EXPLORING SCIENCE

INTERNATIONAL 11–14

7

Mark Levesley, Sue Kearsey, Iain Brand, Penny Johnson

SAMPLE UNIT

Year 7 Unit 7A: Cells, tissues, organs and systems

Under the skin

The bright colour of a poison dart frog warns predators that its skin contains a lethal poison. Although just a tiny amount would be enough to kill a large animal, scientists are now investigating some of the substances in the poison to help them to design new medicines.

Pearson

7Aa DOCTORS PAST AND PRESENT

For thousands of years people have gone to see doctors when they feel unwell. Some of the ways in which doctors examine patients have not changed! For example, 3000 years ago, Ancient Egyptian doctors knew that if a person's **heart** was not beating as well as usual that person could be ill.

Today, doctors still find out how well your heart is beating. They may also measure temperature and do blood and urine tests to see if there are changes in your body compared to normal. These changes are called **symptoms**. Different problems cause different symptoms. The symptoms of a cold include a sore throat and runny nose.

A | Modern equipment can see organs inside our bodies. Scientists have used this technology on Egyptian mummies and found that many had heart problems.

B | Doctors have written instructions for how to treat problems for thousands of years. This Ancient Egyptian carving records the range of instruments and medicines that a doctor used to treat patients. Many of the instruments still look familiar!

A doctor sees if there is a match between a patient's symptoms and a known problem. If there is a match, the symptoms are **evidence** that the person has a certain illness.

Luckily, if you need a **medicine** today it will not contain a favourite ingredient of Ancient Egyptian medicine – animal dung!

1 a| A patient has a high temperature, a headache and a stuffy nose. Which word in bold on this page best describes these findings?

b| Suggest what illness the patient has.

2 A doctor tells a patient that they have acne. Suggest what evidence the doctor has found to make them think this.

3 a| Which of the following best describes the heart:

A| an organ B| a cell
C| a tissue D| a system?

b| State one job that the heart does.

UK NC, iLS, CEE

7Aa LIFE PROCESSES

WHAT DO ALL LIVING THINGS DO?

The Ancient Egyptians believed they had cures for death, including one made from onions. It is doubtful that this worked! When they died, the bodies of important people were treated to stop them rotting – they were mummified. This was done because Ancient Egyptians believed that living things contained a 'life force' called *ka*, which needed somewhere to live.

Today, we have different ideas about what it means to be alive. We look at what things do. If something can do the following **life processes**, it is a 'living thing' or **organism**:

- move
- reproduce
- sense things
- grow
- respire
- excrete waste
- need nutrition.

A | The mummies of some of the most important Ancient Egyptian rulers (the pharaohs) were placed inside huge stone pyramids.

1 Copy and complete the table below with the items in the list.

car, chair, coal, cow, daffodil, goldfish, mouse, octopus, robot, rock, snake, Sun

Organism	Not an organism

2 A **mnemonic** is a word or phrase that helps you remember a list. It is usually made using the first letters of the words in a list. What mnemonic is spelled out by the first letters of the life processes?

Movement

All living things can either **move** from place to place or move parts of themselves.

B | Arctic poppies move parts of themselves. Their flowers turn to follow the Sun during the day.

3 Suggest one difference between how most animals move and how most plants move.

Reproduction

Organisms can make more living things like themselves. We say that they can **reproduce**.

C | **Offspring** are the result of reproduction.

4 Suggest one thing that many plants do to reproduce but animals do not do.

Sensitivity

Organisms **sense** and react to things around them.

D | This sensitive plant closes its leaves if it senses something touching them.

Growth

Living things increase in size. We say that they **grow**.

E | Some types of bamboo can grow 4 cm taller in an hour.

Respiration

Living things use a process called **respiration** to release energy for them to use.

F | Humans, like many living things, need **oxygen** and food in order to respire.

Excretion

Organisms produce waste materials. When they get rid of these waste materials we say that they **excrete** them.

G | Waste materials include liquids (urine).

Nutrition

Living things require various substances to help carry out other life processes. We say that they need **nutrition**.

H | Animals eat food but plants make their own food. However, even plants need small amounts of substances from the soil to help them grow well.

