

Unit 1: Fitness Testing and Training

Components of fitness

A person is considered to be physically fit if they are able to carry out all of their daily tasks easily and without becoming fatigued. However, being 'fit for sport' requires a much higher level of fitness than that needed for activities such as walking the dog or gardening.

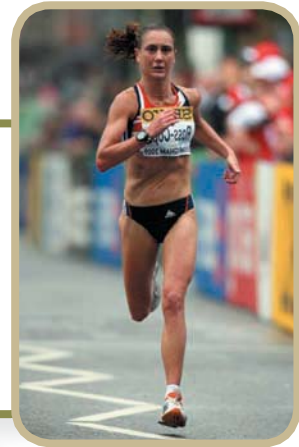
Fitness for sport can be broken down into eleven individual components, grouped under two main headings: physical fitness and skill-related fitness. A good level of both physical fitness and skill-related fitness is needed to be successful in most sports, but the relative importance of each component is dependent upon the sport chosen. A component that may be vitally important for one sport may be much less important for another. Elite athletes need a thorough understanding of all the components in order to be successful, so that training sessions can be tailored to their individual needs.

Physical fitness

Aerobic endurance: This is a measure of how well you are able to keep your muscles supplied with oxygen. It relies on a strong heart muscle to keep blood pumping around your body and a good pair of lungs to keep supplying the blood with fresh oxygen. Aerobic endurance is sometimes called cardiovascular endurance.

Marathon runners and distance cyclists require a high level of aerobic endurance to be able to keep working over a long period of time in a race.

Your cardiovascular endurance can be improved by taking part in aerobic training.



Muscular endurance: You have a good level of muscular endurance if your muscles can keep exerting force for a long time. This can mean that they are able to contract many times, for example, when running a marathon, or it can mean that they can sustain one contraction for a long period of time, for example, when pulling in a tug of war. Muscles need a good supply of oxygen (see aerobic endurance) **and** a good supply of energy in the form of glycogen, a type of sugar that is broken down to release energy.

Professional footballers need a high level of muscular endurance to keep them moving around the pitch for 90 minutes.

Muscular endurance can be improved by taking part in weight training activities, by running or by regularly performing exercises such as sit-ups and press-ups.



Physical fitness

Body composition: This is a measure of how much of your body is made up of muscle compared with how much is made up of fat. It is important to have a good balance of the two but sports players usually have a greater proportion of muscle.

Some sports performers, such as rowers, require a large muscle mass to give them lots of power and strength, but others, such as marathon runners, require a lower muscle mass so that they don't have to carry 'extra' body mass as they are running. Some sports performers, such as sumo wrestlers, even require quite a large mass of body fat to be successful.

Everyone is born with a predisposition to a particular body composition, although small changes can be made by varying your diet and the amount/type of exercise that you take part in. The important thing is to have the correct body composition for your sport.



Flexibility: This is the range of movement possible at a joint. Flexibility is determined by how elastic the ligaments and tendons are at a joint, how strong the muscles are that pull against the joint and the shape of the bones that form the joint. Most joints are designed to give either strength or flexibility, so the shape of the bones is usually the most important factor in determining flexibility. For example, the shoulder joint is made up of a ball-shaped bone (the end of the humerus) and a cup-shaped bone (the end of the scapula), allowing lots of movement in many directions.

Gymnasts have to be flexible so that they can twist their bodies into different shapes when performing routines or vaults.

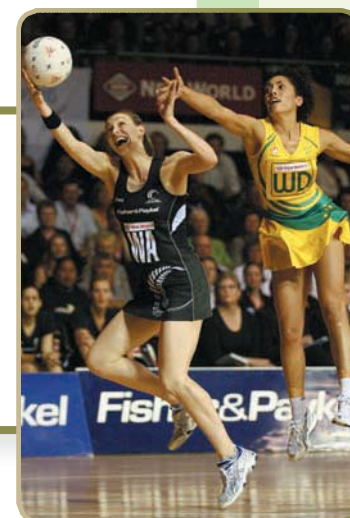
Flexibility can be improved by taking part in lots of stretching exercises on a regular basis.



Speed: This is how fast a muscle can contract, once or repeatedly, in a given amount of time. For example, in order to be good at the 100m sprint, the muscles in your legs and arms have to contract over and over again as quickly as possible. The faster they contract, the more speed you have.

