THE BODY IN MOTION
Human movement results from a complex interaction between systems of the human body. Even the finest movements result from interaction between the nervous system, muscular system, respiratory system, bones and joints. In the human body there are 206 bones over 650 muscles and over 200 joints or articulations.
cranium
mandible
sternum
ulna
radius
carpals
femur
patella
tibia
metatarsals
phalanges

cervical vertebrae
clavical
scapula
humerus
ribs
thoracic vertebrae
lumbar vertebrae
iliac fossa
sacrum
coccyx
metacarpals
phalanges
fibula
tarsal

Figure 1.2
Human skeleton with key bones
The bones (or skeletal system) form a rigid framework to which muscles and other organs attach. The shape and length of the bone, how it joins to other bones and location of the bone in the human body will influence what movement that bone is capable of. There are four main types of bones; long bones, short bones, flat bones and irregular bones.

Long bones are longer than they are wide and tend to work in a hinge arrangement with other bones. Some examples of long bones are those found along the length of the arms and legs and include the humerus, radius, ulna, femur, fibia and tibular, metacarpals and metatarsals (see Fig. 1.3).

Short bones tend to be box shaped and include bones found in the wrists and ankles such as the carpals, scaphoid and capitiate in the wrist (see Fig. 1.4a) and the cuboid, talus and calcaneus in the foot (see Fig. 1.4b).

Flat (or broad) bones have a broad surface and play a protective role in the body and typically only have a limited movement range. Some examples of broad bones include the ribs, bones that form the protective cover over the brain (see Fig. 1.5b) and the scapular in the shoulder girdle (see Fig. 1.5a).

Irregular bones are made up of those bones that do not fit into the other three categories, such as vertebra that make up the human spine (see Fig 1.6).

There are common anatomical terminologies used by scientists and exercise physiologists when describing the location of muscles and bones in the body. These terms are outlined in Table 1.1 on page 86.
The interface between two bones—that is, the joint—has a significant role in human movement. Across the human body this interface differs significantly and can impact on the range of movements possible at that joint. In addition, the ligament and the tendon both play a significant role in movement.

There are three broad categories of joints in the human body. The first type is the immoveable or fibrous joint. These are generally found between flat bones whose main function is to protect vital organs. An example is the eight bones that are fused together by fibrous sutures to form the cranium or skull (see Fig 1.5b). The second type is the slightly movable or cartilaginous joint. An example of this joint is the cartilage discs that lie between each of the vertebrae in the human spine. They offer some protection in absorbing shock but also allow a limited range of movement. The third type of joint is the freely movable or synovial joints. These joints demonstrate a wide range of movement capability and are critical in the movement patterns adopted by athletes of all ages in sports and activities such as gymnastics, dance, swimming and game playing.

Ligaments are bundles of strong fibrous bands that connect bone to bone. They are relatively inelastic and tighten when the joint is under pressure and so prevent excess movement. Muscles and tendons also extend across joints.

Tendons are inelastic cords of connective tissue. They attach muscle to bone and assist the ligaments by holding the joints closed and acting as secondary joint stabilisers.

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structure and function of synovial joints

Synovial joints all have some common features that aid the efficiency of movement they provide. The ends of the bones in a synovial joint are covered with a thin layer of hyaline cartilage, called articular cartilage. This cartilage absorbs shocks and minimises friction, so that the bone ends can easily glide across each other during movement. The part of the bone beneath the cartilage also absorbs shock, so that it helps to protect the bone.

The joint capsule also plays a role in holding the bones of a synovial joint together. This capsule consists of an outer and inner layer. The outer layer is composed of dense connective tissue and completely encloses the other parts of the joint. The inner layer of the joint capsule consists of a lining of loose connective tissue called the synovial membrane. The synovial membrane covers all the surfaces within the joint capsule except those already covered by the articular cartilage.

The synovial membrane secretes synovial fluid into the joint. The fluid acts as a lubricant to reduce friction and also provides nourishment to the joint. Very little fluid is actually secreted; just enough to cover the articulating surfaces with a thin film. There is normally only 0.5 ml or less fluid in the knee.

