

Fitness testing for sport and exercise

Introduction

This unit introduces you to the concepts of fitness testing and health screening. The aim of the unit is to give you the skills, knowledge and experience to allow you to carry out fitness tests on an individual, for example a client from your local sports club. You will look at the different fitness tests, such as the multi-stage fitness test and the sit-and-reach test.

In addition to practical fitness testing, you will also develop the skills and knowledge that will allow you to analyse fitness test results. You will be expected to give feedback to clients based on their results, concentrating on their strengths and areas for improvement, such as a poor level of flexibility.

You will also explore health screening and how it relates to fitness testing. Through medical screening you will consider such topics as questionnaires and blood pressure measurement.

After completing this unit you should be able to achieve the following outcomes:

- Understand a range of laboratory-based and field-based tests.
- Understand the practice of health screening.
- Be able to prepare for, and conduct, appropriate fitness tests.
- Be able to analyse the results of fitness tests.





Think it over

There are many definitions and explanations of fitness – it is a complex subject. Fitness relates to those components of fitness that make up our health and skill status: strength, muscular endurance, aerobic endurance, flexibility, body composition, speed and power.

A fitness trainer, personal trainer or coach assesses a client's fitness through the use of fitness tests such as the multi-stage (or bleep) test, which you might have performed at school or college.

Imagine you are a personal fitness instructor working in your local fitness centre. You work with a variety of people who require testing for their health and fitness. What types of client could you work with at the fitness centre? What health and fitness tests could you perform with your clients?



6.1 Understand a range of laboratory-based and field-based fitness tests

In this section you will consider a range of fitness tests that you can use with a client or athlete. You will also look at the protocol (method) and equipment required. A fitness test is used to measure a client's fitness level for a specific component of fitness, for example strength. Each test measures a specific component ranging from aerobic endurance to flexibility. You will also look at the practicality of the tests in conjunction with the advantages and disadvantages of using a specific one. All fitness tests are classed as either laboratory-based or field-based. Laboratory tests are performed in sports and exercise laboratories and generally use specialist equipment with fairly complex protocols. In the laboratory, a scientist takes measurement of the athlete's body, such as blood lactate levels. These measurements are highly accurate and are used with athletes who have the access and funding for this type of scientific support. In comparison, field-based tests – which include tests in the sports field or sports hall – tend to be more basic in nature and do not need specialist equipment. These tests are fairly simple to use and are used with school children, beginner athletes and local sports clubs.

Fitness tests

There is increasing use of **fitness testing** in professional sports clubs, especially in football, rugby, athletics and hockey. County-level clubs now use fitness testing as many tests are inexpensive and require only a limited level of experience to carry out effectively. Professional sports clubs use the tests to measure an athlete's fitness levels after injury or during pre-season training. These clubs, sometimes in conjunction with universities, have access to the specialist equipment required for more complex fitness tests. Your local sports or fitness centre will use some fitness tests on a daily basis with their

clients. These tests will probably be more basic in nature, although they still require some level of expertise and equipment.

Flexibility

Good flexibility allows you to pick up shopping bags from the floor or to reach for something. Flexibility is defined as the ability of a specific joint, such as the knee, to move through a full range of movement. A flexible joint has a greater range of motion, which aids the performance of skills.

Flexibility is often undervalued and under-trained. Sports performers tend to perform stretches for a couple of minutes at the start and end of their sessions within the warm-up and cool-down. However, flexibility is as important as aerobic endurance and should be specifically trained. The sport, health and lifestyle benefits associated with a good level of flexibility are:

- improvement of posture
- prevention of lower back pain
- maintenance of healthy joints
- reduction in the risk of injury
- better dynamic balance (balance while moving)
- reduction in muscle soreness after exercise
- increased blood flow and nutrients to the joints.

Activity

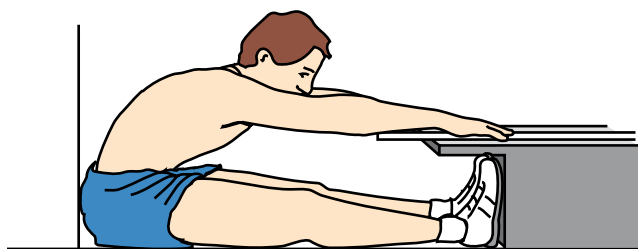
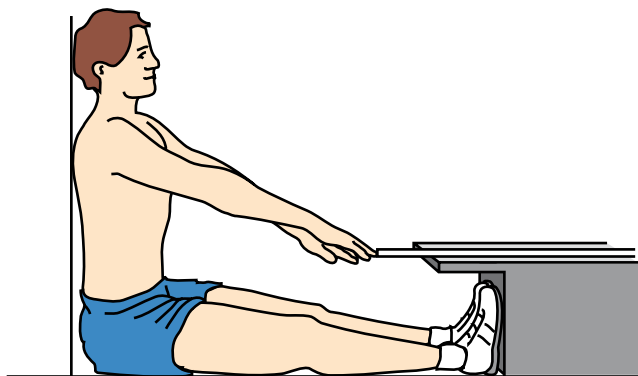
In pairs, choose one sport and identify which techniques (e.g. the tennis serve) or skills require a high level of flexibility. Then state the joints where the flexibility is important.

Key terms

Fitness testing The process of evaluating an individual's fitness through a fitness test.

■ Sit and reach

The most common test for measuring flexibility is the sit-and-reach test, which is designed to assess the flexibility of the hamstrings and lower back. The



▲ The sit-and-reach test

equipment required for this test is minimal – a yardstick and a bench. It is recommended that the client's legs should be 12 inches (30.5 cm) apart with the heels touching the bench. The client should reach forward slowly and as far as possible without causing injury, keeping the hands parallel. The knee joint should not flex. The score is obtained by recording the furthest point obtained by the fingertips against the yardstick. If the client fails to reach the 0 mark then he or she is given a minus score, for example –14 cm.

The test should be done three times with the best score recorded. Evaluate the score against the data in Table 6.1.

Rating	Males (cm)	Females (cm)
Excellent	>17.9	>17.9
Good	17.0–17.9	16.7–17.9
Average	15.8–16.9	16.2–16.6
Fair	15.0–15.7	15.8–16.1
Poor	<15.0	<15.7

Table 6.1 Sit-and-reach test scores

Activity

When performing flexibility tests, it is important that the client has performed a suitable warm-up to avoid injuries. As the tester, it is always good practice to have a warm-up and cool-down available to use. In small groups, produce a double-sided summary sheet that gives details of a suitable warm-up and cool-down.

Strength

Strength is also known as muscular strength. It is important for everyone, and not only clients. Strength can be defined as the ability of a specific muscle or muscle group to exert a force in a single maximal contraction to overcome some form of resistance. A good level of strength allows the individual to perform daily tasks involving strength without feeling fatigue or tiredness. As well as this, a good level of strength:

- helps maintain good posture in old age
- helps maintain an independent lifestyle, e.g. being able to climb the stairs at home
- helps avoid certain types of injuries, e.g. back injuries
- helps with coordination while moving, e.g. for walking and running.

Key terms

Strength The ability of a specific muscle or muscle group to exert a force in a single maximal contraction to overcome some form of resistance.

In relation to sport, strength is vital for a number of activities, such as:

- weightlifting: to lift a heavy weight
- boxing: to produce a powerful punch
- gymnastics: upper body strength is important to maintain a handstand.



Think it over

Think of ten other sports or exercises that require a good level of strength. Discuss your answers with other members in your group.

■ 1RM

The one-repetition maximum strength test (1RM) is often used to measure dynamic strength in a specific muscle group. The test measures the maximum mass in kilograms that the client can lift in one single movement and is normally performed on a fixed resistance machine.

The machine selected for the test should reflect the specific muscle groups used by the client in his or her sport. For example, a rugby league player who requires a good level of lower body strength should use a machine such as a leg press. However, these pieces can be expensive and need to be used in a room that has a supportive floor.

After a suitable warm-up to avoid injury, the client attempts a mass, which is well within his or her capability. After each attempt, the client should increase the mass by no more than 5 kg. Between trials there should be a rest period of three minutes. The client continues to add mass until the one-repetition maximum is achieved. The score can be converted into a percentage of the client's body mass.

Example: a rugby league player who has a body mass of 100 kg and a one-repetition maximum of 110 kg would have a 1RM percentage of 110 per cent.

■ Grip dynamometer

The basic concept behind dynamometers is that the client has to squeeze, push or pull to measure isometric strength, which is measured in kilograms. The dynamometer is a mechanical device to measure the force generated in a specific muscle group. There are a number of different types of dynamometers that test strength in the handgrip, back, and leg.

The grip dynamometer takes a direct measure of peak force generated by the client. The result obtained from the handgrip test should not be used to assess the muscular strength in other muscle groups. In addition, this test is not specific to any sport in particular, although it may be of interest to a racket sport player in terms of holding the racket.

Once the results have been obtained, they can be compared against a table similar to the one shown in Table 6.2.

Dynamometers are relatively cheap to buy and maintain, and easy to use for the client and tester. One disadvantage is that they may lead to strained muscles if poor technique is used. From a health and safety perspective, individuals who have high blood pressure should avoid these isometric exercises as they increase blood pressure and may lead to medical complications.



▲ A grip dynamometer

Rating	Grip (kg)
Super	65.5–73.0
Excellent	60.0–65.4
Good	55.0–59.9
Average	48.5–54.9
Fair	44.0–48.4
Poor	38.0–43.9
Very poor	29.0–37.9

Table 6.2 Norms for the 16–19-year-old age group

Taking it further

By using another type of dynamometer, you can measure strength in the back. Using your research skills:

- 1 Find a picture of a back dynamometer.
- 2 Make a note of the protocol for measuring strength when using a back dynamometer.
- 3 Describe the health and safety issues you would need to address when using this piece of equipment.
- 4 Explain in your own words which sports need a good level of back strength.

Aerobic endurance

Aerobic endurance is also known as stamina or aerobic fitness. It is defined as the ability of the cardio-respiratory system to supply the exercising muscles with oxygen to maintain aerobic exercise for a long period of time. Another common term related to the concept of aerobic endurance is **Vo₂ maximum**, which is the maximal amount of oxygen uptake that can be used by the client during aerobic exercise, such as long-distance swimming, running or cycling.

Key terms

Aerobic endurance The ability of the cardio-respiratory system to supply the exercising muscles with oxygen to maintain the aerobic exercise for a long period of time.

Vo₂ maximum The highest rate at which oxygen can be taken up and utilised during exercise by a person.

It is important to understand that Vo₂ maximum is not the amount of oxygen inhaled by the client; it is the amount extracted and used by the working muscles. Vo₂ maximum can be measured using the following units:

- l.min⁻¹ (litres per minute)

- ml.kg⁻¹.min⁻¹ (millilitres per kilogram of body mass per minute).

Aerobic endurance is important for most sporting activity because good levels of aerobic fitness will supply the muscles with the oxygen required for exercise. As well as helping to decrease body fat, a good level of aerobic fitness can lead to improved confidence and psychological well-being. There are a number of key fitness tests that you could use to measure a client's aerobic endurance.

Multi-stage fitness test

This test is ideal for testing in sports based on multi-sprint activities, such as football and rugby. The test is progressive in terms of intensity (speed) and is used to predict a client's Vo₂ maximum based on how far the client progresses during the test. The equipment required for the test is minimal, consisting of the multi-stage fitness test tape, audio cassette player, cones and a space in excess of 20 metres. Once the tester is clear about the protocol, the test normally takes around 20 minutes.

Before starting the test the client is advised to do a warm-up, which should include a stretching programme. The client is asked to run between cones placed 20 metres apart and keep in time with the bleeps emitted from the tape. The aim is to reach the cone when the tape bleeps, not before or after. After every minute the bleeps become progressively faster, which has the effect of increasing the speed at which the client must run. The goal is to run for as long as possible while keeping up with the bleeps, until fatigue makes it impossible to keep pace. If the client misses three consecutive bleeps, he or she is asked to stop the test. While the client is running the tester should be monitoring the level and shuttle number the client has reached. The Vo₂ maximum score is converted from the last shuttle number completed.

From a health and safety perspective, the following considerations should be taken into account:

- ensure there is a non-slippery surface
- ensure the room is well ventilated
- check that running footwear is suitable, with adequate grip

Rating	Males (age in years)					Females (age in years)				
	14-16	17-20	21-30	31-40	41-50	14-16	17-20	21-30	31-40	41-50
Excellent	12/7	12/12	12/12	11/7	10/4	10/9	10/11	10/8	10/4	9/9
Good	11/2	11/6	11/7	10/4	9/4	9/1	9/3	9/2	8/7	7/2
Average	8/9	9/2	9/3	6/10	6/9	6/7	6/8	6/6	6/3	5/7
Fair	7/1	7/6	7/8	6/7	5/9	5/1	5/2	5/1	4/6	4/2
Poor	<6/6	<7/3	<7/5	<6/4	<5/2	<4/7	<4/9	<4/9	<4/5	<4/1

Table 6.3 Each score gives the test level and the number of shuttles completed successfully (e.g. 4/6 = level four and six shuttles completed)

- ensure the client has not eaten for two to three hours before the test
- avoid dehydration by ensuring a high fluid intake has been achieved over the previous day.

