Certificate IV in Fitness - Module 4

CONTENTS

ADDITIONAL RESOURCES

ADDITIONAL READING

Textbook Chapter 1

- Patient information sheet shoulder dislocation
- ACL rehabilitation- getting back in the game
- Athletic Heart Syndrome
- Stress Fractures
- Examples of Synovial Joints
- Eat for Health Educator Guide

WEBSITES

Exercise Prescription on the Net	www.exrx.net
Brian Mac	www.brianmac.co.uk
Eat for Health	www.eatforhealth.gov.au
Health Professionals	www.humanservices.gov.au/health-professionals
Australian Health Practitioner Regulatory Agency	www.ahpra.gov.au

WEB PAGES & SEARCHES

Web search ‘Sports science’

Web search ‘How do muscles work’

Web search ‘ What is the *cardio vascular system*’ (insert any system)

Web search ‘ How does the body use energy’

Web search ‘Aerobic and Anaerobic energy system’

PLEASE NOTE: Handouts can be found at the back of the module following page 98.

OVERVIEW OF THIS MODULE

This module initially addresses exercise science concepts, by discovering more complex anatomy and physiology principles and how they relate to exercise and health. The module then discovers the Eat for Health program; a government imitative to encourage healthy eating to improve well-being and reduce risks of poor health. The following section briefly identifies the dangers of providing advice outside the trainers scope.

Finally this module discusses the importance of the collaboration between medical and allied health professional and fitness professional in developing and conducting exercise programs to clients with specific needs or conditions.

APPLY EXERCISE SCIENCE PRINCIPLES TO EXERCISE

MUSCULOSKELETAL ANATOMY AND EXERCISE PROGRAMMING

Bodily movement is carried out by the interaction of the:

- muscular system
- skeletal system
- articular system

Collectively this is then referred to as the musculo-skeletal system.

HOW DOES IT WORK IN SIMPLE TERMS?

Step 1 - Muscles generate force.

Step 2 - Tendons connect the muscle to the bone and this transfers the force to the bone.

Step 3 – The bones then move if enough force is transmitted to overcome the weight of the moving body part, gravity, and other external resistance.

PRINCIPLES OF BIOMECHANICS

Force

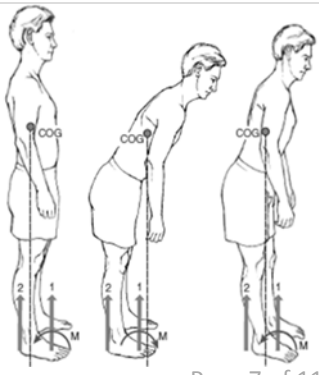
The musculoskeletal system is responsible for generating forces that move the human body in space as well as preventing unwanted motion.

So that you can understand the mechanics of human motion you need to study the forces and movements applied to the body. Force is defined as a "push or pull" that results from physical contact between two objects.

CENTRE OF GRAVITY

The centre of gravity of an object is the point at which all of the weight of that body can be thought to be concentrated, and it depends on a body's shape and mass distribution.

The centre of gravity of the human body in the anatomical position is approximately at the level of the second sacral vertebra.



This location changes as the shape of the body is altered. When a person bends forward his or her centre of gravity shifts anteriorly and inferiorly. The location of the centre of gravity is also affected by body mass distribution changes.

For example, if a person develops more leg muscle mass, the centre of mass would shift inferiorly.

Force production

Force production in the body starts with the nerves stimulating muscles fibres. These fibres contract and place tension on their adjoining connective tissues.

The connective tissues transfer the force to the skeletal system.

The result of the tension depends on the **load** of the muscle. The load is the sum of internal body forces (e.g. the weight of the body parts involved) and external forces (e.g. holding weights) that act against the muscle.

As an example imagine picking up an object. At first, the muscles doing the work contract as the object is lifted. This is concentric action. Then the object is held in a fixed position. Some muscles are still creating tension to counteract the weight of the object but because everything is static, their length does not change. This is isometric action. Finally, the object is lowered back to the ground.

The muscles are still resisting gravity so the object does not just fall to the floor, but the tension is less than gravity. The object is lowered and the muscles lengthen. This is eccentric action.

Exercise and lever systems recap

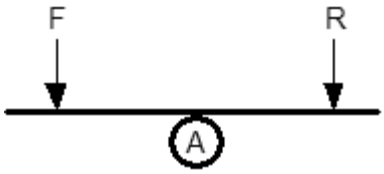
The musculoskeletal system uses the principles of “levers” to move.

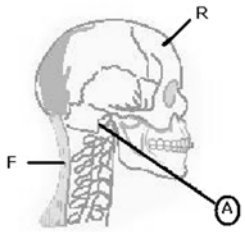
The component parts that are used in a lever are as follows:

- **Lever** - nearly always the bone
- **Fulcrum** - pivot point of the lever, which is usually the joint
- **Muscle Force** - force that draws the opposite ends of the muscles together
- **Resistive Force** - force generated by a factor external to the body (e.g. gravity, friction etc.) that acts against muscle force
- **Torque** - the degree to which a force tends to rotate an object about a specified fulcrum

There are different types of levers dependent upon the position of fulcrum, effort and resistive force.

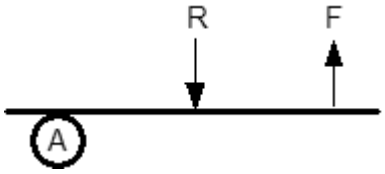
First Class lever

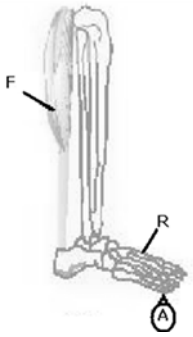




Muscle force and resistive force is on different sides of the fulcrum e.g. the head resting on the vertebral column. As the head is raised, the facial portion of the skull is the resistance, the fulcrum is between the atlas and occipital bone, and the effort is the contraction of the muscles of the back.

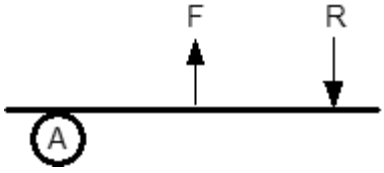
Second Class lever

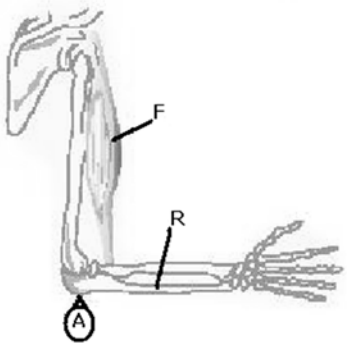




Muscle force and resistive force act on the same side of the fulcrum, with the muscle force acting through the lever longer than that through which the resistive force acts, for example raising the body up onto the toes. The body is the resistance, the ball of the foot is the fulcrum, and the effort is the contraction of the calf muscle.

Third Class lever





Muscle force and resistive force act on the same side of the fulcrum, with the muscle force acting through the lever shorter than that through which the resistive force acts, for example adduction of the thigh. The weight of the thigh is the resistance, the hip joint is the fulcrum, and the contraction of the adductor muscle is the effort.

Most of the limbs of the human body are articulated by third class levers.

Recap of the skeletal system

The Skeletal System provides the following:

- Provides the shape and form for our bodies
- Allows bodily movement
- Protects other organs and tissues
- It produces blood for the body
- It stores minerals

The skeletal system is composed of 206 bones that form the framework for our other soft tissues and organs of the body.

Vital organs are protected by the skeletal system. The brain is protected by the surrounding skull as the heart and lungs are encased by the sternum and rib cage.

Blood cells are produced by the marrow located in some bones. An average of 2.6 million red blood cells are produced each second by the bone marrow to replace those worn out and destroyed by the liver.

Bones serve as a storage area for minerals such as calcium and phosphorus. When an excess is present in the blood, build-up will occur within the bones. When the supply of these minerals within the blood is low, it will be withdrawn from the bones to replenish the supply.

Parts of skeletal system

The human skeleton is divided into two distinct parts:

- Axial Skeleton (white)
- Appendicular Skeleton (grey)

Axial skeleton

The axial skeleton consists of bones that form the axis of the body and support and protect the organs of the head, neck, and trunk.

- Skull
- Sternum
- Ribs
- Vertebral Column

Illustrator: Markus Voll pp. 36-37

Appendicular skeleton

The appendicular skeleton is composed of bones that anchor the appendages to the axial skeleton. These bones are:

- The Upper and Lower Extremities
- The Shoulder Girdle
- The Pelvic Girdle - (the sacrum and coccyx are considered part of the vertebral column)

Illustrator: Markus Voll pp. 36-37

Types of bone

The bones of the body fall into four general categories:

Bone	Description	Example	Picture
Long bones	Longer than they are wide and work as levers are of this type	Humerus, tibia, femur, etc.	

Short bones	Short, cube-shaped	Carpals and tarsals	
Irregular bones	Have varied shapes, sizes, and surface features	Vertebrae and a few in the skull	
Flat bones	Have broad surfaces for protection of organs and attachment of muscles	Ribs, cranial bones, bones of shoulder girdle	
Sesamoid bones	Protects a tendon that passes over a joint	Patella	

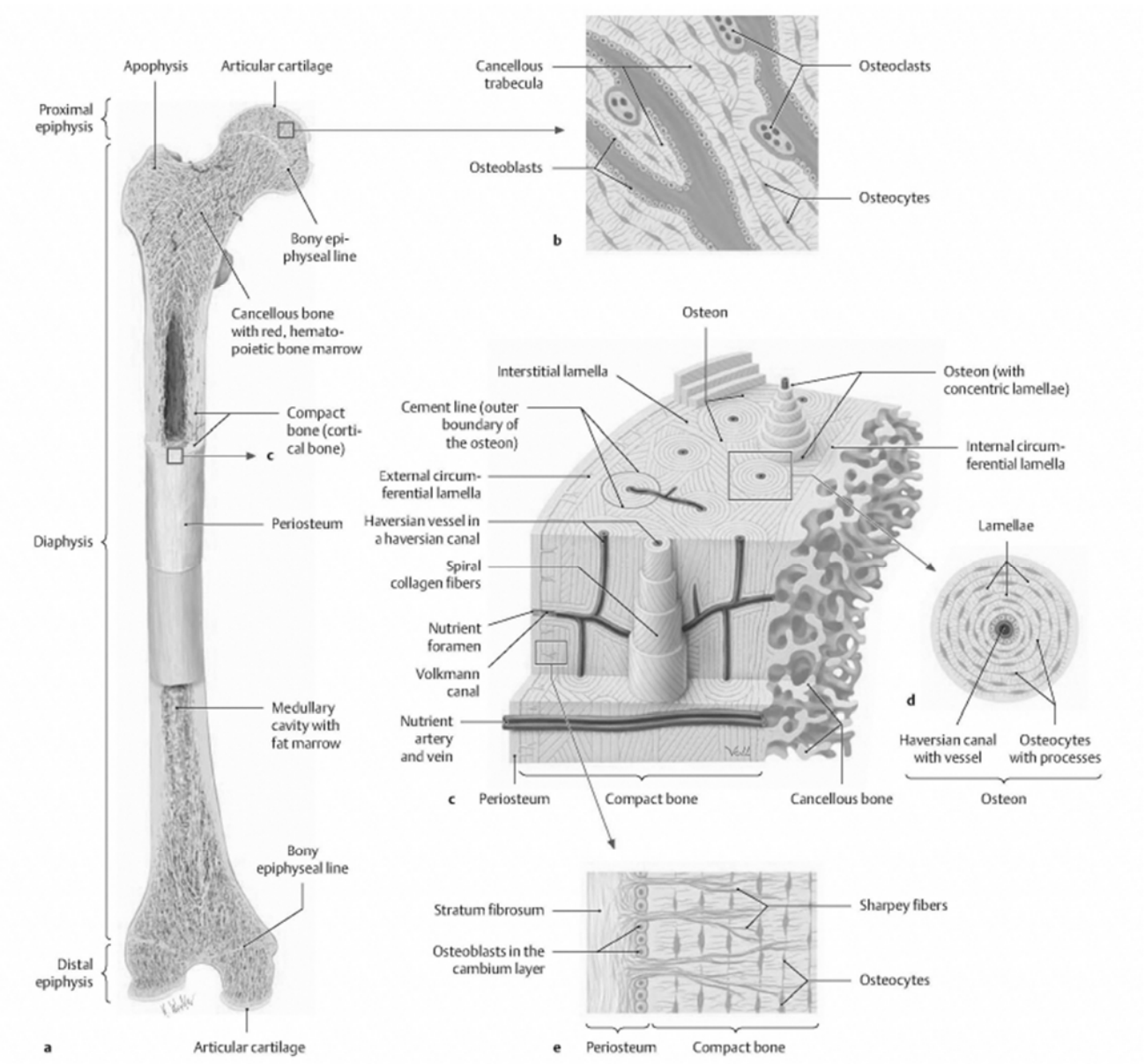
Bone composition

Bones are composed of tissue that may take one of two forms:

1. Compact or dense bone
2. Spongy or cancellous bone

Most bones contain both types. Compact bone is dense, hard, and forms the protective exterior portion of all bones. Spongy bone is inside the compact bone and is very porous (full of tiny holes).

The bone tissue is composed of several types of bone cells embedded in a web of inorganic salts (mostly calcium and phosphorus) to give the bone strength, and collagenous fibres and ground substance to give the bone flexibility.



D Structure of a typical tubular bone, illustrated for the femur

a Coronal saw cuts have been made through the proximal and distal parts of an adult femur.
b Detail from a: The sectioned areas display the lamellar architecture ("lamellar bone") of the cancellous trabeculae.
c Detail from a: Three-dimensional representation of compact bone.
d Detail from c, demonstrating the microstructure of an osteon.
e Detail from c, showing the structure of the periosteum.

Illustrator: Markus Voll pp. 34-35

Bone homeostasis

Bone homeostasis is the maintenance and creation of new healthy bones. Bones will "remodel" themselves. *Remodelling* is the process of creating new bone and removing old bone, thus allowing it to grow and strengthen. It helps redistribute bone tissue to maintain the shape and structure of the bone in response to new stresses applied to it. This process helps increase bone strength while bones are either maturing with age, or repair from an injury.

The process of remodelling involves two cells called:

- **Osteoblasts** – responsible for creating the new bone
- **Osteoclasts** – responsible for breaking down old bone tissue and absorb the tissue back into the body.

These two cells work in conjunction with each other to ensure the bones are in healthy condition. However, conditions like osteoporosis can present themselves if these cells are not working in harmony. This occurs when osteoclasts are breaking down more bone than the osteoblasts are creating causing the density to reduce.

Bones and weight bearing exercise

Exercise is known to increase bone density and health. Activities such as lifting weights stimulate bone formation and retain calcium in the bones that are bearing the load. The force of muscles pulling against bones also stimulates this bone building process.

Research has shown that increases in bone density can be caused by as little as 12 to 20 minutes of weight-bearing exercise performed three days a week.

Research also shows that exercise may help build or maintain bone density at any age.

Impact of ageing on skeletal system

As mentioned earlier, our bones constantly change through the process of absorption and formation.

As we age, the balance between bone absorption and bone formation changes, resulting in a loss of bone tissue. The mineral content of bones decreases, so that bones become less dense and more fragile.

As bones lose mass, osteoporosis develops, affecting both women and men. In the spine, osteoporosis can lead to crush fractures of the vertebrae, resulting in a "dowager's hump". Osteoporosis is also responsible for almost all hip fractures in older men and women.

The chemistry of cartilage, which provides cushioning between bones, changes. With less water content, the cartilage becomes more susceptible to stress. As cartilage degenerates, arthritis can develop.

Ligaments, connective tissues between bones, become less elastic, resulting in a reduction of flexibility.

As research shows, exercise may help build or maintain bone density at any age. Significantly, exercise will have an impact on the skeletal system and how quickly it ages. The ageing of the skeletal system can, in fact, be slowed through regular exercise, especially strength based training.

Skeletal system, injuries & exercise

A bone fracture is a medical condition in which there is a break in the continuity of the bone.

A bone fracture can be the result of high force impact or stress, or trivial injury as a result of certain medical conditions that weaken the bones, such as osteoporosis.

Fractures can be broadly described as either closed (simple) fractures where the skin is intact OR open (compound) fractures where a wound in skin is created due to fracture.

READ	Additional Reading – Stress Fractures

REVISION OF THE ARTICULAR SYSTEM

Bones of the skeleton *articulate* at joints. That is why the series of joints in the body is often called the "articular system".

Joints are described and classified by three qualities:

- The amount of movement permitted by the joint
- The structure of the joint
- The location of the joint

Movement of a Joint

Joints form three categories of movability:

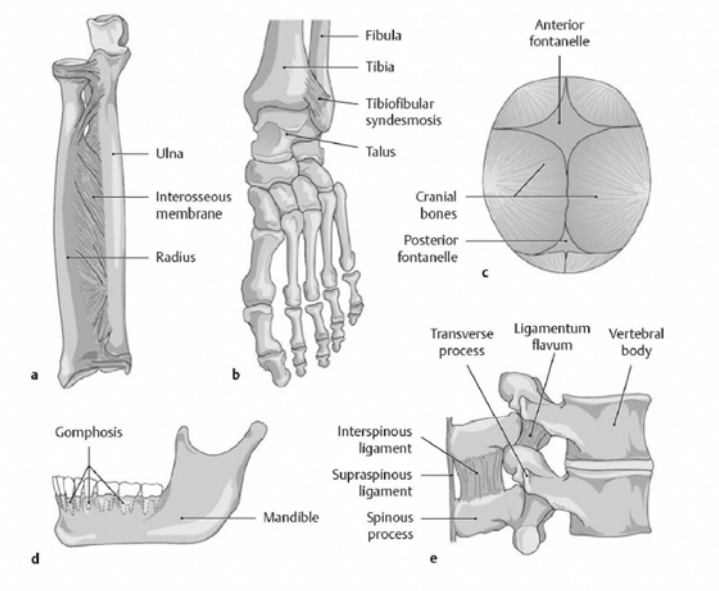
- freely movable (or Synovial)
- slightly movable (or Cartilaginous)
- immovable (or Fibrous)

Structure of a joint

Joints can be formed by different structures. These include:

Fibrous

Composed of dense collagenous or elastic connective tissue, held together by only a ligament. Examples include: teeth, bones of the skull, radioulnar and tibiofibular joints.