There are six types of synovial joints in the human body. The ball and socket joints at the hip and shoulder and the hinged joints at the elbow and knee combine with the bones of the upper and lower limbs to produce the body’s greatest range and speed of movement. Other synovial joints—gliding, condyloid, saddle and pivot joints—combine with these to produce a vast range of refined and dexterous movements (see Fig 1.8).

Some synovial joints contain additional structures. For example, the knee joint contains menisci, which are fibrous discs of cartilage that sit within the joint capital between the femur and the tibia and fibula. Their function is to help cushion shock and distribute body weight. Bursae are fluid-filled sacs associated with certain synovial joints. Each bursa has an inner lining of synovial membrane and contains synovial fluid. Bursae are located between the skin and bony prominences. They cushion ligaments and tendons to protect them against friction and general wear and tear (see Fig 1.9).

There is a balance between stability and mobility in synovial joints. Generally, the lower limbs and the vertebral column need to be more stable and have extra joint structures because of the need to absorb shock and carry the weight of the body. The joints in the upper limbs, such as the ball and socket joints in the shoulder, are not as stable as their counterparts in the hip, but have a much greater range of movement.

---

TABLE 1.1  ▲

**Anatomical terminology**

<table>
<thead>
<tr>
<th>ANATOMICAL TERM</th>
<th>DEFINITION</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>To the front</td>
<td>The sternum is anterior to the cervical vertebrae</td>
</tr>
<tr>
<td>Posterior</td>
<td>To the back</td>
<td>The scapula is posterior to the clavicle</td>
</tr>
<tr>
<td>Superior</td>
<td>Towards the top or above</td>
<td>The cranium is superior to the clavicle</td>
</tr>
<tr>
<td>Inferior</td>
<td>Towards the bottom or below</td>
<td>The tarsal are inferior to the patella</td>
</tr>
<tr>
<td>Medial</td>
<td>Towards the inside or midline of the body</td>
<td>The big toes (in the anatomical position) are medial to the rest of the toes</td>
</tr>
<tr>
<td>Lateral</td>
<td>To the outside or away from the midline of the body</td>
<td>The thumbs (in the anatomical position) are lateral to the index fingers</td>
</tr>
<tr>
<td>Proximal</td>
<td>Nearer the trunk or body mass</td>
<td>The pelvis is at the proximal end of the femur</td>
</tr>
<tr>
<td>Distal</td>
<td>Away from the trunk or body mass</td>
<td>The fingers are distal to the wrist</td>
</tr>
</tbody>
</table>

---

**FIGURE 1.7** ▼

Structure of a simple synovial joint
**Chapter 1**

*Ball-and-Socket Joint*
- Head of humerus
- Scapula

*Hinge Joint*
- Lateral gastrocnemius bursa
- Lateral ligament
- Popliteus tendon
- Lateral semilunar cartilage
- Tibial condyle
- Ligamentum patella
- Tibia
- Patella
- Infrapatellar bursa
- Prepatellar bursa
- Supratellar bursa

*Condylar Joint*
- Metacarpal bone
- Phalanx

*Pivot Joint*
- Radius
- Ulna

*Gliding Joint*
- Metacarpal bone
- Carpal bones

*Saddle Joint*
- Metacarpal bone of thumb

**Figure 1.8**
Six types of synovial joints

**Figure 1.9**
The right knee
- (a) lateral view
- (b) posterior view
— joint actions, e.g. extension and flexion

When the muscles exert force on bones, the structure of the joints allows a diverse range of movements. Each type of movement can be described using anatomical terminology. Some of the key terms are outlined below and are organised in pairs as they reflect a movement and its reverse action.

**Flexion and extension**

Flexion is the bending movement that causes a decrease in the angle between the bones at the joint. Bending the leg at the knee and performing the upward phase of a biceps curl are examples of flexion.