5 Describe two ways in which you show sensitivity.

6 Suggest one difference between how trees grow and how humans grow.

7 Suggest one difference between how fish and humans get their oxygen.

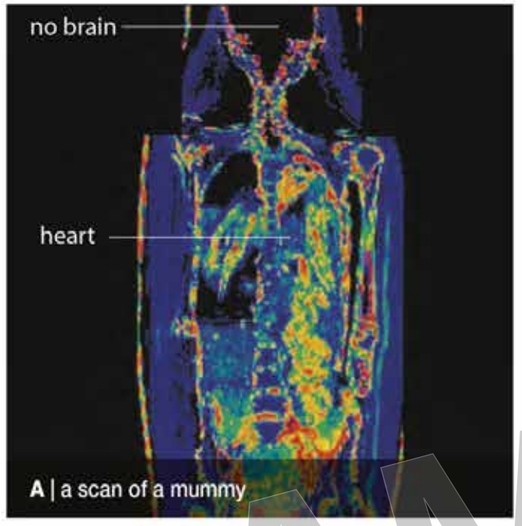
8 a| In what ways is a car like an organism?
b| Why is a car not an organism?

I can ...

- recall and describe the life processes
- explain the differences between organisms and non-living things.

7Ab ORGANS

WHAT DO ORGANS DO?



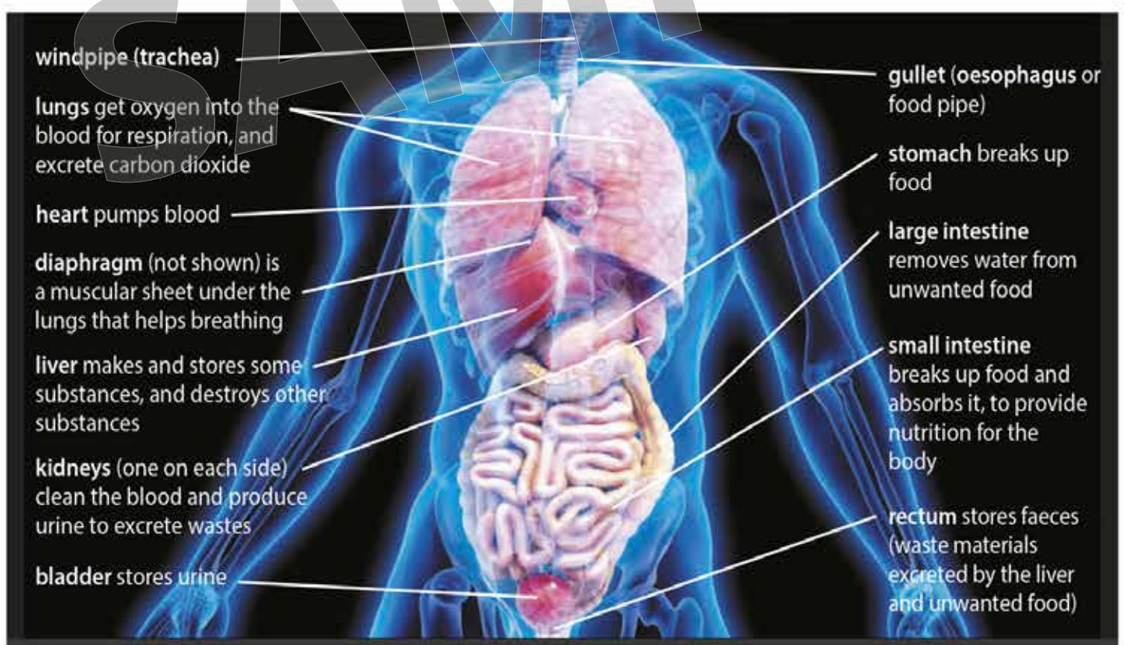
A | a scan of a mummy

In Ancient Egypt, the heart was thought to be the most important part of a person. When people were mummified, the organs in their bodies were removed but the heart was left in place. The stomach, intestines, lungs and liver were thought to be useful on the person's journey in the afterlife and these organs were preserved. They did not think the **brain** was important and so it was often thrown away.

Human organs

The heart, stomach, intestines, lungs and liver are **organs**. Every organ has an important **function** (job). We now know that the brain is also an organ and has the very important function of controlling the body!

Your body's biggest organ is on the outside. It's your **skin**. Skin is used for protection and sensing things.



B | some of the organs in your body

1. Draw a table to show the functions of five different organs in your body.
2. Which organ gets bigger as it fills with air?
3. List the organs that help to get nutrition into the body.
4. List the organs that excrete waste materials.
5. List two organs that store solid or liquid wastes.

Plant organs

Photo D shows some of the main organs in plants.

D | the organs found in most plants

Plants make their own food using a process called **photosynthesis**. This process occurs in the leaves when there is light. Photosynthesis needs **carbon dioxide** from the air, and water. Some plants also have **storage organs**, which they use to store some of the food that they make. Potatoes and carrots are storage organs.

