:

- **Smooth muscle**
- **Cardiac muscle**
- **Skeletal muscle**
- **Smooth Muscle**

The most diverse type of muscle in the body:

- **Found in internal organs e.g. digestive and circulatory systems**
- **Involuntary as it is controlled by the autonomous nervous system**



**Cardiac Muscle**

Also known as Myocardium

- **Found in the heart**
- **Involuntary as it is controlled by the sinoatrial node**

**Skeletal Muscle**

- **Represents the majority of muscle in the body**
- **Attaches to bone across joints via tendons**
- **Produces movements within the body**
- **Determines posture by stabilising body position**
- **Transports and stores substances within then body**
- **Generates heat**
- **Voluntary as it is controlled by the somatic nervous system**

**Muscle Properties**

There are four main properties of muscle tissue:

| | |
|---|---|
| **Elasticity** | Returns to the original length after a stretch |
| **Contractility** | Develops tension in order to perform a contraction |
| **Electrical excitability** | Can respond to a stimulus |
| **Extensibility** | Ability to be stretched or to increase in length |

## Skeletal Muscle Anatomy

There are no exact figures to determine the number of muscles in the human body, although they make up approximately 40% of body weight. They comprise of 70% water, 23% protein and 7% minerals.

Myofilaments are the rigid protein filaments (actin and myosin) within myofibrils and are responsible for the creation of tension during contraction. Many myofibrils are grouped together to form a muscle fibre which is surrounded by endomysium.

The number of muscle fibres varies according to the location and function of each muscle. The greater the demands of the muscle, the more fibres will be required. Each group of fibres is held together by perimysium to form a fascicle which means 'cluster' or 'bundle'.



Finally, the many fasciculi are covered by a fascia of epimysium to form the muscle. Connective tissue is continuous throughout the length of a muscle and these layers come together to form tendons. The tendons attach to the periosteum sheath which surrounds the bone.

### The Sliding Filament Theory

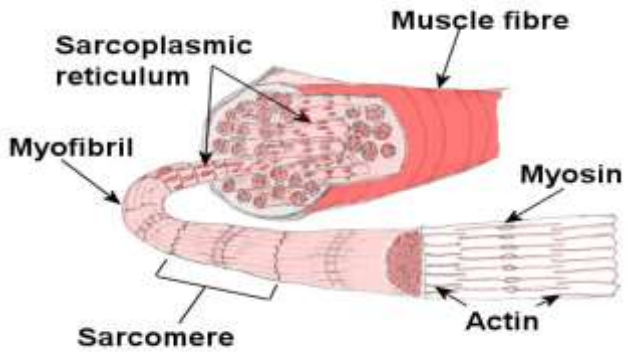
The ability of skeletal muscle to contract is dependent on the movement of protein myofilaments:

| | |
|---|---|
| **Actin** | Thin protein strand |
| **Myosin** | Thick protein strand |

These rigid protein strands do not actually contract or decrease in size, but simply slide over each other to reduce the size of the space they occupy which is called a sarcomere, (this underlying principle of muscle movement was popularised as The Sliding Filament Theory in 1954).

There are many myofilaments in each sarcomere. The heads of the myosin, known as cross bridges attach to a binding site and pull on the actin, causing them to slide inwards causing an overlap in the centre of the sarcomere. This is known as the contraction phase or 'power stroke'. The myosin cross bridges then detach from the actin in the 'recovery stroke'. At this point, the myosin is free to attach to the next binding site and repeat the process.

**Muscle cell structure**






## Types of Muscle Fibre

There are three different types of skeletal muscle fibres depending on the function they perform. Distinct fibre types have been classified according to their characteristics:

| Classification | Structure | Function | Activities |
|---|---|---|---|
| **Type 1**<br>**Slow twitch**<br>**Slow oxidative** | Red coloured<br>Smallest diameter<br>Large myoglobin content<br>Many mitochondria<br>Many capillaries | Increased aerobic delivery<br>Produce less force<br>Resistant to fatigue<br>Slow contractions | Maintenance of posture<br>Endurance based activity |
| **Type 2A**<br>**Fast twitch A**<br>**Fast oxidative** | Red/pink colour Larger diameter<br>Large myoglobin content<br>Many mitochondria<br>Many capillaries | Requires aerobic delivery<br>Produce more force<br>Less resistant to fatigue<br>Fast contractions | Walking, running , sprinting |
| **Type 2B**<br>**Fast twitch B**<br>**Fast glycolytic** | White/pale<br>Largest diameter<br>Small myoglobin content<br>Fewer mitochondria<br>Fewer capillaries | Anaerobic delivery<br>Produce most force<br>Least resistant to fatigue<br>Fastest contractions | Throwing, jumping, weight lifting |

**Muscle Fibre Type Considerations**

Muscles contain a mixture of muscle fibre types. The activities performed will determine the proportion of each fibre type in each. Muscles which are used to support the body will contain more type 1 fibres, such as the muscles that support the back and the head.

In contrast, the muscles responsible for the force generated by the arms and shoulders will contain more type 2 fibres. The muscles of the legs have a more even distribution of both fibre types as they must generate movement and support the structure of the body parts above.

Each person will have different fibre type combinations and no two persons are the same. The athletic ability of each individual will depend on these fibre combinations, which explains the fact that some people excel at endurance activities and others at power disciplines. Appropriate training can develop the size and capacity of both muscle fibre types.



It is possible to transform one fibre type to another with an appropriate shift in training. An increase in aerobic exercise will result in a gradual change from type 2B fibres into type 2A fibres. The opposite will occur with an increase in resistance training.

## Muscle Actions

Muscles can perform different kinds of contractions. They can lengthen, shorten, and remain stationary as well as generating forces to move at differing speeds:

| | |
|---|---|
| **Concentric** | Muscle shortens under contraction |
| **Eccentric** | Muscle lengthens under contraction |
| **Isotonic** | Movements involving both concentric and eccentric contractions |
| **Isometric** | Muscle stays the same length under contraction |
| **Isokinetic** | Muscle moves at a constant speed during contraction |

### Muscle Roles

Movement is dependent on coordination of muscle contraction. Each muscle will play a specific role and be categorised as such. It is important to understand that individual muscles can play a different role depending on the movement being performed:

| | |
|---|---|
| **Agonist/prime mover** | Muscle directly responsible for the desired movement |
| **Antagonist** | Muscle that causes the opposite action to the agonist |
| **Synergist** | Muscle that assists the prime mover |
| **Fixator** | Muscle that stabilises the origin of the prime mover |

**Muscle Tone**

This refers to a state where fibres are contracting at different times within a muscle to provide an overall level of tension. The postural muscles work continuously in order to maintain a standing, seated, or lying position which allows other muscles to generate the forces needed to provide movement. Muscle tone can determine how we are perceived by ourselves and others in terms of aesthetics and physical ability.

## PELVIC FLOOR MUSCLES



Also known as the pelvic diaphragm, these muscles span the area underneath the pelvis along with their connective and surrounding tissues. They form a sling like structure from the pubis at the front of the pelvis towards the coccyx at the base of the spine. The structure is pierced by a narrow gap that transmits the urethra, vagina and anal canal.

The pelvic floor muscles play an important role in providing support for pelvic organs such as the bladder, in maintaining continence, and also aid in the birthing process. They can respond to training in the same way as other skeletal muscle and can play a vital role in health and wellbeing.

**Structure of the Pelvic Girdle**

The bony pelvis consists of the two hip bones (also known as innominate or pelvic bones), sacrum and coccyx.

There are four articulations within the pelvis:

- Sacroiliac Joints (x2) – Between the ilium of the hip bones, and the sacrum
- Sacrococcygeal symphysis – Between the sacrum and the coccyx.
- Pubic symphysis – Between the pubis bodies of the two hip bones.

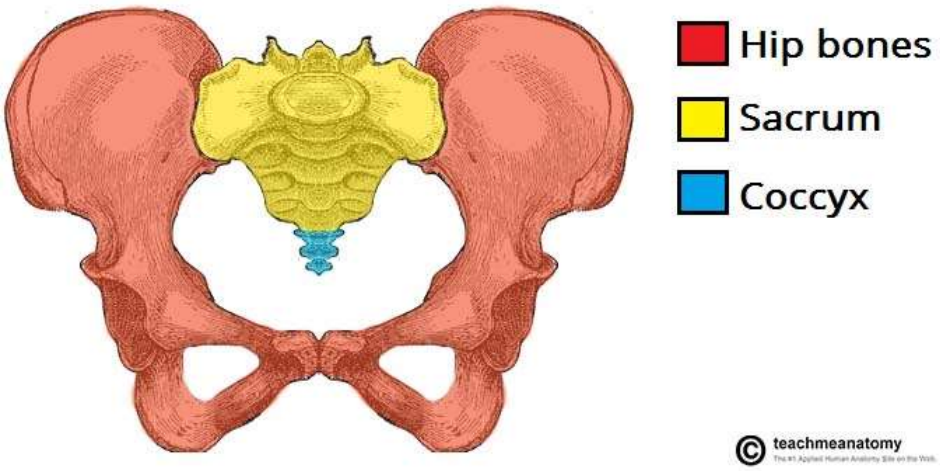



Fig 1.0 – The parts of the pelvic girdle.

Ligaments attach the lateral border of the sacrum to various bony landmarks on the bony pelvis to aid stability.

**Ligaments**

Ligaments and tendons are fibrous bands of connective tissue that attach to bone. Ligaments connect two or more bones together and also help to stabilize joints. Tendons attach muscle to bone. They vary in size and are somewhat elastic.

The system of ligaments in the vertebral column, combined with the tendons and muscles, provides a natural type of brace to help protect the spine from injury. Ligaments keep a joint stable during rest and movement. Further, ligaments help to prevent injury from hyper- extension and flexion movements.



**Anterior Longitudinal Ligament (ALL)**

Primary spine stabilizer. About one inch wide, the ALL runs the entire length of the spine from the base of the skull to the sacrum. It connects the front (anterior) of the vertebral body to the front of the annulus fibrosis.

**Posterior Longitudinal Ligament (PLL)**

Primary spine stabilizer. About one inch wide, the PLL runs the entire length of the spine from the base of the skull to sacrum. It connects the back (posterior) of the vertebral body to the back of the annulus fibrosis.

**Supraspinous Ligament**

This ligament attaches the tip of each spinous process to the other.

**Interspinous Ligament**

This thin ligament attaches to another ligament, called the ligamentum flavum, which runs deep into the spinal column.

**Ligamentum Flavum**

The strongest ligament. This yellow ligament is the strongest one. It runs from the base of the skull to the pelvis, in front of and between the lamina, and protects the spinal cord and nerves. The ligamentum flavum also runs in front of the facet joint capsules.

**Muscles and Tendons**

The muscular system of the spine is complex, with several different muscles playing important roles. The primary function of the muscles is to support and stabilize the spine. Specific muscles are associated with movement of parts of the anatomy. For example, the Sternocleidomastoid muscle assists with movement of the head, while the Psoas Major muscle is associated with flexion of the thigh.

Muscles, either individually or in groups, are supported by fascia. Fascia is strong connective tissue. The tendon that attaches muscle to bone is part of the fascia. The muscles in the vertebral column serve to flex, rotate, or extend the spine.

The term “muscle imbalance” refers to a condition in the body that is present when opposing muscles are out of balance with one another in terms of strength, length and/or tension. Opposing muscles are those that perform opposite functions. They may oppose one another spatially left-to-right or front-to-back. For example, quadriceps are responsible for extending the knee and the hamstring is responsible for flexing it. One is on the front of the thigh, and the other, the back.

When opposing muscle groups are imbalanced, one group is tighter and shorter than the other, which is elongated and lax. Imbalances can cause pain both directly and indirectly. The muscle that is shorter and tighter is chronically tense; muscle memory has trained it to stay in its shortened position. Tense muscles can develop knots called trigger points that cause localized and referred pain. The weaker muscle is prone to strain.



Muscle imbalances can interfere with posture. Tight muscles exert a pulling force on nearby strictures. If a muscle connected to the lumbar spine is tight, for example, it can pull the spine forward and create what is called anterior pelvic tilt. If an imbalance causes postural distortion, pain and dysfunction may be felt throughout the body.

What causes muscle imbalance? Generally, repetitive activity is to blame. This could occur from poor exercise habits or from repetitive movements required by your work. When you engage a muscle, the brain sends a signal to its opposing muscle to relax; this allows the engaging muscle to tense up without resistance. The process is called recirpocal inhibition. Once muscle memory sets in, the tension and laxity can become chronic.

## Origins and Insertions

Muscle attachments are referred to as origins and insertions. During movement the bones will come towards each other with one bone travelling further than the other.

The muscle attachment to the stationary bone is called the origin and the attachment to the moving bone called the insertion. The origin is proximal (closer) to the trunk or midline of the body and the insertion is distal (further away).

**Anterior**

| Muscle | Area of body | Origin | Insertion | Actions |
|---|---|---|---|---|
| **Deltoids** | Shoulder | Clavicle, scapula | Humerus | Abduction, flexion and extension of shoulder |
| **Pectoralis major** | Chest | Clavicle, sternum | Humerus | Flexion, horizontal flexion, adduction and medial rotation of shoulder |
| **Biceps brachii** | Front of upper arm | Scapula | Radius | Flexion of elbow, supination of forearm, flexion of |

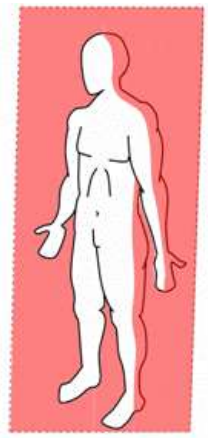
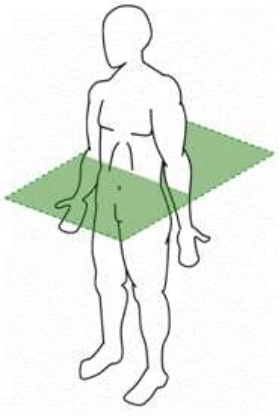
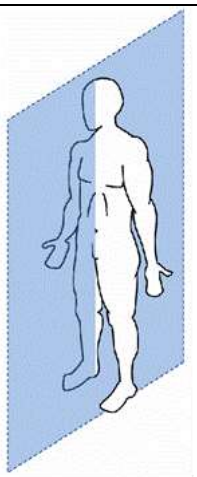
| | | | | |
|---|---|---|---|---|
| | | | | shoulder |
| **Diaphragm** | Beneath rib cage | Sternum, costal cartilage, lumbar vertebrae | Central tendon of diaphragm | Flattens during inspiration, relaxes during expiration |
| **Intercostals** | Between ribs | Borders of ribs | Borders of ribs | Elevate and depress ribs, Aids in breathing |
| **Rectus abdominis** | Centre of abdomen | Pubis | Sternum | Flexion of spine |
| **Transversus abdominis** | Abdomen behind rectus abdominis | Iliac crest, lumbar fascia | Sternum, pubis, linea alba | Compresses abdomen |
| **Internal obliques** | Sides of abdomen | Iliac crest, lumbar fascia | Costal cartilage, linea alba | Rotation and lateral flexion of spine, Compresses abdomen |
| **External obliques** | Sides of abdomen anterior to internal obliques | Lower ribs | Iliac crest, linea alba | Rotation and lateral flexion of spine, Compresses abdomen |
| **Hip flexors** | Through pelvis to front of thigh | Ilium, lumbar vertebrae | femur | Flexion of hip |
| **Adductors** | Inside of thigh | Pubis, ischium | Femur | Adduction, flexion and medial rotation of hip |
| **Abductors** | Outside of thigh | Ilium | Femur, tibia | Flexion, abduction and medial rotation of hip |
| **Quadriceps** | Front of thigh | Ilium, femur | Tibia | Extension of knee, flexion of hip |
| **Tibialis anterior** | Front of lower leg | Tibia | Tarsal, metatarsal | Dorsiflexion and inversion of foot |

**Posterior**

| Muscle | Area of body | Origin | Insertion | Action |
|---|---|---|---|---|
| **Erector spinae** | Both sides of spine | Vertebrae, ribs, ilium, ischium, pubis, sacrum | Occipital bone, temporal bone, vertebrae, ribs | Extension, lateral flexion and rotation of spine |
| **Trapezius** | Upper back | Base of skull, cervical and thoracic vertebrae | Clavicle, scapula | Elevation, depression, and retraction of shoulder girdle |
| **Triceps brachii** | Back of upper arm | Humerus, scapula | Ulna | Extension of elbow, extension of shoulder |
| **Rhomboids** | Upper back beneath trapezius | Upper thoracic vertebrae | Scapula | Retraction of shoulder girdle |
| **Latissimus dorsi** | Sides of the back | Thoracic and lumbar vertebrae, sacrum, ilium, ribs | Humerus | Extension, adduction and medial rotation of shoulder |
| **Gluteus maximus** | Bottom | Ilium, sacrum, coccyx | Femur | Extension and lateral rotation of hip |
| **Hamstrings** | Back of thigh | Ischium, femur | Tibia, fibula | Extension of hip, flexion of knee |
| **Gastrocnemius** | Back of lower leg | Femur | Heel bone (calcaneus) | Flexion of knee, plantar flexion of ankle |
| **Soleus** | Back of lower leg beneath gastrocnemius | Tibia, fibula | Heel bone (calcaneus) | Plantar flexion of ankle |

## THE PLANES OF MOVEMENT

Movements of the human body are often described in terms of the 'plane' in which they pass through. There are three planes of the human body, these planes are shown in the following table.

| Frontal | Transverse | Sagittal |
|---|---|---|
|  |  |  |
| **Description**<br><br>The frontal plane passes through the body from left to right, dividing the body into anterior and posterior portions. | **Description**<br><br>The transverse plane passes through the body in a line parallel to the floor, dividing the body into top and bottom portions. | **Description**<br><br>The sagittal plane passes through the body from front to back, dividing the body into left and right portions. |
| **Example**<br><br>Side to side movements occur in the frontal plane, such as raising your arms or legs out to the side like in a star jump. | **Example**<br><br>Twisting or rotational movements occur in the transverse plane, such as twisting your head from side to side. | **Example**<br><br>Front to back movements occur in the sagittal plane, such as walking, pushing, pulling and squatting. |



## JOINT ACTIONS

Knowing how the body moves and the actions that various joints allow is crucial for safe and effective exercise instruction. Some of the key joint actions that you should know are detailed in the following tables.

**Horizontal flexion:**

Refers to movement where the angle between two bones decreases and on the horizontal plane.

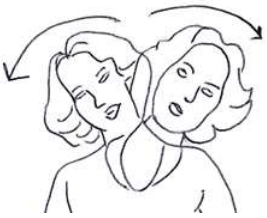
**Horizontal extension:**

Refers to movement where the angle between two bones increases and occurs on the horizontal plane.



**Lateral Flexion:**

Refers to movement of the spine laterally away from the midline of the body. This can be seen when we bend to one side.

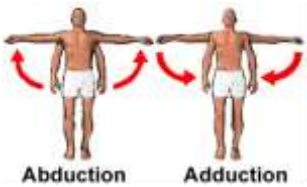


**Abduction:**

Movement of a body segment away from the midline of the body.

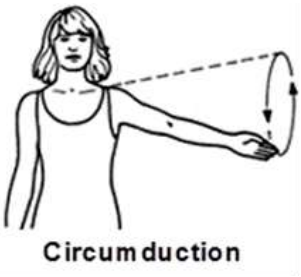
**Adduction:**

Movement of a body segment toward the midline of the body.




**Circumduction:**

This is a movement where the joint is the pivot and the body segment moves in a combination of flexion, extension, adduction and abduction.

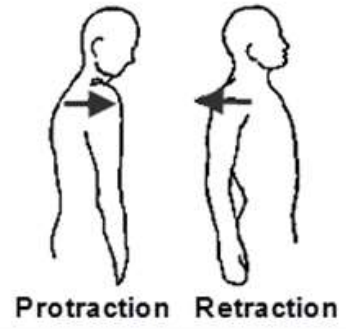



**Protraction:**

This is forward movement of the scapula that results in 'hunching' of the shoulders.

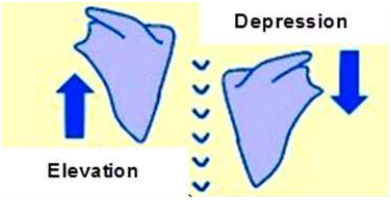
**Retraction:**

This is backward movement of the scapula as they pull together to 'square' the shoulders and push the chest out.



**Elevation:**

Refers to the raising of the scapula to a more superior level (shrugging the shoulders).



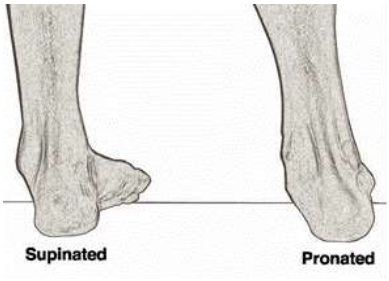

**Depression:**

Refers to the scapula moving to a more inferior position as they are pulled downwards.

**Supination:**

Hand – movement so the palm of the hand faces upward or forward (anteriorly).

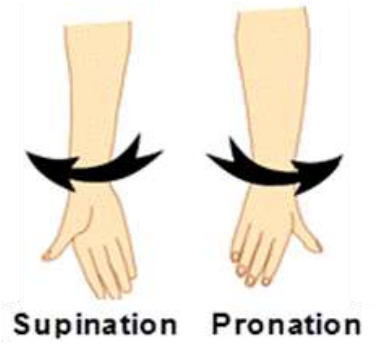
Foot – combination of inversion, plantar flexion and adduction of the foot occurring at the same time.




**Pronation:**

Hand – movement so the palm of the hand faces downward or backward (posteriorly).

Foot – combination of eversion, dorsiflexion and abduction of the foot occurring at the same time.

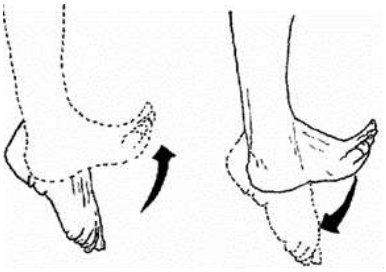



**Plantar flexion:**

Moving the top of the foot away from the shin or 'pointing' the toes.

**Dorsiflexion:**

Moving the top of the foot toward the shin or 'raising' the toes.

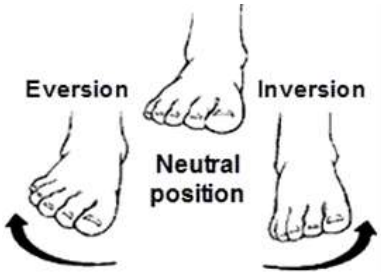


**Eversion:**

The movement of the foot to bring the sole of the foot to face outward.

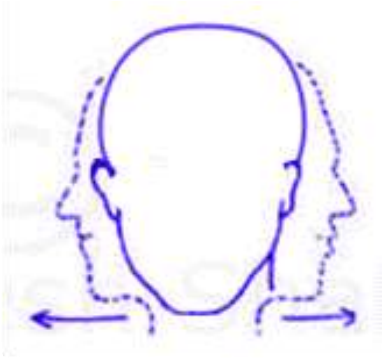
**Inversion:**

The movement of the foot to bring the sole of the foot to face inward.



**Rotation:**

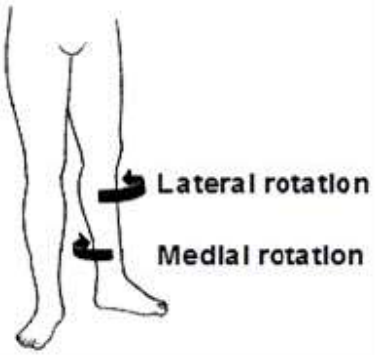
Refers to a pivoting or 'twisting' movement. Rotation is broken down further into medial and lateral rotation.





**Medial rotation:** The movement of a body segment where the front (anterior) of the segment rotates medially (inwards) towards the midline of the body.

**Lateral rotation:** The movement of a body segment where the front (anterior) of the segment rotates laterally (outwards) away from the midline of the body.




## The Life Course of the Musculoskeletal System and its Implications for Special Populations

The instructor should understand that the musculoskeletal system will undergo adaptation and change during the life course of the human body.

### Young People

As children grow, so does their muscle mass. During puberty an increase in hormones can almost double the weight of muscle. Hormonal differences between the sexes mean that boys will experience these differences at a greater rate than girls, although girls may be stronger around the age of 11 as they may have more lean body mass than boys of the same age. Girls also carry more body fat both during and after the growth spurt.

### Growth Spurt

As a child matures their bones also develop. At some point this growth will be rapid which is known as a growth spurt. Boys and girls experience growth spurts at different rates and ages but generally:

| | |
|---|---|
| **Girls** | Between the ages of 10 to 12, growing fastest at 12 to 13. The growth spurt will usually end at the age of 18. |
| **Boys** | Between the ages of 12 and 14, growing fastest at 14 to 15. The growth spurt will usually continue to the age of 20. |

During the growth spurt period a child is at increased risk of injury from both trauma and overuse, where a disruption to the blood and nutrient supply can disturb the growth of bone. Fractures at the growth plates are more common in boys than girls. However girls experience growth spurts earlier and so are more likely to reach this vulnerable period at a younger age.

**Common age for growth plate fractures:**

| | |
|---|---|
| **Girls** | 11 to 13 years old |
| **Boys** | 14 to 16 years old |



Bones which are noted for growth plate fractures are the radius, hip, femur, and the bones of the ankle and foot due to the fact that they are weight bearing or become weight bearing in the event of a fall. The fractures are presented between the shaft of the bone and the growth plates at the ends of the bone.

The severity and management of any injury will be a major factor in the avoidance of complications such as infection and disease. Although growth plate fractures can have long term consequences, the vast majority heal without any permanent damage.

Ligaments attach bones together at joints and any injury to these soft tissue structures can have an adverse effect on bone development.

It is important for the instructor to recognise the potential dangers of overloading the musculoskeletal system during exercise. Exercise prescription should involve varied activities to avoid continuous repetitive movements and avoid heavy loads.

**Older Adults**

Once ossification of bone is fully complete, the mature human skeleton will at some stage experience the loss of bone mass. Osteopenia is a condition where bone mineral density is lower than normal and is a characteristic of the aging process. It may lead to osteoporosis where the bone tissue deteriorates and bone mass decreases to the stage where bones become fragile and more susceptible to the risk of fracture. A common term for this is 'brittle bone disease'.

Although osteoporosis occurs in both sexes, it is more common in females. Menopause can increase a woman's risk of developing osteoporosis due to a drop in oestrogen levels.

Reduction in Range of Movement (ROM) is common as we age. This can be due to a number of factors including the thickening of tissues surrounding the joints and a loss in elasticity of soft tissues. Over time, these structures can break down and make it harder for joints to perform without causing discomfort. Gradually this process becomes accepted and lifestyle choices are made where there is less demand for more extreme movements of the limbs.

This age related deterioration of function will lead to a decrease in fast twitch muscle fibres. As activities become slower and take longer to perform there will be a relative increase in slow twitch muscle fires. The resulting loss of muscle mass is called sarcopenia.

The instructor can help to slow down the degeneration of bone and soft tissues which lead to osteopenia and sarcopenia by prescribing regular weight-bearing exercise. Not only will this improve the integrity of the tissues, but will also bring about associated benefits such as improved balance, mobility, and neuromuscular coordination.

Any exercise programme should be tailored to the individual as the needs and abilities of older adults can be vastly different. In general, low impact exercises are recommended to avoid unnecessary trauma to the skeletal and muscular systems.



Instructional style should take into account that this special population may appreciate more repetition of teaching points and the understanding that performance may be slower than that of a younger person.

Pre and Post-natal Women

During pregnancy a hormone called relaxin is released which softens the cervix and the ligaments. This allows the body to change shape throughout pregnancy and allows the joints of the pelvis to stretch during delivery. The joints of the body are potentially vulnerable and should not be unduly stressed while exercising. Relaxin can be present in the body for some time after it stops being produced which means that no definitive guidelines can be given regarding exercise prescription.

Expectant mothers wishing to exercise should be carefully screened in order to assess the appropriateness of exercise. Any doubts should be referred to their GP before exercise can begin. Exercises should be given to strengthen the pelvic floor muscles which are placed under a lot of stress during pregnancy and can become weakened and stretched as early as the first trimester.

Post-birth, women who wish to return to exercise need to take into account how straightforward the labour was. Those who did regular exercise throughout pregnancy and had a complication free delivery can be expected to return to exercise fairly quickly.

Guidelines of six weeks before resuming full daily activities are being replaced with a more individual approach. Exercise can begin when there is a feeling that ‘you are ready’ but if in any doubt, a consultation with the health care provider will help this decision making process.

Exercise intensity should build gradually with pelvic floor exercises and low impact aerobic activity such as walking. Further exercise should be postponed until after a post-natal check at between six and eight weeks after the birth.

## THE NERVOUS SYSTEM

The nervous system controls every major function that occurs in your body. In fact, without your nervous system, your muscles and other organs would be all but inert. Without your nervous system, your heart wouldn't beat, your blood wouldn't circulate and your muscles wouldn't contract. It's fair to say that your nervous system is your body's governor.

Because the nervous system and muscular system are so closely linked, symbiotic even, they are collectively called the neuromuscular system; neuro pertaining to the nerves and muscular, obviously, pertaining to your muscles.



**Roles of the nervous system**

The nervous system, in its simplest form, is a communications system and it has three main roles:

| | |
|---|---|
| Input | there are a huge array of sensory nerves spread all throughout your body that are constantly gathering information such as the temperature, level of CO2 in your blood, degree of stomach distension, weight of the object you are trying to lift or the angle of the hill you are running up |
| Analysis | The information gathered by the myriad of sensors around your body has to be interpreted and analysed so that the appropriate response can be generated. While some responses are voluntary, many more are automatic or involuntary and are known as reflexes |
| Output | Finally, having gathered and analysed the incoming information, a response or output is initiated e.g. increasing breathing rate because of elevated CO2 levels or sweating to reduce body temperature. |

There are two main parts of the nervous system:

- **The central nervous system or CNS**
- **The peripheral nervous system or PNS**

**The central nervous system**

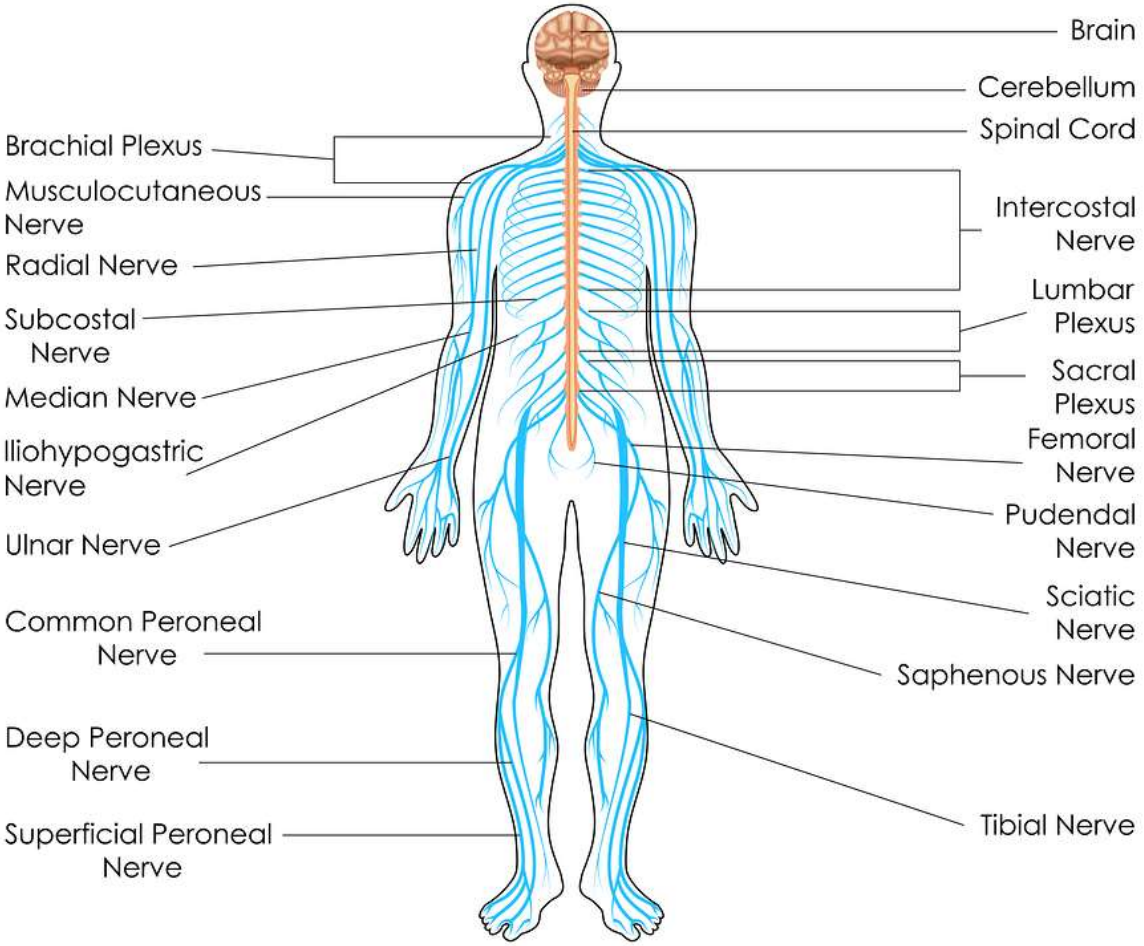
The central nervous system consists of the brain and spinal cord and is responsible for all conscious and unconscious decision making. The brain has a huge capacity – far greater than any computer – and controls dozens if not hundreds of bodily functions simultaneously.

The brain is made up of two hemispheres, the cerebrum, the cerebellum and several other parts, all of which have very specialist functions. For example, the cerebellum's main job is controlling the actions of your muscles and storing memories. The brain is safely contained within your skull or cranium and is surrounded by a layer of fluid and fat which protects it from impact.

The spinal cord is responsible for controlling reflex reactions and also provides the means for connecting the brain to the nerves that supply the rest of the body. It comprises of cervical,

thoracic, lumbar and sacral segments which are all named after the section of vertebral column through which they pass.

**The peripheral nervous system**




The peripheral nervous system is the name used to describe all of the branches of nerves outside of the central nervous system. The PNS transmits information to and from the CNS and is divided into motor nerves and sensory nerves – also called neurons.

Motor neurons transmit impulses from the CNS to organs, glands and muscles. These impulses will cause the muscles to contract and organs and glands to do their specialist jobs. Motor nerves exit the anterior or front of the spinal cord and essentially “flow away” from the CNS.

In contrast, sensory neurons, which attach to the posterior aspect of the spinal cord, flow toward the CNS and relay information such as the positon of the limbs, core temperature, texture, taste and smell.

Information is constantly flowing to and from the CNS via the sensory and motor neurons. Both motor and sensory neurons play an important role in muscle contractions.

**Motor units and muscle fibre recruitment**

Muscles are made up of bundles and bundles of muscle fibres and these fibres are arranged into groups called motor units. A motor unit consists of anywhere between 10 and 1000 muscle fibres and the motor neuron that

innervates or supplies it. The number of fibres present in a motor unit depends on its location and function but, irrespective of where it is located, all muscle fibres within the motor unit are activated by the same, single motor neuron.

Within the motor unit, all the muscle fibres innervated by the motor neuron will either work together at the same time or not at all. This is commonly referred to as the "all or nothing" law.

Once sufficient stimulus is received from the motor neuron, all the muscle fibres within the motor unit will contract with 100% of their contractile ability or not at all.

Muscles contain many motor units; the bigger the muscle, the more motor units are likely to be present. The more motor units that are innervated at the same time, the more force will be produced.



If a lot of force is required, i.e. lifting a heavy weight, a large number of motor units will work together. If, however, a smaller amount of force is needed, fewer motor units will be innervated. At no point do motor units work at anything less than 100% or their contractile ability; force variation is the result or more or fewer motor units being recruited.

If a muscular task takes an extended period of time, motor units are recruited sequentially or, in other words, one after another. That way, as one motor unit fatigues, another one will take over. In examples of very low intensity activity, e.g. walking, this sequential recruitment can be almost never ending but in more intense activities, e.g. a set of press-ups, work finishes when all motor units are exhausted.

The number of motor units that can be innervated or switched on at the same time varies from person to person and is a trainable characteristic. A beginner might only be able to innervate 50% of his or her total motor units whereas a more advanced exerciser might be able to innervate 70% or more. This helps to explain why two people who have the same amount of muscle can have such different levels of strength.

Beginner exercisers often experience rapid increases in strength not because their muscles get bigger but simply because their nervous systems become more adept at innervating a larger number of motor units simultaneously.

While exercise "teaches" the nervous system to work more efficiently so that more motor units can be innervated simultaneously, in order to protect bones, muscles and connective tissue from injury, it is not possible to recruit all motor units at the same time. This limitation is controlled by the Golgi tendon organ.

**Responses of the neuromuscular system to exercise**

Exercise has a profound effect on all the systems of the body, not least the neuromuscular system. Changes can be acute or short term (i.e. during the training session) or chronic or long term (i.e. as a result of several weeks or months of training).

**Acute changes**

During a workout the following may occur:

- **Vasodilation of blood vessels and capillaries to facilitate increased blood flow**
- **Blood diverted away from non-essential organs to working muscles**
- **Increased temperature**
- **Reduced nervous inhibition**

**Chronic changes**

The changes experienced by the neuromuscular system depend on several factors including exercise frequency, exercise duration, exercise volume, exercise intensity and exercise modality.

Long term adaptations to resistance training include:

- **Increased cross-sectional size of muscles (hypertrophy)**
- **Improved balance and coordination**
- **Increased strength due to hypertrophy**
- **Increased strength due to decreased nervous inhibition**
- **Increased glycolytic activity allowing more high intensity work to be performed**
- **Increased size of glycogen stores**



Long term adaptations to aerobic exercise include:

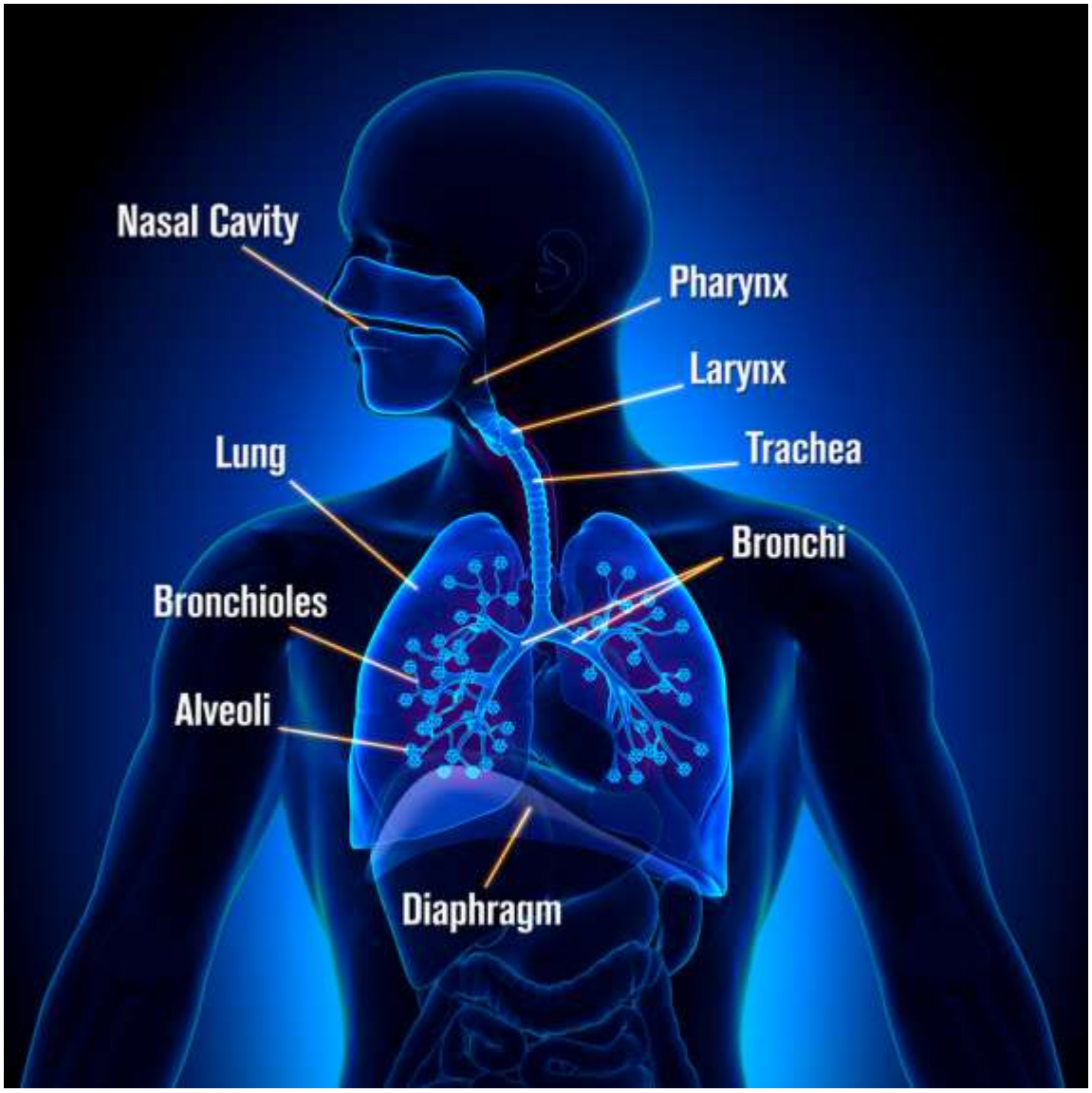
- **An increase in the size and number of energy producing mitochondria**
- **An increase in capillarisation surrounding muscle fibres and at the alveoli**
- **An increase in aerobic enzyme activity, stored glycogen and triglycerides in the muscle fibres**

## THE RESPIRATORY SYSTEM

The respiratory system is responsible for taking oxygen into the body and removing the waste product of aerobic respiration – carbon dioxide, and while you have limited control over breathing, i.e. you can choose to hold your breath, ultimately breathing is controlled by your autonomic or involuntary nervous system.



**Anatomy of the respiratory system**

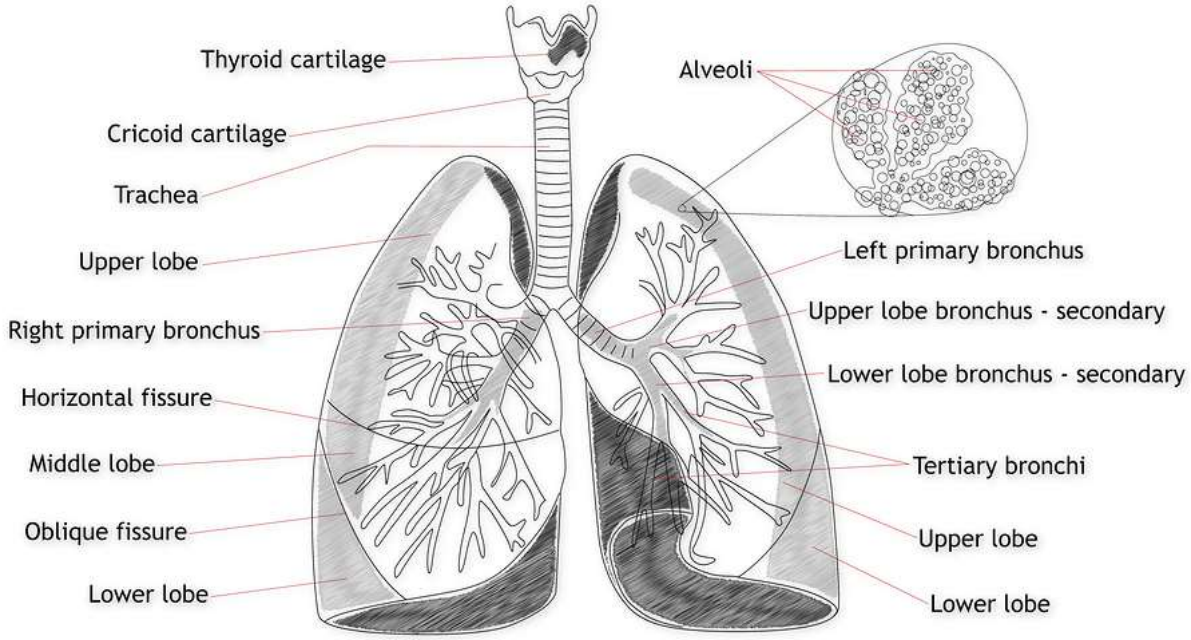



Air enters your body and passes through the following structures:

- Nose or mouth
- Pharynx
- Larynx
- Trachea

- Primary bronchi
- Bronchioles
- Alveoli
- Capillaries

Carbon dioxide exits the body through the same structures but in reverse.






**Essential terminology:**

| | |
|---|---|
| **Inhalation or inspiration** | taking air down and into the lungs |
| **Expiration or exhalation** | expelling air from the lungs |
| **External respiration** | the exchange of gasses between the lungs and blood |
| **Internal respiration** | the exchange of gasses between the blood and the cells |

**The mechanics of breathing**

Breathing describes the cycle of inhalation followed by exhalation. While you can exercise some control over your breathing rate, the majority of the control exerted over breathing is subconscious. Several muscles are involved in breathing:

- **Diaphragm**
- **Intercostals**

- **Rectus abdominus**

**Inhalation**

To draw air into your body, your diaphragm, a dome-shaped muscle across the bottom of your ribs, contacts and depresses. At the same time, your intercostal muscles, which are located between your ribs, contract and pull your ribs upward and outward. This increases the volume of your chest cavity which, in turn, creates a vacuum. Air is then drawn into your lungs until the pressure inside your lungs is equal to the pressure outside.



**Diaphragmatic versus costal breathing**

When you are at rest and oxygen demands are low, your primary breathing muscle should be your diaphragm. Diaphragmatic breathing is characterised by abdominal distension and very little chest expansion. To experience this, lie on your back and place one hand on your abdomen and the other on your chest. Now breathe normally but ensure only your lower hand moves.

To increase your oxygen intake, for example when exercising, more costal breathing is necessary so that sufficient air can be taken in to the lungs.

Again, lying on your back, inhale but this time make sure the hand resting on your chest also moves.

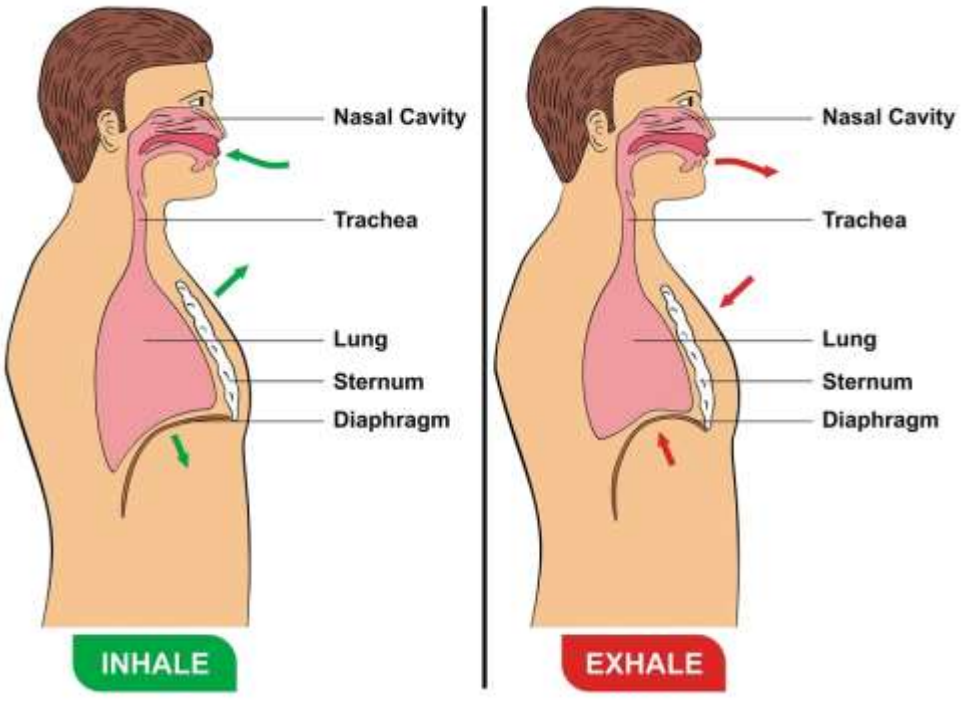
Diaphragmatic breathing is linked to relaxation and is part of yoga, tai chi and can help reduce stress and blood pressure.

Combining diaphragmatic with costal breathing will create the largest possible chest cavity expansion and, therefore, the greatest intake of air.

**Exhalation**

To drive air out of your lungs, the diaphragm relaxes and so to do the intercostals. This causes the ribcage to deflate which pushes the air out of your lungs. Although you can push most of the air out of your lungs, some always remains which is called your Residual Volume (RV).

In addition to the action of the diaphragm and intercostals, you can use your rectus abdominus to



compress your abdominal cavity to exhale more forcefully e.g. when blowing up a balloon.

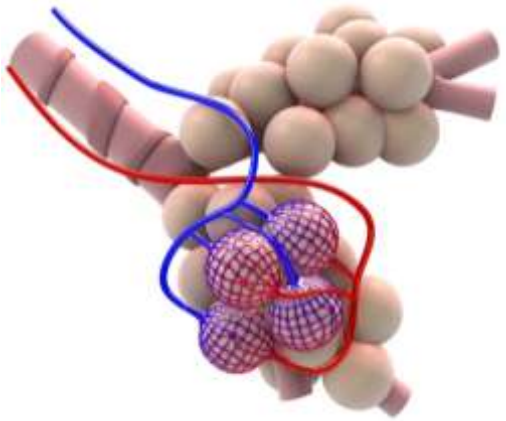
**Gaseous exchange**

As you breathe in, air is drawn down into your lungs and ends up in your alveoli which resemble bunches of grapes. The alveoli provide a very large surface area for moving oxygen (O2) into your blood and removing carbon dioxide (CO2) from your blood ready for exhalation. This "swapping" of gasses is called a gaseous exchange and is also known as diffusion.

Diffusion can be defined as the movement of gasses from an area of high concentration to an area of low concentration and as this is happening to two gasses simultaneously (O2 and CO2) there is an exchange of equal volumes of gasses.



Diffusion is possible because the alveoli are proliferated with tiny blood vessels called capillaries. Capillaries are one-cell thick so that gasses and other substances can pass through them.



As air is inhaled and reaches the alveoli, O2 is extracted from the air and passed through the capillaries and into the blood. The O2 binds to a substance called haemoglobin (essentially your red blood cells and known as Hb for short) and is then transported around the body and used as required.

Conversely, CO2 from the blood diffuses into the alveoli via the capillaries and is exhaled. CO2 is also carried by Hb although when haemoglobin is carrying oxygen it is called oxy-haemoglobin but when it is carrying CO2 it is carboxyhaemoglobin.

**Composition of air**

Air is comprised of several gasses, some of which are very important and some of which are less so. Oxygen is essential for human life but nitrogen, which makes up a large percentage of the air we breathe, is inert. Inhaled air has a different composition to exhaled air because some of the oxygen is used in aerobic respiration.

| Gas | Inhaled air | Exhaled air | Difference |
|---|---|---|---|
| **Nitrogen (N2)** | 79% | 79% | No change |
| **Oxygen (O2)** | 21% | 17% | 4% decrease |
| **Carbon dioxide (CO2)** | <1% | 4% | 4% increase |

< = less than, > = more than

**The stimulus for breathing**

While you can voluntarily control the depth and speed of your breathing up to a point, the majority of the time, breathing is controlled by your autonomic nervous system which means it is involuntary.

When blood CO2 levels reach 4%, breathing will occur. This is why you can only hold your breath for so long and why, even underwater, if you will attempt to breathe if deprived of oxygen for long enough.

When you exercise, CO2 levels increase quickly and so breathing rate increases significantly to prevent CO2 levels exceeding 4%. In contrast, at rest and especially during sleep, CO2 levels are very low and subsequently so too is the breathing rate.



**Measures associated with lung function**

Many aspects of lung function can be measured – a study called spirometry. These measures can be affected by several factors including gender, age, general health, body type and illnesses such as asthma. Spirometry tests involve blowing into measuring devices that analyse and record volume, velocity and/or duration of air flow.

The main measures are:

| | |
|---|---|
| **Breathing rate (BR)** | the number of breaths taken per minute |
| **Tidal volume (TV)** | the amount of air inhaled and exhaled in one breath |
| **Minute ventilation (MV)** | the total amount of air exhaled and exhaled in one minute |

Therefore minute ventilation (MV) which is measured in millilitres per minute (ml/min) or litres per minute (l/min) equals breathing rate (BR) multiplied by tidal volume (TV) or MV = BR x TV

For example:

- BR= 12
- TV= 500ml
- MV = 6000ml/min or 6l/min

**The effect of exercise on lung function measures**

Exercise effects the function of your lungs, both acutely (as you exercise) and as a result to your body adapting to the exercise (chronically). These changes are caused by increased capillarisation at the alveoli, increased haemoglobin density in the blood and improved respiratory muscle strength and endurance.

| Measure | Acute | Chronic |
|---|---|---|
| **Breathing rate** | Increases | Decreases |
| **Tidal volume** | Increases | Increases |
| **Minute ventilation** | Increases | Unchanged or slightly increased |



**The circulatory system**

Once oxygen has been inhaled and has diffused into the blood, it has to be moved around your body for use by the cells, tissues and organs. This is the job of the circulatory system. The circulatory system consists of three main parts:

- **The blood**
- **The cardiac muscle or heart**
- **The blood vessels**

**The blood**

Scientists estimate the volume of blood in a human body to be approximately 7% of body weight. An average adult body with a weight of 150 to 180 pounds will contain approximately 4.7 to 5.5 litres (1.2 to 1.5 gallons) of blood. The body uses blood as a universal transporter for a great many substance, not least oxygen. Blood is made up from four major components:

- **Red blood cells (RBCs)**
- **White blood cells (WBCs)**
- **Platelets**
- **Plasma**

**Red blood cells (Erythrocytes)**

A single drop of blood contains between 240-270 million RBCs so it's safe to say they are pretty prolific. RBCs contain a protein called haemoglobin (Hb) which carries oxygen and carbon dioxide around the circulatory system.

RBCs are produced the red bone marrow and are pigmented which is what gives blood its characteristic red colour. RBCs make up approximately 40% of total blood volume.

A sound diet containing adequate iron ensures that there are plenty of RBCs – too few can result in anaemia which is characterised by fatigue and poor exercise performance.

**White blood cells (Leukocytes)**

WBCs are clear and contain no haemoglobin. There are fewer of them but they too are produced in red bone marrow. WBCs are the cells that fight infection and as infections come in various shapes and sizes, so to do WBCs.

**Platelets (Thrombocytes)**

Platelets are responsible for stopping blood loss and are part of the clotting process. If you cut or otherwise injure yourself, platelets form “plugs” to stop your precious blood escaping. Some medications and diseases can inhibit platelet formation, in particular haemophilia and anti-coagulants such warfarin.



**Plasma**

Plasma is the carrier medium in which all the other blood cells are supported and transported. It also contains proteins and other nutrients, electrolytes, gases, enzymes, minerals, vitamins and metabolic waste products. Plasma is 91.5% water and 8.5% solids and solutes.

## THE HEART

Of all the muscles in the body, the heart is arguably the most important as its sole job is to pump life-giving blood and therefore oxygen around your body. An average heart will beat over 3-billlion times in a lifetime and if it stops prematurely or its function is in some way inhibited, major and potentially terminal health issues will ensue.

In simple terms, the heart is a fist-sized, four-chambered muscular pump located slightly left of centre in your chest behind your sternum.

The heart is divided into two sides – left and right. Each side functions independently of the other and has a different job. The left-hand side of the heart receives and pumps out oxygenated blood while the right-hand side receives and pumps out deoxygenated blood.

Remember, when describing the heart, left and right are reversed so imagine you are describing the heart of someone facing you rather than your own heart.

There are four chambers in total; two upper chambers called atria (the plural of atrium) and two lower chambers called ventricles. The atria are the receiving chambers and the ventricles are the ejecting chambers. The term atrium comes from the Latin for entranceway and houses often have atriums which, in more modern language, are called hallways. The ventricles eject or vent blood out of the heart. This is an easy way to remember which chambers are which.