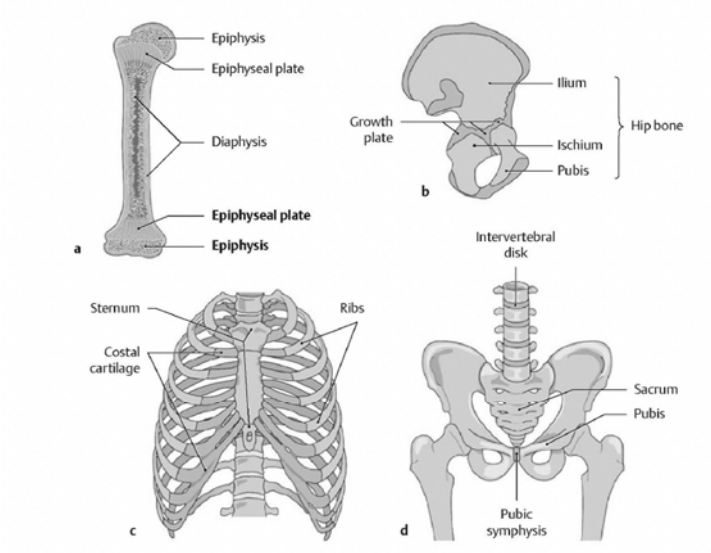
E Syndesmoses (fibrous joints)

a Interosseous membrane.
b Tibiofibular syndesmosis.
c Fontanelles.
d Gomphosis.
e Ligamentum flavum, interspinous ligament and supraspinous ligament.

Illustrator: Markus Voll pp. 36-37

Cartilaginous

Composed of hyaline cartilage or fibrocartilage. Occur where the connection between the articulating bones is made up of cartilage



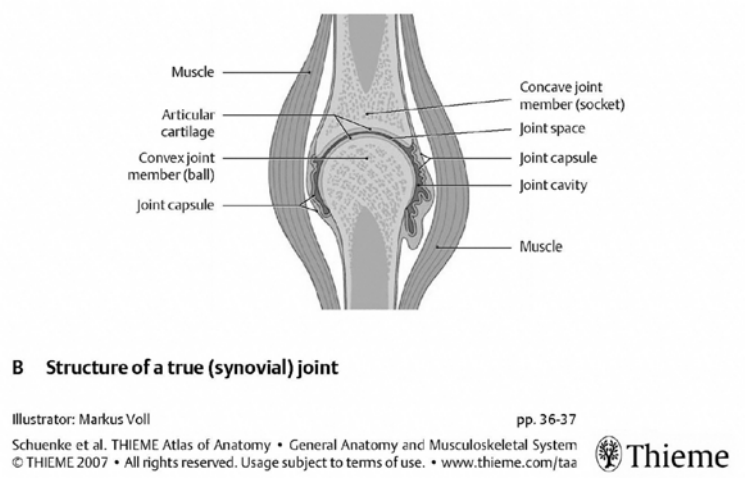
F Synchondroses (cartilaginous joints)

a Epiphyseal plates prior to closure.
b Hip bone before closure of the growth plates.
c Costal cartilage.
d Pubic symphysis and intervertebral disks (intervertebral symphysis).

Illustrator: Markus Voll pp. 36-37

Synovial

Highly moveable joints composed of a collagenous structure and contain a synovial cavity filled with synovial fluid. They have a synovial membrane inside the capsule, which secretes synovial fluid to lubricate the joint. Hyaline cartilage pads the ends of the articulating bones.



B Structure of a true (synovial) joint

Illustrator: Markus Voll pp. 36-37

Schuenke et al. THIEME Atlas of Anatomy • General Anatomy and Musculoskeletal System
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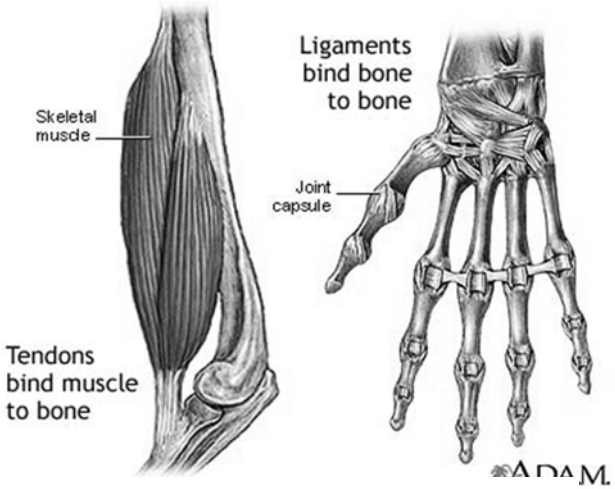
There are 6 types of synovial joints, which are classified by the shape of the joint and the movement available. I.e. hips, knee, shoulder, etc.

READ	Additional Reading – Examples of synovial Joints

Tendons versus ligaments

A tendon is a fibrous connective tissue, which attaches muscle to bone. Tendons have a more uniform structure of collagen fibre, with the fibre direction towards the direction of movement. Ligaments have a less uniform structure with collagen running in all directions.



Tendons may also attach muscles to structures such as the eyeball.

A tendon serves to move the bone or structure.

A ligament is a fibrous connective tissue, which attaches bone to bone, and usually serves to hold structures together and keep them stable.

The impact of ageing on the articular system

Joint motion becomes more restricted and flexibility decreases with age because of changes in tendons and ligaments.

As the cushioning cartilage begins to break down from a lifetime of use, joints become inflamed and arthritic.

Consideration of this decreased flexibility needs to be considered when training older adults. For example, high impact movements may be contraindicated for some clients.

JOINT INJURIES & EXERCISE

Dislocations

Joint dislocation is called a luxation. A subluxation is a partial dislocation.

A subluxation occurs when bones in a joint become displaced or misaligned. It is often caused by a sudden impact on the joint.

Although it is possible for any joint to be dislocated it is most common in shoulders, fingers, and knees.

The ligaments always become damaged as a result of a dislocation so the initial goal of training after a dislocation is strengthening and stabilising the joint again.

A client's physiotherapist or medical practitioner will prescribe light strength exercises to develop early stage strength to the joint.

Your role as personal trainer is to work with this allied health professional to continue this strength training. You may also have to alter normal exercises for future training in order to prevent subsequent dislocations.

READ	Additional Reading – Patient Information Sheet SHOULDER DISLOCATION

JOINT PAIN

Joint pain can be caused by injury affecting any of the ligaments, bursae, or tendons surrounding the joint. Pain is also a feature of joint inflammation or infection.

Injury can also affect the ligaments, cartilage, and bones within the joint. Often the last thing a client with joint pain will want to do is exercise.

However, exercise can be an important part of reducing joint pain.

A common misconception is that exercise will actually aggravate joint pain.

In fact, exercise is beneficial. In order to better protect your joints, the muscles surrounding them should be strengthened and exercise is a good way to do this.

Even simple motions can strengthen joints. There are two basic types of exercises you can recommend:

1. Stretching exercises to help the joint stay flexible and prevent stiffness and deformities.

2. Strengthening exercises to make the muscles, ligaments, and tendons that support the joint stronger and make movement less painful.

Exercise tips for joint pain:

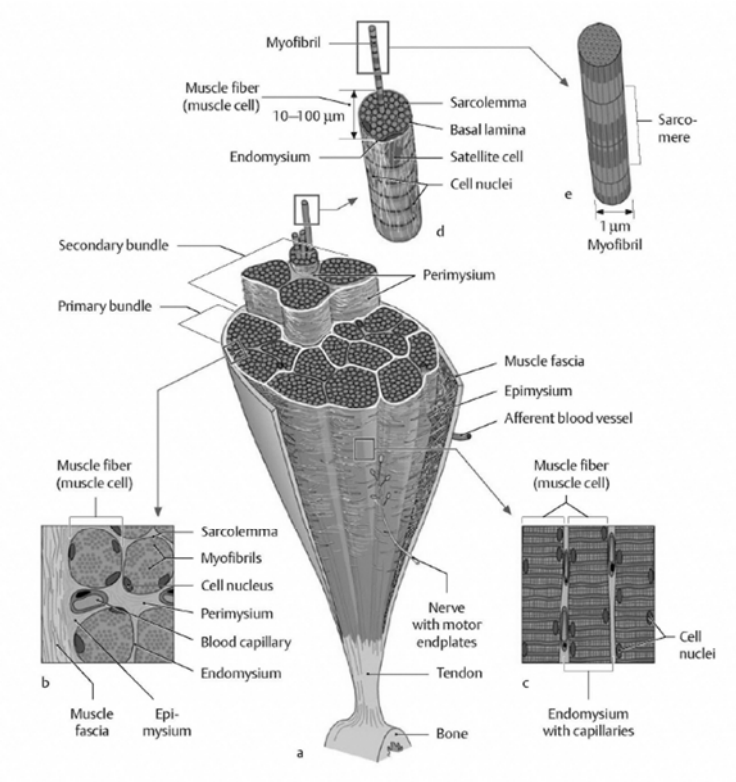
- Do exercises slowly without bouncing or jerking.
- Start with no more than 5 repetitions of each exercise, and take at least 2 weeks to increase to 10 exercises.
- Do the exercises in an order that keeps you from getting up and down a lot.
- Always do the same number of exercises for both sides.

READ	Additional Reading – ACL Rehabilitation: Getting Back in the Game

REVISION OF THE MUSCULAR SYSTEM

The muscular system performs three important functions:

- Motion - walking, running etc.
- Heat production - maintain normal body temperature
- Maintenance of posture - standing, sitting, etc.



D Structure of a skeletal muscle

a Cross section of a skeletal muscle.
b Detail from a (cross section).
c Detail from a (longitudinal section).
d Structure of a muscle fiber (= muscle cell).
e Structure of a myofibril.

Illustrator: Markus Voll pp. 40-41

Schuenke et al. THIEME Atlas of Anatomy • General Anatomy and Musculoskeletal System

Thieme

Structure of a muscle

Muscle fibres are long, thin, tapered cylindrical cells full of the mechanisms required to convert chemical energy into movement.

Fibres are arranged parallel to each other and usually lengthways.

A sheath of collagen surrounds individual fibres. Bundles of fibres and the whole muscle are surrounded by more connective tissue.

Blood vessels, motor neurons (the sort of nerve that innervates muscle fibres) and other nerves wind in between the bundles.

Different skeletal muscles fibres

Skeletal muscle fibres are not alike in structure or function. They can vary by:

- Colour, depending on their content of myoglobin
- Force produced
- Contraction velocity
- Metabolic processes they use to generate ATP
- Onset of fatigue or fatigue resistance (fatigability)
- Stores of glycogen, myoglobin and Phosphocreatine

Skeletal muscles are classified into two main types:

- Type I fibres – Slow Twitch
- Type II fibres – Fast Twitch

Type II fibres are further broken down into two subgroups called Type IIa and IIb (explained in more detail below).

The average person has approximately 60% fast muscle fibre and 40% slow-twitch fibre (type I). There can be differences in fibre composition, but essentially, we all have a total of three types of muscle fibre that need to be trained.

Muscle fibres cannot be converted between slow twitch and fast twitch muscle fibres; an individual is born with a set ratio of slow and fast twitch fibres. Slow twitch fibres cannot be converted into fast twitch fibres and fast twitch fibres cannot be converted into slow twitch, no matter the type of volume of training is performed.

Type I fibres = slow twitch muscles

Also called slow oxidative fibres, these slow muscles fibres are more efficient at using oxygen to generate more fuel (known as ATP) for continuous, extended muscle contractions over a long time. They fire more slowly than fast twitch fibres and can go for a long time before they fatigue. Therefore, slow twitch fibres are great at helping athletes run marathons or bicycle for hours.

Type II fibres = fast twitch fibres

Fast twitch fibres use anaerobic metabolism to create fuel. This means they are much better at generating short bursts of strength or speed than slow muscles, and do not use oxygen to create this energy.

However, Type II muscles fatigue more quickly. Fast twitch fibres generally produce the same amount of force per contraction as slow twitch fibres, but they get their name because they are able to fire more rapidly. Having a great volume of fast twitch fibres can be an asset to a sprinter since they need to quickly generate a lot of force.

Fast twitch fibres can be further categorized into **Type II (A)** and **Type II (B)** fibres:

Type II (a) Fibres (Fast Oxidative) also known as intermediate fast-twitch fibres. They can use both aerobic and anaerobic metabolism almost equally to create energy. In this way, they are a combination of Type I and Type II muscle fibres. These fibres are best found in athletes who play football, hockey, basketball, etc.

Type II (b) Fibres (Fast Glycolytic) use anaerobic metabolism to create energy and are the "classic" fast twitch muscle fibres that excel at producing quick, powerful bursts of speed. This muscle fibre has the highest rate of contraction (rapid firing) of all the muscle fibre types, but it also has a much faster rate of fatigue and can't last as long before it needs rest. These fibres are best found in short distance sprinters.

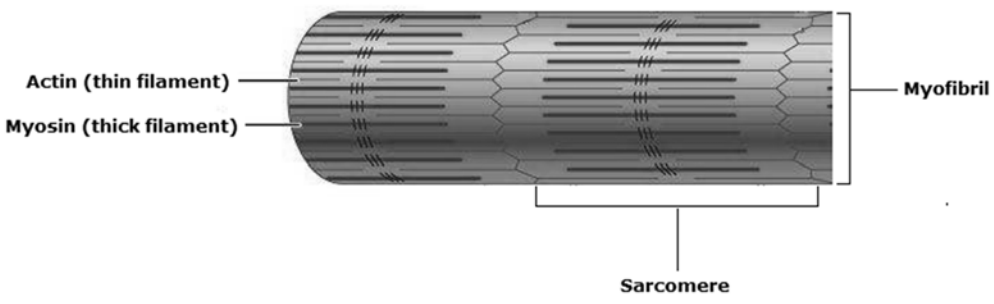
Muscle Fibre Characteristics:

	Slow Twitch Type I	Fast Twitch Type IIa	Fast Twitch Type IIb
Colour	**Red**	**Red – pink**	**White**
Force produced	**Low**	**Intermediate**	**High**
Fatigability	**Low**	**Intermediate**	**High**
Mitochondondrial density	**High**	**Intermediate**	**Low**
Muscle fibre diameter	**Small**	**Intermediate**	**Large**
Myoglobin content	**High**	**Intermediate**	**Low**
Glycogen stores	**Low**	**High**	**High**
Phosphocreatine stores	**Low**	**Intermediate**	**High**

How do muscles contract?

A muscle contracts or shortens through a method called the Sliding Filament Theory. The process involves contractile structures within the muscle fibres called **Actin** and **Myosin**, these are thin and thick filament, which together to create a **sarcomere**. Sarcomeres are arranged parallel with each other and also repeat along the length of a myofibril (muscle fibre).

They work to contract a muscle by joining to form a cross bridge before a power stroke is performed, with the release of energy, to cause them to slide



towards each other. This causes a shortening in the muscles. The phases of a contraction or sliding filament theory are described in more details in the section below.

Sliding Filament Theory:

1. Nerve impulse arrives at the neuromuscular junction (point where the muscles and nerves connect). This stimulates an enzyme called ACETYLCHOLINE to be released, resulting in CALCIUM being released into the sarcoplasmic reticulum (muscle cell membrane).

2. This release of calcium results in the active site being open allowing a CROSS BRIDGE between actin and myosin to form.

3. ATP is broken down to ADP+ Pi producing energy in order to create a power stroke. This power stroke allows the myosin to pull on the actin to shorten the sarcomere, causing a muscle contraction.

4. Once the power stroke has been performed the myosin head detaches itself from the actin. ATP binds to the myosin head.

5. Calcium is removed from the sarcoplasmic reticulum, and the muscle returns to its normal resting state.

Classification of muscular contractions

Isotonic Contraction

Isotonic contraction is where the muscle changes length whilst the muscle in contracting. This occurs in two forms, concentric and eccentric contraction:

Concentric Contraction

A concentric movement is accompanied by a shortening of the muscle, or in other words, the muscle shortens as it contracts. Examples include:

- lifting objects above the head – deltoids shortens
- lifting objects up from lying position – chest muscle shortens
- lifting body up from squat position – quadriceps muscles shorten as legs extend
- doing a sit up – abdominal muscles shorten

Eccentric contraction

In *eccentric* contraction, the force generated is insufficient to overcome the external load on the muscle and the muscle fibres lengthen as they contract. An eccentric contraction is used as a means of decelerating a body part or object, or lowering a load gently rather than letting it drop.

Isometric Contraction

In *isometric* contraction, the muscle remains the same length. An example would be holding an object up without moving it; the muscular force precisely matches the load, and no movement results. Another example would be pushing against a wall.

EFFECT OF EXERCISE ON MUSCULAR PHYSIOLOGY

Various types of exercises can bring about changes in the fibres in a skeletal muscle.

Endurance exercise

Endurance types of exercises, such as running or swimming, cause a gradual transformation of type IIb fibres into type IIa fibres.

In this case the transformed muscle fibres show a slight increase in diameter, mitochondria, blood capillaries, and strength.

Endurance exercises result in cardiovascular and respiratory changes that cause skeletal muscles to receive better supplies of oxygen and carbohydrates but do not contribute to muscle mass.

Strength exercise

On the other hand, exercises that require great strength for short periods, such as weight lifting, produce an increase in the size and strength of type II B fibres.

The increase in size is due to increased synthesis of thin and thick myofilaments. The overall result is that the person develops large muscles.

You can develop your fast-twitch muscle fibres by conducting plyometric exercises to build the fast Type IIa fibres and performing sprinting types of training to build the super-fast Type IIb fibres.

Building muscle size and mass

A common goal of many clients is to increase muscle size, which is done by hypertrophy training.

One-way muscle gets bigger is by a process of damage and repair at the micro-level. Small tears, sometimes called micro-trauma, occur in muscle fibres under load and are repaired and rebuilt stronger when the trainer recovers.

Hypertrophy training usually emphasizes more repetitions with lighter weight than strength training, often with shorter rest intervals between sets. This training enhances factors that result in muscle tissue increases.

Note muscle strength and endurance training is covered in other sections of this course.

EFFECTS OF AGEING ON MUSCULAR SYSTEM

As muscles age, they begin to shrink and lose mass, or atrophy. This is a natural process, but a sedentary lifestyle can accelerate it. Maintaining regular exercise can reduce the speed of this muscle atrophy.

The number and size of muscle fibres also decrease with age and so it takes muscles longer to respond in our 50s than they did in our 20s.

