Biology A level Induction work

Name: _____

Summer Induction work – Year 12 Biology

When you start biology in September you will have two teachers for the 9 lessons. Each teacher will cover a different topic and you will need to organise your files appropriately, so you should come prepared with files, dividers etc in September. An important part of studying for A levels is developing your study skills and in biology you will be asked to do a lot of independent study. This may take the form of reviewing and improving your notes from a lesson, reading around a topic or using the internet to research a topic. Your ability to locate the useful information from large quantities of text is an important skill.

There are 4 tasks for you to complete over the summer in preparation for starting A level biology. These tasks all cover part of the specification and are relevant to your studies. As we will be building on this work during lessons **we expect you to have completed the work ready to hand in during your first biology lesson in September.** Here are a few dos and don'ts which will give you some idea of our expectations for your work.

Do

- Try to complete the work to the best of your ability.
- Attempt all of the questions (leaving questions out suggests a lack of effort and interest).
- Use your initiative if you can't find the answer in the information provided then look on the internet or at any relevant textbooks. We expect to see an attempt at every question.
- Write down the websites and/or textbooks you use.

Do not

- Miss out parts of questions with the excuse that you couldn't do it – TRY.
- Forget to do the work or to hand in the work in your first timetabled biology lesson.
- Cut and paste from the internet or copy directly from books.

Task 1- Cell Ultrastructure

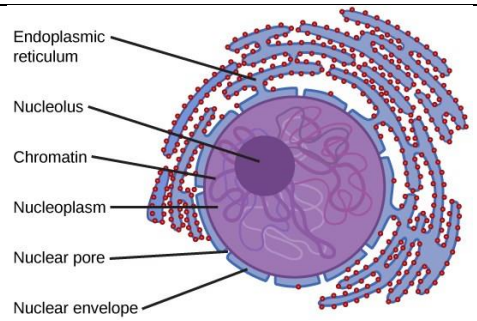
One of the first areas you will cover is cells and microscopy.

The parts of the specification you will cover in this task are:

- *Describe the ultrastructure of eukaryotic cells and the functions of the different cellular components*

Part A

Use the site www.biologymad.com to help you complete a table of organelles and their functions.
The organelles you need to cover are listed in the table below. This is a suggested layout for the table – landscape orientation would be best. You can draw the organelles by hand if you prefer. One is completed to help you.

Name of organelle	Diagram/picture	Notes on structure/ daptation	function
nucleus		Double membrane, with nuclear pores. DNA in association with protein = chromatin Nucleolus - Densely stained region	Contains genetic information Production of ribosomes
Mitochondrion			
Chloroplast			
Endoplasmic reticulum			

Golgi apparatus			
Ribosomes			
Vacuole			
Lysosomes			
Centrioles			
Cell wall			

Task 2 Plasma membranes

This task covers the basics of plasma membranes.

1. State that plasma (cell surface) membranes are selectively permeable barriers;
2. Describe the fluid mosaic model of membrane structure;
3. Describe the roles of the components of the cell membrane; phospholipids, cholesterol, glycolipids, proteins and glycoproteins;

Use the website below to help you complete the following tasks.
http://www.biologymad.com/master.html?http://www.biologymad.com/asbiology.htm

1. Draw and label a plasma membrane.

2. Research the functions of each of the components and draw a table to show this or annotate your diagram.

Task 3 Maths for biology

Mathematical literacy is a vital attribute for modern biologists

Professional biologists routinely use a range of mathematical skills to allow them to carry out their everyday work. Students who emerge from their post-16 courses comfortable and confident with a core of mathematical tools will become better scientists in future studies and will have transferable skills if they take other paths.

Why is maths relevant for Biology AS and A Levels?

- All new Biology A Levels incorporate a list of 28 mathematical skills, , including statistics.
- A minimum of **10% of marks** in written examinations are given for mathematical skills.

