Unit 1

Teaching ideas

Background knowledge

There are two main topics in this unit, so we will look at some background information about each in turn.

Skeletons

The first animals to evolve lived in the sea. They were small, simple invertebrates (animals without backbones). Like jellyfish, their bodies were supported by the seawater. Water exerted pressure on the outside of the body, helping to keep it upright and maintain its shape.

As the invertebrates evolved and moved from the water to habitats on land, they developed a support structure to keep them upright and firm outside the water. As organisms have evolved and become larger, they have developed a variety of different support structures.

Soft-bodied invertebrates such as jellyfish, sea anemones, worms and slugs, are supported by fluid inside their bodies. This type of support is known as a hydrostatic skeleton. The fluid fills the body cells and cavities in the body. The muscles contract against the fluid, which sets up a pressure. (If you squeeze a plastic bag full of water you will see how this works.) Fluid, which is not easy to compress or squash, provides excellent support. However, fluid has no shape. A fluid takes on the shape of its container. So these animals rely on muscles in the body wall to determine their shape.

Some invertebrates have exoskeletons. Exoskeletons are hard outside, or external, skeletons that cover the bodies of arthropods such as spiders, crustaceans such as crabs and crayfish, and insects. The exoskeleton is made up of chitin, which is a hard, tough substance. The chitin forms body plates with flexible joints.

The animal's muscles attach to the exoskeleton and allow for controlled movement. Insects have also developed wings and the ability to fly. As a group, they are very successful. There are more types of insects than of any other group of animal.

Endoskeletons are skeletons inside the body. Endoskeletons are found in vertebrates. Most vertebrates have skeletons made of bone but the cartilaginous fish (sharks, skates, rays) have skeletons made of cartilage. Cartilage is softer and more flexible than bone.

The main advantages of endoskeletons include:

- The development of joints at the ends of bones which makes the body flexible.
- Animals with endoskeletons can grow to a much larger size than those with exoskeletons because the tissues of the skeleton grow as the animal grows.
- The endoskeleton protects internal organs from injury. For example, the skull protects the brain and the ribs protect the heart and lungs.
- Endoskeletons provide more structural support than exoskeletons do because they form a frame inside the body.
- Endoskeletons provide more positions for muscle attachment, which greatly improves the power of the muscles. This is because there can be more muscles. There is also a greater range and control of movement.

Drugs as medicines

A drug is a chemical substance that affects the body in some way. The effects may be medicinal, mood or behaviour changing, or performance enhancing.

Medicinal drugs are produced by pharmaceutical companies and are usually thoroughly tested for effectiveness and safety before they are approved. These drugs may, however, have undesirable effects (especially if they are not correctly prescribed or administered).

In most countries some non-medicinal drugs such as marijuana, cocaine and heroin are illegal. Legal non-medicinal drugs in many countries include tobacco and alcohol. Alcohol use is not allowed in any Islamic states for religious reasons. Both tobacco and alcohol can be harmful to our health. Tobacco has been strongly linked with lung disease. Alcohol use can lead to liver disease, higher risk of heart disease and certain cancers, as well mental and emotional problems such as anxiety, depression, memory loss and behavioural changes.

Over-the-counter medicines, which are available in pharmacies without a prescription from a doctor, include headache tablets, cough mixtures and diet pills. Because they are available without a prescription, it is often assumed that these medicines are safe. However, incorrect administration can be harmful. For example, taking too many headache tablets can damage the kidneys. Some medicines, such as cough mixture, cause drowsiness, while others, such as diet pills, are stimulants. Diet pills can cause behavioural changes. These changes may include being very active all the time and unable to relax, as well as feeling anxious. All of these medicines can lead to death if they are taken in very large quantities.

