Chapter 21
Maintaining health

Unit
1B

Unit content

The relevance of human biology to everyday life
Interest in the human body has often resulted from trying to explain body dysfunction; in maintaining health; and trying to improve human performance. Modern medical methods and alternative therapies differ in their effectiveness and each has its risks, ethical concerns and benefits.

Body dysfunction:
- types of dysfunctions *e.g. cancer, infections*
- requirements for maintaining health *e.g. diet, exercise and hygiene*.

Improve performance:
- changes in training practices *e.g. individuals at Australian Institute of Sport*
- other performance enhancing techniques *e.g. drugs, oxygen therapy and blood doping*.

Alternative medicines:
- types of alternative therapies
- benefits, ethical concerns and risks associated with their use.

Figure 21.1 Regular exercise is an important factor in maintaining health

How long will you live?

No one can answer that question. However, with the knowledge gained by science each of us can do a lot to ensure that our bodies remain as healthy as possible. In this chapter we look at some of the things that can go wrong with the body and how we can take steps to avoid them.

When things go wrong

When things go wrong the body fails to function normally in some way. This is called a **dysfunction**. There are thousands of possible dysfunctions. As we saw in Chapter 20, scientists classify things into groups to make study and discussion easier. We have classified dysfunctions into the following groups to make it easier to discuss them:

- lifestyle diseases
- genetic disorders
- infections
- exceeding tolerance limits
- deficiency diseases
- injury.

Lifestyle diseases

Lifestyle diseases are sometimes called *diseases of affluence*. They become more common as countries become more industrialised, as there is increasing wealth in society and as people live longer. Australia is a typical example of a country where lifestyle diseases have become increasingly common over the past fifty years. Today they are the most common form of illness and the greatest killers in our society.

Lifestyle diseases include some heart and blood vessel diseases and lung diseases, certain types of cancer, obesity and type 2 diabetes. These diseases occur partly because people are living longer and also because the lifestyle that many people lead contributes to their development. There is also evidence to suggest that lifestyle may contribute to depression, kidney failure, asthma, osteoporosis and Alzheimer's disease.

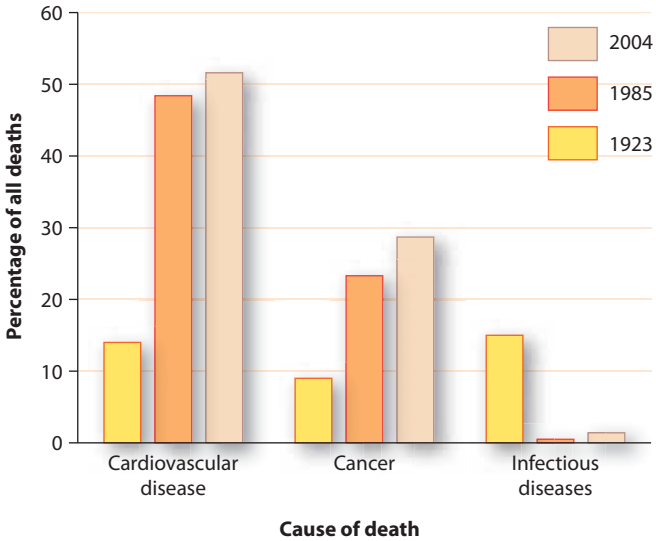

Figure 21.2 Graph showing major causes of death in Australia in 1923, 1985 and 2004

Figure 21.2 shows the changes that have occurred in the major causes of death in Australia over a period of about eighty years.

Factors associated with the increase in lifestyle diseases include:

- reduced amounts of physical exercise and an increased reliance on cars for transport
- consumption of foods that are high in fat and sugar resulting in a person being overweight or obese
- greater use of drugs like alcohol and tobacco
- increased availability of vaccines and antibiotics so that fewer people now die young due to infectious diseases
- improved sanitation and hygiene.

Lifestyle diseases are different from most other illnesses because they can be prevented by adopting a healthy lifestyle. Other differences are that they take many years to develop and when they do occur they are very difficult to cure.

Later in this chapter we will discuss some of the positive steps that you can take to avoid developing a lifestyle disease later in life (ways of reducing the risk of cancer were discussed in Chapter 13).

Genetic disorders

Genetic disorders are caused by abnormalities in a person's genes or chromosomes.

Chromosomal abnormalities may be due to mistakes that occur during meiosis, the cell division that produces the sperm and the eggs. If a defective egg or sperm is involved in fertilisation, the offspring may receive an extra chromosome or part of a chromosome, or may be missing a chromosome or part of a chromosome. In Down syndrome, for example, there is an extra copy of chromosome 21.

Another type of genetic disorder occurs when a defective gene is inherited from the parents. Such disorders are known as **hereditary diseases**. If the defective gene is dominant, offspring who inherit it from one parent will suffer from the disease. Huntington disease is an example of this (see Chapter 17). If the defective gene is recessive, offspring will only suffer from the disease if they inherit it from both parents. Cystic fibrosis, one of the most common hereditary diseases, is caused by a recessive gene.

