physical fitness, training and movement efficiency

Chapter 2

What is the relationship between physical fitness, training and movement efficiency?

Health-related components of physical fitness

Physical fitness has different meanings for different people. What physical fitness means for a professional athlete may be quite unlike what an average person in the street would consider it to be. One way of looking at the components of fitness is to look at those that relate to health and those that have a skill component.

The five health-related components of fitness are so categorised because of their importance to a person’s general level of health. Each component plays an important part in developing an overall sense of wellness and wellbeing:

• cardiorespiratory endurance
• muscular strength
• muscular endurance
• flexibility
• body composition.

Cardiorespiratory endurance

Cardiorespiratory endurance or aerobic endurance is a measure of the ability of a person’s lungs, heart and blood vessels to supply oxygen to the working muscles of the body; it also refers to the ability of the working muscles and other organs to utilise this oxygen. Cardiorespiratory endurance can make a significant impact on daily living because without it a person will commonly experience feelings of tiredness and fatigue. Cardiorespiratory fitness is the major component of fitness for activities such as distance running, road cycling and other physical undertakings that require continuous movement for extended periods of time. Athletes who participate in team sports such as football, basketball, netball and hockey also require a strong aerobic base.

Muscular strength

Muscular strength is the ability of muscles to apply force to an object; it contributes to a person’s health by enabling them to participate in life without feelings of muscular tiredness and fatigue. There are many tasks done in daily life that require strength. Activities such as lifting groceries, carrying a school bag or walking up stairs all require an element of strength.

Strength is also important when participating in physical activity and is particularly significant in team games like rugby league. Strength can be applied in a variety of ways depending on the sport or even the specific game situation in which the athlete finds them. For example, a basketball player may need to apply their core strength to block out an opponent in a rebounding contest, and then may need to apply strength in a different way to pass the ball or sprint the length of the court in another part of the game.

Strength is also a major component of power.
– muscular endurance

Muscular endurance is defined as the ability of the muscles to perform repeated contractions against a load or resistance. In any single day some muscles may contact countless numbers of times in activities such as walking. The ability to keep going without muscle fatigue is important to overall health. The level of resistance that muscles have to work against is an important feature in determining muscular endurance. A person who continually walks up hills or trains muscles using lots of repetitions with light weights may build up high levels of muscular endurance.

Some examples of sports requiring high levels of muscular endurance are middle to long distance running, swimming, rowing, canoeing and cycling. There is also a range of team sports where athletes have to play for extended periods, such as 4 x 15-minute quarters, or 2 x 30-minute halves, which require a high level of muscular endurance to ensure that athletes are able to continually move and create space. Athletes who compete in sports such as tennis or squash, require specific muscular endurance in their legs, wrist, forearm and upper body in order to compete in long rallies and games.

– flexibility

Flexibility is the range of motion around a joint and can make an important contribution to the way people feel. Stiffness and tightness in joints can limit an individual’s freedom of movement and contribute to injury of bones, tendons and muscles. As mentioned earlier a joint is where two or more bones meet, the tendons and ligaments and muscles encapsulating the joint can restrict this range of movement and limit the effectiveness of movements.

Flexibility decreases with age, but can be maintained with regular exercise and stretching routines. Good flexibility aids in mobility and helps to reduce the chances of muscle fibre tears and ligament strains.

While maintaining flexibility is important in daily life, it has a particular significance in some sports. Competitive gymnastics and dancing require high levels of flexibility, so that the performer is able to undertake the skill of the required movement patterns. While a high level of general flexibility is vital in performing well in these activities, many movements can be enhanced by high flexibility. For instance, a tennis player with good shoulder flexibility would be able to take the racquet back further and generate more speed in the serve; an athlete with good hip flexibility would have a longer stride length when running; and a spin bowler with good wrist flexibility would be able to impart more spin on the ball when bowling in cricket.

– body composition

The human body is composed of bones, muscle, fat and other essential internal organs such as the brain, heart, kidneys and liver, all of which have specific functions. The balance between fat, muscle and other components is important for health and wellbeing. The body needs a certain level of fat for metabolism and energy storage, but if a person has too much fat (or adipose tissue) it can impair their fitness levels and impact on their overall status of health.
There are genetic differences in the body composition of males and females, there is strong evidence that females with over 20% body fat and males with over 10% body fat are at significant health risk. Poor body composition has been linked to conditions such as heart disease, stroke, diabetes and many forms of cancer.

- **analyse the relationship between physical fitness and movement efficiency. Students should consider the question ‘to what degree is fitness a predictor of performance?’**

There is a common perception that fitness automatically equates to good performance in physical activity and fitness automatically equates with good health. However, these statements need to be analysed more closely, we have seen that fitness consists of a number of components, each of which can impact on performance in a positive or negative way.

Physical performance in elite sport, dance, gymnastics or aquatics, relies on high levels of specific fitness depending on the activity. Elite performers in a specialist domain may well struggle physically to perform in another sport. It is not uncommon for elite gymnasts to find participation in team games a significant challenge or endurance athletes to struggle physically in short sprint events. Fitness can be quite specific to an event and may not apply as well to another event.

The skill component of any task also needs to be considered carefully when analysing movement performance. Specific areas of fitness, such as muscular endurance and flexibility would be very valuable to a dancer or gymnast, but may inhibit performance in a strength-related activity like power lifting.

- **skill-related components of physical fitness**

These fitness components can be seen as an extension of the health-related components of fitness because they tend to be more related to human performance than the everyday health needs of an individual. The skill-related components of fitness are:

- power
- speed
- agility
- coordination
- balance
- reaction time.

- **power**

Muscular power can be defined as the ability to exert maximum force in the shortest possible time. It is the combination of strength and speed. Power is a significant part of throwing events such as discus, shot put and javelin. Team sports such as volleyball, basketball and Australian rules require powerful jumping movements at regular intervals throughout the game. Even in endurance events, athletes may be required to use the component of power when performing such as sprinting up a hill or to the finish line.