The water content of tendons, the cord-like tissues that attach muscles to bones, decreases as we age. This makes the tissues stiffer and less able to tolerate stress.

Handgrip strength decreases, making it more difficult to accomplish routine activities such as opening a jar or turning a key.

The heart muscle becomes less able to propel large quantities of blood quickly to the body. We tire more quickly and take longer to recover.

THE MAJOR POSTURAL MUSCLES

The muscles that maintain the body's posture and support the body against gravity are called postural muscles or tonic muscles. Other muscles that move the body are called phasic or movement muscles.

Postural muscles include the erector spinae muscles that run down the spine, the hamstrings running down the back of the legs and the chest muscles or pectorals.

Postural muscles, which have great endurance, can support the body for lengthy periods and are hence made up of slow twitch fibres.

However, if they become tight or weak, posture will become distorted over time. On top of that the added stress on the body may result in conditions such as back pain. For example, tight pectorals will tend to pull on the shoulders and round the shoulders and upper back. Upper back pain will result over time.

This means that exercise which includes strengthening and stretching of these major muscles is important for your client's posture.

Note that being flexible in one muscle doesn't mean that you are flexible in another, so you should be aware that stretching all of the major postural muscles will mean that the muscles will loosen, allowing a full range of motion and better overall posture.

B Postural muscles and muscles of movement: characteristics and examples

	Postural muscles (red muscles)	Muscles of movement (white muscles)
Characteristics:	• Phylogenetically older • Predominantly slow-twitch fibers (type 1 fibers, approximately 100 ms) • Function best in endurance • Fatigue slowly • Large motor units • Rich in myoglobin • Abundant mitochondria • Energy derived from oxidative (aerobic) metabolism • Little glycogen (PAS-negative) • Relatively highly vascularized • Prone to shortening (increased resting tonus) and require regular stretching	• Phylogenetically more recent • Predominantly fast-twitch fibers (type 2 fibers, approximately 30 ms) • Brief periods of intense activity • Fatigue more rapidly • Small motor units • Scant myoglobin • Few mitochondria • Energy derived mainly from anaerobic glycolysis • Abundant glycogen (PAS-positive) • Much smaller capillary supply • Prone to atrophy and require regular strengthening
Examples:	Intercostal muscles, masticatory muscles, trapezius (descending part), hamstrings, iliopsoas, adductors, rectus femoris, soleus, erector spinae (mainly the cervical and lumbar part)	Biceps brachii, vastus lateralis and medialis, tibialis anterior, serratus anterior, gluteus maximus, gastrocnemius
Studies have shown that athletes who engage in sports involving intense bursts of muscular activity (e.g., sprinters) have more white (fast-twitch) fibers, while endurance athletes (e.g., marathon runners) have more red (slow-twitch) fibers (Pette and Staron 2001).		

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MUSCLE INJURY AND EXERCISE

Muscle soreness

Muscle soreness can be common with clients – occurring 24 to 72 hours after intense exercise. This is often called Delayed Onset of Muscle Soreness or DOMS.

DOMS causes increases in intracellular pressure that irritates the nerve endings, producing swelling and local pain in muscles.

DOMS can be an indication of potential muscle adaptation to follow. However if it persists or is debilitating then it could indicate over-training or large muscular tissue damage.

An appropriate warm-up and cool-down, may help to avoid or reduce DOMS.

Overtraining

Tired and fatigued muscles do a poor job of protecting their associated connective tissues, increasing the risk of damage to bone, cartilage, tendons and ligaments.

The more a client trains the higher the chances of injury.

Appropriate rest periods or alternating training routines can reduce this risk. Recovery time reduces injury rates by giving muscles and connective tissues an opportunity to restore and repair themselves between workouts.

Weak muscles

Many injuries are caused by weak muscles, which simply are not ready to handle the specific demands of an exercise or sport.

This is why people who start a running program for the first time often do well for a few weeks but then as they add the mileage on, suddenly develop foot or ankle problems, hamstring soreness or perhaps lower back pain.

Solutions could be ensuring resistance training is included in an exercise program to strengthen muscles to meet the needs of an increased training load.

Muscle imbalance

Muscle imbalances consist of two or more muscles that have not developed equally, and usually refer to an imbalance between the same groups of muscles on each side of the body i.e. the trapezius on the right and left side.

These imbalances can be identified visually, view the muscle bulk a visual difference in muscle bulk, or noticeable dysfunction between muscles that work antagonistically or in conjunction as synergists or fixators.

Abnormalities of muscle strength and length can be fundamental to the development of musculoskeletal pain and dysfunction.

Muscle imbalance and strength tests

Strength tests are a good way to measure “weakness” or imbalance in a client's muscular system. Here are some common tests and benchmarks to test:

Leg press/body weight ratio test (one rep max)

Your leg strength/body weight ratio indicates how easily you can get and keep your body moving at high speeds.

This ratio is important to speed improvements in short distances. A good ratio is to be able to press anywhere between 1.8 and 2.2 times your body weight.

Leg strength test

The squat is considered the most functional leg strength test in predicting sprinting and jumping ability. Good 1RM (one rep max) scores are:

Male athletes 2 × "Body Weight"

Female athletes 1.5 × "Body Weight"

Hamstring/Quadriceps strength test

For each leg record the 1RM for the leg curl and leg extension exercises. Divide your leg curl score by the leg curl extension to find the ratio for each leg. For each leg, the curl score should be at least 80% of your extension score.

If the score is less than 80% then you need to devote more training attention to the hamstrings. To reduce the chance of injury the ratio should be at least 75%. If the score is over 100% then you need to devote more training towards your quadriceps.

Bench Press Test

This is a test for upper body strength. The need for maximum upper body strength varies between sports and so it does not always need to be tested for. Good 1RM scores are:

Male athletes 1.25 × "Body Weight"

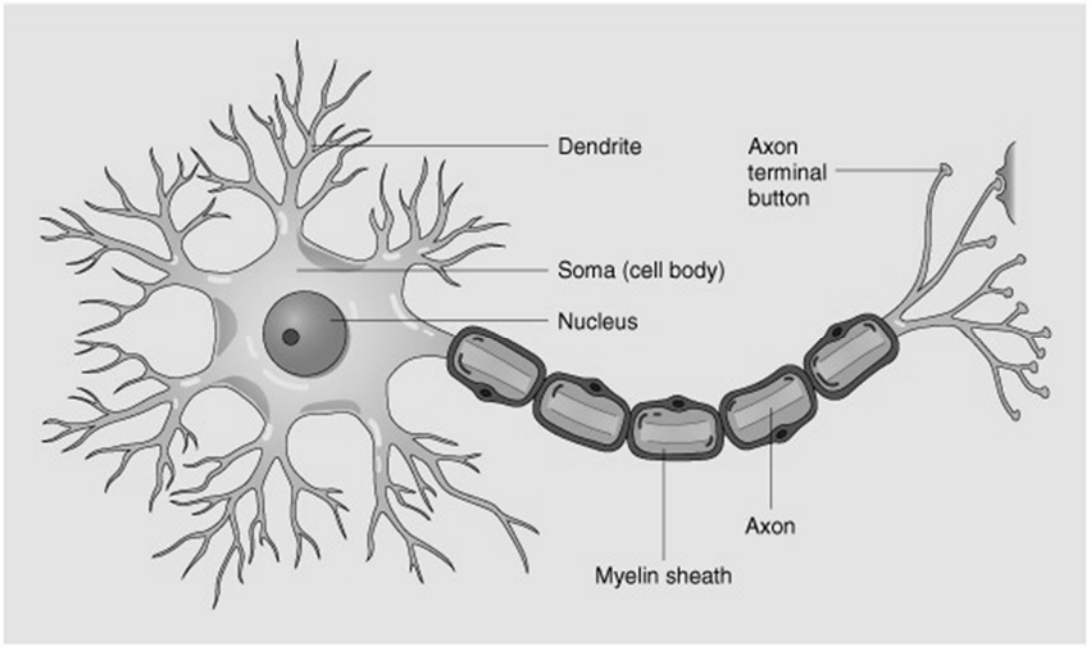
Female athletes 0.8 × "Body Weight"

REVIEW OF THE NERVOUS SYSTEM

The central nervous system controls and regulates human movement through the brain and spinal cord.

The central nervous system transmits information via the nerves in the peripheral nervous system to the skeletal muscle.

Movements can occur either consciously, for example when you exercise, or automatically such as your heart beating.



The nerve cell may be divided on the basis of its structure and function into three main parts:

1. the cell *body*
2. the *dendrites* which receive impulses from other cells and transfer them to the cell body
3. the *axon* which transfers the signal from the cell body to another nerve or to a muscle cell

The reflex arc

Reflexes are automatic, involuntary reactions, which occur as a result of an internal or external stimulus.

Examples include the stretch reflex and inverse stretch reflex.

The stretch reflex is a contracting of the muscle as a direct result of a lengthening in that muscle. The reflex arc consists of:

- ***Receptor*** – receives the signal for the reflex arc to start.
- ***Sensory neuron*** – they are part of the special wiring of the CNS that sends messages from the proprioceptor to the spinal cord.
- ***Association neuron*** – part of the spinal cord that sorts and organises the information ready to be sent back to the skeletal muscle.
- ***Motor neuron*** – the neuron that sends messages from the association neuron back to the skeletal muscle.
- ***Effector*** – the part of the body affected by the reflex, which in this case is skeletal muscle.

Proprioceptors and reflexes

Proprioceptor is a receptor that is involved in movement, posture and locomotion.

Proprioceptors are found in the musculoskeletal system and detect and send messages to the spinal cord about movement and positions and initiate the appropriate reflexes.

Skeletal muscle has its own proprioceptors called muscle spindles. They respond to changes in length and tension within a muscle and are responsible for initiating the stretch reflex.

Within tendons, other proprioceptors are found called Golgi tendon organs near the point where tendon meets muscle. They respond to tension when the muscle shortens or stretches passively and are responsible for initiating the inverse stretch reflex.

Proprioception is the sense of the orientation of one's limbs in space. It is the body's ability to sense where it is relative to other objects and is vital for stability and balance. Without proprioception, we'd need to consciously watch our feet to make sure that we stayed upright while walking.

Proprioception doesn't come from any specific organ, but from the nervous system as a whole. Its input comes from sensory receptors distinct from tactile receptors, that is nerves from inside the body rather than on the surface. Proprioceptive ability can be trained, as can any motor activity.

Stability training equipment such as the balance dome can be used to mimic an unstable situation, which helps to build up the muscles to the desired level. Sometimes these types of exercises are referred to as proprioception exercises.

Sensory receptors and exercise

The stretch reflex occurs if a muscle is being stretched too quickly and the muscle spindle tells the muscle to contract.

When postural muscles are disrupted, they are corrected as the nervous system conveys information that they are out of position. They work constantly to counter the force of gravity on our bodies in an upright position.

The inverse stretch reflex occurs in response to excessive tension in a muscle. The Golgi tendon tells the CNS to relax the muscle involved. It performs as a protective mechanism, which prevents the body from bearing extreme loads that may lead to injury. Proprioceptive neuromuscular facilitation (PNF) stretching involves a static stretch followed by an isometric contraction of the same muscles against a resistance.

Nerve cells and muscle cells are excitable. Their cell membrane can produce electrochemical impulses and conduct them along the membrane. In muscle cells, this results in a contraction of the cells, which leads to contraction of the muscle.

Nervous system and exercise

Like other systems of the body, training will improve the functioning of the nervous system.

When you are training sports people and/or clients who play sport, be aware that good coordination and reaction time can be vital to them. The quicker the reactions, the more chance the individual has of having "the edge" over the opposition.

When training after injury, remember that often after an injury the nerve pathways to the injured area and muscles are weakened just like the muscles. For that reason the nervous system pathway should be retrained.

When training older adults keep in mind that the nervous system is adversely affected by age. As we grow older neurons are lost and not replaced. There is also a decreased capacity for transmitting impulses to and from the brain and both voluntary and reflex actions become slower. Training can therefore maintain a healthier nervous system and response.

REVISION OF THE CARDIOVASCULAR SYSTEM

The cardiovascular system comprises the:

- heart
- blood
- blood vessels
- lymphatic system

The heart

The heart is an organ that pumps blood around the body. It is a hollow, muscular organ divided into four chambers, the left and right atrium and left and right ventricles.

The atrium, consisting of the two top chambers, has a thinner muscular wall that received blood from the body (right atrium) and the lungs (left atrium). The ventricle consists of the bottom two chambers, where the muscle walls are much thicker due to their role in pumping blood to the lungs (right ventricle) and around the body (left ventricle).

The left and right chambers are separated by the septum. The top (atrium) and bottom (ventricle) chambers are separated by valves, which are also involved in preventing the backward flow of the blood.

The roles of each chamber is described below:

Right Atrium – The right atrium received the deoxygenated blood from the rest of the body through a main vein called the vena cava (the biggest vein). This chamber then pumps the blood through the tricuspid valve into the left ventricle.

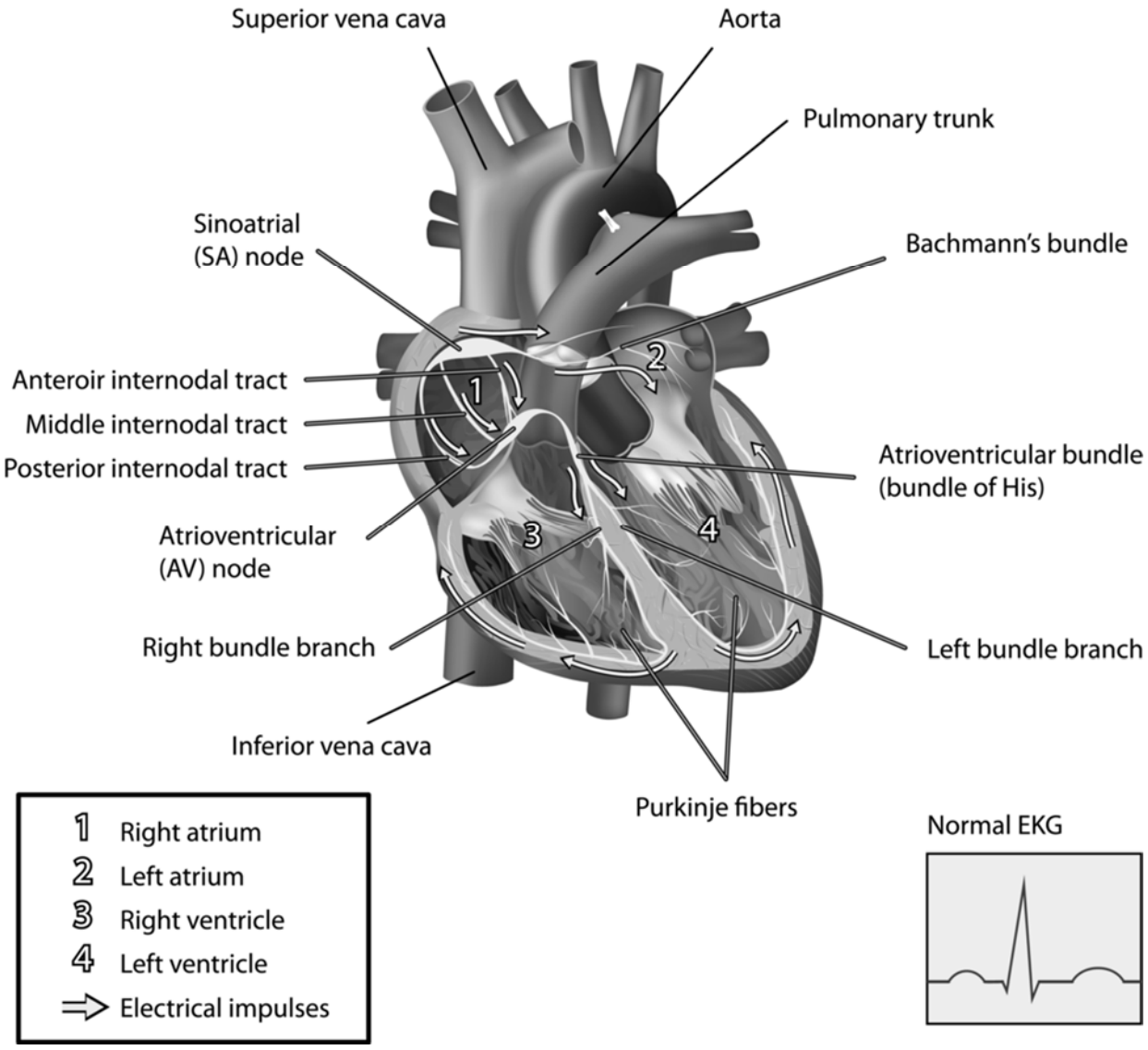
Right Ventricle – Blood arrives in the right ventricle from the right atrium. Once here, it is pumped through the pulmonary semilunar valve along the pulmonary artery towards the lungs to

become oxygenated. (The pulmonary artery, is the only artery in the body that transports deoxygenated blood)

Left Atrium – After picking up oxygen at the lungs, blood then arrives into the left atrium via the pulmonary vein (The pulmonary vein is the only vein in the body that transports oxygenated blood). From here, the blood is pumped through the bicuspid valve into the left ventricle.

Left Ventricle – The left ventricle is the chamber with the thickest myocardium layer, as it is required to pump the oxygenated blood out the heart through the aortic semilunar valve into the aorta (the biggest artery) and then to the rest of the body. The body reaches target cells where oxygen is dropped off and carbon dioxide picked up, and then returned to the right atrium through the vena cava for another cycle to occur.

The following image shows the components of the heart and the location of the chambers, the septum and the valves.



Blood vessels leaving the heart carry oxygenated blood through vessels known as arteries. These are large, hollow elastic tubes with thick muscular walls that are designed to withstand the high pressure with the blood leaving the heart. Their size gradually diminishes as they spread throughout the body, ultimately reaching fine, hair-like vessels known as capillaries.

Blood vessels that return blood to the heart are known as veins, which carry de-oxygenated blood to the heart.

They are elastic tubes containing valves to help prevent back flow of blood.

Blood is forced through arteries by the pressure from the heart, while venous flow is pushed through with the help of muscular contraction.

The only two exceptions to the above are the pulmonary artery, which carries de-oxygenated blood from the heart to the lungs, and the pulmonary vein, which carries oxygenated blood from the lungs to the heart.

Blood

The fluid that surrounds tissue cells throughout the body is called interstitial fluid and is serviced by blood transporting oxygen and nutrients to it while lymph removes toxins and waste products.