Sometimes a change occurs in a gene. This is called a **mutation**. Many cancers are caused by a mutation in a gene or in a group of genes. Mutations may occur for no reason or may be caused by exposure to something in the environment like cigarette smoke. Some mutations can be passed to the next generation through the egg or the sperm.

To learn more about lifestyle diseases go to http://www.wikieducator.org/Life_Style_Diseases

Infections

Infectious diseases, also called *communicable* or *transmissible diseases*, can be passed from one person to another. Infections are caused by micro-organisms reproducing either inside the body or on the skin. The disease is then transmitted when the micro-organism is passed to another person. Most infections are caused by bacteria, viruses or fungi. Of the millions of different types of micro-organisms, only a few cause disease in humans. Micro-organisms that cause disease are called **pathogens** (see Chapter 14 for more detail on types of pathogens and their transmission).

Infectious diseases have become less common because vaccinations are available for many of them. You will have heard of, and may have been immunised against, infectious diseases such as diphtheria, polio, chicken pox, rubella, tuberculosis and tetanus. If people do become infected they can usually be easily treated with antibiotics.

As Figure 21.2 shows, deaths from infectious diseases are much fewer than they were eighty years ago. However scientists are becoming concerned about the prevention and treatment of infectious diseases because many bacteria are becoming resistant to the antibiotics used to kill them. Also, new infections are occurring for which there is no vaccination or effective treatment. Examples of these newer infections are AIDS, bird flu and SARS (severe acute respiratory syndrome).

Exceeding tolerance limits

Our cells work best when the environment inside the body is kept constant. The cells need a constant supply of oxygen and nutrients like glucose. They need to have wastes constantly removed; they need a constant amount of water and dissolved substances and they work best within a very narrow temperature range. Cells can only tolerate very small variations in these requirements. If the cells' tolerance limits are exceeded, body dysfunctions will occur.

We have already discussed the effects of exceeding the cells' tolerance limits for oxygen (Chapter 7), internal temperature (Chapter 9) and water (Chapter 10).

Deficiency diseases

A **deficiency disease** occurs when some vital substance is missing from a person's diet. The substance that is lacking is usually protein, a vitamin or a mineral.

Figure 21.3 One of the symptoms of scurvy is bleeding gums

The deficiency of each particular vitamin or mineral leads to a particular set of symptoms. You may have heard of scurvy, a disease that was often suffered by sailors in the days of sailing ships. Scurvy is caused by insufficient vitamin C in the diet. Vitamin C is contained in fresh fruits and vegetables. On long sailing voyages, before refrigerators were invented, sailors lived on a diet of salted meat and ship's biscuit. The lack of vitamin C in the diet caused symptoms such as bleeding gums and painful joints, a condition known as **scurvy** (see Fig. 21.3).

An example of a deficiency disease caused by lack of a mineral is **rickets**. If there is not enough calcium in the diet the bones of children become soft and weak, the joints are enlarged and the legs are bowed (see Fig 11.8 on p. 138).

Injury

An **injury** is damage to the structure or functioning of the body caused by an outside force. Examples of injuries include cuts in the skin, broken and dislocated bones, muscle and tendon damage, bruises and burns.

Accidents occur, and often there is nothing we can do to prevent them. However we can minimise the risk of injury by avoiding dangerous situations and by taking steps to minimise injury should an accident occur. Use of protective devices such as wearing a helmet when cycling, wearing seat belts in a car and using safety glasses and ear muffs when operating machinery all help to reduce the chance of injury.

What science tells us about maintaining health

Diet

Our food provides us with substances that the body cells need to work normally. These are called **nutrients**. Nutrients may provide energy for cells, or materials to repair old cells, produce new ones or to regulate body processes.

A healthy diet

Such things as vitamin pills, high-protein diets and mineral supplements are unnecessary, provided that you follow a healthy, balanced diet. Foods must be chosen wisely, to obtain the essential substances in the correct quantities but at the same time avoiding too much of certain nutrients. To assist people in making wise choices the Australian Government Department of Health and Ageing has published dietary guidelines for Australians. The latest guidelines, published in 2005, are:

1. Enjoy a wide variety of nutritious foods.
   - Eat plenty of cereals (including breads, rice, pasta and noodles), preferably wholegrain
   - Include lean meat, fish, poultry and/or alternatives
   - Include milks, yoghurts, cheeses and/or alternatives: reduced fat varieties should be chosen where possible
   - Drink plenty of water

   and take care to:
   - Limit saturated fat and moderate total fat intake
   - Choose foods low in salt
   - Limit alcohol intake if you choose to drink
   - Consume only moderate amounts of sugars and foods containing added sugars
2. Prevent weight gain: be physically active and eat according to your energy needs.
3. Care for your food: prepare and store it safely.
4. Encourage and support breastfeeding.

A more detailed version of the dietary guidelines for Australians is available at http://www.nhmrc.gov.au/publications/synopses/_files/n31.pdf

These guidelines emphasise eating a wide variety of foods, with limited amounts of those likely to be harmful. The proportions of each type of food in a balanced diet are shown in Figure 21.4.

Eating a balanced diet with the recommended quantities of each type of food will help you maintain a healthy weight and will ensure that you do not suffer from any deficiency diseases.