Extension is the straightening movement that causes an increase in the angle between the bones at the joint. Straightening the leg at the knee and performing the downward phase of a biceps curl are examples of extension.

**Abduction and adduction**

Abduction is moving the body part in the lateral plane away from the mid-line of the body. An example of abduction is performing a star jump where a person starts with the legs together and arms by the side and then extending the arms and legs so that they are apart in their finishing position.

Adduction is moving the body part in the lateral plane back towards the midline of the body. An example of adduction is completing a star jump from the arms and legs in the apart position to the finishing position of arms by the side and legs together.

**Inversion and eversion**

Inversion is the rotation of the foot so that the sole turns inwards. Eversion is the rotation of the foot so that the sole turns outwards.
Rotation
Rotation is the movement of a bone turning on a central axis. A full rotation is usually not possible because there are ligaments and muscles that restrict the movement. An example of rotation is the neck turning from one side to the other.

Circumduction
Circumduction is the combination of other movements that results in a circular or cone-like pattern. Performing arm circles or a softball pitcher’s wind up and release are examples of circumduction.

Pronation and supination
Pronation is the movement that occurs when the radius rotates around the ulna (the thinner, longer bone of the forearm), so that the hand is facing with the palm downwards.

Supination is the movement that occurs when the radius rotates around the ulna, so that the hand is facing with the palm upwards. Putting the hand out to receive some loose change is an example of supination.

Dorsiflexion and plantarflexion
Dorsiflexion is simply the flexion of the ankle. Pulling the toes back towards the shin when stretching the hamstring muscles is an example of dorsiflexion at the ankle.

Plantarflexion is actually the extension of the foot at the ankle joint and is the opposite of dorsiflexion. A dancer standing up on their toes during a dance routine is an example of plantarflexion.
muscular system

identify the location of the major muscles involved in movement and related joint actions

perform and analyse, eg overarm throw by examining
  - bones involved and the joint action
  - muscles involved and the type of contraction
  - major muscles involved in movement

The basis of all human movement is muscle action. Muscle consists of cells with contractile filaments that move past each other to change the size of the cell. There are three types of muscle in the human body: skeletal, smooth and cardiac. Smooth and cardiac muscles are voluntary muscles that determine movement over which the human body has no control, for example, a heart beat, or the movement of food through the digestive system.

Skeletal muscle is responsible for producing human movement, and groups of muscles in the human body work together to control movement patterns. Figure 1.17 identifies the main muscles in the body. These muscles are further explained in Table 1.2.
**DELTOID**

**Location:** Anterior and posterior shoulder  
**Joint actions:** Abducts arm, anterior muscle flexes and medially rotates arm. Posterior muscles extend and laterally rotates upper arm.

---

**BICEPS BRACHII**

**Location:** Anterior upper arm  
**Joint actions:** Flexes the elbow, supinates the forearm and assists in flexing the shoulder.

---

**TRICEPS**

**Location:** Posterior upper arm  
**Joint actions:** Extends the elbow. Also stabilises the shoulder joint and retracts the capsule of the elbow joint on extension.

---

**LATISSIMUS DORSI**

**Location:** Posterior sub scapula  
**Joint actions:** Extends, adducts and medially rotates the arm. The attachments at the ribs help with deep inspiration and forced expiration.

---

**TRAPEZIUS**

**Location:** Posterior scapular, cervical vertebrae  
**Joint actions:** Laterally rotates, elevates and retracts the scapula. Also extends and flexes the neck.

---

**PECTORALS**

**Location:** Anterior thoracic cage  
**Joint actions:** Flexes and adducts the arm. Also assists in the medial rotation of the arm. Assists with inspiration.