The test is ideal for testing a large number of people (for example, a class of schoolchildren) and produces results within a matter of minutes. However, there is a possibility of inaccurate measurements if the tester miscounts the finishing level, and the audio tape requires calibration (one minute on the tape should be one minute in reality). Table 6.3 gives indicators for aerobic fitness.

■ Step test

The step test, also known as the Harvard step test, is a sub-maximal test, which means it uses the client's recovery heart rate to estimate the Vo_2 maximum score. As this test is not too physically demanding, it can be used with special populations such as over 55s. The client is asked to step up and down on a bench approximately 41.3 cm high to a specific beat (normally generated by a metronome) for a period of five minutes. Males taking the test should step at 24 steps per minute, and females should step at 22 steps per minute. The heart rate is recorded for a 15-second period, between



Case study: Components of fitness

Tariq, a footballer aged 21, plays for the local team. Compared to the other players he has always had a high level of all the components of fitness. However, over the past six months the coach has not been training flexibility, so Tariq's flexibility has become poor. Lack of flexibility in the hamstrings leads to constant muscle tightness and to strains and tears, which means he has missed a number of key matches.

Sheila, a woman aged 50, has a good level of fitness for all components except strength in her triceps and biceps. This lack of strength influences her ability to perform basic activities such as opening a jar.

- 1 Explain why it is important for a footballer to have good flexibility.** **P1**
- 2 Will missing a number of key games through injury have an effect on Tariq's other components of fitness?** **M1**
- 3 What other daily activities will Sheila struggle with if she lacks strength in the biceps and triceps?** **M1**
- 4 Explain why having good flexibility and aerobic fitness are important for someone of Sheila's age.** **D1**

5 and 20 seconds after finishing the exercise. The 15-second heart rate count should then be multiplied by 4 to calculate the heart beats per minute ($\text{b} \cdot \text{min}^{-1}$). For example, $15 \text{ b} \cdot \text{min}^{-1} \times 4 = 60 \text{ b} \cdot \text{min}^{-1}$. The respective heart rate for males and females should then be put into the following formulae to calculate the Vo_2 maximum:

- Male: Vo_2 maximum ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)
 $= 111.33 - (0.42 \times \text{heart rate})$
- Female: Vo_2 maximum ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)
 $= 65.81 - (0.1847 \times \text{heart rate})$.

It is strongly recommended that this test is not used with elite clients, who require precise results, because the validity of the Vo_2 maximum score is questionable. The test is sub-maximal in nature and predicts the score, so there are possible errors. It has been reported that there may be variability in scores of ± 16 per cent, which is considerable.

Taking it further

There are a number of different protocols for the step test. Carry out some research into the different types and compare and contrast three of them. Within your research, explain the advantages and disadvantages of using the step test.

■ Maximal treadmill protocol

There are a number of treadmill protocols you may use, but here we will look at the Bruce test. For this aerobic endurance test you will need a treadmill where speed and grade of slope can be adjusted, together with a stopwatch and a helper to administer the test. There are some important health and safety points to consider prior to testing.

- The client must not eat or drink for three hours before the procedure. This reduces the likelihood of nausea that may accompany strenuous exercise after a heavy meal.
- Diabetics, particularly those who use insulin, will need special instructions from their doctor before attempting this test.
- The client should wear comfortable clothing and shoes that are suitable for exercise.

The athlete runs on the treadmill until he or she is fully fatigued. At timed stages during the test, the speed and

grade of slope of the treadmill are increased, as in Table 6.4.

Stage	Time (minutes)	Speed (km/hr)	Slope (%)
1	0	2.74	10
2	3	4.02	12
3	6	5.47	14
4	9	6.76	16
5	12	8.05	18
6	15	8.85	20
7	18	9.65	22
8	21	10.46	24
9	24	11.26	26
10	27	12.07	28

Table 6.4 The speed and grade of the treadmill slope are increased during the Bruce test

The assistant starts the stopwatch at the start of the test and stops it when the athlete can no longer carry on. Most tests should be around 12 minutes long. To analyse the performance, the results can be compared with the results of previous testing sessions. You can estimate the Vo_2 maximum using the following formulae:

- Male: Vo_2 maximum ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)
 $= 14.8 - (1.379 \times T) + (0.451 \times T^2) - (0.012 \times T^3)$
- Female: Vo_2 maximum ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)
 $= 4.38 \times T - 3.9$.

where T represents the total time of the test expressed in minutes and fractions of a minute.

Speed

Speed is the ability to cover a set distance quickly, and is explosive in nature. Speed is vital for a number of

Key terms

Speed The ability to move a short distance in the quickest time possible.

activities in sport and exercise, especially sprinting and jumping activities. It is also important for certain positions in team-based sports, such as a winger in rugby.

■ **Sprint tests**

A client can be tested for speed over various distances, depending on the demands of his or her sport. For example, a long jumper may wish to test his or her speed over 15 metres, which is a relevant distance for long-jump technique.

On response to a stimulus such as a whistle, the client should sprint as quickly as possible over the prescribed distance. The time is measured in seconds. It is common practice to give the client a one-metre flying start regardless of the test distance. This is because you want to measure the athlete’s true speed and not their ability to react to a stimulus (e.g. a whistle).

This test requires only a suitable surface, a timing device, cones and a measuring instrument. In the past, the timing device was always a traditional stopwatch, but with that method the tester’s reaction speed influences the result, so it is now common to use electronic timing gates.

Table 6.5 gives the rating system for a 35m sprint test.

Rating	Males (seconds)	Females (seconds)
Excellent	>4.80	>5.30
Good	4.80–5.09	5.30–5.59
Average	5.10–5.29	5.60–5.89
Fair	5.30–5.60	5.90–6.20
Poor	<5.60	<6.20

Table 6.5 Rating system for a 35m sprint test

Power

Power is strongly related to strength in conjunction with the speed of movement. It is the ability to generate and use muscular strength quickly. Clients who are stronger tend to be able to produce a greater amount of power during the action. This can be seen with a boxer who is able to produce a fast punch, which shows good strength as well as power.

Key terms

Power The ability to generate and use muscular strength quickly.

■ **Vertical jump**

The vertical jump is a measure of anaerobic power and is specifically related to the leg muscles. The client reaches up against the wall and makes a clear mark (perhaps with chalk), which signifies his or her standing reach. The client then jumps as high as possible in order to make a second mark on the wall. The result is calculated by subtracting the lowest mark from the highest, and is known as the jump distance, measured in centimetres. It is simple to use and requires little equipment.

The client should make up to three attempts, and the highest jump should be recorded. A break of 30 seconds between jumps is advisable. The following formula is applied to calculate power:

$$\text{power (watts)} = 21.67 \times \text{mass (kg)} \times \text{vertical displacement (m)}^{0.5}$$

Activity

- 1

In groups, test six group members who are each to perform a 20m sprint test. You need three testers who will record the times of each sprinter separately.
- 2

Once you have the results, plot line graphs of the results, with three lines to represent each tester.
- 3

Discuss any differences you may have found between the sprinters’ times and between the testers’ scores.
- 4

Identify ways in which you could improve the consistency of the scores between testers.

You can also compare the results against a table like the one shown in Table 6.6. However, one drawback is that there are a number of techniques used, which makes comparing against the table rather difficult.

Rating	Males (cm)	Females (cm)
Excellent	>65	>55
Good	60	50
Average	55	45
Fair	50	40
Poor	<46	<36

Table 6.6 Normative data for the vertical jump test

■ Wingate test

The Wingate test is used with a stationary exercise bicycle to measure anaerobic capacity. It is conducted in a laboratory and requires the following specialist equipment:

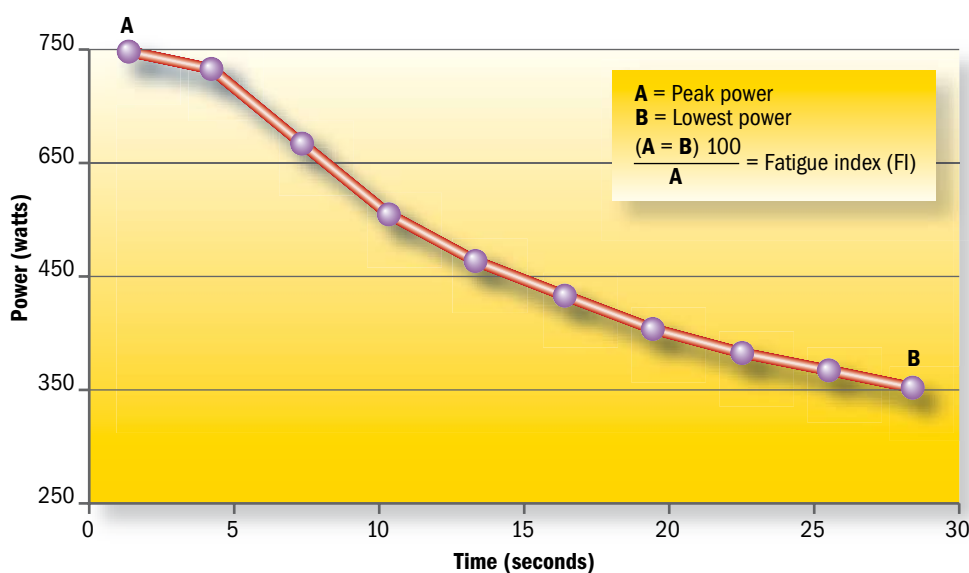
- computer with printer
- Wingate software
- motion sensor (to measure the frequency of the cycle wheel)
- power supply and adaptor
- Monark cycle: a special exercise cycle that can be adapted for this test.

The Wingate test calculates the client's mean power in watts (averaged over a five-second period), therefore measuring anaerobic fitness capacity. It can also measure the peak power (in watts), which is the highest power output during the test (normally after a couple of seconds).

A warm-up on the cycle of three to five minutes is advised so that the heart rate rises above 130 beats per minute, usually with only a small load. The client's mass determines the load applied for the test: 0.075 kg per kilogram of body mass. For example, a 70 kg client would have a resistance or load of 5.25 kg.

After the warm-up, the client pedals as fast as possible without any resistance in order to get a flying start. This normally takes three seconds. On command a helper applies the mass and the computer starts collecting the data. The client cycles as fast as possible for a period of 30 seconds (although this can be changed). The client should then perform a cool-down. The computer will calculate the mean power, peak power and fatigue index. A graph can be produced to show the results. The peak power usually comes after approximately two to three seconds.

The Wingate test is often reported as being the toughest, both physically and psychologically. Some subjects feel dizzy, vomit or even faint after the test, so caution is required to maintain the client's well-being. However, because it is a laboratory-based test, it does produce accurate results, which can be stored and produced in graphical form.



▲ A typical curve showing Wingate test results

Muscular endurance

Unlike strength, which involves the muscle performing one action, **muscular endurance** involves the muscle making a number of continuous movements. Muscular endurance can be defined as a specific muscle or muscle group, such as the biceps, making repeated contractions over a significant period of time (possibly over a number of minutes). There are a number of sporting activities that require good muscular endurance, such as:

- a hockey midfield player would need to make numerous sprints over 10 to 20 metres during the game at high speed
- a boxer would need a high level in their arms when trying to punch their opponent repeatedly
- a rower would need muscular endurance in their arms to make repeated strokes.

Key terms

Muscular endurance A specific muscle or muscle group, such as the biceps, making repeated contractions over a significant period of time (possibly over a number of minutes).

All these activities would be classed as requiring a good level of muscular endurance because they require a number of muscular contractions over a number of minutes. The following tests will help you test for muscular endurance.

■ One-minute press up

The press-up test, also known as the push-up test, is used to assess muscular endurance in the upper body. To improve the validity of the results and avoid injury, it is important that the client uses the correct technique for the test. The hands should be shoulder-width apart and the back straight. The tester should place a fist below the client's chest on the mat or floor. For the press-up to be counted as one repetition, the client's chest should touch the fist on the floor. The client is required to do as many press-ups as possible within one minute, based on the correct technique.

For some individuals who have less upper body strength, the technique can be modified. The client can flex his or her knees to 90° in a kneeling position, with the ankles crossed. However, this method cannot be used to compare against the data in Table 6.7.

The main advantages of this test is quick to run and requires little equipment. However, it is hard to make sure the correct technique is being used, which can make cross-group comparisons difficult.