Table 21.1 shows a few of the important vitamins, the foods that are good sources of those vitamins and the effects of deficiency.

Table 21.2 shows a few of the important minerals, the foods that are good sources of those minerals and the effects of deficiency.

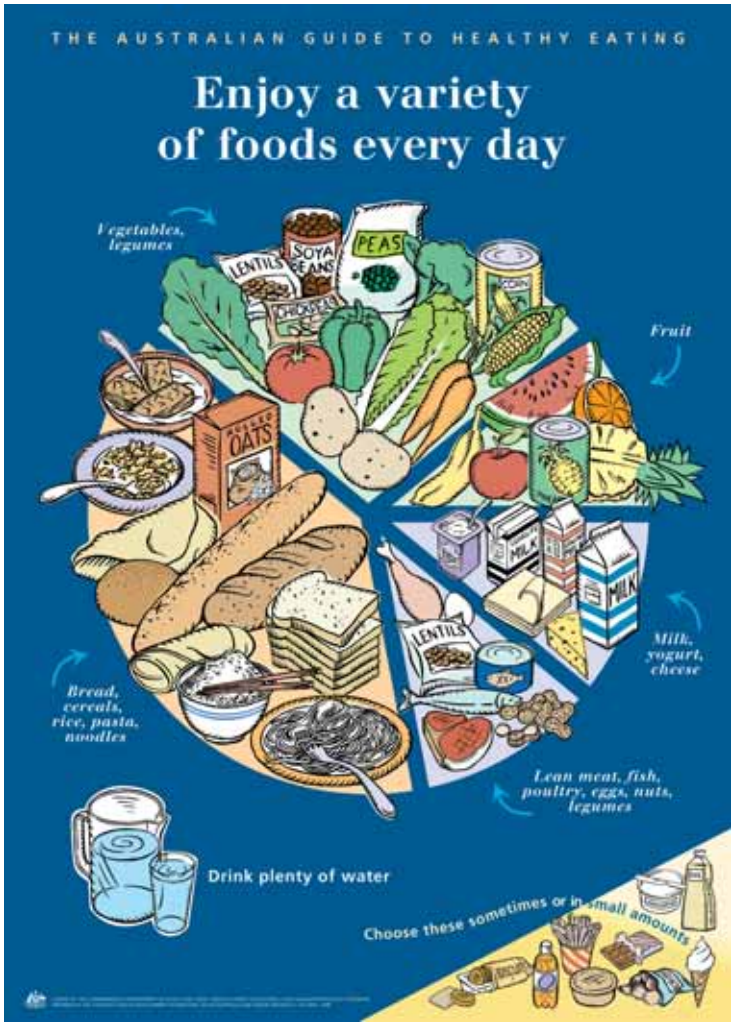

Figure 21.4 The Australian guide to healthy eating

Table 21.1 Some important vitamins, food sources and effects of deficiency

Vitamin	Good food sources	Effects of deficiency
Vitamin A	Milk, butter, cheese, liver, green and yellow vegetables, yellow fruits	Reduced resistance to disease, poor night vision, rough skin, dry cornea of the eye
Vitamin B_1 (thiamine)	Whole-grain cereals, green vegetables, milk, meat, seafood, poultry	Poor appetite, loss of weight, nausea, indigestion, eventually resulting in **beri-beri**
Vitamin B_3 (niacin/ nicotinic acid)	Meat, poultry, fish, potatoes, peas and beans	**Pellagra**: eruptions of the skin, swollen and cracked lip and tongue, nervous disorders
Vitamin B_{12}	Liver, kidney, milk, cheese, meat, eggs	**Pernicious anaemia**: reduced number of red blood cells
Folic acid (folate/folacin)	Yeast, liver, meat, green leafy vegetables, orange juice, whole-grain cereals	Deficiency before and during pregnancy increases risk of neural tube defects such as **spina bifida** and **anencephaly** in the foetus
Vitamin C (ascorbic acid)	Citrus fruits, tomatoes, strawberries, potatoes, leaf vegetables	**Scurvy**: sore gums, bleeding around bones, delayed healing of wounds
Vitamin D	Eggs, cod liver oil, cream; vitamin D is produced by the skin when exposed to sunlight	**Rickets**: soft and weak bones, enlarged joints, bowed limbs

Table 21.2 Some important minerals, food sources and effects of deficiency

Mineral	Good food sources	Effects of deficiency
Calcium	Milk and milk products, fortified soy milk	**Rickets** in childhood: soft and weak bones, enlarged joints, bowed limbs; **osteoporosis** in middle age: loss of calcium from bones causing them to become brittle
Iron	Liver, kidney, meat, canned fish, baked beans, chicken, egg yolk	**Anaemia**: reduced amount of haemoglobin in the blood
Iodine	Milk, iodised table salt, seafoods	Deficiency in infancy causes **cretinism**—retarded physical and mental development; in adulthood, **goitre**—enlarged thyroid gland
Fluorine	Naturally or artificially fluoridated water	Poor formation of tooth enamel

Energy intake

The carbohydrates, proteins and fats in our food provide energy. **Energy** is needed for:

- growth and repair of tissues
- keeping body temperature constant
- maintaining normal body functions such as heartbeat, breathing, digestion, excretion and the functioning of the nervous system
- contraction of muscles in physical activity.

