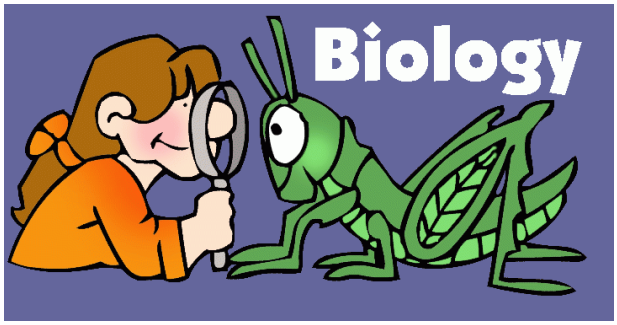
Plymstock School

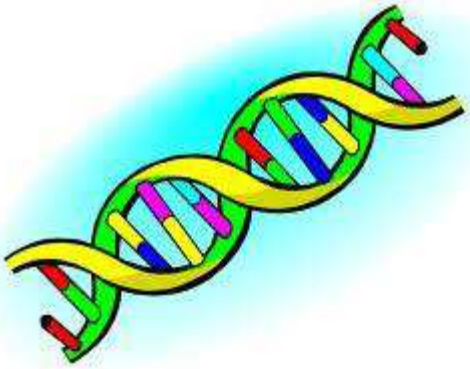
Biology Department

AS Level Biology

Summer Workbook

2016





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Introduction

This workbook has been designed to help you "bridge the gap" from GCSE to AS Level to ensure that you understand what you have let yourself in for and that you are ready for your new course in September.

You will start by looking at some topics covered in Year 12 in the Biology OCR course and give you an idea of what you will be studying, how to find and use resources and apply your knowledge.

This booklet contains:

- Maths for Biology
- Biological terms
- Practical task terms
- Module 2.1.1 Cells and organelles
- Module 2.1.1 Microscopy and Magnification
- Module 2.1.2 Biological molecules

You will be expected to work through this booklet, ensuring it is completed for your ***first Biology lesson*** in September.

There are a different number of tasks that need to be completed:

- Vocab lists – recall
- GCSE recap tasks
- Research tasks
- Math skills

After the first two weeks in Biology, you will be given a short "bridging the gap" test, which will enable the Biology department to assess whether Biology is the right choice for you. The contents of the test will be based on information in this workbook and the first 2 weeks worth of work completed during lessons. 2 years is a long time to be studying a course that you do not enjoy!!

Do not guess the answers to the questions in this booklet. Use A level resources – text books as well as online material – to help you find out the answers

Maths in Biology

Basic maths

Using the data below, calculate the mean, median and range for each set of data. The mean should be rounded to the nearest WHOLE number