Speed is important in many team sports to help players beat their opponents. For example, netballers need speed so that they can get into spaces more quickly than their opponents and rugby players need speed to be able to beat their opponents to the try-line.

Speed is often said to be something that we are born with, although some improvements can be made by taking part in strength training and sprint training.



Strength: This is the amount of force that can be generated by a muscle when it is contracting. There are lots of different types of strength but the main two are:

- Explosive strength, the amount of force that can be exerted in one quick, powerful contraction, which is useful in sports such as the javelin and the high jump. It is closely linked to power.
- Dynamic strength, the amount of force that can be exerted repeatedly by a muscle, which is useful when completing sit-ups or when cycling. It is closely linked to muscular endurance.

Strength can be increased by taking part in weight training. Smaller weights are lifted lots of times to improve dynamic strength and heavier weights are lifted fewer times to improve explosive strength.



BRONZE

1. Choose five sports and, for each one, **describe** the three most important components of physical fitness.

SILVER

2. Choose five sports and, for each one, **explain** the three most important components of physical fitness.

3. Rank the components of physical fitness, in order, from the most important to the least important, for each of the following sports performers: a footballer, a cyclist taking part in the Tour de France and a swimmer in the 50m freestyle. Give reasons to justify your rankings.

Skill-related fitness

BRONZE

1. For each component of skill-related fitness name one sport that requires a high level of that component and one sport that requires a low level of that component. For example, reaction time is very important in sprint events but not very important for those competing in a marathon.

Skill-related fitness

SILVER

2. Choose one sport and rank the components of skill-related fitness, in order, from the most important to the least important. Give an example, from your chosen sport, of each component in action. For example, rowers require a low level of agility because they do not have to change direction very often, other than to move forwards and backwards in a rhythm.

3. Rank the components of skill-related fitness, in order, from the most important to the least important, for each of the following sports performers: a footballer, a cyclist taking part in the Tour de France and a swimmer in the 50m freestyle. Give reasons to justify your rankings.

Agility: Agility is the ability of a sports player to move and change direction quickly and under control. For example, a basketball player has to change direction quickly when dribbling and driving towards the basket. Training has little or no effect on improving agility.



Balance: Balance is the ability to keep the body stable, when still or moving, by keeping the centre of gravity over the base of support, for example, when performing a handstand or a cartwheel. An individual's overall level of balance is not really something that can be trained, although the ability to perform a particular type of balance, such as a handstand, can be improved through practice.



Coordination: Coordination is the ability to use two or more parts of the body at the same time. Even simple acts such as walking require a degree of coordination but a much higher level of coordination is required when playing a tennis shot. Again, an individual's level of coordination cannot be improved through training, although the ability to perform a particular task can be improved through practice.

Power: Power is the ability to combine strength with speed, to perform a strong contraction very quickly. Power is very closely linked to explosive strength. Power is needed in most sports, although it is more obvious in some. For example, boxers need power to be able to punch hard and fast, whilst golfers need power in order to hit the ball over a greater distance.



Reaction time: This is the time it takes to respond to a stimulus, such as a ball coming towards you when fielding in cricket. The shorter the amount of time it takes to respond, the quicker the reactions of the performer. Reaction time is incredibly important in events such as the 100m because the sprinter who responds fastest to the sound of the gun has a better chance of winning the race. Reaction time cannot be improved through training, although the time taken to respond to a simple stimulus like the starting gun can be improved through practice. It is likely, though, that this is more about anticipating the gun than responding to it.