6. Which organ is the main organ of nutrition in a plant?
7. a| What process produces the food stored in plant storage organs?
   b| Why won't a potato grow if the potato plant does not get much light?
8. Which human organ is most similar to a leaf? Explain your reasoning.

FACT

Leaves are plant organs that are designed to collect sunlight. Plants that live in shady areas often have very large leaves. The leaves of the giant water lily can be up to 3 m in diameter.

E | Many plants have underground storage organs, which they use to store some of the food that they make. Humans often eat these.

I can ...

- identify and locate important plant and animal organs
- describe the functions of important plant and animal organs
- describe what happens in photosynthesis.

7Ab MEDICAL DOCTORS

HOW DO MEDICAL DOCTORS USE STEM SKILLS?

STEM stands for sceince, technology, engineering and maths. There are many interesting jobs open to people with skills in these subjects. These include careers in communications, farming, fashion, films, finance, health, sport and video gaming.

All STEM subjects are linked:

- similar skills are needed for each one
- changes or advances in one subject may change the way the others are done.

STEM skills

An important STEM skill is problem-solving. This is often done by thinking up ideas and then testing them. Results from the tests are used as **evidence** (information used to decide if an idea is correct or incorrect). A decision made using evidence is called a **conclusion**.

Doctors think up ideas about what might be wrong with a patient. They then perform tests. They use the test results and their knowledge of the human body to make a conclusion (called a 'medical diagnosis').

1 List the STEM subjects.

B | a doctor performing a test

A | X-ray technology was invented in 1895 and allowed doctors to see the bones inside people. Advances in the technology have produced scanners (like this one) that show the organs inside our bodies. Engineers also use X-ray technology to check joins between pieces of metal.

2 a | When a girl broke her leg, it was put in plaster for 2 months. Suggest how a doctor might check to see if the two ends of the broken bone have now joined together?

b | A doctor thinks that a patient has a heart problem. Suggest why the patient is put in an X-ray scanner.

3 Look at photo B. What organ is the doctor testing?

4 A man has been getting pains in his chest. His doctor thinks the man may have a heart problem.

a | What does the heart do?

b | Suggest two tests the doctor uses to discover if the man's heart is working properly.

5 A patient has yellow skin. The doctor thinks the patient's liver has a problem and is releasing a substance called bilirubin into the blood. A test finds bilirubin in the patient's urine. The doctor says that the patient has liver disease.

a | What does the liver do?

b | What is the doctor's diagnosis?

c | What evidence does the doctor use?

d | Which organ produces urine?

e | Which organ stores urine?

STEM careers

Many other interesting jobs need a knowledge of the human body and its organs. Pathologists use their knowledge of the body and problem-solving skills to reach conclusions about how someone has died.

C | physiotherapists at work

Physiotherapists help people to recover from muscle and bone injuries. Physiotherapists are an important part of your country's sporting teams.

6 Explain why a country's athletics team includes many physiotherapists.

To develop their skills and knowledge, people who want to become physiotherapists, nurses or doctors do more training after they leave school. Doctors, for example, usually train at a university for six or seven years. Some doctors then do even more training to specialise in a certain area of the body or to become surgeons or pathologists.

7 Find out what a cardiologist is.

ACTIVITY

Work with others in your group to think about the different jobs that need a knowledge of the human body and its organs. Write down as many jobs as you can think of. For each job, give a reason why a knowledge of the human body is useful.

PRACTICAL

A doctor uses a stethoscope to listen to a person's heart beating and their breathing. The first stethoscope was a rolled-up tube of paper. In your group, make a range of different stethoscopes using paper, different types of tubing, funnels and sticky tape. Test them out and decide which one works best.

D | a modern stethoscope

7Ac TISSUES

WHY ARE TISSUES IMPORTANT?

Many good detective stories have a 'pathologist', who inspects a dead body to look for evidence to help to solve a murder. Pathologists have a long history; dead bodies were examined in Ancient Egypt, Ancient Greece and in Roman times.

Pathologists are fully trained doctors. Some pathologists examine dead bodies to try to work out causes of death. Others examine small pieces taken from living people to try to identify diseases.

A | Pathologists use microscopes, which magnify things. This allows pieces taken from a body to be examined in great detail.

