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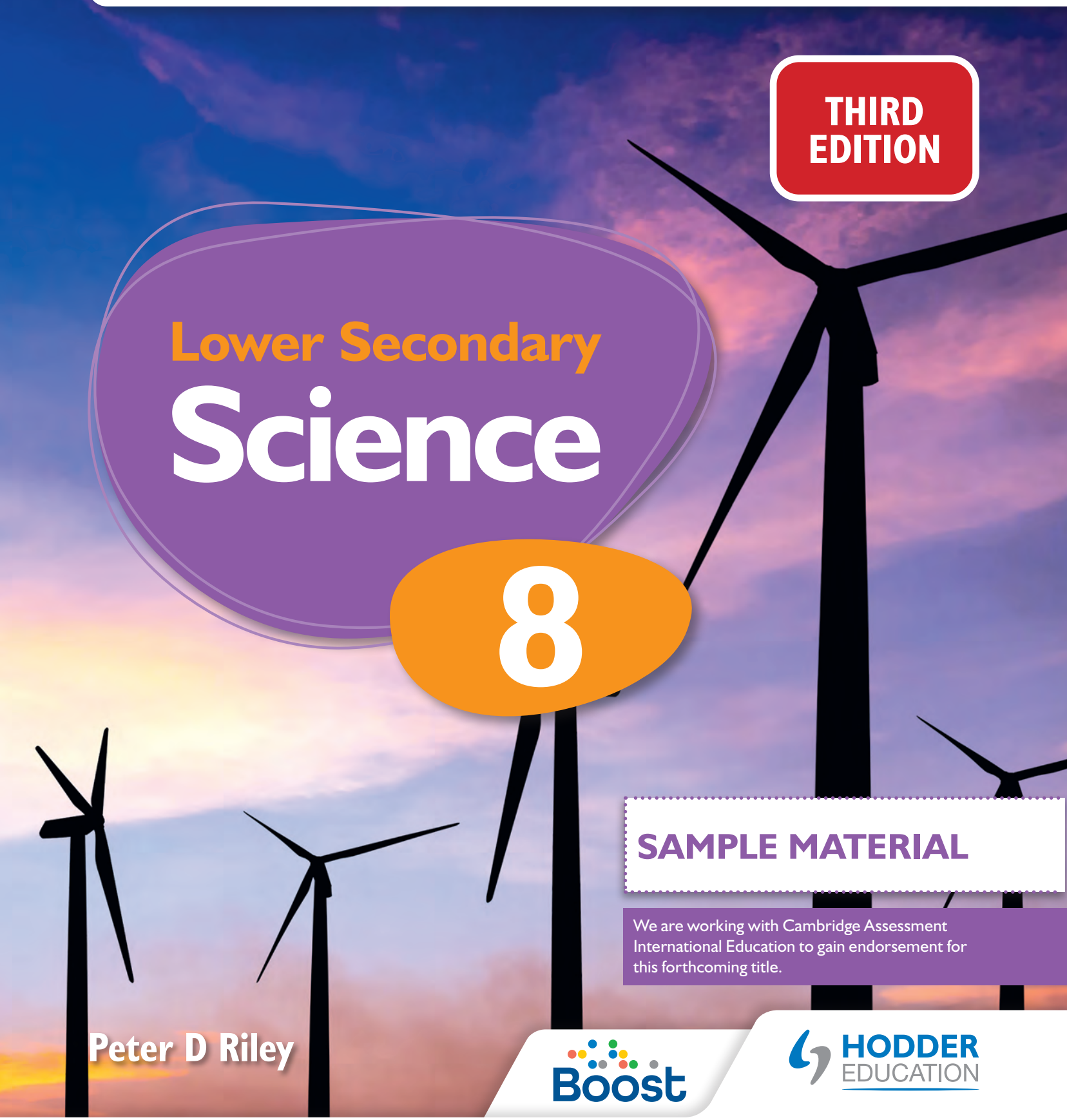

THIRD EDITION

Lower Secondary Science 8

SAMPLE MATERIAL

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming title.

