Chapter 8:
Cells, tissues and organs

Cells: building blocks of life

Living things are made of cells. Many of the chemical reactions that keep organisms alive (metabolic functions) take place in cells.

COMMON FEATURES OF CELLS

All cells (with a few exceptions) have these three things:

Cell membrane: a thin 'skin' that surrounds the cell contents. It controls the passage of dissolved substances into and out of the cell. This membrane is selectively permeable.

Cytoplasm: the contents of the cell (except for the nucleus). It is made up of water and dissolved substances. It also contains small structures **(organelles)** where chemical reactions take place.

Nucleus: the 'control centre' of the cell. It contains the genetic material **(DNA)** that carries the instructions that control the structure and activities of the cell. (Red blood cells do not have nuclei.)

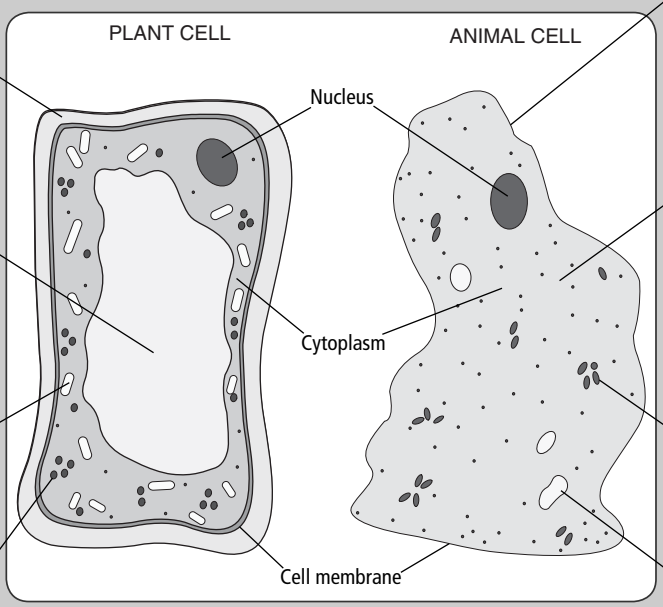
PLANT CELL FEATURES

Cell wall: a rigid (stiff) cell wall made of cellulose. This gives support. As a result, plant cells are fairly regular in shape. Water and dissolved substances can pass through the **permeable** cell wall.

Vacuole: the large, permanent vacuole contains water and dissolved substances **(cell sap)**. This helps to maintain pressure in the cells.

Chloroplasts: these contain **chlorophyll** and the **enzymes** needed for photosynthesis. They are found in the cells of green plants.

Stored food (starch): photosynthesis produces glucose (sugar). This is converted into **starch** and stored in the cytoplasm.



ANIMAL CELL FEATURES

Irregular shape: animal cells do not have a rigid cell wall so they are irregular in shape.

Denser cytoplasm: animal cells contain more dissolved substances and more organelles than plant cells. For example, animal cells contain more of the rod-like structures called **mitochondria** where respiration takes place. This is so they can release lots of energy quickly for fast movement.

Stored food (glycogen): carbohydrates are stored as glycogen in animal cells.

Vacuoles: animal cells may have several small, temporary vacuoles. These can be for digestion or the excretion of excess water.

WORKING OUT THE SIZE OF CELLS: you will need to **measure** something, and use a **magnification** to work out an **actual** size

$$\textbf{MA}\text{gnification} = \frac{\textbf{M}\text{easured length}}{\textbf{A}\text{ctual length}} \quad \text{so} \quad \text{Actual length} = \frac{\text{Measured length}}{\text{Magnification}}$$

Cells, tissues, organs and organ systems

Multicellular plants and animals contain many different types of cell. Each type of cell is designed for a particular function. Cells are organized to form tissues, organs, and organ systems. In a healthy **organism**, all the systems work together.

SPECIALIZED CELLS

A specialized cell is designed to do a particular job.