Unit overview

Topic	**Number of lessons**	**Outline of lesson content**	**Resources in Learner's Book**	**Resources in Activity Book**	**Resources in Teacher's Resource**
1.1 Skeletons	1	Skeletons made of bone support the body from the inside.	Activity 1.1 SE Questions 1, 2, 3, 4, 5 Ex	Exercise 1.1	
1.2 The human skeleton	1	The human skeleton is made up of bones of different shapes and sizes.	Activity 1.2 SE Questions 1, 2, 3, 4, 5, 6 Ex	Exercise 1.2	Worksheet 1.2
1.3 Why do we need a skeleton?	2	Skeletons grow and support and protect the body.	Activity 1.3 SE Questions 1, 2	Exercise 1.3 SE	Worksheet 1.3a SE Worksheet 1.3b SE
1.4 Skeletons and movement	1	Muscles work in pairs to make bones move.	Activity 1.4 SE Questions 1, 2	Exercise 1.4 Ex	Worksheet 1.4 SE
1.5 Drugs as medicines	1	Medicines are drugs that make our bodies better when we are ill .	Activity 1.5 SE Questions 1, 2, 3	Exercise 1.5 L	Worksheet 1.5 SE

1.6 How medicines work	1	Medicines cure symptoms of illnesses. Medicines must be taken safely.	Activity 1.6 Question 1 SE	Exercise 1.6	
Check your progress	1		Questions 1, 2 L, 3, 4, 5	Language review L	

Ex Extension L Language SE Scientific enquiry Su Support

Resources

- different shapes of pasta
- black construction paper
- paper glue
- a tape measure
- a weight such as a heavy book or a school bag

Topic 1.1 Skeletons

The key concept explored in this topic is that many animals have skeletons made of bone that support their bodies from the inside. Learners should already know from Stage 3 that living organisms grow. This topic explains the role of the skeleton in growth.

Learning objectives

- Know that humans and some animals have bony skeletons inside their bodies.
- Make relevant observations.
- Collect evidence.

Ideas for the lesson

- Show the class a life-sized paper outline drawing of a Stage 4 learner. (You can make one by asking a learner to lie on a piece of paper and draw round the outline of the learner. Be aware of cultural sensitivities when doing this though.) Ask learners to suggest which body parts should be added to the outline, and where they should be placed. Continue until learners suggest bones or the need for a skeleton. Ask them about other skeletons they know about, such as exhibits in museums or in TV programmes they have seen.
- Ask why we need a skeleton. Hold up the paper outline and then let it go. Tell the class that, without our skeleton, we would be floppy like the outline.
- Ask learners to think about buildings that they have seen being built covered in scaffolding or buildings that have frames for support, such as traditional homes in Thailand and Japan.
- Before learners do Activity 1.1, tell them that if they move their fingers down the centre of their backs, they will feel the 26 vertebrae that make up their backbone. Demonstrate that when you bend forward at the waist, you can feel the bones adjust as you move. You can think of each individual vertebra as a bead on a string. Just as a beaded necklace is flexible and able to bend, so too is your backbone. If your backbone were just one bone, you would not be able to bend or twist. The observation made from this demonstration will show learners that humans have bony skeletons inside their bodies. Show the learners pictures of animal skeletons to show them that some animals also have bony skeletons.
- Be sensitive to learners who are overweight and may have difficulty in feeling their ribs. They will be able to feel the rib bones with their fingers, but not as easily as thinner learners. It might be easiest for them to feel the ribs by stretching up one arm and then using the opposite hand to feel the ribs on the stretched side. Demonstrate this action, and suggest that the whole class feel their ribs in this way. Tell them to push firmly on their skin until they feel the rib bones.
- Ask learners to feel the bones beneath the skin in one of their hands, then draw a picture of what they think the bones look like. Have learners brainstorm what they know or think they know about bones.

- Once learners have completed Activity 1.1, discuss the observations that the skeleton is made of many bones of different shapes and sizes. Discuss the reason for this after learners have completed Question 3.
- Exercise 1.1 in the Activity Book could be used to extend learners' knowledge of skeletons.