Peter D Riley

Boost

HODDER EDUCATION

Please note this is a sample and not a full chapter

We are working with Cambridge Assessment International Education to gain endorsement for this forthcoming series.

Help students engage with and fully understand topics they are studying with engaging content following the new Cambridge Lower Secondary Science curriculum framework (0893) from 2020.

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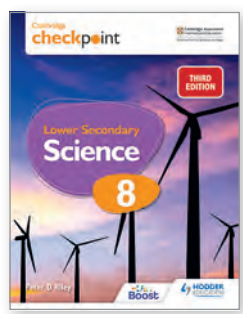

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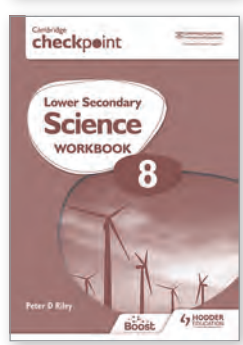

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THIRD EDITION

Lower Secondary Science 8

Peter D Riley

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To Tabitha, Holly and Pippa

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Contents

How to use this book

To make your study of Cambridge Checkpoint Science as rewarding as possible, look out for the following features when you are using this book:

- These aims show you what you will be covering in the chapter.

Do you remember?

This will show you the ideas you have learnt before. Think about what you already know before you begin.

Science activity

Science activities may be about developing a science skill or making a science enquiry.

Science in context

In this box you will find information about how scientists working alone or together have built up our understanding of our world over time, how science is applied in our lives, the issues it can raise and how its use can affect our global environment.

DID YOU KNOW?
This is a fact or piece of information that may make you think more deeply about the topic or that you may share as a fun fact with your family and friends.

Science extra
The information in these boxes is extra to your course, but you may find these topics interesting and they may help you with your understanding of the overall chapter topic.

Summary

This box will show you how much you have learnt at the end of the chapter.

This book contains lots of activities to help you learn. Some of the questions will have symbols beside them to help you answer them. Look out for these symbols:

- This blue dot shows you that you have already learnt some information to help you with this topic.
- If a question has a purple link symbol beside it, you will have to use your English or Maths skills.
- This star shows where your thinking and working scientifically enquiry skills are being used.
- Scientists use models in science to help them understand new ideas. This icon shows you where you are using models to help you with your ideas in science.

LET'S TALK

When you see this box, talk with a partner or in a small group to decide on your answer.

CHALLENGE YOURSELF

These activities are a challenge! You may have to think a bit harder to get the correct answer.

Work safely

This triangle provides you with extra guidance on working safely.

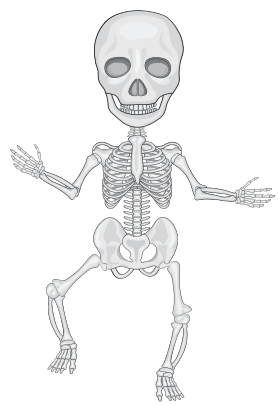
Words that look like **this** are glossary terms, and you will find definitions for them in the glossary at the back of this book. Other key terms that may not be included in the glossary look like **this**.

1 Joints and muscles

- A closer look at the skeletal system
- A closer look at the muscular system
- Joints and muscles working together

Do you remember?

- State three important functions of the skeleton.
- Point to these bones in your body – skull, jaw, rib cage, hip, spine, femur (a leg bone), humerus (an arm bone).



▶ **Figure 1.1**

▲ **Figure 1.2** Children trying out some equipment in a gym

- How can you tell a muscle from a bone?
- How do pairs of muscles make bones move?

Introduction

In this chapter we are going to look at types of joints which allow bones to move and how muscles move bones in one type of joint – the hinge joint.