Blood forms about 79% of the body weight consisting of plasma, corpuscles and platelets. Erythrocytes (red blood cells) transport oxygen and carbon dioxide, leucocytes (white blood cells), produced in red bone marrow (myeloid tissue), and lymphocytes fight infection and thrombocytes (platelets) are essential to blood clotting at the site of an injury.

Plasma is a clear slightly alkaline yellow fluid in which blood; proteins, salts, waste materials, gases, enzymes, hormones and vitamins are dissolved.

The functions of blood are as follows:

Transports

- oxygen from the lungs to the cells
- carbon dioxide from the cells to the lungs
- nutrients from the intestines to the cells
- waste material from the cells
- hormones from the endocrine glands to the cells
- heat from various cells

Regulates

- pH (concentration of hydronium ions)
- body temperature
- salts
- water content in the cells

Protects

- Blood prevents loss by clotting and combats toxins

LYMPHATIC SYSTEM

The lymphatic system is the protective system that picks up materials, cleanses them of waste products and toxins, and returns them to the blood. Although it is described as a separate system, it is really part of the vascular system, being intertwined with the blood circulation.

CARDIOVASCULAR SYSTEM AND EXERCISE

Cardiac output is the quantity of blood pumped from the heart into the aorta each minute. As an example, the average cardiac output for normal young males is about 5.6 litre per minute.

When a person exercises, the cardiac output rises. Cardiac output is proportional to the metabolic body rate; the more active the muscles and organs are, the greater the cardiac output will be.

For example - the cardiac output can rise as high as 30-35 litre per minute in a well-trained athlete during intense exercise. This is 5-6 times the normal value.

The cardiac output increases because during exercise the body's tissues need far beyond the normal amount of oxygen and other nutrients that blood transports to them.

As your body starts to exercise:

- Before exercise your autonomic nervous system is stimulated by the thought of exercise and starts increasing your cardiac output.
- Blood vessels of the muscles become dilated; this instantaneously increases the cardiac output.
- The increased metabolism in the muscles causes an increased use of oxygen and other nutrients as well as the release of vasodilating substances.

The local vasodilation (an increase in the size of blood vessels) in the muscles occurs as a direct consequence of muscular activity and so the muscles determine the amount of increase in cardiac output, up to the limit of the heart's ability to respond.

Effect of exercise on the cardiovascular system

The heart is a muscle, like any other, meaning it can be strengthened or weakened through exercise and activity.

Like any muscle, when there is an increase in activity and usage, there is an increase in size or musculature enlargement. Heavy athletic training causes the heart to enlarge, sometimes as much as 50%.

In addition, the effects of regular exercise on the vascular system include:

- ☐ **Lower blood pressure** - The supply of blood vessels to the heart will increase causing a lower blood pressure and improving the function of the heart.
- ☐ **Lower cholesterol** – Exercise stimulates enzymes that help move LDL from the blood to the liver. There, it is converted into bile or excreted resulting in a reduced risk of arteries clogging and possible heart disease.
- ☐ **Cardiovascular 'fitness'** - The period needed for the heart rate to return to resting after exercise is reduced.
- ☐ **Better blood flow** - The network of capillaries in a muscle will increase and thus increase the supply of blood, oxygen and nutrients to the working muscles.

READ	Additional Reading – Athletic Heart Syndrome

REVISION OF THE RESPIRATORY SYSTEM

Components of the respiratory system include:

- Nose
- Mouth
- Throat
- Larynx
- Trachea
- Bronchi
- Lungs

The respiratory system is made up of all the organs and tissues through which air is passed into and out of the body.

External respiration is where oxygen from the air passes into the blood stream to be carried to the tissue cells and carbon dioxide is collected and transferred back to the lungs and expelled from the body.

Internal respiration involves the vital chemical activities that take place in every cell requiring oxygen and glycogen to combine and release energy, water and carbon dioxide.

The normal rate of inspiration and expiration is about 16 times a minute in an adult.

Respiration at rest and during exercise

The lungs can be expanded and contracted by downward and upward movement of the diaphragm. This lengthens or shortens the chest cavity.

During normal inspiration, respiration takes place simply by contraction of the diaphragm, which pulls or lengthens the lungs. Usually, expiration is an entirely passive process

However, during exercise a greater demand is placed upon the mechanical structures of respiration because the body requires more oxygen during exercise more muscles begin helping in the breathing process. For example, during inspiration, not only does the diaphragm contract, but muscles from the chest, neck and spine also contract to aid in the process. Expiration is no longer passive; it is aided by contractions from the abdominal muscles as well as from the lower rib muscles.

This means, of course, that if these supporting muscles are not strong and capable of functioning efficiently the body will not be able to efficiently get the oxygen it needs during exercise.

Diffusing Capacity and Exercise

During respiration, oxygen is taken into the lungs from the atmosphere. In the lungs oxygen is exchanged with CO2 (waste product from cell metabolism) from the bloodstream.

The ability of the lungs to exchange these gases is expressed in terms of its diffusing capacity.

Under resting conditions, a person diffuses about 21 millilitres of oxygen per minute. However, during strenuous exercise, the diffusing capacity for oxygen increases up to three times this amount.

In order for this to happen, more blood vessels must become available, there must be an expansion of all blood vessels and the lungs' surface must stretch. Therefore:

→ **More exercise**

→ **Increases use of respiration**

→ **Making diffusing capacity more efficient**

ENERGY SYSTEM OF THE BODY

How energy is produced

Energy is produced from the nutrients we eat, including carbohydrates, protein, and fats. These nutrients get converted to energy in the form of adenosine triphosphate or ATP, the energy compound muscle can utilise.

It is the energy released by the breakdown of ATP that allows muscle cells to contract. However, each nutrient has unique properties that determine how it gets converted to ATP. Carbohydrates are the main nutrient that fuels exercise of a moderate to high intensity. It is more efficient than fat metabolism, but has limited energy stores. Carbohydrates are stored in the body as glycogen and can fuel about 2 hours of moderate to high-level exercise.

Fat can fuel low intensity exercise for long periods of time. Fat provides the highest concentration of energy of all the nutrients. One gram of fat equals nine calories. While these calories are less accessible to athletes performing quick, intense efforts like sprinting or weight lifting, fat is

essential for longer, slower, lower intensity and endurance exercise such as easy cycling and walking.

Proteins are generally used to maintain and repair body tissues, and are not normally used to power activity. However they are used to produce energy as a last resort when there is not enough glucose or fat to metabolise, but it is somewhat wasteful of these very specialised and important compounds.

When energy is needed, ATP is broken down using an enzyme known as ATPase into ADP (Adenosine Diphosphate). This process breaks the high-energy phosphate (P) bond in order to provide energy for the body. This can be represented as:

ATP = ADP + P +Energy

Energy systems

The two energy systems within our body are termed as aerobic and anaerobic.

Aerobic, meaning 'with oxygen' is used for long-term, steady paced exercise and day-to-day activities.

Anaerobic or 'without oxygen' produces fast bursts of energy for short, powerful bursts. The anaerobic system can be divided into two further systems:

1. **ATP-PC System**

2. **Anaerobic Glycolysis (Lactic acid system)**

Both energy systems work together, but the intensity and type of activity will determine which system is predominant.

For example, at the start of exercise the body cannot deliver oxygen to the muscles fast enough to initiate the complex chemical reactions, which occur during aerobic metabolism. Therefore, the body relies on anaerobic processes for the first couple of minutes.

Anaerobic energy system

The anaerobic energy system provides energy with no oxygen. This is used in the first few minutes of all exercise, before there is sufficient oxygen available at the muscles for aerobic metabolism.

It is also used for fast, powerful bursts of energy, for which the aerobic system is insufficient.

There are two systems within anaerobic metabolism:

ATP-PC System is where ATP is manufactured when phosphocreatine (PC) is broken down. This system represents the most rapidly available source of ATP for use by the muscle. We only have 120g of creatine within our bodies and so this energy system only last a maximum of 10 seconds.

Anaerobic Glycolysis or Lactic Acid System is where ATP is manufactured when glucose is broken down to lactic acid without the presence of oxygen. Due to lactic acid production, this energy system can only be predominant for up to 2 minutes.

Aerobic energy system

The aerobic system produces the largest amounts of energy, although at the lowest intensity. The aerobic system can be broken down into the following sections:

Glycolysis - Glycolysis is the breakdown of carbohydrates in the form of glucose or glycogen into pyruvic acid. This results in the production of two ATP molecules.

Krebs Cycle - Sometimes known as the Citric Acid cycle, is the second phase in the process of aerobic metabolism. The pyruvic acid produced during Glycolysis enters the mitochondria and is immediately converted to Acetyl Coenzyme A, which combines with oxaloacetic acid to form citric acid.

Electron Transport Chain - Hydrogen produced in the above cycle is transported into the inner membranes of the Mitochondria where it is split into 2 electrons. The electrons are then subject to a series of reactions, which release a large amount of energy in order to resynthesise ATP.

Energy system & exercise

It is usually believed that one energy system is working at one time, however this is untrue. From very short, very intense exercise, to very light, prolonged activity; most of the energy systems make a contribution. However there are some activities, which only utilise 2 out of the 3 systems.

The two factors that influence the main energy system being used are ***intensity*** and ***duration*** of exercise. As you can see in the list of popular sports, each sport is generally played at different intensities and duration indication the contrasting uses of each system.

Sport	ATP-PCr & Glycolysis	Glycolysis & Oxidative	Oxidative
Basketball	60	20	20
Field Events	90	10	0
Golf Swing	95	5	0
Gymnastics	80	15	5
Hockey	50	20	30
Rowing	20	30	50
Distance Running	10	20	70
Skiing	33	33	33
Soccer	50	20	30
Tennis	70	20	10

The goal that many clients seek from exercise is to lose weight. The best way to help your client achieve this goal is by staying within their 'fat burning' zone. Because long lasting, low intensity exercise relies on fatty acids to provide energy, and then it would be wise to advise your clients towards this form of program, but is this the most *effective* way to help them lose weight?

The chart below details the fat calories expended by a 70-kilogram woman during cardio exercise:

	Low Intensity – 60-65% MHR	High Intensity – 80-85% MHR
Total Calories expended per min	4.86	6.86
Fat Calories expended per min	2.43	2.7
Total Calories expended in 30 min	146	206
Total Fat calories expended in 30 min	73	82
Percentage of fat calories burned	50%	39.85%

In previous parts of the course we learned that weight loss is about overall calorie consumption and use.

In this example, the woman burned more total calories and more fat calories at a higher intensity. This means that low intensity training is not necessarily always the best way to burn calories and lose weight.

PHYSIOLOGICAL RESPONSE AND ADAPTATION TO EXERCISE

Physiological response

A physiological response is a temporary change in the body's physiological status that occurs during exercise. The physiological response to exercise is dependent on the intensity, duration and frequency of the exercise as well as the environmental conditions.

As we have seen from previous sections, exercise induces responses in our body including:

- A rise in heart rate
- A rise in heart rate (increases the blood circulation delivering more nutrients to the bodies tissues)
- An increase in cardiac output (muscles require more oxygen and glycogen, therefore the heart increase to achieve this demand)
- An increase in the rate of respiration (body requires more oxygen and needs to expel carbon dioxide, therefore respiration rate increases to do this)
- Increase in body temperature (due to increase metabolism heat = by product)

Physiological adaptation

After frequent training, the body starts to cope with the training load and responds more efficiently.

Central adaptations occur in the primary or 'target' body system being trained, whereas peripheral adaptations occur as a by-product of this training.

As we have seen in different sections of this course, fitness testing is a way of measuring your clients' various fitness components. This includes their adaptation to their ongoing training programs.

Some of the specific physiological adaptations and the reasons behind these adaptations are detailed in the table below:

Physiological adaptation	Reason behind adaptation
Increase heart size, specifically the muscle tissue around the left ventricle	Enable the heart to pump greater volumes of blood in each pump
Increase blood vessels around muscles	For the body to provide more blood carrying nutrients and oxygen to the muscles
Increase blood vessels around alveoli	Increase the body's ability to exchange gases
Increase red blood cells	Increase the body's capacity to carry oxygen and carbon dioxide
Increase muscle myofibril cross-sectional size.	Enable the muscles to perform greater force
Volume of mitochondria increases	Enable the body to create more ATP
Myoglobin stores increases	Increase the ability of the liver and muscles to store substrates used in metabolism
Improved synchronisation of motor units	Enable the body to perform a more forceful contraction

ENVIRONMENTAL CONDITIONS

The environmental condition in which a client trains will impact on their ***physiological responses*** to physical activity.

Exercising in the heat

The ability to perform vigorous exercise for long periods is limited by hyperthermia (over heating) and loss of water and salt in sweating.

As a personal trainer, you should be aware of the hazards of vigorous exercise in hot, humid conditions and understand that heat injuries can occur especially heat exhaustion. Heat Exhaustion can result due to two reasons:

- **Water depletion:**
    - Signs excessive thirst, weakness, headaches and loss of consciousness
- **Salt depletion**
    - Signs nausea and vomiting, frequent muscle cramps and dizziness.

As discussed earlier the he circulatory system functions to deliver nutrients throughout the body, as well as to regulate the temperature of the body. The later, is achieved via the transfer of heat from active muscles to the body's surface through the blood. Therefore, in a hot environment the body adapts by expanding the blood vessels near the skin, this is called vasodilation. This results in more heat being able to dissipate through the skin surface (this is often seen when the skin has a red appearance).

The circulation systems dual role of providing nutrients and heat regulation can have a negative affect on performance. Blood that is being transported to the skins surface to release heat from the body, is not providing muscles with the nutrients they need.

As a result of this, the muscles are being provided less nutrients to convert into energy, consequently muscles produce less energy and perform at a reduced level

At this stage, overheating a heat exhaustion can become a serious problem, so trainers must understand

Exercising in the cold

When the body is cold our cardiovascular system automatically tries to protect our internal organs by increasing blood pressure and heart rate, and reducing the amount of blood closest to the skin surface. This is called vasoconstriction and is where the blood vessels closest to the skin reduce their size, therefore reducing the amount of blood that travels through them.

Another affect of exercising in the cold can be the airway passages of the cardiorespiratory system narrow making the inhalation of air more difficult. This is an important factor to consider when exercising with individual who are susceptible to asthma or exercise-induced bronchitis have greater difficulty breathing in cold air.

Interestingly, exercising in a cold climate results in approximately five times more glucose being used up, this is due to extra energy being used to heat the body as well as for exercise. As a result of this the body switches to the conversion of body fat to create ATP for its energy requirements.

In addition to the effect of cold weather upon the body systems, cold weather creates unique injury hazards. Hypothermia and frostbite are the two chief cold weather injuries.

Exercising in water

Aquatic training, or training in water, provides an exercise modality for fitness and rehabilitation. The properties of water provide support, resistance and assistance in a training program.

An aquatic training program can decrease compression, vibration and torsional forces that occur when training on land. The properties of water influence the body during exercise and at rest.

For example, the buoyancy effect of being in water lets participants experience a partial floating feeling when they enter the pool. When a person is in water, the water will naturally want to push the person up, this is particularly valuable for a person who does not want to place their whole body weight on an affected joint or body part.

THE EAT FOR HEALTH PROGRAM

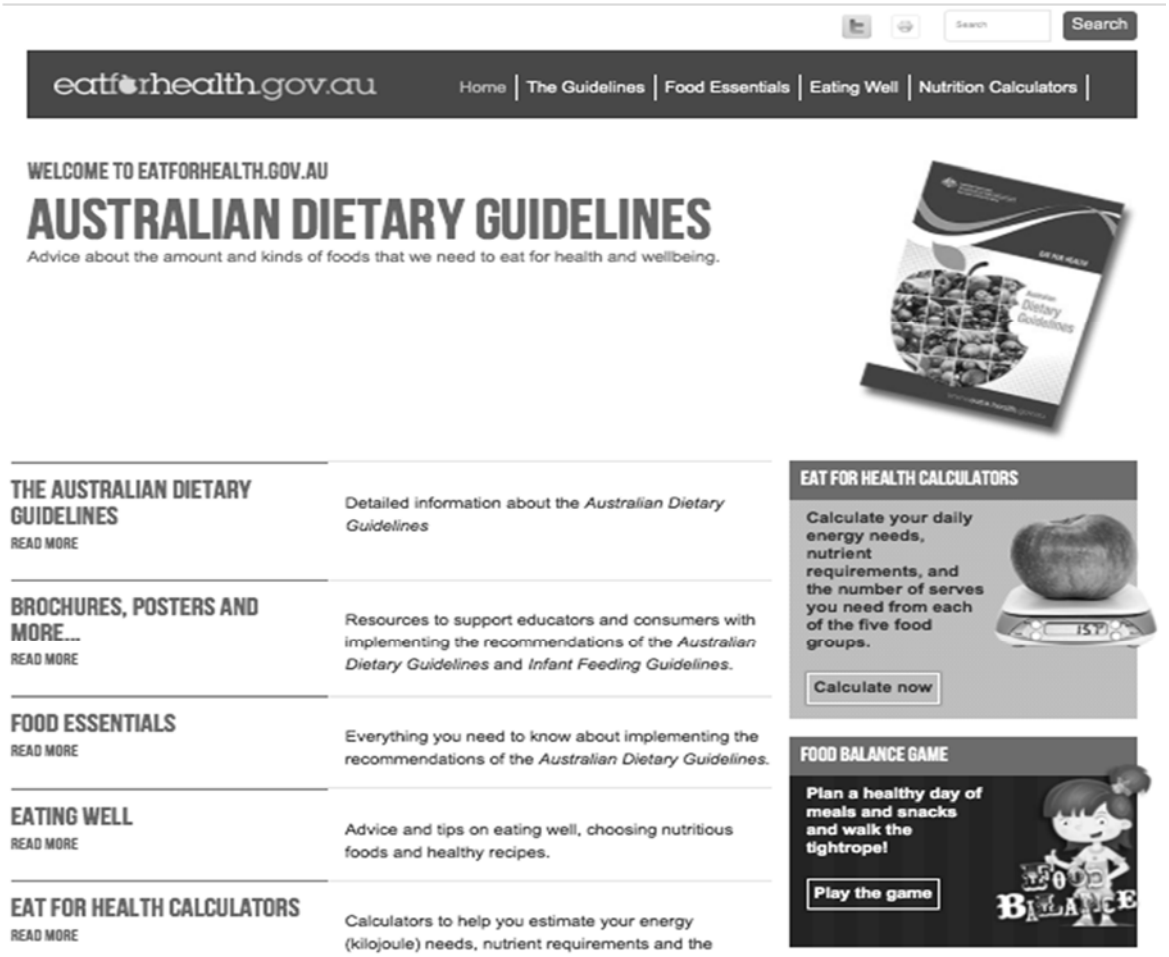
OVERVIEW OF THE EAT FOR HEALTH PROGRAM

The government has produced a healthy eating initiative called the 'Eat for Health' program, which aims to educated and stimulate a change from unhealthy to healthy eating patterns and habits. This program aims to:

- promote health and wellbeing
- reduce the risk of diet related health conditions
- reduce the risk of chronic conditions

The Program contains an *Educator Guide* and incorporates the *Australian Nutritional Guide* as well as other resources that compliment the Program – these can be found on the website:

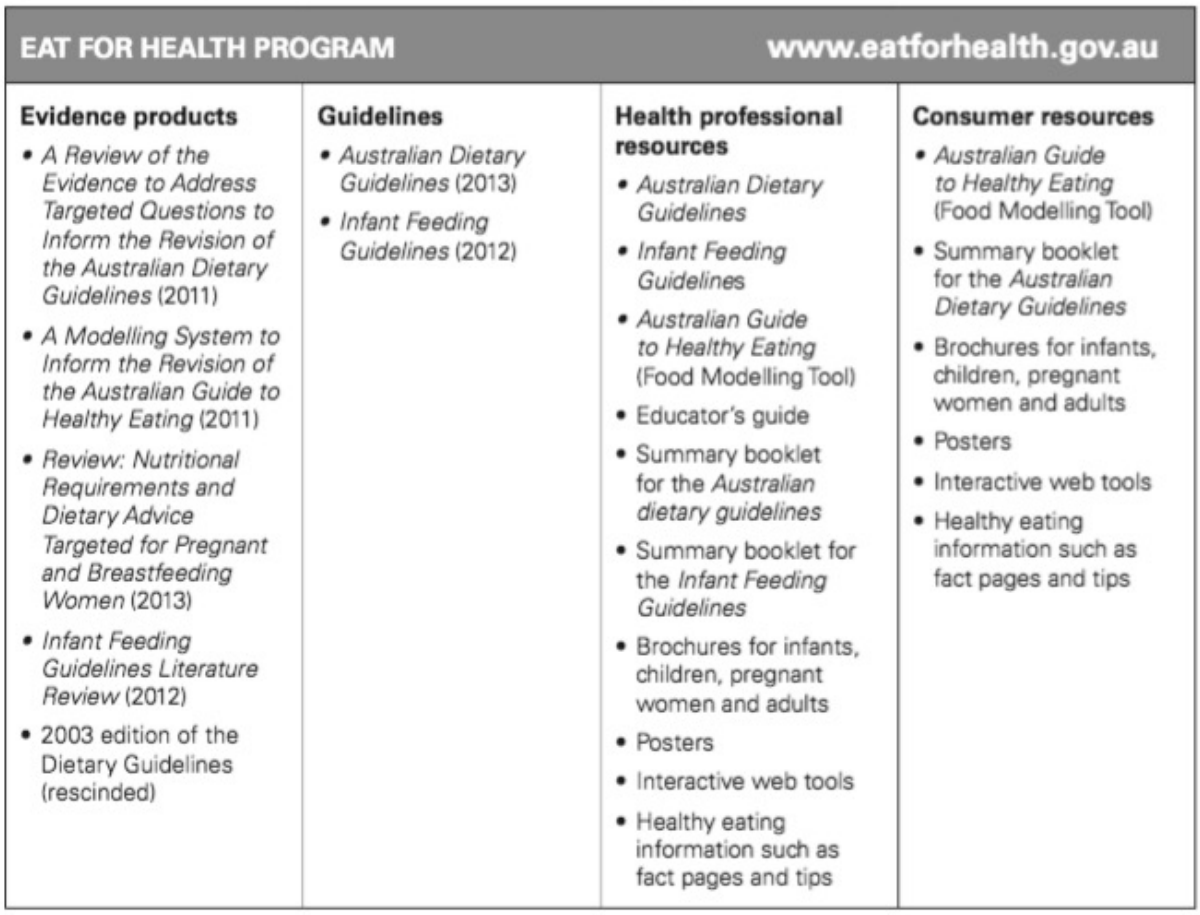
www.eatforhealth.gov.au - The website looks like this:



The *Educator Guide* states that the program was developed:

> *"for good health and wellbeing, using the latest evidence to develop public health nutrition guidelines and educator and consumer nutrition resources (see Figure 1).It includes practical information to help Australians and their health professionals work out the types and amounts of foods they should eat each day based on age, gender, body size, activity level and other factors, such as pregnancy and breastfeeding status."*

Figure 1 Relationship between the documents in the Eat for Health program



EAT FOR HEALTH PROGRAM			www.eatforhealth.gov.au
Evidence products	**Guidelines**	**Health professional resources**	**Consumer resources**
• *A Review of the Evidence to Address Targeted Questions to Inform the Revision of the Australian Dietary Guidelines* (2011)	• *Australian Dietary Guidelines* (2013)	• *Australian Dietary Guidelines*	• *Australian Guide to Healthy Eating* (Food Modelling Tool)
• *A Modelling System to Inform the Revision of the Australian Guide to Healthy Eating* (2011)	• *Infant Feeding Guidelines* (2012)	• *Infant Feeding Guidelines*	• Summary booklet for the *Australian Dietary Guidelines*
• *Review: Nutritional Requirements and Dietary Advice Targeted for Pregnant and Breastfeeding Women* (2013)		• *Australian Guide to Healthy Eating* (Food Modelling Tool)	• Brochures for infants, children, pregnant women and adults
• *Infant Feeding Guidelines Literature Review* (2012)		• Educator's guide	• Posters
• 2003 edition of the Dietary Guidelines (rescinded)		• Summary booklet for the *Australian dietary guidelines*	• Interactive web tools
		• Summary booklet for the *Infant Feeding Guidelines*	• Healthy eating information such as fact pages and tips
		• Brochures for infants, children, pregnant women and adults	
		• Posters	
		• Interactive web tools	
		• Healthy eating information such as fact pages and tips	

(Taken from Eat for Health Educator Guide, 2013)

As previously mentioned the program works in conjunction with the *Australian Dietary Guidelines*; a set of nutritional guidelines that have been based on scientific research on food and health. These guidelines 'provide information on the types and amounts of foods, food groups and dietary patterns that aim to promote health and wellbeing, and reduce the risk of diet-related conditions and chronic disease' (taken from Eat for Health Educator guide, 2013).

These dietary guidelines state that they have been developed for the use of a range of individuals that includes; health professionals, educators, food manufacturers, food retailers, researchers and those interested in health and nutrition.

The *Eat for Health Educator Guide* should be studied by fitness professionals to ensure a clear understanding of all components. It consists of 8 chapters covering the following elements:

CHAPTER 1 – What is the *Eat for Health Program*?

CHAPTER 2 – The nutritional rationale underpinning the *Eat for Health Program*

CHAPTER 3 – The Five Food Groups

CHAPTER 4 – What about other foods and drinks?

CHAPTER 5 – Energy and nutrient requirements

CHAPTER 6 – Planning for a healthy diet

CHAPTER 7 – What about infants and toddlers?

CHAPTER 8 – Achieving healthy dietary patterns

EAT FOR HEALTH PROGRAM AND FITNESS PROFESSIONALS

The *Eat For Health Program* can be used by fitness professionals to educate themselves and their clients about correct nutrition and eating behaviours. To name a few of the benefits that may be experienced when combining a regular exercise and health nutrition:

- Reduce the risk of chronic conditions
- Improve functional capacity and ability to perform daily tasks
- Improved mental well-being
- Reduce the risk of cardiovascular related diseases

In addition to the health benefits, nutrition is an integral component to combine with a training program to help a client achieving their goals.

HOW TO USE THE EAT FOR HEALTH PROGRAM

As mentioned in the previous section, the program provides the trainer with information about the nutrition and recommended dietary needs, but the trainer can apply this to their training programs in the following ways:

- **Educate the client** – the trainer can use the information within the educator guide and the nutritional guide to educate their clients on the following:
    - Correct foods to be consumed
    - How to read a food label
    - How to plan a healthy diet
    - Volume of calories in typical servings of food
    - Unhealthy fats and foods
- **Align client goals** – the guidelines can be used to set the clients goals
- **Map a client's food diary and recommend modifications** – with the knowledge from studying the educator guide and nutritional guidelines, the trainer will be able to determine how healthy a client's current diet is.
- **Set an example** – by adhering to the nutritional guidelines, fitness professionals can set an

example to their clients.

- **Reinforce recommendations to the client** – as the guides are based from scientific research, they can perhaps reinforce the trainer's recommendations to the client.

UNDERSTAND THE LIMITATIONS OF A PERSONAL TRAINER

The *Eat for Health Program* and *Australian Dietary Guidelines* provide generalised information; if advice tailored a specific client's goal is required, the trainer should seek advice from an allied health professional. More information regarding medical and allied health professionals is present in the following sections.

For more information on the Eat for Health Program, refer to the Educator Guide in the additional reading section of this module.

RECOGNISE THE DANGERS OF PROVIDING NUTRITION ADVICE TO CLIENTS

As indicated in Fitness Australia's position statement on the 'Scope of Practice of Registered Exercise Professionals', the scope of practice for a registered exercise professional **does not** include:

'Provision of nutritional advice outside of basic healthy eating information and nationally endorsed nutritional standards and guidelines'

Therefore, fitness professionals can provide nutritional guidance in line with the national standards and guidelines (*Australian Nutritional Guidelines and Eat for Health Program*), but not allowed to recommend any nutritional advice outside this. Information on these guidelines can be found at **www.eatforhealth.gov.au.**

If additional assessment, advice or nutritional planning is required the fitness professional can recommend a suitable medical or allied health professional that will be able to provide relevant and appropriate advice for the individual and their needs. The relevant health professional's consist of:

- An Accredited Practising Dietitian
- An Accredited Sports Dietitian
- A General Practitioner

Referral to these health professionals should be completed in line with the referral process that is explained in the previous section.

Fitness professionals that do not abide by this limitation and provide clients with more complex nutritional advice and plans are risking the health and well being of their client and risking their own jobs.

COLLABORATE WITH MEDICAL AND ALLIED HEALTH PROFESSIONALS

WHAT TO DO WITH THE PRE-EXERCISE SCREENING INFORMATION

When working for an organisation, there may be specific policies and procedures which must be adhered to, however if you are working as an independent gym, there are action, which should be taken. These can be as follow:

Client personal information – this is a snapshot of the clients contact details, to ensure that communication can be made between the fitness professional and the client. It also contains emergency contact details which are required if the client has an emergency and a spouse needed to be contacted.

Health and medical information – the health and medical information is one of the most important aspects of this process that captures all the health and medical information of the clients. This gives the fitness professional an indication of their client's health status and whether they possess a contraindication, which requires clearance from an allied health professional. If clearance is requested, then the client must gain a letter from an allied health professional stating that they are safe to perform exercise. This may also be accompanied with recommended exercises or information on exercises to avoid and may be dependent on the allied health professional. As a fitness professional, it would be helpful for the client to have a list of possible allied health professions to refer too.

Lifestyle and exercise information – lifestyle and exercise information provides the fitness professional with details about the client's lifestyle and exercise experience, which can allow the trainer to develop a program which caters for this information.

Goals of the client – the goal section allows the fitness professional to establish the aims of the client, and can also establish the type of training the client enjoys and likes, helping design the perfect program for the individual.

Declaration – the last element of the questionnaire is for the client to sign, to state that all the information they have provided is correct and up-to-date.

NEED FOR A REFERRAL

During the health screening and risk stratification, the need for a referral can be established, however, it is important to understand what elements determine the need for a referral.

Risk or contraindication – before any consideration about training take place, a trainer will conduct a risk stratification and health screening with their client. This will establish the level of risk they may be expose to if they participate in an exercise program; and will identify the need for a referral.

Fitness Australia's APSS is a tool that can be used to establish the level of risk of a client, which can range from high, moderate-low and low risk. A client that provides a high-risk status indicates that a referral to an allied health professional MUST take place before exercise is undertaken. A client that

Following the APSS further information can be captured to determine the health status of the client, and establish if a referral is needed.

Additional advice outside scope of personal trainer – the trainer may also refer a client to a medical or allied health professional because the advice the client requires is beyond their scope and training. The type of advice a client needs may vary from specific advice on a condition, nutrition, diseases etc.

Type of training – in some cases clients may require specific training for a specific goal or training outcome, which may be outside the scope and understanding of the trainer so referral to another health professional will be required.

There may also be other situation where the trainer feels they would like to refer a client to another allied health professional.

MEDICAL AND ALLIED HEALTH PROFESSIONALS

A fitness professional performs a great deal of training in the field of exercise, health and fitness, however, their knowledge and scope regarding other elements is relatively limited (unless they have undertaken additional qualifications). As a result, trainers require clearance, advice and assistance from individuals who are trained in these other fields, such as nutrition, chronic conditions, diseases or rehabilitation. These individuals who are trained in other fields are known as medical or allied health professionals.

To get the most out of health professionals, a fitness professional should develop a good understanding of the different types of health professionals, their roles and how they can support a fitness professional.

A medical or allied health professional includes, but not limited to:

- General Practitioner (GP)
- Paediatrician
- Physiotherapist
- Exercise Physiologist
- Occupational Therapist
- Accredited Practising Dietician
- Osteopaths
- Podiatrist
- Chiropractor

- Psychologist

General Practitioner (GP)

A GP is one of the most used allied health professional that fitness professional refer to, or gain permission for a client to participate. They identify the overall health of an individual, and deal with acute injury/illnesses to chronic injuries/illnesses. They are interest in the physical and mental wellbeing of the individual, and provide medication or advice regarding actions to take to return to normal wellbeing.

With regards to children, they are involved in immunisation from diseases, acute illnesses as well as chronic conditions treatment and prevention. Therefore a GP is usually the primary point of call for any child who presents with a medical condition and potential or current contraindications during the screening process. The GP can provide advice on whether exercise or physical activity can be performed by the client.

Paediatrician

A paediatrician is a medical doctor that is specifically skilled to understand the well-being of babies and children's, educated in child related conditions. They are also involved with the development and behaviour of children. Paediatrician can specialise into a specific topic or complete general training to cover a broad range of areas. Therefore some GP's will refer onto a paediatrician for a better understanding of a child related illness or disease.

Similar to that of a GP, a fitness professional can seek advice regarding child related conditions or illnesses, to gain permission to perform physical activity or advice.

Physiotherapist

The role of a physiotherapist, as explained by the Chartered Society of Physiotherapy, is to restore an individual's body back to normal function following an injury, illness or disability. Physiotherapists administer a range of treatment methods, on a holistic approach to improve the wellbeing and lifestyle of an individual. A paediatric physiotherapist specialises in injuries or chronic conditions that are related to children.

Physiotherapists can work with children to restore their body's function back to normal state, usually following an injury, illness or change in physical wellbeing.

A fitness professional can work closely with physiotherapists to restore the full physical capacity of an individual, using a combination of treatment methods, one of which is usually exercise. They may also provide advice to the fitness professional as to the recommended or allowed exercises, intensity and durations.

Accredited exercise physiologist

An accredited exercise physiologist is an allied health professional at the top end of the fitness professional ladder. They specialises in understanding the responses and adaptations of exercise on the body; as well as achieving physical and mental wellbeing for special populations, through the prescription of physical activity, lifestyle and behaviours changes.

Children are considered a special population; and therefore an area covered by an exercise physiologist. They are educated in the specific medical or chronic conditions that relate to children and adolescents, and understand the requirements or limitations of performing physical activity or exercise for these young individuals.

An exercise physiologist is an expert in understanding how to train a children suffering from a chronic condition. This provides a referral or advice point for fitness professional. Referral can help the child or their parent develop an understanding and how to deal with the condition. As a result this can help improve their overall well-being.

Occupational Therapist (OT)

An occupational therapist deals with clients to work towards an independent or fulfilled life. For children, an OT will usually work with individuals that have a disability, chronic disease or injuries that affects their daily living, development and learning. They will use various methods to help improve the child's cognitive, physical and motor skills with the overall goal to achieve a better life.

A fitness professional can work with an OT to understanding the specific components or areas to address, and how the use of exercise can improve their condition or overall well-being.

Accredited Practicing Dietician (APD)

Specialising in nutritional and dietary advice, a Dietician understand the specific requirements for all individuals. When dealing with children, an APD can implement a specific nutritional plan to help with the growth and development, as well as their physical activity needs.

An APD can understand dietary related diseases that children may be subject to; and how to create a nutritional plan that caters for these. They also understand child specific allergies or intolerances.

Working with an APD, a fitness professional can help achieve their client goals with the additional of nutritional advice or plans to their program. These may be related to body composition goals or general high intensity training. They may also refer to this individual if the client is concerned about dietary conditions.

Osteopath

Osteopathy is a form of manual medicine that emphasises a holistic approach to diagnose, prevent and treat many health issues affecting the physical body. Osteopaths are trained to recognise conditions that require medical referral. They are also trained to perform standard medical examinations of the musculoskeletal, cardiovascular, respiratory and nervous systems.

Osteopaths can work with all individuals, including children. They can help children have a smooth transition into adult life, improving structural problems that may affect the mobility and function of the body that lead to other problems. Structural problems may develop from:

- Problems during pregnancy or birth
- Accidents or falls during childhood
- Infection or inflammatory conditions
- Genetic disorders

Sports physician

A sport physician specialises in treating musculoskeletal conditions or injuries that arise as a result of participation in a sporting activity. They may also be involved in treating conditions that are related or can affect athletic performance, such as asthma or diabetes.

Their job scope also includes counselling athletes to help them achieve their maximal performance, prevent injuries and lead a healthy life to benefit their sporting performance. They can achieve this by providing dietary recommendation or plans, supplementary advice, exercise and recovery plans.

Remedial massage therapist

A remedial massage therapist is an allied health professional that manipulates soft tissue to assist the management and healing of injuries within the body. They also help alleviate pain and discomfort within muscles that is usually a result of dysfunction, injuries or illness.

Registered chiropractor

Chiropractors are responsible for address changes to the normal structure and function of the skeleton and its supporting structures to enable the body to function efficiently and in harmony. They focus on the returning the body back to normal alignment and function by manually adjusting or manipulating the spine.