Of the four chambers, the ventricles have to work the hardest and so they are the largest and most powerful with the left ventricle being the biggest as it has to pump blood the furthest. As the ventricle contracts to eject blood, it is said to be in systole whereas when it relaxes (and refills) it is said to be in diastole.

In contrast, the atria never have to pump especially hard as they are only pushing blood into the next chamber. Blood enters the atria partly because of gravity and partly because of the pressure in the blood vessels; they do not have to contract very hard at all and so are considerably smaller and less muscular than the ventricles.

**Heart control and rhythm**

The speed and power of each heart beat is controlled by something called the conductive system which ensures the chambers contract in a synchronised rhythm rather than all four chambers contracting at the same time. Your heart's natural "pacemaker" is a bundle of nerves called the sinoatrial node or SAN for short. Along with the atrioventricular node or AV node, your heart will speed up when more blood needs to be pumped around the body e.g. during exercise, and slow down when less blood is needed e.g., while you sleep.

The average resting heart rate is 72 beats per minute (bpm) although an exercising heart can beat over 200 times per minute. A resting heart rate above 72 bpm is called tachycardia while a resting heart rate of 60 bpm or less is called bradycardia. Low resting heart rates are generally seen as an indicator of good circulatory fitness but this is not always the case and unexpected low resting heart rate readings should be investigated.



**Heart valves**

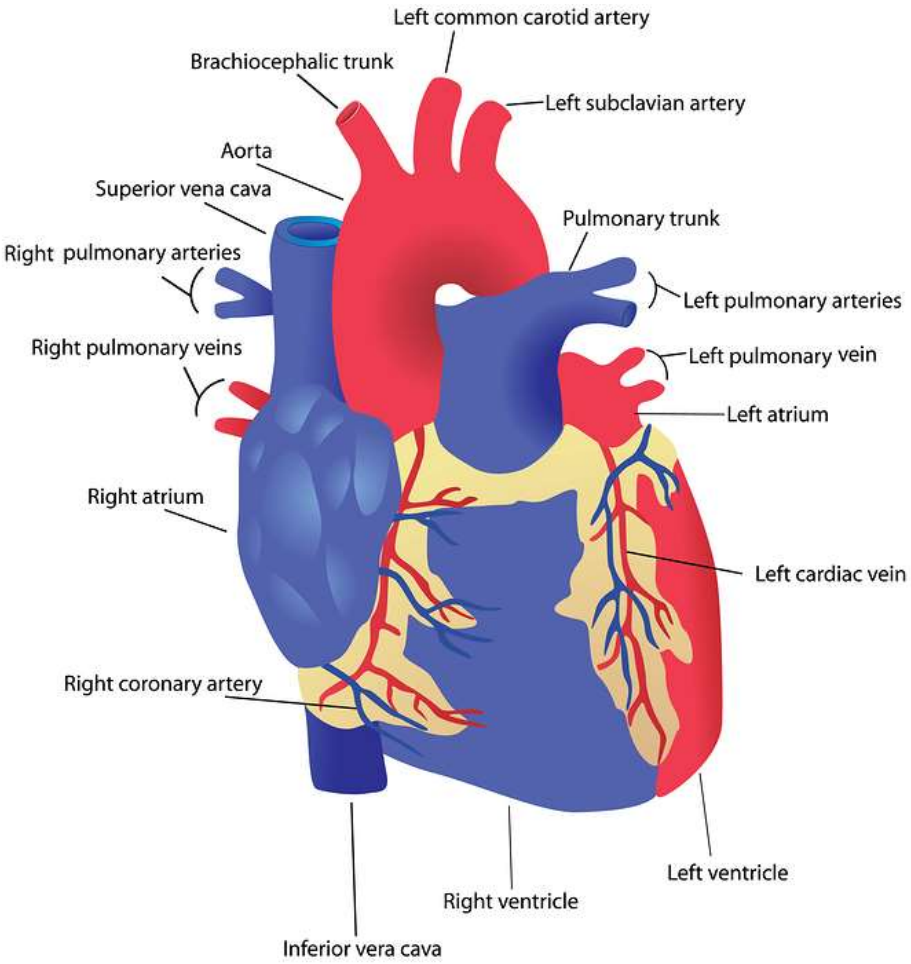
Blood always flows from atrium to ventricle and there are valves that prevent the backflow of blood. The valves between the atria and the ventricles are called the atrioventricular valves or AVs for short.

There are also several other valves in and around the heart; the pulmonary valve prevents blood flowing back into the heart from the pulmonary artery while the aortic valve stops blood re-entering the heart from the aorta. Heart valves are tricuspid which means they are made up from three sections.

**Heart circulation**

As previously discussed, the two sides of the heart have different jobs. The left side receives and pumps oxygenated blood around the body whereas the right side receives and pumps deoxygenated blood back to the lungs. The process of returning deoxygenated blood back to the heart is called venous return. Oxygenated blood is bright red in colour whereas deoxygenated blood tends to have a bluish hue.

Air is inhaled and passes through the pharynx, larynx, trachea, primary bronchi, bronchioles, and then reaches alveoli where oxygen is



extracted and diffused into blood via the capillaries

**Oxygenated blood enters the left atrium via the pulmonary vein**

Oxygenated blood flows from the left atrium to the left ventricle and then is pumped from the left ventricle and into the aorta to be circulated around the body. This is called systemic circulation

**The oxygen is used by the cells, organs and systems of the body and carbon dioxide is produced**



Deoxygenated ($CO_2$ rich) blood is then directed back to the heart via the superior and inferior vena cava where is enters the right atrium and is pumped into the right ventricle

From the right ventricle, the deoxygenated blood is pumped into the pulmonary artery and sent back to the lungs where its payload of $CO_2$ diffuses into the alveoli via the capillaries for exhalation and blood is then re-oxygenated. This is called pulmonary circulation

**Blood vessels**

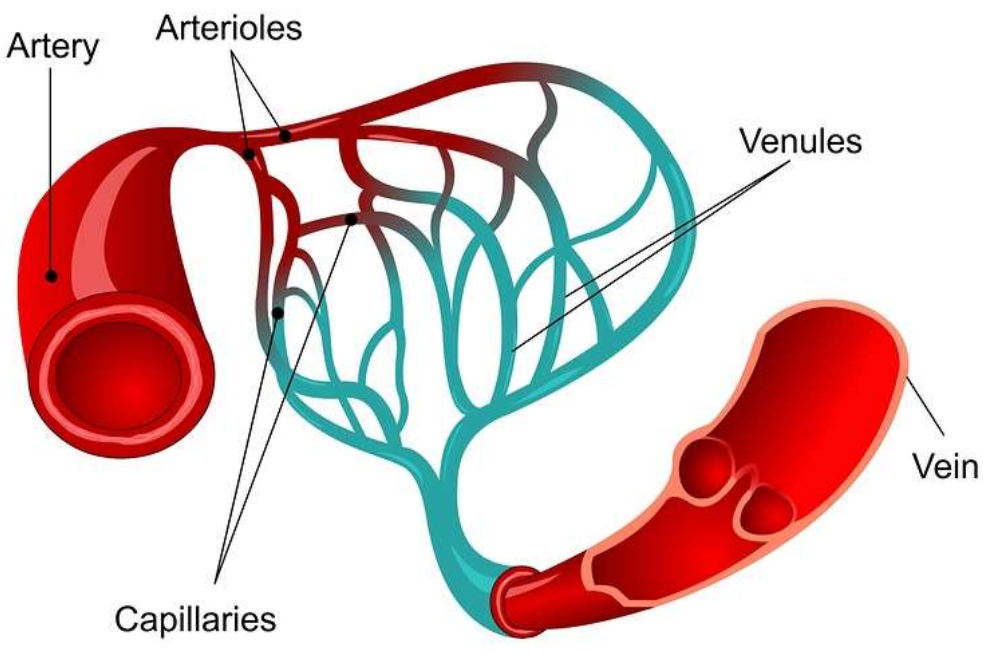
Blood vessels are hollow tubes made from smooth muscle whose function is to transport blood around the body and although there are different types of blood vessel it's important to always remember that they all form a closed, continuous loop and each blood vessel splits to form another type of blood vessel or joins to another blood vessel.

There are three main types of blood vessels:

- **Arteries**
- **Veins**
- **Capillaries**

There are also two sub-categories of blood vessel:

- **Arterioles – small arteries**
- **Venules – small veins**



**Peristalsis**

Made from smooth muscular tubes, all blood vessels can contract. When they contract they squeeze inward and that helps to push the blood they contain along their length. This is called peristalsis. To understand peristalsis, imagine a snake swallowing an egg; the walls of the snake's digestive tract push inward and, using a wave-like motion, push the egg down the length of the snake's body.

**Arteries**

Thick and muscular, arteries are under tremendous pressure and their physical characteristics reflect this. They always carry blood away from the heart hence the high pressure within them. The largest artery in the body is the aorta. They are elastic so that they can expand as the heart beats. If you place your fingertips on your radial artery, just below your thumb on the side of your wrist, you can feel the artery expand each time your heart beats. This is called your radial pulse.



**Veins**

Veins take blood back toward your heart. Under considerably less pressure than arteries, they are not as thick or as muscular. Because they are under less pressure, it is possible that blood could flow backward through a vein so to prevent this, veins have one-way valves to ensure blood does not flow back from whence it came. These one-way valves sometimes go wrong and blood pools within sections of veins. This condition is commonly called varicose veins.

**Capillaries**

One cell thick to allow diffusion, capillaries are semi-permeable to allow various substances pass through them. Capillaries spread through all parts of the body so they can deliver or pick up essential substances. There are more capillaries than any other type of blood vessel and a high density area of capillaries is called a capillary bed. Exercise can cause an increase in the number of capillaries; this is called capillarisation.

**Venous return**

The flow of blood back to the heart via veins (often against gravity) is called venous return. The pressure in the veins is relatively low and so several mechanisms combine to ensure that blood circulates in a timely fashion…

**Peristalsis** – the smooth muscular walls of the veins contract to push blood upward and against gravity

**Skeletal muscle pump** – as skeletal muscles contract, they push against the walls of the veins which in turn pushes the blood through them

**One-way valves** – to prevent the back flow of blood and aid venous return, veins have valves which prevent blood from flowing the wrong way or from "pooling" in one area

**Right atrium** – as the right atrium refills, it creates a slight vacuum effect and pulls blood into it

**Diaphragm** – as it relaxes and returns to its slightly domed position, the diaphragm creates a vacuum in the abdominal cavity which helps draw blood upward

**Gravity** – blood from above the heart flows downward to the right atrium via the superior vena cava and is aided by gravity

**Control of blood flow**

While every part of your body needs oxygen and therefore blood, some areas need more than others at certain times. For example, if you eat a large meal, your digestive system requires lots of blood and if you exercise, your working muscles and heart/lungs require lots of blood.

To ensure there is enough blood in the areas most in need, your body restricts blood flow to one area and increases it to another using vasoconstriction and vasodilation which basically means blood vessels are narrowed or widened respectively and on demand.

This vasoconstriction and vasodilation is why it's never a good idea to exercise after a heavy meal and why your muscles can look "pumped up" after a workout. Both vasoconstriction and vasodilation are possible because blood vessels are made from smooth muscular tubes that can contract or relax as required.

**Blood pressure**

The circulatory system is a closed system and as blood enters one area of the body, the same quantity of blood will be leaving another.

**Oxygenated blood:** Lungs -> pulmonary vein -> heart -> aorta -> arteries -> arterioles -> capillaries

**Deoxygenated blood:** Capillaries -> venules -> veins -> vena cava -> heart -> pulmonary artery -> lungs

This means that there is pressure within the blood vessels and that pressure varies constantly. While some variance is normal and necessary, blood pressure can become too high or too low. The standard definition of blood pressure is "the measure of the force that blood exerts against the walls of the arteries".



There are two measurements associated with blood pressure; systolic and diastolic.

**Systolic blood pressure** is the pressure within the arterial system when the heart beats.

**Diastolic blood pressure** is the pressure in the arterial system when the heart is refilling.

Subsequently, if you get your blood pressure checked, you will receive two readings – a higher reading (your systolic blood pressure) and a lower reading (your diastolic blood pressure). Blood pressure is normally expressed as one figure over another e.g. 130 over 70.

Blood pressure is measured in millimetres of mercury or mmHg. This unit of measure reflects the use of devices called mercurial sphygmomanometers which measured blood pressure against a vertical scale and how high a column of mercury moved during the test. Mercurial sphygmomanometers are no longer widely used but the same unit of measure still is.

**Blood pressure readings**

The optimal blood pressure reading is deemed to be 120mmHg systolic and 80mmHg diastolic. Blood pressure readings of 120/80 mmHg are linked to lower incidences of cardiovascular disease. High blood pressure readings are described as hypertension while low readings are described as hypotension.

Blood pressure is the result of several factors and changes to any of these factors can cause blood pressure to rise or fall accordingly. The three determinants are:

- **Cardiac output**
- **Peripheral resistance**
- **Blood volume**

Therefore blood pressure = cardiac output x peripheral resistance + blood volume

**Cardiac output**

Cardiac output is the amount of blood pumped by the heart in a minute. The higher cardiac output is the higher blood pressure will be. Cardiac output increases any time the heart beats harder or faster.

**Peripheral resistance**

Peripheral resistance is the resistance to the flow of blood through the blood vessels. Peripheral resistance can be affected by blood vessel dilation or constriction and may increase if arteries are blocked by atherosclerotic plaque.



**Blood volume**

Changes in blood volume can affect blood pressure readings. An injury resulting in blood loss would cause a drop in blood pressure whereas severe kidney problems or a diet high in sodium could lead to water retention and the corresponding increase in plasma levels would result in an increase in blood pressure.

**Blood pressure categories**

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

**Effects of exercise on blood pressure – short term**

As cardiac output increases with exercise, most forms of exercise will cause systolic blood pressure to increase. This response is linear and an increase in exercise intensity will cause a similar increase in blood pressure. This is not normally of any concern for healthy individuals as blood pressure should return to normal once cardiac output returns to normal. Cardiac output has the greatest effect on systolic blood pressure.

Diastolic blood pressure normally remains relatively unchanged or may even fall slightly when performing low to moderate intensity aerobic exercise.

However, heavy weight training and especially isometric contractions or where the breath is held to increase intra-abdominal pressure using the Valsalva manoeuvre (exhaling against a closed epiglottis) can increase

diastolic blood pressure in the short term. Again, in healthy individuals, blood pressure should normalise on cessation of exercise.

If an exerciser is hypertensive, care should be taken not to exasperate their health issues by straining so hard that diastolic blood pressure rises excessively. This means that hypertensive exercisers should avoid holding their breath and only exercise to form failure. It is also recommended that hypertensive follow a circuit weight training program rather than use the more traditional multi-set system and avoid overhead and declined exercises.



**Effects of exercise on blood pressure – long term**

Low to moderate intensity aerobic exercise has been shown to have a positive effect of cardiovascular health and can help normalise blood pressure in the long term. Regular aerobic exercise can lower systolic and diastolic blood pressure by an average of 10mmHg each.

**Measures associated with circulatory function**

There are several important measures associated with the circulatory system

The main measures are:

- Heart rate (HR) – the number of heart beats per minute
- Stroke volume (SV) – the amount of blood pumped in one beat
- Cardiac output (CO) – the total amount of blood pumped through the heart in one minute

Therefore cardiac output (CO) which is measured in millilitres per minute (ml/min) equals heart rate (HR) multiplied by stroke volume (SV) or CO = HR x SV

**The effect of exercise on circulatory measures**

Exercise effects the function of your heart and blood vessels, both acutely (as you exercise) and as a result to your body adapting to the exercise (chronically). These changes are caused by increased heart size and strength, increased blood vessel elasticity and increased blood volume.

| Measure | Acute | Chronic |
|---|---|---|
| **Heart rate** | Increases | Decreases |
| **Stroke volume** | Increases | Increases |
| **Cardiac output** | Increases | Unchanged |
| **Systolic blood pressure** | Increases | Normalises |
| **Diastolic blood pressure** | Increases* | Normalises |

* Especially due to heavy strength training

Each artery is responsible for delivering oxygen to some part of the heart. The heart also must have some mechanism to rid itself of blood that is now low in oxygen after supplying the tissues. This is done via coronary veins that carry the blood away, straight back to the heart. It will then be pumped to the lungs for re-oxygenation before again becoming part of coronary circulation.

**Disease effect on blood vessels**

Atherosclerosis is a condition where substance called plaque builds up in the walls of the arteries. This build up narrows the arteries, making it harder for blood to flow through. If a blood clot forms, it can stop the blood flow.



A **heart attack** occurs when the blood flow to a part of the heart is blocked by a blood clot. If this clot cuts off the blood flow completely, the part of the heart muscle supplied by that artery begins to die

An **ischemic stroke** (the most common type) happens when a blood vessel that feeds the brain gets blocked, usually from a blood clot

**Valsava effect and blood pressure**

Although proper breathing during exercise is one of the most important aspects of a safe and effective workout, *correct* breathing is not intuitive for most of us. Instead of breathing freely and openly during exercise, most people actually do the opposite.

When it comes to weight-training, most of us hold (or force) our breath as a means of handling intensity. Unfortunately, breath-holding obviates our ability to produce high intensity muscular contractions, and it can actually be dangerous. Breath-holding during exercise increases blood pressure rapidly and this can lead to fainting, painful Exercise-Induced-Headaches, or even stroke.

The fancy term for breath-holding is *Valsalva*. Taking its name from 17$^{th}$ Century Italian Anatomist, Anton Maria Valsalva, the *Valsalva Maneuver* (or simply, *Valsalva*) occurs when we attempt to forcibly exhale while keeping the mouth and nose closed.

## THE COMPONENTS OF FITNESS

To design effective exercise programs, instructors must have a good understanding of the concepts and components of fitness. Combined with knowledge of anatomy and physiology, this will allow them to produce programs that are appropriate for their client's needs, goals and current ability.

Fitness means different things to different people. For a runner, it could mean being able to run a marathon while for a less-sporty individual, it could mean being able to walk a mile while carrying bags of groceries. Subsequently, fitness can be defined in one of several ways:



1) The successful adaptation to a specific stressor

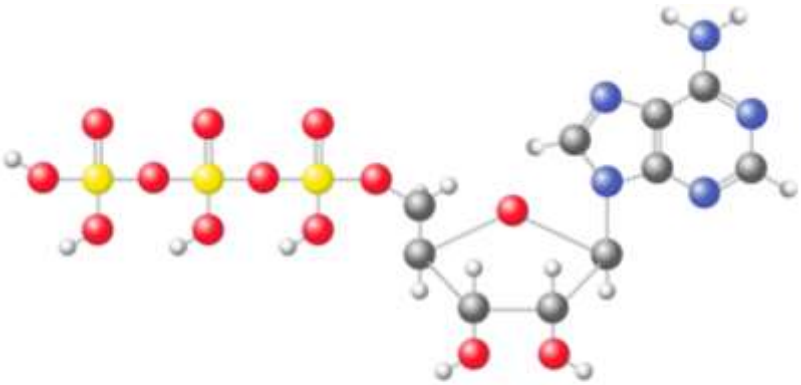
2) A state of well-being that provides for optimal performance

3) Attributes relating to how well one performs physical activity

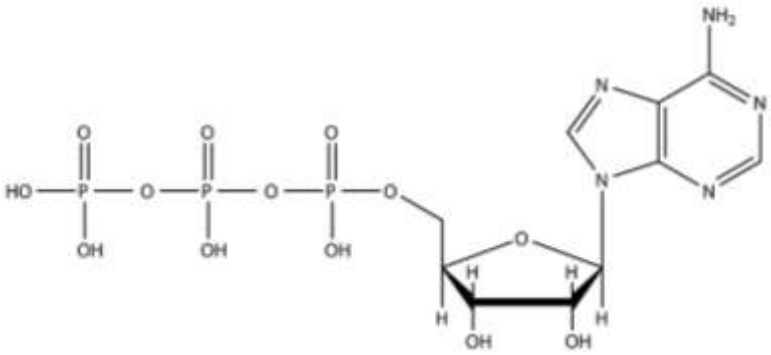
4) The ability to perform everyday tasks without undue stress or fatigue

## THE ENERGY SYSTEMS

The human body is, at its most basic level, a machine and like any machine it needs a supply of energy work. As a car needs petrol or a light bulb needs electricity, your body needs a substance called adenosine triphosphate which is known as ATP for short. ATP is the universal fuel for everything that happens in your body; from lifting weights to running to reading to sleeping – ATP is what powers your body.



ATP is made up of one adenosine molecule and three phosphate molecules. These molecules are held together by high energy bonds which, when broken, release energy for us to use. The result of this reaction is ADP (adenosine diphosphate), energy, and a lone molecule of phosphate.




We only have a very limited supply of ATP stored in our bodies – about enough for 1-2 seconds of activity – however humans convert food into APT to ensure that we always have plenty of energy. In addition to food, ATP can be manufactured from fat stored around your body and the carbohydrate reserves in your muscles and liver called glycogen.

Food + O2 + digestion = energy (ATP) + muscular contractions + CO2 + H2O + heat

Humans use three primary systems for creating ATP or regenerating ADP back into ATP for use by the body. There are two anaerobic e energy systems that operate without oxygen and one that requires an abundance of oxygen. The three energy systems are:

- **Creatine phosphate system – also known as the CP system, the phosphocreatine system or the anaerobic lactate system**
- **Lactate system – also known as the lactic acid system or the anaerobic glycolysis system**
- **Aerobic system – also known as the oxidative system**



While it is certainly easier to learn about and discuss each system in isolation, the reality is all three systems work together. However, the speed at which ATP is being used and needs to be produced dictates which system is doing the majority of the work. Therefore, they key phrase when discussing the role of energy systems in a particular activity is "predominately" i.e.:

**A tennis serve predominately uses the creatine phosphate system**

- **A 400-meter sprint predominately uses the lactate system**
- **A moderate one-hour group exercise class predominately uses the aerobic system**

**The creatine phosphate (CP) system**

The creatine phosphate system uses stored chemical energy to produce ATP and does not require oxygen or food. This makes it an anaerobic energy system. In your muscles you have a very limited supply of ATP waiting to be used. Once this is depleted, the creatine phosphate system quickly regenerates the resulting ADP back into ATP so more energy is available. This is achieved by creatine phosphate "giving" its phosphate molecule to the ADP to turn it back into ATP. This is a very rapid chemical reaction and can only be sustained for around 10-seconds because stores of creatine phosphate are also very limited.

Activities reliant the creatine phosphate system include short sprints, jumping, lifting heavy weights for low repetitions and any other intense, brief activities. The creatine phosphate system is most active during activities involving maximal volitional effort.

Because activities involving the creatine phosphate system are so brief, despite the intensity, they have minimal impact on the cardiorespiratory system so while effort is very high, respiration and heart rate may remain relatively unchanged. How high would your heart rate be after a single maximum effort long jump? The creatine phosphate system take between 30-seconds to five-minutes to fully recover and repeating the activity before full recovery will a) reduce performance and b) push you more toward the lactate system.

**Lactate system**

The lactate system is the second anaerobic energy system and produces ATP from the incomplete breakdown of glucose in an oxygen-free environment hence its other common name; the anaerobic glycolysis system. The lactate system provides energy when a) the activity in question exceeds the capacity of the creatine phosphate system or b) the activity in question exceeds the capacity of the aerobic system.

Glucose is constantly being converted into ATP within your body by cells called mitochondria. The incomplete breakdown and conversion of glucose to ATP results in the formation of a by-product – lactic acid.



At low levels of intensity, lactic acid levels are very low and any accumulation is easily removed.

However, as the level of activity intensity rises, lactic acid production can exceed the body's ability to remove it and this is a problem. The accumulation of lactic acid above the body's ability to disperse it will ultimately necessitate the reduction or cessation of activity.

This phenomenon is known as the onset of blood lactic acid or OBLA for short and is characterised by some or all of the following:

- **Burning sensation in the working muscles**
- **Rapid heart and breathing rate as the body strives to disperse the lactic acid with oxygen**
- **Loss of coordination and, ultimately, the need to stop or reduce exercise intensity.**

The lactate system is very active in activities such as longer sprints lasting 30-seconds or more, boxing, start-stop sports such as soccer and rugby and anytime short but intense activities lasting 30-seconds to 3-minutes are performed.

Interval training, periods of high intensity work alternated with periods of rest, can help improve the ability to tolerate and subsequently deal with OBLA more effectively and efficiently.

The lactate system takes 20-minutes to two-hours to fully break down accumulated lactic acid however it only takes between one to three-minutes for lactic acid levels to fall sufficiently for activity to resume.

**Aerobic system**

Meaning "with oxygen", the aerobic or oxidative system produces ATP from the complete breakdown of carbohydrate and fat. The lower the intensity, the more fat is used and the higher the intensity, more carbohydrate is used. Because both fat and carbohydrate are "burnt" to produce ATP, it is often said that fat burns in the flame of carbohydrate.

The aerobic system can only provide meaningful amounts of ATP when oxygen is abundant i.e. at low to moderate levels of intensity such as while at rest or while walking or jogging.

Unlike the lactate system, the aerobic system produces no fatiguing waste products and while lactic acid is produced, the amounts are very small and are easily dispersed. However, the breakdown of fats and carbohydrates in an oxygen-rich environment does produce the following:

- **Carbon dioxide**
- **Water**
- **Heat**

Different fuel sources produce differing amounts of energy. The complete breakdown of one carbohydrate-derived glucose molecule yields 262 kcal (thousandth of a calorie) while the complete breakdown of one fat-derived molecule of fatty acid will yield 3360 kcals. However, and despite fat providing much more energy per molecule, carbohydrate is the preferred source of ATP in the body because it is released much more quickly.

All ATP, irrespective of which of the three energy systems is responsible, is produced in cells called mitochondria. Aerobic energy production occurs in the organelles of the mitochondria while anaerobic energy production occurs in the cytoplasm surrounding the mitochondria. Mitochondria are best thought of as cellular power stations and the larger or greater the number of mitochondria present, the higher the potential for energy production.



**Oxygen uptake**

During aerobic activity and during the recovery from anaerobic activity, the cells of the body require oxygen. The aerobic system is essentially the "go to" energy system as once anaerobic activity has stopped, the aerobic system is always the system to which your body returns. The use of oxygen by the cells is called oxygen (or O2) uptake or consumption.

At rest, oxygen consumption is approximately 3.5 millilitres per kilogram of bodyweight per minute (ml/kg/min). This value is also known as one metabolic equivalent or one MET for short. As activity intensity increases, so do does oxygen uptake which is mirrored by an increase in heart and breathing rate.

The maximum amount of oxygen that a person can take in, transport and utilise during exercise is called the VO2 max and is a commonly assessed measure used to identify an exerciser's fitness level as well as predict their performance. The greater the potential for oxygen uptake, the higher the VO2 max, the higher the fitness level of the test subject would be.

However, the person with the highest VO2 max score may not necessarily be the winner of an event or race as things like strategy, lactic acid tolerance, mental toughness, recovery, nutritional status and motivational state all play a part in physical performance.

**Adaptations to aerobic exercise**

There are several adaptions that occur as a result of aerobic exercise performed at the appropriate intensity:

Increased number of red blood cells which allows for easier transportation of oxygen to and removal of carbon dioxide from the muscles

Increased lung efficiency so that greater amounts of oxygen can be diffused into the blood and greater amounts of carbon dioxide can be removed

Increased capillarisation at the muscles so that greater amounts of oxygen can be supplied to the working muscles.

**Energy system summary**

**Energy pathways**

| | CP system | Lactate system | Aerobic system |
|---|---|---|---|
| **Aerobic/anaerobic** | Anaerobic | Anaerobic | Aerobic |
| **Energy source** | Creatine phosphate | Glucose | Glucose and fat |
| **Quantity of ATP produced** | Very limited | Somewhat limited | Unlimited |
| **By-product/waste product** | None | Lactic acid | CO2, H2O & heat |
| **Duration** | 1-10 seconds | 30-seconds to 3-minutes | Long duration |
| **Intensity** | 95-100% max. effort | 60-95% max. effort | <60% max. effort |
| **Recovery** | 30-seconds to 5-minutes | 20-minutes to 2-hours | Sufficient time to eat and drink |
| **Dominant muscle fibre type** | Type 2b | Type 2a | Type 1 |



**The energy continuum**

While it should be remembered that at no point do we use one of the three energy systems in isolation, it is possible to identify which system is most dominant in any given activity. This is useful when designing sports-specific exercise programs for athletes.

**The Endocrine System Essentials**

The endocrine system is made up of a network of glands. These glands secrete hormones to regulate many bodily functions, including growth and metabolism. Endocrine diseases are common and usually occur when glands produce an incorrect amount of hormones.

Simply put, the endocrine system is a network of glands that secrete chemicals called hormones to help your body function properly. Hormones are chemical signals that coordinate a range of bodily functions.

The endocrine system works to regulate certain *internal* processes. (Note: *endocrine* shouldn't be confused with *exocrine*. Exocrine glands, such as sweat and salivary glands, secrete externally and internally via ducts. Endocrine glands secrete hormones internally, using the bloodstream.)

The endocrine system helps control the following processes and systems:

- Growth and development
- Homeostasis (the internal balance of body systems)
- Metabolism (body energy levels)
- Reproduction
- Response to stimuli (stress and/or injury)

## THE ENDOCRINE NETWORK

The endocrine system completes these tasks through its network of glands, which are small but highly important organs that produce, store, and secrete hormones.

The glands of the endocrine system are:

- Hypothalamus
- Pineal Gland
- Pituitary Gland
- Thyroid
- Parathyroid
- Thymus
- Adrenal
- Pancreas
- Ovaries
- Testes



These glands produce different types of hormones that evoke a specific response in other cells, tissues, and/or organs located throughout the body. The hormones reach these faraway targets using the blood stream. Like the nervous system, the endocrine system is one of your body's main communicators. But instead of using nerves to transmit information, the endocrine system uses blood vessels to deliver hormones to cells.

### Endocrine Diseases

To ensure that everything runs smoothly (that is, your body functions as it should), certain processes must work properly:

- The endocrine glands must release the correct amount of hormones (if they release too much or too little, it is known as hormone imbalance).
- Your body also needs a strong blood supply to transport the hormones throughout the body.
- There must be enough receptors (which are where the hormones attach and do their work) at the target tissue.

Those targets must be able to respond appropriately to the hormonal signal. The model here would be like primary hypothyroidism, where the pituitary produces TSH, the TSH is carried via the bloodstream to the thyroid, the thyroid has the appropriate receptors, but for whatever reason it isn't able to effectively make or secrete thyroid hormone.

Endocrine diseases are common and happen even when one step in the process doesn't work as it should. If you have an endocrine disease or disorder, you may consult a specialist known as an endocrinologist who will effectively diagnose and help treat your condition.

**Endocrine Disorders**

- Addison's Disease
- Graves' Disease
- Hyperparathyroidism
- Hypothyroidism
- Osteoporosis
- Thyroid Cancer
- Thyroiditis
- Adrenomyeloneuropathy
- Type 1 Diabetes
- Type 2 Diabetes



| | | | |
|---|---|---|---|
| **Growth Hormone (GH)** | Bones, cartilage, muscle, fat, liver, heart | | Acts to promote growth of bones and organs |
| **Thyroid gland** | Thyroxine (T4) | Most tissues | Acts to regulate the body's metabolic rate |
| | Tri-iodothyronine (T3) | Most tissues | Acts to regulate the body's metabolic rate |
| **Insulin** | Muscle, fat tissue | | Acts to lower blood glucose levels |
| **Glucagon** | Liver | | Acts to raise blood glucose levels |

**Corticosteroids** are a class of steroid hormones that are produced in the adrenal cortex of vertebrates, as well as the synthetic analogues of these hormones. Two main classes of corticosteroids, glucocorticoids and mineralocorticoids, are involved in a wide range of physiologic processes, including stress response, immune response, and regulation of inflammation, carbohydrate metabolism, protein catabolism, blood electrolyte levels, and behavior.

**Catecholamines** are derived from the amino acid tyrosine, which is derived from dietary sources as well as synthesis of phenylalanine. Catecholamines are water-soluble and are 50%-bound to plasma proteins in circulation.

Included among catecholamines are epinephrine (adrenaline), norepinephrine (noradrenaline), and dopamine. Release of the hormones epinephrine and norepinephrine from the adrenal medulla of the adrenal glands is part of the fight-or-flight response.

**Total fitness**

Total fitness is made up of five components and while the physical aspect of fitness is usually the focus of an exercise program, the other components are equally important:

| | |
|---|---|
| **Physical fitness** | i.e. muscular strength, endurance, flexibility etc. |
| **Skill-related fitness** | i.e. balance, coordination etc. |
| **Mental and emotional fitness** | i.e. a positive, stress-free mental state |
| **Medical fitness** | an absence of illness and disease |
| **Nutritional fitness** | following a healthy, nutritious diet |
| **Social fitness** | being able to interact with others |

A fitness instructor can have a positive influence on all of the above components however their main area of professional responsibility are physical, nutritional and skill-related fitness.



**The components of physical fitness**

There are five broad components of physical fitness:

**1. Cardiovascular fitness** – pertaining to the ability of the lungs and heart to take in, transport and utilise oxygen, cardiovascular fitness can be improved by performing activities such as jogging and swimming at low to moderate intensities for extended periods of time. Cardiovascular fitness is inextricably linked to cardiovascular health.

**2. Muscular strength** – strength is the ability to generate force. Strength is important because stronger muscles make strenuous everyday tasks easier and the pursuit of strength has a positive influence on bone mass.

**3. Muscular endurance** – muscular endurance is the ability of the muscles to generate low levels of force for an extended period of time e.g. the demand on the leg muscles when climbing a long flight of stairs. A good level of muscular endurance can make many daily tasks easier including gardening, high-repetition exercise and maintaining good posture.

**4. Flexibility and mobility** – the ability to move a joint or joints through a wide, healthy range of movement is defined as flexibility while the health and fluidity of movement of a joint is defined as mobility. Flexibility and mobility are essential for optimal muscular and skeletal function as well as health. Poor flexibility and/or mobility can make many every day and sporting activities difficult and can lead to postural issues.

**5. Body composition** – describing the relationship between fat and lean body weight, body composition is much more important than body weight and all exercisers should strive to achieve optimal body composition. Body composition is influenced by exercise, diet and general lifestyle and a high level of body fat will not only damage fitness levels; it can also damage health.

A healthy level of body fat for men is deemed to be between 13 to 17-percent while for women, 20 to 25-percent is the healthy range. Athletes are sometimes leaner than the low end of these scales and usually experience better performance if they are between 7 to 16-percent for men and 10 to 20-percent for women.

**Skill related fitness**

Skill-related fitness refers to the interaction between the nervous system and the muscular system. There are seven components of skill-related fitness:

**1. Speed** – speed as about quickness of movement whether it is running speed or the ability to throw a quick jab in boxing. Speed is part of virtually every sport and can be developed through training although top-end speed is limited by genetics and dominance of muscle fibre type.



**2. Power** – power is force developed quickly. Where strength has no real speed component, power does. For example, a very heavy squat, where the weight moves slowly, is an example of strength while an explosively performed vertical jump is an example of power. Power is an important part of many sports and activities.

**3. Reaction time** – the ability to respond quickly to a stimulus, such as a starter's pistol, is called reaction time but is sometimes called reflex time. Reaction time is dependent of the speed of sensory and motor nerves working together and can be trained.

**4. Coordination** – the ability to move multiple limbs harmoniously and accurately is called coordination. While some people are definitely more coordinated than others, coordination can be practiced and improved. All sports and many everyday activities require coordination.

**5. Balance** – defined as the ability to keep the centre of mass over the base of support e.g. standing on one leg or maintain a handstand. Balance is especially important for older people who are prone to suffering falls.

**6. Proprioception** – the ability to sense where limbs are placed by feel alone is called proprioception. For example, maintaining neutral spine alignment despite not being able to see the position of your back.

**7. Agility** – rapid changes of direction, being able to overcome obstacles and general athleticism all come under the banner of agility. Agility is the combination of all the preceding components.

**Factors that influence health and fitness**

If you place different two people on the same exercise program, their results are very likely to be different. No two-people respond exactly the same way to exercise. There are several factors that influence how people respond to exercise and the results they will experience.

**1. Age**

Potential for fitness tends to peak in the 20s and early 30s and decline thereafter although this decline can be offset by regular exercise. With age, muscles get weaker, joints become worn, hormone levels decline, reflexes slow and body fat levels increase. Older people are also less able to tolerate high volume/high intensity exercise and require more rest.

**2. Gender**

Men have more testosterone than women and as such have a greater potential for muscle mass and strength. Women, because of the hormone relaxin, tend to be naturally more flexible than men. However, both women can develop impressive levels of strength and men can be very flexible with the correct training.

**3. Physique/body type**

The body type of an individual will have a profound effect on their ability to develop fitness. For example, a heavily built, naturally muscular person is better suited to rugby than long distance running. The usual system for classifying body types is called somatotyping although it is important to note that most people are made up from a mixture of the three main body types.

**Ectomorphs** – naturally slim, lightly muscled, narrow in the shoulders and hips, ectomorphs usually find gaining weight very difficult and are well-suited to endurance sports such as running or cycling where their light bodies will be advantageous.

**Mesomorphs** – with a tendency to be naturally lean and muscular, mesomorphs usually have wide shoulders and narrow waists and tend to be athletic and strong having a good strength to weight ratio.



**Endomorphs** – with a propensity toward fat storage, endomorphs are usually "apple" or "pear" shaped but, despite high body fat levels, are usually also reasonably muscular. Heavy throwing events such as the hammer or shot-put as well as weightlifting are good activities for endomorphs.

Identifying a client's basic body type can be important when ensuring that proposed goals are viable. For example, an ectomorph needs to understand that they are not structurally well-suited to building large amounts of muscle while a mesomorph may need to reconsider thoughts of becoming an elite-class distance runner. However, it should also be noted that hard work and smart programming can still produce excellent results irrespective of the underlying somatotype.

**4. Diet**

For the body to adapt to exercise, it needs a broad range of nutrients including protein and carbohydrates, vitamins and minerals. A low-quality diet can adversely affect gains in fitness.

**5. Activity level**

A few hours of exercise per week will not be sufficient to develop a good level of fitness if, for the other 165-hours a week, the client is sedentary. Conversely, if the client is so active that they cannot effectively recover from the training sessions, they will not experience such noticeable improvements in fitness.

**6. Physical disabilities**

As demonstrated in the Paralympics, people with disabilities can be very fit and strong but, in cases of the body not functioning as it should, a physical disability may place limits on fitness and performance.

**7. Illness and fatigue**

Illness and tiredness can diminish physical performance as both interfere with not only exercise but the recovery from exercise. In some cases, too much exercise – a condition called overtraining – can cause both illness and fatigue.

**8. Drugs**

Pharmaceutical and recreational drugs can adversely affect fitness. Instructors should ask clients if they are taking any prescription or recreational drugs prior to exercise so any potential contradictions should be investigated. If in doubt, the instructor should refer the client to a medical professional.

**9. Stress**

Stress increases the production of the catabolic (breaking down) hormone cortisol and can also cause an elevation of blood pressure, increase the prevalence of heart disease and trigger stress-eating. Stress, therefore, can have an adverse effect on fitness.

**10. Environment**

Water, food and air-borne-toxins can have an adverse effect on fitness and health. Fumes from traffic can significantly impair aerobic function and so too can exercising at altitude. Weather can also effect exercise intensity and duration.

**Health benefits of physical activity**



Exercise has a profound and beneficial impact on not just fitness but health too. In fact, too little exercise has been shown again and again to be the cause of various medical conditions. Despite the message that exercise is "good for you", a large percentage of the population are still so inactive (hypokinetic) that their long term health is at risk.

**Current guidelines for physical activity suggest that:**

- Significant health benefits can be gained by being moderately active for 30-mintes most if not all days of the week
- There are additional health benefits to being active for longer or engaging in more vigorous activity

**Regular physical activity has been shown to:**

- Reduce mortality rates in young and older adults
- Reduce the risk of death from cardiovascular disease, coronary heart disease and other conditions of the cardiorespiratory system
- Lower risk of developing certain cancers including colon cancer where the risk is halved
- Reduce impairment due to osteoarthritis
- Increase bone mass and so reduce the risk of osteoporosis
- Reduce the risk of falls in older adults
- Effectively prevent and treat obesity and weight gain
- Reduce the risk of developing and help manage the symptoms of type 2 diabetes
- Improve mental health and relieve depression and stress
- Increase general quality of life by enhancing physical and psychological well-being

**Effects of exercise on the body**

Exercise has a profound and powerful effect on the body. Effects are acute i.e. occur during exercise, and chronic i.e. happen in the days or weeks following a workout. The acute effects of exercise include increased heart and breathing rate, warmer muscles and increased synovial fluid production in the joints however most exercisers are more interested in the long term effects of exercise.

Exercise is a form of stress, albeit a "good" stress. When exposed to a stress, the body responds or adapts to the stress so that, when exposed to a similar stress, it will be better able to cope. Exercise effects virtually every system of the body but, for fitness instructors, the most relevant are the cardiovascular and neuromuscular systems.

The effect of exercise on the cardiovascular system

**Heart**

- Ventricular hypertrophy (heart size increases)
- Increased contraction strength
- Increased stroke volume
- Increased cardiac output
- Decreased resting heart rate
- Decreased risk of heart disease
- Decreased risk of heart attack



**Blood vessels and blood chemistry**

- Improved blood lipid profile
- Increased haemoglobin levels
- Increased blood volume
- Reduced systolic and diastolic blood pressure

Regular aerobic exercise has been shown to reduce both systolic and diastolic blood pressure by as much as 10 mmHg in mild to moderate hypertensives. However, and with the exception of circuit weight training, exercising with weights shows no such benefit and may actually increase diastolic blood pressure.

**Lungs**

- Increased functional capacity during exercise
- More efficient diffusion of respiratory gasses
- Increased vital capacity
- Improved integrity of respiratory muscles

In addition to effecting the cardiovascular system, exercise also positively effects metabolic and mental function.

**Metabolic function**

- Decreased insulin resistance/improved insulin sensitivity
- Reduced body fat
- Increased maximal oxygen uptake – $VO_2$ max
- Increased metabolic rate after exercise

**Psychological changes**

- Improved self-image
- Decreased depression, stress and anxiety
- Increased feelings of achievement
- Distraction from daily routine

**Effect of aerobic exercise on the skeletal systems**

As the supporting structure of the body, the skeletal system also responds to aerobic exercise in the short and long term.

**Short term**

- Increased synovial fluid production
- Increased range of movement of joints

As a result of increased range of movement, joints become more mobile and, as synovial fluid is a lubricant, the joint is protected from wear and tear. Synovial fluid also nourishes the articular surface of the joint which will help to keep the joint healthy.



**Long term**

- Stronger ligaments
- Increased bone mass
- Reduced loss of bone mass commonly associated with age

It should be noted that the above adaptations are more pronounced with resistance training.

**Effect of aerobic exercise on the muscular system**

Muscles are the engines that drive your body and it is here that the adaptions to exercise are usually the most visible. With aerobic training, it is the type 1, slow twitch, muscle fibres that are predominately effected.

**Short term**

- Vasodilation
- Blood pumped preferentially to working muscles
- Possible DOMS – delayed onset muscle soreness
- Blood pooling

**Delayed onset muscle soreness** normally manifests in the hours and days following harder than normal exercise; typically 12 to 72 hours. It is especially common after starting a new exercise program or sudden increases in exercise volume or intensity.

DOMS is most commonly associated with the eccentric or lengthening portion of an exercise e.g. the descent into a squat or running downhill.

Although not conclusive, research suggests that DOMS is caused by micro trauma or microscopic tears to the muscles which results in an inflammatory response. One thing is clear, severe DOMS does not necessarily indicate a workout has been especially productive and that some people are more prone to DOMS than others. Instructors should understand that if DOMS is especially severe, it can be enough to put a client off of exercise altogether.

**Blood pooling** describes how blood is preferentially directed to the working muscles and then, when exercise ceases, some remains in that area until venous return occurs fully. Blood pooling is most commonly observed in the large muscle groups of the lower body. This can give rise to symptoms of nausea, dizziness and feinting but can be avoided by doing low-intensity cardiovascular exercise as part of the cool down to facilitate venous return.

**Long term**

Most changes to the muscular system as associated with resistance training rather than cardiovascular training however, any repetitive activity such as running or cycling will:

- Improve muscular efficiency
- Increase capillarisation of the muscles
- Increase enzymatic function within muscle cells
- Increase glycogen and creatine phosphate stores
- Increase size and number of mitochondria



**Effects of resistance training on the muscular system**

While aerobic exercise has a beneficial role to play in muscular endurance and conditioning, overload is generally insufficient to trigger meaningful adaptions in terms of strength and/or power in any but the most deconditioned exerciser.

If the goal is to improve the condition of the muscular system, resistance training is the best exercise option. Effects can be short term or long term and predominately effect the type 2a and type 2b muscle fibres. Note; some adaptations are also caused by aerobic exercise.

**Short term**

- Vasodilation
- Blood pumped preferentially to working muscles
- Possible DOMS – delayed onset muscle soreness
- Blood pooling

**Long term**

- Decreased nervous inhibition leading to increased strength, power and speed
- Increased cross-sectional size of muscle fibres – properly called hypertrophy
- Increased glycolytic activity allowing for more work to be done under anaerobic conditions
- Increased creatine phosphate and glycogen stores
- Increased capillarisation
- Increased tendon strength

**Exercise and posture**

Long periods of inactivity or sitting down can have an adverse effect on posture; posture being the optimal alignment of a joint or joints. In addition, badly designed programs that place an emphasis on a limited number of muscles or activities that are very repetitive can also adversely affect posture.

Sitting, arguably the most negative postural stress, encourages a rounded upper back and protracted shoulders as well as a forward head position. Sitting using a computer keyboard is a prime example of another "posture buster" and a habitually rounded upper back is commonly referred to as hyper kyphosis. This hyper kyphotic posture then becomes the norm – even in the standing position.



Poor posture is caused by shortened muscles, poor flexibility, a lack of strength in the muscles responsible for maintaining good posture against gravity and bad habits such as slouching.

As sedentary jobs and subsequently poor posture are so common, instructors should endeavour to include stretches and strengthening exercises in their training programs which help to undo the damage of habitual sitting and slouching. This generally involves stretching the muscles on the front of the body and strengthening those on the back.

Exercises that meet the following criteria will also help address postural issue:

- Involve a full range of movement
- Be compound, functional movement patterns
- Are performed standing and/or unsupported
- Utilise free weights and cables rather than machines

Instructors should also ensure that there is an equal volume of pushing and pulling exercises and that dynamic and static stretches are utilised. Care should also be taken to ensure that all prescribed exercises are performed using good form.

**Resistance training**

There are many forms of resistance training, also known as strength training and weight training. Some clients approach resistance training with a degree of caution because they incorrectly confuse resistance training with bodybuilding or weight lifting.

While there are some similarities between all activities that involve lifting weights, resistance training should be an essential part of all client's exercise programs irrespective of training goal, age or gender because it is incredibly beneficial.

**Benefits of resistance training**

**Morphological factors**

Muscle hypertrophy due to increases in number and size of myofibrils, size of type 2 muscle fibres, increased fluid retention around muscle fibres and increased glycogen and water storage within muscle cells

- Increased size and strength of ligaments and tendons
- Increased bone density and bone strength

**Neural factors**

- Increased motor unit activation, recruitment and synchronisation leading to increased force production
- Increase in discharge frequency of motor neurons
- Decreased neural inhibition leading to improved force production

**Biochemical factors**



- Small but meaningful increases in ATP and CP levels
- Increased testosterone and growth hormone production during and immediately after resistance training
- Increase in insulin sensitivity after resistance training

**Additional factors**

A program of resistance training may also:

- Increase, decrease or maintain body mass depending on exercise and dietary status
- Increase muscle mass
- Decrease fat mass and body fat percentage
- Improve bone and joint health
- Increase strength, power and endurance
- Improve posture
- Improve proprioception
- Increase metabolic rate
- Increase mobility, flexibility and range of movement
- Improve immune system function
- Increase functionality and make everyday tasks easier
- Improve sports performance
- Improve self-image

**Resistance training terminology**

Resistance training, like so many things associated with fitness and exercise, has a language all its own. It is essential that all instructors are not only familiar but are fluent in this language so they can effectively communicate with other instructors and trainers and also with their clients and while exercise names may vary region by region, the terminology that used to describe aspects of resistance training are all but universal.

**Repetitions** – a repetition, or rep for short, is one complete movement of an exercise normally consisting of a lifting phase and a lowering phase. Repetitions are usually prescribed in ranges i.e. 1 to 5, 6 to 12 or 13 to 20.

**Sets** – a group of repetitions performed continuously is called a set. Sets are broken up with periods of recovery lasting from 30-seconds or less to five minutes or more.

**Repetition maximum** – repetition maximum, RM for short, the maximum number of repetitions that can be performed in a single set before failure occurs. A 1RM means the most weight that can be lifted for a single repetition whereas a 10RM is the most weight that can be lifted 10-times. RM is usually given as an indicator of how much weight is to be used e.g. 75% of 1RM for three sets of five repetitions.

**Intensity** – intensity has two meanings; it can refer to how hard and/or painful an exercise or workout is or can relate directly to the percentage of the 1RM being used – the higher the percentage the more intense a workout is deemed to be. Unlike aerobic training, resistance training intensity has no correlation with heart rate as performing a 1RM of, say, bench press, while very intense, would not affect heart or breathing rate significantly.



**Volume** – volume is the amount of work done in a training session, a week, a month or other training period. Volume can be measured in terms of the number of sets performed or the total amount of weight lifted in a given timeframe. Many systems of training, especially bodybuilding and weightlifting, use a high volume approach.

**Compound exercises** – exercises that involve two or more joints simultaneously are deemed to be compound exercises. Compound exercises are, in most cases, more productive and functional. Examples of compound exercises include press-ups, squats, leg presses, lunges, lat pull-downs, dumbbell rows and deadlifts.

**Isolation exercises** – contrary to the name, isolation exercises no not work single muscles in isolation but, instead, isolate joints. Isolation exercises include leg extensions, leg curls, calf raises, biceps curls, pec deck flyes and abdominal crunches. Isolation exercise are not as effective as compound exercises as they are less functional but they are still useful.

**Hypertroph**y – developing bigger muscles is a process called hypertrophy. Hypertrophy is the result of an increase in the cross-sectional size of the muscle fibres actin and myosin and an accumulation of sarcoplasmic fluid inside the muscles. Moderate loads and a high volume of training with short to moderate rests are key features of hypertrophy training, as are multiple exercises per muscle group.

**Anabolism** – the process of building structures in the body is called anabolism. Hypertrophy, discussed above, is an anabolic process. The primary anabolic hormones, the chemical messengers responsible for anabolism, are testosterone and growth hormone. Anabolic steroids are artificial anabolic hormones – usually testosterone.

**Catabolism** – the process of breaking down structures (think catastrophe) in the body is called catabolism and is the opposite of anabolism. Exercise is catabolic i.e. it causes breakdown of muscle tissue. However, after rest and recovery, the muscle tissue grows back bigger and stronger in the anabolic process.

**Types of resistance**

To achieve results from resistance training, muscles must be overloaded. That is to say they must be asked to do a little more work than usual. Overload can come from a number of different types of resistance:

- Free weights e.g. barbells, dumbbells, medicine balls, kettlebells

- Resistance machines e.g. cable or fixed-path
- Body weight e.g. exercises like press-ups and pull-ups
- Manual resistance e.g. force applied by a partner or opposing limb
- Isometrics e.g. contracting a muscle against an immovable object like a wall
- Resistance bands
- Water e.g. hydrotherapy, swimming wearing fins and/or hand paddles

While there are lots of ways to apply overload to your muscles, methods should be selected on merit and based on the needs of the client and, while an instructor may prefer one particular method for their own training, they should be sufficiently familiar with all methods for their client's usage.



**Roles of muscles during exercise**

Resistance exercises are normally chosen because they work a particular muscle group i.e. the bench press to work the chest. However, in any movement, a whole lot more is going on than the work done by the target muscle. Knowing the role of muscles in an exercise is important for several reasons including program design and avoiding overlapping exercises.

**Agonists** – also known as the prime mover the agonist is muscle that contracts to produce force and control the movement and is also the target muscle of the exercise.

**Antagonists** – the opposing muscle and the one that relaxes to allow movement to occur is called the antagonist. This muscle is only usually responsible for the opposite joint action.

**Synergists** – muscles never work in isolation and synergists assist the agonist by modifying the desired movement e.g. in the bench press, the pectoralis major is the agonist but the anterior deltoids and triceps are also involved to a lesser extent. Synergists can be thought of as secondary muscles.

**Fixators** – fixators fix joints in place so that they remain stable and the agonist can work efficiently. In the press-up, the core muscles fixate the spine to prevent the hips dropping. Fixators are also known as stabilisers.

With the help of your tutor, complete the following chart:

| | Shoulder press machine | Barbell biceps curls | Lat pull downs |
|---|---|---|---|
| **Agonist** | | | |
| **Antagonist(s)** | | | |
| **Synergist(s)** | | | |
| **Fixators(s)** | | | |

**Warm up and cool down**

While the main session, be it resistance training or aerobic training, is the productive part of any workout, going from sedentary to exercising hard is not a good idea as it will reduce the effectiveness of the workout and may result in injury and once the hard work is done, as tempting as it might be to do so, it is never a good idea to come to an abrupt halt. All of this means that instructors must ease their client into and out of exercise which requires well-deigned warm ups and cool downs.

**Warm ups**



Warm ups are designed to make you warm (!) and also make the transition from inactive to active as smooth and seamless as possible. A good warm up should prepare your joints, muscles, and neuromuscular system for the workout that follows.

A good warm up will:

- Raise your heart rate
- Increase your body temperature
- Mobilise your major joints
- Stretch your muscles in an appropriate way

Warming up should never be so intense that performance of the main session is compromised but neither should it be so gentle that it is ineffective.

A warm up should mimic the skills of the coming workout and be specific to the demands that face the client i.e. if the client's workout involves running, so too should the warm up. The same is true of resistance training. Warm ups generally consist of a graduated pulse raising activity, joint mobility exercises, appropriate stretching (usually dynamic in nature) and any drills necessary to fully prepare the client for the session to follow.

**Warming up has the following benefits:**

- Increased core temperature leading to improved vasodilation and better delivery of oxygen to working muscles
- Warmer muscles that will contract and relax more readily
- Metabolic processes in the muscles happen more rapidly and efficiently
- Muscle viscosity is reduced and so movement is smoother and more efficient
- Muscles are able to exert more force after an appropriate warm up because of increased neuromuscular facilitation
- Lactic acid production is reduced after a slow and gradual warm up
- Nerve impulses travel faster, reaction times decrease, balance, coordination and general nervous system function improves
- Improved cardiovascular response to strenuous exercise due to increased vasodilation
- Joints are lubricated with synovial fluid resulting in increased range of movement and reduced wear and tear
- Connective tissue and muscles becomes more flexible

- Mental and physical rehearsal effect

Although it is impossible to unequivocally say that warm ups prevent injury as people who have warmed up get injured too, it is safe to say that a good warm up that is specific to the workout that is to follow should reduce the risk of injury.

**Types of warm up**



There are three main types of warm up:

**Passive warm ups** – passive warm ups inevitably involve the use of a sauna, heat lamps, taking a hot bath, using a heat pack, donning extra clothes or getting a massage. While circulation can increase and so to can superficial muscle temperature, core temperature, joint mobility and cardiovascular function will remain largely unchanged. The main value of passive warm ups is continuing the warm up process after a more active warm up, preparing the body for a more active warm up or warming up when injured.

**Active general warm ups** – general warm ups are best used before general workouts and involve activities such as jogging and/or light calisthenics. They affect both cardiovascular and neurological systems and are more effective than passive warm ups.

**Active specific warm ups** – specific warm ups involve using movement patterns that are very similar or even identical to those of the coming workout but with reduced intensity. For example, doing several light but progressively heavier sets of deadlifts before a powerlifting workout. Specific warm ups also provide an opportunity to practice the skills that will be used in the coming workout; the more intense or skilful the workout, the more important specific warm ups become. Active specific warm ups are often proceeded with active general warm ups.

