

# **Good Counsel College**

**Year 9/10 Health and PE  
2021-2022 Workbook**

**Good Counsel College**

Year 9/10 Health and PE 2019–2020 Workbook

ISBN: 9780655016878

First published in 2019–2020 by  
Flexibooks, a Division of Macmillan Science and Education Australia Pty Ltd  
ABN 96 004 688 519  
Level 1, 15-19 Claremont Street  
South Yarra Vic 3141  
flexibooks@macmillaneducation.com.au

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Publisher: Olive McRae

Writers acknowledged on units, additional content: Michelle Bradford, Nigel Chin, Bodye Darvill, Damien Davis, Debbie Fry, Nicole Harvey, Emma Holder, Marie James, Melissa Kemble, Lauren McGregor, Stephanie McLeay, Tess Moloney, Eleni Psillakis, Natalie Tencic, Elizabeth Thorne

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Cover photo: iStockphoto.com/SolStock

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Printed in Australia

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# Foreword

Welcome to Health and Physical Education at Good Counsel College! In Year 9 and 10, you will learn about fitness testing and programming, sports psychology and biomechanics of the body, as well as engage in a range of practical activities and sports. Your Health and PE classes will encourage you to develop your mental and emotional health, as well as your physical strength and endurance. You should consider our classrooms a safe place in which you are able to discuss sensitive topics openly and confidently. Practical lessons will encourage participation for all and a supportive team environment.

Below you will find some guidelines for participation in your Health and PE classes. Please take the time to read through the information, speak to your teacher if you have any questions and sign the declaration on the following page.

Most importantly, remember to try your best and have fun!

## Course outline

You will have one theory lesson and two practical lesson each week.

Year 9	Term 1	Term 2	Term 3	Term 4
Theory	Body Systems	Fitness Testing	Fitness program design	Discrimination in sport
Practical	League Tag	Fitness testing Minor Games	Styles of training (Resistance, Cardio, HIIT, Plyometric, flexibility, etc.)	Netball

Year 10	Term 1	Term 2	Term 3	Term 4
Theory	Movement Skills (skill acquisition)	Biomechanics	Sports Psychology	Drugs in sport (ethics)
Practical	Soccer/Futsal	Volleyball	Archery	Weights/resistance training

## What to bring to your lessons

Please bring the following items to your Health and PE lessons:

### Theory

- This workbook
- Pens and pencils
- Any completed homework or assessment tasks
- A smile!

### Practical

- This workbook
- Correct uniform including shoes (do not forget your hat!)
- Water bottle
- Sunscreen will be provided

## Uniform policy

You are required to wear the correct sports uniform for all practical lessons. This includes:

- Comfortable lace-up sports shoes and socks
- Sport pants or appropriate shorts
- Sport shirt or appropriate sleeved shirt
- School hat

You will be given time at the start and end of each lesson to change into your practical uniform. If you are unable to participate in a practical lesson for any reason, you will need to provide a note from your parent or guardian.

Please ensure any valuables such as jewellery, wallets or laptops are left in your locker before practical lessons. Do not bring them to the sports field or change rooms.

## Illness or injury

If you are unable to participate in a practical lesson due to illness or injury, you will need to supply a note from your parent or guardian. If you are unable to participate for more than three consecutive practical lessons, you will need to supply a doctor's note.

If you are not participating in a practical lesson, you will be required to assist your teacher as needed with setting up or packing up, or complete activities in this workbook for the duration of the lesson.

## Health and PE declaration

I, \_\_\_\_\_, have read and understood all the information above. I agree to participate in both theory and practical lessons to the best of my ability and promote a supportive and encouraging environment for my classmates.

**Student's signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

## Information for parents and guardians

Dear parents and guardians,

Please be aware that during the course of our Health and PE studies at Good Counsel College, we will be addressing issues regarding Drugs in sport. This topic will be studied using the content and activities within this workbook, as well as extra resources including online videos.

All topics will be discussed in a sensitive manner that adheres to the core values of Good Counsel College, and in a way that encourages all students to actively participate in discussions and respect the contributions and opinions of their classmates.

If you have any concerns regarding the topics that will be studied by your child in Health and PE this year, please contact the school to arrange an appointment with myself or your child's teacher.

Kind regards,

Health and PE Coordinator





# Advanced body systems and energy

## Introduction

### Energy and physical activity

Energy systems

### Interrelationships between body systems

The skeletal system

The muscular system

Circulatory system

Respiratory system

# Introduction

To play sport, be physically active and generally move about in our daily lives we need to move our bodies with relative ease and without undue stress. We need fuel and hydration for our bodies to function, and our body systems need to work together to provide efficient movement.

A skilled and physically fit body will resemble an efficient machine that is well hydrated and fuelled, and is geared to automatically move to the most efficient energy system for the task it is about to perform. This machine will perform well in the pursuit of effective movement during sport and physical activity if it is well-tuned (trained).

## Energy and physical activity

They say ‘you are what you eat’. This indicates that what you put into your body is what you will get out of it—by eating healthy foods, you will look and feel healthy. The intake of energy (the food we eat) for physical activity is an important factor to consider before, during and after the performance of any physical activity. It is not simply a matter of how many kilojoules are consumed—the type of food is very important too. If an athlete consumes a lot of sugary foods for instant energy (simple carbohydrates) this will not be of benefit to them, as this quick energy burst can result in very low energy levels soon after, as well as cravings for more. It is far better for an athlete to consume something that offers sustained energy, such as bread, rice, fruits and vegetables. These foods are rich in complex carbohydrates and will maximise energy output. Overall, people should have a nutritious balance of foods in their diet—they will perform much better, feel great and, as a result, be able to maintain a healthier lifestyle.

The three main nutrients we consume are carbohydrates, protein and fats. The most efficient muscle fuel (or energy source) we consume is carbohydrate, as it supplies our muscles with glycogen, which in turn acts as an energy reserve for the muscles. Protein is important for muscle growth and repair, and fat is used for transportation of hormones and insulation, and can also be a source of fuel when glycogen stores are depleted.

When an athlete is participating in a sport or physical activity, they need to balance their **energy intake** (the amount of food and drink consumed) with their **energy expenditure** (exercise completed) to maintain a good level of energy. This is often a fine balance for athletes who have an intense training program.


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### ACTIVITY *Analysing energy intake*

- 1 Which is the better snack option before you run a cross-country race: a wholemeal salad sandwich or a chocolate bar? Explain why.

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2 Examine your energy intake over the course of a day.

- a Indicate what changes you could make to your diet to improve its nutritional value.

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- b How would the changes you make be more suitable in sustaining an active lifestyle?

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3 State the result that the following three situations would have on a person's body weight.

Energy balance	Weight change
Energy expenditure = energy intake	
Energy expenditure > energy intake	
Energy expenditure < energy intake	

## Energy systems

There are two main classifications of energy systems: the aerobic energy system and the anaerobic energy system. One of the most important components of these energy systems is Adenosine triphosphate (ATP), which is the chemical compound that allows your muscles to contract. Your muscles are only able to store about one second's worth of this compound (enough for a powerful contraction), and after this is used, your aerobic and anaerobic energy systems need to produce more to allow you to keep moving.

### Aerobic energy system

The aerobic energy system is used for long duration or endurance exercise that uses oxygen to break down carbohydrates, fats and protein. The aerobic energy system will produce ATP when you are participating in moderate- to low-intensity physical activity, and your muscles are able to get enough oxygen. This system is used most often, as we use it for day-to-day living and basic activities. It is also the most important energy system for endurance athletes. The majority of physical activity will commence with this system and call upon the anaerobic system when faster or more powerful movement is required.

### Anaerobic energy system

The anaerobic energy system is used for exercise that is of short duration or involves stops and starts. ATP is produced by the anaerobic energy system when there is not enough oxygen present in the muscles to produce the energy required for high-intensity activities, like sprinting. The anaerobic system is broken into two types.

#### ATP CP

Commonly known as the phosphate energy system, this system relies on stores of creatine phosphate as the energy source and is used in very fast or explosive movements (10 seconds or less). The phosphate energy system would be used when throwing a javelin, or jumping in long jump. Your aerobic energy system replenishes your store of creatine phosphate while you rest between high-intensity activities.

## Anaerobic glycolysis

Commonly known as the lactate energy system, this system relies on the use of glycogen for energy. Glycogen is stored in the liver and muscles, and when it is broken down during physical activity, it produces ATP. However, the glycogen does not break down completely—it leaves lactic acid as a by-product. An accumulation of lactic acid in the muscles can cause pain, fatigue and weakness. The lactate energy system is able to produce energy for longer than the creatine phosphate system (from 5–30 seconds), and would be used in an activity like the 200 m sprint.

Of these main ways that our bodies can make energy for movement, the energy system that is used is determined by the type, duration (the length of time) and intensity (difficulty) of the exercise undertaken. A combination of these energy systems is used for participation in most sports or physical activities. For example, an endurance athlete would use the aerobic system for the majority of a long distance event but to maintain the same speed up a steep hill they would need to use the anaerobic lactate or phosphate systems for a small amount of time.

## ACTIVITY Exploring energy systems

- 1 Explain what ATP is and what it does.

What are the characteristics of each of the energy systems listed?

**Aerobic**

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ATP CP

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### Anaerobic glycolysis

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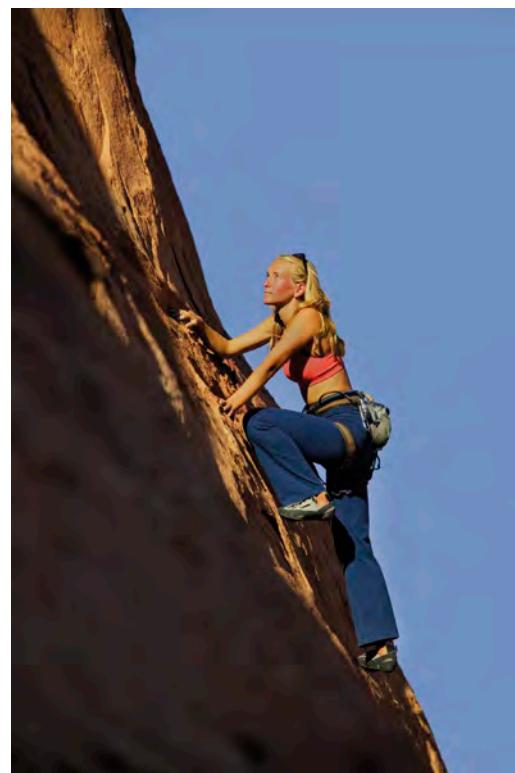
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- 3 Which sort of activities do you think would be most dependent on the ATP CP system? List at least three.

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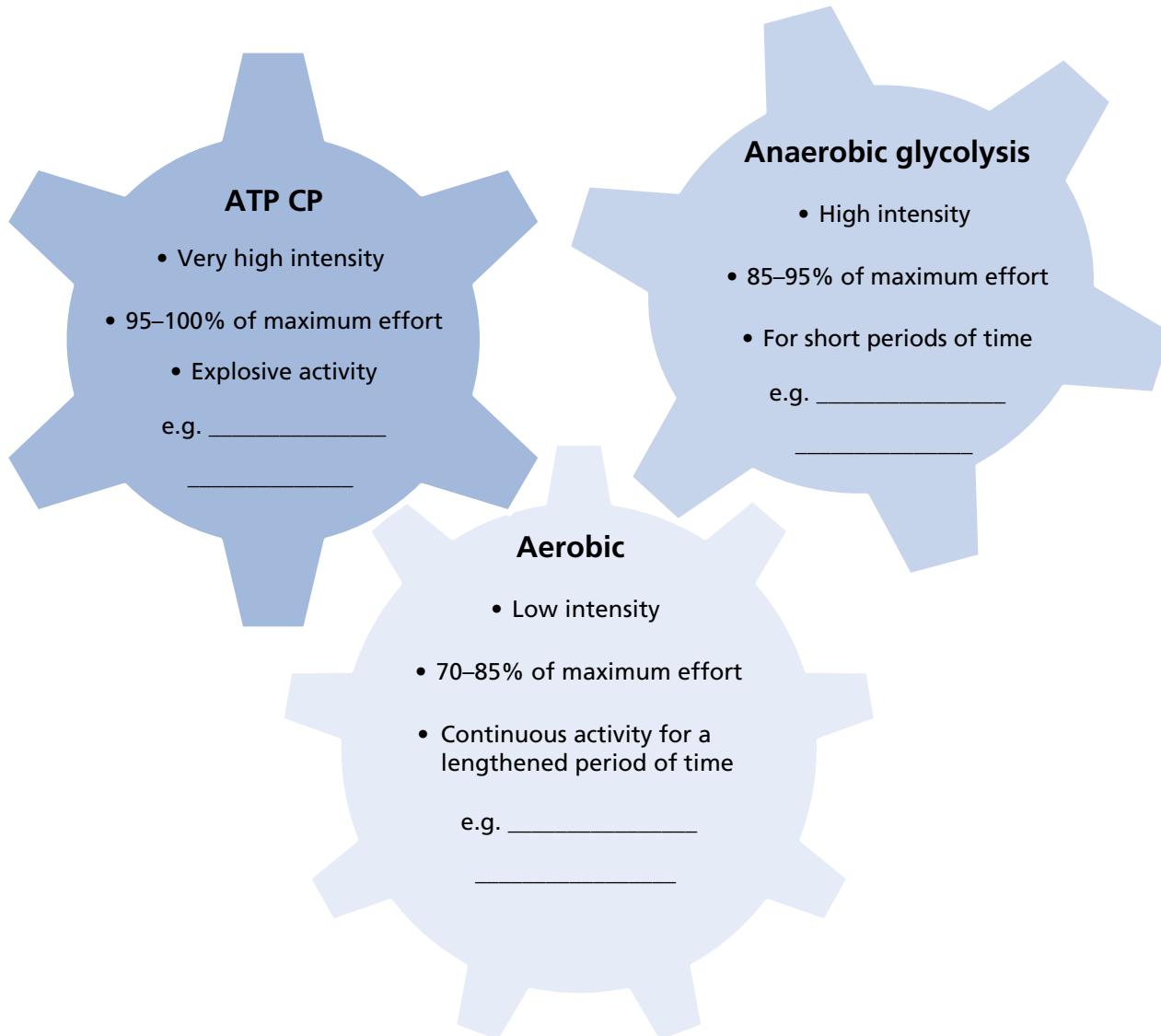
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- 4 In the diagram provided, give an example of a physical activity that would use each energy system.



*Energy systems for exercise*



- 5 Use the table to document all of your physical activity for a week. Identify which energy systems you used for each one, and indicate the approximate proportion each energy system contributed to each activity.

	<b>Physical activity</b>	<b>Energy systems</b>
<b>Mon</b>	e.g. Walked 20 min to bus stop, sprinted at end so would not miss it	aerobic 95%; anaerobic phosphate 5%
<b>Tue</b>		
<b>Wed</b>		
<b>Thu</b>		
<b>Fri</b>		
<b>Sat</b>		
<b>Sun</b>		



- 6 Describe how you would train if you wanted to improve each of the energy systems.

Aerobic

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ATP CP

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Anaerobic glycolysis

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- 7 Read the article 'Anatomy of an athlete' at the following link and identify which energy systems are being used by each athlete: <[flexibooks.com.au/w/22s](http://flexibooks.com.au/w/22s)>.

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## Interrelationships between body systems

Our bodies incorporate a number of systems that play a vital role in keeping us alive, well and functioning. These include the circulatory system, digestive system, and muscular system to name a few. A body system is a set of organs and body parts that do a particular job. All of the body systems are interrelated.

### The skeletal system

The skeletal system consists of over 200 bones, joints, cartilages and ligaments. It is our main support structure in all physical activities and is responsible for:

- Providing stability during movement. For example, to run in a well-balanced way an athlete needs to use the stability of the skeletal system, in combination with the muscular system. The position of the head, shoulders, arms and midline, as well as extension and flexion of the hips, knees, ankles and toes needs to be correct to allow the athlete to stride out and run well.
- Providing the internal frame for our muscles and joints to work together to perform voluntary movement.
- Enabling our bodies to move efficiently, by providing support and leverage so that well-balanced movement can occur.



### ACTIVITY A closer look at the skeletal system

- 1 List three of the main functions of the skeleton. Can you think of any others?

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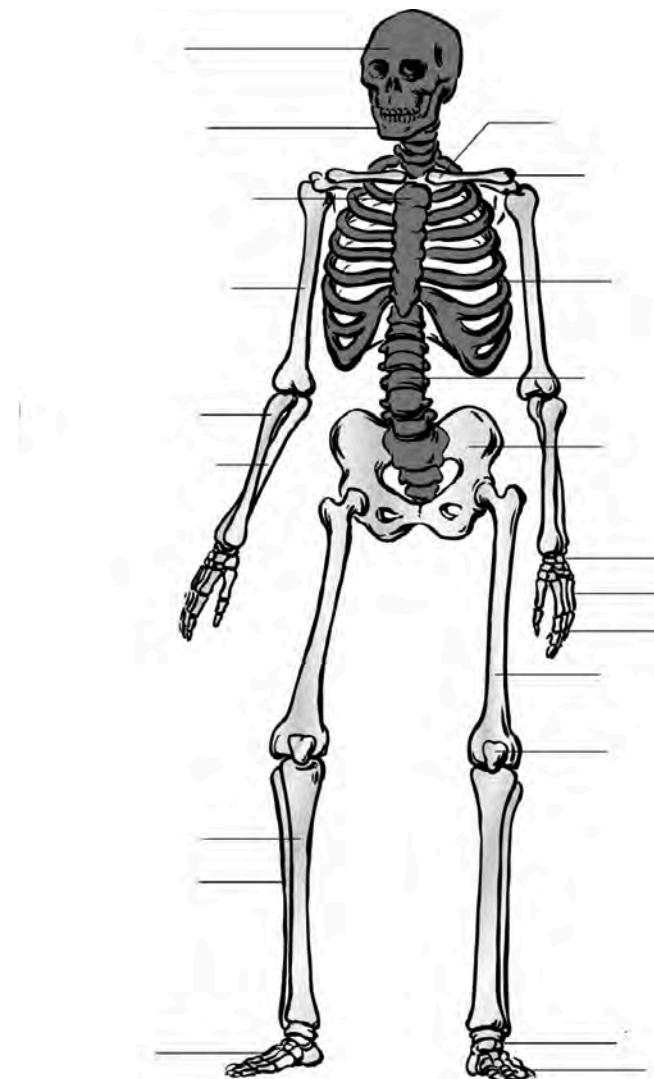
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- 2 Research the human skeleton using the internet or books from the library. Label the skeleton provided using the following words: (Try and also add the common names for the bones e.g. the cranium is commonly known as the skull.)

<b>femur</b>	<b>mandible</b>	<b>spine</b>	<b>humerus</b>	<b>tarsals</b>
<b>ulna</b>	<b>phalanges (x2)</b>	<b>fibula</b>	<b>metatarsals</b>	<b>cranium</b>
<b>clavicle</b>	<b>scapula</b>	<b>ribs</b>	<b>radius</b>	<b>carpals</b>
<b>metacarpals</b>	<b>tibia</b>	<b>patella</b>	<b>sternum</b>	<b>pelvis</b>



- 3 Complete the table by filling in the appropriate answers.

Anatomical term	Common name
	Hip bone
Patella	
	Finger
Scapula	
	Collar bone
Mandible	



4 What bone have you injured if you:

a break your finger?

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b dislocate your knee?

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c break your forearm?

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## The vertebral column (spine)

The spine runs from the skull down to the pelvis, and is made up of 33 bones (called vertebrae). These bones are grouped into five regions:

- **Cervical**—seven vertebrae (C1–C7). The cervical region is broken again into upper (C1 and C2) and lower (C3–C7). C1 is also known as the atlas, and it supports the skull. C2 is known as the axis and it provides a pivot that allows the head to rotate.
- **Thoracic**—twelve vertebrae (T1–T12). These are the bones that your ribs connect to. This part of the spine has a limited movement range.
- **Lumbar**—five vertebrae (L1–L5). As you move down the lumbar region, these vertebrae become larger, as this section of the spine bears much of the body's weight and biomechanical stress.
- **Sacrum**—five vertebrae (S1–S5) that are fused together. The sacrum fits between the hipbones and connects the spine to the pelvis.
- **Coccyx**—three to five vertebrae that are fused together. The coccyx is a residual tailbone, but it is also an important attachment for some muscles, ligaments and tendons.

The vertebral column has a range of purposes. It provides protection for the spinal cord and nerve roots; it is a base for the attachment of ligaments, tendons and muscles; it provides structural support and connects the upper and lower body and it allows flexibility and movement.

5 List the regions of the spine and the number of vertebrae in each.

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6 Why are the vertebrae in the cervical and the lumbar region different sizes?

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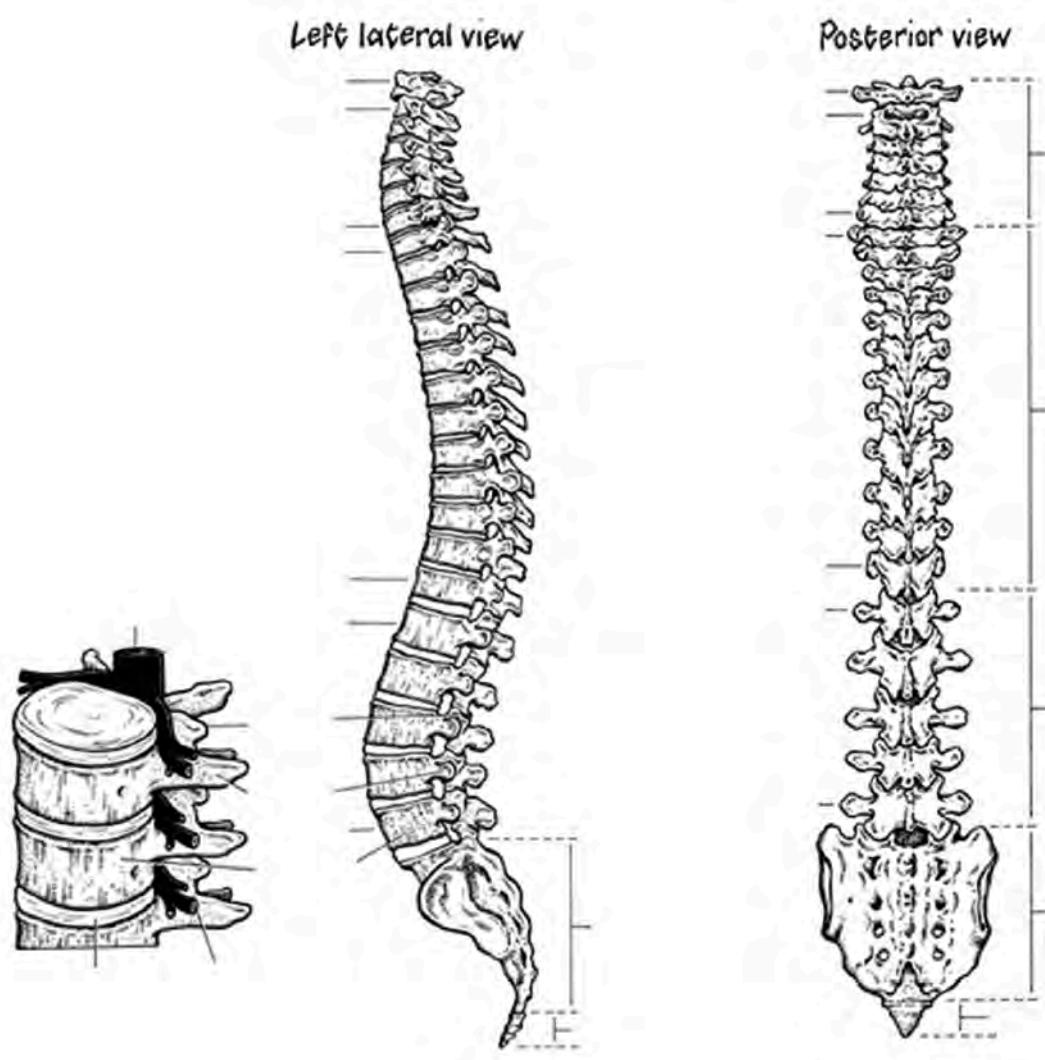
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- 7 Using the information provided, label the vertebral column using the following words.  
Some of these may appear twice on the diagrams.

spinal cord	axis (C2)	coccyx	thoracic vertebrae	nerve root	C7	
lumbar vertebrae	T1	T12	L1	L5	cervical vertebrae	intervertebral disc
			facet joint	sacrum	atlas (C1)	pedicle

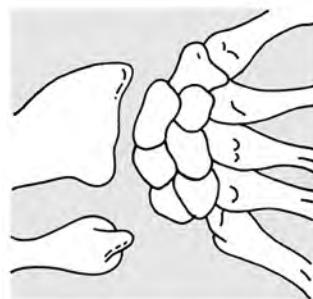
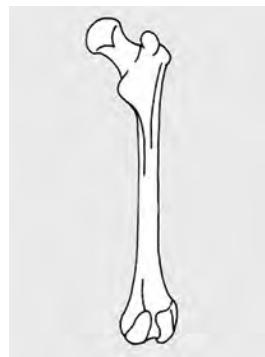
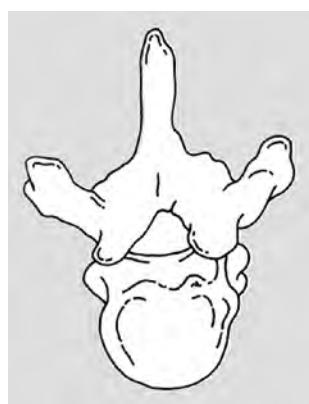
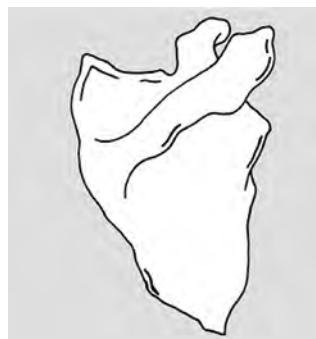


## Bones

Bones are very strong structures that are used to support our body frame. They consist of a hard outer layer, which protects a spongy substance inside called bone marrow. One function of bone marrow is to produce new blood cells.

The skeleton consists of five different types of bones, which are all characterised by their various shapes.

- Long bones—these are long, narrow bones that contain marrow within their shaft, for example, humerus, femur and tibia (Figure 3.3).
- Short bones—these are bones that are as wide as they are long, for example the carpal bones within your wrist (Figure 3.4).
- Flat bones—these protect your vital organs and due to their large surface, provide areas for muscle attachment, for example, the scapula and the rib cage (Figure 3.5).
- Irregular bones—these have no specific shape, however they supply added support and flexibility, for example, vertebrae in the spine (Figure 3.6).
- Sesamoid bones—these are usually short or irregular bones embedded in a tendon, for example, the patella (kneecap).

*Figure 3.4: A short bone**Figure 3.5: A flat bone**Figure 3.6: An irregular bone*

- 8 List the five types of bones and give an example of each (different to the examples already given).

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- 9 Explain why flat bones are important. Give an example.

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## Joins

We already know that the bones of the body fit together to form the skeleton. When two bones join they form what is known as a joint. There are three different types of joints in the body and they are characterised by the type and amount of movement they allow for. They are:

- Immoveable (fibrous) joints—this is where the bones are fused together, therefore allowing no movement to occur, for example, the skull.
- Slightly moveable (cartilaginous) joints—this is where the bones are joined by cartilage. Ribs joining the sternum are an example of this.
- Moveable (synovial) joints—most of the bones in the body form moveable joints in that they can move freely in at least one direction, for example, the knee, ankle and hip. There are various types of synovial joints.

- 10 List the three types of joints and give an example of them (different to the ones already given).

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## Types of synovial joints

Because the majority of joints in the human body are synovial, they are further classified into six categories:

- Hinge—acts like a door hinge, only allowing flexion and extension in one direction, for example, the elbow.
- Ball and socket—allows for a wide range of movement, for example, the shoulder and hip.
- Saddle—allows more movement than a hinge joint, but not as much as a ball and socket. The joint can move back and forth, and up and down, but cannot rotate, for example, the thumb between the carpal and the metacarpal.
- Pivot—is where one bone rotates around another, for example, the first two cervical vertebrae (the atlas and the axis).
- Gliding—is made up of bones that slide past each other, for example, the midcarpal and the midtarsal.
- Condyloid—is where two bones fit together with an odd shape, and one bone is concave and the other convex, for example, the wrist.

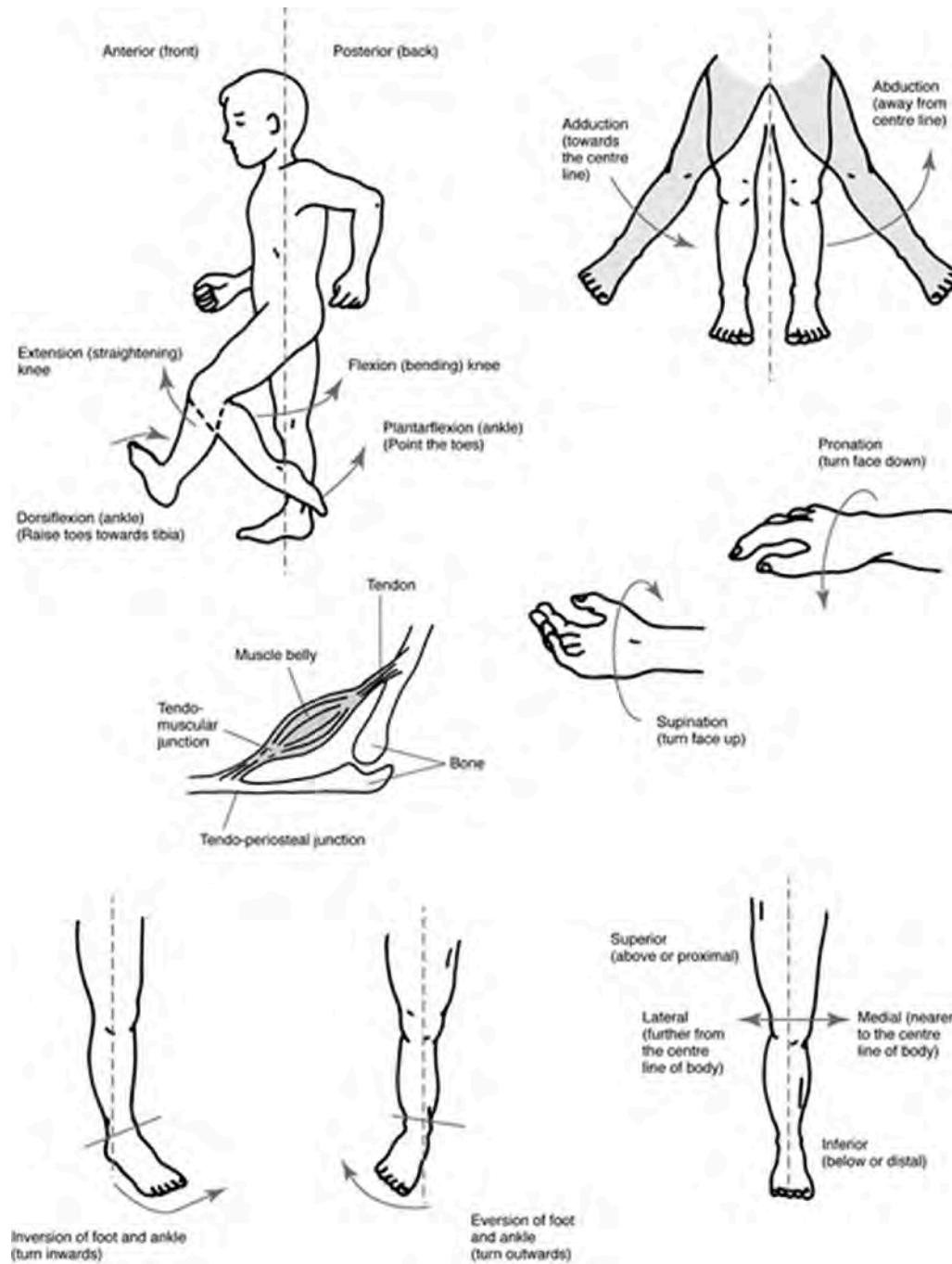
11 Performance lab: Read through the section on 'Types of synovial joints' and the following section on 'Movement' and then use your body to complete the following table.

Joint	Type of joint	Type of movement it performs	Example of skill it could perform
Hip			
Knee			
Neck			
Wrist			
Hand			
Thumb			



## Movement

The synovial joints all allow for various types of movement. Look at the images provided to see what the anatomical names for these movements are.



- 12 Pick three moveable parts of your body that you have not already mentioned in the activities prior, and match them to the type of joint they are.
- 
- 
-



# Joint structures

## Connective tissues

Connective tissues are responsible for supporting the joints of the body, initiating movement and providing stability. There are three main types of connective tissue:

- Cartilage—a smooth, slightly elastic tissue that is found covering the end of the bones in most synovial joints. It provides shock absorption, for example, in the vertebral column, and is resistant to wear.
- Tendons—join muscle to bone. They are very strong and rigid and allow for free movement of joints.
- Ligaments—join bone to bone across joints. Their slight elasticity provides stability however only allow minimal movement at joints.

# The muscular system

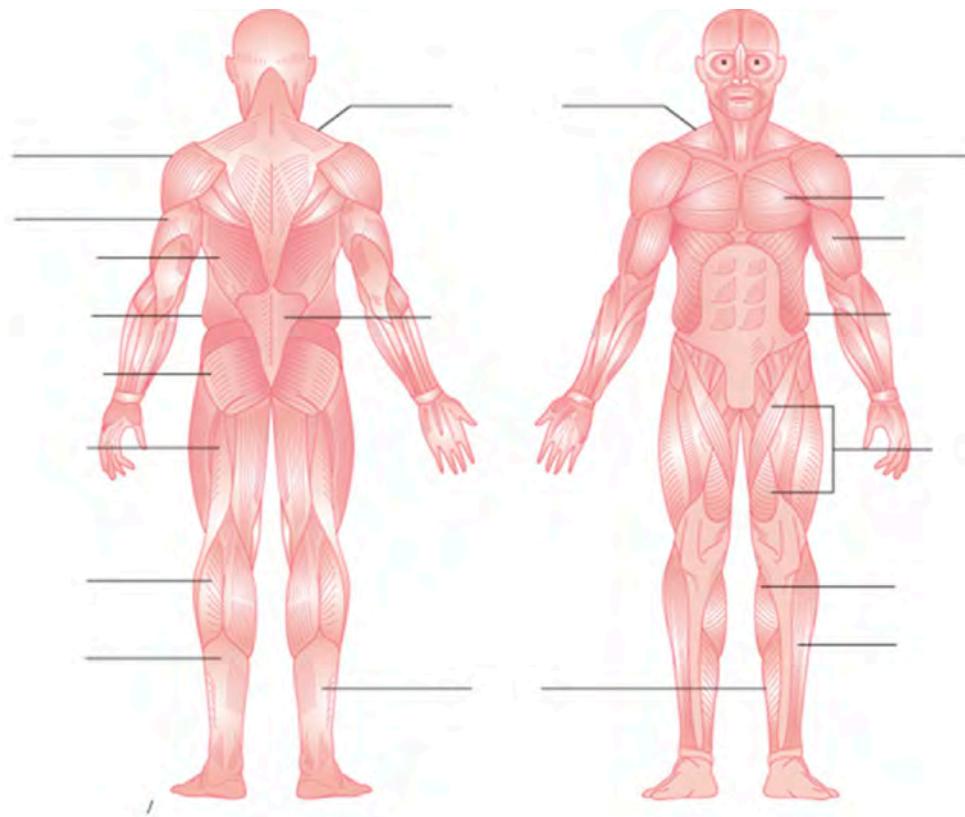
The muscular system consists of over 650 muscles and its role is to allow the body to move in order to participate in day-to-day activities, and to perform sports and physical activity. The muscular system combines with the skeletal and circulatory systems to perform voluntary movements. The more movement muscles perform, the stronger and more efficient they become.

