Name:

MOVING ON TO BIOLOGY AT BHASVIC

We're very pleased that you have chosen to study Biology at BHASVIC. This study pack will review the knowledge you need to make a successful start on your A level course.

What to expect

Making the transition from GCSE to A level is challenging because the scientific ideas you encounter will be more complex than what you have previously met and there is much more to learn. Consequently you will need to use new methods of study to develop the level of understanding required to master Biology although you will receive help from your teacher in developing the skills you need.

When you look at the A level textbook you will see many familiar topics that you have studied at GCSE (and a lot you haven't!) However, A level study is so much more than just memorising the facts for an examination. You have to be able to think like a biologist – asking questions, testing your ideas, handling data and statistics, drawing and evaluating conclusions. The textbook is your guide but there is so much more to explore and the internet will be a valuable source of information throughout the course. From the onset you will be expected to work independently and to develop your research skills, although support is always available if you need it.

It's important to recognise that A level study will be much more demanding – you will need to do a lot of independent study outside of class time – **about 4.5 hours per week** for your first year in Biology is about right.

What will you be doing during your independent study time?

- read more extensively and at a higher level
- learn complex biological processes and recall factual details accurately
- make your own notes and formulate your own questions about your learning
- use scientific vocabulary fluently
- interpret scientific data and draw conclusions
- improve your numeracy and literacy skills
- plan, conduct, and report the findings of your own practical investigations
- practice answering A level examination-style questions

In the first topic you study you will learn about the structure of cells and the methods used to study them. You will quickly realise that a cell is much more complex than the 'blobs' in the GCSE textbook!

In this summer task you are going to use some of the skills that you will use routinely in your independent study in A Level Biology. As you complete each task, record how much time you spent on it:

Task	✓ when complete	Time spent
Review your knowledge of the structure of plant, animal and bacterial cells		
Describe the function of the key cell organelles		
Write three questions you want to ask about cells and organelles		
Write numbers in standard form		
Use SI units		
Use fractions and percentages		
Draw a line graph		
Identify any problem areas with numeracy skills		
Literacy in biology		
Research task – research three chosen organelles and present findings		

Make sure you complete ***all*** the work – use any resources available to help you. You might have GCSE textbooks or revision guides, your GCSE notes or access to the internet. It is important to get used to assessing your own knowledge and understanding and then researching information.

Also make sure you ask questions – you need to have curiousity to be a successful scientist. You can ask different sorts of questions – all are valid:

checking questions *When would I say mitochondrion and when would I say mitochondria?*
applying questions *How does a bacterium respire if it has no mitochondria?*
wide ball questions *Can stem cells be used to grow new organs like a heart or a kidney?*

NB: Please remember to bring this booklet fully completed to your first Biology lesson.

In your first week back we will give you a short test to check that you are ready for A Level study. The test is designed to help us diagnose whether you will need some support at the start of the course to get going successfully with A Level Biology.

CELLS

Why study cells?
Cells are the smallest unit of all living organisms – they are pretty fundamental to biology! The study of cells is called **cytology**.

Watch this video to understand one area of current interest to cytologists - stem cells – and the ethical issues surrounding the topic:
https://www.youtube.com/watch?v=cEB8656TCIE

All living things are made up of cells. The structures of different types of cells are specialised to their functions.

Animal cells and plant cells have many features in common, such as a nucleus, cytoplasm, cell membrane, mitochondria and ribosomes but plants cells have additional features such as a cell wall, chloroplasts and a vacuole.

Bacteria are single-celled organisms that are simpler in structure than animal and plant cells. Bacteria have a cell wall but do not have a nucleus. They have plasmid and chromosomal DNA. The chromosomal DNA carries most of the genetic information. Plasmid DNA forms small loops and carries extra information.

Q1 Can you draw a labelled diagram of the structure of a plant and an animal cell to include all these features?

Animal cell	***Plant cell***

Q2 Can you complete the table to compare animal, plant and bacterial cells?

Does it have…?	***Animal***	***Plant***	***Bacterium***
a cell wall			
a nucleus			
mitochondria			
a cell membrane			
ribosomes			
chloroplasts			

ORGANELLES

Q3. Organelles carry out specific functions. What are organelles? Write a definition below:

The nucleus controls the cells activities. It contains *chromosomes* made from long DNA molecules. A *gene* is a short section of DNA. Each gene codes for a specific protein by specifying the order in which amino acids must be joined together.

Follow the link and scroll down to the Chromosomes part 1 audio clip to revise the structure of DNA:

http://www.bbc.co.uk/schools/gcsebitesize/audio/science_additional/#

Respiration is a series of reactions in which energy is released from *glucose*. Aerobic respiration happens all the time in the cells of animals and plants. Most of the reactions involved happen inside mitochondria.

Watch this video to understand the process of aerobic respiration:

http://www.bbc.co.uk/education/guides/zm6rd2p/video

Ribosomes are tiny structures where proteins are made. Proteins are formed from amino acids and at a ribosome, DNA instructions are decoded to determine the specific sequence in which amino acids are bonded together to make a specific protein.

