Animal Cells

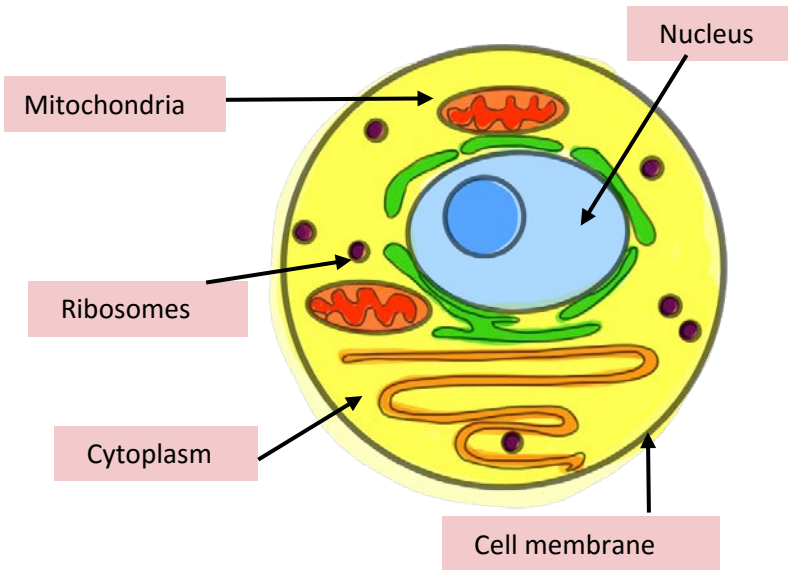
Learning objectives

- ❑ Recall the main parts of animal cells.
- ❑ Describe the functions of the parts of animal cells.
- ❑ Recall the main parts of animal cells.
- ❑ Describe the functions of the parts of animal cells.
- ❑ Compare plant and animal cells

Cells & Organelles

Cells are the building blocks of all living things. Most cells are so small that they can only be seen through a microscope. There are different types of cells, which contain different components and have different functions

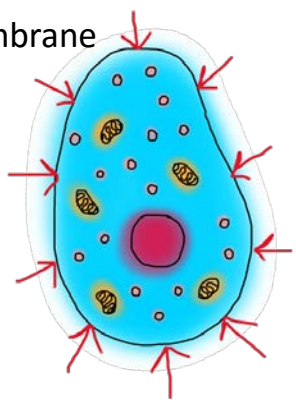
Cells are made of a cell membrane filled with cytoplasm, with a nucleus, mitochondria and ribosomes. The cell membrane goes around the whole cell



It is permeable to some substances but not to others Therefore, it controls the movement of substances in and out of the cell.

Cytoplasm is a jelly-like material. It contains dissolved nutrients and salts. It also holds the components of the cell, called organelles. E.g. ribosomes. It is where many of the chemical reactions happen.

Cell membrane



Permeable:
Allows the passage of substances in and out.

Did you know

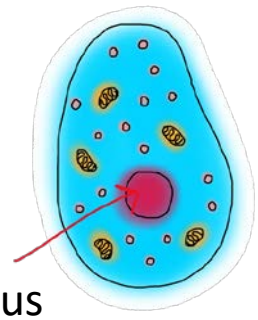
Red blood cells are on average 0.008mm. This means 125 red blood cells could fit in row on the head of a pin!

Animal Cells

Cells & Organelles

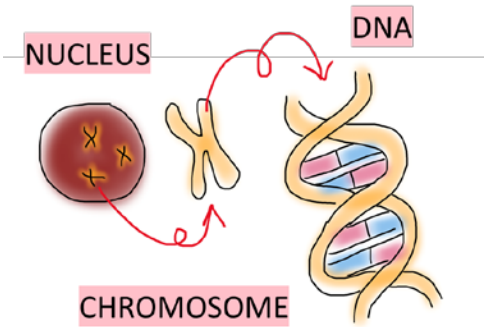
Nucleus

The nucleus contains the cell's genetic material.
It includes DNA and so as a result, it controls the cell's activities. For example this might be making new substances in the body or repairing damage.



nucleus

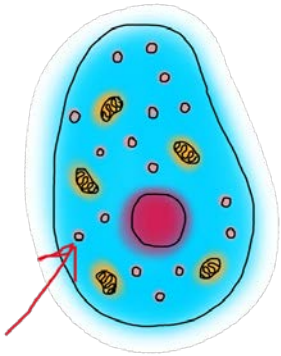
Inside the nucleus are strands of DNA called chromosomes.
DNA is a large complex molecules that contains an organism's genetic code.
The genetic code is a set of instructions for how the body works.
It controls the characteristics of an organism, for example their eye color or whether they can roll their tongue or not.