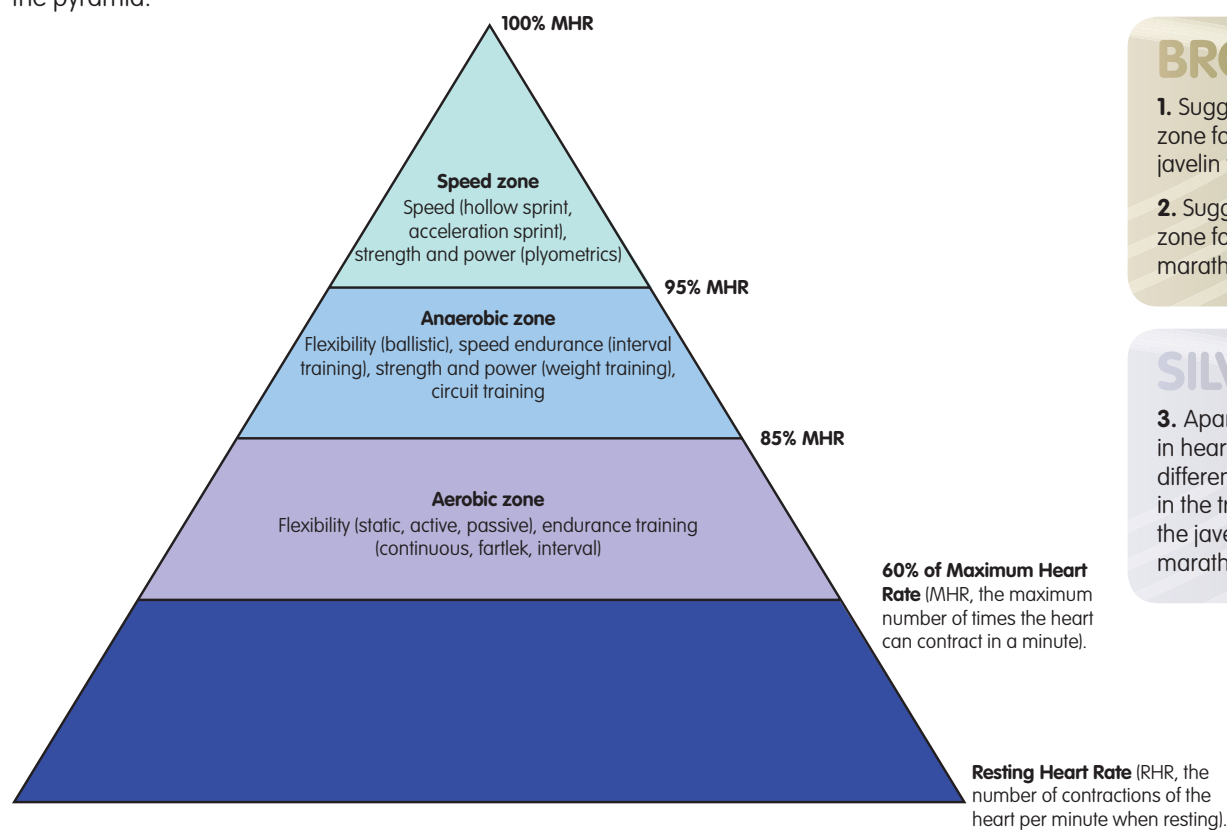


Fitness training methods

Fitness training is much more technical than simply going for a jog each day. Each of the components of fitness has to be trained in a different way and different training methods will develop some components more than others. Because all sports require a mixture of the components of fitness, they require participants to take part in a range of training methods. Indeed, overusing one particular training method is likely to lead to injury in the long term and, for this reason, all sports performers should try to vary their training schedule on a regular basis.

The training pyramid

The training pyramid is a way of calculating how hard you need to train and how long each training session should be. Each section of the pyramid represents a different training zone and the higher the zone, the harder you need to work. The width of the zone represents the amount of time that you need to train in that zone. So, if you are working in the aerobic training zone you would work for longer and have longer but fewer rest periods than you would if you were working in the speed zone, because the aerobic zone takes up a wider section of the pyramid.



BRONZE

1. Suggest a suitable training zone for a 20-year-old male javelin thrower.
2. Suggest a suitable training zone for a 20-year-old female marathon runner.

SILVER

3. Apart from the difference in heart rates, what other differences would there be in the training schedules of the javelin thrower and the marathon runner? Why?

Maximum Heart Rate for men = $220 - \text{age}$
Maximum Heart Rate for women = $226 - \text{age}$

So a 15-year-old male's MHR = $220 - 15 = 205\text{bpm}$ (beats per minute)

From this we can calculate the training zones. The aerobic zone = 60 per cent of 205 to 85 per cent of 205 = 123 to 174bpm

Therefore, a 15-year-old male who wishes to undertake continuous training should work hard enough to make their heart contract between 123bpm and 174bpm. Slower than 123bpm would have little or no training effect and above 174bpm would cause the performer to become fatigued too quickly.

