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Human Perspectives ATAR Units 1 & 2

Answers

Chapter 8 The musculoskeletal system allows movement

Questions 8.1

Recall knowledge

1 List the types of muscle cells.

Answer: Skeletal muscle, smooth muscle, cardiac muscle

2 Describe the properties of muscles.

Answer: Muscles can contract or shorten in length. They have extensibility properties, which means they are able to stretch, and elasticity properties that allow them to return to their original length after being stretched.

3 Which types of muscles are under involuntary control?

Answer: Smooth muscle and cardiac muscle

Apply knowledge

4 List the type of muscle that is associated with each of the following:

a the heart *Answer*: Cardiac

b the oesophagus *Answer*: Smooth

c the hand *Answer:* Skeletal

d the left ventricle *Answer*: Cardiac

e the lower leg *Answer:* Skeletal

f the small intestine. *Answer*: Smooth

5 Predict the consequence of a muscle losing its elasticity.

Answer: If a muscle loses elasticity it will not return to its original length after being stretched, which will result in the muscle being unable to be stretched again.

Questions 8.2

Recall knowledge

1 What holds bundles of muscle cells together?

Answer: A sheath of connective tissue called the epimysium

2 Place the structures in order from the smallest to the largest: actin and myosin, muscle, myofilament, muscle bundle, myofibril, muscle fibres.

Answer: actin and myosin → myofilament → myofibril → muscle fibre → muscle bundle → muscle

3 Define 'sarcolemma'.

Answer: The sarcolemma is the thin, transparent plasma membrane of the muscle cell.

Apply knowledge

4 Explain why meat from younger animals is of a higher quality than meat from older animals.

Answer: Younger animals will have less connective tissue surrounding its muscle fibres, and therefore will be more tender.

5 Explain why skeletal muscle has a striated appearance.

Answer: The striations in skeletal muscle are a result of the organisation of the actin and myosin proteins (thick and thin filaments) in the myofibril.

Questions 8.3

Recall knowledge

1 List the properties of muscles.

Answer: Contractibility, extensibility and elasticity.

2 Define 'sarcomere'.

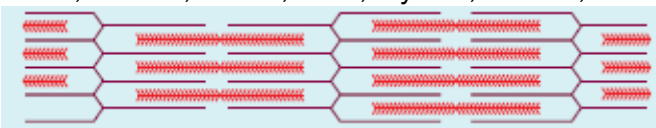
Answer: The contractile unit of skeletal muscle, consisting of actin and myosin filaments.

3 Classify actin and myosin as muscle fibres, myofibrils or myofilaments.

Answer: They are myofilaments. Actin is the thin myofilament and myosin is the thick myofilament.

4 Clearly identify each of the following on the diagram below.

Z line, A band, I band, actin, myosin, H zone, sarcomere



Answer: Refer to Figure 8.9 on page 199 of the student book.

Sarcomere: runs Z line to Z line.

H zone: middle of sarcomere with only myosin

A band: length of myosin

I band: actin either side of the Z line

Myosin: thick myofilaments

Actin: thin myofilaments

5 Use the hamstring and quadriceps as an example to explain the difference between an agonist and antagonist when the leg is flexed.

Answer: The agonist is the muscle completing the desired movement and the antagonist is providing a movement opposite to the agonist. When the leg is flexed, the quadriceps are contracted (agonist) and the hamstrings are relaxed (antagonist).

6 Describe the importance of synergists.

Answer: Synergists steady a joint during a particular movement. They are important in stabilising the joint to prevent unwanted movement so the agonist can function more effectively.

Apply knowledge

7 Explain what happens to each of the following when a muscle contracts.

a The A band *Answer:* No change is seen

b The I band *Answer:* The I band becomes smaller

c The sarcomere *Answer:* The sarcomere shortens in length.

8 Predict what would happen if the tendon attaching the triceps muscle to the bone were severed.

Answer: The triceps muscle would still contract, but it would not be able to pull on the bone, so the forearm would not be extended.

Questions 8.4

Recall knowledge

1 List the functions of the skeletal system.

Answer:

- Scaffold for support of the weight of the body
- Facilitates movement
- Protects vital internal organs
- Produces red blood cells
- Stores and releases minerals and fat

2 State the type of bone for each example.

a Cranium *Answer:* Irregular bone

b Humerus *Answer:* Long bone

c Patella *Answer:* Sesamoid bone

d Carpal bones *Answer:* Short bones

e Pelvis *Answer:* Flat bone

3 Describe the axial and appendicular skeletons.

Answer: The axial skeleton consists of bones that lie around the central axis of the body. It includes the skull, vertebral column, ribs and sternum.
The appendicular skeleton consists of the bones of the upper and lower limbs, the pectoral girdle and the pelvic girdle.

