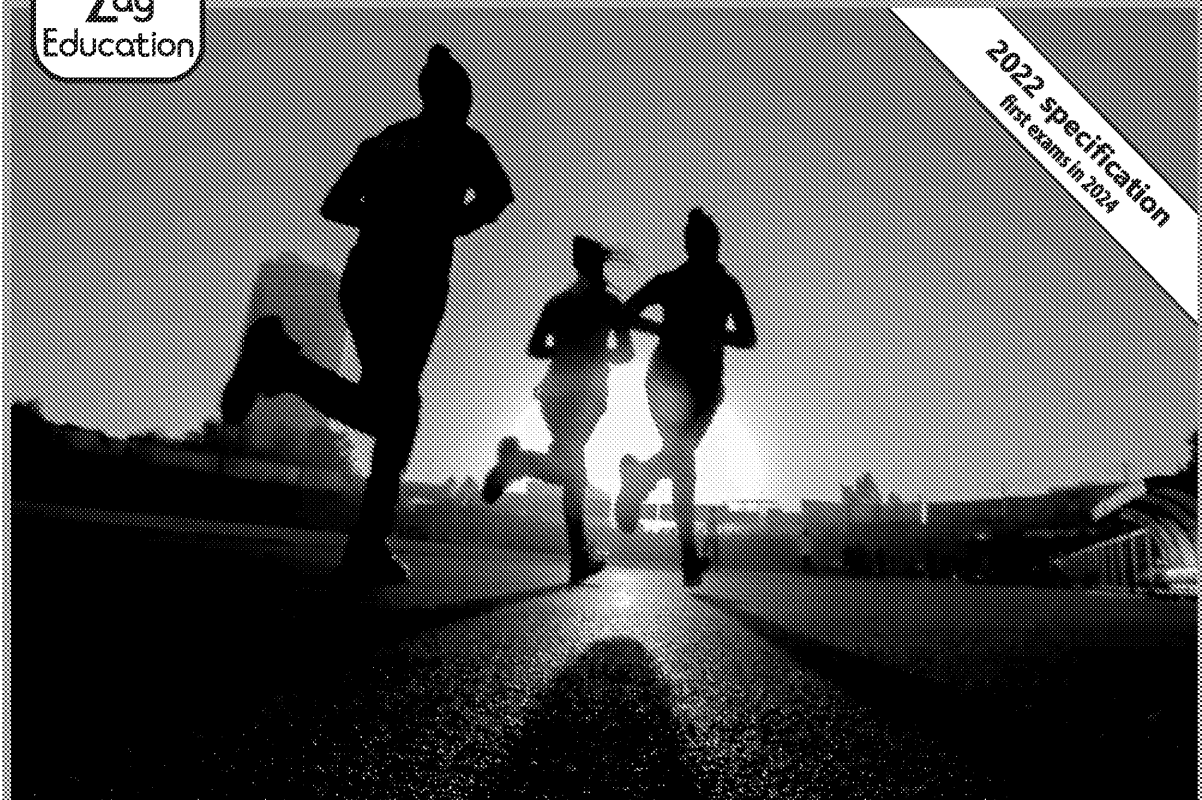




**Sport**

BTEC Tech Award (L1/2) | 603/7068/3



**2022 specification**  
first exams in 2024

# Topic on a Page for BTEC Tech Award (L1/2): Sport

## Component 3: Developing Fitness to Improve Other Participants Performance in Sport and Physical Activity

D Embleton

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*All of the above are provided as summary sheets and activity pages in both A3 and A4 formats.*

# Teacher's Introduction

This Topic on a Page resource has been created for the BTEC Tech Level 1/2 Award in Sport (first teaching 2022). It covers all the teaching content for **Component 3: Developing Fitness to Improve Other Participants Performance in Sport and Physical Activity**. The aim of this resource is to summarise the different areas of the teaching content into manageable sheets of A3 paper, providing students with an overview of each area.

The resource comes with partially completed mind maps which form activity pages, giving students the opportunity to test their knowledge of the content by completing the questions set out on each page. Each page can be used by students of all abilities. For example, high-achieving students could apply additional examples to illustrate each topic area, whereas lower-ability students may wish to annotate the mind maps to enhance their understanding of each topic.

Where normative data is used, we have created data sets that are reasonable estimations of existing normative data. As such, they are realistic and can be used to gauge how fitness test results are rated in comparison for age- and gender-matched norms. **Please note for coursework and alike, students should compare to real normative data obtained from reliable sources.**

## How to use the resource:

- The sheets can be handed out at the end of the course, or at the end of each topic for revision purposes. This can help students recap knowledge at the end of teaching.
- Each page can be printed out in poster size and displayed on your classroom walls as the topic is being taught, so that students have a visual reminder of what they have been covering in their lessons.
- Students should be encouraged to complete the partially completed mind maps to test their knowledge for this unit.

## Specification reference table

There are 15 pages in total which cover the four topic areas within the unit specification. The following table can be used to identify which specification points you are teaching.

Page no.	Title	Spec reference
<b>A – Importance of fitness for sports performance</b>		
1	Components of fitness	A1
2	Fitness training principles and exercise intensity	A2–A3
<b>B – Investigate fitness testing to determine fitness levels</b>		
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8	Skill-related fitness test methods for <i>agility, balance, coordination</i>	B3, B4
9	Skill-related fitness test methods for <i>reaction time and power</i>	B3, B4
<b>C – Investigate different fitness training methods</b>		
10	Fitness training methods for <i>aerobic endurance</i>	C1–C2, C4
11	Fitness training methods for <i>muscular strength and muscular endurance</i>	C1–C2, C4
12	Fitness training methods for <i>speed and flexibility</i>	C1–C2, C4
13	Fitness training methods for <i>skill-related components</i> and provision for taking part	C1, C3–C5
14	Effects of long-term fitness training on body systems	C6
<b>D – Investigate fitness programming to improve fitness and sports performance</b>		
15	Fitness training programme design and motivational techniques	D1–D3

# Body composition

**Definition:** The relative proportions of fat and non-fat mass (muscle, water and bone) that make up our bodies.



## Body composition in sport:

Body composition can influence performance in sport, and different fat-to-muscle ratios will benefit some performers in sport more than others. For example:

- High jumpers have relatively low levels of fat and lean muscle, giving them a light frame
- Boxers have a high level of muscle but a relatively low level of fat, allowing them to be powerful
- Hammer throwers require a high level of muscle for power and strength, but fat helps to impact their performance
- Prop forwards in rugby have high levels of fat, which contributes to their large weight, making them difficult to tackle



# Balance

**Definition:** The ability of the body to maintain its centre of mass over a base of support while stationary (static) or during movement (dynamic).

Balance is important in sports and activities where it is beneficial for the performer to stay on their feet or maintain a steady body position.

## Examples of sports that require balance:

- Gymnastics (e.g. performing a handstand)
- Boxing (e.g. standing after taking a hit)
- Figure skating (e.g. to remain upright when spinning)



# Agility

**Definition:** The ability of the body to move quickly and precisely to change direction at speed.

Agility is useful in many skill-based sports where quick feints and zigzag movements are required. The ability to change direction in order to evade an opponent while maintaining speed and balance.

## Examples of sports that require agility:

- Hockey
- Netball
- Basketball
- Rugby



# Components of Fitness

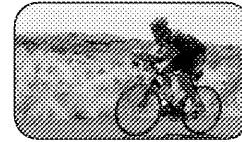
## Aerobic endurance

**Definition:** The ability of the cardiovascular and respiratory systems to function effectively, improving the efficiency of gas (O<sub>2</sub> and CO<sub>2</sub>) and nutrient transport in the blood to allow sustained physical activity.

Aerobic endurance is a component of fitness that is required in endurance events. It also helps to improve the ability to perform all types of aerobic sports.

## Examples of sports that require aerobic endurance:

- Marathon running
- Triathlon
- Invasion games (e.g. football)



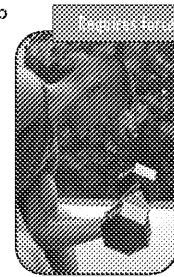
## Muscular strength

**Definition:** The amount of force a muscle or muscle group can generate when contracting against a resistance.

Muscular strength is a component of fitness that is useful for many sports, but especially those that require muscle to contract with force.

## Examples of sports that require strength:

- Weightlifting
- Gymnastics (e.g. the rings)
- Rugby (e.g. rucking an opponent off the ball)



## Power

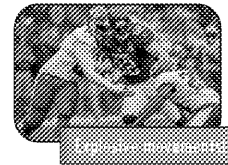
The product of both speed and strength

$$\text{Power (kgm/s)} = \text{Force (kg)} \times \text{Distance (m)} / \text{Time (s)}$$

Power is very important in many contact sports where it is used to barge through opponents, but also in many other sports, such as sprinting, where it is required to drive the body forward.

## Examples of sports that require power:

- American football
- Weightlifting



## Coordination

**Definition:** The ability to efficiently use two or more body parts at the same time.

Coordination is needed in a range of sporting situations and can involve a variation of different body parts. Some skills require more concentration than others; for example, twisting and turning during a gymnastics vault compared to coordinating the arms and legs when running.

## Examples of sports that require coordination:

- Gymnastics (performing a routine)
- Tennis (serving)



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If applied correctly, the principles of training allow for the performer to get the best possible outcome from their training programme.

However, the principles of training are very often incorrectly applied or not applied at all, which may not only prevent the performer from improving, but also increase their risk of injury.



# The Principles of

**Specificity:** Training must be specific to the sport or activity that the athlete wants to improve in (e.g. same muscle groups or skills)

e.g. a gymnast may choose training methods linked to flexibility, such as dynamic stretching, in order to develop flexibility which is required for their performance.

**Progressive overload:** Training must be increasing and progressive in order to promote adaptation of the body and improve performance.

e.g. a weightlifter should gradually increase the load they are lifting in order to stimulate adaptation within the body.

**Reversibility:** The effects of training are reversed if training stops or the intensity is not sufficient to cause adaptation.

e.g. a hurdler may have to decrease their usual training intensity and duration having been off for six weeks due to an injury.

Applying progressive overload...

## EXERCISE INTENSITY

Intensity can be measured in numerous ways. The selection of which measurement to use depends on the type of activity being performed.

For **cardiovascular training**, heart rate is commonly used to determine training zones where working in a specific zone will lead to different fitness improvements:

### TRAINING ZONES

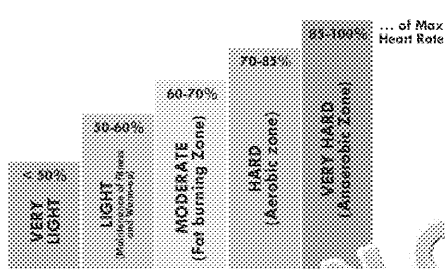
These are calculated from an individual's max heart rate, which is estimated using the following equation:

$$\text{MHR (bpm)} = 220 - \text{age}$$

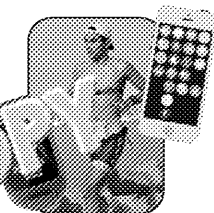
To calculate the training zone you need to multiply Max HR by percentage, e.g.  $220 \text{ bpm} - 15 \text{ years} = 205 \text{ bpm}$  (Max HR)

$$70\%: 205 \text{ bpm} \times 0.70 = 144 \text{ bpm}$$

$$85\%: 205 \text{ bpm} \times 0.85 = 174 \text{ bpm}$$



### TECHNOLOGY TO MEASURE EXERCISE INTENSITY



There are many different types of heart rate monitors available. The most accurate types are chest-based straps (as worn above), but smartwatches are providing increasingly accurate readings.

