TCOLC Sixth Form

Yr11 – 12 Transition Activities

Subject: Applied Science Biology

THE CITY OF LEICESTER COLLEGE

Biology - Cells

The cell is a unifying concept in biology, you will come across it many times during your two years of level 3 study. Prokaryotic and eukaryotic cells can be distinguished on the basis of their structure and ultrastructure. In complex multicellular organisms cells are organised into tissues, tissues into organs and organs into systems. During the cell cycle genetic information is copied and passed to daughter cells. Daughter cells formed during mitosis have identical copies of genes while cells formed during meiosis are not genetically identical
Read the information on these websites and fact sheets below (you could make more Cornell notes if you wish):

http://www.s-cool.co.uk/a-level/biology/cells-and-organelles

http://www.bbc.co.uk/education/guides/zvjycdm/revision

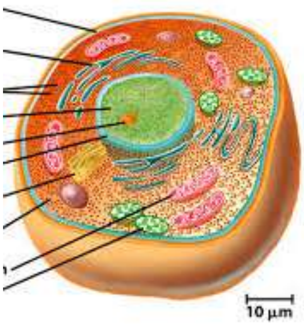
And take a look at these videos:

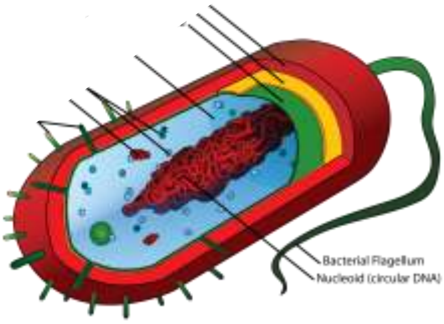
https://www.youtube.com/watch?v=gcTuQpuJyD8
https://www.youtube.com/watch?v=L0k-enzoeOM
https://www.youtube.com/watch?v=qCLmR9-YY7o
https://www.youtube.com/watch?v=HjlWm3LudJs
https://www.youtube.com/watch?v=URUJD5NEXC8

Task:
Produce a one page revision guide to share with your class in September summarising one of the following topics: Cells and Cell Ultrastructure, Prokaryotes and Eukaryotes.

Whichever topic you choose, your revision guide should include:
Key words and definitions
Clearly labelled diagrams
Short explanations of key ideas or processes.

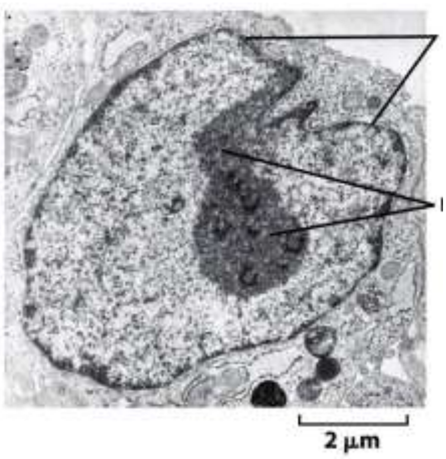
Cells and Cell Ultrastructure





Cell organelles.

For each image, identify the organelle(s) shown, describe the key characteristics that have lead you to make this decision and explain the function of the organelle(s).



Name of organelle: ___________________________

Key features: _________________________________

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Function: ____________________________________

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Name of organelle: ___________________________

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Function: ____________________________________

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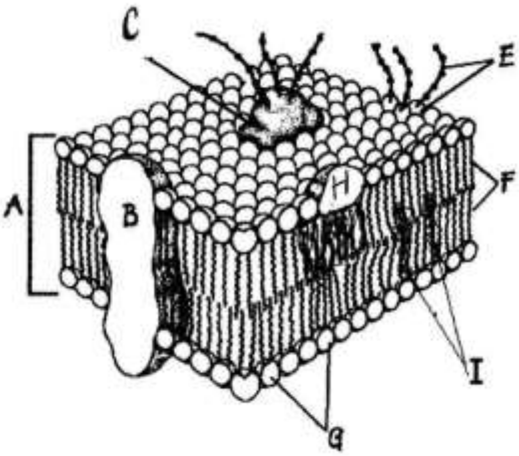

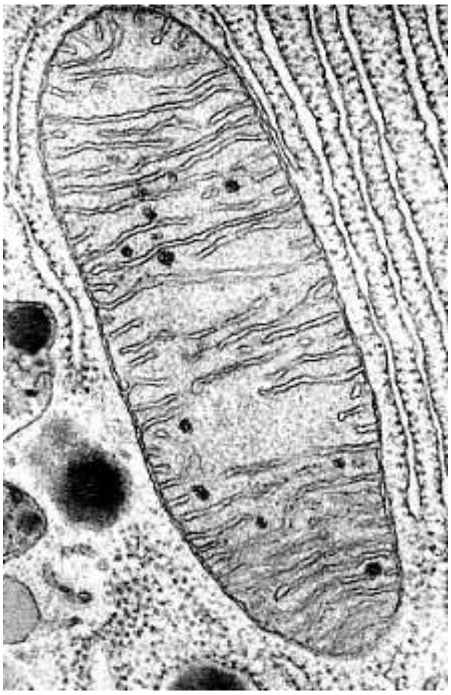

Name of organelle: ___________________________

Key features: _________________________________

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Function: ____________________________________

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Name of organelle: ___________________________

Key features: _________________________________

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Function: ____________________________________

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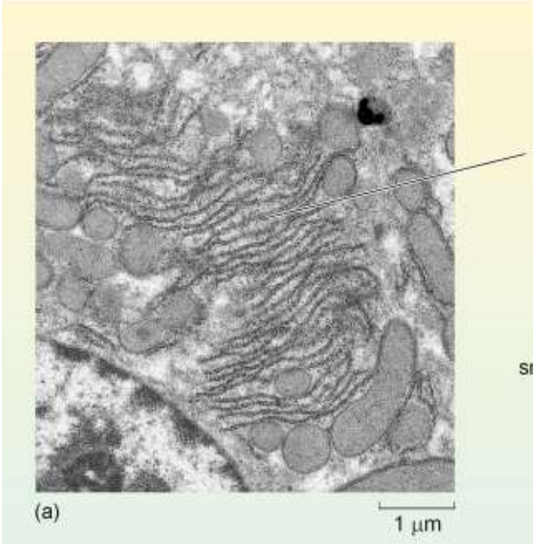

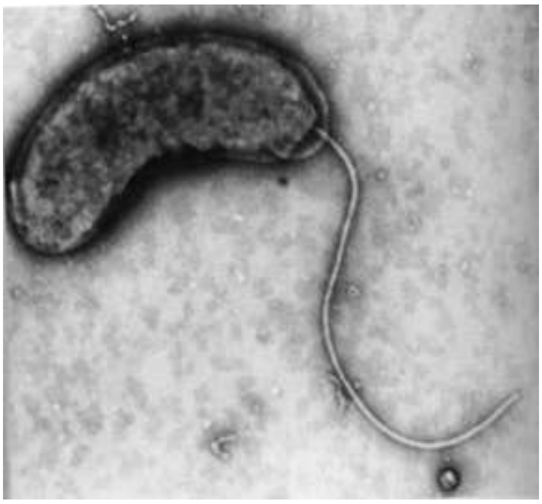

Name of organelle: ___________________________

Key features: _________________________________

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Function: ____________________________________