- **speed**

Speed can be defined as the ability of the muscles to contract quickly. This translates into fast movement of body parts. An individual’s speed is often determined by the muscle fibre they are born with. Human beings have a combination of fast-twitch muscle fibres and slow-twitch fibres. One way to understand the two fibre types is to compare them with those found in a chicken. The fast-twitch fibres of the wings of a chicken look very different from the slow-twitch fibres in the breast.

There is a strong genetic influence on an athlete’s speed. An athlete who was born with a high percentage of fast-twitch muscle fibres has the genetic potential to be quicker than an athlete who has a high percentage of slow-twitch muscle fibres.
Speed can be improved with training, but this will be the result of improving technique and skill, which improves muscle memory. Often better results and times will be misinterpreted as increases in speed; whereas increased strength gains are actually making the athlete more powerful.

– **Agility**

Agility is the ability to change direction or body positions quickly while still maintaining balance. Agility contains a number of skill-related components. Power, speed, balance, coordination and even reaction time are important components of agility. Most team sports that focus on space and possession require athletes to be agile. Some examples of individual sports that require agility include snow skiing, gymnastics, tennis, dancing and ice skating. A range of contact sports such as boxing, wrestling and martial arts also require high levels of agility.

– **Coordination**

Coordination is the result of the interaction between the body’s sense of perception and the central nervous system. A good level of coordination results in movements that appear to be smooth and flowing. Movements can be practised so that the neural pathways between the brain and body parts are established, which lead to learnt movement memory patterns. Once these movement patterns have been established, the athlete can concentrate on piecing other areas of the skill or movement together.

Different sports and activities may require different types of coordination. For example, passing and catching in rugby, netball and basketball require high levels of hand-to-eye coordination. Soccer, Australian rules football and recreational games, such as ‘hackeysack’, require high levels of foot-to-eye coordination. Activities such as dance and aerobics need good levels of coordination between body parts in order for movements to appear smooth and aesthetically pleasing.

– **Balance**

Balance is the ability of the body to maintain its equilibrium. Equilibrium is lost when a person falls over or loses control of their body parts momentarily. Balance is an important component of both agility and coordination.

Balance can be static or dynamic. Static balance is when the body’s equilibrium is held in a fixed or stationary position. Some examples of static balance are a handstand in gymnastics and the ‘set’ position at the start of 100 metre-sprint. Dynamic balance is when an athlete can maintain their equilibrium while moving. In its simplest form, running is an example of dynamic balance. Balance is very significant in activities where the environment in which the movement is performed is unpredictable. Some examples of activities where dynamic balance is required are surfing, water skiing and running with the ball in football.

– **Reaction time**

Reaction time is the time it takes to react to an external stimulus. The external stimulus could be a starting gun or whistle but could be a ball pitched or bowled at a batter in softball, cricket or baseball. The start of a swimming race provides a good example of
gauging different reaction times because there is a time lag between the starting gun and entry into the water. Skilled athletes develop good reaction times and may also possess some inherent skill in this area. A combination of factors such as speed and perceptual ability contribute to strong reaction times.

measure and analyse a range of both health related and skill related components of physical fitness.

As the discipline of sport science has developed, new and innovative ways of measuring fitness, skill and performance have evolved. The most accurate measures are done under controlled conditions using specialist scientific equipment that can provide extremely accurate data about an individual’s performance. There is also a range of easy-to-perform field tests that can provide strong predictions of fitness levels for individual athletes. The following outlines some of the tests that can be used for this purpose.

Measuring cardiorespiratory endurance

The most accurate measure of cardiorespiratory endurance is that of maximal oxygen uptake or VO_2 max. In a laboratory, an athlete can be hooked up to a heart rate monitor and respiratory analysis equipment while they ride, run or swim at various workloads. The workload is progressively increased in increments until it is too intense for the athlete to continue. This is known as a maximal test. Data about the different levels of carbon dioxide and oxygen the athlete breathed out can be used to predict the maximum amount of oxygen that the athlete is able to process. The result is usually expressed in millilitres of oxygen consumed per kilogram of the athlete’s body weight per minute, or ml/kg/min. Highly trained athletes, such as elite triathletes, can achieve levels well above 50 ml/kg/min for women, and 60 ml/kg/min for men.

Maximal VO_2 laboratory tests are not easy to access because of their high cost, the need for trained operators and their unsuitability for testing large groups at once. However, there are a number of field tests that can accurately predict cardiorespiratory endurance without the need for expensive equipment and can test large numbers at one time. The results from these tests—usually distance travelled or heart rate measurement at the end of the test—are then compared to standardised normative tables to indicate levels of cardiorespiratory endurance. These ‘norm’ tables still give relatively accurate readings of cardiorespiratory fitness. They sometimes indicate a category of fitness using descriptions such as; excellent, very good, good, average, below average, poor, instead of a ml/kg/min measurement.

Common field tests of cardiorespiratory endurance are the:

- multi-stage shuttle (beep test)
- Cooper’s 12 minute-run
- ACHPER 1.6 kilometre-run
- Canadian and Harvard step tests
- PWC bicycle ergometer test.

The following outlines how the beep test is used as a predictor of cardiorespiratory endurance.

The multi-stage (beep) fitness test

_Resources_: witches hats or markers, 20 m measuring tape, CD player, multi-stage fitness test CD, flat surface suitable for running

_Background and procedure_: The beep test is a progressive shuttle run between two lines spaced 20 metres apart. Subjects must complete each 20-metre shuttle run by staying in time with the audio beep from the CD. At each beep, the level and stage is also broadcast. Each level continues for 1 minute. The first level is quite slow (8.5 km ph) and is equivalent to a slow jogging pace. There are 7 stages in the first level. The interval between beeps at each level decreases which means that the subject has to run faster to maintain pace with the beeps.