Notes on practical activities

Activity 1.1

The skull should feel like a single bone, but it is made of several bones fused together.

Learners will not be able to feel all 12 pairs of ribs, but should feel at least six or seven.

The hands need many bones (as well as muscles and joints) in order to make many fine movements such as holding a pen and picking up small things.

The bones are different shapes and sizes.

Internet and ICT

- The website: http://www.hants.gov.uk/museum/exhibitions/bones/index.html gives a useful introduction to bones and skeletons.
- You will find interactive games on the website: http://www.bonesandharry.co.uk/main/main.html.
- Learners can compare animal and human skeletons at: http://www.sciencekids.co.nz/gamesactivities/movinggrowing.html.

Assessment

- Learners can check each another's answers to Exercise 1.1 in which they match pictures of skeletons with the animals they come from, and identify some of their bones.

Differentiation

- Lower achieving learners could be supported by getting them to work in pairs and point out the bones of the skull, ribs, spine and hips to one another.
- Higher achieving learners could do Questions 3 and 4 in the Learner's Book.

Talk about it!

The answer to this question is that not all skeletons are made of bones. Some animals such as sharks, skates and rays have skeletons made of cartilage, which is softer and more flexible (rubbery) than bone. Explain that we have cartilage at the ends of our bones and that the outer ears and nose are made of cartilage.

Common misunderstandings and misconceptions

- Learners at this level often think that bones are made of non-living material or non-living parts of the body. This is not true. The fact that bones can grow demonstrates that they are living. They may also think that bones are very heavy, but bones make up only 30–40% of the human body mass and support the remaining 60–70% of our mass.

Homework ideas

- Exercise 1.1 in the Activity Book.

Answers to Learner's Book questions

1 bone
2 To support our bodies.
3 Because they are in different parts of the body that do different things, for example: legs for walking, hand for writing, skull for protecting the brain.
4 Light bones make it easier for the animal to move its body.
5 You should be looking for a drawing of a human blob of jelly.

Answers to Activity Book exercise

Exercise 1.1

1

Animal	Skeleton
bird	C
rabbit	D
frog	B
crocodile	A

2 W is the skull
X is the ribs
Y is the spine
Z is the hip

Topic 1.2 The human skeleton

In this topic, learners explore further the idea that skeletons are made of bones of different shapes and sizes. Learners have the opportunity to familiarise themselves with the basic structure of the human skeleton and recognise bones of different shapes.

Learning objectives

- Observe that bones have different shapes and sizes.
- Understand that bones are joined together to form the skeleton.
- Link evidence to scientific knowledge and understanding in some contexts.

Ideas for the lesson

- Begin the lesson by reminding the class about the conclusion from Activity 1.1: that skeletons are made up of many bones that have different shapes and sizes. You can ask them which bones they think are the biggest and the smallest in the body.
- Talk about the number of bones in the body. Adults have 206 bones in their skeletons but newborn babies have about 275 bones. As a baby grows, some of the bones in the body fuse (join) together. For example, as we grow, some of the bones in our skull fuse together.
- Look at the picture on page 9 of the Learner's Book, or a life-sized skeleton model. You may be able to borrow one from a local secondary school or doctors' surgery. Did learners realise that there are pairs of bones in the lower arms and legs? Also count the ribs on the drawing or model (there should be 12 pairs). Ask learners if the bones are all the same size and shape or if they have different sizes and shapes. Ask learners if they noticed that the bones in the skeleton are in some way connected to the backbone. Point out that the bones are joined together to form the skeleton.
- Learners should do Activity 1.2 in the Learner's Book.
- Worksheet 1.2 and Exercise 1.2 in the Activity Book will help to consolidate the learning in this topic and help learners to link evidence to scientific knowledge.

Notes on practical activities

Activity 1.2

Each pair or group will need:
- different shapes of pasta
- black construction paper
- paper glue.