Podiatrist

Often referred to as a chiropodist, the role of a podiatrist involves providing diagnosis, treatment and preventative care for a range of conditions or problems that affect the lower legs, ankles and feet. These may include:

- Infections
- Conditions related other health conditions i.e. diabetes
- Ailments
- Defects
- Injuries

In addition they can be involved with improving a clients independence and quality of life.

Registered psychologist

A registered psychologist is an allied health professional that deals with human behavior. This involves assessment, interventions and strategies in order to help people overcome challenges or difficulties, improve their mental well-being and improve their performance

Psychologists can be response for a range of conditions or situations such as:

- Eating disorders
- Behavioural problems or patterns
- Sleeping disorders
- Learning problems
- Parenting issues
- Substance abuse
- The effect of chronic illness

Continence nurse advisor

A continence nurse advisor is an allied health professional that has extensive training and specialises in continence care. They assess individuals to determine continence issues and provide management strategies.

THE REFERRAL PROCESS

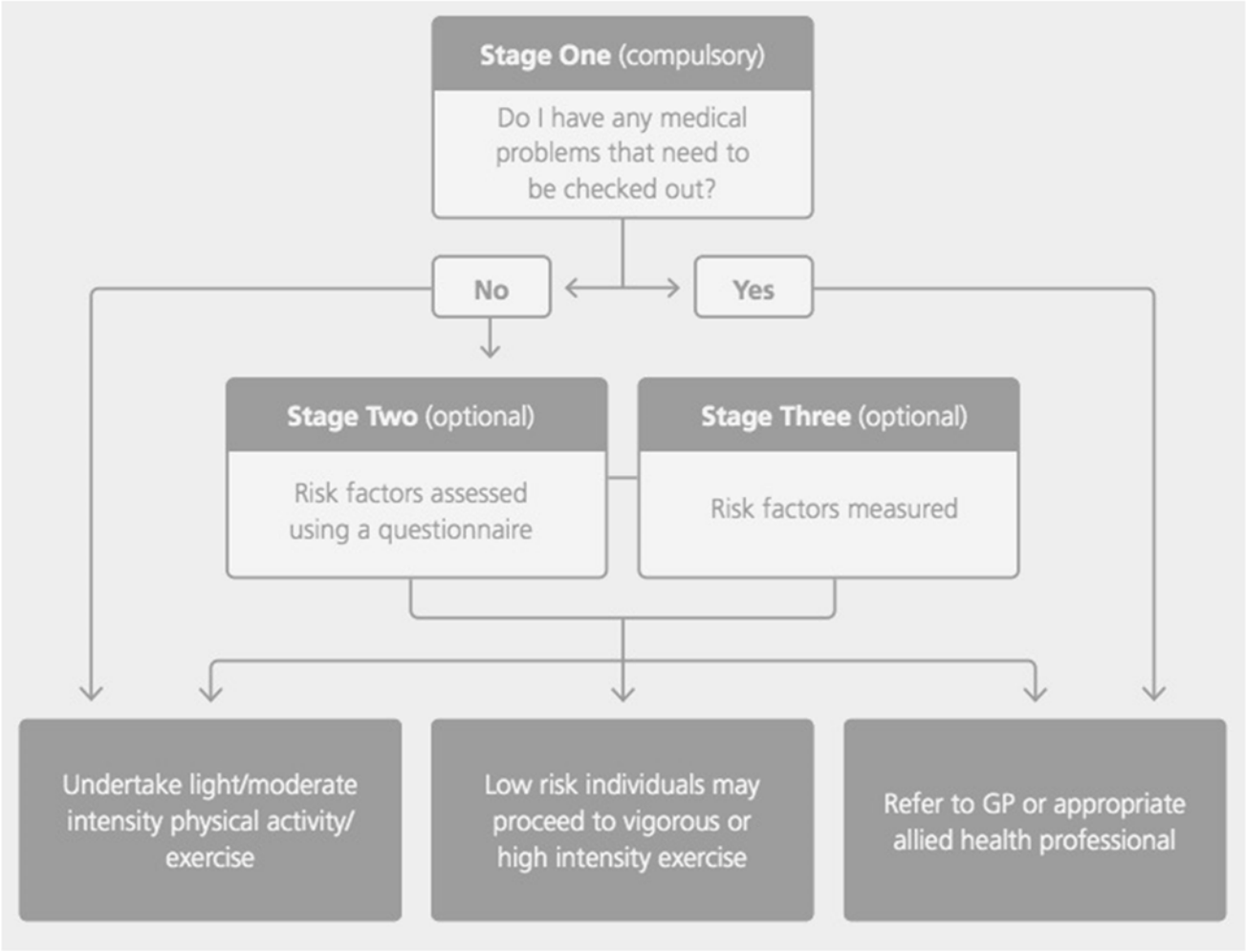
1. Screen and assess

The initial part of the referral process involves the fitness professional conducting a risk stratification and health screening to determine potential contraindications, clients needs and scope of training required. With the outcome of the risk assessment and health screening, the trainer can establish whether they have scope to cater for the clients needs. This means establishing:

- Whether the client has a contraindication or health condition that needs special knowledge or training
- Whether the client has goals that require training that is outside the understanding of the fitness professional?
- Whether the client requires any additional services to meet their goals? I.e. nutritional advice

The industry standard risk stratification produce by Fitness Australia provide guidance on whether a referral is required. The following flow chart (taken from Fitness Australia's 'Essential

Referral Guide') show the action that should be taken following the outcome of the risk stratification:



2. Evaluate

Stage two requires the trainer to understand their scope of practice and duty of care as a fitness professional. They must establish whether the clients health status, goals and needs prove to be outside their scope and referral to an allied health professional is required.

Fitness Australia suggests a fitness professional's role and duty of care is:

> ***'is to deliver exercise tailored to the client's needs and physical capacity in a safe environment, and support them to adhere to the program.'***

Whereas they state the role of a medical or allied health professional is:

> ***'to manage the client's health condition and support the promotion of safe exercise an physical activity.'***

3. Decide

Once it has been established that a referral is required, the next stage involves deciding whom the client should be referred to. This involves considering the reason for the referral to

determine which medical or allied health professional is equipped with the expertise to meet these needs.

The medical or allied health professional consist of the individuals explained in the previous section along with other specialist that may include:

- Obstetricians
- Cardiologists
- Oncologists
- Orthopaedics
- Rheumatologists
- Endocrinologists

To help find an appropriate allied health professional, the Australian Health Practitioner Regulatory Agency (AHPRA) website can be used, where a range of individuals are listed on their searchable register. This can be found at **www.ahpra.gov.au.**

4. Prepare

The next stage consists of prepare all the relevant information in a concise and easily understood manner to deliver to the allied health professional. This is usually achieved through via a referral letter.

Key points when preparing information for the client:

- ***Make it relevant*** – the information provided to the allied health professional should be relevant to referral and avoid containing unnecessary details.
- ***Ensure it is accurate*** – details provided to the allied health professional should be accurate
- ***Keep it concise*** – try not provide too much information to the allied health professional. It is best to ensure the information is concise and straight to the point.
- ***Act in a timely manner*** – Always act promptly, once you have established that referral is required; begin to prepare the information for the health professional. Likewise, ensure a response to an allied health professional is conducted within 24 hours.

To recap on the referral letter, below contains the elements to include in a referral letter along with a same referral letter:

The letter should contain relevant information regarding the client to assist the health professional in providing accurate and useful information. The following points are elements to consider including within the referral letter, but not limited to:

- ***Client's personal details must include full name, and date of birth***. (Optional address and phone number but not necessary).

- ***Client's medical history, presenting condition and rationale for referral***: This is the important element of the referral letter, and should be as detailed as possible - without this information the health professional will not be able to make an informed decision.
- ***Assessment results***: May include girth measurements, blood pressure or any health assessments as well as fitness tests. These help provide the allied health professional with information that can influence where a client is capable of participating in a specific exercise program.
- ***Clients goals and proposed training*** – by explaining the goals and intended training the fitness professional will enable the health professional to:
    a. *Evaluation whether there are any contraindications related to the type of training*
    b. *Analyse whether they believe the intended training is suitable for the clients goals*
    c. Provide any advice on the implementation of the training
- ***Social history***: The client's social habits such as smoking, alcohol consumption (particularly if it is felt that this may be excessive).
- ***Guidance required from the allied health professional***: for the allied health professional to provide the fitness professional with desirable feedback or information, it is important to point out the exact type of guidance required. I.e. clearance or program advice.

SAMPLE REFERRAL LETTER

Dr. ABC
ABC Surgery
111 Main Street,
Sydney,
NSW, 2000
Referral Date: Monday 14th June 2016

Dear Dr. ABC,

Re	**Client Name**	*Client A*
	Client Address	*10 High Street, Sydney, 2000, NSW*
	Client DOB	*12. 07. 1974*

My client - Client A has presented to my business with the goal of losing weight, controlling their diabetes and making daily tasks easier.

Client A's information and measurements recorded during pre-exercise screening include the following:

Current Physical Activity level		**Notes**
Sessions / week	*0*	*Client A's current sedentary and has a participated in very little exercise in the past.* *I am concerned about his health condition due to his BMI result and high waist circumference.* *Please can you provide me with advice on how he can control his blood sugar levels during and following the workout?*
Minutes / week	*0*	
Intensity (low/mod/high/vig)	*0*	
Assessment results:		
Resting HR	*79 bpm*	
Resting BP	*141 / 90*	
Weight	*84 kgs*	
BMI	*31*	
Waist Circ.	*41 inches*	

In response to his/her screening results I am requesting your guidance in relation to Client A's condition to enable me to ensure delivery of a safe and effective exercise program.

Based on Client A's goals, I intend to have him commence an exercise program consisting of the following:

Gentle walking, which will build up to a jog, THREE-FOUR times a week.

Very light intensity resistance exercise TWICE a week. These will be light impact, but will work the whole body.

Please assess Client A's condition and provide clearance that you think he is capable of participating in an exercise program. Please indicate any recommendations you may have in relation to his exercise program, including specific activities he cannot or should not be undertaking at this time, or other relevant notes:

I will keep you informed of Client A's progress and any major changes in his condition. To acknowledge you have received this referral, please complete this section:

<table>
<tr><td rowspan="2">Practitioner name:</td><td rowspan="2"></td><td>Status of Referral:</td><td>Complete</td><td>Incomplete*</td></tr>
<tr><td colspan="3">*please describe action required in notes</td></tr>
<tr><td rowspan="2">Practitioner Title:</td><td rowspan="2"></td><td>Contact person for follow up:</td><td>As above</td><td>New contact**</td></tr>
<tr><td colspan="3">**please provide new contact details in notes</td></tr>
<tr><td>Practitioner Signature:</td><td></td><td colspan="3" rowspan="2">Notes:</td></tr>
<tr><td>Date Referral received:</td><td></td></tr>
</table>

Please include in notes any instructions you may have regarding follow up or progress reporting.

I welcome any advice you feel necessary and can be contacted by phone 0123 456 789 between 10am and 4pm weekdays or email *email@address.com.au* anytime.

Client Consent:	I give my permission for Professional/Business to communicate with the referring Practitioner and/or my GP regarding my health status and my progress relating to my exercise program.		
Client Name:			
Client Signature:		**Date:**	

Your Sincerely,

Joe Blogs
Fitness Instructor
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au

5. Consent

Clients should be incorporated in the referral process.

The fitness professional should provide the client with thorough details regarding the referral, its purpose and expected outcome before ensuring they acknowledge their understanding of the referral.

Once the client understands and is happy to continue with the referral they should be provided with a copy of the letter or information that is being provided to the health professional to give their consent for the referral to take place. Ideally this should be captured through written agreement.

6. Connect

Once the information has been captured, document and the client has give the green light for the referral to go ahead and share their information, the fitness professional should connect with the appropriate allied health professional.

This will involve the fitness professional sending the referral letter, requesting a face-to-face meeting and building rapport with the allied health professional.

Once a referral letter has been sent to medical or allied health professional, the fitness professional should expect a response from them providing them with the advice that is requested. As mentioned in the 'prepare' section, the advice requested from the health professional needs to be concise and clear, so accurate and clear advice is provided.

Depending on the request from the trainer, the health professional may:

- Request to assess the client
- Provide written advice
- Refer to a second allied health professional

The written advice provided by the health professionals will contain information that can by either incorporated into the program or help the trainer design the program, for example suggesting exercises to avoid due to them being contraindications.

7. Exercise program

This stage involves delivering the exercise program with the guidance of the health professional.

8. Commit

The final stage of the referral process is to commit to on-going communication with the allied health professional to send and receive feedback on the outcome of the exercise plan and clients condition.

This involves reporting back to the allied health professional following the conduction of the exercise program and responding to further advice or guidance from them.

Consent from the client should be gained for continual communication or at each communication point.

All documentation between the health professional and the trainer must be kept securely in the clients records file.

CERTIFICATE IV MODULE 4 ASSIGNMENT

Please note that this is included as an example for preparation only. Assignment questions may alter slightly; these changes will be made to the downloadable version.

SECTION 1: EXERCISE SCIENCE

Part A – Consolidate understanding of exercise science principles

1. List 5 websites that you can use to obtain reliable information on exercise science principles.
2. What is the purpose of having a good understanding of exercise science principles?

Part B - Apply knowledge to own professional practice

Musculoskeletal anatomy

Responses to this section should be 50-150 words for each question.

1. Explain the structures of a skeletal bone.
2. List the cellular structures of a muscle fibre.
3. Explain the stages of muscle contraction (sliding filament theory), starting from the action potential arriving at the pre-synaptic cleft.
4. How does muscle fibre type affect exercise selection?
5. Explain the distinguishing features of the following joint categories – fibrous, cartilaginous and synovial joints.
6. Select 3 exercises and answer the following:
    - Joints involved
    - Joint movements
    - Muscles involved
    - Origin, Insertion and actions of 3 muscles involved
    - Potential risk of exercise

Nervous system

7. Identify the components and function of the central nervous system (CNS) and peripheral nervous system (PNS) with regards to exercise.
8. Identify the Structures of a Motor Neuron.
9. Describe the role of a motor neuron and how an impulse travels along to the motor end plate.
10. Explain ‘reciprocal inhibition’ and its influence in exercise.
11. Explain the following muscle proprioceptors:
    - Muscle Spindles
    - Golgi Tendon Organ

What are the neuromuscular adaptations associated with exercise training.

12. The heart possesses several valves – describe their function.
13. What is coronary circulation?
14. Explain the effects of weight bearing exercise on bones and the physiological process of this effect.
15. A certain type of exercise can cause delayed onset of muscle soreness or DOMS. Explain DOMS and list exercises that are likely to cause this effect.
16. Measuring intensity is crucial throughout the delivery of a program, however the different types of measurements have benefits and limitations – explain these for each type.
17. Exercise can affect different components of the body short term (known as responses) and long term (known as adaptations) – describes the effects on the following aspects:
    - Blood pressure
    - Muscles

Mechanics

18. Explain, using examples, how each of the following forces apply to the body during exercise.
    - Resistive
    - Friction
    - Centre of gravity
19. Explain the 3 classifications of levers, with an exercise related example.
20. Identify the role of the following muscles:
    - Multifidus
    - Rotators
    - Transverse Abdominals
21. Explain the benefits and risks of the following types of stretching:
    - Static
    - Dynamic
    - PNF
22. Explain how poor posture can have negative implications on exercise technique.
23. List a minimum of 5 exercises that can benefit posture.
24. Explain the changes the body undergoes to improve the following health-related and skill related components.

    Health-related components

    - Body composition
    - Flexibility
    - Muscle strength
    - Muscle endurance
    - Cardiorespiratory endurance

Skill-related component

- Balance
- Agility
- Power
- Speed
- Reaction time
- Coordination
- Proprioception

25. Reflect on the knowledge gained throughout this module and assess how it will be used, adapted or challenged during exercise delivery.

SECTION 2: SUPPORT HEALTHY EATING THROUGH THE EAT FOR HEALTH PROGRAM

This section is based on the ***Eat for Health*** Program developed by the government accessed here: https://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/n55b_eat_for_health_educators_guide.pdf

Part A – Identify client needs within the Eat for Health Program

1. List 5 different types of goals related to healthy eating.
2. Explain what is meant by 'incidental physical activity'.
3. Explain benefits of combining regular moderate intensity physical activity and healthy eating.
4. Explain limitations as a personal trainer in providing the Eat for Health Program to a client.
5. Explain the role of an Accredited Practising Dietitian, Accredited Sports Dietitian and General Practitioner for referring clients

Part B – Develop client profiles of food choices and eating patterns

1. Explain factors that can influence the food choices people make.

Part C – Provide eating pattern and health status information

1. List the 5 food groups, recommended consumption and examples of what food that make up one serve:
   - Food Groups
   - Recommended consumption of each group
   - Examples of foods that make up one serve
2. View the following 'Eat for health Educator Guide' and explain the advantages and disadvantages of this guide:

   https://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/n55b_eat_for_health_educators_guide.pdf

Part D – Influence healthier eating patterns

1. How can you assist clients in making changes to eating patterns?

2. Explain how assess the following components of a food label, listing the recommended consumption of each.
   - Total Fat
   - Saturated Fat
   - Sugars
   - Sodium
   - Fibre

SECTION 3: COLLABORATE WITH MEDICAL AND ALLIED HEALTH PROFESSIONALS IN A FITNESS CONTEXT

Part A: Refer to medical or allied health professional.

1. List important health information to obtain from clients.
2. Referring to allied health professionals is an important task for a fitness professional, but understanding when and who to refer too is vital.
   a. List exercise intolerances or medical conditions where you would refer clients to an allied health professional:
   b. Explain the roles of the following allied health professional:
      - Sports physician
      - Registered general practitioner
      - Registered physiotherapist
      - Accredited exercise physiologist
      - Occupational therapist
      - Remedial massage therapist
      - Registered chiropractor
      - Registered osteopath
      - Podiatrist
      - Accredited practising dietician
      - Registered psychologist
      - Continence nurse advisor

SECTION 4: RECOGNISE THE DANGERS OF PROVIDING NUTRITION ADVICE TO CLIENTS

Part A: Comply with the scope of practice in provision of nutrition advice

1. List 4 sources where you could obtain reliable nutritional information for clients.
2. How should you deal with clients who have specific nutritional needs?
3. What is the possible outcome of poor nutritional advice for the following people?
4. What are the risks associated with providing nutritional information for the following people?
   - Pregnant or lactating women
   - Very underweight, overweight or obese
   - Impaired Glucose Tolerance, Impaired Fasting Glucose
   - Type 1 or Type 2 diabetes
   - Client with or recovering from Cancer
   - Frail elderly
   - Mental illness
   - High intensity and high volume exercise or sport

- Cardiovascular disease, Renal disease or Liver disease
- Client with food allergies and intolerances

Part B: Identify situations outside of scope of practice.