Many smartwatches have a compatible mobile app which can feed back live heart rate zones and provide a more detailed analysis of training.

### RATING OF PERCEIVED EXERTION

The Borg rating of perceived exertion (RPE) scale is commonly used to measure exercise intensity. Athletes identify on a scale 6 (No exertion) to 10 (Very hard) on how hard they think they were working during a specific training session.

It is particularly useful as a heart rate monitor is limited. It is possible to estimate heart rate using the scale via the following calculation:

$$\text{Rating of perceived exertion (RPE)} \times 10 = \text{Heart rate (bpm)}$$

### ONE-REP MAX

For resistance training, a % of a given repetition maximum (1RM) is used to measure intensity. For strength, it is the heaviest weight that can be lifted in one repetition (1RM). For muscular endurance, it is the most weight that can be lifted for fifteen reps (15RM).

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Principles of

Principles of

Intensity

Intensity

Intensity

Intensity

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# Importance of Fitness Testing and Requirements for Administration

## REASONS FOR FITNESS TESTING

There are various reasons why fitness testing is carried out. The purpose of the testing will depend on the goals of the programme.



**Helps to set goals**  
Baseline fitness testing is used to set goals for the training programme which can be monitored throughout. It also provides the performer with something to aim for with their training.

**Results can provide motivation**  
Feeding back fitness test results to a performer can provide them with motivation, especially if they see the training programme having a positive effect.

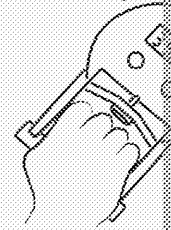
**Provides reliability**  
Fitness testing at the beginning of a programme serves to gauge the performer's initial level of physical- or skill-related fitness.

**Informs the design of the training programme**  
Pre-programme testing allows the performer/coach to identify strengths and weaknesses and tailor the programme to focus on improving these.

**Indicator of whether the training programme is successful**  
Conducting fitness tests throughout the programme allows fitness levels to be monitored and indicates whether the training programme is working. If no improvement is being made, it is likely that the programme will need to be reviewed and modified.

Pedometer

Equipment make sure measurements will have error



## ADDITIONAL ADMINISTRATION INVOLVED IN FITNESS TESTING

- Test conductors should have knowledge of published standard test methods and understanding of appropriate use of equipment
- Results should be measured and recorded accurately. The more precise the measurement, the greater the risk of accurately reflecting the performer's fitness level.
- Results should be compared with published data tables to make practical judgments of fitness levels. Narrative data should be available for different ages and genders and should be taken from reliable sources.
- The most relevant tests should be selected for each individual. Therefore, individual needs should be discussed prior to arranging fitness testing.



## RELIABILITY OF TESTS

Whether a test can be repeated under the exact same conditions and produce the same results is the reliability of a test is, therefore, a key factor in the reliability of a test.

There are many factors that can affect the reliability of a test:

<p><b>Whether equipment is calibrated</b> Equipment used for fitness testing should be calibrated before each test so that it is producing the same results. This is especially the case if different equipment is used on the same participant or to draw comparison between participants.</p>	<p><b>Motivation of the participant</b> To reduce the influence of this factor on results, motivation should be withheld from the participant as it may be given on some tests more than others.</p>
<p><b>Testing conditions</b> Indoor testing tends to be more accurate than outdoor testing; for example, a performer's speed may be the same, but their results could differ because of wind speed.</p>	<p><b>Experience of the test conductor and compliance with procedures</b> An experienced test conductor is more likely to follow the published standard test methods and produce more reliable results.</p>

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## Interpreting fitness test results

Once test results have been recorded for any fitness test, this information is then used and compared to normative data.

- **Normative data** is a reference from a population that is used as a baseline for measuring against. It is essentially the average.

Normative data will often be grouped by:

1. **Age** – fitness components vary by age, as fitness declines with age (e.g. a 65-year-old would expect to have a lower grip strength score than a 20-year-old).
2. **Gender** – men and women and girls and boys will expect to have different results based on their physiological make-up. Additionally, boys and girls aged 14–16 have had their test results adjusted to account for this.

Results will often be rated from the following:  
Excellent – Good – Average – Fair – Poor

Comparing results to normative data allows the performer to see what level they are at and can be used to set goals and targets to improve the fitness rating.

Some tests are easier to analyse than others; for example, the sit and reach test for flexibility simply involves measuring the distance you have stretched (in cm or inches).

However, other tests, such as those used to calculate aerobic endurance, require the data collected to be converted in order to obtain the results for  $\text{VO}_2 \text{ max}$ .

It is important that measurements are accurate to ensure correct results. You should ask these questions before every test:

- Am I **familiar** with using the equipment?
- Can I get consistent results every time I run this test?
- Is it **practical** to use this test?
- Is the test measuring the component of fitness it is meant to measure? (**validity**)
- Am I measuring using the **correct units**?
- Can I **record** the results immediately?

# Fitness Tests for Aerob

## 12-minute Cooper run/swim

The Cooper run can be used in both running and swimming. The premise is the same for both: cover as much distance in a 12-minute period. The main difference being the environment – running on a track compared to swimming in a pool.

### procedure:

1. Two partners, one performs the test and the other keeps the time. The partner who is timing records the number of laps/lengths completed.
2. The performer is to complete a 5-minute warm-up.
3. On the 'go' command of the partner, the runner will run as many laps (of a 400 m running track) as possible within the 12-minute time frame. The number of laps should be accurately reported.
4. After 12 minutes, the performer will stop the test and the other partner will announce how many laps were completed or how much distance (in m) was covered.

### equipment:

400 m running track, stopwatch, partner to monitor time

This is a very valid assessment of aerobic endurance as it challenges the ability of the heart and lungs to provide the muscles with oxygen for an extended period.

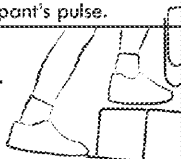


## Harvard step test

The Harvard step test is a sub-maximal test which provides a measure of cardiovascular endurance through the recovery rate of the participant's pulse.

### procedure:

1. The participant begins the test by facing the stepping bench.
2. The test conductor should start a metronome via an audio player at 30 beats per minute.
3. On each beat, the participant should step up onto the bench and down again, alternating the leading leg each time.
4. They should continue to do this for 5 minutes, at which point the test conductor should notify them to stop.
5. The participant should measure their pulse at every minute mark after ending the test, for three consecutive minutes. This can be done by counting the last 15 seconds of every minute and multiplying it by four.
6. A test score can be calculated using the equation:  
$$30 \text{ sec. pul. after 1 min} + \text{pulse after 2 min} + \text{pulse after 3 min}$$



### equipment:

stepping bench, Metronome / audio player

The yo-yo test was designed specifically for participants in team sports who are required to have a strong aerobic endurance as well as change of direction capability.



## Additional fitness tests

The **multistage fitness test** (also known as the **bleep test**) and the **yo-yo test** are also used to measure aerobic endurance. These both involve the participant running from one end of a 20 m track to the other, with cones indicating where to turn. The tests are performed to the pace of a pre-recorded audio which 'beeps' to indicate when the performer should turn. The test is completed until the performer fails to reach the cone on three consecutive beeps.

There are two variations of yo-yo test:  
**Level 1 (beginner)** – slower speeds than the bleep test  
**Level 2 (advanced)** – greater increments in speed  
There are also **intermittent** variants which include recovery periods after every 40 m.

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# Fitness Tests for Muscular Endurance

## One-minute sit-up/press-up test

This test uses sit-ups or press-ups to measure the muscular endurance of the abdominal muscles or the pectorals/triceps.



### procedure:

1. The test involves performing as many sit-ups or press-ups as possible in a period of one minute.
2. The participant lies on their back on a mat on the floor or props themselves up using their hands and feet on a bench.
3. On the start of the test (marking the stopwatch), the participant performs sit-ups (bringing their elbows to their knees) or a press-up (lowering their chest to the floor).
4. They then return to their initial position – that counts as one full repetition.
5. The result of this test is measured as the number of repetitions (reps)

### equipment:

- Stopwatch
- Exercise mat for floor
- Individual to monitor the time / reps



Reliability of these tests will depend on how well the participant's form is at completing each exercise. Racing with a poor sit-up and press-up technique will mean poor reliability with these tests.

### normative data:

The following table displays the normative data for the press-up test for males and females.

**Press-up test normative data (UK)**

Rating	Male
Excellent	
Good	
Average	
Fair	
Poor	

### Sit-up test normative data:

Rating	Male
Excellent	
Above average	
Average	
Below average	
Poor	

The press-up and sit-up tests may not be a good reflection of muscular endurance as they generally take a greater amount of time to perform a given number of reps. Performing these tests to exhaustion is a better reflection of muscular endurance.

## The plank test

This test uses the plank position to measure the muscular endurance of the whole body to maintain the position. It involves a similar procedure to the one-minute sit-up and press-up tests, but instead of the sit-up and press-up, it uses the plank position, and instead of the one-minute time period, the performer must maintain the plank position for as long as possible.



### normative data:

Excellent	Very good	Above average
> 5 min	3–5 min	2–3 min

Source: Estimated and adapted from Strain

### Which test to use?

The selection of sit-up or press-up test depends on the ability of the performer to perform the test – both tests become more difficult as the number of repetitions increases. The press-up test is more difficult to adapt as the participant may relieve some of the weight by performing a kneeling variant.

However, the plank test may be considered a better all-round measure of muscular endurance as the core is the centre of most sporting activities, for example, which requires good core stability. Both tests may not be considered valid for a range of endurance events, however, as they require the repeated contraction of muscles for periods of time longer than one minute.

The plank test involves an isometric muscle contraction (where the muscle does not change in length); therefore, it may only be a valid measure of muscular endurance for activities that require constant tension.

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# Fitness Tests for Strength and Speed

## Fitness tests for muscular strength

### Handgrip dynamometer test

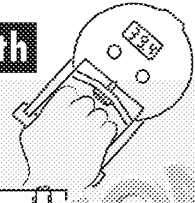
The handgrip dynamometer test measures the strength of the forearm in order to assess the strength of the muscles.

#### procedure:

1. Firstly, an athlete adjusts the handgrip size according to their hand size and then stands, arms parallel to their back.
2. They then squeeze the grip dynamometer as hard as possible for a period of five seconds.
3. It is usually recommended that three tests are performed on each hand, with a rest of at least one minute in between each test.
4. The best score for each hand is then recorded.
5. The results of the test are usually measured in kilogram watts (KgW).