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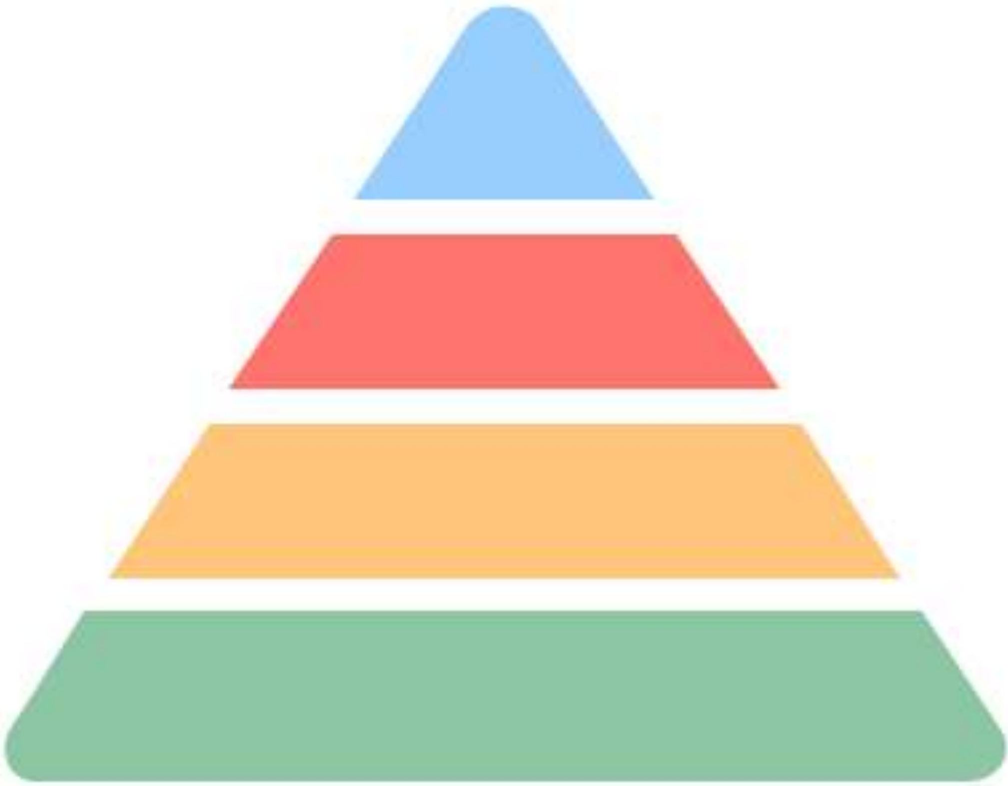
Going Deeper

You will need to be able to use your knowledge of these structures to explain further concepts. The cell membrane is used to explain osmosis, diffusion and active transport. Mitochondria are essential in respiration. Chloroplasts are the site of photosynthesis. Ribosomes are where the DNA code is finally converted into new protein.

Based on your learning , decide which is the most important organelle within a cell. The most important goes at the top of the pyramid and the least important at the bottom. Make sure you justify WHY you think it the most/least important.



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Structure to function in eukaryotic cells

The cell surface membrane and the membranes which form organelles in eukaryotic cells all have the same basic structure, known as the **fluid mosaic model**. Such membranes provide control of the entry and exit of substances into cells and organelles and such control is a result of the phospholipid bilayer and membrane proteins.

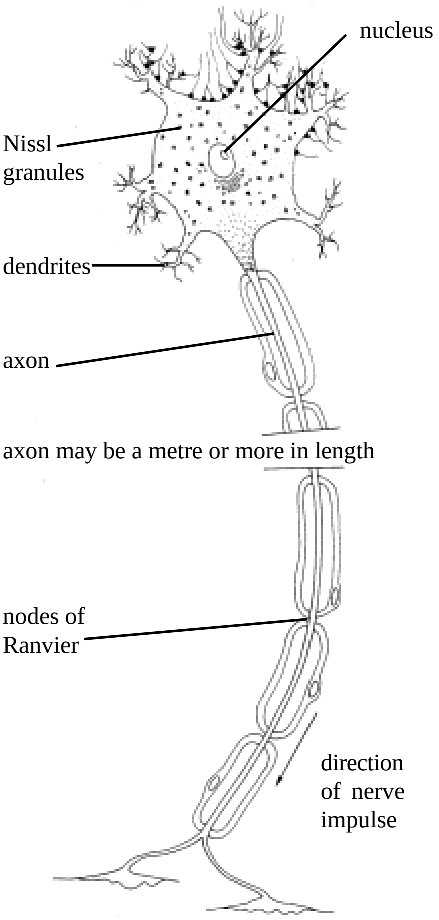
In eukaryotic cells, such membranes divide the cytoplasm into multiple compartments (organelles). Organelles allow different functions to occur efficiently and simultaneously in different parts of the cell. For example, the outer double membrane of the mitochondrion separates out those reactions which occur in mitochondria from those in the general cytoplasm. Furthermore, the internal membranes of the mitochondria allow the enzymic reactions of the Kreb's cycle to be kept quite separate from the electron transfer chain reactions (ETC). This is essential since both sets of reactions have different enzymes, hence different pH optima. By splitting up the cytoplasm of the mitochondria, the membranes which form the crista allow enzymes and substrates to be concentrated and pH to be optimised. Membranes can therefore be said to **compartmentalise** the interior of eukaryotic cells.

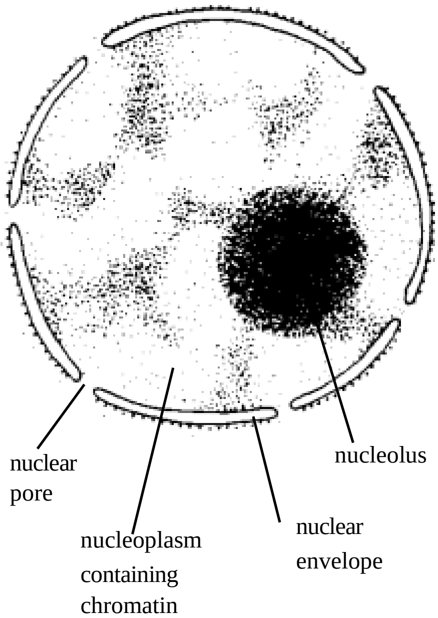
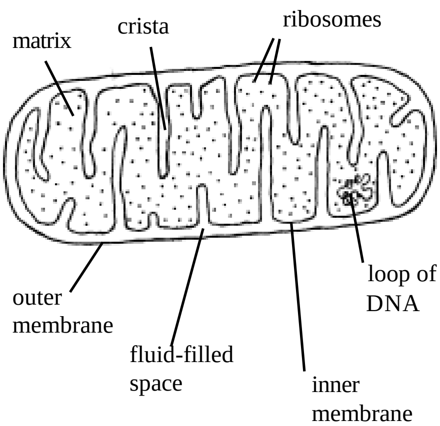
The relationship between structure and function can be described in terms of the whole cell or in terms of the individual organelles of the eukaryotic cell.