Your muscles make up about 40–50 per cent of your total body weight. Muscles provide support to enable good posture, initiate movement and maintain essential bodily functions.

## ACTIVITY A closer look at the muscular system

- 1 Research the muscular system using the internet, or books from the library. Label the diagram provided using the following words:

quadriceps	triceps	biceps brachii	soleus
biceps femoris	gastrocnemius (x2)	latissimus dorsi	pectoralis major
trapezius	gluteus maximus	erector spinae	external oblique (x2)
deltoid (x2)	tibialis anterior	Achilles tendon	





## Muscle types

There are two types of muscles:

- Voluntary muscles—muscles in your body over which you have control.
- Involuntary muscles—muscles that work automatically. You have no control over them, for example, they move food through the digestive system and pump blood from the heart.

### 2 State whether the following movements are voluntary or involuntary.

Heartbeat

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Kicking a football

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Chewing

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Moving food through the digestive system

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Contraction of pupils when exposed to light

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Bending over

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## Muscular contractions

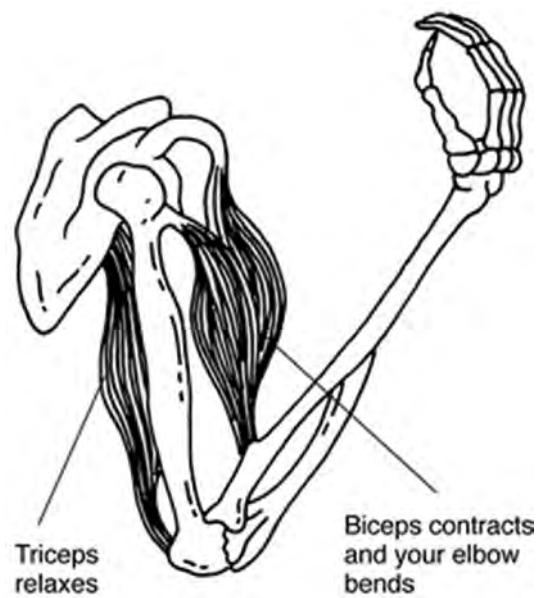
There are different types of muscular contractions.

- Isotonic concentric—all lifting exercises will require isotonic contractions (the muscle shortens as it contracts). You can see evidence of this by flexing your bicep muscle. If you hold an arm out straight, with your palm facing up, and bend your elbow to bring your hand back towards your shoulder, you will notice your bicep muscle will shorten, and bulge.
- Isotonic eccentric—in this case, instead of the muscle shortening as you contract it, the muscle will lengthen. For example, if you lower yourself down a climbing rope, your bicep will lengthen.
- Isometric—this sort of contraction happens when you are contracting a muscle without it changing shape. For example, if you attempt to lift an immovable object, your muscles will be under tension, but will not be able to change shape.

## Skeletal muscle

Skeletal muscles are striped in appearance and work on a voluntary basis. They can either contract (shorten) or relax (lengthen) to allow for movement and develop good posture.

- They work in opposing pairs to control joint movements. When one muscle in a pair contracts (agonist), the opposite muscle relaxes (antagonist). Your biceps bend your elbow while your triceps straighten your elbow and your quadriceps straightens your leg while your hamstring bends your leg.
- When muscles on one side of a joint relax to allow the muscles on the other side of the joint to contract, this is called reciprocal inhibition.





- 3 Explain the difference between the agonist and the antagonist and give an example.

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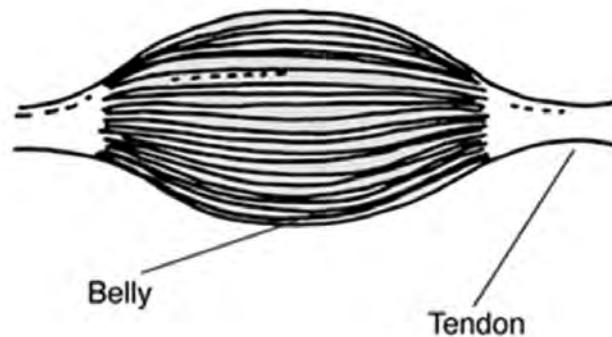
- 4 What is reciprocal inhibition?

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### The belly

Each skeletal muscle is made up of a belly, which is the bulk of muscle consisting of long fibres (cells) that are connected to bones at either end by a tendon. If you bend your elbow you can see your bicep's belly.



### The tendon

The tendon is a thick cord that attaches the belly of the muscle to the bone, for example, your hamstring tendon is behind your knee.

## Smooth muscle

These are involuntary muscles that are found in the digestive system and within the walls of other organs such as the bladder. The diaphragm is a very important smooth muscle since it is involved in the breathing process.

## Cardiac muscle

As the name suggests, the cardiac muscle is the muscle of the heart. It is an involuntary muscle with a striped appearance.

- 5 Performance lab: Perform the following activities in pairs. Identify which major muscles and bones are responsible for each movement.

Activity	Major muscles
10 sit ups	
10 push ups	
Running	
10 squats	
Shooting a basketball	

## Slow and fast twitch muscle fibres

Muscles can be further broken down into two types—slow twitch (type I) and fast twitch (type II). We have both types of fibres in most of our muscles, but the percentage we have of each is genetically determined, and varies in individuals.

Slow twitch muscles fibres are able to use oxygen to create fuel more efficiently, and so they are better for continuous, extended muscle contractions. They are also less susceptible to fatigue than fast twitch muscles fibres. Athletes like marathon runners and endurance riders make good use of their type I muscles.

Fast twitch muscles fibres use anaerobic metabolism to create fuel, so they are much better at producing short bursts of strength or speed. Type II muscles fatigue more quickly, but they would be an asset to a sprinter or a weight lifter.



- 6 Using what you have learnt so far, explain the relationship between the aerobic and anaerobic energy systems and short and fast twitch muscle fibres.

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## Muscle size

During puberty, hypertrophy (muscular growth) will occur, especially in males. Muscle growth can be increased during a person's life through strength training, and other short-duration, high-intensity anaerobic exercise.

The opposite of hypertrophy is atrophy (decrease of muscle mass). Atrophy will make a muscle weaker, as the ability to exert force is related to the mass of the muscle. Many diseases and conditions can cause atrophy—even something as simple as having a cast put on your arm or leg and not being able to move the muscles for several weeks. As a person ages, their ability to maintain skeletal muscle function and mass decreases.

### ACTIVITY *Influences on muscle size*

- 1 Explain hypertrophy and atrophy and give an example of how each can occur.

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- 2 Discuss why researchers suggest that adults should participate in an exercise regime that includes some form of moderate continuous activity in conjunction with weight bearing exercises.

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# Circulatory system

The circulatory system is a very complex system that relies on the heart and lungs to circulate blood, oxygen and waste products around and out of the body. The heart, blood and blood vessels work together to service the cells of the body. All cells in the body need to receive oxygen and nutrients, and they need to have their wastes, such as carbon dioxide and water, removed. The circulatory system also works to control body temperature.

The heart is the centre of the circulatory system. It is a muscle that is positioned in the centre of the chest and is an involuntary muscle (works on 'auto-pilot'). This means that without instruction from the brain the heart will keep pumping blood around the body without stopping.

Arteries carry oxygenated blood from the heart through our bodies, and veins carry deoxygenated blood back to our hearts. The oxygenated blood is carried via red blood cells, which are filled with haemoglobin, a molecule that can bind to oxygen. Red blood cells are also produced in bone marrow.

Capillaries are the smallest blood vessels in the body, and they connect the arteries and veins. They enable the interchange of water, oxygen, carbon dioxide and nutrients and wastes between the blood and the surrounding tissue.

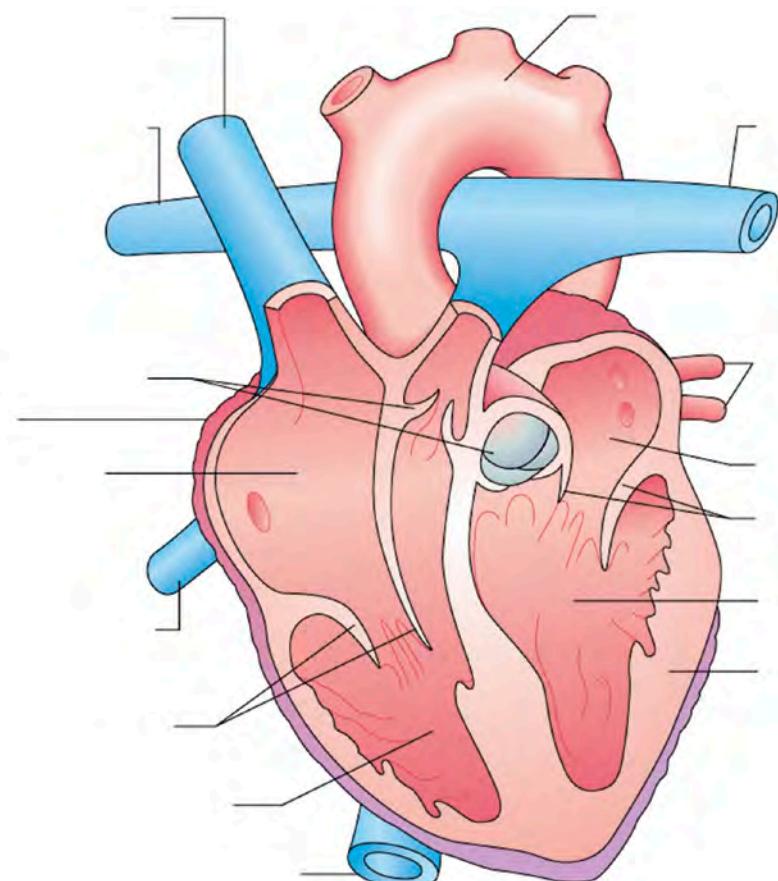
The right upper chamber (atrium) of the heart receives deoxygenated blood that is heavy with carbon dioxide. The blood is pushed into the right lower chamber (ventricle) and taken by the pulmonary artery (the only artery that carries deoxygenated blood) to the lungs, where oxygen replaces the carbon dioxide. (This is known as pulmonary circulation.)

The oxygenated blood travels back to the heart, where it enters the left upper chamber (atrium). It is pumped into the left lower chamber (ventricle) and then into an artery, and circulates around the body (this is known as systemic circulation).

## ACTIVITY Identifying the circulatory system

- 1 Label the diagram with the terms listed. If you can, try and find the name that goes with each of the lines on the diagram. You may need to do further research using the internet, or books in the library.

right atrium	right ventricle	aorta x2	bicuspid valve	superior vena cava
inferior vena cava	pulmonary veins	cardiac muscle	left atrium	left ventricle
fat	tricuspid valve	semilunar valves	pulmonary artery x2	





- 2 Name five of the functions of the circulatory system in our bodies.

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- 3 What is the main function of the chambers of the heart?

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- 4 Using the information on the heart, answer the following questions. You might also find it useful to visit <[flexibooks.com.au/w/2j7](http://flexibooks.com.au/w/2j7)>.

a What are:

Arteries?

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Veins?

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Capillaries?

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b How do these three types of blood vessels differ?

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c What are the roles of the following types of blood cells, and where are they produced?

Red blood cells

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White blood cells

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d Name any other parts of the blood and describe their role.

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- e Blood is circulated through the body through systemic circulation and pulmonary circulation. What do each of these terms mean?

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- 5 Look back at the section on bones, and explain the relationship between blood cells and bones.

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## Circulation and exercise

During exercise the circulatory system works very efficiently to circulate oxygen to the working muscles, which is achieved by the heart pumping blood. During anaerobic exercise, the circulatory system rids the body of the waste product: lactic acid.

The circulatory system regulates the circulation of blood around the body and transports oxygen to our muscles during exercise. When we are in a relaxed state our heart will pump slower than when we move around or perform vigorous exercise. The resting heart rate of a physically fit person will generally be lower, as the heart would be more efficient at pumping blood, and so would not need to pump as often.

When we exercise, the speed at which blood is pumped around our body is increased and our heart rate rises considerably. A heart that is working with ease is said to be an efficient one and the fitness of an athlete, particularly an endurance athlete, is an indicator of an efficient circulatory system.

### ACTIVITY *Analysing the circulatory system*

- 1 Explain how the resting heart rate of an athlete might be different to that of a person who rarely exercises.

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If an athlete is physically fit they will have an efficient target heart rate for exercise and a relatively low resting heart rate (pulse). The average pulse rate for a fit teenager ranges between 60 and 70 beats per minute.

Some of the immediate effects of exercise are:

- increased heart rate—your muscles use oxygen as fuel which allows them to contract when you exercise. Oxygen is delivered to your muscles via your blood. To get more oxygen to your muscles when you exercise, your circulation needs to increase, and therefore, your heart beats faster.
- increased cardiac output—the amount of blood circulated by your heart in one minute is called your cardiac output. This is lower while at rest and rises during activity—the fitter you are, the higher your cardiac output will be. Cardiac output = heart rate x stroke volume (stroke volume is the volume of blood that the heart pushes out into the arteries every time it beats or contracts.)
- increased blood pressure—as your cardiac output increases, blood travels more quickly through your circulatory system, and so it puts more pressure on your artery walls. This is called blood pressure.



- 2 List and briefly explain three of the immediate effects of exercise on the circulatory system.

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- 3 What changes happen to the body in relation to the circulatory system during exercise?

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- 4 Dave has just had his first ever session with a fitness instructor. The instructor told him that he has a high resting heart rate, and Dave is pleased—he thinks that is a good thing and it means he is fit. Help Dave to understand what having a high resting heart rate means.

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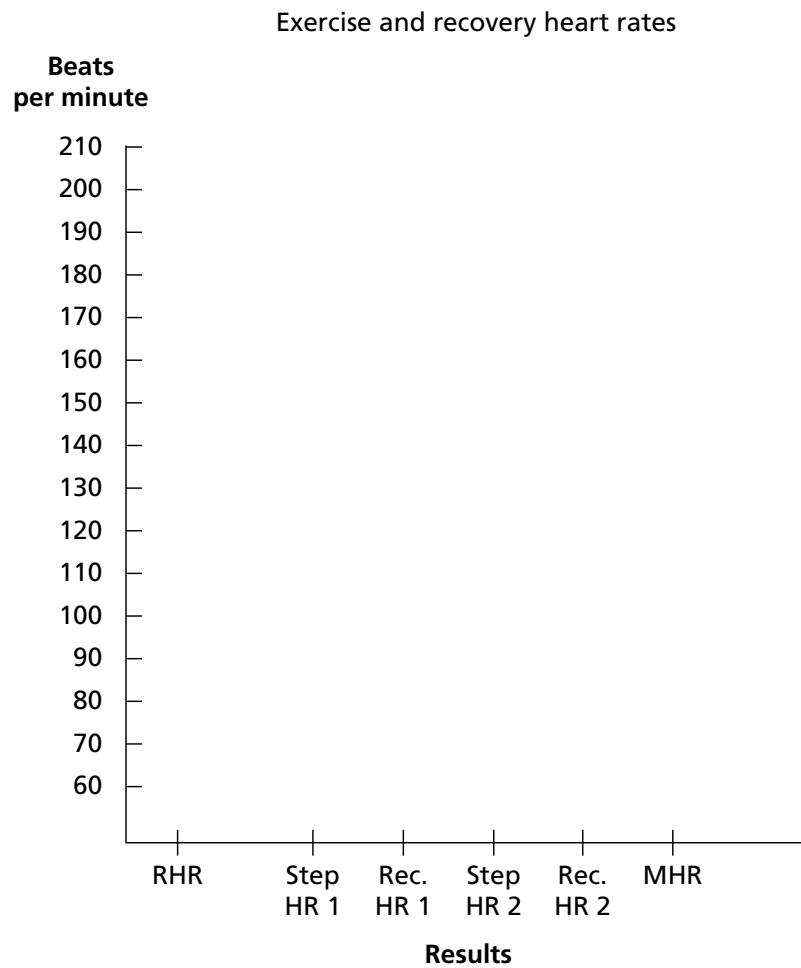
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- 5 Take your pulse to determine your heart rate (in beats per minute) at the intervals specified in these instructions. Work with a partner, who can time you while you count your pulse. Plot your results on the graph.
- Measure your resting heart rate (RHR) while you are relaxed, before you start exercising.
  - Perform an adequate warm-up.
  - Raise your heart rate by stepping on and off a bench as fast as you can for 2 minutes. Take your heart rate immediately after stopping (this is Step HR 1 on the graph).
  - Walk slowly for 1 minute and then rest for 5 minutes. Take your recovery heart rate at the end of this rest (this is Rec. HR 1 on the graph).
  - Raise your heart rate again by stepping on and off a bench as fast as you can for 2 minutes. Take your heart rate immediately after stopping (this is Step HR 2 on the graph).
  - Walk slowly for 1 minute and then rest for 5 minutes. Take your recovery heart rate at the end of this rest (this is Rec. HR 2 on the graph).
  - Calculate your maximum heart rate using the following formula:  
 $220 - \text{your age} = \text{beats per minute}$  (this is MHR on the graph).



## Respiratory system

The respiratory system is a very effective system to supply oxygen to the body. It consists of cavities that allow air to travel to our lungs—the major organ of the respiratory system. The cavities and tubes of the respiratory system lead to our lungs and end with the alveoli—the very important point where oxygen is transported into our blood. Via our blood, oxygen is delivered to our cells, which need oxygen to survive. The respiratory system works closely with the heart to create an efficient circulatory system.

One of the waste products of cells is carbon dioxide. Our respiratory system takes in oxygen from the air we breathe and expels the waste carbon dioxide.



The respiratory system is the system responsible for speech. Exhaled air runs over the vocal cords inside the throat, allowing us to talk.

The movement of air in and out of the body is created by pressure that is regulated by the movement of the diaphragm (the muscle below the lungs). This muscle moves down and the ribs rise to allow air to move into the body (inhaling). The opposite effect is performed in breathing out (exhaling) by raising the diaphragm and lowering the ribs to force the air from the body.

## ACTIVITY *A closer look at the respiratory system*

- 1 List and explain three of the major functions of the respiratory system.

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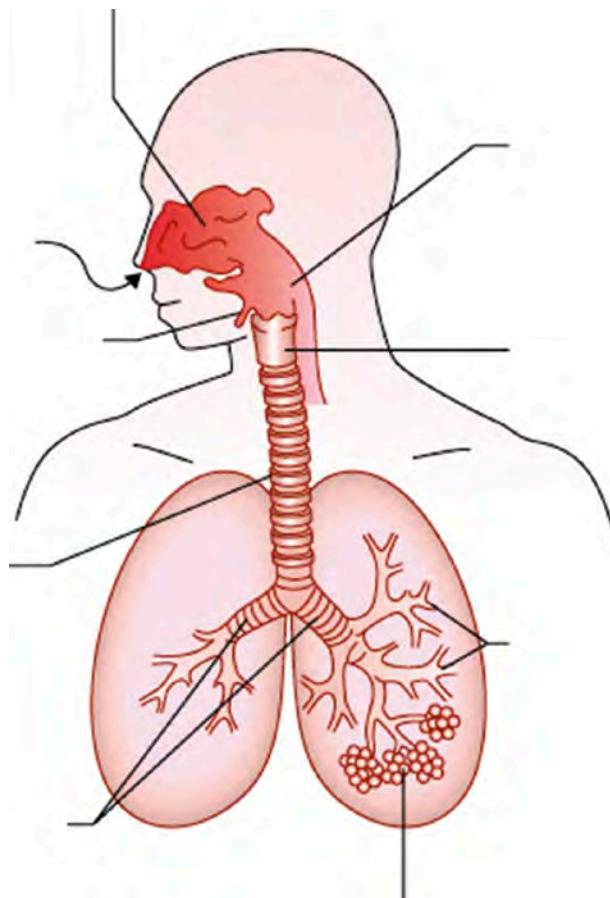
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- 2 Read the information provided and then label the diagram provided with the following terms.

pharynx  
main bronchi  
epiglottis

larynx (voice box)  
alveoli (air sacs)  
nostrils

smaller bronchi  
trachea (wind pipe)  
nasal cavity



*The respiratory system allows for the flow of oxygen in and out of the body.*



# Respiration

**Nose:** The only external organ of the respiratory system. As we breathe, air enters the body through the nostrils, where nose hairs help to trap any particles of dust.

**Nasal cavity:** This is the area inside the nose. Respiratory mucosa lines the nasal cavity—it helps warm and moisten air entering the body, as well as trap invading pathogens.

**Pharynx:** Also known as the throat. It is the muscular passageway that air and food travel through.

**Larynx:** Also known as the voice box. It allows us to create sounds and speak. It also directs food and air to their correct destinations, by means of the flap of elastic cartilage called the epiglottis. Breathing opens the epiglottis and allows air into the lungs, while swallowing closes the epiglottis, directing food into the oesophagus.

**Trachea:** Also known as the windpipe. The warmed air enters the lungs through the trachea, via the bronchi. The trachea is a hollow tube supported by cartilage rings to prevent it from collapsing. Its walls are covered with cilia, which send dust pathogens up the trachea so that they are swallowed and digested.

**Bronchi:** The trachea divides to form the right and left bronchi, which enter each lung.

**Lungs:** The primary organ of the respiratory system, the lungs are inside the chest, protected by the ribcage and wrapped in a membrane called the pleura. They have the appearance of sponges, since they are filled with thousands of tubes, bronchioles, which branch throughout the lungs, becoming smaller and smaller. The smallest components in the lungs are the air sacs called alveoli. There are millions of alveoli in each lung; they are responsible for the transfusion of oxygen to blood. They are also where the exchange of oxygen and carbon dioxide takes place.



- 3 Where can you find the alveoli and what is their function?

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- 4 Where can you find the epiglottis and what does it do?

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- 5 Comment on how the respiratory system and circulatory system are interrelated.

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## Respiration and exercise

The respiratory system supplies oxygen to our muscles to allow movement and supplies oxygen to our brain to allow proper functioning of our body every second of every day. This system is very important for efficient aerobic exercise. It supplies oxygen to the body for all forms of exercise and is vitally important to all athletes, particularly endurance athletes whose main source of energy is oxygen.

To exercise efficiently we need to train our body and this includes our lungs. A trained athlete has a high lung capacity and will be able to transport oxygen with ease into working muscles to enable efficient movement when exercising.

### ACTIVITY *Analysing respiration*

- 1 Describe why the respiratory system is important for aerobic exercise.

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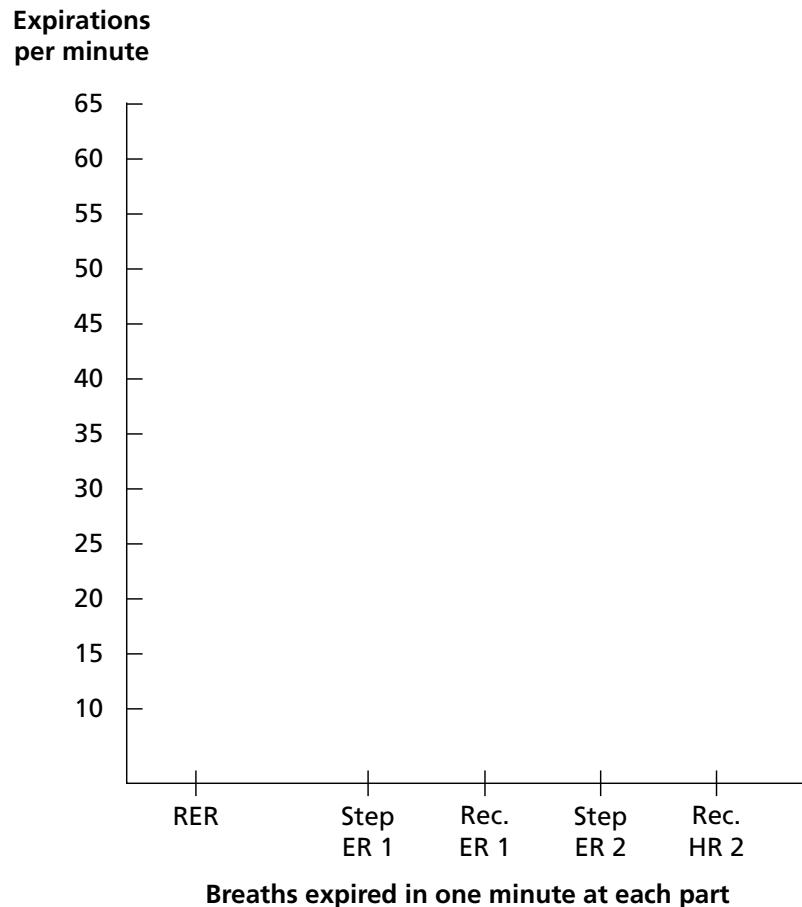
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- 2 Work with a partner to find out how well your lungs perform during physical activity. Count the number of breaths that you expire (breathe out) in one minute to determine your expiration rate (ER). Do this at the intervals specified in these instructions. Plot your results in the graph.

- Measure your resting expiration rate (RER) while you are relaxed and before you start exercising.
- Perform an adequate warm-up.
- Raise your expiration rate by stepping on and off a bench as fast as you can for 2 minutes. Take your expiration rate immediately after stopping (this is Step ER 1 on the graph).
- Walk slowly for 1 minute and then rest for 5 minutes. Take your recovery expiration rate at the end of this rest (this is Rec ER 1 on the graph).
- Raise your expiration rate again by stepping on and off a bench as fast as you can for 2 minutes. Take your expiration rate immediately after stopping (this is Step ER 2 on the graph).
- Walk slowly for 1 minute and then rest for 5 minutes. Take your recovery expiration rate at the end of this rest (this is Rec ER 2 on the graph).



## Expiration rate for exercise and recover



- 3 How did your expiration rate compare at Rec ER1 and Rec ER2?

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- 4 How did your expiration rate compare at Step ER2 and Rec ER2?

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- 5 If you increased your fitness, would you expect the difference between your Step ER and Rec ER to increase or decrease? Why?

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- 6 Work in small groups and research the effects of smoking on the respiratory system. What impact would these effects have on a person while they are exercising? Prepare a poster that displays your findings, and aims to convince young sportspeople not to smoke.

## **ACTIVITY** *Breathe*

Many people, including elite athletes, use exercises such as yoga, tai chi and meditation to develop their ability to control their breathing. Breath control not only improves performance, it has the added benefit of controlling stress levels and relaxing the body.

- 1 As a class, discuss the various ways people within our society use different activities to reduce stress levels.



- 2 In pairs, choose one of these activities and research it further so that you are able to demonstrate it to your classmates.

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- 3 While viewing your classmates' demonstrations, make note of which activities you believe you could practise to maintain your health and wellbeing.

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## What happens when things go wrong?

In order to improve your health and wellbeing it is essential to be aware of your body and how it works. You also need to be able to care for it if you are injured while training or playing sport.

### ACTIVITY *Basic First Aid*

As a class, make a list of the main injuries or conditions that may occur during exercise.

- 1 In groups of three, choose one of the injuries/conditions discussed and do some research to determine the appropriate treatment.

Develop a scenario that you will act out in front of the class which explains how the condition or injury may occur and the appropriate treatment for this condition.

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### ACTIVITY *Review questions*

- 1 Briefly outline the role that the following systems play in our bodies:

Muscular

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Skeletal

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**Respiratory**

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**Urinary**

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**Circulatory**

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**Immune**

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- 2 Can you identify any other systems in our bodies?

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- 3 Describe how the muscular and skeletal systems interact during physical activity.

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- 4 In the table, compare and contrast the demands a long-distance runner and a pole vaulter will place on their body systems.

Body system	Long-distance runner	Pole vaulter
Circulatory/ respiratory		
Muscular		
Skeletal		



# Glossary

**Artery** The part of the circulatory system that carries oxygenated blood from the heart through our bodies.

**Atrophy** Decrease of muscle mass.

**Capillary** The smallest blood vessels in the body, which connect the arteries and veins and enable the interchange of water, oxygen etc.

**Cardiac muscle** The muscle of the heart. An involuntary muscle with a striped appearance.

**Cartilage** A smooth slightly elastic tissue covering the end of the bones in most synovial joints, which provided shock absorption and is resistant to wear.

**Cartilaginous joint** A joint where the bones are joined by cartilage. Ribs joining the sternum are an example of this.

**Energy** A fuel source gained from the food we eat.

**Energy expenditure** Completed exercise.

**Energy intake** The amount of food and drink consumed.

**Fast twitch muscle fibres** Muscle fibres that use anaerobic metabolism to create fuel. They are better at producing short bursts of strength or speed.

**Fibrous joints** Joints where the bones are fused together, therefore allowing no movement to occur, for example, the skull.

**Hypertrophy** Muscular growth.

**Involuntary muscles** Muscles that work automatically, for example, they move food through the digestive system and pump blood from the heart.

**Lactate energy system (Anaerobic glycolysis)** Relies on the use of glycogen for energy, which leaves lactic acid as a by-product.

**Ligament** Joins bone to bone across joints. Their slight elasticity provides stability, however only allow minimal movement at joints.

**Phosphate energy system (ATP CP)** Relies on stores of creatine phosphate as the energy source and is used in fast movements (10 seconds or less).

**Platelets** Tiny, oval shaped cells produced in the bone marrow that help in the clotting process.

**Pulmonary circulation** Deoxygenated blood is taken by the pulmonary artery to the lungs, where oxygen replaces the carbon dioxide.

**Reciprocal inhibition** Muscles on one side of a joint relax to allow the muscles on the other side of the joint to contract.

**Red blood cells** Cells produced in bone marrow and that carry oxygenated blood around the body.

**Slow twitch muscle fibres** Muscles fibres that use oxygen to create fuel more efficiently. Better for continuous, extended muscle contractions.

**Smooth muscle** Involuntary muscles that are found in the digestive system and within the walls of other organs such as the bladder.

**Synovial joints** Joints that can move freely in at least one direction, for example, the knee, ankle and hip.

**Systemic circulation** Oxygenated blood travels back to the heart and is pumped into an artery, and circulates around the body.

**Tendon** Joins muscle to bone. They are very strong and rigid and allow for free movement of joints.

**Vein** The part of the circulatory system that carries deoxygenated blood back to our hearts.

**Voluntary muscle** Muscles in your body over that you have control.

**White blood cells** The cells of the immune system, which defend the body against diseases and foreign material. They are produced in bone marrow.



## ACTIVITY Advanced body systems and energy word search

Find the seventeen words hidden in this word search relating to body systems and energy. Words can run forward, backward, diagonally and vertically.

**Energy****Aerobic****Lactic acid****Sternum****Kilojoule****Cranium****Glycogen****Anaerobic****Femur****Biceps brachii****Intake****Pectoralis major****Quadriceps****Protein****Deltoid****Tibia**

E	F	B	L	Y	N	G	M	V	F	N	Y	S	D	L	G	C	K	N	G
H	N	H	V	F	E	Y	F	E	M	U	R	T	O	A	G	R	V	C	P
T	B	E	M	L	G	O	U	I	T	E	E	E	E	C	Q	E	R	N	E
O	Y	C	R	T	O	X	G	R	V	B	T	R	U	T	D	A	W	H	C
J	U	L	I	G	C	R	V	H	E	A	W	N	H	I	D	T	J	I	T
F	A	R	O	U	Y	G	U	I	I	M	R	U	O	C	P	I	B	T	O
Y	R	H	N	J	L	J	T	D	D	A	J	M	N	A	J	N	Y	U	R
K	H	T	G	E	G	J	B	F	E	W	W	A	V	C	K	E	N	V	A
U	N	G	J	T	V	N	N	M	I	L	H	R	T	I	E	P	W	D	L
K	H	J	N	V	T	U	N	U	I	E	T	B	O	D	W	H	T	G	I
I	N	T	A	K	E	I	H	I	F	D	E	O	Y	G	C	O	E	T	S
L	I	B	E	D	E	T	S	D	Y	R	W	H	I	G	I	S	H	V	M
O	F	E	R	T	Y	G	H	U	J	Y	M	Y	H	D	B	P	X	V	A
J	H	B	O	B	G	B	J	K	U	G	U	B	C	B	O	H	Y	R	J
O	K	R	B	B	H	T	D	E	C	V	I	R	N	V	R	A	Y	F	O
U	P	H	I	V	H	J	T	E	C	G	N	A	R	G	E	T	B	J	R
L	U	T	C	D	E	C	T	I	B	I	A	T	B	U	A	E	V	N	K
E	X	P	E	K	D	Q	T	Y	R	E	R	E	N	C	N	R	E	X	F
M	V	Y	F	E	Y	G	R	S	P	E	C	I	R	D	A	U	Q	U	S
B	B	I	C	E	P	S	B	R	A	C	H	I	I	E	J	I	A	B	A



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# Fitness tests

## Physical fitness

Definitions of physical fitness

## Fitness tests

Test 1: Curl-ups

Test 2: Sit-and-reach

Test 3: 50-metre sprint

Test 4: Vertical jump

Test 5: Push-ups

Test 6: 1.6-kilometre run or multi-stage (beep) test

Test 7: Basketball throw

Test 8: Stork stand

Test 9: Shuttle run

Test 10: Alternate hand wall-toss

Test 11: Grip strength

Summary of ratings

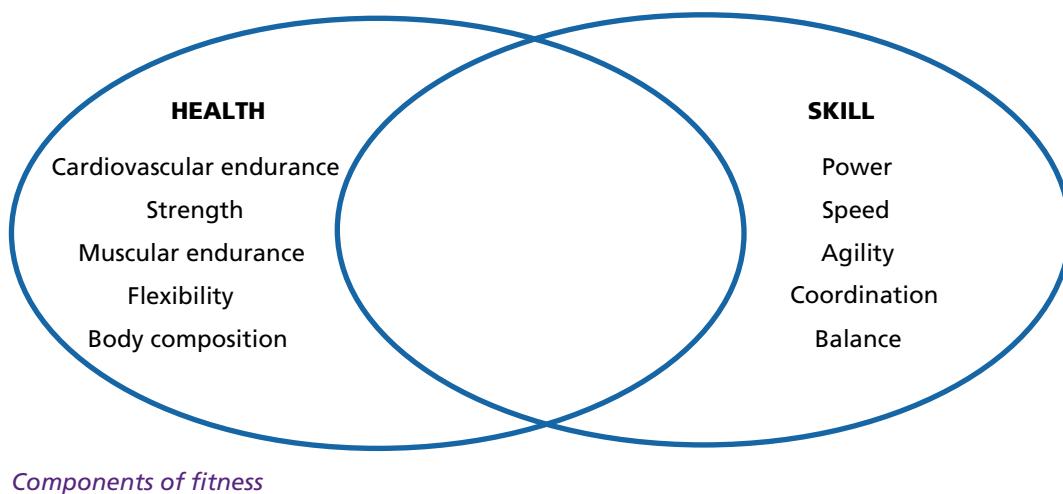
Summary of scores

# Physical fitness

Physical fitness is the ability to perform moderate to vigorous physical activity on a regular basis. This level of fitness requires an understanding of the different components of physical fitness and an awareness of the relationship between training and performance.