---

▲ TABLE 1.2  
Major muscles of the body  

*continued*
<table>
<thead>
<tr>
<th>ERECTOR SPINAE (SACROSPINALIS)</th>
<th>GLUTEUS MAXIMUS</th>
<th>HAMSTRINGS (3 MUSCLES)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Erector Spinae" /></td>
<td><img src="image2" alt="Gluteus Maximus" /></td>
<td><img src="image3" alt="Hamstrings" /></td>
</tr>
<tr>
<td><strong>Location:</strong> Anterior sacrum to base of skull</td>
<td><strong>Location:</strong> Posterior pelvic girdle</td>
<td><strong>Location:</strong> Posterior upper leg</td>
</tr>
<tr>
<td><strong>Joint actions:</strong> Flexion and lateral flexion of spine.</td>
<td><strong>Joint actions:</strong> Extends and laterally rotates the hip. Assists in maintaining knee extension.</td>
<td><strong>Joint actions:</strong> The 3 muscles in this group all flex the knee and extend the hip. The main muscle laterally rotates the knee and the other muscles medially do this.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QUADRICEPS (4 MUSCLES)</th>
<th>GASTROCNEMIUS</th>
<th>SOLEUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4" alt="Quadriceps" /></td>
<td><img src="image5" alt="Gastrocnemius" /></td>
<td><img src="image6" alt="Soleus" /></td>
</tr>
<tr>
<td><strong>Location:</strong> Anterior upper leg</td>
<td><strong>Location:</strong> Posterior lower leg</td>
<td><strong>Location:</strong> Posterior lower leg</td>
</tr>
<tr>
<td><strong>Joint actions:</strong> This group of 4 muscles extends the leg at the knee and flexes thigh at hip. Also stabilises the patella.</td>
<td><strong>Joint actions:</strong> Plantar flexes the foot and also flexes the knee.</td>
<td><strong>Joint actions:</strong> Plantar flexes foot and aids in the venous return of blood.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIBIALIS ANTERIOR</th>
<th>RECTUS ABDOMINUS</th>
<th>EXTERNAL OBLIQUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Tibialis Anterior" /></td>
<td><img src="image8" alt="Rectus Abdominis" /></td>
<td><img src="image9" alt="External Oblique" /></td>
</tr>
<tr>
<td><strong>Location:</strong> Anterior lower leg</td>
<td><strong>Location:</strong> Anterior lower thoracic cage</td>
<td><strong>Location:</strong> Anterior lateral lower thoracic cage</td>
</tr>
<tr>
<td><strong>Joint actions:</strong> Extends (dorsiflexion) and inverts the foot at the ankle.</td>
<td><strong>Joint actions:</strong> Flexes the trunk. Also assists in forced expiration.</td>
<td><strong>Joint actions:</strong> Abducts and rotates the trunk. Also supports the abdominal wall.</td>
</tr>
</tbody>
</table>
Muscles work by generating tension that causes change within the cell. The tension created causes a muscle to shorten, lengthen or remain the same length. This is known as muscle contraction. In those cases where movement results the repeated contraction shortens the muscles’ length. The tendons of the shortened muscle pull on the bones in the direction of the contraction and this produces movement. For example, elbow flexion (see Fig 1.10 on page 88) is caused by the shortening contraction of the biceps. The biceps are attached to the scapula at the origin or fixed end and the radius at the insertion or movable end. As the biceps contracts, it exerts pressure on the movable end and results in the movement of the forearm towards the upper arm.

Muscles usually work in paired groups known as the agonist and antagonist. The muscle that is responsible for the shortening action is called the agonist. As the agonist contracts, the other muscle in a pair relaxes and lengthens. This muscle is called the antagonist. This process is shown in elbow flexion. When the elbow flexes, the agonist muscle is the biceps and the antagonist muscle is the triceps because it relaxes and lengthens at the same time as the biceps contracts. The opposite occurs during elbow extension. The triceps contract and straighten the ulna. The triceps become the agonist and the biceps, which relaxes, becomes the antagonist.

Stabilisers are muscles that assist agonist and antagonists in producing particular movements at a joint. For movement to be effective there must be stability in the joint. Stabilising muscles will often contract statically to hold other parts of the body around the joint still. For example, the radialis and brachoradialis muscles of the forearm assist the biceps in elbow flexion.

