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.
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.

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.
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
- grow
- reproduce
- sense things
- excrete waste

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.

C | Offspring are the result of reproduction.

Reproduction

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

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

Sensitivity

Organisms sense and react to things around them.

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.

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.

G | Waste materials include liquids (urine).

Growth

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

I can ...

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

Excretion

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

J | Waste materials include liquids (urine).
**Organs**

**What do organs do?**

In Ancient Egypt, the heart was thought to be the most important part of a person. When people were mumified, 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.

**Plant organs**

Photo D shows some of the main organs in 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.

**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.

**I can...**

- Identify and locate important plant and animal organs
- Describe the functions of important plant and animal organs
- Describe what happens in photosynthesis
**MEDICAL 7A Ab DOCTORS**

**HOW DO MEDICAL DOCTORS USE STEM SKILLS?**

STEM stands for science, 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.

**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.

- 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.

- B | A doctor performing a test

- C | Physiotherapists at work

- D | A modern stethoscope

**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.

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.

**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.
7A C TISSUES

WHY ARE TISSUES IMPORTANT?

Many good detective stories have a ‘pathologist’ who inspects a dead body to look for evidence to help 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.

What does a microscope do?

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 redder 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.

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!

F | a model of a blue whale heart

FACT

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-lém’). 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.

G | a carrot plant

I can ...

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

**Sample Questions**

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?

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.

**Tips**

- Never point a microscope mirror at the Sun. This can permanently damage your eyesight.
- Wear eye protection when carrying out this method. Slides and coverslips are made of thin glass. Be very careful when using them.

**I can ...**

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

Photo C shows a cell from someone’s cheek, viewed using a modern microscope. The photograph has a magnification of x600, 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.

Plant cells

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

What is a cell?

Granville was able to see much more in the mummy tissue than Hooke saw in the cork tissue. Why was this?

What do organisms always have that things that have never been alive do not?
**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 those 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.)

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!

**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).

4. What organs are found in the breathing system? (Hint: You may find page 18 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 18 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.

**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.
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.

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).

The idea of replacing damaged tissues and organs goes back at least 2,700 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. Draw one cell from biopsy sample X. Label its parts and their functions.
2. In some cancer cells the nuclei become very large. Which biopsy sample (X or Y) shows cancerous tissue?
3. 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.