Apply knowledge

4 Predict what would happen if the skull consisted of cartilage instead of bone.

Answer: As cartilage has a degree of flexibility, the brain would not be as well protected. Any knocks or bumps to the skull could result in severe damage to the brain.

5 Explain why it is important for pregnant women to include sufficient calcium in their diet.

Answer: The developing foetus needs calcium to grow its own bones. If the mother's diet does not provide sufficient calcium for both her the foetus, the body will strip calcium from her own bones to provide for the foetus. This can lead to weakened bones in the mother.

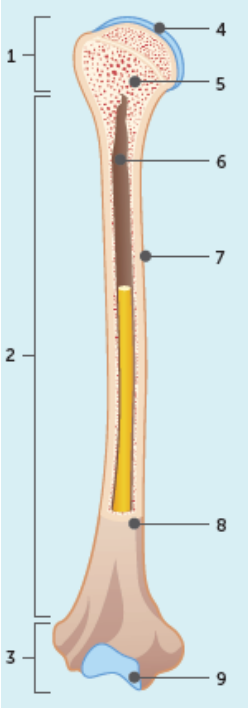
6 Suggest why the wrist is composed of short bones.

Answer: Short bones provide stability but also allow for movement, so that the action of flexion and extension of the hand can occur.

Questions 8.5

Recall knowledge

1 Name the parts of a long bone on the diagram below.



Answer:

1 – Epiphysis

2 – Diaphysis

3 – Epiphysis

4 – Articular cartilage

5 – Spongy bone

6 – Medullary cavity

7 – Compact bone

8 – Periosteum

9 – Articular cartilage

2 Describe the structure of an osteon.

Answer: Each osteon has a central canal at its centre containing nerve cells and at least one blood capillary. Surrounding the central canal are concentric layers of bony matrix called lamellae. Lacunae are small spaces that can be found in the matrix between the lamella, where an osteocyte sits. Tiny canal called canaliculi run between each lacunae.

3 What type of cartilage is found in the ear?

Answer: Elastic cartilage

Apply knowledge

4 Explain the difference between a chondroblast and a chondrocyte.

Answer: A chondroblast is an immature cartilage cell that produces the matrix of the cartilage until they have trapped themselves in a small space. At this point they are considered mature and referred to as a chondrocyte.

5 Explain why cartilage takes longer than bone to heal.

Answer: Cartilage does not contain blood vessels, so diffusion of nutrients and wastes to and from the chondrocytes must occur through the matrix. This is a slow process, and results in the chondrocytes having a slow metabolism and rate of cell division. Bone has a blood supply, and each osteocyte has a blood vessel in close contact to it, meaning a faster rate of metabolism and cell division for repair.

Questions 8.6

Recall knowledge

1 List the types of joints according to their structural classification.

Answer: Fibrous or fixed; Cartilaginous or slightly moveable; Synovial or freely moveable.

2 List two examples of fibrous joints.

Answer: The sutures of the skull bones and the join between the teeth and the jaw.

3 Define ‘synovial joints’.

Answer: Synovial joints are freely moveable, the movement is limited only by the action of ligaments, muscles, tendons and the adjoining bones.

4 Describe the type of joint present in the elbow.

Answer: The elbow is an example of a hinge joint.

5 Describe the function of synovial fluid.

Answer: Synovial fluid fills the synovial cavity and lubricates the joint. It also provides nutrients to the cells of the articular cartilage and contains phagocytotic cells that help remove any debris or microorganisms.

6 State the type of movement that occurs when kicking a football.

Answer: Flexion and extension of the lower limb.

Apply knowledge

7 Describe the difference between a tendon and a ligament.

Answer: A tendon joins muscle to bone, a ligament attaches bone to bone and crosses a joint.

8 Explain why the shoulder joint has a large range of motion.

Answer: The shoulder joint is an example of a synovial joint, a ball and socket joint. This joint type allows for movement in all planes of movement.

9 A joint affected by arthritis often has damage to the articular cartilage. These joints are often swollen. Suggest the reason for the swelling.