Ribosomes

Ribosomes are really tiny! They are the smallest of the organelles an can only be seen using very powerful microscopes.

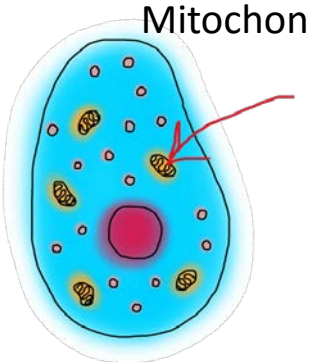
They are responsible for making proteins. They assemble proteins like tiny factories as the body need them.
Proteins are the building blocks in biology, everything in the body is made of or uses proteins. Most importantly, Proteins are used by the body for the growth and repair.



Ribosomes

Mitochondria

Mitochondria



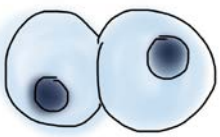
Mitochondria have the job of releasing energy from food. They do this via a chemical reaction process known as aerobic respiration.
They contain special chemicals called the enzymes that do this process .
In biology, enzymes are proteins that speed up reactions, but they're not used up or changed.

Animal Cells

Aerobic Respiration

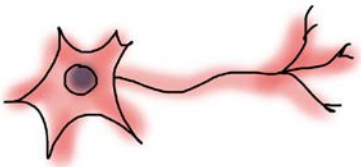
Organisms need energy for many processes. Making new cells by cell division allows the organism to grow and repair itself, this requires energy. For molecules sugar to get into our cells by a process called active transport needs energy and even sending a message along a nerve uses energy.

Cell division



Growth

Nerve impulses



Protein synthesis

Active transport

Muscle contraction

The energy comes from the food we eat, but aerobic respiration releases the energy from food as a type the body can use easily called ATP. Aerobic respiration is a chemical reaction that releases energy in our cells by the breakdown of food substances (glucose) in the presence of oxygen. It happens all the time in animals and plants to provide a continuous supply of ATP energy.

Aerobic respiration can be shown as a chemical reaction equation.

Glucose from food we eat

These are waste products that we breathe out in air

glucose + oxygen → ENERGY + carbon dioxide + water

Oxygen from the air we breath in

$$C_6H_{12}O_6 + 6O_2 \rightarrow \text{ENERGY} + 6CO_2 + 6H_2O$$

This is the chemical formula for glucose, it contains 6 atoms of carbon, 12 atoms of hydrogen and 6 atoms of oxygen

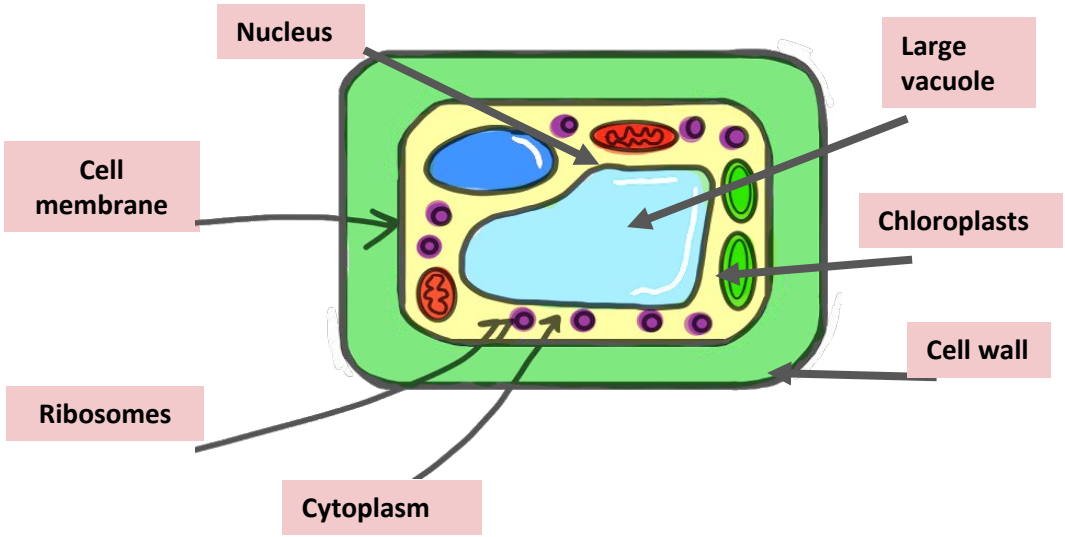
One glucose reacts with 6 molecules of oxygen

Then produces 6 molecules of carbon dioxide and water as well as energy

Plant Cells

Plant Cells

Plant cells are made up of the same structures as animal cells but also have a cell wall, a vacuole and chloroplasts, these extra features make them able to do the plant related jobs.



