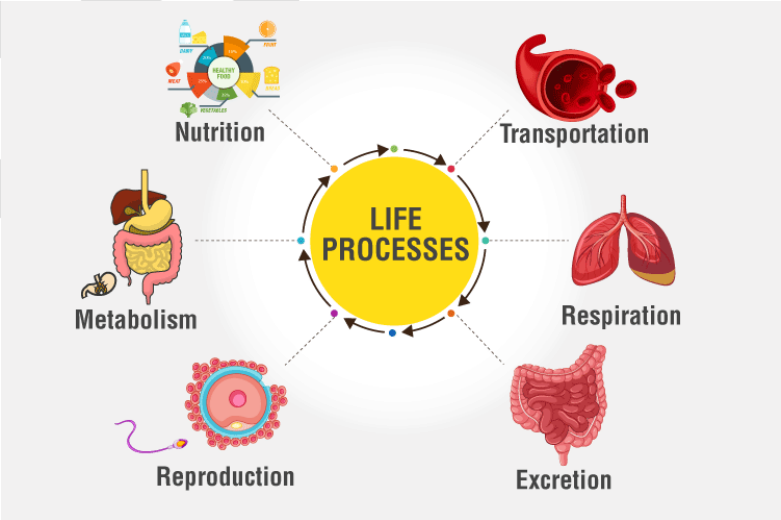
Edexcel OL

Biology

(Code: 4BI1)

Unit 1

Organisms and Life Process



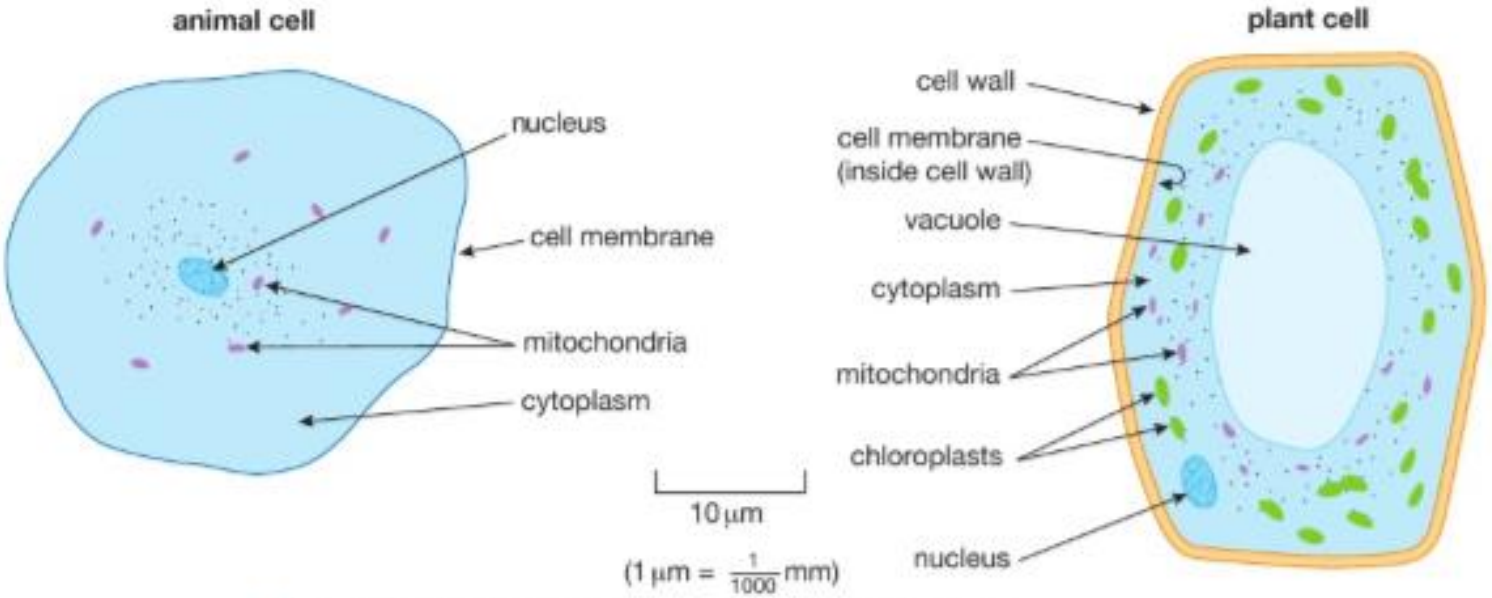
1.1 Life process

All cells are composed of units called *Cells*. The simplest organism is made of a single cell also known as *unicellular* while more complex plants and animals are composed of millions of cells ad they are called *multi-cellular*.

There are eight life processes which take place in most living things:

- Nutrition
  Plants make their own food, animals eat other organisms
- Respire
  Release energy from their food
- Excrete
  Get rid of waste products
- Respond to stimuli
  Are sensitive to changes in their surroundings
- Move
  By the action of muscles in animals, and slow growth movements in plants
- Control their internal conditions
  Maintain a steady state inside the body
- Reproduce
  Produce offspring
- Grow and develop
  Increase in size and complexity, using materials from their food.

Cell structure



▲ Figure 1.2 The structure of a 'typical' animal and plant cell.