Answer: The amount of synovial fluid in a joint increases when there has been inflammation or damage. This helps support the joint, limit movement to prevent further damage and provide an environment for phagocytotic cells to work to remove any debris from the damaged cartilage. This excess fluid production creates a swelling at the joint site.

Questions 8.7

Recall knowledge

1 Define 'osteoporosis' and 'osteoarthritis'.

Answer: Osteoporosis is the loss of bone mass associated with aging, which results in an increased risk of fractures. Osteoarthritis is deterioration of the joint cartilage due to age or injury, to the point where the bone surfaces are not protected.

2 State what can be done to prevent osteoporosis.

Answer: Maintain a diet that provides adequate calcium, get sufficient vitamin D and exercise.

3 By what age is it common to experience some osteoarthritis?

Answer: By the age of 70, everyone will have some symptoms of osteoarthritis.

Apply knowledge

4 Explain why osteoporosis often leads to bone fractures.

Answer: Osteoporosis is a loss of bone density, so that even light knocks or falls can cause a fracture.

5 Explain why osteoarthritis causes painful joints.

Answer: The ends of the bones in the joints are no longer protected and bony spurs may develop on the end of the bones and into the joint cavity. The pain is more severe after exercise or if weight is put onto the joint.

Chapter 8 activities

Activity 8.1 Investigating fast- and slow-twitch fibres

Studying your results

1 Describe what was happening to your muscle fibres while you were in the wall sit position.

Answer: Slow-twitch fibres were constantly contracting to maintain position.

2 List the types of activities that would use fast-twitch fibres and those that would use slow-witch fibres.

Answer: Fast-twitch fibres: sprints, eye movements, throwing or bowling and kicking; Slow-twitch fibres: standing, jogging, cycling and endurance swimming

3 Study the class data.

a Does it appear that students who participate in sports or activities that require endurance are better able to hold the wall sit position?

Answer: Students should find a positive correlation.

b Does it appear that students who participate in sports or activities that require short bursts of energy did not last as long in this activity?

Answer: Students should find a positive correlation.

Summary

Answer: Students may repeat the information given in this activity or, with some research, they could mention some of the following points.
Slow-twitch, fatigue-resistant fibres are red in colour and contract slowly. The red colour means that they have plentiful supplies of myoglobin, which stores oxygen and releases it into the muscle cells by diffusion.
These fibres also have abundant mitochondria, adding to their ability to respire aerobically and produce ATP for a rich energy supply. As they are able to meet their energy requirements through aerobic respiration, they are fatigue-resistant and specialised for endurance that requires strong and

prolonged muscle contraction. This is useful during activities such as standing and maintaining posture, running marathons, or playing a full game of football.

Fast-twitch fibres are usually pale in colour and are larger than the slow-twitch fibres. They contract rapidly and rely on anaerobic pathways for instant energy. These pathways yield very small amounts of energy, but produce large amounts of lactic acid, which accumulates quickly in the cells. These fibres fatigue quickly, but deliver very powerful contractions before they do so. They thus deliver rapid, intense movements for brief periods of time, such as when sprinting, typing and making eye movements.

Activity 8.2 Studying a long bone

Studying your observations

1 Draw a diagram of a longitudinal section of long bone. Label the following structures on your diagram: periosteum, articular cartilage, epiphysis, diaphysis, compact bone, spongy bone and marrow cavity.

Answer: Refer to Figure 8.16 on page 207 of the student book.

2 Describe the function of the articular cartilage. How do the location and texture of the cartilage relate to its function?

Answer: The articular cartilage reduces friction and absorbs stress during the movement of the joint. It occurs where bones articulate with one another, and the smooth surface reduces friction.

3 What is the purpose of the blood vessels in the periosteum? Why does bone require a blood supply?

Answer: Bone is living tissue and the bone cells must respire to release energy for growth and repair, as well as producing blood cells in the marrow. The blood vessels provide the bone cells with nutrients and oxygen, and they also carry away any wastes.

4 Describe how muscles are attached to the bone.

Answer: Muscles are attached to bone via tendons, which are tough fibrous tissues that attach to either the bone or cartilage.

5 What is the thickness of the compact bone (in millimetres) at the epiphyses and the diaphysis?

Answer: Answers will vary, but the compact bone should be much thicker in the diaphysis/shaft compared with the epiphyses/ends.