2
4
10
7

112
97
48
123
43
98
99
345

36
39
32
48
56
52

Mean _____

Median _____

Range _____

Mean _____

Median _____

Range _____

Mean_____

Median _____

Range _____

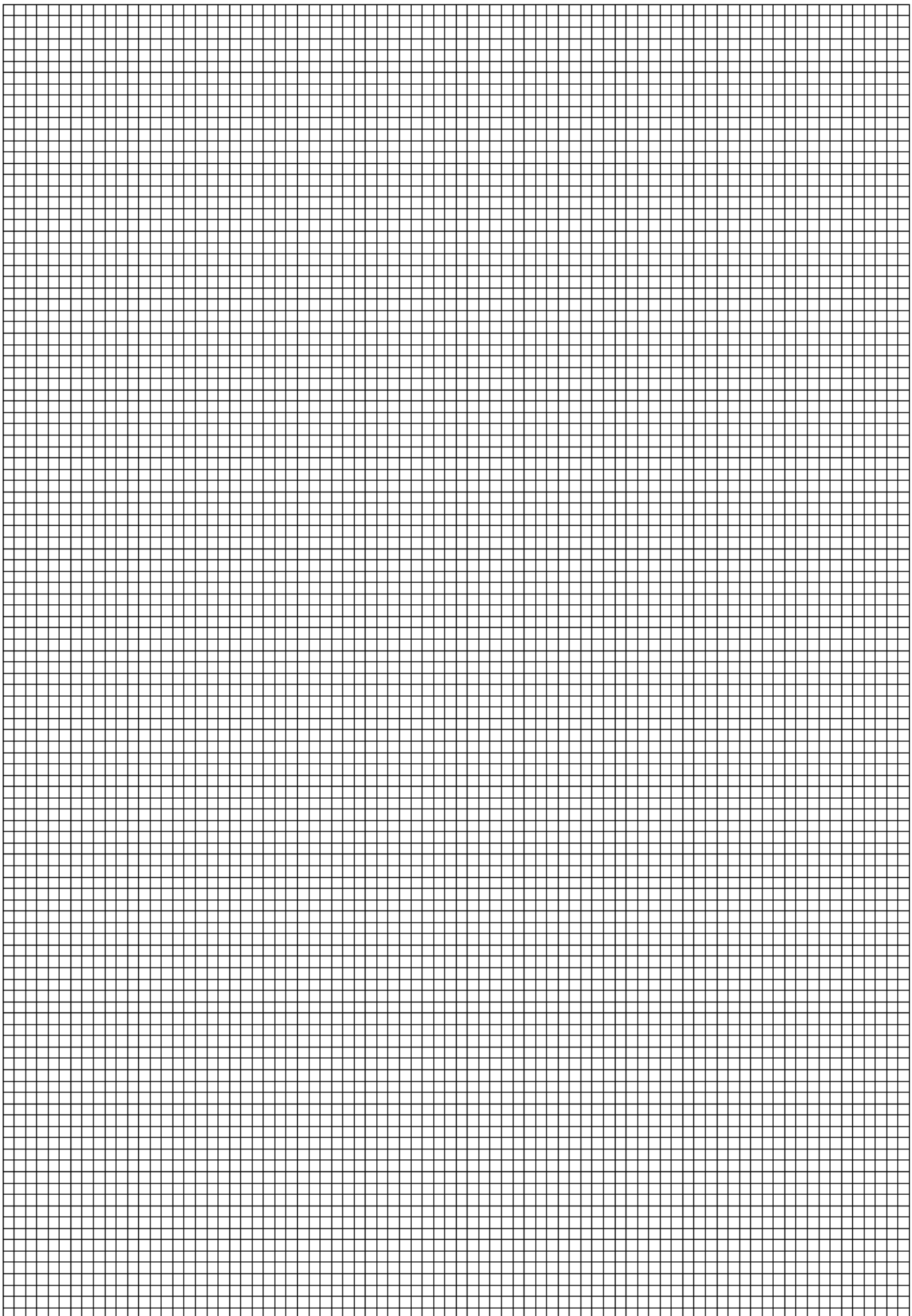
Using the data below, calculate the mean species richness for each area, rounded to the nearest whole number.
Plot the two mean values on a graph
Add range bars to show the highest and lowest values – join together with a line
Indicate with a small cross, the median value on each range bar

AREA	**Species Richness**				
	Quadrat 1	**Quadrat 2**	**Quadrat 3**	**Quadrat 4**	**Quadrat 5**
A	**3**	**5**	**3**	**6**	**3**

B	**9**	**4**	**6**	**6**	**9**

Mean Area A_____

Mean Area B



Units, measurements and standard form

Units are very important part of biology. The common units you should know are:

Unit	Name	Measurement of…
m	metres	Distance or length
kg	kilograms	mass
A	amps	current
s	Seconds*	time
^{o}C	Degrees celsius[1]	temperature
M	Molar	concentration
J	Joule	energy

**Notice 's' is the abbreviation for seconds, not 'sec'.*

[1]You may come across the unit K (Kelvin).
To convert a K temperature to ^{o}C, take away 273. E.g. 373K = 100^{o}C

However, there are several units derived from these basic units that you will come across commonly in biology. These are:

Unit	Name	Measurement of…..
cm^3	centimetres cubed	Volume, usually solids and gases*
ml	millilitres	Volume, liquids*
mm	millimetres	length
µm	micrometres or microns	length
nm	nanometres	length
mV	millivolts	voltage

**Notice that cm^3 and ml are an equal measure i.e. 1cm^3 = 1ml*

What happened to litres?
Instead of using litres (l), at A level you will be expected to use dm^3 (decimetres cubed). This avoids confusing l for litres with a number 1. Millilitres are still represented as ml.