Cytoplasm

The living material that makes up a cell. It has a texture rather than like a sloppy jelly, in other words somewhere between solid and liquid.

Organelles

You can't see most of these under an ordinary light microscope bus electron microscope.

Nucleus

The largest organelle in the cell. Nearly all cells have the nucleus. The nucleus controls the activities of the cell.

Chromosomes

A nucleus contain chromosomes. Human cell contains 46. Chromosomes carries the genetic material, or gene.

Gene

Control the activity of the cell by determining which protein the cell can make.

Ribosomes

The proteins are assembled in tiny structures named Ribosomes. A cell contain thousands of ribosomes, but they are two small to be seen through a light microscope.

Enzymes

One very important group of proteins found in cells. Control the chemical reactions that take place in the cytoplasm.

Cell Membrane (cell surface membrane)

All cells are surrounded by a cell membrane. A thin layer of 'skin' on the surface of the cell. It forms a boundary between the cytoplasm ad the outside. We say that the membrane is *partially permeable*. The membrane can go further than this and actually control the movement of some substances - it is *selectively permeable*.

Mitochondrion

They carry out some of the reactions of respiration releasing energy that the cell can use. Most of the energy required for respiration is released in the mitochondria.

KEY POINT

Nearly all cells contain cytoplasm, a nucleus, a cell membrane and mitochondria. As well as these structures, plant cells have a cell wall and a permanent vacuole, and plant cells that photosynthesise contain chloroplasts.

Cellulose

The main carbohydrate present in cell wall. Cellulose is a tough material that helps the cell keep its shape and is one reason why the 'body' of the plant has a steady shape.

Cell wall

This is an organelle that exists only in plant cells. This is a non-living structure found outside the cell membrane of plant cells.it is made out of a carbohydrate named cellulose mainly. Plant cells absorb water, producing an internal pressure that pushes against adjacent cells, giving the plant support. The cell wall is porous, so it is not a barrier to water or dissolved substances. We call it *freely permeable*.

Vacuole

This is an organelle that exists only in plant cells. This is a permanent feature of the plant cell. A mature (Fully grown) plant cell mostly have a large central vacuole. It is filled with a watery liquid called cell sap, which is a store of dissolved sugars, mineral ions and other solutes. Animal cells do contain vacuoles, but they are only small temporary structures.

Chloroplast

This is an organelle that exists only in plant cells. Chloroplasts absorb light energy to make food in the process of photosynthesis. They contain a green pigment called *chlorophyll*. Cells from the parts of a plant that are not green, such as the flowers, roots and woody stems, have no chloroplasts.

Enzymes: Controlling reactions in the cell

The chemical reaction that take place in the cell are controlled by a group of proteins called enzymes. Enzymes are catalysts. A catalysts is a chemical reaction which speeds up a reaction without being used up itself.

The activities of the cell are controlled:

Genes → proteins (enzymes) → catalyst reactions

Enzymes are necessary because the temperature inside organisms are low and without catalysts, most of the reactions that happen in cells would be far too slow to allow life to go on.

KEY POINT

Secretion is the release of a fluid or substances from a cell or tissue.