6 Explain the differences in location and structure of the spongy bone and the compact bone. Relate these differences to the functions of the two types of bone.

Answer: Spongy bone appears irregular with many spaces in it, compared with the compact bone, which appears very dense and hard. Compact bone is found along the shaft of the bone and around the outside of the epiphyses. It provides strength. Spongy bone is found inside the epiphyses of the bone and helps the bone to resist stress. It also limits the overall weight of the bone because of the spaces between the plates of bone.

7 Why aren't long bones solid? What is the purpose of the marrow cavity? Describe the marrow that fills the marrow cavity.

Answer: Long bones are not solid because they have a cavity running the length of the shaft. This provides increased strength (especially if the bone is compressed), helps to reduce weight and makes the cavity available for other purposes. The marrow that fills the cavity of the long bone is yellow. It stores fat, which the body consumes as a last resort in cases of extreme starvation. It also turns into red marrow in emergencies such as blood loss or anaemia.

8 Why do the ends of the bone, the epiphyses, have a greater diameter than the shaft of the bone, the diaphysis? Suggest at least two reasons.

Answer: The ends are wider to provide a greater surface of articular cartilage to allow for articulation at the joint and to help in carrying the load. The wide ends also allow more space for the attachment of muscles.

Activity 8.3 Investigating the composition of bone

Studying your observations

1 Describe any differences that you observed between the bone left in acid and the bone left in water.

Answer: The bone left in the acid should be very soft, but the bone left in water should be unchanged.

2 Propose a hypothesis to account for any differences that you observed.

Answer: Acid reacts with the hard calcium salts in the bone, dissolving them and leaving soft material behind.

3 If a person does not consume enough calcium in their diet for normal body functioning, calcium is removed from the bones. What would be one of the symptoms of severe dietary calcium deficiency?

Answer: Bones would become soft and structurally weak, possibly resulting in fractures or, in the case of the legs, bending of bones under the weight of the body.

Chapter 8 review questions

Recall

1 List the three types of muscle, and state one location of each type.

Answer: Skeletal muscle – hamstring, bicep, tongue ; Smooth muscle – intestinal wall, stomach, uterus; Cardiac muscle - heart

2 Give a definition and example for: agonist, synergist, ligament.

Answer:

- Agonist – The muscle producing the desired movement. For example, when picking up a book, the biceps acts as the agonist.
- Synergist – The muscle that stabilises a joint, to allow the agonist to move more efficiently. For example, when picking up a book, the pectoral muscles stabilise the shoulder joint to present unwanted movement.
- Ligament – Attaches bone to bone and crosses a joint. For example, the anterior cruciate ligament that many football players tear.

3 Briefly describe five main functions of the skeletal system.

Answer:

- The skeleton provides a firm framework that gives shape to the body and supports its parts.
- The bones provide points of attachment for skeletal muscles. When the muscles contract, they pull on the bones, allowing movement to take place.
- To protect vital organs: the brain is encased within the skull; the spinal cord is contained within the spinal canal formed by the vertebrae; the heart and lungs are protected by the rib cage; and the pelvis protects the internal reproductive organs and bladder.
- The bones of the skeleton act as storage organs for mineral salts and fat. Calcium, phosphorus, sodium and potassium are the main minerals stored within bone. Fat is stored in the marrow of long bones.
- Blood cell production: the red marrow contained within certain bones produces blood cells.

4 Describe the external and internal structure of a typical long bone.

Answer: A long bone consists of:

- a shaft, called the diaphysis, making up the main portion of the bone
- the ends, or epiphyses, which are the enlarged ends of the bone. A thin layer of cartilage, the articular cartilage, covers each epiphysis.

When the bone is cut lengthwise, the diaphysis can be seen to be a hollow cylinder of compact bone surrounding a cavity. This cavity is used as a fat storage site and is often called the yellow bone marrow cavity.

The epiphyses have compact bone on the outside, but their central regions contain spongy or cancellous bone. Cancellous bone is more porous than compact bone, and contains many large spaces filled with marrow. In certain bones this may be red bone marrow, where blood cell production takes place. On the outer surface of the bone there is a dense, white, fibrous covering, the periosteum. There is no periosteum at the joints where the bone is covered with an articular cartilage.

5 Draw and label a diagram of the microscopic structure of compact bone.

Answer: See Figure 8.17 on page 208 of the student book. Students should label an osteon, central canal, lacuna, canaliculus and lamella.