Joints

The place where bones meet is called a **joint**. In some joints, such as those in the skull, the bones are fused together and cannot move. Most joints, however, allow some movement. Some joints, such as the elbow or knee, are called **hinge joints** because the movement is like the hinge on a door. The bones can only move forwards or backwards. A few joints, such as the hip and shoulder joints, are called **ball-and-socket joints** because the end of one bone forms a round structure, like a ball, that fits into a cup-shaped socket. This allows movement backwards and forwards, from side to side and even circular movement, as when you move your arm in a circle.

Two examples of the hinge joint are the elbow joint and the knee joint. Two examples of the ball and socket joint are the hip joint and shoulder joint.

DID YOU KNOW?
The strongest bone in the body is the femur. It is between your hip and knee joint.

1 Label each letter shown on Figure 1.3 as either a hinge joint, or a ball and socket joint.
2 Use Figure 1.3 to find each marked joint on your own body. Can you tell which type of joint each one is by feeling how they move? Explain your answer.

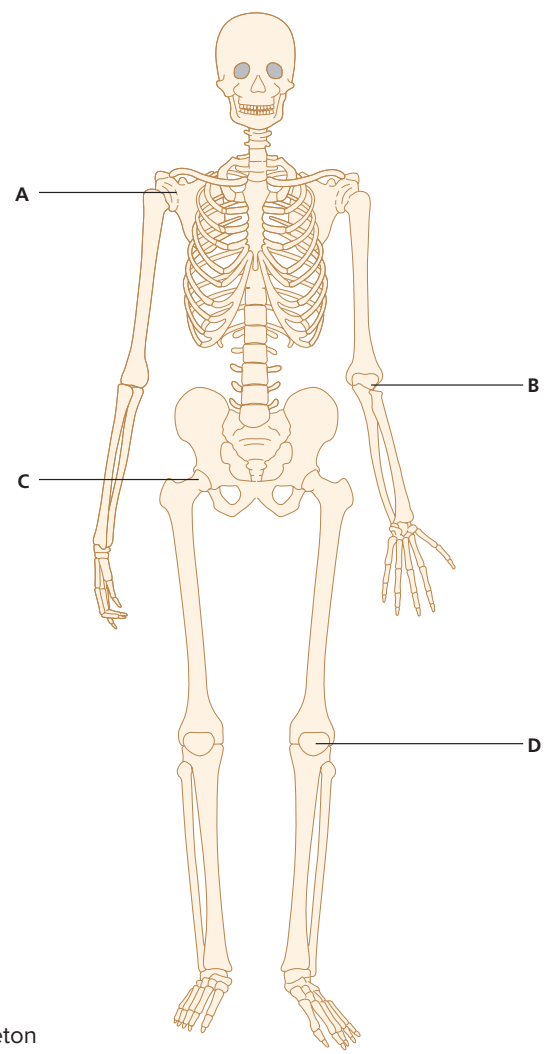
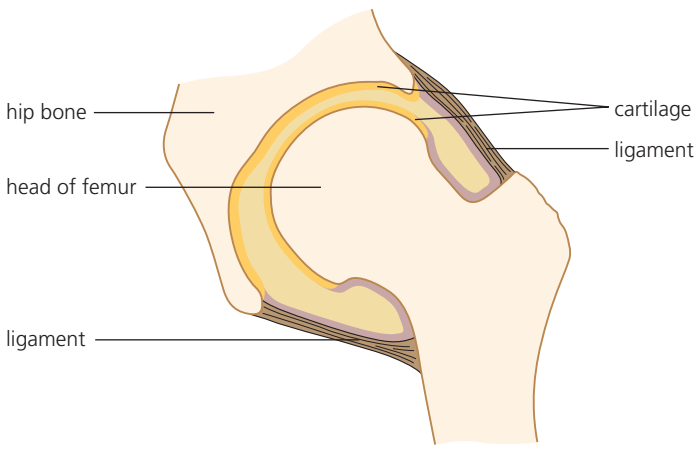


Figure 1.3 The human skeleton

LET'S TALK
What would the body be like without a skeleton of bones? Could your body survive without its skeleton?