■ One-minute sit up

The one-minute sit-up test is similar to the press-up test in nature, as it measures local muscular endurance. It is also known as the curl-up or abdominal curl test. It is important that there is a helper for this test to hold the feet in a stationary position. The client is positioned on the mat with the hips flexed and knees flexed to 90°, with the feet flat on the mat. The normative data in Table 6.8 is based on a protocol that requires the client to perform as many as possible until there is total fatigue. A full

Rating	Males (age in years)					Females (age in years)				
	15-19	20-29	30-39	40-49	50-59	15-19	20-29	30-39	40-49	50-59
Excellent	>39	>36	>30	>22	>21	>33	>30	>27	>24	>21
Good	29-38	29-35	22-29	17-21	13-20	25-32	21-29	20-26	15-23	11-20
Average	23-28	22-28	17-21	13-16	10-12	18-24	15-20	13-19	11-14	7-10
Fair	18-22	17-21	12-16	10-12	7-9	12-17	10-14	8-12	5-10	2-6
Poor	<17	<16	<11	<9	<6	<11	<9	<7	<4	<1

Table 6.7 Norms for the press-up test

Rating	Males (age in years)					Females (age in years)				
	18-25	26-35	36-45	46-55	56-65	18-25	26-35	36-45	46-55	56-65
Excellent	60-50	55-46	50-42	50-36	42-32	55-44	54-40	50-34	42-28	38-25
Good	48-45	45-41	40-36	33-29	29-26	41-37	37-33	30-27	25-22	21-18
Above average	42-40	38-36	34-30	28-25	24-21	36-33	32-29	26-24	21-18	17-13
Average	38-36	34-32	29-28	24-22	20-17	32-29	28-25	22-20	17-14	12-10
Fair	34-32	30-29	26-24	21-18	16-13	28-25	24-21	18-16	13-10	9-7
Poor	30-26	28-24	22-18	17-13	12-9	24-20	20-16	14-10	9-6	6-4
Very poor	24-12	21-6	16-4	12-4	8-2	17-4	12-1	6-1	4-0	2-0

Table 6.8 Norms for the sit-up test

movement requires the elbows to touch the knees, and the shoulders must touch the mat after the downward movement. Clients with neck or back pain should not try this test. It should be preceded by a suitable warm-up of neck and leg muscles.

Body composition

Body composition is the amount (normally expressed as a percentage) of body fat and lean body tissue the athlete possesses. Lean body tissue is water, blood, skin, muscle and bone. From a health point of view, it is important to have low levels of body fat. Increased levels of fat can usually happen through injury or during the off-season period and can lead to a decrease in performance. You can see this when footballers return to pre-season training in July and are carrying extra weight, which has to be lost. The increase in body fat can reduce the fitness of the player by making them slower. You can use following tests for body composition.

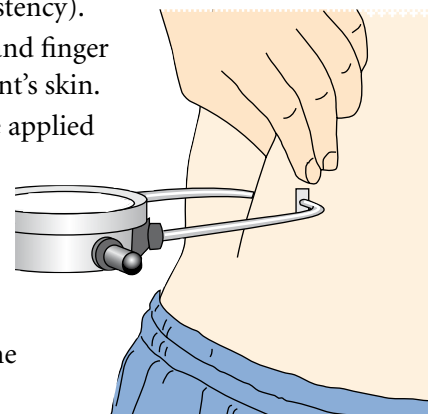
Key terms

Body composition The amount (normally expressed as a percentage) of body fat and lean body tissue the individual possesses.

■ Skinfold callipers

Skinfold measurement requires a trained and competent tester who can make reliable measurements over a period of time. Skinfold measurement is a reliable test because it has a correlation of 0.70 to 0.90 (see page XX). The following procedure is used to complete the test.

- Measurements are taken from the right side of the client (for consistency).
- Use the thumb and finger to pinch the client's skin.
- The callipers are applied 1 cm below and at right angles to the pinch.
- A reading can be taken from the gauge after one or two seconds.
- Two measurements should be taken and the mean used.
- Measurements within one to two millimetres of the previous reading indicate the results are reliable.



▲ **Skinfold callipers measure the amount of subcutaneous fat (fat immediately below the skin) in millimetres**

Numerous sites can be measured: abdomen, triceps, biceps, chest, calf, subscapular, suprailiac

and thigh muscle. Most protocols use three sites, such as:

- male: chest, thigh and abdomen
- female: triceps, suprailiac and thigh.

The measurements for the three sites are added together to produce a total in millimetres, which can be evaluated in terms of a percentage of body fat using conversion tables that take into account the client's age. A body fat percentage of 15–25 per cent is considered optimal for women, and 10–20 per cent for men.

However, there is no distinction between fat and fat-free mass. This method cannot be used with pregnant women or with clients who are very muscular.

■ Bioelectrical impedance analysis

This method requires little in the way of tester skill and experience. The machine passes a harmless electronic current through the client's body and records the impedance (opposition) to the current. The current will flow through tissues with a high water content faster than through tissue with less water, such as fat. A client who has more fat will record a slower speed for the current. The speed at which the current moves is measured and used to determine body composition.

One type of impedance machine requires the client to remove footwear including socks and stand on a plate. It produces a computer printout detailing the parameters of body composition, such as fat-free mass. Research has shown that this method has a good level of accuracy with only ± 4 per cent error.

The following are the requirements for a bioelectrical impedance procedure.

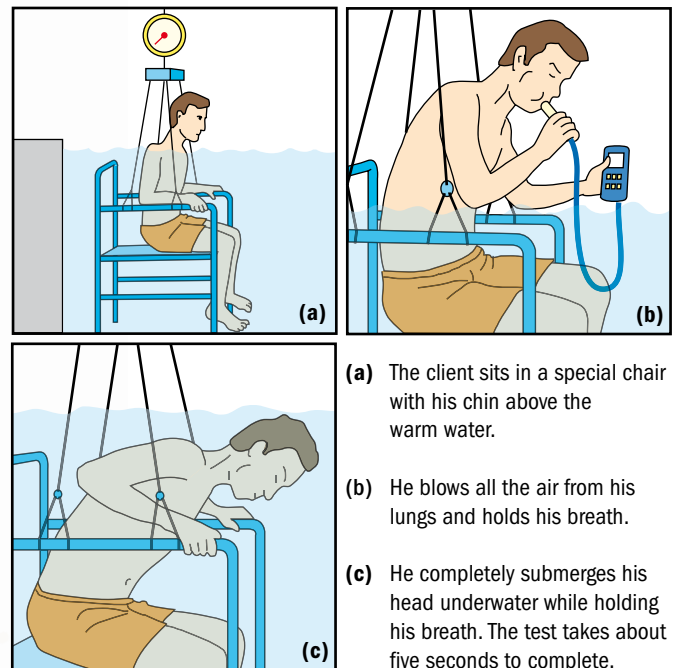
- The client should not drink for three to four hours prior to the test.
- The client should not undertake physical activity of moderate or high intensity for 12 hours prior to the testing session.
- The client should not consume alcohol for two days prior to testing, and should avoid caffeinated drinks such as coffee.

■ Hydrodensitometry

Hydrodensitometry is also known as hydrostatic weighing, or weighing underwater. It is fairly common in the research field and is the method often found in universities and specialist sports science facilities.

Research has proven that this method produces the most accurate results in terms of determining body composition. Other methods such as skinfold measurements can be assessed against it to determine the reliability of their results.

The dry weight of the client is recorded. Then, wearing a swimsuit, the client is lowered into a tank of water, after exhaling the air from the lungs. All parts of the body must be underwater. Fat is less dense than water and acts as a buoyancy force, causing the individual to rise. However, bone and muscle tissue are more dense than water, causing the client to sink. Therefore, a client who has a greater amount of muscle mass and bone will weigh more underwater in relation to his or her dry weight.



▲ Because of cost and space requirements, hydrodensitometry is unlikely to be found in the local fitness centre



Assessment practice

Produce and prepare a presentation which explores a range of fitness tests that you might use with a client. You need to describe one fitness test for each of the following components of fitness:

- flexibility
- strength
- aerobic endurance
- speed
- power
- muscular endurance
- body composition.

Describe and explain the advantages and disadvantages of the tests you use.

P1 M1

Advantages and disadvantages of different tests

Regardless of whether you are using a laboratory- or a field-based test, there are certain advantages and disadvantages of each test. It is important to recognise these because you need to be able to select the test that is right for each client. Poor test selection may lead to results that are invalid or have no meaning to the athlete. Specific advantages and disadvantages for each test are given on pages [fitness tests section above] XX to XX. This section highlights the general issues you need to consider.

Cost

Some of the fitness tests we have looked at require little financial investment to set up. For example, the step test can be run with just using a stop-watch and a step at the bottom of a flight of stairs. On the other hand, some tests such as the Wingate cost a great deal of money because it needs specialist:

- computer software (Wingate package)
- computer hardware (printers, cables, etc.)

- bicycle equipment
- scientific knowledge and support.

Most schools are able to afford only basic equipment and technical knowledge, whereas top universities and sports clubs are usually able to purchase all the equipment they need as they have access to more funding. This funding pays for sports and exercise scientists and specialist lab technicians. However, it is important to note that they may not use all the methods because they can afford the more accurate ones, which are normally laboratory-based.



Think it over

Which of the following tests do you think would be available at your local school and which would be used at a top university? Your decisions should be based not only on cost but also on the practicality and validity of each test. Discuss your views with the rest of your group.

- Step test.
- Bruce test.
- One-minute press-up test.
- Sprint test.
- Hydrodensitometry.
- Sit-and-reach test.
- Multi-stage fitness test.
- Wingate test.

Time

When considering time in relation to selecting a test, there are two key aspects:

- time taken to test the client
- time taken to analyse the results and produce feedback.

For example, you can test up to 20 clients at once using the multi-stage fitness test and get almost immediate results (within 20 minutes). However, it can take more than 20 minutes to test one client during a treadmill protocol, with over an hour for the results to be



▲ A laboratory contains a wide range of scientific equipment, which can measure a client's athletic capability

generated. So if you were testing a full rugby squad in a laboratory, you can see the cost in terms of time.

Equipment requirement

Certain fitness tests require specialist equipment, which will have cost implications. However, all fitness tests require some form of equipment – even the one-minute press-up test needs a stopwatch and an exercise mat.

Facility requirements

In a sports or leisure centre, you will have basic equipment such as a grip dynamometer and height

Activity

In pairs, produce an equipment list that can be stored on a database. Each pair should look at three different fitness tests and add the equipment required to the database. Therefore, when all the pairs have added their information, the group can access the database to find out what equipment is required for each type of test.

charts, etc. On the other hand, a sports science laboratory will have specialist equipment that requires specialist technical knowledge to use it.

Taking it further

One of the pieces of equipment that a sports science laboratory will have is a Douglas Bag system. Through your research, answer the following questions:

- 1 What component of fitness does the Douglas Bag system measure?
- 2 Explain briefly how the Douglas Bag system works.
- 3 Detail a treadmill protocol that could be used with the Douglas Bag system.
- 4 Explain the advantages of using this piece of equipment over a field-based method.

Skill level of person carrying out test

Through your training within the sports centre or within this course, you will be able to perform basic tests such as one-minute press ups or the multi-stage fitness test with your clients. However, when you are working with elite-level athletes, you will need to use specialist equipment and protocols, which require more training. Part of this extra training can come through working with the British Association of Sport and Exercise Sciences (BASES).

In the UK, BASES works in the field of sport and exercise science, and its members include academics and fitness practitioners. Its aims include promoting the relevance of sport and exercise to society. When you working will elite-level athletes, you need to become BASES accredited. This means you have a professional status and the experience to work with the best athletes.

Web links

Visit the BASES website at www.bases.org.uk to find out more about the association and the accreditation process.

■ Issues with test validity

When choosing a fitness test, the tester must consider its **validity**. Only a test that has reliable results and is

valid will provide useful information. When assessing for validity, the tester should try to answer the following question: Does the fitness test or piece of equipment (for example, heart rate monitor) measure what it is supposed to measure?

Key terms

Validity A concept relating to truth or worth in relation to a fitness test.

The component of fitness to be tested should always be matched with an appropriate test.

Activity

The new coach of a local rugby team needs to test the players' fitness levels. He decides to test the players' speed, as this is important for rugby. After some thought, the coach decides to time the athletes in a step test.

- 1 Is the step test a valid test in this context? Explain your views.
- 2 Suggest other aerobic endurance tests the coach could use.
- 3 Discuss the implications of this test for the players, the coach and the possible team selection.

■ Issues with test reliability

A major part of whether a test and its results are valid is its **reliability**.

Key terms

Reliability The consistency of the scores obtained while testing on different occasions.

We can see from Table 6.9 that the results of the second client's tests were highly variable, and we would class these scores as unreliable. Poor reliability means that the test is not valid and does not produce any meaningful or useful information. There may be a number of reasons for poor reliability, such as poor testing technique or a different tester being used. The first client's scores do seem consistent and valid, so the results could be used in relation to a baseline score.

Client 1	Client 2
32	25
32	34
31	36
33	21
32	23
34	29

Table 6.9 Two client's fitness test scores obtained from the vertical jump

When you assess a test's reliability, you should consider the *r* value that is given to the test. For example, the multi-stage fitness test has a value ranging from 0.87 to 0.93. This test looks at the relationship between the score obtained on the test (in levels and shuttles) and the actual Vo₂ maximum score. The closer the score is to 1 the better, because this means there is a perfect correlation, but remember that not all tests have an *r* value. Table 6.10 will help you assess a test's reliability (*r*) value.