Inside the cells the process of respiration breaks down carbohydrates, fats and proteins to release energy. If more energy is consumed than is required for the needs listed above, the excess energy is stored as fat. Energy is measured in units called kilojoules (kJ). For every 32 000 kJ of energy consumed above the requirements, 1 kg of body fat is stored. It is important, therefore, to be aware of your energy needs.

Factors affecting energy requirements include:

- the resting energy requirement: this varies from person to person, partly due to size and build but other factors, that have not yet been discovered, also contribute to the variations
- the amount of physical activity both at work and during leisure time
- body size: bigger individuals have more mass to move around and require more energy
- sex: women generally require less energy than men, partly because of smaller size, but also because they have a higher percentage of body fat (body fat requires less energy than muscle)
- age: more energy is needed during periods of rapid growth
- climate: in colder climates individuals require more energy to keep body temperature constant.

The energy needs for males and females of different ages and different levels of physical activity can be seen at http://www.nhmrc.gov.au/publications/synopses/_files/n35.pdf

Overweight and obesity

The high numbers of overweight and obese people is of great concern in Australia. As Figure 21.5 shows, the proportion of Australians who are overweight has been

steadily increasing in recent years. More than half of the adult population and more than one-quarter of children are now overweight or obese.

A person's weight status is determined by the **body mass index** (BMI). Body mass index is calculated using the formula:

$$\text{Body mass index} = \frac{\text{Weight (in kilograms)}}{\text{Height} \times \text{Height (in metres)}}$$

Table 21.3 shows the relationship between body mass index and a person's weight classification.

Increase in weight occurs when a person eats food that contains more energy than the body uses. Just a small extra intake of energy each day can lead to a major weight problem in the long term.

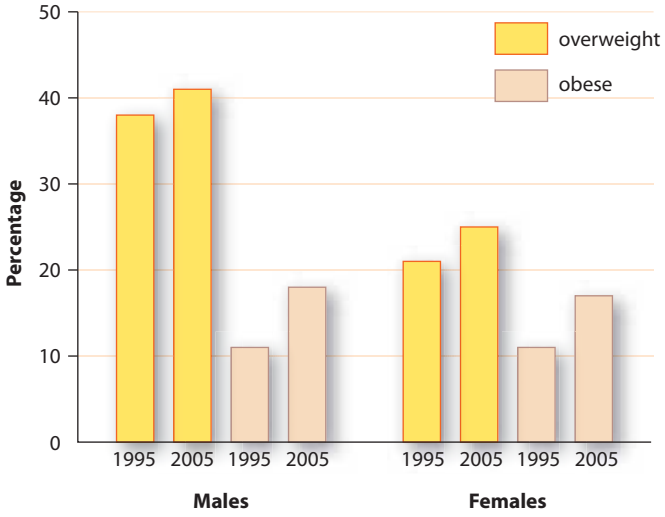

Figure 21.5 Graph showing the increasing prevalence of overweight and obesity among Australian adults

Table 21.3 Body mass index and weight categories

Classification	Body mass index
Underweight	Less than 18.50
Normal weight range	18.50 to 24.99
Overweight	25.00 to 29.99
Obese class 1	30.00 to 34.99
Obese class 2	35.00 to 39.99
Obese class 3	40.00 or more

Exercise

To allow our muscles to work efficiently, they must be exercised. Exercising the muscles of the body also brings about a general feeling of well being. Later in life exercise plays a significant part in helping to reduce blood pressure, heart disease and cholesterol problems.

Some of the positive effects of regular exercise are:

- Exercise programs make the heart and lungs work more effectively. The heart rate and capacity of the heart to pump blood increase. The air passages in the lungs gradually enlarge so that air flow improves. These changes allow the heart and lungs to support more prolonged muscular activity.
- The amount of high-density lipoprotein (HDL) in the blood increases. HDL helps to prevent the development of the blockages in blood vessels that lead to heart attacks and strokes.
- Regular exercise lowers the risk of death from circulatory diseases and cancer. Studies have shown that only moderate exercise is needed to lower the risk of a heart attack by one-third. Other studies have shown that people who exercise regularly are less likely to develop colon, breast, cervical, uterine and ovarian cancers.
- Physical training involving weights improves bone density and strength, and muscular strength and endurance in all adults regardless of age. Even men and women in their 80s and 90s make substantial gains in bone and muscle strength.

- Exercise helps prevent osteoporosis, a condition in which the bones are weak and tend to break. It increases activity of bone cells in both younger and older people. The stronger the bones when a person is young, the less chance of osteoporosis as that person ages.
- Exercise helps prevent weight gain not only because the level of activity increases but also because muscles use up chemical energy faster than other tissues. As a person becomes more muscular, it is less likely that fat will have a chance to accumulate.
- Exercise relieves depression and makes a person feel better about themselves. Exercise releases chemicals that reduce pain and make a person feel relaxed.
- Muscles that are not used or that are used for only very weak contractions decrease in size. This can be seen when a broken leg or arm is placed in a cast; the muscles very quickly decrease in size. On the other hand, forceful muscle activity over a prolonged period causes muscle to increase in size.