Types of muscle contraction (concentric, eccentric, isometric)

As mentioned previously, body movement occurs when there is a shortening of a muscle with the agonist lengthening at the same time. In this case both the agonist and antagonist will be contracting or creating tension. Where the muscle is shortening the contraction is classified as a concentric contraction. The antagonist will be lengthening but will still be creating tension to control the movement. This contraction while extending is known as an eccentric contraction.

Muscles can also be working or creating tension without a change in muscle length or body movement. These isometric contractions occur where the muscle generates force against a fixed resistance that does not move. There is no significant change in the muscle length. An example of this would be doing a calf stretch against a wall. Other sporting examples include an athlete performing a crouch start before a sprint, with muscles tensed waiting for the starter’s gun. Rock climbers will often perform isometric muscle contractions as they keep parts of their bodies still while searching for a new hand or foothold.
Concentric contraction involves the muscle length shortening during a contraction. An example of this is when the biceps contracts while performing the upward phase (flexion) of a biceps curl.

Eccentric contraction involves the muscle lengthening during a contraction. Eccentric contractions often involved movements where a resistance is being lowered. An example of this is when the biceps relaxes while performing the downward phase (extension) of a biceps curl.

**respiratory system**

**analyse the various aspects of lung function through participation in a range of physical activities.**

- **structure and function**

The human respiratory system plays a significant role in human movement. Whether it is short, sharp movements over a limited time span or repeated movements over a long period of time, the human lungs will have a role to play. Figure 1.19 shows the key features of the human respiratory system: the mouth, nose, trachea, lungs and diaphragm.

The respiratory system supplies the blood with oxygen through the breathing process. When humans breathe, oxygen is inhaled and carbon dioxide is exhaled. This exchange of gases is the respiratory system’s means of getting oxygen to the blood.

When humans breathe in (inhale), oxygen enters the respiratory system through the mouth and the nose. The inhaled breath then passes through the larynx (where speech sounds are produced) and the trachea, which is the main tube entering the chest cavity. In the chest cavity, the trachea splits into two smaller tubes called the bronchi. Each bronchus then divides again forming the bronchial tubes. The bronchial tubes further divide into many smaller tubes (bronchioles), which connect to tiny air sacs called alveoli. There are over 600 million of these sponge-like alveoli in a healthy human lung. The wall of the alveoli is very thin and it is here that oxygen exchange takes place. Oxygen inhaled into the lung passes through the thin wall of the alveoli and into the blood stream. At the same time, poisonous carbon dioxide passes back into the lung through the wall of the alveoli.
Control of the breathing action is done by the muscular diaphragm, which lies across the bottom of the chest cavity. The diaphragm’s job is to help pump the carbon dioxide out of the lungs and create space to allow oxygen to flow into the lungs. When the diaphragm contracts, oxygen is drawn into the lungs. When the diaphragm relaxes, carbon dioxide is pushed out of the lungs (exhale).

The ability to make use of atmospheric oxygen and remove poisonous carbon dioxide from the body is one that not only keeps human beings alive, but it can have a significant impact on the body’s ability to move efficiently. Poor lung efficiency can contribute to muscle fatigue and the build up of lactic acid and inhibit movement patterns.

The efficiency of the respiratory system has a big impact on human performance. Those athletes who display highly efficient lung function will often perform well in endurance sports such as triathlon, marathon running and ocean swimming.

- lung function (inspiration and expiration)
- exchange of gases (internal, external)

There are a number of measures that can be used to determine lung function. These can vary from simple analysis of how ‘puffed’ an athlete feels after performing a set amount of work through to sophisticated scientific measures of lung capacity and gas exchange.