6 State the function of the following microscopic structures of compact bone: central canal; lamellae; lacunae; osteocytes; canaliculi.

Answer:

- Central (or Haversian) canal: Contains blood vessels and nerves
- Lamellae: Concentric rings of hard bone matrix that are around each central canal.
- Lacunae: Small cavities in the matrix in which the osteocytes lie
- Osteocytes: Mature bone cells
- Canaliculi: Extend from lacunae and connect them to each other and to the central canal, permitting diffusion of nutrients, oxygen and wastes to and from the bone cells and the blood vessels in the central canal.

7 Describe the factors that limit the amount of movement about a joint.

Answer: The factors that limit the amount of movement at a joint include the type of connective tissue that binds the bones together, and the structure and shape of the bones that are joined.

8 Distinguish between the three main types of joints based on:

a structure

b function.

Answer:

- Fixed or fibrous joints. When no movement occurs between the bones concerned, the joint is described as fixed or immovable. The bones are held in place by fibrous connective tissue, as is the case with the sutures of the skull.
- Slightly movable or cartilaginous joints. These joints are held in place by cartilage, which allows slight movement to occur.
- Freely movable or synovial joints. Most of the joints of the body are freely movable, the amount of movement possible being limited by ligaments, muscles, tendons and adjoining bones. These joints are also known as synovial joints and they occur at the shoulder, elbow, wrist, fingers, hip, knee, ankle and toes.

9 List the functions of synovial fluid.

Answer: Synovial fluid fills the joint capsule, lubricates the joint, helps keep the articulating surfaces from touching, provides nourishment for the cartilage cells and contains phagocytotic cells that help remove microorganisms and debris from wear and tear.

10 Draw a labelled diagram of a synovial joint.

Answer: Refer to Figure 8.24 on page 214 of the student book.

Explain

11 Explain how the sliding filament theory accounts for the action of muscles.

Answer: The sliding filament model explains the method by which muscles are thought to contract. The model states that the actin and myosin filaments slide past one another so that the sarcomeres shorten and the Z bands move closer to each another. When a muscle relaxes, the actin and myosin filaments are pulled past one another in the opposite direction and the sarcomere lengthens.

12 Explain how muscle tone contributes to a person's posture.

Answer: Muscle tone is maintaining partial contraction of skeletal muscles. It contributes to a person's posture with the partial contraction of those muscles that hold the body in a particular position.

13 Explain how muscles produce movement about a joint. In your answer, distinguish between the roles of agonists and antagonists.

Answer: Muscles that move the parts of the skeleton about a joint are always grouped in pairs. Contraction of one of the pair produces movement of bones in one direction, while contraction of the other produces movement in the opposite direction. Such pairs of muscles are referred to as antagonists because they have opposite actions. When a muscle contracts to move a limb, it is called an agonist; the antagonist is the muscle that has to relax as the agonist contracts.

14 Explain what is meant by the term 'joint', with regard to the skeleton.

Answer: A joint is the site at which two or more bones come together.

15 Differentiate between the axial skeleton and the appendicular skeleton.

Answer: The axial skeleton forms the upright axis of the trunk and provides protection for the brain, spinal cord and organs within the thorax. It consists of the skull, vertebral column and bony thorax. The appendicular skeleton consists of all other bones of the skeleton and is adapted to carry out movement.

16 Describe all the factors that contribute to keeping the articulating surfaces of a synovial joint in contact with each other.

Answer: The articular capsule has an outer layer, the fibrous capsule, which consists of dense, fibrous connective tissue attached to the periosteum of the articulating bones. The fibrous capsule is one of the principal structures that holds the bones together. The other is the reinforcing ligaments, some of which may be part of the capsule, while others occur outside the capsule, holding the bones together, directing bone movement and preventing excessive motion.

17 Explain why articular discs are important in some joints.

Answer: Articular discs are thin, oval plates of fibrocartilage that divide the joint cavity into compartments. This helps to direct the flow of synovial fluid to areas of the articular cartilage that experience the most friction.

Apply

18 How does muscle tissue differ from the other tissues of the body?

Answer: Muscle tissue has the ability to contract through the action of the special proteins actin and myosin. No other tissue in the body can do this. Skeletal muscle cells (fibres) are very long and have many nuclei.

19 Describe the characteristics that would allow you to classify a muscle as skeletal or smooth when viewed on a microscope slide.