As a general rule, warm ups should be gradual and progressive and end when the client feels they are ready to start their main session. There is no set length to a warm up – it should be as long as necessary but no longer so energy is conserved for the main session. Cold weather, advancing age, injury or muscle soreness and the intensity of the workout to follow will all influence the length of the warm up.

**Cool downs**

Cool downs help return the body to its pre-exercise state and just as a warm up should be gradual, so too should a cool down. A sudden halt to physical activity can leave a client sore and suffering from DOMS and could cause blood pooling.

The objectives of the cool down are:

- Gradually decrease pulse rate
- Decrease body temperature
- Stretch muscles in the appropriate way

Cool downs generally involve a short period of aerobic exercise where intensity is gradually decreased over several minutes. This facilities venous return and prevents blood pooling. On completion of this "pulse lowerer", stretching is performed according to the needs of the client. Stretches are generally static in nature and are designed to maintain or improve the client's current level of flexibility.

**Flexibility**

Flexibility is best defined as the range of movement at a joint or joints and is influenced by joint structure, the shape of the bones and cartilage involved and the length and elasticity of the muscles the cross the joint.



Flexibility varies significantly from person to person and is specific to individuals. Poor flexibility can have an adverse effect on posture and function but so too can excessive flexibility or hypermobility.

While flexibility is, in many ways, genetic, some sports and activities are responsible for a reduction in flexibility. For example, long periods of sitting can shorten several important muscles including the hamstrings and hip flexors whereas jogging and cycling, activities that utilise a small range of movement, can also cause muscles to shorten. This phenomenon is called adaptive shortening.

Some activities are linked to or require a high degree of flexibility; the most obvious examples being dance, gymnastics and most martial arts.

Flexibility is developed by stretching which involves moving the muscle origin and insertion further apart. There are several notable benefits to stretching:

- Increased range of movement
- Reduced muscle tension
- Increased physical and mental relaxation
- Reduced risk of non-specific back pain
- Possible reduced risk of DOMS (delayed onset muscle soreness)
- Decreased muscle viscosity resulting in smoother movements
- Improved coordination
- Improved proprioception
- Improved circulation
- Improved posture
- Possible reduced risk of injury

**Factors affecting flexibility**

Flexibility can vary significantly from one individual to another and the potential for developing flexibility is, in part, limited by several factors.

**Age** – babies are very flexible but, as they start to walk and more joint stability is required, muscles begin to tighten up. Younger people tend to be naturally more flexible than older people and muscle elasticity tends to decline with age unless regular stretching is performed.

**Gender** – women tend to be naturally more flexible than men. The reasons are two-fold. Women have a higher amount of the hormone relaxin which does exactly what its name suggests – it relaxes soft tissue and muscle. This facilitates greater flexibility. Relaxin levels increase significantly during pregnancy so that the women's body can stretch to accommodate the growing foetus and for the birth itself. Additionally, women are statistically more likely to participate in activities such as dancing or gymnastics where flexibility is important and therefore developed.

**Temperature** – direct or indirect heat make muscles and tendons more elastic. Conversely, a decrease in temperature can significantly reduce flexibility.

**Exercise history** – years of running or cycling can adversely affect flexibility while performing full-range movements such as deep squats, high kicks and other dynamic activities will enhance it. A well-designed resistance training program utilising full ranges of movement will positively influence flexibility whereas the same program performed using shortened range of movement will reduce flexibility.



**Heredity** – hypermobility is a hereditary trait; some people are born with a tendency toward hypermobility or, what is incorrectly referred to as "double joints". Hypermobility increases the risk of injury and joint dislocation and it essential that muscles are strengthened to protect at-risk joints.

**Fashion** – high heels and tight skirts can adversely affect flexibility because they place muscles in a shortened position or restrict range or movement.

### Methods of stretching

There are several methods and types of stretching that an instructor should be familiar with so that they can chose the right one for their client:

| Method | Type of stretching | Example |
|---|---|---|
| Active stretching | Static – maintenance | Seated hamstring stretch |
| | Static – developmental | Standing chest stretch |
| | Dynamic | Leg swings |
| | Ballistic | Standing toe touches |
| Passive stretching | Static – maintenance | Partner assisted hamstring stretch |
| | Static – developmental | |

**Active stretching**

Active stretching involves effort from the individual doing the stretching. This may be because they adopt and hold a stretch themselves or use the antagonist of the target muscle to stretch the opposing muscle. Examples include using the middle trapezius, rhomboids and posterior deltoids to horizontally extend the shoulders and retract the shoulder girdle to stretch the pectoralis major and anterior deltoids.

**Passive stretching**

Passive stretching uses an external force or prop to stretch the target muscle. For example, a length of rope to stretch the hamstrings of one leg while lying on your back or the use of a partner. Passive stretches are usually better when a longer stretch is required as they are comfortable and require little or no input from the client. If a training partner or instructor is providing stretching assistance, it is essential that the force of the stretch is applied gradually and carefully and is accompanied by good communication between both parties as it's all too easy to overstretch and cause injury.

## TYPES OF STRETCH

**Static –** as the name suggests, static stretches involve little or no movement. The muscle in question is stretched until the point of bind (end of range) is reached and that position is then held with no bouncing. This should result in a mild stretching sensation but no actual pain in the target muscle or joints.

Static stretches can be used to maintain the current level of flexibility (maintenance stretching) or increase flexibility (developmental stretching).



Maintenance stretches are held for 10 to 15-seconds and then released whereas developmental stretches are held for 30-seconds or more. Developmental stretches are usually increased incrementally as muscles gradually relax. In general, the longer a stretch is held, the greater the increase in flexibility will be.

Care should be taken not to force a stretch or stretch a cold muscle as injury can result. It is also important to ensure that increases in the depth of a stretch come from elongation of the target muscle and not nearby joints e.g. rounding the lower back in a hamstring stretch.

**Dynamic** – dynamic stretches involve taking a muscle or group of muscles through a wide range of movement without stopping in the fully extended position. For example, to stretch the hamstrings, you could swing your legs forward from your hips in an alternating high kick. Dynamic stretches are always performed smoothly and in a controlled manner to minimise the risk of injury and should mimic the movements or activities of the following workout or sport.

Other examples of dynamic stretches include forward lunges with a waist twist, wide-foot squats and repeatedly reaching your arms up above your head. Dynamic stretches are normally best performed in sets of 10 to 15-repetitions and, usually, three to five dynamic stretches are all that are required.

**Ballistic** – this form of stretching involves using momentum and bodyweight to stretch a muscle beyond its normal point of bind. This is done using repetitive bouncing movements. For the vast majority of exercisers, this method is not recommended as rapidly and forcefully exceeding the point of bind may cause injury. However, for certain sportspeople and for stretching adhesions and stubborn fibrous tissue in physiotherapy and rehabilitation, it may be necessary to use ballistic stretching.

**When to stretch?**

Stretching should be part of virtually every workout but is important that the right stretches are used at the right time. For example, static developmental stretches cause muscle relaxation and can inhibit force production so they are not really suited to the warm up. However, if a client has very bad flexibility in one or several muscles which makes the performance of a particular exercise more difficult than normal, statically stretching hypertonic muscles may be beneficial e.g. statically stretching the calves prior to squats. In contrast, the active nature of dynamic stretches mean they are not really suitable for cool downs.

| Warm up | Cool down |
|---|---|
| **Dynamic stretching** | Static stretching – maintenance |
| **Ballistic stretching** | Static stretching – developmental |
| **Static stretching** | |

* For corrective purposes only

In the majority of cases, stretching is a safe and very beneficial activity however some population groups could suffer injury or health concerns as a result of stretching. An instructor should know who is and isn't a suitable candidate for flexibility training.



Considerations when flexibility training include:

- Avoid any developmental or ballistic stretches during pregnancy because of the softening effects of relaxin
- Do not force a stretch if movement is inhibited by a bony block
- Avoid stretching the muscles surrounding a fracture site for 8-12 weeks post-injury
- Stop stretching if any sharp muscle or joint pain occurs
- Stop stretching is any muscle cramps occur during stretching
- Do not stretch joints or tissue that is infected
- Avoid stretching any muscle or joint that is acutely inflamed
- Do not stretch any bruised or sore muscles if the cause was overstretching

Flexibility training is all too easily left out of exercise programs because of lack of time, not seeing the value or lack of knowledge. However not stretching can increase acute and chronic injury risks and regaining lost flexibility takes much longer than developing and maintaining it in the first place.

## PRINCIPLES AND VARIABLES OF FITNESS IN DESIGNING AN EXERCISE PROGRAM

One of the main jobs of a fitness instructor is designing exercise programs. The results experienced by the client are largely the result of the program they follow so it is essential that instructors learn and practice designing programs to ensure that they perform this vital job skill effectively and efficiently.

### The training principles

The training principles are best thought of as program design rules for success. If a program adheres to these principles, it is much more likely to be effective. There are five main training principles.

**1. Specificity** – the principle of specificity dictates that the adaptations in the muscles, organs and systems will be specific to the type of training performed. This is also known as the SAID principle – short for specific adaptions to imposed demands. If a client wants to improve their ability to run, a large amount of their training should involve running. Similarly, if the client wants to get stronger, they need to lift heavy weights.

**2. Progressive overload** – if you run a mile every time you exercise, your body will adapt to that level of stress and your fitness will plateau; you'll only ever be "one mile fit". However, if you want to increase your fitness further, you'll have to make your workout progressively harder. This is called overload. Overload comes from the intensity of the exercise, the duration of the exercise, the frequency of the exercise and several other factors that can all be manipulated to make the workout more demanding and therefore more productive. This is covered in the section on training variables.

**3. Reversibility** – fitness cannot be stored and, if an individual stops exercising, over the coming weeks and months, their fitness will decline. To maintain any aspect of fitness, be it strength, flexibility or cardiovascular fitness, exercise must be maintained.



**4. Recovery** – the cells, muscles and systems of the body only adapt during periods of rest and recovery so recovery must be programmed alongside exercise for best results. While training every day might seem like a good idea, the lack of rest may actually inhibit rather than result in superior fitness gains. The key to success is doing as much exercise as the body can tolerate without becoming over trained from lack of rest. Rest between sets, workouts and even weeks of intense training all require consideration.

**5. Individuality** – physiological factors such as age, gender and somatotype will all affect program design and the results experienced by the client. While one exercise or program type may suit some clients perfectly, they may be completely contraindicated for others. It is essential, therefore, the programs are designed on an individual basis and do not follow "cookie cutter" templates.

**General exercise variables**

Doing the same workout over and over will cause fitness gains to stagnate or plateau. This can lead to client frustration and even exercise drop out. To ensure the client's fitness levels continue to improve, it is essential that instructors know how to manipulate the general exercise variables which can be summarised using the acronym F.I.T.T.

**F** – frequency

**I** – intensity

**T** – time

**T** – type

**Frequency –** refers to the number of training sessions per day, week, month or year. A beginner client may start out exercising three-times a week whereas an advanced athlete might train 12-times a week (twice a day for six-days.) Exercise frequency should increase gradually over time and reflect not only the client's level of fitness but also their ability to recover and the amount of time they have available.

**Intensity** – a workout's difficulty is properly referred to as intensity. Intensity can be measured using the rating of perceived (RPE) exertion scale, the percentage of 1RM (one repetition maximum) being used or the average exercise heart rate and is influenced by the training variables discussed elsewhere in this manual but including speed, distance, resistance, duration of recovery and level length.

**Time** – the duration of a workout, the time between sets, the time between workouts and even the amount of time taken to perform a single repetition can all be varied to elicit a specific training response. Time is an important exercise variable so instructors should wear a watch to be able to monitor this factor.

**Type** – choosing the right type of exercise depends on the client's goals, physiology and their current skill level but should, in the majority of cases, be specific to what the session is designed to achieve. While both running and swimming both can positively affect the cardiovascular system, if the client's goal is to become a better runner, then running should make up the majority of their workouts. However, the type of exercise can be manipulated to elicit a specific fitness response as many exercises have broad similarities and can be used to provide program variety.



**General F.I.T.T. guidelines for common fitness goals**

| | Strength | Hypertrophy | Endurance | Health | Cardiovascular |
|---|---|---|---|---|---|
| **Frequency** | 1-2 times per week per muscle group | 1-2 times per week per muscle group | 2-3 times per week per muscle group | 5+ sessions per week | 3+ sessions per week |
| **Intensity** | High - >85% 1RM | Moderate 67-85% 1RM | Low <67% 1RM | Low 6/7 RPE | Medium/high 60-90% MHR |
| **Type** | Split routine | Split routine | Whole body routine | Any physical activity | CV exercise |
| **Time, reps** | 1-5 reps | 6-12 reps | 13-20+ reps | 30+ minutes | 20+ minutes |
| **Recovery between sets** | 3-5 minutes | 1-2 minutes | 30-60 seconds | N/A | 1-10 minutes depending on energy system |
| **Sets per exercise** | 2-6 sets | 3-6 sets | 2-3 sets | 1 | 2+ (if using intervals) |

Regarding frequency, as fitness levels increase, so too does the ability to recovery from exercise and where a beginner may need several days rest between hard workouts, a more advanced exercisers may only need 24-hours. Therefore workout frequency should reflect a client's training status/age or level of experience.

However, it is also important to realise that the ability to recover from exercise is also affected by age, nutritional status, sleep, stress and gender so while the following guidelines are useful, they should not be considered to be "set in stone".

| Training status | Frequency (per week) |
|---|---|
| **Beginner** | 2-3 |
| **Intermediate** | 3-4 |
| **Advanced** | 4-7+ |

**Principles of a progressive training program**

Doing the same workouts over and over is a sure-fire route to a fitness plateau and a lack of meaningful progress could result in the client losing enthusiasm and motivation for exercise. To avoid such stagnation, the fitness and exercises variables should be manipulated over time to ensure that the client continues to progress toward his or her goals. This planned progression is called periodisation.

**Progression and periodisation**

The human body is very responsive and will do its best to adapt to whatever stress it is exposed to. Exercise is a form of stress and, assuming the dose of stress is correct and there is sufficient rest and recovery between bouts of exercise, the result of doing exercise should be positive.

However, repeated bouts of the same exercise, too much exercise too soon or too little will not provide a stimulus for change and lack of progress is likely to result in client dissatisfaction.

In the majority of cases, beginners adapt the quickest because literally any stress is new. As exercisers transition from beginner to intermediate, improvements in fitness start to slow down. Advanced exercisers, because they are so close to their genetic potential, make only very small fitness improvements.



Unfortunately, because a beginner is so adaptable, they will experience improvements in fitness even if they are following a program that is incorrectly designed. These initial gains, are, however, short lived and this is why program design and periodisation are so important if continual progress is to be maintained.

It is once fitness progress begins to slow that manipulation of the so-called training variables becomes essential. However, over-zealous programming, not paying attention to recovery and a sub-par approach to nutrition can result in overtraining.

**Overtraining**

Exercise that exceeds the client's ability to recover and adapt can lead to a condition called overtraining or, to give its full name, chronic overtraining syndrome. Overtraining can be caused by the instructor's program as well as what the client does outside of the gym so it is important that both parties know how to recognise the symptoms.

**Signs of overtraining include:**

- Decrease in coordination
- Inability to concentrate
- Reduction in performance
- Irritability
- Oversensitivity to criticism
- Disrupted sleeping patterns
- Non-specific aches and pains
- Loss of training enthusiasm
- General lethargy
- Limbs "feel heavy"
- Increased frequency of colds and other illnesses
- Digestive upset
- Elevated resting heart rate
- Dysmenorrhea (irregular periods) or amenorrhea (absence of periods)

If overtraining is suspected, a short break and regression of the training plan must be implemented. Trying to "smash through" overtraining can make matters much worse and could necessitate a long break from exercise.

# UNIT 2 APPLYING THE PRINCIPLES OF NUTRITION TO A PHYSICAL ACTIVITY PROGRAM

**By the end of this unit, you will:**



- ✓ Understand the principles of nutrition
- ✓ Understand key nutritional guidelines
- ✓ Understand recommended practices in relation to providing nutritional support
- ✓ Understand the relationship between nutrition and physical activity
- ✓ Understand how to collect client information regarding nutrition
- ✓ Be able to collect, analyse and interpret nutritional information
- ✓ Understand the principles of nutritional goal setting
- ✓ Be able to apply the principles of nutrition to a physical activity program

Nutrition is the study of food and how it effects your body. From the cradle to the grave, your body needs and uses food for energy, for growth, repair and development and for maintaining good health.

It's commonly accepted that healthy food is essential for a healthy body and everyone needs to consume a "balanced diet" however, because there is so much often contradictory information available as to what constitutes a balanced diet, many people are confused and have no real idea as to what they should be eating.



The media doesn't help and most newspapers and magazines happily champion the latest fad diet seemingly oblivious to the fact that they are completely contradicting the information that the published previously.

A balanced diet should reflect the needs of the individual and address health, performance and weight management – the word balanced implying that all food groups should be included and that the exclusion of food groups (e.g. carbohydrates or fats) would lead to an unbalanced diet. Unfortunately, nutrition is not that cut and dried but following a balanced diet is much better than eating too much the junk food that now weighs down the shelves of every major supermarket.

The word diet deserves some consideration also; for many, it's a four-letter word meaning a period of reduced food intake specifically for weight loss as in "I'm going on a diet". However diet is more accurately the sum total of the food you eat – restricted or otherwise. A diet can be good, bad, balanced, unbalanced, healthy, unhealthy, fattening or lead to weight – it all depends what foods make up the diet.

**Personal trainers need to understand the importance of nutrition for several reasons:**

- A healthy diet underpins everything that happens in the body
- A lack of the correct balance of nutrients can significantly inhibit fitness gains
- Lack of fitness gains will often be blamed on the program or the trainer
- A large percentage of clients are exercising specifically for weight loss
- Exercise will be all but ineffective for weight loss without addressing diet
- Dietary advice provides an additional revenue stream for personal trainers
- Correct nutrition can make your clients healthier and happier
- Happy, healthy clients are great adverts and a source of referrals

With so much misinformation around, personal trainers are in a great positon to educate clients about the importance of nutrition. Everybody, whether they are fit or fat, likes to talk about food and nutrition!

## THE NUTRIENT GROUPS

A balanced diet is made up from five nutrient groups plus water. These five nutrient groups can be divided down into two categories – macro nutrients and micro nutrients. Both macro and micro nutrients are important for health and function.

| Macronutrients | Basic functions |
|---|---|
| Carbohydrates<br>Protein<br>Fat<br>Alcohol | Needed in large amounts for energy, growth, repair and building structures. NB, alcohol provides energy but is not classed as a nutrient |
| **Micronutrients** | **Basic functions** |
| Vitamins<br>Minerals | Needed in very small but meaningful amounts, micronutrients are necessary for all bodily functions and are essential for health |



Each of these nutrient groups will be discussed in some depth in the following chapters.

## YOU ARE WHAT YOU EAT

While it's not clear who first uttered the words "you are what you eat" you can guarantee it was someone well ahead of their time and it's a nutritional truism that is worth remembering. The food we consume is broken down and either becomes part of us or is used for fuel and anything that isn't used passes through our digestive tracks to be excreted. Our bodies have a very intimate relationship with the food we eat and so the type and quality of the food consumed is of paramount importance as food effects our bodies' at the most fundamental level.

To fully comprehend "you are what you eat", consider the basic organization of life:

**Food > Chemicals > Cells > Tissues > Organs > Systems > The human body**

Alternatively, consider how protein is used in the body:

**Protein > Amino acids > Actin > Muscle fibres > Muscles > Muscular system**

Other systems to which the same organization applies include:

- Skeletal system
- Nervous system
- Digestive system
- Respiratory system
- Circulatory system
- Lymphatic system
- Endocrine system
- Reproductive system

**National food and nutritional guidelines**

For many years, various governments around the world have used a food pyramid model to help us decide what to eat. These models, which vary slightly from country to country, provide a graphic representation of what we should eat and in what quantities. Easy to understand and simple to follow, food pyramid models are designed to make it obvious which foods you should be eating more of (the ones in the lower tiers) and which foods you should be eating less of (the ones in the upper tiers).



The first US Department of Agriculture food pyramid was released in 1992 and updated in 2005 and again in 2011. All models suggest that the majority of the energy in your diet should be derived from carbohydrates, especially grains and grain foods such as bread, rice and pasta. Next, you should be consuming around three to five servings of fruits and vegetables. Protein rich foods make up the next level with, according to the USDA, meats, fish, eggs and dairy all being equally comparable. Finally, at the top of the pyramid are the foods you should be eating the least – specifically fats, oils and sugar. Images – 1992 food pyramid and 2005 food pyramid

Since their inception, all of the food pyramid models have been criticized. Accused of being shaped by agriculture rather than nutritional requirements of the majority of the population, it has been suggested that the pyramid is biased in favour of vegetable and grain farmers over meat farmers.

Dieticians also point out that comparing soya, nuts and beans with meat, as the food pyramid suggests, sends out the wrong message about the protein content and quality of two very different food groups. Finally, anyone with gluten or dairy intolerance or following a vegetarian diet is not catered for in the food pyramid.

Others suggest that the food pyramid is an acceptable method of eating if you are very active but a carbohydrate-based diet is not suitable for those members of the population that are sedentary. Some theorists suggest that the food pyramid models are actually responsible for the current obesity epidemic but this accusation is more properly aimed at food manufacturers and the abundance of high calorie/low nutrient junk food that many people eat far too much of.

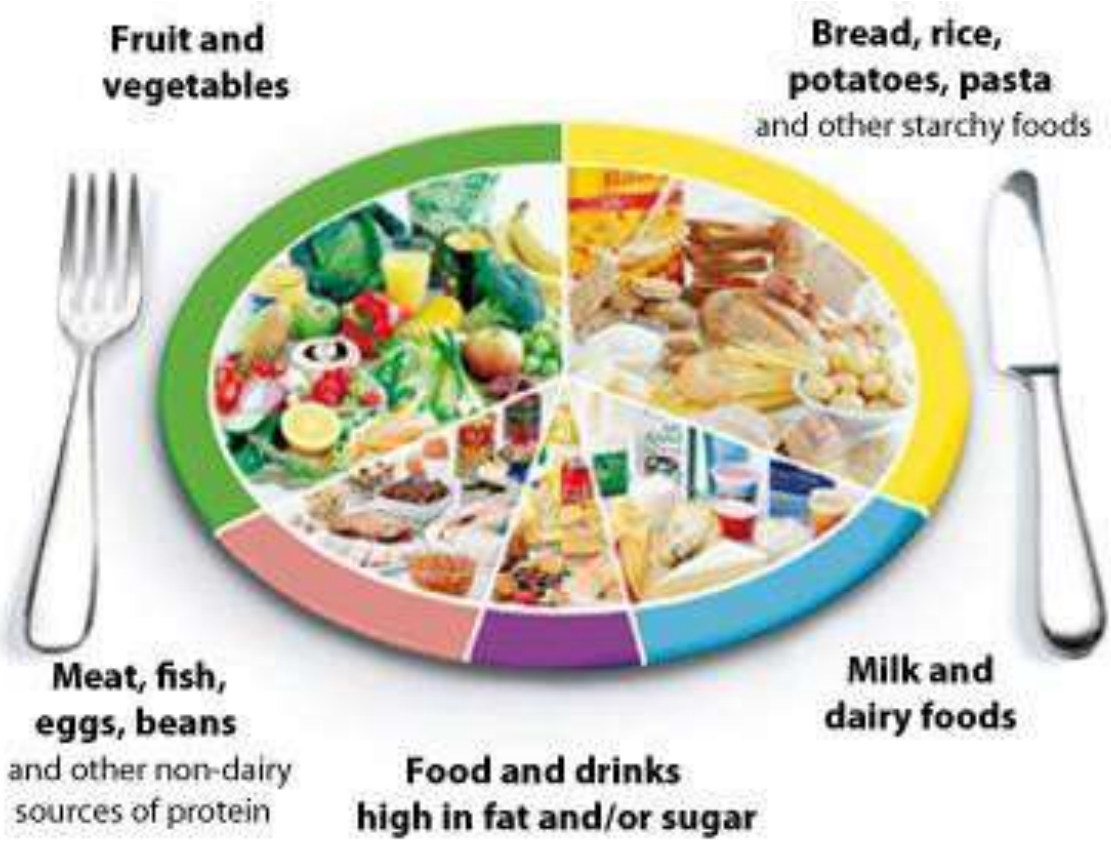
**The UK Eat Well Plate**

In the UK, since 2007, we have adopted an alternative to the pyramid models called “The Eat Well Plate”. While very similar to the food pyramid models, the Eat Well Plate graphic itself is less detailed but is also accompanied by more directional advice.

There are eight healthy eating tips that support the Eat Well Plate:

- ✓ Base your meals on starchy carbohydrates
- ✓ Eat lots of fruit and vegetables (5 portions per day)
- ✓ Eat more fish (2 portions per week – 1 oily)
- ✓ Cut down on saturated fat and sugar
- ✓ Eat less salt – no more than 6 grams per day
- ✓ Get active and try to maintain a healthy weight
- ✓ Drink plenty of water (6 to 8 glasses per day)
- ✓ Don’t skip breakfast





The Eat Well Plate also stipulates the following targets:

**Adult males:** 2550 calories per day Adult females: 1950 calories per day

The following macro nutrient ratios are also recommended:

- Minimum of 50% of calories from carbohydrate
- Maximum of 35% of calories from fat
- Minimum of 55 grams of protein per day (9-12%)



The different macro nutrients provide differing amounts of energy. It should be noted that these are accepted approximations and are not 100% accurate:

- Carbohydrate – 4 calories per gram
- Protein – 4 calories per gram
- Fat – 9 calories per gram
- Alcohol – 7 calories per gram

Eating according to the Eat Well Plate requires some calorie counting and portion measuring but, for many people, this is simply impractical. If counting calories is not a viable option, it is still possible to adhere to the Eat Well Plate by following suggested predetermined portion sizes.

Note; the size of an average portion according to a manufacturer may have very little in common with what constitutes a "real world" portion. Be sure to read labels carefully to ensure you know more accurately what you are eating.

| Food group | Portion guide |
|---|---|
| **Fruit** | **Small fruit –** 2 Satsumas, 2 plums, 2 kiwi, 7strawberries, 14 cherries<br>**Medium fruit –** 1 apple, 1 banana, 1 orange, 1 pair<br>**Large fruit –** half a grapefruit, one 5cm piece of melon, 1 large slice of pineapple<br>**Dried fruit –** about 30 grams of raisins or sultanas, handful of banana chips<br>**Fruit juice -** 150ml |

| | |
|---|---|
| **Vegetables** | **Green veg –** 2 broccoli spears, 4 heaped tablespoons of kale, spinach or green beans<br>**Salad veg –** 3 sticks of celery, 5cm piece of cucumber, 1 medium tomato, 7 cherry tomatoes<br>**Cooked veg –** 3 heaped tablespoons of carrots, peas, corn or cauliflower |
| **Grains** | 1 slice of bread, handful of rice or pasta, handful of breakfast cereal, 1 small to medium-sized 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, 150 ml of yogurt, piece of cheese the size of a small match box |
| **Foods and drinks high in sugar/fat** | Limit these foods to less than 8% of total daily intake |



So are either of the food pyramid models or the Eat Well Plate suitable for everyone? No; but they do represent a considerable improvement over the diet that many people currently follow. And like almost every diet and exercise program, the food pyramids and Eat Well Plate offer advantages but also have limitations. A good personal trainer should be able to identify these advantages and limitations and make adjustments and suggestions to their clients to reflect their individual needs.

| **The food pyramid and Eat Well Plate** | |
|---|---|
| **Advantages** | **Limitations** |
| Easy to understand and interpret | Aimed at populations and not individuals |
| Encourages people to think about the food they eat | Assumes a “one size fits all” approach to diet and nutrition |
| Promotes a reduction in processed foods | Criticized by being shaped by food agencies rather than |
| Encourages consumption of fruit and vegetables | nutritionists |
| Allows for moderate alcohol intake | Does not cater for people with specific nutritional requirements |
| Incorrectly compares some types of food e.g. beans and meat | Makes no specific reference to food quality |

**Food quality**

Eating a balanced diet is one thing and managing intake quantities is another but another important factor that must be considered is the quality of food.

Beyond the refinement processes that often strip food of much its nutritional value, the farming, handing, manufacturing and preparation of food from seed to eating can adversely affect food quality.

Modern farming methods and even common cooking methods can have an adverse effect on the nutritional and therefore healthful qualities of the food we eat.

Consider the cycle of food quality described below:



Nutritionally, many seemingly healthy foods are considerably less nutritionally dense than they were as few as 50-years ago because of intensive farming methods, breeding to increase profitability, the routine use of artificial fertilizers, pesticides, herbicides and fungicides and antibiotics and growth hormones.

Thankfully, there is an alternative; Organic farming.

**Organic farming**

Organic farming began in the 1940s in response to the mass-food production methods that developed as a result of World War II and has, in the last few decades, become a very marketable force in the food industry.



Organic food producers are bound by strict legislation that helps ensure a higher level of farming which leads to more nutritionally-dense and therefore healthier food.

Several studies have demonstrated that food grown organically contains far more essential nutrients than traditionally-farmed foods but none of the harmful artificial substances used in regular farming.

The soil association, the regulatory body governing organic food production, stipulates that organic food must:

- Contain minimal additives
- Use no pesticides, fungicides or herbicides in production
- Contain no genetically modified ingredients
- Involve no non-essential or routine antibiotic treatment on animals
- Ensure animal welfare is paramount

While it is irrefutably true that organic food is more nutritious than non-organic food, this health benefit comes at a price and unscrupulous food manufacturers often attempt to “dupe” unwary consumers into buying organic “junk food” by making them believe that anything organic must be healthy.

While organic fruit, meat, vegetables, nuts, seeds and grains are undoubtedly healthy, organic cookies, cakes, ice creams, sugary breakfast cereals or processed meals are still far from healthy and should be consumed in moderation if at all.

**Nutrition and health**

Lack of physical activity and poor nutritional choices can have a very negative impact on health – health being optimal bodily system function and an absence of disease. Exercise is very important for fitness and health but the food we eat arguably has the biggest impact; it is possible to be healthy and not fit after all. Because the food we eat affects us at a cellular levels (remember; you are what you eat), unhealthy foods lead to unhealthy bodies and poor nutritional choices are inextricably linked to a wide range of often avoidable medical conditions and diseases. Examples include:

- Obesity
- Heart disease
- Strokes
- Several cancers
- Metabolic syndrome
- Tooth decay
- Diabetes
- Hypertension
- High cholesterol
- Asthma
- Some forms of arthritis
- Menstrual irregularities
- Difficulty conceiving naturally
- Hormonal imbalances
- Food allergies
- Attention deficit disorder
- Hyperactivity
- Insomnia
- Eczema
- Systemic inflammation

The list of diseases directly attributable to poor nutrition is almost endless and yet, in the vast majority of cases, the cause of these problems is all but ignored (poor nutrition) and the bulk of medical resources is directed at finding treatments for symptoms.

However, as important as the link between food and disease is, it is important to understand that personal trainers ARE NOT qualified to offer advice or attempt to treat medical conditions with food or exercise; that is beyond the scope of this level of qualification. If, on screening, a client reveals that they are suffering from a medical condition such as one of those listed above, the personal trainer, for legal and ethical reasons, must initially refer their client to an appropriately qualified registered dietician.



On completion of this course, the trainer will be qualified to offer nutritional advice to healthy individuals. However, they are not qualified to treat medical conditions using food and/or supplements and doing so exceeds the limits of this qualification. It is worth noting that implementing the information in this course will significantly reduce the risk of developing many of the conditions listed.

**Nutritionists versus dieticians**

There is a lot of confusion over the terms used to describe people who offer nutritional advice. With job titles like lifestyle coach, nutritional adviser, dietician, nutritionist, weight loss coach and nutritional therapist being bounded around, it's no wonder that many of the public are unsure of who they can turn to for advice on what they should and shouldn't eat.

Of all the terms used to describe someone qualified to give nutritional advice, the term "nutritionist" is probably the most widely used however this is an unprotected term and can, in theory, be used by anyone who offers nutritional advice – qualified or otherwise.

In contrast, the term "dietician" is a protected term and can only be used by qualified people approved and registered with the Health Professions Council. Dieticians generally have Bachelors or Masters Degrees and are trained to interpret complex scientific information into practical dietary advice.

Dieticians are regulated by the British Dietetics Association which, as well as being a regulatory body, also serves as the dietician's professional union. The other main regulatory body that dieticians may be members of is the Nutrition Society which requires an appropriate degree and supporting evidence before granting membership.

As a personal trainer, and on successful completion of this course, you can legally call yourself a "Nutritional Therapist" and it is important to stress that a nutritional therapist is not as qualified as a dietician. Nutritional therapists are regulated by The British Association of Nutritional Therapists (BANT) and Nutritional Therapy Council.

The title Nutritional Therapist is clearly defined by these bodies and states that qualified individuals can offer advice to individuals on eating for optimal health however those same individuals cannot offer advice on the prevention or treatment of disease or the use of supplements.

It's also worth noting that general practitioners (GPs) do not cover much information on nutrition during their otherwise lengthy studies and so should not be considered good sources of nutritional information or advice. Nutrition is simply not part of a GPs job.

Nutrition is a huge, complex, and ever-evolving subject and everyone working in nutrition must keep abreast of any changes. In order to give up-to- the-minute information, nutritional advisers must keep their knowledge up to date and know where to look to get quality, authoritative information. Those sources include:

- The Food Standards Agency
- The Committee on Medical Aspects of Food and Nutrition (COMA)
- The British Nutrition Foundation
- The Institute of Optimal Nutrition
- Any scientific nutrition journals e.g. the British Journal or Nutrition



Unfortunately, a very large percentage of the population get their nutritional advice from unqualified sources such as fitness magazines, supplement companies, the mass media and unqualified nutritionists which helps explain why so much confusion surrounds the subject of nutrition. Many of the population's information about nutrition comes from sensationalist media headlines e.g. "Eggs – as bad for you as smoking".

In additional to understanding the effect and impact of the nutrient groups, dieticians and nutritional advisers also need to have a broad familiarity with cultural and religious practices and attitudes to food and nutrition. These practices and attitudes must be respected if offence is to be avoided because some clients will be unable to follow some of the well-meaning advice given by even the most knowledgeable food professional. In many cases, where familial traditions can be modified, religious and cultural practices cannot so the nutritional adviser must be prepared to acknowledge, respect and then work around such practices.

Food and nutrition are often very sensitive subjects because beliefs can be so ingrained. No one likes to be told that the things they believe to be true are, in fact, completely wrong despite overwhelming evidence to the contrary (poor health, being significantly overweight etc.). For that reason, personal trainers must be non-judgemental, show empathy toward their clients and be sensitive to the opinions and beliefs of their clients.

In order for a personal trainer to offer nutritional advice to otherwise healthy clients, he/she should have a sound understanding of the various nutrient groups and be familiar with how they affect the human body. That way, the trainer will be able to provide recommendations based on the needs of the client and according to the current nutritional guidelines.

## MACRONUTRIENTS

### Protein

Protein is an organic compound that serves many functions in the body. Containing four-calories or 16.8 kilojoules of energy per gram, protein is a vital nutrient that makes up a large amount of your body's tissues including your hair, skin, nails, and bones and, of course, your muscles. It is also an important factor in controlling homeostasis and can, under certain circumstances, be used for fuel.

The word protein is derived from the Greek word for primary or first – proto, and is made up from smaller units called amino acids. Amino acids can be thought of as the protein alphabet although, unlike the 26 letters in the English alphabet, there are only 20 amino acids. When digested, protein is broken down into these amino acids which are then re-ordered and re-built back into useable proteins for use in the body.

**Peptides**

Animal and plant amino acids are joined together to make substances called peptides. This process results in chains of amino acids of varying length. When the chain of amino acids is long or complex enough, it forms a protein. To be considered a protein, the polypeptide chain must contain 100 or more amino acids.

| Peptides | | |
|---|---|---|
| **Two amino acids** | Dipeptide | **Di meaning two** |
| **Three amino acids** | Tripeptide | **Tri meaning three** |
| **4-9 amino acids** | Oligopeptide | **Oligo meaning few** |
| **10 or more amino acids** | **Polypeptide** | **Poly meaning many** |



**Amino Acids**

Of the 20 amino acids, nine are classified as essential while eleven are classified as non-essential or conditionally essential. The nine essential amino acids must be present in the food you eat while the remaining eleven non- essential amino acids are synthesized by your liver providing that the essential amino acids are present in your diet. Non-essential amino acids are also present in some foods and consumption of these foods will “spare” the essential amino acids.

**The 9 essential amino acids are:**

- Histidine
- Isoleucine*
- Leucine*
- Lysine
- Methionine
- Phenylalanine
- Threonine
- Tryptophan
- Valine*

*Leucine, isoleucine and valine are collectively called the branch chain amino acids and make up approximately 35% of the amino acids found in muscle tissue. For this reason, BCAA supplements are very popular as it is hypothesized that consuming BCAAs can help repair muscle tissue from exercise-induced muscle damage and may reduce muscle soreness. Whether this is true or not, BCAA supplements are popular with many athletes.

The 11 non-essential/conditionally essential amino acids are:

- Alanine
- Arginine
- Asparagine
- Aspartic acid
- Cysteine
- Glutamic acid
- Glutamine
- Glycine
- Proline
- Serine
- Tyrosine



**Complete and incomplete proteins**

Foods that contain adequate amounts of all the essential amino acids are classed as complete. Complete proteins include eggs, meat, fish, dairy produce, poultry, soya and quinoa. A diet rich in these foods means that you have all the amino acids necessary to synthesize the non-essential amino acids.

Many plants contain a variety of amino acids but are often deficient in some of the essentials and are therefore classed as incomplete proteins. Because they are lacking one or more of the essential amino acids most plant foods are considered to be carbohydrates rather than proteins. Examples include vegetables, seeds, nuts, beans and grains.

| Sources of | protein |
|---|---|
| **Complete proteins** | **Incomplete proteins** |
| Eggs | Cereals |
| Dairy foods | Grains |
| Poultry | Nuts |
| Fish | Beans |
| Meat | Lentils |
| Soy foods | Seeds |
| Buckwheat and Quinoa | Vegetables |

**Complimentary proteins**

Like pieces of a jigsaw, you can slot incomplete proteins together to make a fully-fledged protein. This is important for vegetarians and for people who want to consume non-animal protein sources.

It's simply a matter of making sure that, between them, the incomplete proteins supply all of the essential amino acids in sufficient amounts. A protein made up in this way is called a complimentary protein and provides a convenient way to obtain adequate dietary protein without having to eat any animal-protein foods. There are a number of food combinations you can use to form a complimentary protein.



- Grains and pulses
- Vegetables and nuts
- Vegetables and seeds
- Grains and dairy
- Nuts and seeds
- Nuts and pulses
- Seeds and pulses

With a little culinary imagination it is possible to turn any of the incomplete proteins listed into a healthy source of complete protein, or, at the very least put some peanut butter on your toast or some nuts in your vegetable stir fry! However, it's worth noting that complementary proteins do not need to be consumed in the same meal to be effective. In fact, recent research suggests that a viable complete protein can be created from two complementary proteins consumed in the same 24-hour period. Foods that are considered to be complementary proteins also contain not insignificant amounts of carbohydrate which must be considered when calculating energy intake.

**Functions of protein**

In addition to dietary protein, there are three other types of protein which are categorised according to their function in the body:

- Structural proteins
- Homeostatic proteins
- Fuel proteins

**Structural proteins** form the framework of many bodily components including collagen which is present in bone and connective tissue and keratin which is present in skin. Muscle tissue, hair and nails are other examples of structural proteins.

**Homeostatic proteins** are an integral part of the synthesis of hormones, enzymes and blood cells. These substances regulate various bodily functions and include insulin and adrenalin and infection-fighting white blood cells (WBCs).

**Fuel proteins** are not the body's preferred source of energy but is a viable source of energy when glycogen (stored glucose) levels start to run low and an alternative source of energy is required e.g. during periods of starvation or during long duration endurance events. Amino acids can be converted to glucose, fatty acids or a substance called ketones to produce adenosine triphosphate (ATP).



**Catabolism and anabolism**

Catabolism describes the breaking down larger structures into smaller ones in the body; specifically protein. Exercise, aging and illness all cause catabolism and some degree of catabolism is happening all of the time inside your body. As cells are broken down, they are built back up using recycled and fresh amino acids. In the case of exercise-induced catabolism, tissue, specifically muscle, is built back bigger and stronger but in the case of age- related catabolism, the repair process is eventually outpaced by the breakdown process and the result is the ageing process.

The process of building within the body, i.e. renewing skin cells or building muscle, is called anabolism; anabolism primarily occurs during periods of rest and recovery. Characterised by tissue growth, repair and renewal, the process of anabolism required adequate dietary protein otherwise both health and performance may suffer. Anabolism always follows catabolism – providing there are enough amino acids available to fuel the process.

**Rating protein**

Protein foods are rated in terms of quality using a number of different scales. The various scales evaluate the digestibility of a protein and the availability of essential amino acids. The greater the amount of the consumed protein that can be utilized by your body, the higher the score will be. Most animal origin proteins such as eggs, meat, fish as well as soya score very highly whereas incomplete proteins score much lower.

The most well-known scale for protein quality is the Biological Value scale or BV for short however other scales include Net Protein Utilization or NPU, Protein Efficiency Ratio or PER and the Protein Digestibility Corrected Amino Acid Score or PDCAAS. Each rating method is slightly different and uses a variety of criteria for scoring a protein, hence the variance in the chart below.

| Source | | | | |
|---|---|---|---|---|
| Whey Protein | 104 | 92 | 3.6 | 1.0 |
| Whole Egg | 100 | 94 | 3.8 | 1.0 |
| Beef | 80 | 73 | 2.0 | 0.92 |
| Casein (Milk) | 77 | 76 | 2.9 | 1.0 |
| Soy | 74 | 61 | 2.1 | 0.99 |
| Rice | 59 | 57 | 2.0 | 0.26 |
| Beans | 49 | 39 | 1.4 | 0.68 |



**Protein requirements**

Protein requirements vary from one person to another; it depends how big you are and how active you are. Because the food pyramid and Eat Well Plate nutrition models place an emphasis on carbohydrate over protein, it's not unlikely that a significant percentage of the exercising population is actually consuming too little protein. This can adversely affect the potential benefits of exercise. By contrast, eating too much protein can result in increases in body fat.

Protein should feature as a major part of most meals and daily intake then fine-tuned to ensure protein needs are being met.

The table below outlines the American College of Sports Medicine's (ACSM) recommendations for protein consumption which is widely accepted as being appropriate in the majority of cases.

| Daily protein requirements in grams per kilogram of bodyweight | |
|---|---|
| **Sedentary adult** | **0.8** |
| **Recreational adult exerciser** | **0.8 – 1.5** |
| **Adult endurance athlete** | **1.2 – 1.6** |
| **Growing teenage athlete** | **1.5 – 2.0** |
| **Adult building muscle mass** | **1.5 – 1.7** |
| **Adult estimated upper limit** | **2.0** |

**Protein recommendations**

It's clear then that that all proteins were not created equal. However, it's not just the quality of the protein you should consider but also the actual food quality as well. As the old adage goes; "If you put junk in you'll get junk out" so it pays to try and consume the best quality protein foods you can. Lean organic meats and poultry, free range eggs, organic milk and raw nuts are all good sources of protein that will provide amino acids and other essential nutrients.

Not-so-good protein choices include burgers, sausages, meat pies, UHT dairy, roasted nuts, non-organic pulses, reformed meats such as luncheon meat and battery farmed eggs. Reformed and processed meats often contain as little as six percent actual meat, a figure allowable by law, and much of their weight consists of water, fillers such as wheat, sugar and bone meal.

**Carbohydrates**

Carbohydrates, also known as carbs or simply CHO, are a controversial topic in popular nutrition with a clear divide between high carb and the low carb camps. In truth, both low and high carb dietary approaches can work – it very much depends on your personal preferences, activity levels, fitness goals, bio-individuality and, of course, your likes and dislikes. Rather than dwell on the high or low carb argument, this section will focus on a general overview of carbohydrate and its role in your body.



**What is carbohydrate?**

Carbohydrates are plant foods that are made up from sugar molecules called saccharides. Saccharides are found singularly, in pairs and in complicated chains. The structure of a carbohydrate dictates how it is categorised. Carbohydrates provide four calories of energy per gram or around 16.8 kilojoules and are the preferred source of energy for your brain and higher intensity activities such as weight lifting and sprinting. On consumption, all digestible carbohydrates are broken down into glucose.

Carbohydrates are found in three basic categories:

- Simple carbohydrates – also known as sugars
- Complex carbohydrates – also known as starches
- Non-starch polysaccharides (NSP) – also known as fibre

**Refined versus unrefined**

Digestible carbohydrates can be further subdivided into two categories: unrefined and refined

**Unrefined carbohydrates** have gone through very little in the way of processing and, subsequently, contain larger amounts of vitamins, minerals and fibre than refined carbohydrates. Examples of unrefined carbs include brown rice, brown pasta, wholemeal bread and fruit. Both simple and complex carbs can be unrefined or refined.

**Refined carbohydrates** have been through more processing than unrefined carbs and, subsequently, are often stripped of much of their nutritional value. White bread, white rice, white pasta and sugary sweets are good examples of refined carbohydrates.

**Simple carbohydrates**

Simple carbohydrates can be found in two forms – monosaccharides or disaccharides. Monosaccharides consist of single saccharide molecules whereas disaccharides are pairs of molecules joined together. Simple carbohydrates are often referred to as sugars which carries a negative connotation and implies all simple carbohydrates are bad for you.

While sugar is a simple carbohydrate, a disaccharide called sucrose to be precise, not all simple carbohydrates are sugar! Most fruit is also a simple carbohydrate and everyone knows just how good fruit is for you. In addition to fruit and fruit derivatives such as juices and dried fruit, simple carbohydrates are also commonly found in confectionary, sports drinks, dairy products and energy bars.



There are three primary monosaccharides

- Glucose
- Fructose
- Galactose

And three primary disaccharides

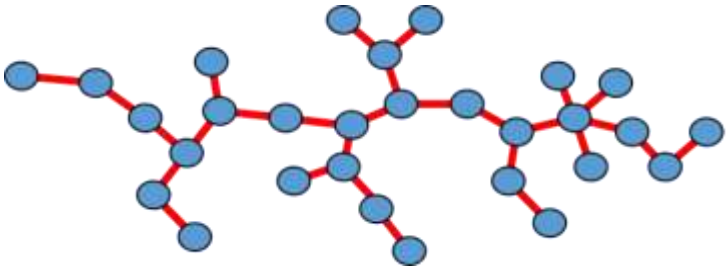
- Sucrose (glucose and fructose)
- Lactose (glucose and lactose)
- Maltose (glucose double bonded to glucose).

| Healthy: Fruit | Less healthy: sweets |
|---|---|
| Contains fructose and glucose in varying amounts | Contains more than 15g of sugar per 100g of food (FSA) |
| **Contains vitamins, minerals and fibre** | Contains low quality, processed fats |
| **Contains anti-oxidants and phytochemicals** | High energy/low nutrient ratio |
| **Contains trace amino acids** | Has an adverse effect on blood glucose and insulin |
| **Much healthier than refined sugars** | levels |
| | Contains no fibre |

The energy contained in carbohydrates cannot be released without vitamins and minerals, the most important being the B vitamins. Eating lots if refined carbohydrates, which are devoid of many vitamins, can cause depletion of vitamin and mineral reserves which makes it hard for the body to utilize carbohydrate for fuel. For this reason, heavily refined carbohydrates are often referred to as anti-nutrients or nutrient-robbers as they require vitamins but do not contain any.

**Complex carbohydrates**

Complex carbohydrates are made from multiple chains of saccharide molecules called polysaccharides – poly meaning many. Polysaccharides are also called starches. Starches make up the greatest percentage of most people's food intake and can be found in bread, rice, pasta, vegetables and grain-based foods. Like simple carbohydrates, complex carbohydrates can be refined or unrefined.





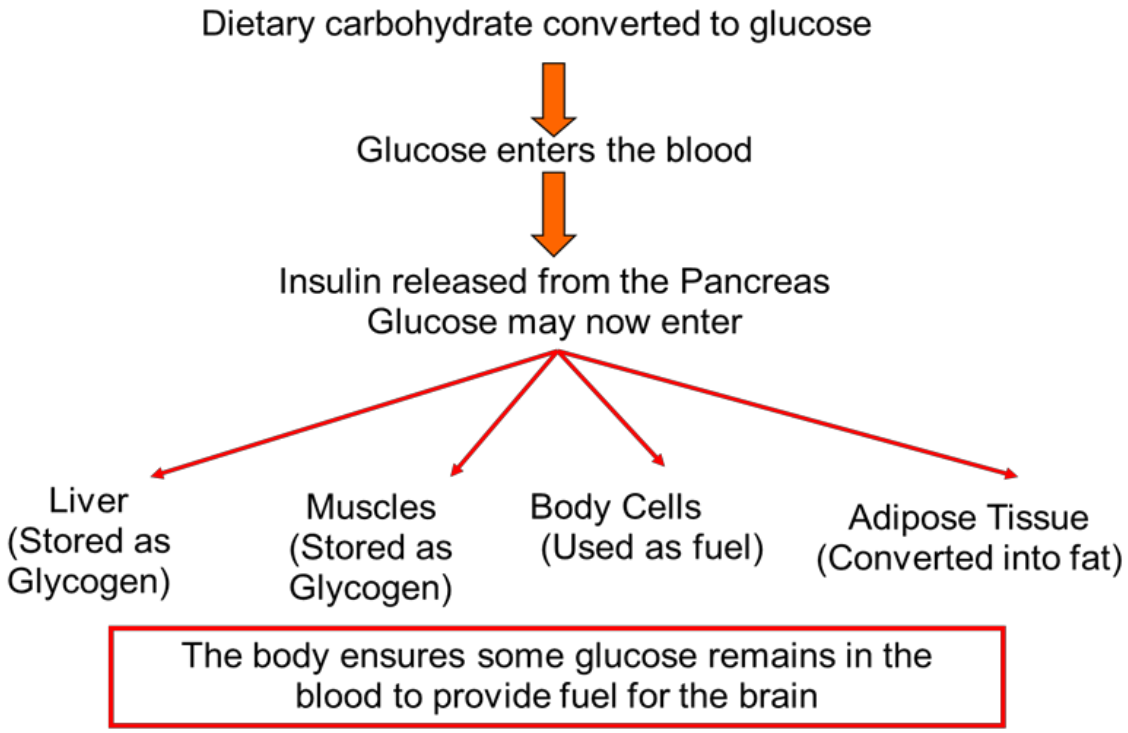
| Sources of refined complex carbohydrate | Sources of unrefined complex carbohydrate |
|---|---|
| White bread | Wholemeal/wholegrain bread |
| White pasta | Wholegrain/wild rice |
| White bread | Fresh and frozen vegetables |
| White rice | Pulses |
| **Properties** | **Properties** |
| Contains more than 15g of sugar per 100g of food (FSA) | Contains fructose and glucose in varying amounts |
| Contains low quality, processed fats | Contains vitamins, minerals and fibre |
| High energy/low nutrient ratio | Contains anti-oxidants and |
| Has an adverse effect on blood glucose and insulin levels | phytochemicals |
| Contains little or no fibre | Contains trace amino acids |
| Likely to cause overeating | Much healthier than refined carbohydrates |

**The fate of dietary carbohydrate**

Whatever type of carbohydrate you consume; all carbohydrate is broken down by digestive enzymes called pancreatic and salivary amylase and turned into glucose. Your body has a number of different uses for glucose. Once digested, glucose enters your bloodstream and stimulates your pancreas to release the hormone insulin. Insulin acts like a key to unlock you cells and allows the glucose to enter various tissues. Glucose is stored for later use in the form of glycogen, used for fuel or, if there is an excess, converted to fat. A small amount of glucose also remains in your blood and is the primary fuel for your brain.

Glycogen is locked into your liver or muscles. Liver glycogen provides a reservoir of glucose for your brain whereas muscle glycogen provides energy for contractions by the muscles in which it is stored.






**The glycaemic index**

It's clear then, considering refined and unrefined, simple and complex carbohydrates, not all carbohydrates have been created equal and some sources of carbs are definitely healthier than others in terms of nutritional density. It's easy enough to select which carbohydrates contain the least amount of refined sugars and greatest number of micronutrients but there is yet another way that carbohydrates are carbohydrates are classified; glycaemic index.

The glycaemic index is a scoring system that rates carbohydrates according to the speed at which they are digested and converted into blood glucose. The glycaemic index uses a 1 to 100 scale. Fast acting carbohydrates score very highly while slower acting carbohydrates get more moderate scores. The glycaemic index gives you a good indication of what carbohydrates to eat when. There are numerous interpretations of what constitutes a low, moderate or high glycaemic index but the chart below is fairly representative of the norm.

- High Glycaemic Index – 60 to 100
- Moderate Glycaemic Index – 40 to 60
- Low Glycaemic Index – Below 60



High glycaemic foods such as sugary cereals, refined grain products and confectionary are quickly digested and converted to usable glucose. This makes them ideal if you need a quick burst of energy during or just before a workout or want to refuel as fast as possible after a workout.

Low glycaemic index foods such as beans, apples, most dairy and porridge oats take longer to digest and will release their energy slower. This means that you tend to feel fuller for longer after eating low glycaemic index carbohydrates and experience more stable energy levels throughout the day as a result.

As with all of your food choices, try to select the most nutritionally dense form of carbohydrate that you can. Although all carbohydrates provide energy, they are by no means equal in terms of vitamin, mineral and fibre density. Given the choice between a fresh apple and a cookie, the apple should be your food of choice – most of the time anyway.

**Fibre**

Fibre is part of the carbohydrate group and is present to one degree or another in all grains, fruits, vegetables, pulses, legumes and nuts. Technically a non-starch polysaccharide or NSP for short, the human digestive systems lacks the necessary enzymes to break fibre down and so, as far as we are concerned, fibre is a calorie-free food. Animals that can extract energy from fibre have more than one stomach or have the ability to produce specialised enzymes so they can digest this tough plant-derived starch. For humans, although fibre does not contribute any energy to your daily diet, it provides numerous other health-related benefits.

**Types of fibre**

Fibre can be classified as soluble or insoluble. This refers to its interaction with water.

**Soluble fibre** forms a gel-like substance as it passes through your digestive track. Like a dry sponge, it soaks up liquid as it passes through your intestines and absorbs small but significant amounts of bile acid, cholesterol and fat in your digestive system. Soluble fibre is found in the soft flesh of fruits, vegetables and grains.

**Insoluble fibre** is sometimes called roughage and is found in the tough outer husk of grains as well as the skins of vegetables and fruit. Insoluble fibre passes through your digestive system like an old-fashioned bottle brush and gives it a good internal scrubbing.

**Fibre requirements**

Despite being calorie and nutrient-free, fibre offers a wide range of health benefits. The RDA (recommended daily allowance) for fibre is around 35 grams per day, split evenly between soluble and insoluble varieties. Your total daily fibre requirement varies according to your age, weight and the amount of food you are eating which is why you may often see a recommended range for fibre consumption of 24 to 35 grams.

As fibre is calorie free, there is little harm in making sure you hit the upper ranges of this scale. If you are currently eating too little fibre and decide to eat more increase your daily fibre intake gradually. Going from a low fibre diet to a high fibre diet overnight is like trying to run a marathon on the first day you take up jogging. Increase your fibre intake slowly and gradually over a few weeks to minimize your chances of suffering digestive discomfort.



**Fibre benefits**

**Weight Control –** as previously discussed, fibre is calorie free. This means that foods that contain a lot of fibre such as whole grains, fruits and vegetables are generally lower in calories than less fibrously-dense foods. To put this in perspective, an apple and a typical biscuit both contain around 60 calories. Because much of the mass of the apple is made up from calorie-free fibre and water, compared to sugar and fat in the biscuit, the apple is bigger, far more filling and much more satisfying to eat. Most of us can eat a few biscuits in a single serving but it's pretty unlikely you'll eat the same number of apples! Filling up on fibre is a great way to prevent overeating. Stretch receptors in your stomach send signals to your brain when it is full so you know when to stop eating. This message can take as long as 30 minutes to be sent and received. Fibrous foods cause greater gastric distension than non-fibrous foods. Simply put, this means you feel fuller, quicker which results in your brain getting the "stop eating" signal sooner than usual. This limits your potential for overeating.