A sensible exercise program is one that provides all the benefits without being too strenuous. Exercising excessively can be harmful and may result in injuries to the back, knees or other parts of the body. Increasing daily activity by walking to the shopping centre instead of driving and by taking the stairs instead of an escalator or lift can improve your health.

Personal hygiene

Infections are caused by micro-organisms. Chapter 14 described the many defences that our bodies have to prevent infection by disease-causing organisms.

Good personal hygiene habits can help the body's natural defences. If you do have an infection, good hygiene will help to prevent the spread of the infection to other people.

One of the most effective things that you can do to reduce the spread of micro-organisms is to wash your hands with soap and water.

Hands should be washed:

- before you prepare or eat food
- after using the toilet
- before and after caring for a person who is ill
- before and after giving first aid
- after coughing or sneezing
- after handling any blood or body fluids
- after handling pets or other animals.

Other habits that you should develop are to:

- cover your mouth when you cough or sneeze
- wear gloves when handling blood or other body fluids
- never share personal items like towels, toothbrushes or syringes
- use heavy gloves or tongs to pick up discarded syringes or condoms, and when picking up rubbish in public places.

Figure 21.6 Regular handwashing reduces the spread of micro-organisms

Figure 21.7
Chinese medicine is an example of an alternative therapy

Alternative medicine

Alternative medicine is a treatment for an illness that is used instead of the type of medical care recommended by doctors. For example, some people may treat cancer with a special diet rather than methods that would be recommended by a doctor specialising in cancer treatment. Examples of alternative therapies include herbal medicine, Chinese medicine, chiropractic, osteopathy, naturopathy, iridology, reflexology, aromatherapy, acupuncture, massage and meditation.

Alternative medical treatments have become very popular in recent times. Some doctors now recommend alternative therapies in addition to conventional treatment. This is called **complementary medicine**—a combination of conventional and alternative treatments.

Although alternative treatments may have value in, for example, helping patients to feel more relaxed or feel they have more control over their illness, most have not been tested scientifically and are not evidence based (see Chapter 22). For conventional medical treatments extensive testing is necessary and they must be approved by a government appointed authority. Similarly, doctors must be qualified and registered but often this is not the case for alternative therapists. Alternative therapies have their place but each of us must make up our own minds about their use.

Improving performance

Changes in training practices

In the past, training for a sport mainly involved improving physical fitness and practising the skills required for the sport. **Physical fitness** includes efficient heart and lung function, muscle strength, muscle endurance (being able to perform a task for long periods) and flexibility of joints. Achieving a reasonable level of fitness should be a goal for everyone—the benefits of regular exercise were listed earlier in this chapter.

The desire to improve human performance has led to the intensive study of the human body and how it functions, particularly how the body functions when placed under pressure. Such studies have, in turn, led to a much more scientific approach to training for sports. This has resulted in great improvements in performance. For example, the world record for the men's 1500 m freestyle (swimming) in 1923 was 21 minutes 35.30 seconds; in 2001 the record was set at 14 minutes 34.56 seconds. The world record for the women's 5000 m run was 15 minutes 41.4 seconds in 1977; in 2007 a new record was set at 14 minutes 16.6 seconds.

How have these huge improvements in human performance been achieved? Many of the factors involved in improved performances have little to do with human biological science. Much of it is related to the increasing amounts of money made available for sports from governments and private sponsorship. However, a very significant factor has been the much more scientific approach to sport that has taken place in the past forty years. The Australian Institute of Sport (http://www.ausport.gov.au/ais), opened in 1981, has applied scientific principles in coaching and training. Many Australian universities now have departments for the study of human movement. The results

of their investigations are passed on to the community through education programs and through the training of physical education teachers for schools.

Discussion of all the sporting changes that have resulted in improved human performance is beyond the scope of this book but we can give a couple of examples.

Specialised training

Training for improved performance in a sport is now highly specialised. The Australian Institute of Sport has separate coaching teams for each of twenty-six different sports. Each of the sports runs training programs aimed at developing the particular attributes required for that sport.

Training programs are also specialised for each individual. The athlete's body functioning is tested in the field and in the laboratory; movements are analysed using video and other equipment; nutritional requirements are assessed and detailed records are kept of performance. The training program is then arranged according to the individual's needs. There is a continuous process of performance assessment and adjustment of the training activities aimed at constant improvement.

Figure 21.8
Coaches tailor training to the needs of the individual and the requirements of the particular sport

Altitude training

As we saw in Chapter 7, changes in the way the body functions occur when people who live near sea level go up to a higher altitude. Over time there is an increase in production of red blood cells. This means that the blood is able to carry more oxygen than it would at sea level. Extra blood capillaries also develop so that blood can be taken closer to the cells that require oxygen.

These changes that occur at high altitude have been used by competitors in endurance sports to improve their performance. Some sportspersons have trained at high altitudes so that their bodies will develop more red blood cells and more capillaries. When they return to sea level to compete, their muscles will be more effectively supplied with oxygen. The increased oxygen allows the muscles to get more energy from cellular respiration and performances will thus be improved.