- Nerve cells have long fibres to carry messages.
- Muscle cells can contract and relax.
- Red blood cells carry oxygen around the body. They contain **haemoglobin**, which can combine with oxygen.

Specialized cells
red cells carry oxygen
white cells attack bacteria
platelets help clotting

TISSUES

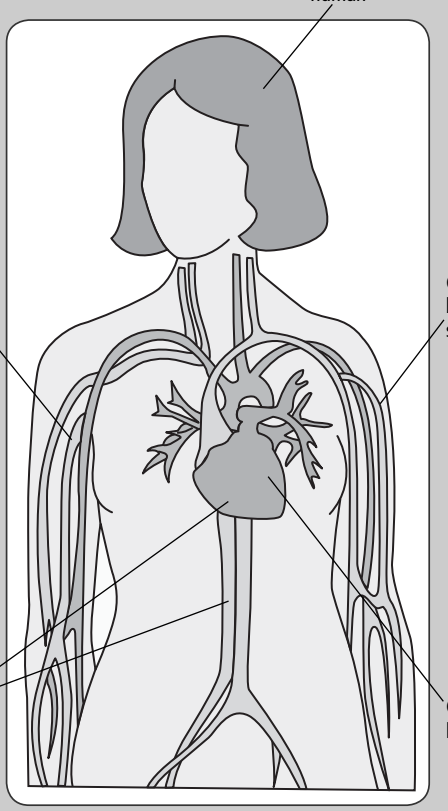
Large numbers of specialized cells together make up **tissue**.

Muscle, blood and nerves are all tissues.

Blood tissue contains red cells for carrying oxygen, white cells for destroying harmful bacteria, and **platelets** to cause clotting in cuts.

Tissues
blood vessels (capillaries)
muscles
(especially in the heart)
blood

NB Arteries and veins are usually thought of as organs as they consist of several tissue layers.



ORGANS

Various tissues together make up an **organ**. Each organ has its own specific job. The heart, the stomach and the brain are all organs.

The **heart** has to pump blood around the body. It is made up of **muscle tissue**, **blood vessels** and **nerves**.

ORGANISM

Various organ systems together make up an **organism**.
You are a human organism. You have:

- a respiratory system
- a digestive system
- a circulatory system
- a nervous system
- an endocrine system