Rating	Correlation value
Excellent	0.90–1
Very good	0.70–0.89
Good	0.50–0.69
Moderate	0.30–0.49
Weak	0.10–0.29
None	0–0.09

Table 6.10 Correlation data

6.3 Understand the practice of health screening

Health screening is an important component of any exercise programme, and should be carried out with all individuals who are contemplating starting an exercise or fitness testing programme. It should be taken seriously by testers in the health and fitness industry, because its aim is to ensure the health and well-being of clients.

The aims of the health screening process are to identify individuals who:

- have a medical condition (e.g. angina), which should exclude them from a testing or exercise session

Key terms

Health screening This aims to detect any diseases, illnesses or injuries before starting an exercise programme. It also provides the individual with a number of baseline scores (for example, body fat percentage) so that any changes to health status can be monitored.

- require supervision or assistance while involved in a structured exercise programme
- because of their background and history, should have a medical check with their GP before having a fitness test or starting an exercise programme
- possess other special needs, e.g. Braille testing instructions for the visually impaired.

In this section you will look at all aspects of health screening, such as questionnaires and client consultation. In addition, you will be able to gain practical experience in assessing an individual's health by measuring heart rate, blood pressure and other health-related tests.

Health screening procedures

Health screening must take place before any exercise or testing is performed by the client, and it must be administered by the tester. It usually takes the form of a questionnaire and its aim is to identify any medical condition that may prevent the client from exercising safely. Its aim is to ensure the health and safety of the client.

A high-quality health screening programme should involve a number of health checks, which might include the following components:

- taking the client's past medical history
- taking the client's family's medical history
- recording blood pressure
- measuring lung function
- checking cholesterol levels
- measuring body composition
- using an electrocardiograph (ECG) for monitoring heart conditions (used only in specialist facilities).



Remember!

Health screening aims is to identify any medical condition and takes place before any form of exercise.

Taking it further

Carry out some research into the practice of health screening at your local gym or fitness centre. Try to discover what health tests might be performed on you before starting an exercise programme.

It is important to understand that a number of organisations offer exercise facilities and programmes and are therefore involved in the practice of health screening and fitness testing. These organisations include:

- local authority-owned leisure centres
- health clubs
- fitness facilities
- primary care settings that offer facilities for target groups, such as the elderly.

Health screening questionnaires

The health or fitness instructor/tester should use a questionnaire on health and physical activity. These questionnaires ask specific questions relating to past or current illnesses. The instructor should use the information to select the correct level and types of exercises for the client. The aim of the health screening questionnaire is to identify any conditions that might worsen with exercise. It is important that the completed questionnaires are kept in a secure place for reasons of confidentiality, and that they can be accessed only by authorised people looking to find details about the client's medical history.

Client consultation

The client consultation stage is important for the tester and the client as it builds the relationship between them. The initial consultation may take up to an hour and involves a number of factors, such as:

- taking a record of personal details, e.g. name, contact number, GP's name
- identifying and setting out the client's goals, e.g. assessing and improving aerobic fitness
- lifestyle evaluation

Medical history questionnaire

General information

Surname _____ First name _____ Middle initial _____
Date of birth _____ Sex _____
Home phone _____ Mobile phone _____
Work phone _____ Doctor/GP _____
Address _____
_____ Post code _____

Section A

- 1 When was the last time you had a physical examination?

- 2 If you are allergic to any medications, foods or other substances, please name them.

- 3 If you have been told that you have any chronic or serious illnesses, please list them.

- 4 Give the following information on the last 3 times you have been hospitalised. *Note: Women, do not list normal pregnancies.*

	<i>Hospitalisation 1</i>	<i>Hospitalisation 2</i>	<i>Hospitalisation 3</i>
Type of operation	_____	_____	_____
Month and year	_____	_____	_____
Hospital	_____	_____	_____

Section B

During the past 12 months:

- | | | |
|---|-----|----|
| 1 Has a doctor prescribed any form of medication for you? | Yes | No |
| 2 Has your weight fluctuated by more than a few pounds? | Yes | No |
| If yes, did you attempt to bring about this weight change through diet or exercise? | Yes | No |
| 3 Have you experienced any faintness, light-headedness or blackouts? | Yes | No |
| 4 Have you had any trouble sleeping? | Yes | No |
| 5 Have you experienced any blurred vision? | Yes | No |
| 6 Have you had any severe headaches? | Yes | No |
| 7 Have you experienced chronic morning cough? | Yes | No |
| 8 Have you experienced any temporary change in your speech pattern, such as slurring or loss of speech? | Yes | No |
| 9 Have you felt unusually nervous or anxious for no apparent reason? | Yes | No |
| 10 Have you experienced unusual heartbeats such as skipped beats or palpitations? | Yes | No |
| 11 Have you experienced periods in which your heart felt as though it were racing for no apparent reason? | Yes | No |

Section C

At present:

- | | | | |
|-----------|--|-----|----|
| 1 | Do you experience shortness or loss of breath while walking with others your own age? | Yes | No |
| 2 | Do you experience sudden tingling, numbness, or loss of feeling in your arms, hands, legs, feet or face? | Yes | No |
| 3 | Have you ever noticed that your hands or feet sometimes feel cooler than other parts of your body? | Yes | No |
| 4 | Do you experience swelling of your feet and ankles? | Yes | No |
| 5 | Do you get pains or cramps in your legs? | Yes | No |
| 6 | Do you experience any pain or discomfort in your chest? | Yes | No |
| 7 | Do you experience any pressure or heaviness in your chest? | Yes | No |
| 8 | Have you ever been told that your blood pressure was abnormal? | Yes | No |
| 9 | Have you ever been told that your serum cholesterol or triglyceride level was high? | Yes | No |
| 10 | Do you have diabetes? | Yes | No |

If yes, how is it controlled?

- ☐ Dietary means
 ☐ Insulin injection
 ☐ Oral medication
 ☐ Uncontrolled

- 11**
- How often would you characterise your stress levels as being high?

- ☐ Occasionally
 ☐ Frequently
 ☐ Constantly

- 12**
- Have you ever been told that you have any of the following illnesses?

- ☐ Myocardial infarction
 ☐ Arteriosclerosis
 ☐ Heart disease
 ☐ Coronary thrombosis
☐ Rheumatic heart
 ☐ Heart attack
 ☐ Coronary occlusion
 ☐ Heart failure
☐ Heart murmur
 ☐ Heart block
 ☐ Aneurysm
 ☐ Angina

Section D

Has any member of your immediate family been treated for or suspected to have any of these conditions? Please identify their relationship to you (e.g. father, mother, sister, brother).

Diabetes _____ Stroke _____
 Heart disease _____ High blood pressure _____



◀ It is important that the trainer uses appropriate questions and listens for any possible issues that may warrant further discussion with the client

- health evaluation
- listing any medications taken
- obtaining informed consent for fitness tests and programmes
- health-related fitness tests, e.g. blood pressure and body composition
- setting out your aims as a tester: what you will do, how you will approach the issue, etc.

Activity

Many clients do not enjoy the initial consultation stage for a variety of reasons. This means that some people are deterred from returning to the fitness or leisure centre. In small groups, draw up a list of the possible reasons why people could regard the initial consultation as an unpleasant experience. In your discussions, include possible communication issues between the client and the tester.

■ Questioning

With some clients, it may be necessary to hold a further one-to-one session where you question them further to gather more information. You may need clarification on some of the details obtained from the health screening questionnaire. In addition, the health-based tests (e.g. blood pressure) or fitness tests (e.g. treadmill) might have alerted you to certain issues, such as shortness of breath, that need to be explored with the client. When questioning, ensure it is a quiet environment with no distractions, as some information may be confidential and personal. It is important not to baffle the client with science or technical jargon unless he or she understands these terms. For example, say 'stamina' rather than 'aerobic endurance'.

■ Listening

Although questioning the client is important, the key to a good consultation is to listen to the client. If you are a good listener, which will come from experience, you should be able to identify any issues that are not obvious at first. You will also be able to discuss in more depth any issues that come to light.

■ Non-verbal communication

It is estimated that 93 per cent of all communication is based on non-verbal communication. This type of communication is information we take from others, but it does not involve any words. Non-verbal communication is based on body language and includes things like how we sit and our hand actions when we talk. When having a consultation with a client, it is important that we try to recognise non-verbal communication, as this may bring up some key issues that need to be addressed.

Activity

In small groups, produce a short information booklet that shows some different forms of non-verbal communication and their possible meanings. Include drawings and photos of body language to help the reader's understanding.

■ Client confidentiality

Anyone involved in health screening and fitness testing has a duty of **confidentiality** regarding their clients. They should ensure that personal information such as medical history is stored in a secure place. The details should remain confidential and should not be discussed with other instructors or clients. It is also recommended that, when working in exercise referral schemes, exercise testers have a policy on confidentiality included in their contract of employment.

Key terms

Confidentiality This means that you will not pass on any personal information to anyone else without that person's permission.



Case study: Data Protection Act

Under the Data Protection Act, clients have the right to have inaccurate data corrected, destroyed, blocked or erased. They may seek compensation for any damage or distress caused by you by such inaccuracy. Inaccurate data means information that is incorrect or misleading about any matter of fact. The Act also governs the way in which you may use the personal information given to you, and clients have the right to require you to stop, or not to begin, using their personal information for direct marketing purposes.

- 1 **As a fitness tester, you will hold a great deal of personal information that must be kept safe and confidential. Draw up a list of the types of information you must keep confidential.** **P1**
- 2 **As a fitness tester, explain why you need to abide by the Data Protection Act.** **M1**
- 3 **If clients discover that you have passed on their personal information to a third party, outline the implications for yourself and the fitness centre that employs you.** **D1**

Informed consent

The client must complete an informed consent form before testing begins. The form should explain the purpose and nature of the physical fitness tests the client is about to undertake. It should also detail any potential risks that may be present, and explain the benefits of the tests to the client. If you are testing anyone under the age of 18, the consent form must be signed by a parent or carer before testing.

A number of designs for informed consent forms are available. Here is an example.

Consent form

Informed consent for physical fitness test

In order to more safely carry on an exercise programme, I hereby consent, voluntarily, to exercise tests. I shall perform a graded exercise test by riding a cycle ergometer or walking/running on a treadmill. Exercise will begin at a low level and be advanced in stages. The test may be stopped at any time because of signs of fatigue. I understand that I may stop the test at any time because of my feelings of fatigue or discomfort or for any other personal reason.

I understand that the risks of this testing procedure may include disorders of heart beats, abnormal blood pressure response, and, very rarely, a heart attack. I further understand that selection and supervision of my test is a matter of personal judgement.

I also understand that skinfold measurements will be taken at a number of sites to determine percentage body fat and that I will complete a sit-and-reach test and a one-minute sit-up test to evaluate factors related to lower back function.

I desire such testing so that better advice regarding my proposed exercise programme may be given to me, but I understand that the testing does not entirely eliminate risk in the proposed exercise programme.

I understand that information from my tests may be used for reports and research publications. I understand that my identity will not be revealed.

I understand that I can withdraw my consent or discontinue participation in any aspect of the fitness testing or programme at any time without penalty or prejudice towards me.

I have read the statements above and have had all of my questions answered to my satisfaction.

Signed _____

Witness _____

Date _____

(Copy for participant and for programme records)



Case study: Coronary heart disease

Coronary heart disease (CHD) is a preventable disease that kills more than 110,000 people in England every year. More than 1.4 million people suffer from angina and 275,000 people have a heart attack annually. CHD is the biggest killer in the country. The government is committed to reducing the death rate from coronary heart disease and stroke and related diseases in people under 75 by at least 40 per cent (to 83.8 deaths per 100,000 population) by 2010.

- 1 **If someone has a heart attack, what are the possible lifestyle implications for that person and their family?** **P1**
- 2 **How can people reduce their chances of getting a CHD?** **M1**
- 3 **What are the costs for the National Health Service in treating CHD?** **D1**
- 4 **What initiatives can the government bring in to meet its 2010 target?** **D1**



Remember!

The aim of the form is to explain the purpose and nature of the physical fitness tests that the client is about to undertake.