Cytoplasm	A substance that fills the inside space of the cell and contains dissolved nutrients and the sub-cellular structures, it is also where some chemical reactions happen.
Nucleus	Structure contains the genetic material; DNA.
Cell membrane	Structure is a boundary and controls what substances can go into and out of the cell.
Mitochondria	Structure that does respiration and makes energy.
Ribosomes	Structure where proteins are made.

Plant cells only:

Chloroplast	Contains the green pigment, chlorophyll. It absorbs light for photosynthesis.
Cell wall	This is extra support the cell, it is as well as the cell membrane.
Vacuole	This is filled with cell sap which contains nutrients and helps give the cell its shape.

Plant Cells

Plant Cells & Photosynthesis

Photosynthesis produces a sugar called glucose. This is important as the plants 'food'. Plants use glucose for many things, most importantly, making storage molecules of fat to put inside seeds. Building cell walls on new cells and like animals; making new proteins.

BUILDING THE CELL WALL

STORING FATS

MAKING PROTEINS

Photosynthesis is a chemical reaction and needs light energy to make it happen. That's why chloroplasts are so important – they capture the light energy for the reaction.

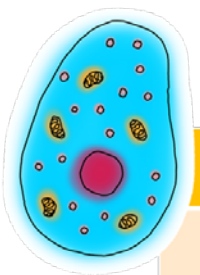
Carbon dioxide taken in from the air

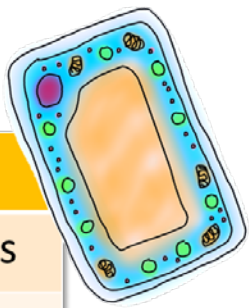
Oxygen is a waste product and the plants release it in to the atmosphere

Carbon dioxide + water → (Light) **glucose + oxygen**

Water taken in from the roots

$$6CO_2 + 6H_2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + 6O_2$$





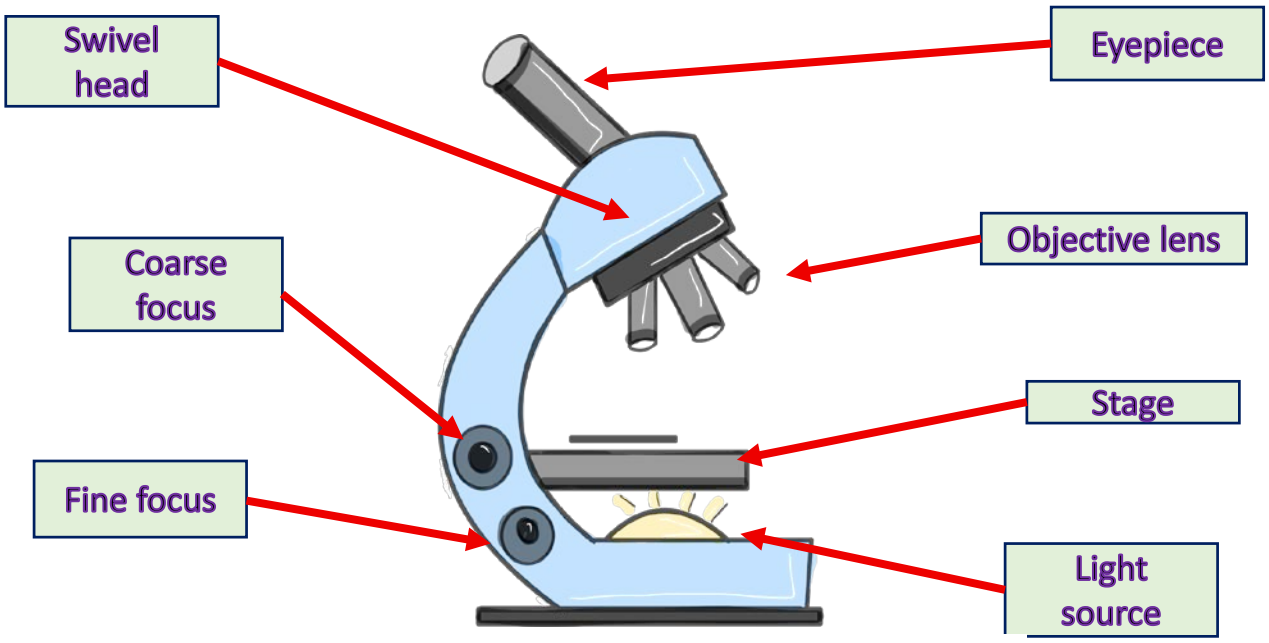
Animal cells	Plant cells
Cell membrane	Additional features
Cytoplasm	Cell wall
Nucleus	Vacuole
Ribosomes	Chloroplasts
Mitochondria	