1. What does a microscope do?
2. Look at photo B. Describe what a heart looks like.

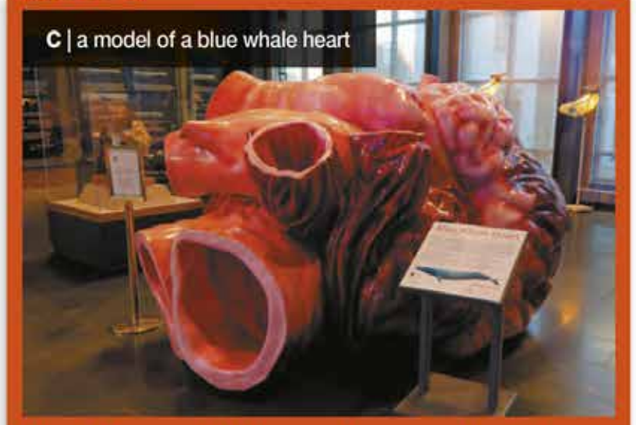
B | a human heart

A pathologist will look at a heart in detail because it is such an important organ and damage to it often causes death. Its function is to pump blood around the body. The blood carries oxygen and nutrients (from food) for all the different parts of the body to use.

The heart has different parts. In photo B, the whiter parts are fat and the reddish parts are muscle. These are **tissues**. All organs are made up of different tissues.

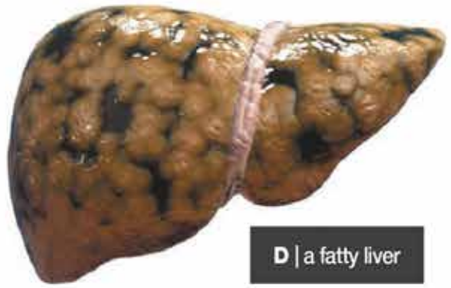
Each tissue in an organ has a certain function. For example, the **muscle tissue** in the heart is the part that moves, to pump blood. The **fat tissue** helps to protect the heart.

FACT



C | a model of a blue whale heart

About 20 per cent of the mass of a mammal heart is fat. For an adult human, that is about 60 g of fat. For an adult blue whale that is about 120 kg of fat; a blue whale heart can have a mass up to about 600 kg!



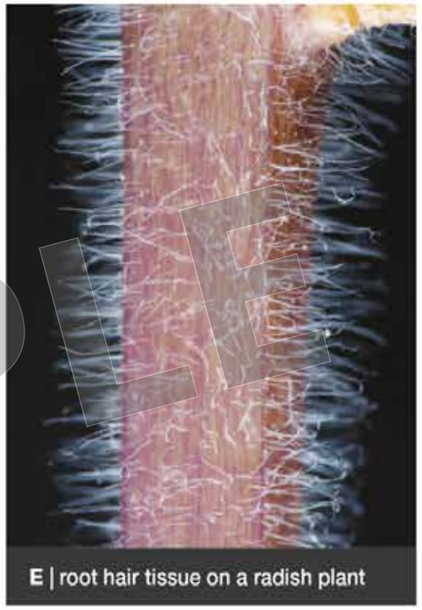
D | a fatty liver

3. a| Name two tissues found in the heart.
   b| What does each of these tissues do?
4. A pathologist says that the liver in photo D comes from someone with 'fatty liver disease'. Compare it with the healthy liver in diagram B on page 8. What evidence supports the pathologist's conclusion?
5. Your intestines move, so that food is pushed along. What tissue would you expect to find in intestines?

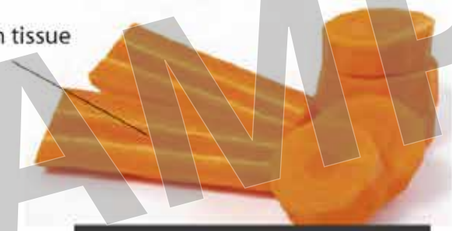
Plant tissues

Plants also have organs made out of tissues. Many roots, like the one shown in photo E, have hairs on the outside. This is **root hair tissue** and it helps the root to take water out of the soil quickly.

If you cut open a plant organ, you can see more tissues. Photo F shows that a carrot contains different tissues. The tissue in the middle of the carrot is called **xylem tissue** (pronounced '***zy***-*lem*'). Xylem tissue carries water. In a carrot, the xylem tissue carries water up from the roots, through the carrot and on into the rest of the plant.



E | root hair tissue on a radish plant



F | Carrots contain different tissues.

G | a carrot plant

6. a| What sort of organ is a carrot?
   b| How many tissues does a carrot contain? Explain your reasoning.
7. a| Name two tissues you would expect to find in a radish plant root.
   b| What does each of these tissues do?
8. Name a plant organ that is above ground and contains xylem tissue.
9. Which life process does xylem tissue help with?

I can ...

- identify and recall named tissues in human and plant organs
- describe the functions of different tissues in an organ.

7Ac MICROSCOPES

HOW IS A LIGHT MICROSCOPE USED TO EXAMINE A SPECIMEN?