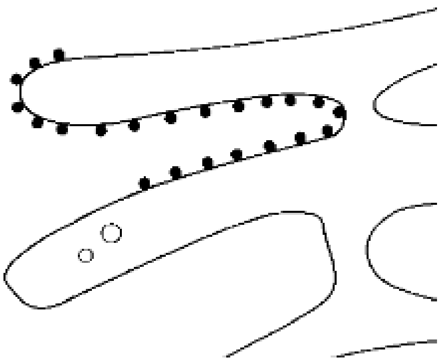
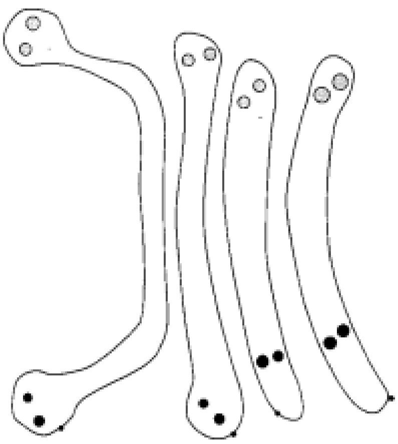
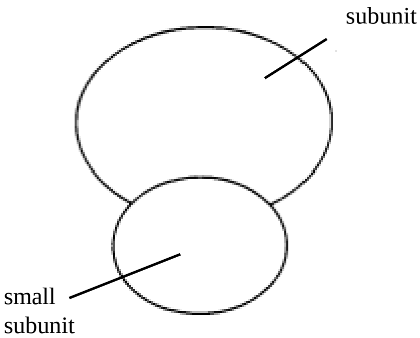
Table 1 describes the structure and function of a motor neuron cell which is commonly featured in examination questions. The structure and function of eukaryotic organelles is described overleaf.

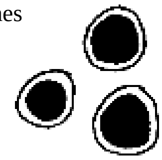
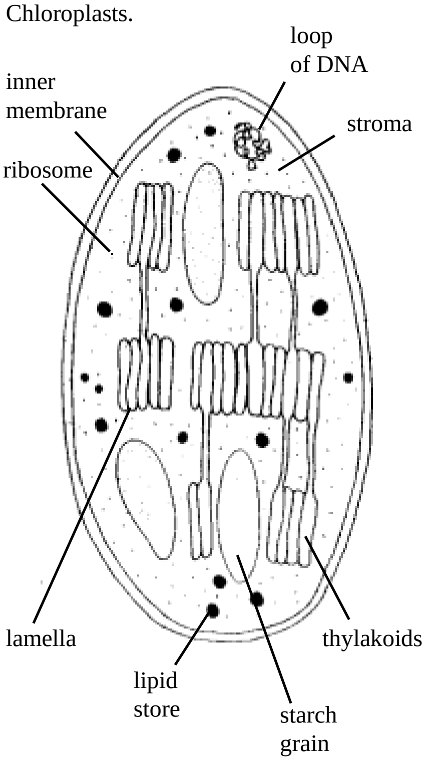
> ***Exam Hint*** *- Structure to function questions are very commonly set on all A level Biology syllabuses. They are one of the syllabus areas where all candidates should be capable of gaining the highest marks. Once the functions of organelles have been memorised, candidates should become confident at interpreting the function of unknown cells.*

Table 1.

Cell	Structure	Function
Motor Neuron 	Cell body contains: (i) Nucleus (ii) dense groups of ribosomes and endoplasmic reticulum called Nissl granules	Provides the genetic code for the production of neurotransmitter substances, e.g. acetylcholine and enzymes, eg. cholinesterase. For production and transport of proteins and neurotransmitters.
	Long axons Axon contains axoplasm	For rapid transmission of nerve impulse. Synapses, where two nerves join, is the slowest part of transmission, so the longer the axon, the fewer the synapses and the faster the impulses transmitted. Allows transport between cell body and axon
	Nodes of Ranvier between Schwann cells High phospholipid content in membrane of Schwann cell	Allows Na$^+$ /K$^+$ pump to operate which sets up resting potential. Schwann cells of myelin sheath speed up the impulse because they increase the surface area for transmission of current. Provides electrical insulation.
	Synaptic knob at end of dendrite contains: (i) many mitochondria (ii) numerous vesicles	To provide ATP for active refilling of synaptic vesicles. For modification and release of chemical transmitters across the synapse.
	Many dendrites	To allow communication with other neurons.

Structure and Function of Organelles	Structure	Function
Nucleus 	Double nuclear envelope	To enclose and protect DNA (normally visible as chromatin granules).
	Nuclear pores. Normally, the nuclear pores are plugged by an RNA/protein complex.	Allow entry of substances such as nucleotides for DNA replication and exit of molecules such as mRNA during protein synthesis. Small molecules pass through the pores by diffusion, whereas large molecules such as partly completed ribosomes pass through actively.
	Nucleoplasm contains chromatin granules made of DNA and associated proteins. Nucleoplasm also contains nucleoli	It is these which, during cell division, condense to form chromosomes. Produces partly-completed ribosomes, coenzymes, nucleotides, proteins (including enzymes for nucleic acid synthesis) and RNA molecules.
	The outer membrane of the nuclear envelope is continuous with the rough endoplasmic reticulum membranes.	This makes the perinuclear space continuous with the lumen of the endoplasmic reticulum, thus allowing easy transport of substances.
Mitochondrion 	Double membrane	Isolates reactions of the Kreb's cycle and electron transfer chain from the general cytoplasm. Such compartmentalisation allows high concentrations of enzymes and substrates to be maintained which increases the rate of respiratory reactions. Whereas the outer membrane is permeable to small molecules such as sugars, salts and nucleotides, the inner membrane is selectively permeable. This enables the mitochondrion to control the chemical composition of the matrix, thus optimising conditions for enzyme activity.
	The inner membrane is spanned by proteins (porins)	Allows entry of pyrovic acid and oxygen and the exit of ATP and carbon dioxide.
	The inner membrane is folded to form cristae	Greatly increases the surface area for the attachment of enzymes and co-enzymes involved in the electron transfer chain and allows the sequential attachment of electron carriers in the ETC.
	(i) The matrix contains 70S ribosomes (ii) DNA (iii) enzymes eg. decarboxylase	For protein manufacture eg. enzymes. codes for proteins. eg. in Kreb's cycle