Review the process of protein synthesis here:

http://www.bbc.co.uk/schools/gcsebitesize/science/a

Q4 What is the difference between breathing and respiration?

Q5 What is the balanced equation for aerobic respiration?

Q6 What is the link between the function of the nucleus and the function of the ribosomes?

Your questions about cells and organelles:

1.

2.

3.

NUMERACY IN BIOLOGY

Numeracy skills are essential in Biology. You will be working with figures, rearranging equations, performing calculations and plotting and interpreting graphs throughout the course. These are areas you will certainly be examined on. Hence being confident and capable in numeracy is incredibly important.

Writing numbers in standard form (also called scientific notation)

Human faeces contain more than 10 000 000 000 000 bacteria per cm^3. This is a very large number, and rather than write out all the zeros every time it is convenient to use a shorthand system: *standard form*. We would write: human faeces contain more than 1×10^{13} bacteria per cm^3. Standard form is commonly used in science to present numbers that are very large or very small. The number is written in two parts:

First: just the digits (with the decimal point placed after the first digit)

Followed by: x10 to a power that would put the decimal point back where it should be.

So: 43 700 000 becomes 4.37×10^7 (because we have to move the decimal point 7 places to the left to get to standard form)

0.000 192 becomes 1.92×10^{-4} ($\times 10^{-4}$ tells you that the decimal point has been moved four places to the right).

Q7 Try these examples. Convert the following numbers into standard form:

a. 4370 | **b.** 0.0699 | **c.** 11900

d. 810000 | **e.** 7.7×10^4 | **f.** 4.9×10^{-3}

SI units

SI units are the units used by scientists internationally to make quantitative measurements. Here are the most common units:

Measure	SI unit	Symbol
length	metre	m
mass	gram	g
time	second	s
temperature	degree Celsius	°C
area	metre squared	m^2
volume	metre cubed	m^3
pressure	pascal	Pa
energy	joule	J

When we are working with cells our measurements are much smaller than a metre. We use prefixes to indicate smaller units:

Prefix	Symbol	Size relative to SI unit
kilo	k	1000 x or 10^3
deci	d	$\frac{1}{10}$ or 10^{-1}
centi	c	$\frac{1}{100}$ or 10^{-2}
milli	m	$\frac{1}{1000}$ or 10^{-3}
micro	μ	$\frac{1}{1000\,000}$ or 10^{-6}
nano	n	$\frac{1}{1000\,000\,000}$ or 10^{-9}

Q8 Complete the table:

Unit	Size	Symbol
a joule		kJ
b metre	10^{-9}	
c metre		cm
d second		ms
e second	10^{-6}	

Q9 Convert the following values into metres:

a 0.13 cm	m
b 43 cm	m
c 7×10^{-3} cm	m
d 14 mm	m
e 1.3 mm	m
f 0.06 mm	m
g 60 µm	m
h 0.8 µm	m
i 763 µm	m

Fractions and percentages

These are both ways of showing numbers of a proportion. It is important to be able to calculate these routinely, however they are frequently miscalculated in exams so it is worth recapping and practising. You will often be required to calculate a **percentage change** (increase or decrease):

$$\text{Percentage change} = \frac{\text{Final value} - \text{original value}}{\text{original value}} \times 100$$

Worked example: A sample of potato tissue weighed 14.50g at the start of an osmosis experiment, and at the end it weighed 10.73. Calculate the percentage change in mass.

$$\text{Percentage change} = \frac{10.73 - 14.50}{14.50} \times 100 = -26\% \text{ (minus sign indicates a loss)}$$

Fractions show a **part** over the **total**:

Worked example: A tissue containing 72 cells is viewed under a microscope. 2/9 of the cells are undergoing mitosis. How many cells in the sample are undergoing mitosis?

1. Divide the total number of cells by the number on the bottom of the fraction 72/9 = 8
2. Then multiply by the number on the bottom of the fraction: 8x2 = 16 cells

Q10 One food sample had a total mass of 40g, the mass of protein in the sample was 12g. What percentage of the food was protein? Show your working:

Q11 Work out the percentage change in plant height between week 2 and week 5. Show your working and fill in the table:

Plant	Height at week 2 /cm	Height at week 5 /cm	Percentage increase /%
1	7.6	11.4	
2	6.7	10.7	
3	8.5	11.9	

Q12 It is estimated that, in the UK, 1/2500 of the population are affected by cystic fibrosis. In a sample of 1500 people, how many would you expect to suffer from cystic fibrosis? Show your working.

Q13 The estimated frequency of carriers of the cystic fibrosis gene in the population is 4%. In a sample of 4500 people, how many would you expect to be carriers? Show your working.