Answer: Skeletal muscle would look striated, arranged in parallel bundles and be multinucleated. Smooth muscle would have a spindle-shaped cell, with one nucleus and no striations.

20 Compare and contrast the muscles that move the lower arm with those that move the lower leg.

Answer: Compare: Both muscles occur in pairs – the hamstring and quadriceps (lower leg) and the biceps and triceps (lower arm). Both are skeletal muscles and move under voluntary control.
Contrast: The muscles that move the arm are much smaller than the muscles that move the leg.

21 Using an example, describe how a fixator muscle can act as a stabiliser to allow other muscles to perform a particular movement.

Answer: A fixator muscle acts as a stabiliser of one part of the body during movement of another part. Fixator muscles hold the scapula firmly against the chest so that when the arm muscles contract, only their insertions are moved.

22 Differentiate between:

a compact and cancellous bone

Answer: Compact bone consists of many similar units called osteons or Haversian systems. At the centre of each osteon is a central canal (or Haversian canal), around which are concentric layers of bony matrix called lamellae. Between the lamellae are small spaces in the matrix, the lacunae. A bone cell, or osteocyte, occupies each lacuna.
On the other hand, cancellous or spongy bone is not organised into osteons. It consists of an irregular arrangement of thin, bony plates called trabeculae. The bone cells occupy spaces in the trabeculae, but the lamellae are not arranged in concentric layers, and nerves and blood vessels pass through irregular spaces in the matrix. Cancellous bone is more porous than compact bone, and contains many large spaces filled with marrow.

b yellow bone marrow and red bone marrow

Answer: Yellow bone marrow is a store of fat. It fills the cavity in the hollow diaphysis of long bones. Red marrow is found in cancellous bone. Cancellous bone is more porous than compact bone and contains many large spaces filled with marrow. In certain bones this may be red bone marrow, where blood cell production takes place.

c diaphysis and epiphysis

Answer: Diaphysis is the shaft of the long bone; the epiphysis is the end of the long bone. It is usually wider than the diaphysis.

d osteon and trabeculae.

Answer: An osteon is a microscopic unit of compact bone. It has a regular arrangement of concentric layers of bony matrix surrounding a central canal. Osteons run parallel to the long axis of the bone to give strength. Trabeculae are irregular arrangements of thin bony plates, where bone cells, nerves and blood vessels can be found through the irregular spaces in the matrix. They are found in spongy bone.

23 Use an example to differentiate between:

a flexion and extension

Answer: Flexion (or bending) decreases the angle between the articulating bones; for example, bending the knee or bending the elbow. In contrast, extension (or straightening) increases the angle between the articulating bones; for example, straightening of the arm or leg after flexion.

b abduction and adduction.

Answer: Abduction is movement away from the midline of the body; for example, lifting the arms upwards and away from the body. In contrast, adduction is movement towards the midline of the body; for example, returning the arms to the sides after abduction.

24 Compare and contrast osteoporosis and osteoarthritis.

Answer: Osteoporosis occurs when the loss of bone mass associated with ageing impairs normal functioning. With decreasing bone density, an individual has an increased risk of fractures to the extent that even a minor bump or fall can result in a serious fracture. Osteoarthritis is a gradual change in the joints that occurs over time. It is also associated with ageing, but other factors include irritation of the joints, and wear and abrasion. With osteoarthritis, the joint cartilage deteriorates so that the bone surfaces are no longer protected. The exposed bone begins to wear away and bony spurs or growths may develop from the exposed ends of the bone forming the joint. These growths and spurs decrease the space within the joint cavity, restricting movement of the joint.

25 Suggest reasons why epiphyses of long bones are composed of cancellous bone, while the diaphysis is composed of compact bone.

Answer: The cancellous bone that fills the epiphyses of a long bone is made up of bony plates (trabeculae), which are arranged to provide maximum strength along the lines of stress in the bone.

Also, if the whole bone were made of compact bone it would be very heavy. Having cancellous bone at the epiphyses reduces the overall weight.
Bones are most likely to break somewhere along their length. The compact bone that makes up the shaft is stronger than the cancellous bone at the epiphyses.

26 Eight types of joints are described in this chapter. Rank them from the type that allows the greatest degree of movement to the one that allows the least.