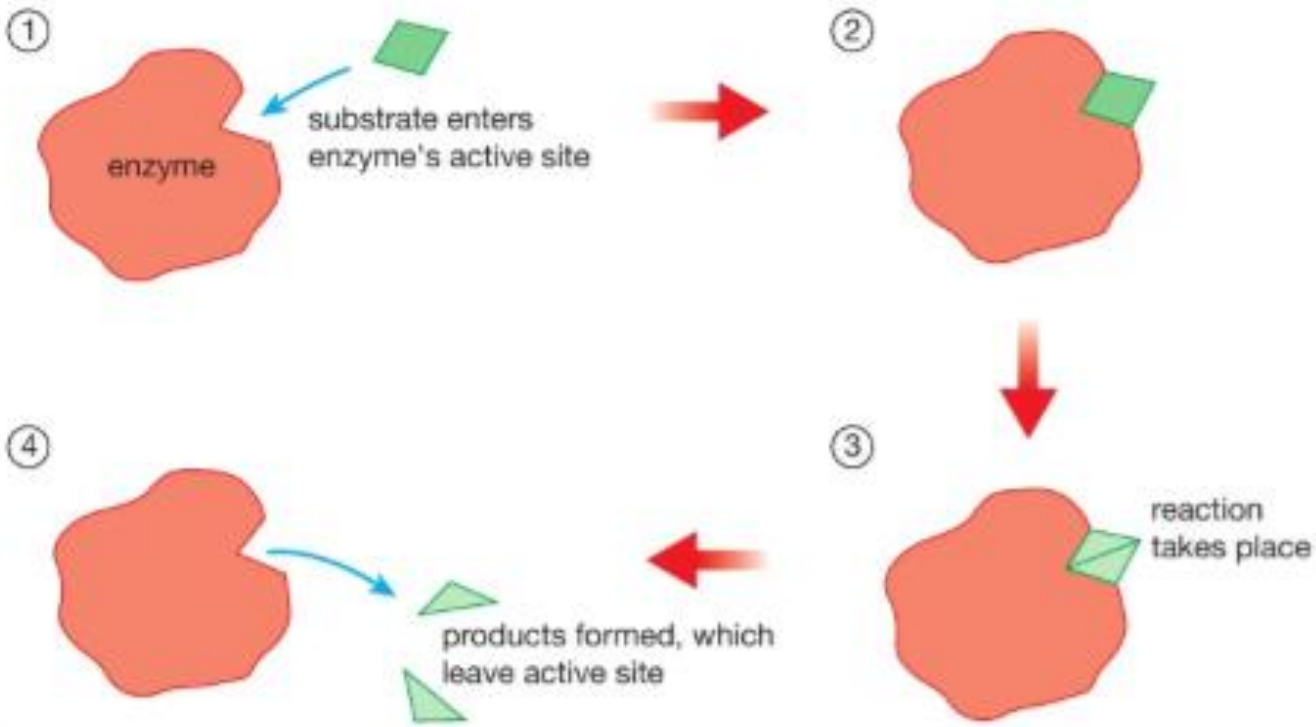
KEY POINT

The chemical reactions taking place in a cell are known as metabolic reactions. The sum of all the metabolic reactions is known as the **metabolism** of the cell. The function of enzymes is to catalyse metabolic reactions.

KEY POINT

You have probably heard of enzymes being involved in digestion of food. In the intestine enzymes are secreted onto the food to break it down. These are called *extracellular* enzymes, which means they function 'outside cells'. However, most enzymes stay inside cells and carry out their function there; they are *intracellular*. You will find out about digestive enzymes in Chapter 4.

The molecule that an enzyme acts on is called its substrate.

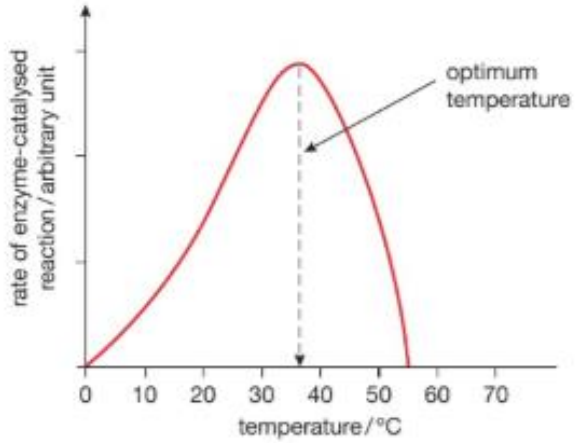


▲ Figure 1.5 Enzymes catalyse reactions at their active site. This acts like a 'lock' to the substrate 'key'. The substrate fits into the active site, and products are formed. This happens more easily than without the enzyme – so enzymes act as catalysts.

Factors affecting enzymes

1. Temperature

   Enzymes in the human body have evolved to work best at body temperature (37°C). From 40°C upwards, the heat destroys the enzyme. We say this is *denatured*.



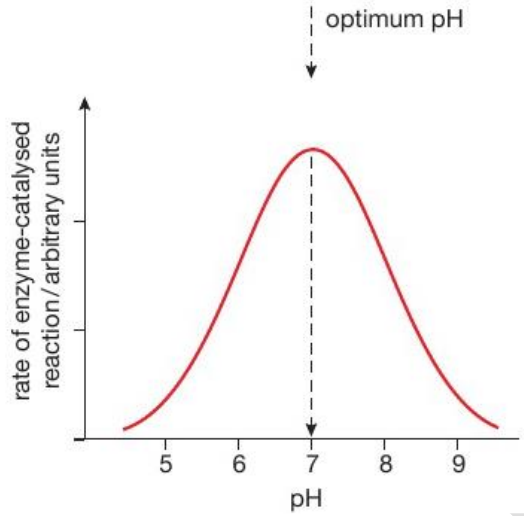
DID YOU KNOW?

Kinetic energy is the energy an object has because of its movement. The molecules of enzyme and substrate are moving faster, so they have more kinetic energy.

KEY POINT

'Optimum' temperature means the 'best' temperature, in other words the temperature at which the reaction takes place most rapidly.

2. pH
the pH inside cells is neutral (pH 7) and most enzymes have evolved to work best at this pH. The pH at which the enzymes work best is called *optimum pH.*



KEY POINT

Although most enzymes work best at a neutral pH, a few have an optimum below or above pH 7. The stomach produces hydrochloric acid, which makes its contents very acidic (see Chapter 4). Most enzymes stop working at a low pH, but the stomach makes an enzyme called pepsin which has an optimum pH of about 2, so that it is adapted to work well in these unusually acidic surroundings.

How the cell gets its energy

Breaking down food molecules to release the stored the chemical energy that they contain. This is called *respiration*. The main food oxidized is a sugar called glucose. Respiration releases some heat energy, bus most of it is used to make a substance called *ATP*.

KEY POINT

Respiration is called an *oxidation* reaction, because oxygen is used to break down food molecules.

