Chapter

1

Life

1.1 Cells

All living organisms are made up of cells.

Robert Hooke

1-2

In 1665 a scientist called Robert Hooke published a book called *Micrographia*. His book was all about what you could see under a microscope. In this book he used the word **cell** for the first time. He was describing what cork looked like, and thought that the box shapes he could see were like the rooms that monks lived in, called cells. Today the word cell describes what all living things are made up of. Unlike Robert Hooke's empty boxes, we know that cells are not empty but full of important structures and chemicals.

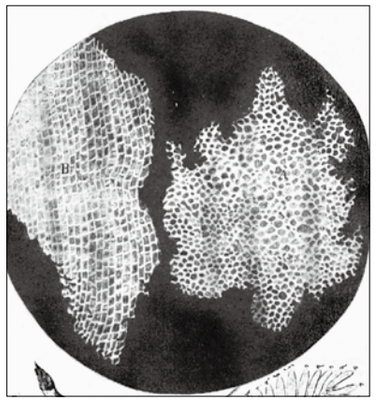


Figure 1 Hooke's drawing of the cells in cork

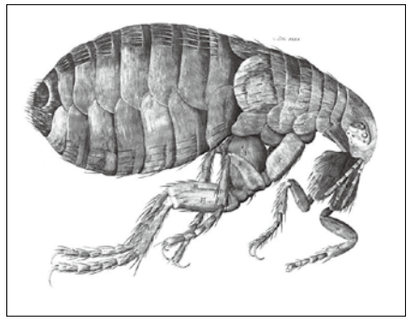


Figure 2 A drawing from Hooke's book *Micrographia*

Cell Structure

1-3

Plant and animal cells have a number of things in common and a few differences. Figure 3 shows you what a typical animal cell and a typical plant cell look like.

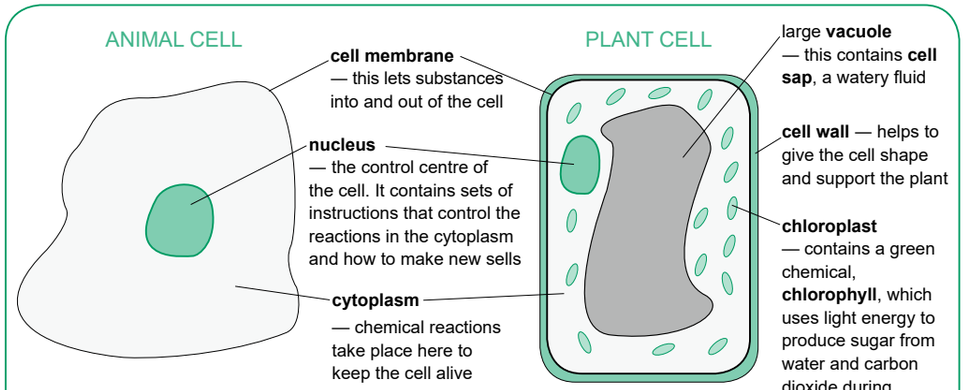


Figure 3

Questions

1. Copy out the following table under the heading 'Cells'. Put a tick if a structure is present in the cell and a cross if it is not. Use the diagrams to help you.

Cell structure	Animal cell	Plant cell
cell membrane	√	√
cell wall		
cytoplasm		
nucleus		
large vacuole		
chloroplast		

2. Plants have a cell wall that helps to give the cell shape. What do humans have to give them support and shape?

3. Chloroplasts in plant cells use water and carbon dioxide to make sugar. They join these two chemicals together using the energy from sunlight. What is this process called?

4. As a plant loses water, the large vacuole inside its cells gets smaller, but the cells do not lose their shape because of the strong cell walls. This means that the plant does not collapse. When the cell gets more water again, the large vacuole increases in size. Draw a strip cartoon to show what happens. Write a story under each picture to explain what is happening.

Remember

Fill in the blanks in the passage below.

cell wall nucleus cells vacuole cell membrane nucleus cytoplasm

All living things are made up of 1 ( ). Plant and animal cells have a 2 ( ), 3 ( ) and 4 ( ). Plant cells also have a 5 ( ), and a 6 ( ). Cells are controlled by the 7 ( ). Chemical reactions, which keep the cell alive, take place in the cytoplasm.