**Spirometry**

More sophisticated testing of lung function can be used to determine a range of measures of lung function. These measures include:

- Total lung capacity (TLC). This measures the amount of air in the lungs after a person has inhaled as deeply as possible.
- Forced vital capacity (FVC). This measures the amount of air a person can exhale with force after they have inhaled as deeply as possible.
- Forced expiratory volume (FEV). This measures the amount of air a person can exhale with force in one breath. The amount of air a person exhales may be measured at 1 second (FEV1), 2 seconds (FEV2), or 3 seconds (FEV3). FEV1 divided by FVC can also be determined, this is the ratio of FEV1 to FVC and is essentially the proportion of the lung volume that can be expired in one second.
- Peak expiratory flow (PEF). This measures how quickly a person can exhale. It is usually measured at the same time as the person’s forced vital capacity (FVC).
- Maximum voluntary ventilation (MVV). This measures the greatest amount of air a person can breathe in and out during one minute.
• Expiratory reserve volume (ERV). This measures the difference between the amount of air in a person’s lungs after a normal exhale (FRC) and the amount after a person has exhaled with force (RV).

- circulatory system
- analyse the movement of blood throughout the body and the influence of the circulatory and respiratory systems on movement efficiency and performance
- components of blood

The circulatory system plays a critical role in human movement. It is through the circulatory system that oxygen and nutrients are transported to muscle and waste products are carried away. The circulatory system consists of the heart and blood vessels that transport blood around the body.

The blood has a vital role in human health and wellbeing and it is often through blood tests that medical practitioners determine health problems.

Blood is a fluid tissue. The material between the cells of the blood is called plasma, which makes up about 55% of the blood volume; the other 45% of cellular component contains red cells, white cells and platelets. Red blood cells carry the protein hemoglobin, which gives blood its colour and can combine with oxygen, which enables the blood to carry oxygen from the lungs to the tissues. White blood cells protect the body against bacteria. Platelets are tiny cell fragments which aid in the clotting of blood in the event of a cut or injury. The components of blood can be seen in Figure 1.22.
The physiological and performance-related effects of altitude

Altitude is generally defined as the height of a location above sea level. As the altitude increases, the atmospheric pressure decreases and this means that there is less oxygen available for the body to process. Some people suffer altitude sickness when first arriving at high altitudes (usually anything over 2400m). The body acclimatises to altitude by producing more red blood cells to carry more oxygen and the lungs increase in size to facilitate the oxygen transfer.

On returning to sea level after successfully acclimatising to altitude, the body usually has more red blood cells and a greater lung capacity than necessary. This results in a period of improved athletic performance. Athletes have been using forms of altitude training for many years, particularly competitors in endurance events such as marathons. Latest research shows that a ‘live high train low’ regime is the most beneficial form of training for improving athletic performance.

- structure and function of the heart, arteries, veins, capillaries
- pulmonary and systemic circulation

The heart is a complex muscular organ that regulates life by controlling the flow of blood around the body. Figure 1.23 shows the key features of the human heart.

The circulatory system is the way blood is circulated around the body. Figure 1.24 shows how this trip around the body takes place. The heart muscle contracts and forces blood to the lungs through the pulmonary artery. The blood offloads carbon dioxide in the lungs and becomes enriched with oxygen. It then returns to the heart through the pulmonary vein.

From here the oxygen rich blood, travels to the aorta and out to the rest of the body though a complex series of arteries and smaller capillaries. It is along these capillaries that nutrients pass to body cells and waste products are returned to the blood. The blood then returns to the heart through a series of larger vessels called veins.