Training at high altitude has its limitations. Because there is less oxygen available in the air at high altitude, training sessions cannot be as long and are not as effective as at sea level. In many countries training institutes for athletes now include a 'high altitude house'. The Australian Institute of Sport in Canberra has such a house. Rooms in the house are sealed off and nitrogen gas is pumped in, reducing the concentration of oxygen. This makes it similar to the oxygen available at altitudes of 2600 to 3000 m. Before competing in a major event, endurance athletes may spend eight to twelve hours per day over a two to three week period in the altitude house. While in the house, production of red blood cells is increased and other changes occur that help to improve the athletes' performances. When not in the house they are able to train normally.

Figure 21.9 A section of the AIS Recovery Centre

Recovery after training

Scientific investigation has shown that recovery techniques are very important to ensure a high level of performance in the next training session or the next competition. During recovery the chemical by-products of exercise that built up in the muscles are transported away by the blood. Heart rate and blood pressure return to normal; muscle soreness and fatigue are reduced.

Recovery is considered to be so important that the Australian Institute of Sport has a recovery centre that sportspersons use after training. Techniques used at the Recovery Centre depend on the particular sport and on the individual's needs. Facilities include a massage room, flotation tank, a warm down area with stretching mats and exercise bikes, a spa with jets that target particular muscle groups, hot and cold showers and a plunge pool.

Other performance enhancing techniques

Performance enhancing drugs

Many dietary supplements and sports drinks are advertised as performance improvers. Their use is legal and consuming them at moderate levels is unlikely to harm a person's health. Sports drinks do provide carbohydrates as a source of energy and dissolved substances to replace those lost in sweating. However, there is little evidence that dietary supplements and sports drinks do actually improve performance. The same result could be achieved by getting carbohydrates and fluids from other sources.

Performance enhancing substances are usually taken by athletes who are trying to gain an advantage in their particular sports. The World Anti-Doping Agency (WADA) has worldwide standards relating to the use of drugs in sport. These standards try to make sure that all athletes compete on an equal footing and that athletes do not have to risk their health to reach a high standard of performance.

For more information on steroids visit http://www.health.nsw.gov.au/public-health/dpb/publications/steroidsnapshot.htm

Although many prohibited drugs are able to increase athletic performance they do have side effects that can cause death or life-long disability. **Anabolic steroids** are an example of drugs that have been used to try to improve athletic performance. Their use in sport is not allowed but they can be prescribed by doctors to treat certain illnesses. Anabolic steroids stimulate production of protein, especially in the muscles. The male sex hormone, testosterone, is an anabolic steroid and there are human-made substances that have similar effects. As well as increasing muscle and bone growth these drugs also increase the body's male characteristics.

Like any drug, there are risks involved in taking steroids. People may become dependent on the drug or may suffer withdrawal symptoms if they stop using it. Steroids can also have serious effects on a person's health depending on age, gender, level of exercise, the type of drug, how much is used and the purity of the drug. Risks are especially high for young people who are still growing.

Blood doping

Red blood cells carry oxygen to the muscles and other tissues. If a person could increase the number of red blood cells in the body, the blood could carry more oxygen. The muscles would then get more oxygen that they could use to release more energy. This extra energy would allow the muscles to contract more strongly and for longer. **Blood doping** is increasing the number of red blood cells in order to improve performance.

There are three ways that blood doping can be done.

- Blood from another person can be transfused into the athlete. This increases the number of red blood cells in the circulation but there are risks. Certain diseases, such as HIV/AIDS, are transmitted through blood and there is a risk of a reaction to the foreign blood.
- An athlete's own blood can be collected, stored and transfused close to the time of competition. There is no risk of disease or reaction but a disadvantage of this method is that for a time the athlete is deficient in red blood cells and unable to train with normal intensity.
- A hormone called EPO (erythropoietin) can be injected. EPO occurs naturally in the body and it stimulates production of red blood cells. When extra EPO is injected the body responds by making extra red blood cells. This method also has risks. Some athletes have died because their blood has become so thick with red cells that the heart has been unable to pump effectively.

Find out more about blood doping at http://www.wisegeek.com/what-is-blood-doping.htm

Blood doping has mainly been used by competitors in endurance sports, especially cycling. Although used to treat some diseases it is not allowed in sport and tests have been developed to try to detect it. There are now reliable tests for EPO and for transfusions of blood from another person. Transfusions of a person's own blood are more difficult to detect but it is hoped that a test will soon be available.

Working scientifically

Activity 21.1 A good start to the day

A good breakfast cereal is high in complex carbohydrate (from whole grains). It also contains protein, soluble fibre, vitamins and minerals with very little fat, salt and sugar.

Choose six breakfast cereals (a range of different types) from supermarket shelves and refer to the nutrition information on the package (salt—sodium chloride—is often shown as sodium in tables of nutritional information).

Rank your six cereals from that which would provide the healthiest breakfast to that which would be the least healthy. Justify your ranking.

To look at a wider sample of breakfast cereals compare your rankings with those of others in the class.