#### equipment:

Handgrip dynamometer, Assistant



Correlative data:  
The following table displays the normative data for 14–16-year-olds.

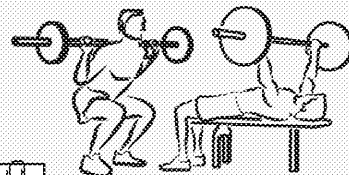
Rating	Males	Females
Excellent	> 50	> 32
Good	48–50	29–32
Average	43–47	24–28
Fair	37–42	18–23
Poor	< 37	< 18

Source: Estimated and adapted from Davis (2000)

Grip strength will vary by age, as well as gender, as strength deteriorates with age and varies between genders.

### One-rep max (1RM) test

A 1RM is the heaviest weight that can be lifted in a single repetition. There are a number of different exercises that can be used for the 1RM, with the bench press and back squat being most common for upper-body and lower-body strength, respectively.



#### procedure (for the back squat):

1. The performer should stand with their feet shoulder width apart with an unweighted bar resting on their back.
2. To perform a squat, they should sit back until their thighs are parallel with the floor, keeping their feet firmly planted and back straight.
3. They should perform a single squat each time, gradually increasing the weight loaded onto the bar with each round.
4. They should do this until they reach the maximal weight they can lift in one rep.
5. The total weight (plates plus bar) is given as the score.

#### equipment:

Barbell, bench / squat rack and a spotter (for safety support) are also needed for the test. A maximum of one attempt at a lift.

#### scoring:

The highest weight that the performer is able to complete one rep for is used as the score. This is added to a log of the performer's 1RM, which is usually 20 kg. The 1RM value is used to prescribe training loads, e.g. a training load > 70 % 1RM for few reps.

The 1RM test requires large amounts of motivation; therefore, it might not produce as reliable results as the handgrip dynamometer test.



#### Specificity to different sports

The one-rep max test is more specific to strength required in different sports and activities as it is more reflective of specific sporting actions. For example, the back squat is similar to the movement used in a rugby scrum, whereas handgrip strength has limited application to sports (mainly weightlifting, where grip strength is required).



## Fitness

### 30-metre sprint

The 30-metre sprint test measures the speed of an athlete over a short distance.

#### procedure:

1. Athlete warms up and the assistant marks the start and end of the 30-metre distance.
2. The athlete starts the sprint when the assistant says 'go' and then sprints the distance as fast as possible while the assistant times the sprint.
3. With adequate rest, the athlete attempts this three times.
4. Data is compared to the athlete's previous performance.

#### equipment:

- Cones
- Stopwatch
- Assistant
- Non-slip running shoes

### 30-metre flying

The 30-metre flying sprint test measures the speed of an athlete over a short distance, but instead of a start signal, the athlete is allowed to reach peak speed before the 30-metre distance is measured.

#### procedure:

1. Athlete warms up and the assistant marks the start and end of the 30-metre distance.
2. The athlete builds up speed until they reach their peak speed for the sprint.
3. As they cross the start line, the assistant starts the stopwatch and stops it as they cross the 30-metre line.
4. The time taken to cover the 30-metre distance is used as the score.

#### Specificity to different sports

The 30-metre sprint test is more specific to speed required in different sports such as the 100 m race, basketball and football. The 30-metre flying sprint test is more specific to speed where performers are running backwards in rugby, where the ball is intercepted.

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# Fitness Tests for Flexibility and Body Composition

## Flexibility fitness tests

### Sit-and-reach test

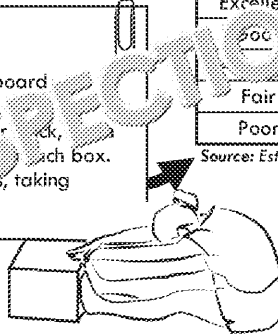
The sit-and-reach test measures the flexibility of the muscles, particularly the hamstrings group and the lower back muscles.

#### procedure:

1. Perform a warm-up to help prevent injury.
2. Sit with your feet pressed up against the board, knees touching the floor (see image).
3. Stretching your legs (hamstrings) and lower back, the furthest distance possible to reach each box.
4. Record your measurements, taking your average.

#### equipment:

Sit-and-reach box, ruler and assistant.



normative data:

The following table displays the normative data for 14–16-year-olds.

Rating	Male	Female
Excellent	> 12.1	> 16.5
Good	9.4–12.1	16.5–13.2
Fair	12.0–7.7	13.1–7.7
Poor	7.6–4.4	7.6–4.4
Poor	< 4.4	< 4.4

Source: Estimated and adapted from Davis (2000)

A high score in this test will be relevant to sports that require flexibility of the hamstrings and lower back. However, it is not so relevant to sports that require flexibility in other areas of the body.

### Calf muscle flexibility test

Unlike the sit-and-reach test, this fitness test assesses the flexibility of the calf muscles. This is important for a range of movements, particularly weightlifting exercises such as the squat.

#### procedure:

1. The participant stands facing a wall with one foot in front of the other.
2. The participant should lean forwards, keeping their front foot firmly planted to the floor, and attempt to touch the wall with their knee.
3. For the first attempt, the front foot should be close enough to the wall so that the performer can comfortably reach the wall.
4. The performer should then move their foot back at increasing distances from the wall until they can no longer reach it with their knee.
5. The furthest distance from the front of the foot to the wall, by which they can reach with their knee, is measured in centimetres and used as the test score.

#### equipment:

- Ruler
- Assistant

The reliability of flexibility tests will depend on how well the participant has warmed up, as the warmer the muscles the more flexible they are.

### Shoulder flexibility test

There are a number of different flexibility tests for the shoulder. One of the most common tests is the overhead reach (also known as the trunk scratch test). This involves the participant reaching up with one arm and letting their hand rest on the other arm, alternating with the other arm and letting their fingers of both hands.

A rating is given (see table).

	Descriptor
Good	Fingers are able to touch each other
Fair	Fingers are less than 5 cm (2 inches) apart
Poor	Fingers are greater than 5 cm (2 in) apart

#### Specificity to different sports

The different flexibility tests target different areas of the body; therefore, different tests will be specific to some sports or activities more so than others. For example, hamstring and shoulder flexibility is important in a range of gymnastics events, such as the pommel horse and the vault; as such, the sit-and-reach test and shoulder flexibility test will be suited.



### Body mass index

This is a simple estimate of body composition which takes into account an individual's weight and height.

#### procedure:

1. Measure the individual's weight, preferably using a scale.
2. Measure the individual's height, preferably using a stadiometer.
3. Divide the individual's weight by their height squared to calculate their BMI.
4. Use the diagram to determine the BMI category.

### Bioelectrical impedance

This test uses a piece of equipment that sends an electrical current through the body.

#### procedure:

1. The participant stands with their hands on the electrodes.
2. Information relating to the electrical current is displayed on the screen of the device.
3. This includes data on body mass and fat percentage, as well as other body composition metrics.

### Waist-to-hip ratio

WHR is another popular method used alongside BMI to assess body composition.

#### procedure:

1. The subject stands with feet together and arms at their sides.
2. Using a tape measure, measure the circumference of the waist by passing the tape over the top of the hips.
3. Record the measurement.
4. The tester should use the same technique to measure the hips.
5. Record the measurement.
6. Divide the waist measurement by the hip measurement to get a ratio.
7. Compare this ratio to the normative data.

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# Fitness Tests for Agility, Balance and

## Coordination fitness tests

### Alternate hand wall-toss test

This test assesses hand-eye coordination by tossing a ball with one hand against a wall and catching it with the other.

#### procedure:

1. The performer stands two metres away from a wall with a tennis ball in their hand.
2. On the command 'go' the performer tosses the ball off the wall with one hand and catches it with the other.
3. They must repeat this as accurately as possible for 30 seconds.
4. The number of successful catches is used as the test score and compared against normative data.

#### equipment:

- Tennis ball
- Flat wall
- Assistant

This is a highly practical test as it requires simple equipment, facilities, takes up little time, and can be performed without assistance.

### Stick flip coordination test

This test also measures hand-eye coordination but involves finer movements than throwing with the alternate hand wall-toss test.

#### procedure:

##### Part A (half turn)

1. The subject holds two sticks, one in each hand, at waist height and parallel to the ground.
2. The test conductor then places a third stick horizontally across the two held sticks.
3. The participant has five attempts at flipping the horizontal stick so that it completes one half turn and lands on the two held sticks.
4. One point is awarded for each successful half-turn flip of the stick.

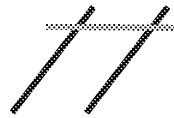
##### Part B (full turn)

5. Steps 1–3 are repeated, but this time the participant must make a complete flip of the stick.
6. The tip of the stick being flipped is marked and compared to determine whether a full flip has occurred.
7. Two marks are awarded for each successful full flip.
8. The total of marks for both parts is taken and used as the test score.

#### equipment:

- Three sticks
- Tape/paint
- Assistant

The reliability of this test can be improved by using the same appropriately sized sticks each time. The recommended length of each stick is 60 cm with a 2 cm diameter.



### T test

This test requires the participant to move as quickly as possible in a combination of forwards, backwards running and

#### procedure:

1. The participant starts at cone A. On the command 'go' they should run as quickly as possible to the opposite cone and touch it with their right hand.
2. From here, they should shuffle across to the cone on the left and touch it with their left hand.
3. They should then shuffle across all the way to the cone on the right and touch it with their right hand.
4. The participant should shuffle left once more to the cone, touching it with their left hand.
5. Finally, they return to the starting cone by running.
6. The time taken to complete the test is used as their score.

### Illinois agility test

This test involves numerous changes of direction and weaving in and out of cones.

#### procedure:

1. The participant performs a 10-minute warm-up while the test conductor marks out a 10 m × 5 m course, as shown in the diagram to the right.
2. On the command 'go', they should aim to complete the course as quickly as possible, in the direction shown.
3. The test conductor times how long it takes, and this value is compared to normative data.

### Standing stork test

This test is used to assess the static balance of an individual.

The standing stork test involves standing on one leg and placing the other leg on the standing leg.

#### procedure:

1. The participant should be given the opportunity to practise the stance.
2. Once the participant has familiarised themselves with the correct stance, they should adopt the stance ready for testing.
3. Once the participant is in position, the test conductor starts the stopwatch.
4. The participant should try to maintain their balance for as long as possible.
5. If the participant loses balance at any point, the test conductor should stop the test and record the time.



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# Fitness Tests for Reaction Time a

## Reaction time fitness tests

### Ruler drop test

This fitness test involves subject and tester and can be conducted using just a 30 cm ruler and a table.

#### procedure:

1. The performer sits at a table with their forearm on the surface and an open hand hanging over the edge.
2. The test conductor holds a ruler vertically, parallel to the performer's hand, with the zero mark perpendicular to the performer's hand.
3. In the test conductor's hand, they drop the ruler without giving any advance warning.
4. The performer catches the ruler as quickly as possible by catching the ruler.
5. The point of the caught ruler at the top of the hand is used as the measure of reaction time.