Each progression in levels equates to an increase in running speed of 0.5 km ph. As a result: level 2 has 8 stages, level 4 has 9 stages, level 6 has 10 stages, level 8 has 11 stages, level 10 has 12 stages, level 11 has 13 stages and level 16 has 14 stages.
When the subject drops out, the result (level and stage) of their last successful shuttle run is recorded. Results can then be compared to tables to obtain an indication of VO2 max. There are also a number of internet sites such as the one given below that have beep test result calculators which will allow the subject to determine their VO2 max and provide the absolute value of oxygen consumed by the body each minute.

www.brianmac.co.uk/beep.htm

Figure 2.5 Subjects participating in a beep test

<table>
<thead>
<tr>
<th></th>
<th>MALES</th>
<th></th>
<th>FEMALES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RATING</strong></td>
<td><strong>BEEP TEST RESULT</strong></td>
<td><strong>VO2 MAX (ML/KG/MIN)</strong></td>
<td><strong>BEEP TEST RESULT</strong></td>
<td><strong>VO2 MAX (ML/KG/MIN)</strong></td>
</tr>
<tr>
<td>Excellent</td>
<td>Above 14.10</td>
<td>Above 63.0</td>
<td>Above 12.1</td>
<td>Above 54.0</td>
</tr>
<tr>
<td>Very good</td>
<td>11.11–14.10</td>
<td>53.1–63.0</td>
<td>10.8–12.1</td>
<td>49.1–54.0</td>
</tr>
<tr>
<td>Good</td>
<td>11.7–11.10</td>
<td>52.1–53.0</td>
<td>9.3–10.7</td>
<td>44.1–49.0</td>
</tr>
<tr>
<td>Average</td>
<td>9.6–11.6</td>
<td>45.1–52.0</td>
<td>7.6–9.2</td>
<td>38.1–44.0</td>
</tr>
<tr>
<td>Fair</td>
<td>7.8–9.5</td>
<td>39.1–45.0</td>
<td>5.10–7.5</td>
<td>33.1–38.0</td>
</tr>
<tr>
<td>Poor</td>
<td>5.9–7.7</td>
<td>33.0–39.0</td>
<td>4.2–5.9</td>
<td>27.1–33.0</td>
</tr>
<tr>
<td>Very poor</td>
<td>Below 5.9</td>
<td>Below 33.0</td>
<td>Below 4.2</td>
<td>Below 27.0</td>
</tr>
</tbody>
</table>

Measuring muscular strength

Strength can be measured accurately using complex weight machines designed specifically for the purpose. A simpler field test is outlined below.

Dominant hand grip dynamometer test

**Resources:** hand grip dynamometer

**Procedure:** Make sure that the dynamometer needle has been returned to zero. Grip the dynamometer with the testing hand and stand up straight with the feet shoulder-width apart. Extend the testing hand up vertically directly above the head. Keeping the arms straight, lower the arm to the side of the thigh, squeezing the handle as tightly as possible during this lowering phase. Record the scores and compare to the norm table below to obtain the subject rating.

<table>
<thead>
<tr>
<th>DYNAMOMETER READING (KG)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&gt;60.0</td>
<td>55.0–59.9</td>
<td>48.5–54.9</td>
<td>44.0–48.4</td>
<td>&lt;44.0</td>
</tr>
<tr>
<td>Female</td>
<td>&gt;36.5</td>
<td>32.0–36.4</td>
<td>29.0–31.9</td>
<td>25.0–28.9</td>
<td>&lt;25</td>
</tr>
</tbody>
</table>
Measuring muscular endurance
The push-up test

Resources: chair, stopwatch and chalk.

Procedure: Place the chair against the wall and measure the distance of the feet from the front of the chair for each subject. This is done by getting the subjects to lie on the ground, face up with arms by their side, and the soles of the feet level with the front of the chair. The chalk is then used to mark a line level with the elbow joint. The feet are now placed behind this line as the subject reaches forward to place both hands, shoulder width apart, on the front of the chair.

Subjects align their body in a straight line, with arms extended in the ready position. On the starting signal, the subject completes as many push-ups as possible in the set time of 30 seconds. For a push-up to be counted successfully the chest must touch the front edge of the chair of the lowering phase of the push-up and the arms must return to straight during the upward phase. Body alignment is also important. The back must be straight and be kept in alignment with the legs. Record the scores and compare to the norm table below to obtain the subject strength rating.

<table>
<thead>
<tr>
<th>Number of Push-ups Completed</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&gt;24</td>
<td>22–24</td>
<td>19–21</td>
<td>&lt;19</td>
</tr>
<tr>
<td>Female</td>
<td>&gt;12</td>
<td>11–12</td>
<td>5–10</td>
<td>&lt;5</td>
</tr>
</tbody>
</table>

The sit-up test

Resources: stopwatch, gym mats or carpeted area

Procedure: The subject lies on the ground, face up. The subject holds a pencil in both hands and rests their hands on their thighs. The knees are bent at an angle of approximately 90° and the feet should remain flat on the floor.

A partner, who also acts as the counter, should kneel in front of the feet and grasp both ankles making sure that the soles of the feet stay on the ground. On the start command, the subject curls up and raises the trunk, rolling the pencil up towards their knees, until the lower back is perpendicular to the floor. A successful attempt is counted when the student returns to the starting position.

For males, time is called at the end of 2 minutes and the score is recorded. For females, time is called at the end of 1 minute only. Results can then be compared to the norm tables below to obtain an overall rating.

<table>
<thead>
<tr>
<th>Number of Sit-ups Completed</th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (2 min)</td>
<td>&gt;69</td>
<td>62–69</td>
<td>52–61</td>
<td>44–51</td>
<td>&lt;44</td>
</tr>
<tr>
<td>Female (1 min)</td>
<td>&gt;33</td>
<td>28–33</td>
<td>23–27</td>
<td>17–22</td>
<td>&lt;17</td>
</tr>
</tbody>
</table>
Measuring flexibility

The sit and reach test

*Resources:* sit and reach testing box or box with measuring tape or ruler attached.

*Procedure:* Ensure that the subjects have had an adequate warm-up, including hamstring and lower back stretches. Place the measuring box against a brick wall for their stability. The subject removes their shoes and sits on the floor with the soles of their feet pressed against the front face of the blocks. Subjects keep their knees straight, bend forward from the trunk and gently slide the indicator as far forward as they can. The indicator must be pushed with the fingers of both hands level with each other and held for a count of approximately 2–3 seconds for a successful attempt to be recorded. The tester may use another person to use their hands to apply light pressure on the knees of the subject to discourage the knees from being bent.