Learners should arrange the pasta shapes to make the form of a human skeleton. It need not be accurate, but it should show the general body form with a skull, spine, ribs, arms, legs and hips. See the example in the Learner's Book, page 9.

Internet and ICT

- Look at: www.bbc.co.uk/bitesize/ks2/science/living_things/skeletons_muscles/read/1/ for a summary of the topic.
- The website: www.everyschool.co.uk/science-key-stage-2-ourselves-2.html has a bone labelling activity and provides a link to interactive games about the skeleton.
- The website: www.ehow.com/how_12039762_make-human-skeleton-model-using-pasta.html explains how to make a pasta skeleton.

Assessment

- Learners can check one another's answers to Worksheet 1.2 to see if they have grasped the concept that different bones are joined together to form the skeleton.

Differentiation

- Lower achieving learners can do Exercise 1.2 in the Activity Book, in which they arrange bones to make a simple paper skeleton. They can also answer Questions 1, 3 and 4 in the Learner's Book.

- Higher achieving learners could answer Questions 2, 3, 5 and 6 in the Learner's Book. They could also find out the scientific names of the bones of the skeleton they have learnt about in the topic.

Talk about it!

Giraffes also have seven neck bones. The bones are much bigger than the neck vertebrae of humans.

Common misunderstandings and misconceptions

- Learners often think that bigger animals have more bones in their skeletons than smaller animals. Often, it is the size of the bones that is different but the number of bones in the bodies of most mammals, for example, is similar.

Homework ideas

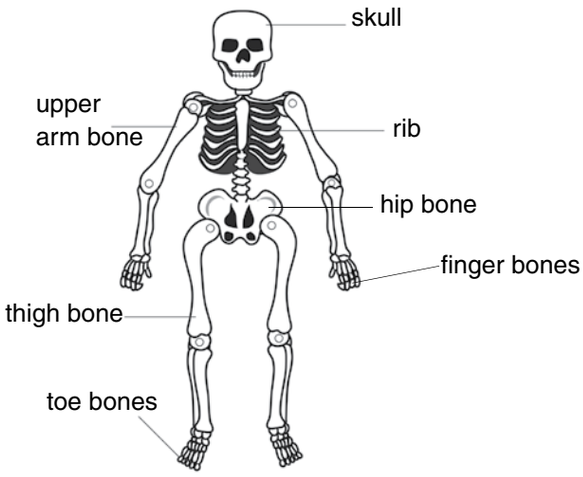
- Worksheet 1.2.

Answers to Learner's Book questions

1 It is made of many bones joined together.
2 The skull protects the brain and sense organs (eyes, ears, tongue).
3 Thigh bone. It supports the all weight of the upper body.
4 Ear bones.
5 Ribs surround heart and lungs to protect them.
6 Women have babies. Their hips are wider to allow the baby to grow inside the mother's body and to be born.

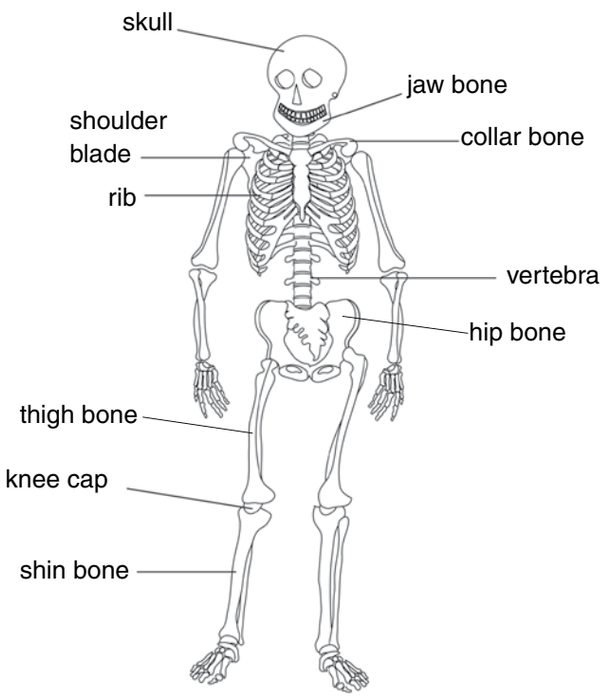
Answers to Activity Book exercise

Exercise 1.2



Answers to Worksheets

Worksheet 1.2



Topic 1.3 Why do we need a skeleton?