Uses of ATP:

- contraction of muscle cells, producing movement
- active transport of molecules and ions
- building large molecules, such as proteins
- cell division

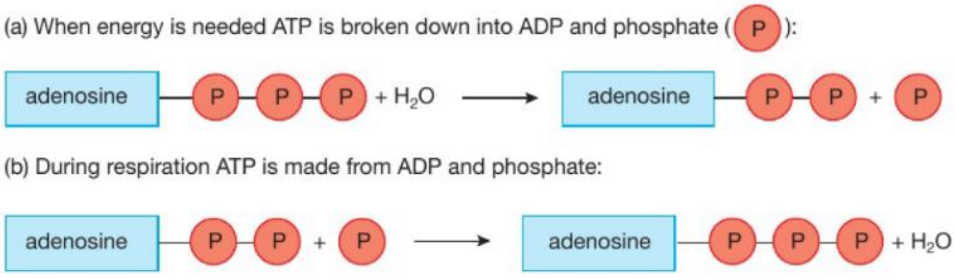
The heat energy released is also used to maintain the body temperature.
The overall reaction for respiration (aerobic respiration) will be;

glucose	+	oxygen	→	carbon dioxide	+	water	(+ energy)
$C_6H_{12}O_6$	+	$6O_2$	→	$6CO_2$	+	$6H_2O$	(+ energy)

This is called aerobic respiration because it uses oxygen.

ATP – The energy 'currency' of the cell

Calls have a way of passing the energy from respiration to the other process that need it. They do this using a chemical called adenosine triphosphate or ATP.



Anaerobic respiration

There are some situations where cells can respire without using oxygen. This is called anaerobic respiration. In this process the glucose molecule is not completely broken down, so less energy is released. The advantage of anaerobic respiration is that it can occurs when situations where oxygen is in short supply.

Two important examples for this is:

1. Yeast
   Yeast are single- called Fungi.

   $$\text{glucose} \rightarrow \text{ethanol} + \text{carbon dioxide} (+ \text{some energy})$$

2. Muscle cells
   This time the glucose is broken down into a substance called lactate.

   $$\text{glucose} \rightarrow \text{lactate} (+ \text{some energy})$$

   The volume of oxygen needed to completely oxidise the lactate that builds up in the body during anaerobic respiration is called *oxygen debt*.

Movement of materials in and out of cells

There are three main ways that molecules and ion can move through the membrane:

1. Diffusion
   Many substances can pass through the membrane by diffusion. Diffusion happens when a substance is more concentrated in one place than another. This difference in concentration is called a *concentration gradient*.
   The rate of diffusion is affected by various factors:
   - Diffusion happens more quickly when there is a steep concentration gradient
   - The surface area to volume ratio
   - The distance
   - The temperature
2. Active transport
   The movement of substances against a concentration gradient, using energy from respiration.
3. Osmosis
   Is the net movement of water from a dilute solution to a more concentrated solution across the partially permeable cell membrane.

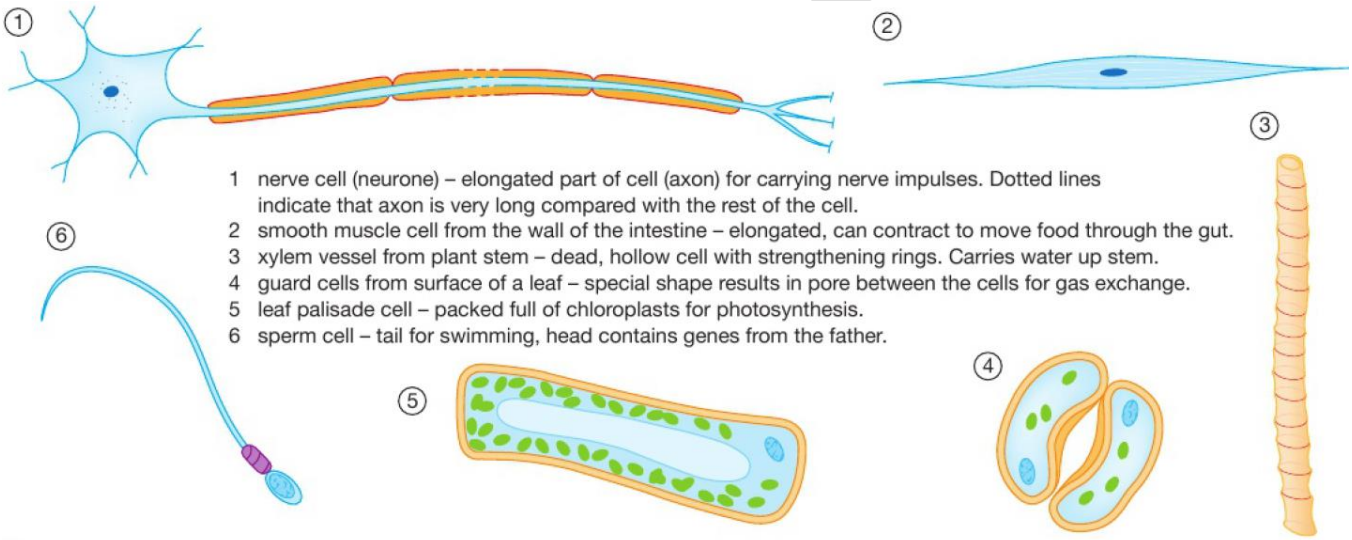
Specialized exchange surfaces

- The alveoli allow the exchange of oxygen and carbon dioxide to take place between air and the blood during breathing.
- The villi of the small intestine provide a large surface area for the absorption of digested food.