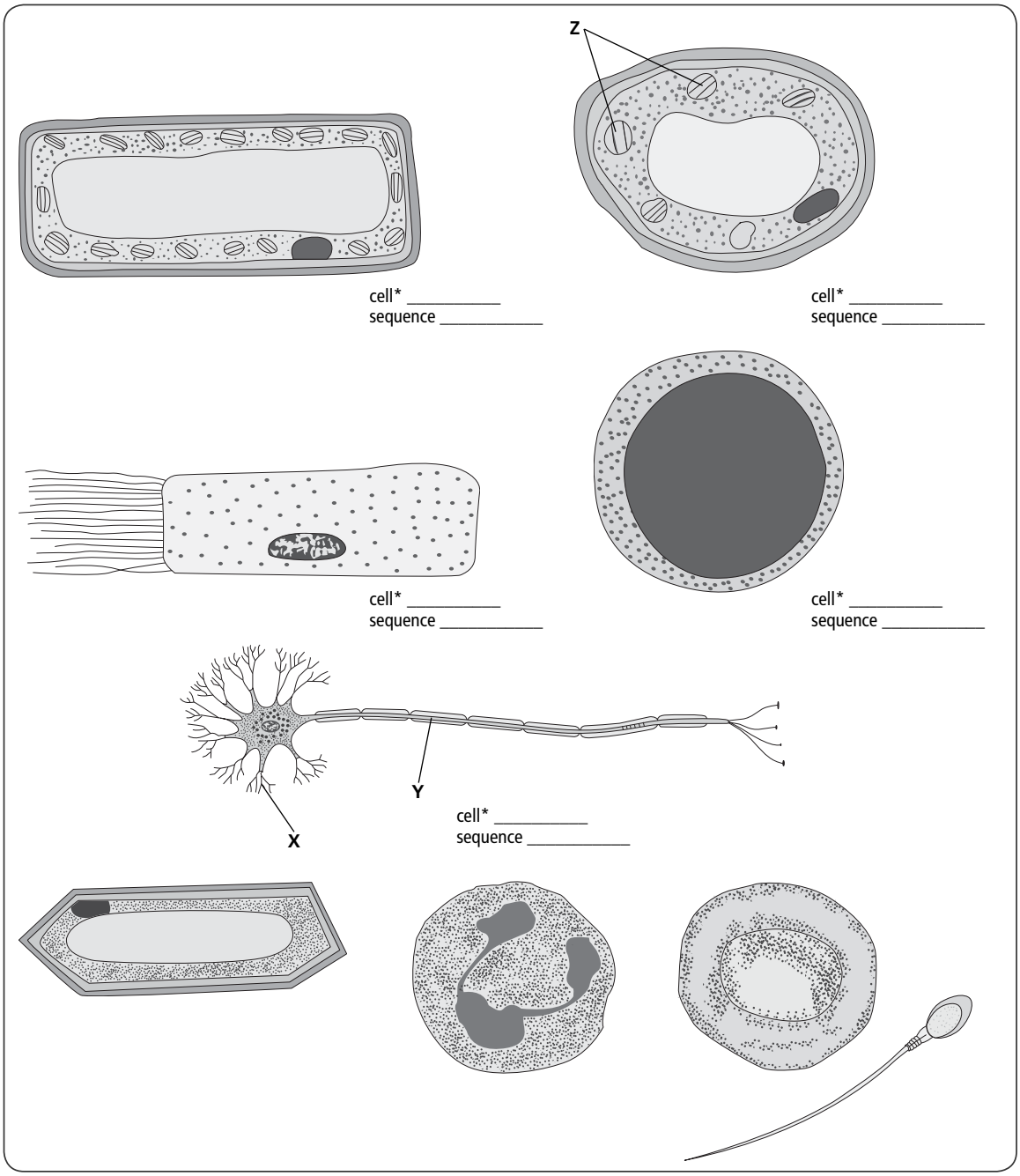
Organ system
blood circulation system

ORGAN SYSTEMS

Various organs together make up an **organ system**. For example, the **circulatory system** carries blood to all parts of the body. It is made up of the heart, the arteries, the veins, the capillaries and, of course, the blood.

Organ
heart (to pump blood)

1. The diagram below shows several types of animal and plant cell (not drawn to scale).



(5)

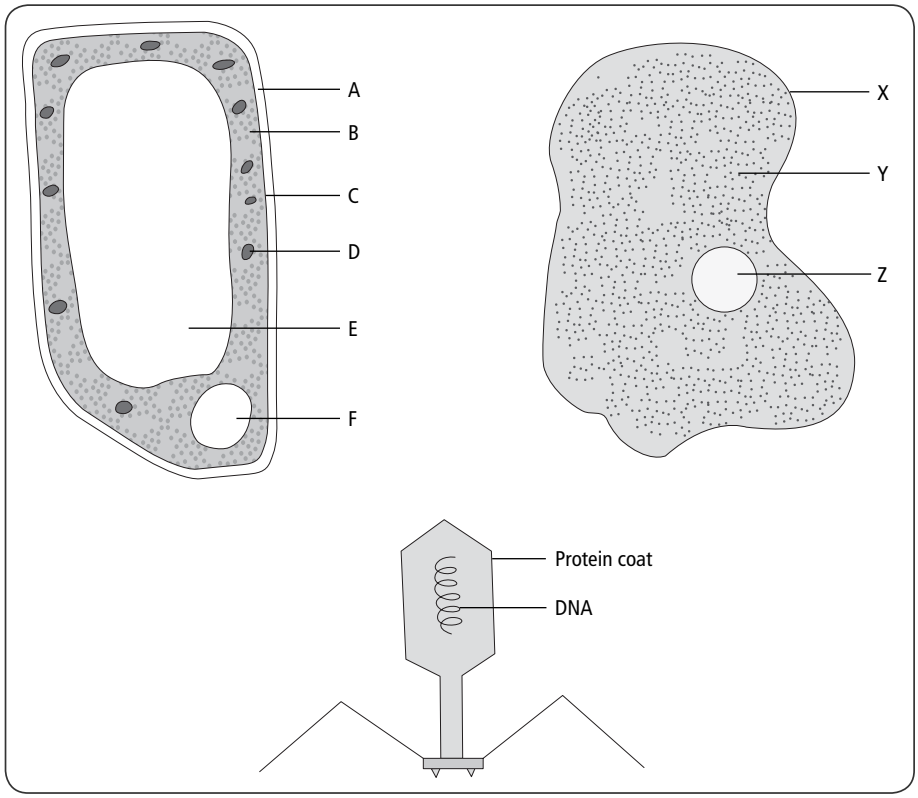
a. Use the key below to identify each of the cells marked with an asterisk (*). Write the letter corresponding to each cell next to the appropriate diagram. For each of the asterisked cells write the sequence of numbers from the key that led to your answer.