Please complete the following activities below to refresh these key maths skills you will use on the biology course Note that this is a sample not all of them. All these skills you should have covered during maths or science GCSE

Maths skills – M0.1 Recognise and make use of appropriate units in calculations

Quiz – converting between units

Answers to all of these questions should use standard form e.g. use 5.6 x 10^3 rather than 5600, use 4.2 x 10^{-2} rather than 0.042.

1. How many?

mm in a m		µm in a mm	
µm in a m		nm in a µm	
nm in a mm		nm in a m	
mm in a µm		m in a µm	
µm in a nm		mm in a nm	
µ*l* in a litre		m*l* in a litre	
µ*l* in a m*l*		ms in a s	
µs in a ms			

2. Convert each of the following into metres.

(a)	70 nm	
(b)	5 µm	
(c)	1 mm	
(d)	0.2 mm	

3. Convert each of the following into µm.

(a)	4 m	
(b)	200 nm	
(c)	17 mm	
(d)	0.3 nm	

4. Areas. How many?

(a)	μm^2 in a m^2	
(b)	μm^2 in a mm^2	

5. Volumes. How many?

(a)	mm^3 in a cm^3	
(b)	μm^3 in a mm^3	

6. Convert each of these into more sensible units using standard form to express your answers if appropriate.

(a)	0.0003 µm	
(b)	0.004 km	
(c)	4500000 nm	
(d)	0.0007 s	

Quiz – Rates of change

1. Express these rates of change with the correct units:

(a)	2 µg per cm^3	
(b)	200 kJ per m^2 per year	
(c)	10 g per dm^3	
(d)	15 cm^3 per minute	

2. In an experiment you were measuring the growth rate of *Salmonella*. You started with 100 *Salmonella* and after 2 hours you had 6500 *Salmonella*. What is the bacterial growth rate?

3. In an experiment you were measuring the growth rate of *Salmonella*. You started with 80 *Salmonella* and after 4 hours you had 5000 *Salmonella*. What is the bacterial growth rate?

4. How would you express the following in numbers and units?

a) A woodlouse crawled 5 cm in 10 min.

a) A patient's drip flowed with 10 drips every 30 s.

b) The growth of a slime mould colony was 40 cells per millimetre cubed per hour.

c) A breathing rate of 20 breaths in 30 s.

d) A change in temperature of 1.2 degrees over three years.

Maths skills – M0.3 Use ratios, fractions and percentages

Quiz – Percentages: Practice calculations

Learners may be tested on their ability to:

- Calculate percentage yields
- Calculate surface area to volume ratio
- Use scales for measuring
- Represent phenotypic ratios (monohybrid and dihybrid crosses)

7. Ventricular systole lasts for 0.3 s. The cardiac cycle lasts for 0.8 s. What percentage of the cardiac cycle is ventricular systole?

8. In an onion root tip squash, 200 cells were observed and each cell was assigned to a stage of the cell cycle. Here are the results:

Stage	Number of cells
Interphase	150
Prophase	20
Metaphase	12
Anaphase	4
Telophase	8
Cytokinesis	6

What percentage of cells were at each stage of the cell cycle?

9. A soil sample weighed 2.4 g. After heating at 100 ^{0}C in an oven to evaporate the water, it weighed 1.8 g. What percentage of the soil sample was water?

10. Stearic acid has the formula $C_{17}H_{35}COOH$. What percentage of the atoms in stearic acid are:

    (a) carbon?

    (b) hydrogen?

    (c) oxygen?

Quiz – Ratio: Practice calculations

5. Calculate the surface area-to-volume ratios of the following cuboids:

(a) A cuboid with sides: 2 cm x 2 cm x 2 cm

(b) A cuboid with sides: 1 m x 2 m x 4 m

(c) A cuboid with sides: 1 mm x 1 mm x 8 mm

Quiz – Phenotypic ratio: practice calculations

1. Plants were grown either in the light or the dark and the length of the stem was measured.

Growing conditions	Stem length (cm)
Light	10
Dark	25

a) What was the ratio of stem length, light to dark?

b) What was the ratio of stem length, dark to light?