## Definitions of physical fitness

Physical fitness refers to **health-related** and **skill-related** components of fitness, which impact the ability to perform physical activity on a regular basis. Health-related physical fitness describes the components of fitness that keep you healthy, including cardiovascular endurance, strength, muscular endurance, flexibility and body composition. Skill-related physical fitness describes the components of fitness that require certain skills such as agility, balance, coordination, power and speed.



## Health-related physical fitness

There are five components of health-related physical fitness:

- **Cardiovascular endurance** is sometimes referred to as aerobic fitness and is the ability of the heart, lungs and blood vessels to supply oxygen to the muscles during prolonged physical activity of moderate to vigorous intensity.
- **Strength** is the maximum amount of force a muscle or muscle group can produce in a short period of time.
- **Muscular endurance** is the ability to exert force several times while resisting fatigue.
- **Flexibility** is the ability to move a joint through its complete range of movement and the degree of flexibility is specific to each joint.
- **Body composition** is a measure of the proportionate relationship of body tissues, including muscle, bone and fat. In terms of fitness, it refers to the percentage of body weight that is made up of body fat.

## Skill-related physical fitness

There are five components of skill-related physical fitness:

- **Agility** is the ability to change the direction of the body or body parts quickly and with control.
- **Balance** is the ability to keep the body upright or in position while static or moving.
- **Coordination** is the ability to move different parts of the body together at the same time.
- **Power** is the ability to use strength with speed, or the maximum force exerted in the shortest time possible.
- **Speed** is the ability to perform movement quickly. It involves anaerobic energy that allows the body to provide quick explosive energy for sprints, jumps or gymnastics routines.



## ACTIVITY Assessing types of activity

- 1 Think about the types of physical activity you participate in and list the four you most enjoy in the table provided.

Assess how the activities you enjoy doing may develop the health-related and skill-related components of physical fitness. Place a cross next to any components of fitness your activity may improve and then answer the questions that follow.

Components of fitness	Example: Yoga	Activity 1: _____	Activity 2: _____	Activity 3: _____	Activity 4: _____
Cardiovascular endurance					
Strength	X				
Muscular endurance	X				
Flexibility	X				
Body composition	X				
Agility					
Balance	X				
Coordination	X				
Power					
Speed					

- 2 Which activity improves the most components of fitness?

---

- 3 Which are most commonly improved: the health-related or skill-related components of fitness?

---

- 4 Which components of fitness are not being developed in the physical activities you enjoy?

---

- 5 What activities could you participate in to develop these missing components of fitness?

---

## Fitness tests

This section outlines how to test each fitness component. Here are some important points to note:

- fitness tests are a guide to your fitness at this stage of your life
- fitness test results tell you the components that you need improvement in, and those you need to maintain at their current level
- you must try your best on each test or the result will tell you nothing.



# Test 1: Curl-ups



## Purpose

Curl-ups give you an indication of the strength and endurance of your abdominal muscles.

## Equipment

- stopwatch
- gym mat
- partner
- pencil (to hold)
- ruler (to place on knees)
- metronome or recorded beat (set at one beat per 3 seconds)

## Description

- Lie on the mat with your knees bent at 90 degrees and feet flat on the floor.
- Hold a pencil in both hands and keep your arms straight.
- Your partner kneels level with your knees and holds a ruler along the top of your knees.
- In time with the beat, curl up by sliding your fists along your thighs until they touch the ruler.
- Uncurl until your head touches the mat.

## Rules

- Your partner counts.
- Your fingers must continually grip the pencil and touch the ruler each curl-up.
- Your head must touch the mat at the end of each curl-up.
- You must stay in time with the beat.
- Both your feet must stay on the floor.
- Your arms must stay straight.
- You are eliminated if you break a rule two curl-ups in a row.

## Score

The number of correctly completed curl-ups up to the maximum of 60, i.e. 20 per minute for a 3 minute period.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 2: Sit-and-reach

### Purpose

Sit-and-reach gives you an indication of the flexibility of your lower back and hamstrings. Students with lower back or hamstring injuries should not do this test.

### Equipment

- one-metre ruler
- tape
- 30-centimetre-high box
- partner



### Description

- Tape the ruler to the top of the box, parallel to the floor, with the 23-centimetre mark level with the front edge of the box (leaving 77 centimetres in contact with the box).
- Sit on the floor with your left leg straight, and your right leg bent so the right sole is against the inside of your extended left leg.
- Your left sole should be against the box just to the side of the ruler.
- Place one hand on top of the other, with your fingertips level, and slowly slide your hands down the ruler as far as possible.
- Hold your maximum distance, which your partner will read, for three seconds.
- Repeat with your right leg straight and both legs straight. Your partner may need to lightly hold the knee straight.

### Rules

- You must not bend the straight knee.
- You must hold for three seconds.
- Hands must not separate.

### Score

The fingertip score on the ruler for each attempt.

Left leg: \_\_\_\_\_ Right leg: \_\_\_\_\_ Both legs: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 3: 50-metre sprint

## Purpose

This test gives you an indication of your speed.

## Equipment

- flat 50-metre track with start and finish lines
- stopwatch

## Description

- The starter gives the commands 'On your marks', 'Set', 'Go'.
- Begin with your toe behind the line and sprint as fast as possible across the finish line.
- Do not slow down until you are well past the finish line.
- Find out your time from the timer.

## Rule

- Wait for the starter's commands.

## Score

The time taken from 'Go' until you cross the finish line.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 4: Vertical jump

## Purpose

The vertical jump gives you an indication of the strength and power of your hip and leg muscles.

## Equipment

- chalk powder/chalk
- tape measure or measuring board
- partner



## Description

- Stand facing the wall or measuring board with your feet together and arms stretched as high as possible. Measure the height of your fingertips.
- Dip your fingertips in magnesium chalk powder or hold a piece of chalk.
- Next, stand side-on to the wall or measuring board and jump as high as possible, touching the wall or board at the peak of your jump with one hand. The chalk should show the spot.
- You may swing your arms and bend your knees as much as you want at take-off.

## Rules

- There is no run-up allowed.
- Your feet must not move before you jump.

## Score

The maximum distance between your standing outstretched fingertip height and your jump height.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 5: Push-ups

## Purpose

Push-ups give you an indication of the muscular strength and endurance of your arm and chest muscles.



## Equipment

- standard 46-centimetre chair
- stopwatch
- chalk



## Description

- The chair should be against a wall or held steady to prevent slipping. To mark the position for the feet, lie face up, with the soles of both feet in line with the front of the chair seat. Mark a line on the floor at the level of the elbows.
- Stand behind this line. Reach forward to place both hands, shoulder-width apart, on the front edge of the chair.
- Make sure your body and legs are in a straight line, with your arms extended and at an angle of about 90 degrees to the body.
- On the command of 'Start', do as many push-ups as possible in a period of 30 seconds. For a push-up to be counted, you must lower yourself until your chest touches the front edge of the chair, then raise yourself until your arms are straight. Count aloud the number of completed push-ups.
- If a push-up is not completed satisfactorily, repeat the previous instruction until you have performed a correct action.

## Rule

- Make certain that your chest touches the chair, and that your arms are returned to the fully extended position for each push-up.

## Score

The number of push-ups completed in 30 seconds.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 6: 1.6-kilometre run or multi-stage (beep) test



## 1.6-kilometre run

### Purpose

This run gives you a good indication of your aerobic capacity or stamina.

### Equipment

- accurately measured and flat 400-metre track
- stopwatch

### Description

- The task is to run four laps of the track as fast as possible.
- Start at a comfortable, steady pace that you can maintain for the whole distance.
- As you come to the last lap, speed up if you feel okay.
- Listen for your time as you cross the finish line, but keep on walking until you recover. Do not lie down.
- Stretch before you shower.

### Rule

- You must complete four laps (1600 metres).

### Score

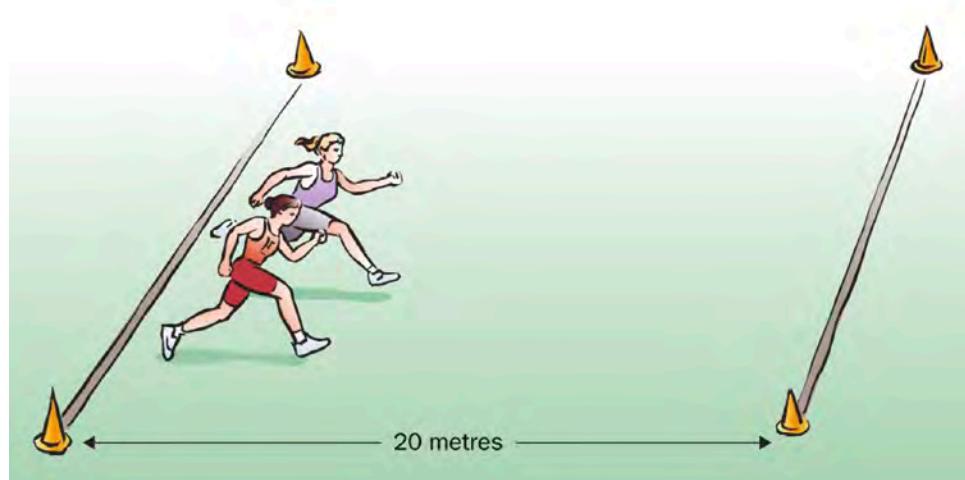
The time taken to complete four laps.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Multi-stage (beep) test



### Purpose

This test gives you a good indication of your aerobic capacity or stamina.

### Equipment

- flat surface with two parallel lines 20 metres apart
- multi-stage CD and player

### Description

- You begin standing on one line facing the other.
- The CD will signal when to start.
- You run back and forth between the lines at the pace determined by the CD.
- You must keep pace with the CD for as long as possible. Do not race the CD. Time your arrival at the line as the CD beeps.
- When you cannot keep up with the CD, remember the last level and shuttle you completed e.g. 8.2.

### Rules

- You must touch the line with your foot just before or as the CD beeps.
- Pivot as you touch the line. Do not make large circles when turning.
- When you do not make the line two beeps in a row you are eliminated.

### Score

The last level and shuttle you completed successfully.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 7: Basketball throw



## Purpose

This test measures your arm, shoulder and chest muscle power and strength.

## Equipment

- two partners
- tape measure
- basketball
- 32-centimetre hoop
- wall

## Description

- Sit on the floor with your back firmly against the wall, your legs straight and your feet together.
- One partner will place a hoop on top of your toes.
- Hold the basketball in a chest-pass position and, when ready, perform a two-handed chest pass for distance.
- The ball must travel through the hoop (near the top).
- Your other partner will measure the distance.

## Rules

- Your buttocks, back, shoulders and head must stay in contact with the wall.
- The ball must pass through the hoop.
- Your legs must remain straight.

## Score

The distance from your feet to where the basketball first hits the ground in metres and centimetres.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 8: Stork stand



### Purpose

This test measures your ability to balance.

### Equipment

- stopwatch

### Description

- Stand comfortably on both feet and place your hands on your hips.
- On the signal to start, lift one leg and place your toes against the inside of your other knee. Take care not to put any pressure on the knee with the angled leg, as this can strain the kneecap.
- At the same time, raise your heel and stand on your toes.
- Repeat balancing on other leg.

### Rule

- During the balance, your heel must not touch the floor or your other foot move away from your knee.

### Score

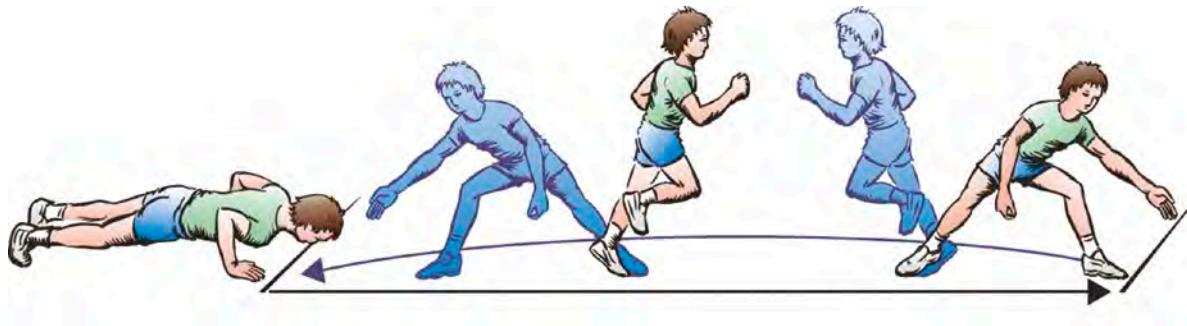
The length of time you can hold your balance.

Right leg: \_\_\_\_\_ Left leg: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 9: Shuttle run



### Purpose

The shuttle run gives you an indication of your agility.

### Equipment

- stopwatch
- two lines 10 metres apart

### Description

- Start this test in a push-up position with your forehead on the start line.
- On the signal 'Ready ... go', jump to your feet and sprint to the opposite line.
- Touch the opposite line with your fingers and sprint back to touch the start line.
- Sprint back to touch the opposite line, then finish by sprinting across the starting line.

### Rule

- Each line must be touched with your fingers, except when you finish.

### Score

Time to the nearest 0.1 of a second.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 10: Alternate hand wall-toss

## Purpose

This test gives you an indication of your level of coordination.

## Equipment

- rebound wall
- stopwatch
- tennis ball.

## Description

- Stand two metres away from and facing the rebound wall.
- On the starting signal, throw the ball with your right hand against the wall and catch the rebound with your left hand.
- Throw with your left hand and catch the rebound with your right hand.
- Do this as quickly as possible for 30 seconds.

## Rule

- You must alternate hands and stay behind the two-metre line.

## Score

The number of successful alternate hand catches.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



# Test 11: Grip strength



## Purpose

To give you an indication of the strength of your fingers, hands and forearms.

## Equipment

- handgrip dynamometer.

## Description

- Adjust the dynamometer so that it fits your hand comfortably.
- Holding the dynamometer away from your body, squeeze the handgrip as hard as possible.
- Repeat with the other hand.

## Rule

- Use only one hand at a time.

## Score

The reading on the dynamometer is your score.

Right hand: \_\_\_\_\_ Left hand: \_\_\_\_\_

Date: \_\_\_\_\_



# Summary of ratings

## Girls

Fitness test	14-year-old females			15-year-old females			16-year-old females		
Rating	WT	A	E	WT	A	E	WT	A	E
Curl-ups	30 or fewer	31–39	40 or more	32 or fewer	33–42	43 or more	32 or fewer	33–34	43 or more
Sit-and-reach (both legs)	22 or less	23–28	29 or more	25 or less	26–31	32 or more	25 or less	26–31	32 or more
50-metre sprint	8.51 or slower	8.50–7.92	7.91 or faster	7.62 or slower	7.61–6.90	6.89 or faster	7.62 or slower	7.61–6.90	6.89 or faster
Vertical jump	22 or less	23–28	29 or more	23 or less	24–30	31 or more	23 or less	24 to 30	31
Push-ups	9 or fewer	10–13	14 or more	11 or fewer	12–16	17 or more	11 or fewer	12–16	17 or more
1.6-km run	9.55 or slower	9.56–8.29	8.28 or faster	9.41 or slower	9.40–8.21	8.20 or faster	9.41 or slower	9.40–8.21	8.21 or faster
Multi-stage (beep) test	5.6 or less	5.7–6.1	6.2 or more	5.9 or less	6.0–6.5	6.6 or more	5.9 or less	6.0–6.5	6.6 or more
Basketball throw	4.40 or less	4.41–4.60	4.61 or more	4.80 or less	4.81–5.40	5.41 or more	5.00 or less	5.01–5.59	5.60 or more
Stork stand	19 or less	20–29	30 or more	19 or less	20–29	30 or more	19 or less	20–29	30 or more
Shuttle run	12.6 or slower	12.5–12.1	12.0 or faster	12.5 or slower	12.4 to 11.9	11.8 or faster	12.3 or slower	12.4 to 11.8	11.7 or faster
Alternate hand wall-toss	12 or fewer	13–18	19 or more	13 or fewer	14 to 21	22 or more	14 or fewer	15 to 22	23 or more
Grip strength (preferred hand)	24 or less	25–30	31 or more	Less than 28	29 to 33	34+	Less than 30	31 to 33	34+

Rating:

WT = Working towards health and fitness benefits

A = Achieving health and fitness benefits

E = Enjoying optimum health and fitness benefits



## Boys

Fitness test	14-year-old males			15-year-old males			16-year-old males		
Rating	WT	A	E	WT	A	E	WT	A	E
Curl-ups	33 or fewer	33–41	42 or more	38 or fewer	39–45	46 or more	39 or fewer	40–46	47 or more
Sit-and-reach (both legs)	17 or less	18–23	24 or more	18 or less	19–24	25 or more	19 or less	20–25	26 or more
50-metre sprint	8.27 or slower	8.26–7.94	7.93 or faster	8.17 or slower	8.16–7.80	7.79 faster	8.05 slower	8.04–7.76	7.75 faster
Vertical jump	26 or less	27 to 36	37 or more	31 or less	32–39	40 or more	33 or less	34–41	42 or more
Push-ups	18 or fewer	19–24	28 or more	25 or less	26 to 34	35 or more	27 or fewer	28 to 36	37 or more
1.6-km run	7.39 or slower	7.38–6.45	6.44 or faster	7.36 or slower	7.35–6.31	6.30 or faster	7.33 or slower	7.32–6.27	6.26 or faster
Multi-stage (beep) test	7 or less	7.1–7.5	7.6 or more	8.4 or less	8.5–9	9.1 or more	8.8 or less	8.9–9.4	9.5 or more
Basketball throw	4.60 or less	4.61–5.00	5.01 or more	5.11 or less	5.12–5.50	5.51 or more	5.49 or less	5.50–5.74	5.75 or more
Stork stand	19 or less	20–29	30 or more	19 or less	20–29	30 or more	19 or less	20–29	30 or more
Shuttle run	12.3 or slower	12.2–11.8	11.7 or faster	12.0 or slower	11.9–11.6	11.5 or faster	11.8 or slower	11.7–11.4	11.3 or faster
Alternate hand wall-toss	21 or less	22–28	29 or more	22 or less	23–31	32 or more	23 or less	23–32	33 or more
Grip strength (preferred hand)	28 or less	28–43	44 or more	30 or less	31 to 44	45 or more	33 or less	33 to 51	52 or more

Rating:

WT = Working towards health and fitness benefits

A = Achieving health and fitness benefits

E = Enjoying optimum health and fitness benefits



### Sit-and-reach: for each leg

Girls: left, right leg

Rating	WT		A		E	
Age	L	R	L	R	L	R
14	24 or less	24 or less	25–30	25–30	31+	31+
15	27 or less	27 or less	28–33	28–33	34+	34+
16	27 or less	27 or less	28–33	28–33	34+	34+

Rating:

WT = Working towards health and fitness benefits

A = Achieving health and fitness benefits

E = Enjoying optimum health and fitness benefits

Boys: left, right leg

Rating	WT		A		E	
Age	L	R	L	R	L	R
14	19 or less	19 or less	20–25	20–25	26+	26+
15	20 or less	20 or less	21–26	21–26	27+	27+
16	21 or less	21 or less	22–27	22–27	28+	28+

Rating:

WT = Working towards health and fitness benefits

A = Achieving health and fitness benefits

E = Enjoying optimum health and fitness benefits



# Summary of scores

Fitness test	Fitness component	Date		Date		Date	
		Result	Rating	Result	Rating	Result	Rating
Curl-ups	Strength/ muscular endurance						
Sit-and-reach (both legs)	Flexibility						
Sit-and-reach (left and right legs)	Flexibility						
50-metre sprint	Speed						
Vertical jump	Strength/ power						
Push-ups	Strength/ muscular endurance						
1.6-km run	Aerobic capacity						
Multi-stage (beep)	Aerobic capacity						
Basketball throw	Strength/power						
Stork stand	Balance						
Shuttle run	Agility						
Hand wall-toss	Coordination						
Grip strength	Strength						



## ACTIVITY *Applying fitness principles*

Physical fitness is not only important for our own well-being, it can also be vital for some occupations. Emergency services such as the fire brigade, police and ambulances require all applicants to complete a series of tests, including a fitness test that is specific to the job.

- 1 Research what fitness tests are required for one of the emergency services and compare them to the ones you have completed in this unit. Complete the table below and conclude if you think you would pass the fitness tests for your chosen emergency service and which areas you feel you would need to improve in.

Name of fitness test	Brief description of test	Component of fitness tested	Comparison to completed fitness test from this unit

- 2 Which emergency service have you chosen?

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- 3 Do you feel you would be prepared for the fitness tests above?

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- 4 Which components of fitness do you feel you need to improve in?

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# Fitness program

## Designing a fitness program

- Step 1: Identify the purpose of your program
- Step 2: Conduct a fitness analysis
- Step 3: Select suitable fitness tests
- Step 4: Select a suitable training session format
- Step 5: Follow the training principles
- Step 6: Select suitable training methods
- Step 7: Plan and timetable the training sessions
- Step 8: Evaluate the program



# Designing a fitness program

The eight steps for an effective fitness program are as follows:

<b>Step 1</b>	Identify the purpose of your program
<b>Step 2</b>	Conduct a fitness analysis
<b>Step 3</b>	Select suitable fitness tests
<b>Step 4</b>	Select a suitable training session format
<b>Step 5</b>	Follow the training principles
<b>Step 6</b>	Select suitable training methods
<b>Step 7</b>	Plan and timetable the training sessions
<b>Step 8</b>	Evaluate the program

## Step 1: Identify the purpose of your program

The purpose of your program is to improve your fitness. ‘Fitness’ can mean many things, because different types of physical activities result in different types of fitness. So it is better to not use the word ‘fitness’ and more meaningful to instead talk about ‘fitness components’.

There are 10 fitness components:

- 1 Muscular strength
- 2 Muscular power
- 3 Flexibility
- 4 Muscular endurance
- 5 Stamina or aerobic capacity
- 6 Speed or anaerobic capacity
- 7 Agility
- 8 Balance
- 9 Coordination
- 10 Body composition

All the fitness components apply to sport-related fitness, but only some are relevant to health-related fitness.

Your program could be specifically designed to improve:

- health-related fitness
- skill-related fitness
- an individual fitness component
- general fitness
- individual or team fitness.

For your body to produce movement for the various fitness components, your muscles need energy to contract. Muscles can make this energy through:

- anaerobic energy production (without oxygen)
- aerobic energy production (using oxygen).

Anaerobic energy is used when your muscles require quick, explosive energy for sprints, jumps or throws. The two types of anaerobic energy are 1) phosphate anaerobic energy and 2) lactic acid system anaerobic energy.

Phosphate anaerobic energy is stored in your muscles and gives you energy for explosive activities for between five to 10 seconds. After that time, phosphate energy runs out and lactic acid system energy takes over.

Lactic acid system anaerobic energy gives you energy for rapid activities that last from 10 seconds to two minutes. It gets produced in your muscles when glucose from the carbohydrates you have eaten is converted to lactic acid.

Aerobic energy is created when your muscles need energy for steady-paced, long activities, such as jogging or cycling. The muscles make this energy by using their stores of carbohydrates and fats taken from food you have eaten and combine them with the oxygen you breathe in.



*Swimmers need to use anaerobic muscle power to start the race.*

## ACTIVITY *Purpose statement*

The purpose of your fitness program will determine what you include in it, so you need to clarify your purpose before you start.

An example of a purpose statement is:

### **Soccer fitness program**

My program is designed to improve my soccer fitness as a player in my club's second division competition, over a six-week period.

- 1 Write down a purpose statement for your own fitness program.

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- 2 What is meant by sport-related fitness?

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- 3 List which fitness components, out of the 10 mentioned, are applicable to health-related fitness.

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## 4 Using the following words, complete these sentences:

**anaerobic capacity**  
**muscular strength**  
**agility**  
**muscular power**

**muscular endurance**  
**flexibility**  
**aerobic capacity**

**body composition**  
**balance**  
**coordination**

- When you are able to accelerate quickly, dodge, weave and turn, this is called \_\_\_\_\_.
- \_\_\_\_\_ is needed to perform an action that requires large amounts of force and can only be completed a maximum of 10 times.
- The ability of your muscles to produce small efforts that are repeated over and over again is called \_\_\_\_\_.
- \_\_\_\_\_ is your ability to time your movements so that you perform skills smoothly and accurately.
- If your muscles, ligaments and tendons are able to stretch enough so that your joints allow large movements you have \_\_\_\_\_.
- \_\_\_\_\_ is the ability of your heart and lungs to deliver oxygen through your blood to your muscles to produce energy.
- Your skill at staying upright or in control of your body position when you are moving or stationary is called your \_\_\_\_\_.
- When you are able to get your body moving quickly you have good \_\_\_\_\_.
- \_\_\_\_\_ is the ability to use strength quickly to produce an explosive effort.
- \_\_\_\_\_ differs for everyone and is the proportion of fat, bone and muscle within the body.

## 5 Match the following sport activities with their primary fitness component:

- |                          |                      |
|--------------------------|----------------------|
| 1 gymnastics             | a muscular endurance |
| 2 shot-put               | b coordination       |
| 3 long distance kayaking | c balance            |
| 4 downhill skiing        | d flexibility        |
| 5 tennis                 | e muscular strength  |
| 6 lifting weights        | f agility            |
| 7 100 m sprint           | g aerobic capacity   |
| 8 hockey                 | h muscular power     |
| 9 marathon running       | i anaerobic capacity |

## 6 List which fitness components, out of the 10 mentioned, you would most like to improve. You will be referring back to these components later in the unit when you design your fitness program.

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## Step 2: Conduct a fitness analysis

The first step in fitness analysis involves deciding exactly what type of analysis you will conduct. You may want to analyse movement patterns, work-to-rest ratio and additional involvements. Then you must select the additional involvements needed to get the fitness statistics you want.

### Analysing movement patterns

Movement pattern analysis involves charting and recording the on-field movements of players throughout a sporting match or game, usually by recording them on a chart. It can be done through direct observation at the venue, or by using video of the game.

The distances covered by each player are recorded on a scale diagram, and the intensity of each effort is also recorded and put on a summary sheet at the end of the game. The movement pattern results can be analysed to show the intensity and length of effort required to play the sport. Shorter, high-intensity efforts require speed while long, low-intensity efforts require aerobic fitness.

Using the information gained from the movement pattern analysis, a training program can be designed to exactly duplicate the demands of the game.

### Calculating the work-to-rest ratio

The work-to-rest ratio (W:R) is the amount of time a player is active (working) compared to the amount of time they are resting (recovering). Work-to-rest ratios are important for stop–start team sports such as basketball, hockey, netball, soccer, football or volleyball. Work-to-rest ratios can be calculated using stopwatches to time each period of work and rest. These periods are then totalled, and the two totals compared. It is necessary to define what ‘work’ and ‘rest’ actually mean. For example, work may be defined as activities of an intensity greater than jogging, such as cruising or sprinting, while rest might include standing, walking or jogging.

During a 20-minute half, a player may be ‘working’ for five minutes and ‘resting’ for 15 minutes. The work-to-rest ratio would be 1:3 for this player—this is a typical ratio for team sports. Whatever ratio is calculated for the sport you have chosen must become the one incorporated into your training program: you must become used to the length of work intervals and take rest intervals to match with this ratio.

### Additional involvements

As well as calculating the level of speed or aerobic fitness in a particular sport, there are other statistics needed in order to examine the other essential physical actions in a game. These actions are called additional involvements, and include direction changes, stretches or lunges, contacts/collisions, skill frequency and jumps. These actions can also be recorded on a chart as per movement patterns and work-to-rest ratios.

Fitness analysis based on all the methods described will show you the most important fitness components for your chosen sport or activity.

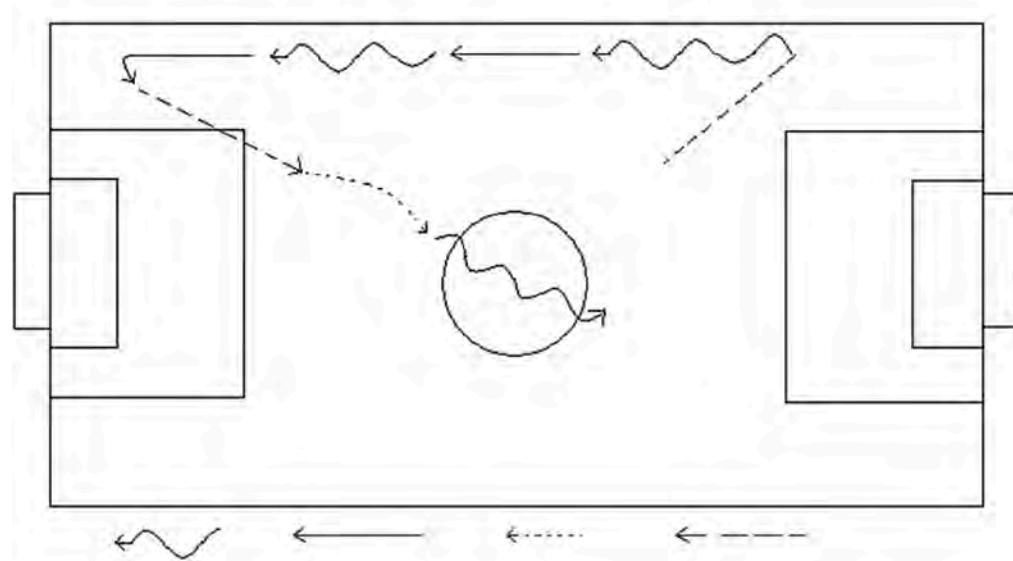


## Tracking physical activity

Following are examples of a tally sheet for the on-field movements of a soccer player, a chart showing movement patterns and game involvement and a summary sheet for a hockey game.

First half					
Intensity	10 m	20 m	30 m	40 m	50 m
Sprint	7	10	5		3
Cruise		3	12		7
Jog	5	1	6	3	6
Walk	12	1			

Tally sheet



Movement patterns and game involvement

	0–10	11–30	31+	Total reps	Total distance
Sprint	24	24	4	126	856
Jog	36	92	16	152	2692
Sideways	20	—	—	20	80
Backwards	28	96	—	120	480

Summary sheet



## ACTIVITY *Tracking progress*

- 1 Go to a local sporting event (it can be soccer, netball, rugby, hockey or any type of on-field match). Define what will be considered 'work' and 'rest' periods for the sport. Choose a player to follow during the match, and fill out tally sheets for each period of play, then compile a summary sheet for the whole game. Also record movement charts for that player for each period of play. Draw up more of the blank tables provided as needed on separate sheets of paper.

<b>First half</b>					
<b>Intensity</b>	<b>10 m</b>	<b>20 m</b>	<b>30 m</b>	<b>40 m</b>	<b>50 m</b>
Sprint					
Cruise					
Jog					
Walk					

<b>Summary sheet for whole game</b>							
<b>Intensity</b>	<b>10 m</b>	<b>20 m</b>	<b>30 m</b>	<b>40 m</b>	<b>50 m</b>	<b>Total reps</b>	<b>Total distance</b>
Sprint							
Cruise							
Jog							
Walk							

- 2 Chart of player movement patterns (draw a scale diagram of the sporting field, one for each period of play):



Provided is an example of a table for work-to-rest results during a hockey match.

Work	Rest
2 seconds	3 seconds
9 seconds	16 seconds
4 seconds	25 seconds
12 seconds	34 seconds
19 seconds	45 seconds
The work-to-rest intervals are random samples from the total number of intervals given	
Total work	Total rest
8 minutes	17 minutes
1	2
<b>Work-to-rest ratio:</b> approximately 1:2	

- 3 Attend another local sporting match, nominate a player to follow, record his or her work periods and rest periods. Calculate your player's work-to-rest ratio for the whole game.

Work	Rest
Interval times	Interval times
<b>Total work time (add up the interval times above)</b>	<b>Total rest time (add up the interval times above)</b>
<b>Work-to-rest ratio:</b>	

## Step 3: Select suitable fitness tests

The fitness tests you select should be based on the fitness components that you found were important in question 6 of step 1. There is space at the end of this section for you to record your selections.

From the following tests you can choose the best ones for evaluating the fitness components you want to measure.

This section outlines how to test each fitness component. Here are some important points to note:

- Fitness tests are a guide to your fitness at this stage of your life.
- Fitness test results tell you the components that you need improvement in, and those you need to maintain at their current level.
- You must try your best on each test or the result will tell you nothing.



## Test 1: Curl-ups



### Purpose

Curl-ups give you an indication of the strength and endurance of your abdominal muscles.

### Equipment

- stopwatch
- gym mat
- partner
- pencil (to hold)
- ruler (to place on knees)
- metronome or recorded beat (set at one beat per three seconds)

### Description

- Lie on the mat with your knees bent at 90 degrees and feet flat on the floor.
- Hold a pencil in both hands and keep your arms straight.
- Your partner kneels level with your knees and holds a ruler along the top of your knees.
- In time with the beat, curl up by sliding your fists along your thighs until they touch the ruler.
- Uncurl until your head touches the mat.

### Rules

- Your partner must count.
- Your fingers must continually grip the pencil and touch the ruler in each curl-up.
- Your head must touch the mat at the end of each curl-up.
- You must stay in time with the beat.
- Both your feet must stay on the floor.
- Your arms must stay straight.
- You are eliminated if you break a rule two curl-ups in a row.

### Score

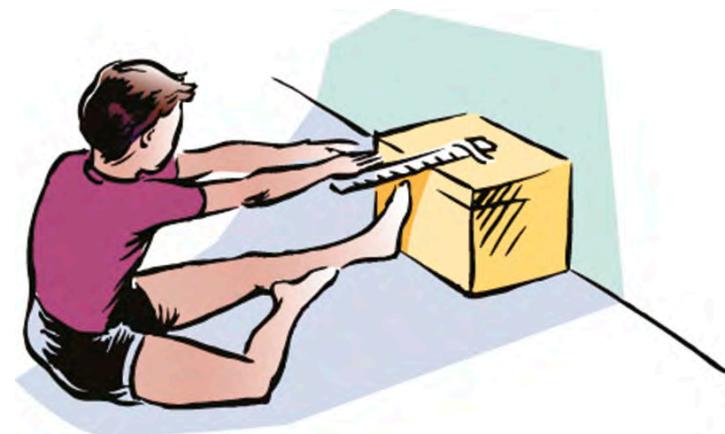
Record the number of correctly completed curl-ups, up to a maximum of 60, i.e., 20 per minute for a three-minute period.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 2: Sit-and-reach



### Purpose

Sit-and-reach gives you an indication of the flexibility of your lower back and hamstrings. Students with lower back or hamstring injuries should not do this test.