'Per'
At GCSE, you would have written metres per second like this: m/s
A levels use a different notation: ms^{-1}

There is a mathematical reason for this, but you don't need to know it….
The minus sign when present in units tells you that it should be read as 'per', e.g.

- kg per second kgs^{-1}
- bubbles per minute bubbles min^{-1}

- per litre dm^{-3}

Prefixes
These go before a unit to alter its magnitude. You will be familiar with some of them already.

Symbol	Prefix	meaning	Example
M	Mega	x 1,000,000 (million)	MJ
k	kilo	x 1,000	kg
m	milli	÷ 1000	mV
µ	micro	÷ 1,000,000 (millionth)	µm
n	nano	+ 1,000,000,000 (billionth)	nm

Millivolts are often used in measuring voltage in cells.
µm are commonly used in measurements of cells and organelles.
nm are used in measuring wavelengths of light.

Standard form
Biology often uses numbers that are too large to be written down conveniently. Standard form is a short hand way for writing large or small values.

Instead of 1400 m standard form would be 1.4×10^3 m

This is the same as saying 1.4 x 10 x 10 x 10. If you work this out, it is the same as 1400 m. You can use 1.4km which is the same thing, but as you will see below, it is good practice to get used to using standard form. Notice that the first value will be a number between 1 and 9, so that:

1450 m is 1.49×10^3 m

Another way to think about it is by moving the digits along, so:
1.49×10^3m move the digits 3 places to the left of the decimal point:

			1	.	4	9
1	4	9	0	.	0	0

However, you will be much more likely to come across small values is biology. In standard form, a minus sign is used, so that:

0.003m is 3×10^{-3} m

This time, you move the digits 3 places to the right of the decimal point:

3	.				
0	.	0	0	3	

It gets easier when you start to recognise the relationship between standard form and the prefixes:

Standard form	Same as	
$x10^{3}$	kilo	x1000
$x10^{-3}$	milli	÷10000
$x10^{-6}$	micro	÷1,000,000
$x10^{-9}$	nano	÷1,000,000,000

TASK

1 Rewrite the following using prefixes:

12000 g
0.005 m
0.000087 V

2 What do the following units represent?

gcm^{-3}
Jkg^{-1}
$mm^{3}s^{-1}$
$kgm^{-2}y^{-1}$

3 Rewrite the following in standard form:

1942 kg
0.007 m
0.000002 A
0.034 s

14.5 MJ
178846 km
440 mm

4 Find values for:

Wavelength of red light
Diameter of a nucleus
Mass of the earth
Energy in 1g sugar

Statistics

The χ^2 Test

Use this test when:
The measurements relate to the number of individuals in particular categories;
The observed number can be compared with an expected number which is calculated from a theory.
The χ^2 test is a statistical test to compare observed results with theoretical expected results.
The calculation generates a χ^2 value; the higher the value of χ^2, the greater the difference between the observed and the expected results.

1. State the null hypothesis
This is a negative statement, basically saying that there is no statistical difference between the observed and the expected results.
Eg there is no difference between the observed results and the expected results.

2. Calculate the expected value
This is the mean of the total observed values and will therefore be the same for each variable (eg sex)
Or when studying inheritance, you add up the expected values and apply a ratio.

3. Calculate χ^2
The formula is: $\chi^2 = \sum \frac{(o-e)^2}{e}$

o = observed value
e = expected value
$\sum$ = the sum of

4. You will also need to know the degrees of freedom.
- This is calculated using the formula (n-1)
- where n = the number of sets of results.