#### equipment:

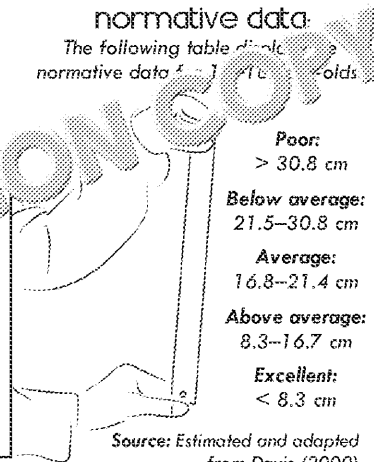
- Ruler
- Table
- Assistant

The ruler drop test has high practicality as it is quick, cost-efficient and can be carried out in a range of environments.

normative data:  
The following table provides normative data for the ruler drop test.

- Poor:**  
> 30.8 cm
- Below average:**  
21.5–30.8 cm
- Average:**  
16.8–21.4 cm
- Above average:**  
8.3–16.7 cm
- Excellent:**  
< 8.3 cm

Source: Estimated and adapted from Davis (2000)



### Online reaction time test

There are many online reaction time tests available. The most common ones require a click of the mouse or a press of the space button when something changes colour or appears.

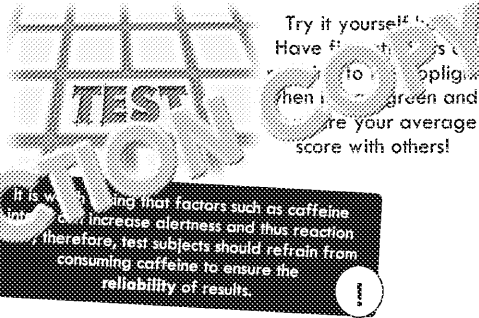
#### procedure:

1. Open up an online reaction time tester using a trusted website.
2. Read the instructions on how to carry out the test.
3. Start the test.
4. When the object changes colour or appears, respond as quickly as possible by hitting the space button or clicking the mouse (as advised by the instructions).
5. The computer should then automatically record your reaction time to the nearest milliseconds.
6. You may have to repeat the test several times to obtain an average reaction time score.

equipment:  
Computer/tablet



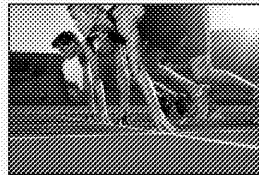
Try it yourself!  
Have friends test you to see how you compare. To apply this to your own training, when you see a green and red light, measure your average score with others!



It is well known that factors such as caffeine can increase alertness and thus reaction time. Therefore, test subjects should refrain from consuming caffeine to ensure the reliability of results.

### Validity and specificity of reaction time tests

Reaction time tests are highly valid measurements of reaction time as a fitness component as they are effective at isolating that component from others. However, when considering the different examples of where reaction time is needed in sport, they are not very sport-specific. Therefore, caution should be taken when translating fitness test results to success in sport.



## Power fitness tests

### Vertical jump

The vertical jump test, measures the power of the lower body.

#### procedure:

1. The athlete stands with their feet shoulder-width apart and their fingers touching the ceiling.
2. The athlete stands with their feet firmly on the ground.
3. The athlete reaches up as high as possible.
4. The athlete jumps up as high as possible, reaching as high as possible with their hands.
5. The assistant measures the height of the jump (standing) and the height of the jump (jumping) three times on each side.

### Standing long jump

The standing long jump test measures the power of the lower body.

#### procedure:

1. The participant performs several jumps to get used to the starting point.
2. The test conductor marks the starting point.
3. The participant prepares for the jump.
4. Whenever the participant jumps, they should place a tape at the starting line.
5. They should measure the distance from the starting line to the end of the jump.
6. This distance is used as the measure of power.

### Margaria-Kalamita

This test also assesses power.

#### procedure:

1. The participant stands on a platform.
2. They then start the test.
3. On the command, they jump three times at a time.
4. The tester starts the stopwatch when they make contact with the ground.
5. The tester should record the participant's time.
6. The participant repeats the test three times.

(Weight (kg) × Vertical jump (m))

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## Requirements for following fitness training methods

Fitness training should be carried out safely and effectively. All of the training methods mentioned on pages 10-13 should include the following:

- ✓ **Warm-up** – preparing the body for exercise and reducing the likelihood of injury. This should include:
  1. Pulse raiser
  2. Mobility
  3. Stretch
- ✓ **Cool-down** – gradually reducing heart rate and breathing rate to resting levels. Maintaining elevated heart rate through gentle jogging/jumping helps remove lactic acid and help reduce the effect of soreness.



Training methods should also:

- ✓ Last to the appropriate fitness component
- ✓ Apply the FITT principles (see page 2)
- ✓ Apply appropriate training intensities (see page 2)

## Evaluating the appropriateness of fitness training methods

It is important to select the most appropriate fitness training methods for a given situation. Evaluating fitness training methods should consider the following:

- Number of participants that can take part at once
- The costs of training (e.g. equipment, facilities)
- How easy it is to set up
- Access to facilities (e.g. gym)
- The risk factors related (e.g. a beginner who may need supervision with weight training)
- Effectiveness of training method
- Specificity to component of fitness
- How well the training method replicates the demands of the sport



# Training Methods for Aerobic

## Fartlek training

- Varied level of intensity (walking, sprinting)
- Improves cardiovascular endurance
- Alternating between those intensity levels
- Aerobic and anaerobic systems can be trained
- Can also be over varying terrains
- Example: slow jogging up a hill followed by sprinting to the next tree or lamp post

## Continuous training

- Steady training at moderate intensity
- No breaks/rest
- At least 30 minutes duration
- Improves cardiovascular endurance
- Example: long distance running to prepare for a marathon



Also known as 'speed play'

<b>Advantages</b>	<ul style="list-style-type: none"> <li>• No equipment required</li> <li>• Can be done in many environments</li> <li>• No cost for training (e.g. can be done in open fields)</li> <li>• Easy for participants to understand</li> <li>• Easy to set up</li> <li>• Easy to develop progressive overload</li> <li>• Adaptable for needs, e.g. disability, age, experience</li> <li>• Targets aerobic endurance</li> </ul>	<ul style="list-style-type: none"> <li>• Athlete has time to do an active recovery</li> <li>• Can reduce early onset of fatigue as low intensity</li> <li>• Athlete can control the level of intensity they put in</li> <li>• Has the ability to train both energy systems</li> <li>• No equipment required</li> <li>• Can be done in many environments</li> <li>• Good for training (e.g. can be done in many terrains)</li> <li>• Easy for participants to understand</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Can be tedious and boring</li> <li>• Over-reliance on speed can result in muscle injuries if little rest</li> <li>• May result in hassle in planning routes if not on a track</li> <li>• Participants may be reluctant to push the intensity and may, therefore, not progress that way; motivation required</li> <li>• May be uninspiring if athlete is doing it alone without others</li> <li>• Little room for adapting to make training more interesting</li> </ul>	<ul style="list-style-type: none"> <li>• Does not necessarily mimic the demands of a real environment</li> <li>• Participants may fatigue more quickly due to the sprint intervals</li> <li>• Some terrains may increase risk of injury (e.g. uphill)</li> <li>• May increase tedium as effectively repeating the same thing</li> <li>• May be quite a vague form of training (e.g. how long should each walk, sprint and jog section be? How long should the overall session be?)</li> </ul>

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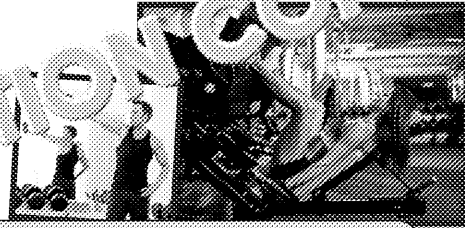


# Training Methods for Muscular Strength

## Free weights and fixed resistance machines ...for muscular strength and endurance

Training for muscular strength and endurance can be done by using either free weights or resistance machines. Both include applying a resistance to the muscle when moving. Heavy loads with strength training creates microtears in the muscle, leading to hypertrophy (increase in size) of the muscle and increased strength, whereas light loads for muscular endurance builds up a resistance to fatigue.

- **Free weights** are not fixed to a machine and include dumb-bells, barbells and kettlebells.
- **Fixed resistance machines** are fixed to a machine and include e.g. hamstring and leg press machine.



### Repetitions and sets

Free weight and fixed resistance training involves performing specific exercises that focus on different muscle groups using sets and reps.

- A **rep** is the number of times an exercise is performed, e.g. if you wanted to do 12 squats that would be 12 reps.
- A **set** is the number of cycles of reps that are done, e.g. doing 12 squats 3 times would be 3 sets of 12 reps, with rest periods for recovery in between.

The number of reps and sets should be manipulated for muscular strength and endurance training to apply the principle of progressive overload and put the muscle under the relevant stress to stimulate growth or resistance to fatigue, depending on the component of fitness the performer is aiming to improve.

### For muscular strength:

- **Weight:** High; above 70 % of one-rep max
- **Reps:** Low; approx. 4-8
- **Sets:** 3-5

### For muscular endurance:

- **Weight:** Low; below 70 % of one-rep max
- **Reps:** High; approx. 12-15
- **Sets:** Typically 3 or more

**Did you know?** The load, reps, sets, and lengths of training sessions are typically manipulated to apply the principle of progressive overload.

### Rest periods

Rest periods are the time taken between sets to allow the body to recover. It is important to allow for rest periods to prevent the risk of injury and to delay early fatigue.

To improve muscular strength, it is said that 3 minutes should be taken in between sets to allow ATP to replenish.

### Order of exercises

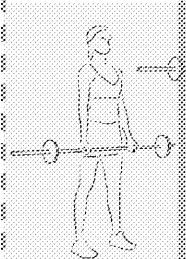
Effective order of exercises can prevent fatigue, due to working one muscle group, which can help achieve a more effective workout.

## Circuit

Circuit training involves performing a set amount of exercises at different stations.

Each station uses a different exercise depending on the goal to avoid overtraining and resulting in early fatigue.

One complete circuit is performed multiple times in the same session.



Station 1: Bicep curl (Biceps)

### Applying progressive overload

- **Frequency:** adding more sessions every other week
- **Intensity:** increasing the number of reps, or the weight at each station in circuit training
- **Time:** increasing the length of training sessions
- **Type:** varying exercises, e.g. body weight

Free weights		Resistance machines	
Advantages ✓	Disadvantages X	Advantages ✓	Disadvantages X
<ul style="list-style-type: none"> <li>• Allow a variety of exercises to be performed</li> <li>• Can train multiple muscle groups within the same movement</li> <li>• Widely available in a gym</li> </ul>	<ul style="list-style-type: none"> <li>• A spotter or guide may be required if training close to 1RM</li> <li>• Correct technique must be used</li> <li>• Greater risk of injury</li> </ul>	<ul style="list-style-type: none"> <li>• Allow for more controlled movements</li> <li>• Effective for isolating muscle groups</li> <li>• No spotter required; athlete can train on their own</li> <li>• Lower risk of injury</li> </ul>	<ul style="list-style-type: none"> <li>• Equipment expensive to purchase for home use</li> <li>• Gym membership required for access</li> <li>• Limited availability in a gym</li> </ul>

- Circuit training is specific to the goal
- It has a low risk of injury
- Circuit training can be used for either strength or endurance
- Full body circuit training

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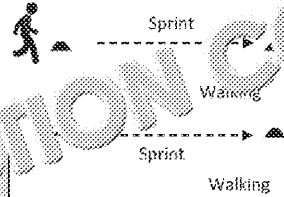


# Training Methods for Speed and Flexibility

## Training methods for speed...

### Interval training

Interval training involves short periods of speed/sprint training, followed by an active recovery/rest period, e.g. walking or gentle jogging.