### Equipment

- one metre ruler
- tape
- 30-centimetre-high box
- partner

### Description

- Tape the ruler to the top of the box, parallel to the floor, with the 23-centimetre mark level with the front edge of the box (leaving 77 centimetres in contact with the box).
- Sit on the floor with your left leg straight, and your right leg bent so the right sole is against the inside of your extended left leg.
- Your left sole should be against the box just to the side of the ruler.
- Place one hand on top of the other, with your fingertips level, and slowly slide your hands down the ruler as far as possible.
- Hold your maximum distance, which your partner will read, for three seconds.
- Repeat with your right leg straight and both legs straight. Your partner may need to lightly hold the knee straight.

### Rules

- You must not bend the straight knee.
- You must hold for three seconds.
- Your hands must not separate.

### Score

Record the fingertip score on the ruler for each attempt.

Left leg: \_\_\_\_\_ Right leg: \_\_\_\_\_ Both legs: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 3: 50-metre sprint

### Purpose

This test gives you an indication of your speed.

### Equipment

- flat 50 metre track with start and finish lines
- stopwatch

### Description

- The starter gives the commands 'On your marks', 'Set', 'Go'.
- Begin with your toe behind the line and sprint as fast as possible across the finish line.
- Do not slow down until you are well past the finish line.
- Find out your time from the timer.

### Rule

- Wait for the starter's commands.

### Score

Record the time taken from 'Go' until you cross the finish line.

Score: \_\_\_\_\_

Date: \_\_\_\_\_

## Test 4: Vertical jump



### Purpose

The vertical jump gives you an indication of the strength and power of your hip and leg muscles.

### Equipment

- chalk powder/chalk
- tape measure or measuring board
- partner

### Description

- Stand facing the wall or measuring board with your feet together and arms stretched as high as possible. Measure the height of your fingertips.
- Dip your fingertips in magnesium chalk powder or hold a piece of chalk.
- Stand side-on to the wall or measuring board and jump as high as possible, touching the wall or board at the peak of your jump with one hand. The chalk should show the spot.
- You may swing your arms and bend your knees as much as you want at take-off.

### Rules

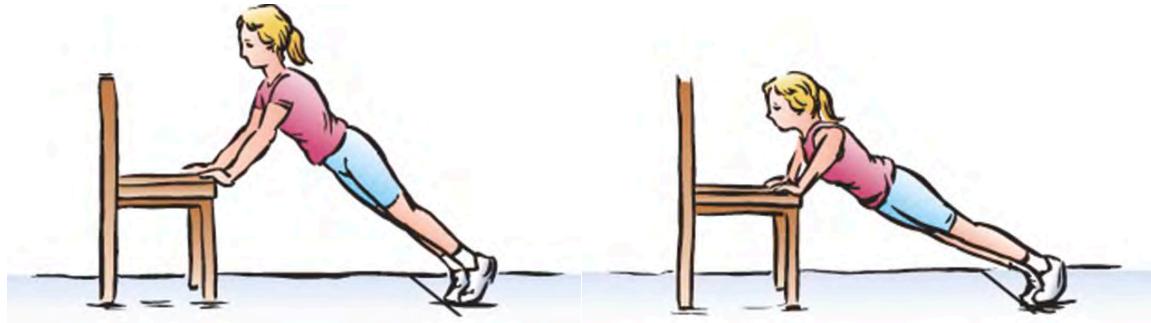
- There is no run-up allowed.
- Your feet must not move before you jump.

### Score

Record the maximum distance between your standing outstretched fingertip height and your jump height.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 5: Push-ups

### Purpose

Push-ups give you an indication of the muscular strength and endurance of your arm and chest muscles.

### Equipment

- standard 46 centimetre chair
- stopwatch and chalk.

### Description

- Ensure that the chair is against the wall or someone is supporting it so the chair does not move. To mark the position for the feet, lie face up, with the soles of both feet in line with the front of the chair seat. Mark a line on the floor at the level of the elbows.
- Stand behind this line. Reach forward to place both hands, shoulder-width apart, on the front edge of the chair.
- Make sure your body and legs are in a straight line, with your arms extended and at an angle of about 90 degrees to the body.
- On the command 'Start', do as many push-ups as possible in a period of 30 seconds. For a push-up to be counted, you must lower yourself until your chest touches the front edge of the chair, then raise yourself until your arms are straight. Count aloud the number of completed push-ups.
- If a push-up is not completed satisfactorily, repeat the previous instruction until you have performed a correct action.

### Rule

Make certain that your chest touches the chair, and that your arms are returned to the fully extended position for each push-up.

### Score

Record the number of push-ups you completed in 30 seconds.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 6: 1.6 kilometre run or multi-stage (beep) test

### 1.6 kilometre run



#### **Purpose**

This run gives you a good indication of your aerobic capacity or stamina.

#### **Equipment**

- accurately measured and flat 400 metre track
- stopwatch

#### **Description**

- The task is to run four laps of the track as fast as possible.
- Start at a comfortable, steady pace that you can maintain for the whole distance.
- As you come to the last lap, speed up if you feel okay.
- Listen for your time as you cross the finish line, but keep on walking until you recover. Do not lie down.
- Stretch before you shower.

#### **Rule**

- You must complete four laps (1600 metres).

#### **Score**

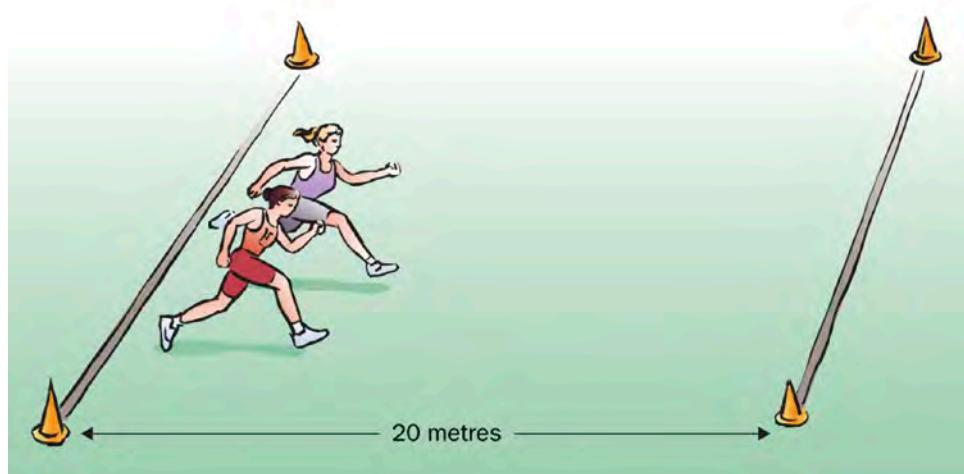
Record the time you took to complete four laps.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Multi-stage (beep) test



### Purpose

This test gives you a good indication of your aerobic capacity or stamina.

### Equipment

- flat surface with two parallel lines 20 metres apart
- multi-stage CD and player

### Description

- Begin by standing on one line facing the other.
- The CD will signal when to start.
- Run back and forth between the lines at the pace determined by the CD.
- You must keep pace with the CD for as long as possible. Do not race the CD. Time your arrival at the line as the CD beeps.
- When you cannot keep up with the CD, remember the last level and shuttle you completed e.g. 8.2.

### Rules

- You must touch the line with your foot just before or as the CD beeps.
- Pivot as you touch the line. Do not make large circles when turning.
- When you do not make the line two beeps in a row you are eliminated.

### Score

Record the last level and shuttle you completed successfully.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 7: Basketball throw



### Purpose

This test measures your arm, shoulder and chest muscle power and strength.

### Equipment

(for each group of three)

- tape measure
- basketball
- 32 centimetre hoop
- wall

### Description

- Sit on the floor with your back firmly against the wall, your legs straight and your feet together.
- One group member will place a hoop on top of your toes.
- Hold the basketball in a chest-pass position and, when ready, perform a two-handed chest-pass for distance.
- The ball must travel through the hoop (near the top).
- The other group member will measure the distance.

### Rules

- Your buttocks, back, shoulders and head must stay in contact with the wall.
- The ball must pass through the hoop.
- Your legs must remain straight.

### Score

Record the distance from your feet to where the basketball first hits the ground in metres and centimetres.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 8: Stork stand

### Purpose

This test measures your ability to balance.

### Equipment

- stopwatch



### Description

- Stand comfortably on both feet and place your hands on your hips.
- On the signal to start, lift one leg and place your toes against the inside of your other knee. Take care not to put any pressure on the knee with the angled leg, as this can strain the kneecap.
- At the same time, raise your heel and stand on your toes.
- Repeat balancing on other leg.

### Rule

- During the balance, your heel must not touch the floor, and your other foot must not move away from your knee.

### Score

Record the length of time you can hold your balance.

Left leg: \_\_\_\_\_ Right leg: \_\_\_\_\_

Date: \_\_\_\_\_

## Test 9: Shuttle run

### Purpose

The shuttle run gives you an indication of your agility.

### Equipment

- stopwatch
- two lines 10 metres apart



### Description

- Start this test in a push-up position with your forehead on the start line.
- On the signal 'Ready...go', jump to your feet and sprint to the opposite line.
- Touch the opposite line with your fingers and sprint back to touch the start line.
- Sprint back to touch the opposite line, then finish by sprinting across the starting line.

### Rule

- Each line must be touched with your fingers, except when you finish.

### Score

Record your time to the nearest 0.1 of a second.

Score: \_\_\_\_\_

Date: \_\_\_\_\_



## Test 10: Alternate hand wall-toss

### Purpose

This test gives you an indication of your level of coordination.

### Equipment

- rebound wall
- stopwatch
- tennis ball

### Description

- Stand two metres away from and facing the rebound wall.
- On the starting signal, throw the ball with your right hand against the wall and catch the rebound with your left hand.
- Throw with your left hand and catch the rebound with your right hand.
- Do this as quickly as possible for 30 seconds.

### Rule

- You must alternate hands and stay behind the two-metre line.

### Score

Record the number of successful alternate hand catches.

Score: \_\_\_\_\_

Date: \_\_\_\_\_

## Test 11: Grip strength

### Purpose

To give you an indication of the strength of your fingers, hands and forearms.



### Equipment

- a handgrip dynamometer

### Description

- Adjust the dynamometer so that it fits your hand comfortably.
- Holding the dynamometer away from your body, squeeze the handgrip as hard as possible.
- Repeat with the other hand.

### Rule

- Use only one hand at a time.

### Score

Record the reading on the dynamometer.

Left hand: \_\_\_\_\_ Right hand: \_\_\_\_\_

Date: \_\_\_\_\_



## Summary of ratings for girls

Fitness test	14-year-old females			15-year-old females			16-year-old females		
Rating	WT	A	E	WT	A	E	WT	A	E
Curl-ups	30 or fewer	31–39	40 or more	32 or fewer	33–42	43 or more	32 or fewer	33–34	43 or more
Sit-and-reach (both legs)	22 or less	23–28	29 or more	25 or less	26–31	32 or more	25 or less	26–31	32 or more
50-metre sprint	8.51 or slower	8.50–7.92	7.91 or faster	7.62 or slower	7.61–6.90	6.89 or faster	7.62 or slower	7.61–6.90	6.89 or faster
Vertical jump	22 or less	23–28	29 or more	23 or less	24–30	31 or more	23 or less	24 to 30	31
Push-ups	9 or fewer	10–13	14 or more	11 or fewer	12–16	17 or more	11 or fewer	12–16	17 or more
1.6-km run	9.55 or slower	9.56–8.29	8.28 or faster	9.41 or slower	9.40–8.21	8.20 or faster	9.41 or slower	9.40–8.21	8.21 or faster
Multi-stage (beep) test	5.6 or less	5.7–6.1	6.2 or more	5.9 or less	6.0–6.5	6.6 or more	5.9 or less	6.0–6.5	6.6 or more
Basketball throw	4.40 or less	4.41–4.60	4.61 or more	4.80 or less	4.81–5.40	5.41 or more	5.00 or less	5.01–5.59	5.60 or more
Stork stand	19 or less	20–29	30 or more	19 or less	20–29	30 or more	19 or less	20–29	30 or more
Shuttle run	12.6 or slower	12.5–12.1	12.0 or faster	12.5 or slower	12.4 to 11.9	11.8 or faster	12.3 or slower	12.4 to 11.8	11.7 or faster
Alternate hand wall-toss	12 or fewer	13–18	19 or more	13 or fewer	14 to 21	22 or more	14 or fewer	15 to 22	23 or more
Grip strength (preferred hand)	24 or less	25–30	31 or more	Less than 28	29 to 33	34+	Less than 30	31 to 33	34+

Rating: WT = Working towards health and fitness benefits; A = Achieving health and fitness benefits; E = Enjoying optimum health and fitness benefits



## Summary of ratings for boys

Fitness test	14-year-old males			15-year-old males			16-year-old males		
Rating	WT	A	E	WT	A	E	WT	A	E
Curl-ups	33 or fewer	33–41	42 or more	38 or fewer	39–45	46 or more	39 or fewer	40–46	47 or more
Sit-and-reach (both legs)	17 or less	18–23	24 or more	18 or less	19–24	25 or more	19 or less	20–25	26 or more
50-metre sprint	8.27 or slower	8.26–7.94	7.93 or faster	8.17 or slower	8.16–7.80	7.79 faster	8.05 slower	8.04–7.76	7.75 faster
Vertical jump	26 or less	27 to 36	37 or more	31 or less	32–39	40 or more	33 or less	34–41	42 or more
Push-ups	18 or fewer	19–24	28 or more	25 or less	26 to 34	35 or more	27 or fewer	28 to 36	37 or more
1.6-km run	7.39 or slower	7.38–6.45	6.44 or faster	7.36 or slower	7.35–6.31	6.30 or faster	7.33 or slower	7.32–6.27	6.26 or faster
Multi-stage (beep) test	7 or less	7.1–7.5	7.6 or more	8.4 or less	8.5–9	9.1 or more	8.8 or less	8.9–9.4	9.5 or more
Basketball throw	4.60 or less	4.61–5.00	5.01 or more	5.11 or less	5.12–5.50	5.51 or more	5.49 or less	5.50–5.74	5.75 or more
Stork stand	19 or less	20–29	30 or more	19 or less	20–29	30 or more	19 or less	20–29	30 or more
Shuttle run	12.3 or slower	12.2–11.8	11.7 or faster	12.0 or slower	11.9–11.6	11.5 or faster	11.8 or slower	11.7–11.4	11.3 or faster
Alternate hand wall-toss	21 or less	22–28	29 or more	22 or less	23–31	32 or more	23 or less	23–32	33 or more
Grip strength (preferred hand)	28 or less	28–43	44 or more	30 or less	31 to 44	45 or more	33 or less	33 to 51	52 or more

Rating: WT = Working towards health and fitness benefits; A = Achieving health and fitness benefits; E = Enjoying optimum health and fitness benefits

### Sit-and-reach: for each leg

#### Girls: left, right leg

Rating	WT		A		E	
Age	L	R	L	R	L	R
14	24 or less	24 or less	25–30	25–30	31+	31+
15	27 or less	27 or less	28–33	28–33	34+	34+
16	27 or less	27 or less	28–33	28–33	34+	34+

Rating\*

WT = Working towards health and fitness benefits

A = Achieving health and fitness benefits

E = Enjoying optimum health and fitness benefits

**Boys: left, right leg**

Rating	WT		A		E	
Age	L	R	L	R	L	R
14	19 or less	19 or less	20–25	20–25	26+	26+
15	20 or less	20 or less	21–26	21–26	27+	27+
16	21 or less	21 or less	22–27	22–27	28+	28+

Rating\*

WT = Working towards health and fitness benefits

A = Achieving health and fitness benefits

E = Enjoying optimum health and fitness benefits

 **ACTIVITY Measuring up**

- For each of the fitness components you identified earlier for your own fitness program, choose the fitness tests that will measure your current fitness level for that component. (For example, a soccer player could choose the beep test for aerobic capacity, the 50-metre sprint for anaerobic capacity/speed, the shuttle run test for agility, etc.).

In the table provided, write in the tests and the fitness component measured by each test, then complete those tests and fill in your initial results and ratings for them in the 'Pre-test' column (the Post-test column will be filled in later, at Step 8).

Fitness test	Fitness component	Pre-test		Post-test (see Step 8)	
		Result	Rating	Result	Rating



# Step 4: Select a suitable training session format

A correctly planned fitness training session should include these three phases:

- warm-up
- workout
- cool-down

## ACTIVITY *Training the right way*

- 1 List the things you should do as part of a warm-up and the reasons why a warm-up should be done.

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- 2 What would happen if you did not cool down?

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- 3 If you were going to go for a 30-minute jog, outline the stages in the training session that should be used.

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# Step 5: Follow the training principles

For your fitness training program to be successful there are six training principles or guidelines you should follow. Each will assist you in setting up a program that will improve the fitness components you have identified for yourself.

## 1 Specificity

The specificity principle means 'You Get What You Train For'. So if you want a specific fitness outcome, you need to make decisions in your fitness program that will give you these results. Lifting weights will develop your strength, but not your aerobic capacity, for example. To plan a fitness program properly you need to know its purpose and you need analysis and test results. Then you can choose the training methods (Step 6) you require to specifically improve your chosen fitness components. If, for example, you wanted to develop aerobic capacity for the sport you play, and your beep test result was poor, you could choose continuous or circuit training to specifically improve your aerobic capacity.

## 2 Progressive overload

The progressive overload principle says to set a realistic fitness goal, and then plan small increases in an effort to gradually reach this goal. This is better than always exercising at the same level, which means you will not improve, or beginning a program with too much intensity, meaning you will not last long enough to complete it.

## 3 Frequency

To have a successful training program you must train frequently enough to stimulate your body to make changes that result in your fitness improving. Two training sessions per week is enough to gain some improvement, but three or four sessions per week is ideal. More than four sessions per week is really only for elite athletes and would need careful monitoring. Three to four sessions per week for four to six weeks will result in real improvement. If you stop training for a period of time your body will start losing fitness, which is why it is important to be active your whole life.

## 4 Intensity

This principle is a guide to how hard you should train. For most people training three times each week, two hard sessions and one easy session are recommended. For those training twice per week both sessions can be hard.

## 5 Variety

The variety principle helps you maintain your motivation during a training program. To stay interested and keep training it is best to vary how you train, where you train, how hard you train and with whom you train.

## 6 The stages of fitness

This principle will help anyone starting an exercise program realise that there are three stages of fitness:

- the discomfort stage
- the physical stage
- the psychological stage.

The discomfort stage can last from two to ten weeks, depending on how long it has been since you last exercised regularly. Although you will probably find the training a pain, you must keep pushing yourself to see it through.

At the physical stage, the exercise stops hurting and can begin to feel good. You will start to notice the beneficial changes in your body, so although it is still difficult you now know it is worth it.

Not many people reach the psychological stage; this is where you can get a mental 'high' out of exercising and become addicted to it. It is usually associated with endurance training (long distance swimming, running, etc.). It takes years to reach this point, and you do not need to be at this stage to keep training effectively.



## ACTIVITY Applying knowledge

- 1 Tick the 'True' or 'False' column for each statement provided.

Statement	True	False
It is best to keep exercising at the same level, week in-week out; that way you can get in a good routine and not get injured.		
It is good to start off doing as much exercise as you can and push yourself really hard; that way you will find out what your limits are straight away.		
Having a training session once a week is probably not enough to make any real gains in physical fitness.		
If a long-distance runner has poor upper body muscular power, this is a weakness he needs to train to overcome.		
The best way to improve your aerobic capacity for playing soccer is to do weight training.		
Doing 100 curl-ups a day is not the best way to improve your beep test score.		
Training more than four times a week should only be done by serious athletes under supervision.		
Being motivated to exercise for mental wellbeing, relaxation, enjoyment and 'escape' occurs during the 'discomfort stage' of fitness training.		
Road cycling training should emphasise aerobic energy and muscular endurance.		
Mild discomfort, feeling out of breath and wanting to stop are not what you would feel during the 'Psychological stage' of fitness training.		

- 2 Using the progressive overload principle, suggest a progressive exercise program over 10 weeks for each of the three goals in the table.

Goal/timeframe	To be able to swim 1 km of a lap pool continuously	To be able to bench press 30 kg	To complete a 20 km road cycling route without stopping
Example: Weeks 1–3	Example: Swim 500 m	Example: Bench press 20 kg	Example: Cycle 10 km

- 3 List the ways in which you could vary a training program to keep it interesting and to keep yourself motivated.

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- 4 Have a discussion in class about what you should say to someone who has just started exercising regularly and is not enjoying it, but who needs encouragement to keep going.

- 5 Do some research to find any motivational or encouraging apps or programs that might help you improve your fitness. What is it about these apps that you find useful?

- 6 Feeling unmotivated to train is not uncommon when you first begin a training regime. Write a list of positive self-talk statements you can use to keep you motivated to exercise.

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- 7 Research the phenomenon of addiction to physical exercise. Write a brief report on your findings, including whether you believe it is a positive or negative thing.

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## Step 6: Select suitable training methods

To improve your fitness components for general fitness or a specific sport you need to use what are called training methods. Each training method requires you to follow a special formula or rule to improve one or more of your fitness components. The training methods are:

- continuous training
  - interval training
  - circuit training
  - resistance (weight) training
  - flexibility callisthenics
  - Fartlek training.

## Continuous training

This training is designed to improve your aerobic (heart and lung) capacity and your muscular endurance. Continuous training is the most important training method for both health and sport-related fitness.

The FITT formula for continuous training is:

F for frequency—three or four exercise sessions each week

I for intensity—to improve your heart and lung (aerobic) efficiency, you must exercise at or above your target heart-rate.

T for time—to get any real benefit, you must exercise for at least 20 minutes and continuously (no rests).

T for type—the best types of aerobic activity are running, cycling, swimming, aerobics classes, surfing, rollerblading and power walking.

# Interval training

The interval training method is designed to improve strength and power, agility and speed (anaerobic capacity). It is the best training for sports such as football, soccer and netball that have highly active periods (such as chasing the ball) followed by rest or recovery periods (when the ball is at the other end of the field). In the same way as these sports, interval training also has work intervals followed by rest intervals.





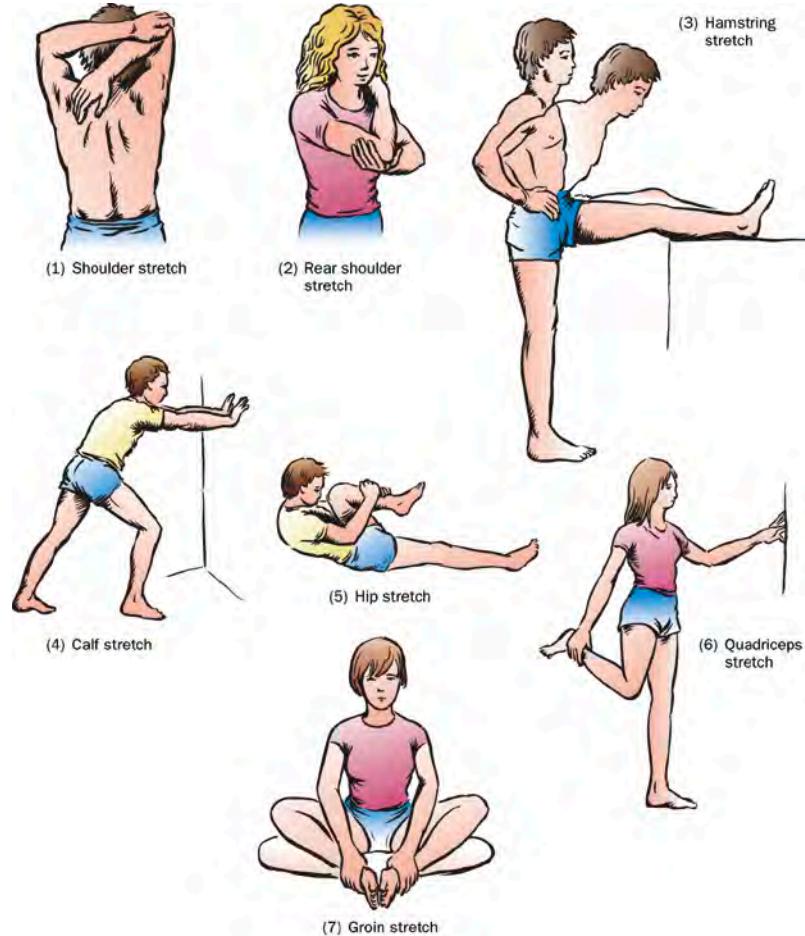
## Circuit training

This training method can improve your body strength, power, muscular endurance, agility and aerobic capacity all at the same time. Circuit training usually consists of a series of 10 exercises arranged around your house, backyard, sports hall, weight training facility, or oval. You perform the exercises in order as fast as you can.

## Resistance training

Resistance training improves your strength and power or muscular endurance, by using either weights in a gym or your own body weight to make your muscles work.

A resistance circuit can be performed in a gym, in your backyard, your garage or your house. You can replace exercises with easier or harder alternatives, you can use your initial load repetitions for each exercise or you can perform a set number of repetitions for each lap.



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## Flexibility callisthenics

This method of training improves your joint and muscle flexibility. Any exercise that puts a muscle in a stretched position develops your flexibility.

The formula for improving your flexibility is:

- slowly stretch the muscle or joint to the greatest range possible
- hold this position while you count 30 seconds
- relax, then repeat the exercise
- never bounce or jerk in a stretched position
- never move quickly to a stretched position.

Practise the stretches using the previous formula.



## Fartlek training

This training method involves short bursts of speed (e.g. sprinting) interspersed throughout a continuous training session (running), so it is used to develop both aerobic and anaerobic capacities. The overall distance of the session, the distances of the sprints and the length of the recovery period can be chosen to suit the fitness analysis of any sport.

### ACTIVITY Aerobic fitness

- 1 Why is improving aerobic capacity through continuous training important for health-related fitness?

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- 2 Tick the 'Yes' or 'No' column in the table provided to show which of the activities are ideal for developing aerobic fitness.

Sport	Yes	No
Tennis		
Running		
Squash		
Weightlifting		
Badminton		
Swimming		
Cycling		
Racquetball		

- 3 Following the 'intensity' element of the FITT formula, calculate your target heart-rate and target zone:

The rate at which your heart should be working during a continuous training session is known as your target heart-rate. This rate varies with age, so you need to work out your own target heart-rate. To do this, first determine your maximum heart-rate. This is done by subtracting your age from 220. Your target heart-rate is now worked out by calculating 75 per cent of your maximum heart-rate.

Then, your target zone is the range in which your body should be working. This zone generally ranges from 75 to 85 per cent of your maximum heart-rate.

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- 4 Outline an interval training session of running for someone playing Australian Rules football.

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- 5 Explain how interval training differs from Fartlek training, and then outline a Fartlek training session of running, for the same footballer as before.

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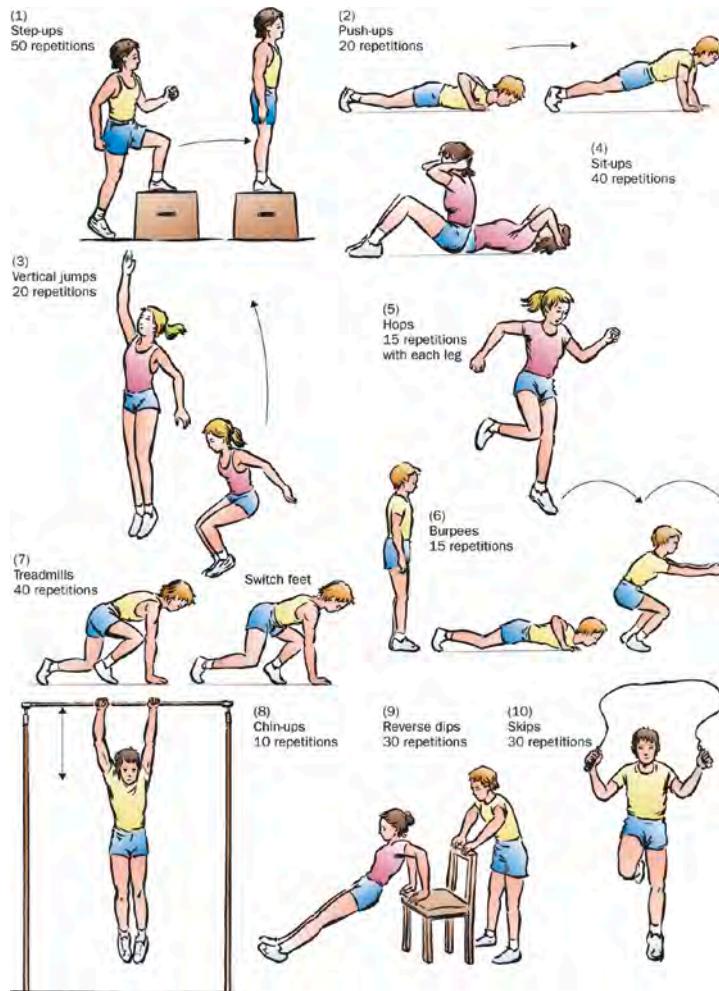
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- 6 Set up your own circuit training program, as pictured.

- Choose 10 exercises (see the examples in the image or table provided; you can choose others if you wish).





- In the box provided, draw an overhead map of your circuit (whether it is in your house, backyard, sports hall, etc.) to ensure you have planned a clear and unimpeded course for your training.
- Test yourself to see how many repetitions you can do of each exercise in one minute. Record the number for each exercise. This is called your one-minute maximum (in column 1 of the table).
- Divide your one-minute maximums in half. These numbers are called your initial load (column 2 of the table).
- Next session, do two laps of your circuit, without stopping between exercises or laps, performing the initial load numbers for each exercise. Your aim is to be able to complete three laps.
- When you can complete three laps of your circuit, record the date and time of each session, and try to improve it (columns 3 and 4 of the table).
- Every four weeks, change the exercises in your circuit.

*Overhead map of circuit*

Exercise	One-minute maximum	Initial load	Date	Three-lap times		
1 Step-ups						
2 Push-ups						
3 Vertical jumps						
4 Sit-ups						
5 Hops						
6 Burpees						
7 Treadmills						
8 Chin-ups						
9 Reverse dips						
10 Skips						

- 7 Suggest some safety tips for weightlifting as part of resistance training, and describe why each one is important.

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- 8 Based on the fitness program you described in Step 1, question 1, list the fitness components required for it and choose the training methods for it that will best help you achieve these fitness goals.

Fitness component	Training method

## Step 7: Plan and timetable the training sessions

Once you have decided what training methods to use to improve your fitness components, the next step is to plan how many training sessions will be in your program and what you will do in each session.

To produce results you will need to train three or four times per week for at least six weeks. So plan a minimum of  $3 \times 6 = 18$  sessions. What you do in these sessions depends on what fitness components you have chosen to develop and what training methods you will use to develop them.

For example, anaerobic speed and aerobic capacity could be developed by using interval training, Fartlek and continuous training. For your 18 sessions, you could therefore plan six sessions of interval training, six of Fartlek and six sessions of continuous training.

Then, plan exactly what you will do in each session of each training method and write it down, taking into account the training principles (such as specificity, progressive overload, intensity and variety) already discussed.

Once you have planned the content of each session you are ready to timetable your sessions into a training grid. Factor into your training grid your lifestyle and current commitments (study, part-time job, etc.). Here's an example of a training grid:

Day	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Monday	Jog 10 mins	Jog 10 mins	Jog 15 mins	Jog 15 mins	Jog 20 mins	Jog 20 mins
Tuesday						
Wednesday	Swim 10 mins	Swim 10 mins	Swim 15 mins	Swim 15 mins	Swim 15 mins	Swim 20 mins
Thursday				Cycle 20 mins		
Friday	Circuit training					
Saturday			Cycle 20 mins			
Sunday	Cycle 15 mins	Cycle 15 mins			Cycle 25 mins	Cycle 25 mins



## ACTIVITY *My own training*

- Now fill out your own six-week training grid.

Day	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						

## Step 8: Evaluate the program

The last step is making sure your fitness program is really working. To find out if it is effective you should re-test all of the fitness tests once you have completed the six-week program. This is called post-testing and your post-test (after the fitness program) results can be used to compare with your pre-test (before the fitness program) results.

If there is a significant improvement in a fitness component as demonstrated by the post-tests then your program has been successful. If a particular fitness component has not improved, it could be because your pre-test score was already very good or you did not use the right training methods and principles to develop that component.

Based on your post-test results you should evaluate each fitness component being worked on in your fitness program and then suggest modifications needed if the program is to continue.

- After completing your six-week training program (at Step 7), re-test yourself on the fitness tests you performed before the program (at Step 3).
  - Fill in your post-test results and ratings on the table used at Step 3.
  - For each fitness component tested, evaluate the effectiveness of your program by comparing the pre-test and post-test results.

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- c Suggest any modifications to your program to make it a more effective fitness program.

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## ACTIVITY *Fitness program word search*

Find the fifteen words hidden in this word search relating to fitness programs. The words can run forward, backward, diagonally and vertically.

**Interval**  
**Circuit**  
**Specificity**  
**Intensity**  
**Creatine phosphate**

**Continuous**  
**Fartlek**  
**Progressive overload**  
**Aerobic**  
**Lactic acid**

**Oxygen**  
**Resistance**  
**Frequency**  
**Anaerobic**  
**Carbohydrates**

H	J	F	P	M	I	T	J	S	Y	B	J	K	H	H	S	B	H	E	H
J	C	M	R	B	C	G	C	I	B	O	R	E	A	Q	H	O	L	N	J
P	A	H	O	F	I	N	T	E	R	V	A	L	E	G	H	B	F	K	P
I	R	I	G	T	R	C	G	N	F	R	T	T	J	B	B	V	D	T	I
L	B	R	R	E	F	R	X	V	T	R	T	R	O	J	Y	I	K	L	L
U	O	Y	E	T	B	H	T	F	D	I	C	A	C	I	T	C	A	L	U
U	H	I	S	T	J	T	B	B	U	I	U	F	T	R	V	K	R	L	U
I	Y	U	S	B	F	G	T	E	R	E	Y	N	R	H	J	L	E	T	I
V	D	H	I	K	B	Y	T	C	O	N	T	I	N	U	O	U	S	P	V
P	R	I	V	O	G	T	U	I	N	H	F	E	R	C	Y	J	I	K	P
B	A	J	E	T	E	I	T	V	G	R	D	H	D	I	F	H	S	F	B
C	T	X	O	R	T	E	R	G	U	B	T	E	R	B	O	J	T	R	C
I	E	R	V	V	H	N	J	I	Y	R	H	I	U	O	T	C	A	E	I
I	S	P	E	C	I	F	I	C	I	T	Y	B	H	R	T	R	N	Q	I
C	F	E	R	T	B	H	Y	J	U	I	K	K	L	E	B	F	C	U	C
T	R	T	L	B	F	D	W	Q	T	C	V	N	I	A	L	I	E	E	T
U	V	R	O	X	Y	G	E	N	I	Y	B	K	O	N	L	O	I	N	U
C	R	E	A	T	I	N	E	P	H	O	S	P	H	A	T	E	X	C	C
Y	R	Y	D	U	N	E	S	G	S	F	H	Y	I	N	V	I	L	Y	Y
X	U	L	Y	T	I	S	N	E	T	N	I	K	L	T	I	D	T	Y	X



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# Discrimination in sport

## Discrimination in sport

- Race
- Religion
- Disability

## Gender and sexuality

- Hypermasculinity
- Sexism
- Funding
- Salaries
- Media coverage
- Homophobia

## Monitoring ethics

- Anti-Discrimination Commission
- Sporting tribunals
- Court of Arbitration for Sport

## To finish

# Discrimination in sport

Discrimination is the act of treating someone differently, usually in a negative way, because they possess certain characteristics against which you are prejudiced. Often, these prejudices involve race, religion, disability, gender and/or sexuality.