2. The stem length experiment was repeated by growing plants under four different coloured lights:

Light used for growth	Stem length (cm)
Blue	25
Green	3
Yellow	10
Red	15

What was the ratio of stem length blue to green to yellow to red?

M1.1 – Use an appropriate number of significant figures

Quiz

1. In each case convert to the number of significant figures quoted.

a) 2342 to 3 sig fig

b) 2342 to 2 sig fig

c) 456 to 2 sig fig

d) 0.07842 to 3 sig fig

e) 0.07842 to 2 sig fig

f) 0.003004 to 3 sig fig

(Note: for questions 2 to 4 you should be able to identify the appropriate number of significant figures to which to give your answer as well as convert the calculated result to that number of sig figs. If you are finding the calculations themselves difficult please refer to M2.3 and M2.4).

2. A hypothermic patient was rewarmed from 30.6°C to 37.1°C over the course of 3.4 h. What was the rate of warming (use °C h^{-1} as your units)?

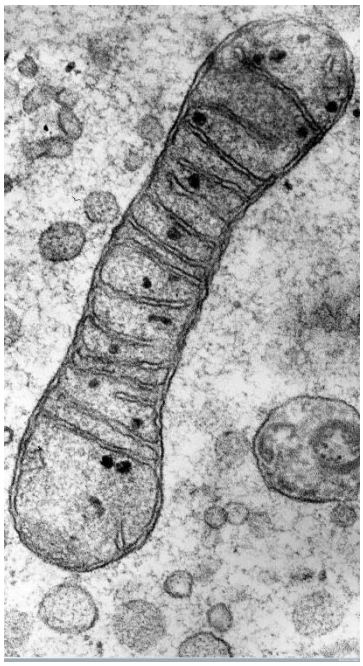
3. A willow coppice woodland in the UK has an area of 1.15 ha. (ha is the symbol for heactare – an area of land equal to 10,000 m^2). When the willow harvest is taken each year, and dried, it yields 9 odt (oven-dry tonnes) of biomass. What is the productivity of the land (the amount of biomass produced per unit area) in units of odt ha^{-1}?

4. A model cell is made of visking tubing (partially permeable membrane) containing sucrose solution and is immersed in distilled water. In 23.5 min the volume of the model cell increases by 1.0 cm^3 due to inflow of water by osmosis. What is the rate of osmosis in units of cm^3 min^{-1}?

M1.8 Make order of magnitude calculations

Quiz

1 This is an electron micrograph of a mitochondrion. Its actual length is 5 µm. Calculate the magnification of the image.



B0000119 Credit Prof. R. Bellairs, Wellcome Images
TEM of a mitochondrion
A transmission electron micrograph of a mitochondrion in a chick embryo cell.

Collection: Wellcome Images

2 This botanical illustration from about 250 years ago shows a banana plant. The image has a scale line where each division represents 30 cm. What is the magnification?

V0043033 Credit: Wellcome Library, London
Banana plant (Musa species): flowering and fruiting plant with stolons and separate floral segments and sectioned fruit, also a description of the plant's growth, anatomical labels and a scale bar. Etching by G. D. Ehret, c. 1742, after himself.

By: Georg Dionysius Ehret
Size: platemark 63.2 x 46.5 cm.
Collection: Iconographic Collections
Library reference no.: ICV No 43624

Full Bibliographic Record Link to Wellcome Library Catalogue

3 A false-colour transmission EM image of a white blood cell has a magnification of x2000. What is the diameter of the white blood cell?

B0004162 Credit University of Edinburgh, Wellcome Images
Monocyte and two red blood cells
Colour-enhanced image of a monocyte and two red blood cells. Monocytes are white blood cells that develop into macrophages, cells that ingest and destroy dead cells and micro-organisms.

Transmission electron micrograph 1980 - 2000
Collection: Wellcome Images

TASK 4- Evolution and Natural selection , Genetic engineering and Cloning

Due to the pandemic and advanced information given before your GCSE exams you may have some gaps in knowledge. The following activities below are sought to address these gaps. Upon embarking on A- level biology it is of key importance that you have covered the GCSE syllabus. So please keep your text books and use them to go through any areas where you have gaps.