Flexibility training

Most sports performers undertake flexibility training as part of their regular training programme. Some, such as dancers and gymnasts, do so in order to enable them to stretch further and perform more complex and difficult actions. Others, such as footballers, use flexibility training as a way of preventing injuries such as torn muscles and ligaments. There are four types of flexibility training:

- static stretching
- passive stretching
- active stretching
- ballistic stretching.

Static stretching

Here, there is no movement and the stretch is held for 10–16 seconds. An example would be leaning against a wall to stretch the muscles in the lower leg.



Active stretching

Here the performer moves slowly into the stretch to apply extra force to the muscle. An example would be taking slow, small steps and rising up on tiptoes to stretch the muscles of the lower leg with each step.



Passive stretching

Here the force of the stretch is applied by a partner, while the performer tries to relax. The most common form of passive stretching is the hamstring stretch, where the performer lies flat on the floor and a partner lifts a leg, trying to raise it to an angle of 90 degrees or further.



Ballistic stretching

This is sometimes known as 'bounce stretching', because the performer tries to use extra force by bouncing the muscles to stretch them further. A good example is the high kick action which is often performed by hurdlers before a race.



BRONZE

1. Try to perform each type of flexibility training to see how it feels. Then, suggest a sports performer that would benefit from each type of training and a sports performer who would gain little or no benefit from each type of training.

Circuit training

Circuit training consists of a series of exercises arranged in order and designed to develop general fitness, physical fitness, and/or skill-related fitness specific to a particular sport, depending on the exercises chosen.

The great advantage of circuit training is that, depending on the exercises chosen, it can be used to develop strength, power, muscular endurance, agility, aerobic endurance and anaerobic endurance (the ability to work without burning oxygen for an extended period of time; top class 800m runners can work anaerobically for approximately 90 seconds) in a limited time and limited space. It can also involve large numbers of participants in a relatively small space, and participants of different fitness levels can train together.

To improve a component of fitness it is necessary to 'overload', to work harder than your body is used to working normally. Overload is achieved in circuit training by:

- reducing target times (the time taken to complete a given number of repetitions)
- increasing exercise resistance (increasing the difficulty of the exercise)
- increasing repetitions (increasing the number of times the exercise is repeated, possibly in a given time)
- increasing circuits (increasing the number of times the circuit is completed).



There are a number of things to think about when designing a circuit:

- Decide on the fitness requirements of the people completing the circuit and choose the exercises accordingly. Do they want to develop general fitness, physical fitness and/or skill-related fitness for a specific sport or physical activity?
- The number of participants.
- The current level of fitness of the participants.
- The time, space and equipment available.

And, don't forget the golden rule: the same body part should not be exercised consecutively. For this reason, it is important to alternate between exercises designed to work the upper body and exercises designed to work the lower body.

BRONZE

1. Design a circuit training session for a sport of your choice. Explain why you have included each of the exercises you have chosen.

SILVER

2. Explain how you would adjust your circuit to accommodate participants of varying fitness levels.

Strength and power training

Weight training

An effective way to improve strength is to use weight training. Here, a combination of free weights and resistance machines are used to put the muscles under stress. As a muscle works the individual fibres in the muscle tear and, as they repair themselves over the next 24 hours or so, they become stronger and bigger. Over time this leads to an overall increase in the size and strength of the muscle.

In general, resistance machines are much safer than free weights. They can usually be used when working alone, whereas free weights often require a 'spotter', a partner who is there to help set up and keep the performer safe. Resistance machines are also much better at working individual muscles and there are a range of machines available, each targeted at a specific muscle group. This gives them a distinct advantage over free weights, which are often inappropriate for training certain muscles.

Each time a performer completes a lifting or moving action they are working against a 'resistance' (an amount of force or weight that must be lifted or moved). Each lift is known as one repetition or 'rep'. A set is the name given to the number of repetitions a performer completes without a rest. For example:

Strength

8 reps
3 sets
Heavy weight (load)

Power

8 reps (performed at speed)
3 sets
Heavy weight (load)

Plyometrics

This is designed to improve strength and power. It involves the performer jumping down off a box and then immediately back up onto another box, or something similar. On hitting the ground, the quadriceps muscle lengthens to act as a brake. By immediately jumping back upwards the quadriceps is forced to shorten quickly, thereby producing more power. You can see how this works by stretching an elastic band between your fingers. You will find that the further you stretch the elastic band, the more powerfully it contracts back.