Microscopes

Learning objectives

- ❑ State what microscope do
- ❑ State the different types of microscopes
- ❑ Describe the use of the different types of microscope
- ❑ Calculate magnification
- ❑ Use the magnification formula

The Light Microscope



Animal cells are between 0.01mm – 0.05mm. Plant cells are between 0.01mm – 0.10mm. The human eye can see objects as small as around 0.5mm, So cells are not visible with the naked eye. Microscopes are required to see cells in detail.

Light microscopes are used to study living cells and even small organisms. They are good for regular use as they are small and easy to use. Compared to some other microscopes they have low magnification though.

The object to be viewed is placed on a glass slide and put on the stage. Light shines up from the light source, through the slide and into the lens.

Did you know

Scientists have estimated the number of cells in the human body at around 30 trillion. Written out, that's 30,000,000,000,000!

Microscopy

Microscopes use lenses to **MAGNIFY** and increase the **RESOLUTION** of images that can't be seen with the naked eye. Light microscopes shine light through the object to be viewed (the specimen) which then passes through a lens to produce an image.

Magnification:
A measure of the size of an image compared to the size of the object

Resolution:
The ability for two points to be seen separately and not as one

1590s - Dutch spectacle makers, Janssen, put lenses in tubes that magnified x3 to x9.

Late 1600s - Dutch scientist van Leeuwenhoek made a microscope with a spherical lens that magnified x275

First bacteria seen

1590 **Microscope Development** **1700**

First cells seen

1650 - British scientist, Robert Hooke, observed 'cells' using a compound microscope.

The magnification of light microscopes has increased over time as microscopes have improved. But very high magnifications are not possible, ribosomes are still too small to be seen, using a light microscope.
The maximum magnification with a light microscope is around ×1500, this means the microscope image is 1500 times bigger than the actual object.

Magnification

So what is magnification?

It's a measure of how much bigger the image of the object appears, school microscope typically magnify up to 400 times the actual size, e.g., if you viewed a 2mm flea, it would appear 800mm wide!

Microscopy

The Electron Microscope

The Electron Microscope is a microscope that uses abeam of electrons – very small particles from atoms. Electrons move very fast is this allows the microscope to have a higher magnification. EMs reveal structures in cells that are not visible with the light microscope but, living cells cannot be observed using an electron microscope because samples are placed in a vacuum a space without any atmosphere or air. There are two types of electron microscope:

The transmission electron microscope (TEM)

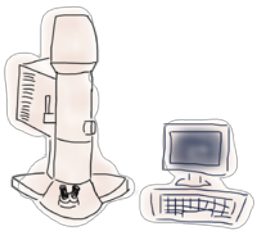
The scanning electron microscope (SEM)

Transmission Electron Microscope

These are used to examine thin slices or sections of cells or tissues. TEMs have a maximum magnification of around ×1,000,000. The limit of resolution of a TEM is now less than 1nm.This means they can clearly view things that are 1nm big.

Scanning Electron Microscope

SEMs have a large depth of field so can be used to examine the surface structure of specimens. SEMs are often used at lower magnifications, up to ×30,000. The limit of resolution of a SEM is lower than that of a TEM, approximately 50nm.