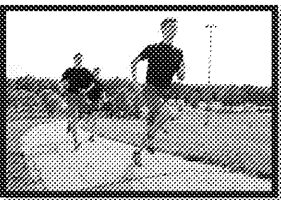
**Did you know?** Interval training can also be used to train aerobic endurance. If using to train speed, the sprint should be of a higher intensity and shorter duration, and the rest period should be longer.



### Resistance drills

Adding a form of resistance to a sprint can be a useful method for developing speed.

Hill runs can be used as a natural form of resistance and involve sprinting up a hill (that is available, and between 5% and 15% gradient) and then walking back down for an active recovery (typically lasting 60-90 seconds) before sprinting back up again. This is repeated for a number of sets (e.g. 3 sets of 6 hill runs).

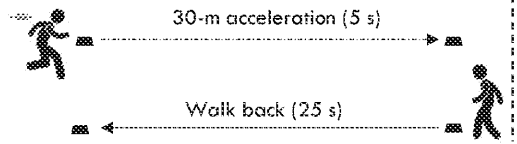


Other types of resistances include:

- Parachutes
- Sleds
- Resistance bands
- Bungee ropes

### Acceleration sprints

Acceleration sprints involve a graded increase in the speed of running from a static or rolling starting position, through to jogging, striding and then into a sprint. Each acceleration is followed by a period of recovery as the performer prepares for the next bout. This can be used to return to the initial starting position, as shown in the example to the right.



Interval training	Resistance drills	Acceleration sprints	Interval training	Resistance drills	Acceleration sprints
<ul style="list-style-type: none"> <li>Good for invasion games that mimic interval principles</li> <li>Requires minimal equipment</li> </ul>	<ul style="list-style-type: none"> <li>Sessions are over quick</li> <li>Can be done in a variety of locations</li> <li>Highly specific to linear sprinting events</li> </ul>	<ul style="list-style-type: none"> <li>Can be performed on grass, on a track or on tarmac</li> <li>Lower risk of injury due to gradual increase in pace</li> </ul>	<ul style="list-style-type: none"> <li>Difficult to gauge work-to-rest ratio</li> <li>Increased risk of muscle soreness</li> </ul>	<ul style="list-style-type: none"> <li>May require expensive equipment (sleds)</li> <li>Increased risk of injury due to maximal intensity</li> </ul>	<ul style="list-style-type: none"> <li>More specific to developing change of speed (acceleration)</li> <li>Risk of injury during the maximal sprint if not properly warmed up</li> </ul>

## Flexibility

### Static stretching

Static stretching involves holding a stretch for a period of time. There are two ways this can be done:

- Active**
  - Stretches performed while the performer is moving
  - Involves applying a force to the stretch, e.g. sitting on the floor and pulling one leg towards the other
- Passive**
  - Stretches performed while the performer is stationary
  - e.g. while sitting on the floor, pulling one leg towards the other and holding the position down to reach the stretch



Static stretching
<ul style="list-style-type: none"> <li>Simple to perform</li> <li>Lowest risk of injury</li> <li>No need for special equipment</li> <li>Suitable for all ability levels</li> <li>Can be done with minimal or no equipment</li> <li>Effective in injury prevention</li> <li>Can focus on specific muscle groups</li> </ul>

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# Training Methods for Skill-Related C

## Plyometrics ...for power

Plyometric training consists of three phases:  
 (Phase 1) maximal eccentric contraction (muscle lengthening)  
 (Phase 2) amortisation phase (transfer of elastic energy)  
 (Phase 3) concentric contraction (muscle shortening).

Because the focus is on generating maximum power, most movements are performed using only body weight.

Types of exercise include:

- Lunging, box jumps, rope climbs, claps

It is important that the correct technique is used as this type of training has a high risk of injury.



Advantages ✓	Disadvantages ✗
<ul style="list-style-type: none"> <li>• Highly effective training method</li> <li>• Can be made sport-specific</li> </ul>	<ul style="list-style-type: none"> <li>• High risk of injury</li> <li>• Often requires access to equipment</li> </ul>

## SAQ® ...for agility

This training method involves both speed and quickness over short distances that also involve the changing of direction; for instance, through the use of ladders and cones. This type of training may be useful for sports that involve speed and agility, in which an athlete may have to change direction rapidly throughout the game.



**Did you know?**  
 SAQ® training can be used to mimic the movements of certain sports, e.g. by running sideways.

Advantages ✓	Disadvantages ✗
<ul style="list-style-type: none"> <li>• Can replicate demands of the sport</li> <li>• Can be performed without specialist facilities</li> </ul>	<ul style="list-style-type: none"> <li>• May require equipment such as ladders or hurdles</li> </ul>

**Did you know?**  
 SAQ® training is trademark-registered and provides equipment, conditioning programmes and courses through its website.

**Reminder:** Reaction time is the time taken to respond to a stimulus; therefore, training methods should aim to improve this.

Training methods for developing reaction time involve an activity that challenges the performer to respond quickly to a stimulus. Common examples of training methods include:

- Responding to the colour of a reaction ball which has uneven edges, meaning the direction of the ball is unpredictable.
- Sport-specific drills that require the performer to react to a situation; for example, calling out a colour to indicate the direction a player must run.



Advantages ✓	Disadvantages ✗
<ul style="list-style-type: none"> <li>• Simple to perform</li> <li>• Low risk of injury</li> <li>• No requirement for facility access</li> </ul>	<ul style="list-style-type: none"> <li>• May not replicate the demands of the sport</li> <li>• May require equipment/IT</li> </ul>

**Did you know?** Response time is similar to reaction time but also involves the time taken to complete the movement; therefore, a good reaction time improves the response time.

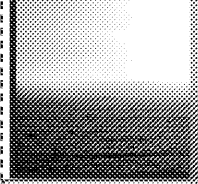
## Training methods ...

Balance training involves training on unstable surfaces with the aim of improving balance.

**Balance boards** – the performer must correct its posture to ensure its centre of gravity stays within the base of support.  
**Exercise balls** – these are used to improve balance and cater for different levels of difficulty.  
**Single leg exercises** – require the performer to support to one foot to maintain balance.

Advantages ✓
<ul style="list-style-type: none"> <li>• Easy to set up</li> <li>• Low cost of equipment</li> <li>• Highly specific to the sport as a component of fitness</li> </ul>

**Reminder:** Coordination is the ability to use two or more parts of the same side of the body together.



The most common types of balance training involve processing visual information while using the hands.

Balance training is available to all levels of performer and is available through various channels.

**Public places:** Facilities and programmes available to the general public, such as swimming pools, gyms, leisure centres, etc.

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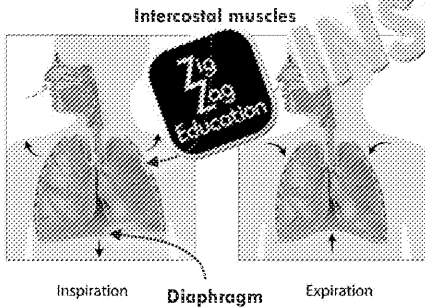
# Long-Term Effects of Fitness Training on

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## Aerobic endurance

### Increased strength of respiratory muscles

The muscles which aid the respiratory process – the intercostal muscles and the diaphragm – increase in strength, which allows the thoracic cavity to expand further to allow more air into the lungs during inhalation. This results in more oxygen being delivered to the working muscles.



### Cardiac hypertrophy

- Increased heart size
- Increased length of heart muscle
- Increased volume of blood pumped from the left

### Capillarisation around alveoli

Capillarisation is the increase in the number of capillaries. These are small blood vessels involved at the site of gaseous exchange in the lungs – the alveoli.

Capillarisation of the alveoli increases the efficiency of oxygen transport from the lungs to the blood so that it can travel to the muscles.

### Decreased resting heart rate

- A by-product of the heart undergoing hypertrophy
- The heart does not have to work as hard to pump blood
- The volume of blood can be pumped in fewer beats

## Flexibility

Flexibility training has effects on the connective tissue systems. This is due to the stretching of connective tissue, which allows for greater movement at a joint.

### Increased range of motion

The combined increase in muscle length and flexibility of tendons means that there is a greater range of motion around a joint. This allows the body to move more efficiently in physical activity with a reduced risk of injury to the connective tissue to stretch to its limits.

## Muscular strength and power training

### Hypertrophy

The muscular system adapts to regular strength and power training by undergoing hypertrophy. This is where the muscles increase in size as a result of healing microtears (thereby increasing the size or number of muscle fibres), allowing the body to better meet the demands of exercise.

### Increased ligament and tendon strength

Tendons (which connect muscles to bones) and ligaments (which connect bone to bone) become stronger and more flexible as a result of exercise as they adapt to the overload placed upon them. This results in injury prevention, an improved range of motion, increased strength and, therefore, improved performance.

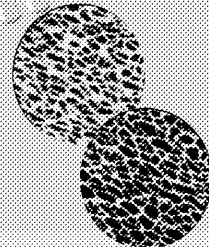
### Increased bone density

Bone density is a measure of how much mineral is in the bone. The denser a bone, the stronger it is. This is particularly important in contact sports where impact is likely, and also in healthy ageing.

Weight-bearing exercise is effective in increasing bone density and involves activities that put stress on the bones, such as weightlifting and box jumping.

This occurs as a result of the body absorbing important minerals such as calcium, magnesium and zinc, which add to overall bone density. Strong bone density is particularly important in contact sports where impact is likely, and also in healthy ageing.

### Low bone density



## Muscular endurance training

Muscular endurance training targets adaptation of the muscular system, but in a different way from muscular strength training. Instead, training for muscular endurance targets the body's ability to use oxygen for repeated contractions, resulting in a distinct body shape of endurance athletes.

### Capillarisation of muscles

As oxygen is exchanged at the alveoli, the process is also carried out at the muscle. Capillarisation at the muscle results in:

- Increased delivery of oxygen and nutrients to the muscle
- Increased removal of carbon dioxide and lactic acid

### Greater muscle tone

Over time, endurance training improves body composition by burning fat and, in turn, reduces the ratio of fat mass to fat-free mass. This results in an increase in muscle tone and a lean appearance of muscles.