5. Compare the χ^2 value against a table of critical values.
- Refer to the degrees of freedom,
- Look up the critical number at the p = 0.05 level

6. Make a conclusion:
- Biologists need to feel confidence in their results in order to say that a difference occurred due to a biological reason.
- They will only accept this if they have greater than 95% confidence.
- If they have less than 95%confidence, they are only willing to say that the difference between the results occurred due to chance alone.
- If the number exceeds the critical number at the 0.05 level then, as a biologist, you can reject the null hypothesis.
- If the χ^2 value is less than the critical number then you can accept the null hypothesis.
- Eg the calculated value is greater than the critical value so the null hypothesis is rejected and there is a significant difference between the observed and expected results at the 5% level of probability.

- P=0.05 is the same as 5% probability – it can be expressed either way

Chi-squared test example 1

Naked mole rats are a burrowing **rodent** native to parts of East Africa. They have a complex social structure in which only one female (the queen) and one to three males reproduce, while the rest of the members of the colony function as workers. Mammal ecologists suspected that they had an unusual male to female ratio. They counted the numbers of each sex in one colony.

Sex	Number of animals
Female	52
Male	34

State the Null hypothesis

Sex	Observed	Expected	O - E	$(O - E)^2$	$(O - E)^2/E$
Female	52				
Male	34				
TOTAL					

Calculate the expected results

Calculate the chi-squared value

$\chi^2 =$

What are the degrees of freedom?

DF =

Compare the calculated value with the critical value

Degrees of freedom	Significance level		
	5%	2%	1%
1	3.84	5.41	6.64
2	5.99	7.82	9.21

Make a conclusion

Chi-squared test example 2

You have been wandering about on a seashore and you have noticed that a small snail (the flat periwinkle) seems to live only on seaweeds of various kinds. You decide to investigate whether the animals prefer certain kinds of seaweed by counting numbers of animals on different species. You end up with the following data:

TYPE OF SEAWEED	Number of animals on each kind of seaweed
serrated wrack	45
bladder wrack	38
egg wrack	10
spiral wrack	5
other algae	2
TOTAL	100

State the Null hypothesis

Calculate the expected results

Calculate the chi-squared value

Seaweed	Observed	Expected	O - E	$(O - E)^2$	$(O - E)^2/E$
serrated wrack	45				
bladder wrack	38				
egg wrack	10				
spiral wrack	5				
other algae	2				
TOTAL					

$\chi^2 =$

What are the degrees of freedom?

Compare the calculated value with the critical value

Degrees of freedom	Significance level		
	5%	2%	1%
1	3.84	5.41	6.64
2	5.99	7.82	9.21
3	7.82	9.84	11.34
4	9.48	11.66	13.27

Make a conclusion

Module 2 Foundations in Biology

Magnification

$$\text{Actual size} = \frac{\text{Image size}}{\text{Magnification}}$$

$$\text{Magnification} = \frac{\text{Image size}}{\text{Actual size}}$$

TASK

Easy calculations (same units)