Although many sports have a strong focus on teamwork and unity, a number of Australian athletes have faced discrimination from the media, fans, rival players and even teammates. While some discrimination is thought worthy enough to make the news headlines, other instances go unreported or receive minimal coverage.

## Race

Discriminating against a person based on their race, skin colour or ethnic background is illegal in Australia, yet it continues to be a major problem for many Australians. Aboriginal and Torres Strait Islander peoples and ethnic minority groups all face discrimination, which is apparent in the disparity between Anglo and non-Anglo employment rates, education and health. Australia has a diverse population, with many races represented in our society. People from any background should be provided with equal opportunity to play sport and participate in physical activity.

Racism takes many forms in a sporting context, and can include passing over a player for a position on a team due to his or her race; not including a particular race of people in a local or international sporting event; and racial abuse and vilification from the media, fans and players. Sporting clubs and leagues should have a strict code of conduct that covers all forms of discrimination and provides clear and strict guidelines on punishing racist behaviours. Any racial discrimination within a sporting community should be reported immediately.

### ACTIVITY Case study

During a game in the 2013 AFL season, Adam Goodes, a veteran member of the Sydney Swans Football Club and a member of the Indigenous Team of the Century, was verbally abused by a 13-year-old girl in the crowd. Just a few days after that incident, and after supporting Goodes, Eddie McGuire, President of the Collingwood Football Club, said on his breakfast radio show that Goodes should promote the King Kong musical that was playing in Melbourne at the time.

Read the article at <[flexibooks.com.au/w/392](http://flexibooks.com.au/w/392)> and then answer the following questions.

- 1 Why do you think incidents like this happen during sporting events?

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- 2 After the incident, Goodes said that he 'didn't blame' the young girl, and she went unpunished. Eddie McGuire also did not get punished for his behaviour. Do you think this was appropriate? Justify your response.

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In 2015, Goodes retired from AFL. Read the article at <<http://www.heraldsun.com.au/sport/afl/teams/sydney/adam-goodes-exit-from-afl-disgraceful-says-sydney-swans-ceo-andrew-ireland/news-story/92135f8348737d3d2ba418870c83e1cd>> and then answer the questions that follow.



- 3 Explain how these incidences of racism, and others, leading to the end of Goodes's career affects how you view the lack of punishment for the young girl and McGuire.

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- 4 Think about the impact of discrimination in sport. How does it affect the athlete, the fans and the culture of the team or club?

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### **ACTIVITY** *Celebrating diversity*

In Australia, we are lucky to have numerous Aboriginal and Torres Strait Islander people who play sport at an elite level.

- 1 Conduct some research to identify one of these athletes.

a Name

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b Sport

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c Achievements

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d Sponsors

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e What challenges do you think this athlete may have faced throughout his or her career?

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- f What positive impact do you think this athlete has had on Aboriginal and Torres Strait Islander peoples in particular and Australian culture in general?

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## Religion

Another form of discrimination present in Australian sport is religious discrimination. Treating any person unfairly based on their religious beliefs is discrimination. In a sporting community, this includes athletes, coaches, officials, administrators and spectators.

Religious discrimination in sport may be as blatant as refusing to allow a person to join a team because of their religion. Often though, this kind of discrimination is indirect. An example of this indirect discrimination would be requiring athletes to wear strict uniforms, thereby excluding athletes who may wear certain headwear, jewellery or a particular style of clothing for religious reasons. Indirect discrimination such as this is more likely to go unnoticed than direct discrimination, which is dangerous as it is therefore unlikely to be addressed.

Due to Australia's diversity, there are many religions represented within our population. A person's religious beliefs should not have a negative effect on their ability to participate equitably in sport.

### ACTIVITY Case study

- 1 Read the article 'Muslim women find a new goal with AFL' and answer the following questions.  
<[flexibooks.com.au/w/393](http://flexibooks.com.au/w/393)>
  - a Why have these women formed their own AFL team?  

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  - b Can you think of any other sports that Muslim women who cover their heads and bodies could participate in while still observing their religious customs?  

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  - c Consider any sports that you currently play, whether competitively or socially at school. How could you make sure that this activity is accessible to and inclusive of people with differing religious customs?  

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# Disability

It is important that people with disabilities are provided equal opportunities to participate in sport and physical activity. Providing these opportunities may be as simple as installing wheelchair access at the local tennis club, or it may involve modifying games to be more inclusive. Many of these modified games, or adaptive sports, such as wheelchair basketball, have become very popular competitive sports played worldwide.

Modifying the rules, however, is not always the best way to be inclusive of disabled athletes. Decisions regarding an individual's participation should be based on their skills and abilities, rather than their disability. For example, if a student with epilepsy passes the same fitness and skills tests required for other students to join the school volleyball team, it would be discriminatory to exclude that student from joining the team.

Every four years, athletes with disabilities from all over the world come together to compete in the Paralympic Games. Athletes compete in different categories depending on their level of disability so that the playing field is kept fair. The Paralympic Games includes every sport present in the Olympic Games program. Some of these sports have been modified, however many follow the same rules as their Olympic counterparts. Despite the incredible athletic ability of paralympians, the Paralympic Games still struggles to gain extensive media coverage.

## ACTIVITY *Being inclusive*

- 1 Research an Australian paralympian and answer the following questions.

- a What is the athlete's name? What is his or her disability?

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- b What sport does this athlete play? Is it an adaptive sport?

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- c If the sport is adaptive, in what ways is it modified from the sport upon which it is based?

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- d Why do you think the Paralympic Games does not receive as much media coverage as the Olympics?

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- 2 Consider a sport played by students at your school during lunch. In what ways could the sport be modified to be more inclusive of students with disabilities?

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# Gender and sexuality

## Hypermasculinity

The sporting culture in Australia is 'hypermasculine'. This means that characteristics and behaviours that are stereotypically 'manly' are valued and therefore exaggerated. Football and rugby codes in particular are extremely hypermasculine, and this often has negative consequences for athletes and for members of the public.

Fans of these hypermasculine sports may develop unrealistic expectations of what it means to be a man, including violently acting on feelings of aggression and bottling up their emotions. Young boys can begin to copy these behaviours, and young girls can be discouraged from playing these sports altogether because they are seen as 'boy games'.

Hypermasculinity can also lead to incidents of homophobia as homosexuality is still stereotypically linked to being effeminate and weak.



### ACTIVITY *Understanding hypermasculinity*

- 1 List some characteristics and behaviours that are stereotypically masculine.

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- 2 Consider how these characteristics and behaviours might negatively impact athletes, as well as members of the public.

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## Sexism

An unfortunate byproduct of hypermasculinity is sexism. Sexism is the belief that one gender, usually female, is inferior to the other because they are thought to be less competent or valuable than the other. Obvious examples of sexism towards female athletes include sports commentators speaking negatively about a female player's physical appearance. Less obvious examples include a lack of media coverage of women's sports. Games played at local sports clubs can demonstrate sexism in how they are spread out over the week. Male teams often get to play on weekends, which is a prime timeslot because more people can attend the games. In contrast, women's teams are often relegated to playing on weekdays, when the opportunity and audience will be much smaller.



Language you might hear at a sporting event can also be sexist. Have you ever heard the saying 'you throw like a girl'? It is usually said as an insult to boys. Not only does it imply that girls are incapable of playing sports as well as boys, it also implies that it is *better* to be a boy than a girl because girls are thought to be less physically skilled.



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## ACTIVITY *Sexism in sport*

- Before the 2013 Wimbledon women's final, a BBC commentator said that one of the finalists, Marion Bartoli, was 'never going to be a looker'. What impact does commentary like this have on female athletes? Are male athletes subjected to similar scrutiny regarding their physical appearance? If not, why do you think this is so?

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- Sexism in sport is not only limited to athletes. Women are under-represented as officials and coaches, especially in traditionally male-dominated sports. In pairs, list three reasons you think may account for this disparity.

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- In 2012, Chelsea Roffey became the first AFL goal umpire to officiate a grand final match. In what ways do you think the media coverage surrounding this event may have affected sexism within the AFL?

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- 4 Using the internet, conduct research on an event, initiative, program or organisation that is aimed at promoting gender equality in sports. Make notes on exactly how this is achieved, as well as how people can get involved. Present your findings to the class, explaining why you think it is a worthwhile cause.

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- 5 As a class, discuss any examples you have witnessed of sexism in sport. The examples could be from the media or your own life. In what ways could the people involved have shown respect and been inclusive of the person being discriminated against?

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## Funding

Australian sports receive funding from the Australian Sports Commission (ASC). Nearly \$134 million was allocated for sport funding over the 2016–2017 financial year, with more than \$88 million of this going towards achieving Australia's Winning Edge High Performance targets, which include finishing in the top five at the Olympics and Paralympics, in the top 15 at the Winter Olympics, first at the Commonwealth Games and 20 world champions annually.

However, money is not limitless and funds are not allocated equally across all sports. Archery, athletics, canoe, cycling, pentathlon, synchronised swimming and winter sports all received increases in funding for 2016–2017, while football, judo, volleyball and water polo were among the sports that had their funding cut.

Individual athletes also receive funding from sponsors. Unfortunately, female athletes receive less funding than their male counterparts or are passed over altogether. This is because women's sports receive less media coverage than male sports and, therefore, investors risk not making back their money or making less profit. This is despite Australian women's teams traditionally ranking higher than Australian men's teams.

## Salaries

Salaries paid to Australian athletes depend on the sport, the success of the individual athlete and the gender of the athlete. Of the highest-paid Australian sportspeople in the same year, the sports they were most commonly linked to were basketball and golf. All but three of the 50 highest-paid Australian athletes on the list were men.

Cricket is one sport in which the salary divide between men and women has been starkly apparent, despite the women's team's sporting success. Even reforms in 2015 that increased the minimum retainer for the women's cricket team by 36 per cent, bringing the maximum salary of a member up to \$85 000, left women's earnings still trailing behind the Australian men's cricket team, whose members had a minimum retainer of \$260 000 written into their contracts. However, further moves are being made to address this gap. In 2017, after drawn out negotiations with players, Cricket Australia introduced a standard agreement for both men and women, increased the pay pool for women from \$7.5 million to \$55.2 million, and raised the base rate for women by 80.2 per cent.

Provided is a table of the highest-paid Australian athletes of 2017.

Ranking	Name	Sport	Earnings in millions
1	Jason Day	Golf	\$18.29
2	Ben Simmons	Basketball	\$14.35
3	Matthew Dellavedova	Basketball	\$12.49
4	Adam Scott	Golf	\$10.82
5	Joe Ingles	Basketball	\$10.65
6	Daniel Ricciardo	Motor racing	\$10.45
7	Marc Leishman	Golf	\$9.57
8	Patty Mills	Basketball	\$9.29
9	Andrew Bogut	Basketball	\$8.84
10	Aron Baynes	Basketball	\$7.04

[flexibooks.com.au/w/236](http://flexibooks.com.au/w/236)

## ACTIVITY Class debate

- 1 Male and female tennis Grand Slam winners are usually paid equally even though men are required to play five sets and women only three. As a class, divide into teams and debate whether female tennis players should be paid less because they play less. Write notes in the space provided.



# Media coverage

The media can provide a specific sport with an international profile, create heroes and role models, increase spectator appeal and encourage profitable sponsorship opportunities. Through the media, sports transmit messages about social issues such as national identity, gender and sexuality.

The most print space and airtime is given to football, horseracing, and (seasonally) cricket and tennis. The media design their content for particular spectator audiences. For example, the Australian media generally cater for male fans.

Media coverage of sporting events favours men and male-dominated sports. A report released by the Australian Sports Commission in 2010 found that:

- only 7 per cent of Australian television sports coverage is for women's sports;
- news coverage of men's sports lasts, on average, 30 seconds longer than coverage of women's sports; and
- to gain media coverage, female athletes generally need to win and male athletes will get coverage even if they lose.

The lack of media attention on women's sports can lead to decreased funding and to women being discouraged from playing sport altogether.



## ACTIVITY *Mapping media coverage*

- 1 Over seven days, look through the sports section of newspapers or watch the sports segment of a news program. Assess how much coverage is assigned to men's sports as opposed to women's. In the following table, record anything interesting you notice about the stories for men and women, such as what they tend to cover. Discuss your findings with the class and make notes in the space provided.

Day	Number of stories about men's sports	Approximate length of men's stories (in minutes or words)	Number of stories about women's sports	Approximate length of women's stories (in minutes or words)
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				



Day	Number of stories about men's sports	Approximate length of men's stories (in minutes or words)	Number of stories about women's sports	Approximate length of women's stories (in minutes or words)
Saturday				
Sunday				

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## Homophobia

Another unfortunate byproduct of hypermasculinity is homophobia. Homophobia is when a person feels uncomfortable around and is not accepting of people who are not heterosexual. People who are homophobic are often hostile towards gay people.

A number of athletes have come out as gay in recent years, including Olympians Matthew Mitcham and Tom Daley. Unfortunately, homophobia persists. A study by VicHealth and Victoria University reports that men who play sport badly are often labelled by others as gay because a lack of athletic ability means they cannot be 'real' men. Conversely, women who play sports well are regarded as gay because they lack femininity. Women who played a traditionally female sport and were suspected of being lesbian were excluded by teammates, but *all* women playing a traditionally male sport were thought to be lesbians.

### ACTIVITY *Coming out*

- 1 Tom Daley, an Olympic medal-winning diver, came out as gay in 2013. List some of the consequences that you think he would have faced. Try to think of positive and negative consequences.

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- 2 Imagine you are a gay professional athlete. Do you think you would come out to your teammates or fans? List the sorts of things you might consider before choosing whether to come out.

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# Monitoring ethics

There are a number of organisations that exist to monitor the behaviour of athletes in terms of on-field conduct and drug use. Some organisations, such as the AFL tribunal, work with a specific sporting community. Others are more general and work with the entire Australian sporting community.

## Anti-Discrimination Commission

The Anti-Discrimination Commission is an organisation based in Queensland that deals with complaints of discrimination across all areas of life (including sport) that are covered by the Anti-Discrimination Act 1991.

They advise that all sports and clubs have a Code of Conduct to ensure all players are behaving appropriately both on and off the field, and that players in violation of the Code are suitably disciplined.

Players, officials, coaches and spectators should all be covered in the Code of Conduct. Complaints can and should be put forward by anyone experiencing or witnessing discrimination in a sporting club, league or team.

It is important to note, however, that some exemptions are allowed under the Act to cater for sporting situations that would ordinarily be considered acts of discrimination.

These include:

- sporting competitions for men or women only;
- separate facilities for men and women in clubs, if it is not practical for men and women to use the facilities or benefits at the same time and access to an equivalent benefit is provided;
- unjustifiable hardship, where a club or business does not provide services for disabled people due to financial constraints; and
- fitness centres for women only.

### ACTIVITY *Showing understanding*

- 1 Choose one of these exemptions and explain why it would not be considered discriminatory.

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- 2 For each of the exemptions listed, provide an example of when this might occur.

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- 3 Consider the following scenario: A gym has advertised that they will start running a boxing class every week for men only, and have not offered a similar class for women. Is the gym covered under the Anti-Discrimination Act? Justify your response.

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## Sporting tribunals

A sporting tribunal is a court that resolves conflicts between players and officials, and ensures that the Code of Conduct for the sport or team is followed. All official clubs should have a tribunal.

It is important to remember that a tribunal is not a real court of law. The laws or constitution of the club will determine the legal process of the tribunal, but everyone appearing in front of the tribunal is entitled to a fair trial.

All tribunals should follow three directives to ensure a fair trial:

- 1 the accused should be notified of the allegations;
- 2 the accused should be given the chance to respond to and defend themselves against the allegation; and
- 3 the tribunal members should all be unbiased and have no personal investment in the accused or the allegations made.

The ultimate decision of the tribunal should not be influenced by rumour or speculation, and the penalties imposed must be outlined in the constitution of the club.



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## Court of Arbitration for Sport

The Court of Arbitration for Sport (CAS) is an independent, international organisation. It exists to mediate and arbitrate (settle through legal argument) sports-related conflicts.

In cases of arbitration, the decisions of the CAS are binding and can only be appealed in a small number of cases, including lack of jurisdiction, the violation of procedural rules or incompatibility with public policy. Where the CAS is asked to mediate, the proceedings are informal and non-binding.

There are two types of disputes put in front of the CAS: disputes that are commercial and disputes that are disciplinary.

Commercial disputes are generally concerned with sponsorship and sponsorship contracts; television rights; the staging of sporting events; player transfers; and employment and agency contracts.

The disciplinary disputes are often doping-related, but also deal with on-field violence and abusing referees and officials. These disciplinary disputes are usually dealt with by local tribunals in the first instance, but are then appealed to the CAS.

The CAS is also responsible for putting together non-permanent tribunals, as for the Olympics, the Commonwealth Games and other major international sporting events.



# To finish...

Discrimination is everywhere in the sporting community. Athletes face marginalisation based on their race, religion, disability, gender and/or sexuality. No one likes to be left out so if you are joining a local sports team, or even just playing a game during lunchtime, remember to be accepting of anyone who wants to join in so the game can be enjoyed by everyone.

All sports and sporting communities, whether they are professional, local or school-based, should be equitable. This means that they are fair and just, and that no members of that community should feel marginalised or be discriminated against in any way. Whether you are a player, official or spectator, as part of a sporting community it is your responsibility to promote and encourage equitable participation and report discrimination in all its forms.

## List of useful websites

Anti-discrimination Commission Queensland  
[<flexibooks.com.au/w/395>](http://flexibooks.com.au/w/395)

Australian Sports Commission—Participating in Sport  
[<flexibooks.com.au/w/396>](http://flexibooks.com.au/w/396)

Australian Sports Commission—Anti-discrimination  
[<flexibooks.com.au/w/397>](http://flexibooks.com.au/w/397)



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# Developing movement skills

## Introduction

- The nature of movement skills
- Types of movement skills
- Fundamental versus specialised movement skills
- Skill continuums

## Transferring movement skills

- Positive transfer of movement skills
- Negative transfer of movement skills

## Practice

- Qualities of effective practice
- Practice methods
- Mental practice and rehearsal

## The value of mastering skills

- Acquiring specialised movement skills

# Introduction

Movement skills are the tools that we use to participate in sports, games and general physical activities. Your level of movement skill can be measured by how efficiently you can complete a goal-directed movement task. Movement skills can be classified in many ways and are learnt most efficiently through quality practice.

## The nature of movement skills

Movement skills are actions that require body movement to achieve predetermined objectives. They can involve small movements, such as throwing a dart; large movements, such as a sprint run; or a combination of both, as in spin bowling in cricket. All movement skills are goal-directed and require practice to achieve proficiency. Skilled performers have excellent movement skills and make few errors. In the early stage of skill development, novice performers make frequent large errors and need to see the skill demonstrated effectively to help them learn. Movement skill performance can be improved with quality instruction, a supportive environment and opportunities to practice.

## Types of movement skills

One of the ways to classify movement skills is by how difficult they are to perform. In this way, skills are classified as either fundamental movement skills or specialised movement skills.

Another way to classify movement skills is by the type of movement they involve. Based on this classification, movement skills can be described as locomotor, non-locomotor or manipulative.

- **Locomotor movement skills** involve moving the body from one point to another. Some examples are running, swimming and cycling.
- **Non-locomotor movement skills** are performed while you are stationary, such as a static balance (for example, an arabesque or a stork stand), bend, sway and twist. Pivoting in basketball is also an example of a non-locomotor skill.
- **Manipulative movement skills** involve the control of a piece of equipment, such as a ball, bat or stick. Examples include bowling in cricket, striking in baseball and throwing a dart.

### ACTIVITY *Understanding movement*

- 1 Working with a partner, choose two popular sports and list the locomotor, non-locomotor and manipulative skills involved in each. Share your results with the rest of the class.

a \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b \_\_\_\_\_  
\_\_\_\_\_

- 2 Educational gymnastics is a style of gymnastics that relies on the execution of movement skills to develop dynamic and entertaining routines.

- a In pairs, develop a sequence consisting of at least 15 different movement skills. Use the space provided to record your ideas.
- b Your teacher will provide the opportunity for you to practise your routine in order to make necessary changes and refine your performance.
- c Once happy with your routine, you will perform it to the class. This will be followed by a discussion about what movement skills you incorporated into your routine.



# Fundamental versus specialised movement skills

Fundamental movement skills provide the foundation for participation in most major sports and games. These skills are less complicated movement skills and include locomotor, non-locomotor and manipulative skills. The sprint run, vertical jump, overarm throw, catch, two-handed strike and kick are all examples of fundamental movement skills.

## Sprint run

Running is a locomotor skill used in many games, sports and physical activities. The key points of the sprint run are:

- head and chest held up to create erect posture
- body leaning slightly forward
- high knee lift as leg swings through
- arms and legs moving forward without sideward deviation
- elbows bent at 90°
- arms drive forward and back in opposition to legs.

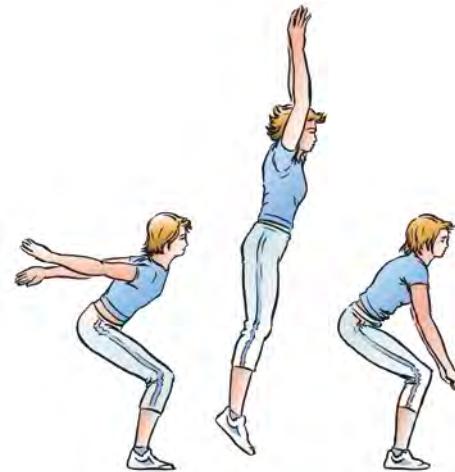


*Running technique*

## Vertical jump

The vertical jump is a locomotor skill that forms the basis for jumps used in a variety of sports and activities, including athletics, gymnastics, basketball, netball, rugby and volleyball. The key points of the vertical jump are:

- eyes focused forward or upward throughout the jump
- crouched with knees bent and arms behind the body
- arms used to generate upward force
- legs straighten in the air as arms are thrust forward and upward
- land on the balls of the feet and bend knees to absorb impact
- controlled landing with no more than one step in any direction.



*Vertical jump technique*

## Overarm throw

The overarm throw is a manipulative skill used in cricket, softball, netball, basketball and many other sports. The key points of the overarm throw are:

- standing side-on to the target
- as the throwing arm is moved in a backswing, weight is shifted to the back foot
- throwing arm moves in a downward and backward arc
- step towards target with foot opposite the throwing arm
- hips and then shoulders rotate forward
- throwing arm follows through, down and across body.



*Overarm throw technique*

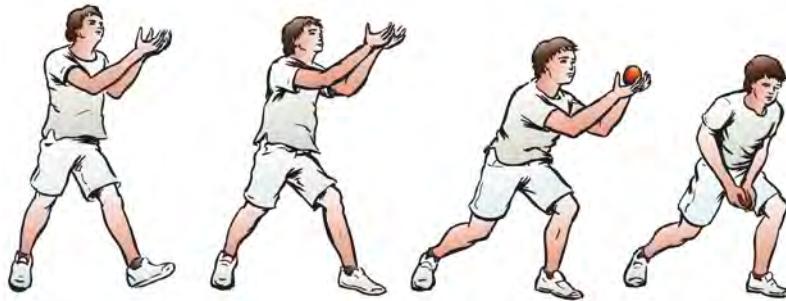


## Catch

Catching is a manipulative skill used in cricket, softball, baseball, netball, rugby and basketball.

The key points of the catch are:

- eyes focused on the object throughout the catch
- feet move to place the body in line with or behind the object
- hands and fingers relaxed and slightly cupped to catch the object without grabbing at it
- object is caught cleanly with the hands only (no shoulders or chest involved)
- elbows bend to absorb force as the object makes contact with the hands.

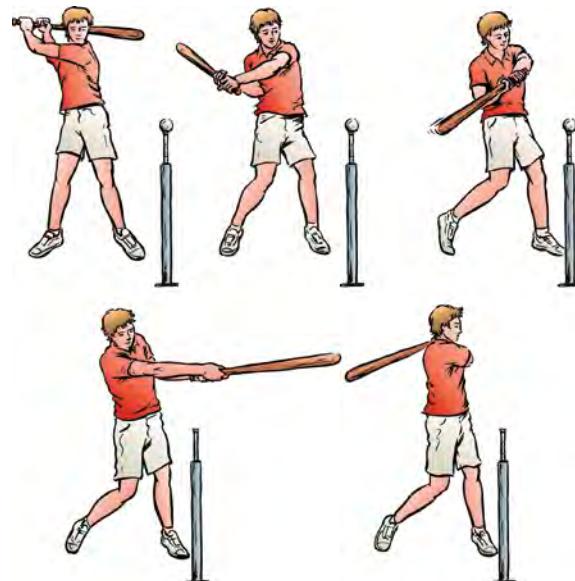


*Catching technique*

## Two-handed strike

The two-handed strike is a manipulative skill that forms the foundation of a number of advanced skills, including the drive in cricket, the strike in T-ball and baseball, the golf swing and the ground strokes in racquet sports. The key points of the two-handed strike are:

- standing side-on to the target
- eyes focused on the ball throughout the strike
- hands next to each other on the bat, the bottom hand matches the front foot
- step towards the target with the front foot
- hips and then shoulders rotate forward
- ball contact made on the front foot with straight arms
- follow through with the bat around the body.



*Two-handed strike technique*

## Kick

The kick is a manipulative skill used in soccer, rugby and Australian Rules football. Although there are differences in the technique used for various sports, the key points for the stationary place kick are:

- eyes focused on the ball throughout the kick
- forward and sideward swing of the arm opposite to the kicking leg
- non-kicking foot placed beside the ball, pointed towards the target
- arms kept out to the side for balance
- contact the ball with the top of the foot (shoelaces) or instep
- kicking leg follows through high, towards the target area.



*Kicking technique*



## ACTIVITY *Evaluating performance*

- 1 Working in groups of four or five, use the key points from the six fundamental movement skills described (sprint run, vertical jump, overarm throw, catch, two-handed strike and kick) to evaluate the skill proficiency of your group members.
  - a Each student will demonstrate their best technique in relation to each of the FMS by completing the skill three times. One of these times must be in slow motion.
  - b Using the table provided, rate the performance of the respective skills of other students based on whether each of the components were performed correctly (1 = needs work, 2 = fair, 3 = good).

	Student 1:	Student 2:	Student 3:	Student 4:
Sprint run				
Vertical jump				
Overarm throw				
Catch				
Two-handed strike				
Kick				

- c Each group should choose the student who performed the best. These students are then filmed performing the skill. The class can view the performances and discuss the FMS and relevant technique.
- 2 a What common errors or weaknesses did participants display?

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- b Choose three of the faults you identified and write what feedback you could give the athlete to help them identify what needs to be improved and how they can alter their technique to refine their performance.

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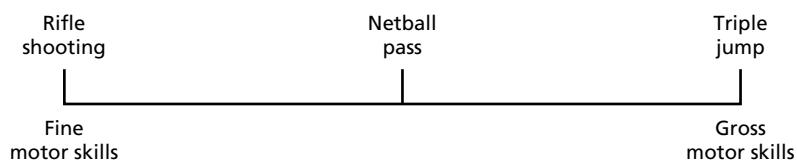


# Skill continuums

It can be difficult to classify movement skills because they have many characteristics that can change in different situations. Each skill can also be classified using a number of dimensions. These dimensions include: type of muscular involvement, continuity of the skill, environmental factors influencing performance, level of interaction with other competitors, and level of organisation. Each of these dimensions is a continuum, or a range. At each end of the continuum the dimensions are opposites (for example, open versus closed), while the middle represents a merging of the characteristics.

## Muscular involvement continuum

Gross motor skills involve large muscle movement, where the precision of movement is not as important to the successful execution of the skill; for example, running and jumping. Fine motor skills require motor control of the small muscles of the body to achieve the skill outcome. They generally involve hand–eye coordination and a high degree of precision; for example, writing and spin bowling.



*The muscular involvement continuum*

### ACTIVITY Reviewing muscular involvement skills

- 1 Which do you think is the more important type of motor skill, gross or fine? Why?

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- 2 Choose a sport and identify the skills required in the game as either a fine motor or gross motor skill.

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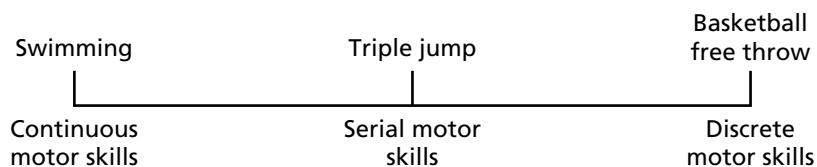
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## Continuity continuum

Continuous motor skills have no distinct beginning or end points. The start and finish of the skill is determined by the performer or by an external force, but not by the task itself. For example, in swimming and running the performer's movements are a continuous flow of actions. Serial skills comprise several discrete skills put together into a series; for example, triple jump. Discrete motor skills have distinct starting and finishing points; for example, pitching in softball is a discrete skill, because when the ball is released the skill is complete.



*The continuity continuum*



## ACTIVITY *Reviewing continuity skills*

- 1 Is throwing a javelin a continuous, serial or discrete skill? Why?

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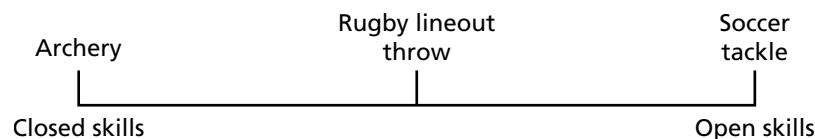
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- 2 Identify whether the activities or events are discrete, continuous or serial motor skills.

Event	Discrete	Continuous	Serial
2000 m (athletics)			
Shot-put			
Steeple chase			
Chest pass (netball)			
Rowing			

## Environmental requirements continuum

Closed skills are performed in predictable environments where the performer determines when to start the action: for example, dart throwing, archery, tenpin bowling. Open skills are performed under conditions where the surrounding environment is unpredictable and constantly changing. There is less certainty about what to do and when to do it, with limited time to make decisions; for example, rugby, hockey, sailing and surfing.



*The environmental requirements continuum*

## ACTIVITY *Reviewing environmental requirement skills*

- 1 How does the open–closed skill continuum relate to learning a new movement skill?

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- 2 Is practising basketball goal shooting in a stadium a closed skill or an open skill? Why?

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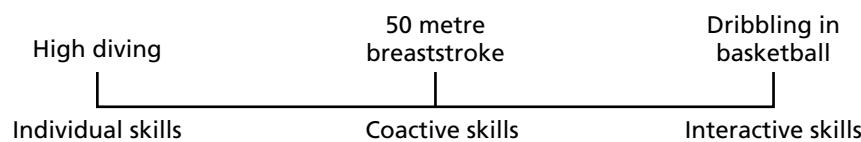


- 3 Using the example provided as a guide, choose five closed activities that can develop into open activities.

Closed activity	Open activity
Chest passing to a partner 15 times during netball training.	Throwing a chest pass to a player during a game situation.

## Interaction continuum

Individual skills are those performed in isolation without opposition or the cooperation of team-mates; for example, a high diver's competitor cannot directly influence performance. Coactive skills are performed at the same time, but competitors cannot directly impact the performance of others. In a 50-metre breaststroke race a swimmer cannot physically prevent their opponent from achieving a good result, but they are competing at the same time. Interactive skills are those in which performance can be directly influenced by the opposition. For example, a point guard dribbling the ball in basketball must avoid having the ball stolen by the opposition.



*The interaction continuum*

### ACTIVITY Reviewing interaction skills

- 1 Is weight lifting an individual, coactive or interactive skill? Why?

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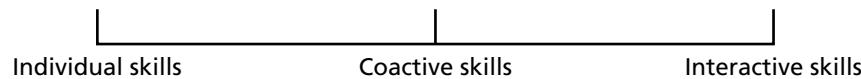
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- 2 Place the activities along the interaction continuum provided.

- performing a gymnastics routine
- running a marathon
- shooting in netball
- hitting a baseball.





- 3 Sports such as archery or darts, which require closed and individual skills, may not have the same physical complexities as an open or interactive skill; however they have their own challenges. Make a list of the factors that may influence an athlete performing sports requiring these skills.

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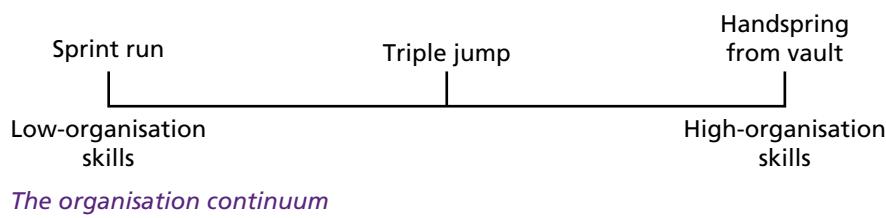
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## Organisation continuum

Most skills are comprised of a number of subcomponents. Low-organisation skills are comprised of fewer and less complex components; for example, swimming and running. High organisation skills involve closely integrated and difficult subcomponents that need to be combined. A handspring from a vault in gymnastics is an example of a highly organised skill because it involves run-up, take-off, vault contact, rotation in the air and landing.



### ACTIVITY Reviewing organisation skills

- 1 Is cycling a low- or a high-organisation skill? Why?

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- 2 Choose one of the following sports and identify the characteristics of the major skills involved using the continuums discussed: soccer, indoor swimming, netball or shooting.

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## Transferring movement skills

Skill transfer is the effect that the learning and performance of one movement skill has on the learning and performance of another. Proficiency in fundamental movement skills provides the foundation for many specialised skills and helps you learn skills more quickly.