In addition to being low in calories, fibrous foods generally take longer to chew and eat and keep you feeling fuller for longer. Fibre is a major gastric inhibitor. This simply means that fibre delays the emptying of your stomachs contents into your small intestine. The longer food stays in your stomach, the longer you feel full.

A real-world example of this phenomenon is Chinese food. It's an old truism that after eating a Chinese meal, 20 minutes later you are hungry again. Why? White rice! White rice is mostly devoid of fibre and subsequently passes out your stomach and into your small intestine very rapidly. This means you can go from feeling full to feeling empty very quickly.

By delaying gastric emptying, fibre also helps to control your blood glucose levels. Large fluctuations in blood glucose trigger corresponding fluctuations in insulin levels. Roller coasting blood glucose levels play havoc with your hunger. A rapid drop in blood glucose can often result in cravings for carbohydrate (one reason never to go grocery shopping on an empty stomach) so by ensuring that your stomach empties slowly, fibre helps ensure that your blood glucose levels remain relatively stable.

**Digestive health**

The hollow tubes of your intestines are made of smooth muscle and like the muscles of your chest, arms and legs, benefit from a regular workout. Fibre provides the means to exercise your digestive system. A diet devoid of fibre will result in poor intestinal health in the same way that a lack of exercise will result in a flabby, weak body.

To push food though your digestive system, the smooth muscular tubes that make up your digestive tract must squeeze inward in an action called peristalsis. Picture a snake swallowing an egg and the wave-like undulations as the snake squeezes the egg down the length of its body – that's peristalsis. Low fibre foods do not travel through your hollow digestive tubes very easily. A large amount of pressure is required to push food along. Imagine trying to get the very last bit of toothpaste out of the tube – it's a real challenge! Fibre adds bulk to your food and, consequently, it passes through your digestive system much more easily and with far less pressure.



Easy food passage and reduced food transit time (the time it takes from ingestion to elimination) has a major impact on digestive health and is strongly linked to a lower incidence of diverticular disease, also known as diverticulitis. This is a painful and serious medical condition where bacteria- filled bulges develop in the walls of your intestines. By consuming adequate fibre, intestinal pressure is kept to a minimum and there is much less likelihood of developing this unpleasant disease.

**Getting enough**

While getting enough fibre is very important, supplementation is seldom the best way. Fibre supplements such as bran and psyllium husks do indeed provide fibre but they do not provide any of the other nutritious benefits associated with eating fibrous fruits, vegetables and whole grains; specifically vitamins and minerals. An overreliance on fibre supplements may actually result in a vitamin and mineral deficiency.

The best way to get enough fibre in your diet is to eat a wide variety of fruit, vegetables, grains and other natural food. Refined foods such as white bread, white rice, white pasta and processed meals contain very little fibre so, wherever possible, seek out foods in their most natural and unprocessed state. Simply following the old advice of eating an apple a day is one way to make sure you are on your way to getting enough essential fibre in your diet.

**Fats or lipids**

Weighing in at 9 calories or 37.8 kilojoules per gram, dietary fats are much maligned and often misunderstood. The media frequently vilifies them and food marketers take advantage of our "fat-phobia" by actively promoting low-fat products. While dieticians usually suggest cutting reducing your fat intake, proponents of Palaeolithic and low carbohydrate diets insist that fat is good and should be well represented in your daily diet. Who is right and who is wrong is a book in the making so the intention of this section is to discuss how your body uses fat and the different types of fat you will find in your diet. Fat plays an important role in many physiological functions:

Key physiological functions of fat

- The formation of virtually all cell membranes
- The formation of myelin sheaths within nervous system
- Constitutes the majority of the CNS and spinal cord
- The synthesis of steroid hormones
- Assists in the regulation of enzymes
- Provides insulation through subcutaneous adipose tissue
- Provides protection to the internal organs and brain
- Facilitates the transportation, storage and usage of vitamins A, D, E and K
- Provides primary fuel source at low levels of intensity
- Provides a means for storing energy – i.e. adipose tissue



**Types of dietary fats**

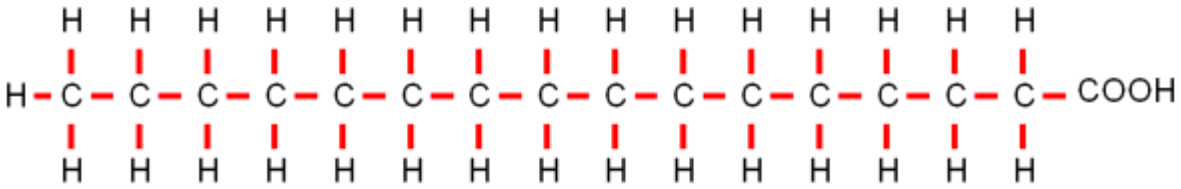
Fats, also known as lipids, come in four main types – saturated, monounsaturated, polyunsaturated and trans fats. They are broken down into fatty acids when digested and each fat has a very specific chemical structure which dictates its role in your body.

**Triglycerides**

In nature, fatty acids usually occur in threes. These three-fatty acid units are called triglycerides because the three fatty acids are attached to a carbohydrate "backbone" called glycerol.

**Saturated fats**

Often considered the "bad boy" of dietary fats, saturated fats are comprised of chains of carbon atoms that are packed or saturated with hydrogen. This makes them, with the exception of palm oil and coconut oil, solid at room temperature and chemically inert. Saturated fats do not react very much to heat, light or oxygen which makes them ideal for cooking. Foods such as butter, animal produce, eggs and dairy contain large amounts of saturated fat.




Your body likes to use saturated fats for energy during aerobic activity, as stored energy for later use within your adipose tissue, protection of vital organs, cell membrane integrity, transport and storage of fat soluble vitamins and is also essential for protein utilization.

| Common sources of saturated fat | |
|---|---|
| **Animal** | **Non-animal** |
| Meat | Coconut oil |
| Poultry | Palm oil |
| Dairy | |
| Eggs | |



Despite their negative reputation, research has revealed that saturated fat should be included in all healthy diets and is, in fact, a vital nutrient.

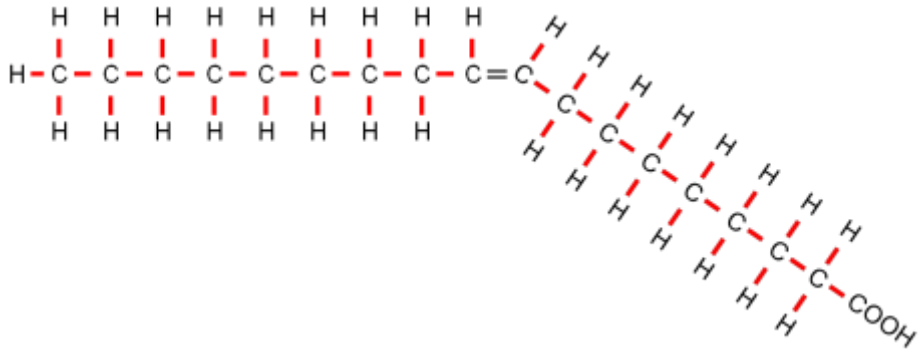
Saturated fat has several important functions:

- Enhancement of immune system function
- Provides energy and structural integrity to cells
- Enhances liver function and provides protection against alcohol
- It anti-microbial and anti-viral

The wrist thing that can be said about saturated fats is they have a high propensity to being converted to body fat is consumed in large quantities and with high levels of carbohydrate. For this reason many people reduce their saturated fat intake in an effort to create a calorific deficit and lose weight.

**Monounsaturated fats**

A monounsaturated fat is missing some hydrogen and, as a result, a double bond is formed in the carbon chain. The double bond causes a bend in the carbon chain and, in chemistry, shape dictates function. This means that a monounsaturated fat behaves differently to a saturated fat.



Monounsaturated fats are moderately reactive and more susceptible to changes caused by heat, light and oxygen. Liquid at room temperature, monounsaturated fats are linked to cardiovascular health and feature heavily in the olive oil-rich Mediterranean diet.

Other sources of monounsaturated fats include nuts and nut derived oils and butters, beef, avocados and numerous seeds. The relative chemical instability of monounsaturated fats means that, while they can be heated and used for cooking, overheating them can make them less healthful. To avoid turning your good monounsaturated into less healthy trans fats (discussed later) do not overheat olive oil or nut oil when cooking. You can tell when you have overheated an oil when it begins to smoke.



For cooking, choose oils that have a high “smoke point”. Olive oil, for example, has a smoke point of around 200 degrees centigrade compared to flaxseed oil that will smoke at around 100 degrees centigrade.

| Sources of monounsaturated fats | |
|---|---|
| Olives and olive oil | Rapeseed oil |
| Lard | Avocados |
| Beef | Most nuts |
| Peanuts, peanut oil and butter | Most seeds |

**Polyunsaturated fats**

Polyunsaturated fats contain two or more double bonds in their carbon chains. This characteristic makes them highly reactive when exposed to heat, light or oxygen. Examples of polyunsaturated fats include oily fish, sunflower seeds, sesame seeds, walnuts, soya beans and any oils subsequently extracted from these sources.

The inherent reactivity seen in polyunsaturated fats means that exposing an otherwise healthy polyunsaturated fat to high temperatures is likely to result in the formation of trans fats. Polyunsaturated fats are not ideal oils for cooking and more stable saturated and monounsaturated fats are the better choice. Consume the majority of your polyunsaturated fats in a raw state to maximize their healthfulness.



Polyunsaturated fats, many of which are considered essential for health hence their common moniker "essential fatty acids" or EFAs for short, can be subcategorised as omega three of omega six fatty acids.

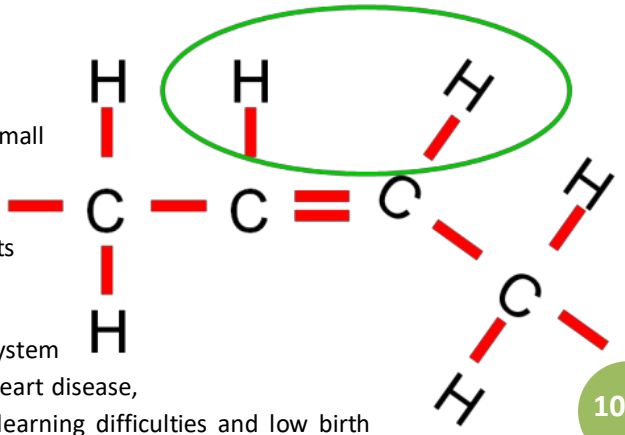
Omega, the final letter in the Greek alphabet, refers to the position in the chain at which the last double bend is located i.e. three from the end or six from the end. These extremely healthful fats are responsible for the a wide range of functions within your body including the formation of cellular hormone-like substances called prostaglandins, the regulation of inflammation, mental function and development and skin, hair and immune system health.

Many people take cod liver oil to help "lubricate their joints" but, in actuality, cod liver oil is an effective anti-inflammatory agent and helps reduce joint pain rather than increasing lubrication!

| Omega 3 fatty acids | Omega 6 fatty acids |
|---|---|
| Oily fish | Sunflower seeds and oil |
| Flax oil | Safflower oil |
| Walnuts | Pumpkin seeds |
| **Note: all oils need to be cold presses, "extra virgin" and unprocessed** | |
| **An ideal ratio of Omega 3 to 6 fatty acids is 1:2 or 1:1** | |

EFAs have been shown to reduce blood clotting, lower triglyceride levels, lower total cholesterol levels, raise good HDL cholesterol levels and reduce overall heart disease risk.

**Hydrogenation and trans Fats**



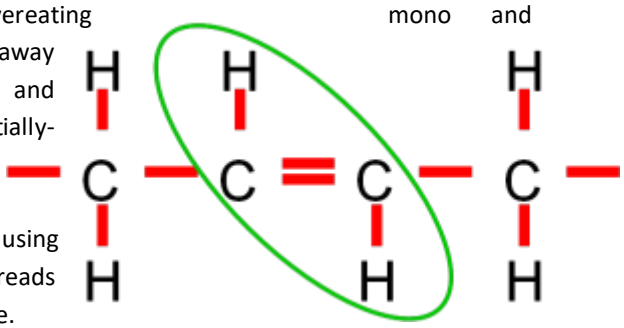
Trans fats occur in nature and, when consumed in relatively small amounts, do not present any real problems for your health. However, many manmade foods and modern food preparation n methods result in an abundance of trans fats being formed and consumed.

Over consumption of trans fats is strongly linked to immune system dysfunction, bone and tendon weakness, sterility, coronary heart disease, high cholesterol and triglyceride levels, inability to lactate, learning difficulties and low birth weight babies.



In food manufacturing, large amounts of unsaturated oils are heated and then, after a catalyst (usually nikel) is added, hydrogen is pumped in under high pressure. This causes the normally "bent" fatty acid chain to straighten and thereofre take on the properties of a saturared fat but the arrangement of the hydrogen atoms means that trans fats do not behave like "real" saturated fats. Trans fats "block" healthy mono and polyunsaturated fats from entering cells resulting in impairment of cellular function which may lead to poor health.

- Normal placement of hydrogen atom – as seen in a mono or polyunsaturated fat
- Diagonal placement of hydrogen atoms – as seen in a trans fat



You can minimize your consumption of trans fats by not overeating mono and polyunsaturated fats, cutting down on processed and takeaway foods, using saturated fats for high- temperature cooking and avoiding food products that contain hydrogenated or partially-hydrogenated vegetable oils. It is also a good idea to keep your mono and polyunsaturated oils in dark glass air-tight containers, buying extra-virgin cold-pressed oils and consider using butter instead or margarine as many margarine-type spreads contain hydrogenated vegetable oils. Check the label to be sure.

| Common sources of trans fats | |
|---|---|
| Most margarines and vegetable oil spreads | Pies |
| | Pastries |
| Biscuits | |
| | Pre-prepared foods |
| Cakes | |
| | Many "low-fat" foods |
| Take-away foods | |
| | Ice cream |

**Fats – maybe not as bad for us as we are often lead to believe...**

Many of the health problems associated with fats are due to the fact they can make you fat. Being over-fat presents a much greater health risk than fats alone ever could. Your body needs a certain amount to fat for health and eliminating fat from your diet can lead to a host of medical problems. By being more "fat aware" you can make sure you consume the fats that are best for you while avoiding those that can cause you harm.



**Cholesterol**

Cholesterol is a lipid molecule that effectively contains no calories and does not represent a source of energy despite being present in many foods. However, and despite often being labelled as unhealthy, cholesterol have several important functions:

- A vital part of cell membranes
- Essential in the production of steroid hormones
- Necessary for the production of bile acid
- Vital for the synthesis of vitamin D

Although cholesterol is present in a number of foods, most notably eggs and seafood, cholesterol is so important for body health and function that it is synthesised by the liver. In fact, 70-80% of the body's supply of cholesterol is made by the liver and if dietary cholesterol intake should be insufficient, the liver will increase production to meet any shortfall. Typically, the body needs between 1000 to 1500mg of cholesterol per day.

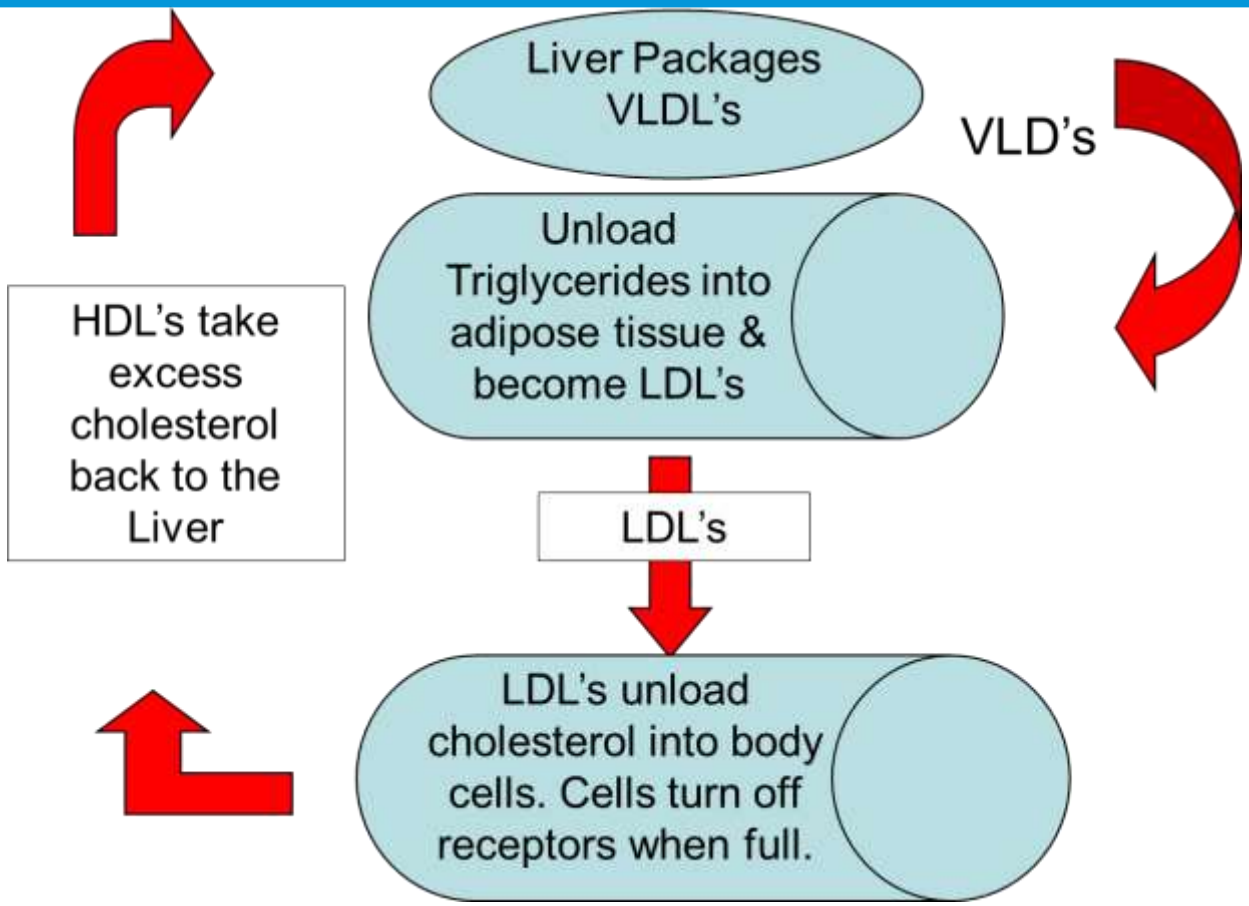
Because cholesterol is a lipid, it is not soluble in water and, therefore, will not mix with blood plasma which is predominately water. Therefore the body uses protein-based transporters called lipoproteins to carry cholesterol around the body.

There are three key lipoproteins:

**Very low density lipoproteins** (VLDLs) – manufactured by the liver, VLDLs contain both triglycerides and cholesterol and are responsible for transporting triglycerides into adipose (fat) cells.

**Low density lipoproteins** (LDLs) – formed from VLDs that have deposited their triglyceride payloads into the adipose cells, LDLs transport cholesterol throughout the body to the cells where it is needed.

**High density lipoproteins (**HDLs) – synthesised by the liver, HDLs "mop up" excess cholesterol from the tissues and blood and transport it back to the liver.






Measuring serum cholesterol and triglyceride levels has become a key risk indicator and pathology marker for cardiovascular disease. Elevated triglyceride, LDLs and cholesterol and a 25% lower HDL reading have all been identified as multipliers for the risk of developing heart disease. The upper desirable limit for serum cholesterol in the UK is 5.2mmol/dl (millimoles of cholesterol per litre of blood plasma) and levels exceeding this will usually result in lifestyle changes (increase exercise, lose weight, cut down on fat intake, give up smoking, reduce stress etc.) and the possible use of cholesterol-lowering drugs called statins.

However, and controversially, several prominent experts suggest that lowering cholesterol using statins is like running the police out of an area of high crime as cholesterol levels often increase because of an overconsumption of trans fats and the cholesterol is necessary for repairing the damage done by this harmful lipid.

**Macronutrient summary**

With a basic understanding of the macronutrients and their effect on the body, a personal trainer should be able to provide some general food recommendations so that clients can adapt their diet for improved health and performance. These recommendations should include:

| Avoid | |
|---|---|
| **Low quality meats** | **Fresh, organic meat, poultry and fish** |
| **Battery farmed eggs** | **Organic organ means such as liver and kidney** |

| | |
|---|---|
| **UHT or processed dairy products** | **Organic free range fresh eggs** |
| **Meat pies** | **Organic whole milk and dairy** |
| **Low-quality sausages or burgers** | **Whole grains and whole grain products** |
| **Overcooked meats** | **Organic, fresh fruit and vegetables** |
| **Refined sugars and syrups** | **Home baked foods rather** |
| **White flour, white bread, white rice, white pasta** | **than commercially baked** |
| **Sweets and confectionary** | **Slow cooked food at lower temperatures** |
| **Sugary drinks** | **Organic butter, olive oil, coconut oil and flax oil** |
| **Fruit juice made from concentrate** | **Organic seeds and nuts** |
| **Margarine, hydrogenated and partially hydrogenated fats** | |
| **Cheap vegetable oils especially corn oil, sunflower oil, soybean oil and low calorie spray oil** | |



**Micronutrients**

Vitamins and minerals are the very sparkplugs your body needs for life. In fact, if your diet is deficient in vitamins and/or minerals, ill health is likely to be the result.

Whilst vitamins and minerals don't contain any meaningful energy themselves, they allow your body to unlock energy within the macronutrients and also act as biological catalysts in the myriad reactions that occur in your body.

A diet that is lacking in vitamins and minerals results in sluggish or even a complete absence of life-sustaining reactions. For example, it is common knowledge that that vitamin C can help you ward off a cold. This is because vitamin C plays an important role in immune system function. Ironically, many people only worry about their vitamin C intake when they actually get a cold, by which time it's too late!

Selected vitamins and their uses

| Vitamin | Uses |
|---|---|
| A | Protects cells from free radical damage |
| D | Activates carrier proteins which transport calcium for bone formation |
| E | Protects cells from free radical damage, helps maintain skin health |
| K | Essential for formation of platelets for blood clotting |
| B | Needed to releasing energy from carbohydrate |
| C | Vital for immune system function |



We get vitamins from plant foods or from animals that have eaten plant foods. We also synthesise a small amount of vitamins in our digestive tracts. We also get vitamins from substances called pro-vitamins. Pro-vitamins are organic compounds that can be synthesized into vitamins once eaten. For example, the pro-vitamin beta-carotene is converted into vitamin A. Vitamins are organic compounds that can be classed as water or fat soluble.

**Water soluble vitamins**

Vitamins B and C are soluble in water. This means that you need to consume them on a daily basis as your body is unable to store them in any meaningful amounts. Any excess is eliminated in your urine which is why high doses of vitamin C can turn your urine bright green! Too much vitamin B and C are seldom toxic as your body simply flushes away the surplus but that doesn't mean you should go overboard. Too much vitamin C can increase the acidity levels in your digestive and urinary system and cause an upset stomach. Some B vitamins, specifically biotin and riboflavin, are also produced by the bacteria in the digestive tract.

**Fat soluble vitamins**

Vitamins A, D, E and K are transported and utilized in the presence of fat and, subsequently, do not have to be eaten every day as you can store them in your body. Because you can build up high levels of these micronutrients, it is possible, albeit unlikely, to reach toxic levels if you consume a large amount. A diet low in fat can lead to a deficiency in the fat soluble vitamins. The manufacture of steroid hormones (testosterone, oestrogen and cortisol) from cholesterol requires a plentiful supply of vitamin A.

While it is not essential to know the all the functions that vitamins perform in human metabolism, it may be useful to have broad understanding of some of the major purposes of the fat and soluble vitamins.

| Fat soluble vitamins | | |
|---|---|---|
| **Vitamin** | **Purpose** | **Sources** |
| **A** | Stimulates gastric juices for protein digestion<br>Plays a vital role in bone building<br>Promotes blood cell health<br>Protects against pollution and degenerative damage | Butter from grass- fed cows<br>Pasteurized whole eggs<br>Liver<br>Seafood |
| **D** | Needed for calcium and phosphorus absorption<br>Helps form strong bones and teeth<br>Helps protect against cancer and multiple sclerosis | Butter from grass- fed cows<br>Pasteurized whole eggs<br>Liver |
| **E** | Aids blood circulation<br>Helps with tissue repair and healing<br>Slows the aging process<br>Powerful antioxidant | Unrefined vegetable oils<br>Butter<br>Organ meats<br>Raw nuts and seeds |
| **K** | Important for blood clotting<br>Aids in bone formation | Liver<br>Pasteurized whole eggs<br>Whole grains<br>Dark leafy green vegetables |
| **B** | Promotes healthy nerves, skin, eyes, hair, liver and muscle tone<br>Prevents fatigue<br>Vital for carbohydrate metabolism<br>Helps produce cholesterol<br>Helps maintain iron levels in blood | Whole refined grains<br>Fresh fruit<br>Fresh vegetables<br>Raw nuts<br>Legumes |
| **C** | Aids tissue growth and repair<br>Strengthens capillary walls<br>Supports lactation<br>Supports adrenal gland function<br>Vital for collagen formation | Fresh fruit<br>Fresh vegetables<br>Some organ meats |

**Minerals**

Minerals are inorganic compounds that are present in the very earth in which your food grows. Plants absorb the minerals and then we eat the plants. Minerals are vital for numerous processes within your body including regulating fluid balance, muscle contractions, bone formation and nerve function and make up around 4% of total body mass. Like vitamins, minerals are essential for health and wellbeing. For example, a lack of calcium could increase your risk of developing osteoporosis whereas a lack of iron will negatively affect your ability to transport oxygen in your blood.

Minerals can be sub-divided into two categories – macro and trace. Although all minerals are important, the macro minerals are required in greater amounts than the trace minerals.

| Mineral | Functions | Sources |
|---|---|---|
| Calcium | Bone growth<br>Muscle contractions<br>Regulates acid/alkali balance | Dairy products<br>Fish with soft bones<br>Green leafy veg |
| Chloride | Regulates acid/alkali balance<br>Regulates fluid balance<br>Aids protein and carbohydrate digestion | Natural unprocessed sea salt<br>Coconut flesh |
| Magnesium | Nerve transmission<br>Bone formation<br>Metabolism of carbohydrates<br>Absorption of other minerals<br>Tooth enamel | Natural unprocessed sea salt<br>Fish<br>Dairy produce<br>Nuts |
| Phosphorus | Bone growth<br>Kidney function | Animal produce<br>Whole grains |
| Potassium | Fluid balance<br>Cellular chemistry | Natural unprocessed sea salt<br>Raw nuts<br>Vegetables |
| Sodium | Water balance<br>Cellular fluid distribution<br>Nerve stimulation | Natural unprocessed sea salt<br>Meat broths<br>Zucchini |
| Sulphur | Protects from infection<br>Helps form cartilage and skin<br>Protects against radiation and pollution | Cruciferous vegetables<br>Eggs<br>Dairy products |

In addition to the macro minerals, many other minerals are to be found in the food we eat. Essential for good health but required in much smaller amounts, there are many recognised trace minerals; the most important are listed below:

| | Trace minerals |
|---|---|
| Copper | Selenium |
| Manganese | Zinc |
| Iodine | Cobalt |
| Boron | Chromium |
| Iron | Molybdenum |
| Nickel | Silicon |

**Phytochemicals**

Phytochemicals can be considered as junior vitamins in that it is acknowledged they are essential for health but they have not been awarded full vitamin status. Synthesized by plants, phytochemicals are linked to all aspects of good health including regulation of cholesterol, protection from cancer and preventing free radical damage to cells. There are a large number of known phytochemicals but the more notable ones are:

- Carotenes
- Flavonoids
- Isoflavones
- Phytosterols



**Enzymes**

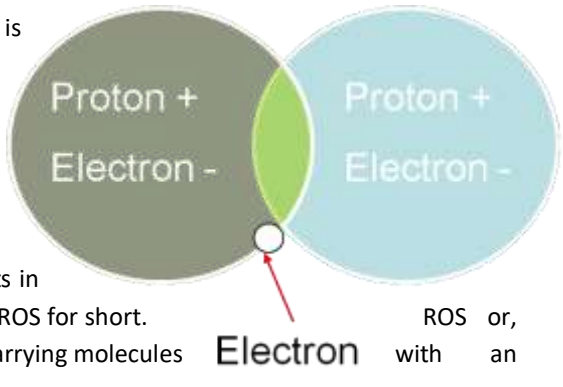
For every physiological reaction that occurs in the body, protein-derived substances called enzymes provide the stimulus. Enzymes ensure that all chemical reactions happen quickly and are biological catalysts in that while they are essential for making reactions happen, they do not actually become part of the reaction. The speed and rate at which reactions happen in the body varies greatly but the right enzyme can increase them by one hundred thousand to one millions times.

For enzymes to work, they need vitamins and minerals and in enzymatic reactions, vitamins are known as co-enzymes and minerals are co-factors. Different enzymes require different combinations of vitamins and minerals to function.

Enzymes are three-dimensional structures and by altering their structure, the body can turn them on or off as necessary – not unlike a switch. Substances that bind to enzymes are called substrates and substrates can only attach to enzymes when the receptor sites are active. Once the substrate and active enzyme are "locked together" a chemical reaction occurs. Only specific substrates can bind on to specific enzymes subsequently there is a huge array of different enzymes.

**Free radicals and antioxidants**

One of life's greatest ironies is that the very substance that is essential for keeping us humans alive is also the thing that contributes to our eventual demise. That substance is oxygen. Oxygen is necessary for just about every life-sustaining reaction that occurs on your body; just try holding your breath and you'll soon see.




Unfortunately, around five percent of all aerobic activity results in the production of something called Reactive Oxygen Species or ROS for short. ROS or, as they are more commonly known, free radicals, are oxygen-carrying molecules with an unpaired electron in their outer shells.

The main problem is that free radicals want to have paired electrons and so, they bounce into other molecules and, for all intents and purposes, rob them for an electron. The robbing "victim" also wants to be balanced and does so by robbing another molecule. Once this reaction starts, it can take days to stop and all the while damage is being done to millions of the cells that make up your body. Cell damage can result in cell mutation or cells simply dying off faster than they can be replaced. This is the very essence of aging and age- related physical degeneration.

Free radicals are known to cause damage to:



- DNA – essentially the blueprints that tell your cells how to function and replicate
- Arteries – free radicals cause your blood vessels to harden and lose elasticity
- Cell membranes – which exposes cell bodies to damage
- Synovial joints – resulting in degenerative arthritic conditions
- Eyes – resulting in age-related macular degeneration
- Skin – one of the reasons your skin loses elasticity, gains wrinkles and gets thinner with age

In addition to breathing, the following are also causes of free-radical production and damage:

- Pollution
- Smoking
- Oxidized unsaturated fats – trans fats
- Ultra-violet radiation – the sun and sunbeds
- Stress
- Aerobic exercise – increased mitochondrial activity
- Strength training – ischemic reperfusion injury and micro tears in muscle fibres

**Anti-oxidative defences**

We are not defenceless against free-radicals. Our bodies are very capable of fighting off the effects of ROS. Exercise increases your production of anti- oxidative enzymes – AOEs for short. These enzymes have the power to stop free radical reactions in their tracks by donating or receiving an electron without becoming unbalanced themselves. The AOEs may have complicated-sounding names but luckily we don't need to be able to list these soldiers in the war against ROS – they go into battle for us regardless.

The primary AOEs are:

- Superoxide dismutase
- Catalase
- Methione Reductase
- Glutathione Peroxidase
- Heme-Oxygenase-1

In addition to the AOEs, there are also a number of anti-oxidative nutrients, AONs for short, that can also give up or receive electrons to put a halt to free radical damage. The primary AONs are:

- Vitamin A
- Vitamin C
- Vitamin E
- Zinc
- Copper
- Selenium
- Manganese



Foods rich in AONs are rated according to their ability to absorb ROS using the ORAC scale. Standing for Oxygen Radical Absorbance Capacity, the ORAC scale states which foods offer the most “bang for your buck” in terms of free radical defense. Foods that score very highly on the ORAC scale are often described as “super foods” and it seems barely a week goes past without a new super food being championed by the media. Regardless of the foods, super or otherwise, you eat, it is suggested that you consume around 3,000 ORAC units a day. While this might sound like a lot, a few portions of fresh fruit and vegetables, some natural unsweetened cocoa and a glass of red wine is going to take you well above this figure.

ORAC units per 100 grams/3.5 ounces of some common foods:

- Unprocessed cocoa Powder 26,000
- Dark chocolate 13,200
- Prunes 5,770
- Raisins 2,830
- Blueberries 2,400
- Blackberries 2,036
- Kale 1,770
- Strawberries 1,540
- Spinach 1,290
- Raspberries 1,220
- Brussels Sprouts 980
- Plums 949
- Alfalfa Sprouts 930
- Broccoli Florets 890
- Beets 840
- Oranges 750
- Red Bell Peppers 710
- Red Grapes 739
- Cherries 670
- Onion 450
- Corn 400
- Aubergine 390

While free radicals are clearly something we need to control, over consumption of anti-oxidative nutrients is by no means a guarantee of eternal youth or a disease-free life. Studies have been inconclusive as the long term effect of overconsumption of AONs. The consensus of opinion is that too few AON can definitely lead to ill health but too many may be ineffective at best and unhealthy at worse. Some free radical activity is essential and is one of the triggers for increased fitness and strength after demanding exercise and white blood cells produce free radicals to help fight bacterial infections so it's not simply a case of all free radicals being bad.

The bottom line is, minimize the production of excessive free radicals by avoiding pollutants, enjoying but not abusing exposure to the sun, not smoking, avoiding trans fats, keeping stress levels to a minimum, exercising regularly but not chronically and enjoying a well-balanced diet rich in naturally nutrient-dense foods. By following these simple tips, you should be well on your way to winning the war on free radicals.



**Micronutrientrequirements**

The nutritional information label on pre-packaged food often lists vitamin and mineral content. Food manufacturers boast that their products contain 100 percent of, for example, your RDA of vitamin C. But what does RDA actually mean and is 100 percent actually worth boasting about?

When it comes to vitamin and mineral consumption, there are a wide number of opinions as to how much you actually need. While one authority may recommend fractions of a gram, another will recommend multiple grams. It seems no one can really agree as to what quantity of vitamins and minerals you need to consume for health and wellbeing. Subsequently, there are a number of dietary reference values or DRVs for vitamin and mineral consumption.

**RDA** – Recommended Daily Allowance. RDA is the absolute minimum amount of vitamins and minerals required. This does not guarantee good health but simply survival. This is a very low figure! RDA is so low that many food manufacturers' can boast their products contain upward of 100 percent of your RDA. 100 percent of a small number is still a small number. Most people would benefit from exceeding their vitamin and mineral RDA.

**EAR** – Estimated Average Requirements. EAR caters for around 50 percent of the population. It's a bigger amount than RDA but some groups will still be deficient if they only meet these targets. The elderly, children, nursing mothers, hard training sportsmen and those convalescing from illness need more vitamins and minerals than the EAR suggested figures.

**RNI** – Reference Nutritional Intake. RNI caters for around 70 percent of the population but some groups such as hard training sportsmen would still deficient even if they achieved the RNI intake guidelines. Because this is a significantly higher figure than RDA, it is very unlikely you will see many food manufactures boasting about 100 percent RNI scores.

While RDA is the accepted minimum level of micronutrients required to maintain health, there are several special population groups who are more likely to experience nutritional deficiency and therefore may benefit from an increase in micronutrients. Because of their limited level of qualifications, personal trainers should always defer to dieticians in these instances. Populations that may require increased micronutrients due to possible deficiencies include are but not limited to:

- Children
- The elderly
- Pregnant or lactating women
- Those with chronic diseases
- Athletes
- Those following a restrictive diet e.g. vegetarians



**Vitamin and mineral supplementation**

While it is beyond the scope of this qualification to recommend supplements of any kind, a personal trainer needs to have some awareness of the use of vitamin and mineral supplements as it is so common.

While some supplements can be deemed “natural” such as fish oils, others are made in laboratories. Some supplements are derived from natural pre- cursors however even these products are not as natural as consumers are led to believe as they have to be processed into tablet, capsule or oil form for consumption.

Another potential shortfall of vitamin and mineral supplementation is that vitamins come in a wide number of varieties. For example, there are a large number of B vitamins and even so-called B complex supplements do not contain all forms of vitamin B.

Supplementary vitamin C is almost always in the form of ascorbic acid but, in nature, seldom occurs in isolation and is normally accompanied by a substance called rutin which acts as an acidity buffer and increases bioavailability.

Minerals, like vitamins, seldom occur in isolation but are usually found in complexes; often with vitamins. Isolated minerals, like isolated vitamins, do not exhibit the same degree of bioavailability as naturally occurring vitamins and minerals. Additionally, minerals are usually found in several different forms, only some of which offer any real nutritional benefits. Vitamin and mineral supplements are also devoid of the majority of phytochemicals and other essential nutrients.

While taking vitamin and mineral supplements may help provide a nutritional “safety blanket”, even the best nutritional supplement is no match for what is commonly found in nature. Any supplementation should only use the best possible quality products and should follow the advice of a dietician.

**Micronutrient summary**

With a basic understanding of the micronutrients and their effect on the body, a personal trainer should be able to provide some general food recommendations so that clients can adapt their diet for improved health and performance. These recommendations should include:

| Avoid | Advise |
|---|---|
| Limiting food choices | Eat a wide variety of fruit and vegetables |
| "Fresh" produce from overseas | Eat seasonal, fresh produce |
| Fortified foods | Eat locally produced fruit and vegetables |
| Processed fruit and vegetables | Eat raw or lightly cooked food where possible |
| Cooking at high temperatures | |
| Cheap/low quality vitamin and mineral supplements | |



**Digestion**

The digestive system can be best thought of as the body's food processing plant and is responsible for the digestion and absorption of the food we eat. The body is unable to use food in its unprocessed state and so the digestive system breaks foods down into substances the body can use.

| Macronutrient | End product |
|---|---|
| Carbohydrates | Glucose |
| Protein | Amino acids |
| Fats | Fatty acids, glycerol |

While digestion and absorption of nutrients is partially a mechanical process, digestion also involves several chemicals called enzymes. The primary digestive enzymes are:

| | | |
|---|---|---|
| Salivary amylase | Mouth | Breakdown of carbohydrate |
| Pepsin | Stomach | Breakdown of protein |
| Lipase | Small intestine | Breakdown of fat |
| Pancreatic amylase | Small intestine | Breakdown of carbohydrate |
| Trypsin | Small intestine | Breakdown of protein |

**The digestive system**

The food we eat passes the length of the digestive system:

**Mouth** is responsible for the mechanical breakdown of food through mastication (chewing) and the production of saliva, which lubricates food, keeps the mouth healthy and contains enzymes that start the breakdown of carbohydrates

**Oesophagus** – the hollow tube which connects the mouth to the stomach

**Stomach** – where chemical breakdown occurs and hydrochloric acid is secreted to kill 'bad bacteria and start the breakdown of tough proteins

**Small intestine** – primary site for nutrient absorption into the blood

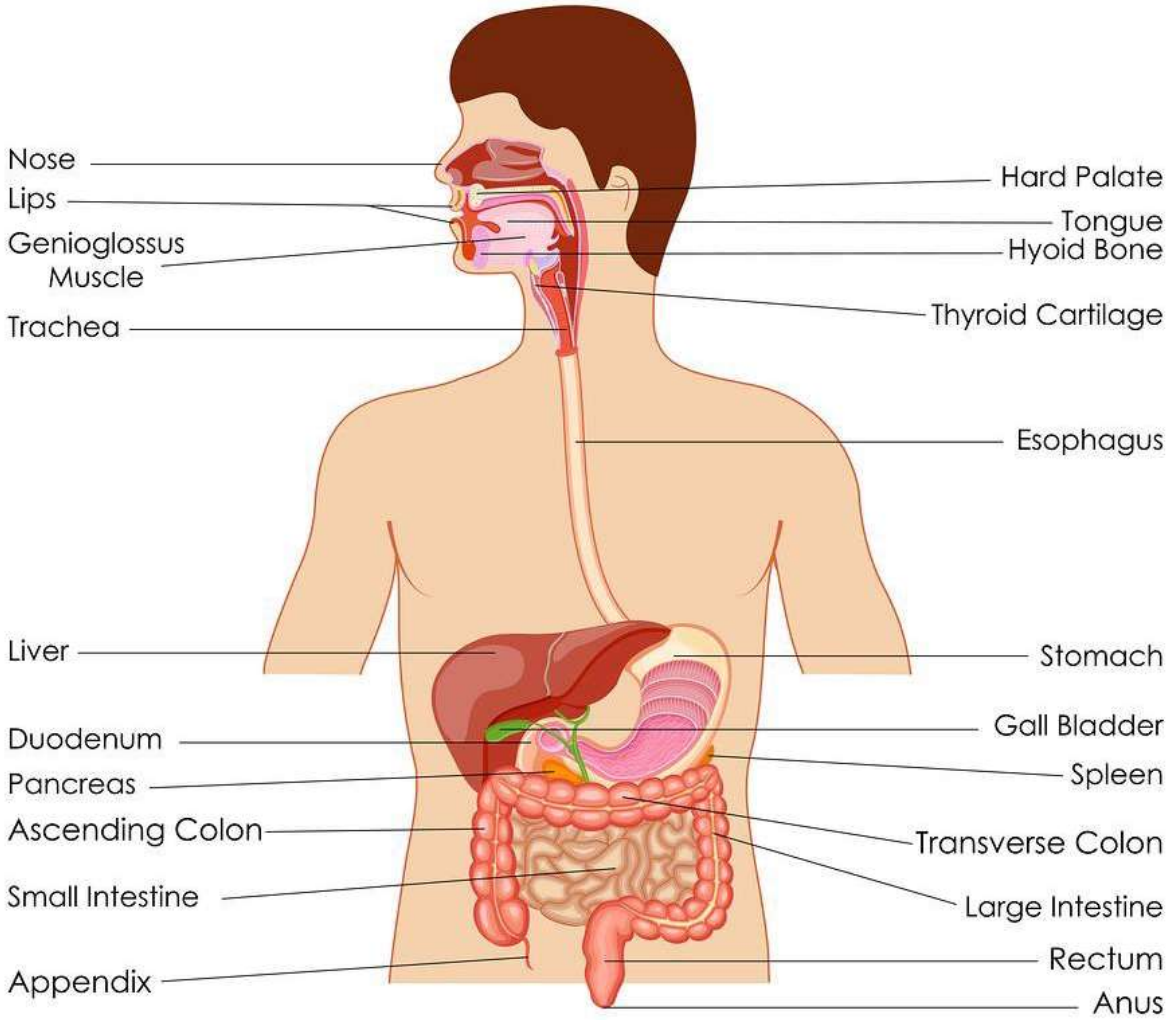
**Large intestine** – also called the colon. Vitamins, minerals and water are absorbed and waste matter is turned into faeces prior to excretion

**Liver** – produces bile acids which break down fats so that they can be emulsified (mixed with water)

**Gallbladder** – stores bile acid produced by the liver



**Pancreas** – secretes enzymes for the breakdown of protein into amino acids, carbohydrates into glucose and fats into fatty acids and also produces insulin which is necessary for the movement of glucose into the body's cells.




These organs have numerous functions and work together in the digestive process...

**Ingestion** – the taking in of food into the stomach

**Propulsion** – the movement of food through the hollow tubes of the gastro intestinal tract

**Digestion** – the breaking down of protein, carbohydrates and fats into smaller units

**Absorption** – the movement of nutrients into the blood

**Elimination** – the excretion of any waste products out of the body

**The passage of food through the digestive system**



Just the thought of food triggers enzymes (substances that control chemical reactions) to be released and saliva to be produced in preparation for eating. Chewing breaks down food into smaller pieces, which makes it easier to swallow and digest. Saliva is produced by the salivary glands and lubricates food for easy passage through the tubes of the digestive system. After swallowing, food passes down the oesophagus and into the stomach. The movement of food through the hollow tubular organs of the digestive system is called peristalsis. Once in the stomach food is broken down into even smaller units and mixed into a liquid called 'chyme' and digestion is completed. When the chyme is ready, the stomach empties into the first part of the small intestine (long in length, but small in diameter) called the duodenum where absorption begins. Nutrients are extracted from the chyme by structures called 'villi' and absorbed into the blood for use in the body's cells.

Once the chyme has reached the end of the small intestine it passes into the large intestine (large in diameter but shorter in length) where water is absorbed and waste material formed into faeces ready for elimination from the body.

**MOT your digestive system**

Like your muscles, your digestive system needs some care and attention to keep it in top shape. To prevent common digestive problems, it is essential to eat well and drink plenty of water. Fibre (found in fruit, vegetables and whole grains) is vital for the easy passage of food through the intestines. Without sufficient fibre and water, the propulsion of matter through the hollow tubes of the digestive system can become sluggish. This can result in constipation or less frequent and/or more difficult bowel movements, which puts an unnecessary strain on the digestive system. If left unchecked this strain can develop into a condition called 'diverticular disease', where bulges occur in the walls of the large intestine and bacteria builds up resulting in abdominal pain.

To maintain the health of the digestive system, eat plenty of fresh fruit and vegetables, whole grains in preference to refined grains, drink plenty of water, take care with food hygiene and exercise regularly.

**Food labelling**

Understanding and interpreting food labels is an essential skill for anyone interested in nutrition. Food manufacturers are required by law to put certain information on their labels and this information can be helpful when deciding what to eat.

**Nutrition label basics**

Food label layout and contents must follow a certain universal format and include the following information:

- Identify macronutrient and calorie values per 100g/typical serving
- List ingredients in order of weight from greatest to smallest
- Manufacturer's details
- Total volume or weight
- A "best before date"
- Storage instructions
- Preparation instructions
- Potential allergens in the product



The label provides average nutritional values but it should be stressed that a 20% margin of error is permissible by law and, in a 2005 BBC study, it was revealed that out of 70 products tested for 570 nutrients, only 7% actually matched the stated values and food sold lose or cooked in-house is not covered by the same labelling legislation.

In the UK, food manufacture, marketing, sales and labelling is controlled by the Food Standards Agency or FSA for short. This independent body acts in the public interest and serves as an advisory body to the government regarding food. The current food manufacture and labelling standards, the 1990 Food Safety Act, and the Eat Well Plate both fall under the auspices of the FSA.

**Marketing terminology**

There are a wide variety of terms that are used by food manufacturers in an effort to promote the food they produce. The FSA provide numerous guidelines as to what terms manufacturers can and cannot use. Terms like "fresh", "pure", and "natural" all carry certain connotations that can heavily influence consumers and so many such terms and their meanings are regulated.

| Term | Meaning |
|---|---|
| Fresh | To identify food sold close to harvest time |
| Pure | A single ingredient food or to highlight ingredient quality |
| Natural | Comprised of natural ingredients |
| Authentic | Remains unchanged, originates from area implied by its name |
| Homemade | Made in the home or of domestic manufacture |
| Traditional | A method of preparation that has existed for a long time |
| Farmhouse | Other than bread, should refer to farm produce |
| Original | A method of preparation that has remained unchanged for a long time |

While each of these terms conjures up images of healthy food produced naturally, in reality they can be used and misused (as they are 75% of the time) to mislead consumers. For example, the term "traditional" emotes images of recipes handed down through the generations but the food in question may actually be a factory-produced version of something that as once made in the home.

In addition to the common food marketing terms, an entire sub-language of marketing terms exists for foods aimed at dieters and those interested in healthy eating. Some of these terms are also regulated by the FSA but, like regular marketing terms, can be used and interpreted in more than one way.



| | |
|---|---|
| Light, low, reduced, or high | No specific guidelines exist except they must not be misleading |
| Reduced fat, low fat | Must be at least 25% lower in fat than original |
| Low calorie | Must have fewer calories than original but no set percentage |
| Sugar-free | Contains no added sugar but will usually contain artificial sweeteners |

**Food additives and labelling**

Food manufacturers are allowed to use a large number of food additives but additives must be listed on food labels. Not so many years ago, this meant food labels contained lots of so-called "E numbers" that identified the added ingredients. However, more recently, the health-conscious majority of consumers have become more label-savvy and know to avoid foods containing ingredients like E101.

To counter this, but still keep true to the law, many food manufacturers now list added ingredients by their real chemical names. Additives are used for a variety of purposes but, generally, this is to increase food profitability rather than the healthful qualities of the food in question. Additives include anti foaming agents, carrier solvents, bulking agents, firming agents, and flavour enhancers, flour treatment agents, glazing agents, modified starches and raising agents.

**Refined sugars**

In many cases, the list of ingredients in processed and refined foods includes refined sugars. Refined sugars are very sweet, mildly addictive, contain empty calories and help increase sales. They are strongly linked to diabetes and obesity and are best avoided where possible.

Common refined sugars and sweeteners include:

- Dextrose
- Glucose syrup
- High fructose corn syrup
- Glucose-fructose syrup
- Inverted sugar syrup
- Mannitol
- Xylitol
- Sorbitol
- Maltodextrin

In addition to these caloric sweeteners, there are several low calorie and calorie free sweeteners in current use including stevia, aspartame, saccharine and acesulfamine K.

Low and no-calorie sweeteners are often used in “diet” products but are a very controversial subject as many are linked to things like high blood pressure, seizures, depression, numbness, aching muscles, diarrhoea, headaches, rashes, hyperactivity and even cancers. It is safe to say that switching from sugar to using artificial sweeteners instead is not an automatically healthy option.



In addition to artificial sweeteners, another less-than-healthy but common food additive is the flavour enhancer monosodium glutamate or MSG for short. MSG has mildly addictive qualities and increases appetite so its inclusion is likely to increase the amount of food eaten; good for profit margins but not so good for your waistline.

Variants/indicators of the presence of MSG include:

- Yeast extract
- Hydrolysed protein
- Whey protein isolate
- Soy protein isolate
- Carrageenan
- Some “natural” flavourings

**Additive categories**

Although not as commonly used as in the past, E numbers reveal what category of additive(s) are present:

| Category | Use |
|---|---|
| E100s | Colourings |
| E200s | Preservatives |
| E300s | Anti-oxidants, acidity regulators and anti-caking agents |
| E400s | Emulsifiers, thickeners, stabilizer and gelling agents |
| E900s | Waxes, sugars and sweeteners |

**Additive safety**

Officially, food additives are deemed to be safe when consumed in small quantities and relatively infrequently however:

- 150 additives have had concerns raised after signs of adverse reactions
- 70 additives are known to cause allergic reactions in some people
- 30 additives are known to be harmful

Artificial additives are a relatively new addition to our food and so it's not really known what sort of long term effect they will have on health and wellbeing. For that reason alone it is worth trying to keep intake of artificial ingredients to a minimum. To do that, personal trainers should make the following recommendations:

| Avoid | Advise |
|---|---|
| Processed foods | Buy organic whenever possible |
| Fast foods | Use whole, fresh produce |
| Confectionary | Bake at home so you can choose the ingredients |
| Soft drinks and cordials | Always read the food labels first and make an informed |
| Pre-packaged meals | choice |
| Refined baked goods | Do not replace naturally occurring sugar with artificial sweeteners |
| Reduced or lower fat foods | |
| Cheap sausages or burgers | |



**Exercise nutrition**

Nutritional intake should be aligned to activity levels and relevant to the training program. Because of the demands of exercise on the body differ according to the type of activity being performed, the food consumed should be specific to the training goal.

In addition to the food they eat day by day, the serious exerciser also has several choices when it comes to deciding how to fuel their workouts:

- The sole use of food
- The sole use of sports drinks
- The sole use of protein drinks
- A combination of sports drinks and food
- A combination of protein drinks plus food
- A combination of protein drinks and sports drinks
- A combination of food plus water
- The sole use of water

**Carbohydrate and physical activity**

Carbohydrates are an important fuel for most physical activity and the higher the intensity, the bigger the role carbohydrate plays in energy production. Subsequently, there is a strong link between carbohydrate consumption and exercise. This can be seen in the common usage of products like sports drinks and energy gels which all supply fast acting carbs in abundance.

However, as carbohydrates are never used in isolation but also in the presence of fat, the importance of dietary fat should not be underestimated. As the chart below illustrates, even in activities such as sprinting which are dominated by the anaerobic energy systems, a meaningful contribution is made by the aerobic system which requires fat for fuel.

| Event | Gender | Aerobic | Anaerobic |
|---|---|---|---|
| 100 meters | Male | 21% | 79% |
| | Female | 25% | 75% |
| 200 meters | Male | 28% | 72% |
| | Female | 33% | 69% |



That being said, even the leanest of body's have a abundance of fat for energy and as low blood glucose and low muscle glycogen can adversely affect energy production, it makes sense to be "carbohydrate aware" when discussing exercise nutrition.

**Pre-exercise carbohydrate**

Pre-exercise carbohydrate ensures that blood glucose levels and muscle glycogen stores are maximized. Starting a workout with low carbohydrate levels can impair performance intensity and duration and lead to hypoglycaemia.

Around two hours or so prior to exercise, low glycaemic index (slow releasing) carbs are often believed to be best so that they are fully digested and blood glucose/muscle glycogen levels are optimized by the time the workout is due to begin.

Exercising on a stomach full of food is at best uncomfortable and at worst can cause severe cramp and stomach upset and is best avoided. More recent research has revealed that the glycaemic index of the 2-hour pre-training carbohydrate is not that important and even a high glycaemic index carb will be effective as they do not, contrary to popular belief, trigger a hypoglycaemic episode.

The actual length of time an exerciser can eat before activity varies from person to person but 90 to 120 minutes is about right for most people. Closer to the start of the workout, a higher glycaemic (fast acting) carbohydrate is believed to be more beneficial and as digestion can be impeded by exercise, a drink is a better choice than food.

**Carbohydrate during exercise**

In certain circumstances, consuming carbohydrates during exercise can be beneficial. For the majority of recreational exercisers plain water is adequate but where performance is more important than burning calories or fat, carbohydrates consumed during exercise may be beneficial. Consuming carbs during exercise is acceptable if:

- The session is longer than one hour
- If the match or race is longer than 90-minutes

If a pre-exercise carbohydrate meal is not possible e.g. early morning training

The consumption of carbohydrates during prolonged exercise has been shown to delay the onset of fatigue but it is important to realise that ingesting carbs during exercise can inhibit fat loss.

**Post-exercise carbohydrate**



After exercise, muscle glycogen, liver glycogen and blood glucose can be partially depleted; the degree of depletion depending on the intensity and duration of the exercise. On completion of exercise, this used glycogen must be replaced to facilitate recovery.

To ensure the fast and complete restocking of used glycogen stores, the muscles and cells are much more sensitive to the effect of the glucose transport hormone insulin and this increase in sensitivity lasts approximately two hours after exercise.

Fast acting, high glycaemic carbohydrates are most appropriate at this time. High glycaemic carbohydrates will:

- Increase glucose availability
- Increase insulin production
- Increase glucose uptake into cells
- Increase glycogen synthesis

Some studies have used convoluted systems for replacing lost glycogen such as consuming one gram per kilo of bodyweight every two hours for 12 hours. However the simpler and more accessible method of consuming a sports drink immediately after exercise and a high glycaemic carb-based meal such as white rice within two hours of exercise has been shown to be similarly effective. It appears that small, infrequent feedings and less frequent but larger feedings produce very similar results.

**General exercise**

For most general exercisers, no special emphasis needs to be put on pre, during or post-training carbohydrate consumption. For those individuals, the following guidelines are appropriate:

- Aim to stay within energy balance
- Create a daily calorific deficit of 250 kcals if trying to lose weight
- Choose low to moderate glycaemic carbohydrates to fulfil carbohydrate needs
- To avoid fuel conflicts, do not consume high fat/high carbohydrate meals
- Eat smaller, more frequent meals to favour digestion
- Micronutrient intake should be high
- Fibre intake should be adequate
- Protein intake should match exercise goals
- EFAs should be eaten in balance
- Water consumption should be plentiful and sufficient to ensure hydration

**Hydration and sports drinks**

Your body is made up of between 65 to 75 percent water so a ten-stone (140 pound/64 kilogram) person's body contains around 42 to 48 litres of water! It's no wonder then that virtually every nutritional expert places a high value on hydration, rehydration and avoiding dehydration.