BRONZE

1. Try to perform each type of strength and power training to see how it feels. Then, suggest a sports performer that would benefit from each type of training and a sports performer who would gain little or no benefit from each type of training.
2. Design a training session for a performer who wants to develop muscular power.



Using free weights.



Using a resistance machine.



Plyometrics training.

Endurance training

Endurance training requires the sports performer to work for an extended period of time, often longer than the actual event for which he or she is training. For example, Paula Radcliffe will often train upwards of four hours at a time, even though her event (the marathon) is usually over in less than two-and-a-half hours. Endurance training should take place largely in the aerobic training zone of the training pyramid and the work to rest ratio should be in the region of 3:1. This means that if you work for 30 minutes you should follow it with a ten-minute rest and then repeat the session again. There are three types of endurance training:

- continuous training
- fartlek training
- interval training.

Continuous training

Continuous training involves performing an activity – such as jogging, swimming, cycling, walking or rowing – for an extended period of time (usually longer than 20 minutes) without rest. To improve aerobic fitness you should complete three to four sessions of continuous training per week.

Fartlek training

Fartlek training, also known as ‘speed play’, is a form of road running or cross-country running in which the runner, usually running alone, varies their pace significantly during the run. It is usually regarded as an advanced training technique for an experienced runner who has been using interval training to develop speed and to raise their anaerobic threshold. However, the ‘average’ runner can also benefit from a simplified form of fartlek training, to develop self-awareness and to introduce variety into the training programme.

Fartlek is similar to interval training in that short, fast runs are alternated with recovery periods of slow running or jogging. The vast majority of the running takes place in the aerobic zone but the short, fast sprints push the performer to work anaerobically for short periods at a time. However, with fartlek training you are running on the road or in a park and there is no predetermined schedule to follow. Instead the athlete sets the length of the intervals and their pace in response to how they are feeling. An advantage of fartlek training is that the athlete concentrates on feeling the pace and their physical response to it, thereby developing self-awareness and pace-judgement skills. Also, the athlete is free to experiment with changes of pace and endurance, making it an excellent component of a distance runner’s training programme. However, it is primarily a technique for advanced runners because it requires honesty to ensure a demanding workload, and maturity to avoid overdoing the pace or length of the intervals.

Interval training

Interval training consists of alternating intervals of running over a specific distance in a set time (fast running in other words), with recovery periods that are specified in terms of duration, distance or both. Interval training can improve endurance when the work period is longer than 20 minutes and the rest period is one third of the work period. Training sessions will focus on specific race demands.

Interval training is similar to fartlek training, except that it is much more rigid. You decide before you start how long to run for, at what speed, and how long and often your rest periods will be. It is more suitable for the inexperienced athlete, as it does not require the same level of honesty and decision making as fartlek training.

This type of training is a component of a balanced training programme that will include recovery days and a range of other running activities, depending on the goals of the individual. Mixing interval training with running a range of distances, and different types of running (such as, cross-country running and hill running), can contribute to overall fitness and the capacity to engage in successful competitive running.



Endurance training is crucial to the success of athletes such as Paula Radcliffe and Lance Armstrong.

BRONZE

1. Try to perform each type of endurance training to see how it feels. Then, suggest a sports performer that would benefit from each type of training and a sports performer who would gain little or no benefit from each type of training.

2a) Design a training session for a distance runner.

b) Based on the performer’s ability, suggest ways of changing the session if they were running at school, county, regional, national and international level.

3. List the benefits of fartlek training for an elite international athlete.

Speed and speed endurance training

Speed training is a way of developing a performer's speed over short distances. This is useful in almost all sports because speed can often be the difference between winning and losing. For example, footballers need to be able to cover a distance quickly to beat an opponent to the ball and tennis players need to be quick to reach the ball during a rally. Speed training should always be carried out in the speed zone of the training pyramid. It is of a very high intensity, so work periods should be short and frequent, and interspersed with lots of short rest periods. This makes speed training a type of interval training. It is generally accepted that a work to rest ratio of 1:6 is desirable. This means that a performer should work at a maximum level for a very short period, usually up to about 15 seconds, and then follow this with a rest period that is six times longer, repeating the sequence several times. There are two types of speed and speed endurance training:

- hollow sprints
- acceleration sprints.