1. Identify 4 conditions or situation where you would refer clients or obtain advice from allied health professionals in the nutritional field.

SCENARIO 1 – ROBERTA LOPEZ

Part A – Write referral letter

You have been employed to work with the under 19's Qld female development tennis squad. The squad trains eight times a week, 5 tennis session and three gym sessions. You have been providing the athletes with information regarding nutrition and tennis from the AIS website:

www.ausport.gov.au/ais/nutrition/factsheets/sports/tennis

A new member of the squad is lactose and gluten intolerant and wants to gain more specialised advice for sports performance and her eating condition.

a. Using the template below write a letter to an allied health professional asking for specialist nutritional advice.

Client:	*Roberta*

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Roberta Lopez

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 2 – MARCUS MOSCOS

Part A – Write referral letter

Marcus has set a goal of qualifying for the NSW rowing team for the Australian Rowing Regatta Championships in 8 months' time. He currently rows four mornings a week and has employed your services in the gym three times a week. He has asked if you could help him with a detailed nutritional plan to maximise his results in the gym and while training in the water.

You understand stand your limitations to give nutritional advice and explained to Marcus you will refer him to an allied professional.

a. Using the following template write a referral to a suitable allied health professional asking for the advice your require.

Client:	*Marcus*

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today
Dear **[State the allied health professional you wish to refer to],**

Re Client Name Marcus Moscos

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs

Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 3 – BRENDA ZIMMER

Part A – Write referral letter

Brenda has been attending your boot camp group for the past six months in the park next door to her house. She turned up this morning with a limp, which clearly impaired her natural walking gait. When you asked what happened she told you she filled in for a friends touch football team on the weekend and felt a sharp pain in the back of her right leg when she stretch to put the ball down. She thought she might participate in the boot camp session that day, and seek your advice regarding her injury.

You inform her that you will refer her to a suitable allied health professional regarding this injury and then using their advice train her once she is ready to be trained.

a. Using the template below write a referral letter to the necessary allied health professional.

Client:	*Brenda*

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today
Dear **[State the allied health professional you wish to refer to],**

Re Client Name Brenda Zimmer

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

Part B – Receive response and write follow up letter

a. The following letter was received from the allied health professional; write a program suitable for Brenda to undertake once she is able to participate in exercise.

Dear Trainer,

Thank you for referring Brenda to us. She has sustained a grade two-hamstring strain to her right leg. We are looking at around 4 – 6 week of rehabilitation and post rehabilitation before returning to unrestricted exercise activities. I will be in contact with you via email over the next week to discuss the post rehab phase where she can return to train with you. As mentioned before I would imagine this to be in around two weeks.

Regards,

Simone Velez

Physiotherapist

Simon@physioworks.com.au

Client Name	**Brenda Zimmer**				
Program duration:	60 mins				
Client Goals					
Warm-up					
Conditioning		**Reps**	**Sets**	**Load**	**Rest**
Cool down					
Tutor comments:					

b. Write a follow up letter to the physiotherapist giving them details of the program that you plan to deliver to Brenda.

Client:	*Brenda*

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Brenda Zimmer

In the space below write the follow up letter to the allied health professional:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 4 – OLDRICH SWARTZ

Part A – Write referral letter

As a result of a heart condition, Oldrich has an artificial pacemaker, which limits his participation in exercise. You have limited knowledge of the restrictions so want to consult an allied health professional to determine suitable training for Odrich. He has purchased a 10 pack of P.T session with you at the gym and completed a pre-screening form.

a. Using the following template write a letter to a suitable allied health professional.

Client:	Oldrich

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today
Dear **[State the allied health professional you wish to refer to],**

Re Client Name Oldrich Swartz

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL

Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

Part B – Receive response, design program and write follow up letter

a. You received the following letter from the allied health professional about Oldrich. With this advice write a sample program for Oldrich.

Dear Trainer,

Thanks for getting in touch with me regarding Oldrich.

Oldrich can participate in light intensity exercise that does not raise his heart rate above 75% above his max heart rate. This is roughly 120 beats per minute. I recommend this is closely monitored throughout the workout and also that Oldrich purchases a heart rate monitor to his daily activity.

I think it is best to slowly build Oldrich's cardiovascular fitness as well as his functional fitness, but ensure that you avoid any isometric exercises and exercises which requires him to hold his hands above his head as this can put additional stress on his heart.

The sessions should only last 30 minutes to begin with and then can be increased gradually to a 45-minute workout.

If you have any further questions do not hesitate to contact me.

Regards,

Ben Schumer
Randwick GP's
Ben@randwickdoctors.com.au

Client Name	**Oldrich Swartz**				
Program duration:	30 mins				
Client Goals					
Warm-up					
Conditioning		**Reps**	**Sets**	**Load**	**Rest**
Cool down					

Tutor comments:	

b. Write a follow up letter to the physiotherapist giving them details of the program that you plan to deliver to Oldrich.

Client:	*Oldrich*

For the purpose of this question only modify the elements in RED.

[Health professional's Name]

[Clinic Name]

[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Oldrich Swartz

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs

Personal Trainer

FITNESS4ALL

Phone: 0123 456 789

Email: email@address.com.au

111 Main Street, Sydney, NSW, 2000

SCENARIO 5 – WENDY BURROWS

Part A – Write referral letter

Wendy has joined your running group; she has a history in competitive triathlon racing before the birth of her child. She is already swimming and riding once a week in her own time but thought it would be good to work on her running technique and have a trainer to bounce ideas off. She mentioned that she is concerned with how exercise may affect her milk when breast feeding and wanted to better understand nutritional requirements when training and breast-feeding. You have supplied her with some information from your resource 'Nutritional Concerns in Recreation, Exercise, and Sport' pg. 301 – 305. She is grateful but has expressed an interest to see a specialist.

a. Using the following template write a letter to an appropriate allied health professional.

Client:	**Wendy**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today
Dear **[State the allied health professional you wish to refer to],**

Re Client Name Wendy Burrows

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 6 – EUGEN ENIN

Part A – Write referral letter

Eugen is a recreational ice hockey player who has just finished his rehabilitation with North Side Physio & Exercise Physiology last week. He suffered an ACL tear and had to have surgery. His goal is to start playing again next season in six months' time, and wishes to train three days a week with you. Eugen has completed a pre-screening form with you at your fitness studio.

a. Using the template below write a letter to a suitable allied health professional:

Client:	*Eugen*

For the purpose of this question only modify the elements in RED.
[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today
Dear **[State the allied health professional you wish to refer to],**
Re Client Name Eugen Enin

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

Part B – Receive response, write program and feedback to the allied health professional regarding the program you intend to deliver

a. You have received the following response from a physiotherapist. With the advice from the exercise physiologist, write a program for Eugen.

Dear Trainer,

Thank you for contacting us, yes we have been dealing with Eugen, and he has made excellent progress through the rehabilitation phase. We have reached the stage where Eugen's know is sufficiently strong enough to perform more complex workouts and incorporate dynamic and compound exercises.

Our exercise physiologist Stuart McDowell has recommended the following type of training for Eugen:

- Continue to strengthen Eugen's VMO and quads
- Incorporate balance and stability exercises
- Include lower limb lateral movements in the program
- Work on torso rotation and balance simultaneously
- Continue to strength hamstrings – he had a left hamstring graft for the ACL operation

For further advice please don't hesitate to contact Stuart on Stuart@NSPEP.com.au.

Regards,

Lianne Leow

Physiotherapist
Lianne@NSPEP.com.au

Client Name	**Eugen Enin**				
Program duration:	60 mins				
Client Goals					
Warm-up					
Conditioning		**Reps**	**Sets**	**Load**	**Rest**

Cool down					
Tutor comments:					

b. Write a follow up letter to the exercise physiologist giving them details of the program that you plan to deliver to Eugen.

Client:	*Eugen*

For the purpose of this question only modify the elements in RED.

[Health professional's Name]

[Clinic Name]

[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Eugen Enin

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 7 – CYRIL BASTOUIL

Part A – Write referral letter

Cyrill wishes to train with you at your fitness studio. He wants to lose 18kg and explains he was diagnosed with type two diabetes just before coming over from France. He is unable to provide you with any information from his G.P in France.

a. Using the following template, write a referral letter to a suitable allied health professional:

Client:	**Cyril**
For the purpose of this question only modify the elements in RED. [Health professional's Name]	

[Clinic Name]
[Address]
Referral Date: Today
Dear **[State the allied health professional you wish to refer to],**

Re Client Name Cyril Bastouil

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

Part B – Receive response, design fitness program and write follow up letter

a. You received the following letter from an allied health professional, with the advice given; create a suitable program for Cyril.

Dear Trainer

Thank you for contacting me regarding Cyril's health and fitness goals. Initially I advise that exercise intensity should be at a comfortable level (RPE 5–7) and should progress cautiously as tolerance for activity improves. Resistance training has the potential to improve muscle strength and endurance, enhance flexibility and body composition, decrease risk factors for cardiovascular disease, and result in improved glucose tolerance and insulin sensitivity. Avoid any isometric, plyometric, overhead or maximal lifts.

I have organised Yasmine to go see a nutritionist and passed your details on as well so you can liaise with her. You can reach her via e-mail at Michellenitrition101@gmail.com.

If you have any further questions please don't hesitate to contact me.

Regards,

Brian Bell

Sydney GP's
Brian@sydneygps.com.au
0422 328 733

Client Name	**Cyril Bastouil**

Program duration:	60 mins				
Client Goals					
Warm-up					
Conditioning		**Reps**	**Sets**	**Load**	**Rest**
Cool down					
Tutor comments:					

b. Write a follow up letter to the exercise physiologist giving them details of the program that you plan to deliver to Cyril

Client:	**Cyril**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]

[Clinic Name]

[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Cyril Bastouil

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs

Personal Trainer

FITNESS4ALL

Phone: 0123 456 789

Email: email@address.com.au

111 Main Street, Sydney, NSW, 2000

SCENARIO 8 – NADIA ELKOJJE

Part A – Write referral letter

Nadia has just completed her initial consultation with you. She has expressed an interest in lowering her body fat and increasing muscle tone. Carefully review the results to ascertain whether a referral may be required.

a. Using the following template, write a letter to an appropriate allied health professional:

Client:	**Nadia**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Nadia Elkojje

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

Part B – Receive response, design program and write follow up letter

a. You received the following letter from an allied health professional. With the advice from the exercise physiologist, write a program:

Dear Trainer,

Thank you for referring Nadia. She is suffering with some body image issues and this is affecting her diet and body composition. She will now be working with you, my self, an ADP, and psychologist. She was happy that I share this information with you as she wishes to continue a modified training regime. Essentially Nadia is malnourished so she is susceptible to getting infections, thinning bones, irregular heart rhythms and higher risk of heart attacks. I recommend focusing on developing muscle and bone strength/density through resistance exercises. Avoid plyometric exercises like bounds or box jumps. Look to avoid high intensity interval training, and high intensity and volume cardiovascular exercise. I have asked her to see you twice a week.

Feel free to contact me if you have any further questions.

Regards,

Brian Bell

Sydney GP's
Brian@sydneygps.com.au
0422 328 733

Client Name	**Nadia Elkojje**

Program duration:	60 mins				
Client Goals					
Warm-up					
Conditioning		**Reps**	**Sets**	**Load**	**Rest**
Cool down					
Tutor comments:					

b. Write a follow up letter to the exercise physiologist giving them details of the program that you plan to deliver to Nadia.

Client:	**Nadia**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Nadia Elkojje

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 9 – ROSS HEART

Part A – Write referral letter

Has wanted to join your sports performance high intensity sessions you deliver at the local gym. You have asked about his exercise history and if he has had any issues with health. He mentioned that he is a vegan for the last 18 months. He has noticed he struggles with his breath and is getting dizzy when doing higher intensity aerobic exercise lately and that's why he wants to train with you. He usually rides and uses the rower in the gym along with some body weight exercises.

a. Using the following template write a letter to a suitable allied health professional:

Client:	**Ross**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Ross Heart

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

SCENARIO 10 – XAVIER YEOMAN

Part A – Write referral letter

Xavier has joined your boot camp to improve his asthma. He regularly goes surfing and participates in cardiovascular events with his friends, but always becomes very wheezy and out of breath so feels like his asthma is holding him back.

a. Using the following template, write a referral letter to an appropriate allied health professional:

Client:	**Xavier**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]
Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Xavier Yeoman

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

Part B – Receive response and write follow up letter

a. You received the following letter from an allied health professional. With their advice write a suitable program for Xavier.

Dear Trainer,

Thank you for contacting me regarding Xavier's asthma.

I believe Xavier should be able to train normally as long as he uses his Ventolin inhaler for each session, and builds up his cardiorespiratory fitness gradually. It is best to perform sessions that increase his ventilation rate and keep it elevated, until he progress with this gradual training, I would avoid bouts of high intensity which will increase and then lower his ventilation rate and place a great deal of stress on his respiratory system.

Also, it is important he conducts an extended warm up and cool down to prepare and lower his respiratory system.

In the case of an asthma attacked, which should not occur if you follow my advice, this is what he should do:

1. 1 x Puff followed by 4 breaths, repeat 4 times in a row
2. Wait 4 minutes
3. If symptoms are still present, call ambulance and repeat the above steps until the ambulance arrives

Be aware that cold dry conditions (winter mornings) are more likely the cause irritation to the airways; I have informed Xavier of this risk as well.

If you have any further questions please feel free to contact me.

Regards,
Brian Bell
Brian@sydneygps.com.au

Client Name	**Xavier Yeoman**				
Program duration:	60 mins				
Client Goals					
Warm-up					
Conditioning		**Reps**	**Sets**	**Load**	**Rest**
Cool down					
Tutor comments:					

b. Write a follow up letter to the physiotherapist giving them details of the program that you plan to deliver to Xavier Yeoman.

Client:	**Xavier**

For the purpose of this question only modify the elements in RED.

[Health professional's Name]
[Clinic Name]
[Address]

Referral Date: Today

Dear **[State the allied health professional you wish to refer to],**

Re Client Name Xavier Yeoman

In the space below write the referral letter with all the necessary information:

Your Sincerely,

Joe Blogs
Personal Trainer
FITNESS4ALL
Phone: 0123 456 789
Email: email@address.com.au
111 Main Street, Sydney, NSW, 2000

ADDITIONAL READING ARTICLES

The following articles and additional reading will support your learning for this module.

Modelling appropriate communication

By having a positive and attentive approach to caring for children, you are already beginning to demonstrate a respectful approach to children. By making yourself available to the children and taking an active role in their interests you will be well on your way to being a respectful communicator.

By being accessible you will be available for the child to approach you whenever they feel the need. There are many ways you can make yourself accessible for the children.

Turn to face the child when they communicate

When a child is communicating with you, always turn to face the child. This demonstrates your positive interest and role models respectful communication as you listen to the child. By facing the child as they speak, you will also be more likely to pick up non-verbal cues such as facial expressions.

Go down to a child's physical level when you communicate

When communicating with a child, you should always move down to their physical level. This is a great way of demonstrating that you consider the child an equal, and that you are willing to engage in communication together. Standing over a child when they're talking to you could make them feel intimidated. Moving down to the child's level is a way of role modelling equality and respect.

Never ignore or pass over a child

Children (just like adults) like to feel valued. Ignoring or passing over a child when they're trying to interact with you is like sending a signal that says, “I'm not interested

in you". Whatever you're doing, always make time to pay attention to a child. This role models respect for others.

Always stay within sight or hearing range

When a child is communicating or interacting with you, it is important that they feel you are interested in their interests or concerns. Always stay within visual and hearing range, so you can see and hear what they're communicating. By role modelling respect for others in this way, you are providing an excellent example for others to follow.

Remember to treat children the way that you would like to be treated. Children are like sponges - they absorb everything.

Did you know that you're a super model? Not the fashion model type, but a model of appropriate behaviour for the children you care for.

Remember, children are very impressionable - they will be watching everything you do and say very closely. As they watch you interact and communicate with other people, they will be learning from the skills you demonstrate. Be aware of this responsibility you have as a role model, and make sure that you are modelling the types of behaviours that you want the children to develop.

Limits and guidelines

Before you can expect the children in your care to behave appropriately at your Centre, the guidelines and limits you want children to **adhere** to need to be stated clearly and up front.

You must ensure that children are aware of these guidelines, and the limits on their behaviour. If the children are not aware, they will not know what is appropriate and what is not.

Communicating behaviour limits and guidelines

These guidelines and limits must be clearly communicated, and role modelled by yourself and the other caregivers in your Centre. By being upfront you know that everyone has been informed and therefore there should be no misunderstandings, or 'not knowings.'

By being clear, you need to ensure that the children have heard and understood you when you explain the limits and guidelines. If necessary, have them repeat what you have told them so you can be sure. Ask them what the limits and/or guidelines mean to them, so you can see if the message has been understood.

Limits need to be worded in a positive way to allow children to understand what they can do.

Applying limits and guidelines to children's behaviour

Applying these limits and guidelines to children's behaviour involves directing the children towards the desired behaviour in a positive and caring way. Directing (or redirecting) behaviour is similar to refocusing someone's attention - you do it to change the pathway in which they are heading. This does not always mean that the pathway they are heading in is wrong, it just may be inappropriate at that time.

For younger children, these guidelines and limits are important as they are still developing their understanding of what's right and wrong. Knowledge of why the limit is in place is equally important for older children, who are more likely to already be aware of what behaviour is acceptable. By understanding the reasons why they exist, the children are more accepting and willing to respect the limit.

For example, if you were asking a child to stop running in the Centre, it would help them to understand why the limit exists if you explained why running is dangerous.