Q14 Remind yourself of enzyme functioning from GCSE using the following link:
http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/enzymes/enzymes1.shtml

GRAPH DRAWING: It is an important skill for a biologist to be able to clearly plot data and draw conclusions from it. The key points when plotting graphs are shown here:

Line graph drawing checklist

	Self-review – achieved?
1. The independent variable is plotted on the x axis, and the dependent variable in on the y axis.	
2. The axes are labelled correctly with **units** (as in results table)	
3. A **linear** scale is used on each axis – this means that there should be **equal intervals** between each number	
4. There should be a number at the origin (start) of **both** axes – this can be 0 on both axes or another number	
5. At least half of the graph paper grid should be used on both axes – no tiny graphs allowed!	
6. Accurate plotting, using a **sharp pencil** and a **cross** to mark the plot	
7. A ruler is used to draw a line joining each cross through the centre, and the line should not extend past the first and last plot (no extrapolation)	

An experiment was carried out to see how temperature affected the rate of reaction of an enzyme. Plot the following data onto the graph paper, and use the above grid to improve your graph:

Temperature / °C	**Enzyme activity / arbitrary units**
10	13
25	35
40	46
60	23
80	2

Describe the graph: Remember to link the variables and be clear about which range you are referring to.

Explain the graph: Remember to use key words (e.g. kinetic energy, enzyme-substrate complex, denaturation, optimum)

Following this recap on maths skills, make a note of any areas that you are not so confident with and need extra help. Your teacher will tell you how you can access this help when you start in September.

LITERACY IN BIOLOGY

Literacy skills are essential in Biology. You must be able to draw out important information from text and evaluate how trustworthy the sources of information are. Read the article below and answer the questions.

The energy generators inside our cells reach a sizzling 50°C

By Michael Le Page
New Scientist 4 May 2017

Our body temperature might not ever get much hotter than 37°C. But it turns out that the insides of our cells can reach a scorching 50°C.

Our cells effectively burn food in oxygen to produce energy. Unlike a fire, this is a controlled process involving several steps, but it still generates a lot of heat. But because respiration, as this process is known, happens inside tiny structures inside cells called mitochondria, measuring just how hot they get has not been possible. However, in the past year or so, several research teams around the world have developed dyes that fluoresce in different ways as temperatures change.

Pierre Rustin of INSERM in France and colleagues have now used a dye developed by a group in Singapore to measure the temperature inside the mitochondria of human kidney and skin cells kept at 38°C. They found that mitochondria operate at temperatures at least 6 to 10°C higher than the rest of the cell.

Hot hot heat

While Rustin's study is the first to look specifically at the temperature of mitochondria, another group might just have beaten them to the punch. A paper published in February by a team in Japan that describes another temperature-sensitive fluorescent dye briefly mentions that mitochondria in human cancer cells appear to be 6 to 9°C hotter than the rest of the cell.

'The finding makes sense when you think about it,' says biochemist Nick Lane at University College London, author of a book about mitochondria. "Mitochondria are the main sources of heat, and they have to be hotter than the rest of the body," he says. 'I'd never really thought of that before.'

'If the mitochondria in mammals – and presumably birds – have indeed evolved to operate at higher temperatures than we realised, biologists may have to recheck the many previous experiments that assume they operate at body temperature,' Rustin's team writes. The mitochondria in cold-blooded plants and animals presumably operate at far lower temperatures, but this is something else that now needs to be checked.

Questions:

Q15. If the inside of a cell can reach 50°C, what is this difference as a percentage increase above normal body temperature? Show your working.

Q16. Scientists used human kidney and skin cells kept at 38°C. Why do you think they used this temperature?

Q17. Is there any evidence is this report that the researchers' findings were reliable? Explain your answer.

Q18. In what way do scientists think the operating temperature of mitochondria of plants and animals might differ? Explain why scientists expect them to differ.

RESEARCH TASK

The ability to be able to research a topic, drawing on information from a **variety** of sources and then presenting your findings is an essential skill in biology. When reporting findings, many students fall into the trap of cutting and pasting information. However, **it is important that you report your findings in your own words and this is one of the skills that we will be looking for in this task**.

Your task is to choose three organelles from the list below and to do some research on each of the organelles you select. Your research must include details about the structure and function of each but can include any other information you think is appropriate or interesting.

- Nucleus
- Golgi body / Golgi apparatus
- Ribosome
- Mitochondria
- Chloroplast
- Rough endoplasmic reticulum
- Smooth endoplasmic reticulum
- Plasma membrane

You must then present the findings of your research. You may present your findings in any format you choose and this must be handed in to your teacher after the summer. For example you might choose to write a report, build models, do some imaginative baking (accompanied by some form of written explanation), write an information leaflet, make a power-point presentation, make a film or animation, write and record a song etc. Your chosen format must be handed to your teacher in either a physical format or electronically on a named memory stick.

The following links will take you pages where you can find information to start your research but you are welcome and encouraged to draw on other sources too. You should use a variety of sources to inform your research.

https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article

http://www.buzzle.com/articles/organelles-and-their-functions.html

http://www.biologyguide.net/resources/bk/cell_structure_function.php

https://alevelnotes.com/Organelle-Structure-and-Function/111

https://www.youtube.com/watch?v=cj8dDTHGJBY

https://www.youtube.com/watch?v=1Z9pqST72is

https://www.youtube.com/watch?v=URUJD5NEXC8