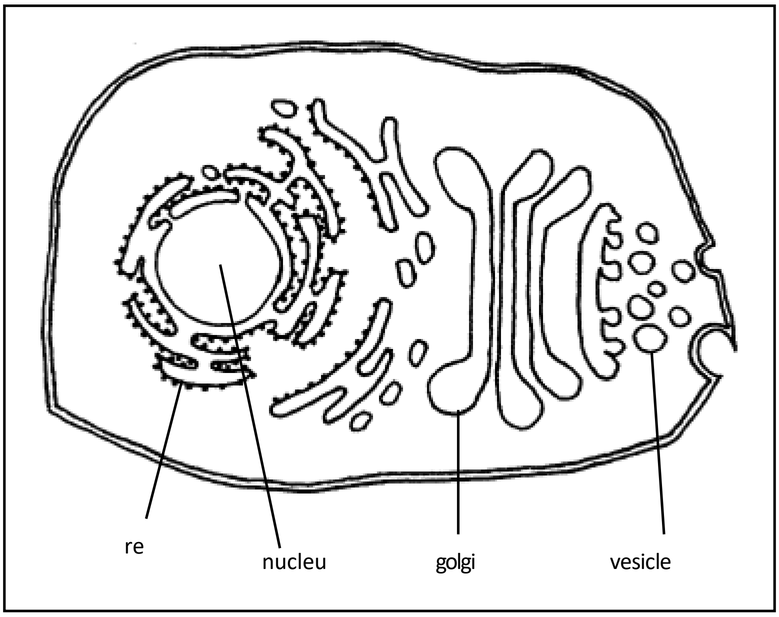
Cell	Structure	Function
Endoplasmic Reticulum 	Endoplasmic reticulum is a system of hollow tubes and sacs.	Allows transport of substances within the cell.
	Rough endoplasmic reticulum (rer) is covered with ribosomes and consists of an interconnected system of flattened sacs,	The ribosomes on the rough endoplasmic reticulum may synthesise proteins which can then be transported through the cell in the cavities of the endoplasmic reticulum. The percentage of rer is high in cells which produce proteins for export e.g. - digestive enzymes, growth factors and serum proteins. The smooth endoplasmic reticulum can give rise to Golgi bodies and this allows the packaging of newly produced proteins in Golgi vesicles which can then move to the cell surface membrane for secretion.
	Smooth endoplasmic reticulum (ser) - which lacks ribosomes - is a system of interconnected tubules.	The smooth endoplasmic reticulum is the site of carbohydrate and lipid metabolism eg. it synthesises triglycerides, cholesterol and phospholipids which become part of the cell surface membrane and is also involved in the modification of substances such as steroid hormones which will then be secreted. The percentage of smooth endoplasmic reticulum is high in cells which are involved in the metabolism of lipids and drugs.
Golgi body 	Golgi body consists of flattened cisternae (membrane bound cavities) which may be stacked on top of each other and which may invaginate and fuse to form vesicles	Allows internal transport. Vesicles contain materials to be secreted. Vesicles protect the molecules as they are transported across the cytoplasm to the cell surface membrane.
	The Golgi body is connected to the rer	Proteins from the rer are modified before secretion. For example, carbohydrates may be added to proteins to form glycoproteins such as mucus which can then be enclosed in vesicles for secretion out of the cell. Golgi vesicles may also fuse with primary lysosomes which will then form secondary lysosomes capable of digesting food particles.
Ribosome 	Ribosomes consist of two sub-units both made of rRNA and protein. The rRNA part of the ribosome is formed in the nucleus and moves out of the nucleus via the pores. The protein part is then assembled in the cytoplasm. Ribosomes may occur in dense clusters in the cytoplasm where they are known as polysomes or may occur on the membranes of the endoplasmic reticulum.	Ribosomes provide: (i) Binding sites for the binding of mRNA which allows translation of the DNA code. (ii) Two sites for the binding of 2 tRNA molecules. (iii) The enzymes necessary for (i) and (ii). Ribosomes recognise the initiation and termination codons on mRNA. Ribosomes are capable of moving along the mRNA strand. This allows decoding of the mRNA and synthesis of a polypeptide chain.

Cell	Structure	Function
Lysosomes 	Lysosomes are vesicles which contain hydrolytic enzyme, collectively known as lysozymes.	When released, these enzymes can break down old organelles, storage molecules or, indeed, the whole cell, when it dies.
Chloroplasts. 	Double Membrane	Allows the isolation of photosynthetic reactions.
	The stroma contains a series of membrane-bound flattened sacs called thylakoid membranes. Thylakoid membranes may be stacked into grana.	Grana allow a huge surface area for the assembly of chlorophyll molecules for light absorption and also allow the sequential attachment of enzymes and co-enzymes involved in the electron transfer chain of the light-dependent stage. Such membranes also allow quite different chemical reactions to occur in different parts of the chloroplast.
	The chloroplast stroma contains: (i) Starch grains. (ii) Lipid stores - otherwise known as plastoglobuli. (iii) Pyrenoids - crystallised RuBPC. (iv) DNA RNA and ribosomes.	(i) Which act as a carbohydrate store. (ii) Accumulate when membranes have been broken down, for example during senescence. (iii) The enzyme which fixes carbon dioxide. (iv) All involved in nucleic acid and protein synthesis.

Movement of substances within the cell.

The organelles within eukaryotic cells work closely together. For example, in the production of a secretary protein such as a digestive enzyme:

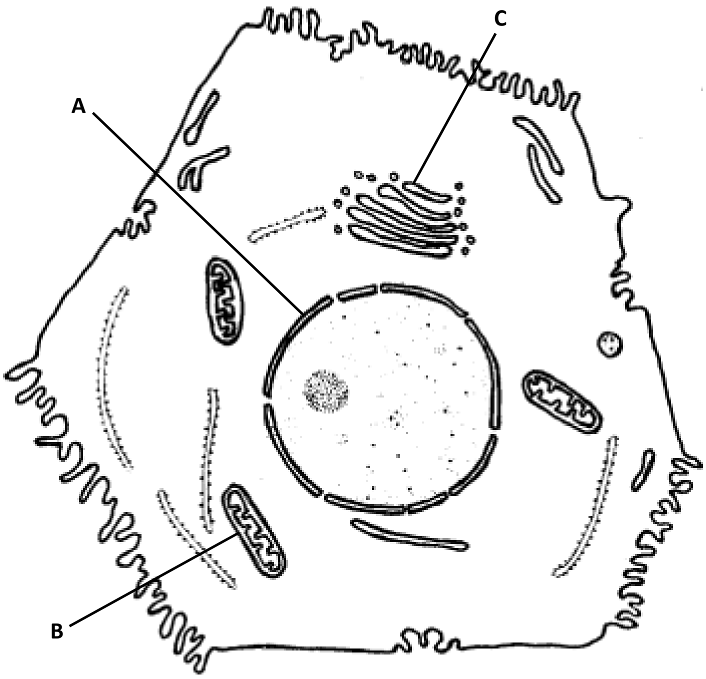
1. The genetic code for the protein lies in the chromatin granules in the nucleoplasm of the nucleus.
2. This code, now in the form of mRNA, moves through the nuclear pores.
3. The mRNA attaches itself to ribosomes on the rough endoplasmic reticulum which is continuous with the outer membrane of the nuclear envelope.
4. The code is translated into apolypeptide chain.
5. The polypeptide pass into the lumen of the endoplasmic reticulum.
6. The polypeptide is transferred to the golgi body and packaged in a vesicle.
7. The vesicle merges with the cell surface membranes and the protein is released.