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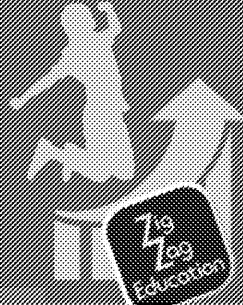
# Fitness Programme Design

## Motivational Techniques

Link to fitness testing (pages 4-6)

Fitness test results should inform the design of a training programme by identifying any weaknesses and targeting them for improvement.

The effectiveness of the programme can then be evaluated based on any change of results in pre- vs post-fitness testing.



### Personal information

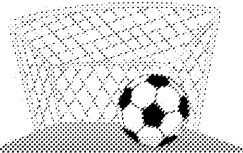
The PAR-Q collected prior to the training programme should establish the participant's lifestyle and medical history. This is necessary in order to inform the programme design.

For instance, the programme should be modified based on whether the participant is asthmatic, diabetic, pregnant, previously inactive, recovering from surgery or rehabilitating from a recent injury.



### Aims (what?) and objectives (how?)

A programme should have a number of aims. Firstly, an overall aim should clarify which component of fitness will be targeted for the duration of the training programme and by how much the performer will improve them. Aims will then also be set throughout the programme in the form of objectives, e.g. to run an additional 1 km on the treadmill each week or to increase the load lifted on a resistance exercise within a single session. These objectives tie in with goal-setting, which gives the participant accountability during their training sessions.



### Personal goals

Goal-setting ties in with the aims and objectives of a training programme. It also gives the performer motivation by providing direction with the programme and maintaining focus on the end goal.

Goals should adhere to the SMARTER principles:

<b>S</b> SPECIFIC	Goals should relate to the overall aims of the training programme, which should target an aspect of the performer's sport/activity that needs improving.
<b>M</b> MEASURABLE	Goals should be able to be monitored through some sort of unit of measurement such as time taken or weight lifted.
<b>A</b> ACHIEVABLE	Goals should be tailored to allow for 'quick wins' to be made and to maintain motivation.
<b>R</b> REALISTIC	Goals should be set within a realistic time frame that allows the performer to achieve them with a reasonable effort.
<b>T</b> TIME-RELATED	Goals should include a set duration in which they should be achieved and the rate of progress against the goal should be expected.
<b>E</b> EXCITING	To overcome the boredom of training, goals should allow the performer a level of excitement to maintain motivation.
<b>R</b> RECORDED	Goals should allow a record to be kept for reference when reviewing the success of the training programme.

### Motivation

There are two types of motivation:

- **Intrinsic motivation** is obtained from internal sources, such as personal satisfaction
- **Extrinsic motivation** is obtained from outside sources, as tangible money and trophies, or as intangible forms such as praise and encouragement.



### Short-term goals

- Set over short period (one day to one month)
- Continually updated
- Allows for quick wins/successes to aid motivation

e.g. a football player may set themselves the short-term goal of achieving a >90% pass completion rate for the upcoming weekend match.

### Long-term goals

- May take up to a number of years to achieve
- Have an end reward
- Tie in with the performer's overall objectives

e.g. a gymnast might set a long-term goal of qualifying for regional championships.

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# Body composition

**Definition:** The relative proportions of fat and non-fat mass (muscle, water and bone) that make up our bodies.



## Body composition in sport:

Body composition can influence performance in sport, and different fat-to-muscle ratios will benefit some performers in sport more than others. For example:

- Prop forwards in rugby will have high levels of fat, which contributes to their large weight, making them difficult to stop

Describe one other example of a sport where body composition is important.

B



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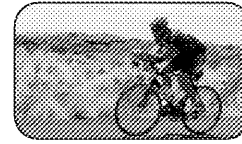
# Components of

## Aerobic endurance

**Definition:** The ability of the cardiovascular and respiratory systems to function effectively, improving the efficiency of gas (O<sub>2</sub> and CO<sub>2</sub>) and nutrient transport in the blood to allow sustained physical activity.

- Explain why each of these fitness components is important, using the examples given.
- Give one other example of a sport that requires each component of fitness.

Examples of sports that require aerobic endurance:  
• Triathlon



Key words: aerobic, endurance

## Muscular strength

**Definition:** The amount of force a muscle or muscle group can generate when contracting against a resistance.

Examples of sports that require strength:  
• Weightlifting



Key words: strength, muscular

## Balance

**Definition:** The ability of the body to maintain its centre of mass over a base of support while stationary (static) or during movement (dynamic).

Examples of sports that require balance:

- Gymnastics (e.g. performing a handstand)

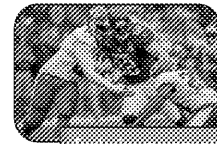


## Power

The product of both speed and strength

$$\text{Power (kgm/s)} = \text{Force (kg)} \times \text{Distance (m)} / \text{Time (s)}$$

Examples of sports that require power:  
• Football



Key words: power, speed, strength

## Agility

**Definition:** The ability of the body to move quickly and precisely to change direction at speed.

Examples of sports that require agility:

- Rugby

Describe one other example of a sport that requires agility.



## Coordination

**Definition:** The ability to efficiently use two or more body parts at the same time.

Examples of sports that require coordination:

- Tennis (serving)



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# The Principles of

Specificity:

e.g.

e.g.

Reversibility:

e.g.

Applying progressive overload...

Principles of

Describe each principle of training and give an example of how each principle is applied.

If applied correctly, the principles of training allow for the performer to get the best possible outcome from their training programme.

However, the principles of training are very often incorrectly applied or not applied at all, which may not only prevent the performer from improving, but also increase their risk of injury.



## EXERCISE INTENSITY

Intensity can be measured in numerous ways. The selection of which measurement to use depends on the type of activity being performed.

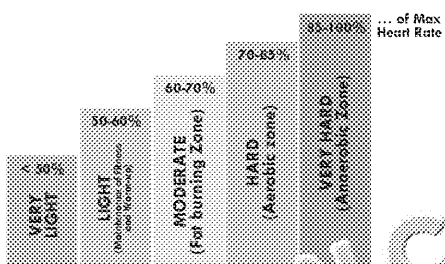
For cardiovascular training, heart rate is commonly used to determine training zones where working in a specific zone will lead to different fitness improvements:

### TRAINING ZONES

These are calculated from an individual's max heart rate, which is estimated using the following equation:

$$\text{MHR (bpm)} = 220 - \text{age}$$

Calculate the heart rate range for a 15-year-old looking to train in the anaerobic zone.



### TECHNOLOGY TO MEASURE EXERCISE INTENSITY



Name two types of technology that can be used to measure exercise intensity.

- 1.
- 2.

### RATING OF PERCEIVED EXERTION

The Borg rating of perceived exertion (RPE) scale is another way to measure exercise intensity. Athletes identify on a scale 6 (No exertion) to 10 (Very hard) on how hard they think they were working during a specific training session.

It is particularly useful for activities where a heart rate monitor is limited. It is possible to estimate heart rate using the RPE scale via the following calculation:

State the equation for the relationship between RPE and heart rate.

### ONE-REP MAX

For resistance training, a % of a given repetition maximum (1RM) is used to measure intensity.

For strength: \_\_\_\_\_ RM

For endurance: \_\_\_\_\_ RM

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# Importance of Fitness Testing and Requirements for Administration

Explain three other reasons for fitness testing. **A**

## REASONS FOR FITNESS TESTING

There are various reasons for fitness testing. This could be for a variety of purposes such as to get a baseline of performance for a training programme.

**Helps to set goals**  
Baseline fitness testing is used to set goals for the training programme which can be monitored throughout. It also provides the performer with something to aim for with their training.

## ADDITIONAL ADMINISTRATION INVOLVED IN FITNESS TESTING

- Test conductors should have knowledge of published standard test methods and understanding of appropriate use of equipment.
- Results should be measured and recorded accurately. The more precise the measurement, the less the risk of accurately reflecting the performer's fitness level.
- Results should be compared with published data tables to make practical judgments of fitness levels. Normative data should be available for different ages and genders and should be taken from reliable sources.
- The most relevant tests should be selected for each individual. Therefore, individual needs should be discussed prior to arranging fitness testing.

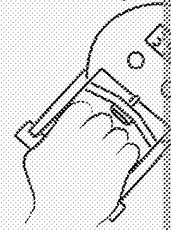
## RELIABILITY OF TESTS

Whether a test can be repeated under the exact same conditions and produce the same result, the reliability of a test is, therefore, a key factor to consider if it is.

Explain three factors that affect the reliability of a fitness test. **C**

Pedometer

Equipment make sure measurements will have error



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### Interpreting fitness test results

Once test results have been recorded for any fitness test, this information is then used and compared to normative data.

- **Normative data** is a reference from a population that is used as a baseline for measuring against. It is essentially the average.

Identify two common categories used to group normative data and suggest a reason why each is used.



Results will often be rated from the following: Excellent --- Good --- Average --- Fair --- Poor

Comparing results to normative data allows the performer to see what level they are at and can be used to set goals and targets to improve the fitness rating.

Some tests are easier to analyse than others; for example, the sit and reach test for flexibility simply involves measuring the distance you have stretched (in cm or inches).

However, other tests, such as those used to calculate aerobic endurance, require the data collected to be converted in order to obtain the results for  $\dot{V}O_2$  max.

It is important that measurements are accurate to ensure correct results. You should ask these questions before every test:

- Am I familiar with using the equipment?
- Can I get comfortable with the test? (e.g. run this test?)
- Is it practical for this test?
- Is the test measuring the component of fitness it is meant to measure? (validity)
- Am I measuring using the correct units?
- Can I record the results immediately?

# Fitness Tests for Aerob

## 12-minute Cooper run/swim

The Cooper run can be used in both running and swimming. The premise is the same for both: cover as much distance in a 12-minute period. The main difference being the environment – running on a track compared to swimming in a pool.

procedure:

Describe how the 12-minute Cooper run and Harvard step test are carried out.

equipment:

400 m running track, stopwatch, partner to monitor time

This is a very valid measure of aerobic endurance as it challenges the ability of the heart and lungs to provide the muscles with oxygen for an extended period.

## Harvard step test

The Harvard step test is a sub-maximal test which provides a measure of cardiovascular endurance through the recovery rate of the participant's pulse.

procedure:

equipment:

step bench, Metronome / audio player

## Additional fitness tests

Describe how to carry out one additional fitness test for aerobic endurance.

Fitness test: \_\_\_\_\_

Description of how it is carried out: \_\_\_\_\_

The yo-yo test was designed specifically for participants from sports who are required to have a strong aerobic engine as well as changes of direction capability.

There are two variations of yo-yo test:  
**Level 1 (beginner)** – slower speeds than the bleep test  
**Level 2 (advanced)** – greater increments in speed  
There are also intermittent variants which include recovery periods after every 40 m.

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# Fitness Tests for Muscular Endurance

## One-minute sit-up/press-up test

This test uses sit-ups or press-ups to measure the muscular endurance of the abdominal muscles or the pectorals/triceps.