Results are recorded in cm and can then be compared to the norm tables below to obtain an overall rating.

<table>
<thead>
<tr>
<th>MAXIMUM REACH (CM)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&gt;10.0</td>
<td>6.0–10.0</td>
<td>2.0–5.0</td>
<td>-5.0–+1.0</td>
<td>&lt;5.0</td>
</tr>
<tr>
<td>Female</td>
<td>&gt;15.0</td>
<td>13.0–14.9</td>
<td>11.0–12.9</td>
<td>6.0–10.9</td>
<td>&lt;6.0</td>
</tr>
</tbody>
</table>

Measuring body composition

Body composition can be measured using sophisticated computer imaging, however a simpler estimate that is widely used is measuring body mass index. This measure has come under some criticism but is commonly used to compare obesity and overweight levels across population groups. Body mass index is calculated by dividing the weight of a person (in kilograms) by their height (in metres) squared, that is: \( \text{BMI} = \frac{\text{weight}}{(\text{height})^2} \).

This result can be compared to a normative table that uses the following rating:

<table>
<thead>
<tr>
<th>BMI</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>15–20</td>
<td>underweight</td>
</tr>
<tr>
<td>20–25</td>
<td>healthy weight</td>
</tr>
<tr>
<td>25–30</td>
<td>overweight</td>
</tr>
<tr>
<td>30+</td>
<td>obese</td>
</tr>
</tbody>
</table>

Hydrostatic or underwater weighing can provide an accurate predictor of body composition, but it is not time-efficient and very expensive.

Another accurate measure of body fat percentage can be determined by collecting accurate skinfold measurements using skinfold calipers. Skinfold calipers measure the size of subcutaneous fat deposits under the skin. A common skinfold test requires measurements of skinfolds from four body sites. The total of these measurements are then added and compared to normative tables, which give a reading for the percentage of body fat that the person is carrying.

At elite or professional level, athletes may be subjected to skinfold measurements from up to nine body sites to provide more accurate data. The rationale behind this is that the measurement of more skinfold sites will give a more comprehensive overview of total body fat percentages.
Skinfold measurements

*Resources:* skinfold calipers and a tester with previous experience of skinfold measurement is preferred.

*Procedure:* Skinfold readings are commonly taken at four sites: the biceps, triceps, subscapular (located 1–2 cm below the angled bottom ridge of the scapular bone), and the suprailiac (located 3–4 cm above the hip bone).

It is standard practice for the tester to measure on the right side of the body. The tester grasps the skinfold between thumb and forefinger of the required site. The skinfold should include skin and underlying (subcutaneous) fat but not muscle. The calipers are applied just below the fingers that are holding the skinfold at a width which is the same thickness as the skinfold.

The skinfolds at each site (except the sub scapular) should be measured in the vertical plane. The measurement at each site should be repeated to ensure consistency. If the reading between the two measurements is more than 1 mm, a third reading should be made. In this case, the average of the two closest readings should be taken as the final result. The totals of the four sites are then added and converted to body fat percentage using the tables below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4.8</td>
<td>6.3</td>
<td>70</td>
<td>23.2</td>
<td>31.6</td>
</tr>
<tr>
<td>15</td>
<td>8.6</td>
<td>11.6</td>
<td>75</td>
<td>23.9</td>
<td>32.5</td>
</tr>
<tr>
<td>20</td>
<td>11.4</td>
<td>15.3</td>
<td>80</td>
<td>24.5</td>
<td>33.3</td>
</tr>
<tr>
<td>25</td>
<td>13.5</td>
<td>18.2</td>
<td>85</td>
<td>25.1</td>
<td>34.1</td>
</tr>
<tr>
<td>30</td>
<td>15.2</td>
<td>20.6</td>
<td>90</td>
<td>25.6</td>
<td>34.9</td>
</tr>
<tr>
<td>35</td>
<td>16.7</td>
<td>22.6</td>
<td>95</td>
<td>26.1</td>
<td>35.6</td>
</tr>
<tr>
<td>40</td>
<td>17.9</td>
<td>24.3</td>
<td>100</td>
<td>26.6</td>
<td>36.1</td>
</tr>
<tr>
<td>45</td>
<td>19.0</td>
<td>25.9</td>
<td>105</td>
<td>27.1</td>
<td>36.6</td>
</tr>
<tr>
<td>50</td>
<td>20.2</td>
<td>27.2</td>
<td>110</td>
<td>27.5</td>
<td>37.3</td>
</tr>
<tr>
<td>55</td>
<td>20.9</td>
<td>28.5</td>
<td>115</td>
<td>27.9</td>
<td>38.0</td>
</tr>
<tr>
<td>60</td>
<td>21.8</td>
<td>29.5</td>
<td>120</td>
<td>28.3</td>
<td>38.6</td>
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<tr>
<td>65</td>
<td>22.5</td>
<td>30.6</td>
<td>125</td>
<td>28.7</td>
<td>39.2</td>
</tr>
</tbody>
</table>
Measuring power

The standing long jump test

_Resources_: measuring tape, chalk or markers to draw a starting line, flat and level surface.

_Procedure_: The subject stands with both feet just behind the starting line. The feet should be in a comfortable position and may be slightly apart. The subject then bends their knees to perform a squat and jumps as far forward as possible, landing on both feet. The arms may be swung during the movement to help gather _momentum_. The distance from the take-off onto the landing spot at the back of the heels is then measured and compared to the norm table to obtain a rating.