Practice Questions

1. Outline the similarities between chloroplasts and mitochondria.

2. The diagram shows a generalised eukaryotic cell.



Identify structure:

(i) A
(ii) B
(iii) C

3. Explain how the structure of each of the following organelles aids its function:

(i) chloroplast
(ii) mitochondrion

4. Complete the table below by filling in the blanks:

Organelle	Structure/Features	Function
.....(i)...........	Flattened cisternae	Carbohydrate and lipid metabolism
.....(ii)...........	Internal membranes greatly folded into cristae	Increases surface area for .....(iv)..........
.....(iii)...........	Pores normally blocked by an RNA/protein complex	.....(v)...........
Chloroplast	Thylakoid membranes stacked into grana	.....(vi)...........
Rough endoplasmic reticulum	Flattened interconnecting sacs covered in ribosomes	.....(vii)...........

Answers

Marking points are shown by semicolons

1. Both organelles are surrounded by two membranes;
Both show internal compartmentalisation - i.e. internal membranes which allow different reactions to occur in different parts of the organelle;
Both have DNA;
Both have ribosomes;
Both are therefore capable of enzyme synthesis;
Both possess a readily permeable outer membrane and a selectively permeable inner membrane;
In both cases, permeability is brought about by proteins (porins) which span the membrane;

2. (i) Nuclear membrane;
(ii) Mitochondrion;
(iii) Golgi body;

3. See text

4. (i) Golgi body;
(ii) Mitochondrion;
(iii) Nucleus;
(iv) Electron transfer chain reactions/enzymes;
(v) Control of entry/exit of substance;
(vi) Increases surface area for chlorophyll to absorb light/allows sequential arrangement of electron carriers;
(vii) Ribosomes synthesise protein which can be transported through the endoplasmic reticulum

Acknowledgements;
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Structure to function in prokaryotic cells

The contents of this Factsheet cover the relevant AS syllabus content of the major examining boards. By studying this Factsheet the candidate will gain a knowledge and understanding of the structure of a prokaryotic cell, the range of prokaryotic organisms and the importances of prokaryotic organisms.

Introduction

Bacteria (eg *Escherichia coli*) and Cyanobacteria (blue-green algae) (eg *Nostoc*) are single-celled and characteristically possess no nucleus. They are prokaryotic organisms.

> ***Remember*** *– the Cyanophyta or blue-green algae are now classed as Cyanobacteria because they are prokaryotic. Algae are all eukaryotic since they possess nucleated cells and cell organelles. In some older textbooks you may still find blue-green algae classed as Cyanophyta. This is now considered to be incorrect and you should refer to them as Cyanobacteria in AS and A2 examinations.*

The prokaryotic cell is the simplest type of living cell. They are relatively small having a diameter in the range of 1 - 5 μm (micrometre), and a volume somewhere between one thousandth and one hundred thousandth of the volume of a typical plant or animal cell. Prokaryotic cells do not have membrane-bound organelles. Remember that a micrometer is 10^{-6} metre.

Form

Prokaryotes show a variety of cell shapes. The three most common are spheres (cocci), rods (bacilli) and spirals (spirilla). Examples of these are shown in Fig 1.

> ***Remember*** *– a light microscope will only show the general shape of bacterial cells and does not have the magnification or resolving power to show the cell contents. To see the ultrastructure of cells, that is, the details of cell contents, an electron microscope is required.*

Ultra-structure

The prokaryotic cell has a **cell wall**, external to the plasma membrane. The wall confers rigidity and maintains the characteristic shape of the cell. It provides physical protection and prevents the cell from bursting in an hypo-osmotic environment in which the cell contents are more concentrated than the external solution. In bacterial cells the wall is 10 - 100 nm (nanometre) thick. (A nanometre is 10^{-9} of a metre). It is made from lipids, polysaccharides and proteins. Most bacterial cell walls contain a unique material called **peptidoglycan**. This compound consists of polymers of modified sugars cross-linked by short chain polypeptides. The specific polymers used vary from species to species. The end result is a net-like multilayered structure. The Blue-green algae have walls similar in structure to some bacteria. Cellulose is not used.

A gelatinous sheath or **capsule**, may be found external to the cell wall. This is found most commonly in blue-green algae. This structure, composed of polysaccharides, absorbs water. The capsule is therefore slimy and serves as a protective layer. (see Fig 2 and 3 overleaf)

Fig 1. Appearance of prokaryotic cells as seen under the high power of a light microscope

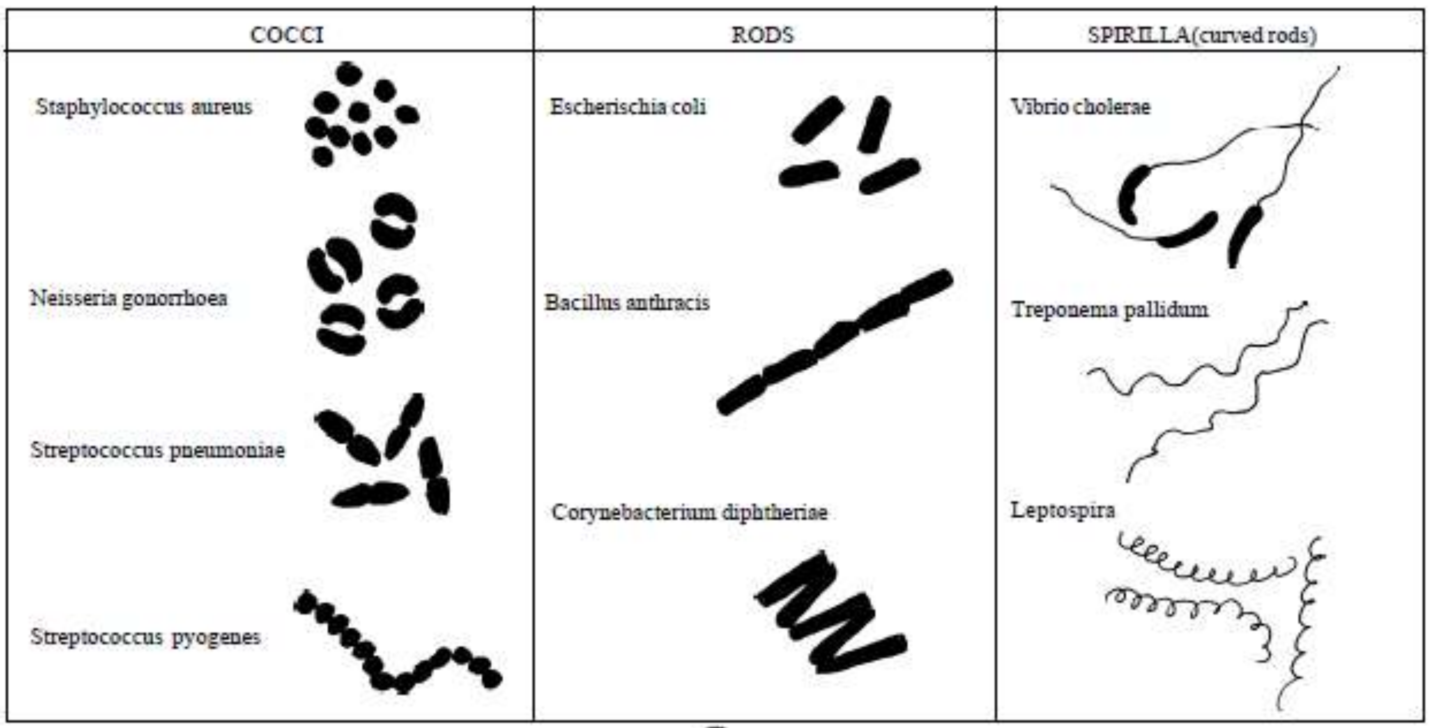


Fig 2 and 3 show the general ultrastructure of a rod-shaped bacterium and a blue-green algal cell.