Cell division and differentiation

Multicellular organisms, begin life as a single fertile cell called the *zygote.* This type of cell division is called *mitosis*. First of all, chromosomes in the nucleus is copied then the nucleus split into two, so that the genetic information is shared equally between the two 'daughter' cells. The cytoplasm then divides forming to smaller cells.

As the developing embryo grows, cells become specialized to carry out a particular role. This specialization is also under the control of genes, and is called specialization.



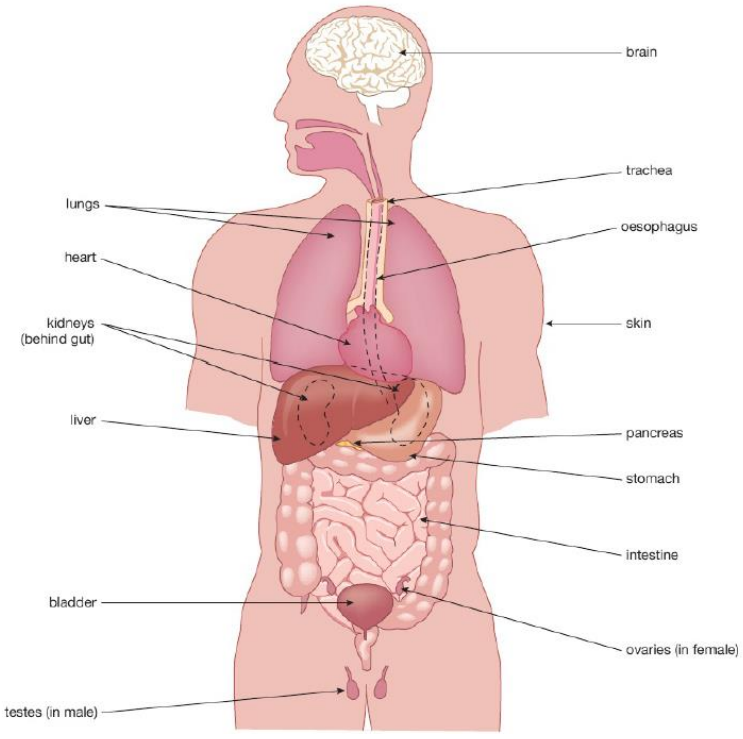
▲ Figure 1.16 Some cells with very specialised functions. They are not drawn to the same scale.

Call, Tissues and Organs

Cells with similar function are grouped together as *tissues*. A collection of several tissues carrying out a particular function is called an *organ*. Several different organs working together is called an *organ system.*

Main systems in the human body:

- Digestive system
- Gas exchange system
- Circulatory system
- Excretory system
- Nervous system
- Endocrine system
- Reproductive system



Stem cells

A stem cell is a cell that has the ability to divide many times by mitosis while remaining undifferentiated. In human there are two main types:

- Embryonic stem cell
  Are found in the early stage of development of the embryo. They can differentiate into any type of cell.
- Adult stem cell
  They have lost the ability to differentiate into any type of cell but can form a number of specialized tissues.

The use of stem cells to treat a disease, or to repair damaged tissues is called *stem cell therapy*.

EXCERSISE

1. Bacteria, fungi and viruses have different structures. The table lists some structures. In each box, place a tick if the structure is present or a cross if the structure is absent. One has been done for you.

Structure	Group		
	bacteria	fungi	viruses
cell wall			
nucleus			
chloroplast	✓		

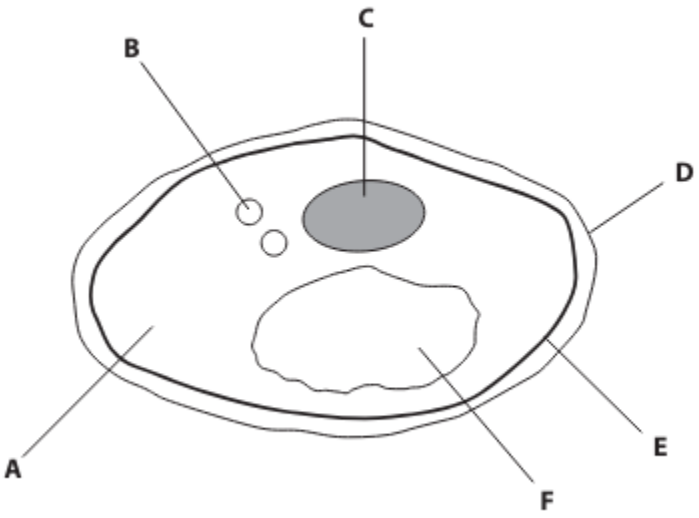
2.
   a. The table shows features found in three groups of living organisms. Complete the table using a tick to show that the group of living organisms shows the feature and a cross if the feature is absent.