Water is a number of functions in your body including:

- Temperature regulation through sweating
- Movement of chemicals around your body
- Medium for chemical reactions
- Lubrication of digestive tract
- Elimination of waste materials and toxins
- Integral part of all muscles
- Provides a carrier medium for blood cells – known as plasma



Water is the most essential part of your diet. You can live for quite a long time without food as even the leanest person has a significant supply of body fat but, as we cannot store much water and it is essential for virtually every reaction that occurs in your body, you won't live more than a few days without water to drink.

**Staying hydrated**

As it is water your body needs, it is water you should drink but there are numerous opinions about how much water you need. The most common hydration recommendation is six to eight tall glasses of water a day; the equivalent of around two litres. Interestingly, this figure has absolutely no scientific basis and is not the result of any studies, medical journals or statistical research. It's simply a figure that was proposed back in 1945 by the American Nutrition and Food Board that was adopted by just about everyone thereafter. That is not to say that these figures are wrong but only that two litres is an arbitrary number based on one organization's opinion as opposed to scientific fact.

The Table below provides a summary of the suggested water intake according to bodyweight:

| Bodyweight (kg) | Water intake (litters) |
|---|---|
| 55 | 1.70 |
| 60 | 1.85 |
| 65 | 2.00 |
| 70 | 2.15 |
| 75 | 2.30 |
| 80 | 2.45 |
| 85 | 2.60 |
| 90 | 2.75 |
| 95 | 2.90 |
| 100 | 3.05 |

Rather than focus on the amount that your body MAY need, it is better to focus on what your body actually DOES need. The best determinant of your water needs, are your thirst and your urine colour and output.

### Thirst

Thirst should be our best hydration indicator. Our caveman ancestors' probably only used thirst to govern their water drinking habits. If you were thirsty, you needed to drink. Simple! The problem now is that, because modern man often slakes his thirst with sweetened, calorie dense beverages, thirst and hunger signals can become confused. In other words, you might feel hungry but, in reality, you are actually thirsty but your brain gets the signals all turned around. This was not a problem for our non-sugary drinking ancestors. Subsequently, thirst has become a less accurate indicator of hydration. Because of this lack of thirst sensitivity, it is better to drink enough water to avoid thirst in the first place.



### Urine colour and output

Other than your first urination of the day, most experts agree that your urine should be relatively clear, fairly copious and also odourless. Dark, smelly and infrequent urination can be a sign of dehydration and the less than rosy odour suggests a build-up of undiluted toxins and waste-products.

By avoiding thirst and making sure most of your urinations are a light straw-like colour and neutral smelling, you can be confident that your body has all the water it needs to maintain healthy metabolic and thermoregulatory functions.

### Dehydration

Mild dehydration is common. A hard workout, too much coffee or alcohol, too little water or hot weather can all result in less than optimal water levels in your body. This is not a serious problem if this is a short term or infrequent occurrence but regular and/or long term dehydration can cause numerous performance and medical related problems.

**Signs of dehydration – in approximate order of onset and severity**

- Dry mouth (sometimes referred to as "cotton mouth")
- Reduced urine output
- Dark, odious urine
- Headache
- Muscle cramps
- Fatigue
- Cessation of sweating
- Hot, dry skin
- Elevated heart rate
- Confusion
- Elevated core temperature
- Heart palpitations
- Unconsciousness
- Kidney failure
- Coma
- Death

**Too much of a good thing?**

While water is essential for life, too much water can actually be harmful to your health. Although very rare, some people have suffered from a condition called hyponatraemia, also known as water intoxication. This condition can manifest if you drink very large volumes of water, for example during a long distance running event where you consume significantly more water than you are losing by over taking on water at each and every feed station.

This results in a dangerous dilution of essential minerals, collectively called electrolytes and specifically sodium. Sodium is essential for muscle contractions, regulating inter and extracellular fluid levels and pressure as well as controlling heart rate and rhythm. A significant enough sodium dilution can even prove to be fatal. Needless to say, this is a very rare occurrence and is usually the result of an underlying medical condition combined with an extreme excess in water or sports drink consumption.



**Sports drinks**

No discussion of hydration would be complete without mentioning sports drinks. With so many on the market and so much advertorial information telling you what drink you should consume when, it can be very hard to choose a sports drink that is ideally suited to your needs.

The first question to ask yourself is, however, do you really need a sports drink? If you are exercising for 60 minutes or less, are exercising for weight loss and have eaten properly in the hours leading up to your workout, it is suggested that plain water is more suited to your purposes. If, on the other hand, you have not eaten properly before training, are going to be working for 60 minutes or more and are not trying to burn fat during your workout, a sports drink is an acceptable way to stay hydrated.

There are three main types of sports drinks:

**Hypotonic** – with a very low amount of carbohydrate, a hypotonic drink is mostly about hydration and offers very little in the way of fuel. That being said, ingesting any carbohydrates can suppress fat burning so water is the better choice if that is your exercise goal

**Isotonic –** containing around 6 grams of carbohydrate per 100 millilitres of water, isotonic drinks are the most common sports drinks. Usually engineered to provide a mix of slow, medium and fast acting sugars for energy plus essential electrolytes, an isotonic drink provides fuel and hydrating fluids in equal measure. Isotonic drinks are ideal for long workouts where a drop in blood glucose or muscle glycogen levels would result in decreased performance. However, the carbohydrate content and extra calories in these types of products would negate most of the benefits of a fat-burning workout.

**Hypertonic** – ten plus grams of sugar per 100 millilitres of water means that hypertonic drinks are more food than rehydrating fluid. The high level of sugar may actually interfere with water absorption so these drinks are not ideal for helping you stay well-hydrated. If you chose to use a hypertonic drink, you should also consume plenty of plain water to make sure that you rehydrate as well as refuel.

Many sports drinks contain artificial flavours, colours, sweeteners and a host of other chemicals that have no place in a beverage designed to be healthy. If you would prefer not to use commercial sports drinks, you can easily make your own isotonic sports drink by following these recipes from the Paralympic Association:

- Dissolve 60g of glucose powder into a litre of water and add one-fifth of a teaspoon of natural unprocessed salt
- Mix 500ml of unsweetened natural fruit juice with 500ml of water and add one-fifth of a teaspoon of natural unprocessed salt



**Protein shakes**

Protein shakes are a very popular group of supplements especially in bodybuilding and strength training circles. Advertising in magazines and on the internet helps drive sales and as people involved in strength training generally need more protein than sedentary people, protein shakes make a lot of sense as it's no easy thing to get enough protein from real food if you have a high bodyweight and/or limited opportunities to eat real food.

Protein shakes can be made from a variety of ingredients including egg, soya, rice, hemp and milk but arguably the most common form of protein shake is made from whey.

Whey protein is a derivative of milk and is actually a by-product of the cheese manufacturing process – think curds and whey. Until it was used in the manufacture of protein shakes, whey was either discarded or used in animal feed.

Whey has a very high concentration of the heavily catabolised branched chain amino acids leucine, isoleucine and valine and also scores very highly on the biological value scale which means that whey has a good affinity with muscle.

However, one tub of whey protein can significantly differ from another and there are even different types of whey protein.

### Whey protein isolate

Whey protein isolate or WPI for short is the purest form of whey protein currently available and by weight contains between 90 to 95 percent protein. WPI contains very little or no lactose which makes it ideal for individuals who suffer from lactose intolerance. WPI contains only trace amounts of carbohydrates and fats which makes it ideally suited for those looking to gain lean mass or lose fat. The purity of WPI can mean it is slightly more expensive than other types of whey but as you get a purer and more concentrated product, there is a benefit to this elevated cost. Of all the whey protein forms, WPI is the fastest and most easily digestible which makes it especially well-suited for post exercise consumption.

### Whey protein concentrate

Whey protein concentrate, WPC for short, is less pure than WPI and provides anywhere between 25 to 85 percent protein by weight depending on the quality of the product in question. Lower grade WPC is often used in protein bars and also as an added ingredient in more common foods such as soups, crackers and cereals. WPC contains more carbohydrate in the form of lactose plus slightly more fat and also minerals and water when compared to WPI and this reduction in purity is usually reflected in the price. If you use WPC, seek out products that provide around 80% protein by weight as these are the most useful for muscle growth and repair.



### Hydrolyzed whey protein

Protein is made up of chains of amino acids called polypeptides. The longer and more complex the polypeptide chain, the longer the protein will take to digest. Sometimes, for example between meals or late at night, a slow digesting protein maybe useful but in the period immediately before and after exercise, a more fast acting protein is better. In hydrolyzed whey protein, the long polypeptide chains have been broken down into shorter chains called oligopeptides which are rapidly digested and provide a very quick supply of amino acids to your muscles. This rapid delivery of amino acids results in a speedier recovery from strenuous exercise. Hydrolyzed whey protein is more expensive than WPI and WPC and is best kept for immediately post-exercise. Of all they forms of whey protein, hydrolyzed whey is the least likely to cause digestive upsets.

### Whey protein blends

While it is possible to buy products that contain either whey protein isolate, whey protein concentrate or hydrolyzed whey protein, many products use a customized blend so that you can benefit from the unique properties of each type of whey. Whey protein blends are usually good value for money and suitable for a wide variety of users and purposes as well as being widely available. Read the ingredients list so you know exactly what is in your whey protein blend and be aware that many products use a lot of whey protein concentrate as it is the cheapest form of whey.

When considering a whey protein product consumers should:

Seek out cold processed protein powders manufactured below 50 $^{O}$C to avoid denaturing (damaging the protein and rendering it less digestible)

- Choose products with no added sugar, sweeteners or artificial flavours
- Mix whey protein with full fat milk, organic peanut/almond butter or coconut oil to enhance protein metabolism
- Remember that whey protein shakes are a supplement to and not a replacement for healthy food
- Protein consumption beyond what is actually needed will not automatically be converted to muscle but may actually become fat

Supplements such as protein shakes are often marketed as being essential but, in reality, it is quite possible to get all the protein required to fuel muscle growth by eating meals based on meat, fish, poultry and eggs and through the use of complimentary proteins. However, protein shakes do make for a convenient way to get additional protein if eating a solid meal is not practical.

Nutrition for exercise can be a complex subject and that complexity is partially because very little of the information around is actually impartial. Much of the research and information is biased toward a particular product and often paid for by the manufacturers.

Rather than try to decipher the often wildly inaccurate exercise and sports nutrition information in the fitness magazines that is often advertising in disguise, personal trainers should endeavour to stick to the tried-and-tested exercise nutrition principles outlined below:



| Avoid | Advise |
|---|---|
| Low quality protein shakes and most commercial sports drinks | Make your own isotonic drink if needed for energy* |
| Most cereal bars and energy gels | Eat organic animal products for protein |
| Low quality refined carbohydrates | Eat organic nuts, seeds, fruit etc. for snacks |
| Using carbohydrates in isolation for energy | Allow time to prepare and eat "real" food rather than |
| Ignoring the importance of pre and post-exercise meals | Rely heavily on supplements |
| Ingesting carbohydrates during short workouts or when **F**at loss is the primary goal | Drink water as primary rehydrating fluid |

**Weight management**

The goal of weight management is to prevent the accumulation of excess body fat or reduce fat levels to an acceptable level in order to minimize the health risks associated with obesity. To achieve a bodyweight with which they are happy, many people embark on one of the many diets available or exercise specifically to burn calories.

**Adipose tissue**

Excess calories (energy) from any macronutrient group are ultimately converted to fat and stored in specialist cells called adipocytes which are collectively called adipose tissue. Adipocytes can swell in size and can even undergo hyperplasia which means they increase in number. It is theorized that being overweight, especially during puberty, can increase the number of adipocytes which can lead to an increased risk of obesity and diabetes in later life. Genetics can also play a role in the size and number of adipocytes but, despite this, a sound diet and exercise program can still result in fat loss.

**Distribution of body fat**

The distribution of body fat is influenced by genetics and gender and plays a part in how dangerous accumulated body fat can be to health. There are two main types of body fat accumulation:

- Android or apple-shape
- Gynoid or pear-shape

**Android obesity** is characterised by fat accumulation around the midsection and internal organs and is also known as central obesity. This fat accumulation is most commonly associated with men and is often seen as a large "beer belly". Influenced by the hormone testosterone, android obesity is a leading factor in the development of coronary heart disease. While more common in men, some women can experience android obesity if their oestrogen levels decline and testosterone levels rise.



**Gynoid obesity** is characterised by fat accumulation around the body's periphery e.g. the hips, thighs, chest and arms. Normally associated with females, this fat accumulation presents less of a CHD risk but still increases the risk of developing diabetes and other fat-associated health risks. While normally associated with females, men can suffer this type of obesity if their testosterone levels decline sufficiently.

There are several methods commonly used to assess the health risks of obesity and the different fat distribution sites:

- Body mass index
- Abdominal circumference
- Hip to waist ratio

While none of these methods directly measure body composition, they are all simple to perform and have been shown to identify major risk indicators.

**BMI –** is calculated by dividing body weight in kilograms by height in meters squared or KG/$M^2$. This calculation is straight forward but there are also several BMI calculators available on the internet. While BMI is a good indicator of risk for BMI in sedentary people, it is less useful when assessing people with above average amounts of muscle who tend to be heavier than non-exercisers but considerably leaner. The table below provides information on how to assess risk based on BMI.

| Classification of obesity by Body mass index (BMI) | | |
|---|---|---|
| **Classification** | | **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 |
| Severe obesity | II | 35 – 39.9 |
| Morbid obesity | II | >40 |

**Abdominal circumference –** the larger the abdominal circumference, the greater the risk of suffering health issues such as coronary heart disease. Measurements should be taken horizontally around the umbilicus or belly button as that point will not move and provides a handy reference for future measurements.

| Lowered risk | High risk |
|---|---|
| Men <94cm or <37 inches | Men >102cm or >40 inches |
| Women <80 cm or <32 inches | Women >88cm or >35 inches |



**Hip to waist ratio –** fat stored in greater amounts around the abdomen as opposed to the hips is a prime health risk indicator. The measurement of the waist is simply divided by the widest measurement around the hips and the results can then be compared to the chart below.

| 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 | |

**The starvation response**

To reduce body fat levels for either aesthetic or health reasons, many people use low calorie diets. Unfortunately, cutting calories too low can trigger something called the starvation response. In addition to being a storage site for energy, adipose tissue is also a secreting organ; the main secretion being the hormone leptin. Leptin levels are proportional to the amount of fat mass and rapid fat loss will result in rapid falls in leptin. A very low calorie diet leading to a rapid fall in leptin levels is detected by the hypothalamus region of the brain and is what triggers the starvation response.

The starvation response was once an essential mechanism for keeping humans alive during periods of famine but is now redundant. However it still remains active and will result in the following:

Decreased metabolic rate to preserve fat stores

- Increased hunger
- Increased use of muscle for fuel
- Increased LPL activity – LPL being the enzyme responsible for moving triglycerides into adipocytes

Once the diet is over and the client returns to eating normally, the reduction in metabolic rate and muscle mass and the increased LPL activity will mean that fat is not only regained, but more is regained than was originally lost. This results in what is commonly referred to as yoyo dieting where instead of losing weight and fat, dieters actually get fatter over time.

To avoid triggering the starvation response, any energy restriction should not exceed 250 kcals below total daily energy expenditure or TDEE.

**Task** – using the following "Harris-Benedict Formula" calculate your Basal Metabolic Rate (BMR)

Then calculate your approximate TDEE by applying the activity multiplier.

Men: 66 + (13.7 x weight kg) + (5 x height cm) – (6.8 x age) Woman: 655 + (9.6 x weight kg) + 1.8 x height cm) – (4.7 x age)

| Activity level | Activity multiplier |
|---|---|
| Sedentary | BMR x 1.2 |
| Lightly active | BMR x 1.375 |
| Moderately active | BMR x 1.55 |
| Very active | BMR x 1.725 |
| Extra active | BMR x 1.9 |



**Genetics**

Some people are much more likely to gain fat than others. Those with endomorphic tendencies, those with a higher than average number of adipocytes and hormonal disruption can all play a part. However, obesity has not been common enough for long enough for major genetic changes to have occurred and, in reality, environmental factors are more likely to be the cause of obesity than genetics in the vast majority of cases. In an environment conducive to weight loss, even genetically predisposed people with obesity will lose weight.

It is worth noting that, according to set-point theory, there is a percentage of body composition at which your body prefers to be and it will ultimately "swing back" to that level given the opportunity to do so. This may help explain why some people can only maintain a low body fat percentage for a relatively short time.

**Energy and metabolism**

Energy and metabolism are essential players in the battle against body fat. It is important for any trainer to know not just where energy comes from (the macronutrients) but how it is expended (metabolism). Metabolic energy expenditure is made up from several components:

**Basal metabolic rate –** BMR for short, this refers to the amount of energy used by the body at rest in a 24-hour period. This is the sum total of calories required to sustain body function at complete rest and when no digestion is occurring.

**Thermal effect of food –** TEF for short, this refers to how much energy is used during the ingestion, digestion, absorption, storage and elimination of food. TEF accounts for between 6 to 10 percent of total daily expenditure for men and 6 to 7 percent for women.

**Thermal effect of activity –** TEA for short, this figure refers to the energy used during planned and unplanned physical activity. Low levels of activity mean that fewer calories are used and higher levels of activity mean that more calories are used. TEA accounts for 20 to 40% of total daily energy expenditure and is also the most modifiable form of energy expenditure.

The following chart provides a rough estimate of the amount of energy used during different activities for a 65kg female and a 79kg male.

| | | |
|---|---|---|
| High impact aerobics | 553 | 455 |
| Badminton | 356 | 293 |
| Basketball | 632 | 520 |
| Light cycling | 474 | 390 |
| Building work | 435 | 358 |
| Heavy cleaning | 237 | 195 |
| Table tennis | 316 | 260 |
| Swimming vigorously | 790 | 650 |
| Volleyball | 316 | 260 |
| Weight training | 390 | 390 |
| Dancing | 356 | 293 |
| Rugby | 790 | 650 |
| Golf | 237 | 195 |
| Horse riding | 316 | 260 |
| Jogging | 553 | 455 |
| Pilates | 277 | 228 |
| Pushing baby buggy | 198 | 163 |
| Tennis | 553 | 455 |
| Brisk walking | 395 | 325 |
| Sitting | 198 | 163 |



**Total daily energy expenditure –** TDEE for short, TDEE is the sum total of all energy required to fuel all activities including eating, sleeping and physical activity. If this figure is equal to energy input, body fat levels and weight should remain stable but if food intake is greater than TDEE, body fat and weight will increase. Conversely, if calorific intake is less than TDEE fat loss should be the result. Expending more calories than are consumed is called creating an energy deficit and is an intrinsic part of weight management.

**Creating an energy deficit**

To avoid triggering the starvation response and preserving muscle during a period of caloric restriction, it is recommended that dieters do not reduce their energy intake by more than 500 calories below TDEE. While greater deficits are possible, they are much more likely to result in a fat gain rebound.

An energy deficit of 500 calories per day should result in a one-pound fat loss per week as 500 multiplied by seven days will result in a 3500 calorie deficit which is the approximate amount of energy contained in a pound of fat.

An energy deficit can be achieved in several ways:

- Diet restriction alone
- Exercise alone
- The combination of diet restriction and exercise

In the majority of cases, option three is the best choice. Diet restriction alone means that diet must be very strict and may be nutritionally poor while exercise alone means that approximately one hour of exercise must

be performed every single day. Combining diet and exercise has been shown to be the most sustainable method for creating the required energy deficit.

**Effective dietary interventions**

Just as exercise must be programmed correctly to be effective, so too must any dietary interventions. Just skipping a meal or "eating less" will not be as effective as implementing tried-and-tested dietary interventions. Factors to consider include:

- Frequency of meals
- The effect of insulin
- Macronutrient balance
- Biological individuality



**Frequency of meals**

Eating little and often has been shown to be a beneficial strategy for weight management. Studies suggest that people three meals of 500 calories versus people eating a single meal per day of 1500 calories lose weight faster, experience less hunger and enjoy a higher degree of dietary compliance. More frequent meals are also linked to a reduction in loss of fat free mass, more stable blood glucose levels and more stable energy levels; therefore a minimum of three meals per day is advised.

**The effect of insulin**

Insulin is an essential hormone that helps drive nutrients into cells. Produced by the pancreas, insulin levels increase whenever blood glucose levels increase. Insulin is essentially an anabolic or building hormone and its benefits can be harnessed by always consuming a post-workout meal to facilitate rapid restocking of muscle and liver glycogen.

However, elevated insulin levels can also inhibit fat loss and is partially responsible for the uptake of unused glucose into fat cells. For this reason, foods that trigger a rapid rise in blood glucose and therefore insulin are not conducive to weight management; low glycaemic index carbohydrates are the carbs of choice when eating for weight control.

In addition to avoiding high glycaemic foods and the associated high insulin levels, it is also important to try and increase insulin sensitivity. This is best achieved through exercise and especially resistance training.

**Macronutrient balance**

Balancing intake of the three macronutrients is key to preventing weight gain and facilitating fat loss. All three macronutrients are essential but need to be consumed in the right balance if they are to be utilized efficiently.

Excess dietary fat, which is high in calories, is easily converted to body fat while carbohydrate, which is lower in calories, can also be easily converted to fat when consumed in excess. Protein, which has the highest thermal effect of the three food groups, is much tougher to convert to fat when consumed in excess and should be present in most if not all meals.

With all these points in mind, it makes sense to either reduce fat intake or reduce carbohydrate intake. This reduces any competition for fuel, will help control insulin levels or negate the negative aspect of elevated insulin levels and ensure meals have as high a thermal effect as possible.

**Biochemical individuality**

"One man's meat is another man's poison" said Roman philosopher Lucretious back in 200BC. Without realizing it, Lucretious was referencing something we today call biochemical individuality. Biochemical individuality describes how we are all slightly biologically and chemically different and respond differently to the foods we eat. That is why dietary models such as the food pyramid and Eat Well Plate do not work for everyone.



Because of biochemical individuality, there is no one perfect diet and this premise helps explain why some diets work for some people and not for others. Some people seem much better suited to lower carb, higher protein and moderate fat diets while other thrive on higher carbs, low fat and moderate protein. This means that any adopted nutritional approach may need to be adjusted or even abandoned if it does not work for a particular individual.

**Modern systems for weight management**

Open any fitness or popular entertainment magazine and you will inevitably find a diet being promoted. Every month a new diet tops the non-fiction book charts and celebrities do their part by talking about their latest weight loss regimen. There are literally hundreds of different diets around many of which are effective for no other reason than they result in an energy deficit. Other diets create more than a simple energy deficit and are designed to make the most of hormones, metabolism and enzymes in an effort to maximise fat loss.

Some diets are actually very safe and effective while others are less so. In reality, there is no real need to follow a diet so long as food intake is restricted slightly to facilitate a caloric deficit.

That being said, a personal trainer needs to have a passing knowledge of popular, modern diets so they can offer appropriate advice to his/her clients.

| | | |
|---|---|---|
| Fasting | Helps detoxify bodily systems<br>Creates significant energy deficit<br>Gives digestive system "a rest"<br>Result in rapid weight loss | Risk of malnourishment<br>Low energy levels<br>Severe hunger<br>Increased risk of headaches, allergies, aches and pains and bad breath |
| Very low calorie diets | Result in rapid weight loss<br>Designed for obese people | Should be conducted under medical supervision<br>Often only 800 calories per day<br>Severe hunger and lack of nutrients<br>Constipation and digestive upset<br>Risk of heart damage |
| Calorie counting diets | Controls calorific intake<br>Provides guidance as to which foods are to be consumed | Focus placed on calories rather than nutrients<br>Very time consuming and restrictive |
| Meal replacement diets | Easy to implement as no calorie counting required | Does not teach new nutritional habits<br>Not suitable for long term use<br>Meal replacements |

| | | |
|---|---|---|
| | | can be more<br>expensive than food<br>Can result in social exclusion<br>at meal times |
| Food combining | Proteins and carbohydrates are digested better separately<br>Foods eaten separately more likely to be burnt as fuel and less likely to be stored as fat | Meals will be very restrictive<br>No real data to support<br>claims Not practical so low level of adherence |
| Fat burning supplements | Creates an energy deficit by raising metabolic rate | Fat burners are generally ineffective or dangerous<br>Effective fat burners only raise<br>metabolism very<br>slightly |
| The wholefood diet | Low in fat, high in unrefined carbs and contains moderate amounts of protein<br>Foods should be unprocessed<br>Wide range of foods<br>recommended<br>Naturally low in sugar, salt and additives | High carb intake may not be suitable for less-active<br><br>Caters individuals Caters for population rather than individuals |
| Ketogenic diets | High thermal effect of protein elevates metabolism<br>Low carbohydrate intake eliminates<br>competition for<br>fuel<br>Blood glucose and insulin levels stabilized to<br>facilitate fat loss<br>Ketones (produced from protein and fat) are inefficient energy sources which create a greater caloric deficit<br>Palaeolithic diet  All modern foods such as bread, refined foods and sugar eliminated<br>Food consumed that was available to hunter/gatherer ancestors<br>Some low GI carbohydrates are allowed<br>Contains lots of omega 3 and<br>omega 6 fatty acids<br>Can help stabilize blood glucose levels<br>Foods eaten in as natural a state as possible | Can make some people feel unwell and lacking in energy Lack of carbohydrate can make diet nutritionally unbalanced Initial weight loss is water – not fat Adherence levels low<br>Very restrictive Lack of Some concerns over heart and kidney health<br><br>Food choice very restrictive<br>Some concerns over lack of fibre<br>and carbohydrate<br>Deemed to be a<br>high fat diet so some concerns over increased CHD risk<br>Lack of dairy may mean low calcium intake |

**General weight management nutrition guidelines**

**Frequent Smaller Meals**

- Increases metabolism (metabolic bursts)
- Staves of hunger
- Helps regulate blood glucose levels
- Smaller meals less likely to be stored as fat
- Negative Energy balance
- Reduce energy intake by 250 – 300 kcal a day
- Include activities to use a further 250 – 300 kcal
- Never consume fewer kcal than BMR



**Nutrient intake**

- Consume vitamin and mineral-rich whole foods
- Intake of fibrous food should be high
- Avoid processed, energy dense, sugary foods
- Drink at least 2 litres of water a day
- Avoid high carbohydrates and high fat at the same time

**General weight management exercise guidelines**

**Resistance Training**

Aim: To maintain/increase FFM

**Cardiovascular Training**

Aim: To increase metabolic rate and increase energy expenditure

**Activities of Daily Living (ADLs)**

Aim: To increase overall energy expenditure

**Disordered eating**

While weight management usually means maintaining or lowering body fat levels to within healthy parameters, in some instances, weight management can be taken to unhealthy extremes or the methods used for weight

control can themselves be unhealthy. This is usually described as disordered eating. There are several types of disordered eating but the most common are anorexia nervosa and bulimia nervosa.

**Anorexia and bulimia nervosa**

Personal trainers are not equipped to deal with people suffering with disordered eating as the behaviours associated with these two different problems are medical and specifically psychological in nature. The National Institute of Clinical Excellence (NICE) advocate that most disordered eating patients should be treated on an outpatient basis and with appropriate psychological treatment and familial support where appropriate. Unfortunately many sufferers of disordered eating are in denial that they have a problem and that means referral, the correct course of action, can be difficult and must be treated sensitively.



While personal trainers should not attempt to treat or otherwise intervene if they suspect disordered eating, they should be able to recognise the signs and symptoms of both anorexia nervosa and bulimia nervosa for referral purposes.

In working with people who have previously suffered disordered eating, it is essential that the subject of weight, nutrition and food is dealt with very sensitively so as not to cause a repetition of the original condition.

| Signs and symptoms of anorexia nervosa | | | |
|---|---|---|---|
| **Physical** | **Psychological** | **Behavioural** | **Long term** |
| Extreme weight loss<br>Insufficient growth<br>Constipation or abdominal pains<br>Dizzy spells<br>Hair loss<br>Poor circulation<br>Dry, rough, discoloured skin<br>Dysmenorrhoe | Intense fear of weight gain<br>Distorted perception of body – body dysmorphia<br>Dental problems<br>Mood swings | Eating rituals<br>Eating in secrecy<br>Restlessness and hyperactivity<br>Wearing baggy clothes<br>Vomiting or taking laxatives | Difficulty getting pregnant,<br>Osteoporosis<br>Death |
| **Signs and symptoms of bulimia nervosa** | | | |
| **Physical** | **Psychological** | **Behavioural** | **Long term** |

| | | | |
|---|---|---|---|
| Frequent weight changes | Uncontrollable urges to eat | Binging and vomiting cycles | Heart attack |
| Going to the toilet after eating | Obsession with food | Excessive use of laxatives | Rupture to stomach |
| | | Periods of fasting | Teeth erosion |
| Sore throat and tooth decay | Body dysmorphia | Excessive exercise | Choking |
| Swollen salivary glands | Mood swings | Eating in secrecy | Death |
| Swollen face | Anxiety and depression | Abuse of fat burning supplements | |
| Poor skin | Low self esteem | | |
| Dysmenorrhea | Guilt associated with eating | | |
| Lethargy and tiredness | | | |

# CONSULT, COMMUNICATE AND GOAL SET

**Introduction**

Nutrition is a sensitive subject for many people because many attitudes to nutrition are based on familial traditions and are likely to have had a major impact in the client's health and appearance. Because of this, any discussions about nutrition have to be conducted on a very open, honest, professional, non-judgemental and empathetic basis.



Unlike exercise which happens in front of the personal trainer's eyes, nutrition happens outside of the trainer's supervision and so the client must be encouraged to be 100-percent honest about the food they eat and they will only do this if they feel they are in a safe environment.

Personal trainers have several methods at their disposal for gathering information about their client's eating habits but before using any of these methods, the trainer should obtain written and signed "informed consent" stating that the client is happy to share what is often personal information. Once informed consent has been obtained, the trainer may then use some or all of the following:

- Questionnaires e.g. lifestyle, nutritional, medical PAR-Q
- Completed food diary
- Interview/consultation
- Short and long-term observation
- Goal setting
- Nutritional assessments/tests

To be able to give well-developed information and advice, it is essential that the trainer gets "the full picture" from their client so that no incorrect assumptions are made. This will also ensure all advice given is individualized to the client's wants and needs. This is often best done in an interview/consultation during which all relevant information can be collected. When gathering information through interview the personal trainer should:

- Communicate clearly so that information shared is understood by the client
- Generate enthusiasm and motivation for change
- Avoid being judgemental and be aware that the trainers beliefs and opinions might not be the same as the client's
- Understand the constraints placed on the client by familial commitments, religious practices, employment and cultural practices
- Try to foresee any obstacles that may reduce adherence to nutritional changes and investigate potential obstacles tactfully using appropriate questioning
- Provide a variety of options so that the client is free to choose the option they prefer the most and ensure all information is aligned to the goals of the client



**Communication**

The key to a good consultation is communication. Without good communication is very difficult to establish a professional relationship which will undermine not just the initial consultation but the changes that need to be implemented over the coming weeks and months.

Good communication means different things to different people and as there are several forms of communication for the trainer to use, he/she must endeavour to use the one that is most suited to the client's needs

Nutritional principles can often be very complex and the trainer must be able to convey this principles to the client so that they can understand how these principles are to be implemented. It's all well and good the trainer knowing the principles, if they cannot convey them to the client then the information is all but wasted.

Good communication is essential for getting new clients and keeping current ones as it is vital for building rapport. With rapport established, the trainer will me much better able to enthuse, educate, coach, encourage, correct, understand, question and enjoying spending time with a client.

Good relationships go hand-in-hand with good communication. A solid, professional relationship is one of mutual respect and can only be built with good communication.

**Conditions that promote an effective consultation/interview**

To facilitate an effective consultation, a trainer must pay attention to the following:

The room

- Comfortable, bright, airy, appropriate temperature
- No barriers i.e. both sit on same side of desk

- Comfortable chairs that are angled slightly for easy eye contact but not directly facing – 45-degrees is ideal
- No loud noises or distractions, conversation should not be overhead
- No prominent clocks

### The consultant

- Genuine, interested, open minded, knowledgeable
- Have unconditional regard and respect for the client
- Posture and body language should be open, friendly and welcoming
- Use active listening skills to show he is fully engaged in the process
- Encourage the client to "open up"
- Be prepared to facilitate the consultation by asking relevant questions but leaving gaps for the client to answer



### The consultation

- Should be organized but unhurried
- Follow a structure and be led by the trainer
- Relevant responses recorded
- Considered confidential

**Using questionnaires**

Questionnaires provide a convenient way to gather information and can serve as the "springboard" for a subsequent consultation during which answers can be more fully explored. Questionnaires can help identify:

- Tome available for purchasing food and preparing meals
- Perceived barriers to behavioural change
- Employment, social and familial commitments
- Level of client commitment
- Any potential support network
- Social habits and activities that may help or hinder
- Any health or dietary problems that may require more specialist help

It should be stressed that clients may be inclined to answer questionnaires in a way that they think they should rather than honestly – as though they are sitting an exam. Therefore, nutritional questionnaires should be supported with food diaries whenever possible.

**Using food diaries**

Food diaries are arguably the most effective way for a trainer to gain information about their client's nutritional habits. Time should be spent explaining the importance of the food diary and how to use it so that the information gathered is as useful as possible. Consider these points when using a food diary:

For accuracy, complete the food diary after each meal rather than the end of the day

- Record accurately what was eaten
- Identify amounts eaten
- Identify food brands wherever possible
- Note time of intake
- Note fluid intake
- Note what/when exercise or physical activity was done
- Assess energy, mood and mental clarity 1-2 hours after each meal



Once information has been collected, it needs to be analysed and interpreted so that feedback can be given. The following information is amongst the most important:

- Amount of carbohydrate consumed per day
- Frequency or carbohydrate consumption
- Types of carbohydrate consumed i.e. refined versus unrefined
- Energy, mood and mental clarity in response to carbohydrate intake
- Amount of fruit and vegetables consumed
- Variety of fruit and veg
- Amount of protein consumed per day
- Quality of protein
- Frequency of protein consumption
- Energy, mood and mental clarity in response to protein intake
- Amount of fat in daily diet
- Quality and types of fat consumed
- Sources and ratio of omega threes and omega sixes
- Timings of meals throughout the day
- Quantity and quality of fluid intake per day
- How food fits in with exercise, work and familial commitments
- Conscious or subconscious eating patterns
- Alcohol habits and intake
- Sources of trans fats and artificial additives
- Supplement use

**Providing feedback**

Once all the information is analysed, the trainer needs to provide feedback to the client. As some negative behaviours may need to be highlighted and discussed, this needs to be done in a diplomatic, honest, empathetic, sensitive way. Feedback should be non-judgemental and the trainer should endeavour to remember that the client has sought out the trainers help and expertise because they want help to change and are already aware that some of their nutritional habits are possibly unhealthy.

Feedback should follow a logical structure and highlight areas for change as well as acknowledging things the client is already doing well. If there are several areas for change, they should be prioritized by considering which changes will have the most benefit and which changes will be the easiest to make. The trainer should also identify the client's willingness to change so that both parties know where to direct their efforts. All information should be written down in the form of a report so the client can take it away for future reference.



Once the client has been made aware of their nutritional areas of strength and weakness and what changes need to be made, the trainer should then identify nutritional goals and provide options for attaining those goals. By setting goals, the client's energies will be more focused and by having options, they can choose the best way to work towards these goals for themselves. This prevents them feeling like they are being "railroaded".

Nutritional goals can include:

- Reduction in body fat or BMI
- Increase in muscle size
- Eating to achieve optimal health
- Fuelling exercise or sport
- Breaking poor nutritional habits

Whatever goals are discussed, it is important that they are SMART goals. SMART goals are much more likely to be successfully achieved.

**S**pecific – a statement of the objective
**M**easurable – must be quantifiable
**A**greed – between client and trainer
**R**ealistic – to increase chances of success
**T**ime-bound – to help focus attention

The timeframe attached to the goals should reflect how big the change is and how much of a priority the goal is. As time passes and priorities change, new less important goals can be added as required.

Goals should be recorded and available for easy reference by the client to help remind them of what they are working toward. Goals also need to be periodically reviewed and may need to be adjusted according to the client's progress.

To help clients achieve their goals, it is important that the trainer identifies both the resources available (knowledge, skills, support, motivation) and any barriers that exist. If motivation is insufficient or the barriers are greater than the level of motivation then performance will inevitably suffer. This is illustrated in something called the performance equation.

Clients who are able to stay focused, act in accordance with their objectives, and take 100% responsibility for their outcomes are rarely distracted by their barriers. However, some individuals who are resistant to change, perceive barriers to be greater than they are or lack genuine motivation are much less likely to achieve their goals.



**Investigating concerns and barriers**

It is important that the trainer identifies any client concerns or barriers to change before sending the client on their way to begin implementing the agreed changes. This is best done by identifying the client's readiness to change and current level of motivation and commitment. Asking open- ended questions such as "how do you feel about that" can allow the trainer to identify any issues that may need to be addressed.

Examples of potential barriers to compliance include:

- Client likes the taste of unhealthy food
- Client often engages in comfort eating
- There are financial concerns over the cost of healthier food
- Family members, spouse or partner do not support change

There are time constraints that may make shopping and preparing healthy food difficult

Dietary choices are influenced by cultural or religious practices or are ingrained habits the client cannot foresee changing

All barriers need to be explored and, where possible, solutions developed to minimize the impact of these barriers. For example, the trainer may help the client develop a weekly meal plan so the client can buy groceries in advance to save time. The trainer may also provide tried-and-tested healthy recipes, produce hand-outs to give to family members, identify low cost healthy eating options or make suggestions on time-efficient ways to prepare healthy food. By the end of this process, the client should feel more positive about overcoming their perceived barriers.

There are also several motivational tools and strategies the trainer can use to support the client in their efforts to eat more healthily:

**Self-monitoring** – the client should continue to keep a food diary, record thoughts and feelings before and after eating so they can identify and modify their behaviour accordingly e.g. identifying triggers for stress eating.

**Reinforcement –** the client should be praised for making positive progress and meeting goals**.** Emails, texts and phone calls can all help reinforce behaviour as too can support from family and friends.

**Behavioural contracts** – informal documents that are signed by both parties identifying areas of responsibility and an agreement to work together in the pursuit of nutritional and fitness goals. Should be revisited periodically to ensure both parties are being true to the spirit of the contact.

**Recruit supportive "other"** – it is often much easier to make significant changes when support is available e.g. from a spouse or friend. Support should be positive rather than negative.

**Periodic testing** – reassessing BMI, body composition, circumferential measurements or fitness level will provide information on progress and can be very motivating. The trainer should ensure that testing is only done when enough time has passed for changes to be positive. Because bodyweight fluctuates so much from day to day, care should be taken when using bodyweight as a progress marker.

**Decision balance sheets** – make lists of pros and cons of making nutritional changes. Inevitably, the benefits will outweigh any perceived drawbacks.



**Chart progress** – both trainer and client should record and review progress. Improvements in mood, energy levels and mental clarity as well as weight or inch loss can all be very motivating. "Before and after" photos can also be beneficial.

**Reward systems** – for example, a free T-shirt awarded for consistent maintenance of new behaviours.

**Liaising with others**

There are numerous professionals and people with whom a trainer may have to work to help their client achieve success. In some cases, this may be because the trainer is out of his or her professional depth and needs assistance because of the medical needs of a client. Alternatively, it may be that the trainer needs to try and get a family member "on board" so they too support the client's behaviour. People the trainer may have to liaise with include:

- Doctor
- Dietician
- Personal trainer/fitness instructor
- Friends
- Spouse
- Family members
- Psychologist
- Employer

Communication should always be professional and courteous and the success of the client placed at the centre of any discussion.

However, as potentially sensitive and private information may need to be discussed between parties, it is essential that consent to share information is obtained, preferably in writing, from the client themselves and that the rules pertaining to data protection are observed.

**Data Protection**

Because consulting with a client will always result in personal information being recorded, it is essential that the trainer has a good understanding of the Data Protection Act of 1998 and how it pertains to them and their clients. Consent must be obtained from the client prior to the recording of any information and all data recorded must confirm to the following two legal obligations:

**First obligation**

Information is fairly and lawfully obtained and processed:

- The information is used only for the intended purpose as explained to the client
- The information is adequate to the purpose, relevant and not beyond the needs of the purpose
- All information is accurate and current

Subjective and objective information should be differentiated and recorded Information should only be stored for the legally required duration:

- Information must be stored securely in a fireproof cabinet or on a password-protected computer
- Information should not breach the rights of the individual



Information should not be passed to third parties without the express permission of the client in writing

**Second obligation**

Inform the Information Commissioner of the intention to store date – a form is available at www.gov.uk/data-protection-register-notify-ico- personal-data

**Sample food diary**

A food diary is one of the most important tools available to personal trainers for gathering nutritional information. While you can design your own or use something like a standard exercise-type book, a more structured document may be useful. Feel free to use the document below or modify it to suit your specific needs.

About the energy/mood indicators



Assess your energy and mood levels one hour after each meal by ticking the relevant symbol. If you are somewhere in between the specified levels, simply highlight the two symbols that best describe how you feel. For example, if, after breakfast you feel fairly energetic and in a good mood mark both  and . If you are feeling slightly below average but not rock-bottom, highlight and .

- Feeling very happy and/or energetic
- Average feelings of happiness and/or energy
- Feeling unhappy and/or lacking energy Remember to explain the following to your client:
- For accuracy, complete the food diary after each meal rather than the end of the day
- Record accurately what was eaten
- Identify amounts eaten
- Identify food brands wherever possible
- Note time of intake
- Note fluid intake
- Note what/when exercise or physical activity was done
- Assess energy and mood 1-2 hours after each meal

| | Meal One | Meal Two | Meal three | Meal Four | Meal Five | Meal Six |
|---|---|---|---|---|---|---|
| Monday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |
| Tuesday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |
| Wednesday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |
| Thursday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |
| Friday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |
| Saturday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |
| Sunday | | | | | | |
| Energy/Mood? | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ | ☺😐☹ |

# UNIT 3 & 4 PROGRAMMING PERSONAL TRAINING WITH CLIENTS

**On completion of this unit the learner will be able to:**

- ✓ Understand how to prepare personal training programmes
- ✓ Understand the importance of long term behaviour change for personal training
- ✓ Understand the principles of collecting information to plan a personal training programme
- ✓ Understand how to screen clients prior to a personal training programme
- ✓ Understand how to identify personal training goals with clients
- ✓ Understand how to plan a personal training programme with clients
- ✓ Understand how to adapt a personal training programme with clients
- ✓ Understand how to instruct exercise during personal training sessions
- ✓ Understand how to adapt exercise to meet client needs during personal training sessions
- ✓ Understand how to review personal training sessions with clients

# COLLECTING CLIENT INFORMATION FOR PROGRAMMING PERSONAL TRAINING WITH CLIENTS EXERCISE

Introduction



The planning  a session is necessary in order to ensure that all has been done to make it as safe and effective as possible. Most people who wish to begin exercising are apparently healthy individuals looking to realise the many benefits associated with structured exercise activities. Individuals who are physically active are less likely to develop major chronic conditions such as obesity, diabetes and heart disease.

However some individuals are not as healthy as they may believe, or are already aware of a medical risk or condition that may affect their ability to exercise. Consequently, this can increase the risks of engaging in exercise, which could exacerbate any symptoms of a current condition.

The instructor can minimise risk associated with exercise participation by consulting the client with a view to assessing their suitability for activity in a gym environment. A gym instructor is not qualified to diagnose any medical conditions or rehabilitate from injury, surgery or disease, and may need to obtain medical clearance from a General Practitioner (GP) before exercise can begin.

There are various stages involved in the planning of gym-based exercise, many of  which are performed during a consultation.

**The Consultation**

Where possible, a consultation should be carried out face-to-face with a client. This is usually the quickest and most effective way of gathering all the information needed by the instructor, in order to assess the client suitability for exercise and to prepare an exercise program which will meet their needs and objectives.

There are 4 stages in the consultation process:

- ✓ Screening the client
- ✓ Gathering information
- ✓ Pre-exercise testing
- ✓ Programme design



## STAGE 1: SCREENING THE CLIENT

There is a need to identify whether an individual may embark on an exercise programme immediately, or if the client is at a higher health risk status and further action must be taken.

**PAR-Q**

Typically a PAR-Q will be completed by the client but may be completed by the instructor with consent from the client. The YES/NO answers required by a seven question PAR-Q allow simple identification of medical contraindications to exercise. Any YES answer will result in the need for medical clearance from a GP before exercising.

**Informed consent**

A gym instructor must obtain consent prior to involving the client in any testing procedure or participation in a gym-based exercise programme. This will involve the instructor giving explanations for all procedures involved in testing and what the client can expect from a planned session. Once the client has been informed and understands the facts, only then can the instructor proceed, with their consent. Most gyms will use informed consent documents for clients to complete and a client signature should be obtained as well as verbal consent.

**Referral**

There are four criteria for referral of a client to their GP:

**1. Instant medical referral**

- Any diagnosed metabolic, pulmonary or cardiovascular disease
- Signs or symptoms of pulmonary or cardiovascular disease

**2. Special attention categories and temporary deferral**

- Several fitness testing results are in the special attention category
- Minor illness or minor injury

**3. Doubt or uncertainty**

- The instructor should act with caution and refer

**4. Client preference or doubt**

- The client may prefer to obtain medical clearance for peace of mind

These four criteria may cause concern among clients, and even distress if they believe that information provided in a PAR-Q or results of fitness testing will have an imminent detrimental effect on their wellbeing. It is important that the instructor reassures a client and follows up any referral. It can take a great deal of courage for an individual to enter a fitness environment and such a perceived setback could prevent their return.



## STAGE 2: GATHERING INFORMATION

Client information can be gathered in a number of different ways. There are advantages and disadvantages of each and it is the job of the instructor to identify the method which is most suitable for each client. More than one method can be used to gather information.

**Questionnaire**

The use of questionnaires is an excellent way of accumulating lots of information in a relatively short time and can be completed face to face or given to the client to fill in and return at a later date. They provide a consistent format for the instructor to follow in the pursuit of information relevant to programme design. A perceived negative can be that some questions may be confusing or misunderstood, leading to an incomplete document or one that needs further explanation from the instructor.

**Interviewing**

This method can be quicker than using a questionnaire, although there is scope for deviation from the subject which can be time consuming. A client can be interviewed by phone but is more likely to be in the company of a member of staff. Interviewing can provide an opportunity for both parties to strike a rapport with each other and the technique of the instructor will improve with practice. It is important for an interview not to come across as interrogation which can lead to information being withheld by the client.

**Observation**

General observation can identify if the client suffers from signs of postural abnormally. It will take a relatively experienced instructor to be able to take such information and incorporate it effectively into programme design. Observation which reveals any serious deviations from normal posture may prove to be outside the level of qualification of a fitness instructor and may need to be referred to another fitness or medical professional.

**Lifestyle considerations**

| | |
|---|---|
| **Occupation** | hours of work, manual or sedentary, repetitive movements |
| **Leisure** | general interests, active or inactive |
| **Activity** | frequency of activity, intensity of activity, types of activity |

| | |
|---|---|
| **Nutrition** | types of food and drink, consumption |
| **Alcohol** | frequency, type, volume |
| **Smoking** | history, frequency |

**Available time**

Clients may have restrictions on the amount of time they can or are willing to devote to gym-based exercise. The instructor must try to incorporate the exercise programming within these boundaries. Both client and instructor must be realistic about what is attainable in the time scheduled for exercise.



**Training status**

A client who has never been involved in gym-based exercise will respond very differently to one who has been, or is a regular gym user. The training status of a client can be determined by obtaining specific information such as details of previous training programmes including types of exercise, frequency of participation and intensity of workouts. This information will help the instructor to design a programme which may involve aspects of familiarity or be completely different, depending on the preferences of the client.

Generally, clients are categorised as beginner, intermediate or advanced training status.

**Beginner**

A novice who does not recognise basic exercises or has poor technique

**Intermediate**

Has sound exercise technique and has retained benefits consistent with regular exercise

**Advanced**

Excellent knowledge and exercise technique which has resulted in elite performance. Know the limits of their bodies and have learned to overcome challenges.

It is common to encounter those who have been gym users for years but have not progressed significantly, and therefore could not be considered as having advanced training status. Very few exercisers genuinely deserve to be regarded as holding such a status. This can be a delicate subject and it is important not to offend a client, therefore it may be prudent to use terms such as “experienced beginner” for someone who has been a regular gym-user but has had a period of non-exercise.

**Likes and dislikes**

Clients may be drawn to certain forms of exercise or shy away from others. There can be many reasons for this and the instructor cannot always deliver a perfect programme. Over time and the experience of working with a client, the instructor may be able to help overcome barriers to certain types of exercise and encourage the client to try new techniques. It is important to be able to deliver a balanced programme and if the client can be educated on the merits of exercises which have been traditionally avoided, then there is a greater chance of providing a workout to ascertain their goals. Gym instructors often negotiate in the form of “a little of what you want, and a little of what you need” when coming to an acceptable compromise with a client.

**Objectives**

There are many different objectives a client may wish to realise when looking to start an exercise programme. A combination of resistance training and cardiovascular exercise will generally bring improvements in the following areas:

- ✓ Muscular strength
- ✓ Muscular endurance
- ✓ Muscular size
- ✓ Aerobic fitness
- ✓ Fat loss
- ✓ Posture
- ✓ General health



The above is not an exhaustive list, but are a selection of the more common objectives desired by clients. It is common for a client to desire certain goals which are not fully understood in technical terms or dedication in order to succeed. Again, the instructor may be wise to negotiate a compromise whereby the client feels satisfied that their interests and preferences are being considered.

## STAGE 3: PHYSICAL MEASUREMENTS AND TESTS

Physical measurements can be taken in order to calculate current health status and also act as a reference point for measurements taken in the future. This can cause apprehension among clients who may feel embarrassed by certain tests and so it is important for the instructor to take a sensitive approach or use an alternative, less invasive practice.

**Appropriateness of testing**

Tests should be selected that are appropriate to the needs, goals and capabilities of the client to perform. This also applies to the instructor, who should only attempt to administer a test in which they are confident of the protocol and their ability to evaluate results.

**Validity of tests**

There are many tests available to determine levels of health and fitness. There is also a growing trend for applications to be used in conjunction with personal phones and computers. Many such tests and calculations are not regarded as valid, reliable or objective and the instructor must use only tests and procedures which are provided by the employer.

**Equipment and environment**

All equipment used in conjunction with measurements and tests should be in good working order, serviced regularly, and stored correctly. The environment should be appropriate for testing procedures to be carried out. Lighting, temperature and security are all factors which should be addressed to make the experience as comfortable and professional as possible for the client.

**Timing**

The time of the day should be recorded and remain constant for future tests. Any changes should be noted and taken into account when evaluating results. Measurements and tests may be repeated after a period

where any modifications to lifestyle and activity have had a chance to take effect. Four to eight weeks is generally regarded as sufficient time between tests.

**Client**

A client who is scheduled to undertake any form of measurement or test should follow a standard protocol in order to allow the greatest accuracy of test results. Any deviation from the protocol can result in temporary deferral of testing at the discretion of the instructor. Such pre-testing procedures may include:

**Consumption**



Avoid heavy meals less than three hours prior to testing. Avoid excessive alcohol intake on the day before testing and no alcohol should be taken during the day of the test. Avoid caffeinated drinks and smoking for two hours before testing

**Lifestyle**

The day before testing should not involve strenuous physical activity and the client should endeavour to have a good nights sleep. Avoid the use of equipment that stimulates the systems of the body, such as jacuzzi or sauna, for two hours prior to testing.

**Clothing**

Wear clothing that will allow ease of testing and will not adversely affect testing protocol. For continuity, wear the same or similar clothing for repeat measurements and tests.

**Medical**

Bring any current medication which may become relevant in a physical exercise environment, such as inhalers. Do not attempt testing if feeling unwell. Defer or cancel the assessment if there is any doubt in the ability to perform a test.

Indications for termination of an exercise test

Testing can cause stress to the body and the instructor must be vigilant at all times. Tests should be stopped immediately and client referred under the following circumstances:

- Chest pain that is increasing, suspicion of heart attack or unusual heart rhythms
- Drop in systolic blood pressure (SBP) below standing resting pressure
- Drop in SBP with increasing workload accompanied by signs or symptoms
- Signs of poor circulation, blood flow, cold or clammy skin
- Pale appearance or blueish skin colour
- Unusual breathing patterns, shortness of breath or signs of severe fatigue
- Central Nervous Systems (CNS) symptoms
- Failure of equipment
- Client request
- Anthropometric testing

Tests of anthropometry include measurements of body size, structure and composition. It is important to be aware of change and the effects of change to such measurements.

There are common measurements and tests used in the fitness industry. They are used in order to assess the current health or fitness status of an individual. Subsequent testing should be performed at similar times of the day for continuity. The following tests are suitable for an instructor to administer:

- Weight
- Height
- Body mass index
- Circumferential measurements
- Waist to hip ratio
- Resting heart rate
- Cardiovascular fitness
- Muscular endurance
- Flexibility



**Weight**

- Use calibrated scales
- Client removes shoes and heavy clothing
- Perform re-tests with client dressed in similar clothing

**Height**

- Use calibrated stadiometer (height measure) which is attached to a wall
- Client removes shoes and stands tall without overstretching
- Record the highest part of the head with client facing forward

**Body mass index (BMI)**

BMI is a measure of height to weight ratio. It is calculated by taking a persons weight and dividing it by their height squared. The results can give an indication of whether a client is overweight or not. It must be noted that BMI does not take account of an individual's body composition and may prove inaccurate for those who have a higher than normal amount of muscle mass.

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{weight (kg)}}{\text{Height (m}^2\text{)}}$$

Classification and health risk by Body Mass Index

| BMI | **Classification** | **Level of health risk** |
|---|---|---|
| **under 18.5** | underweight | minimal |
| **18.5 - 24.9** | normal weight | minimal |
| **25 - 29.9** | overweight | increased |
| **30 - 34.9** | obese | high |
| **35 - 35.9** | severely obese | very high |
| **40 and above** | morbidly obese | extremely high |

Classification for BMI can appear worrying or offensive, and may come as a shock to some clients. It is therefore essential for the instructor to evaluate whether this test is appropriate for use on a particular client.

**Circumferential measurements**

**Use tape measure at exact location**

**Keep tape measure horizontal and not overly loose or tight**

**Take measurements on skin and not over clothing if possible**

**Take the average of three readings per site**



**Site descriptions**

**Chest**

At the level of the middle of the sternum with the tape passing under the arms. It may be appropriate to take the measurement from the side or back

**Waist**

At the level of the narrowest point between the ribcage and the top of the hips, usually above the umbilicus

**Hips**

At the level of the greatest protrusion of the gluteal muscles

**Arm**

At the level of the measured midpoint between the acromion process of the shoulder and olecranon process of the elbow

**Waist : Hip ratio**

The ratio of the waist circumference to hip circumference is considered to be an indicator of risk factor for Coronary Heart Disease (CHD). Health risk increases with waist : hip ratio and classification varies between males and females.

| Classification | Male | Female |
|---|---|---|
| **high risk** | >1.0 | >0.85 |
| **moderate frisk** | 0.90 – 1.0 | 0.80 – 0.85 |
| **low risk** | < 0.90 | <0.80 |

Alternatively the following classification can be used to identify risk of morbidity:

| Gender | Lowered risk | Higher risk |
|---|---|---|
| **Male** | < 94cm | >102cm |
| **Female** | < 80cm | >88cm |

**Cardiovascular fitness testing**



Research suggests that aerobically fit adults enjoy a better quality of life and live longer than those who are not aerobically trained. There are many tests that can be used to evaluate cardiovascular fitness and it makes sense to use tests that will be appropriate for beginners to perform in a fitness environment. Those who have not exercised aerobically for some time may have unrealistic expectations of their aerobic capacity, based on what they were able to achieve in the past. It can be disappointing for a client to learn that they aren't as fit as they believed.

**Resting heart rate (RHR)**

RHR is the number of times the heart beats every minute when an individual is at rest. It is measured in beats per minute (BPM). Generally, lower readings indicate a higher level of aerobic fitness, although the RHR test alone cannot guarantee this.