Fig 2. Ultrastructure of a rod-shaped bacterium

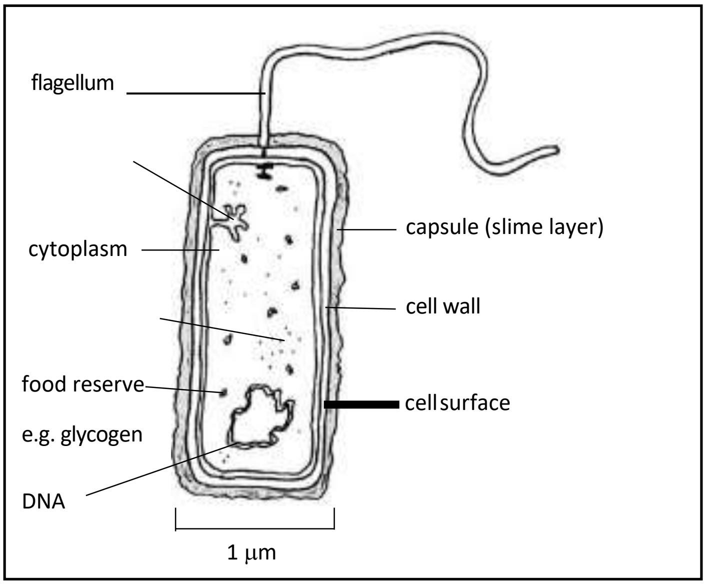
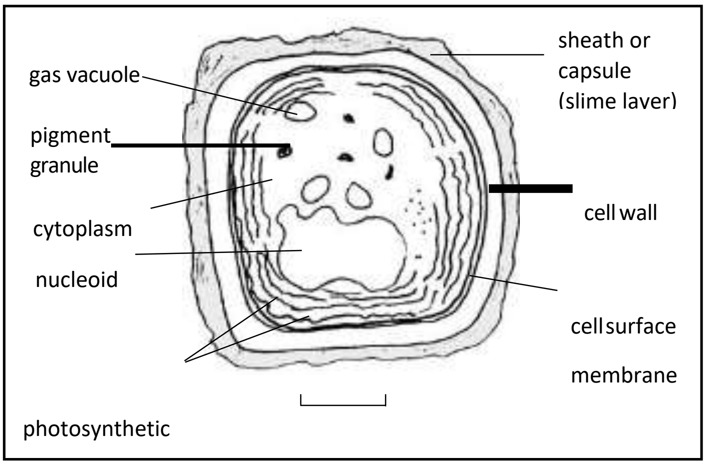


Fig 3. Ultrastructure of a blue green alga



The cell surface membrane, the **plasma membrane,** is composed of phospholipids and proteins. The proteins include enzymes that are involved in respiration, electron transport and nucleic acid synthesis. The membrane is partially permeable and exerts some control over which small molecules and ions can enter and leave the cell.

The cytoplasm of a prokaryote contains storage products (glycogen granules and lipid droplets), ribosomes and plasmids(circular pieces of DNA). The prokaryotic cell is not divided into areas of different function (compartmentalised) by internal membranes. The plasma membrane may however form **invaginations** (mesosomes) , to provide internal membrane surfaces for special purposes; for example, the mesosomes are thought to be the site of respiration.

The feature that makes a prokaryotic cell very different from a eukaryotic cell is its genetic material. The bacterial DNA is in direct contact with the cytoplasm. There is no enclosing membrane and therefore **no recognisable nucleus**. Prokaryotes possess a single, continuous, **circular thread of DNA**. The DNA is located in a region of the cytoplasm called a **nucleoid**. Small structures called **plasmids** may also be present. These carry DNA with only a few genes responsible for special metabolic pathways and resistance to antibiotics. Plasmids can transfer between bacteria and it is this property that has made them important in genetic engineering.

The **ribosomes** found in prokaryotic cells are smaller than those of eukaryotes and are involved in protein synthesis. The rate at which bacteria divide requires a high level of protein synthesis and thus many ribosomes are needed. Thus ribosomes may constitute as much as 40% of the cell mass. Prokaryotic cells possess 70S ribosomes whereas eukaryotic cells possess 80S ribosomes.(S stands for Svedberg units and is a measure of how rapidly the ribosomes sediment in a centrifuge. 80S ribosomes sink quickest because they are heaviest)

Motile bacteria use **flagella** to move. These fibrous projections propel the cell through its environment by rotating clockwise or anticlockwise. The cell movement that results will be in a straight line or in a more uncontrolled, tumbling motion depending on the direction in which the flagellum is rotating.The flagella have a much simpler structure than the complex microtubule flagella of eukaryotic cells.The gas containing vacuoles of blue-green algae are probably for flotation so that the cells remain near the surface of the water and thus receive more light for photosynthesis.

Exam Hint *- Candidates should be able to recognise and describe the features of prokaryotic cells as seen under the electron microscope*

Table 1. Comparison of prokaryotic and eukaryotic cells

Feature	Prokaryote	Eukaryote
Diameter	0.5 - 5μm	up to 40μm
Organisation	Single-celled	Usually part of a tissue
Nucleus	Absent	Present
DNA	Single circular thread	Several linear chromosomes
Phospholipid plasma membrane	Present	Present
Ribosomes	Small 70S	Large 80S
Mitochondria	Absent	Present
Cell wall	Always present made from peptidoglycans (cellulose absent)	Present only in plant cells (cellulose present)

Importances of prokaryotes

1. Chemical cycles

Prokaryotes recycle elements linking the biological and physical components of the ecosystem. They play a significant role as decomposers in the carbon and nitrogen cycles, for example, the nitrifying bacteria *Nitrosomonas* and *Nitrobacter*. Some bacteria function as symbionts, for example, *Rhizobium leguminosarum* in the root nodules of Papilionaceous plants such as clover is important in the fixation of gaseous atmospheric nitrogen. Bacteria such as *Azotobacter* and blue green algae such as *Nostoc* are important free living nitrogen fixing bacteria in the soil.

2. Bacteria and disease

Poisonous chemicals called toxins, released by bacteria, are the most common cause of symptoms of bacterial disease. Toxins released by some types of bacteria may cause disease, even when the bacteria themselves are no longer present. Other types of bacteria produce toxins that are an integral part of the outer membranes of the bacterial cell itself. Both types of pathogen disrupt the natural physiology of the affected individual. Examples of pathogenic (disease causing) bacteria can be seen in Fig 1. For example, Streptococcus pyogenes can cause sore throats and tonsilitis, Bacillus anthracis causes anthrax, Corynebacterium causes diphtheria, Vibrio cholerae causes cholera, Treponema causes syphilis and Leptospira causes leptospirosis(rat borne fever).