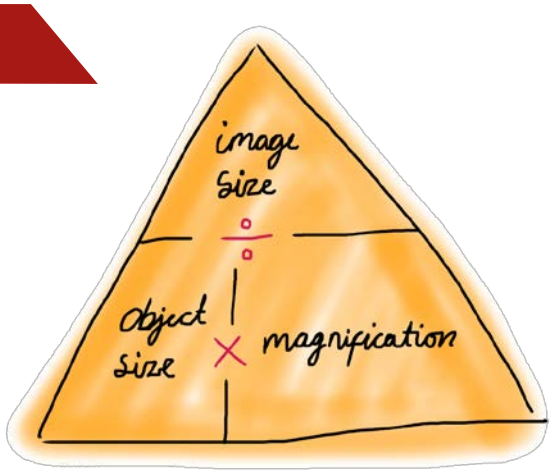


Both light microscopes and electron microscopes have pros and cons to their use.

Light Microscope	Electron microscope
Uses light to focus	Uses electrons to focus
Small and cheap	Big and expensive
Lower magnification	Higher magnification
Lower resolution	Higher resolution
Specimens viewed living	Specimens viewed dead

Microscopy

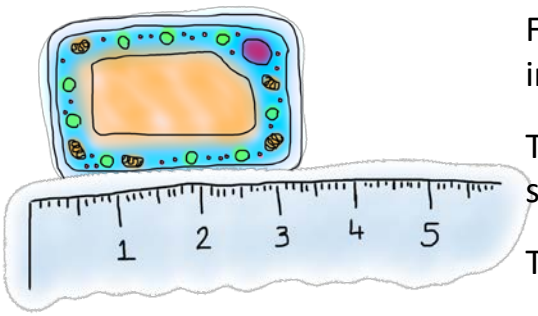
Magnification



Microscopes magnify an object to give an image that appears larger, so it can be useful to calculate the magnification of the object or the actual/real size of the object or even the size of the image. This can done using the formula:

Magnification = size of image ÷ object size

For example, a cell is magnified to 3cm



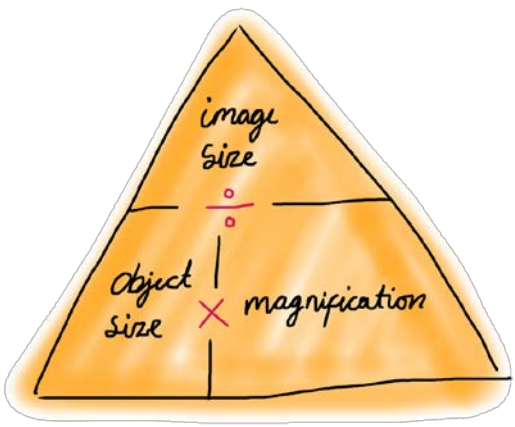
But, Its actual size is 0.1mm

Firstly, convert 3cm to mm so that the units match in all the values, 3cm in mm = 3 x 10 = 30mm.

Then divide the image size: 30mm by the actual size of 0.1mm 30/0.1 = 300

The image has been magnified by x300.

If you want to find out the image size or the object size rearrange the formula. Cover up the thing you want to calculate, the parts you still see, is the formula to use.



For example, a strand of hair has an image size of 6cm, it has been magnified x1.7, what is its actual size?

Firstly, cover up the section of the triangle that says ‘object size, this is what we want to find out. It leaves the formula image size / magnification.

So, image size is 6cm, divide this by magnification of 1,7

6/1.7 = 3.5 . So, the actual size is 3.5cm.

Tissues & Organs

Learning objectives

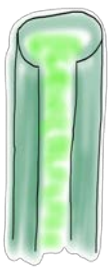
- ❑ Describe a tissue using an example
- ❑ Describe an organ using an example
- ❑ State how tissues and organs are related
- ❑ Describe the relationship between tissues, organs and systems
- ❑ Describe an organ system using an example

Tissues

Animal and plant cells can work together to form tissues. A tissue is a group of cells with similar structures, working together to perform a shared function.

In animals, muscle is a tissue. It is made up completely of the same type of muscle cells. These cells then work together to contract and move a bone. One cell cannot do this bob alone, so many cells work together.

Muscle tissue made up from many individual muscle cells



In plants, xylem is a tissue. Xylem is made entirely of hollow xylem cells. They form one long continuous tube that lets them carry out their function of transporting water in plants from the roots to the leaves. Many cells need to work together to cover the distance.

Organs

An organ is a structure made up of a group of tissues, working together to perform specific functions.