The key idea explored in this topic is that skeletons allow us to grow. They also support and protect other body parts. Learners should already know about sense organs from Stage 3. You can link this prior knowledge with the protective role of the skull. The skull protects the brain. The brain controls sense organs.

Learning objectives

- Know how skeletons grow as humans grow and support and protect the body.
- Measure length.
- Record results in a table.
- Present results in a bar chart.
- Identify simple trends and patterns in results and suggest explanations for some of these.

Curriculum links

- In Activity 1.3, learners measure bone length which links with Mathematics. Remind learners about how to measure length with their rulers.
- Exercise 1.3 and Worksheet 1.3 require graphing skills which are also links with Mathematics. You could ask learners what they remember about drawing bar charts from their lessons in Mathematics. For example, how they label bars, how they decide how long the bars should be.

Ideas for the lesson

- Begin the lesson by asking learners why children are small and adults are big. Ask for their ideas about how we get bigger as we get older. Then let the learners do Activity 1.3, in which they measure and compare bone lengths. They will also record measurements in a table and make a prediction based on the evidence collected.
- In Worksheet 1.3, learners draw a bar chart of results, identify a pattern in the results and suggest reasons for the pattern.
- In Exercise 1.3, learners obtain information about bone length from a bar chart and make deductions from the results.
- Remind learners that we need a skeleton to support our bodies. Discuss body support in soft-bodied invertebrates such as worms and snails. If possible, observe some of these animals in the classroom.
- Ask the class if they have seen cyclists and motorcyclists wearing helmets. Ask the learners to explain why cyclists and motorcyclists need a helmet. Point out how the skull acts like a helmet and provides protection for the brain. You can also ask learners which sense organs are housed in and protected by the skull as revision of Stage 3 work. Ask them which other parts of the skeleton protect our inside parts. Discuss the rib cage and how it protects the lungs and heart.
- If possible, bring some X-rays (or find photos of X-rays) to class for learners to examine and find the fracture.

Notes on practical activities

Activity 1.3

Each group will need:

- a tape measure.

Learners should work in groups of 4 or 5.

Demonstrate how to use the tape measure by measuring the length of your own *femur* (thigh bone). Learners can record the measurement in their data tables.

Remember that the measurements will not be completely accurate as you will not be able to measure to the very ends of the femur, which are enclosed in the joint capsules at the hip and knee. It is easier to measure from the knee upwards. You will feel the ends of the bone on either side of the knee cap. Measure up the outer side of the leg to the point at the top of the leg at which the leg bends and lifts. If all measurements are taken in the same way, then you will get a fair comparison of femur lengths.

It may best for learners to measure the bone lengths of learners of their own gender within the group. This will avoid overstepping any cultural or religious boundaries regarding contact between males and females.

If you do not have enough tape measures for each group, they can use 30 cm rulers to measure the length of the *humerus* (upper arm bone) and *tibia* (shin) bones. They will need to take turns using the tape measures in order to measure the femur (thigh bone) length, which is likely to be longer than 30 cm.

Typical measurements are as follows.

Bone	Length in cm	
	Me	Teacher
upper arm bone	25	30
thigh bone	31	37
shin bone	26	32

The teacher's bones are longer.

A teenager's bones will be longer than an 8-year-old's bones but shorter than an adult's. Teenagers' skeletons are still growing but are not fully grown.