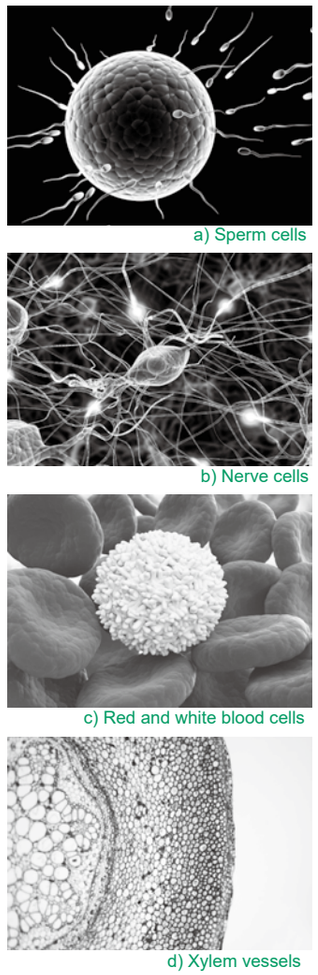
1.2 Tissues

Groups of cells of the same kind are called a tissue. Tissues carry out different jobs or functions.

Different cells, different functions!

1-4

Different cells have different functions. Some make things, others control things. Some protect us, others provide support. They often work together in groups.



a) Sperm cells

b) Nerve cells

c) Red and white blood cells

d) Xylem vessels

Figure 1 Plant and animal cells come in different shapes and sizes.

Animal tissue	Function
skin	to protect the body and stop harmful things entering
blood	to carry oxygen, carbon dioxide and chemicals from food around the body
bone	to give support
nervous tissue	to carry messages
muscle	to help us move

Plant tissue	Function
xylem	to carry water and minerals from the roots to the leaves
phloem	to carry food dissolved in water around the plant

Table 1 Some examples of animal and plant tissues

Growing tissues

1-5

Some animals and plants can replace damaged parts and tissues. Humans do this when we repair cuts and broken bones. Large parts of plants can be cut off without the plant dying. Gardeners deliberately prune some plants to make them grow.

A starfish can replace one of its 'arms' if it is eaten by a larger animal. Regrowing damaged parts is called **regeneration**. Some people think that if you cut a worm in two you will have two worms. This is not true. The top half may grow a new tail but the tail end will die.

Figure 2 The starfish will regenerate a missing 'arm'. A person cannot do this, but we can regenerate a fingernail that gets lost in an accident.

Plant and animal tissues can be grown outside the body. Scientists do this for a number of reasons, for example to study cells better, or to replace damaged tissue. When tissues are grown like this they are called **tissue cultures**. They have to be grown in very clean or **sterile** conditions. In order for the cells to grow they need nutrients or food. A special jelly called a **culture medium** provides this. If you take the tip off the shoot of a plant and grow this in a culture medium, you can grow a whole new set of shoots, leaves and flowers. When this is planted in soil, the plant will develop roots.

Questions

1. What do we mean by a 'tissue culture'?
2. Give an example of regeneration.
3. What does a culture medium provide?

Remember

Unscramble the words on each line to make one or two sentences.

a) cells different different jobs have
b) same kind called a tissue groups of cells of the are
c) called tissue cultures can be grown plant and animal tissues outside the body these are

1.3 New cells from old

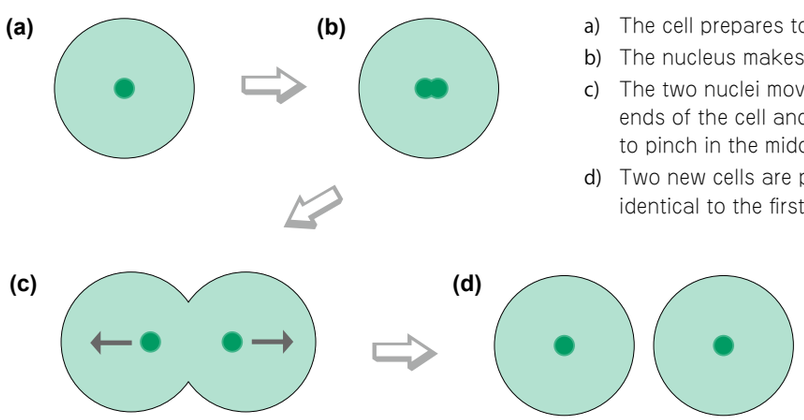
Cells in our bodies are continually being replaced.