Using a GCSE textbook and online resources (bitesize) review what **evolution** is and the mechanisms of **natural selection** and **selective breeding** then answer the questions.

Evolutionary theories

Specification references:

- B6.3.1 Theory of evolution
- WS 1.1, 2.1, 3.6,

Aims

Evolution, the gradual change of organisms over time, may be explained using different ideas. Darwin explained evolution in terms of survival of the fittest, now understood as the selection of genetic characters from parents that give a better chance of survival.
Lamarck proposed that advantageous physical changes gained by an organism during its life could be passed on.

The aim of this task is to look at the different theories.

Learning outcomes

After completing this worksheet, you should be able to:

- describe the Darwinian theory of evolution by natural selection using an example
- describe Lamarck's ideas about evolution
- evaluate evidence for the theories.

Task

Start by revising the ideas of Darwin and Lamarck.

Questions

1 Use a named example to describe the major events involved in Darwin's theory of evolution.

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(*6 marks*)

2 Identify and explain why Darwin's theory was so slow to be accepted, using the following categories:

a religious influences

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(*3 marks*)

b evidence

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3 marks)

c genetics

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(*2 marks*)

3 Describe the main points of Lamarck's theory of evolution.

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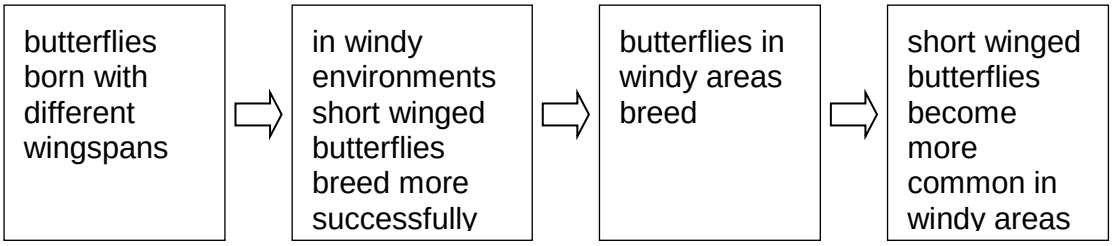
(*3 marks*)

4 Examine the following sequences of statements, which describe real observations. Do the sequences support the ideas of Darwin or Lamarck? Explain how each sequence contributes to an understanding of the evolutionary mechanisms proposed by Darwin and Lamarck, identifying which theory is supported in each case.



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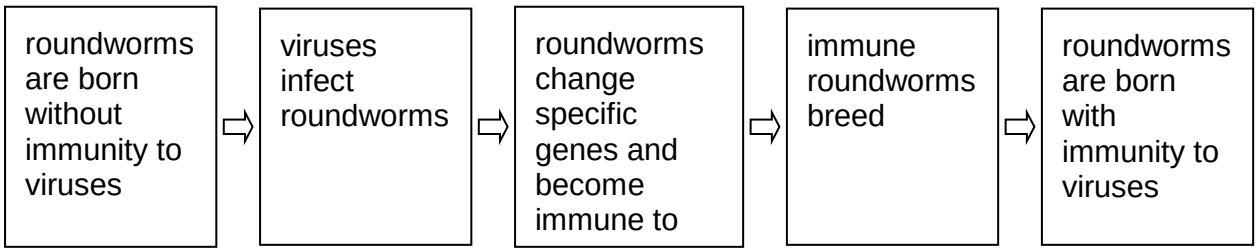
(*3 marks*)