3. Biotechnology

Prokaryotes are useful agents employed in a variety of ways. Examples include:

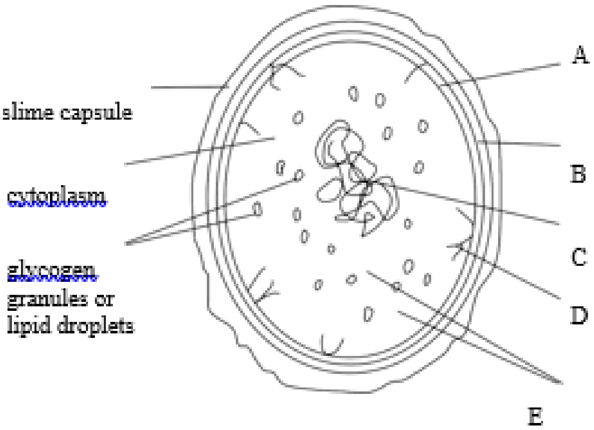
- use of decomposers in sewage treatment;
- bacterial conversion of milk to yoghurt and cheese;
- manufacture of vitamins and antibiotics;
- use in recombinant DNA technology.

Practice Questions

1. Describe the organisation of genetic material in a prokaryotic cell. 6

2. What are:
   (a) peptidoglycans, 4
   (b) mesosomes, and 4
   (c) plasmids? 4

3. The drawing below shows the ultrastructure of E. coli.



(i) Label structures A to E 5

(ii) State a function of part D. 1

(iii) What term is given to this bacterial shape? 1

(iv) List three ways in which prokaryotic cells differ from eukaryotic cells. 3

Answers

Semicolons indicate marking points.

1. no true nucleus;
   DNA forms continuous circular structure;
   located in region of cytoplasm called nucleoid;
   plasmids;
   small circles of DNA;
   few genes; 6

2. (a) found in bacterial cell walls;
   polymers;
   modified sugars;
   crosslinked to short polypeptides;
   species specific;
   max 4

   (b) invaginations;
   plasmamembrane;
   specific functions;
   e.g. site of respiration; 4

   (c) short strand of DNA;
   circular;
   carry few genes;
   associated with resistance;
   useful in recombinant DNA technology; 4

3. (a) (i) A = plasma membrane; B = cell wall; C = nuclear mass;
   D = mesosome; E = ribosomes; 5

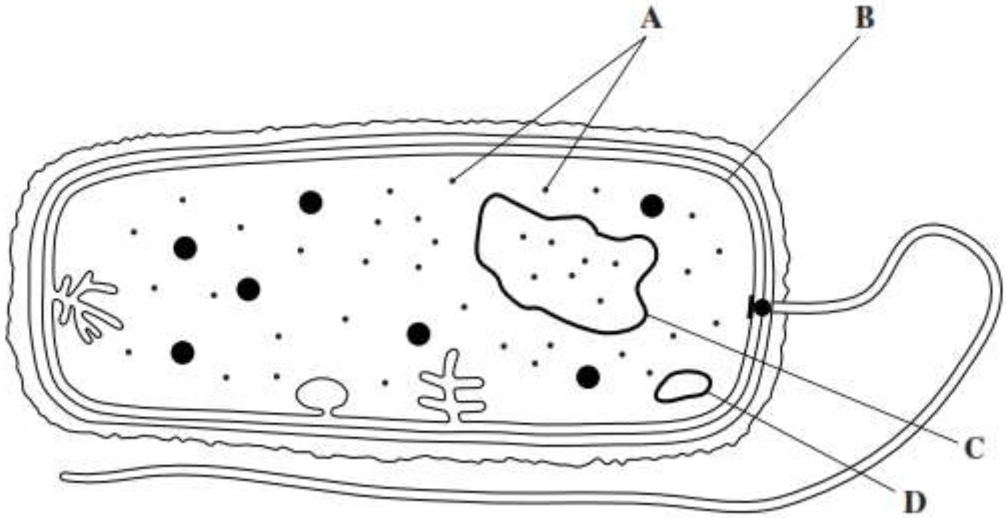
   (v) contain the enzymes for respiration/cell wall synthesis; 1

   (vi) coccus; 1

   (b) prokaryotic cells contain no membrane-bound organelles, eukaryotes do;
   prokaryote cells have no nuclear membrane, eukaryotes do/ prokaryotes have a nuclear mass;
   eukaryotes have a nucleus/prokaryotes have one long chromosome, eukaryotes have many chromosomes;
   prokaryotes have no nucleoli, eukaryotes do;
   prokaryotic cell walls contain murein, eukaryotic cell walls (if present) contain cellulose;
   prokaryotes contain 70S ribosomes, eukaryotes contain 80S ribosomes; max 3

Q1.

The diagram shows a bacterium.



(a) Name

(i) organelle **A** ____

(1)

(ii) structure **B** ____

(1)

(b) Give **two** ways in which the structure of this bacterium is different from the structure of cells lining the alveoli of a human lung.

1. ____

____

2. ____

____

(2)

(c) Structures **C** and **D** are made of the same type of biological molecule. They have a similar function.

What is the function of **C** and **D**?

____

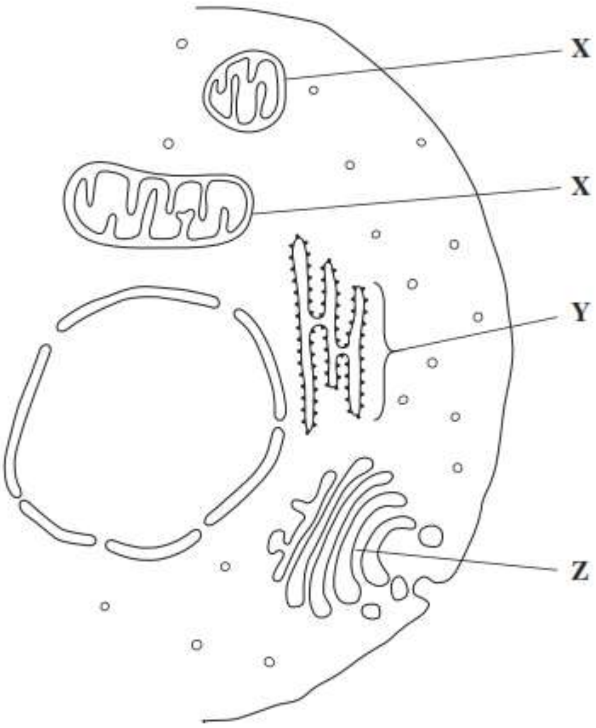
____

(1)

(Total 5 marks)

Q2.

The drawing shows part of a human cell.



(a) Name organelles

X ______________________________

Y ______________________________

(2)

(b) (i) The organelles labelled **X** all have very similar shapes in this cell. Explain why they appear to have different shapes in this drawing.