Growth

1-6

You are not the same person today as when you were born. It may sound silly, but it's true. Since you were born you have grown and developed. In fact you no longer have any of the cells in your body that you were born with! As we grow and develop, the cells, tissues and organs in our body grow and change. How do they do this? Well, cells are always being replaced and old cells die and get broken down in our bodies. In fact in the time it has taken to read this paragraph, many of the cells in your body have died and many new ones have taken their place. A normal cell does not live forever.

Figure 1



a) The cell prepares to divide.
b) The nucleus makes a copy of itself.
c) The two nuclei move to opposite ends of the cell and the cell starts to pinch in the middle.
d) Two new cells are produced identical to the first cell.

All of the cells in our body, except mature red blood cells, have a **nucleus**. The nucleus controls what the cell does (its function) and when and how it should divide. Look at the cartoon above (Figure 1) to see how cells divide. Cells make copies of themselves when they divide.

In 1961, a cancer scientist called Leonard Hayflick found out that normal human cells eventually die. He also noticed that the oldest cells he grew in his lab usually died first. Hayflick suspected that cells contain some sort of clock that tells them when it is time to stop dividing. Later he discovered that cells have what he called an 'event counter' — this counts the number of times a group of cells will double, *not* how long the cell has been alive. Most groups of cells can double between 50 and 100 times before they die completely. Some cells, such as red and white blood cells, can double many more times. Other cells, like nerve cells, cannot double at all. A small group of two cells that doubles three times would end up as a group of 16 cells. Two cells double to four, four cells double to eight, and eight cells double to 16.

Questions

1. Which cells are the only cells not to have a nucleus when they are mature?
2. Do normal cells live forever?
3. Cells are often given what scientists call a 'Hayflick limit', that is the number of times the cells will be able to double before they die. If a group of cells had a Hayflick limit of 5, how many new cells could one of these cells produce before the cells die?
4. When someone is paralysed in a horse riding accident, he/she may not be able to walk afterwards. Why?

Remember

Use the words given here to complete the sentences below.

die live copies blood nucleus divide decides

Cells do not 1 ( ) forever. They make 2 ( ) of themselves and die. All cells have a nucleus except mature red 3 ( ) cells. The 4 ( ) controls the cell and 5 ( ) when it should 6 ( ) and when it should 7 ( ).

1.4 Henrietta Lacks and her immortal cells

Cancer cells can divide forever and never die.

1-7

Henrietta Lacks was born in 1920 in a town called Clover in the United States of America. Although she died of cancer in 1953, some of the cells from her body that she donated to science are still alive and reproducing. The cells have no Hayflick limit. They have helped scientists to learn about cancer and also help doctors in their research into diseases such as polio. Henrietta's cells have made her immortal and many people's lives have been saved because of what scientists have found out through studying them.

Henrietta Lacks lived a happy normal life with her husband David, moving to the town of Turner's Station near Baltimore. She had five children and then, after the birth of her fifth child in 1951, she became ill. She was admitted to Johns Hopkins University Hospital and was found to be suffering from a type of cancer that only affects women — cancer of the cervix (the cervix is found at the entrance to the womb). This resulted in an uncontrolled growth of tissue called a **tumour**. In the 1950s, treatment for cancer was not very advanced and many women died. Today, about 4500 cases of cancer of the cervix are diagnosed in this country every year, but if found and treated in its early stages, it can be successfully cured.