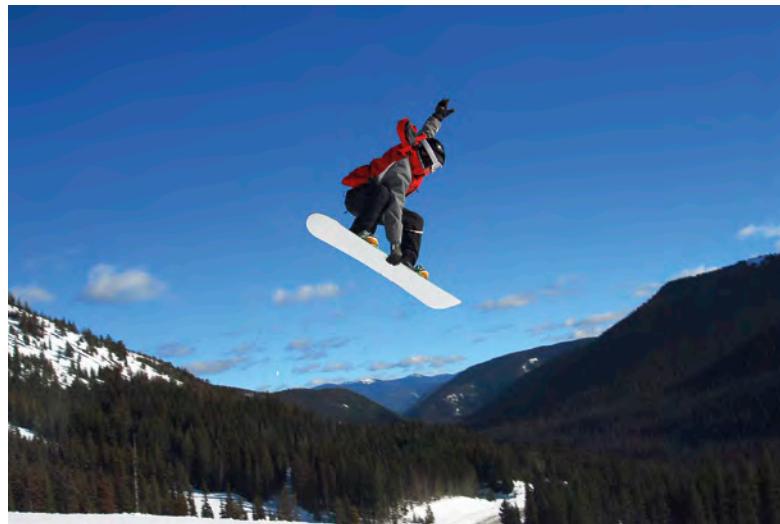


# Positive transfer of movement skills

Positive skill transfer occurs when your proficiency in one movement skill is enhanced by your previous learning and experience in a similar movement skill. For example, the movement skills involved in surfing are similar to the movement skills involved in skateboarding and snowboarding. The positive transfer of movement skills will help you learn a new, similar skill more easily.



iStockphoto.com/BirdofPrey



iStockphoto.com/Marco Coda

# Negative transfer of movement skills

Negative skill transfer occurs when your ability to learn a new skill is impeded by your knowledge of and experience in a similar movement skill. This may occur when skills share some similarities but have important differences. For example, although the tennis and squash forehand strokes appear similar, the wrist action is very different. The tennis forehand requires a firm wrist, while the squash forehand requires flexible use of the wrist. Negative skill transfer will make it more difficult for an individual to learn a new skill.



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iStockphoto.com/WebSubstance



## ACTIVITY *Understanding transferring movement skills*

- The overarm throw is a fundamental movement skill that can be transferred to a variety of specialised skills. Working in pairs, participate in the following skills:
  - volleyball overhead serve
  - javelin throw (using a soft javelin)
  - tennis smash
  - basketball overarm throw
  - tennis overhead serve
  - overarm throw using a tennis ball
  - badminton smash.



- a After completing the activities, discuss the common elements shared by all of the skills performed.

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- 2 Consider the following specialised movement skills (you may wish to use video footage or clips from a YouTube or Google video to help you visualise the skills): tennis serve, volleyball overhead serve, rugby union tackle, rugby league tackle, javelin throw, ice hockey dribble, field hockey dribble and baseball pitch.

- a Which of the skills might provide an example of positive skill transfer?

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- b Which of the skills might provide an example of negative skill transfer?

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- c Describe the possible consequences of negative skill transfer.

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- d Describe the benefits of positive skill transfer.

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- 3 In pairs, discuss examples of your own experiences with positive and negative transference of skills.

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## Practice

To learn and improve movement skills, you will need to practice. While traditional practice will require individuals to physically perform movement skills, skills can also be improved through mental rehearsal, which is another form of practice. It is recommended that you use a variety of practice techniques to develop movement skill proficiency.



# Qualities of effective practice

While individuals will develop movement skill proficiency at different rates, skill level can be increased through quality movement skill practice. The following qualities of effective practice have been identified to help people learn skills more efficiently.

- ‘Practice with feedback, makes perfect.’ It is not enough for individuals to just receive the opportunity to practise; the emphasis should be on quality of movement. This can be achieved by focusing on technique rather than outcome. For example, someone learning how to shoot a free throw in basketball should focus on addressing the key points of the skill rather than the outcome of the shot—that is, whether or not the basketball went through the hoop.
- In all sports and physical activities the simplest skills should be learnt before the more complicated ones. The correct sequencing of skills can help to promote skill development, maintain individual motivation and prevent injury. For example, the skill sequence in volleyball is dig, set, serve, spike, block then dive.
- Complicated skills should be broken down into smaller parts when they are being learnt for the first time. For example, individuals learning the tennis serve for the first time should learn how to toss the ball correctly before attempting to complete the full serve.
- Pressure should be increased as skill proficiency improves. Once individuals become more confident performing skills, additional pressure should be added. The practice should progress from ‘closed’ to ‘open’ on the environmental requirements continuum, with gradual increases in skill performance and decision-making demands. For example, dribbling in hockey should be first learnt without any external pressure; as proficiency increases, the task should become more difficult, with defenders introduced, culminating in a game context.



Shutterstock.com/Nicholas Riabow

*In long jump, the run up, the take-off and the landing are each key skills.*

## Practice methods

There are many types of practice that you can undertake to enable you to improve your performance. The most appropriate practice method will depend on a number of factors, including the amount of time available, the ability of the athletes, the equipment available and the type of skill to be learnt. Some practice methods are:

- **Massed practice** involves long, continuous practice sessions. Better initial results are achieved with massed practice but more injuries tend to occur because of mental and physical fatigue. Massed practice is suitable when the skill is simple, motivation for learning is high, and time available for practice is short.
- **Distributed practice** involves practice sessions that are spread out over a set time and are alternated with rest periods. Better long-term learning and skill retention is achieved with distributed practice. Distributed practice is useful when the skill to be learnt is new and complex, fatigue may lead to injury, attention spans are short and motivation is low.
- **Whole practice** involves practicing the skill in one complete sequence. Practicing the skill as a whole can help an athlete appreciate the complete movement and execution of the skill. This method is appropriate when the skill being learnt is simple and does not include multiple components or when the performer is at an advanced stage of skill development.
- **Part practice** breaks the task into distinct parts for individual practice. Once each part of the task is mastered, the skills are combined to form a whole. For example, the lay-up in basketball might be taught by breaking the skill down into the footwork and the shooting action. Part practice is useful when the skill being learnt is complicated and when the performer is in the early stages of skill development.

## Mental practice and rehearsals

Many athletes will use mental rehearsal to visualise themselves performing a skill before actually performing it. Combining mental and physical practice often gives improved results. The advantages of mental practice include increased confidence and the prevention of physical fatigue.



## **ACTIVITY** Learning through movement

Mental practice used in conjunction with positive self-talk is a positive and effective way to refine your skills.

- 1 Choose a skill from a sport that you play and practice visualising yourself performing it successfully.

Write a short dialogue outlining some positive self-talk phases or tips you could give yourself to enhance your visualisation practice and improve your performance.

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## **ACTIVITY** Reviewing practice

- 1 Debate the following topic as a class: 'To what extent should a coach insist on the development of conventional technique?' For example, if a young cricket bowler is generating speed and accuracy with an unusual action, should their technique be reconstructed?

- 2 Choose a sport and list an example of where each type of practice may be useful.

Sport: \_\_\_\_\_

Massed practice \_\_\_\_\_

Distributed practice \_\_\_\_\_

Whole practice \_\_\_\_\_

Part practice \_\_\_\_\_

- 3 As a class, conduct a test of the effectiveness of each type of practice.

a Divide the class into five groups.

b Decide on a skill that everyone will learn such as a lacrosse throw, a basketball lay-up or juggling.

c Allocate a type of practice to each group.

d Devise a peer-assessment tool to assess the effectiveness of each type of fitness. Record your peer-assessment tool in the space provided.

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e Predict the results and give reasons for your predictions.

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- f Have each group learn the skill using only their assigned type of practice and record the results. Discuss the final results of each method as a class.
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- g Did the predicted and final results match for each practice type? If not, can you think of any reasons why this might be?
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- h Draw conclusions about the most appropriate practice method for learning the skill your class chose.
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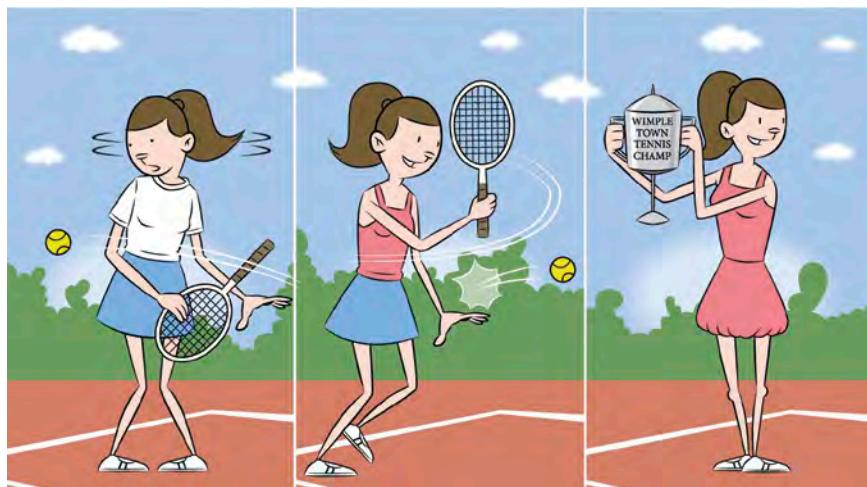
## The value of mastering skills

Research suggests that there is a window of opportunity for the development of fundamental movement skills. The first eight years of a child's life are regarded as the 'golden years' for skill development, because this is the time during which new skills are learnt most easily. However, you do not automatically develop movement skills, instead they are learnt through quality instruction, a supportive environment and opportunities to practise. Research suggests that it takes between 240 and 600 minutes for the average child to become proficient in one fundamental movement skill.

## Acquiring specialised movement skills

You progress through a number of stages as you develop proficiency in new movement skills. This will occur for different people at different rates and some people may never reach the final stage. Characteristics of the three stages of skill acquisition are:

- **Cognitive stage:** individual needs to learn about how to execute the task, frequent large errors are made, a great deal of feedback is required, individual needs to see the skill demonstrated correctly, performance is inconsistent.
- **Associative stage:** fewer errors are made, individual learns to detect and correct performance errors, individual relates to the correct technique, performance becomes more consistent.
- **Autonomous stage:** automated performance of the skill, skill actions are highly refined, less emphasis on skill mechanics and more on tactics and strategies. Depending on the skill, this stage may be unachievable for most.



*You will get better at a movement skill as you move through its stages*



## ACTIVITY *Understanding movement stages*

- 1 What stage do you think a professional athlete would be at in their chosen sport, and in a sport they play for fun?

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- 2 Describe how an individual moves through a number of stages as they learn and master a new skill.

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- 3 Modified games are designed so that young players can concentrate on developing foundation skills of their required sport. List the modified sports that are available for children to play.

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- 4 Choose one of the modified games and list the rule changes that are in place for young players and how each of these changes aid in their development of skills.

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- 5 In groups of five, develop a modified version of a sport you are currently studying, so that your classmates have a greater opportunity to develop and refine their skills. Discuss your ideas as a class in order to come up with the final version of your game.

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## ACTIVITY *Fill in the gaps*

**closed skills**  
**gross motor skill**

**cognitive stage**  
**individual skills**  
**part practice**

**fine motor skill**  
**massed practice**  
**skill transfer**

**fundamental movement skills**  
**mental rehearsal**

\_\_\_\_\_ are the building blocks for all types of games, physical activities and sports. Running is an example of a \_\_\_\_\_ because it involves large muscle groups. Writing requires greater precision and use of smaller muscles, and is therefore considered to be a \_\_\_\_\_.

\_\_\_\_\_ are performed in predictable environments where the performer determines when to start the action. \_\_\_\_\_ are those performed in isolation without opposition or the cooperation of team-mates. \_\_\_\_\_ refers to the effect learning and performance of one movement skill has on the learning and performance of another movement skill.

Visualising the performance of a movement skill without physically performing the skill is known as \_\_\_\_\_.

More injuries tend to occur with \_\_\_\_\_ because of mental and physical fatigue.

\_\_\_\_\_ involves breaking a movement skill into smaller parts and then learning them. The \_\_\_\_\_ is the first stage of skill acquisition and is often characterised by frequent errors.

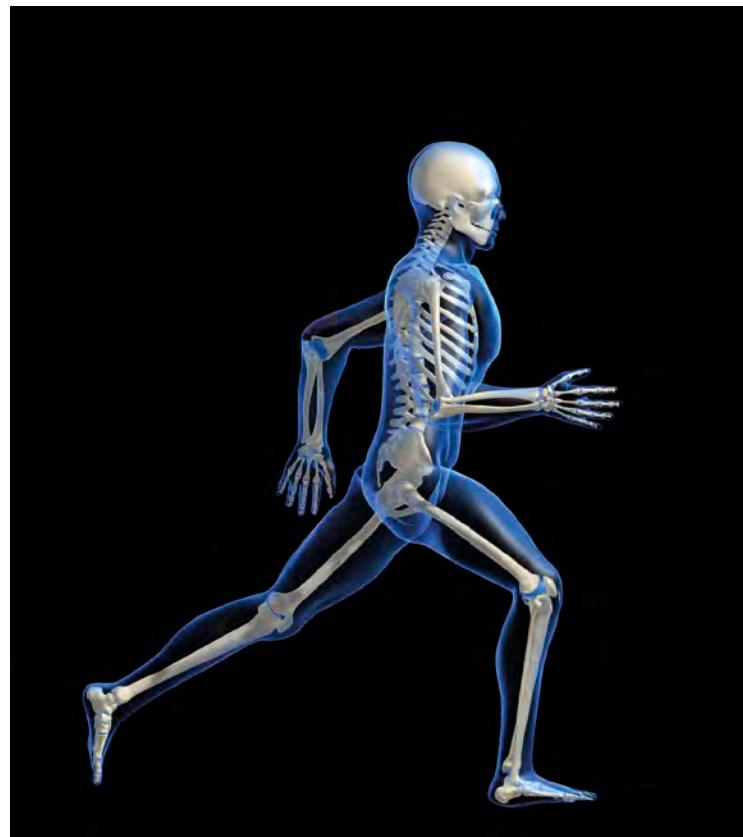


## ACTIVITY *Developing movement skills word search*

Find the twelve words hidden in this word search relating to developing movement skills. The words can run forward, backward, diagonally and vertically.

**Movement****Sprint****Catch****Locomotor****Practice****Jump****Mental****Transferring****Skills****Kick****Throw****Interaction**

I	N	T	R	O	D	I	C	R	I	O	N	T	W	F	G	M	O	H
E	A	L	T	H	E	D	I	U	O	A	T	I	O	N	A	N	D	P
E	V	A	M	O	V	E	M	E	N	T	L	U	E	S	R	E	L	A
T	I	N	G	E	D	I	S	L	I	K	O	W	O	P	E	R	K	G
I	N	G	I	C	N	R	N	T	H	R	E	M	R	O	D	I	T	N
H	U	C	K	S	X	T	S	L	I	K	E	A	O	C	A	B	N	I
C	H	A	V	S	C	F	A	D	F	U	C	N	I	C	A	N	N	R
T	G	O	V	K	B	A	C	L	U	T	P	S	T	A	O	E	R	R
A	T	O	L	I	E	V	E	L	I	T	T	E	R	E	E	L	I	E
C	H	E	M	L	M	A	V	C	I	O	L	N	T	A	A	N	D	F
L	A	U	E	L	R	A	E	W	O	P	D	S	I	O	S	D	Y	S
B	U	I	L	S	D	E	R	S	A	E	E	P	R	R	H	G	B	N
T	K	I	T	L	A	T	H	E	T	H	R	O	W	K	P	C	S	A
H	A	I	I	A	M	T	S	K	I	L	L	T	R	Y	I	S	G	R
T	O	T	C	E	R	I	C	K	Y	A	M	O	V	E	M	A	M	T
I	N	T	E	K	A	Z	C	B	N	I	M	P	M	U	J	V	L	O
A	C	B	X	V	N	F	E	G	Y	K	A	B	T	O	Z	Q	E	Y
Y	E	N	S	D	H	I	N	T	E	R	A	C	T	I	O	N	T	J
M	B	T	C	E	Y	M	D	E	N	K	R	L	R	V	X	E	H	I



# Biomechanics

## Introduction

### What is biomechanics?

### Force and movement

Displacement

Velocity

Acceleration

### Newton's laws of motion

The law of inertia

The law of acceleration

The law of action and reaction

### Momentum and impulse

Momentum

Impulse

### Resistive forces

## Principles of motion

Angular motion and torque

Moment of inertia

Projectile motion

## Balance and stability

Centre of gravity

Base of support

Levers



# Introduction

In any given sport or physical activity the human body will undergo a series of trained, well-rehearsed movements to succeed in meeting the objective of that particular activity.

Whether the playing field is the pool or the pitch, the oval or the track, the athlete's body responds to every plausible method of play. These movements are practised, timed, precise and, from the spectator's perspective, seemingly natural and flawless. Yet their importance is immeasurable; completely undetectable by a scoreboard or time clock.

The possibilities and limitations of human movement are dependent on the environment in which we participate. To fully understand this relationship we turn to the study of biomechanics.

## What is biomechanics?

**Biomechanics** is the study of forces, both internal and external, and the effects of those forces on and within the human body. Whenever a force is applied to the body, biomechanics can analyse and interpret its cause and effect.

Through observation, measurement and analysis of training and competition performance, biomechanists use their expertise to support athlete development.

Biomechanics does not simply determine how our bodies *can* move; it is a science that allows us to work out how our bodies *should* move. Kicking a soccer ball, running a marathon or serving an ace are activities that, through biomechanics, can be performed more efficiently in order to produce optimum results.

To understand the usefulness of biomechanics, we need to examine the key areas of force, motion, balance and levers.

### **ACTIVITY Streamlining movement**

- 1 Athletes at the most elite levels spend years perfecting their technique so that they make the most efficient movements possible. Read 'Anatomy of an athlete' at the link provided, and explain what areas they have to focus on to optimise their movements.

<[flexibooks.com.au/w/22y](http://flexibooks.com.au/w/22y)>

a Kelsey

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b Larissa

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c Brooke

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- 2 Why do track athletes have to limit the amount of time they spend practicing their specific sport, and focus much of their training on general strength and speed?

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# Force and movement

**Forces** can most accurately be defined as either pushes or pulls that change an object's movement. No object will demonstrate motion unless it is subjected to a force.

## ACTIVITY Identifying forces

- State which type of force (push or pull) is responsible for the following examples of motion:

putting the shot:

rowing a canoe:

kicking a football:

freestyle swimming:

Force can be produced either internally (through the contraction of muscles), or externally (through the effects of gravity, friction, water and air). It is typically described in terms of an object's mass and its acceleration.

The unit of measurement for force is called a Newton (N), named after Sir Isaac Newton (1642–1727) a famous scientist who formulated the law of gravity and the laws of motion.

It is important to note that there are always **two** objects involved whenever a force is applied and that only an unbalanced force acting on an object can change its velocity.

For example, when a rugby player runs towards the tryline, an unbalanced force (his opponent) will attempt to prevent his progression through the play by tackling and throwing him off-balance. In this example, the unbalanced force decreases or slows down the velocity of the attacking player.

## Displacement

In order to describe the effects of movement, we must first know the initial position of an object and how that position changes to meet its objective. **Displacement** is the movement of an object in a specific direction.

Imagine that Venus Williams has just served the ball. Upon impact she may run forward from the baseline toward the middle service line to return her opponent's volley. This movement from baseline to a new position on the court is known as displacement. At any point during her game, Williams' displacement can be described by measuring in metres how far she is from her last position on the court. The total distance she runs over the course of her game can be measured by following the path created by her displacement.

## Velocity

The rate at which an object moves from one location to another is known as **velocity**. Velocity is characterised by speed and direction. To determine a person's velocity, we must know that person's displacement path and divide it by the time it has taken to complete it.

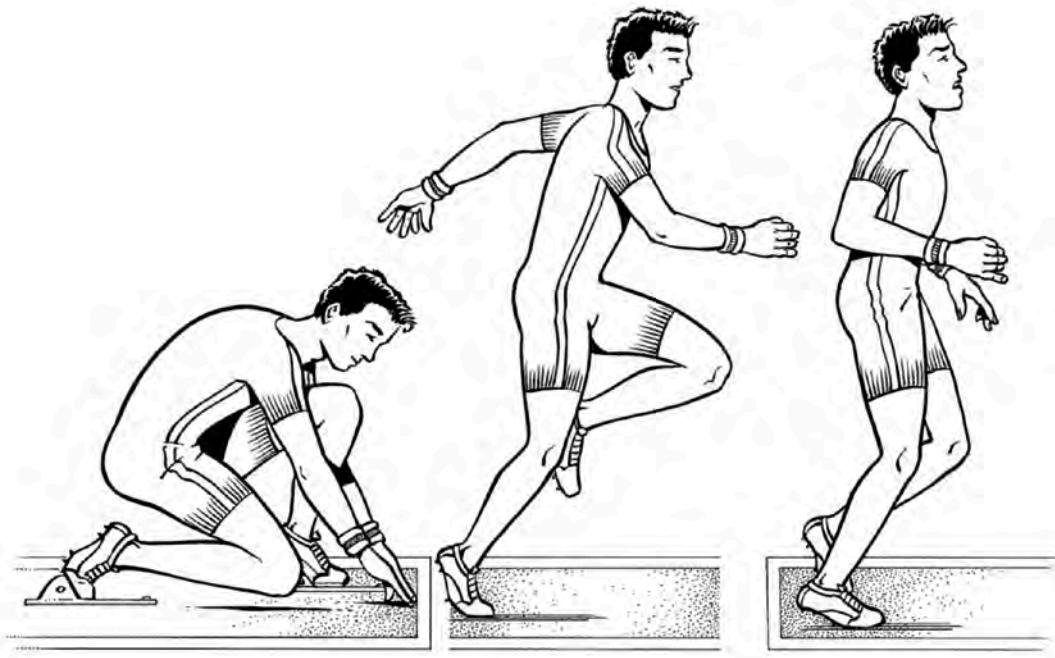
$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}} \quad \text{or} \quad V = \frac{d}{t}$$

For example, in a 100 metre sprint event, a sprinter who completes the race in 10 seconds has a velocity of 10 m/s.

When an object is travelling at a high velocity, the time it takes to cover a specified distance is less than an object travelling at a slower velocity. Simply stated, the winner of any race involving distance should always be the person with the **highest average velocity**. It is important to note that the calculation for velocity over an entire race provides an average result only.



As a sprinter pushes off the starting blocks, velocity rapidly increases for a time. By around the middle stages of the race, velocity should peak, the sprinter attempting to maintain this velocity to the end of the race. At any one point in the race an instantaneous velocity can be measured. This is often examined to determine precisely where in a race an athlete needs to further hone their skills in order to reduce time and improve average velocity.



### ACTIVITY *And the winner is...*

- 1 In pairs, take turns to time how long it takes each of you to complete a 100 m sprint.
  - a Work out your average velocity and share your results with the class.
  

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  - b Use the data to predict who is the fastest runner.
  

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  - c Test your hypothesis by holding a 100m final to determine who is the fastest runner.
  

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- 2 What other aspects may influence a runner's final result?  

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## Acceleration

In the velocity example, the sprinter uses an internal force to create motion. When we apply force to something to make it move, our objective is to speed it up, slow it down, stop it completely or make it change direction. This change in velocity over a specific period of time is called **acceleration** (or deceleration, if the force slows the object down).

$$\text{acceleration} = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$



To calculate the acceleration of the sprinter in the previous example, we would take the initial velocity (0 m/s) from the final velocity (10 m/s) and divide by the 10-second time period it took to complete the race. This gives an acceleration (or a change in velocity) of 1 m/s<sup>2</sup>.

Compare this to a skater who goes from a standstill position to a speed of 6.7 m/s in 12 seconds. The acceleration of the skater is calculated here:

$$a = \frac{v_f - v_i}{t}$$

Since the skater was at a standstill position and not in motion, the initial velocity of the skater was zero. The skater reached a speed of 6.7 m/s in 12 seconds, which is the final velocity.

$$a = \frac{6.7 \text{ m/s} - 0 \text{ m/s}}{12} = \frac{6.7 \text{ m/s}}{12}$$

$$a = 0.56 \text{ m/s}^2$$

## ACTIVITY *Understanding acceleration*

- 1 Compare the rates of acceleration for the sprinter and the skater. Can you think of reasons why the sprinter's acceleration is greater?

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When acceleration is greater, it tells us that velocity is changing quickly; when it is smaller it tells us that velocity is changing slowly. **Zero acceleration** means that there may be no change in velocity. As with a tennis ball or golf ball flying through the air, it is possible to be travelling very quickly at zero acceleration.

Furthermore, acceleration cannot be sustained for the duration of an event. It is obviously important at the start of events but once maximum velocity has been achieved, there is no change in velocity (zero acceleration) until the end of the event when velocity changes as a result of deceleration.

- 2 Explain why rapid acceleration is much more important for a sprinter than it is for a middle-distance or long-distance runner.

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- 3 Predict what you believe would be faster: running 100 metres from a standing start or a crouch start.

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Test your hypothesis with a partner and explain your results.

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Like velocity, the calculation for acceleration produces an average result only. As it is possible for acceleration to vary at given intervals during a specified time, it is also possible to examine instantaneous acceleration at differing points in time.



# Newton's laws of motion

Three scientific laws of motion developed by Sir Isaac Newton in 1687 govern the reaction of objects to applied forces.

## The law of inertia

An object at rest will remain at rest until a force causes it to accelerate. An object in motion will continue its movement in a straight line unless a force causes an acceleration to make it slow down or change direction.

## The law of acceleration

When a force acts on an object, the acceleration that takes place depends on the amount of force applied, and the mass of that object.

This law is expressed in an important equation frequently used in the study of human movement and sport.

$$\text{Force (N)} = \text{mass} \times \text{acceleration} \text{ or } F = ma$$

This equation can also be expressed as follows.

$$\frac{\text{Force (N)}}{\text{mass}} = \text{acceleration} \text{ or } \frac{F}{m} = a$$

Keeping in mind that objects will move in the direction of their force, an object with a larger mass is harder to accelerate than an object with a smaller mass. Compare bowling a ten-pin bowl with a mass of 7 kg to throwing a basketball with a mass of 0.5 kg. Applying a force of 10 N and using the law of acceleration, we can conclude the following:

bowling ball

$$F = ma$$

$$a = \frac{F}{m}$$

$$a = \frac{10 \text{ N}}{7 \text{ kg}}$$

$$a = 1.43 \text{ m/s}^2$$

basketball

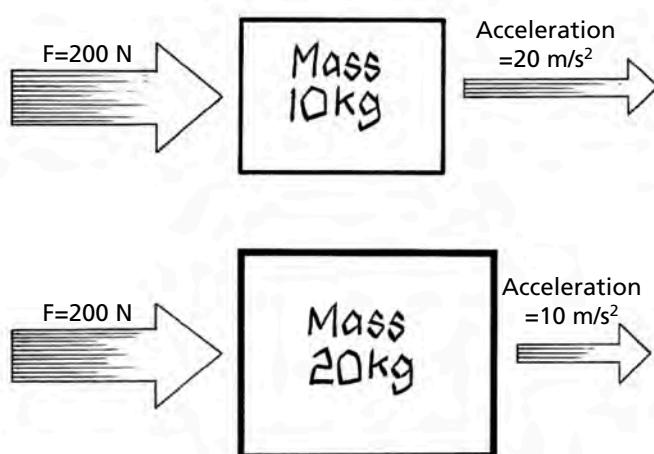
$$F = ma$$

$$a = \frac{F}{m}$$

$$a = \frac{10 \text{ N}}{.5 \text{ kg}}$$

$$a = 20 \text{ m/s}^2$$

The basketball accelerates at a much greater rate than the bowling ball because its mass is smaller. The bowling ball requires a force larger than 10 N if we want to increase its acceleration and change its speed. Conversely, smaller masses are easier to accelerate and do not require as great a force to change speed. In basic terms, acceleration increases by the same or proportional amount that mass decreases and vice versa.





## ACTIVITY Calculating acceleration

- 1 Calculate the following:

Force (N)	Mass (kg)	Acceleration ( $\text{m/s}^2$ )
100	50	
150	50	
200	50	

- 2 The relationship between the law of inertia and the law of acceleration depends on one underlying difference. What is it?

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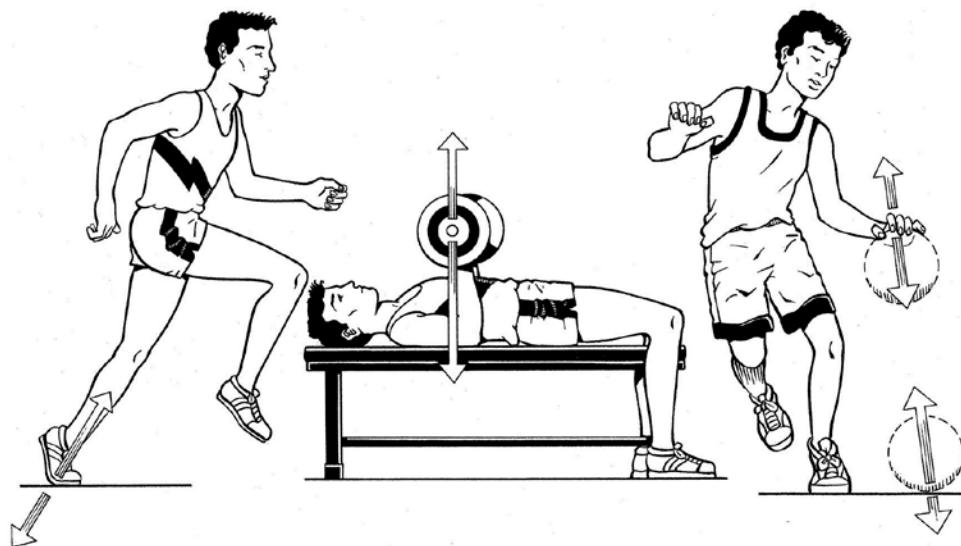
## The law of action and reaction

For every action, there is an equal and opposite reaction. This means that when an object exerts a force on a second object, the second object must also exert an equal-sized force back onto the first object in the opposite direction.

## ACTIVITY Applying Newton's laws of motion

- 1 In the illustration provided, mark beside the arrows which force is the **Action** and which is the **Reaction** of the sporting example used.

Briefly explain how the law is at work for each.




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- 2 Use the third law of motion to describe what happens when teams in a scrum push against each other but neither moves.

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- 3 Why is running on sand more difficult than running on a track?

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- 4 Explain how all three laws of motion operate when a canoe is rowed along a river.

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## Momentum and impulse

Two concepts associated with Newton's laws of motion are momentum and impulse.

### Momentum

Newton's first law of inertia tells us that once an object starts to move, its tendency is to keep moving. This 'quantity of motion' is called **momentum**. It is measured by multiplying the object's mass by the rate at which it is moving (velocity).

If a shot-put has a mass of 7 kg and a velocity of 10 m/s, the formula for momentum (mass x velocity) tells us that the momentum of the ball is 70 kg m/s. Compare this to a discus with a mass of 2 kg and a velocity of 20 m/s. Its momentum only achieves 40 kg m/s.

The shot-put has the greater momentum because, although it is not travelling as fast as the discus, its mass sufficiently contributes to greater momentum.

*The more mass an object has, the greater its momentum.*

However, what if the discus also weighed 7 kg? It would have a greater momentum than the shot-put because its velocity is greater.

*The faster an object moves, the greater its momentum.*

### Conservation of momentum

How difficult is it to stop an object that has gained momentum? It depends on the total momentum of both objects both before and after their point of impact.

Successfully catching a football will depend both on the ball's momentum and the momentum of the hands as both absorb the impact of the collision. This principle, known as **conservation of momentum**, is best explained by Newton's third law that for every action there is an equal and opposite reaction, and it is particularly relevant to contact sports.

AFL players who have a large mass and can run fast can achieve high momentum, and are therefore very difficult to stop. A player with less mass must run more quickly in order to generate the same amount of momentum, otherwise they become easier to stop when tackled.

When a collision between two objects occurs, the total momentum of the two objects before impact is equal to the total momentum after impact.



## ACTIVITY *Understanding momentum*

- 1 If a 156 g cricket ball and a 151 g baseball are moving at the same velocity, which will be harder to catch? Explain why.

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- 2 If two rugby players both with a mass of 100 kg are moving towards each other at different velocities, who will be easier to stop? Explain why.

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- 3 As a class, you will be given the opportunity to participate in a tug-o-war. Use the conservation of momentum principle to explain what was happening throughout the competition.

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- 4 True or false? A lighter player can never seriously affect a heavier player in a contact. Explain your reason.

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- 5 In groups of three, take turns doing a chest pass using a netball or a basketball. Try different catching methods to determine which is the best at absorbing the impact during catching. Share your answer with your class and explain your decision.

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## Impulse

Applying a force to an object over a given amount of time causes a change in momentum. This change is called **impulse**.

$$\text{Impulse} = \text{Force (N)} \times \text{Time of force application(s)}$$

The formula for impulse tells us that a change in momentum is affected by two factors: the strength of the force applied and the time over which a force is applied.

In freestyle swimming, the arms apply force over a great range of motion increasing the time over which forces can be applied.

Conversely, in the case of a field hockey player driving the ball the collision is over in an instant. Therefore, in this case impulse has more to do with force than the time over which force is applied.

Impulse and momentum are strongly related. The more impulse applied to an object, the greater its velocity since its mass remains constant.



## ACTIVITY *Evaluating impulse and momentum*

- 1 Explain how impulse and momentum are present in kicking a soccer ball.

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- 2 Perform a number of cricket deliveries to experiment the ways in which a cricket player changes the momentum of a ball during bowling.

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## Resistive forces

If a force is being applied to an object to make it move, a **resistive force** acts in opposition to it in order to resist or slow its movement.

**Gravity** is a constant force acting vertically to the centre of the earth. It acts through the centre of mass of the body opposing upward movement away from the earth.

**Fluid resistance** is a force arising from air or water. Moving through the fluid requires an object to push it aside, creating a **drag** force that tends to slow movement. It is most prevalent in high-velocity sports such as sprinting and cycling. In a basic example, if running velocity increased by a factor of two then drag resistance would increase by a factor of four. As a result clothing and equipment are specially designed to minimise its effect.

**Friction** is a force that opposes movement due to contact between two surfaces moving across each other. Depending on the sport, increased friction can improve a player's performance. Footwear is designed to increase friction between the ground and a player's feet so that slipping is minimal and stability can be maintained.

In other sports, such as those played on snow or ice, decreasing friction by waxing skis and sharpening ice skates maintains the slipperiness of their surfaces.

## ACTIVITY *Identifying forces*

- 1 List five sports, or skills within sports, and explain how any or all of the resistive forces mentioned affect performance and how they may be counter-balanced.

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- 2 In teams of four, participate in a handball competition in various venues across the school, including a grass court, a bitumen court and a cement/wooden court.
- Predict what factors will affect your performance and which court service you believe will be more suitable for optimal performance. Justify your response.

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- Revisit your opinion at the conclusion of the competition to determine whether or not you were correct.