Identification Key

1 Cell with distinct cell wall ..... go to 2
Cell with membrane but no cell wall ..... go to 4
2 Cell with chloroplasts in the cytoplasm ..... go to 3
Cell without chloroplasts in the cytoplasm ... CELL A
3 Cell with less than 10 chloroplasts visible ..... CELL B
Cell with more than 10 chloroplasts visible .. CELL C
4 Cell containing a nucleus ..... go to 5
Cell lacking a nucleus ..... CELL D
5 Cell with projections at one or more ends ... go to 6
Cell without projections ..... go to 8
6 Cell with projections at each end ..... CELL E
Cell with projection/projections at one end only .....
..... go to 7
7 Cell with a large number of projections at one end .
..... CELL F
Cell with a single, long projection at one end .....
..... CELL G
8 Cell with a many-lobed nucleus ..... CELL H
Cell with a round nucleus ..... CELL I

b. **Three** of the cells shown in the diagram are types of human blood cell. Name each of the three cells and describe **ONE** function of each of the cells.
   i. Name of cell
   Function
   ii. Name of cell
   Function
   iii. Name of cell
   Function (3)

2. The diagrams below show a plant cell, an animal cell and a virus. The diagrams are NOT drawn to the same scale.



a. The parts of the plant cell are labelled A, B, C, D, E and F. Write the letter of the named part in the box next to its name in the list below.

CELL WALL ☐

CYTOPLASM ☐

VACUOLE ☐ (3)

b. Name the part labelled Z in the diagram of an animal cell. (1)

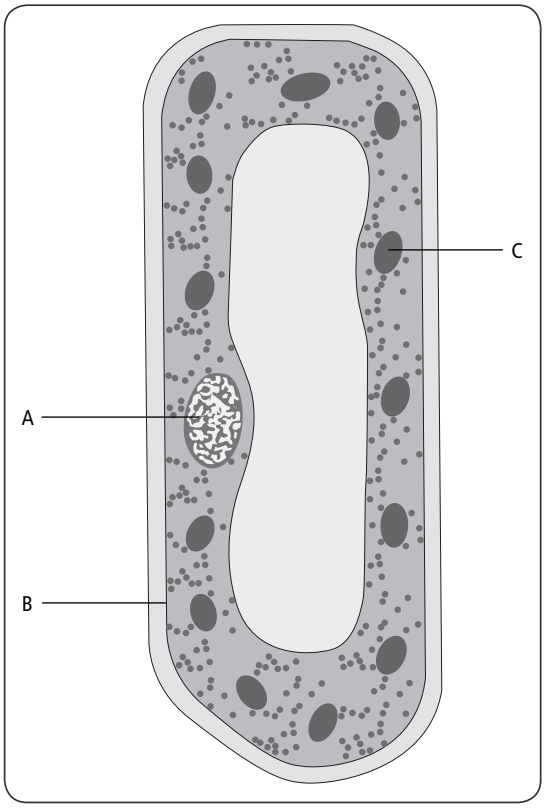
c. State TWO differences, shown in the diagrams, between the plant cell and the animal cell. (2)