Activity 21.2 Does the school canteen promote good health?

Assess the nutritional value of food sold by your school canteen. In cooperation with others in your class, make a survey of foods bought at the canteen by different groups in the school. For example, is there any difference in the eating habits of males and females, or of students of different year groups?

As an extension to this activity you could compare lunches brought from home with those bought at the school canteen. Which are better in terms of the healthy eating guide?

Activity 21.3 Food advertising

Select a food advertisement that you have seen on TV and analyse the message that is being presented by considering the following points and any others that may be relevant.

- Who is the target audience for the advertisement?
- What properties of the food are being promoted?
- Is any nutritional information about the food provided?
- How is the advertisement trying to induce the consumer to purchase the food?
- Are any of the statements made in the advertisement misleading or ambiguous?
- Do the dietary guidelines for Australians recommend eating the food?
- What is your opinion of the advertisement?

Activity 21.4 Scurvy: a deficiency disease

Scurvy is one of the oldest diseases known to humankind. The symptoms are described in Egyptian writings dating to 1500 BC and are also mentioned in the early books of the Bible. In the days of sailing ships, sailors were very commonly afflicted with scurvy. In 1600 a British report estimated that about 10 000 sailors had died from the disease in the previous twenty years.

1. What is the cause of scurvy?
2. What are the symptoms of scurvy?
3. Why were sailors more likely to be affected by scurvy than others in the population?

One of the first scientific experiments to try to find a cure for scurvy was carried out by James Lind in 1747. Lind was ship's doctor on board the HMS *Salisbury*, which was sailing from England to the colony of Plymouth in America. During the voyage he selected twelve men, all seriously ill from scurvy, and divided them into six pairs. All of the men were given the same food for breakfast, lunch and dinner, but each pair was given a different supplement in addition to the normal diet.

The supplements given each day were:

- two teaspoons of vinegar three times during the day
- a quart (about 1.2 L) of apple juice
- half a pint (300 mL) of sea water
- a mixture of herbs and spices
- twenty-five drops of a mixture of sulfuric acid and other compounds
- two oranges and one lemon.

The recovery of the men given oranges and a lemon each day was remarkable. Within six days one was fit for normal duties and the other was well enough to be appointed to look after the other sick men. The two men who drank apple juice also improved but were not well enough to work. None of the other men showed any improvement.

4. What conclusions can be drawn from Lind's experiment?
5. List three variables that Lind controlled in his investigation.
6. Why would Lind not have been able to make valid conclusions from the experiment if he had not controlled those variables?

It was not until the 20th century that the substance that prevented scurvy was identified as ascorbic acid (vitamin C). Another scientist to investigate ascorbic acid was an American doctor, John Crandon, working in the 1930s. Crandon put himself on a diet that contained hardly any ascorbic acid. He cut himself with a scalpel and the cut healed normally in about four days. After three months on the diet he cut himself again and that cut took three months to heal. After six months on the diet a cut would not heal at all.

7. What conclusion do you think Crandon would have made from his experiment?
8. Do you think any conclusion made would be valid?
9. How could Crandon's experiment be improved?
10. Suggest why Crandon chose to experiment on himself.

As a result of the experiments of Lind, Crandon and others, we now know that ascorbic acid is essential for the body to make connective tissues—the tissues that hold body organs together. It is thus essential for wound healing. We also know that scurvy results from a deficiency of ascorbic acid in the diet. Scurvy is rare in our society, but it does occur still in places where people are entirely dependent on food aid, such as refugee camps in developing countries or in populations affected by drought and famine.

11. Why would scurvy occur in situations where people depend on food aid?
12. Suggest what providers of aid could do to reduce the risk of people developing scurvy.

Activity 21.5 Vitamin C

The presence of vitamin C (ascorbic acid) in liquids can be detected by the use of a blue dye called dichlorophenol indophenol (DCPIP). When vitamin C is added, the DCPIP changes from blue to colourless or pale yellow. The relative amounts of vitamin C in a solution can be determined by comparing the number of drops of the solution that are required to turn, say, 2 mL of DCPIP from blue to colourless. In this activity you will compare the vitamin C content of a number of foods.

You will need

Fresh DCPIP solution, 0.1%; a variety of foods (from which liquid can be extracted); test tubes; droppers; 2 mL pipette; other apparatus depending on the design of your experiment

What to do

Design an investigation to find out which one of the foods available contains the greatest amount of vitamin C. You may need to refer to the section on design of experiments, pages 5–7.

Studying your results

Your teacher may want you to write a formal scientific report on your investigation. If so, use the format described on page 10.

In the 'discussion' section of your report mention any difficulties you had in carrying out the investigation and ways the investigation could have been improved.

As a follow up to your investigation you could test the effects of food preparation (e.g. boiling, freezing, canning, microwaving) on vitamin C content of a particular food or selection of foods.

Activity 21.6 How fit are you?

Most tests for physical fitness assess aerobic fitness; that is, the ability of the lungs and heart to supply the muscle cells with the oxygen they require for aerobic respiration. In this activity you will assess your own aerobic fitness or that of others in your group.