To find out what is wrong with an organ, doctors do tests. Some tests involve taking a small piece of tissue (a biopsy) from an organ and looking at it under a light microscope. Microscopes make things appear bigger; they magnify things. The Method below shows how to use a light microscope.

Method

A | Place the smallest **objective lens** (the lowest **magnification**) over the hole in the stage. Turn the **coarse focusing wheel** to make the gap between the objective lens and the stage as small as possible.

B | Place the **slide** under the clips on the **stage**. The slide contains the **specimen** (the thing you want to look at). Then adjust the light source so that light goes up through the hole.

C | Look through the **eyepiece lens.** Turn the coarse focusing wheel slowly until what you see is in focus (clear and sharp).

D | To see a bigger **image**, place the next largest objective lens over your specimen.

E | Use the **fine focusing wheel** to get your image in focus again. Do not use the coarse focusing wheel since you can break the slide and damage the objective lens. If you cannot see your specimen clearly go back to a lower magnification.

Never point a microscope mirror at the Sun. This can permanently damage your eyesight.

1. How many types of lenses are found in a light microscope?
2. Write down some rules of your own for:
   a| using a microscope safely
   b| taking care of a microscope.
3. What part of a microscope makes the image clearer?
4. What is a specimen?

Both of the lenses in a light microscope do some magnifying. How much a lens magnifies is written on its side (e.g. ×10). To work out the total magnification of both lenses working together, we use this formula:

5. A microscope has a ×10 eyepiece lens and a ×15 objective lens. What is its total magnification?

total magnification = magnification of eyepiece lens × magnification of objective lens

Preparing a specimen

The specimen on a microscope slide needs to be thin so that light can pass through it. A thin, glass **coverslip** is put on the specimen to keep it flat, hold it in place and stop it drying out. The Method below shows how to prepare a slide of onion tissue.

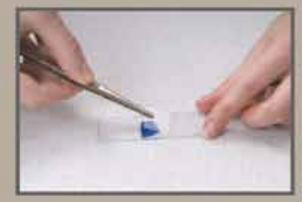
Method

A | Take a slide and place a drop of water in the centre. The water may contain a **stain** to make the specimen show up better.

B | Use some forceps to peel off the inside layer of a piece of onion.

C | Place a small piece of onion skin onto the drop of water on your slide.

D | Use some forceps to lower a coverslip onto your specimen. If you do this carefully and slowly you will not get air bubbles trapped under the coverslip.



Wear eye protection when carrying out this method. Slides and coverslips are made of thin glass. Be very careful when using them.

6. Why does a specimen need to be thin?
7. Why do we use coverslips?
8. Suggest the names of two plant and two animal tissues you could examine using a light microscope.
9. Plan an investigation to examine rhubarb stem tissue in detail.
10. Jake sets up a microscope but only sees darkness when looking into the eyepiece lens. What might be wrong? Write down as many things as you can think of.

I can ...

- describe how to prepare a microscope slide
- describe how to use a light microscope to examine a specimen.

7Ad CELLS

HOW ARE PLANT AND ANIMAL CELLS SIMILAR AND DIFFERENT?

Mummification preserves tissues. In 1825, Dr Augustus Granville tried to work out how a 2500-year-old Egyptian 'mummy' had died. His study included using a microscope to examine tissues. His conclusion was 'cancer'. Technology has now advanced and another examination of the same mummy in 2009 concluded that the person died from a lung disease called tuberculosis (TB).

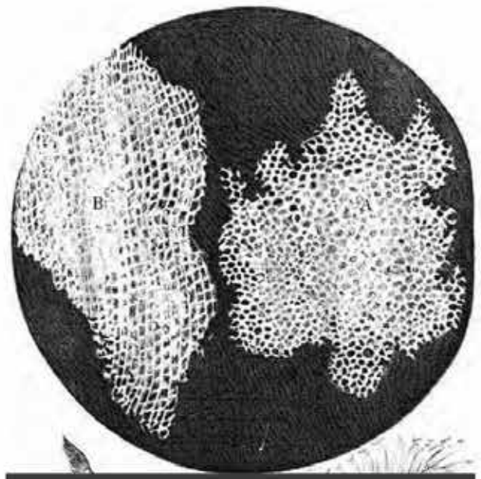
FACT

Today's most powerful microscopes are called electron microscopes. One of them can show things that are one ten-millionth of a millimetre wide.

A | Hooke's microscope (far left) had a total magnification of about ×30. Early 19th-century microscopes magnified to about ×200. Modern light microscopes go up to about ×1500.