Henrietta let Dr George Gey take a sample of the cancer cells from the tumour she had developed. Dr Gey was working on ways of growing human cells outside the body. Normal cells he had tried to grow did not survive long once they had been removed from the body. The cells he had from Henrietta Lacks, however, kept on growing and dividing and did not die like samples from other people. In order to keep Henrietta's identity secret and to avoid upsetting her family, he called the cells HeLa cells. HeLa cells are still being reproduced today, nearly 50 years after her death and scientists all over the world use them in their research into cancer.

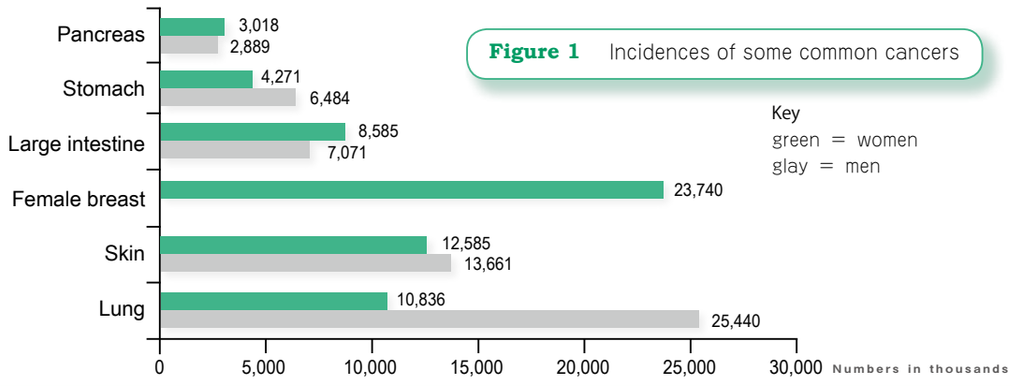


Figure 1 Incidences of some common cancers

Looking for cancer

1-8

Tumours can be either **benign** or **malignant**. Benign tumours are not cancer. They can usually be removed without any problem. It is the malignant tumours which are cancer.

Cancer can often be found before the disease causes symptoms. Checking for cancer (or for conditions that may lead to cancer) in a person who does not have any symptoms of the disease is called **screening**.

Screening may involve a physical examination, medical tests or scans. During a physical exam, the doctor looks for anything unusual and feels for any lumps or growths. Examples of laboratory tests include blood and urine tests and looking through a microscope at cells. Scans involve the use of X-ray images (such as mammograms to check the breasts).

In a special kind of X-ray imaging, a CT or CAT scan uses a computer linked to an X-ray machine to make a series of detailed pictures of the inside of the body.

What is cancer?

1-9

Cancer is the uncontrolled division of cells. A cancerous cell will keep on dividing and each of the cells it produces also keeps on dividing. Eventually a tumour can form. Cancerous cells can also travel around the body in the bloodstream and new tumours can be produced at other sites in the body. Many things can cause cancer, including exposure to radioactivity, strong chemicals and too much sunbathing.

Not all cancers will kill you. Many cancers can be treated if caught early, by **radiotherapy** (killing the cancer cells with radiation), **chemotherapy** (killing the cells with powerful drugs) or removing the cancerous cells by **surgery** (cutting them out of the body). The likelihood of someone getting cancer will vary with age. You are very unlikely to have cancer as a child or young person. The older you are, the greater the chance of having some type of cancer. It is not just found in humans though — cats, dogs, farm animals, birds and fish can all suffer from cancer.

Questions

1. How did Dr Gey come up with the term HeLa cells?
2. Explain what is meant by the term 'tumour'.
3. What are the three most common treatments for cancer?
4. What are the main causes of cancer that we know about?
5. There are more cases of skin cancer diagnosed today than there were 50 years ago. Why is this ?
6. How do cancer cells move around the body?

Remember

Use the words given here to complete the sentences below.

successful cancer cure uncontrolled removing treatment research

1 ( ) is treated by killing and 2 ( ) the cells that are dividing in an 3 ( ) way. The 4 ( ) is very difficult and sometimes is not 5 ( ). A great deal of medical 6 ( ) is looking for a 7 ( ) for cancer, but we still haven't yet found one simple cure for all cancers.