Describe how the fitness tests for muscular endurance are carried out.



procedure:



equipment:

- Stopwatch
- Exercise mat for floor
- Individual to monitor the time / reps

Reliability of these tests will depend on how well the participant follows all instructions for each exercise. Working with a partner will help participants perform with more accuracy with these tests.

normative data:

The following table displays the normative data for the press-up test for males and females.

Press-up test normative data (units: number of press-ups)

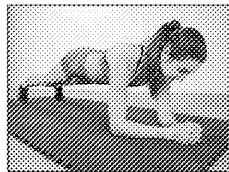
Rating	Time
Excellent	
Good	
Average	
Fair	
Poor	

Sit-up test normative data:

Rating	Time
Excellent	
Above average	
Average	
Below average	
Poor	

## The plank test

This test uses the plank position to measure the muscular endurance of the whole body to maintain the position. It involves a similar procedure to the one-minute sit-up and press-up tests, but instead of the sit-up and press-up, it uses the plank position, and instead of the one-minute time period, the performer must maintain the plank position for as long as possible.



The press-up and sit-up tests may require performing a given number of reps. Performing these tests to exhaustion is a more accurate reflection of muscular endurance, but they generally take a greater amount of time.

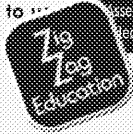
procedure:

The following table displays normative data for the plank test.

Excellent	Very good	Above
> 5 min	3–5 min	2–3 min

Source: Estimated and adapted from Strathclyde University.

Which test to use will depend on the individual's needs and individual needs may influence the choice of test for muscular endurance.



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# Fitness Tests for Strength and Speed

## Fitness tests for muscular strength

### Handgrip dynamometer test

The handgrip dynamometer test measures the strength of the forearm in order to assess the strength of the muscles.

procedure:

A



Describe how each of the following tests for muscular strength.

Interpretative data:  
The following table displays the normative data for 14–16-year-olds.

Category	Males	Females
Excellent	> 50	> 32
Good	48–50	29–32
Average	43–47	24–28
Fair	37–42	18–23
Poor	< 37	< 18

Source: Estimated and adapted from Davis (2000)

Grip strength will vary by age, as well as gender, as strength deteriorates with age and varies between genders.

equipment:

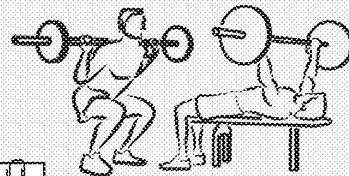
Handgrip dynamometer, Assistant

### One-rep max (1RM) test

A 1RM is the heaviest weight that can be lifted in a single repetition. There are a number of different exercises that can be used for the 1RM, with the bench press and back squat being most common for upper-body and lower-body strength, respectively.

procedure (for the back squat):

A

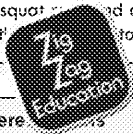


scoring:

The highest weight that a performer is able to complete one rep for is used as the test value. This includes the weight of the barbell, which is usually 20 kg. The 1RM value is used to prescribe strength training, e.g. a training load > 70 % 1RM for few reps.

equipment:

Barbell, bench / squat rack and a spotter (or support) are also needed for the test. The performer should make a maximal attempt at a lift.



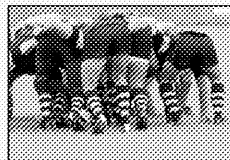
The 1RM test requires large amounts of motivation, therefore, a maximal attempt is essential to obtain the maximum dynamometer test value.

I

Specificity to different sports

Assess the specificity of the fitness tests for muscular strength to different sports.

B



## Fitness

### 30-metre sprint

The 30-metre sprint

procedure:

equipment:

- Cones
- Stopwatch
- Assistant
- Non-slip running shoes

### 30-metre flying

The 30-metre flying sprint is similar to the 30-metre sprint but instead of a start block, the performer starts from a standing position to reach peak speed.

procedure:

Specificity to different sports

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# Fitness Tests for Flexibility and Body Composition

## Flexibility fitness tests

Describe how each of the fitness tests for flexibility is carried out.

normative data:

The following table displays the normative data for 14–16-year-old males.

Rating	Score	Normative Data
Excellent	> 4	16.5
Good	3.4–12.1	16.5–13.2
Fair	12.0–7.7	13.1–7.7
Poor	7.6–4.4	7.6–4.4
Poor	< 4.4	< 4.4

Source: Estimated and adapted from Davis (2000)

A high score in this test will be relevant to sports that require flexibility of the hamstrings and lower back. However, it is not so relevant to sports that require flexibility in other areas of the body.

### Sit-and-reach test

The sit-and-reach test measures the flexibility of the muscles, particularly the hamstrings group and the lower back muscles.

procedure:



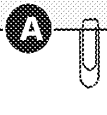
equipment:

Sit-and-reach box, ruler and assistant.

### Calf muscle flexibility test

Unlike the sit-and-reach test, this fitness test assesses the flexibility of the calf muscles. This is important for a range of movements, particularly weightlifting exercises such as the squat.

procedure:



equipment:

- Ruler
- Assistant

The reliability of flexibility tests will depend on how well the participant has warmed up, as the warmer the muscles the more flexible they are.

### Shoulder flexibility test

There are a number of different flexibility tests for the shoulder. One of the most common tests is the overhead reach (also known as the trunk scratch test). This involves the participant reaching their arms overhead with one arm and letting their hand rest on the other arm's shoulder, alternating around with the other arm and letting their hand rest on the other arm's shoulder.

A rating is given (see table).

Rating	Description
Good	Fingers are able to touch each other
Fair	Fingers are less than 5 cm (2 inches) apart
Poor	Fingers are greater than 5 cm (2 in) apart

Assess the specificity of the fitness tests for flexibility to different sports.

Specificity to differ



Describe how each of the fitness tests for body composition is carried out.

### Body mass index

This is a simple estimate of body composition which takes into account an individual's weight and height.

procedure:

### Bioelectrical impedance

This test uses a piece of equipment that sends an electrical current through the body to estimate body composition.

procedure:

### Waist-to-hip ratio

WHR is another measure of body composition which is used alongside BMI to assess body composition.

procedure:

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# Fitness Tests for Agility, Balance and

## Coordination fitness tests

Describe how each of the fitness tests for coordination is carried out.

### Alternate hand wall-toss test

This test assesses hand-eye coordination by tossing a ball with one hand against a wall and catching it with the other.

procedure:



#### equipment:

- Tennis ball
- Flat wall
- Assistant

Describe how the alternate hand wall-toss test is practical.

### Stick flip coordination test

This test also measures hand-eye coordination but involves finer movements than throwing with the alternate hand wall-toss test.

procedure:

Part A (half turn)

Part B (full turn)

#### equipment:

- Three sticks
- Tape/paint
- Assistant

The reliability of this test can be improved by using the same appropriately sized sticks each time. The recommended length of each stick is 40 cm with a 2 cm diameter.

### T test

Describe how each of the fitness tests for agility is carried out.

This test requires the participant to move as quickly as possible in a series of directions including forwards, backwards, sideways, and diagonally.

procedure:

### Illinois agility test

This test involves numerous changes of direction and weaving in and out of cones.

procedure:

### Straiten's stick test

This test is used to assess the static balance of an individual.

The standing stork and placing the standing leg

procedure:



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# Fitness Tests for Reaction Time a

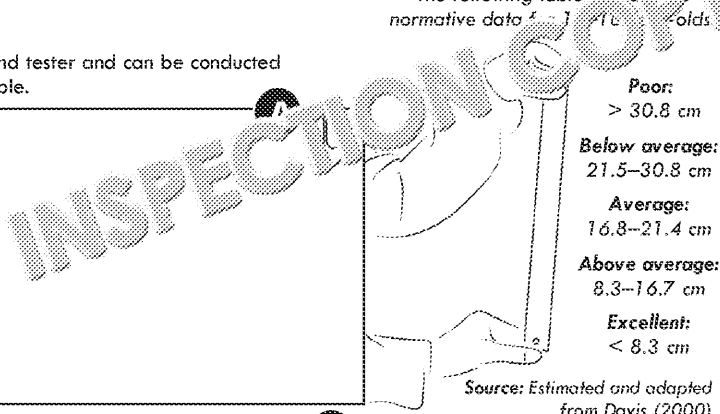
## Reaction time fitness tests

**A** Describe how each of the fitness tests for reaction time is carried out.

### Ruler drop test

This fitness test involves subject and tester and can be conducted using just a 30 cm ruler and a table.

procedure:



normative data:  
The following table displays normative data for 1000 males.

- Poor:**  
> 30.8 cm
- Below average:**  
21.5–30.8 cm
- Average:**  
16.8–21.4 cm
- Above average:**  
8.3–16.7 cm
- Excellent:**  
< 8.3 cm

Source: Estimated and adapted from Davis (2000)

equipment:

- Ruler
- Table
- Assistant

**B** Describe how the ruler drop test is practical.

### Online reaction time test

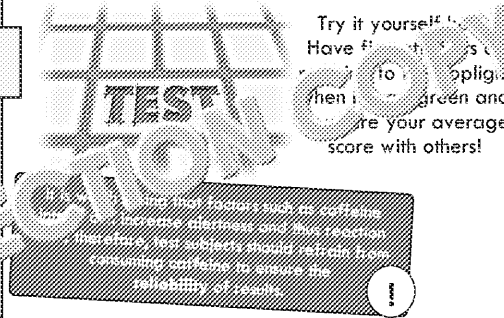
There are many online reaction time tests available. The most common ones require a click of the mouse or a press of the space button when something changes colour or appears.

procedure:

**A** equipment:  
Computer/tablet



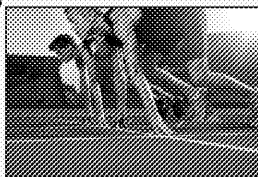
Try it yourself!  
Have friends test you to compare scores. To apply, when the light turns green and press your average score with others!



! Be aware that factors such as caffeine, adrenaline, and the reaction time stimulus and the reaction time test itself should remain from remaining constant to ensure the reliability of results.

Validity and specificity of reaction time tests

**C** Assess the validity and specificity of reaction time tests in sport.



## Power fit

### Vertical jump

The vertical jump test, measures the

procedure:

### Standing long

The standing long

procedure:

### Margaria-Kal

This test also assesses

procedure:

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### Requirements for following fitness training methods

Fitness training should be carried out safely and effectively. All of the training methods mentioned on pages 10–13 should include a warm-up and cool-down.

Describe the importance of a warm-up and a cool-down and the components that make up each.



Training methods should also:

- ✓ Link to the appropriate fitness component
- ✓ Apply the FITT principles (see page 2)
- ✓ Apply appropriate training intensities (see page 2)

### Evaluating the appropriateness of fitness training methods

It is important to select the most appropriate fitness training methods for a given situation. Evaluating fitness training methods should consider the following:

- Number of participants that can take part at once
- The costs of training (e.g. equipment, facilities)
- How easy it is to set up
- Access to facilities (e.g. gym)
- The risk factors related to the method (e.g. a beginner who may need supervision for weight training)
- Effectiveness of training method
- Specificity to component of fitness
- How well the training method replicates the demands of the sport



# Training Methods for Aerobic

Describe each of the training methods for aerobic endurance.