Robert Hooke was the first person to study tissues with a microscope. In 1665, he examined the bark of a cork oak tree and saw little box shapes. He thought that they looked like the **cells** (small rooms) in a monastery and so that's what he called them.

Today we know that cells are the basic units from which all tissues and all living things are made. A tissue is a group of cells of the same type working together.



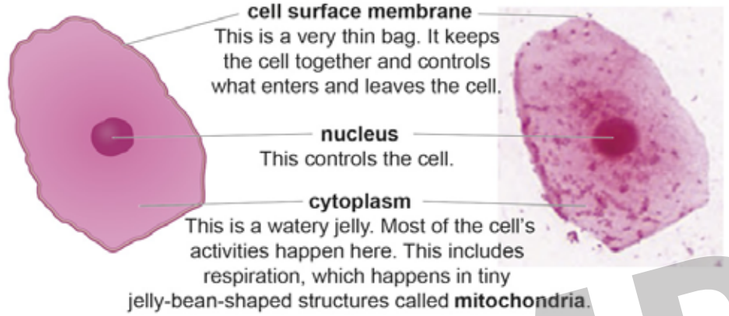
B | Hooke's drawing of cork cells, published in his book *Micrographia*

1. What is a cell?
2. Granville was able to see much more in the mummy tissues than Hooke saw in the cork tissue. Why was this?
3. What do organisms always have that things that have never been alive do not?

Animal cells

Photo C shows a cell from someone's cheek, viewed using a modern microscope. The photograph has a magnification of ×600, which means that it is 600 times bigger in the photo than in real life. The different parts of the cell are labelled.

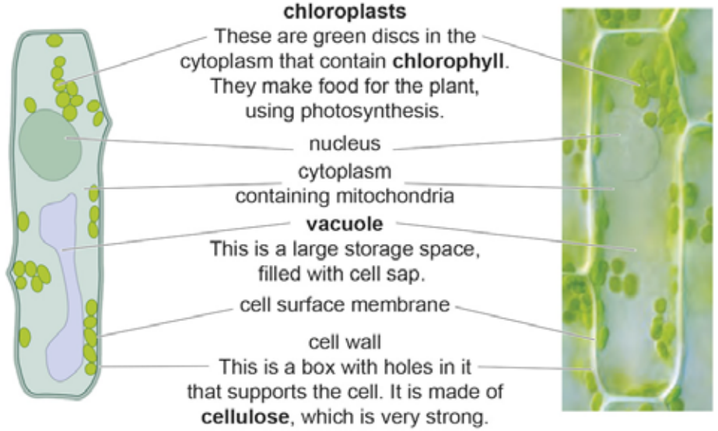
All animal cells have the same basic parts, but cells from different tissues have different shapes, sizes and functions to help them do their jobs. The cells are **specialised**.



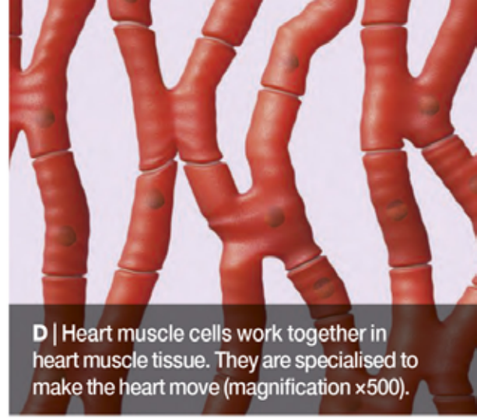
C | a drawing and microscope image of a cheek cell showing its parts (magnification ×600)

Plant cells

Plant cells have thick **cell walls** and may have some other features that are not found in animal cells.



E | a drawing and microscope image of a leaf cell showing its parts (magnification ×275)



D | Heart muscle cells work together in heart muscle tissue. They are specialised to make the heart move (magnification ×500).

4. a| Look at photo D. What are the dark blobs?
   b| What do these structures do?
   c| What other parts would you find in a heart muscle cell?
   d| What do these parts do?
5. a| Measure the widest part of the animal cell in photo C. Work out its real width.
   b| Measure the length of the plant cell in photo E. Work out its real length.
6. Draw a table to compare the parts that can be found in animal cells and plant cells.
7. a| What makes some plant cells green?
   b| Which are bigger, chloroplasts or mitochondria? Explain your evidence.
8. Draw and label a root hair cell.

F | Root hair cells are specialised to take water from the soil (magnification ×30).

I can ...

- identify the main parts of animal cells and plant cells and describe their functions.

UK NC, iLS, CEE

7Ae ORGAN SYSTEMS

HOW DO CELLS, TISSUES AND ORGANS WORK TOGETHER?