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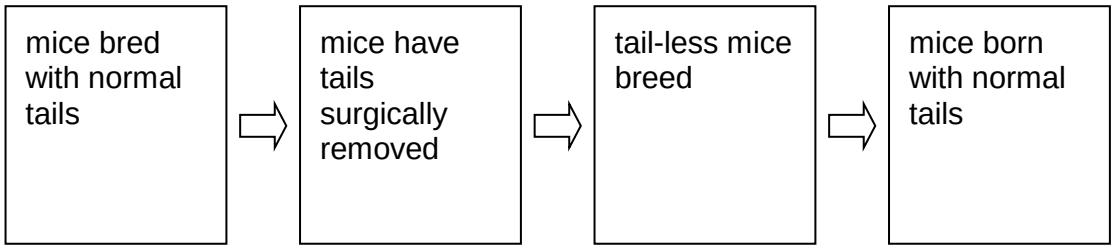
(3)



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(*3 marks*)

Antibiotic resistant bacteria

Specification reference:

- B6.3.4 Resistant bacteria
- WS 1.2, 1.4, 3.3, 3.5

Aims

The aim of this worksheet is to reinforce your understanding of the development and spread of antibiotic resistance in bacteria.

Setting the scene

Bacterial resistance to penicillin was first discovered in 1947 in the species *Staphylococcus aureus*. This was only four years after the drug was first used. The resistant form, now commonly known as MRSA (methicillin-resistant *Staphylococcus aureus*), was identified in the UK in 1961. By 1999 nearly 40% of UK deaths from blood poisoning were due to MRSA. Strains of MRSA are increasingly resistant to newer antibiotics. In addition, many other species of bacteria now show antibiotic resistance.

Worked example

It is possible to calculate bacterial populations using the expression:

$N_t = N_0 \times 2^n$

where N_t is the population after a given time, N_0 is the initial population and n is the number of generations in the given time.

For example, after six generations a starting population of three bacteria would increase to

$3 \times 2^6 = 192$ cel

Questions

1 **a** Describe the main steps involved in the development of resistance by bacteria.

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(*4 marks*)

b Give two reasons why bacteria are vulnerable to a high mutation rate.

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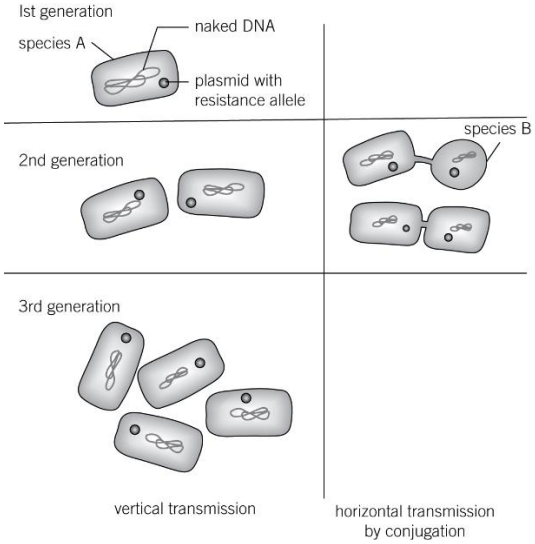
(*4 marks*)

2 The figure below shows transmission of antibiotic resistance between bacteria in three generations. The resistance allele is in a plasmid.



a What is a plasmid?

.....

(*1 mark*)

b Name the type of cell division involved in vertical transmission.

.....

(*1 mark*)

c Each generation doubles the population of the bacteria. If the time for one generation is 30 minutes, calculate the population of bacteria that would be produced after 2 days.

.....

.....

Developing dog breeds

Specification references

6.2.3 Selective breeding

Learning outcomes

After completing this you should be able to:

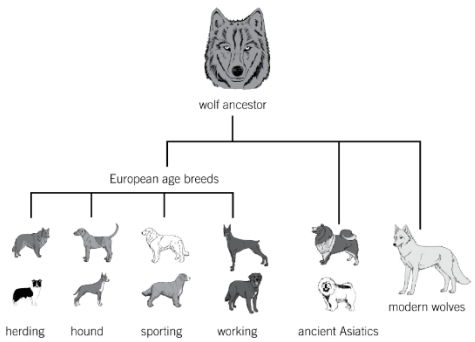
explain how and why humans have used selective breeding in dogs.