<table>
<thead>
<tr>
<th>Percentage Body Fat</th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&lt;10.0</td>
<td>10.0–12.9</td>
<td>13.0–16.9</td>
<td>17.0–19.9</td>
<td>&gt;20.0</td>
</tr>
<tr>
<td>Female</td>
<td>&lt;16.9</td>
<td>17.0–19.9</td>
<td>20.0–23.9</td>
<td>24.0–26.9</td>
<td>&gt;27.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance Jumped (m)</th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&gt;2.50</td>
<td>2.31–2.50</td>
<td>2.21–2.30</td>
<td>1.91–2.20</td>
<td>&lt;1.91</td>
</tr>
<tr>
<td>Female</td>
<td>&gt;2.00</td>
<td>1.81–2.00</td>
<td>1.71–1.80</td>
<td>1.41–1.70</td>
<td>&lt;1.41</td>
</tr>
</tbody>
</table>

The standing vertical jump test

_Resources_: measuring tape or ruler fixed on wall, chalk or chalk powder, wall and surrounding area free of obstacles.

_Procedure_: The subject faces the wall with both arms fully extended overhead. The point at which the tips of the middle fingers touch the wall is measured and recorded as the starting point. The subject turns side on, bends their knees to perform a squat and jumps. At the highest point of the jump the subject touches the measuring tape with the hand closest to the wall. The starting point measurement is subtracted from the jump height to obtain a result.

![Figure 2.11 Measuring set up, starting jump and jump](image-url)
Coordination and timing can impact significantly on the results of these tests so the subject should be given to all three trials and their best score taken. This result is then recorded and compared to norm table is to obtain a rating.

<table>
<thead>
<tr>
<th>DIFFERENCE IN HEIGHT (CM)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&gt;65</td>
<td>50–65</td>
<td>40–49</td>
<td>30–39</td>
<td>&lt;30</td>
</tr>
<tr>
<td>Female</td>
<td>&gt;58</td>
<td>47–58</td>
<td>36–46</td>
<td>26–35</td>
<td>&lt;26</td>
</tr>
</tbody>
</table>

**Measuring speed**

Speed can be measured in a number of ways. Most elite sporting programs use light gates or stopwatches to measure the time taken to cover a short distance to estimate speed. This could be a sprint (with standing start) over 20 metres, a 50-metre pass through light gates or a 25-metre swim sprint. The following example measures a 50-metre sprint and may be relevant to a sport like Australian football.

**50-metre sprint**

*Resources: stopwatches, 50 m measuring tape, marker cones.*

*Procedure:* After a comprehensive warm-up, time subjects running speed over a 50-metre course from a standing start. Round times to the nearest tenth of a second.

Results are then compared to the norm table below to obtain an overall speed rating.

<table>
<thead>
<tr>
<th>TIME (S)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&lt; 7.6</td>
<td>7.6–7.9</td>
<td>8.0–8.4</td>
<td>8.5–8.8</td>
<td>&gt; 8.8</td>
</tr>
<tr>
<td>Female</td>
<td>&lt; 8.1</td>
<td>8.2–8.6</td>
<td>8.7–8.9</td>
<td>9.3–9.0</td>
<td>&gt; 9.4</td>
</tr>
</tbody>
</table>

**Measuring agility**

The Illinois agility run

*Resources: measuring tape, stopwatch, 4 standard classroom chairs, 2 marker cones.*

*Procedure:* The subject starts in a lying down position facing forward with arms flexed and hands just behind the start line. Start the stopwatch on the start command. The subject jumps to their feet and sprints to the end line around marker cone A and then sprints back around chair 1. The subject continues to weave between chairs 2, 3 and 4. When they reach chair 4, the subject runs around chair 4 and repeats the process in reverse by weaving between chairs 3, 2 and 1.

When the subject has completed the up and back weaving between chairs they sprint around marker cone B and sprint back to the finish line. The time is recorded as they cross the finish line. Results are then compared to the norm table below to obtain an overall agility rating.

<table>
<thead>
<tr>
<th>TIME (S)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&lt;16.7</td>
<td>16.8–17.3</td>
<td>17.4–17.9</td>
<td>18.0–18.5</td>
<td>&gt; 18.5</td>
</tr>
<tr>
<td>Female</td>
<td>&lt;19.0</td>
<td>19.0–20.4</td>
<td>20.5–21.7</td>
<td>21.8–23.0</td>
<td>&gt; 23.0</td>
</tr>
</tbody>
</table>
The agility t-test

*Resources:* stopwatch, 4 marker cones, measuring tape.

*Procedure:* Four marker cones, A, B, C, D, are set up according to the instructions shown in Figure 2.13.

The stopwatch is started on the start command. The subject sprints from A to B and touches the bottom of cone B with their right hand. They then shuffle sideways to their left and touch the base of cone C with their left hand. They then continue to shuffle sideways to their right until they touch the base of cone D with their right hand. They then shuffle sideways back to cone B and touch the base with their left hand. Once cone B has been touched they sprint backwards to the starting point at cone A. Their time is recorded once they cross the line at cone A.

<table>
<thead>
<tr>
<th>TIME (S)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&lt;9.5</td>
<td>9.5–10.5</td>
<td>10.6–11.0</td>
<td>11.1–11.5</td>
<td>&gt;11.5</td>
</tr>
<tr>
<td>Female</td>
<td>&lt;10.5</td>
<td>10.5–11.5</td>
<td>11.6–2.0</td>
<td>12.1–12.5</td>
<td>&gt;12.5</td>
</tr>
</tbody>
</table>

Measuring coordination

The alternate hand wall toss

*Resources:* 1 tennis ball per subject, brick wall, marker cones or chalk, measuring tape.

*Procedure:* Using chalk or marker cones, measure a line 2 metres away from the brick wall. The subject begins with the ball in one hand and throws it underhand at the wall and catches it on the full with their opposite hand when directed to start. The process is repeated as many times as possible in the allotted 30 seconds. It may be advisable to have some tennis balls on standby to replace those that may roll away.

Results are being compared to the norm table below to obtain an overall coordination rating.

<table>
<thead>
<tr>
<th>NUMBER OF SUCCESSFUL CATCHES</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&gt;33</td>
<td>30–32</td>
<td>26–29</td>
<td>23–25</td>
<td>&lt;23</td>
</tr>
<tr>
<td>Female</td>
<td>&gt;24</td>
<td>20–23</td>
<td>17–19</td>
<td>14–16</td>
<td>&lt;14</td>
</tr>
</tbody>
</table>

Measuring reaction time

The ruler drop test

*Resources:* A 1-metre ruler with cm markings, a flat and level student desk and a chair.