Group	Feature			
	Cell wall	Plasmid	Cytoplasm	Nucleus
bacteria			✓	
fungi				✓
protoctists	×	×		

   b. Some bacteria, fungi and protoctists are pathogens
      i. Name another type of pathogen.
      …….
      ii. Give an example of a disease caused by a protoctist

……

3. Yeast is a single-celled fungus. The diagram shows a yeast cell with parts labelled A to F



A - ……

B - ……

C - ……

D - ……

E - ……

F - ……

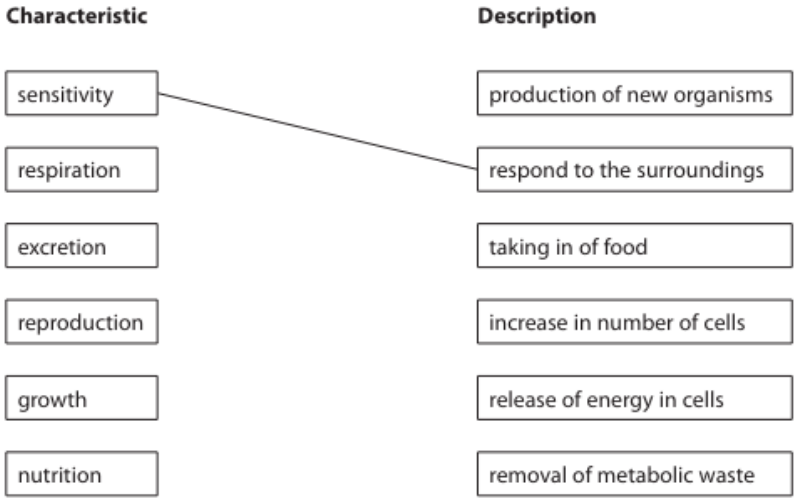
a. The table lists functions of different parts of the yeast cell. Complete the table by giving the letter of the part that carries out the function.

Function	Letter of part
controls the movement of molecules into the cell	
contains DNA that controls the cell	

b. The table lists statements. Put a tick in the boxes next to the statements that are correct for yeast.

Statement	Tick
can be used in the production of beer	
contains chloroplasts	
cell wall is made of chitin	
can only reproduce inside living cells	
contains plasmids	

4. Living organisms share some basic characteristics. Draw a straight line from each characteristic to its correct description. The first has been done for you.



5.

a. Complete the table to show the characteristic features of the three groups of organisms. Use a tick if the group has the characteristic and a cross if the group does not have the characteristic. The first box has been done for you.

Group	Can carry out photosynthesis	Have a cell wall	Can be pathogenic
bacteria	✓		
fungi			
viruses			

b. The table below shows some characteristics shared by most animals. Complete the table by giving the missing characteristics and examples.

Characteristic	Example
they require nutrition	eating food
they respire	releasing energy from carbohydrate
	some animals can fly
they control their internal conditions	
	increase of the population of foxes
they grow	

c. Another characteristic shown by animals is the ability to respond to their surroundings. For example, a person may withdraw their hand from a hot object. Describe the sequence of events that cause this response.

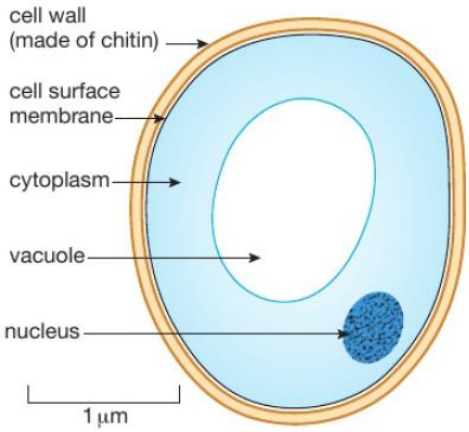
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

1.2 The variety of living organisms

The five major groups of living organisms:

1. Plants
   This group's, or kingdom's, main distinguishing feature is that their cells contain chloroplast and they carry out photosynthesis. Plants make many organic compounds as a result of photosynthesis; starch, sucrose.
2. Animals
   - Vertebrates - fish, amphibians, reptiles, birds, mammals
   - Invertebrates - molluscs, worms, starfish, sponges, crustaceans, insects

   There calls never contain chloroplasts, so they are unable to carryout photosynthesis. Instead they gain their nutrition by feeding on other animals or plants.
3. Fungi
   Fungi includes mushrooms, toadstool and moulds which are multicellular and yeast which unicellular. They don't contain chloroplasts, so they cannot photosynthesize. Their cells have cell walls but not composed of cellulose.