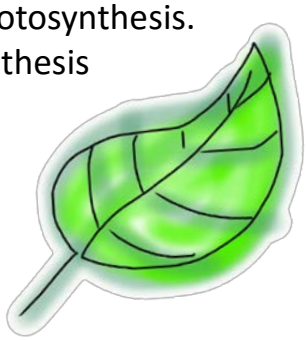
The tissues that make up an organ can be different, this means the organ is made up of different specialised materials for example, the heart is an organ made up of muscle tissue, elastic tissue, connective tissue – all working together to pump blood.

Did you know

There are 79 known organs in the human body. The largest one being the skin.

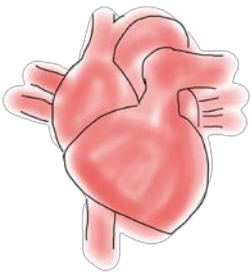
Tissues & Organs

Leaves are a type of plant organ. They are made up of several different tissues that work together to perform the function of absorbing light for photosynthesis. For example, they have xylem to transports water for photosynthesis and a tissue called palisade mesophyll that contains cells full of chloroplasts.

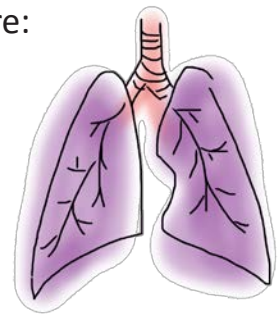


Organ Systems

An organ system is a group of organs with related functions, working together to perform body functions



The main organ system in the human body are:



- circulatory system
- respiratory system
- digestive system
- nervous system
- reproductive system

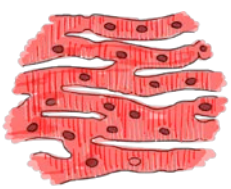
The respiratory system

Contains the organs:
nose,
trachea,
bronchi,
lungs
All working together to perform the function of gas exchange

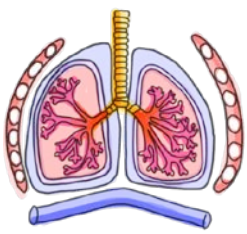
The circulatory system

Contains the organs:
arteries,
veins,
heart
All working together to perform the function of oxygen transport

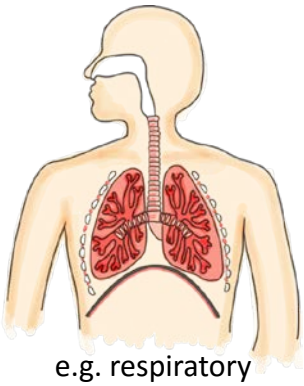
e.g. epithelial cell



e.g. alveoli tissue



e.g. lung



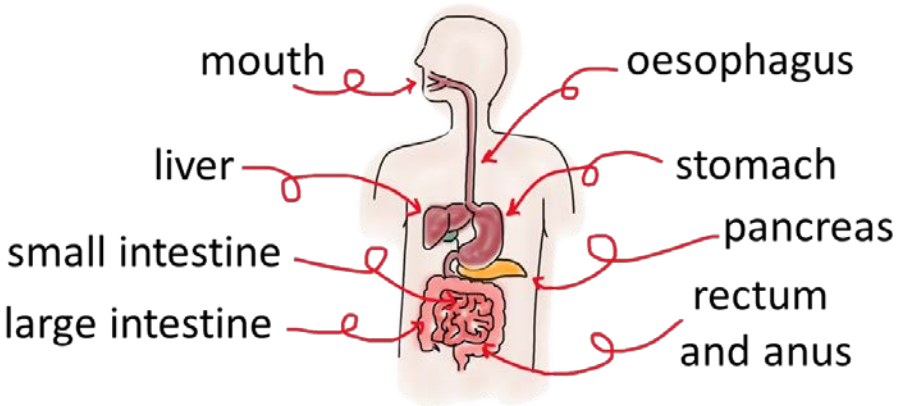
e.g. respiratory

Cells → Work together to form a **Tissue** → Work together to form an **Organ** → Work together to form a **System**

Tissues & Organs

The Digestive System

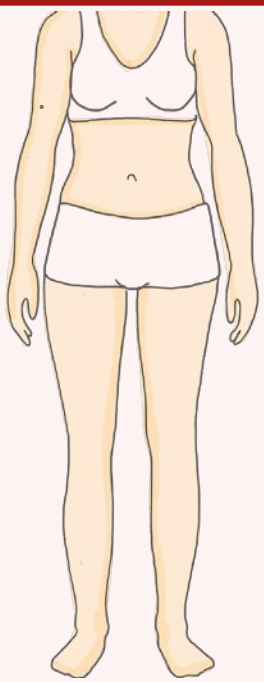
These are the organs of the digestive system



The organs all have their own specific function, but work together to perform digestion. One organ alone cannot complete digestion, only when the organs work as a system can digestion take place fully.