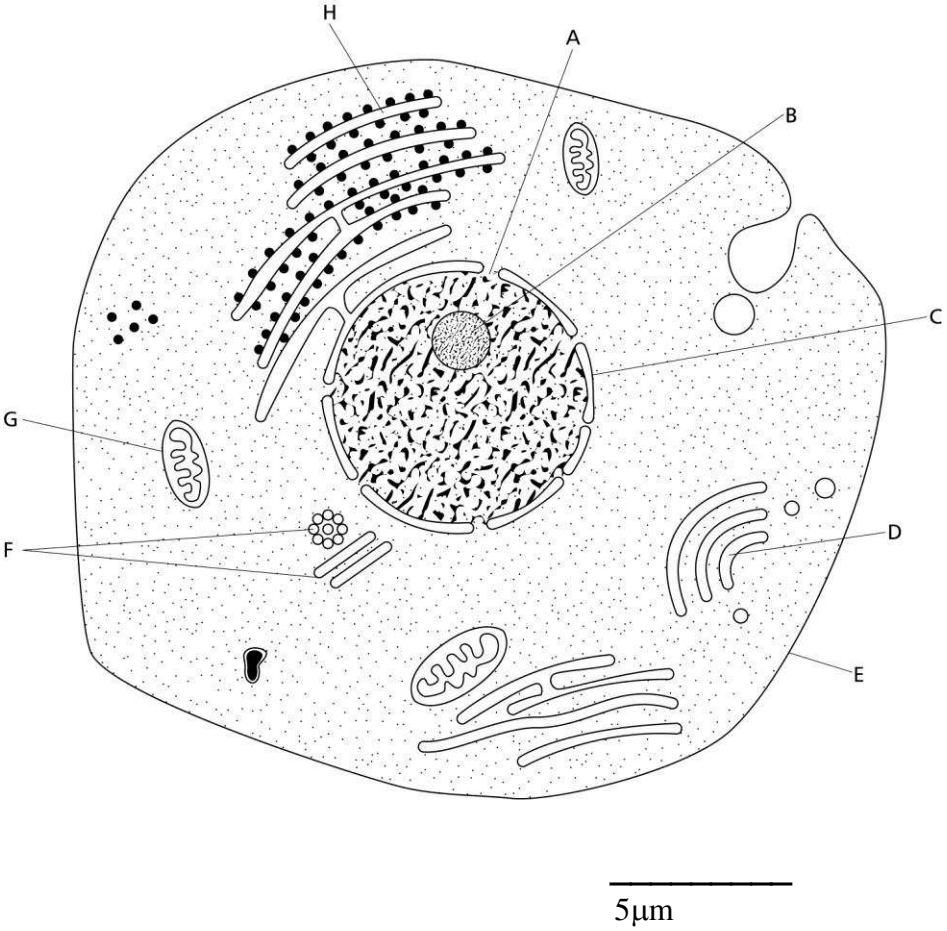
Object	Image size	Actual size	Magnification
E Coli	20 mm	0.002 mm	x
Yeast cell	10 mm	0.006 mm	x
Blood cell	300 mm	0.01 mm	x
Pollen grain	40 mm	0.5 mm	x
Hair	6 cm	3.5 cm	x

Harder calculations (different units)

Object	Image size	Actual size	Magnification
Salmonella	1.5 cm	0.003 mm	x
Crystal	3 cm	0.05 mm	x
White cell	20 mm	20µm	x
Dust	25 mm	0.1 cm	x
Finger nail	5 mm	1.5 cm	x

Cell Structure

The diagram below shows the general structure of an animal cell as seen under an electron microscope.