## Continuous training

## Fartlek training



Also known as speed play

State three advantages and three disadvantages for each training method.

Advantages ✓		
Disadvantages ✗		

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# Training Methods for Muscular Strength

## Free weights and fixed resistance machines

Training for muscular strength and endurance can be done by using either free weights or resistance machines. Both include applying a resistance to the muscle when moving. Heavy loads with strength training creates microtears in the muscle, leading to hypertrophy (increase in size) of the muscle and increased strength, whereas light loads for muscular endurance builds up a resistance to fatigue.

Give two examples of free weights and two examples of fixed resistance machines.

- Free weights: 1. \_\_\_\_\_
- Fixed resistance machines: 1. \_\_\_\_\_

### Repetitions and sets

Free weight and fixed resistance training involves performing specific exercises that focus on different muscle groups using sets and reps.

- A **rep** is the number of times an exercise is performed, e.g. if you wanted to do 12 squats that would be 12 reps.
- A **set** is the number of cycles of reps that are done, e.g. doing 12 squats 3 times would be 3 sets of 12 reps, with rest periods for recovery in between.

The number of reps and sets should be manipulated for muscular strength and endurance training to apply the principle of progressive overload and put the muscle under the relevant stress to stimulate growth or resistance to fatigue, depending on the component of fitness the performer is aiming to improve.

### For muscular strength:

- Weight: \_\_\_\_\_
- Reps: \_\_\_\_\_
- Sets: 3–5

State an appropriate weight (as a % of 1RM) and number of reps that would be used for muscular strength and endurance training.

### For muscular endurance:

- Weight: \_\_\_\_\_
- Reps: \_\_\_\_\_
- Sets: Typically 3 or more

Did you know? The load, reps, sets, and lengths of training sessions are typically manipulated to apply the principle of progressive overload.

### Rest periods

Rest periods are the time taken between sets to allow the body to recover. It is important to allow for rest periods to prevent the risk of injury and to delay early fatigue.

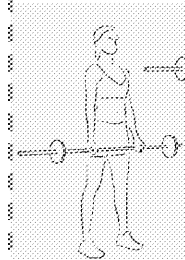
To improve muscular strength, it is said that 3 minutes should be taken in between sets as this allows ATP to be replenished.

### Order of exercises

Effective training should be done in order of exercises that prevent fatigue, due to working one muscle group, which can help achieve a more effective workout.

## Circuit training

Describe how a circuit training session would be structured.



Station 1: Bicep curl (Biceps)

### Applying progressive overload

- Frequency: adding extra sessions every other week.
- Intensity: increasing the number of reps, or the weight used at each station in circuit training.
- Time: increasing the length of training sessions.
- Type: varying exercises, e.g. body weight exercises.

State two advantages and two disadvantages of free weights and resistance machines.

Free weights		Resistance machines	
Advantages ✓	Disadvantages ✗	Advantages ✓	Disadvantages ✗

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# Training Methods for Speed and Flexibility

## Training methods for speed...

### Interval training

Describe how interval training is carried out for speed and how it differs from interval training for aerobic endurance.

Adding a form of **resistance** to be a useful method for developing speed.

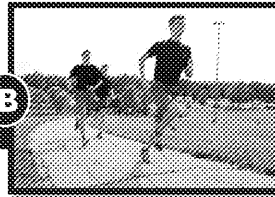
Hill runs can be used as a **resistance** added form of resistance and involve sprinting up a hill (that is available, and between 5% and 15% gradient) and then walking back down for an active recovery (typically lasting 60–90 seconds) before sprinting back up again. This is repeated for a number of sets (e.g. 3 sets of 6 hill runs).

Other types of resistances include:




Other than hill runs, name three types of resistance that can be used.

### Resistance drills



### Acceleration sprints

Describe how acceleration sprints are carried out for speed.

Advantages			Disadvantages		
Interval training	Resistance drills	Acceleration sprints	Interval training	Resistance drills	Acceleration sprints

State one advantage and one disadvantage for each training method for speed.

## Flexibility

### Static stretching

Static stretching involves... There are two ways this can be done:

1. Active
2. Passive



Static

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# Training Methods for Skill-Related C

## Plyometrics ...for power

State one advantage and one disadvantage of each type of training method.

B

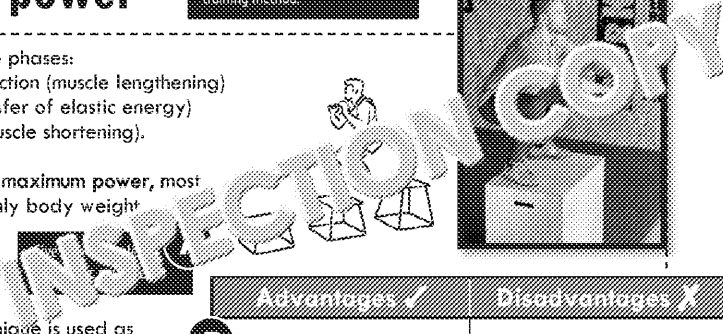
Plyometric training consists of three phases:  
 (Phase 1) maximal eccentric contraction (muscle lengthening)  
 (Phase 2) amortisation phase (transfer of elastic energy)  
 (Phase 3) concentric contraction (muscle shortening).

Because the focus is on generating maximum power, most movements are performed using only body weight.

Types of exercise include:

1. \_\_\_\_\_ 2. \_\_\_\_\_

It is important that the technique is used as this type of training is high risk of injury.



Advantages ✓	Disadvantages X

B

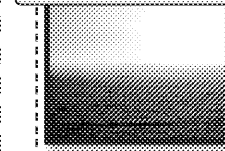
## Training methods ...

Balance training involves unstable surfaces with

Balance boards – the correct its posture to gravity stays within the

Advantage

Reminder: Coordination ability to use two or parts at the same



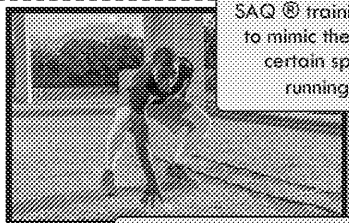
The most common type of coordination involves visual information with the hands or feet.

Handy training equipment is available to all at private provision club or an alternative available through grants and projects.

Public provision

## SAQ® ...for agility

This training method involves both speed and quickness over short distances that also involve the changing of direction; for instance, through the use of ladders and cones. This type of training may be useful for sports that involve speed and agility, in which an athlete may have to change direction rapidly throughout the game.



Did you know? SAQ® training can be used to mimic the movements of certain sports, e.g. by running sideways.

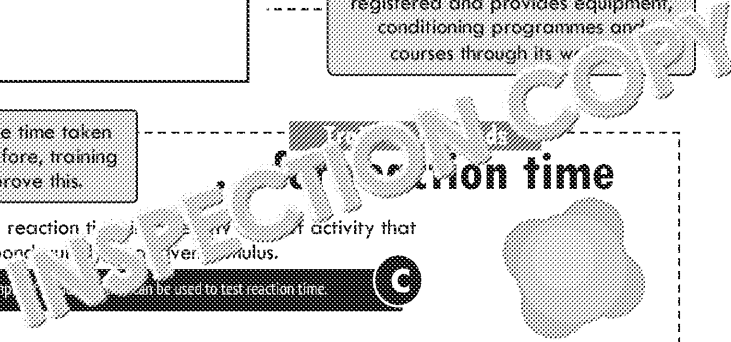
Advantages ✓	Disadvantages X

B

Did you know? SAQ® training is trademark-registered and provides equipment, conditioning programmes and courses through its website.

Reminder: Reaction time is the time taken to respond to a stimulus; therefore, training methods should aim to improve this.

Training methods for developing reaction time involve any activity that challenges the performer to respond to a stimulus.



Advantages ✓	Disadvantages X

B

Did you know? Response time is similar to reaction time but also involves the time taken to complete the movement; therefore, a good reaction time improves the response time.

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# Long-Term Effects of Fitness Training on

Explain how each of the adaptations from the different training methods benefits the different components of fitness in sport and exercise.

A

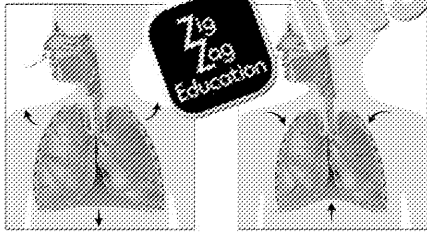
## Aerobic endurance

Increased strength of respiratory muscles

Cardiac hypertrophy

## Flexibility

Flexibility training has systems. This is due to connective tissue, which movement at a joint.



Inspiration

Expiration

Capillarisation around alveoli

Decreased resting heart rate

Increased range of

## Muscular strength and power training

**Hypertrophy**

Increased ligament and tendon strength

Increased bone density

Low bone density

## Muscular endurance training

Muscular endurance training targets adaptation system, but in a different way from muscular training. Instead, training for muscular endurance body's ability to use oxygen for repeated contraction a distinct body shape of endurance training.

Capillarisation of muscles

Greater muscle tone

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Link to fitness testing (pages 4–8)

Fitness test results should inform the design of a training programme by identifying any weaknesses and targeting them for improvement.

The effectiveness of the programme can then be evaluated based on any change of results in pre- vs post-fitness testing.

# Fitness Programme Design Motivational Techniques

## Personal information

The PAR-Q collected prior to the training programme should establish the participant's \_\_\_\_\_ and general activity history. This is necessary in order to \_\_\_\_\_ the programme design.

Fill in the gaps for \_\_\_\_\_ on the use of personal aims and objectives in the programme.  
modified lifestyle

For instance, the programme should be \_\_\_\_\_ based on whether the participant is asthmatic, diabetic, pregnant, previously inactive, recovering from surgery or rehabilitating from a recent \_\_\_\_\_.

## Aims (what?) and objectives (how?)

A programme should have a number of aims. Firstly, an overall aim should clarify which component of fitness will be targeted for the duration of the training programme and by how much the performer will improve them. Aims will then also be set throughout the programme in the form of objectives, e.g. to run an additional 1 km on the treadmill each week or to increase the load lifted on resistance exercise within a single session. These objectives tie in with goal-setting, which gives the participant accountability during their training sessions.

## Personal goals

Goal-setting ties in with the aims and objectives of a training programme. It also gives the performer motivation by providing direction with the programme and maintaining focus on the end goal.

Goals should adhere to the SMARTER principles:

Identify and describe the different SMARTER principles of goal setting.

<b>S</b>	
<b>M</b>	
<b>A</b>	
<b>R</b>	
<b>T</b>	
<b>E</b>	
<b>R</b>	

## Motivation

Give one example of a type of motivation.

There are two types of motivation:

- Intrinsic motivation is obtained from internal sources, such as \_\_\_\_\_
- Extrinsic motivation is obtained from outside sources, as tangible \_\_\_\_\_

Benefits for performer

Identify four benefits of motivation on the performer.

One day → One month

One year

## Short-term goals

Give one example of a short-term goal and one example of a long-term goal for the same sport of your choice.

Long-term goal

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