1.5 Are you irreplaceable?

1-10

Although the cells in our bodies are continually dividing, we cannot re-grow limbs or organs, unlike the starfish on page 11. If our organs become damaged, we may need an **organ transplant**.

You may be surprised to learn that you can live without quite a lot of your body. Even so, it is still best to hang on to what you have for as long as you can and look after it carefully.

Body part	How can you live without it?
skull cap	Your skull protects your brain but metal plates can be used instead.
arms/legs	Many people have lost an arm or a leg in an accident. You can adapt to living without a limb or you can have a replacement false limb fitted.
liver	You can lose 3/4 of your liver without serious problems. In children the liver can grow back!
spleen	The spleen breaks down old red blood cells. You can live without one.
appendix	This section of your intestine can be removed with no problems.
gall bladder	This produces bile that neutralises the acid which is added to your food in the stomach. You have to be careful when you eat but you can live without it.
pancreas	This makes enzymes that break down food. If this is removed, you have to take medication for the rest of life.
stomach	Most of your stomach can go. It adds acid to your food but most digestion takes place in the small intestine.
large intestine	This takes water from the food passing through your body. You do not need it all to live.
small intestine	Most of the digestion of your food happens here. The small intestine is several feet long and you could lose most of it, although you might have to be fed through a tube with a mixture that is partly digested. Not very tasty!
kidney	You have two kidneys and you can happily lead a normal life with just one. Damage that and you may need a replacement or some artificial help.
reproductive organs	None of these are essential to life and can be removed if they have cancer. They produce chemicals called hormones which have to be replaced.
thyroid gland	This produces chemicals that control your growth. If you have this taken away you will need medication for life.
adrenal gland	This produces hormones. Without it you will need to take hormone replacements for ever.

Table 1

Groups of cells form tissues and groups of tissues form organs. Organs make up organ systems and organ systems working together add up to a living organism.

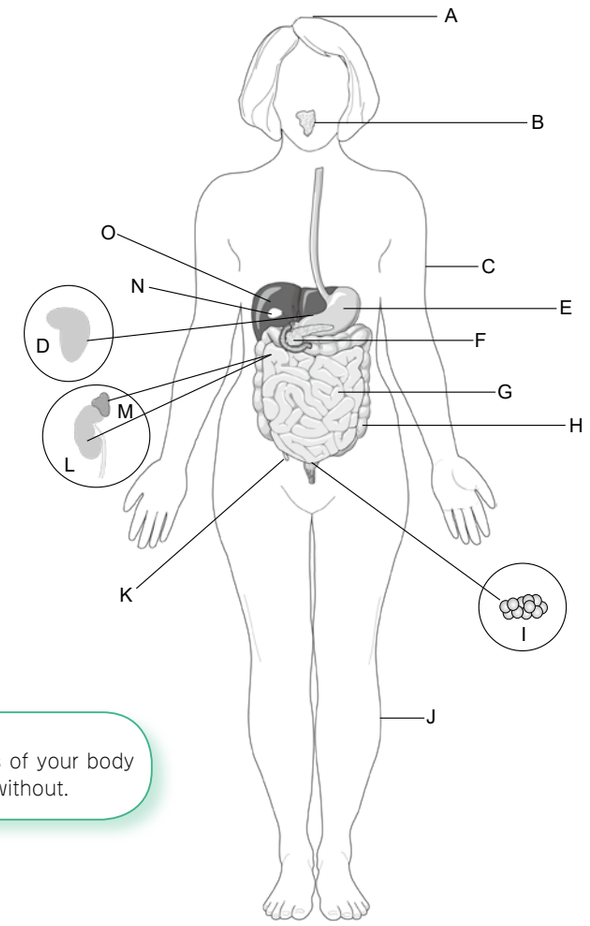


Figure 1
These are the bits of your body that you can live without.

Questions

1. Table 1 tells you which organs or parts of the body you could lose and still live a near normal life. Match the body parts in Table 1 to the letters on the diagram.
2. Name a part of the body on Table 1 that can be lost and cause a person no bother at all.

Remember

Unscramble these names for body parts you can do without.

NIYKED LENEPS HAMCOTS XIPADPEN

GELS RODHITY VILER