Digestion:
The process by which larger molecules are broken down into smaller ones so that they can be absorbed

Medicine in action: The Integumentary System



The skin is part of the integumentary system. This system contains other organs and structures such as the nails, hair, and the exocrine glands.

It is an incredibly large organ, and makes up on average, 15% of an adult's total body weight.

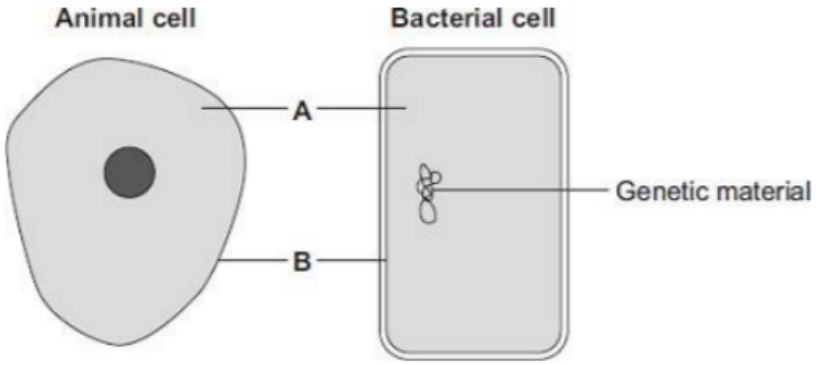
The skin id not the same all over the body, skin thickness is different in different areas. The thickest skin is found on the back, the palms of the hands, and the bottoms of the feet, where it can be up to 3 mm thick.

The thinnest skin is found on the eyelid, it is just 0.05 mm thick because it does not contain a thick layer of fat like other areas of the body.

Cells

Exam questions

The diagrams show an animal cell and a bacterial cell.



(a) (i) Structures **A** and **B** are found in both the animal cell and the bacterial cell.

Use words from the box to name structures **A** and **B**.

cell membrane	**chloroplast**	**cytoplasm**	**vacuole**

A ..... *cytoplasm* .....

B ..... *cell membrane* .....

(ii) Both cells contain genetic material. **(2)**

Name the structure in the animal cell that contains genetic material.

nucleus

..... **(1)**

(b) **List A** gives three structures found in animal cells.

List B gives four functions of cell structures.

Draw **one** line from each structure in **List A** to its correct function in **List B**.

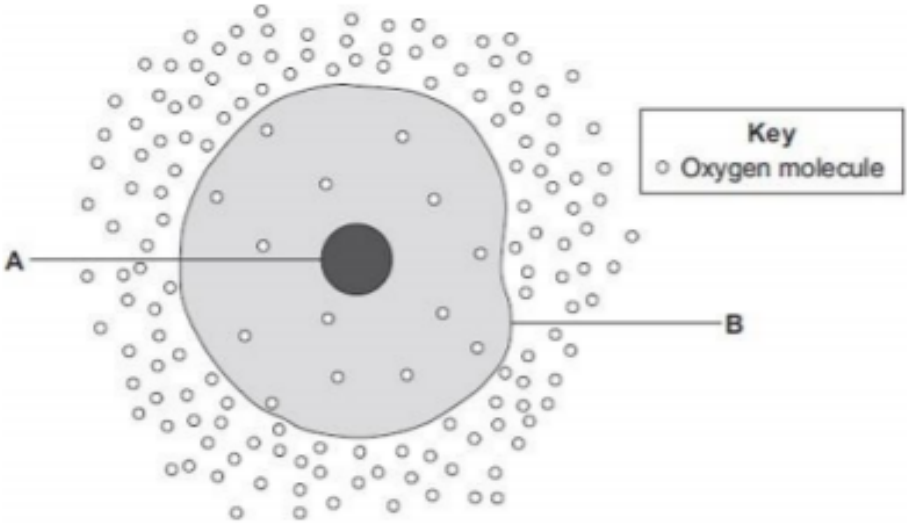
List A – Structure	**List B – Function**
Cell membrane	Controls what substances enter the cell
Mitochondrion	Photosynthesis
Ribosome	Protein synthesis
	Respiration

(3)

Cells

Exam questions

The diagram shows a cell.