1) Calculate the magnification factor of the diagram

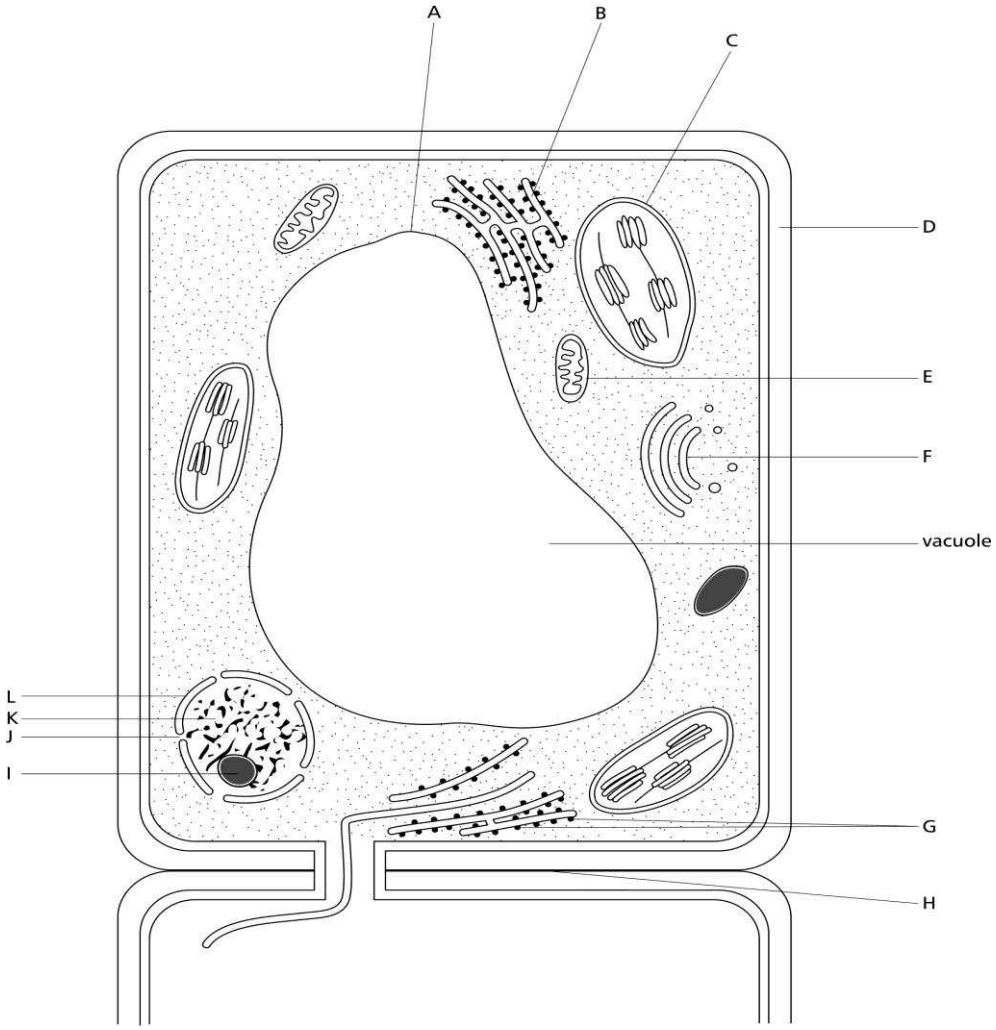
2) Calculate the length of structure G

3) Calculate the diameter of the nucleolus (structure B)

4) Calculate the diameter of the nucleus

5) Calculate the diameter of the cell at its widest point

The diagram below shows the general structure of a plant cell when viewed under and electron microscope.



40µm

1) Calculate the magnification factor of the diagram

2) Calculate the thickness of the cellulose cell wall.

3) Calculate the length of the cell.

4) Calculate the length of structure C.

5) Calculate the length of the vacuole.

Microscopes

Research the features of the 3 different types of microscope

Feature	**Light Microscope**	**Transmission electron microscope (TEM)**	**Scanning electron microscope (SEM)**
Source of image			
How is the beam focused			
Maximum effective magnification			
Maximum resolution			
Can a live specimen be used?			
Section or external view of the specimen			
Cost			
Can the image be viewed directly			
Is staining of the specimen required?			

Use the information in the table and any other relevant information to write a paragraph summarising each of the microscopes

Light Microscope

_____

_____

_____

_____

_____

_____

Transmission Electron Microscope

_____

_____

_____

_____

_____

_____

Scanning Electron Microscope

_____

_____

_____

_____

_____

_____

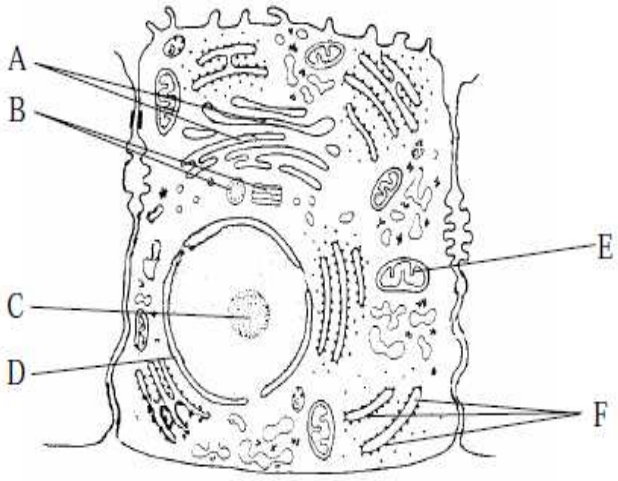
Cell Structure and Organelles

- Compare and contrast *eukaryotic* and *prokaryotic* cells
- Research the different organelles found in eukaryotic organisms and explain the function of each organelle

N.B The next few pages have been left blank for you to decide how to present your work. However you decide to do so, once it is complete it must be placed in the workbook.