Coronary heart disease risk factors

Coronary heart disease (CHD) can be classified into two types: angina and heart attacks (myocardial infarction). Both occur because the arteries carrying blood to the heart become blocked or narrowed, usually by a deposit of fatty substances. Angina is a severe pain in the chest brought on by exertion such as exercise and relieved by rest and medication. A heart attack is due to obstruction of a coronary artery either as a result of fatty substances or a blood clot. There are a variety of causes of CHD:

- cigarette smoking
- increased blood pressure over a long period of time

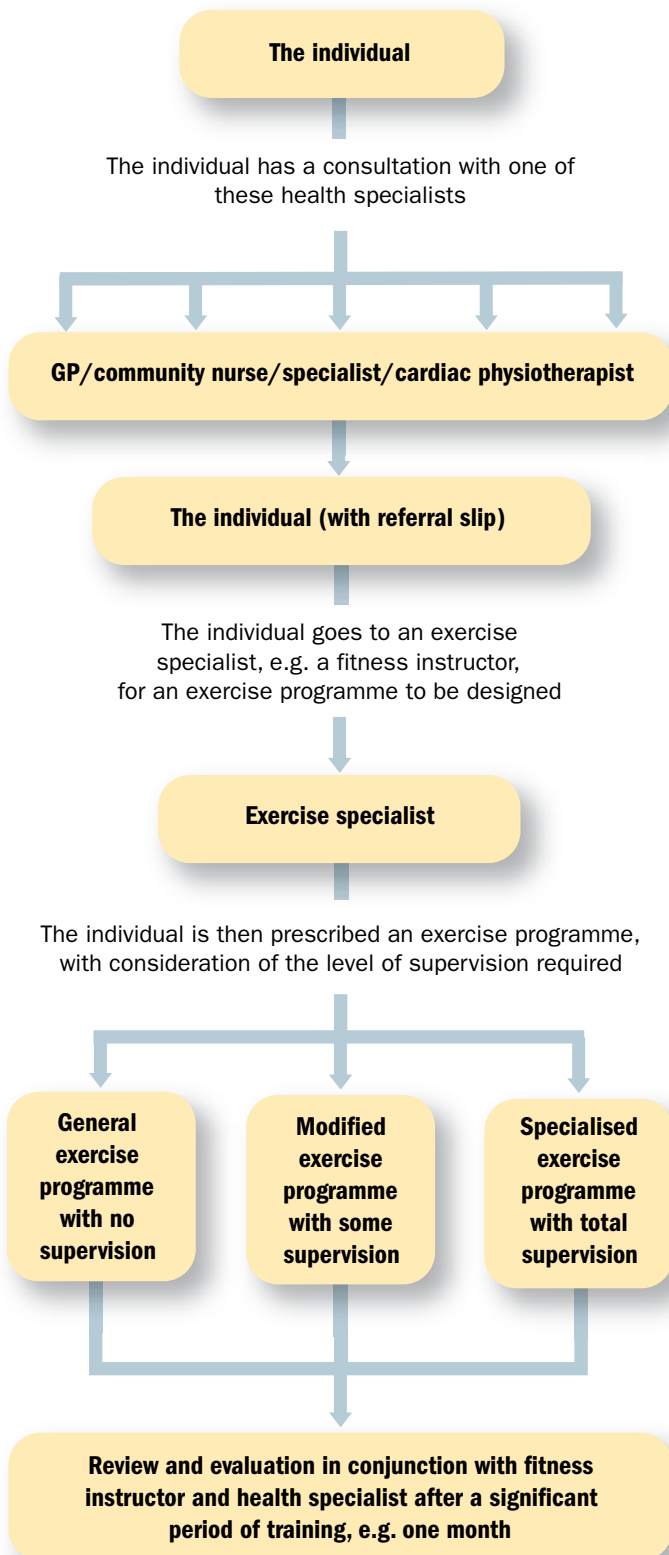
- high cholesterol levels
- a diet high in saturated fats
- lack of exercise
- increased weight over a long period of time
- high levels of stress
- lack of sleep over a long period of time.

Medical referral

Since the early 1990s, many areas of the UK have introduced medical referral schemes, also known as exercise-on-prescription schemes, with the aim of promoting a healthier lifestyle for individuals with certain medical conditions. The medical referral scheme works through a partnership of medical testers – GPs, practice nurses and other healthcare professionals – with local authority leisure centres. There are a number of specific conditions that may benefit from regular exercise, including:

- hypertension (raised blood pressure)
- obesity
- depression.

The process involved is shown in the following flowchart.



▲ The referral process

An individual can be given a recommended exercise programme on the initiative of a variety of health specialists, for example the GP. The individual is then directed to a facility or professional who can design a specific fitness programme based on the individual's background. If the health specialist deems the individual low risk, the programmes reflect this, with a reduction in the supervision required. A high-risk individual requires more supervision while working on the specific programme.

High-risk clients may have angina, established CHD or high blood pressure, for example. As shown in the flowchart, the referral may come from a cardiac physiotherapist or specialist at the local hospital. For low-risk referrals, it is the GP's role to ensure the patient is medically fit to start the exercise programme, but in high-risk cases the specialist (e.g. the cardiologist) takes clinical responsibility.



Assessment practice

- 1 Design a short health screening questionnaire that you could use with one of your fellow students and a member of your family. The questionnaire should have around ten questions and should focus on items such as diet, smoking, exercise, etc. **P2 P3**
- 2 After your classmate and family member have completed the questionnaire, describe each participant's strengths (e.g. non-smoker) and areas for improvement (e.g. too many fatty foods). Do this by providing them each with verbal feedback. **P3 M2**
- 3 As part of your verbal feedback, evaluate the health screening questionnaire. To aid your evaluation, support your findings with appropriate literature. For example, explore the possible health implications of smoking and eating too many fatty foods. You also need to offer lifestyle recommendations, such as changes to their daily diet. To record the verbal feedback, record the consultation on tape or ask your tutor to write you a witness statement. **D1**

Health monitoring tests

As the fitness tester within the health screening process and during the initial consultation, you will need to perform health monitoring tests. These tests include assessing heart rate, blood pressure, lung function and body composition. They are vital as they may help you to highlight a possible health issue with a client. However, it is not your job to diagnose a health condition. Your role is to send a client to a GP for an exercise referral if you have any concerns.



Remember!

If any doubts are raised during health screening over a client's suitability for exercise, ask them to visit their GP immediately prior to any exercise.

Heart rate

To test heart rate, you may take a number of measurements with the aim of identifying any possible health issues. It is likely that you will have access to a heart rate monitor, which can produce more reliable results than counting the pulse under normal conditions.

It is important that you place a small amount of water on the electrodes (inside the band) before fitting and place it below the sternum (breast bone). As part of the screening, you need to monitor both resting and exercising heart rate.

Heart rate varies depending on the client's age

Resting heart rate should be between 60 and 80 beats per minute, although it may be higher due to anxiety. In terms of exercising heart rate, you need to consider the intensity of exercise being performed and the age of the client. The following graph should be used to assess heart rate.

Activity

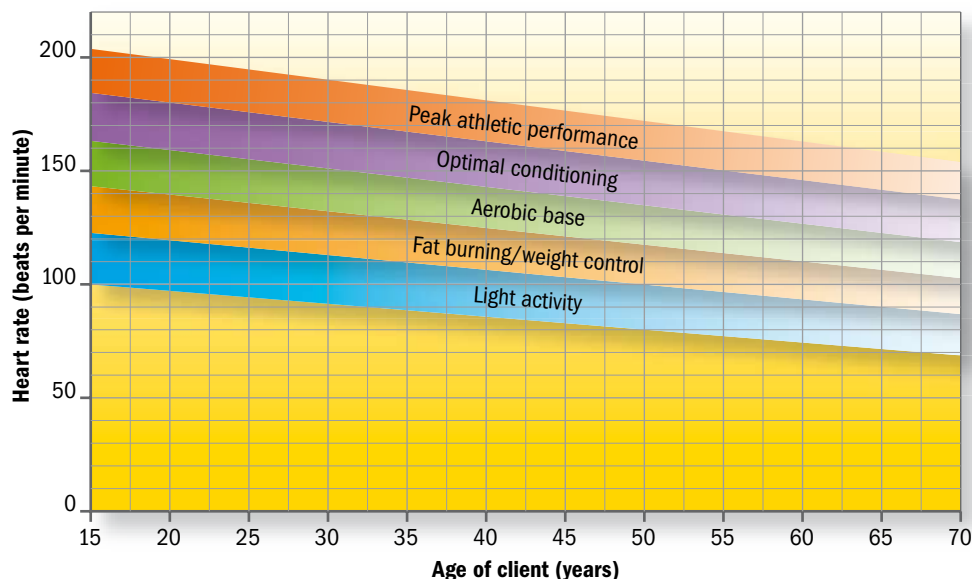
Briefly describe any factors that might raise heart rate but which are not exercise-related.

Blood pressure

Measuring blood pressure is an important part of any test and it should be done with all individuals. Hypertension (high blood pressure) is a widespread health problem. It affects 20 per cent of the world's adult population according to the World Health Organization. If blood pressure remains high over a long period, there is an increased risk of heart attacks, strokes and kidney failure.

There is an increase in blood pressure as we age. A number of factors cause hypertension, including:

- excessive amounts of body fat
- low levels of physical activity



- excessive intakes of salt
- excessive consumption of alcohol.

Blood pressure is normally measured using a mercury or digital sphygmomanometer. This measures **systolic** and **diastolic** blood pressure. The average adult reading for blood pressure is 120 (systolic) over 80 (diastolic). Blood pressure is measured in millimetres of mercury, which is written down as mmHg. Everyone has a different blood pressure and it can change in the same person during the day and night. The lowest blood pressures occur when you are asleep or if you relax all your muscles. Standing up, exercising or anxiety all cause an increase in blood pressure. In a single day, your blood pressure may vary by 30–40 mmHg systolic, with similar proportionate changes in diastolic pressure. This is why it is important to measure blood pressure under the same conditions every time.

Key terms

Systolic The pressure in the arteries when the heart contracts and forces blood through them.

Diastolic The pressure in the arteries when the heart relaxes.

The following table shows what different readings indicate.



Case study: Blood pressure

Martin, the local butcher aged 40, has been referred to your fitness centre in order to start a training programme. He was told by his local GP that his blood pressure was 165 over 100, and that he should start to exercise.

- 1 Comment on the blood pressure reading given to Martin, in terms of the possible health risks.**

P1

A number of sources of inaccuracies can influence the reading given. Poor technique by an inexperienced tester can invalidate the reading. The presence of a doctor, nurse or tester can cause an increase in blood pressure because the client feels anxious, so an incorrect diagnosis of hypertension can be made. The protocol for measuring blood pressure is as follows.

- The client should be in a resting state, normally seated, for five minutes before measurement.
- The client should avoid intake of nicotine and caffeine for 30 minutes before measurement.
- The arm should be relaxed and at heart level.
- Place the rubber cuff around the upper arm so it covers the brachial artery (see the diagram below).
- Inflate the cuff, using the pump, above 170 mm HG – this stops the blood flow.
- Place a stethoscope over the brachial artery – there should be no sound because there is no blood flow.
- Release the pressure slowly by using the valve. At the systolic pressure the blood comes through the artery and a tapping sound is heard.
- Continue to reduce the pressure. When the sounds disappear this represents the diastolic blood pressure.
- Measure blood pressure twice within a three-minute period and record a mean average reading.

Taking it further

Carry out some research to investigate ‘white coat syndrome’ and explain why you would need to consider its effects when measuring blood pressure.

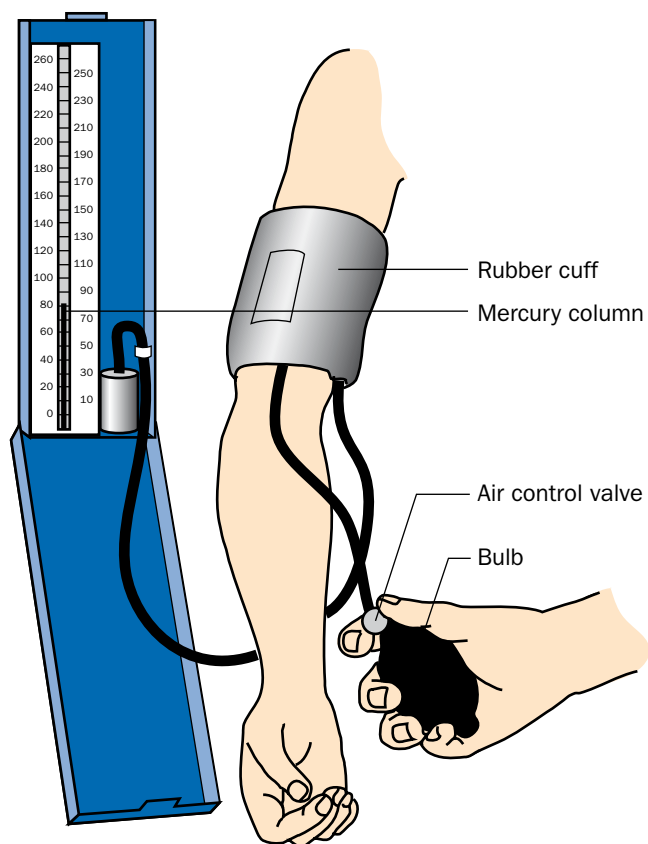
- 2 Which components of health-related fitness should you train, with the aim of reducing blood pressure? Explain why.**
- 3 Are there any forms of exercise that Martin should not do for health reasons?**

M1

D1

If you are using a digital blood pressure machine, follow these guidelines.

- The client should be in a resting state, normally seated, for five minutes before measurement.
- The client should avoid intake of nicotine and caffeine for 30 minutes before measurement.
- The arm should be relaxed and at heart level.
- Place the rubber cuff around the upper arm so it covers the brachial artery (see the diagram below).
- Inflate the cuff, using the pump, above 170 mm HG – this stops the blood flow.
- When you hear a double beep, stop inflating.
- The pressure will gradually decrease, as will the monitor value.
- The final value will be displayed on the monitor with a signal beep.