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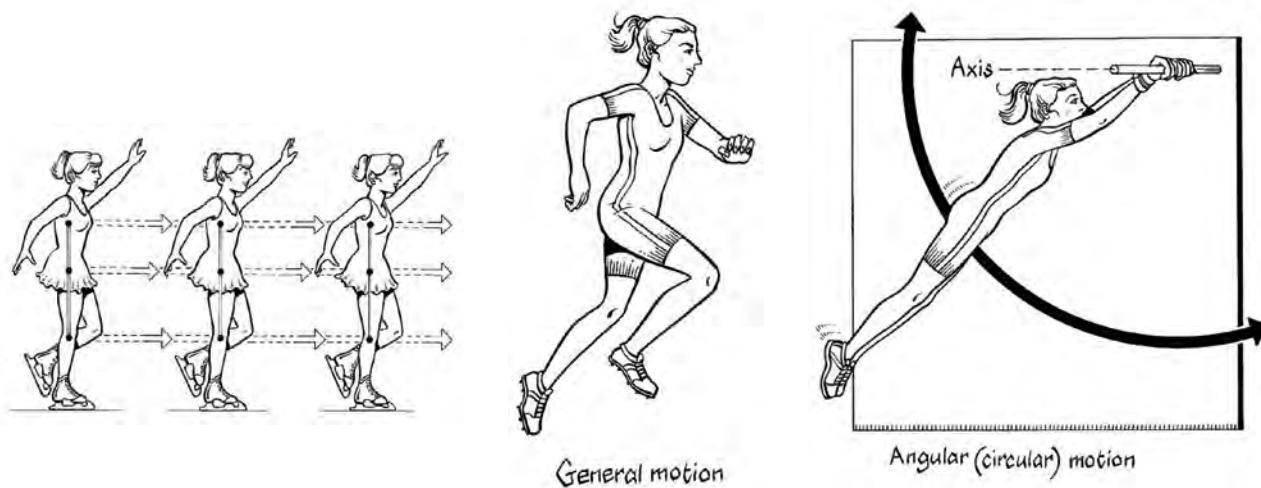


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## Principles of motion

So far we have been looking at how forces cause, alter, sustain or terminate movement. Most of our examples have been about the occurrence of motion in a straight line. However, in sport, movement does not only occur in a straight line (linear motion), but can also occur as a rotation around a fixed point (angular motion), or a combination of both (general motion).

**Motion** can be defined as a change in the location of an object in space and time. Even the most basic of human movements—bending the leg, turning the head, twisting the torso—demonstrate a change in location. Each change is the result of an applied force.



*Linear motion (skater), general motion (runner) and angular motion (gymnast)*

## Angular motion and torque

**Angular motion** is achieved when the line of the force is directed to one side of the axis of rotation. This is known as **torque**, a turning effect that changes the rotational acceleration of the object.



In sport, objects (including the human body) will spin, bend or rotate in some way. The degree to which these movements are accelerated depends on the amount of torque applied and the distance from the axis of rotation to the line of force. Greater torque means greater change in the rotational acceleration of the object, especially if there is greater distance between the axis and the line of force.

## ACTIVITY Identifying motion types

- 1 State whether the following activities constitute linear, angular or general motion:

a sprinter in a 100 m sprint

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b swimmer in a 100 m butterfly event

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c sliding down a water slide

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d gymnast on the horizontal bar

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*Hand force applied to the push rim at a given distance from the axle of the wheel delivers torque to the wheel, which in turn translates to increased velocity of the wheelchair.*

## Moment of inertia

The resistance to change of an object in angular motion is known as its **moment of inertia**. The greater an object's mass and its distance from the axis of rotation, the more difficult it will be to change the rotation of the object and vice versa.

In junior sport, the moment of inertia can be greatly reduced by modifying equipment. Lightweight bats and short-handled racquets reduce mass and the distance from axis of rotation of the hands to the centre of mass of the bat, making it easier for younger or inexperienced participants to change the rotation of the bat.

## ACTIVITY Modifying inertia

- 1 Choose three sports and list the modifications that are allowed for younger players to encourage greater success.

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## Angular momentum

**Angular momentum** measures the amount of a rotating object's angular motion. A rotating object will be harder to stop if its moment of inertia and rotational velocity are high, and easier to stop if its moment of inertia and rotational velocity are low.



Conservation of angular momentum is a term used to describe how the total momentum of a body stays constant during a movement. Athletes can change their body shape to assist with this. For example, a diver can move from a straight position into a tuck position in order to decrease inertia through minimising the distance from the axis of rotation. This motion increases velocity, conserves angular momentum and makes it very difficult for an unbalanced torque to destabilise the movement.

## ACTIVITY *Understanding the rate of rotation*

- 1 In the somersault, various body positions such as the tuck and pike will influence the rate of rotation (angular velocity). Explain how this is true.

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## Projectile motion

The movement of an object through the air is referred to as **projectile motion**. The objective of many sports is to control and manipulate the flight path of a projectile in order to achieve optimal distance for that particular sport.

The velocity, height, angle and attitude at which an object is released together with air resistance affects its flight path or **trajectory**. The object's orientation to its trajectory at release is its **attitude**.

### Velocity at release

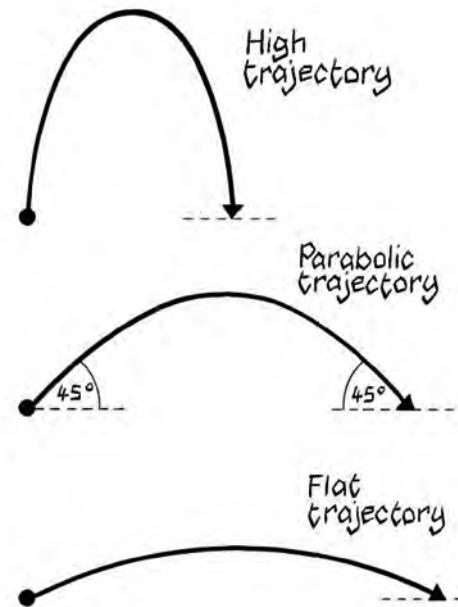
When a shot-putter releases the shot-put with increased velocity, all else being equal the shot will increase its time in the air and travel over a greater distance. Of all factors at release, velocity accounts for the greatest increases in distance.

### Angle of projection

The shape of the trajectory depends on the angle at which the object is released and will vary across many sports. In the absence of air resistance an object would travel in a true parabolic trajectory. In reality, and in the presence of air resistance, a typical sport object delivered from shoulder height would be projected at approximately  $45^\circ$  to cover the greatest possible distance.

### Height of release

As a general rule, increasing the height of the projection results in greater time in the air and distance travelled if velocity and angle of projection are held constant.



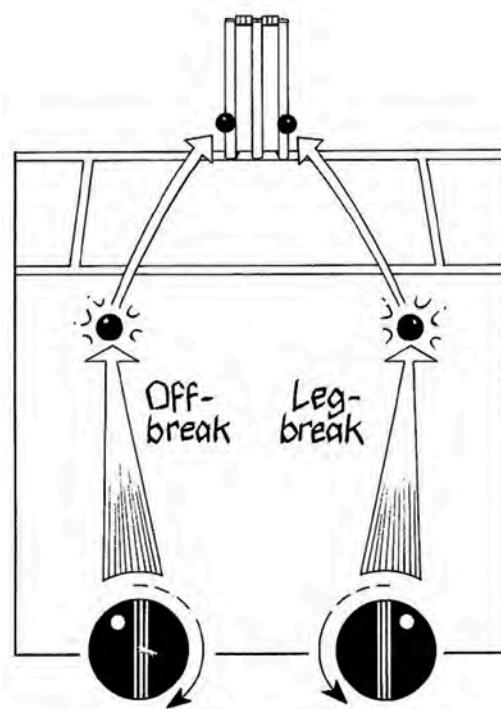
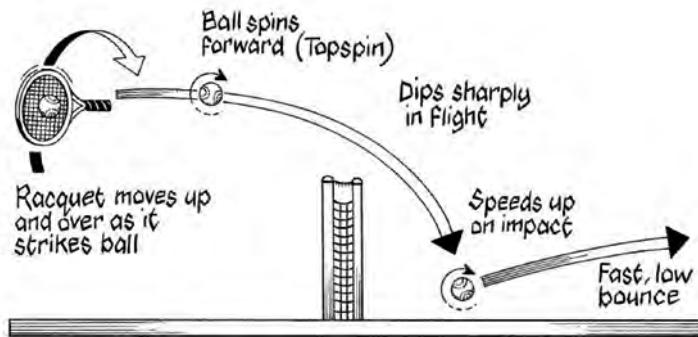
### Air resistance and spin

Air resistance, wind and other elements may alter the projectile's trajectory. This is why in many sports such as tennis or soccer, to ensure equal advantage, teams are required to change sides of the court or pitch.

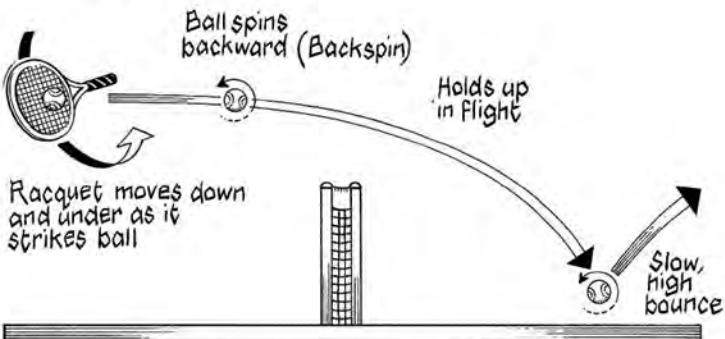
The greater the surface area of the projectile and the more velocity it has, the greater the effect of air resistance.

With a spinning ball, differences in the velocity of airflow around the surface of the ball will result in a condition known as the **Magnus effect**. The differences in airflow, in turn, result in changes to the pressure on either side of the ball causing it to deviate from its flight path. Tennis players, soccer players and golfers are examples of athletes who use the Magnus effect to curve the ball's trajectory, either giving the ball topspin, backspin, slice or draw.

### Topspin tennis stroke



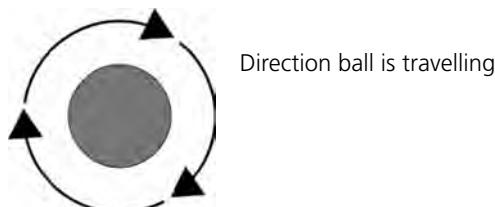
### Backspin tennis stroke



*The direction of spin, in a tennis stroke and in the off break and leg break bowl for a right-handed cricket batsman*

## ACTIVITY Understanding spin

- This diagram shows a side-on view of a table tennis ball spinning in flight.



- What type of spin is on the ball?

- When compared to a ball without spin, what effect does this type of spin have on the flight of the ball through the air?

- c Explain how the player would be able to impart this type of spin on the ball.
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## Balance and stability

**Balance** is the ability to maintain equilibrium and in biomechanics it plays an ever-present role in human movement.

For balance to exist, coordination and control are essential components. These are strongly highlighted in sports such as figure-skating and gymnastics where rules indicate that set positions (known as **static balance**) must be maintained. Other sports such as tennis or basketball require balance while moving, such that a body's position can be altered easily (known as **dynamic balance**).

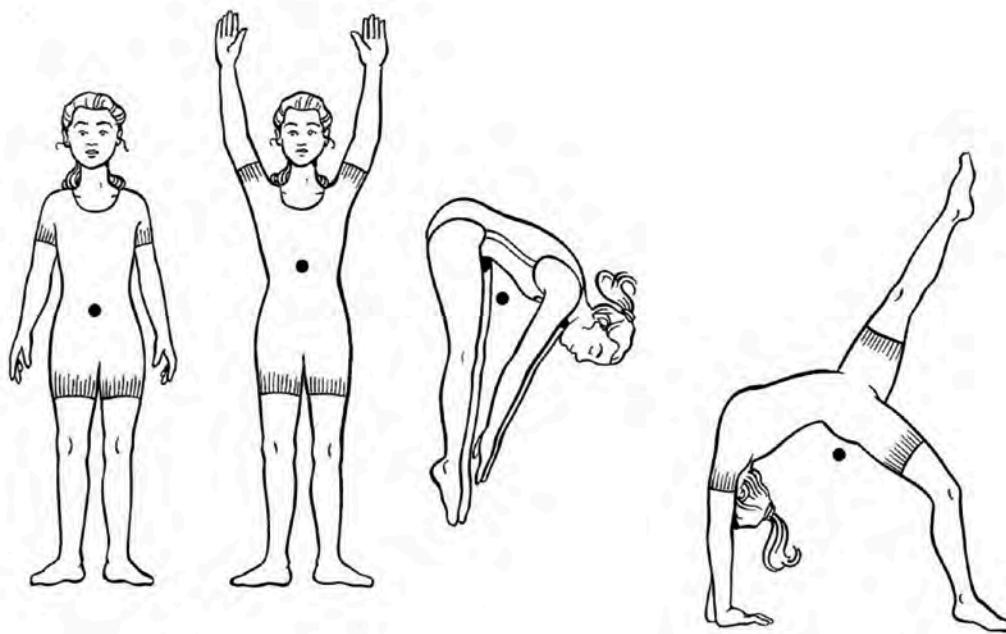
While balance may not be the overall aim of a sport, a person's level of **stability**, that is the ability to resist movement or disruption to balance, can have far greater implications for their success. There are several factors that influence balance and stability.

## Centre of gravity

**Centre of gravity** is the centre of balance of an object and the centre of the gravity effect on the body. Objects with regular shapes and mass distribution, such as a ball or ruler, have their centre of gravity in their geometric centre.

With arms at their sides, humans have their centre of gravity located approximately mid-height (57 per cent of the way up the body or slightly lower for females). However, a person's centre of gravity changes with their body position and, depending on the movement, can often be located outside the body.

Lowering one's centre of gravity can maintain stability. Movements in any number of sports, from the tackle in Australian football to wrestling, require the participants to bend their knees slightly as a method of resisting being toppled over by an opposing force.



## Base of support

**Base of support** refers to the part(s) of the body in contact with a surface. The larger the base of support in the direction of the oncoming force the greater the body's stability. A rugby player who increases his base of support by widening his stance towards the oncoming player and lowering his centre of gravity by bending his knees will be harder to tackle and turn over.



## ACTIVITY Identifying base of support

- 1 Perform the following gymnastic skills: handstand, front support, V-sit, shoulder stand, stork stand.
  - a Identify the base of support for each position.

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- b Rank each skill in order of most to least stable.

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## Line of gravity

In the figures of the standing girls, the centre of gravity is directly in line with the middle of the base of support. Drawing an imaginary line between these points is called the **line of gravity**. When the line of gravity moves outside the parameters of the base of support, stability is lost.

## ACTIVITY Applying principles of gravity

- 1 Find the centre of gravity of a ruler. Using an eraser, explain how distribution of mass affects centre of gravity.

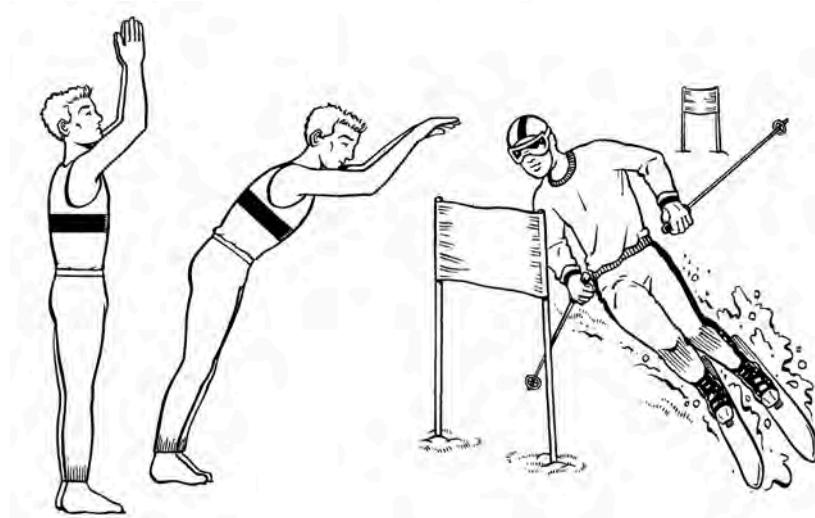
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- 2 Use a ruler to help mark the centre of gravity, the line of gravity and the base of support on these diagrams.



- 3 Explain the importance of balance while performing a skill such as hitting a baseball.

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# Levers

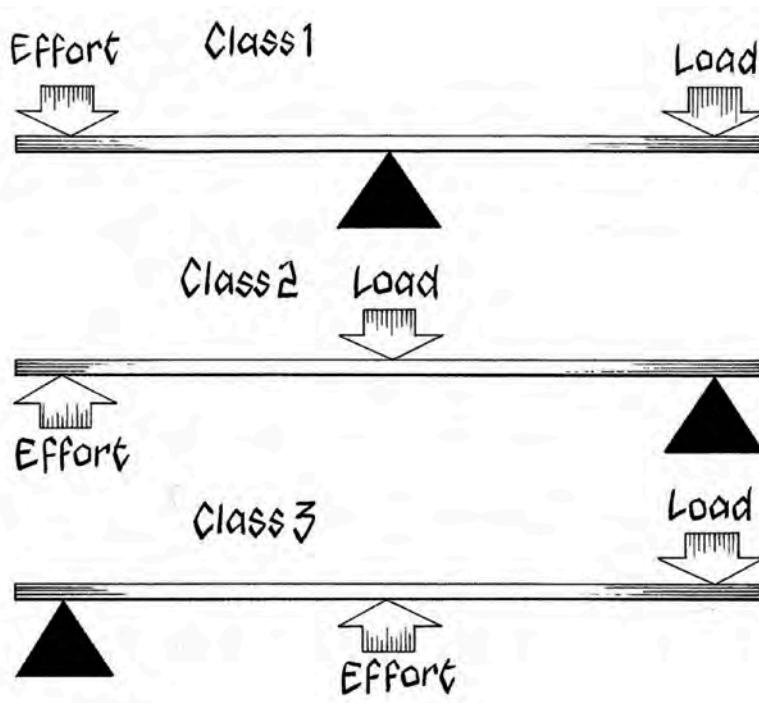
To understand how the human body applies force we turn to **levers**, machines that help us transfer energy from one object to another.

In the human body, bones, muscles and joints work together to make up lever systems. The bone is a rigid bar that revolves around a fulcrum or axis (the joint) whenever a force is applied to overcome a resistance. Attached to the bone are muscles, which deliver the force, and are required to move the resistance. In biomechanics, there are three types of levers within the human body.

*First class lever*—the fulcrum or axis is located between the load (resistance) and the effort (force) needed to move it.

*Second class lever*—the load is located between the axis and the effort.

*Third class lever*—the effort is located between the axis and the load.

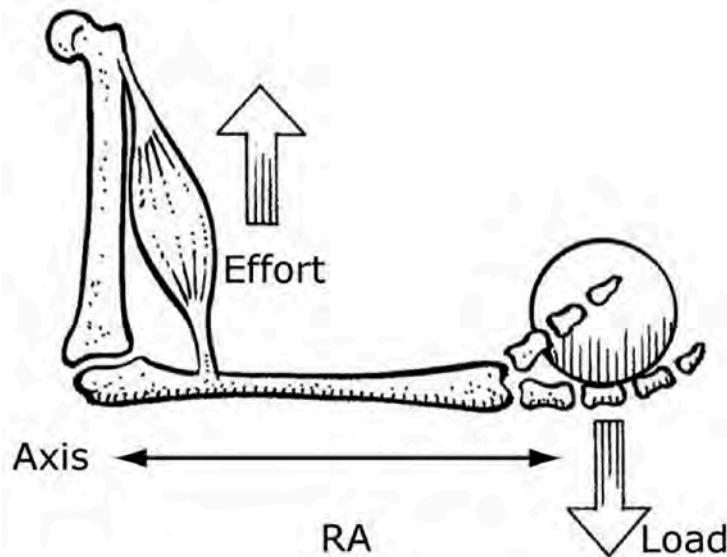


Most sporting situations require the use of third class levers, with first and second class levers having limited applications.

Third class levers have the effort (muscle) located between the axis (joint) and the load (resistance). This system provides a long resistance arm (RA) and the lever can be swung through a much greater range of motion and with a much greater velocity. Levers in the human body are therefore more adept at increasing our ability to move quickly than increasing our ability to move heavy objects.

**Extended levers**, or sporting equipment such as bats, sticks and racquets, help illustrate this point. A baseball bat has a long resistance arm extending from the hands to the end of the bat and, while it requires more effort to swing it, increasing the RA means that the end of the bat has a greater range of motion. The bat strikes the ball with a much greater force than it would have had the implement not been used, and as a result generates a higher ball velocity.

The effectiveness of such an extended lever to maximise performance will therefore depend on its length, the ease with which it can be swung and the muscular strength of the player.



A typical third class leverage system



## ACTIVITY *Understanding levers*

- 1 Why is it often a disadvantage for a younger or inexperienced player to use a longer racquet, bat or club?

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- 2 Explain why most levers in the body have short force arms and long resistance arms.

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# Drugs in sport

## Drugs in sport

- Caffeine
- Diuretics
- Anabolic steroids
- Human growth hormone (HGH)
- Beta blockers
- Blood doping
- Erythropoietin (EPO)
- Legal methods to improve performance
- Drug testing
- Participation for all



# Drugs in sport

Illegal drug use captures media attention, but the most commonly used drugs are legal. Caffeine is a legal drug and as such is not listed on the *World Anti Doping Code (2008)*.

## Caffeine

Caffeine is one of our most socially accepted drugs. It is a stimulant found in coffee, tea, cola drinks, chocolate and stimulant tablets such as *No-Doz*. As a stimulant, caffeine has rapid short-term effects such as:

- energy release in your muscles
- shaking or trembling hands
- increased body temperature
- increased urine production.

List some other effects:

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Large doses of caffeine can cause headaches, shakiness, nervousness, delirium and even death. Consuming six or more cups of coffee a day—or three cans of a cola soft drink, two chocolate bars and one coffee—may give you:

- chronic insomnia
- persistent anxiety.

List some other effects:

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A regular intake of about five cups of coffee daily causes physical dependence on caffeine. People who are physically dependent show classic withdrawal symptoms—severe headache, irritability and tiredness.

### ACTIVITY *Dangers of caffeine*

1 How could caffeine be misused?

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2 Is caffeine potentially dangerous for some people? Explain how.

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3 What ethical issues arise if caffeine is used for improved performance at a school carnival?

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- 4 As a class, debate whether caffeinated drinks should be used in school sports. Plan your arguments in the space provided.

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## Diuretics

Diuretics are used by athletes to stimulate urine production. This aids athletes who participate in sports where weight is an issue, for example weight-lifting and horseracing. Diuretics are also used by some athletes to dilute their urine to mask the use of particular drugs such as anabolic steroids. Dehydration is a common side effect of diuretic use and abuse may also lead to kidney problems.

### ACTIVITY *Diuretics as medication*

- 1 Diuretics are widely available within our community. What non-sporting reasons may someone have for taking this as a form of medication?

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## Anabolic steroids

Anabolic steroids have received enormous amounts of publicity in recent years because athletes in many sports have been using them to win by cheating. However, a much more serious problem has arisen: there is now a trend towards adolescent abuse of steroids as a result of media pressure, inappropriate role models and availability. Australia follows America in many social trends, and steroid abuse by teenagers appears to be one of these trends. Recent studies have also shown that it is not just boys taking steroids. Girls are starting to experiment in their quest to achieve the perfect body.

Anabolic steroids can cause a host of harmful side effects, some of which may not become apparent until years later. Initial side effects can include

jaundice, acne, trembling, fluid retention and high blood pressure. More insidious, long-term effects include an increased risk of stroke and heart attack, infertility, and, in young people, stunted growth. In men, steroid use can lead to reduced testicle size, breast growth, and premature baldness. Steroids can also cause masculine traits to develop in women, such as a deeper voice, larger clitoris, facial hair and smaller breasts, as well as causing periods to become irregular or stop altogether.

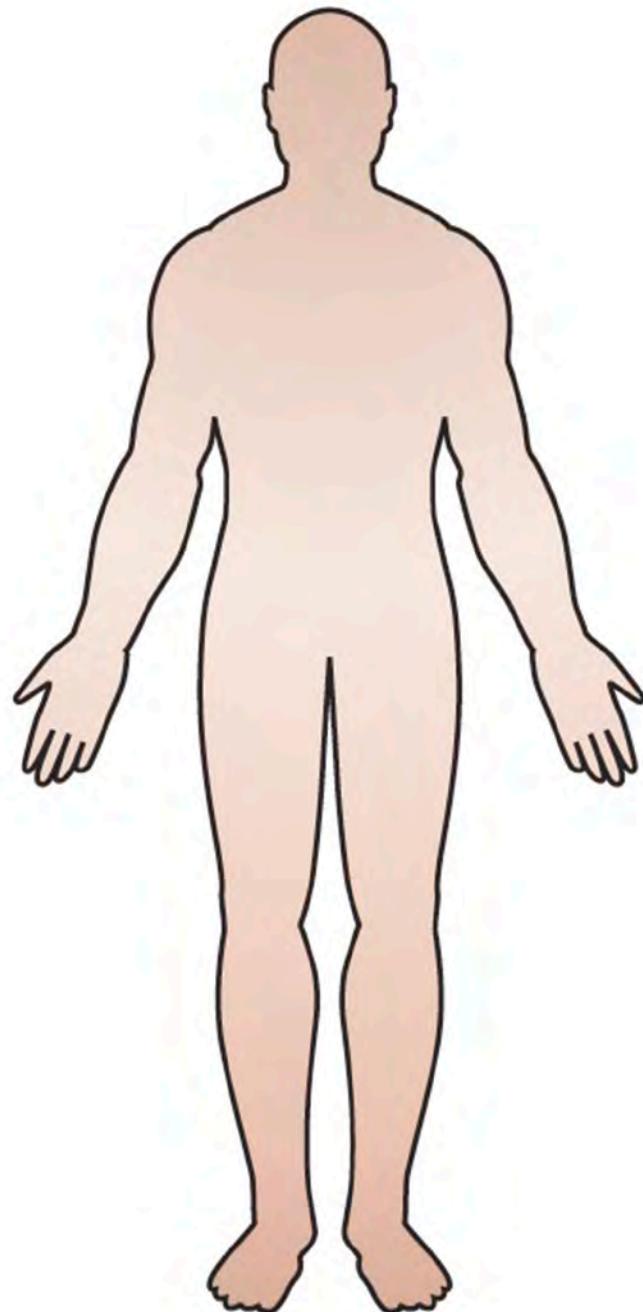


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## ACTIVITY *Effects of steroids*

- 1 Conduct research online on the different effects and side-effects of steroids, then label them on the diagram provided.



- 2 Are male or female adolescents more likely to use steroids? Where does the pressure to use steroids come from?

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# Human growth hormone (HGH)

Human growth hormone (HGH) is used by athletes to promote physical growth. It has the ability to increase red blood cells, increases heart function and increases available energy. It is often used by athletes requiring strength and power for their sport.

Athletes who abuse HGH may develop diabetes and are at risk of heart failure.

## Beta blockers

Beta blockers are taken to reduce stress and anxiety therefore they are advantageous in sports such as shooting and archery where fine motor control is important.

## Blood doping

Blood doping is where blood is taken from an athlete in the weeks leading up to a competition to be injected in to them just prior to their race or event. The advantages of this are that the increased blood volume improves oxygen intake.

## Erythropoietin (EPO)

Erythropoietin (EPO) is an artificial hormone designed to stimulate the production of red blood cells thus allowing the blood to carry more oxygen. This drug is advantageous for endurance athletes such as cyclists.

When too much EPO is absorbed into the body the increased number of red blood cells can cause clotting, heart attacks, strokes and even death.

### ACTIVITY *Illegal usage*

- 1 What type of sports would benefit from blood doping?

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- 2 Drugs that are sold legally in shops must be labelled carefully and there is strict control over the ingredients. What is the situation for drugs that are sold illegally? If you bought a bad batch of illegal drugs, how could you tell, and what could you do about it?

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- 3 Many people would not pick a lolly up off the ground and eat it, and would think twice about taking one from a stranger; however people will still buy illegal drugs from someone they do not know. Write what you would say to a friend who is considering testing an illegal substance to improve their performance.

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# Legal methods to improve performance

Legal methods that athletes use to improve performance include consuming sports drinks and using creatine, which is utilised by the muscles to provide instant energy.

Training at higher altitudes is also believed to be an advantage to endurance athletes as it trains the body to perform on lower amounts of oxygen. As a result, when the athlete competes in countries with a lower altitude their body is more efficient in using oxygen.

## ACTIVITY Legal versus illegal enhancement drugs

- 1 In pairs, use the internet to research examples of other legal ergogenic aids that can be used by athletes to increase performance. Discuss your findings with your class.

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- 2 Complete the table, listing the type of ergogenic aid represented.

Ergogenic aid	Pharmacological, physiological, nutritional, mechanical, psychological	Use in sport (legal/illegal)
Creatine		
Blood doping		
Carb-loading		
Anabolic steroids		
Altitude training		
EPO		
Hypnosis		
Nasal strips		

- 3 What do you think is meant by this statement:

*'Just because some drugs are legal to take it does not mean taking them to improve performance is ethical.'*

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- 4 With so many credible and legal alternatives to drug taking why do you think athletes still choose unethical options to increase performance? Discuss your results as a class.

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## Drug testing

The Australian Sports Anti-Doping Authority (ASADA) conducts regular analysis of Australian athletes. ASADA implements the World Anti-Doping Code. See <[flexibooks.com.au/w/hv](http://flexibooks.com.au/w/hv)>.

While codes of sport conduct their own tests, sporting bodies make athletes available to testing on a program determined by ASADA.

ASADA testing follows protocols of analysis:

### *Urine*

- The laboratory will analyse part 'A' of an athlete's urine sample for the presence of prohibited substances or doping methods.
- If part 'A' of a urine sample returns an adverse analytical finding the athlete has the right to have part 'B' of his or her urine sample analysed to confirm the analytical result.

### *Blood*

- The laboratory will analyse an athlete's blood sample for the purpose of detecting the use of prohibited substances or methods.
- If the sample returns an adverse analytical finding the athlete maintains the right to have confirmatory procedures performed in relation to this analysis.
- There is no available testing method for EPO however testing is performed to measure the number of red blood cells present in blood. This however may only indicate possible EPO abuse and therefore a more reliable test is needed.

Blood testing is often used to test for very recent drug use, i.e. within a couple hours of use. Urine testing detects drug use for a longer period of time. Urine testing is one of the most common methods of testing because it is easier to administer and provides more accurate results.

## Masking agents

A masking agent is any substance that is taken or action that is performed to decrease the chance of drug cheating being identified. More efficient technology and strict testing procedures means that it is getting harder and harder for athletes to use these.



## ACTIVITY *Random sampling*

There are now protocols for drug testing at major events and competitions, however, drug cheats can be caught at any time. Random sampling involves testing various athletes at different times of the season to ensure that they are not taking drugs prior to an event and stopping within a certain time frame to minimise chances of the drugs being detected.

The use of illegal performance-enhancing drugs contributes to participants making unfair gains in performance and personal bests. This is due to the drugs' ability to help the athlete recover faster between exhausting training sessions (anabolic steroids, EPO) or to boost the body's ability to handle performance (beta blockers).

- 1 Try the doping quiz at <[flexibooks.com.au/wlhw](http://flexibooks.com.au/wlhw)>
- 2 Compare the number of athletes who tested positive for drug use at the Sydney, Athens and Beijing Olympics. Write a short report that explains whether you think drug use is declining, growing or staying the same.

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- 3 In small groups, debate the following statements.
  - a Performance-enhancing drugs should be allowed for all athletes—then the competition would be fair.
  - b Drug testing authorities should have access to an athlete anytime and anywhere.
- 4 Use the internet to research what the International Olympic Committee (IOC) drug testing protocols are.

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- 5 Drugs in sport not only affect the players but they can have a detrimental effect on the code of sport being played.
  - a As a class, discuss which sports are often in the media due to players taking drugs. What effect does this have on the public's opinion of the sport and what flow on effect could it have?

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- b What penalties should be imposed on drug users?

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# Participation for all

Many people invest a lot of time and money investigating ways to achieve an unfair advantage over their opponents in their quest to become the best. On a community level, and from a health perspective, we need to be moving away from this and instead researching ways for all people to have equal access to sport and physical activity.

Individuals participate in sport for a variety of reasons. It is important to consider that different groups have different interests and needs regarding participation in physical activity.

The history of an activity or sport impacts on the way it is played or participated in during modern times. Factors such as gender, class and accessibility have influenced the sports traditionally played in Australia and the groups who participate.

## ACTIVITY *Sport and gender*

- 1 List three sports that are traditionally seen as men's sports.

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- 2 Why do you think these sports are so closely associated with men?

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- 3 List three sports that are traditionally seen as women's sports.

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- 4 Why do you think these sports are so closely associated with women?

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- 5 What do you think can be done (or has been done) to make both men and women feel comfortable playing these sports?

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- 6 List some factors that might mean a sport is not accessible for all and explain the reasons behind your choices.

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## ACTIVITY Drugs in sport word search

Find the eleven words hidden in this word search relating to drugs in sport. The words can run forward, backward, diagonally and vertically.

**Drugs****Sport****Caffeine****Diuretics****Steroids****Performance****Legal****Illegal****Hormones****Energy****Muscles**

E	E	I	L	L	E	G	A	L	B	S	I	O	L	L	A	G	E	L
N	D	R	U	G	S	K	I	U	S	P	E	W	A	R	D	S	A	T
I	M	S	T	U	P	O	Q	U	A	O	C	N	M	G	J	K	S	I
E	O	N	B	V	G	K	L	Y	U	R	E	N	I	T	U	O	R	O
F	T	D	C	V	G	T	D	T	S	T	R	A	T	E	G	I	E	S
F	M	A	I	V	T	H	J	K	L	T	Y	U	E	O	O	A	X	V
A	U	A	R	U	F	T	Y	S	B	G	N	H	M	H	M	L	S	Q
C	S	B	V	C	R	N	C	E	D	T	R	A	T	I	O	N	E	P
O	C	M	D	T	C	E	O	I	U	I	E	S	T	R	T	H	N	S
F	L	T	H	I	U	N	T	E	W	E	O	S	L	J	O	T	O	S
R	E	H	E	K	U	P	Q	I	C	L	Y	R	D	S	U	C	M	M
E	S	S	T	A	N	R	T	J	C	L	Y	Z	E	N	B	C	R	T
P	R	E	S	S	U	R	E	P	R	S	S	E	T	T	I	E	O	P
L	W	E	F	E	G	A	T	T	W	O	T	K	R	D	S	M	H	N
D	I	R	E	C	T	I	O	N	S	A	I	S	G	F	A	C	I	N
H	Q	E	N	E	R	G	Y	F	B	Y	G	P	U	A	S	N	Y	A
L	A	X	Q	C	Q	R	T	G	R	B	E	D	R	U	K	O	L	P
X	F	B	U	I	E	G	R	H	U	K	O	K	O	L	P	V	R	C
V	Y	W	M	N	P	E	R	F	O	R	M	A	N	C	E	E	C	T



# Weighing it up: Assessment task

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Monitoring date: \_\_\_\_\_

Due date: \_\_\_\_\_

## Extended response

One of the biggest issues concerning drugs in sport is the use of anabolic steroids. This concern is not limited to athletes, but to many people in the pursuit of a 'perfect body'. The pressure on young men to look good has increased, with boys as young as 13 using steroids without adequate knowledge of the associated dangers.