*Procedure:* The designated subject requires a partner who aligns and drops the ruler. The subject sits at the desk, leans forward and rests their forearms on the desk, with their hands past the edge of the desk. The index finger and thumb are placed in the ‘pinch’ position approximately 3 cm apart ready to catch the ruler. The partner stands beside the subject’s hands and aligns the ruler so that the bottom of the ruler with the ‘zero’ cm marking is level with the thumb and index finger.

When the partner is ready, they let go of the ruler. The subject attempts to catch the ruler and the score is read at the point in cm where the ruler was caught by the pinching action of the thumb and index finger. Allow three attempts with each hand and record the best result. Results are then compared to the norm table below to obtain an overall reaction time rating.

<table>
<thead>
<tr>
<th>TIME (S)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm</td>
<td>&lt; 7.5</td>
<td>7.5–15.9</td>
<td>15.9–20.4</td>
<td>20.4–28.0</td>
<td>&gt;28</td>
</tr>
</tbody>
</table>
Measuring balance

The stork stand

Resources: stopwatch and flat, level surface.

Procedure: The subject stands in the upright position and places both hands on their hips. The subject then lifts one leg and bends the knee so that the sole of that foot is resting on the knee of the supporting leg. On the start command, the subject lifts the heel of the supporting leg off the ground so that they are now balanced only on the toes of the supporting leg. The timekeeper calls out the seconds as they pass.

The balance is over when the hands break contact with the hips, when the sole of the bent leg lifts off the knee of the supporting leg, when the heel touches the ground or when the subject hops on the supporting leg. As balance is lost, the subject notes the time elapsed in seconds and this becomes their score. Results are then compared to the norm table below to obtain an overall static balance rating

<table>
<thead>
<tr>
<th>TIME (S)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>AVERAGE</th>
<th>FAIR</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seconds</td>
<td>&gt;50</td>
<td>40–50</td>
<td>25–39</td>
<td>10–24</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

Figure 2.14 The stages of the stork stand

– think critically about the purpose and benefits of testing physical fitness

Over time, a wide variety of tests have been developed to measure aspects of fitness and human performance. The information gained from such testing can provide valuable guidance to coaches and athletes about levels of fitness, standard of fitness against other population groups and improvements in performance over time. Some can also provide indicators for overall health status. Test results can also be misused or applied incorrectly.

Some of the variables that will determine the value of fitness testing are:

• purpose of the test
• validity and reliability of the test
• age of candidates being tested
• use of results
• analysis of the results.
**Purpose of the test**

When used in an appropriate manner, fitness tests can provide individuals with valuable information about general health and wellbeing or levels of preparedness for performance in games and sport. Well-designed and well-measured tests can give information about general heart and lung health, the ability to get through daily life without fatigue, strength and flexibility. The information can also give very clear data about an athlete’s capabilities, particularly in sports where specific components are vital to performance, such as endurance in Australian rules football, speed in 100-metre sprinting and strength in weight lifting. Good tests can also be very informative in picking up information about injury, for example, testing the muscle strength of agonist and antagonist muscles to determine joint stability.

Fitness testing can also have negative outcomes if used to embarrass or scare people into action. Simple tests such as measuring weight or skinfolds can impact negatively if done in a public place where it may humiliate the person being tested.

**Validity and reliability**

Many fitness tests provide information about a specific component of fitness and these results cannot be transferred to broad statements about overall physical fitness. Some field tests only provide broad observations rather than scientific data. To be of value a test must really measure what it says it is measuring (validity) and produce consistent results when testing the same person at the same point in time (reliability). For example, a beep test using an old stretched audiotape would not be considered a valid or reliable test for cardiorespiratory endurance.

**Age of testing**

There is no doubt that advanced testing techniques such as gas analysis and the beep test have great value to elite athletes in providing information about readiness for play, capability to play in certain positions and fitness level for elite performance. The information gathered for elite performance does not always apply to young children and the testing methods used aren’t always appropriate for use with young children. Testing can often become a source of embarrassment or a ‘turn off’ factor for young people in participating in physical activity.

**Use of results**

If testing results are used appropriately they can inform and guide improvement in performance and wellness. If the results are over-emphasised and used as a source of public embarrassment or to threaten young people, testing can have a significant negative impact. The average person on the street will not react to test results in the same way as an elite athlete and interpretation and information sharing of results need to be considered carefully.

**Analysis of results**

Care should always be taken when making conclusions about test results. Drawing incorrect conclusions or using the data inappropriately can be misleading. As with all scientific data there are limitations on what any set of data means.
Aerobic and Anaerobic Training

Aerobic fitness is a significant component of good overall health and plays a significant part in many sports and physical activities. For athletes such as marathon runners and triathletes, aerobic conditioning will be the basis of most of their training.

Energy is derived aerobically when oxygen is used to contribute to the production of energy. Events that require high levels of endurance rely highly on aerobic energy. Aerobic training targets an athlete’s endurance capacity by targeting improvement in delivery of oxygen to working cells. Athletes who require high levels of endurance will train 4–6 days a week. Some examples of aerobic activities include walking, jogging, running, non-sprint cycling, swimming and cross-country skiing.

The critical feature of aerobic activity is continuous activity over a medium to long period of time. Most training involves many repetitions of similar movements e.g. marathon runners will do most of their training as running; while cross training by doing swimming or cycling will provide some benefit, but specific running endurance training is needed to get improvement.

Anaerobic training is training that is done when insufficient oxygen is delivered to working muscles. This training tends to be shorter and more intense; and usually puts the body under greater stress. This enables improvement in anaerobic capacity. Activities such as sprint repetitions, wind sprints and lots of short, sharp burst of activity with short rest spells are typical of anaerobic training. This type of training does not allow for full recovery between bouts of work. Athletes involved in strength and power activities, such as football, basketball, volleyball, running events under 800 metres and swimming events under 100 metres, utilise anaerobic energy sources to supply the majority of their required energy.