Hollow sprints

These are similar to interval training, in that a period of work is broken up by a 'hollow' period of either rest or lower level work. A typical hollow sprint session would look something like this:

50m	Sprint	(6–7 secs)
50m	Jog	(25 secs)
50m	Sprint	(6–7 secs)
50m	Walk	(30 secs)
50m	sprint	(6–7 secs)
150m	Walk	(90 secs)

This is repeated five times before a longer, ten-minute rest period.

Acceleration sprints

As the name suggests, the aim here is to improve acceleration from a starting position. This equates to the first five to ten metres of any race, such as a 100m sprint or a race to a loose ball in rugby. Training is usually designed to match the demands of a particular sport. For example, rugby players may start the sprint by lying on the ground to simulate a ruck, whereas footballers may start with their back to the direction of the sprint to simulate turning away from a defender and sprinting into a space. A typical session may look something like this:

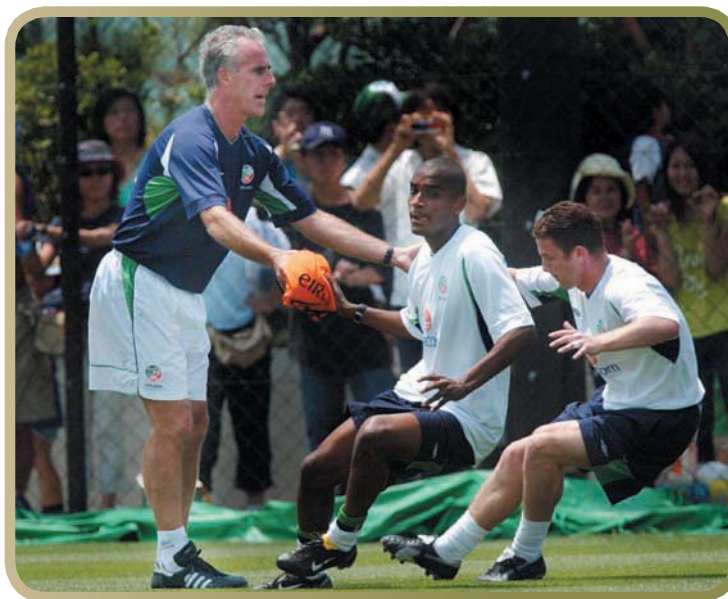
10 x 5m sprint (walk back to start each time)
30-second rest between each sprint.

BRONZE

1. Try to perform each type of speed and speed endurance training to see how it feels. Then, suggest a sports performer that would benefit from each type of training and a sports performer who would gain little or no benefit from each type of training.



American sprinter Tyson Gay works on improving his speed in training.



Speed training for footballers often involves turning away from a defender.

SPOTLIGHT on fitness and training requirements

BRONZE

Completing these activities will help you to achieve a **Pass** in your assignment.

1. Complete the table below :

Sport	Type of strength	Example of this type of strength in action
Rugby	Explosive	
Gymnastics	Explosive	Vaulting
Football		
Hockey		Penalty flick
Netball		
Rowing	Dynamic	
100m sprint		

2. What is meant by 'cardiovascular endurance'? Name five sports where cardiovascular endurance is important.

3. Name two sports where muscular endurance is important and, for both, suggest which muscle groups the competitors should concentrate on improving.

4. Describe three fitness training methods that could be used by basketball players.

SILVER

Completing these activities will help you to achieve a **Merit** in your assignment.

5. Name three sports in which flexibility is important. Compare and contrast the different types of flexibility training and decide which would be most appropriate for each of the sports you have chosen.

6. Explain the major differences between interval training and continuous training. Under which circumstances would a marathon runner choose to train using the interval method?

7. Write a paragraph to justify the following statement: 'International footballers need a much higher level of strength, endurance and flexibility than international rugby union players'.

8. Explain how knowledge of the training pyramid can be used to improve the quality of a fartlek training session.