Write an argumentative essay that responds to the following statement:

*'For both men and women, the risks of using steroids far outweigh the benefits.'*

To gather information for your response, complete the following criteria:

- View the YouTube video on the dangerous health effects of steroids <[flexibooks.com.au/w/kj](http://flexibooks.com.au/w/kj)>
- Read the article at <[flexibooks.com.au/w/jd](http://flexibooks.com.au/w/jd)>
- Visit the ASADA (Australian Sport Anti-Doping Authority) website at <[flexibooks.com.au/w/je](http://flexibooks.com.au/w/je)> and complete a list of:
  - the eight anti-doping rule violations
  - three athletes who have violated the rules. What was their sport, the substance and the sanction they received?

Back up your response with statistics and facts concerning the effects of steroid use.





# Introduction to sport psychology

## What is sport psychology?

Sport psychologists

What are the skills?

## Sport psychology techniques

Goal-setting and motivation

Mindset—thinking for excellence

## Arousal, stress and relaxation

The inverted U curve

Relaxation strategies

## Mental strategies for peak performance

Routine

Mental rehearsal

Improve focus and minimise distractions

Flow for the ultimate performance



# What is sport psychology?

Sport psychology is the scientific study of the mental and emotional factors related to performance in sports. Although there has been interest and study in the area of psychology and sports for over 100 years, the field of sport psychology emerged in the late 1960s. Research in the area has become extensive and the practice of using psychology to facilitate excellent sporting performances has seen a steady growth in popularity. Champion athletes and professional sporting teams have sport psychologists as part of their coaching and support crew to assist them to perform at their best. Today, skills in sport psychology are commonly accepted as valuable tools that sportspeople of any age or skill level can benefit from. They are relevant for anyone who wants to improve their performance in a sporting pursuit, whether it is for fun and fitness, elite competition or anything in between.

The pie chart shows the elements that are required for excellent sports performances. To be able to perform at one's best in



*Performance elements*

a sport, a person requires skills such as physical strength, endurance, speed and knowledge of the sport. Training is essential to continue to develop and improve skills. Psychological readiness (the right mindset) is also an essential part of performance. Sport psychology helps us understand how our thinking relates to our emotions and actions. We can learn to use mental skills to deliver our best possible sports performances.

## Sport psychologists

Sport psychologists are psychologists who specialise in the area of sports performances. They work with individuals and teams to help them perform at their best. A sport psychologist may be involved with research, provide education or help with specific skill development. They may be employed by clubs, institutions, individuals or work in private practice.

## What are the skills?

Important concepts taught in sport psychology include goal-setting, positive thinking and self-talk, confidence, arousal, stress management, relaxation, routine, mental rehearsal, focus, flow and overcoming challenges.

These skills have been shown to be very effective in assisting sportspeople to excel. They can also be applied to many other areas of life and coaching in order to enhance performances, for example, business, musical or dramatic performances, academic pursuits, or public speaking.



## ACTIVITY *The psychological side of sports*

- As a class, brainstorm the concepts taught in sport psychology and create some basic definitions or explanations for these terms. Why might these skills be essential for peak performances? Write in the spaces provided.

Goals

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Motivation

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Positive mindset

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Confidence

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Self-talk

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Arousal

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Stress

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Relaxation and recreation

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Routine

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Mental rehearsal

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Teamwork

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Focus

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Overcoming setbacks and injuries

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- 2 List three settings in which a sport psychologist could be employed.

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- 3 List some of the mental or psychological qualities displayed by successful sportspeople.

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- 4 Describe an example of an action or behaviour that reflects one or more of these qualities. You may write about a situation using a famous sportsperson or someone that you know or have watched.

## Dream large

- 5 If you could achieve anything, what would it be? Imagine there are no obstacles. Your dream may be a sports dream or it may be something else. You may have more than one dream. Record your response in the space provided.

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# Sport psychology techniques

# Goal-setting and motivation

Set a direction and achieve more!

For a moment, consider your ambitions or your heart's desire. If a person has a goal that they really want to achieve, the first step is to make a commitment. They are making a mental promise to work hard, meet challenges and keep persisting so they can achieve their dream.

Goal-setting is a powerful tool to help turn this dream into a reality. Goal-setting is a technique that is used by top-level sportspeople (as well as business people and other very successful people) to build confidence, increase focus and provide motivation. It is a concrete map for their path to success. Setting goals allows you to think about the steps required to achieve your dream, organise priorities, manage time and make a written commitment. It helps people to recognise and minimise distractions that will impact upon achieving their goals.





A well-defined and specific goal plan will act as a MAP to:

- increase **motivation**,
- set down your **action** plan, and
- track your **progress**.

M  
A  
P

## Types of goals

### Short-term goals

These are usually smaller goals that you can aim for and achieve in a relatively short time frame (say, less than one year). Short-term goals are often set with a bigger or long-term goal in mind that you are working towards. For example, if your ultimate goal is to break an Olympic record in long jump, some examples of short-term goals might be to achieve a personal best (PB), to train five times a week or to break the athletics club record.



### Long-term goals

Long-term goals are usually bigger goals that will take a sustained effort and focus to achieve. They may take a long time. These are most often achieved with the individual working through a succession of short-term goals that will lead to the long-term goal. The long-term goal provides an ultimate vision and motivation for working through the short-term goals.

## ACTIVITY Applying knowledge

- 1 Can you think of an example of a long-term goal that a sportsperson might have?  

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- 2 Develop a long-term goal that relates to your performance in the sport you are currently studying in practical lessons.  

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- 3 List three short-term goals that will help you work towards achieving your long-term goal.  

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### Process goals

Process goals commonly involve skills or activities and often relate to training or practice. They are within your control and you can measure them. For example, if the team hopes to increase fitness so that players are quicker and less fatigued on the football field, this is an objective over which the individuals and team has a lot of control. They can commit to regular training schedules and they can measure fitness levels at regular intervals.



### Performance goals

Performance goals are goals that relate to your actual performance relative to your own standard (for example, personal best or consistent performance level). For example, the goal may be to achieve a personal best in pole vault this season with a 3 cm increase in jump height.



## Outcome goals

Outcome goals relate to the outcome, for example, winning the game, being selected to go on the sports tour or running the fastest time in the competition. The difficulty with setting an outcome goal is that the individual does not control all the variables—the outcome often is related to the performance of the opposition. You may swim your best time ever, but someone else swims faster.

### ACTIVITY Considering different goals

- 1 In the table provided, write the main differences between the various goals.

	Process	Performance	Outcome
<b>Short-term</b>			
<b>Long-term</b>			

- 2 Consider your long- and short-term goals. Identify whether your goals can be identified as process, performance or outcome.

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## Setting goals

If you are setting a goal, it is important to identify exactly what it is that you really want to achieve. Consider what kind of goal you are setting (short-term, long-term, process, performance or outcome). A realistic and achievable goal will be one that is challenging, but not too difficult to accomplish.

### SMART goals

An acronym that is commonly used to describe and remember the elements of goal-setting is 'SMART'.

- |            |   |
|------------|---|
| Specific   | (What actions will you do?)   |
| Measurable | (How and when will you measure activity or progress?)                             |
| Achievable | (Is the goal challenging, but not impossible to achieve?)                         |
| Realistic  | (Is your plan and time frame realistic—can you stick to it?)                      |
| Time frame | (Set days and times for your activities and a date for completion and/or review.) |

For example, if Tom wishes to improve his ability to shoot goals in basketball, which approach do you think will be most effective in making this goal a reality?

- A:** 'I hope to improve my goal shooting.'
- B:** 'I will practise shooting goals three times a week for six weeks. I will do this for 45 minutes on a Monday, Wednesday and Thursday straight after school.'

Tom is more likely to follow through with 'B' because he has thought about how he will achieve his goal of improvement in making a time for practice. He has set a short-term process goal.

Tom could also have chosen a performance goal. At the moment he can score a goal in four out of ten attempts. His goal might be to increase this scoring rate to seven out of ten. He might decide that a reasonable time frame is six weeks based on his knowledge and experience. Tom can write down his goal and monitor his progress. He may find that he achieves his target in three weeks. If this happens he might review his goal and try to shoot from the three point line or introduce a distraction. If after six weeks Tom has not achieved his goal, he may find that he needs to review the time frame or the amount of practice he is doing. Even if he does not quite achieve his aim, Tom may still be pleased with his progress and will know how far he has come.

You can make your goals even SMARTER by adding **Evaluation** and **Rewards**.

<b>Evaluation</b>	It is very important to keep your goals in mind and review them regularly. Was your time frame realistic? Was your goal achievable? Are you on track?
<b>Rewards</b>	Keep yourself motivated by having a list of 'rewards'—things you can do or enjoy to give yourself a pat on the back for your small successes. For example if I stick to my rehearsal schedule every week, I will... <ul style="list-style-type: none"> <li>• treat myself to a sports magazine</li> <li>• rent a DVD to relax</li> <li>• take a day off training</li> <li>• go out with friends.</li> </ul>

It is very important to acknowledge and celebrate your progress!

### *Sample of Tom's SMARTER goal plan*

Goal: To increase goal shooting success rate from 4/10 to 7/10.

<b>S</b>	I will shoot goals three times a week for six weeks.
<b>M</b>	I will test myself once a week and record the result.
<b>A</b>	I know that previously when I practised each day I improved within 2 weeks—this is a challenging but achievable goal.
<b>R</b>	If I train straight after school I will be able to stick with it as I am usually free at this time.
<b>T</b>	I will do this for 45 minutes on a Monday, Wednesday and Thursday straight after school for five weeks beginning April 6.
<b>E</b>	I will review this plan after six weeks.
<b>R</b>	Each week that I achieve my training target, I will reward myself by going out with friends on Friday after school.



iStockphoto.com/Photawa



### Sample of Tom's record sheet

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Date:	April 6					
Practice X / ✓ :						
Monday	✓					
Wednesday	✓					
Thursday	✓					
Progress	Score /10	Score /10	Score /10	Score /10	Score /10	Score /10
Reward?	Go out Friday ✓					
Review Date: Comments						

### ACTIVITY Rewards

- 1 List some 'rewards' you can use to motivate yourself to stick with your goal plan. They do not need to be expensive or large.

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### ACTIVITY Make your own goal plan

- 1 Consider the type of goal you wish to set (a short-term process or performance goal is recommended). You can choose a sports goal or any goal that is important to you (such as music, leadership or academic).
- 2 Use the goal plan template to write up a SMARTER goal plan—ensure your goal is specific, measureable, achievable and realistic. Set time frames for your actions, evaluate how you are progressing and include rewards for your success!

#### Tips:

- Place your goal plan where you can look at it regularly.
- Share your goals with someone who will support you.
- Work with a partner who also has goals so you can motivate each other.
- Research shows that the biggest challenges to following through with a goal plan include: time pressure, academic commitments, social relationships, stress and fatigue.



## Goal plan

Goal: \_\_\_\_\_

S	
M	
A	
R	
T	
E	
R	

- 3 In the box, design your own record sheet using the sample provided.



## ACTIVITY *Managing goals*

- 1 Why is it important to set goals?

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- 2 List two or more strategies a person might use to help them stay motivated to achieve their dreams.

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- 3 Why is it helpful to write down and display goals?

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- 4 What are three challenges that people might face when following through with their goal plan?

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- 5 Develop one or more strategies that a person could include in their goal plan to help them overcome these challenges and stay on track.

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## Mindset—thinking for excellence

Skill development, training and good physical health are essential to improve and be competitive in sports. Another crucial element that can make or break a performance is a person's mindset. Mindset is really about thinking. It may include a person's view of themselves and their abilities (confidence, self-belief), the way they interpret or explain situations to themselves and the way they motivate, encourage or criticise themselves (their self-talk).

Many skilled and talented sports professionals have had times when they have not performed to the best of their ability due to mental obstacles. A term often used to describe this in sports is 'choking'. Examples of such psychological obstacles include:

- lack of self-belief or confidence ('I can't beat her, she's too strong')
- fear (of losing, of taking a risk)
- stress/pressure ('If I don't win this, I am a total failure'/'Bob will be disappointed/angry if I don't win.')
- worry ('What if I don't swim well today?')
- distractions/lack of focus (this could be due to some disruption like someone in the crowd yelling out or due to thinking or worrying about other things unrelated to the sport)
- self-blame ('It's all my fault we lost')
- negative thinking ('I won't ... I can't ... I'm not good enough')
- believing negative things said to you or about you.

The 'right mindset' means to think in a way that will help you, that will propel you to success. For example, in order to be confident a person needs to have an unwavering self-belief that they can achieve—no matter what happens or what anyone says.

To learn to do this, a person must first listen to their self-talk (the thoughts that they have) and understand how thinking directly affects emotions and actions. Many people believe that feelings are a result of situations or events—the things that happen. This is not true. Feelings arise from *our interpretation* of events—our thinking, perceptions and judgements about the event. Psychologist Albert Ellis uses a model to explain this:

**Event (A)** → **Thought or 'self-talk' (B)** → **Feelings (C)**

Example:

#### Mary, Hawthorn supporter

Event (A)	Self-talk (B)	Feelings (C)
Hawthorn loses the Grand Final	It is not fair, we worked so hard. We deserved to win.	Disappointment, maybe even very upset or angry.

#### John, not interested in football

Event (A)	Self-talk (B)	Feelings (C)
Hawthorn loses the Grand Final	Oh, did they?	OK

#### Brendan, Hawthorn supporter

Event (A)	Self-talk (B)	Feelings (C)
Hawthorn loses the Grand Final	We were so close! What a fantastic game—we played really well. It is too bad we lost, but it is only a game.	OK—maybe a bit disappointed.

#### Jack, Collingwood supporter

Event (A)	Self-talk (B)	Feelings (C)
Hawthorn loses the Grand Final	Yes! We beat them! We won the premiership!	Very happy, elated.

As you can see from this very simple example, the situation is the same for all four people, yet they view it differently and they feel very differently. Both Mary and Brendan are Hawthorn supporters but they view the loss differently and, as a result, Brendan does not feel as badly as Mary does.

#### This is the key to a positive mindset!

We can listen to our thoughts and choose to think things that will allow us to feel confident and good about ourselves. It is very important that the thinking we choose is positive and realistic. This allows us to have real hope and confidence, and to look ahead. An example of a positive (but unrealistic) thought is Kate believing that she will win the gold medal at the club gymnastic competition when she has only just started and many other competitors have been training for years.



istockphoto.com/duncanc1890

#### ACTIVITY Thinking about it

- Comment on how an understanding of the link between thoughts and feelings can help in sports.

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## Five steps to thinking like a winner

- 1 **Identify** self-talk. (Really listen to your thoughts.)
- 2 **Evaluate** self-talk. (Are your thoughts true and accurate?)
- 3 **Challenge** the self-talk. (Are these thoughts helpful? Are there alternative thinking options?)
- 4 **Generate** a positive alternative thought. (Think of self-talk that is positive and helpful.)
- 5 **Choose to think in a positive way.** (Continue to reflect on thinking and challenging negative self-talk.)

### ACTIVITY *Creating a new mindset*

- 1 The following activity provides examples of negative self-talk that a sportsperson may have. First, write in a feeling that could relate to their self-talk. Next, write an alternative thought that constitutes positive self-talk. Below that, write the feeling that could relate to the new self-talk.

a Thought: 'Every time I compete against this guy, I lose. I may as well not bother to turn up.'

Feeling:

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Alternative thought:

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Feeling:

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b Thought: 'I'm sure I'll do something wrong. If I mess up the coach will be mad with me.'

Feeling:

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Alternative thought:

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Feeling:

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c Thought: 'In the last athletics competition I knocked over two hurdles. It will happen again today.'

Feeling:

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Alternative thought:

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Feeling:

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d Thought: 'That tough girl on the other netball team is staring me down. She hates me.'

Feeling:

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Alternative thought:

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Feeling:

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- e Thought: 'If I can't block this goal we will lose and it will be all my fault.'

Feeling:

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Alternative thought:

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Feeling:

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A lot of research has been done on the power of a positive mindset. People who have an optimistic outlook have been shown to be higher achievers in a whole range of life areas including sports, academic pursuits, business and the arts. They even tend to have better health and to be happier! This is because they expect to do well and to be happy. They find ways to overcome challenges and they keep trying in the face of setbacks or disappointments.

- 2 Adolescence can be an emotional time for many young people. You may experience issues with relationships, friendship groups and school work. As a result, you may find yourself thinking negative thoughts. In pairs, use the table to list the type of thoughts or negative self-talk you may find yourself thinking. Use the second column to turn these statements into positive self-talk.

Negative self-talk	Positive self-talk

## Tips to improve self-confidence

- Focus on achievements, strengths and successes.
- View setbacks or failure as a learning experience on which you can build.
- Do not dwell on negatives or listen to destructive criticism.
- Believe in yourself and give yourself only positive messages.

Sometimes coaches or parents may yell at a team or player or tell them that they are 'hopeless' or 'not trying' with the aim of getting them motivated to prove them wrong and to increase their performance. This is a negative way to motivate someone and will not be effective, especially if a person is already feeling low or lacks confidence. It often will make them feel worse and decrease their performance.



## ACTIVITY *Imagination*

- 1 Describe how a person might handle this sort of situation in a helpful way.

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- 2 Some people tend to imagine the worst will happen so that if it does happen, they will not be shocked or disappointed (as though they knew it all along). Outline ways in which this type of thinking impacts upon a person's mindset.

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- 3 If a person believes that a positive mindset can help them achieve better and they choose to develop a positive mindset, list some steps to achieve this goal.

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## Affirmations and inspiration

Many successful sportspeople use affirmations (positive statements that affirm or encourage) or quotes to help them stay inspired and motivated.

Write an affirmation on a card for yourself or one for a friend. Place it on a small card that could fit in a wallet or pocket. Examples are: 'I can do this!', 'Keep going', 'I believe in you', 'I will win!' and 'Stay with the dream.'

Find a quote, image or inspirational story to put in the box provided.

## Arousal, stress and relaxation

Stress is the response to psychological and/or physiological tension. Stress is a normal part of everyday life and is certainly normal when competing in sports. Stress that impacts on a sports performance can arise from things within the sport (for example, a disagreement with the coach or time pressure) or may have nothing to do with sports (for example, a fight with a friend, too little sleep or an overdue essay).



Some stress can be positive and actually help a person to be at their best in preparation for performances: it is the feeling of readiness or arousal that people feel when they are about to race, compete or perform. It can motivate people to prepare well and keeps their minds and bodies alert to enable them to deliver their very best effort.

Stress becomes a problem if it is too excessive for the person to manage or is ongoing for an extended period of time. If stress impacts upon a person's ability to focus, stay calm or maintain their commitment to their goal, then it is having a negative bearing on that person's ability to do well.



## ACTIVITY *Signs of stress*

- 1 Brainstorm and list some of the symptoms of stress.

Mind	Body	Emotions

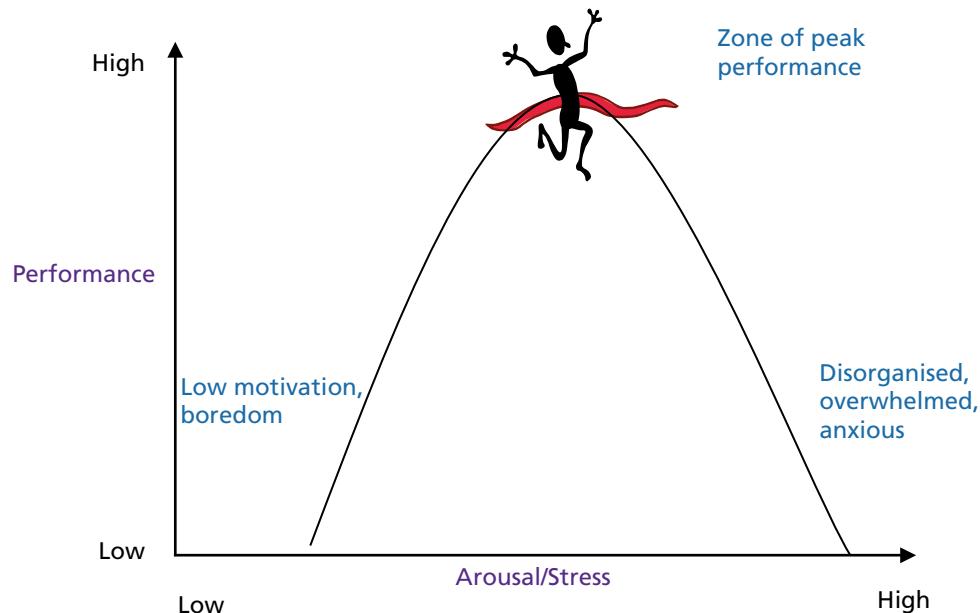




# The inverted U curve

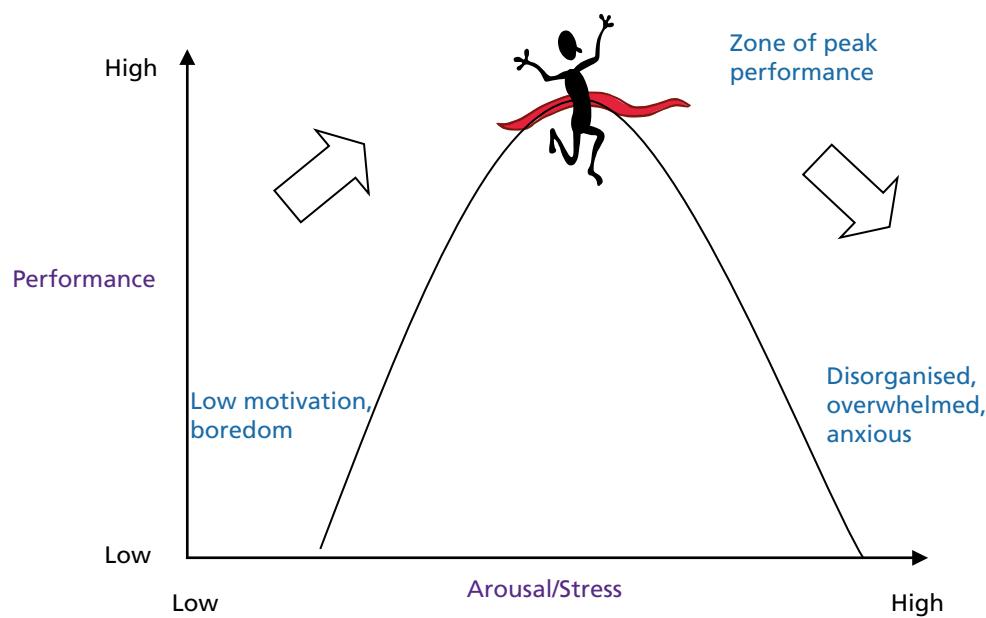
The **inverted U curve** first described by Yerkes-Dodson (1908) illustrates the relationship between stress (or arousal) and performance. For a person to perform at their best they need to be sufficiently aroused and motivated. Too much stress will create anxiety and disorganisation and the performance will suffer.

## *Relationship between stress and performance*



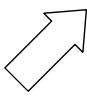
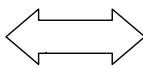
## *Rate your stress levels*

Think of a recent performance in a sporting activity (or other performance if you do not have a sports example). Using a blue pen, mark an 'X' along the **bottom axis** at the point indicating your level of arousal or stress at this time.





## Strategies for getting (and staying) in 'the zone'

Aims	Objectives	Activities to achieve
<b>1 Building up to the zone</b> 	Increase arousal, motivation and drive	Focus on your dream. Set goals (training and process goals). Write them down and place them where you can see them. Surround yourself with positive people who will support your goals.
<b>2 Staying in the zone</b> 	Maintain a balance	Review your goals regularly. Adjust as necessary. Maintain a positive attitude and reward yourself for goals achieved. Ensure that stress does not get out of hand by maintaining regular physical and mental relaxation. Use problem solving or get help if needed.
<b>3 Getting back to the zone</b> 	Reduce stress/pressure—it is too high	Focus on relaxation techniques as a priority (see the following section). Use positive and realistic thinking. Get perspective on where you are at and ask for assistance if required to help you get back to where you need to be. You may wish to seek help from your coach, mentor, or psychologist for assistance with priorities, time management, goal-setting, thinking skills etc.

## Relaxation strategies

### 1 Getting the mindset right: calm, positive and focused on the game plan.

Negative thinking or worry can increase stress and anxiety. Distractions can make a person lose focus and feel stressed about being out of control. Positive thinking can help people maintain perspective and stay calm.

Here are some examples of situations where calm, positive thinking will help these individuals:

- There are seconds to go, the score is even. Matt has the ball and is lining up for a shot at the goals.
- Phil is trying out for the rowing team and really wants to be selected.
- Jessica's competitor looks very strong and confident.
- Brent has been criticised and feels he needs to 'prove himself.'

### 2 Talking to someone about any worries or concerns. It might be a friend, family member, teacher, coach or sport psychologist. Often just talking can help sort out issues, ease tensions and allow a person to focus.

### 3 Regular relaxation with music or meditation can really assist the mind and body to relax.

### 4 Regular exercise is a great way to reduce stress. If a person is already training hard for sports, they might use stretching, yoga, Pilates, walking, tai chi or other forms of physical exercise to release stress.

### 5 Taking a warm, relaxing bath or shower.

### 6 Being with people who are supportive and caring.

### 7 Sleeping. (Did you know that teens need at least nine hours a night?)

### 8 Listening to music, drawing, writing, dancing, cooking or doing something else that is enjoyable.

### 9 Deep breathing—this is simple and very effective! Deep breathing will slow the heart rate, helping a person to immediately relax. This is a great technique people use to calm down before any competition, race or performance (or even to relax before sleep).



## ACTIVITY *Relaxation toolkit*

- 1 Think about strategies you use to get you into a positive mind set. List five strategies, which may include the ones listed above, that enable you to relax and explain why you believe they work for you.

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## Breathing practice

Practise taking three long, slow and controlled deep breaths. Find a comfortable position—standing, lying or sitting straight. Take the air in slowly through your nostrils expanding your lower belly and diaphragm and hold for three seconds. The inhalation should be easy and relaxed. Next, let it out in a slow controlled way through your mouth (the exhalation should be very slow and take approximately eight seconds). Feel your abdomen deflate as the air escapes slowly—even making a ‘shhhh’ noise as it is released. Repeat this exercise several times. Notice how you are feeling.



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## ACTIVITY *Reviewing relaxation*

- 1 You have been appointed coach of the up and coming tennis star, Ben Boomer. You notice he is disorganised and agitated. Brainstorm some strategies to ensure he will be in the peak performance zone for the finals:

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- 2 Explain the relationship between stress and performance.

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- 3 Describe some of the physical, mental and psychological reactions to stress.

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- 4 Describe one activity that helps you relax.

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# Mental strategies for peak performance

Jack Nicklaus (the golfer) once said that the game of golf is '90% mental'. This type of comment has been made about competing at the top level in many other sports. What it means is that when the sporting competition is at an elite level, all of the competitors have a high level of skill and fitness, and it is mental strategies to enhance performance that can give competitors the edge. Such strategies can be the difference between performing to the very best of a person's ability and having an 'off day'. It is crucial to know how to use the mind as a tool for success.

## Routine

Developing and sticking to a routine (or a preparation process) before a sports performance is a technique that allows the athlete to feel calm and in control and to mentally prepare before the competition. The routine allows the person to not have to think too much about what they should be doing in the lead up—they can focus on the performance. Some things that might form part of a routine might be the process of getting ready, the time they arrive at the venue, the way they organise equipment, their relaxation or mental preparation and the music they listen to. Some people even incorporate articles of clothing or special actions in their routines that help them to feel better or more confident before the performance (for example, wearing the 'lucky' underwear or Granny's special medal, meditation, repeating personal affirmations, or speaking to a loved one.).

### ACTIVITY *Preparing a routine*

- 1 Design a pre-competition routine for a sporting performance.

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- 2 Music is often used by athletes to both motivate their performance and reduce stress.

- a Make a list of songs that you could use to motivate you and prepare you for a performance.

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- b List the songs that you find help you to unwind and relax.

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- c Choose one of these songs to present to the class and explain what effect you believe it would have on an athlete's performance.



# Mental rehearsals

Mental rehearsal is the process of using your imagination to create in your mind the sports performance that you desire. It is a process very like visualisation (seeing the images in your mind), but mental rehearsal incorporates other senses also, such as sounds, smells, feelings, touch and even taste to enhance the reality and intensity of the experience. It is like re-creating the entire experience in 'real time' (not faster or slower than reality) in your mind.

Mental rehearsal is a highly powerful tool. When used correctly, it can assist to greatly increase confidence as well as actual skill and performance level. How does it work?

- 1 When mental rehearsal is used to create a successful sports (or other) performance, the brain records this as a positive experience of success. This mental process allows a person to feel more confident and relaxed because they have 'done it all before' successfully (in their mind).
- 2 The mental rehearsal helps a person actually develop their skills much in the same way as physical practice does. The brain is going through the whole game process—thinking about the physical skills, tactics and timing. The brain is analysing and rehearsing the strategies required for the ultimate sports performance. Time spent in mental rehearsal is time well spent.

## A simple guide to mental rehearsals

- 1 Allow time to find a comfortable position where you can relax and not be disturbed. Breathe deeply and allow your body and mind to relax.
- 2 Create the sports performance you would like to achieve. Include sights, sounds, smells, feelings (for example, the touch of the fuzzy ball, the feel of the wind, the look of your opponent, the sound of the crowd, the power of your serve, the elation at your victory). Immerse yourself in the experience.
- 3 Create your mental rehearsal in 'real time'. Allow it to unfold minute by minute. Do not try to speed it up or play in slow motion.
- 4 Always make your imagery positive. See yourself doing well. If there are challenges or setbacks, see yourself overcome them to be successful. You do not want to rehearse failure or disaster!

### Tips for mental rehearsal:

You can incorporate mental rehearsal into a pre-competition routine.

You can also use mental rehearsal to help you in other performances (such as taking exams, playing music or public speaking).



### ACTIVITY Scripting a mental rehearsal

Write a script for a mental rehearsal that you can use for a sports competition or performance. Remember to incorporate many elements (sights, sounds, touch, emotions, taste, etc.) to make it realistic. You can record this script and listen to it as you relax.

- 1 When thinking about an upcoming sporting performance or competition, why is it unhelpful to imagine or mentally rehearse negative experiences, failures or possible disasters?
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## Improve focus and minimise distractions

Maintaining focus is crucial in sports. One moment of distraction can cost you a point or even the match. A person who is not focused is likely to produce a performance that is not their best. Many things can cause a person to be distracted before or during a competition.



## ACTIVITY *Losing focus*

- 1 List all the distractions you can think of.

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The ability to focus can be increased through practice. Motivation and emotion is also linked to focus.

Consider how the following situations might impact on focus.

- If a person did not care about accuracy and no-one was going to check, how accurate would the skills or performance be?
- If the person had just had a fight with their girlfriend, would this affect their performance?
- How accurate would they be if friends keep coming past and talking or their phone kept beeping with messages?
- If they were offered a million dollars to be very accurate and focused, do you think they could do it? How could they keep their focus?

## Stay focused and beat distracters—a look at the experts

- Australian tennis player Lleyton Hewitt regularly yells 'Come on!' to himself on court during play—this is a form of motivational self-talk to keep him alert and focused.
- Champion golfer Tiger Woods learnt how to keep his intense concentration on the course from a very early age with the assistance of his coach and father, Earl Woods. Earl would introduce random distractions while Tiger practised to help him learn to keep his focus.
- Ex-Australian cricketer Shane Warne endured many scandals, press and gossip about his off-field behaviour during his sporting career. He faced discipline for involvement in supplying information to a bookmaker, multiple accusations of infidelity and harassment, taking a banned substance and a marriage breakdown. Through it all, he still managed to regularly deliver exceptional performances on the field.

## ACTIVITY *Minimising distractions*

- 1 How did Shane Warne stay on top of the game? Discuss as a class.

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- 2 Suggest a way that an athlete could minimise the distraction of heckling spectators.

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## Overcoming obstacles and disappointment

In sports, like in life, there are the highs and the lows. It is inevitable that there will be disappointments and various stumbling blocks in any sporting career.



## ACTIVITY *Dealing with challenges and disappointment*

- 1 Brainstorm some possible obstacles or disappointments a sportsperson may face. Consider the sportsperson's physical and mental fitness, the team, the environment, the supports, the distractions and the competition.

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- 2 Sally Robbins was an outstanding Australian rower competing in the 2004 Olympics in the Women's Eight. During the final, Sally was mentally and physically unable to go on and literally froze, dropping her oar and lying down in the boat while her team screamed at her to perform. She did not continue and the team came last. In the hours, days and weeks following, Sally was dubbed 'lay down Sally' and faced enormous speculation as to what happened as well as high emotion and criticism from teammates, the media and the public.

Can you imagine how Sally might have felt?

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Sometimes obstacles seem too big and too hard to overcome. However, in sports and in any field, persistence and determination will help a person move forward. Self-belief can help them achieve great things.

Strategies to assist in coping with any challenge include:

- Time (allow some time to overcome shock, disappointment, loss, hurt).
- Releasing the emotion (talking, therapy, writing in a journal, relaxation).
- Getting some perspective (recognising good things in life, other opportunities, having hope for the future).
- Reflecting and reframing (learning from the past, having a positive attitude about the future, setting new goals and moving forward).



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## Flow for the ultimate performance

Psychologist Mihály Csíkszentmihályi has used the term 'flow' to describe the feeling and mental state that is experienced when a person is really immersed in an activity in which they are skilled and that they enjoy. The sensation is often experienced in sports, but also in other activities too. Flow occurs when a person is in their peak performance zone. They are prepared, motivated, ready and focused. The mind and body work in harmony to produce an excellent performance without thinking, worrying or planning—it seems effortless. Time seems to fly and the person feels energised, exhilarated and satisfied with a sense of accomplishment.

When a person is in a state of flow they are able to produce their best performances. It is not realistic to expect to achieve flow for every single performance. However, it is realistic for a person to work towards enabling themselves to experience flow as often as possible.



Provided are some scenarios that describe experiences of flow in sporting performances.

- With moments to go and only two points difference, Tom leaps for the football, rises above the pack and takes a spectacular mark. He barely pauses as he lines up for the goal. He does not seem to notice the anticipation and excitement in the crowd as he kicks confidently through the goalposts and the game is won.
- Jen's eyes are focused as she sprints down the track toward the long jump pit. Her speed increases until she is going as fast as she possibly can. The spectators are a blur. She takes off at just the right point and she thrusts herself forward. High and fast, she is practically flying over the pit and knows even before she lands that this is her best jump ever. She feels sensational.

## ACTIVITY **Better performance**

- 1 Describe a situation (either sporting or in another setting) when you have experienced flow.

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- 2 Why might athletes use a routine prior to a performance?

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- 3 List some things a sportsperson can do to be in their peak performance zone so they are able to experience flow more often in sports performances.

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- 4 Research a person who has faced a challenge or obstacle in sport. Did they overcome it? If so, how?

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## Resource

You may find the following resource helpful if you want more information on sport psychology:

Brandon, C. & Ivens, C. *Thinking Skills for Peak Performance*, Macmillan Education Australia, Melbourne, 2009



istockphoto.com/istisharp