**Figure 1.23**

The structure of the heart

- The superior vena cava brings deoxygenated blood to the heart from the upper body
- The right atrium receives blood that has been around the body
- Semi-lunar valves stop blood flowing from the arteries back into the ventricles
- Atroventricular valves stop backflow of blood from the ventricles to the atria
- The right ventricle pumps blood to the lungs
- The inferior vena cava brings deoxygenated blood to the heart from the lower body
- The aorta takes oxygenated blood to the body
- The pulmonary arteries take deoxygenated blood to the lungs
- The pulmonary veins bring oxygenated blood to the heart from the lungs
- The left atrium receives blood from the lungs and pushes blood into the left ventricle
- The left ventricle pumps blood to all parts of the body (except the lungs)
- The left ventricle has more muscle in the wall because it has to pump blood all over the body
- The right ventricle has a thinner wall than the left because it only pumps blood to the lungs
- The inferior vena cava brings deoxygenated blood to the heart from the lower body
- The aorta takes oxygenated blood to the body
- The pulmonary arteries take deoxygenated blood to the lungs
- The pulmonary veins bring oxygenated blood to the heart from the lungs
- The left atrium receives blood from the lungs and pushes blood into the left ventricle
- The left ventricle pumps blood to all parts of the body (except the lungs)
- The left ventricle has more muscle in the wall because it has to pump blood all over the body
- The right ventricle has a thinner wall than the left because it only pumps blood to the lungs
The circulation of the blood is controlled by the regular contractions of the heart muscle. An efficient heart may beat at 60–65 beats per minute while at rest. When a person exercises or comes under strain the heart responds by beating faster to circulate oxygen and nutrients and remove waste products. Each time the heart contracts or beats, the pressure of the blood against the walls of the arteries and veins increase. This blood pressure can be measured using simple pressure gauges. These blood pressure gauges measure the pressure of blood against the walls of an artery at two points. The highest reading is the pressure of blood against the artery walls when the heart contracts. The lowest reading is the pressure when the contraction is completed and the blood flow is at its weakest; for example, 120/80 millimetres of mercury (mmHg). The high reading is known as the **systolic blood pressure** and the low measure is **diastolic blood pressure**.

---

**Figure 1.24**
The key arteries and veins of the circulatory system.

The arteries carry oxygen-rich blood from the heart to the organs of the body and the veins carry waste products back to the lungs.
**Activity 1 (Page 82)**
Research the internet or magazines and find photos showing athletes, dancers, gymnasts or swimmers performing movement tasks. Use your understanding of bones and joints to **identify** the key bones and joints that are used in the movement, the type of joint involved and **describe** the movements at the joint. Follow the example given below.

The bowler:
- left leg: flexion at knee (hinge joint)
- left hip: flexion (ball and socket joint)
- right shoulder: rotation of ball and socket joint
- right elbow: extension.

**Activity 2 (Page 93)**
Using the images from Activity 1, add information about the muscles that may be involved in these movements.

Perform a vertical jump, push-up, shot-put throw and football kick. **Analyse** the bones, joints and muscles involved in these movements.

**Activity 3 (Page 94)**
Perform the following tasks and record how you feel and **describe** how your lungs are functioning during and after performing each activity:
- sprinting 20 metres
- sprinting 100 metres
- running up a set of stairs.

  a. Measure how many breaths you take each minute after each activity.
  b. Measure your rate of breaths per minute when at rest.

**Explain** the observations and **discuss** what other class members have recorded when doing the same activities. Why is there variation between individuals? What can you do to improve performance of the lungs?

**Predict** how each of the lung function measures may vary between a highly trained triathlete and an average person in the street.

**Activity 4 (Page 96)**
**Identify** the key components of blood and describe how they contribute to human movement.

**Activity 5 (Page 98)**
What role do the arteries and veins play in circulation?
Review Questions

1. **Identify** the bones that form each of the following joints. Identify the movements the joint can perform and **explain** how the bones and joint type influence those movements:
   - hip joint
   - shoulder joint
   - elbow joint
   - shoulder joint

2. **Identify** a simple skill from the following physical activities and **describe** the movements required to perform that skill:
   - football
   - netball
   - ballet
   - modern dance
   - gymnastics
   - swimming

3. **Identify** the agonist and antagonist in the following actions:
   - extension of the elbow
   - rotation of the shoulder
   - flexion of the hip
   - hyperextension of the hip
   - rotation of the neck

4. **Explain** the different types of contraction that muscles are able to perform.

5. **Identify** some sport-based movements where isometric contractions are required.

6. Draw a simple diagram **identifying** the flow of blood around the human body and the main organs and vessels involved.

7. **Explain** how blood pressure is measured and what the final reading means.

8. **Describe** how an inefficient cardiorespiratory system can influence human movement.

9. **Explain** the key measures of lung function.

10. **Describe** how lung function can impact on human movement.