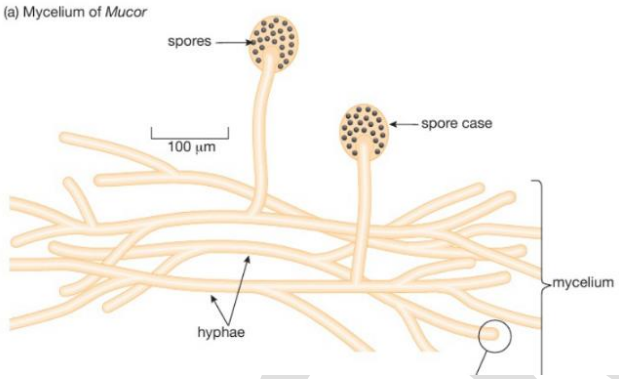


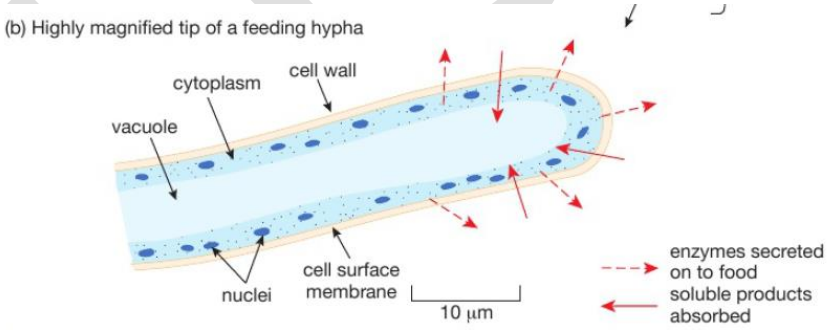
▲ Figure 2.4 Structure of a yeast cell

a mushroom or a toadstool is the reproductive structure of the organism, called a fruit body. Under the soil, the mushroom has many fine thread-like filaments called *hyphae*. A mould is rather like a mushroom without the fruiting body. It just consists of the network of hyphae. The whole network is called a *mycelium*.

KEY POINT

The singular of hyphae is hypha.

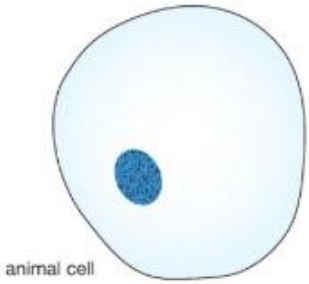


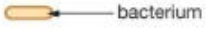


When an organism feed on dead organic material the way mucor do, and digestion takes place outside the organism, it's called *saprotrophic nutrition*. The enzymes that are secreted out of cells for this purpose are called *extracellular enzymes*.

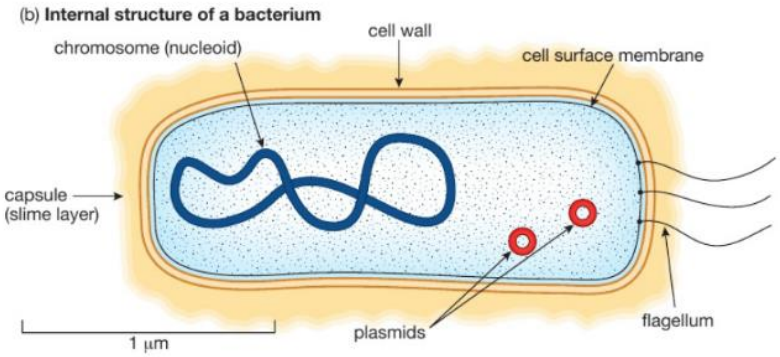
4. Protoctists
   They belong to something called the 'Dustbin Kingdom' because they are a mixed group of organisms that don't fit into plant, animal or fungi.
   - Amoeba
     Looks like animal cell. Known as protozoa.
   - Algae
     More likely plants.

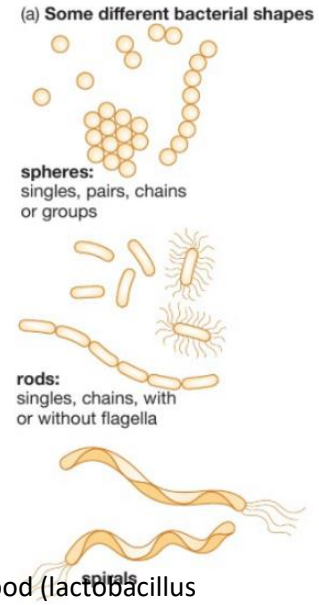
5. Bacteria
   Single–celled organism. Their cells are much smaller than those of eukaryotic organisms and have a much simpler structure.
   There are three basic shapes; spheres, rod and spirals.





All bacteria are surrounded by a cell wall which is made of a complex compound of sugar and protein called *peptidoglycan.* Some species have another layer outside this wall, called a *capsule* or a slime layer. Since it is a prokaryotic cell, the bacterium has no nucleus. Instead, its genetic material (DNA) is in a single chromosome, loose in the cytoplasm, forming a circular loop.





Flagella

Hair like structure involved in the locomotion of a cell (swimming).

Plasmids

A small, circular, double-stranded DNA molecule that is distinct from a cell's chromosomal DNA.

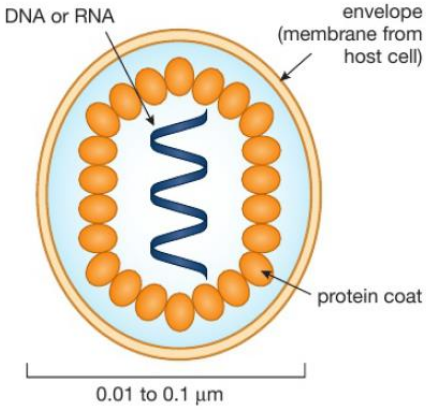
some bacteria are important decomposes. Some bacteria are used to make food (lactobacillus bulgaricus) like yoghurt from milk. Other species are pathogens.

Eukaryotic and prokaryotic organisms

Eukaryotic – have a nucleus

Prokaryotic – no nucleus

Viruses



All viruses are parasites, and can only reproduce inside living cells. The cell in which the virus lives is called *host*.