FITT principle

The FITT principle provides a useful framework for developing physical training programs, particularly when aiming to achieve improved aerobic fitness. The key determinants of success or improvement in fitness are:

- **F**: frequency of training
- **I**: intensity of training
- **T**: type of training
- **T**: time of training
Frequency

In order for changes in fitness to take place training must be more than just a one-off event. The body needs to undergo some stress or overload to for changes to take place.

The guidelines for improving aerobic fitness (or cardiorespiratory training) is a minimum of three sessions per week of moderate physical activity and ideally five or six sessions per week. Little or no benefit is gained by training less than this. For improvements in strength or muscle flexibility, training would need to be regular with each muscle group exercised at least every couple of days to get improvement.

Intensity

Intensity refers to how hard an athlete is working in any one session. For example there are athletes who train every day but will concentrate on different muscle groups in each session to allow recovery and rest. There needs be a balance between finding enough intensity to overload the body but not so much that it causes overtraining. When doing aerobic training, the heart rate is often used as the determinant of training intensity. A heart rate known as the aerobic threshold can be determined for individuals and it signifies the rate the heart needs to work at or above to get improvements in aerobic fitness. This threshold varies greatly from person to person depending on their age, level of fitness and other factors.

Many gyms provide broad ranges of heart rate that will suit certain age athletes. For most people, a target heart rate zone of 50–70% of their maximum heart rate is a good place to start. Maximum heart rate is usually estimated as: 220 – age (beats per minute).

For resistance training, workload is the primary measure of intensity. Workload can have three components:
1. The amount of weight lifted during an exercise.
2. The number of repetitions completed for a particular exercise.
3. The length of time to complete all exercises in a set or total training session.

An individual can increase their workload by lifting heavier weights; or they could increase the number of repetitions with the same weight. Finally, they could lift the same weight for the same number of repetitions, but decrease the rest time between sets.

Type

The type of training refers to the method used to improve fitness. For aerobic fitness the types of training activities usually referred to are walking, running, cycling, swimming and rowing. For resistance training, training types such as free weights, weight machines resistance bands and bodyweight can be used.

Time

The final component in the FITT principle of training concerns how long an individual should exercise for. Individuals with lower fitness levels should aim to maintain their heart rate within the target heart rate zone for a minimum of 20–30 minutes to achieve improvements in aerobic fitness. This can increase to as much as 45–60 minutes as fitness levels improve. In terms of the duration of the program as a whole, research suggests a minimum of 6 weeks is required to see noticeable improvement and as much as a year or more before a peak in fitness is reached.

For resistance training, sessions of no longer than 45–60 minutes are often recommended, but shorter, harder sessions can also be effective.
FITT Principle Guidelines

Here are some basic FITT principle guidelines for both aerobics and strength training to help you plan an exercise program.

Please keep in mind that these examples represent general guidelines only for those of us with low to moderate fitness levels. Use these guidelines to establish a program and then customise your program to fit your specific needs and goals as your experience and knowledge increases.

And remember to always consult your doctor before commencing any new exercise program and consult a fitness professional (personal fitness trainer, gym instructor, etc) if you require help.

**Basic Aerobic Training Guidelines**

*Frequency*: Exercise between 3 and 5 times per week.

*Intensity*: Maintain a heart rate of between 60–80% of your maximum heart rate.

Your Maximum Heart Rate can be calculated using a maximum heart rate test conducted by a fitness or health professional or estimated using the formula:

For women: \(230 - \text{age} = \text{maximum heart rate}\)

For Men: \(220 - \text{age} = \text{maximum heart rate}\)

The best and most practical way to monitor your heart rate is with a heart rate monitor.

*Time*: Those of us with low levels of fitness should maintain our heart rates in our selected target zone for a minimum of 15 to 20 minutes, excluding warm-up and cool down periods.

Those with a good fitness base should exercise for between 20 and 60 minutes in their target heart rate zone.

*Type*: Exercises that involve as many muscles as possible and allow a relatively consistent level of intensity are best. Good examples of these include: walking, jogging, cycling, swimming, rowing and hiking.

**Basic Strength Training Guidelines**

*Frequency*: Exercise each body part 1–2 times per week. For lower intensity workouts or for those who have trained for some time, try exercising each body part 2–3 times per week. You can exercise different parts of the body on different days (called split routines) or you can train your whole body at each workout.

*Intensity*: Choose a weight that can be performed 10–15 times (repetitions) per set.

When you can perform more than 15 repetitions without rest, increase the weight slightly for your next workout.

If you are training your whole body each time you exercise, only do 1–2 exercises for each muscle group and perform 1–3 sets of each exercise.

If you employ a split routine try performing no more than 2–3 exercises per muscle group and 2–4 sets of each exercise.

*Time*: Beginners usually benefit from exercise sessions that last between 30–45 minutes.
As you become fitter and stronger, you may want to increase your total workouts from 45–90 minutes. For most of us, particularly those with limited time, sessions of 60 minutes are typically ideal.

With rest between sets, try not to take longer than 2–3 minutes as a beginner. As you get fitter, try to reduce this time to 1 minute or less.

**Type:** Generally speaking, there are two types of exercises for muscles, compound exercises and isolation exercises.

Compound exercises use more than one muscle group to perform and are the most effective for those interested in losing weight. Examples of compound exercises include bench press, push-ups, squats, shoulder press and dead-lifts.

Isolation exercises use only one muscle group to perform and include bicep curls, tricep extensions, leg extensions, etc.

For those new to resistance training, compound exercises are best. Once you have a base level of strength you can add isolation exercises to your workouts for variety and to help shape individual muscles.

**Conclusion**

No matter what your goal, current fitness level or exercise experience, you can employ the FITT principle to plan an effective long-term exercise program.

By using the guidelines above, you too can plan an effective regime that will help you to improve your cardiovascular fitness, strength, flexibility and of course help you lose weight.

Using the FITT principle in your exercise planning will ensure that you achieve your weight loss goals as efficiently as possible. Not only will you achieve your goals in the shortest possible time, you’ll also enjoy your routine more because of the variety built into it.