Setting the scene

There are many different breeds of dog. Each breed has its own particular group of characteristics that makes them different from each other. Many have been bred for a purpose, for example the greyhound for speed, the sheepdog for herding, and the husky for working in cold environments. The aim of this activity is to explain how these different breeds have been developed.

Task

Most modern dogs have been selectively bred from one common ancestor, a wolf. Consider the problems that inbreeding has caused in some breeds. You can choose which breed to focus on, and fill in the table below



Research evidence sheet

Research area	Information found
select a breed of dog and its use	
characteristics of the modern breed of the dog	
characteristics of the original parent dogs from which the modern dog has been bred	
method for selectively breeding a dog	
problems caused by	

Questions

1 State what is meant by the term 'selective breeding'.

.....

(*1 mark*)

2 Sporting is one activity that dogs have been bred for. Name two other activities dogs have been selectively bred for.

.....

- .....

(*2 marks*)

3 State what is meant by the term ‘beneficial characteristic’.

.....

.....

(*1 mark)*

Advantages and disadvantages of adult cell cloning

Specification references

- B6.2.5 Cloning

Aims

Cloning mammals has been possible for many years now. Recently the possibility of cloning adult human cells in order to produce stem cells for use in therapy has arisen. There are ethical difficulties (to do with right and wrong) with this procedure which will be examined in this exercise, leading to a fuller understanding.

Task

Read the following passage and then answer the questions.

The process of adult cell cloning is as follows:

4 The nucleus is removed from an unfertilised egg cell.

5 At the same time, the nucleus is taken from an adult body cell, for example a skin cell of another animal of the same species.

6 The nucleus from the adult cell is inserted in the empty egg cell.

7 The new egg cell is given a tiny electric shock that stimulates it to start dividing to form embryo cells. These contain the same genetic information as the original adult skin cell and the original adult animal.

With cloning of other mammals, when the embryo has developed into a ball of cells, it is inserted into the womb of an adult female to continue its development.

With human adult cell cloning, the last stage is not carried out (although it could be). Embryonic stem cells are extracted from the embryo. These stem cells can be used in therapy to grow cells that could be introduced back into the adult human in order to combat an illness or body damage. Examples would include rebuilding bones and cartilage, repairing damaged immune systems, or making replacement heart valves. This is called **therapeutic** cloning.

Other mammals can undergo **reproductive cloning** and may be genetically engineered, for example, to supply insulin in milk. They may also be used for meat.

Ethical arguments

A Regenerative medicine, e.g., growing new organs benefits many	**B** Destroying an embryo is equivalent to murder of an identical twin	**C** No need for immunosuppressant drugs	**D** Organ harvesting is abuse
E Overcomes the shortage of donor organs for transplants	**F** Humans are special and to create them artificially is wrong	**G** To grow old is not good – aging can be combatted by therapeutic cloning	**H** Malformations and biological damage can result from cloning
I Meat from cloned animals may be unsafe for human consumption	**J** An embryo is not a human	**K** We should not do what is wrong, no matter what the benefits are	**L** Greatest good for the greatest number is ethically right
M Our understanding of science will benefit, perhaps in unforeseen ways	**N** Confuses normal kinship relationships – who is the mother: the egg/DNA donor or the surrogate?	**O** Reproductive cloning would allow infertile couples to have children	**P** It is against many religious teachings

Questions

1 Which statements are in support of adult cell cloning?

..... (*1 mark*)

2 Which statements are against adult cell cloning?

..... (*1 mark*)

3 Which statements refer exclusively to reproductive cloning?

..... (*1 mark*)

4 Which statements refer to exclusively therapeutic cloning?

..... (*1 mark*)

5 Choose two statements you definitely agree with. Give their letters and say why you agree with them.

Statement 1 .....

Reason:

.....

.....

(*1 mark*)

Statement 2 .....

Reason:

.....

.....

(*1 mark*)

6 Choose two statements you definitely disagree with. Give their letters and say why you disagree with them

Statement 1 .....

Reason:

.....

.....

(*1 mark*)

Statement 2 .....

Reason:

.....

.....

(*1 mark*)