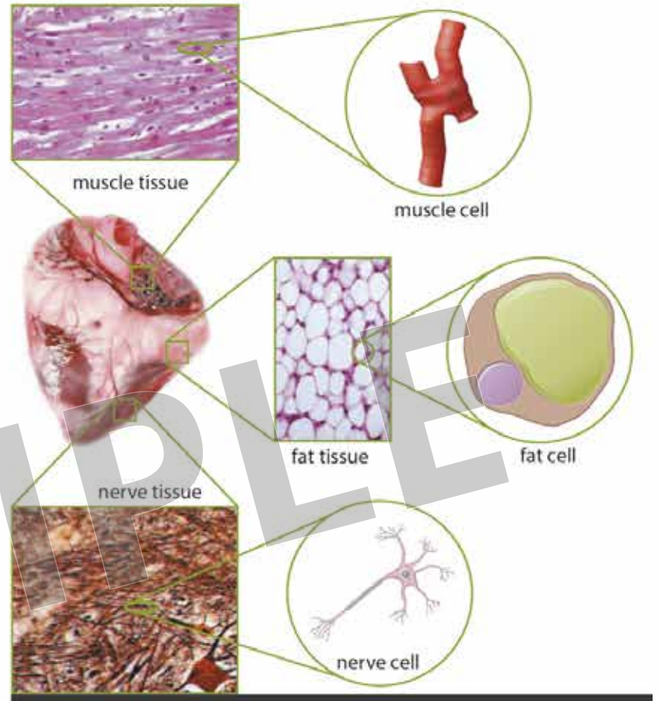
When cells of the same type are grouped together they form a tissue. Different tissues are found grouped together in an organ.

1 Name three tissues found in the heart.

Doctors in Ancient Egypt could see that organs were connected but did not understand how or why. For example, they thought that you breathed air into your lungs and your heart, and all the tubes going to and from your heart. They could only examine the heart and its tubes in dead bodies when these organs were full of air, and so they thought that they always contained air.

Today we know that the heart and its tubes carry blood around the body. The tubes are called **blood vessels** and work with the heart to form an **organ system** called the **circulatory system**.

An organ system is a group of organs that work together. Other organ systems in humans include the **locomotor** (muscles and bones), **digestive**, **urinary**, **nervous** and **breathing systems**. (The last of these is also called the **respiratory system**.)



A | Organs, such as the heart, are made of many tissues.

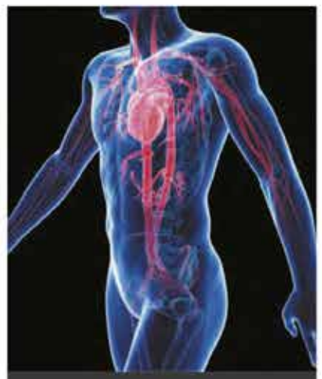
2 a| Why did Ancient Egyptians think that blood vessels contained air?

b| Suggest a piece of evidence that we have today that shows this is not correct.

3 What is an organ system?

FACT

An adult's circulatory system contains over 100 000 km of blood vessels. That is four times around the Earth!



B | The circulatory system carries oxygen and nutrients (from food) around the body.

C | The digestive system breaks down food and takes nutrients from it into the blood.

4 What organs are found in the breathing system? (*Hint:* You may find page 8 helpful.)

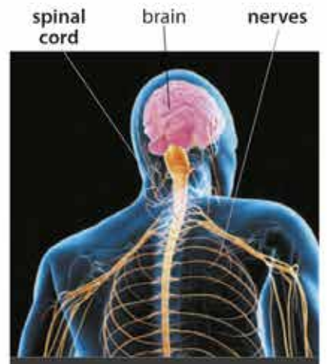
5 Draw a table to show the organs found in each human organ system mentioned on pages 18–19. (*Hint*: You may find page 8 helpful.)

6 Which life processes do the organ systems in diagrams C, D and E help with?

FACT

In your urinary system, your kidneys clean all of your blood every 40 minutes.

D | The urinary system gets rid of waste materials produced in the body.

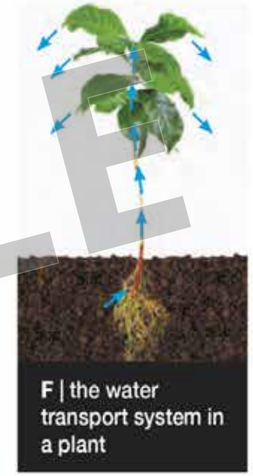


E | The nervous system allows you to sense things.