▲ Preparing to measure blood pressure with a sphygmomanometer

Lung function

The tester should assess the client's lung function during the health screening process. Assessing lung function may identify conditions such as:

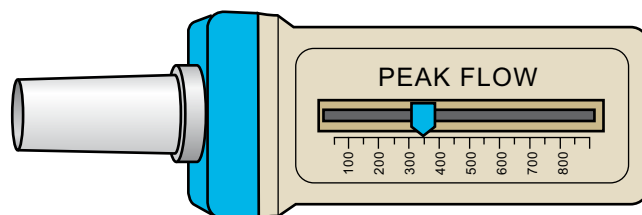
- asthma: lung disease that reduces the amount of air inhaled
- dyspnea: shortness of breath or laboured breathing, possibly due to various types of lung or heart diseases.

The normal measurement used when assessing lung function is known as peak flow. This is a measurement of how much a person can exhale. Peak flow is measured by using a simple device known as a peak flow meter.

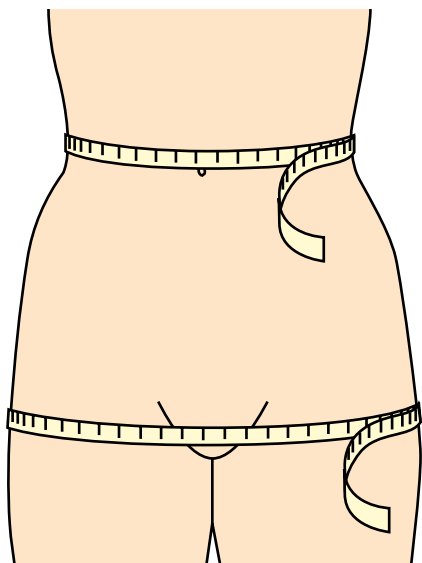
As with other tests, it is important that you use the correct procedures for measuring peak flow.

- Ensure the meter is set to zero or base level.
- Ask the client to stand, unless disabled.
- Ask the client to take a deep breath.
- Place the meter in the client's mouth, ensuring the lips are placed around the mouthpiece.
- Instruct the client to blow out as hard as possible, which normally takes one to two seconds.
- Repeat this process so you have three readings. Take the highest value.
- Make sure you record the score on the evaluation sheet for the client.

Peak flow depends on age, height and sex. For example, a young boy who is 4 feet 10 inches tall should have a peak flow of approximately 350 litres per minute. A 50-year-old man of 5 feet 9 inches should have a peak flow of approximately 600 litres per minute. It is also important that you evaluate peak flow readings based on the client's previous scores, looking for any deterioration that might indicate a problem.



▲ Peak flow meter used to measure lung function



▲ Measure the waist at the narrowest point and the hips at the widest point

Waist to hip ratio

Waist to hip ratio is a measure of the body's fat distribution. The ratio is used to predict the possible health risks associated with obesity. An increased amount of fat around the abdominal area is associated with an increased risk of conditions such as hypertension and type 2 diabetes. The following equation is used to calculate the ratio:

$$\frac{\text{waist circumference}}{\text{hips circumference}}$$

The measurements should be taken at the narrowest part of the waist and the widest part of the hips.

For men, a ratio above 0.85 to 0.90 would be deemed unsafe; for women a ratio above 0.75 to 0.80 is a cause for concern.

Body mass index

Another method of evaluating body composition is to use the body mass index (BMI) method, which evaluates weight in relation to height using the following equation:

$$\frac{\text{body weight in kilograms}}{\text{height in metres squared (m}^2\text{)}}$$

This method assesses the appropriateness of an individual's weight in comparison to height. For example, if a client's height is 1.70m and weight is 70 kg, then:

$$1.70 \times 1.70 = 2.89$$

$$\frac{70}{2.89} = 24.22 \text{ BMI}$$

This can be evaluated using Table 6.11.

Classification	BMI score
Underweight	<20
Normal weight	20-24.9
Overweight	25-29.9
Very overweight	30-40
Seriously overweight	>40

Table 6.11 BMI classification table



Case study: BMI

The Health Services Authority's community dietitian, Bethany Smith, along with many other health experts, dietitians and nutritionalists, recently advised using the BMI to help determine someone's appropriate weight.

'A person's weight is considered healthy if their BMI is between 18.5 and 24.9,' she said in a recent article. However, recent research from the USA suggests that this popular way of assessing health and body fat may be flawed and a more accurate gauge should be developed, according to doctors. Writing in the Lancet medical journal, the researchers from the Mayo Clinic College of Medicine, Rochester, Minnesota, found that patients with a low BMI had a higher risk of death from heart disease than those with normal BMI. Overweight patients had better survival rates and fewer heart problems than those with a normal BMI.

This apparently perverse result, drawn from data from 40 studies covering 250,000 people with heart disease, did not suggest that obesity was not a health

threat but rather that the 100-year-old BMI test was too blunt an instrument to be trusted.

'Rather than proving that obesity is harmless, our data suggests that alternative methods might be needed to better characterise individuals who truly have excess body fat compared with those in whom BMI is raised because of preserved muscle mass,' said lead researcher Francisco Lopez-Jiminez.

- 1 **What do you think about the range given above for a 'healthy' BMI?** **P1**
- 2 **Explain the main weakness of using BMI as a method for measuring body composition.** **M1**
- 3 **What are the possible implications for you as a fitness tester when using the BMI?** **M1**
- 4 **What do you think of the validity of the findings based on the data sample size (number of people studied)?** **D1**



Assessment practice

- 1 Measure two members of your group's resting heart rate, blood pressure, peak flow and BMI. Then ask them to complete a health-screening questionnaire. In this way, the group members are acting as your clients. **P4**
- 2 Record your results on a table because you will need to report your findings back to your clients. The feedback should be in the form of a two-page typed summary document. In the document, you should describe the strengths and areas for improvement of the clients in relation to accepted health ranges. **M2**
- 3 Evaluate the health screening tests you have carried out. To aid your evaluation, support your findings with appropriate literature. For example, explore the possible health implications for someone with high blood pressure. You also need to offer lifestyle recommendations, such as increasing certain types of exercise. **D1**

6.3 Be able to prepare for and conduct appropriate fitness tests

In this section, you will be expected to carry out fitness tests with your clients to gain practical experience and awareness. There are a number of activities within this section that you could use with your fellow students to improve your practical skills. It will be important to use the correct protocol (method) and equipment while maintaining a high level of health and safety so that you provide a professional service to the client.

Fitness tests

See pages XX–XX for details on the correct procedures to use for the following fitness tests.

Multi-stage fitness test

In groups, test each other using the multi-stage fitness test and record your results in a table. During the following week and at the same time of day to avoid biological fluctuations, test for aerobic fitness using the step test, and again record your results.

- 1 Calculate the differences between the two sets of raw data from the different protocols.
- 2 Compare and contrast any differences and offer any possible reasons.
- 3 Based on the reliability and validity of results, decide which protocol would be most suitable for use with an elite-level athlete. Explain your opinions.

Step test

There are a number of protocols for the step test. In groups, perform two tests using two different protocols to increase your understanding of the influence on results. Once you have your results, draw a scattergraph to look at the correlation between the two sets of data.

Maximal treadmill protocol

One of the main factors that can explain an athlete's fitness level is age. As a general rule, as we become older we tend to lose some of our aerobic endurance.



Theory into practice

In groups, draw up a list of the possible reasons for a decrease in aerobic endurance as people age. Discuss the key points.

Activity

Carry out the Bruce test with the following people and compare the results:

- a fellow group member aged 16–18
- a 30-year-old (possibly a teacher in your school or college)
- a 50–60-year-old from your family or local community.

1RM

Depending on the sport you play, you may require strength in different parts of your body. For example, shot putters need strength in their upper body whereas sprinters need it in their lower body.

Activity

In small groups, test for a group member's upper and lower body strength and then convert the data into a percentage of the person's body mass. Once you have your results, test your results using Microsoft® Excel test to test for a correlation. Remember that your value should be between –1 and 1 (see page XX for more details about correlations).

Grip dynamometer

In some sports such as tennis and cricket, you need grip strength in both your dominant and non-dominant hand.

Activity

In small groups, test for any differences between your dominant and non-dominant hand and look for any significant individual differences. Then draw a correlation graph using appropriate software if available.

Vertical jump

Due to the similarity of muscle groups used, there should be some correlation between vertical and horizontal jump performance.

Taking it further

Research the protocol for the standing broad jump (horizontal jump) including a normative data table. Then test members of your group for both vertical and horizontal performance. Using your raw data, run a Pearson's correlation test (see page XX) through Microsoft® Excel to assess the correlation. Once you have your r value, write a brief report on your findings and suggest possible reasons for your results.

Wingate test

If you have the equipment within your school or college, you will be able to administer this test. However, if you do not you can work through the following activity, which will aid your understanding of the test.

Activity

Using the graph on page XX, answer the following questions.

- 1 At what point has fatigue set in for the athlete?
- 2 What is the peak force (in watts) recorded by the athlete?
- 3 Write a brief summary of the profile by explaining the results.
- 4 Why is it important to have a rolling start on the Wingate test?

Sprint tests

Test members of your group for their speed over the following distances: 15m, 25m and 40m. Once you have collected your results, rank them in order for each of the three distances. Try to answer the following questions:

- 1 Are there any differences in the order of group members for the different times? If, so why do you think this is?
- 2 How reliable do you think the timings are, and how could the timing be improved in terms of reliability?
- 3 Which sporting activities require a high level of speed?

One-minute press up and one-minute sit up

Muscular endurance is the capacity of a specific muscle or muscle group to make repeated contractions over a period of time. The two main tests for muscular endurance are the one-minute press-up and the one-minute sit-up tests. Muscular endurance is very specific to a particular muscle group. To demonstrate this, test your group using the press up and sit up test and look for any similarities and differences on an individual basis.

Skinfold callipers

To due the technical nature of this test, make sure you understand the correct protocol (see page XX). Remember most protocols use three sites, such as:

- male: chest, thigh and abdomen
- female: triceps, suprailiac and thigh.

As this test requires practice to perfect your technique, use your fellow students as clients.

When using skinfold callipers, make sure you a private room to maintain the dignity of the client.

Bioelectrical impedance analysis

Look at the reading shown below, which was taken using a bioelectrical impedance machine, and answer the following questions.

Bioelectrical impedance readout

Name	Joe
Age	30
Height	1.70m
Weight	87 kg
Fat	34%

- 1 Consider the percentage body fat and the age of the client. Is the percentage too high for an individual of this age and gender?
- 2 Using the height and weight chart on page XX, comment on the client's weight.
- 3 Identify possible health issues that may arise from an excessive amount of body fat.

Hydrodensitometry

It is unlikely that your school or college will have the facilities to measure you using hydrodensitometry, but if you continue your studies you should have the opportunity at university.

Web links

Use the following website to identify the strengths and weaknesses of hydrodensitometry as a technique for

measuring fitness: www.topendsports.com/testing/tests/underwater.htm.

Preparation for tests

When you are prepare for a test there are a number of key jobs you must do before the testing starts. You can use the following checklist to help you.

Preparation for tests checklist

- ☐ Complete a risk assessment.
- ☐ Ask the client to complete a consent form.
- ☐ Ensure the client has completed a pre-testing health questionnaire.
- ☐ Check the equipment works.
- ☐ Familiarise yourself with the protocol.
- ☐ Make sure you are comfortable with any calculations you will need to do.
- ☐ Produce a raw data recording sheet.
- ☐ Book the facility, e.g. sports hall.
- ☐ Inform the client of any appropriate clothing to be worn.
- ☐ Ensure the client has observed pre-test routines, e.g. no eating and drinking before.
- ☐ Make sure you have an assistant if required, who is comfortable with the testing procedure and their role.

Selection of tests

A number of tests are available for you to use, so it is important that you select the appropriate test for your client.



Remember!

Each client will have different requirements.

When choosing a test, consider the medical and lifestyle history of the client. For example, a patient who suffers from angina should not be given a maximal test for

aerobic endurance as this may cause severe injury or illness. It would be advisable to select a low-intensity exercise test for this type of client, such as the step test. You also need to consider the main sport of your client. For example, if the local rugby team wants you to test a player for aerobic endurance, this should be a test based on running and not swimming.

■ Reliability

For more information on reliability and validity, see pages XX–XX. In addition, have a look through the different tests at the start of the unit on pages XX–XX as this contains important information on reliability and validity.

■ Validity and practicality of tests

When you are choosing a test to use with a client, it is important to consider the practicality of the tests. Consider:

- the time available to you and the client
- the equipment and facilities you have access to
- the understanding and experience you have
- the level of the athlete, e.g. it is not practical to use the step test with an elite-level athlete
- the speed at which the results are needed.

■ Pre-test procedures

Use the following points as a pre-test procedure checklist.

Pre-test procedures checklist

- ☐ Ensure that all tests are suitable for the client.
- ☐ Check that all the resources needed for the test are available.
- ☐ Check whether the cost of the equipment is within your budget.
- ☐ Use a health and safety checklist to ensure client safety at all times.
- ☐ Put tests in the correct sequence to avoid fatigue and false results.
- ☐ Check the relevance of tests – are they appropriate for the sport in question?
- ☐ Ensure a risk assessment, health screening questionnaire and informed consent form have been completed.