Simple exam style questions

The diagram below shows an electron micrograph of a cell.



(a) Name the parts labelled A, B, C, D, E and F.

A: ..... D: .....

B: ..... E: .....

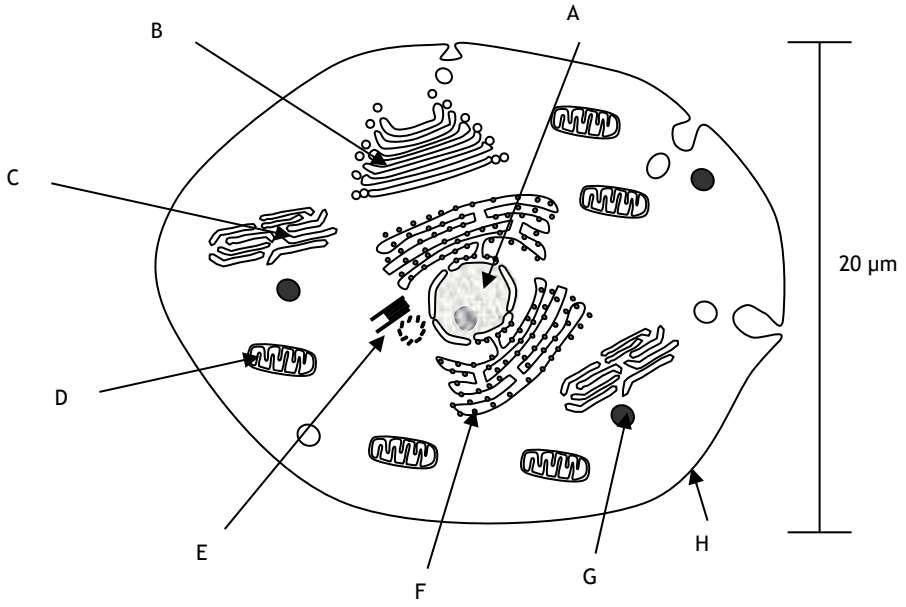
C: ..... F: .....

[6]

The table below describes the structure and function of organelles in eukaryotic cells. Complete the table by filling in the empty boxes A, B, C, D and E

Organelle	Structure/Feature	Function of feature
Nucleus	Nucleoli present	A
B	Inner membrane folded into cristae	C
D	Vesicles containing hydrolytic enzyme	Breakdown of old organelles. Cell lysis.
Smooth endoplasmic reticulum	Consists of flattened membrane- bound sacs called cisternae	E