Joints and sports injuries

The bones in a joint are held firmly together by tough fibres called **ligaments**. The ends of the bones in the joint are covered in **cartilage**. This substance has a hard, slippery surface. It reduces the **friction** between the ends of the bones and stops them wearing away as they rub over each other when the muscles move them. The positions of the ligaments and cartilage in the hip joint are shown in Figure 1.4.



▲ **Figure 1.4** Inside a hip joint

Some sports injuries are due to damage to the ligaments and cartilage. A sprained ankle occurs when someone's foot rolls over and pulls the ligaments so that they weaken. A cartilage injury may occur at the knee when the leg is suddenly twisted.

CHALLENGE YOURSELF
How are 3-D printers used to help people with damaged hands?

Survey the internet. Look at a few different sources. Do they all present their information in the same way, or are some biased or in favour of a particular point of view? Write a short account of three paragraphs or make a presentation of your findings.

LET'S TALK
How frequent are sports injuries in your group? Make a list of injury types and how they happened, and then discuss what was done to help people recover from them.

Science in context

X ray photographs of joints

When a joint is damaged through illness such as arthritis, or injury such as can occur in sport, doctors investigate by taking X ray photographs of the joint to help them plan a course of treatment.

X rays are a form of energy that can pass through flesh such as muscles and skin but they are stopped by the material in bones, and this is what makes bones visible on X ray photographs.

3 Why would a doctor use X rays to investigate first, rather than cut open the flesh around the joint to have a look?

4 Here are X ray photographs of four joints.

▲ **Figure 1.5 A** Photograph showing an X ray of an elbow joint

▲ **Figure 1.5 B** Photograph showing an X ray of a hip joint

▲ **Figure 1.5 C** Photograph showing an X ray of a knee joint

▲ **Figure 1.5 D** Photograph showing an X ray of a shoulder joint

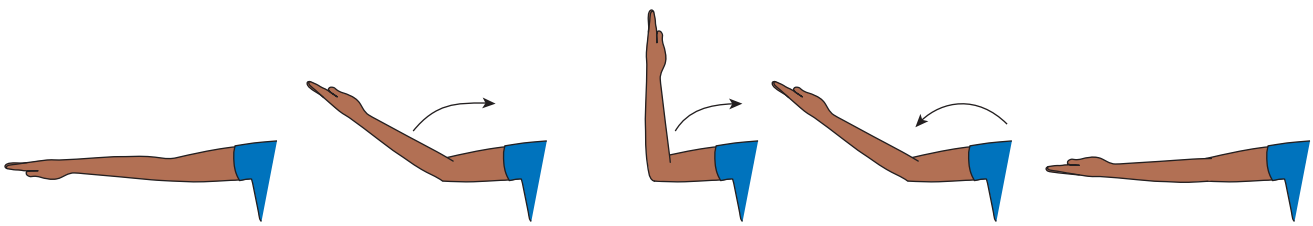
Which joints are a) hinge joints and b) ball and socket joints?

LET'S TALK

What problems do people have with unhealthy joints? Think about older people you may know who have arthritis, or think of a time when you damaged a joint of your own in an accident or in a sporting injury.

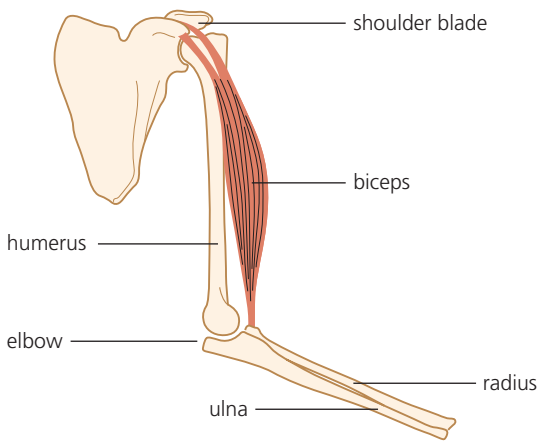
Muscles in a hinge joint

Exercise the muscles in your upper arm to move your lower arm as shown in Figure 1.6.