You will need

A measured course (such as a school athletic track) of 200 m, 300 m or 400 m length; measuring wheel (if no measured course available); stopwatch

What to do

A person should not act as subject for this activity if there is any medical reason for not being involved in strenuous exercise.

1. Work in pairs, one person acting as subject and the other as recorder.
2. The subjects should warm up for a couple of minutes with some gentle activity and stretching exercises.
3. Subjects then try to cover the greatest distance they can in a time of twelve minutes. It is important that subjects try to do their best but if the subject suffers any distress, stop at once.
4. Recorders: start the stopwatch when the subject begins running; keep a count of the laps covered; inform the subject of elapsed time on the completion of each lap; mark the point on the course that the subject reaches after exactly twelve minutes and estimate the distance covered in the last lap.
5. On conclusion of the twelve minute run subjects should continue to walk around the track for about five minutes.
6. Calculate the total distance covered in the twelve minutes.
7. Recorder and subject may swap roles and complete the test again.

Studying your results

1. Make a list of all the changes that you noticed occurring in your body as the exercise progressed, e.g. breathing, heart rate, colour of skin, sweating.
2. For each of the changes that you have on your list suggest a reason for the change.
3. Use Table 21.4 to assess your physical fitness. How fit are you?
4. Are you satisfied with your level of fitness?
5. List as many reasons as you can for maintaining a good level of fitness.
6. If you are dissatisfied with your fitness devise an exercise program that will enable you to progress to the next fitness level.

Table 21.4 Fitness levels based on the 12-minute test (metres covered in 12 minutes)

Age groups	13–19	20–29	30–39	40–49	50–59
Very poor					
males	< 2090	< 1960	< 1900	< 1830	< 1660
females	< 1610	< 1540	< 1490	< 1430	< 1350
Poor					
males	2090–2200	1960–2110	1900–2100	1830–2000	1660–1870
females	1610–1900	1540–1790	1530–1700	1430–1580	1350–1490
Fair					
males	2210–2520	2120–2400	2110–2340	2010–2240	1880–2100
females	1910–2080	1800–1970	1710–1900	1590–1790	1500–1700
Good					
males	2530–2770	2410–2640	2350–2520	2250–2470	2110–2320
females	2090–2300	1980–2160	1910–2080	1800–2000	1710–1900
Excellent					
males	2780–3000	2650–2840	2530–2730	2480–2660	2330–2550
females	2310–2430	2170–2340	2090–2240	2010–2160	1910–2100
Superior					
males	≥ 3010	≥ 2850	≥ 2740	≥ 2670	≥ 2560
females	≥ 2440	≥ 2350	≥ 2250	≥ 2170	≥ 2110

REVIEW QUESTIONS

1. **(a)** What is a lifestyle disease? Why are certain diseases called lifestyle diseases?
   (b) In what ways are lifestyle diseases different from other types of diseases?
2. Give two examples for each of the following dysfunctions:
   (a) infections
   (b) genetic disorders
   (c) lifestyle diseases
   (d) deficiency diseases.
3. **(a)** What proportion of a person's diet should be made up of foods like bread, cereals, rice, pasta and noodles?
   (b) What proportion of a person's diet should be made up of vegetables and fruit?
   (c) What foods should be eaten only sometimes or in small amounts?
4. **(a)** Why does the body need energy?
   (b) Describe four factors that affect a person's energy requirements.
5. What is body mass index?
6. List five benefits of regular exercise.
7. Hand washing is a simple and effective way of reducing the spread of micro-organisms. When should you wash your hands?
8. **(a)** What is alternative medicine?
   (b) What is the difference between alternative and complementary medicine?

9. Explain how altitude training can help to improve a person's sporting performance.
10. Why is recovery after exercise now considered to be an important part of training?
11. Explain how blood doping can help to improve a person's performance.

APPLY YOUR KNOWLEDGE

1. **(a)** A person was 181 cm tall and had a body mass of 88 kg. What was the person's body mass index?
   (b) What advice about diet would you give to that person?
2. Examine your own diet in the light of the facts presented in this chapter.
   (a) Is your diet balanced? Are all of the food groups covered (see Fig. 21.4)?
   (b) Do you think there are any deficiencies in your diet?
   (c) Do you consume excessive amounts of any foods?
   (d) Can you suggest any ways in which your diet could be improved?
3. Figure 21.2 shows how the proportion of deaths in Australia from infectious diseases has been greatly reduced over the past eighty years.
   (a) How has this dramatic decrease been achieved?
   (b) Explain why the same methods cannot be used to decrease deaths from cardiovascular disease or cancer.
4. More than half of Australian adults and more than one-quarter of Australian children are now overweight or obese. What are some of the reasons for this big proportion of overweight people?
5. **(a)** Use reference material to describe some of the risks of using drugs to improve performance.
   (b) If there are risks associated with the use of performance enhancing drugs, why do people continue to use them?
6. Many people who visit a gym have a strenuous workout, then immediately go home. What advice would you give to these people?
7. The energy needs for males and females of different ages and different levels of physical activity can be seen at http://www.nhmrc.gov.au/publications/synopses/_files/n35.pdf
   From the tables provided at the website find out your daily energy requirement.