Bradycardia is a RHR of less than 60 BPM. Causes include:

- High fitness levels
- Hypothermia (low body temperature)
- Hypothyroidism (low thyroid function)
- Hyperkalaemia ( high potassium levels in bloodstream)
- Disease of the heart
- Certain drugs for treatment of high blood pressure or heart problems
- Genetics

Tachycardia is a RHR of greater than 100 BPM. Causes include:

- Poor fitness levels
- Excessive caffeine, alcohol or nicotine
- Physical fatigue
- Stress, anxiety or stimulation
- Heart attack or disease
- Fever
- Forms of medication or misuse of drugs
- Pulmonary embolism (blockage of lung arteries)
- Hypervolaemia (too much fluid in the blood)

**Resting Heart Rate Assessment**

- Rested client seated or in supine position
- Locate site of carotid artery (either side of front of neck) **or** locate radial artery (thumb side of the forearm)
- Apply light pressure to site with index and middle finger (not thumb)
- Allow client time to relax before beginning test
- Count pulse for 60 seconds and record the result
- Repeat test
- Repeat a third time if first two tests produce vastly different readings



Evaluate results by using RHR classification chart. The chart below shows the different RHR categories:

Resting Heart Rate

| | Men (BPM) | Women (BPM) |
|---|---|---|
| **Normal** | 60 - 80 | 60 - 80 |
| **Average** | 70 | 75 |
| **Special attention** | 90 or above | 90 or above |
| **Medical referral** | 100 or above | 100 or above |

**Rockport walking test**

This test uses calculations to reach a value called VO2max.

VO2max is the maximum volume of oxygen that can be utilised by the body in one minute during maximal exercise. It is measured as millilitres of oxygen used in one minute per kilogram of body weight.

For the duration of the test, the client should walk as fast as possible for one mile. As soon as they have completed the mile, their heart rate should be taken. This can be done with the use of a heart rate monitor or manually using a stopwatch by counting the number of beats for one minute whilst holding the wrist at the site of the radial artery. The time taken to complete the distance should be recorded.

Before using the calculation to determine VO2max, the instructor will need to know the client age and body weight in pounds (lbs). Therefore the vital information needed for calculation is as follows:

- Time needed to complete one mile walking as fast as possible
- Heart rate taken immediately after the distance has been completed
- Client age
- Client body weight in pounds (lbs)

The following calculation can be used to determine the clients VO2max:

**132.853 – (0.0769 x weight) – (0.3877 x age) + (6.315 x gender) – (3.2649 x time) – (0.1565 x heart rate)**

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 per minute
- Age is in years



This score can then be measured against the normative data in the chart below.

Fitness categories for males based on VO2max 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 |

Fitness categories for females based on VO2max 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 |

**Muscular endurance testing**

There are many muscular endurance tests available for use by the fitness instructor. Tests that are suitable for a client who has limited experience of resistance exercise training should be used. Safety is a great consideration as the client may be working hard and reach a stage where they cannot continue through fatigue. This will increase the risk of injury which is to be avoided. Emphasis should be placed on technique, which is more valuable than results in the early stages of resistance training and maximal effort may result in

muscle fatigue or discomfort in the days after testing. Severe after-effects of training may discourage the client from returning to exercise.

**Press up test**

- Client adopts the start position for a full press up (alternatives also apply)
- Client lowers to 90 degrees of elbow flexion and returns to the start position
- The test aims for the total number of completed press ups before failure



Male results

| Age | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| **20 - 29** | >54 | 45 - 54 | 35 - 44 | 20 - 34 | <20 |
| **30 - 39** | >44 | 35 - 44 | 25 - 34 | 15 - 24 | <15 |
| **40 - 49** | >39 | 30 - 39 | 20 - 29 | 12 - 19 | <12 |
| **50 - 59** | >34 | 25 - 34 | 15 - 24 | 8 - 14 | <8 |
| **60+** | >29 | 20 - 29 | 10 - 19 | 5 - 9 | <5 |

Female results

| Age | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| **20 - 29** | >48 | 34 - 38 | 17 - 33 | 6 - 16 | <6 |
| **30 - 39** | >39 | 25 - 39 | 12 - 24 | 4 -11 | <4 |
| **40 - 49** | >34 | 20 - 34 | 8 - 19 | 3 - 7 | <3 |
| **50 - 59** | >29 | 15 - 29 | 6 - 14 | 2 - 5 | <2 |
| **60 +** | >19 | 5 - 19 | 3 - 4 | 1- 2 | <1 |

**Abdominal curl test**

- Provide a mat for comfort during test
- Client lies supine with knees bent to 90 degrees
- Straight arms by side with palms facing down
- Line marked three inches away from tips of fingers in resting position
- The test aims for the total number of completed abdominal curls where fingers reach line or beyond

Male results

| Classification | **<35 years** | **35-45 years** | **>45 years** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **Excellent** | 60 | 50 | 40 |
| **Good** | 45 | 40 | 25 |
| **Fair** | 30 | 25 | 15 |
| **Poor** | 15 | 10 | 5 |

| Female results | | | |
|---|---|---|---|
| Classification | **<35 years** | **35-45 years** | **>45 years** |
| **Excellent** | 50 | 40 | 30 |
| **Good** | 40 | 25 | 15 |
| **Fair** | 25 | 15 | 10 |
| **Poor** | 10 | 6 | 4 |



**Flexibility testing**

Flexibility is defined as the range of motion in a joint or group of joints. It is also the ability to move joints effectively. There are a number of ways in which the instructor can test flexibility and the most common within the fitness industry is the sit and reach test.

As with all fitness tests, the ability of the client to perform should be evaluated before the test is carried out. This particular test will involve a significant amount of spinal flexion, therefore if a client has experienced a back condition in the past, the test should be administered with caution.

**Sit and reach test**

This test predominately assesses the flexibility of the hamstrings and lower back, however there can be a significant amount of movement through the shoulders as the client leans further forward and stretches the arms along the surface of the sit and reach box.

- Client should warm up before attempting test
- Remove shoes and any clothing that will restrict joint movement
- Feet should be placed against the vertical board with straight legs and back
- Client slowly reaches forward maintaining a straight back for as long as possible
- Record distance at the point where client starts to flex spine. This is a measure of hamstring flexibility

Client continues to reach forward as far as possible stretching fingers to the furthest point on the sit and reach box. This is a measure of hamstring and lower back flexibility

## STAGE 4: PROGRAMME DESIGN

Once the client has been screened and all relevant information gathered including results from measurements and tests, it is time for the instructor to design a gym-based exercise programme for the client. It is important to revisit the clients original SMART goals and tailor them to all of the other aspects of the consultation in order to plan a safe and effective programme which can be developed over time.

Consideration of the variables of exercise will play a major part in this process, therefore the Programme Objective Guidelines should be used as a blueprint for programme design. They will act as the foundation for the exercise that the client will perform:



**Programme Objective Guidelines**

| Training Goal | Strength | Hypertrophy | Endurance | Cardiovascular Health | Cardiovascular Fitness |
|---|---|---|---|---|---|
| Intensity | High | Moderate | Low | Low (aerobic) | Higher (aerobic) |
| Load | >85% of 1RM | 67-85% of 1RM | <67% of 1RM | n/a | n/a |
| Reps/ Duration | 1-5 | 6-12 | 13+ | 30+ mins | 20+ mins |
| Recovery between sets | 3-5 mins | 1-2 mins | 30-60 secs | n/a | n/a |
| Sets per exercise | 2-6 | 3-6 | 2-3 | 1 | 1 |
| Frequency per muscle group | 1-2 per week | 1-2 per week | 2-3 per week | 5+ sessions per week | 3+ sessions per week |

Once the programme guidelines have been established, the frequency of exercise can be determined. As the client gains more experience, the number of sessions may increase. The following chart is based on resistance training only, and not aerobic or flexibility training. Each client will progress at a different rate and the following is for guidance only:

| Training status | Frequency |
|---|---|
| **Beginner** | 2-3 sessions per week |
| **Intermediate** | 3-4 sessions per week |
| **Advanced** | 4-7 sessions per week |

**Programme design**

The three elements to be covered in an exercise programme for most beginners are:

- Resistance training
- Aerobic training
- Flexibility training

Each element must be designed to complement the others in order to create a balanced exercise programme.



**Programme design for muscular endurance**

Exercise selection and order of performance will profoundly influence the effectiveness of programme design. Design rules can be manipulated but when programming for a beginner exerciser the following programme design rules apply:

- Promote muscular balance
- Train large muscles first
- High skill and complex exercises first
- Train synergists and fixators last

**Rule 1- Promote muscular balance**

The aim is to choose exercises that will allow the body to progress as a working unit and should therefore work all the major muscle groups equally. Exercises which are regarded as functional, or have a resemblance to actions performed in daily life are recommended as they will take account of posture, balance and coordination as well as strength. The number of exercises involved will depend on the aims of the workout, client ability and time available, although 4-10 exercises are commonly used.

**Rule 2 – Train large muscles first**

The largest of the muscle groups to be worked should be selected first. They require the most energy to perform and including them early in the workout will produce the greatest training benefits. Training smaller muscle groups first may deplete energy stores needed to work the larger muscles later in the programme.

**Rule 3 – High skill and complex exercises first**

Greater neuromuscular coordination is needed to perform multi-joint movements which frequently target larger muscle groups. Therefore more energy will be required in the safe and effective execution of these exercises. Fatigue will limit the ability of the beginner to perform these types of exercises.

**Rule 4 – Train synergists and fixators last**

Synergists that are trained prior to the agonists will become ineffective in performing their main role in assisting the agonists, and therefore should be trained afterwards. Fixators generally perform isometric contractions to stabilise the body while larger muscles provide movement. Fatigue of the fixators can result in poor posture which in turn will increase the risk of injury. It is usual for a beginner to try to avoid this by performing exercises for the core muscles towards the end of the workout.

**Student task**

Effective programme design depends on the ability of the instructor to arrange exercises in an appropriate order.

Re-order the following list of exercises to satisfy the programme design rules:

1. plank
2. dumb bell bicep curl
3. dorsal raise
4. deadlift
5. barbell squat
6. Barbell bench press
7. Lateral pull down
8. Cable triceps extension
9. Wide grip bent over row
10. Dumb bell shoulder press



| Exercise | Muscles used | Joint actions | Compound/isolation |
|---|---|---|---|
| | | | |

**Programme design for hypertrophy**

Hypertrophy, or the increase in muscle size, requires planning for a long term exercise strategy. The client must demonstrate a readiness to progress to this more advanced type of training. It is not only the strength of the muscles which need to be able to overcome greater load intensity, but the skeleton, soft tissue structures and mental attitude of the client must be able to cope with this more demanding training method.

The change in stimulus will demand that the body reacts to overcome the challenges and result in muscular hypertrophy. The programme should be modified periodically to maintain client motivation and to prevent the risk of plateau, where the client fails to experience positive results. There is a danger that a move to this type of training will place too great a demand on the exerciser and so an interim programme may aid the transition.



**Strength endurance training**

Although the volume and intensity of exercise will be lower than that of hypertrophy training, strength endurance training is regarded as a stepping stone between muscular endurance and hypertrophy. As the following example demonstrates, the programme objective guidelines are very similar to those of hypertrophy, but crucially there is a reduction in the number of sets to be performed for each exercise. This can result in a 50% decrease in the workload experienced by each muscle throughout the duration of the workout when compared to a full hypertrophy session. It will still provide a significant increase in workload when compared to a muscular endurance workout, and in particular the intensity of each exercise as a percentage of 1RM.

| Programme objective | Guideline |
|---|---|
| **Intensity** | Moderate |
| **Load as % of 1RM** | 67-85% |
| **Reps** | 6-12 |
| **Recovery between sets** | 1-2 mins |
| **Sets per exercise** | 2-4 |
| **Frequency per muscle group** | 1-2 per week |

**Hypertrophy training**

The move from muscular endurance to strength endurance will better prepare the body for hypertrophy training. It is a characteristic of hypertrophy workouts to train only certain muscle groups during any one session. This is because there are more sets of each exercise to perform in order to gain the required training effects. As a result the muscles worked need more time to rest in terms of recovery periods and more time before the next workout is performed. In addition, the amount of energy used during this method would leave insufficient energy left to train other body parts effectively. The chart below compares the two different approaches of endurance and hypertrophy training:

| Characteristic | Endurance | Hypertrophy |
|---|---|---|

| | | |
|---|---|---|
| **Intensity** | Low | Moderate |
| **Load as % of 1RM** | <67% | 67-85% |
| **Reps** | 13+ | 6-12 |
| **Recovery between sets** | 30-60 secs | 1-2 mins |
| **Sets per exercise** | 2-3 | 3-6 |
| **Frequency per muscle group** | 2-3 per week | 1-2 per week |
| **Type of workout** | Whole body | Split routine |



**Split routines**

The demands of hypertrophy workload mean that there will simply not be enough time during a session to train the whole body. This means that a different approach is required to other forms of training. The split routine is a well-used format whereby muscle groups are trained on different days in a cyclical way. A 2-way split will divide the muscles to be trained into two groups, each of which will be trained on different days.

Example of a 2-way split

| Mon | **Tues** | **Wed** | **Thur** | **Fri** | **Sat** | **Sun** |
|---|---|---|---|---|---|---|
| **Rest** | Lower body | Upper body | Rest | Lower body | Upper body | Rest |

A 3-way split will divide the muscle groups to be trained into more concise groups.

Example of a 3-way split

| Mon | **Tues** | **Wed** | **Thur** | **Fri** | **Sat** | **Sun** |
|---|---|---|---|---|---|---|
| **Legs and shoulders** | Rest | Chest and triceps | Rest | Back and biceps | Rest | Rest |

It can be a feature of split routines to add additional workouts on rest days not associated with hypertrophy workload. These include workouts for core muscles or cardiovascular training.

**Considerations when programming resistance training for beginners**

The beginner will often demonstrate issues which will affect their ability to train safely and effectively. The instructor must consider these issues and programme exercises that will allow the beginner to progress. It is often argued that a beginner should not attempt free weights exercises as there is an increased risk of injury due to the de-conditioned state of the body. These often complex exercises can be disregarded initially, in favour of fixed path resistance machines which it is also argued will aid in support of the body and postural alignment during exercise.

The opposing view is that under the instruction of the fitness professional, such complex movements demanded by many free weight exercises can be taught at a level of intensity suitable to the ability of the beginner. Reduced range of movement and lower intensity are options to consider when adopting this approach. Introduction to such exercises from the outset may also reduce any apprehension the client may have in relation to these exercises.

There are no hard and fast rules and the instructor should weight up both sides of this dilemma. The decision making process should take account of the following issues that may be presented by a beginner:

- Lack of muscular strength and endurance
- Poor posture
- Poor core strength
- Poor technique
- Lack of proprioception (sense of positional awareness)
- Low tissue tolerance
- Weak connective tissue
- Poor aerobic conditioning



The instructor should aim to provide exercises which promote free-standing, multi-joint movement using larger muscle groups that imitate functional everyday movement patterns to address the issues listed above. This approach will improve daily function and as the client recognises their own improvement will provide a sense of achievement.

A beginner may not fully understand the reasoning behind balanced programming and may not appreciate the need to perform compound multi- joint exercises. Therefore in addition to the exercises which will improve the general issues presented by the beginner, it is important to add some isolation exercises to the programme. The single joint actions of such exercises will make them easier to perform and give the client more variety within the programme.

**Advanced training methods**

Super Sets

Performing an exercise set immediately after a different exercise set. Nearly no rest is taken between exercises (sets), only that which is taken to get in position for the second exercise.

**Antagonist Super Set**

Performing antagonist muscle group in super set (eg: Leg Extension / Leg Curl). Challenges general muscular endurance.

**Pre-exhaust Super Set**

Performing an isolated exercise immediately before a compound exercise for the same muscle group (eg: Chest Fly / Chest Press). Challenges local muscular endurance.

**Tri Set**

A tri set is one large set comprising of three sub-sets of different exercises which all target the same muscle group.. These three exercises are performed back to back without any rest.

Giant set

**A giant set really consists of four sets (usually of 10-ish reps) of four different exercises working the same muscle group**

**Pyramid training**

Performing an exercise or two, for a particular rep and then working your way down to 1, intended to fatigue the muscle. This type of training can be employed as an upward or downward sequence in weight or reps. It works because you wind up with a much higher level of training volume AND training density. Pyramid Training can be done with any piece of fitness equipment, and if you are stuck you can even use your own bodyweight. All you need is some creativity and hard work.



**Forced repetitions**

Forced repetitions are assisted movement by a training partner, or spotter. They are typically performed with heavy weight or near the end of a set at the onset of failure.

**Negative /eccentric training**

The exerciser slowly lowers a very heavy resistance through the eccentric phase of an exercise. Although, not considered a negative, a training partner assists the exerciser through the concentric phase of an exercise (See Forced Reps above) so the exerciser can complete additional negatives. The exerciser can lower (requiring eccentric contraction) approximately 20% greater load than they would be able to lift (requiring concentric contraction). Negatives are commonly used with submaximal repetitions near the end of a set after exhaustion and immediately following forced repetitions.

**Pre-exhaust** involves using one isolation exercise prior to one compound exercise.

**Post-exhaust** involves using one compound exercise prior to one isolation exercise.

Using the bench press as an example: The agonist is the pectorals major, with the main synergist being the triceps. Often, the triceps will fail before the stronger pectoral muscles. By employing either a pre or post exhaust isolation exercise it is possible to “bypass” the weak synergist and permit greater fatigue of the target muscle – in this example pectorals.

In **pre-exhaust** the pectoral isolation exercise is performed prior to the compound e.g. cable crossovers performed before bench press.

In **post-exhaust** the pectoral isolation exercise is performed after the compound e.g. bench press performed before cable crossovers.

Select an isolation (single joint) exercise for the target muscle

- Select a compound (multi-joint) exercise for the target muscle

then either:

• Perform the desired number of sets of the isolation exercise, then move on to perform sets of the compound exercise (normal rest intervals apply)

or

• Perform the isolation exercise immediately followed by the compound exercise (this is an example of a pre-exhaust superset). Rest between supersets and repeat as required

**Muscular strength and endurance**



Muscular strength is the ability of the muscles to lift weight. Muscular endurance is the ability to sustain exertion for a specified period of time. Muscular endurance is an aerobic mechanism, meaning that it requires **oxygen**. Muscular strength is an anaerobic mechanism, meaning that it does not require **oxygen** as an energy source.

**Student task**

Design the main session of a resistance programme for 30 year old client

The client is new to the gym environment and presents no injury or illness that will affect their ability to perform any exercise you select



The programme should include 8-10 exercises with details of reps and sets for each

Your programme must follow the programme design rules to achieve objectives suitable for a beginner

Assume that the client has completed a suitable warm up prior to the main session

| Exercise | Reps and sets | Recovery between sets | Muscles used |
|---|---|---|---|
| | | | |

**Programme variables**

The variables of resistance exercise must be manipulated in order for exercisers to attain their fitness goals and maintain progress. Unfortunately it is very common for individuals to stick with the same programme long after it has ceased to be effective. Periodically the instructor must make changes to an exercise programme and make alterations to the following variables:

- Type of exercises
- Number of exercises
- Repetition range
- Number of sets
- Recovery periods
- Complexity of exercises
- Tempo
- Workout frequency
- Resistance Training progression



A long term plan or strategy will help the client to continue to meet their training goals. The instructor must look ahead and make changes based on current ability of the client and whether original goals are maintained or there is a change of focus.

Basic progression can be shown as a pyramid which can work in both directions depending on the goals agreed between the client and instructor.


This pyramid shows the progression from endurance to hypertrophy and finally strength training, however a client who has previously exercised for hypertrophy may wish to concentrate on endurance training for a period.

## Student task

Your 30 year old client has performed the original program for 8 weeks and has made significant progress

The client has good exercise technique and wishes to progress the exercise programme while introducing some new exercises for variety



Design a new main session to satisfy these goals. Changes should be made to the exercise variables and show a logical progression from the first programme

| Exercise | Reps and sets | Recovery between sets | Muscles used |
|---|---|---|---|
| | | | |

**Programme design for aerobic training**

Aerobic fitness is regarded as the ability of an individual to take in, transport and utilise oxygen. There are many ways in which the aerobic element of a programme, which may have a duration of 20-30 minutes, may be designed. This type of training differs from resistance exercise which has a relatively short period of work within each set. The duration of an aerobic "set" can require the need for stimulus in order to avoid boredom. Changes in intensity can fulfil this task and also contribute to the aerobic curve with an increase in intensity after a warm up period, and a decrease in intensity towards the cool down. Generally, aerobic exercise can be identified by what happens in each type of training:



- Long slow duration (LSD) training
- Interval training
- Fartlek training

**Long Slow Duration training (LSD)**

LSD training involves working for an extended period of time at a consistent workload. For beginners this will be at a relatively low intensity. With adherence, LSD training will provide all of the desired physiological adaptations and is therefore suited to those with limited ability or experience of aerobic conditioning. It can be easy to persevere with this type of training whilst under the impression that it will fulfil all of the requirements needed for improvement. However, performed exclusively, it can actually stagnate performance and therefore improvement, due to a lack of stimulus. The instructor should employ this method of exercise with a view to progressing on to more advanced training systems.

**Interval training**

The structured periods of work and recovery which form the basis of interval training can allow the aerobic system to fully develop. By interchanging these two variables to their extremes, interval training can be utilised by almost anyone in the pursuit of improved performance. Work periods can be programmed at low intensity with frequent rest periods, or at high intensity with short rest periods, which can cater for relative beginners or elite athletes. The harder the workload, the more oxygen is demanded by the body and at some point, for every individual, oxygen demand will outstrip oxygen supply. At the aim is to programme rest periods before this occurs, otherwise the body will not be able to continue exercising. Alternatively, if the rest periods are too long and the work periods lack sufficient intensity, there will be insufficient stimulus for the body to make improvements. An associated benefit of interval training is that it develops the ability to tolerate the build-up of lactic acid in the body which allows the body to continue exercising while experiencing levels of discomfort. This is something that the beginner who uses LSD training alone may find more difficult to do.

There are a number of variables to consider when programming for interval training:

- Duration and intensity of work periods
- Duration and intensity of rest periods
- Number of intervals (total number of work and rest periods)

**Fartlek training**

"Fartlek" is a Swedish term meaning "speed play". It involves random periods of workload at different intensities and is therefore less structured than other types of aerobic exercise. It can be similar to interval training in that there are higher and lower intensities involved that to some extent replicate the work and rest periods of interval training. Fartlek training takes great skill on the part of the instructor, as too much high intensity work without the balance of lower intensity activity will cause the participant to cease exercising through fatigue. The random nature of fartlek requires more "on the spot" decisions which can be difficult to coordinate for a whole aerobic exercise session.



**Prescribing aerobic exercise**

The following table shows the current guidelines for aerobic exercise prescription in the maintenance of health and improvement of aerobic fitness:

| Variables | Maintaining health | Improving fitness |
|---|---|---|
| Frequency | 5 x per week | 3 x per week |
| Intensity | Moderate | Vigorous |
| Time | Up to 20 mins | Up to 30 mins |
| Type | Rhythmical exercise involving large muscle groups | |

Aerobic intensity has been credited to be beneficial when performed at between 60-90% of maximum heart rate (MHR). In the maintenance of health, moderate intensity can be described as causing a person to become slightly out of breath but not too fatigued. This would also describe the lower end of the 60-90% MHR parameter.

Vigorous exercise will cause individuals to become out of breath and show greater physical signs of stress, including sweating and a reddening of the skin, particularly in the face. Exercise would be at the higher end of the 60-90% MHR scale. It is assumed that by exercising at this higher intensity, the benefits of maintaining health are also achieved.

**Training for beginners**

Beginners should aim to train 3-4 times per week with a view to progressing to the recommended five times per week. 30 minutes of continuous exercise that does not cause undue fatigue should be the goal. Although a beginner may not be able to exercise continuously for 30 minutes initially, they will demonstrate improvements fairly quickly and be able to progress from LSD training to interval training in order to meet the target for maintaining health.

**Intermediate and advanced exercisers**

On being able to complete 30 minutes of continuous activity five times per week, it is time to develop training methods by manipulating the training principles (FITT) in order to progress further. It can be a great source of inspiration for an exerciser to reach this milestone as it represents a significant achievement. Many people are happy to maintain this level of ability and not all exercisers are driven to push themselves further. Those who embrace this opportunity will learn more about their body's capabilities as they try to overcome the challenges

of vigorous activity. As performance improves, the individual will notice that future gains become smaller and harder to achieve. It is the job of the instructor to mix increasingly difficult interval training sessions with LSD training to keep the client motivated, and allow the opportunity for the body to recover between sessions.

An advanced exerciser will aim to complete whole sessions of vigorous activity and be able to repeat this many times per week, with the elite performer training every day for months at a time. This can involve highly specialised planning and only an experienced instructor will be able to program for this and could certainly involve the use of fartlek training. It will draw on all of the knowledge learned by the instructor and involve integration of other lifestyle factors outside the gym environment.

**Student task**

Design two weekly schedules of aerobic training. The first schedule is for a sedentary beginner and the second for an intermediate exerciser. Include details of the fitness variables in both programmes.

Sedentary beginner



| | |
|---|---|
| Monday | |
| Tuesday | |
| Wednesday | |
| Thursday | |
| Friday | |
| Saturday | |
| Sunday | |

Intermediate exerciser

| | |
|---|---|
| Monday | |
| Tuesday | |
| Wednesday | |
| Thursday | |
| Friday | |
| Saturday | |
| Sunday | |

The beginner client from the previous task has made improvements and the exercise programme should be updated. Design a further six weeks of training, including the fitness variables, to account for improvements as the week's progress.



| | Week1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 |
|---|---|---|---|---|---|---|
| Monday | | | | | | |
| Tuesday | | | | | | |
| Wednesday | | | | | | |
| Thursday | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Friday | | | | | | |
| Saturday | | | | | | |
| Sunday | | | | | | |



**Programme design for flexibility training**

The principles of flexibility have been determined earlier in the training manual. In summary, dynamic stretches are generally performed as part of the warm up as they involve movements similar to those to be performed during the main session. Two or three different stretches should be performed.

Static stretches are typically included at the end of the session in order to reduce tension within the muscles. The stationary nature of theses stretches is compatible with a desired reduction in heart rate as the exerciser returns to a pre-exercise state. The number of stretches performed can depend on the muscle groups used, but in general, eight to ten stretches will suffice. These stretches can be performed as maintenance or developmental versions.

Student task

Design a flexibility programme for a beginner including three stretches to be performed at the beginning of the session after the warm up, and 8-10 stretches to be performed at the end of the session after the cool down. Include basic diagrams, type and duration of each stretch.

**Stretches at beginning of session**



| | | |
|---|---|---|
| | | |

**Stretches at end of session**

| | | | | |
|---|---|---|---|---|
| | | | | |

**Group training**

Group exercise provides the opportunity for like-minded exercisers and instructors to communicate, develop rapport and build a greater exercising community. Traditionally, group exercise classes were one hour sessions which did not necessarily reflect the exercise preferences, abilities or time constraints of all those who attended. Shorter sessions are an excellent way of providing a diverse timetable with many opportunities for attendance.

There are many types of group exercise sessions. Traditional aerobics, step and spinning classes may still attract an audience, but alternatives are being added with greater frequency.

Group sessions allow exercisers to receive instruction in a similar way to one-to-one sessions, but without the associated costs.



## ADVANTAGES OF GROUP SESSIONS

For the client:

- Social atmosphere
- More sources of motivation
- Exercise variety
- Greater access to instruction

For the instructor:

- Relatively easy to plan
- Can be less physical to teach than group classes
- Additional revenue stream
- Provides target audience for related products and services

Disadvantages of group sessions:

- Difficult to monitor all participants
- Limited one-to-one instruction
- Goals of all participants more difficult to achieve
- Possibility of competitive friction among exercisers
- Components of a group session

Essentially the format will be similar to that of one-to-one instruction:

- Preparation
- Warm up
- Main session
- Cool down
- Preparation
- Session time and type
- Range of participants
- Risk assessment of exercise environment
- Equipment checklist and availability
- Screening procedure
- Exercise plan
- Procedure for post-session evaluation

**Warm up**

- Screening
- Brief outline of session
- Rhythmical, progressive and repetitive exercises suitable for group participation
- Dynamic stretches

**Main session**

The session may focus on a specific aspect of fitness rather than a whole body workout. Types of equipment may include:

- Resistance bands
- Dumbbells
- Skipping ropes
- Cones
- Hurdles
- Steps
- Medicine and stability balls
- Agility ladders
- Sparring pads
- Mats

The equipment listed above is extremely transportable which increases options for the exercise environment. The use of bodyweight exercises is also recommended.

**Cool down**

- Simple, less technical movements with reducing intensity
- Static stretches
- Brief summary of session to group

**Safety considerations**

In order to maximise safety, the more participants there are in a group session, the greater the vigilance of the instructor must be. The instructor must also comply with relevant insurance guidelines.



**Participants and exercises**

The instructor may want to group a range of clients with differing abilities within the same session. This will present the greatest challenge, especially in the planning of the session. A selection of exercises to meet the needs of all participants and alternatives for each must be prepared.

The options for operating group sessions can be almost endless. Special populations, individual components of fitness, sport specific and beginner only sessions are examples of the variations available.

**Work and recovery periods**

Each period of work will generally be 20-60 seconds with time for recovery in between each workload. This may differ for sport specific endurance sessions.

Recovery can be timed or under the control of the instructor, for example when all participants have reached the next work station, or preparing for use of equipment such as gloves and pads. When designing the format of the session, the following factors must be considered:

- Aims of the session
- Duration of session
- Ability of participants
- Number of participants
- Number of work stations
- Equipment needs

The chart below offers examples of suggested work to rest period ratios with the aims of the session for each:

| Work | Recovery | Ratio | Aim of session |
|---|---|---|---|
| **30 secs** | 30 secs | 1:1 | Aerobic and muscular endurance for beginners |
| **45 secs** | 15 secs | 3:1 | Intermediate aerobic and muscular endurance |
| **60 secs** | 30 secs | 2:1 | Aerobic endurance for beginners |
| **60 secs** | No recovery | 1:0 | Advanced aerobic endurance |

There must be some compromise when using a circuit format where ratios don't always compare with those in a multiple set workout. A balance must be struck so participants are able to gain the intended training effects within a group environment where longer rests may affect the atmosphere of the session. For this reason circuit training is most beneficial for those looking to gain improvements in general fitness, from the beginner to an athlete working in off or pre-season. Strength training, which employs greater work to rest ratios are better served by other training methods.

**Order of exercises**

Generally, exercises should be alternated to prevent overloading of any particular muscle group, therefore avoidance of consecutive exercises for the same dominant muscle group are to be avoided. On the contrary, an aerobic circuit for runners may well aim to target leg muscles in this way.

**Types of group training sessions**

**Timed circuit**

This is the most common method, where a timing station or instructor dictates the movement of the exercisers throughout the circuit. There should be a participant for each exercise when using a timing station, otherwise the instructor may have to intervene to maintain the flow of the session. Work times are often changed between each circuit within the session, creating a peak work rate and intensity curve, for example:



First circuit - 30 seconds each station

Second circuit - 45 seconds each station

Third circuit - 35 seconds each circuit

**Cardiovascular session**

Individual disciplines can be enjoyed by small groups using the same equipment throughout the session such as studio cycling, or participants can alternate between types of equipment for multi-discipline activities such as triathlon.

**Floor based session**

In terms of equipment, this will be amongst the easiest to prepare and is suited to facilities with busy operating timetables for a dedicated space, such as an exercise studio. Exercise mats are easy to transport and require no set up as participants will prepare their own exercise space and often bring their own equipment. The aim of the session is often far more technical than other group sessions, with specialised movements, stretches and body positions to instruct. This type of session often requires specialist instructor qualification and teaching methods.

**Instructional styles**

The style of instruction can be dictated by the abilities of the participants. Beginners may want to be directed through every aspect of a session and may demand an autocratic approach that defines the timings, instructions and decisions throughout. Training for advanced exercisers or professional athletes may require a more inclusive approach where participants contribute to the operation of the session in terms of timing and fluidity. More importantly, the instructor should adapt their leadership which can empower individuals or prevent chaos within a session.

Observation of the group at all times is essential to ensure safety and correct exercise technique. The instructor should also be observable by all members of the group and should try to give equal attention, rather than concentrating on one workstation or individual. In such cases, the instructor would have to evaluate whether the exerciser or workstation was appropriate for the session.

**Monitoring exercise intensity**

The intensity of the session can be monitored in a number of ways:

- Observation
- Talk test,
- Questioning,
- Rate of perceived exertion (RPE)
- Heart rate monitors
- Checking pulse

When monitoring exercise intensity, feedback received from the group can dictate the future instruction of the session. It must be the aim of the instructor to guide all participants through the whole session in order that they gain the maximum physiological benefits for their level of ability and performance.

**Developing and maintaining relationships**

**Forming effective working relationships with clients**

To be successful, an instructor must know how to support clients taking part in a program of exercise or physical activity. Being an effective communicator and implementing exercise adherence strategies are all part of forming a good working relationship. Both the instructor and the client will benefit from an effective working relationship.



During a career, an instructor will form relationships with a wide range of long term and occasional clients, work colleagues and other instructors, supervisors and managers and professionals from other fields.

Developing and maintaining effective working relationships with all of the above is important for establishing professionalism and maintaining and improving the reputation of the organisation the instructor represents while helping to generate repeat business.

**Developing a professional relationship with a client**

Every relationship is different and it's important to realise that what makes for a good relationship with one client may not transfer effectively to another. Different personalities respond in different ways to things like motivational strategies, instruction, criticism and forms of communication. Where one client may respond well to a firm "tough love" approach, another client may prefer a more nurturing environment.

That said, all relationships will flourish if they contain these characteristics:

- MMutual respect
- Trust
- Good communication
- Rapport
- Feelings of safety and security
- High ethical standards

Good relationships do not happen by accident and often require a lot of work. The three main aspects of developing and maintaining good relationships are:

- Communicating clearly and effectively
- Good personal conduct
- Respect of personal barriers and boundaries

**1. Communicating clearly and effectively**

Communication is a key skill that all instructors need to master. During any working day, an instructor can expect to communicate with a host of people regarding any number of subjects and he will be judged on his ability to communicate effectively. There are several aspects to consider if communication is going to be effective:



**Listening -**Effective communicators must be good listeners. Listening is a skill and while most people can hear, not everybody listens! Instructors should engage in "active listening" which means doing more than just hearing but also looking for the meaning behind the words being spoken so that the message can be clearly understood.

Active listening should also be accompanied by good observation as much of the information we communicate is non-verbal. In the gym environment this means watching exercise technique, facial expressions, paying attention to the tone of voice, observing posture and maintaining an appropriate amount of eye contact. As gyms can be noisy places, these non-verbal forms of communication are even more important. Non-verbal communication is often considered un-censored which means an observant instructor can obtain valuable information about a client that exceeds the words they are hearing.

**Building rapport -**People like people that are like themselves. That tongue-twister helps to explain the importance of building rapport with a client. Building rapport will make communication much easier as both parties will be more engaged and attentive. To build rapport, consider the following:

**Body language** – body language should communicate attention and interest and not boredom or lethargy. For example, an instructor should maintain appropriate amounts of eye contact, use nods and gestures to show understanding, lean toward a client to show attentiveness while all the time respecting and maintaining an appropriate distance so as not to invade the client's personal space. Crossed, arms, slouching, looking away and not making eye contact are all examples of poor body language.

**Show empathy** – empathy should not be confused with sympathy; where sympathy means feeling sorry for someone, empathy means seeing something from someone else's perspective or point of view. This will make it easier to make sense of what the client is saying and make the relationship more positive and supportive.

**Be accepting** – it is important not to judge a client's point of view but, instead, accept it even if you do not agree with it. Being judgemental will only place a strain on the working relationship.

**Provide support** – an instructor should show a willingness to help the client to achieve their goals by offering praise and support. This will help the client feel as though they are not "going it alone". Ideally, the client and instructor should feel they are part of a team, both of whom have the same goals.

**Facilitating responses -** In order to get the most out of communicating with clients, an instructor will sometimes need to facilitate responses. This basically means encouraging a client to share information pertinent to their goals and lifestyles by using specific communications strategies…

**Paraphrasing and summing up** – this means using your own words to repeat what the client has said. This shows understanding and also gives the opportunity for clarification. Summarising salient points is another way of showing understanding. The client should then be given the opportunity to agree or disagree with the information being summarised.

**Clarifying** – rather than simply assume they have understood, instructors should clarify the information they receive from the client and also check if the client needs clarification of anything said by the instructor. For example, if the instructor tells their client to "maintain neutral spine", does the client know what that means or does the instructor need to clarify?

**Silence** – not saying anything puts the onus for communication on the client. This is especially useful when asking questions. Additionally, silence gives the client an opportunity to speak, ask questions or express concerns – something they cannot do if they are not given the opportunity to speak. The expression "We have two ears and one mouth so that we can listen twice as much as we speak" is especially relevant to fitness instructors.



**Explaining the reasons behind questions** – when discussing sensitive issues, instructors should always be prepared to explain their line of questioning. If you are unable to justify your question, you probably shouldn't be asking it.

**However, instructors should avoid:**
**Using jargon** – the fitness industry is littered with jargon, slang and abbreviations which mean very little to non-instructors and especially beginner clients. Avoid using terms that the client will be unfamiliar with so as not to exclude them in anyway. They may not feel comfortable asking for an explanation.

**Jumping to conclusions** – while it is tempting to make deductions based on incomplete information, it is never a good idea to "jump the gun" and give information or advice until all the facts have been revealed. Avoid making assumptions and, instead, get all the relevant information before acting.

**Giving input that exceeds their level of qualification** – because of health and safety, ethics, and the code of professional conduct, it is essential that instructors do not exceed their level of qualification. For example, a fitness instructor – no matter how well-meaning – is not qualified to give advice on the management of medical conditions. Doing so would be unethical and could harm the instructor's and the organisation's reputation and even harm the client.

**2. Good personal conduct**

Good personal conduct covers several concepts and means different things to different people. At the root of personal conduct is the concept of behaving in a way that will not bring the instructor or the organisation into disrepute or, in other words, behaving professionally.

**Professional appearance** – the clothes you wear and your personal grooming should be consistent with the image you want to portray or that of the organisation. A professional appearance presents a professional first impression and includes things like wearing a uniform, making sure the uniform is clean and pressed, wearing a name badge and otherwise being clean and tidy.

**Punctuality** – turning up on time is a sign of professionalism and shows that you care enough to make an effort. Lack of punctuality suggests that you believe your time is more important than the people who are

waiting for you. Lateness looks bad on behalf of the instructor and organisation and strategies should be developed to ensure punctuality such as getting up earlier or catching an earlier bus.

**Integrity** – having good integrity means having and living by a high moral code, being honest and reliable. People of good integrity are trustworthy, law-abiding and professional. Dishonesty, gossiping, treating people differently because of their race or beliefs are all examples of behaviour that lacks integrity.

**Walking the walk** – while instructors do not have to be champion athletes or fitness models, they should at least practice what they preach if they are to be taken seriously. That means that they should exercise regularly and follow a healthy diet if, for no other reason, it makes it easier to empathise with clients.



**3. Respect of personal barriers and boundaries**

Relationships exist within a framework of boundaries that both parties must respect and while legal boundaries are clear cut and so too are the rules of sport, relationship boundaries are harder to discern.

Boundaries within the role of a fitness instructor include touching and when it is justified i.e. when spotting, discussing things that are outside of the instructors professional remit i.e. the client's personal life, either party making unwanted sexual advances or any other behaviour that either party finds uncomfortable or upsetting.

Situations that may violate boundaries include giving a client a hug when they meet a fitness goal or accepting a gift from a client.

When considering professional boundaries, an instructor should use the following phrases…

- A professional fitness instructor always…
- A professional fitness instructor never…
- The limit of a professional fitness instructor's role is determined by…
- When working with a client, it is a professional fitness instructor's business to…
- When working with a client, it is a professional fitness instructor's business not too…
- Good rules for a professional fitness instructor to follow to ensure they do not allow clients to step over professional barriers are…

Create your own code of conduct by competing these phrases.

**Instructional skills**

While fitness instruction is a rewarding and enjoyable job, instructors can make a much greater impact and form more lasting, positive relationships if they hone their instructional skills. Instructional skills include knowledge of all things pertaining to fitness and exercise within the confines of their level of qualification but also include several other factors. Like knowledge can be gained, these other skills can also be practiced and developed.

**Be professional** – by adopting high standards in conduct and ethics, an instructor will enhance his professional standing and reputation and that of the organisation he represents

**Be patient** – working with beginners and those less skilled requires patience as progress can be slow. Impatience can be off-putting for a client

**Be compassionate** – understand a client's needs, wants and expectations

**Be sensitive** – understand that others have a valid point of view and opinions and preferences that should be respected

**Be punctual** – frequent lateness does nothing to enhance professionalism and shows a distinct "don't care" attitude

**Be honest** – not telling the truth is not an acceptable aspect of any code of professional practice

**Be reliable** – make sure that all commitments are met



**Be enthusiastic** – it might be your fifth session of the day but client still needs to be made to feel motivated. Enthusiasm is contagious but so too is lethargy

**Have a sense of humour** – have fun while doing your job; maintaining a light-hearted approach will often achieve the best results but make sure that professionalism is always maintained

**Be motivational** – never fail to provide encouragement and positive feedback

**Be approachable** – customers, who are all potential clients, should feel comfortable coming to you to ask questions

**Be self-confident** – good leaders and teachers are always self-confident; something that develops over time. Do not be over-confident though as that can turn many people off

**Maintain client confidentiality** – never discuss the personal details of your clients with third parties unless you have the express permission of the client, preferably in writing

**Develop good communication skills** – without good communication skills you will be unable to effectively instruct or build solid working relationships with clients and colleagues

**Be organised** – plan exercise sessions in advance, keep a day-to-day diary, arrive early to set up, prepare your uniform the night before; being organised means thinking ahead

**Become a role model** – practice what you preach if you want to be seen as a professional and so clients are comfortable looking to you for guidance

**Be adaptable** – while being organised is essential, even the best plans can go awry. Develop plans and systems so you are always prepared for the unexpected. E.g. have alternative exercises is mind in case the gym is very busy

**Be empowering** – educate your clients so they can become self-sufficient if they want to

**Ethics**

A code of ethics is designed to ensure that no harm is done to a client. Harm can mean physical or emotional. This means that a code of ethics governs professional behaviour and ensures high standards are set and met for all aspects of a professional's responsibilities.

Codes of ethics guide professionals in their day-to-day work and help them make the right decisions and breaking these codes will result in a disciplinary measure being taken against said professional. A professional breaking the code of ethics of his or her organisation can expect a reprimand or even dismissal even if no laws have been broken.

Most ethical codes can be summarised by nine primary principles:



- Professionals will cause no harm to clients
- Clients have the right to choose their own direction
- Professionals should be faithful to their clients, their profession, their organisation and themselves
- Professionals should be fair and just to all clients and be non-discriminatory in all their actions
- Professionals should promote their client's welfare and be of benefit to them
- Professionals should treat all clients with fairness, dignity and respect
- Professionals should maintain clear and unwavering professional boundaries

REPS, the Register of Exercise Professionals, states that:

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

Adhering to this principle means that instructors must:

- Respect individual differences and diversity
- Challenge discrimination and unfairness
- Practice discretion when dealing with confidential client information

In summary, when dealing with clients, a professional instructor should treat all clients and customers equally, fairly and with the highest standard of customer care irrespective of race, colour, religion, age, nationality, ethnic origin, educational achievement, sex or sexual orientation, marital or parental status, disability, political views or socio-economic class.

Doing so ensures the instructor and organisation is operating within the legal framework of the Sex Discrimination Act of 1975, Race Relations act of 1976 and amendment of 2000, the Disability Discrimination Act of 1995, the Sexual Orientation Regulations of 2003 and the Religion or Belief Regulations of 2003.

**Supporting clients to adhere to exercise/physical activity**

While a not insignificant percentage of the exercising population is self-motivated, a large number of people find maintaining or even starting a program of exercise or physical activity very difficult. Established exercisers can also suffer periods of low motivation and may drop out of exercise.

Adhering or sticking with an exercise program can be challenging however it is important to understand that fitness instructors can and must support their clients so that they maintain their fitness regime.

**Developing change**

For many exercisers, enthusiasm is highest when starting a new fitness routine or regime; the novelty aspect of going to the gym or starting a new exercise class is all the stimulus they need. However, as time passes and the novelty effect wears off, self-motivation can wane.

Self-motivation can come from several sources:

- Persuasion by respected authority e.g. directed to exercise by doctor
- Observation of others e.g. seeing positive changes in an exercising spouse
- Physiological feedback e.g. clothes feel tight, unflattering photos, feel unfit
- Successful performance e.g. seeing weight loss goals realised
- Enjoyment e.g. the feelings of wellbeing associated with exercise



People with low levels of self-motivation will often seek guidance from fitness instructors and personal trainers; however it is important that clients also take personal responsibility for their own fitness and motivation.

While skilled fitness professional can develop effective training strategies and give good dietary advice, the client has to put this information into action; not just for the two or three hours they spend with the instructor but for days, weeks, months and years.

If the client is overly reliant on the instructor, they are much less likely to develop independence and adhere to the exercise program. They may even blame the instructor for lack of progress when, in fact, it is their own lack of personal responsibility that is the issue.

For example, the best workout in the world will be ineffective if the client does not get enough sleep, is under too much stress, and participates frequently in activities outside of the gym that are counter-productive to the goals or eats too much junk food. However, despite lack of personal responsibility, the instructor may be the one who is blamed for the lack of progress.

Ultimately, an instructor can only show a client the way; the client has to do the work and the decision to change also lies with the client.

**The stage of change model**

Making the move from non-exerciser to self-motivated exerciser can be challenging, as can any significant change in behaviour. The stage of change model illustrates the process a person goes through when looking to modify their current behaviour or adopt new behaviours. It is important that an instructor can identify which stage of change their client is in so that they can provide the right level of support at the right time.

**Pre-contemplation**

This stage describes a client who is not actively thinking about making a change i.e. they have no meaningful thoughts about starting an exercise program of changing their diet. At this juncture, an instructor should be

prepared to provide educational information on the benefits of exercise and a healthy diet and answer any questions that may arise. The instructor should also be a suitable role model.

**Contemplation**

This stage describes when an individual gives serious consideration to starting an exercise program or diet in the next six-months but who is currently inactive. At this stage, an instructor should help the client identify suitable goals, activity options and try to stimulate interest to encourage the client to make a start. During this stage, clients usually know that exercise is "good for them" or that they "need to lose weight" but are often unsure how to move forward.



**Preparation**
During this stage, plans are made to facilitate change e.g. checking out gyms in the local area, joining a gym, buying new workout clothing, writing shopping lists for healthy, nutritious food or booking an appointment with a personal trainer. At this stage of change, an instructor should give more advice on the options available and work to keep the client enthused.

**Action**
This stage describes a client who is actively involved in exercise. After a few weeks they will start to see changes in their fitness, performance and/or appearance but, after these initial changes, may reach a plateau. At this stage, because of the novelty factor, motivational levels are normally very high but the "exercise habit" may yet to have become firmly established. It is important an instructor not only focuses on results at this stage of change but also client enjoyment.

**Maintenance**
An instructor's job at this stage is to maintain client enthusiasm by reinforcing goals and monitoring exercise adherence. The instructor may also use one or several motivational strategies such as fitness diaries and progress checks. It is during this stage that a client may drop out of exercise as self-motivation can be difficult to maintain.

**Relapse**
Hopefully, most exercisers will remain in the "maintenance" stage but some will drop out of exercise and revert to their previously inactive lifestyle. At this juncture, an instructor must be supportive, non-judgemental and also investigate the cause of the relapse. A relapse can be temporary i.e. a few days or weeks of missed exercise, or permanent. The instructor should offer encouragement to the client to get back into exercise while avoiding the cause of the relapse.

**Reasons for exercising**

People exercise for a wide variety of reasons and knowing why your client is exercising means that an instructor will a) be able to design an appropriate program of exercise and b) know what makes the client "tick"; information that can be used in maintaining motivational levels.

Examples of why people exercise include:

**Enjoyment** – some people simply enjoy exercise. Exercise results in an increase in endorphin production; endorphins being the body's natural feel-good hormone. People with otherwise sedentary jobs often enjoy the opportunity to be physically active.

**Health and well-being** – more and more people are becoming aware of the health benefits of exercise and that exercising can help ward off many of the medical conditions associated with modern living. People who

exercise also tend to have more energy and, in the case of older people, retain or regain strength, balance, coordination, mobility and fitness.

**Appearance** – gaining muscle, increasing muscle tone, improving posture, improving body composition; many people exercise specifically to look better. Improved appearance is frequently linked to improved self-image and better self-esteem.

**Weight control** – with a very large and ever-growing percentage of the population overweight or even obsess, many people exercise to lose weight or to prevent weight gain.

**Social/fashion status** – some people exercise simply because "it's the in-thing to do". It may be a social status to work with a particular trainer, follow a certain workout, play a certain sport or be a member of a specific fitness club.



**Rehabilitation** – following an illness or injury, exercise can help restore full fitness and is normally an important part of the recovery process e.g. after a back injury. Once the rehabilitation process is complete, some participants may continue with their exercise program to prevent a recurrence of the initial medical issue.

**General fitness** – some people take up exercise simply because they want to develop a basic level of strength, cardiovascular endurance and flexibility or to lose some fat. Other than "looking better and feeling fit" they have no specific fitness or performance goals.

**Improved sports performance** – anyone involved in sport will probably engage in a fitness routine designed to improve their sporting performance. Any such program must specifically address the demands of the sport.

**Personal satisfaction** – for many people, the process of exercising and reaching fitness goals can be very rewarding. They are motivated by personal challenges but have no desire to compare their performance to anyone else and, as such, are not involved in any formal sports.

**Job requirement** – several forms of employment require a basic, good or even advanced level of fitness including working in the fire service or military or working as a manual labourer. Like training for sport, programming must specifically address the demands of the job.

**Why do people drop out of exercise?**

Despite their best intentions, a percentage of exercisers all too quickly drop out of exercise. In fact, many gyms have large memberships made up from paying but inactive members. Go to any gym early in the New Year and you will see lots of new, enthusiastic members exercising hard. However, revisit that same gym three-months later and as many as 70-percent will have dropped out.

There are several often-quoted reasons why people drop out of exercise:

- Boredom
- Lack of improvements
- Weight loss is slow or plateaus

- Poor instruction
- Lack of support
- Loss of motivation
- Poor facilities
- Expense
- Lack of time
- Unable to break old, unhealthy habits such as smoking

While all of these reasons are valid, many can be overcome and need not be the cause of exercise dropout. A good instructor should, given the opportunity, be able to pre-empt or address these and most other reasons for exercise dropout.



**Encouraging exercise adherence through goal setting**

One of the most effective tools available for encouraging exercise adherence is goal setting. Ideally, goal setting should be used as a preventative measure before motivation begins to wane. Goal setting is an excellent strategy that helps enhance motivation and adherence by establishing targets and then working toward them. Goal setting is used in business, in sports, for behavioural change and in exercise and fitness.

Goal setting will:

- Develop persistence – sustain effort until the goal is reached
- Focus attention – keep the individuals thoughts focused what is trying to be achieved
- Mobilise effort – direct the intensity of effort toward certain tasks or outcomes
- Promote strategic planning – reaching a goal requires long-term planning and organisation

Despite being very effective, many people fail to set goals. Reasons for not setting goals include:

- Some people do not see the value of goal setting
- They do not know how to set goals
- There is a fear of failing to reach goals
- They do not know what they want to achieve or have so many or such lofty goals they don't know where to start

**Types of goals**

Goal setting can used by captains of industry, captains of sports teams and anyone in between. Goals can be set for business development, for self-improvement, for developing relationships, for financial matters, for career development and can be small and easily achievable or as grand as winning the next Olympics or launching a new internet company.

Broadly speaking, there are three types of goals:

**Process goals** – focusing on the actions that an individual must master in order to perform well, a process goal could be mastering a specific exercise technique, eating breakfast every day or exercising a certain number of times per week.

**Performance goals** – making comparisons with one's own achievements, performance goals are all about setting "personal bests" rather than competing against anyone else. An example of a performance goal is losing 10-lbs/4.5kg. Achieving performance goals, unlike outcome goals, are under control of the individual.

**Outcome goals** – where performance goals pit the individual against him/herself, an outcome goal is all about doing well in an event or situation e.g. winning a race or a competition. Achieving an outcome goal depends not only in the

**Goal categories**

Goals can be short, medium or long term and very lofty goals should be broken down into smaller, medium term, goals so that each small goal acts as a stepping stone toward the ultimate long term goal.



For example, an athlete with the long term goal of winning the Olympics may set the following short/medium term goals:

- Win regional championships
- Win national championships
- Win national team selection
- Win European championships
- Win World championships
- Win Olympic selection

Even for recreational exercisers it is important to set both short and long term goals to maximise motivation and exercise adherence.

| Goal category | Approximate duration | Example |
|---|---|---|
| **Short term** | One day to one month | Lose one kilo |
| **Medium term** | One to six-months | Run 5km non-stop |
| **Long term** | Six-months to several years | Run a half-marathon |

**Principles of goal setting**

Effective goal setting involves seven main principles…

1) Say what you want, not what you want to avoid – goals should be positive rather than negative. For example, rather than say "I won't get fatter", instead say "I will improve my body fat percentage."

2) Make goals challenging but realistic – the odds of success should be stacked in your favour so do not set goals that are so lofty that it is unlikely you will ever achieve them. In contrast, easy goals are seldom motivating and will diminish achievement.

3) Choose goals that are under the individual's influence – achieving goals should not be influenced by the actions or inactions of others except in the case of outcome goals where competitive sports are involved. For most exercisers, performance goals are best.

4) Measure progress – progress towards achieving goals should always be measurable and have a deadline. Open-ended and non-quantifiable goals have little value. “I want to lose weight” is not as good a goal as “I want to lose five-pounds in four-weeks.”

5) Check resources – make sure that any resources required for reaching goals are readily available. Also look for additional resources that may help. Examples include exercise equipment, time, books, competent instruction, familial support and even motivation.

6) Count the cost – will achieving a goal leave you injured, cost more money than you can afford, result in social losses? Is the cost justifiable?

7) Provide rewards – achievement of goals should be rewarded but avoid rewards that involve indulging in the previous bad habits e.g. don’t give up sweets for a month and then reward yourself with giant bar of chocolate!



**Get SMART!**

There are many ways to set goals but arguably the most effective and widely recognised way is to use the acronym SMART.

**S**pecific
**M**easurable
**A**greed
**R**ealistic
**T**ime constrained

| | |
|---|---|
| Specific | **Rather than choose vague goals or goals not pertaining to fitness, goals should be specific to fitness, exercise or nutrition e.g. increase strength, lose body fat or improve core stability** |
| Measurable | Any goals set must be quantifiable i.e. a number must be applied to it. Instead of “I want to get fit”, a more measurable goal would be “I want increase my VO2 max to 50 |
| Agreed | Goals should be agreed between the client and the instructor. This may require some negotiation but the instructor’s experience in achieving goals should be considered as part of the goal setting process |
| Realistic | Goals should reflect several factors including client’s current fitness and motivation level, resources available, size of goal and any other pertinent information so that the goal is realistic and therefore achievable in the proposed timeframe |
| Time constrained | Goals must have a deadline. Open-ended goals do not drive action and provide no real motivation. Deadlines should be achievable but also put the client under an appropriate amount of pressure to focus action and promote adherence. |

A well-thought out goal will always follow these criteria and SMART goals have a considerably higher chance of success than non-SMART goals. For example “I want to lose weight” will do very little to enhance exercise adherence and motivation. However, “I want to lose 45-lbs/20-kgs in 12-months” is a good long term goal.

**Additional goal setting factors**

Allow the client to set the goals – psychological research tells us that humans do not like being told what to do. Clients who set their own goals are much more likely to “buy in” than a client who has goals set for them.



Instructors may need to facilitate goal setting – clients with vague or unformed goals may need guidance from an instructor to form SMART goals. For example, if a client states that they want to get fitter, the instructor could ask “What do you want to be fit enough to do?” This should elicit a more specific response.