d. Which part of the plant cell contains the genes/ alleles? (1)

e. What biological term describes a group of similar cells? (1)

f. Use ONLY the information in the diagram to suggest TWO reasons why the virus is not a cell. (2)

3. The diagram shows a cell from a plant leaf.



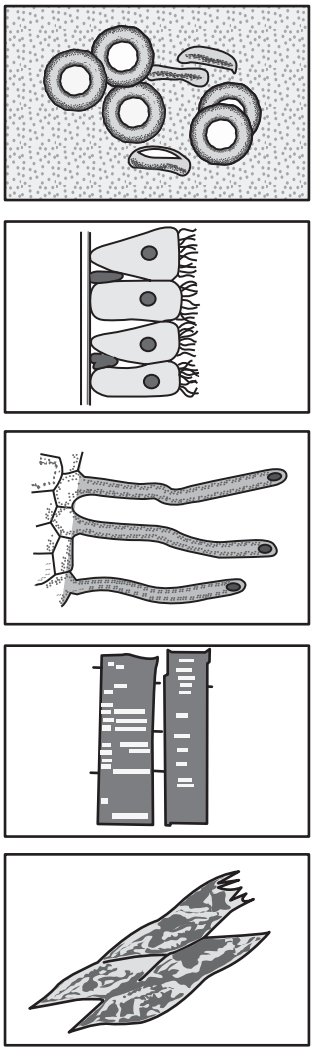
a. Name structures **A** and **B**. (2)

b. Structure **C** is a chloroplast. What is the function of a chloroplast? (1)

c. A plant cell has chloroplasts where as an animal cell does not.
Give **two** more differences between plant and animal cells. (2)

d. An average plant cell is 50 µm long and 20 µm wide. How many plant cells could fit into 1 mm^2? Show your working. (1)

4. a. The diagrams below show five types of tissue. Match each tissue with its correct function. (5)



Absorbs water and minerals from soil for the plant

Carries oxygen around the body of mammals

Contracts to cause movement within animals

Moves dust and bacteria up the bronchi of a mammal

Transports water and minerals through the stem of a plant

b. Explain why the heart is described as an organ and not as a tissue. (2)

REVISION SUMMARY: Fill in the missing words

Use words from this list to complete the following paragraphs. The words may be used once, more than once or not at all.

PALISADE CELL, EPIDERMIS, TISSUES, EXCRETORY SYSTEM, SPECIALISED, CELLS, BLOOD, KIDNEY, CHLOROPLASTS, LEAF, RED BLOOD CELL, DIVISION OF LABOUR, XYLEM, PHLOEM, NERVOUS, SYSTEMS, ENDOCRINE, ORGAN

a. Large numbers of ……that have the same structure and function are grouped together to form ……, for example …… Several separate tissues may be joined together to form an ……, which is a complex structure capable of performing a particular task with great efficiency. In the most highly developed organisms these complex structures may work together in ……, for example the …… in humans is responsible for the removal of the waste products of metabolism. (6)

b. The structure of cells may be highly adapted to perform one function, i.e. the cells may become …… One excellent example is the …… which is highly adapted to carry oxygen in mammalian blood. If the different cells, tissues and organs of a multicellular organism perform different functions they are said to show …… One consequence of this is the need for close co-ordination between different organs – this function is performed by the …… and …… systems in mammals. (5)

c. In plants an example of a cell highly specialized for photosynthesis is the ……, which contains many …… These cells are located in the organ called the ……, which also contains other tissues such as ……, which limits water loss, and ……, which transports water and mineral ions to the leaf. (5)