(a) (i) Use words from the box to name the structures labelled **A** and **B**.

cell membrane	chloroplast	cytoplasm	nucleus

A *nucleus*

B *cell membrane*

(2)

(ii) The cell in the diagram is an animal cell.

How can you tell it is an animal cell and **not** a plant cell?

Give **two** reasons.

1 *no cell wall*

no vacuole

2 *no chloroplasts and chlorophyll*

(c) The cell shown in the diagram is usually found with similar cells.

Draw a ring around the correct answer to complete the sentence.

Scientists call a group of similar cells

an organ.
a system.
a tissue.

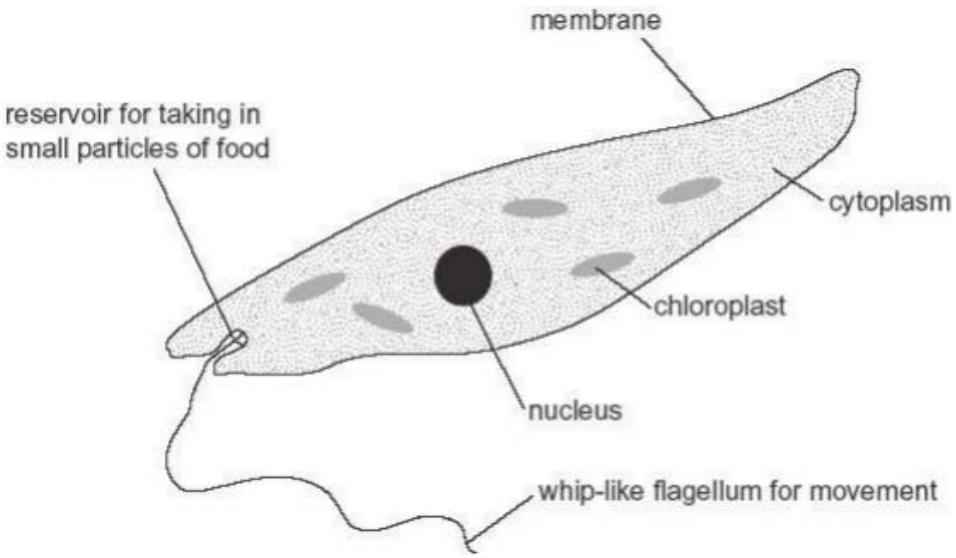
(1)

Cells

Exam questions

The diagram below shows an organism called Euglena.

It is made of only one cell. It lives in ponds and streams.
Euglena have features of both plants and animals.



(a) Look at the diagram of Euglena.

Give **two** pieces of evidence which suggest it is an **animal** cell and **not** a plant cell.

1 *it does not have a cell wall*

1 mark

2. *it does not have a vacuole*

1 mark

(b) Plant cells can carry out photosynthesis.

How can you tell from the diagram that Euglena can carry out photosynthesis?

it has chloroplasts

1 mark

(c) Complete the word equation for photosynthesis.

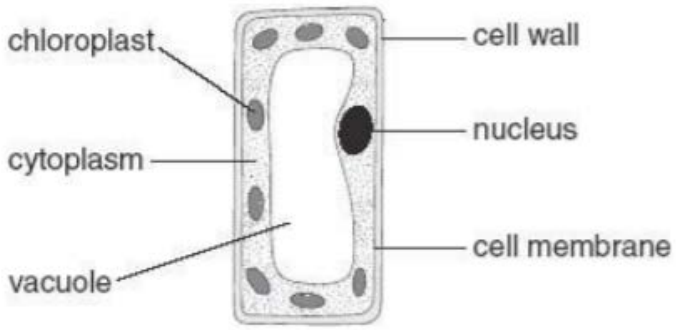
carbon dioxide + *water* → glucose + *oxygen*

2 marks

Cells

Exam questions

The diagram below shows a plant cell.



(a) In which part of a plant would you find this type of cell?

leaf

1 mark

(b) (i) Give the function of the nucleus.

it controls the cell's activities

1 mark

(ii) Give the function of the chloroplasts.

absorbs light for photosynthesis

1 mark

(iii) Give the function of the cell wall.

supports the cell

1 mark

(c) Give the names of **two** labelled parts that are **not** present in animal cells.

1. *cell wall*
2. *chloroplast*

2 marks