Purpose

Fitness testing has become more popular with the widespread recognition of the importance of fitness to physical performance and health. Fitness testing is used to measure and evaluate a component of fitness for a variety of reasons.

■ Identify components of fitness which need to be improved

Fitness tests are used for identifying the strengths and areas for improvement of a performer. For example, a speed test may find that a goalkeeper has poor speed, which influences his or her ability to clear a through ball.

Tests are also used as part of the health screening process. They identify issues that require further discussion with the sports practitioner or medical staff.

■ Give a benchmark from which to measure improvement

Fitness tests provide information on the level of the client's fitness before a training programme. These are known as **benchmark scores**. Retesting the client after a significant number of training weeks makes it possible to evaluate whether the programme has been a success.

Key terms

Benchmark scores Give a current fitness status (baseline score) prior to starting a training programme.

■ Allow a more specific programme to be written

Using fitness tests allows for a specific programme to be devised, according to the needs of the client. In the case of rehabilitation after injury or illness, for example, the fitness test informs the client about his or her recovery. Before injury, a runner could run one mile in five minutes. After months of rehabilitation, the runner records a time of 5 minutes 20 seconds. The test has highlighted the fact that the runner is still not at the level

of fitness achieved before the injury and requires further aerobic training.

■ Play a role in educating individuals about health and fitness

When testing a group of individuals such as schoolchildren, it may be possible to identify talent in relation to a specific sport. If a child performs well in a test of upper body strength, he or she may be suited to the shot put, for example.

Conduct

When conducting fitness tests with your client, it is important to implement a number of key factors such as test sequence and health and safety.

Test sequence

When you administer a number of tests, it is important that you test in the correct sequence with adequate rest periods in between. If you do not test in a logical order, the results are likely to be invalid. For example, if you test for aerobic endurance, which is physically demanding, this will lead to an increase in heart rate. If you then test for resting heart rate, your results will be distorted. Follow these guidelines for test sequence.

- 1 Resting blood pressure and heart rate.
- 2 Body composition.
- 3 Aerobic endurance.



Case study: Test sequence

Paulo, 17, is a new employee at the Sunshine Gym. He has recently performed his first set of fitness tests on a client, John. He performed the tests in the following order:

- 1 Flexibility.
- 2 Aerobic endurance.
- 3 Resting blood pressure and heart rate.
- 4 Strength/muscular endurance.
- 5 Body composition.

- 4 Strength/muscular endurance.
- 5 Flexibility.

Test protocols

Each fitness test has a specific protocol. A **test protocol** is a list of rules that sets out the correct way of using the test. If the tester does not follow the correct protocol, the results will not be valid and will not show a true picture of the client's fitness.

Key terms

Test protocol A list of rules that sets out the correct way of using the test.

The protocol for each test should state the following:

- the equipment to be used, e.g. treadmill
- the duration of the test, e.g. three minutes
- the correct technique for the test
- the type of facilities required, e.g. a gym
- who the test is suitable for, e.g. schoolchildren
- the sequence of activities, e.g. run for three minutes and then take the pulse rate for 15 seconds
- the data required, e.g. pulse rate or distance covered in metres

- 1 **Why did John suffer a pulled abdominal muscle while performing the flexibility test?** **P1**
- 2 **Why were his resting blood pressure and heart rate readings higher than his normal values?** **M1**
- 3 **Why did John feel uncomfortable and self-conscious about having his skinfold measurements taken after an aerobic fitness test?** **M1**

- how to calculate the results: some fitness tests require a specific formula to be used.



Remember!

As all fitness tests have different protocols, they require different equipment to be used. This equipment can range from a simple tape measure to a complex machine that measures body composition.

Health and safety

As a tester, you have three main duties regarding the equipment.

- Ensure on a regular basis that the equipment works as described by the manufacturer and that it is

calibrated correctly (one kilogram on the scales should really be one kilogram).

- Through practice and guidance, you should be capable of using the equipment in a professional manner, for example taking blood pressure readings requires a level of experience and expertise. If you do not possess this level of expertise, your results are likely to be invalid and unreliable, giving the client the impression that you are unprofessional.
- Maintain the health and safety of the client. As a tester, you should have a good understanding and awareness of health and safety when testing a client. Maintaining good practice is paramount to ensure the health and safety of yourself, the client and others.

It is important to consider health and safety issues before, during and after the testing session. Throughout this unit we have identified a number of factors that must be considered in relation to health and safety. To remove these factors prior to testing, it is advisable to carry out a risk assessment similar to the one below.

Risk assessment

Name

Date
Signature

Hazard	Those involved	Outcome	Severity (1–5)	Probability (1–5)	Ways to reduce risk
Slipping on floor while running during the multi-stage fitness test	Athlete	Possible bruising, broken bones	2	2–3	Check floor surface before testing sessions



▲ Clients can stop the test at any point during the test, as their welfare is your top priority as the tester

Reasons to terminate fitness test

You may decide to stop testing due to the following reasons:

- equipment failure
- a radical change in environment, e.g. the weather (if you are testing outside)
- the athlete seems to be in distress, e.g. feeling faint or becoming uncoordinated
- the tester has to leave the testing environment for any reason.

Recording test results

When recording results, it is important to store them in an appropriate place for future reference. You will need to access them in the future to look for changes in fitness levels. The results can be stored using the following formats:

- spreadsheets
- databases
- tables
- graphs
- charts
- log books
- training diaries.

Always keep your raw data results in case you need to recheck anything later.



Assessment practice

- 1 Carry out six fitness tests on a member of your group and write a report covering the following points.
 - a Decide on the components of fitness that are important for your client. These may come from the sport they play.
 - b Identify the fitness tests you are going to use with your client.
 - c Complete a risk assessment and health screening questionnaire for the tests prior to testing.
 - d Ask the client to read and sign an informed consent form.
 - e Administer the fitness tests, making safety a priority. Record the results on a raw data sheet.
- 2 Justify why you have used the six fitness tests with your client. Add notes to your report on the following topics:
 - a suitability
 - b reliability
 - c validity
 - d practicality.

P5

M3

6.4 Be able to analyse the results of fitness tests

In this section you will consider the important aspects of results analysis and feedback. As a tester, it is important to evaluate fitness tests because you need to provide valid feedback that identifies strengths and areas for improvement. Based on this feedback, you need to provide recommendations for future training to improve fitness. You will explore how to give feedback to a client, including assessment of normative data, as well as offering recommendations for future activities or training.

Normative data

You can use normative data tables to analyse your fitness testing results. Researchers who have studied hundreds of people to generate normal values produce these normative data tables. When using normative data tables, there are some important factors to consider:

- they can be gender-based
- most are based on specific age ranges

- some specify the level of performance, e.g. county standard
- they can have different values based on the source of information
- some tests do not have normative data tables.

Population norms

Normative data tables are based on different populations (e.g. gender, age, sporting background). Make sure you use the correct normative data table in relation to your client.

Norms for sports performers

Although it may be difficult to locate, you should be able to compare some of your results to data generated by sports performers. This is useful because you can compare a client's results with data from sports they play.

Norms for elite athletes

Unlike other clients elite-level clients or athletes will be tested for their fitness on a regular basis to maximise their training and performance potential.

The testing procedure is designed to:

- assess fitness levels against previous levels
- monitor progress towards a major competition
- assess fitness after or during injury/illness
- identify strengths and areas for improvement.

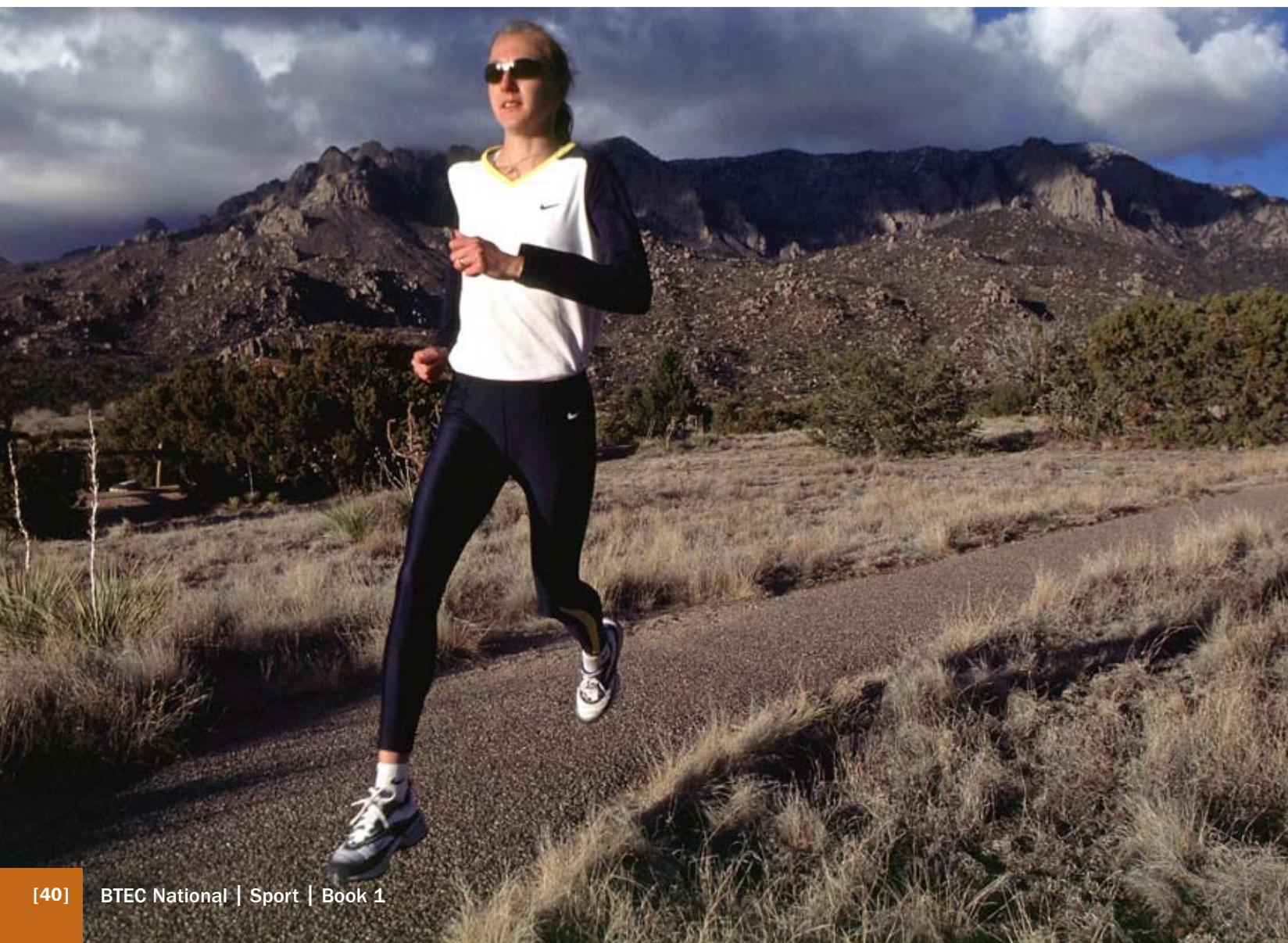
This information is kept confidential so that fellow athletes do not gain a competitive advantage.

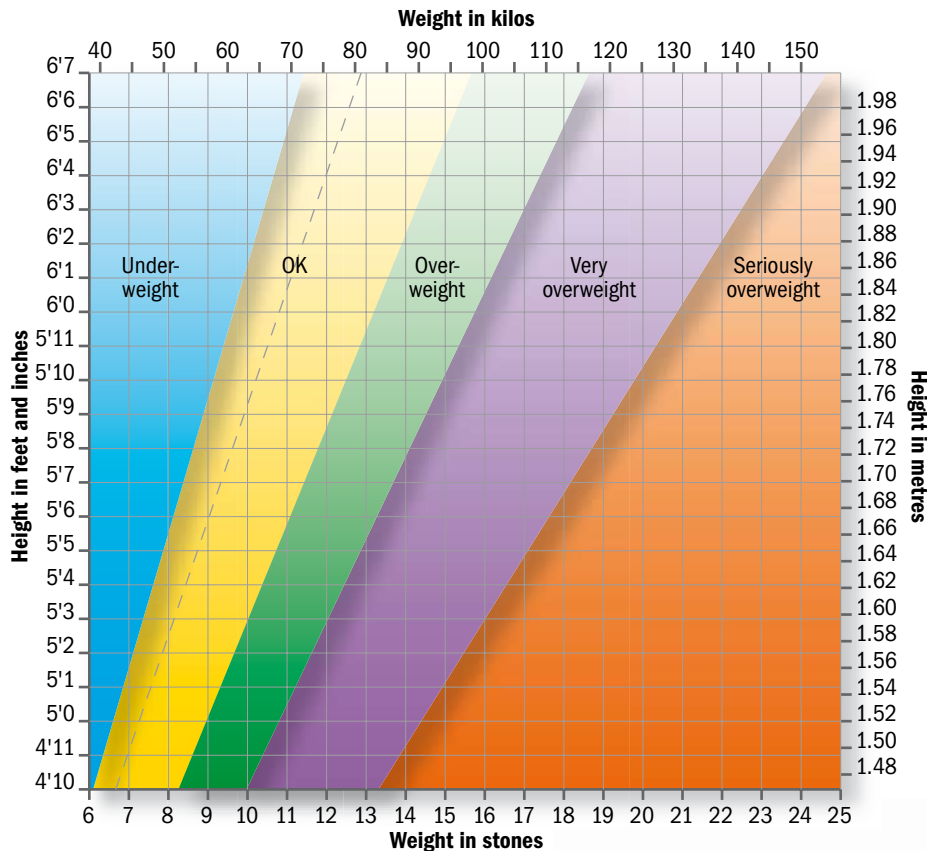
Accepted health ranges

On page XX we have looked at some accepted health ranges for health variables such as BMI.