It has no nucleus or cytoplasm, and is composed of a core of genetic material surrounded by a protein coat. The genetic material can be either DNA, or a similar chemical called RNA.

Sometimes a membrane called an envelope may surround a virus particle, but the virus does not make this. Instead it is 'stolen' from the surface membrane of the host cell.

Viruses do not feed, respire, excrete, move, grow, or respond to their surroundings. They do not carry any of the living characteristics except of

reproduction, and they can only do this practically. A virus reproduces by entering the host cell and taking over the host's genetic machinery to make more virus particles. Diseases caused by virus; influenza, cold, measles, mumps, polio, rubella and for plants: tobacco mosaic virus.

EXCERSISE

1. Bacteria, fungi and protoctists can cause disease and have features common to all living organisms. Viruses can cause disease but are not classified as living.
   a.
      i. Explain why viruses are not classified as living
      ……
      ……
      ……
      ……
      ……
      ii. Name a disease caused by a virus.
      ……
   b. A new group of pathogens called prions was discovered in the 1980s. Prions are simple proteins. All known prion diseases can be fatal because the immune system does not recognise prions as foreign. Suggest two ways in which prions differ from viruses.
   ……
   ……
   ……
   ……
   ……
   ……
2. The table gives features of three different groups of organism. Complete the table by putting a tick (9) in the box if the organisms in the group have the feature and a cross (8) in the box if the organisms in the group do not have the feature. The first one has been done for you.

Feature of organism	Group of organism		
	Bacteria	Fungus	Virus
have a protein coat	×	×	✓
all are pathogens			
cell walls made of chitin			
contain DNA in a nucleus			
respire			

3. The following organisms can be classified into major groups

Amoeba	*Lactobacillus*	bean	*Mucor*	mosquito

a. From the list above give the name of
   i. a bacterium ……
   ii. a fungus ……
   iii. a flowering plant ……
   iv. an animal ……

b. Viruses are not included in most classification systems.
   i. Give three ways in which viruses differ from other living organisms.
   ……
   ……
   ……
   ii. Give one example of a disease caused by a virus, name the organism it infects and describe its effect on the organism.
   ……
   ……
   ……

4.
   i. Suggest two reasons why most biologists do not classify viruses as living organisms
   ……
   ……
   ii. Name one example of a virus. ……
   iii. Give one structural difference between a bacterium and a virus.
   ……

5.
   a. Antibiotics are chemicals used to kill pathogens that cause infections.
      i. Name the type of organism that make antibiotics. ……
      ii. Name the type of pathogen that is killed by antibiotics ……
   b. Some antibiotics are no longer effective in killing pathogens. Use your knowledge of natural selection to explain why.
   ……
   ……
   ……
   ……

6. The use of a pesticide may result in an increase in the number of pest organisms that are resistant to the pesticide. Use your knowledge of natural selection to explain the increase in the number of pest organisms that are resistant to the pesticide.
……
……
……

……

……

7.

a. The table shows four different groups of organisms. Complete the table to give an example for each group.

Group	Example
animals	
fungi	
bacteria	
protoctists	

b. Different groups have different features. Complete the table below to show if the feature is present in all, some or none of each group. Some of the table has been completed for you.

Group	Are multicellular	Cells have nucleus	Cells contain chloroplasts	Cells have cell walls
fungi		all		all
bacteria			some	all
protoctists	none		some	

c.

i. Give one way in which the structure of a virus differs from a bacterium.

……

ii. Bacteria and viruses can act as pathogens. Give an example of a disease caused by a virus.

……

8.

a. Although plants and animals have many different features, they also have some features in common. The table lists some features. In each box, place a tick if the feature is present or a cross if the feature is absent. One has been done for you.

Feature	Plants	Animals
can move from place to place	✗	✓
can carry out photosynthesis		
are multicellular		
have cells with cell walls		
store carbohydrate as glycogen		

b. Organisms that cause disease are known as pathogens. Give two groups of organisms that include pathogens.

……
……
……

9. Doctors sometimes give antibiotics to very ill patients. The passage below describes the treatment. Complete the sentences in the passage by writing a suitable word or words on each dotted line.

Antibiotic solution is given to the patient through a tube. The tube is connected to a vein in the arm of the patient, using a needle. It is connected to a vein rather than an artery because veins have a lower ..... than arteries. The antibiotic travels to the heart in the largest vein in the body called the ..... . It enters a chamber called the right atrium, and passes to the right ..... before being pumped to the lungs in the ..... artery. The antibiotic returns to the heart and eventually leaves the heart in the aorta, the largest ..... in the body. The antibiotic is then carried to the tissues where it leaves the smallest blood vessels called ..... . The antibiotic then kills pathogens called ..... that were responsible for the patient being very ill.

10.

a. A student is given two samples of carbohydrates. He tests to see if one is glucose and the other one is starch. Describe the two chemical tests he should use to identify each carbohydrate.

……
……
……

b. Different groups of organism store carbohydrate as different molecules. Complete the table to show an example from each group of organisms and the molecule they use to store carbohydrate.

Group	Example from the group	Molecule used to store carbohydrate
animals	cat	
plants	maize	
fungi		