Goals should be recorded – write down goals and make sure the client keeps a copy. They should revisit this document whenever they need reminding of what they are trying to achieve. Putting goals somewhere easily accessible or visible can only enhance motivational levels.

Back up goals with imagery – clients should be encouraged to visualise how they will look and feel when they reach their goals. Mental imagery makes the process much more real.

Develop a plan to achieve the goals – exercise programs, diet and lifestyle should all be aligned to the goal being pursued. If the client’s goal is to run 10km in 50-minutes, their workouts and diet should match this goal.

Back the plan with determination – goals will only be achieved if the client commits to the plan and is determined. It is not enough to hope for success; the client must work hard too. This needs to be explained at the outset to the client.

Have a support system in place – to help clients through moments of weakness and/or doubt, there should be a support system in place. For example, if a client’s goal is giving up smoking but, due to stress, they are tempted to light up, what should they do to avoid reverting to old habits?

**Develop and implement an action plan to prevent such incidences.**

Keep a diary – clients should record all activities pertaining to their goals as well as any other information that may influence the outcome. This will help “keep them honest” and seeing how far they have come can also be very motivating.

Use reminders – anything that can be done to help in the achievement of goals is useful. Putting up pictures of the ideal self, putting motivational notes in a training diary and/or posting progress reports on blogs can all enhance motivation and therefore progress. However, some of these methods will only work for a short period as clients soon learn to ignore things they see over and over again.

**Reviewing and revising goals**

Setting goals is of limited use if progress is not reviewed and goals are not periodically revised. This means that any SMART goals set must be followed up on. This can be done informally during a scheduled exercise session or at a specific review appointment.

Lack of or rapid progress should be acknowledged and investigated and goals or workout/diet plans adjusted as necessary.

If the goal has been met, a different or loftier goal should be set; just because a client has reached their goal doesn't mean they can rest on their laurels! Goal setting can and should be a never-ending process designed to maximise results and promote exercise adherence.



**Goal setting conclusion**

SMART is not the only way to set goals but it provides much needed structure to what can, otherwise, be a very imprecise process. SMART provides a good framework for goal setting but don't be afraid to adapt it to suit your needs and those of your clients. Goal setting WILL enhance motivation which is an aid to encouraging exercise adherence and is a very powerful tool that benefits both the instructor and the client.

The best way to understand goal setting is to set lots of goals so, with the help and guidance of your tutor, use the acronym SMART and set yourself an exercise goal and a career goal.

| Exercise goal | Career goal |
|---|---|
| | |
| | |
| | |
| | |
| | |

**Addressing barriers to exercise/physical activity**

The benefits of exercise and following a balanced nutritional plan are widely known and yet a large percentage of people do not exercise regularly if at all or do not follow a healthy diet. On order to effect a change, barriers to participation need to be overcome – something an instructor can help with.

**Barriers to participation**

Barriers to participation can be physical or psychological but very few barriers are insurmountable. Identifying and removing barriers can help the client "take the brakes off" and start a program of exercise or physical activity, make changes to their diet or otherwise make positive changes to their current, unhealthy, lifestyle.



**Commonly-cited barriers include:**

**1. Physical barriers**
Physical barriers include perceived lack of fitness, illnesses and injuries. Many people believe they are not fit enough to begin an exercise program and that, if they go to the gym, they will be the least fit or most fat person there. Ironically, this is the very reason they should start an exercise program.

Where lack of fitness is the perceived barrier, it is the instructor's role to educate the client and also ensure any prescribed exercise does not exceed the participant's current physical capacity; an overly-demanding workout may put the unfit exerciser off exercise forever so caution and common sense should dictate program design.

In the case of illnesses and injuries, if the client does not "pass" the screening requirements for exercise, they should be referred to an appropriate medical professional. If, however, no specific condition exists, a basic, capacity-appropriate workout can be prescribed.

**2. Emotional barriers**
Fear, lack of enjoyment, previous unpleasant exercise experiences, embarrassment, lack of confidence and poor results can all become emotional barriers to exercise participation. The role of the instructor in this instance is to ensure that they are empathetic and supportive and do not put the client in a position where the client experiences these responses again.

If a client finds the gym an intimidating environment, home workouts may be more appropriate. Exercising with friends may help make the exercise process more enjoyable and help bolster confidence. In a nutshell, the instructor should do all that they can to make exercise as emotionally comfortable as possible.

**3. Motivational barriers**
As previously discussed, not everyone is self-motivated to exercise and some people simply have little or no motivation. Lack of enjoyment or not realising the benefits can contribute to lack of motivation. To enhance motivation, instructors should use strategies such as goal setting, be sure to include activities that clients will enjoy, include plenty of variety in the exercise program to prevent boredom and be very supportive and encouraging.

**4. Time barriers**
One of the most often-cited reasons for not exercising is lack of time. However, in the majority of cases, this

excuse is used to disguise other barriers such as lack of motivation. With 168-hours in the week, all but the busiest person can find three-hours if they prioritise and manage their time properly. By designing short workouts and identifying opportunities for increasing general physical activity, an instructor should be able to remove this barrier. Advice on time management may also be beneficial. In many cases, lack of time actually means lack of energy for exercise; another barrier that can be addressed by the instructor.

**5. Facility/equipment/financial barriers**
Many people believe they must join a gym or have access to state-of-the-art exercise equipment or the latest workout clothes if they are going to start an exercise program. This is completely untrue. A good level of fitness can be developed using bodyweight exercises and items that are often found around the home, garden or garage. There are several low-cost gym chains in operation now and as for exercise clothing, there are more and more online and high-street discount outlets to choose from. Getting fit and being healthy need not be an expensive pursuit and can be achieved using a very "no-frills" approach.



**Rewards and incentives**

Rewards and incentives can be used to enhance motivation and promote exercise adherence. Regular attendance can be rewarded i.e. a free personal training session for every ten completed, and so to can the achievement of goals. The reward should be small enough to not impact negatively on the instructor's or organisation's profit margin but big enough to be meaningful. Examples of suitable rewards include T-shirts, water bottles, and discount vouchers for appropriate services or any other suitable means of recognition.

Careful consideration should be made before implementing any reward scheme to ensure it is fair and sustainable and that, if an element of competition is involved, participation will be fair and not lead to overtraining or overuse injuries. Reward schemes should also be fully inclusive so that less-fit participants are not left out.

It also goes without saying that any rewards should be healthy – a large bar of chocolate or vouchers for beer at the member's bar are not appropriate.

**Additional strategies for encouraging exercise adherence**

In addition to goal setting and removing/pre-empting barriers to participation, there are several other strategies that an instructor or organisation can use to encourage exercise adherence and reduce exercise drop out. These include:

**Change workouts regularly** – doing the same workouts over and over will probably result in boredom and also cause a plateau in fitness gains. Make sure that the exercise program is changed often enough to prevent this but not so often that the client doesn't get time to adapt to a workout. Every four to eight-weeks is usually optimal.

**Suggest exercising with a training partner or in a group** – training with other people can provide support, company, an element of competition and otherwise enhance exercise adherence. It also adds a second layer of commitment as the individual's participation becomes answerable to the training partner or group.

**Keep a training diary** – recording workouts and progress will show that, over time, significant progress has been made and it is very motivating and satisfying to review this progress from time to time. All instructors should record their client's workouts.

**Keep a nutrition diary** – for the same reason keeping a training diary is beneficial, a nutrition diary can also be motivating. It also helps keep clients "honest" and will also highlight unhealthy eating patterns and triggers that can be addressed and subsequently prevented.

**Use a decision balance sheet** – Balancing the costs of exercise and eating healthily against the benefits is an effective way of demonstrating just how much participants get from exercise compared to what they have to invest. A competed decision balance sheet should be displayed prominently so that the participant is reminded of the rewards of their exercise and dietary changes.



For example:

| Benefits | Drawbacks |
|---|---|
| Will lose weight | May have to get up earlier |
| Will feel fitter | Will have to cut back on sweets |
| Will be less tired | Will have to go to bed at a reasonable time |
| Will have more energy | Will have to commit to going to the gym three-times a week |
| May be ill less frequently | |
| Will meet new people | |
| Will look better in swimsuit | |
| Will be stronger | |
| Will be more confident | |
| Will reduce risk of heart disease | |
| Will sleep better | |
| Will look better to spouse | |
| Will be more toned | |
| Will have fewer aches and pains | |
| Will look better in jeans | |

**Use social support networks** – some people drop out of exercise because they think that no one else values or notices what they are trying to achieve. Social support networks are designed to provide a forum for telling others how they are progressing so that they will receive encouragement and support in return. A social support network might simply be a spouse or other family member, a friend or group of friends or one of the many internet support groups that are now available.

**Providing customer care and service**

Customers are the lifeblood of any business as without customers there would be no one to buy the products and services on offer. Subsequently, the customer should be at the heart of every business but, sadly, this is not always the case. Tales of poor customer service are rife and unhappy customers will often go elsewhere, taking their money with them!



Getting customers on board initially is hard and can be expensive because of advertising costs so it makes sense that every effort should be made to ensure that customers are happy and become loyal to the organisation or business. And, as the saying goes, a happy customer will tell a few people about their experience but an unhappy customer will tell lots.

The ethos of good customer service should also be applied to all professional dealings including colleagues and other professionals. This "treat others as you would have them treat you" mentality can make any working environment more enjoyable and more profitable.

In the fitness industry, customers will ask questions, need information, want guidance, demand clean and well-maintained equipment and require support to reach their fitness and health goals. This is part and parcel of the job of an instructor and should never be seen as an inconvenience or annoyance.

Remember, your fifth client of the day may only see you for one hour a week so they should expect to receive your best service even if you are tired or they are asking you a question you have answered a dozen times before.

Good customer service consists of four principle elements:

1. Expanding the definition of service
2. Knowing who the customer is
3. Forming positive relationships
4. Developing a customer-friendly attitude

**Expanding the definition of service**

Service can be good, bad or indifferent but should generally meet or exceed the customer's expectations and requirements. For example, if an instructor is asked whether they can do personal training, rather than just say no, they could recommend a colleague who can provide this service without the customer having to find out for themselves. In this example, the instructor went above and beyond the original remit – to answer a question – and provided information that exceeded the customer's request.

This is generally known as "going the extra mile" and makes a huge difference to satisfying the needs of the customer. Going the extra mile reflects well on the individual and the organisation. Other examples of going the extra mile in a fitness environment include following up on client complaints or comments, emails, calls or

texts to see how a client's new workout is progressing, courtesy calls if a client has been unwell and cards for customers on their birthday.

**Knowing who the customer is**

Customers can be defined as internal or external. Internal customers are people who, in the fitness environment, rely on the instructor for support, information or products and include managers, cleaners, maintenance staff, professional colleagues and receptionists while external clients are usually gym members who pay for products or services, Using these definition, a customer is anyone which you have professional contact.



The relationship between the internal and external customers is called the customer chain and, like any chain, is only as strong as its weakest link. The people that make up these links must all "do their bit" for the chain to work.

For example, if a piece of gym equipment is broken, a member may tell the duty gym instructor. It is not the instructor's job to fix the equipment but they need to notify the maintenance team, the gym receptionist and ultimately the facility manager to ensure a speedy rectification of the problem. Each party has a role to play in turning what could initially be a negative situation into a positive one by following the principles of good customer care.

**Forming positive relationships**

At the centre of good customer service is forming positive relationships with both internal and external customers. Positive relationships lead to happy, stress-free interactions both up and down the customer chain and happy customers are much more likely to become loyal customers that will remain loyal to the organisation.

Good relationships are built on rapport; the concept of rapport being that people like people that are like themselves. A relationship of mutual respect and influence, another definition of rapport, involves seeing things from the customer's perspective or, in simpler terms, walking in their shoes.

Rapport is built on effective communication and effective communication requires:

- Active listening i.e. nodding, making eye contact, leaning toward the person speaking, paraphrasing, summarising, clarifying etc.
- Positive body language i.e. use of hand gestures, being aware of posture, smiling, avoiding crossing arms or slouching, avoiding standing over a client, being aware of a client's personal space etc.
- Tonality and use of language i.e. speaking at an appropriate speed and volume, not using jargon or overly technical terms, avoiding monotones, expressing enthusiasm, not using inappropriate language, explaining concepts clearly and patiently etc.

**Developing a customer-friendly attitude**

Placing the customer at the centre of any organisation or business is the key to developing a customer-friendly

attitude. Too many organisations see customers as “a necessary evil” rather than their sole reason for existence.

Developing a customer-friendly attitude must start with initial contact as first impressions are usually very long lasting impressions. A smile and a warm, sincere greeting will go much further than a scowl and a grunt.

The acronym C.A.R.E illustrates how to develop a customer-friendly attitude:

**C**onsideration

- Offer to help promptly and enthusiastically – before being asked if possible
- Only make promises you know you can keep
- Be honest about the services/products being offered
- Consider the feelings of the customer



**A**ctive listening

- Don’t just hear – listen. Try to understand the meaning behind the words being spoken and respond accordingly

**R**esponsiveness

- Go the extra mile – without being asked
- Deal with requests and complaints promptly

**E**mpathy

- Don’t be judgemental
- Understand the needs of the customer
- See things from the customer’s point of view

**Dealing with customer complaints**

Despite the best effort of individuals and organisations, things can and will go wrong. These issues often give rise to customer complaints. Services not delivered on time, broken equipment, double-bookings and the behaviour of other facility users can all give rise to complaints.

Complaints can range from notes placed in a comments box to angry clients shouting at receptionists or gym staff. Remember the client has every right to complain however not all complaints are justifiable or avoidable and should be handled effectively and professionally.

If you have to deal with a complaint, make sure you:

- Listen to the complaint and take ownership of it
- Always be polite
- Keep calm and do not enter into an argument
- Record the complaint and inform the relevant persons or services
- Offer to be a point of contact for the client
- Advise the client of possible solutions or available alternatives if possible
- Provide reassurance to the client that their complaint is being investigated

- Feed back to the client once the complaint has been dealt with

All complaints should be dealt with in a timely fashion and any delays in processing the complaint should be communicated to the client as soon as possible. Keeping the client "in the loop" can go a long way to demonstrating a high standard of customer care and turning an otherwise negative situation into a positive one.

Dealing with complaints can be hard, especially if the client becomes angry. In this situation it is essential that you remain calm, do not match their angry language or behaviour, avoid being confrontational and use assertive rather than aggressive language…



| Aggressive language | Assertive language |
|---|---|
| "Don't speak to me like that." | "I would prefer it if you did not speak to me that way." |
| "With an attitude like that, how can I help you?" | "I understand your frustration. Please calm down so that I can help you." |
| "Stop swearing at me or I will put the phone down." | "If you continue to swear I will not be able to continue this conversation." |

Every organisation should have a pre-set procedure for handling complaints which all members of staff are aware of, are trained in and should use if they have to deal with one. Of course, the best way to avoid complaints is to practice a very high level of customer care in the first place.

Despite doing this, things can and do go wrong so it is essential that complaints are dealt with properly and professionally and to both parties satisfaction. Treat every complaint as an opportunity to go the extra mile for your customers.

**By the end of this unit, you will be able to…**

- ✓ Prepare self, client and facilities for a gym-based workout
- ✓ Consider relevant health and safety for a gym-based workout
- ✓ Prepare client for a gym-based workout
- ✓ Deliver a gym-based exercise workout
- ✓ Instruct and supervise client during a gym-based workout
- ✓ Bring a gym-based workout to its conclusion
- ✓ Reflect on own performance during a gym-based workout
- ✓ Support clients during and after participation in a gym-based workout



**Session preparation**

Writing and then delivering gym-based workouts is the main role a fitness instructor can expect to perform. The client's enjoyment and results as well as their health and safety all hinge on the effective delivery and subsequent supervision of an appropriate program of exercise. A successful workout begins with proper preparation.

**Preparing the instructor**

Before the exercise session begins, the instructor should ensure that all resources that will be required for the workout are present and in good working order. Factors that need to be considered include:

- ✓ The program has been written and is ready for use
- ✓ The workout program meets the needs of the client
- ✓ The instructor is on time
- ✓ The instructor is clean, presentable, and promotes a positive image
- ✓ The equipment required is available and in good working order
- ✓ Alternatives have been identified in case of last minute changes to the workout

By preparing for the workout in advance, the instructor insures that the session will go as smoothly as possible and that they will not be "blindsided" by anything other than very unusual events.

**Preparing the client**

Once the instructor and facilities are ready and the client arrives, the following steps should be followed before the commencement of exercise:

**1. Welcome the client and explain any emergency procedures**
A warm welcome will help establish rapport and put the client at ease from the outset of the session. Welcoming the client in a friendly but professional manner will set the tone for the rest of the session. If this is the client's first workout in this particular facility or there have been any procedural changes since their last visit, the instructor should clearly explain the location of the emergency phone, first aid kit and duty first aider and detail the procedures that should be followed in the case of a fire or other emergency.

**2. Explain the purpose of the session**

Give the client a brief outline of the session and its purpose so they can understand the value of the exercises they will be performing. This also gives them the opportunity to air any concerns regarding the upcoming session and provide any last-minute input.

**3. Carry out a verbal PAR-Q**

Prior to starting exercise, ask the client if, since completing their written PAQ-Q, has anything regarding their health changed i.e. do they have any aches or pains that need to be considered, are they feeling unwell in any way, are they still tired from the previous workout. This information should then be used to modify the workout as necessary and, in the case of illness or injury, may necessitate postposing the session.



Once this pre-amble is complete, it is time to move onto the warm up, main session and cool down.

**Instructional skills**

It's all well and good having a very effective program planned and all the equipment set up in advance but if the instructor is unable to effectively communicate what the client needs to do, the workout can be much less productive than it ought to be.

Delivering clear, concise and correct instructions is a skill that all instructors need to develop and practice if they are to be successful.

Communicating can be verbal or visual and both types of communication are important to fitness instructors.

| Verbal communication | Visual communication |
|---|---|
| Giving instructions | Demonstrations |
| Providing motivation and praise | Body language |
| Delivering teaching points | Teaching position |
| Providing corrections | Eye contact |
| Counting | Facial expression |
| Cueing | Physical contact |

**Verbal communication**

The ability to verbally communicate clearly and concisely is one of the instructor's most powerful tools. Clearly communicating concepts, ideas, reasoning, instructions and feedback will enhance the whole workout. To communicate effectively, the instructor should be mindful of the following:

**Terminology** – instructors must realise that not all clients will be familiar with terms like "neutral spine", "keep your knees soft", "avoid hyperextending your elbows" and "brace your core". Technical terminology, if used at all, must be qualified with a clear initial explanation. Avoid the use of fitness jargon and abbreviation but, instead, use terms that your client will understand. Use the session as an opportunity to teach any relevant terminology to the client but do not try to "blind them with science" by making explanations unnecessarily technical.



**Motivation** – as the workout progresses, the instructor will need to motivate most if not all clients to work at the appropriate level. This is best done by exuding enthusiasm and confidence and being passionate about what they do. Accompanied by the appropriate intonation and volume, terms like "Well done – only two more reps to go" or "You can do it!" can help the client work through any momentary discomfort. Avoid terms like "Don't stop" as the client can all too easily focus on the negative.

**Teaching points** – teaching points are phrases, key words and reminders used by the instructor to encourage good exercise technique. Always positive, teaching points remind the client about what to do rather than what NOT to do. For example, when doing press-ups, the instructor may use teaching points like "keep your elbows soft", "long neck", or "keep your elbows soft". Use teaching points to pre-empt technique errors before they happen or correct errors when the do. Avoid overly length or technical teaching points; a teaching point is not a fully-developed instruction but a brief phrase that is easily understood.

**Correction –** despite the instructor's best efforts, even the most advanced clients will still make mistakes and need correction. Corrections, like teaching points, should always be positive i.e. tell the client what they need to do, not what they must stop doing. For example, "keep your elbows soft as you press the weight up" is much better than "don't lock your elbows". Correction should be delivered patiently and in such a way that it does not come across like a "telling off" or being judgemental.

**Cueing and counting –** cueing means letting the client know what is about to happen in their workout, for example counting them in as your hand them a weight, letting them know you are about to speed up or slow down the treadmill or warning them that you are about to increase the depth of a partner-assisted stretch. Counting, in contrast, tells the client how their set is progressing and how many reps they have let to do. An instructor should count, coach and encourage during each and every set and avoid just counting reps only.

**Voice intonation –** while the words used during an exercise session are important, the way they are spoken are is important too. Voice intonation can reinforce the meaning behind the words and make all the difference to how information is interpreted. For example, saying the word "explode" in a monotonic way will have very little meaning whereas saying the word like it sounds "EXPLODE!!!" as the client drives up and out of the bottom position of a heavy squat is much more emotive and useful. Similarly, when it comes to lowering intensity and moving into the cool down stretches, a calmer, more measured voice will aid in relaxation and a better stretching experience.

Often, older people will respond better to a lower level of intonation while younger clients may prefer a more upbeat, energetic tone. Try to vary the volume, speed and general tone of your voice according to the component of the program; mirror the intensity of the workout with your voice.

**Visual communication**

In addition to communicating verbally, instructors must also be familiar with non-verbal forms of communication. In noisy gyms and for reinforcing verbal communication, visual communication is essential.

**Demonstrations** – to successfully teach an exercise, instructors must be able to do a good demonstration using proper technique. A demonstration should be precise, practiced and ultimately as perfect as possible. Make sure the client is positioned in such a way that they can clearly see the demonstration and do enough reps that they get adequate opportunity to see all the relevant points of the exercise being shown; 5 to 8 is ideal.

Make the demo very controlled and emphasises the important aspects including breathing, lower back position etc. Use a light weight when doing demonstrations so that a) there is no reason for technique not to be perfect, b) to allow for the fact that you are not warmed up or may have to do dozens of demos already, and C) avoid intimidating the client. If you cannot demonstrate an exercise, it can still be taught providing you can give very clear instructions but a demonstration is usually the best option. Once the demonstration is complete, the client should have the opportunity to ask questions before they have a go.



**Observation** – when the client is performing any exercise, the instructor should adopt a good position from which to observe performance. This often means moving from one positon to another to watch the client from a variety of angles. What looks look good exercise technique from the front could actually be very poor technique when viewed from the side so the instructor must not only move but also know the best position from which to spot common technique errors. In addition, the instructor must also end up in the right position at the right time to spot and help the client re-rack the barbell or put down dumbbells.

**Body language** – body language is often described as uncensored communication and while it's easy enough to sound motivating and enthusiastic, body language can give out a different message. Avoid slouching, sitting down, crossing your arms or otherwise looking anything other than being an enthusiastic, professional, approachable instructor and remember, body language can be read not just by the client but anyone else who happens to be in the gym.

**Touching** – it is sometimes necessary to touch a client e.g. when getting them into a correct exercising position, when spotting and in the case of Hilton's law (the nerves that innervate the skin also innervate the muscles underneath) however not everyone likes to be touched so it is important that the instructor obtains informed consent before touching the client and can always justify the use of touching. If no justification exists, it is possible that touching is unwarranted, may be unwelcome and could lead to allegations of misconduct.

**Instructing a new exercise**

One of main roles of an instructor is introducing clients to new exercises; either on a one-to-one basis or in group inductions. It is very important that this initial instruction is done well as techniques learnt now will potentially influence how client's perform exercises for the foreseeable future and it is much easier to teach someone how to do an exercise properly from the outset than re-teach them once they have develop bad habits.

There are several ways to teach a new exercise to a client but the best methods follow a logical pattern, are concise and give both the instructor and the client a framework with which to work. One such instructional method uses the acronym **N.A.S.T.Y.**

**N**ame the exercise and the muscles involved – call the exercise by its correct/accepted name and name the part of the body involved. E.g. "This is the leg extension machine and it mainly works the muscles on the front of your thigh – the quadriceps."

**A**djustments – show the client how to adjust the machine or their body position for safe and effective exercise performance. Set the machine up for yourself ready for your demo.

**S**ilent demonstration – do 5 to 8 reps without saying anything making sure the demo is as clear and precise as possible. Ensure the client is in the best place to see.

**T**eaching points – continue with the demonstration but add relevant teaching points and instructions. Be careful not to over-explain; time may be a limiting factor. However, make sure all important information is conveyed. Use non-technical dialogue so teaching points are easily understood.



**Y**ou have a go! – get the client into positon so that they can perform the exercise. Count, coach and encourage them while they exercise.

Some exercises are harder to master than others so make sure you are prepared to regress an exercise if the client is unable to perform a particular exercise properly or safely. It may be necessary to break complex exercises down into their constituent parts so that the client can master one small part of the movement at a time. Remember to only increase exercise intensity when good technique is demonstrated and never sacrifice good technique for heavier weights or more reps.

If in doubt, choose easier/less technically demanding exercises that target the same fitness component and introduce more demanding exercises as the client's skill level increases.

**Managing group inductions**

Many organisations induct or introduce groups of new members to the gym simultaneously. This job normally falls to the gym instructor. Inducting a group is more challenging than working with an individual for several reasons:

- Mixed ability groups mean that advanced and beginner exercisers have to be catered for at the same time
- Limited equipment means while some members of the group will be exercising, others will not
- In large groups, some people may feel excluded
- It is much harder to supervise a group of people that it is to supervise an individual
- Time limitations may mean that not all members of the group get to try all exercises
- It is very difficult to coach, correct and encourage each member of the group equally
- Members of the group may get in each other's way and make it hard to see the instructor's demonstrations
- Less outgoing client's may feel uncomfortable asking questions in a group environment
- More outgoing client's may try to monopolise the instructor's time and attention
- Group inductions make it very difficult for the instructor to offer personalised exercise recommendations

To manage group inductions effectively and efficiently, instructors may be required to only demonstrate a sample of the exercise equipment available so that the clients have sufficient knowledge to use other machines unsupervised. While not ideal, this is the only real way to deal with large numbers of new members. Secondary, more personalised, inductions should be offered when time permits.

**Spotting**

Spotting involves providing hands-on assistance to a client while they are performing a resistance exercise. Spotting is a skill and while good spotting is always well received and beneficial to the client, bad spotting can disrupt a set and be very annoying and even dangerous. Spotting needs to be practiced.



There are three main functions of spotting:

- Assisting the client if they are in difficulty
- Applying exercise intensifying techniques such as “forced reps”
- Reinforcing correct technique

In general, the greater the potential for injury, the more important spotting becomes. For example, in the bench press where the bar is held over the chest, a failed rep could result in serious injury so spotting is very important. However, for an exercise like triceps cable push-downs, spotting is much less important.

Exercises that commonly require spotting include:

- Supine exercises such as barbell or dumbbell bench presses
- Overhead exercises such as barbell shoulder presses
- Squats and lunges where the barbell is supported on the upper back
- Any other exercise where a failed rep could result in injury

Power exercises that are performed at high speed, such as kettlebell swings, cleans or push-presses, should not be spotted as there is a high risk of injury to both the exerciser and the instructor. Some machine exercises can also be spotted however this is generally done to intensify the workout rather than for reasons of safety.

Spotters should:

- Be strong enough to safely assist if required
- Know the correct way to spot safely and effectively
- Be in the right position at the right time to assist
- Know how many repetitions are being attempted and when their help is likely to be needed
- Be attentive at all times and monitor exercise performance
- Understand that for some exercises, such as heavy squats, more than one spotter may be necessary
- Be in the optimal position to assist without risking injury to themselves
- Maintain neutral spine to minimise risk of injury
- Establish and maintain good communication with exerciser
- Not end up doing all the work for the client

Except in the instance of an acute injury or negative-only repetitions, the spotter should never have to lift all of the exercise weight on their own. Assistance should be limited to just enough so the repetition(s) can be

completed with the client doing the majority of the work. If the instructor is lifting more weight than the client, the exercise has ceased to be productive and/or the load is too much for the client.

Instructors should also avoid the temptation to spot each and every exercise in a program; some exercises simply do not need to be spotted or cannot be spotted safely. Overly-enthusiastic spotting can be as problematic as not spotting at all.

**Spotting techniques**

- Different exercises require different spotting techniques:
- Barbell exercises are usually best spotted by gripping the barbell
- Dumbbell exercises are best spotted by applying pressure under the elbows or by grasping the wrists
- Machine exercises are best spotted by applying pressure to the machine lever arm



**Monitoring safety**

Monitoring safety is an essential part of a gym instructor's role, whether they are working 1-to-1 with a client or supervising the gym. That means that he/she must be able to stop incorrect and potentially dangerous exercise technique and offer corrections. While it is possible for any exercise to be done incorrectly, the most common incorrectly-performed exercises are bodyweight and free weight exercises is movement paths are not guided and it's all too easy to forget about things like spine position when focusing on working a seemingly unrelated part of the body.

**Planning exercise for health reasons**

While many people exercise for improved sports performance or enhanced appearance, many exercisers work out simply because they want to be healthier and live longer. In this instance, periodisation becomes less important because simply being active will improve health status as well as reducing the risk of developing diseases such as obesity and heart disease.

Research suggests that being physically active reduces all-cause mortality and being hypokinetic (sedentary) is a major risk factor for many medical conditions.

Despite the fact that "exercise is good for everybody's body", a study by the Health Education Authority (HEA), now called The National Institute for Health and Clinical Excellence revealed the following:

- 90% of adults believe that exercise is important however only 40% actually do it
- Most adults believe they are active enough to keep fit
- 80% of adults do not know how much exercise they need to do
- 70% of men and 80% of women are not active enough to benefit their health
- 2/3 of women and 1/3 of men find walking briskly uphill for a few minutes very demanding
- 1/3 of men and 1/2 of women aged 65 to 74 do not have enough strength to lift 50% of their body weight, making everyday tasks like climbing stairs and walking very demanding if not impossible
- Amount of exercise necessary to benefit health and fitness

Health and fitness are two very different things. Health is an absence of disease whereas fitness is more to do with performance and the ability to perform physical work. It is possible to be very healthy but not fit and fit but not especially healthy (for example someone who exercises but smokes heavily) and according to the American College of Sports Medicine (ACSM), the exercise prescription for health and fitness differ significantly.

**To reduce mortality**



Frequency – 5-7 times a week
Intensity – moderate or 50-70% MHR
Time – 30 minutes in total per day
Type – any sustained, physically demanding activity using large muscle groups

Simply being physically active for 30 minutes or more a day provides health benefits e.g. gardening or walking for transport or leisure. Research suggests that the time can be cumulative providing eight or more minutes of activity are performed at a time. For general physical activity to have health benefits, the participant should get slightly out of breath and generally feel warm.

**To improve fitness AND reduce mortality**

Frequency – 3-5 times a week
Intensity – vigorous 60-90% MHR
Time – 20-60 minutes in total per day
Type – sustained exercise using large muscle groups e.g. jogging, rowing etc.

Examples of activities listed by intensity:

| Moderate | Vigorous |
|---|---|
| Cycling for pleasure | Running at 5mph |
| Step machine | Hockey |
| Rowing machine | Squash |
| Walking briskly | Tennis |
| Cricket | Rugby |
| Golf | Hill walking |
| Swimming | Stair climbing |
| Gardening and mowing the lawn | Cross country skiing |
| Badminton | Rock climbing |
| DIY | Circuit training |

**Benefits**

When trying to "sell" exercise, it is important that instructors are able to explain the myriad of benefits that can be gained from participating in a regular fitness program. While many benefits are physical e.g. weight loss, or have a positive health benefit, exercise can also have a positive effect on the mind and may even be socially or spiritually beneficial.

While it cannot be guaranteed that all exercisers will experience all the benefits, it is certain that being physically active will counter the effects of inactivity and can only be a positive undertaking.



**Student task**

List as many benefits of following a regular program of physical activity as you can. Remember to think in terms of physical, social and psychological.

| Physical | Social | Psychological |
|---|---|---|
| | | |

**Monitoring exercise intensity**

For exercise to be beneficial, it needs to be appropriately intense; not enough intensity and there is no stimulus to trigger adaptation but too much intensity and overtraining and injury may result. Subsequently, it is important that instructors not only prescribe exercise at the correct intensity but also know how to monitor the intensity their client is working at. Knowing how hard the client is working will provide a benchmark to compare future workouts against and also determine the success of the session.

There are four reliable methods that an instructor can use to monitor exercise intensity:

- Heart rate
- Rating or perceived exertion
- Talk test
- Subjective assessments



This is arguably the most common and accurate way to monitor exercise intensity. The main way to monitor the heart rate is either by taking the pulse manually at the radial (wrist) or carotid (neck) artery or, more conveniently, using a heart rate monitor.

Commonly, when performing aerobic exercise, the heart rate should be 60 to 90% of the individual's age-adjusted maximum. Therefore, the first part of any heart rate calculation requires a maximum heart rate.

**Estimating maximum heart rate**

All heart rate calculations are based on percentages of maximum heart rate (MHR) i.e. the highest possible pulse. This is normally calculated as:

MHR = 220 – age in years

For example, 35 year-old exerciser would have a maximum heart rate of 185 beats per minute (BPM).

However, this calculation is known to have an error range of +/- 11 BPM so our 35 year-old exerciser's actual maximum heart rate could be anywhere between 174 to 196 BPM.

For this reason, maximum heart rate and the calculations derived from this number should be treated as guidelines only and while many exercisers will fit neatly into 220 minus age, some may find that percentages based on this figure will result in workouts that are too intense or not intense enough.

The only true way to determine a maximum heart rate is to exercise a client to exhaustion and then take their heart rate; for example, after running a maximum speed 400 meters. Needless to say, this type of stress testing is only suitable for very experienced clients who are medically fit. Anyone not meeting that criteria should use the 220 minus age calculation instead.

**Heart rate training zones**

Once an individual's maximum heart rate has been determined, the instructor must then determine at what percentage the client should exercise. The accepted range is 60 to 90% of MHR but in some circumstances, heart rates outside of this range may be appropriate.

As a rule, beginners should exercise at the lower end of the scale while more advanced exercisers should exercise at the middle and upper end. This is simply because lower intensity (60-70% MHR) is less intense and

generally less stressful making it more suitable for novice exercisers. As the exerciser gets fitter, a higher level of intensity would be appropriate but like all things exercise related, increases in intensity should be gradual.

**The fat burning myth**

A common myth associated with aerobic training zones is the existence of the fat burning myth. It is often believed that exercising at a low heart rate percentage (around 60-70% MHR) results in a higher rate of fat metabolism. However, while this level of intensity does result in fat burning, so too does working at 80% or even 90%. The truth is that there is no "fat burning zone" and, actually, the higher the intensity the more calories are burnt and that is much more important than the amount of energy coming from fat.



**Rating of perceived exertion**

The rating of perceived exertion scale (RPE for short) was developed by Scandinavian physiologist Gunnar Borg and is sometimes referred to as Borg's scale. It is designed to identify exercise intensity based on symptoms experienced by the exerciser or, in simple terms, how they feel.

Borg based his scale on fit athletes (cross country skiers) with an average resting heart rate of 60 BPM and an average maximum of 200 BPM. He then simply dropped the last zero and came up with his classic scale of 6 to 20. Borg's scale has since been simplified to run from 1 to 10.

With practice, an exerciser should be able estimate their level of exertion very accurately using either the classic or modified scales.

| Classic Borg's Scale | Modified Borg's Scale | Corresponding heart rate | Classification |
|---|---|---|---|
| <9 | <3 | <50% | Very light |
| 10-11 | 3-4 | 50-64% | Light |
| 12-13 | 5-6 | 65-79% | Moderate |
| 14-16 | 7-8 | 80-89% | Heavy |
| 17-20 | 9-10 | 90-100% | Very heavy |

Unlike heart rate, which can only be used for monitoring cardiovascular exercise intensity, Borg's scale can also be applied to resistance training. For example, using a predetermined weight, a client could be instructed to perform repetitions until they reach nine on the modified scale. This would be one or two reps shy of muscular failure.

Using RPE takes practice and often needs quantifying before use so take time to explain the scale being used before the participant starts exercising. E.g. "If RPE one is sat on your sofa at home with your feet up and ten is running flat out in a race, for this exercise, you need to be at level five to six".

**Important:** client's that do not enjoy exercise or who are finding a particular activity repetitive or boring, will usually overestimate their RPE whereas a client who is "in the zone" and flowing or who does not want to revel how hard they are finding a particular workout may underestimate it. RPE should be used with care and preferably in concert with other methods of assessment.

**Talk test**

Though not as accurate as measuring heart rate or either of the Borg RPE scales, the talk test is a simple method that gives a good indication of how hard a client is exercising. Because speech is affected by breathing, there is an inextricable relationship with exercise intensity, breathing and therefore how easily someone can speak during exercise.

| Activity level | Response |
|---|---|
| Light | Breathing lightly, talking easily |
| Moderate | Comfortable but breathing is faster and speech more laboured and broken |
| Vigorous | Breathing deeply and quickly, speech becoming increasingly difficult |



The easiest way to use the talk test is through simple observation and paying attention to how your client responds to your questions. For a fuller picture of their response to exercise, you can combine the talk test with RPE by asking them to estimate their current RPE. A few well-timed questions will easily confirm their estimate or lead you to your own conclusion.

**Subjective assessments**

Simply observing your client while they exercise can give a good indicator of their current level of intensity although these observations are not easily quantified. Examples include:

- Sweating
- Redness
- Technique
- Previous performance
- Facial expression
- Switching from nose to mouth breathing

Everybody responds differently to exercise but, after a few workouts, an observant instructor should soon be able to identify their client's "tells".

**Contraindications to exercise and safety guidelines for special populations**

In exercise, a contraindication is anything that will do more harm than good. Some exercises are deemed harmful (behind the neck press and bent over rows with a rounded back for example) however some exercises that are perfectly safe for the vast majority of exercisers may be harmful to others because of pre-existing medical conditions or age; the so-called special population groups.

An instructor should make special considerations when designing programs for special population groups to avoid including any contraindicated exercises or activities that may adversely affect health.

Special population groups are normally identified prior to exercise during the screening process and when filling in the PAR-Q. In many cases, a positive answer in the PAR-Q will require a medical referral. If exercise is

deemed to be appropriate then the instructor must design a workout that is safe, effective and is no way contraindicated. This may be done with or without input from the medical professional.

There are several special population groups that an instructor should be familiar with:

- Older clients
- Pre and post-natal clients
- Disabled clients
- Younger clients



**Older**clients

Anyone over the age of 50 is deemed to be an older exerciser because it is recognised that many physiological and medical changes occur at and around that age. Even fit and healthy-looking older people may be suffering the effects of aging so instructors always need to be mindful that, regardless of outward appearances, aging is having an impact. 40 is the usual age for seeing more pronounced signs of aging and 50 is when progressive loses in the neuromuscular and skeletal systems may require adaptation to the exercise program.

Aging is not a disease but simply describes the fact that, with advancing years, the systems of the body start to break down faster than they can be rebuilt. This results in declines in physiological and even psychological fitness which can adversely affect exercise ability and performance. Eventually, these loses lead to increased frailty and an inability to respond to stress and disease.

Functional status can be positively affected by exercise and diet which means that exercise is increasingly important for people over the age of 40 but while exercise can significantly slow the decline, aging is an inevitable process.

At a rate of approximately 1-2% per year, aging results in a loss in:

- Muscle strength
- Muscle power
- Bone density
- Aerobic endurance
- Balance and coordination
- Flexibility and mobility

Additionally, aging can result in sensory and cognitive declines including:

- Difficulty learning new skills
- Visual impairment
- Aural impairment
- Reduced short term memory

It goes without saying that an instructor needs to be aware of these changes and be prepared to adapt any program of exercise accordingly.

To be safe and to follow best practice, the following guidelines should be observed for exercising adults who are 50 or older:

All people over the age of 50 should be screened prior to exercise to establish whether they are asymptomatic (free from symptoms) and any adverse symptoms should result in a medical referral prior to participation.

Warm ups should be longer and more gradual and include additional mobility exercises for all major joints. 15-minutes or longer is an appropriate duration.

Cool downs should be longer and gradual than for younger exercisers to minimise the potential for blood poling and delayed onset muscle soreness. 15-minutes or longer is the appropriate duration.



Exercise intensity should be challenging but health-related i.e. without pain or strain. Intensity should be adjusted so client is working within their own individual comfort zone by using RPE and the talk test. Energy levels and joint pain can fluctuate from one day to the next so the instructor should be prepared to change the program on short notice according to how the client is feeling on any given day.

- Ensure correct technique is used at all times because of the increased risk of musculoskeletal injury with this group.
- Allow for more time and be prepared to provide assistance when moving from floor to standing exercises.
- Simplify exercises to allow for loss of coordination and balance. Give suitable alternatives to clients who find certain exercises difficult. Make sure the risk of suffering a fall is minimised.
- Learn new exercises in the easiest position e.g. seated or using a machine, and then progress in difficulty gradually.
- Avoid extreme spinal flexion i.e. sit-ups, to reduce wear and tear on an already potentially worn spine. Focus on bracing exercises instead.
- Be prepared to explain exercises clearly and repeatedly because of developing auditory and memory issues.
- Understand that older joints are less mobile than younger ones so it may be necessary to reduce the range of movement to reflect this.
- Programs should include resistance training to help slow the loss of muscle and strength and maximise bone mass.

Older exercisers are a very important special population that is growing every year and are very rewarding to work with. Older people often have more free time and disposable income to dedicate to exercise and are more aware of the health and functional benefits of exercise in the maintenance of quality of life. By modifying exercise appropriately, an instructor can have a huge impact on the life of an older client.

**Pre and post-natal clients**

In the not too distant past, exercise was frowned upon for women during pregnancy. It was thought that exercise could have a negative effect on foetal development and could even lead to a premature birth. More recently, opinions have changed and more and more women are choosing to exercise through their pregnancy.

In the vast majority of cases, exercise is safe for both the mother-to-be and the baby and exercise of the appropriate intensity and in line with the current recommendations should not have any adverse effect on foetal development or the birth. However, this makes the assumption that no history exists that would make even the right sort of exercise problematic. If any such history exists, the client should be referred to their doctor before commencing or continuing with an exercise program.



While it seems normal and natural for an already exercising woman to exercise through their pregnancy, some women actually choose to take up exercise when they become pregnant. This means that not only is their body trying to adapt to being pregnant, they also have to adapt to exercise too. In this instance, the instructor should program 15-minutes of continual aerobic exercise and gradually increase week by week up to 30-minutes per session.

There are several key guidelines to consider when working with otherwise healthy pre and post-natal clients:

- Pregnant women should endeavour to stay well hydrated and avoid exercising in hot or humid conditions to reduce the risk of foetal hyperthermia or overheating
  Sessions should be limited to around 45-minutes and be adjusted according to the mother-to-be's energy levels on the day
  Use RPE rather than heart rate as changes in the cardiovascular system make heart rate ranges less accurate
  Severe calorie restriction is not recommended during pregnancy as it may harm foetal development

Pregnant women should not exercise in the supine position after 16-weeks of pregnancy to avoid foetal hypertension

- No exercise in the prone position
- Avoid prolonged, motionless standing
  No prolonged overhead work, heavy exercise, prolonged isometrics or uncontrolled movements
- Avoid loaded forward flexion exercises
- No rapid changes of direction or position especially uncontrolled twisting
- Avoid exercises where there is a risk of falling or abdominal trauma
- No developmental stretches, hip abduction or hip adduction exercises because of joint laxity
- Do not perform exercises on an unstable surface e.g. BOSU
- Limit impact after first trimester and always wear one or even two sports bras to support the breasts

Pregnant women should stop exercising and seek medical advice if they experience any of the following:

- Dizziness, nausea or faintness
- Bleeding or leakage of amniotic fluid
- Abdominal or contraction-type pain

- Unexplained back, pelvic, groin, buttock or leg pain
- Excessive shortness of breath, chest pain, a racing pulse or palpitations

**Additional pre and post-natal exercise considerations**

Hormonal and postural changes mean that women are more vulnerable to injury during pregnancy. Joint instability, laxity and misalignment, muscle imbalances, impaired balance, increased bodyweight and size and decline in motor skills all increase injury risk and become more apparent as the pregnancy develops.



During pregnancy, as the baby grows, there is an increased tendency toward forward flexion and lumbar hyper lordosis and thoracic hyper kyphosis leading to lower back and neck pain. Exercise should be adapted accordingly.

- Instructors must monitor for faintness, dizziness and nauseas and be prepared to stop the session if the client experiences any of these or other symptoms

- Women should only return to exercise after their post-partum 6-8 week medical check. In the case of caesarean deliveries, this extends to 12-weeks
- The return to exercise should be gradual to allow recovery from the birth and ensure the new mother has sufficient energy to look after their baby
- Post-partum exercise programs should be designed to re-establish joint stability and muscle imbalances but high impact exercises, rapid changes of direction and twisting movements are best avoided for at least 6-months into the post-natal period
- Strengthening the core and pelvic floor muscles should be a priority in the post-natal period, so too should postural re-education. Crunches and sit-up type exercises are not appropriate in the immediate post-natal period
- Babies should not be used for resistance training and should be excluded from the exercise area

Women should be referred to their health professional is they suffer any of the following post-natal symptoms:

**Stress incontinence or noticeable pelvic floor weakness**

“Dragging” pain or a feeling of heaviness in the lower abdomen or pelvic area

Groin or lower back or any difficulty in walking

Abdominal muscle weakness or doming, failure of the separated abdominals to return to their original position, softness/sinking at the umbilical line, umbilical hernia

During pregnancy, a woman’s body changes from one week to the next and the exercise program should reflect this; what was fine last week may not be okay this week.

The instructor should remain flexible and be prepared to change the workout at a moment’s notice and understand that the expected physical changes do not always happen on schedule. Get constant feedback from the client and remember that exercise must not only be safe for the mother but also the growing foetus.

**Disabled clients**

It's widely recognised that exercise can be very physically and psychologically beneficial for people with disabilities. The benefits are, by and large, the same as for a non-disabled exerciser but may also reduce the risk of developing complications associated with the disability in question and enhance functionality making the tasks of everyday living easier to perform.

However, many people with disabilities and, in particular, mobility limitations often experience a lack of suitable facilities and qualified staff needed for them to exercise.



**The Disability Discriminations Act of 1995 (DDA)**
According to the DDA it is unlawful to refuse to serve a disabled person or offer a reduced level of service. Service providers must make "reasonable adjustments" to their facilities to ensure they are accessible by all.

Adjustments must be made in advance of any potential usage by disabled persons and not retrospectively as it is unreasonable for a disabled person to have to wait to obtain access or services.

**Exceptions to the DDA include:**

- Where meeting the needs of the disabled person endangers the health and safety any person – including the disabled person in question
- If serving the disabled person means the service producer is unable to serve others
- If the disabled person is unable to enter into a legally enforceable agreement or give informed consent

If providing a service for disabled persons at the same level as for other people means that it wold not be possible to provide a service for all or if a higher charge would have to be made to others.

**The Inclusive Fitness Initiative (IFI)**

The IFI provides guidance and support for service providers interested in welcoming disabled people into their facilities and for disabled people wanting to exercise or be more active. The following information is provided in line with the policies of the IFI.

**Physical disabilities**

Because of the wide range of possible disabilities, the instructor must realise that it is impossible to provide a definitive exercise guide for all conditions. Instead, the instructor should work with the disabled person to establish what is and what isn't possible.

Some disabilities are classified as progressive which means they get worse over time – multiple sclerosis for example. Progressive disabilities require careful monitoring to ensure the current exercise program is not making the condition worse.

Strokes, cerebral palsy and loss of limbs can result in asymmetrical weakness or loss of function i.e. they affect one side of the body more than the other. If there is a difference in strength and/or functionality from one side to the other, the instructor should endeavour to strengthen the affected side as much as possible without

neglecting the side that is unaffected. However, if nerve control or tissue damage is very severe, the ability to improve the affected side will be very limited.

**Spasticity**

Spastic muscles are very tight and/or rigid. Spasticity is a common feature of many disabilities and must be addressed with flexibility training. However, before starting a program of stretching, the instructor must consult an appropriate health care professional so they can learn how to stretch a spastic muscle without causing injury.



## NEUROLOGICAL CONDITIONS

Muscles can become weaker because of a decline in central nervous system (CNS) function e.g. muscular dystrophy. Any rapid decline in strength or general muscle function should be reported to the appropriate medical professional but the pursuit of general fitness and strength can help make neurological conditions less progressive.

**Damage to sensory nerves**

Many disabilities involve damage to sensory nerves. Loss of sensation can mean that the disabled client is unable to feel when things are not right and so the instructor must monitor closely. Rubbing shoes leading to blisters and pressure sores from prolonged sitting a prime examples.

D**epression**

Depression is a common secondary symptom for many disabled people and is the result of the physiological and psychological challenges associated with living with a disability. While exercise is empowering and an effective anti-depressant, depression could cause someone to drop out of an exercise program.

**Disabled clients – Summary**

Fitness instructors are not medically trained and are not qualified to offer medical advice on the treatment and/or management of disabilities. That being said, exercise can have a powerful and profound effect on many disabilities and the instructor should not underestimate the impact they can have on the life of someone living with a disability. If, however, the instructor does not feel adequately qualified or experienced to work with someone with severe disabilities, they should refer the client to someone who is.

**Younger clients**

Until relatively recently, young people got plenty of exercise at school and as a part of everyday living. More recently, with the advent of passive entertainment like games consuls and computers and the emphasis many schools place on academic league tables, structured physical activity is on the decline.

As a result, more and more young people are overweight and even obese and are developing conditions more commonly associated with older people such as type 2 diabetes and arthritis.

Subsequently, an increasing number of young people are joining (or being enrolled in) fitness programs. However, young people are a legitimate special population group that must be exercised with caution and while following certain guidelines.

**Growth plate fractures** .



The growth plate is the weakest area of a growing skeleton so any injury affecting the joint is more likely to damage the growth plate than the ligaments or cartilage.

Growth plate fractures make up 15% of all childhood fractures and are most common in boys aged between 14 to 16 and girls aged 11 to 13.

To minimise the risk of growth plate fractures and other "growth related" injuries, the instructor should:

- Prevent excessive training, avoid sports that do not suit the participants' body type and avoid heavy weight training/lifting without specialist supervision
- Remember gender differences and differing stages of development within the same sex
- Avoid inappropriate size pairings in contact sports
- Avoid high impact moves on the spot
- Always teach an appropriate warm up and cool down
- Provide the right size/weight equipment according to age and physical size of participants

**Flexibility in regards to children**

Care should be taken when teaching children how to stretch. Lack of motor skills mean that they may not perform the exercises correctly or might overstretch because they do not know how to interpret "mild tension" or the "point of bind". Additionally, during growth spurts, muscles are often already overstretched and more stretching could prove injurious. Forced stretching, as seen in gymnastics and martial arts, could have long lasting damage on a growing child and should only be done by a trained professional and with the express permission of the child's parents.

**The cardiorespiratory system in regards to children**

Children may seem untiring but if you observe a child during 20 or more minutes of continuous exercise you will observe that they naturally slow down and speed up to allow themselves to periodically cool off. Children are less able to regulate their body temperatures so it is important that they are given the opportunity to slow down and cool off when necessary.

Additional considerations regarding body temperature include:

- Allow regular water breaks
- The warm up component can be shorter than for adults
- The cool down component can be shorter than for adults
- Active rest should be given between bouts of intense exercise
- Monitor for signs of heat exhaustion and dehydration



Because their cardiovascular systems are not yet fully developed, instructors must be aware of the risk factors associated with sustained, high intensity, aerobic training for children.

**Lung volume and peak flow rates** – measures associated with lung volume and peak flow increase steadily until adulthood. Not yet fully developed lungs mean that children have inferior pulmonary functions to adults. This is characterised by more rapid breathing and a tendency to get out of breath quickly.

**Cardiovascular function** – children have smaller heart and heart chambers which means that stroke volume is lower than adults both at rest and during exercise. Children compensate for this by having higher resting and exercising heart rates however, even a higher heart rate cannot compensate for reduced cardiac output.

**Aerobic capacity** – $VO_2$ max increases from 6 to 18 years in boys and 6 to 14 years in girls but, because of the corresponding increase in bodyweight, this is not reflected in fitness levels. There is a slight decline in $VO_2$ max in girls at puberty because of an increase in body fat levels whereas boys, who gain muscle at this age, usually experience a slight further increase.

Absolute $VO_2$ does not limit performance in young people. The limiting factor is more likely to be lack of movement efficiency, limb size and muscle development. Because children develop at differing rates, the mitigating factor in sports and exercise performance and more likely to be the stage of physical development as more developed muscles and bones are better able to exert force.

**Anaerobic exercise**

Anaerobic capacity is not fully developed until the age of 20. Due to their smaller muscles, children have smaller glycogen and creatine phosphate stores than adults and will fatigue faster as a result. Combined with their reduced ability to control their body temperatures, anaerobic training should be carefully monitored and not performed in excess or to exhaustion.

**Exercise equipment**

Most resistance training equipment is designed for adults and will not fit a smaller child's body. Weight increases are normally quite large also. Cardiovascular equipment is often no better in terms of size. For that reason, free weight and bodyweight exercises are a much better choice for young exercisers as there is no issue with body size and weight increases can be very small. However, good technique must be taught and practised from the outset.

**Technique**

Lack of body awareness and poor coordination mean that many children and adolescents require much more supervision than adults to ensure exercises are performed with good technique. Therefore, the instructor should begin with non-complex, low-resistance exercises which mirror common everyday activities. Intensity should only be increased once proper technique is mastered. Doing too much too soon or doing exercises with poor technique can lead to severe and lasting injuries.



**Young clients – Summary**

Taking sport or exercise too seriously at too young an age is a recipe for drop out; especially if the child in question does not enjoy a particular activity or sport. A child forced to exercise or participate in sport that he/she does not enjoy will likely become a non-exercising adult. Care should be taken at all levels to ensure that exercise and sport are enjoyable and all-inclusive.

## Exercise for special populations task

With guidance from your tutor, provide adaptations and/or alternatives for the following special population scenarios. Include your reasoning behind the changes you suggest.

| Scenario | Potential risk | Alternative/adaptation | Reasoning |
|---|---|---|---|
| Blind person using a cross trainer | | | |
| Pregnant client performing the barbell bench press | | | |
| Young person using very heavy weights in | | | |

| | | | |
|---|---|---|---|
| the squat | | | |
| Older exerciser running on a treadmill | | | |



**Personal training environments and resources**

Personal Trainers may find employment in a variety of locations. Some of the environments in which personal trainers will work in include: health and fitness clubs, recreation centers and gyms, country clubs, yoga and Pilates studios, universities, resorts, the homes of clients, hospitals and in corporate organizations.

**Hours & Timings**

A personal trainer's hours and working conditions must be adaptable and flexible; to include work in several different settings alongside their clientele. Depending on where a trainer is working, different skills may be required of them.

For example, if the trainer is working in a hospital environment, they may need to be able to deal with people with emotionally and physically challenging health problems/situations.

**What Venues?**

Most personal trainer's hours and working conditions include work inside, in a gym, a fitness club, or home environment that is open or available to accommodate the client schedules. These public or private facilities are likely to contain different types of training equipment. The trainer will either work in one or more facilities in which clients are coming to them in order to obtain professional training, or the trainer will go to meet the clients at their homes or other places that are convenient for the client.

Some trainers will split up their schedules during the day in order to reach a larger number of clients. They may travel to multiple locations in one day and offer their services from morning to evening, with breaks in between. Trainers will have most of their training sessions scheduled in the evenings and on the weekends, and occasionally during holiday times.

During different times of the year, a trainer may find that their schedule is busier than at other times, especially after the Christmas season. Trainers who work both in public facilities and as well as private settings are likely to be effected by busy seasons and changing schedules. A personal trainer's hours and working conditions must have a flexible in order to work with clients wherever and whenever they have time to receive their training sessions.

**Looking after Your Body**

The work environment and duties of the personal trainer are such that they are vulnerable to sustaining injuries when they are training clients, and during any other training related physical activity. This risk is evident across the various levels of professional personal trainers in the industry. A personal trainer is not only responsible for the safety of themselves during the training session, but also that of their clients. As the nature of the job is very physically demanding, the trainer must also seek to maintain a high level of fitness.

The work environment of the personal trainer is fairly flexible. The trainer has the freedom to create the training programs for their clients, and implement them in the way that they see fit. This aspect of the job can lead to feelings of satisfaction, and it can be very rewarding as they witness the results of their planning and training in the lives of their clients.