In addition, you need to assess a client's height and weight. This is the most widely used method of assessing an individual's body composition. It offers a judgement about the client's weight in relation to his or her height, although it makes no attempt to assess the percentage of body fat. It is common to see a graph like the one here displayed on posters in local fitness centres and GPs' surgeries, suggesting acceptable weight ranges for each height.

▼ **Elite-level athletes will compare their fitness test results with their previous tests or performance**





There are many height and weight charts available

Feedback

The feedback you give to the athlete can take many forms, including:

- verbal
- written
- text-based
- numerical
- tables
- graphs or charts.

Some feedback may be presented immediately after the performance and some at the next training session.

Verbal

The information you have gained from the fitness test should be given to the client as verbal or written feedback. There are a few basic rules to follow when giving verbal feedback.

- Ensure the feedback is given in a quiet environment with no distractions, as some information may be confidential and personal.
- Don't baffle the client with science or technical jargon unless he or she understands these terms.
- Remember to link the results to the targets or goals set.
- If the client has made only small improvements below target, remain positive and stress that the results are going in the right direction.
- If the results are poor, be ready to suggest other ways of improving fitness. For example, what about changing from running to swimming, if this is more suitable for the individual?
- It may be appropriate to reset goals or targets based on the results. For example, someone who now has good aerobic endurance may want to concentrate more on speed or flexibility.

Written

Written feedback to clients can be produced in a number of formats. However, as with verbal feedback, it should be clear and easy to understand, and applicable to the client. You can show a comparison of the client's data against normative data using graphs or table. These can be generated using a computer programme, which then provides a fitness profile for the client to show strengths and weaknesses.

Tests carried out

When reporting the tests you carried out, remember to include the following information:

- name of test
- component of fitness tested, e.g. body composition
- units of measurement, e.g. metres or kilograms
- normative data rating, e.g. very good or poor
- reference for normative data: author, year of book or full website address.

Test results

It is vital that you record all the results from all your testing sessions as these form the basis of your analysis and interpretation. Remember that these results must remain confidential.

For recording your results, you may wish to use a simple paper-based method using a table designed by you. However, it is a good idea to transfer these results to a computer programme, which will help you generate graphs and tables for analysis. You must keep your records in a safe place (asking the client to retest because you have mislaid the results would be very unprofessional). The results should be filed with the health and medical questionnaires in the client's own file.

Some of the tests you do will require a number of practitioners or helpers. It would be advisable for someone else to write down the results while you are involved in the testing to avoid confusion.

You need to analyse and interpret the data you have gathered, with the aim of making an assessment of

the client's fitness in terms of either a baseline score or progress in a training programme.

Compare your data against normative data for the specific test you have used. Normative data allows you to analyse how well the client has performed compared to others of the same age and gender. Classify your data according to the rating given, which normally ranges from poor to excellent. In addition, analyse the results in comparison with the client's baseline data or previous scores for that test.

Levels of fitness

We have discussed the importance of using normative data for assessing levels of fitness on page XX, but you also need to consider each client's individual progress. You should look at the profile of the results over a period of time to make a judgement on strengths and areas for improvement.



Case study: Test results

Brian, a 35-year old truck driver who suffered an arm injury, has been trying to build up his strength in his arm because driving requires upper body strength. To assess his progress, Brian has completed a number of 1RM tests, which measure strength by looking how much weight can be lifted in kilograms. The results are shown in the table below.

Schedule	Result (kg)
Before training programme	35
Four weeks into training programme	40
Eight weeks into training programme	50
End of programme (12 weeks)	55

- 1 Using normative data, report on Brian's test results. **P1**
- 2 Describe the progress made by Brian based on his test results. **M1**
- 3 Explain the strengths and weaknesses of a 1RM test. **D1**

Strengths and areas for improvement

In any feedback you need to identify the strengths and areas for improvement (also known as weaknesses). This will allow you suggest possible recommendations for future training and activities. It is probable that you will have a combination of strengths and areas for improvement.

Strengths

- High levels of hamstring flexibility.
- Excellent levels of aerobic endurance.
- Good levels of muscular endurance.

Areas for improvement

- Overweight on BMI classification (Baxter and Smith, 2005).
- Poor flexibility at the shoulder joint.
- Very poor strength using the leg press.

As good practice you should also provide the normative data reference where possible, as in the example above.

Recommendations

To complete the evaluation process, you need to offer recommendations to the client to either improve or maintain their fitness. You may have to design a training programme, although, for high-level athletes, this is usually done by a fitness coach. For example, if you need to improve a client's aerobic endurance, you could use the following training methods:

- continuous/steady state exercise (see page XX)
- interval training (see page XX)
- Fartlek training (see page XX)

When looking to improve fitness, you should also consider more contemporary approaches such as spinning or Pilates.

Activity

In pairs, produce an A3 poster that explores the different training methods you can offer a client. You should describe the different training methods. In your group, you should cover all physical and skill-related components.



Assessment practice

- 1 As a follow-on from the Assessment practice on page XX where you performed six fitness tests on a group member (client), you are to give feedback to the client. Add a new section called Feedback at the end of your report and write notes on the following points.
 - a A description of the results.
 - b Data representation (e.g. graphs and tables where appropriate).
 - c An interpretation of the results against normative data. **P6**
- 2 Identify the strengths and areas for improvement for the client, which could be in the form of a bullet-point list. Compare the results with normative data. **M4**
- 3 Provide future training or activities to improve your client's fitness. You need to explore the different training methods such as Interval training, as well as carry out a results analysis. This analysis needs to be backed up by supporting literature. The analysis could concentrate issues such as:
 - What do the results mean in relation to your client's sports?
 - How will this level of fitness influence your client's performance? **D2**



Knowledge check

- 1 Outline the protocol for the multi-stage fitness test.
- 2 Why is it important to consider flexibility in relation to sporting performance?
- 3 State the advantages and disadvantages of the step test.
- 4 Explain why it is important to maintain client confidentiality.
- 5 Use an example to explain how to calculate BMI.
- 6 Why is it important to screen a client's health prior to starting a fitness test or training programme?
- 7 What is the difference between the reliability and validity of a test?
- 8 Outline the factors that may cause coronary heart disease in the long term.
- 9 Identify three tests that can assess a client's aerobic endurance.
- 10 Identify three reasons why you would terminate a fitness test.
- 11 Describe two methods of measuring body composition.
- 12 Why is it important to evaluate test scores against normative data?



Preparation for assessment

- 1 Imagine you have decided to work at a local fitness centre to gain work experience during your course. As part of the work placement, you have been asked by your supervisor to perform some extra tasks to expand your knowledge of fitness testing and health screening.

You are to produce and prepare a PowerPoint® presentation which explores a range of fitness tests that you may use with a client. In the presentation you should describe one fitness test for each of the following components of fitness:

- flexibility
- strength
- aerobic endurance
- speed
- power
- muscular endurance
- body composition.

In the descriptions, you should include:

- protocols
- equipment required
- equations/calculations
- units of measurement.

Printouts from the presentation will be displayed in the consultation room to increase awareness for clients, so make sure you describe the advantages and disadvantages of each test. **P1**

- 2 There have been some concerns about the quality of the health screening questionnaire used by the fitness centre. Based on these concerns, you have been asked to produce a new health-screening questionnaire.

To help you generate some suitable questions, research some examples on the Internet or look again at the one on page XX. Your questionnaire should have about 15 questions and focus on issues such as diet, smoking, exercise and alcohol intake. You should use:

- closed questions, e.g. 'Do you smoke?'
- open questions, e.g. 'What causes you stress in your life?'
- scaled questions, e.g. 1 = poor; 5 = excellent. **P2**

- 3 To test the new questionnaire, you have been asked to use it on 20 clients within the fitness centre (you can use the tutors at your college or school). **P3**



Grading tips

Grading Tip **M2**

Once you have the completed questionnaire, describe the strengths and areas for improvement for two clients by providing them with verbal feedback through a consultation. It is important you go through all the questions step by step with the client, so you should write down some notes before the consultation so that you are clear.

Grading Tip **D1**

As part of the verbal feedback, you need to evaluate the health screening questionnaires. To aid your evaluation, support your findings with appropriate literature, such as exploring the possible health implications of not eating enough vegetables. You also need to offer lifestyle recommendations such as changes to their daily diet.



Grading tips

Grading Tip **M1**

Try to explain the advantages and disadvantages of the tests you use. For example, you could say that the step test is fairly unreliable because it uses a predictive heart rate and therefore is open to variability.

- 4 One of the key objectives for your work placement is to improve your practical skills for health assessment. Using two clients, administer four health monitoring tests, for example peak flow. Record your results in a table.

P4



Grading tips

Grading Tip **M2**

Produce a written report that describes the strengths and areas for improvement of the clients in relation to accepted health ranges such as blood pressure data.

Grading Tip **D1**

As part of the written report, evaluate the health monitoring tests. To aid your evaluation, support your findings with appropriate literature, for example explore the possible health implications of having a BMI above 25. You also need to offer lifestyle recommendations such as changes to their daily diet to reduce their intake of fatty foods.

- 5 Your supervisor has suggested that you should add to your health-based testing with physical fitness testing and suggests you test a client. You need to administer six fitness tests, such as the vertical jump test, on one individual, who could be:

- a member of your family
- a member of your class
- a school or college sports person
- a tutor or teacher
- a local athlete.

You should produce a report that includes the following parts.

- a Decide on the components of fitness that are important for your client. These may come from the sport they play.

- b Identify the fitness tests you are going to use with your client.
- c Complete a risk assessment and health screening questionnaire for the tests prior to testing.
- d Ask the client to read and sign an informed consent form
- e Administer the fitness tests, making safety a priority. Record the results on a raw data sheet.

P5



Grading tips

Grading Tip **M3**

Justify why you have used the six fitness tests with your client. Add notes to your report on the following topics:

- suitability
- reliability
- validity
- practicality.

- 6 It has come to the attention of your work placement supervisor that you have little knowledge and experience of providing feedback to clients. Therefore, he has suggested that you provide feedback to the client whom you performed six fitness tests on.

In the consultation room, provide verbal and written feedback to the client on their test results and interpretation of their fitness levels. The feedback should include:

- a description of the results.
- data representation (e.g. graphs and tables where appropriate)
- an interpretation of the results against normative data.

P6



Grading tips

Grading Tip **D2**

Identify the strengths and areas for improvement for the client, and compare the results with normative data by showing them normative data tables.

Grading Tip **D3**

Provide future training or activities to improve your client's fitness. You need to explore the different training methods such as Interval training, as well as carry out a results analysis. This analysis needs to be

backed up by supporting literature. The analysis could concentrate issues such as:

- What do the results mean in relation to your client's sports?
- How will this level of fitness influence your client's performance?
- What effects might your client's fitness have on their lifestyle?

To record the verbal feedback, record the consultation on tape or ask your tutor to write you a witness statement.

To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 Assessment practice Page XX Describe the test for each component of physical fitness, including advantages and disadvantages	M1 Assessment practice Page XX Explain the advantages and disadvantages of one fitness test for each component of physical fitness	
P2 Assessment practice Page XX Prepare an appropriate health screening questionnaire		
P3 Assessment practice Page XX Devise and use appropriate health screening procedures for two contrasting individuals	M2 Assessment practice Page XX Describe the strengths and areas for improvement for two contrasting individuals using information from health screening questionnaires and health monitoring tests	D1 Assessment practice Page XX Evaluate the health screening questionnaires and health monitoring test results and provide recommendations for lifestyle improvement
P4 Assessment practice Page XX Safely administer and interpret the results of four health monitoring tests for two contrasting individuals		
P5 Assessment practice Page XX Select and safely administer six different fitness tests for a selected individual recording the findings	M3 Assessment practice Page XX Justify the selection of fitness tests commenting on suitability, reliability, validity and practicality	
P6 Assessment practice Page XX Give feedback to a selected individual following fitness testing, describing the test results and interpreting their levels of fitness against normative data	M4 Assessment practice Page XX Compare the fitness test results to normative data and identify strengths and areas for improvement	D2 Assessment practice Page XX Analyse the fitness test results and provide recommendations for appropriate future activities or training