Internet and ICT

- Look at: www.chiff.com/health/skeleton.htm for basic information on the functions of the skeleton.
- For a video clip on body support in invertebrates look at: www.bbc.co.uk/learningzone/clips/invertebrate-skeletons/2304.html.
- The website: www.kidport.com/reflib/science/animals/animalindexinv.htm is an interactive webpage about invertebrates.
- This site has good images of broken bones: http://orthopedics.about.com/cs/brokenbones/l/blxray_aptibfib.htm.

Assessment

- Assess learners' skills in drawing bar charts by getting them to draw bar charts of the bone length measurements taken in Activity 1.3. Worksheet 1.3a provides a table for learners to record results, and a set of axes on which they can draw their bar charts. Use these criteria in the following table:

Question	Marks
Does the chart have a heading?	1
Are the bars correctly plotted and spaced on the set of axes?	2
Are the bars the correct height?	4
Are the bars correctly labelled?	2
Is the chart neatly drawn using a ruler?	1
	Total 10 marks

Differentiation

- Lower achieving learners should be able to answer Questions 1 and 2 in the Learner's Book.
- Higher achieving learners can complete Worksheet 1.3b, in which they draw a bar chart of the results and identify patterns in the results.
- Ask the learners to do some research to answer the question 'How does an X-ray let us see inside our bodies?'. The research should reveal the following: X-rays work by a beam of very high energy radiation passing through the body. The beam travels until it comes in contact with body tissue. In our body, soft tissue cannot absorb the high energy ray and it passes straight through. Bone absorbs the rays. The rays that pass through the body hit a sheet of metallic film positioned behind the patient, which stops the beam. The black areas on the X-ray are the areas on the film that absorb the rays that passed through the soft tissue. The white areas are the unexposed areas, where the rays are not absorbed by tissue. The white areas show the bones.

Talk about it!

Children are still growing whereas old people are not. This means that their bones grow much faster and can heal much quicker than an older person's bones.

Common misunderstandings and misconceptions

- Tell the learners that fractures are always painful. Some very small fractures may not be hurt at first, but eventually you will feel some pain.

- Learners may think that when a fracture heals, the bone is stronger than before the break. This is not so. The bone will be as strong as it was before, especially in young people, but not stronger. In older people, the healed bone may be weaker.

Homework ideas

- Exercise 1.3 in the Activity Book.

Answers to Learner's Book questions

1 The baby will stay small and will not grow into a child.
2 The ends of the broken bone grow back together again.

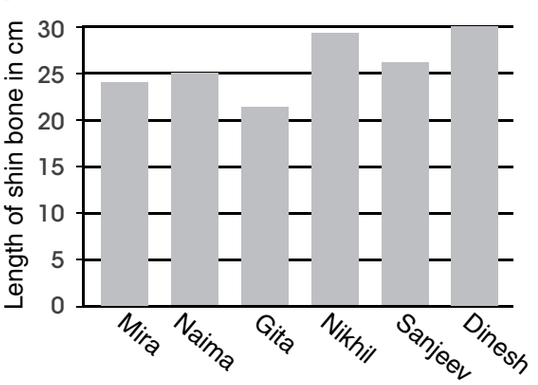
Answers to Activity Book exercise

1 Meshack
2 14 cm
3 Ali is the oldest. His upper bone is longer than Ahmed's. Our bones get longer as we get older.
4 Ali, Nasreen, Ahmed. Ali has the longest upper arm bone, Ahmed has the shortest.
5 **a** Fatima and Meshack
b They have the longest upper arm bones.
6 33 cm. Meschack will be a similar height to his father. His father maybe a little shorter.

Answers to Worksheets

Worksheet 1.3b

1



2 **a** Dinesh's
b Gita's
c The boys have longer shin bones than the girls. This could be because boys of that age grow faster than girls, or any other reasonable suggestion.

Topic 1.4 Skeletons and movement

The key concept explored in this topic is that muscles, which are joined to the bones of skeletons, act in antagonistic (opposite) pairs to allow us to move. Learners also have the opportunity to plan an investigation on muscle strength.