Answer: The order will depend on whether students interpret degree of movement as planes of movement or range of movement in one plane. Answers will therefore vary, but a possible order could be:
a ball and socket joints
b saddle joint
c hinge joint, pivot joint, gliding joint and condyloid joint
d slightly movable (cartilaginous) joints
e fixed (fibrous) joints.

Extend

27 Use your understanding of the mechanism of breathing and the structure of joints to explain why the ribs are attached to the sternum with cartilage.

Answer: The ribs must be able to expand the thoracic cavity to cause air to enter the lungs during inhalation. Thus, the rib joints need to have strength while retaining flexibility. The joints being made of cartilage allows for this movement.

28 Explain how the muscular and skeletal systems must work interdependently.

Answer: The muscular system allows the skeleton to move. The skeleton provides the flexible framework for muscles to attach to so when the muscle contract, they move the bones at the moveable joints.

29 In doing the wall sit in Activity 8.1, your quadriceps muscle was contracting isometrically. Muscles are also able to contract isotonically. Find out the difference between these two types of muscle contraction. Then, using the biceps muscle as an example, describe situations that would result in each of these two types of contraction.

Answer: If a stimulated muscle is held so that it does not shorten, it simply exerts tension. This is called an isometric (‘same length’) contraction. If the muscle is allowed to shorten, the contraction is called isotonic (‘same tension’). All lifting exercises require isotonic contractions. This happens

when the muscle shortens as it contracts. An example of isotonic contraction can be seen when we flex the biceps muscle. An isometric contraction happens when there is tension on the muscle but no movement is made, causing the length of the muscle to remain the same. This type of contraction is also referred to as a static contraction.
Examples of where this would occur when attempting to lift an immoveable object or when holding a weight at arm's length.

30 Sarcopenia is the degenerative loss of skeletal muscle mass and strength associated with ageing. Conduct research to ascertain the effect that ageing has on:

a the number and size of muscle fibres

Answer: The total number of muscle fibres is reduced with age and the size of muscle fibres is also reduced.

b changes in muscle contractile properties and the effectiveness of the motor unit

Answer: The research indicates that with aging there is a reduction in muscle contractile properties and an overall reduction in effectiveness of the motor unit. The neuromuscular junction is reduced in effectiveness at the cellular and molecular level. There are decreased average firing rates at the neuromuscular junction leading to reduced muscle contraction.

c the effectiveness of the mitochondrial proteins

Answer: The research indicates that mitochondrial function declines with age. However, it is uncertain if the amount of ATP produced at the mitochondria becomes less with age.

d how exercise can help a person avoid some of the detrimental effects of ageing.

Answer: Exercising has a positive effect on aging of skeletal muscle. By using the skeletal muscles, the person is reducing any muscle loss. Weight-bearing exercise is also good for retaining bone density, reducing the effects of osteoporosis. Exercise is also shown to improve mental health.

31 The sliding filament model is more complex than the explanation given above. Find out:

a the shape of the myosin molecules and how they are arranged to make up the thick filaments

Answer: Myosin makes up the thick filaments. It has one long tail and two globular heads and is shaped like a golf club. The myosin filaments are arranged in a parallel staggered array with the myosin heads half arranged to the right and the other half arranges to the left.

b the composition of the thin filaments and the active sites they contain

Answer: The actin filaments are the thin filaments that are bound to the Z-line. Along the actin active sites can be found, covered by regulatory proteins called troponin and tropomyosin.

c the function of the protein tropomyosin

Answer: Tropomyosin wraps around the actin filament covering the active sites. Calcium attaches to the troponin and changes its position, allowing the myosin heads to attach to the active sites on the actin to form cross bridges.

d the location and role of the protein titin.

Answer: Titin functions as a molecular spring. It connects the Z line to the M line in the sarcomere and keeps the myosin molecule in place. Its role is to provide elasticity to the muscle.

32 Conduct research to find out how smooth and cardiac muscles contract.

Answer: Smooth muscle and cardiac muscle contraction is caused by the sliding of myosin and actin filaments over each other. The energy for this to happen comes from the hydrolysis of ATP. Crossbridge cycling – the same seen in skeletal muscle – causes contraction of myosin and actin complexes. Smooth muscle does not have the calcium-binding protein troponin. Contraction in smooth muscle is initiated by calcium-regulated phosphorylation of myosin. Cardiac muscle fibres contract via excitation contraction coupling, using a mechanism unique to cardiac muscle called calcium-induced calcium release.