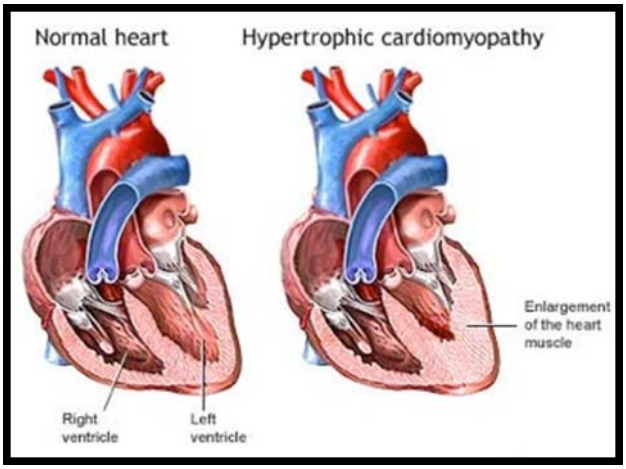
Redirecting children's attention

One of the techniques used by caregivers to modify a child's inappropriate behaviour involves redirecting the child to something else more appropriate; in other words, get them to focus on something else.

When redirecting a child's behaviour, the language you use needs to be appropriate to their age and stage of development. This means that you will need to alter your approach accordingly. You also need to ensure that you are modelling appropriate behaviours yourself - in other words, 'practise what you preach.'

Like many things in life, redirection will become a habit after you have performed it a few times, you just need to break the old habit first if you have one.

Athletic Heart Syndrome



Athletic heart syndrome refers to the normal changes that the heart undergoes in people who regularly do strenuous aerobic exercise (for example, very well conditioned athletes) and, to a variable extent, in those who do extensive weight training.

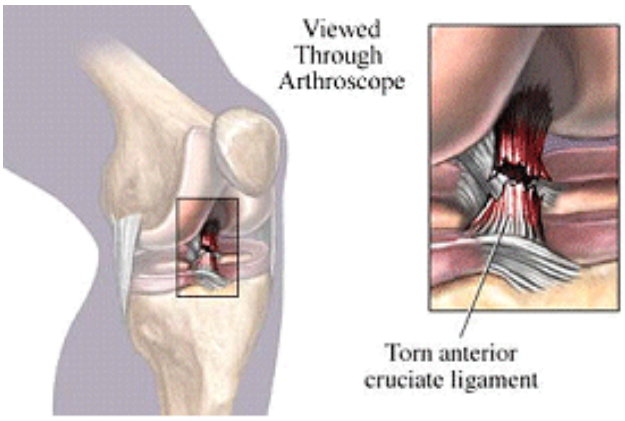
In a person with athletic heart syndrome, the heart is larger and its walls thicker than in a nonathlete. The chambers inside the heart get somewhat larger. This increase in size and thickening of walls allow the heart to pump substantially more blood per heartbeat without much increase in heart rate. The large volume of blood flowing through the heart results in a slower, stronger pulse (which can be felt at the wrist and elsewhere on the body) and sometimes in a heart murmur. These murmurs, which are specific sounds created as blood flows through the valves of the heart, are perfectly normal in an athlete and are not dangerous. The heartbeat of a person with athletic heart syndrome may be irregular at rest but becomes regular when exercise begins. Blood pressure is virtually the same as in any other healthy person.

The enlarged heart can be seen on an echocardiogram and sometimes on a chest x-ray. A variety of changes are detectable on an electrocardiogram. These changes would be considered abnormal in a nonathlete but are perfectly normal in an athlete.

When an athlete stops training, the athletic heart syndrome slowly disappears—that is, heart size and heart rate tend to return gradually to those of the nonathlete.

Athletic heart syndrome is not thought to affect health in any way. The rare sudden deaths of athletes are usually due to underlying heart disease that was not previously detected rather than to any danger resulting from athletic heart syndrome.

ACL Rehabilitation:
Getting Back in the Game



ACL injuries are common problems involving the knee joint

Recent studies indicate that 1 in 10 female college athletes have sustained this type of injury some time during their athletic carrier. Research indicates that females participating in activities that "require cutting and jumping activities were 5 times more likely to suffer serious knee injuries compared to their male counterparts" (NWS, 2008, p.1).

The ACL is one of four ligaments critical to the articular stability between the upper and lower leg. Many wonder why the ACL is so vulnerable to injury, especially among females. The ACL can be hurt when one puts force on the knee while twisting. Examples of this kind of action happens during a side-step, pivot, or when landing. Other examples include contact injuries in contact sports when someone hits the knee or it gets twisted in a pile.

The ACL is more vulnerable to some people than others. The reason for this is based on "osseous landmarks of femoral attachment of the ACL" (Ferretti , Ekdahl, Shen, & Fu, p.1).

The ACL femoral attachment has a unique topography with a constant presence of the lateral intercondylar ridge and often an osseous ridge between anterior medial (AM) and posterior lateral (PL) femoral attachment; commonly referred to as the lateral bifurcate ridge. In the anatomy of the knee joint, an intercondylar notch lies between the lateral and medial condyles of the femur.

The ACL moves within this notch, connecting the femur and the tibia, thus providing stability to the knee. The ACL prevents the tibia from sliding forward and rotating medially. The majority of females have a small notch, therefore restricting ACL movement. "When movement is restricted, the femoral condyles can pinch the ACL within the joint, especially during twisting or hyper-extended movements often resulting in a tear or rupture of the ligament" (Vlach, 2008). For some athletes, especially females, these attachment points may be smaller; a contributing factor involving female susceptibility to ACL injuries.

Rehabilitation

There are many variations of ACL rehab that take considerable time to get back in proper physical condition. Each athlete has their own specific rehab plan, even if a lot of the exercises are similar to another athlete. Each plan depends on the person's age, functional disability, and functional requirements (Cross, 1998). The major goals of rehabilitation following ACL surgery are:

- Restoration of joint anatomy
- Provision of static and dynamic stability
- Maintenance of the aerobic conditioning and psychological well being
- Early return to work and sport

Following ACL reconstruction surgery, range of motion exercises are started immediately with walking being an important component to post operative rehabilitation. Being mobile during this time will help in incurring degrees involving range of motion with the initial focus on regaining full extension of the knee. In general, flexion (ability to bend) is much easier to gain than extension (Cluett, 2008a).

A typical rehabilitation program consists of four distinct phases. During the first phase, emphasis is placed on minimizing pain, swelling, and maximizing motion. Throughout the second phase of rehab increased ranges of motion is the main objective.

During stage two the patient is subjected to **resistance training** designed to increase range of motion through a well designed regiment of lifting exercises specific to the quadriceps and hamstrings.

During the third phase, muscle control, increased strength, and greater endurance are the goal. At this stage, ones range of motion should be completely back. During the final phase of rehabilitation the subject will be encouraged to engage in gradually work back into their sport (Palmer, 2005b).

Working with physical therapists is one way to make rehab more successful. Therapists know what and where someone should be at during their specific program. They can make sure that one is not overdoing it. Overdoing it could result in not healing the injury properly. Different exercises that one can do tolerably include: heel slide, isometric contraction of quads, and the prone knee flexion. Other exercises that can be done once able to stand include: passive knee extension, heel raise, half squat, knee extension, and standing on one leg. (Quinn, 2008)

Getting patients on a stationary bike is a good way for them to regain motion and improve strength. Other activities that one can do are, working in a pool, on a trampoline, wobble board, and jogging, among many others. These activities are used during the different phases, so do not think that right after surgery one can be on a wobble board. Take things slow and make sure that the injury heals correctly so that one does not end up back at the beginning of rehab.

Once rehab is finished, the doctor will have the ultimate say in when one is able to return to a sport or work fully. The doctor's decision can be based on how well one did during rehab and the graft type (if one was done). Certain grafts are believed to take longer to heal and therefore, the doctor may not want to push the knee to far too soon. After all is said and done, the athlete may ask the question of "should I wear a brace?" Simply put, it all depends on the athlete. Some prefer a brace while others do not. No studies show that a brace helps or harms one when wearing it (Cluett, 2008a)

Palmer (2005) offers some encouraging information for all to consider: Many struggle to regain form after a serious sports injury and lengthy rehab period, some take months or fail completely. Getting back into form will be slow if we do not know exactly what it is that needs to be recovered. Natural talent for a sport comes from the right sort of conditioning. Good quality movement executed in the sporting activity sets up appropriate learnt movement patterns that reside at a subconscious level. (Palmer, 2005a, p. 2)

Jackson A. et al (2009), "ACL Rehabilitation: Getting Back in the Game", BrianMac Sports Coach: www.brianmac.co.uk/articles/article048.htm

Patient Information Sheet

SHOULDER DISLOCATION

1. What is it?

It is a disruption of the joint capsule of the major shoulder joint (the glenohumeral joint).

2. What causes it?

It is caused by a sudden jolt to the shoulder joint, usually in a rugby tackle or heavy fall. The socket of the shoulder joint (glenoid) is quite shallow, so the shoulder is not as stable as other joints like the hip.

3. Symptoms – what you notice

a. Pain – because of tearing of the joint capsule, there is severe pain when it first occurs. Recurrent dislocations are usually less dramatic.
b. Stiffness – when the humerus (upper arm bone) is out of the socket, movement is very restricted.

4. Signs – what the doctor finds

a. Deformity – there is usually a loss of the usual prominence of the humerus (upper arm bone). In very muscular people, the deformity may be hard to see.
b. Tenderness – over the torn tissue, or other tissue that is under extreme tension.
c. Stiffness – shoulder movement is very restricted.
d. Pain – on restricted movement.
e. Occasionally there may be numbness of an area of skin over the shoulder, plus weakness of shoulder movement. This suggests that the axillary nerve around the shoulder has been stretched during the dislocation.

5. Investigations

X-rays can show the dislocation, plus any associated bony injury, e.g. a fracture of the rim of the socket (glenoid rim fracture or Bankart lesion). It is important to order a west point x-ray view to show this fracture. If surgery is being considered, an MRI scan may be ordered.

6. Treatment

a. Reduction of the dislocation. This should be done as soon as possible, by the best qualified person available. First time dislocations usually need reduction at an A & E clinic or hospital, but repeat dislocations can often be put back on the sideline.
b. A sling for four weeks provides support and helps ease the pain.
c. Pain relief with paracetamol or Voltaren or similar medications.
d. After four weeks a series of muscle exercises from an experienced physiotherapist can help restore normal strength and mobility.
e. Surgery may be required to repair torn tissue. The chance of re-dislocation is higher in young athletes playing contact sports like rugby. The decision to have surgery needs to be carefully considered between the patient and their surgeon, and depends on many factors. Any person having surgery needs to commit to a rehabilitation programme lasting several months.

7. Recovery time

Average recovery time is 2-3 months without surgery. If surgery is required, depending on the complexity of the procedure, recovery time is between 4 and 12 months.

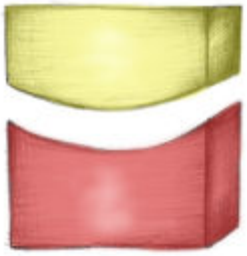
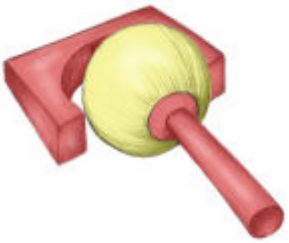
8. Recovery sequence

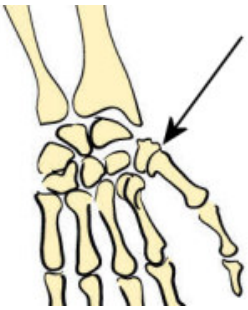
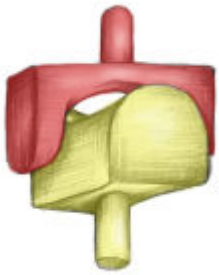
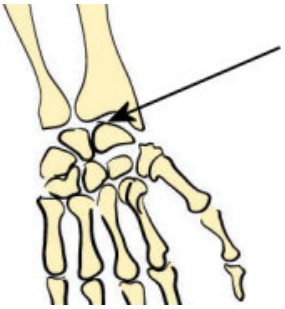
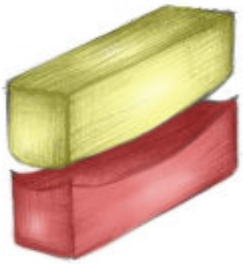
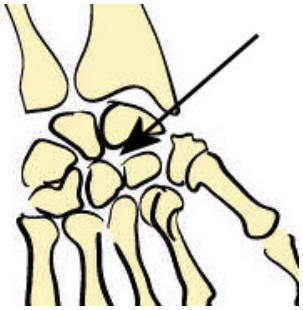
Step 1 Reduction of dislocation.
Step 2 Sling and painkillers.
Step 3 After four weeks start gentle passive exercises.
Step 4 As range of movement increases, move onto strengthening and stability exercises using theraband and weights with pulleys.
Step 5 Restart gentle contact training when cleared by your physiotherapist or doctor.
Step 6 Continue a maintenance exercise programme to keep your rotator cuff muscles strong.

Dr Chris Milne
Sports Physician

January 2006
revised April 2008

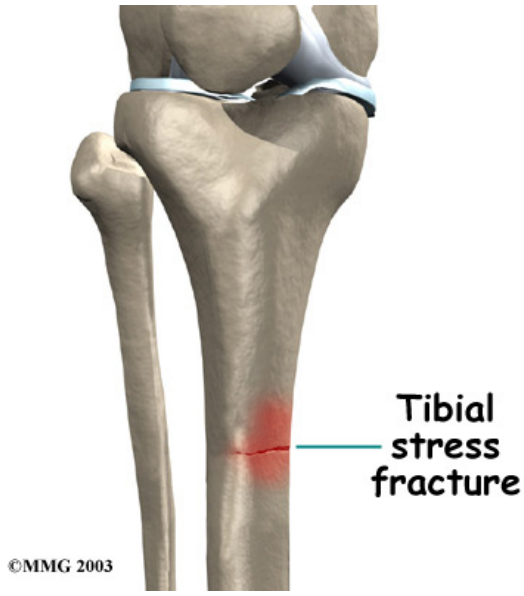
Examples of Synovial Joints

Joint Type	Movement at joint	Examples	Structure
Hinge	Flexion/Extension	 **Elbow/Knee**	 **Hinge joint**
Pivot	Rotation of one bone around another	 **Top of the neck** (atlas and axis bones)	 **Pivot Joint**
Ball and Socket	Flexion/Extension/Adduction/ Abduction/Internal & External Rotation	 **Shoulder/Hip**	 **Ball and socket joint**

Saddle	Flexion/Extension/Adduction/ Abduction/Circumduction	 **CMC joint of the thumb**	 **Saddle joint**
Condyloid	Flexion/Extension/Adduction/ Abduction/Circumduction	 **Wrist/MCP & MTP joints**	 **Condyloid joint**
Gliding	Gliding movements	 **Intercarpal joints**	 **Gliding joint**

STRESS FRACTURES & TRAINING

Stress fractures are partial or complete fractures of bone, often called fatigue fractures since they are caused by repetitive strain during sub-maximal activity. They result from the inability of the bone to react favourably to the stress imposed. There are two main types of stress fracture: 'fatigue' fracture and 'insufficiency' fracture. A fatigue fracture results from the application of abnormal muscle stress or torque to a bone with normal elastic resistance, and is associated with new or different activity, and strenuous or repeated activity. Insufficiency fractures result from normal muscular activity stressing the bone, and are commonly seen in post-menopausal and/or amenhorroeic women, whose bones are deficient in mineral or elastic resistance



Lower limbs tend to be the most common sites for stress fractures, although the specific anatomical site depends on the type of activity. Gymnasts and cricketers may develop fractures in the lumbar spine, while dancers develop them in the foot. Stress fractures have been reported to occur in almost all sports, including swimming and wrestling

What causes them?

There are two theories about the origin of stress fractures. The 'fatigue theory' suggests that during repeated efforts (as in running), the muscles become unable to support the skeleton during impact as the foot strikes the ground. Instead of the muscles absorbing the shock, the load is transferred to the bone. As the loading surpasses the capacity of the bone to adapt, a fracture develops. The 'overload theory' suggests that certain muscle groups contract in such a way that they cause the attached bones to bend. After repeated contractions and bending, the bone breaks.

Stress fractures are probably preceded by periostitis (inflammation of connective tissue covering the surface of bone), causing bone pain and pain during exercise. Management of shin splints involves rest; if the symptoms still persist after two weeks, a stress fracture is suspected. When the pain has persisted for six weeks or more, a stress fracture is the likely cause. In about half of the cases, symptoms start appearing slowly, while in the other half they appear without warning. First, pain is felt during training but not at rest. With continued training, pain increases as the intensity increases.

Pain will persist after exercise, and at some point localised swelling and tenderness are apparent at the fracture site. Stress fractures are not seen initially on X-ray, which makes diagnosis difficult. The treatment of stress fractures involves rest from usual weight-bearing activity for about four-to-eight weeks, and until the pain has gone

How common are they?

In runners, stress fractures tend to be more common than in all the other sports put together. Stress fractures have been reported to comprise about 10 per cent of all sports injuries, and between 4.7 per cent and 15.6 per cent of all running injuries. Among women runners, some studies have found that the incidence of fracture was 49 per cent among those with very irregular menstruation and 39 per cent among those with irregular menstruation. In addition, runners with menstrual irregularities tended to suffer more from multiple stress fractures

About 20-25 per cent of stress fractures occur in the fibula, the tibia and the metatarsal bones. Runners most frequently develop fractures of the tibia.

What are the risk factors?

There are a wide variety of factors commonly linked with the risk of stress injuries to the bone:
Age: The risk appears to grow with increasing age as the bone in older individuals is less resistant to fatigue. The risk is also linked to declining fitness

Training errors: Commonly, stress fractures appear after a change in activity and an increase in running mileage and intensity. Excessive running on hard surfaces that absorb force poorly, and running on crowned roads which cause an unequal distribution of weight within the foot, have been implicated. If, after a lay-off, training is resumed at the same volume and intensity, the athlete will be at an increased risk of developing stress fractures. Beginners are similarly at risk.

Prevention

Although the occurrence of stress fractures and stress reactions on the bone is often multi-factorial and not very well understood, there are a number of important preventive measures you can take

1. Avoid abrupt increases in overall training load and intensity. Take adequate rest
2. Buy less expensive shoes and change them frequently. As a general rule, running shoes tend to lose their shock-absorbing capacity by 400 miles
3. Bony alignment may be modified to some extent by the use of orthotics in the shoes and taping the foot and/or ankle. Those with hyperpronating feet may choose shoes with maximally rigid heel counter. Expert advice is needed for correct choice of insoles and taping techniques
4. Women athletes should pay careful attention to training, hormonal status and nutrition, and recognise any eating disorder