____

____

(Extra space) ______________________________

____

(1)

(ii) Large numbers of organelles **X** and **Z** are found in mucus-secreting cells. Explain why.

____

____

____

____

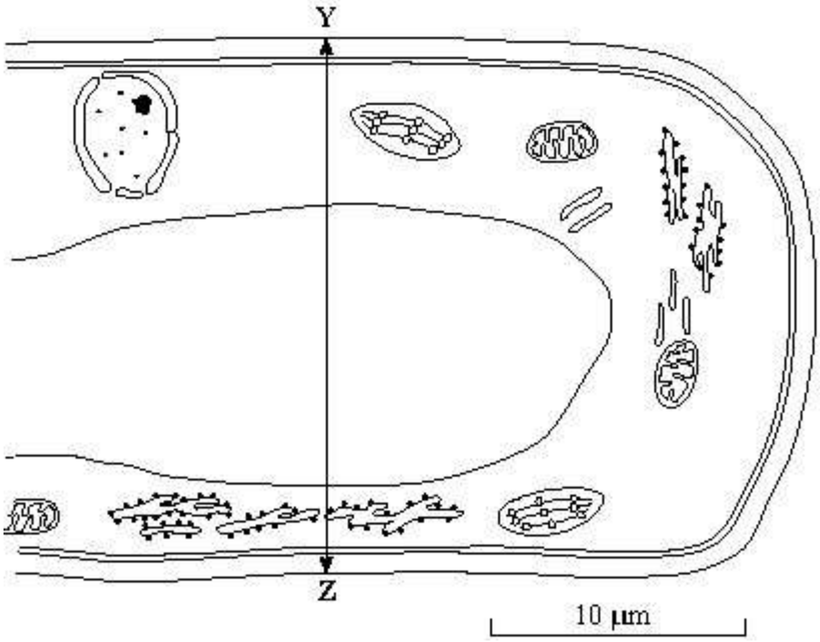
(Extra space) ______________________________

____

(2)
(Total 5 marks)

Q3.

The drawing shows part of a plant cell as seen with an electron microscope.



(i) Give **two** features shown in the drawing which are evidence that this cell is eukaryotic.

1. ____

____

2. ____

____

(2)

(iii) Give **one** way in which a typical animal cell differs from the cell shown in the drawing.

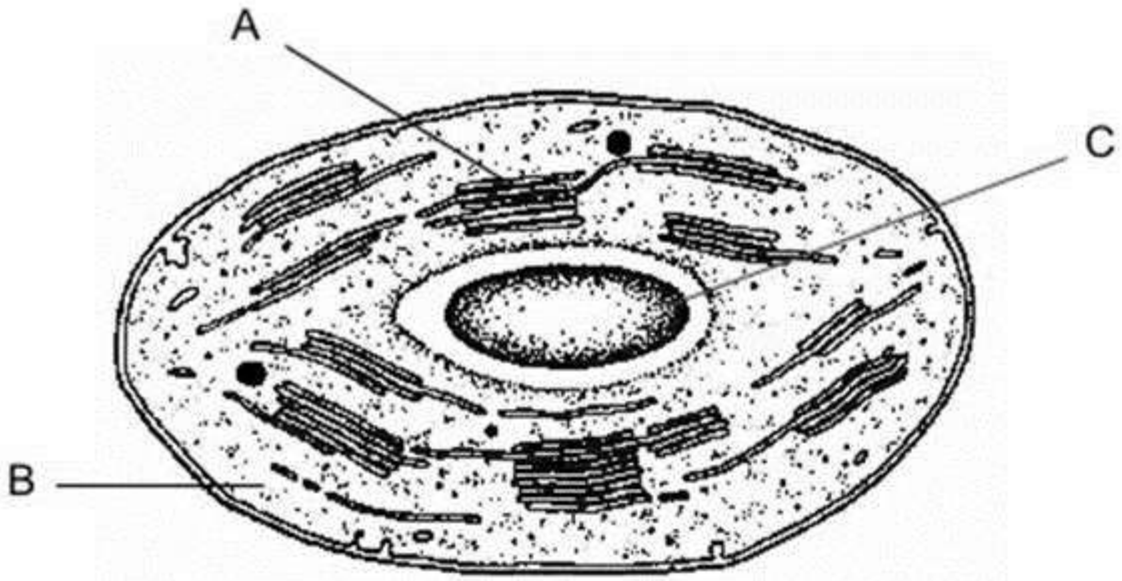
____

____

(1)
(Total 5 marks)

Q4.

The electron micrograph shows part of a chloroplast.



(a) Name the parts labelled **A** and **B** and, for each, describe **one** role in the process of photosynthesis.

A Name ______________________________

Role ______________________________

(2)

B Name ______________________________

Role ______________________________

(2)

(b) (i) Name the main substance present in the part labelled **C**.

____

(1)

(ii) How is this substance formed?

____

____

(1)

(Total 6 marks)

Mark schemes

Q1.

(a) (i) Ribosome(s);

1

(ii) Plasma/cell (surface) membrane;

Accept membrane unless disqualify with, e.g. nuclear membrane

1

(b) **Two** suitable comparisons, accepting bacterial cell has;
Examples,
Bacterial cell has capsule/slime layer;
Cell wall;
(Bacterial) flagellum;
Mesosome;
Different size ribosomes;
Circular DNA;
Human cell has nucleus;
Membrane-bound organelles;
Two named examples of membrane-bound organelles;

Reject ref to thin and flat

2 max

(c) Carry genetic information/genes;

Reject/ignore to carry DNA to carry genetic code
Accept genetic material with coded information –
information for protein synthesis
Ignore genetic material on its own

1

[5]

Q2.

(a) X = mitochondria;
Y = (rough) endoplasmic reticulum;

Accept ribosomes/ER/RER for Y
Reject smooth endoplasmic reticulum for Y

2

(b) (i) (Sections cut at) different angles/in different planes;

Ignore name given to organelle

1

(ii) Z modifies/packages/transports/secretes mucus/ Z adds sugars to proteins;
X provides ATP/energy (for this);

Accept makes in relation to Z but not X
Ignore names of organelles if function correct

2

[5]

Q3.

(i) <u>named</u> organelle e.g. nucleus / nuclear envelope; vacuole;
chloroplast; RER; mitochondrion; no membrane bound organelles;

(only award if no organelles named)
(reject ribosomes, cell membrane, cell wall)

ref to large(r) size

2 max

(iii) no cell wall (permanent) / (large) vacuole / chloroplasts / smaller;

(accept microvilli)

1 max

[5]

Q4.

(a) A – granum / thylakoid;
chlorophyll molecules to trap light / light absorbing pigments /
light dependent reaction / part of light dependent reaction;

2

B – stroma;
(contains enzymes for) carbon dioxide fixation / light-independent reaction /

part of light-independent reaction;
(allow ribosome role of protein in photosynthesis)

2

(b) (i) C – starch; **1**

(ii) from glucose in a condensation / polymerisation reaction / many glucose molecules joined together; **1**

[6]