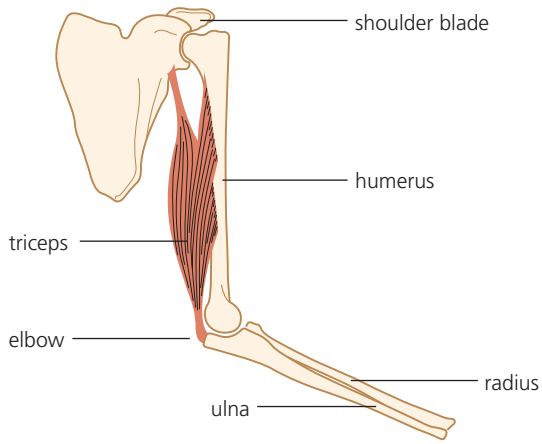


▲ **Figure 1.6**

The muscle action is producing movement across a hinge joint. To understand this action we need to look more closely at what is going on under the skin. Muscle is made up from tissue that has the power to move. It can contract to become shorter. A muscle is attached to two bones across a joint. When muscle gets shorter, it exerts a pulling **force**. This moves one of the bones, but the other stays stationary. For example, the biceps muscle in the upper arm is attached to the shoulder blade and to the radius bone in the forearm. When the biceps shortens (or contracts), it exerts a pulling force on the radius and raises the forearm.



▲ **Figure 1.7** Biceps on arm bones



▲ **Figure 1.8** Triceps on arm bones

5 Draw a diagram featuring both the biceps and the triceps, showing the triceps fully shortened.

6 Using dotted lines, draw on the position of the forearm when the biceps is fully shortened.

A muscle cannot lengthen or extend itself. It needs a pulling force to stretch it again. This force is provided by another muscle. The two muscles are arranged so that when one contracts it pulls on the other muscle, which relaxes and lengthens. For example, in the upper arm, the triceps muscle is attached to the shoulder blade, humerus and ulna. When it contracts, the biceps relaxes and the force exerted by the triceps lengthens the biceps and pulls the forearm down. When the biceps contracts again, the triceps relaxes and the force exerted by the biceps lengthens the triceps again and raises the forearm. The action of one muscle produces an opposite effect on the other muscle and causes movement in the opposite direction. The two muscles are therefore called an **antagonistic muscle pair**. The action can be summarised as follows:

- Biceps contracts, triceps relaxes, lower arm raised.
- Biceps relaxes, triceps contracts, lower arm lowered.

DID YOU KNOW?
Muscles are attached to bones by tendons. They do not stretch or shorten when the muscles do.

DID YOU KNOW?
Many scientists believe that the strongest muscle in the human body is the masseter muscle (or jaw muscle) which you use when you bite your food.

CHALLENGE YOURSELF

How does a muscle feel when it contracts and relaxes?

Stand up and let your left arm hang down by your side. Spread out the fingers of your right hand and push them into your biceps muscle. Move your fingers around a little to feel the muscle. Raise your left forearm, keeping the upper arm still, and feel the muscle with your fingertips. Lower your forearm again and feel the muscle.

Describe any changes that you felt in the muscle.

7 Think about what you found out about the biceps in the challenge and the triceps in the investigation. Did you find any patterns or trends? Explain your answer.

DID YOU KNOW?
Muscles which move your bones are called skeletal muscles, but there are two more types of muscle – smooth muscle which moves food along your digestive system, and cardiac muscle which forms the heart and pumps your blood around your body.

Triceps investigation

Scientists often use an observation from an activity to set up an investigation. Here is an example. Use the changes you felt in your biceps muscle when you raised and lowered your arm to think about what you might feel if you tested your triceps muscle.

Hypothesis

Build up your hypothesis by

a writing down what you think will happen when you feel your triceps muscle as you raise and lower your forearm
b explaining the changes from your study of antagonistic muscles.