If that weren’t enough, you’ll also minimise the chances of experiencing annoying and painful overtraining injuries that can stall or stop your weight loss and fitness progress.

While anyone with the basic knowledge provided above can plan their own workout, if you are new to exercise or have an existing injury or ailment, we suggest you consult a personal trainer or other fitness professional.

As well as designing a personal plan for you using the method above, they can help you rehabilitate or work around existing injuries, teach you the right techniques for each exercise in your program and advise you of when to modify your plan to take advantage of your new fitness levels.

Whether you plan your own workouts or get help from a professional, we hope that the information presented above helps you to become a happier, healthier you.

compare the relative importance of aerobic and anaerobic training for different sports eg gymnastics versus soccer

Any exercise or physical activity is usually a combination of aerobic and anaerobic activity. For example, in a gentle jog the body will work anaerobically or without sufficient oxygen until the body systems adjust to the increased workload. However, it is possible to determine the dominant energy system in most sports or physical activity and thus focus training on that aspect of performance.

Generally, there is a need for aerobic training in most sport or physical activity because aerobic fitness provides a general feeling of wellbeing and gets the body working efficiently without excess fatigue. Even for explosive activities like shot put and javelin, a reasonable level of aerobic fitness is required. Aerobic fitness will delay fatigue and contribute to increased concentration and focus needed for these events.

In other activities there will be a need for a combination of training, such as in a field team game like soccer, hockey or Australian rules football. These players will need high levels of aerobic training, particularly at the start of the season to get a base of overall fitness. Players will also require a range of anaerobic training to allow effective participation in the game. Components such as strength for jumping and sprinting, speed for effective game movement and flexibility to manage a wide range of movements will also be required.

Overall, aerobic training benefits cardiorespiratory function and decreases body fat and allows an individual to engage in moderate activity for extended periods of time. This is valuable for many sports. Anaerobic activity can also benefit cardiorespiratory function and decrease body fat, but anaerobic activity is also able to produce big improvements in power, speed, strength and muscle mass. Anaerobic conditioning allows us to exert tremendous forces over a very brief time. Basketball, football, gymnastics, boxing, track and field events under 1500 metres, soccer, swimming events under 400 metres, volleyball, wrestling and weightlifting, are all sports that require the majority of training time spent in anaerobic activity. Long distance and ultra-endurance running, cross-country skiing and 1500 plus metres swimming, are all sports that require aerobic training at much higher levels than individuals concerned with total conditioning or optimal health.

immediate physiological responses to training

examine reasons for the changing patterns of respiration and heart rate during and after sub maximal physical activity

- stroke volume
- cardiac output
- lactate levels

The human body’s capacity to function effectively in a wide range of physical activities results from its capacity to adapt and respond to different types of training. As we have seen with the FITT principal, the frequency, intensity, type and time of training can be manipulated to get different results. To understand how the body responds to long-term training it is important to understand the short-term physiological responses to training. The table below summarises how the body reacts to training in the short term. It can be analysed through simple observations of one’s own body when going for a run or swim.
The rate of blood pumped by the heart (cardiac output) is a product of the rate at which the heart beats (heart rate) and the volume of blood that the heart pumps with each beat (stroke volume). In a resting heart, the cardiac output is about 5 litres a minute ($0.07 \times 70 \text{ beats/min} = 4.9 \text{ L/min}$).

- **heart rate**
- **ventilation rate**

The key changes in heart rate and ventilation that occur during training are usually easily observed or felt by an athlete. Closer analysis shows that these changes occur because of the demands that training places on muscles and other cells. During exercise, the individual’s sympathetic and parasympathetic nervous systems gradually change the heart rate through the release of hormones and other chemical messengers. As muscles demand more energy, the sympathetic nervous system increases heart rate, blood pressure and breathing. After exercise, or during a rest period, the parasympathetic nervous system gently applies the brakes and brings the heart rate back down to resting beat.

Due to the changes taking place in the working muscles, the lungs and the rest of the respiratory system need to provide more oxygen for the blood. The rate and depth of breathing will increase because of these changes. Sympathetic nerves stimulate the respiratory muscles to increase the rate of breathing. Metabolic by-products from muscles such as lactic acid in the blood stimulate the respiratory centres in the brain, which, in turn, further stimulates the respiratory muscles.

Blood pressure will also increase slightly—caused by the increased force of each heartbeat and by the elevated cardiac output—and then fluctuate as the body adjusts and recovers from exercise. The increase in blood pressure opens blood flow to more air sacs (alveoli) in the lungs; and this increases the ventilation and allows more oxygen to enter the blood. As the lungs absorb more oxygen and the blood flow to the muscles increases, the muscles have more oxygen.
Activities

Activity 1 (Page 102)
**Predict** what health-related components of fitness could benefit the following:
- tiredness and fatigue during the day
- participation in a social tennis competition
- a feeling of stiffness and tiredness in the joints
- participation in social dance group
- participating in weekend bushwalking
- surfing
- kite surfing

Activity 2 (Page 106)
**Critically analyse** tests used to measure cardiorespiratory endurance.

Activity 3 (Page 116)
Review the Feature Article on page 118 about using the FITT principles for losing weight. **Analyse** the information and comment on the accuracy and appropriateness of the advice.

Activity 4 (Page 120)
For each sport below **identify** whether aerobic or anaerobic training would be the most significant and **describe** circumstances where aerobic and anaerobic training might benefit performance.
- football
- tennis
- gymnastics floor routine
- trampolining
- race walking
- marathon swimming
- triathlon
- road cycling
1. **Describe** the components of physical fitness. **Outline** how each component may influence human movement.

2. **Evaluate** the use of skinfold testing and weight measurement for use in a primary school fitness program.

3. **Explain** the difference between aerobic and anaerobic training and **outline** the benefits athletes may get from each type of training. List examples of activities that provide aerobic exercise and activities that provide anaerobic exercise.

4. **Describe** the role anaerobic training could play in improving the fitness components required for the decathlon or heptathlon event.

5. What is the range recommended for heart rate during exercise?

6. How much exercise does your body need each week for good cardiovascular health?