Learning objectives

- Know that animals with skeletons have muscles attached to the bones.
- Understand that muscles work in pairs to help us move.
- Know how a muscle has to contract (shorten) to make a bone move.
- Design a fair test and plan how to collect sufficient evidence.
- Choose apparatus and decide what to measure.
- Measure length.
- Present results as a drawing.

Curriculum links

- This topic can be linked with Physical Education (P.E.) and the benefits and effects of using muscles when we exercise.
- In Worksheet 1.4, learners have to measure length which is a link with measurement in Mathematics.

Ideas for the lesson

- Muscles enable us to move our bones, because they are attached to the ends of the bones and can shorten or lengthen. When muscles contract (shorten) they allow us to move.
- Ask the class to demonstrate different movements they can make, such as bending, twisting their bodies, walking, picking up a pencil, and so on. Tell them that, when any part of our body moves, muscles are working. Ask them to look closely at their

upper arm as they curl their arm towards their chest from their side; the muscle gets fatter and bulges. As the arm is raised the biceps (on the front of the arm) contracts, at the same time a muscle on the back of the arm, the triceps, relaxes. The two muscles work together to control the lifting arm. As the arm is lowered the opposite happens, the biceps relax and the triceps contract. Tell the class that muscles act in pairs and can only pull. They cannot push. Then ask them to do Activity 1.4.

- Explain that, often, many muscles work together to create a single movement or effect. For example, it takes 17 pairs of muscles to smile and 43 pairs to frown. Get learners to make different faces such anger, sadness, surprise, happiness. Ask them to feel their face for each expression they make. Which muscles are hard (contracted) and which are soft (relaxed)?
- Tell learners that they are going to make a model of their arm to show how two muscles of the upper arm work as a pair when the arm moves at the elbow. Then get learners to do Worksheet 1.4 in which they will have to measure card, and cut it to length. The model can demonstrate to learners why, if muscles can only pull and not push, two muscles are needed to move a bone. They could use their models to explain to one another how muscles work to produce movement. Learners can consolidate their understanding of muscle action by designing a fair test in Question 1. They will have to decide which apparatus to use and what to measure. Remind them that that only one factor must be changed and everything else must be kept the same.
- Exercise 1.4 in the Activity Book can be set as a homework task in which learners make drawing of how muscles work.

Notes on practical activities

Activity 1.4

Each group will need:

- a weight such as a heavy book or a school bag.

Learners should work in groups of 4 or 5.

Learners should hold their arms quite firmly in order to feel the change in the muscles. Contraction and relaxation of the muscles are more easily observed in well-developed muscles.

Learners should observe that: the muscle at the front gets shorter and fatter; the muscle at the back gets longer and thinner; the muscle at the back gets shorter and fatter; and the muscle at the front gets longer and thinner.

Worksheet 1.4

Each group will need:

- a piece of thick card
- two elastic bands (one longer than the other)
- a ruler
- scissors
- a paper fastener (split pin)
- a stapler and staples
- a piece of sticky tack or Plasticine®.

Learners should work in groups of 4 or 5.

It is important that the paper fastener is inserted at least 5 cm from the ends of the lengths of cardboard. This allows the antagonistic (opposite) action of the elastic band 'muscles' to be demonstrated clearly.

If the elastic bands are pulled too tight, then the learners will not be able to demonstrate muscle action as their elastic band 'muscles' will be fixed in a contracted position.

Internet and ICT

- The website: http://www.bbc.co.uk/science/humanbody/body/factfiles/workinpairs/biceps_animation.shtml provides an explanation and animation of muscle action. There is also an interactive game on body muscles which may be suitable for higher ability learners.
- The website: http://www.bbc.co.uk/learningzone/clips/muscles-and-movement/2305.html is very useful for showing how muscles work to allow body movement.
- The website: http://www.kidshealth.org/kid/body/muscles_noSW.html helps learners to find out more about how muscles and joints help us move.