Organ systems in plants

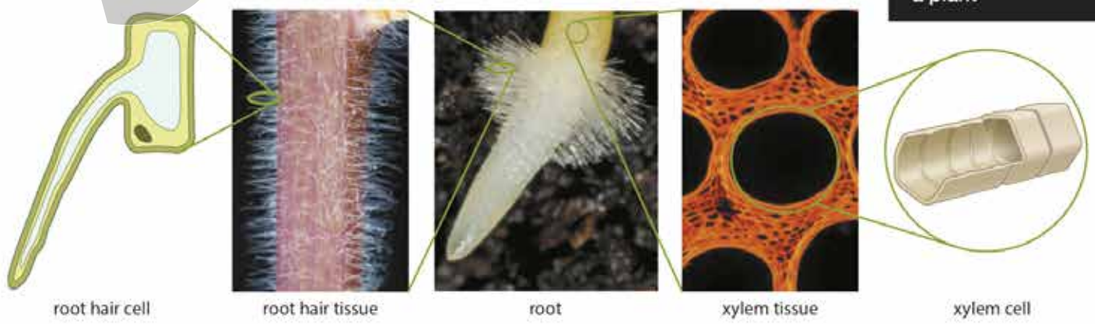
Plants also have organs made up of tissues.

Plant organs work together in organ systems too. For example, the water transport system takes water from the ground up to the leaves. Water is always flowing through this organ system because leaves constantly lose water (by **evaporation**).



F | the water transport system in a plant

G | A plant root is made up of different tissues.



7 a| What are the organs in a plant's water transport system?

b| Name one tissue you would expect to find in all these organs.

8 Leaves lose water through small holes. How would you examine a leaf to find out whether more water is lost from its upper or under side? Plan an investigation.

I can ...

- identify and recall the main organs in the plant water transport system
- identify and recall the main organs in the human locomotor, digestive, circulatory, breathing, urinary and nervous systems.

7Ae TRANSPLANTS

WHAT IS AN ORGAN TRANSPLANT?

Doctors today know a lot about cells, tissues and organs. They also have microscopes and other tools to help investigate problems with our bodies.

If a doctor thinks there is something wrong with an organ, a biopsy (piece of tissue) might be taken from the organ and examined. This can help to identify the problem and a doctor can plan a treatment.

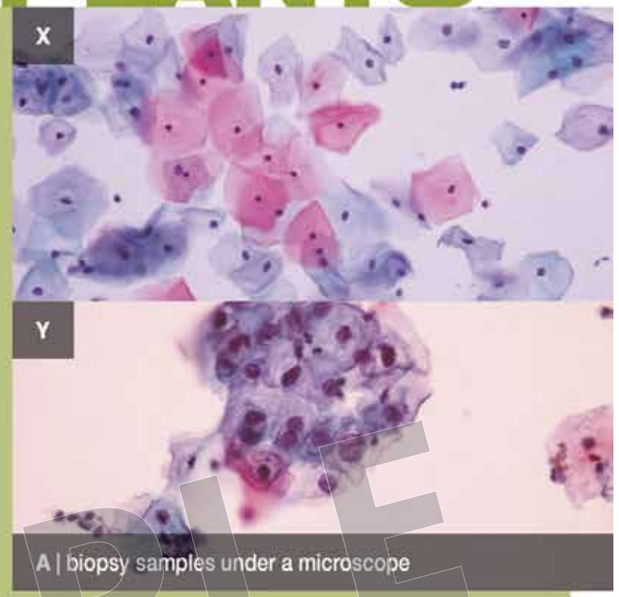
B | This farmer was given a double arm transplant.

The idea of replacing damaged tissues and organs goes back at least 2700 years to an Indian doctor, called Sushruta. He successfully replaced skin on a part of someone's body using nearby skin from the same person. Today doctors can transplant hearts, lungs, livers, kidneys and even faces, arms and legs between different people.

1 a| Draw one cell from biopsy sample X. Label its parts and their functions.

b| In some cancer cells the nuclei become very large. Which biopsy sample (X or Y) shows cancerous tissue?

2 Draw a diagram to show how organ systems, organs, tissues and cells are linked. In your diagram use one example from plants and one from humans.



A | biopsy samples under a microscope

Sometimes an organ cannot be treated and doctors may consider doing an **organ transplant**. This is when an unhealthy organ is replaced with a healthy organ (usually from a person who has recently died).

C | Some people want their organs to be used for transplants if they die. They may carry a card to show this.

HAVE YOUR SAY

'People should carry cards only if they do not want to donate their organs – the opposite of donor cards.' What you do you think of this idea?