The development of training programs can be challenging as the trainer must continually monitor the progress of the client and change the fitness training plan as needed. The work environment may be busy or quieter depending on where the trainer is working and how many clients use the same area of training space.

The environment must be risk assessed to be aware of any potential hazards and to ensure these are taken in t account and minimised or eliminated where possible.

There is a wide range of equipment that can be used within the environment, these could be fixed or portable

- Cardio fitness equipment
- Functional equipment
- Core stability equipment
- Strength and resistance training equipment

When working in environments that are not specifically designed for exercise/physical activity (such as outside or in a person's home), the area must be risk assessed, cleared of any hazards and ensured that there is enough room to safely complete the exercises for the workout. There should be access to a first aid kit, a safe fire escape, adequate heating/ventilation and access to clean drinking water.

## HEALTH AND SAFETY

Health and safety is of primary importance in the health and fitness industry. Instructors must be legally aware of their organisations 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 at work act 1974**

This is the fundamental piece of health and safety legislation. It places general duties on employers, employees, manufacturers and people in control of premises. These general duties form the framework for all health and safety regulations.

**Employer duties**

The employer has a duty of care to ensure that, as far as possible, the health, safety and welfare of employees is protected. Employers must:

- Provide a Health and Safety Policy Statement for five or more employees
- Provide equipment, machinery and an environment that is safe to use
- Control use and exposure of substances that may damage health
- Provide information, instruction, training and supervision where needed
- Take precautions against potential risks
- Ensure that visitors and members of the public are not put at unnecessary risk
- Report accidents, injuries, diseases and dangerous occurrences
- Provide adequate first aid facilities



**Employee responsibilities**

Employees also have responsibilities and must:

- Take care of their own health and safety and that of others
- Co-operate with the employer to help comply with health and safety legislation
- Inform the employer about any work situations that present a serious risk

**Regulations**

The Management of Health and Safety at Work Regulations 1999 identifies in detail what is required from employers to manage health and safety in the workplace.

**Risk assessment**

- A hazard is anything that can cause harm
- A risk is the chance, whether high or low, that somebody will be harmed
- Each employer must make a suitable and sufficient assessment of risk. How to control risks in a fitness environment will be addressed in more detail later in this section.
- Control of substances hazardous to health (COSHH)
- Requires employers to control substances which are hazardous to health
- Can be a substance, mixture of products or a process to create substances

**Reporting of injuries, diseases and dangerous occurrences regulations (RIDDOR)**

- Includes responsibility of employers and people in control of premises

- Involves the reporting of injuries, diseases and dangerous occurrences
- Requires the reporting of certain incidents to the enforcing authority

**Personal protective equipment (PPE)**

- Must be appropriate for the task and the risks involved
- Must be maintained and stored correctly
- Must meet European legislation and carry the CE kitemark
- Should fit the wearer correctly
- Must be used in accordance with instructions and training



**Noise at work**

- Ensures that workers' hearing is protected from excessive noise in the workplace
- Hearing protection must be provided in hearing protection zones

**Manual handling**

- Involves the use of the body to lift, lower, carry, push or pull a workload
- Consideration of the ability of the employee must be considered
- Avoid manual handling where practicable if there is a possibility of injury
- Provision of mechanical equipment where necessary

**First aid**

- A first aid needs assessment should be carried out
- Should have a first aid box which holds contents that reflect first aid needs
- People appointed to take charge of first aid arrangements
- Trained first aider(s)

**Health and safety policy considerations for the instructor**

Instructors must become familiar with health and safety policy and in particular the regulations most relevant to the job.

**General**

A fitness environment will generally promote health and safety and can be the responsibility of the health and safety manager, or even a duty manager who may be responsible on an operational level.

As the duty of care filters throughout the employees it will be the job of the fitness instructor to carry out a number of health and safety checks during their hours of work. It will be the duty of the instructor to conduct all safety checks in accordance with company policies and procedure and any failure to do so may result in liability for any incidents or accidents that occur.

Working practices are designed to ensure a high level of health and safety practice and compliance which may include the following considerations:

**Emergency action Plan (EAP)**

The purpose of an EAP is to facilitate and organise employer and employee actions during workplace emergencies. For smaller organisations the plan may be communicated verbally and not necessarily written but essentially must demonstrate:

- What to do in the event of a specified emergency
- What to do during the emergency
- What to do after the emergency



**Qualification**

Fitness professionals must hold valid and current qualifications for the tasks they are required to perform. These qualifications may differ between regions.

**Register of exercise professionals (REPs)**

This is a regulating organisation for fitness professionals. It was developed to protect the public from those who do not hold appropriate qualifications and to recognise the skills and qualifications of exercise professionals. Those who hold a qualification which meets REPs approval can apply for membership for which there is an annual fee. REPs levels can vary depending on region and globally there are six levels in total.

**Public liability insurance**

An essential cover for most types of business and will cover the fitness professional working in a place of employment. Work carried out elsewhere must be covered by an additional policy.

**Competency**

Any qualification or job description will describe the tasks which can be performed by the instructor. Any other duties which are not outlined are outside the areas of competency of the fitness professional.

**Health screening**

A common role of the instructor is to carry out a Physical activity readiness questionnaire (PAR-Q) with clients before participating in physical activity. This screening process must be carried out by all those wishing to participate within the exercise environment. Any doubts as to the suitability of the client to embark on an exercise programme should be referred to a GP before exercise can begin.

**Risks of pre-exercise testing and exercise**

Exercise and fitness testing carries the risk of injury and the possible exacerbation of existing conditions brought on by performance. The client should be informed of these risks before deciding whether to undertake such tests or exercise.

**Physical activity readiness questionnaire**

**The PAR-Q has two purposes:**

- Informs the instructor of the suitability of the client to begin exercise participation
- Raises the awareness of the client to the risks involved in exercise



**Delivery of PAR-Q**

A busy fitness environment will present difficulties in trying to deliver a PAR-Q with clients from time to time. It is not always possible to present a written document or forward the detail of such a document to the instructor before a session is due to start. However, it is a necessary procedure and there are options available to the instructor:

- A written PAR-Q is the preferred format, which gives both the instructor and the client the ideal opportunity to determine activity readiness.
- Verbal questions will present the opportunity for participants to give any information which may prevent them from taking part in an exercise session. This method can be used regularly to determine if there is any change in the wellbeing of clients between sessions and is frequently used in group exercise environments.
- Passive signage such as a PAR-Q poster in the exercise environment will inform participants of their duty to inform the instructor of any health related reason why they may not be able to participate. The instructor should reinforce this with verbal questions before the start of each session.
- Each fitness environment will have their own health screening system and this must be communicated to the instructor(s).

**Additional information**

Instructors may not be responsible for screening of every participant , but must be aware of where this information is stored in case of emergency, follow up or changes which need to be made to documents.

**Health commitment statement (HCS)**

The health commitment statement will set out the standards that users can reasonably expect from the organisation, facility, staff and each other. It should be drawn to the attention of the user and may be incorporated into membership or screening documents. The purpose of the HCS is to:

- 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 be 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**

In tort law, a duty of care is a legal obligation to provide and adhere to a reasonable standard of care while performing any acts that could foreseeably harm others. It must be the first element to be established with an action in negligence. A negligent act may be unintentional but nevertheless may still breach a duty of care.

Instructors will have a different and sometimes greater duty of care for the range of clients under their supervision. This can include but not be limited to young people, older adults, pre and post-natal women and vulnerable adults. The acquisition of knowledge without qualification relating to such special populations may allow the instructor to present greater opportunity for access to the exercise environment, however this does not permit the instructor to provide specialist advice or instruction. Where instructors find themselves frequently working with special population clients, they should seek to obtain the appropriate qualification, otherwise they could find themselves in breach of their duty of care. It is also important to have the appropriate insurance policy which covers the instruction of such clients.

**Security procedures**

There are a number of security measures which are designed to protect both indoor and outdoor facilities. Security can help to protect staff, users, possessions and the facility itself.

**External security**

A fitness environment may be incorporated within another facility and may not be directly responsible for outdoor security. Those which are will be responsible for the safety of users who drive, park and walk to and from the facility. Security depends not only on the installation of equipment, but also the ability to operate it effectively.

**Video monitoring system**

CCTV can be used to monitor access and egress from the facility and land upon which the facility is placed. Car parks, entrances and emergency exits should have camera equipment which is capable of recording and storing this information.

**Lighting**

Outdoor security lighting can be permanently lit or operated with motion detectors.

**Security staff**

The presence of employees often acts as a deterrent to crime. Staff may be issued with secure two way radios for effective communication in the event of a security breach. Employment of dedicated security staff from an external organisation may be required for a larger facility.

**Signage**

The use of signs, posters and stickers in potentially vulnerable areas, windows and doors can also deter criminal behaviour.



**Internal security**

When users enter the facility it is the role of internal security measures to help provide a safe environment.

**Controlled access**

Staffed receptions, barriers, swipe cards and coded entry locks provide secure modes of entry. The facility itself will usually determine which combination of methods is most suitable.

**Alarms**

Intruder alarms are fitted in buildings to protect against unlawful entry.

Panic alarms can be installed in areas where one-to-one contact is frequently encountered. These can provide piece of mind for both staff and users in environments such as offices and consultation rooms.

Personal alarms may be worn by individuals to attract attention when necessary.

**Electrical communication**

Radios, pagers and mobile phones allow effective communication between staff, users and emergency services

**Training**

Staff training will inform employees of new equipment, regulation, legislation and changes in industry standards. Specialist agencies such as the police force can provide information on newly identified risks and any community issues which may become relevant.

**Confidentiality**

A secure workplace will maintain confidentiality regarding all users of the facility. Secure storage and restricted access to confidential information should follow procedures which are communicated to all staff.

**Prevention**

Criminal and unsocial behaviour can be deterred through effective work methods. Cash handling procedures, transportation of valuable possessions/ information and staff shift rotation can be organised in a manner which eliminates opportunist and organised crime.

The fitness professional has a duty of care to all aspects of the fitness environment in which they work. They must be aware of their responsibilities and encouraged to act accordingly, in the knowledge that the employer will support them in providing a safe and healthy environment.

**How to control risks in a fitness environment**

Essentially a risk assessment is a formal examination of the workplace to find anything that could cause harm to people. It is the aim to make sure that nobody gets hurt or becomes ill at work and this process will determine whether enough precautions have been made or whether more needs to be done.



**How to assess risk**

An individual does not have to be a health and safety expert to carry out a risk assessment. There are five steps to follow:

**1. Identify the hazards**

Slips, trips, falls, chemicals, machinery, electricity, manual handling, noise, lighting, temperature

**2. Decide who might be harmed**

Gym/office staff, members, cleaners, contractors, visitors, people with disabilities. A shared building will have to take others into account

**3. Evaluate the risks**

- Decide how likely it is that harm will occur
- Balance the risk against the measures needed to control the risk

**Record your significant findings**

- Record the hazards, how people might be harmed and what is in place to control the risks
- Risks are calculated using a risk assessment severity scale of 1-5 where 1 is low risk and 5 is high risk.
- A 5x5 risk matrix can be used for assessment

Risk rating:

Low
Medium
High

| | **Likelihood (probability)** | | | | | |
|---|---|---|---|---|---|---|
| **Consequences** | | 1 | 2 | 3 | 4 | 5 |
| | 1 | 1 | 2 | 3 | 4 | 5 |
| | 2 | 2 | 4 | 6 | 8 | 10 |
| | 3 | 3 | 6 | 9 | 12 | 15 |
| | 4 | 4 | 8 | 12 | 16 | 20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 5 | 10 | 15 | 20 | 25 |

| Likelihood (probability) | Consequences |
|---|---|
| **1. Rare** | 1. Minor injury - no 1st aid required |
| **2. Possible (unfortunate)** | 2. Minor injury - 1st aid required |
| **3. Possible** | 3. Injury requires doctor or hospital |
| **4. Probable** | 4. Major injury resulting in disability |
| **5. Almost certain** | 5. Fatality |



**Regularly review your risk assessment**

Environments and work methods change so it makes sense to review what you are doing on an ongoing basis.

**Manual handling**

Any job that requires manual handling will carry an associated risk. Lifting an object may seem straight forward but if you add the risk of carrying, climbing, turning or lowering then the risk will increase. Repetitive movements and holding positions can compound the risk further and this series of events can cause damage to all tissues of the body either by trauma (sudden injury) or wear and tear over a period of time.

**Correct handling techniques**

**Lifting**

Keep loads close to the body and near to persons' centre of gravity, using diagonal foot positions to provide greater stability. Move loads from waist height where possible and when lifting from the floor, maintain a neutral spine while using the power of the legs.

**Pushing and pulling**

Pushing is generally easier than pulling. Lean forward when pushing and lean backward when pulling. It is important to use the arms and legs in unison and avoid twisting where possible.

**Pivoting**

Handlers are safer when pivoting their shoulders, hips and feet with the load in front of the body. Try to avoid excessive and repetitive twisting actions.

**Climbing**

When climbing with a load it is important to try and maintain contact with the ladder or stairs at three points (two feet and one hand or two hands and one foot).

In all situations of manual handling large heavy loads, the assistance from another person or mechanical lifting device would be recommended.

**Exercise risk assessment**



This process will start with the PAR-Q which will highlight the risks of participating in any form of exercise. Once it is established that the client may undertake exercise, it is the job of the instructor to decide which forms of exercise will be appropriate. All exercises involve an element of risk and the instructor must consider these factors when programming for the individual. There is no combination that suits all clients so considering the following factors will serve as a guide to making safe exercise choices:

**Medical status**

Avoid any exercise which may aggravate a current condition. Clients may present test results which place them in a special attention category. Previous or present injuries may require the avoidance of exercise for certain muscle groups and past injuries and conditions may reduce performance during exercise.

**Body type (somatotype)**

There are three categories of body type. A person will generally present characteristics of one of these groups. Each somatotype will be more suited to certain types of exercise and unsuited to others.

**Ectomorph** - thin, fragile, lightly muscled, and delicate with narrow shoulders and hips. Tend to excel at aerobic activities and may be unsuited to contact sports.

**Mesomorph** - athletic build with strong muscle development. Broad shoulders and narrower hips, will excel at strength and power disciplines. May find endurance events uncomfortable.

**Endomorph** - rounded heavy build with under developed musculature. Shoulders can be narrower than hips. May have slow reactions but can develop ability through specific training.

**Occupation**

The physical requirements of a persons' job may identify risks in prescribing certain exercises. In addition, the time of day most suited to exercise will need to be considered. Stress levels, hours of work, length of working day and motivation to exercise before or after work can present a challenge in exercise programming.

**Lifestyle**

The way in which individuals choose to live their dives can be vastly different. Sleep patterns, social choices, sedentary or active habits are only a few of many lifestyle choices. The effect on energy levels and time available to exercise can affect the exercise diary, levels of intensity and duration of sessions

**Nutrition**

Dietary choices can influence our ability to exercise. Calorific intake, eating patterns and choice of food groups can influence how we feel and determine our performance during exercise.



**Exercise choices**

- Type of exercise
- Resistance and intensity
- Speed
- Balance and proprioception

**The exercise risk continuum**

The risk associated with an exercise can be evaluated by using the following diagram. It is important to understand that there is no right or wrong exercise. An exercise may be suitable for one client but inappropriate for another. All health factors, fitness levels, client goals, equipment and environment should be considered by the instructor in the decision making process. The risks of performing an exercise must be weighed up against the benefits when deciding if an exercise is appropriate.

**Exercise risk continuum**

| 100% effort | 80% effort | 60% effort |
|---|---|---|
| Fast pace | Medium pace | Slow pace |
| High resistance | Medium resistance | Low resistance |



**Emergency procedures in a fitness environment**

The fitness environment can be a dangerous one. Such facilities are generally stocked with machines and equipment that has the potential to cause injury. Even when used correctly a gym relies on the vigilance and spacial awareness of all gym users. Often there is a gym etiquette which is difficult to understand for a beginner client or inexperienced member of staff, but in time this often unwritten code of conduct is learned and implemented.

When faced with an emergency, whether caused by equipment which affects an individual, or on a larger scale where the whole facility is at risk, the instructor must become familiar with emergency operating procedures.

**Types of emergency**

There are various threats to the workplace when an unforeseen situation can threaten employees, customers or the public. Emergencies may be natural or manmade and can cause physical and environmental damage. These can include:

- Fire
- Floods
- Hurricanes/storms
- Chemical spills
- Toxic gas release
- Explosions
- Civil disturbance
- Workplace violence

**Accidents and sudden illness**

From time to time a gym user can suffer an accident or illness which may be caused by exercise. Alternatively, it can be an unfortunate coincidence which occurs while on the premises. The instructor has a role to perform in such a situation.

**C**alm yourself
**A**ssess situation
**L**ocate assistance
**M**ake area safe
The emergency services should be called when there is a medical emergency whereby someone is seriously ill or injured and their life is at risk.

For example if someone has:

- Lost consciousness
- Fits that are not stopping
- A confused state since the incident
- Persistent, severe chest pain
- Difficulty in breathing
- Severe bleeding that can't be stopped



When contacting the emergency services the following key information should be given:

**L**ocation - postcode, telephone number, general area or landmarks

**I**ncident - describe what has happened

**O**ther services required - e.g. fire brigade, police

**N**umber of casualties - number, sex, age

**E**xtent of injuries - describe what you see

**L**ocation - repeat description of location

In the event of an accident that can be dealt with by an appointed first aider on the premises, the contents of a first aid box may be required. The contents should reflect the findings of the first aid needs assessment. A minimum stock of first aid items may include:

1 general guidance leaflet on first aid

20 individually wrapped sterile plasters of assorted sizes

2 sterile eye pads

6 safety pins

2 individually wrapped triangular bandages

2 large sterile individually wrapped unmediated wound dressings

6 medium sized sterile individually wrapped unmediated wound dressings

3 pairs of disposable gloves

**Other emergencies**

It is important for the instructor to follow emergency operating procedures calmly and correctly, as provided by the employer. This is more likely to ensure the safety of everybody on the premises than performing an alternative procedure. Any deviation from the procedures implemented, trained and practiced by the employer may result in liability on the part of the instructor as a result of any harm caused during the emergency.

An emergency situation may require the assistance of one or more of the external emergency services, each with a separate role to perform:

**Police** provide community safety and act to reduce crime against persons and property

**Fire department** provides fire fighters to deal with fire and rescue operations

**Emergency medical service** provides ambulances and staff for medical emergencies



## SAFETY OF PERSONS IN AN EMERGENCY SITUATION

Organisations providing services to the public must take responsibility for all people who enter its premises, otherwise it may be viewed as discriminatory. The procedures implemented by each facility should account for the safety of all groups and provide full training to the relevant staff. Children, older people and those with disabilities may be particularly vulnerable in an emergency situation.

**Guidelines for assisting special populations:**

**Children**

In an emergency, children have special needs and become more dependent on adult guidance and support. Where possible, rehearsal of emergency procedures will prepare them for a potentially frightening experience and assure them that there is a plan to overcome such a situation. In the event of an emergency the instructor should explain what is happening, listen to any fears a child may express and give concise answers where appropriate. The instructor should remain calm and positive as their behaviour will be interpreted and may be reflected in the actions of a child. Physical contact such as “holding hands” or “guiding direction” may also be appropriate.

**Older people**

An older adult may have developed impairment in movement, vision, hearing or mental agility and control. This deterioration in physiological and psychological function may result in a loss of independence in an emergency situation. A member of staff can offer physical assistance in evacuation by acting as a “buddy” to ensure their safety.

**People with disability**

Procedures will vary depending on the needs of a disabled person. Physical assistance may be necessary to aid speed of movement or to overcome obstacles. The maintenance of any specialist equipment, surfaces and wheelchair routes on the premises should be up to date and recorded to avoid failure in the event of an emergency. Staff can attend “assisting disabled people” training courses which will prepare their attitude, communication and assistance skills in order to act appropriately in the event of an emergency.

**Safeguarding children and vulnerable adults**

It is the duty of all professions to safeguard the welfare of children and vulnerable adults. The vigilance of professionals will help in recognising signs of abuse and the reporting of such findings will maintain and improve the safety of these groups.

The following key principles should be included in any organisational policy statement:

- Adults must demonstrate proper conduct and personal behaviour at all times
- Adults must always respect and champion the rights of every individual who participates in leisure activities
- Adults must develop a relationship with children, vulnerable adults and staff based on openness, honesty, mutual trust and respect

Adults working in the active leisure sector must maintain a high level of competence by attaining qualifications and through a commitment to ongoing training in order to ensure safe and correct practice



**Policy content**

The policy of an organisation should also include:

- A checklist for the recruitment, employment and deployment of staff and volunteers
- Procedures to respond to breaches of codes of conduct
- Specific codes of conduct for different groups

**Safeguarding children**

All those who work with children and young people are able to provide a link in the identification of a child who is at risk of, or has been harmed. Review of working practice should reinforce the recognition and compliance of codes of conduct. The ability to recognise indicators of abuse, and take appropriate action, will be vital in the immediate welfare of a child.

The Criminal Records Bureau (CRB) and Independent Safeguarding Authority (ISA) have merged to become the Disclosure and Barring Service (DBS). CRB checks are now called DBS checks. A DBS check may be needed for jobs or voluntary work with children. An employer can ask for a DBS check if they are looking to employ staff in certain roles and there three types of criminal records check:

**Standard check**

Spent and unspent convictions, cautions, reprimands and final warnings

**Enhanced check**

Standard check plus any additional information held by local police that is reasonably considered relevant to the job

**Enhanced with list checks**

Similar to the enhanced check and includes a check of the DBS barred lists

There is a monetary charge for these checks if the employer is looking to employ paid staff, but the checks are free if looking to work with eligible volunteers who will not be paid. It is a criminal offence for an employer to knowingly appoint a person who is barred from working with children. Both the employer and the person applying for the job may face prosecution.

**Role and responsibilities of the instructor**

By adopting best practice the instructor will exemplify the standards expected of professional adults who work with children. Professionalism is a word which encompasses all desirable traits expected of an individual who excels in their work.

Such practice can be embodied by first impressions and the wearing of a company uniform will introduce the instructor as an employee to parents, carers and children. Name badges further enhance the identification of staff when required.

Best working practices include:

- Adhering to policies and procedures
- Adhering to codes of practice
- Working in an open environment
- Avoiding spending time alone with children
- Never taking photographs without full written consent from all involved



**Recognising abuse**

Child abuse can be presented in many forms, but it can be broadly separated into five categories:

- Physical
- Emotional
- Neglect
- Sexual
- Bullying and harassment

**Physical abuse**

When someone causes physical harm or injury to a child. Examples include:

- Hitting or shaking a child
- Scalding or burning a child
- Providing access to inappropriate drugs or alcohol
- Causing other forms of physical harm

Indicators and signs of physical abuse:

- Flinching
- Withdrawn behaviour
- Unexplained bruises, scalds, burns, bite marks or broken bones
- Keeping arms and legs covered
- Fear of going home
- Fear of parent being contacted
- Running away
- Aggressive or angry outbursts
- Depression

**Emotional abuse**

Maltreatment that adversely affects the development of a child. Emotional abuse can also be a characteristic of other forms of abuse. Examples of emotional abuse are:

- Making a child feel unloved, unvalued or worthless
- Threatening, shouting at or taunting a child
- Making a child feel frightened or in danger

Indicators and signs of emotional abuse:

- Self-isolation
- Neurotic behaviour
- Self harm
- Sudden speech disorders
- Fear of making mistakes
- Fear of parent being contacted
- Delay in development of child



**Sexual abuse**

When adults or other young people use a child to satisfy their own sexual needs. This can involve:

- Touching children in a sexual manner
- Sexual acts or intercourse
- Involving children in the showing or production of pornographic material

Indicators and signs of sexual abuse:

- Pain, bruising or itching of genital area
- Discomfort in walking or sitting
- Stomach pains
- Pregnancy
- Sexually transmitted disease
- Advanced sexual knowledge
- Sexually explicit language or behaviour
- Sexual drawings
- Fear of one person
- Sudden behavioural change
- Self harm
- Suicidal thoughts
- Bedwetting
- Running away

**Neglect**

When adults fail to meet the basic physical or psychological needs of a child, such as:

- Failure to provide adequate shelter, food or clothing
- Regularly leaving child alone or unsupervised
- Failure to give access to appropriate medical care
- Regular refusal to give child attention

Indicator and signs of neglect:

- Scruffy appearance
- Repeated hunger
- Unexplainable weight loss
- Truancy or poor timekeeping
- Child doesn't want to go home
- Bullying and harassment



Deliberate hurtful behaviour directed at a child which is repeated over a period of time. It can be verbal, physical, written or communicated using social media. Examples include:

- Threats, name calling or gestures
- Physical assault
- Being ignored and outcast
- Racist or sexist taunts

Indicators and signs of bullying and harassment:

- Shyness
- Overly sensitive
- Insecurity

**Safeguarding vulnerable adults**

Instructors have a duty of care to vulnerable clients, who may be put at greater risk in an exercise related environment. A vulnerable adult may be a person who is 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.

There are six different types of abuse:

**Physical**

Include hitting, slapping, kicking, pushing, restraint, misuse of medication, inappropriate sanctions

**Sexual**

Include rape and sexual assault, sexual acts to which the vulnerable adult has not consented, or could not consent to or was pressured into consenting

**Psychological**

Include emotional abuse, threats of harm or abandonment, deprivation of contact, humiliation, blaming, controlling, intimidation, coercion, harassment, verbal abuse, isolation or withdrawal from services or support networks

**Financial or material**

Include theft, fraud, exploitation, pressure in connection with wills, property or inheritance or financial transactions, or the misuse or misappropriation of property, possessions or benefits

**Neglect and acts of omission**

Include ignoring medical or physical care needs, failure to provide access to appropriate health, social care or educational services, the withholding of the necessities of life, such as medication, adequate heating and nutrition

**Discriminatory**

Include racist, sexist, that based on a person's disability, and other forms of harassment, slurs or similar treatment



**Indicators and signs of abuse**

These can be similar to those presented by children who are suspected victims of abuse and may include:

- Visible injury or not wanting to be touched
- Being withdrawn or very eager to do tasks asked of them
- Lack of concentration or focus, showing compulsive behaviour
- Lack of money, possessions, difficulty with finances or unpaid bills
- Being over-protective of money or possessions
- Pain, discomfort, failing health, changes in appearance
- Very Hungry or thirsty
- No personal clothing or untidiness
- Regularly admitted to hospital

**Acting on suspected abuse**

Abuse can be difficult to define as the ideas of what constitutes abuse can differ over time from person to person and place to place. Tangible evidence of abuse can be difficult to source and an abused person may withdraw explanations of abuse through fear and even love of the abuser. It is important to listen to a child or vulnerable adult if they approach you, record the information given and reassure the individual. This can be the first step in protecting them against further abuse. The instructor is not expected to be an expert and should never judge whether a person is being abused.

The instructor should follow the organisations child or vulnerable adult protection policy if such guidelines exist. This may involve reporting to a senior manager who can then contact the relevant protection officer or emergency service. There is an obligation to act on sourced information whilst reassuring all concerned that the matter will be dealt with sensitively and appropriately.

- Listen
- Record
- Reassure
- Report
- In an emergency dial 999

Information on suspected abuse may be forwarded by other means, such as:

- A conversation with another person
- Direct observation

- Anonymous allegation

Such information should be recorded in the same way as disclosures. Direct questioning of any of the parties involved must be avoided.

**Statutory agencies**

The statutory agencies responsible for safeguarding children and vulnerable adults:

- Police
- Crown prosecution service
- Probation service
- Child welfare agencies and officers
- Childline
- Child protection officer, senior manager or appointed person in the workplace
- Local authorities
- Social care services
- Carer support groups
- DSS benefit agencies



Confidentiality of information relating to possible abuse

- All documents must be securely locked away
- Contact the child protection officer for help and support
- Contact a senior manager for help and support
- Inform anyone on a need to know basis only

# DELIVERING PERSONAL TRAINING SESSIONS



**By the end of this unit, you will:**

- ✓ Understand how to instruct exercise during a personal training session
- ✓ Know how to adapt exercise to meet the needs of the individual
- ✓ Be able to review personal training sessions with clients
- ✓ Be able to plan and prepare personal training sessions
- ✓ Be able to prepare clients for personal training sessions
- ✓ Be able to instruct and adapt planned personal training sessions
- ✓ Be able to bring personal training sessions to an end
- ✓ Be familiar with a variety of different resistance training exercises
- ✓ Be familiar with a variety of different power exercises
- ✓ Be familiar with a variety of partner-assisted stretches

**Instructing and adapting exercise**

One of the main parts of a personal trainer's job is selecting, instructing and being able to adapt exercises to meet the needs of the client. This level is skill is usually beyond the capacity of a typical gym instructor. This important difference between personal trainers and gym instructors should be explained to the client so that he/she understands the value of personal training – both financial and with regards to the benefits available.

Compared to a gym instructor, a personal trainer should:



- Be able to create a variety of programs to suit the needs of an individual
- Be better prepared for a fitness session
- Be a better observer and have better communication skills
- Be skilled in exercise adaptation, progression and regression
- Be able to review fitness session and provide feedback
- Be able to act on feedback to improve personal practice

**Session preparation**

Once the initial fitness consultation has been conducted, the personal trainer should have a fuller picture of the wants and needs of the client. Combined with their health and exercise status and history, this should allow them to write an appropriate exercise program that caters for the client's goals. Where gym instructors are more likely to produce and supervise general fitness sessions, a personal trainer's approach should be much more specific.

Prior to arrival of the client, the personal trainer should ensure all required resources are available and are in good working order. Any adjustments to the program because of changes in or lack of equipment should be made in advance.

**When the client arrives**

Once the trainer and facilities are ready and the client arrives, the following steps should be followed before the commencement of exercise:

- Welcome the client and explain any emergency procedures

A warm welcome will help establish rapport and put the client at ease from the outset of the session. Welcoming the client in a friendly but professional manner will set the tone for the rest of the session. If this is the client's first workout in this particular facility or there have been any procedural changes since their last visit, the trainer should clearly explain the location of the emergency phone, first aid kit and duty first aider and detail the procedures that should be followed in the case of a fire or other emergency.

- Explain the purpose of the session

Give the client a brief outline of the session and its purpose so they can understand the value of the exercises they will be performing. This also gives them the opportunity to air any concerns regarding the upcoming session and provide any last-minute input. If the client should show any concerns or reservations about the coming session, the trainer should acknowledge and address these prior to starting the session.

- Carry out a verbal PAR-Q

Prior to starting exercise, ask the client if, since completing their written PAQ-Q, has anything regarding their health changed i.e. do they have any aches or pains that need to be considered, are they feeling unwell in any way, are they still tired from the previous workout. This information should then be used to modify the workout as necessary and, in the case of illness or injury, may necessitate postposing the session.



Once this pre-amble is complete, it is time to move onto the warm up, main session and cool down.

**Instructional skills**

A successful fitness session hinges on good communication; the best written program in the world will be much less productive if the trainer is unable to instruct effectively. Good instructional skills are essential for ensuring the client develops a sound understanding of exercise techniques and can work toward becoming a self-sufficient exerciser.

The following factors will contribute toward an effective fitness session:

- Clear, concise and technically correct
- Stress positive exercise technique
- Avoid teaching common technique errors
- Be observant and offer appropriate corrections and praise as required
- Adapt teaching and motivational style to suit the client
- Ease back on instructions as form improves to allow exercise independence to develop
- Listen to and act upon feedback gained from the client

As the client becomes more familiar with exercise, the trainer can gradually increase the amount of information they tell the client about the movements being performed.

Where initially the main focus of the session might have been the correct performance of the exercise, as good form becomes less of a conscious effort, the trainer may add new information about muscles and joints, levers, future exercise options and benefits of the exercise being performed.

During performance of exercises, the personal trainer must count, coach and encourage and offer feedback at appropriate junctures. Try to avoid stopping performance of an exercise to deliver information but, instead, give the client modifications/corrections as they perform each exercise. Only stop the performance of an exercise if poor form may lead to injury.

The personal trainer can enhance their instructional skills by using both verbal and non-verbal communication and also identifying their client's dominating learning style and adapting their own teaching style to reflect this.

**Dominant learning styles**

Different people learn in different ways and aligning your teaching style to the client's preferred style of learning can make the process of learning much easier. The three main learning styles are:

- Visual
- Auditory
- Kinaesthetic



While it is unlikely any one style will be used in isolation, the trainer should ensure that an emphasis is placed on the style best suited to the needs and preferences of the client.

**The visual learner**

Visual learners learn best from watching demonstrations, seeing pictures and observing body language. They respond well to hand gestures and eye contact so trainers should ensure they are within view when explaining and/or correcting.

**The auditory learner**

Auditory learners respond best to verbal instructions and information so explanations, cues, and teaching points should be emphasised. Instructors should use vocal tonality, volume and pitch variations to communicate effectively.

**The Kinaesthetic learner**

Kinaesthetic learners learn best by doing and feeling. Explanations should be brief for kinaesthetic learners with the bulk of the explanation describing how/what the client should feel. Physical contact is more important with kinaesthetic learners but should always be justified and not unwarranted.

**Other motivating factors**

Using the dominant learning style will help keep the client motivated but there are other aspects of motivation that need to be considered. Trainer

need to have access to a range of motivational methods so they can match motivational output with their client's needs. Factors to consider include:

- Volume of voice
- Use of visual imagery
- Reinforcing beliefs
- Inverse motivation
- Identifying key performance markers
- Praise

**Volume of voice**

When a workout starts to become more demanding, it is usual for the trainer to raise his or her voice by a similar degree. Likewise, as intensity levels come down, so too should the trainer's voice. Volume should generally be higher when the client needs a real boost in motivational energy. However, not all clients respond to loud voices and some may prefer a more restrained level of motivation. Overuse of a loud voice devalues its impact somewhat so save increasing volume until it is appropriate.



**Use of visual imagery**

Creating images with words can help visual dominant clients get a better idea of what is expected of them. This can be something as simple comparing an exercise to an everyday task and asking the client to picture themselves doing it e.g. "squat down as though you are sitting on a low stool just behind you". Visual imaging can also be used during cardio e.g. "keep going – you can almost see the top of the hill now!"

**Reinforcing beliefs**

When exercise gets difficult, some people may think they just cannot achieve what is being of asked of them. Of course, a good trainer will always push their clients hard but within their current level of ability and reinforcing beliefs by using terms like "you can do it" can help maintain motivation.

**Inverse motivation**

Inverse motivation involves challenging exercisers to work harder than they might otherwise want to. For example by saying "I bet you can't do two more reps!" This form of motivation is only really suitable for more advanced exercisers and those whose motivation won't be derailed if they fail to meet the proposed challenge. Needless to say, perfect form must be maintained!

**Identifying key performance markers**

Monitoring time, weight, repetitions performed and other quantifiable workout measurements can be used for motivational performance i.e. setting bench marks or goals that the client should try and achieve or even surpass.

**Praise**

Genuine, deserved praise can be very motivating however flippant or undeserved praise has no value. Praise should be earned but never withheld if it is deserved.

**Adapting Exercise**

During a workout, a PT must be observant and able to adapt exercise to suit their client's needs. This can be to make an exercise easier OR make it more difficult depending on the client's performance.

Reasons for adjustment include:

**Inability to perform an exercise properly**

Not all clients can do all exercises. If a client is unable to perform an exercise properly, the trainer must regress the exercise so that they can exercise the same body part of muscle group safely and with perfect form.



**Exercise is too intense**

Too much weight, too many reps or too little rest between sets can make an exercise overly intense. While exercise needs to be intense enough to trigger fitness improvements, prescribed intensity should always err on the side of caution to minimise risk of injury.

**Exercise is not intense enough**

Exercise that is not demanding enough will be unproductive. If the exercise being performed is too easy the trainer must adapt the exercise by choosing a more difficult variation or increasing weight, reps, sets or by decreasing reps.

**Client is feeling tired**

If the client is still tired after a previous workout, because of their employment or for any other reason, it may be necessary to adapt the exercise or workout to reflect this.

**Special population requirements**

Exercise may need to be adapted to reflect the needs of a special population group e.g. if the client is under the age of 16, is an older adult, is pregnant etc.

**Size/shape of client**

Size and shape can make some exercises more demanding. Long levered ectomorphs may find exercises like the squat and bench press very difficult whereas very heavy individuals may not be able to safely perform high impact exercises.

**Technical ability**

Some exercises are more technically demanding than others and need to be progressed toward rather than introduced suddenly. Power exercises are a good example of this. Technical mastery of certain basic movements needs to occur before more advanced movements are introduced.

### Monitoring progress

During the workout the trainer should monitor how hard the client is working to ensure progress is being made. Using a training log or diary is essential for doing this. The trainer should record the following information where appropriate:

- Exercises performed
- Weight used
- Rep range or reps performed
- Sets
- Tempo
- Recovery between set
- Heart rate
- Rating of perceived exertion
- Speed/resistance/incline level
- Any deterioration in form
- Notes for adjustment for next session e.g. increase weight, decrease recovery etc.



By recoding and referring to this information, the PT will be able to track progress from one workout to the next and also evaluate the success of the workout. This information can also be used for setting and tracking progress toward goals and for future program design.

**Session conclusion**

Once the main session is over and the cool down is compete, it is time for the instructor to bring the session to a close. This includes reviewing the workout, gaining feedback from the client and giving feedback to the client.

**Getting feedback** on your own performance and how the client felt the workout went is vital for shaping future workouts. Questions to answer include:

- Was the workout enjoyable?
- Was the workout productive and intense enough?
- Was the workout safe?
- Did the workout address the client's goals?
- Was the PT motivating?
- Did the instructional and motivational style match the client's needs?
- Was communication effective?
- Was the client encouraged toward exercise independence?

**Giving feedback** to the client on their performance is also important. Feedback should be positive and focus on what the client did well and not what they didn't manage to achieve. Where appropriate, feedback can include action points for the next workout; "Great work on the squats this week. To get even more from the exercise make sure you really keep your chest up and your knees out. We'll work on that next week".

Once feedback has been asked for and given, both parties should know what they need to do to make the next workout even more productive and enjoyable. All that is left to do now is confirm the time and date of the next workout.

**Personal reflection**

Self-analysis is very useful but not always practical immediately after a workout – especially if your next client is waiting to begin their session. However, at the end of the working day, a personal trainer should take time out to reflect on the workouts that they delivered and how they might improve their personal practice. Personal reflection should not just focus on things that need work but also acknowledge the things the trainer is good at there is no need to be unnecessarily negative or harsh unless it is ruly deserved.

A trainer who asks for and receives feedback and honestly evaluates his or her performance is much more likely to get better and better than one that doesn't practice these things. If a PT wants more clients, to earn more money or otherwise be better at his or her job, personal reflection is essential.



Ultimately, at the end of each and every session, a trainer should be able to think that they did their very best for their client and, if they didn't, they should know what they need to change so that, next time, they can.

**Resistance training exercises – sagittal plane**

Exercise name: Sagittal plane lunge with overhead medicine ball press

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, deltoids, triceps brachii Teaching points: Keep torso upright and brace abs, step forward into lunge and simultaneously press medicine ball overhead, maintain neutral spine and avoid leaning backward. Front shin should be vertical, rear knee just above the floor. Lower the ball back to chest-height as the front leg is recovered. Alternate leading legs.

Alternative options: Use dumbbells instead of a medicine ball, use a single dumbbell to increase lateral instability and increase demand on core.

Exercise name: Sagittal plane squat with cable row

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, erector spinae, latissimus dorsi, posterior deltoids, middle trapezius and rhomboids, biceps brachii

Teaching points: Stand with feet shoulder-width apart and cable handles pulled into lower ribs. Keep your weight on your heels. Break at the hips and squat down while simultaneously extending arms. Stand back up and pull the hands back into the lower ribs. Do not allow weight to shift forward onto toes. Keep chest up and spine neutral throughout.

Alternative options: Exercise can also be performed using an appropriately anchored resistance band.

Exercise name: Sagittal plane single leg medicine ball deadlift

Primary muscles used: Hamstrings, gluteus maximus, erector spinae  Teaching points: Start in a split stance with weight placed predominately on the front leg. Maintain neutral spine and hinge forward from the hips. Extend non-weight bearing leg to the rear for balance. Lower weight down toward the ground without rounding lower back. Stand back up and repeat. Alternative options: If balance is an issue keep rear foot in light contact with the floor. This exercise can also be performed without weight or using dumbbells.

Exercise name: Sagittal plane overhead medicine ball reach

Primary muscles used: Rectus abdominus, erector spinae, hip flexors, deltoids Teaching points: In a staggered stance and neutral spine with slight hip/spine flexion, hold a medicine ball in front of the thighs. Raise the ball up and overhead while leaning slightly backward. Avoid spinal and shoulder hyperextension. Keep the elbows soft. Lower the medicine ball back to the starting positon.

Alternative options: This exercise can be performed without weight or using dumbbells. An alternating rearward stepping action can also be added. Bend the arms to shorten the lever length and reduce the intensity of this exercise.



**Resistance training exercises – frontal plane**

Exercise name: Frontal plane dumbbell lunge

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, adductors Teaching points: Start with feet together and hips square. Step and lunge out to the side. Bend one knee and keep the opposite leg straight. Shift weight and centre of gravity toward bent leg. Lower dumbbells either side of the knee. Keep chest up, arms straight and shoulders back. Maintain neutral spine. Return to the starting positon and repeat.

Alternative options: Perform with an alternating leg action, rest and hold a barbell on your shoulders or discard weights and use bodyweight only as required.

Exercise name: Frontal plane overhead dumbbell lunge

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, adductors Teaching points: With the arms raised above the head, Start with feet together and hips square. Step and lunge out to the side. Bend one knee and keep the opposite leg straight. Shift weight and centre of gravity toward bent leg. Keep chest up, arms straight and shoulders back. Maintain neutral spine. Return to the starting positon and repeat.

Alternative options: Hold dumbbells or a barbell overhead in place of medicine ball, perform using an alternating leg action, discard weights and use bodyweight only as required.

Exercise name: Frontal plane step up

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, adductors and abductors Teaching points: Stand sideways on to a knee-high platform. Place closest foot flat on top of step. Push down through nearside leg and step onto platform. Use opposite leg as little as possible. Keep core tight and maintain neutral spine throughout. Step down to the floor and repeat.

Alternative options: Rest and hold a barbell across the shoulders, hold dumbbells in your hands or perform without weights entirely. Raise or lower the height of the platform as necessary. Travel over the top of the platform and step down on the opposite side to increase technical difficulty.

Exercise name: Single leg stabilityball squat

Primary muscles used: Quadriceps, hamstrings, gluteus maximus

Teaching points: Stand on one leg with stability ball placed between lower back and a smooth wall. Use arms for balance as required. Bend leg and, leaning against the ball for stability, squat down. Do not allow knee to travel beyond the toes. Stand back up and repeat.

Alternative options: Hold a dumbbell in the hands to increase exercise intensity. Use non-working leg for added balance if required.



**Resistance training exercises – transverse plane**

Exercise name: Transverse plane dumbbell lunge

Primary muscles used: Quadriceps, hamstrings, gluteus maximus

Teaching points: Lunge outward to 90 – 135 degrees from start position. Lean forward slightly and lower dumbbells to either side of the leading knee. Do not allow knee to travel forward of the toes. Keep rear leg straight and toes in line with knee. Return to the starting positon and repeat.

Alternative options: The shallower the angle, the less demanding this exercise is. Omit the weights to make exercise less demanding. Raise weights above the head or use a barbell to raise centre of gravity.

Exercise name: Stability ball single arm dumbbell press

Primary muscles used: Pectoralis major, deltoids, triceps brachii, gluteus maximus, hamstrings, obliques

Teaching points: Lie on stability ball with ball behind the shoulders, core braced, hips level with shoulders and shins vertical. Hold a single dumbbell. Press one weight from the shoulder up to full arm extension. Lower weight and repeat. Do not allow hips or shoulders to rotate.

Alternative options: Perform one-arm presses on a bench for increased stability. Use free arm as a counterbalance. Widen feet to increase stability or move them together to increase instability.

Exercise name: Medicine ball press-ups

Primary muscles used: Pectoralis major, deltoids, triceps brachii, core Teaching points: In the press-up position, place one hand on a medicine ball.

Brace core tightly and maintain neutral spine throughout. Bend arms and lower chest toward the floor. Push back up and repeat.

Alternative options: Perform ¾ press-ups (knees on the floor) to lower exercise intensity, place opposite foot on a medicine ball to increase stability demands of the exercise.

Exercise name: Squat with medicine ball reverse wood chop

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, deltoids, obliques, erector spinae

Teaching points: Descend into the bottom of a squat and hold a medicine ball between the knees. Maintain neutral spine and keep shoulders back and down. Stand up and simultaneously raise the medicine ball overhead and over the right shoulder. Lower the medicine ball and return to the starting positon and then repeat to the opposite side.



Alternative options: Perform in a split squat position to increase stability demands of this exercise. Use a dumbbell if medicine ball is not available.

**Resistance training exercises – Power**

Exercise name: Squat jumps

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, gastrocnemius and soleus

Teaching points: With feet shoulder-width apart, push hips back and descend into a ¼-depth squat. Explosively jump upward. Land on slightly bent knees and repeat.

Alternative options: Hold dumbbells in hands or a barbell across the shoulders for added resistance. Jump up onto a raised platform and then step back down to reduce impact.

Exercise name: Split squat jumps

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, gastrocnemius and soleus

Teaching points: In a staggered stance, descend into a ¼-depth lunge and then explosively jump upward. Land on slightly bent knees and repeat.

Alternative options: Alternate leading legs while in mid-air to make this exercise more demanding – see jumping lunges. Hold dumbbells in hands or a barbell across the shoulders for added resistance.

Exercise name: Jumping lunges

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, gastrocnemius and soleus

Teaching points: In a staggered stance, descend into a ¼-depth lunge and then explosively jump upward. Change lead legs while in mid-air and then, on landing, immediately transition into another rep.

Alternative options: Hold dumbbells in hands or a barbell across the shoulders for added resistance.



Exercise name: Frontal plane hop

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, gastrocnemius and soleus

Teaching points: Standing on one leg, descend into a ¼-depth squat and hop laterally and then, on landing, immediately hop back to your starting position. Minimise ground-contact time. Change legs and repeat.

Alternative options: Make this exercise less demanding by performing two- footed jumps rather than hopping. Make it harder by holding dumbbells.

Exercise name: Medicine ball rotational throws

Primary muscles used: Total body especially obliques

Teaching points: Stand with soft knees and in an athletic stance. Holding a medicine ball, rotate away from target (e.g. wall or training partner) and then quickly reverse direction. Release ball. Catch and repeat.

Alternative options: If space allows, on releasing ball, chase after it and then throw again to add a general conditioning effect to this exercise.

Exercise name: Dumbbell push press

Primary muscles used: Total body especially quadriceps, hamstrings, gluteus maximus, deltoids and triceps brachii

Teaching points: In an athletic stance, hold dumbbells at shoulder-level. Descend into a ¼-depth squat and then extend legs explosively. Use momentum to drive weights overhead. Lower weights back to shoulders and repeat. Keep core braced and chest up throughout.

Alternative options: Perform this exercise with a barbell, a single dumbbell or kettlebell or in a split stance.

Exercise name: Plyometric medicine ball press-up

Primary muscles used: Pectoralis major, deltoids, triceps brachii

Teaching points: Adopt the press-up position with a medicine ball directly under the chest. Bend arms and touch chest to the ball. Extend arms explosively and “jump” hands up onto ball. Explosively jump hands out and back down to the floor and repeat. Land as softly on the floor as possible and keep core braced throughout.



Alternative options: Clap hands instead of using medicine ball. Bend legs and rest on knees to reduce exercise intensity.

**Exercises for motor skills**

Exercise name: Two-point box stance

Primary muscles used: Oblique’s, erector spinae, gluteus maximus, deltoids Teaching points: Knee on all fours with shoulders directly over hands and hip over knees. Maintain neutral spine and head alignment. Raise arm and opposite leg while keeping hips and shoulders square. Lower limbs and repeat.

Alternative options: Lift one arm or one leg only to reduce exercise difficulty. Place a stability disc under hand or knee to increase difficulty.

Exercise name: Stability ball twist

Primary muscles used: Oblique’s, erector spinae, gluteus maximus, hamstrings Teaching points: Adopt a bridge positon with shoulders resting on stability ball and shins vertical. Keep core braced. With hands together and held directly above the chest, rotate the upper body through 90-degrees while keeping hips square. Return to centre and repeat. Do not allow the hips to drop.

Alternative options: Use a narrow stance to reduce exercise difficulty or a wider stance to make it easier. Hold a weight in the hands to increase resistance.

Exercise name: Single leg foot touches

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, gastrocnemius, soleus

Teaching points: In an athletic stance and with weight on one leg, squat slightly and extend opposite leg out to the front, side and rear to lightly touch the floor. Distance of travel should be approximately 18-inches. Alternate legs set by set.

Alternative options: Hold a broom handle across the back of the shoulders to make exercise more demanding or use arms for balance to make it less so. Reduce range of movement to reduce balance demands.

Exercise name: Single leg transverse bends

Primary muscles used: Quadriceps, hamstrings, gluteus maximus, gastrocnemius, soleus



Teaching points: Standing on one leg, hinge forward from the hips and reach down to touch the floor with the opposite hand. Reach outside the weight- bearing foot. Alternatively, keep the shoulders squared and extend the non- weight bearing leg across and behind.

Alternative options: Stand on a stability disc to make this exercise more demanding.

Exercise name: Single leg medicine ball wood chop

Primary muscles used: Obliques, deltoids

Teaching points: Stand on one leg and hold a medicine ball in front of the hips. Raise the ball up and above the opposite shoulder. Lower the ball and repeat. Change legs and repeat the exercise to the opposite side.

Alternative options: Perform the exercise faster or slower to change the balance demand. Use a dumbbell if a medicine ball is not available. Perform a single leg squat to increase exercise difficulty.

Exercise name: BOSU squats

Primary muscles used: Quadriceps, hamstrings, gluteus maximus

Teaching points: Stand on flat side BOSU ball and get balanced. Push the hips back and squat down as deeply as balance and flexibility allows. Do not allow knees to travel forward of the toes and try to keep feet, hips and shoulders level. Keep chest up and spine neutral. Look straight ahead. Use arms for balance as required.

Alternative options: Narrow stance to increase balance demands. Hold a weight to increase resistance.

**Core training exercises**

Exercise name: Cable wood chop

Primary muscles used: Oblique's

Teaching points: With feet shoulder-width apart, stand side-on to a cable column with the handle at head-height. Grasp the handle with both hands. Keeping the arms straight, turn the upper body through 180-degrees while keeping torso upright and allowing the hips to move naturally. Return to starting position and repeat.

Alternative options: Add a lateral lunge to make this a full-body exercise. Can be performed using resistance bands instead.



Exercise name: Reverse cable wood chop

Primary muscles used: Oblique's

Teaching points: With feet shoulder-width apart, stand side-on to a cable column with the handle at knee-height. Grasp the handle with both hands. Keeping the arms straight, turn the upper body through 180-degrees while keeping torso upright and allowing the hips to move naturally. Return to starting position and repeat.

Alternative options: Add a lateral lunge to make this a full-body exercise. Can be performed using resistance bands instead.

Exercise name: Cable Russian twist

Primary muscles used: Oblique's

Teaching points: With feet shoulder-width apart, stand side-on to a cable column with the handle at shoulder-height. Grasp the handle with both hands. Keeping the arms straight, turn the upper body through 180-degrees while keeping torso upright and allowing the hips to move naturally. Return to starting position and repeat.

Alternative options: Add a lateral lunge to make this a full-body exercise. Can be performed using resistance bands instead.

Exercise name: Dead bug

Primary muscles used: Rectus abdominus, transverse abdominus, hip flexors Teaching points: In a supine position, bend the knees and hips to 90-degrees and extend arms to vertical. Brace the abdominals and lower one leg and the opposite arm toward the floor. Pause and then return to the starting position. Do not allow the lower back to arch excessively.

Alternative options: Extend the leg to lengthen the lever and make this exercise more demanding. Lower both arms simultaneously or hold a weight in the hands to increase resistance.

Exercise name: Stability ball plank

Primary muscles used: Rectus abdominus, transverse abdominus, hip flexors, shoulder stabilisers



Teaching points: Kneel behind a stability ball place elbows and forearms on the ball. Extend the legs so that weight is supported on arms and toes only. Make sure the feet, hips and shoulders form a straight line. Hold this position (but not the breath) for the desired duration. Do not let the hips drop or lift. Maintain neutral spine and abdominal bracing throughout.

Alternative options: Make this exercise easier by bending the legs and resting on the knees. Make it harder by making small circles with the ball while maintaining plank position.

Exercise name: Prone twister

Primary muscles used: Rectus abdominus, transverse abdominus, gluteus maximus

Teaching points: Adopt the prone position over the stability ball and grasp the sides of the ball with the arms and hands. Extend the legs so that weight is supported on feet and chest/abdomen only. Lean carefully to the side but stop just before balance is compromised. Return to the centre and then lean to the opposite side. Keep legs and core braced throughout.

Alternative options: Place the feet wider apart to make exercise less demanding or closer together to make it more demanding.

**Assisted stretching**

**Important:** Good communication is essential for safe and successful assisted stretching. The trainer MUST get feedback from the client as to how the stretch feels and should ease off the stretch if any unwarranted shaking or pain occurs. As the client relaxes, the trainer should increase the depth of the stretch gradually, smoothly but without going beyond the client's comfort level. Additionally, the trainer should adopt the most comfortable, anatomically correct position to avoid becoming injured.

Exercise: Lying gastrocnemius stretch

How to perform: With client in a supine position, the trainer raises and holds one leg at 45-degrees and, while supporting the leg with one hand, dorsi- flexes the ankle with the other by applying pressure to the ball of the elevated foot. The trainer can also use the length of his forearm as a lever to increase the stretch.

Exercise: Lying hamstring stretch

How to perform: With the client in a supine position, the trainer raises and rests one extended leg on his shoulder and uses his bodyweight to gently push the hip into a flexed position. The trainer should endeavour to maintain neutral spine throughout.



Exercise: Lying gluteus maximus stretch

How to perform: With the client in a supine position, the trainer gently supports and bends one leg and presses the knee toward the chest.

Exercise: Lying gluteus and piriformis stretch

How to perform: Client lie supine with one leg bent 90-degrees at the knee and hip and the opposite leg crossed so the foot rests on the knee. The trainer grasps the knees and pushes the legs gently in toward the chest.

Exercise: Figure-4 stretch

How to perform: Client lies supine with one leg bent, foot flat on the floor, and one leg straight. Arms should be extended outward at shoulder-height and resting on the floor. The trainer applies pressure to the outside of the bent leg and the same side arm and pushes the knee across and down toward the floor while keeping the client's shoulders flat and square.

Exercise: Side lying adductor stretch

How to perform: Client lies on their side with their bottom leg slightly bent and top leg straight. Kneeling behind, the trainer supports and lifts the straight leg into abduction. The hips must remain squared throughout and the trainer must endeavour to maintain neutral spine.

Exercise: Prone quadriceps stretch

How to perform: Client lies in a prone position with their head resting on folded hands and legs together. With their free hand resting on client's posterior superior iliac crest, the trainer presses on the clients shin to take the knee into flexion. Ease the foot closer toward the buttock to increase the stretch

Exercise: Prone rectus femoris stretch

How to perform: As above but lift the flexed knee slightly off the floor to increase hip extension.



Exercise: Side lying quadriceps stretch

How to perform: Client lies on their side with shoulders and hips square and head resting on their outstretched arm. With one hand on the top hip, the trainer supports and bends the leg and pushes the heel toward the buttock. The hip can also be extended and abducted slightly to intensify the stretch.

Exercise: Oblique's and latissimus dorsi stability ball stretch

How to perform: Client lies on their side over a stability ball with arms raised overhead. The trainer stands behind and stabilises the ball with their legs. Placing one hand on the client's hip and one on their extended upper arm, the trainer gently pushes the client's shoulder and hip down and apart.

Exercise: Seated stability ball pectoralis major stretch

How to perform: Client sits comfortably on the floor with arms and shoulders flexed to 90-degrees and back supported by a stability ball. With their knees against the other side of the ball, the trainer reaches over and grasps the client's upper arms and pulls them back into horizontal extension/retraction. The trainer should endeavour to maintain neutral spine throughout.

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