Show your hypothesis to your teacher and, if approved, make a prediction.

Investigation

Observe closely with your finger tips on your triceps as you slowly raise and lower your forearm. Decide on a number of times to do this in order to check your observation.

Analysis

Write down how the triceps felt when you

a raised the forearm and
b lowered the forearm.

Conclusion

Compare your analysis with your hypothesis and prediction and make a conclusion.

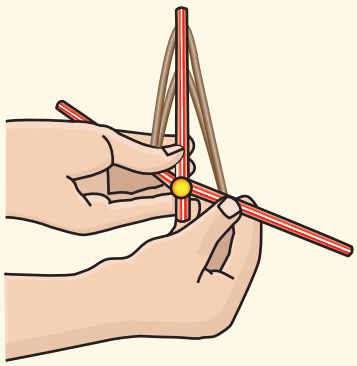
Does your evidence support or contradict your hypothesis?

What are the limitations of your conclusions?

Can you make improvements to the investigation? Explain your answer.

Modelling muscles

Figure 1.9 shows an idea for making a model of the arm using elastic bands for muscles.



▲ **Figure 1.9** Model of an arm, using elastic bands for muscles

Use the idea shown to make a model and demonstrate how the muscles work. Select your materials and make a diagram of how you will fit them together. If your teacher approves, make the model.

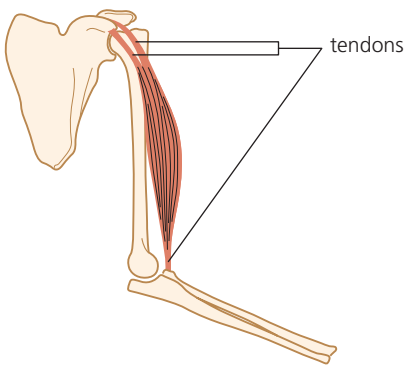
Describe the analogies used in your model.

What are the strengths and limitations of your model?

Science extra: Muscles and sports injuries

If a muscle is suddenly stretched hard, an injury called a pulled muscle can occur. One set of muscles which can be damaged in this way are the hamstring muscles at the back of the upper leg. They may be damaged by running hard in a sprinting race. Another set of muscles which can also be damaged in sports are the muscles on the inside of the top of the leg from hip to knee in an area called the groin. Groin injuries, called groin strains, can be caused by kicking, jumping, running and twisting at the same time.

Muscles are attached to bones by tendons, as Figure 1.10 shows.



Tendons are made of tough fibres like ligaments and can also be damaged in sports injuries. They can be torn if a joint is overused. A common tendon injury is called tennis elbow, which can occur in people who play a great deal of tennis.

▲ **Figure 1.10** The tendons of the biceps muscle

CHALLENGE YOURSELF

Use the internet to find out about the common sport injuries in tennis, athletics, cricket, football and any other sport of your choice. Are some injuries found in more than one sport? Explain your answer.

Summary

- ✔ Ball and socket joints.
- ✔ Hinge joints.
- ✔ X ray photographs of joints.
- ✔ Antagonistic muscles moving bones at a hinge joint.
- ✔ Describe how a scientific hypothesis can be supported or contradicted by evidence from an enquiry.
- ✔ Make a prediction of a likely outcome for a scientific enquiry based on scientific knowledge and understanding.
- ✔ Describe any trends or patterns in results.
- ✔ Using an existing analogy for a purpose.

End of chapter questions

1 Name two hinge joints.
2 Name two ball and socket joints.
3 How is a hinge joint different from a ball and socket joint?
4 When the biceps contracts, what happens to
   a the triceps?
   b the lower arm?
5 What do you understand by the term ‘a pair of antagonistic muscles’?

Cambridge
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Lower Secondary Science 8

Help students engage with and fully understand topics they are studying with engaging content following the new Cambridge Lower Secondary Science curriculum framework.

- Provide activities to increase students' subject knowledge and develop the skills necessary to think and work scientifically.
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