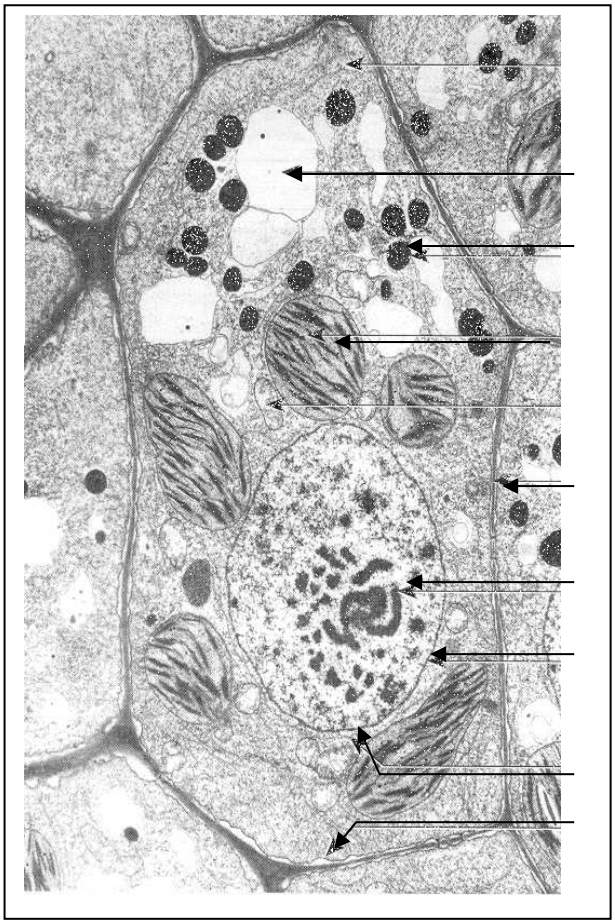
The diagram is a line drawing of a cell as seen with an electron microscope.



Complete the table by matching the label to the function and then naming the appropriate part. The first one has been completed for you.

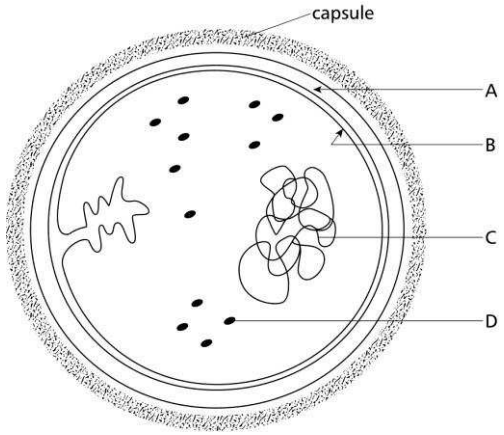
Function of Structure	**Label**	**Name of Part of the Cell**
Controls the activity of the cell.	A	Nucleus
Protein/polypeptides are made here.		
Aerobic respiration takes place here.		
Produces secretary vesicles.		
Controls the entry of substances into the cell.		
Contains hydrolytic enzymes.		
Makes lipids, including steroids.		

Use the word bank at the bottom of the page to label this plant cell



Nuclear envelope,	Nucleolus,	Chloroplast,	Mitochondria,	cytoplasm
Endoplasmic reticulum,	starch grain,	Cell wall,	plasma membrane,	vacuole

The diagram below shows *Staphylococcus,* which is a prokaryotic cell. Label parts A to D



A) _____ C) _____

B) _____ D) _____

The following table compares some features of a prokaryotic and eukaryotic animal cell. Complete the table by using 'present', 'absent' or a short descriptive phrase. The first has been completed for you.

Cellular Feature	**Prokaryotic Cell**	**Eukaryotic Animal Cell**
Cell wall	Present	Absent
Cell surface membrane		
Nucleus		
Membrane bound organelles		
DNA		
Plasmids in the cytoplasm		

Use table 1 to compare plant (eukaryote), animal (eukaryote) and prokaryotic cells. For each cell type indicate whether the feature is present or absent using a tick or cross.

Feature	Plant cells	Animal cells	Prokaryote cells
Chloroplasts			
Large permanent vacuole			
Cellulose cell wall			
Peptidoglycan (murein) cell wall			
Linear chromosome			
Circular chromosome			
Plasmids			
Endoplasmic Reticulum			
Golgi body			
DNA free in the cytoplasm			
ATP is produced in the mitochondria			
ATP is produced at infolded regions of the cell membrane called mesosomes			
Undulipodia contain 9 + 2 circular arrangement of microtubules			
Flagella made from spiral protein called Flagellin			
Ribosomes			
Cell membrane			

Biological Molecules - Water

Research how hydrogen bonding occurs between water molecules and how these bonds explain water's unusual properties.

Biological Molecules – Carbohydrates and Amino acids

Describe, with the aid of a diagram, the difference between alpha and beta glucose

Describe, with the aid of a diagram, the structure of amino acids